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## European Technical Assessment

**ETA-16/0320**  
of 13.05.2016

General part

### Technical Assessment Body issuing the European Technical Assessment

Österreichisches Institut für Bautechnik (OIB)  
Austrian Institute of Construction Engineering

### Trade name of the construction product

FLAMRO KSL

### Product family to which the construction product belongs

Fire Stopping and Fire Sealing Products:  
Penetration Seals

### Manufacturer

FLAMRO Brandschutz-Systeme GmbH  
Am Sportplatz 2  
56291 Leiningen  
GERMANY

### Manufacturing plant

FLAMRO Brandschutz-Systeme GmbH  
Leiningen

### This European Technical Assessment contains

64 pages including Annexes A1 to H-4 which  
form an integral part of this assessment

### This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of

Guideline for European technical approval for  
“Fire Stopping and Fire Sealing Products”, ETAG  
026 Part 2: “Penetration Seals”, edition August  
2011, used as European Assessment Document  
(EAD)

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Specific parts

**1 Technical description of the product**

“FLAMRO KSL” is a kit to be used as cable- and/or pipe penetration seal (mixed penetration seal) based on the following components and additional insulations.

Components of “FLAMRO KSL”	Characteristics
FLAMRO BML	Ablative fire stop coating – filled in buckets
FLAMRO BMS	Ablative fire stop mastic – filled in buckets
FLAMRO BMK	Ablative fire stop mastic – filled in cartridges
FLAMRO Variant N-RM	Flexible intumescent strip (can be provided with a self-adhesive device) with a nominal thickness of 1,5 mm and a width of 100 mm
FLAMRO BSL	Mineral wool board “Hardrock 040” / “Hardrock II” pre-coated with 0,5 mm (dry layer thickness) “FLAMRO BML” on the visible surface
Hardrock 040 / Hardrock II	Mineral wool board from manufacturer “Deutsche Rockwool Mineralwoll GmbH & Co. OHG” according to EN 13162 with classification A1 according to EN 13501-1 with a nominal thickness of 50 mm, a minimum apparent density of 150 kg/m <sup>3</sup> and a melting point ≥ 1000 °C according to DIN 4102-17
FLAMRO Variant N II A	Pipe collar according to Annex B-1 of the ETA with sheet steel housing and an inlay made of intumescent material

Insulations (additional components)	Characteristics
Mineral wool insulation	Lamella mats or prefabricated pipe shells (can be covered with reinforced aluminium foil) according to EN 14303 made from glass wool or stone wool with classification A2-s1,d0 or A1 resp. A2 <sub>L</sub> -s1,d0 or A1 <sub>L</sub> according to EN 13501-1 and a minimum density of 23 kg/m <sup>3</sup> (e.g. "Lamellenmatte ML 3" from manufacturer „Saint-Gobain Isover G+H AG“)
Stone wool insulation	Lamella mats or prefabricated pipe shells (can be covered with reinforced aluminium foil) according to EN 14303 made from stone wool with classification A1 resp. A1 <sub>L</sub> according to EN 13501-1 and a minimum density of 42 kg/m <sup>3</sup> (e.g. "Rockwool Klimarock" from manufacturer „Deutsche Rockwool Mineralwoll GmbH & Co. OHG“)
Prefabricated shells	Prefabricated pipe shells, covered with reinforced aluminium foil and provided with a self-adhesive device, according to EN 14303 made from stone wool with classification A2 <sub>L</sub> -s1,d0 or A1 <sub>L</sub> according to EN 13501-1 and a minimum density of 80 kg/m <sup>3</sup> (e.g. "ASTRATHERM® Steinwoll-Rohrschale alukaschiert" from manufacturer „Austroflex Rohr-Isoliersysteme GmbH“)
AF/Armaflex	Closed cell, flexible elastomeric foam (FEF) insulation in form of (slotted) tubes (can be provided with a self-adhesive device) with classification B <sub>L</sub> -s3,d0 – including "Armaflex Kleber 520" (Armaflex Adhesive 520) – according to EN 13501-1 from manufacturer "Armacell GmbH" (see Annex B-2 of the ETA)
AF/Armaflex Band selbstklebend (AF/Armaflex self-adhesive tape)	Closed cell, flexible elastomeric foam (FEF) insulation in form of tapes with a self-adhesive device with classification B-s3,d0 according to EN 13501-1 from manufacturer "Armacell GmbH"
Armaflex Kleber 520 (Armaflex Adhesive 520)	Polychlorene-based adhesive, free from aromatic compounds (special adhesive for processing of all flexible Armaflex insulating material – except "HT/Armaflex") from manufacturer "Armacell GmbH"

## **2 Specification of the intended use(s) in accordance with the applicable European Assessment Document**

### **2.1 Intended use**

“FLAMRO KSL” is intended to be used as a cable- and/or pipe penetration seal (mixed penetration seal) to temporarily or permanently reinstate the fire resistance performance of flexible wall constructions, rigid wall constructions and rigid floor constructions where they have been provided with apertures which are penetrated by various cables, conduits / tubes, metal pipes, plastic pipes, multi-layer composite pipes and cable support constructions (perforated or non-perforated steel cable trays and steel ladders).

The thickness of the penetration seal in flexible walls or rigid walls has to be minimum 100 mm (two layers of mineral wool boards according to clause 1 of the ETA with a nominal thickness of 50 mm and a gap width of 0 mm between the two layers of boards).

The thickness of the penetration seal in rigid floors has to be minimum 150 mm (two layers of mineral wool boards according to clause 1 of the ETA with a nominal thickness of 50 mm and a gap width of 50 mm between the two layers of boards).

The maximum opening size of the penetration seal has to comply with the dimensions as specified in the following table.

The minimum perimeter length to seal area ratio of the penetration seal in rigid floors is – according to clause 13.5.2 of EN 1366-3:2009 – 2,769 m/m<sup>2</sup>, resp. 0,002769 mm/mm<sup>2</sup>.

Blank penetration seals with maximum opening sizes as specified in the following table have been tested.

“FLAMRO KSL” can be installed only in the types of separating elements as specified in the following table.

Separating element	Construction	Maximum opening size of the penetration seal (width x height)
Flexible walls	<ul style="list-style-type: none"> <li>&gt; Steel studs or timber studs lined on both faces with minimum 2 layer of boards (minimum thickness 12,5 mm) with classification A2-s1,d0 or A1 according to EN 13501-1</li> <li>&gt; For timber stud walls there shall be a minimum distance of 100 mm of the penetration seal to any timber stud. The cavity between the penetration seal and the timber stud has to be closed with minimum 100 mm of insulation with classification A1 or A2 according to EN 13501-1</li> <li>&gt; Minimum thickness 94 mm</li> <li>&gt; Classification according to EN 13501-2: <math>\geq</math> EI 90</li> <li>&gt; The aperture lining shall be made from steel studs with a thickness of minimum 0,6 mm and boards of the same specification as those used in the wall in practice</li> <li>&gt; This European Technical Assessment does not cover sandwich panel constructions and flexible walls where the lining does not cover studs on both sides. Penetrations in such constructions shall be tested on a case by case basis</li> </ul>	1100 mm x 2200 mm
Rigid walls	<ul style="list-style-type: none"> <li>&gt; Aerated concrete, concrete, masonry</li> <li>&gt; Minimum thickness 100 mm</li> <li>&gt; The rigid wall shall be classified in accordance with EN 13501-2 for the required fire resistance period</li> </ul>	1100 mm x 2200 mm
Rigid floors	<ul style="list-style-type: none"> <li>&gt; Aerated concrete, concrete</li> <li>&gt; Minimum density 550 kg/m<sup>3</sup></li> <li>&gt; Minimum thickness 150 mm</li> <li>&gt; The rigid floor shall be classified in accordance with EN 13501-2 for the required fire resistance period</li> </ul>	see Annex F-2 of the ETA

“FLAMRO KSL” can only be configured as specified in the following tables. Other parts or service support constructions shall not penetrate the penetration seal.

Penetrating element	Construction characteristics of the penetrating element in “FLAMRO KSL” in flexible walls and rigid walls
Cables	<ul style="list-style-type: none"> <li>&gt; All types of sheathed cables<sup>1</sup> (except waveguides) currently and commonly used in building practice in Europe (e.g. electrical / telecommunication / data / optical fibre cables) with a diameter <math>\leq 80</math> mm</li> <li>&gt; Tied bundles<sup>2</sup> up to 100 mm overall diameter containing sheathed cables (except waveguides) currently and commonly used in building practice in Europe (e.g. electrical / telecommunication / data / optical fibre cables) with a diameter <math>\leq 21</math> mm</li> <li>&gt; Non-sheathed electrical cables with a diameter <math>\leq 24</math> mm</li> </ul>
Conduits	<ul style="list-style-type: none"> <li>&gt; Steel conduits / tubes, <math>\varnothing \leq 16</math> mm (without cables): steel conduits according to EN 61386-21 and / or EN 10305-4 or -6</li> <li>&gt; Plastic conduits, <math>\varnothing \leq 16</math> mm (without cables) according to EN 61386-21</li> <li>&gt; Plastic conduits, <math>\varnothing \leq 32</math> mm (with / without cables <math>\varnothing \leq 21</math> mm) according to EN 61386-22, wall thickness 0,3 mm to 0,8 mm (for polyolefine) or 0,3 mm to 0,6 mm (for PVC-U)</li> <li>&gt; Bundles<sup>3</sup> of plastic conduits (with / without cables <math>\varnothing \leq 21</math> mm) with a maximum outer diameter <math>\leq 125</math> mm: conduits acc. to EN 61386-22 with <math>\varnothing 16</math> mm to 63 mm, wall thickness 0,3 mm to 0,8 mm (for polyolefine) or 0,3 mm to 0,6 mm (for PVC-U)</li> </ul>
Plastic pipes	<ul style="list-style-type: none"> <li>&gt; PVC-U pipes according to EN ISO 1452-1 or EN ISO 15493 and DIN 8061 / DIN 8062 with diameters and wall thicknesses as defined in Annex D-5 of the ETA. For interpolation between pipe diameters and wall thicknesses see Annex E-3 of the ETA.</li> <li>&gt; PE-HD pipes according to EN 1519-1 or EN ISO 15494 and DIN 8074 / DIN 8075 with diameters and wall thicknesses as defined in Annex D-5 of the ETA. For interpolation between pipe diameters and wall thicknesses see Annex E-3 of the ETA.</li> <li>&gt; PP pipes according to EN ISO 15494 and DIN 8077 / DIN 8078 with a diameters and wall thicknesses as defined in Annex D-5 of the ETA. For interpolation between pipe diameters and wall thicknesses see Annex E-3 of the ETA.</li> </ul>
Multi-layer composite pipes	<ul style="list-style-type: none"> <li>&gt; “Geberit Mepla Systemrohr” from manufacturer “Geberit Vertriebs GmbH &amp; Co KG” with diameters and wall thicknesses as defined in Annex D-6 of the ETA.</li> </ul>

<sup>1</sup> Single or multicore cable with individual insulation of the cores and an additional protective covering of the assembly

<sup>2</sup> Several cables running in the same direction, densely packed and bound tightly together by mechanical means

<sup>3</sup> Including single penetrations

Metal pipes	<ul style="list-style-type: none"> <li>&gt; Metal pipes of reaction to fire class A1 according to EN 13501-1 with a melting or decomposition point greater or equal than copper (1006 °C for EI 90) and a thermal conductivity smaller or equal than copper with diameters and wall thicknesses as defined in Annex D-2 of the ETA. For interpolation between pipe diameters and wall thicknesses see Annex E-1 of the ETA.</li> <li>&gt; Metal pipes of reaction to fire class A1 according to EN 13501-1 with a melting or decomposition point greater or equal than steel (945 °C for EI 60; 1006 °C for EI 90) and a thermal conductivity smaller or equal than steel with diameters and wall thicknesses as defined in Annex D-3 and Annex D-4 of the ETA. For interpolation between pipe diameters and wall thicknesses see Annex E-2 of the ETA.</li> </ul>
Cable support constructions	<ul style="list-style-type: none"> <li>&gt; Steel cable trays (perforated or non-perforated)</li> <li>&gt; Steel ladders</li> <li>&gt; Steel cable trays (perforated or non-perforated) and steel ladders with organic coatings shall at least be classified A2 according to EN 13501-1</li> </ul>

Penetrating element	Construction characteristics of the penetrating element in "FLAMRO KSL" in rigid floors
Cables	<ul style="list-style-type: none"> <li>&gt; All types of sheathed cables<sup>4</sup> (except waveguides) currently and commonly used in building practice in Europe (e.g. electrical / telecommunication / data / optical fibre cables) with a diameter ≤ 80 mm</li> <li>&gt; Tied bundles<sup>5</sup> up to 100 mm overall diameter containing sheathed cables (except waveguides) currently and commonly used in building practice in Europe (e.g. electrical / telecommunication / data / optical fibre cables) with a diameter ≤ 21 mm</li> <li>&gt; Non-sheathed electrical cables with a diameter ≤ 24 mm</li> </ul>
Conduits	<ul style="list-style-type: none"> <li>&gt; Steel conduits / tubes, Ø ≤ 16 mm (without cables): steel conduits according to EN 61386-21 and / or EN 10305-4 or -6</li> <li>&gt; Plastic conduits, Ø ≤ 16 mm (without cables) according to EN 61386-21</li> <li>&gt; Plastic conduits, Ø ≤ 32 mm (with / without cables Ø ≤ 21 mm) according to EN 61386-22, wall thickness 0,3 mm to 0,8 mm (for polyolefine) or 0,3 mm to 0,6 mm (for PVC-U)</li> <li>&gt; Bundles<sup>6</sup> of plastic conduits (with / without cables Ø ≤ 21 mm) with a maximum outer diameter ≤ 125 mm: conduits acc. to EN 61386-22 with Ø 16 mm to 63 mm, wall thickness 0,3 mm to 0,8 mm (for polyolefine) or 0,3 mm to 0,6 mm (for PVC-U)</li> </ul>

<sup>4</sup> Single or multicore cable with individual insulation of the cores and an additional protective covering of the assembly

<sup>5</sup> Several cables running in the same direction, densely packed and bound tightly together by mechanical means

<sup>6</sup> Including single penetrations



Penetrating element	Construction characteristics of the penetrating element in "FLAMRO KSL" in rigid floors
Plastic pipes	<ul style="list-style-type: none"> <li>&gt; PVC-U pipes according to EN ISO 1452-1 or EN ISO 15493 and DIN 8061 / DIN 8062 with diameters and wall thicknesses as defined in Annex G-5 of the ETA. For interpolation between pipe diameters and wall thicknesses see Annex H-4 of the ETA.</li> <li>&gt; PE-HD pipes according to EN 1519-1 or EN ISO 15494 and DIN 8074 / DIN 8075 with diameters and wall thicknesses as defined in Annex G-6 of the ETA. For interpolation between pipe diameters and wall thicknesses see Annex H-4 of the ETA.</li> <li>&gt; PP pipes according to EN ISO 15494 and DIN 8077 / DIN 8078 with a diameters and wall thicknesses as defined in Annex G-7 of the ETA. For interpolation between pipe diameters and wall thicknesses see Annex H-4 of the ETA.</li> </ul>
Multi-layer composite pipes	<ul style="list-style-type: none"> <li>&gt; "Geberit Mepla Systemrohr" from manufacturer "Geberit Vertriebs GmbH &amp; Co KG" with diameters and wall thicknesses as defined in Annex G-8 of the ETA.</li> </ul>
Metal pipes	<ul style="list-style-type: none"> <li>&gt; Metal pipes of reaction to fire class A1 according to EN 13501-1 with a melting or decomposition point greater or equal than copper (1006 °C for EI 90; 1049 °C for EI 120) and a thermal conductivity smaller or equal than copper with diameters and wall thicknesses as defined in Annex G-2 and Annex G-3 of the ETA. For interpolation between pipe diameters and wall thicknesses see Annex H-1 and Annex H-2 of the ETA.</li> <li>&gt; Metal pipes of reaction to fire class A1 according to EN 13501-1 with a melting or decomposition point greater or equal than steel (945 °C for EI 60; 1006 °C for EI 90; 1049 °C for EI 120) and a thermal conductivity smaller or equal than steel with diameters and wall thicknesses as defined in Annex G-3 and Annex G-4 of the ETA. For interpolation between pipe diameters and wall thicknesses see Annex H-2 and Annex H-3 of the ETA.</li> </ul>
Cable support constructions	<ul style="list-style-type: none"> <li>&gt; Steel cable trays (perforated or non-perforated)</li> <li>&gt; Steel ladders</li> <li>&gt; Steel cable trays (perforated or non-perforated) and steel ladders with organic coatings shall at least be classified A2 according to EN 13501-1</li> </ul>

## 2.2

### Use category

"FLAMRO KSL" is intended for use at temperatures below 0 °C, but with no exposure to rain nor UV, and can therefore – according to ETAG 026-Part 2 clause 2.4.12.1.3.3 – be categorized as Type Y<sub>2</sub>. Since the requirements for Type Y<sub>2</sub> are met, also the requirements for Type Z<sub>1</sub> and Z<sub>2</sub> are fulfilled.

Although a penetration seal is intended for indoor applications only, the construction process may result in it being subjected to more exposed conditions for a period before the building envelope is closed. For this case provisions shall be made to protect temporarily exposed penetration seals according to the ETA-holder's installation instructions.

## **2.3 Working life**

The provisions made in this European Technical Assessment are based on an assumed working life of "FLAMRO KSL" of 10 years, provided the conditions laid down in the technical literature of the manufacturer relating to packaging, transport, storage, installation, use and repair are met.

The indications given on the intended working life cannot be interpreted as a guarantee given by the producer or the Technical Assessment Body, but are to be regarded only as a means for selecting the appropriate product in relation to the expected economically reasonable working life of the works.

The real working life might be, in normal use conditions, considerably longer without major degradation affecting the Basic requirements for construction works.

## **2.4 General assumptions**

### **2.4.1** It is assumed that

- > damages to the penetration seal are repaired accordingly,
- > the installation of the penetration seal does not effect the stability of the adjacent building element – even in case of fire,
- > the lintel or floor above the penetration seal is designed structurally and in terms of fire protection such that no additional mechanical load (other than its own weight) is imposed on the penetration seal,
- > the aperture lining within a flexible wall is supported by the studs (transoms and mullions) in such a way that the mechanical load imposed to the aperture lining by the penetration seal does not affect the stability of the aperture lining and the flexible wall,
- > the thermal movement in the pipe work will be accommodated in such way that it does not impose a load on the penetration seal,
- > the installations are fixed to the adjacent building element in accordance with the relevant regulations in such a way that, in case of fire, no additional mechanical load is imposed to the penetration seal,
- > the support of the installations is maintained for the required period of fire resistance and
- > pneumatic dispatch systems, compressed air systems, etc. are switched off by additional means in case of fire.

**2.4.2** This European Technical Assessment does not address any risks associated with the emission of dangerous liquids or gases caused by failure of the pipe(s) in case of fire nor does it prove the prevention of the transmission of fire through heat transfer via the medium in the pipes.

**2.4.3** This European Technical Assessment does not verify the prevention of destruction of adjacent building elements with fire separating function or of the pipes themselves due to distortion forces caused by extreme temperatures. These risks shall be accounted for by taking appropriate measures when designing or installing the pipe work.

The mounting or hanging of the pipes or the layout of the pipe work shall be implemented in such a way that the pipes and the fire resistant building elements shall remain functional within a period of time which corresponds to the fire resistance period required.

**2.4.4** The risk of downward spread of fire caused by burning material which drips through a pipe to floors below, is not considered in this European Technical Assessment (see EN 1366-3:2009, clause 1).

2.4.5 The durability assessment does not take account of the possible effect on the penetration seal of substances permeating through the pipe walls.

2.4.6 The assessment does not cover the avoidance of destruction of the penetration seal or of the adjacent building element(s) by forces caused by temperature changes in case of fire. This has to be considered when designing the piping system.

## 2.5 Manufacturing

The European Technical Assessment is issued for the product on the basis of agreed data/information, deposited with the Österreichisches Institut für Bautechnik, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to the Österreichisches Institut für Bautechnik before the changes are introduced.

The Österreichisches Institut für Bautechnik will decide whether or not such changes affect the European Technical Assessment and consequently the validity of the CE marking on the basis of the European Technical Assessment and if so whether further assessment or alterations to the European Technical Assessment, shall be necessary.

## 2.6 Installation

The product shall be installed and used as described in this European Technical Assessment.

Additional marking of the penetration seal shall be done in case of national requirements.

## 3 Performance of the product and references to the methods used for its assessment

Basic requirements for construction works	Essential characteristic	Method of verification	Performance
<b>BWR 2</b>	Reaction to fire	EN 13501-1	Clause 3.1.1 of the ETA
	Resistance to fire	EN 13501-2: 2007+A1:2009	Clause 3.1.2 of the ETA and Annex D-1 to D-6 and Annex G-1 to G-8 of the ETA
<b>BWR 3</b>	Air permeability (material property)	No performance assessed	
	Water permeability (material property)	No performance assessed	
	Content and/or release of dangerous substances	European Council Directive 67/548/EEC and Regulation (EC) No 1272/2008 as well as EOTA TR 034, edition October 2015	Declaration of conformity by the manufacturer

Basic requirements for construction works	Essential characteristic	Method of verification	Performance
BWR 4	Mechanical resistance and stability	No performance assessed	
	Resistance to impact / movement	No performance assessed	
	Adhesion	No performance assessed	
BWR 5	Airborne sound insulation	No performance assessed	
BWR 6	Thermal properties	No performance assessed	
	Water vapour permeability	No performance assessed	
BWR 7	No performance assessed		

### 3.1 Safety in case of fire (BWR 2)

#### 3.1.1 Reaction to fire

The components of “FLAMRO KSL” were assessed according to ETAG 026-Part 2 clause 2.4.1 and classified according to EN 13501-1.

Component	Class according to EN 13501-1
FLAMRO BML	<b>E</b>
FLAMRO BMS	<b>E</b>
FLAMRO BMK	<b>E</b>
FLAMRO Variant N-RM	<b>E</b>
FLAMRO BSL	<b>F</b>
Hardrock 040 / Hardrock II	<b>A1</b>
FLAMRO Variant N II A	<b>E</b>

The sheet steel housing of “FLAMRO Variant N II A” is classified Class A1 according to Commission Decision 96/603/EC<sup>7</sup>.

#### 3.1.2 Resistance to fire

“FLAMRO KSL” was tested according to ETAG 026-Part 2 clause 2.4.2, prEN 1366-3.2:N185:2007-07 and EN 1366-3:2009 in conjunction with EN 1363-1:1999.

Based upon the gained test results and the field of application specified within prEN 1366-3.2:N185:2007-07 and EN 1366-3:2009 the cable- and/or pipe penetration seal (mixed penetration seal) “FLAMRO KSL” has been classified according to EN 13501-2:2007+A1:2009. The individual fire resistance classes are listed in Annex D-1 to D-6 and Annex G-1 to G-8 of the ETA.

<sup>7</sup> Official Journal of the European Communities no. L 267, 19.10.1996, p. 23

The maximum fire resistance class of the penetration seal in vertical or horizontal separating element depends on the fire resistance class of the penetrating elements. The fire resistance class of the penetration seal is reduced to the fire resistance class of the penetrating element with the lowest fire resistance classification.

The resistance to fire classification listed in Annex D-1 to D-6 and Annex G-1 to G-8 of the ETA is only valid if "FLAMRO KSL" is installed according to Annex A-1 to A-11 of the ETA.

### **3.2 Hygiene, health and environment (BWR 3)**

#### **3.2.1 Air permeability**

No performance assessed.

#### **3.2.2 Water permeability**

No performance assessed.

#### **3.2.3 Release of dangerous substances**

According to the manufacturer's declaration the components of "FLAMRO KSL" do not contain dangerous substances detailed in Council Directive 67/548/EEC and Regulation (EC) no 1272/2008 as well as EOTA TR 034 (General BWR 3 Checklist for EADs/ETAs – Dangerous substances), edition October 2015 above the acceptable limits.

A written declaration in this respect was submitted by the ETA-holder.

In addition to the specific clauses relating to dangerous substances contained in this European Technical Assessment, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Regulation, these requirements need also to be complied with, when and where they apply.

### **3.3 Safety in use (BWR 4)**

#### **3.3.1 Mechanical resistance and stability**

No performance assessed.

#### **3.3.2 Resistance to impact / movement**

No performance assessed.

Provisions shall be taken to prevent a person from stepping onto a horizontal penetration seal or falling against a vertical penetration seal (e.g. by covering with a wire mesh).

#### **3.3.3 Adhesion**

No performance assessed.

### **3.4 Protection against noise (BWR 5)**

#### **3.4.1 Airborne sound insulation**

No performance assessed.

### 3.5 Energy economy and heat retention (BWR 6)

#### 3.5.1 Thermal properties

No performance assessed.

#### 3.5.2 Water vapour permeability

No performance assessed.

### 3.6 Sustainable use of natural resources (BWR 7)

No performance assessed.

### 3.7 General aspects relating to fitness for use

All components of "FLAMRO KSL" fulfil the requirements for the intended use category.

"FLAMRO KSL" is therefore appropriate for use at temperatures below 0 °C, but with no exposure to rain nor UV, and can therefore – according to ETAG 026-Part 2 clause 2.4.12.1.3.3 – be categorized as Type Y<sub>2</sub>. Since the requirements for Type Y<sub>2</sub> are met, also the requirements for Type Z<sub>1</sub> and Z<sub>2</sub> are fulfilled.

It is assumed that the sheet steel housing of "FLAMRO Variant N II A" is sufficiently protected against corrosion by the used type of powder coating.

## 4 Assessment and verification of constancy of performance (hereinafter AVCP) system applied, with reference to its legal base

### 4.1 AVCP system

According to the Decision 1999/454/EC<sup>8</sup>, amended by Decision 2001/596/EC<sup>9</sup> of the European Commission the system(s) of assessment and verification of constancy of performance (see Annex V of Regulation (EU) No 305/2011) is given in the following table.

Product(s)	Intended use(s)	Level(s) or class(es) (resistance to fire)	System of assessment and verification of constancy of performance
Fire Stopping and Fire Sealing Products	for fire compartmentation and/or fire protection or fire performance	any	1

<sup>8</sup> Official Journal of the European Communities no. L 178, 14.7.1999, p. 52

<sup>9</sup> Official Journal of the European Communities no. L 209, 2.8.2001, p. 33

In addition, according to the Decision 1999/454/EC, amended by Decision 2001/596/EC of the European Commission the system(s) of assessment and verification of constancy of performance, with regard to reaction to fire, is given in the following table.

Product(s)	Intended use(s)	Level(s) or class(es) (reaction to fire)	System of assessment and verification of constancy of performance
Fire Stopping and Fire Sealing Products	for uses subject to regulations on reaction to fire	A1*, A2*, B*, C*	1
		A1**, A2**, B**, C**, D, E	3
		(A1 to E)***, F	4
<p>* Products/materials for which a clearly identifiable stage in the production process results in an improvement of the reaction to fire classification (e.g. an addition of fire retardants or a limiting of organic material)</p> <p>** Products/materials not covered by footnote (*)</p> <p>*** Products/materials that do not require to be tested for reaction to fire (e.g. products/materials of class A1 according to Commission Decision 96/603/EC, as amended)</p>			

## 5 Technical details necessary for the implementation of the AVCP system, as provided for the applicable European Assessment Document

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with the Technical Assessment Body Österreichisches Institut für Bautechnik.

The notified product certification body shall visit the factory at least once a year for surveillance of the manufacturer.

Issued in Vienna on 13.05.2016  
by Österreichisches Institut für Bautechnik

The original document is signed by:

Rainer Mikulits  
Managing Director



## 1 General

- > "FLAMRO KSL" can be used in apertures in walls (vertical separating element) and floors (horizontal separating element) according to clause 2.1 of the ETA.
- > The penetration of cables, conduits / tubes, metal pipes, plastic pipes, multi-layer composite pipes and cable support constructions according to clause 2.1 of the ETA is permitted.
- > The total cross section of the installations (including insulation and cable support constructions) must not be more than 60 % of the opening size of the penetration seal.
- > Each metal pipe, plastic pipe or multi-layer composite pipe which is to be sealed off has to be protected separately by the appropriate additional precaution as described in Annex A-5 to Annex A-10 of the ETA.

### 1.1 Pipe end configuration

- > For plastic pipes classified with pipe end configuration U/U the pipe end configuration can be U/U, C/U, U/C, C/C.
- > For metal pipes classified with pipe end configuration C/U the pipe end configuration can be C/U and C/C.
- > For multi-layer composite pipes classified with pipe end configuration U/C the pipe end configuration can be U/C and C/C.
- > Plastic conduits were tested U/C.
- > Steel conduits / tubes were tested C/U.

### 1.2 Orientation of the penetrating elements

- > Conduits / tubes, metal pipes, plastic pipes and multi-layer composite pipes have to be installed perpendicular to the surface of the penetration seal.

### 1.3 Service support constructions

- > All types of cables, conduits / tubes, metal pipes, plastic pipes and multi-layer composite pipes – in flexible walls and rigid walls – have to be supported on both side of the separating element by steel cable trays (perforated or non-perforated), steel ladders or alternative service support constructions (e.g. pipe hangers) made of metal with a melting or decomposition point greater or equal than 945 °C for EI 60, 1006 °C for EI 90 or 1049 °C for EI 120 (e.g. stainless steel or galvanized steel) according to the ETA-holder's installation instructions.

**FLAMRO KSL**

**- Details for installation -**

**ANNEX A-1**



- > All types of cables, conduits / tubes, metal pipes, plastic pipes and multi-layer composite pipes – in rigid floors – have to be supported at least on the top side of the separating element by steel cable trays (perforated or non-perforated), steel ladders or alternative service support constructions (e.g. pipe hangers) made of metal with a melting or decomposition point greater or equal than 945 °C for EI 60, 1006 °C for EI 90 or 1049 °C for EI 120 (e.g. stainless steel or galvanized steel) according to the ETA-holder's installation instructions.
- > Steel cable trays (perforated or non-perforated) or steel ladders can pass through or end at the surface of the penetration seal.
- > Lidded cable trays / trunkings must not pass through the penetration seal.
- > The length of the steel cable trays (perforated or non-perforated) or steel ladders has to be minimum 575 mm on both sides of the penetration seal (measured from the surface of the penetration seal).
- > The first support (service support construction) for cables, conduits / tubes, metal pipes, plastic pipes and multi-layer composite pipes in flexible walls and rigid walls has to be at maximum 500 mm (measured from the surface of the penetration seal).
- > The first support (service support construction) for cables, conduits / tubes, metal pipes, plastic pipes and multi-layer composite pipes in rigid floors has to be at maximum 420 mm (measured from the surface of the penetration seal).
- > All types of cables, conduits / tubes, metal pipes and plastic pipes have to be fixed according to the ETA-holder's installation instructions to the service support construction.

#### 1.4 Aperture lining

- > For flexible walls according to clause 2.1 of the ETA the aperture lining shall be made from steel studs and boards of the same specification as those used in the wall in practice.
- > The reveal of the aperture has to be delimited with an all-around trimming made from steel studs (sheet steel profiles) with a thickness of minimum 0,6 mm which are connected to each other and force-fitted at the vertical steel studs (mullions).
- > The reveal of the aperture has to be lined with minimum two layers of boards (minimum thickness 12,5 mm) with classification A2-s1,d0 or A1 according to EN 13501-1 and a width of minimum 100 mm. For flexible walls with a thickness of 94 mm the boards have to be installed centred within the reveal of the aperture so that they protrude the flexible wall by  $\geq 3$  mm on both sides of the flexible wall. The boards have to be fixed to the all-around trimming (sheet steel profiles) with steel drywall screws with a distance of maximum 200 mm between the steel drywall screws.

**FLAMRO KSL**  
**- Details for installation -**

**ANNEX A-2**

- > The flexible wall around the reveal of the aperture has to be lined with minimum two layers of boards (minimum thickness 12,5 mm) with classification A2-s1,d0 or A1 according to EN 13501-1. Each layer has to be fixed separately to the all-around trimming (sheet steel profiles) with steel drywall screws with a distance of maximum 300 mm between the steel drywall screws. The length of the steel drywall screws has to be sufficient so that they project at least 10 mm into the all-around trimming (sheet steel profiles) resp. the flexible wall.
- > Joints between the aperture lining and the flexible wall have to be filled with gypsum joint filler (non-combustible material with classification A2-s1,d0 or A1 according to EN 13501-1 which is dimensionally stable) on both sides of the penetration seal according to the ETA-holder's installation instructions.

## 2 Details for installation of "FLAMRO KSL" (see Annex B-1 to H-4 of the ETA)

- > "FLAMRO KSL" (including all additional precautions as described in Annex A-5 to Annex A-10 of the ETA) has to be installed according to the ETA-holder's installation instructions.
- > For the installation of "FLAMRO KSL" two layers of mineral wool boards according to clause 1 of the ETA ("FLAMRO BSL" or "Hardrock 040" / "Hardrock II") with a nominal thickness of 50 mm have to be used.
- > In vertical separating elements with a thickness of 94 mm to 100 mm the two layers of mineral wool boards have to be installed centred within the separating element. In vertical separating elements with a thickness > 100 mm the two layers of mineral wool boards can be installed flushed to the surface of the separating element, centred within the separating element or in all positions in between.
- > In horizontal separating elements with a thickness of 150 mm the two layers of mineral wool boards have to be installed flushed to the surface of the separating element. In horizontal separating elements with a thickness > 150 mm the two layers of mineral wool boards have to be installed flushed to the top side of the separating element.
- > The gap between the two layers of mineral wool boards in vertical separating elements has to be 0 mm.
- > The gap between the two layers of mineral wool boards in horizontal separating elements has to be 50 mm.

**FLAMRO KSL**  
**- Details for installation -**

**ANNEX A-3**

- > All edges of the mineral wool boards "FLAMRO BSL" or "Hardrock 040" / "Hardrock II" or the reveal of the aperture in the area of the mineral wool boards have to be coated with "FLAMRO BML" or "FLAMRO BMS" / "FLAMRO BMK" with a thickness of minimum 1 mm (total dry layer thickness).
- > All mineral wool boards "FLAMRO BSL" or "Hardrock 040" / "Hardrock II" have to be bonded with "FLAMRO BML" or "FLAMRO BMS" / "FLAMRO BMK".
- > Gaps and joints (maximum width 5 mm) between the mineral wool boards as well as the mineral wool boards and the separating element have to be completely filled with "FLAMRO BML" or "FLAMRO BMS" / "FLAMRO BMK" on both sides of the penetration seal.
- > Gaps and joints (maximum width 10 mm) between the mineral wool boards and the penetrating elements (cables, conduits / tubes, metal pipes, plastic pipes, multi-layer composite pipes and cable support constructions) have to be completely filled with "FLAMRO BMS" / "FLAMRO BMK" on both sides of the penetration seal. Gaps and joints (maximum width 10 mm) between the mineral wool boards and the penetrating elements (cables, conduits / tubes, metal pipes, plastic pipes, multi-layer composite pipes and cable support constructions) can alternatively be completely filled with mineral wool (stone wool with classification A1 according to EN 13501-1, a minimum compacted apparent density of 50 kg/m<sup>3</sup> and a melting point  $\geq 1000$  °C according to DIN 4102-17) which is impregnated with "FLAMRO BML" or "FLAMRO BMS" / "FLAMRO BMK", and afterwards coated with "FLAMRO BML" or "FLAMRO BMS" / "FLAMRO BMK" with a thickness of minimum 1 mm (total dry layer thickness) on both sides of the penetration seal.
- > For tied cable bundles the space between the cables need not be filled.
- > The mineral wool boards have to be coated single-sided on the visible surface with "FLAMRO BML" with a thickness of minimum 1 mm (total dry layer thickness) on both sides of the penetration seal.
- > The transition area between mineral wool boards and the vertical separating element has to be coated with "FLAMRO BML" with a thickness of minimum 1 mm (total dry layer thickness) on both sides of the penetration seal so that the layer extends at least 20 mm beyond the mineral wool boards.
- > All penetrating elements (cables, conduits / tubes, metal pipes, plastic pipes, multi-layer composite pipes or cable support constructions) have to be protected by the appropriate additional precautions as described in Annex A-5 to Annex A-10 of the ETA.

**FLAMRO KSL**  
**- Details for installation -**

**ANNEX A-4**

<p><b>3 Additional precautions</b></p> <p><b>3.1 Cables, conduits / tubes, cable support constructions in vertical separating elements and in horizontal separating elements</b></p> <ul style="list-style-type: none"> <li>&gt; All cable trays / cable ladders (plate and flanges), cables and conduits / tubes (except conduit bundles) have to be coated with “FLAMRO BML” with a thickness of <math>\geq 1</math> mm (total dry layer thickness) at a length of <math>\geq 150</math> mm on both sides of the penetration seal (measured from the surface of the penetration seal) and at the penetration area (area below and in between the two layers of mineral wool boards) with a thickness of <math>\geq 1</math> mm (total dry layer thickness).</li> <li>&gt; In vertical separating elements all cables with a diameter <math>&gt; 21</math> mm have to be coated with “FLAMRO BML” with a thickness of <math>\geq 1,5</math> mm (total dry layer thickness) at a length of <math>\geq 150</math> mm on both sides of the penetration seal (measured from the surface of the penetration seal) and at the penetration area (area below and in between the two layers of mineral wool boards) with a thickness of <math>\geq 1,5</math> mm (total dry layer thickness).</li> <li>&gt; All conduits / tubes (including conduit bundles) resp. the annular gap between the cable(s) and the conduit / tube has to be filled to a depth of minimum 10 mm on at least one side of the penetration seal (depending on the tested pipe end configuration, see Annex A-1, clause 1.1 of the ETA) with “FLAMRO BMS” / “FLAMRO BMK”. Empty conduits / tubes (including conduit bundles) have to be filled to a depth of minimum 10 mm with “FLAMRO BMS” / “FLAMRO BMK” or mineral wool (stone wool with classification A1 according to EN 13501-1, a minimum compacted apparent density of <math>50 \text{ kg/m}^3</math> and a melting point <math>\geq 1000</math> °C according to DIN 4102-17) and additionally “FLAMRO BMS” / “FLAMRO BMK” with a thickness of <math>\geq 1</math> mm (total dry layer thickness).</li> <li>&gt; For conduit bundles see Annex A-9, clause 3.3 of the ETA.</li> </ul>	<table border="1"> <tr> <td data-bbox="113 1915 1160 2087"> <p align="center"><b>FLAMRO KSL</b></p> <p align="center"><b>- Details for installation -</b></p> </td><td data-bbox="1160 1915 1481 2087"> <p align="center"><b>ANNEX A-5</b></p> </td></tr> </table>	<p align="center"><b>FLAMRO KSL</b></p> <p align="center"><b>- Details for installation -</b></p>	<p align="center"><b>ANNEX A-5</b></p>
<p align="center"><b>FLAMRO KSL</b></p> <p align="center"><b>- Details for installation -</b></p>	<p align="center"><b>ANNEX A-5</b></p>		

### 3.2 Metal pipes in vertical separating elements and horizontal separating elements

- > Metal pipes have to be insulated (local-sustained or continued-sustained) with "AF/Armaflex" or mineral wool insulation (e.g. "Lamellenmatte ML 3") according to clause 1 of the ETA – or in some cases (see Annex G-4 of the ETA) with stone wool insulation (e.g. "Rockwool Klimarock") according to clause 1 of the ETA – and protected with "FLAMRO Variant N-RM".
- > In horizontal separating elements – for fire resistance class EI 120 (see Annex G-4 of the ETA) – steel pipes with a diameter > 88,9 mm have to be insulated with stone wool insulation (e.g. "Rockwool Klimarock") according to clause 1 of the ETA and protected with "FLAMRO Variant N-RM".

#### 3.2.1 Installation of „AF/Armaflex“

- > The tube of "AF/Armaflex" has to be installed centred in the opening of the penetration seal so that it protrudes the penetration seal on both sides by  $\geq 550$  mm (measured from the surface of the penetration seal) and that it is continuous along the required minimum insulation length.
- > The thickness of the tube of "AF/Armaflex" has to be chosen from Annex D-2 and Annex G-2 (as well as Annex B-2) of the ETA in accordance with the outer diameter of the pipe to be sealed off and the corresponding inner diameter of "AF/Armaflex" (e.g. for pipes with an outer diameter of 10 mm the nominal insulation thickness has to be 11 mm).
- > When installing "AF/Armaflex" all butt joints and longitudinal joints (except for "AF/Armaflex" with self-adhesive device) have to be glued with "Armaflex Kleber 520" (Armaflex Adhesive 520) and can be covered with "AF/Armaflex Band selbstklebend" (AF/Armaflex self-adhesive tape).
- > The amount of "Armaflex Kleber 520" (Armaflex Adhesive 520) shall not be more than 300 g/m<sup>2</sup>.
- > The strip of "AF/Armaflex Band selbstklebend" (AF/Armaflex self-adhesive tape) has to be 50 mm x 3 mm (width x thickness).
- > The tube of "AF/Armaflex" can be either pushed onto the pipe or slotted and glued at the longitudinal joint.
- > Branches or elbows also have to be equipped with "AF/Armaflex" along the required minimum insulation length ( $\geq 550$  mm – measured from the surface of the penetration seal) on both sides of the penetration seal.
- > For further details see technical literature of the manufacturer.

**FLAMRO KSL**

**- Details for installation -**

**ANNEX A-6**

### 3.2.2 Installation of mineral wool insulation (e.g. "Lamellenmatte ML 3")

- > The mineral wool insulation (e.g. "Lamellenmatte ML 3") has to be wrapped around the pipe to be sealed off so that it protrudes the penetration seal on both sides by  $\geq 550$  mm (measured from the surface of the penetration seal) and that it is continuous along the required minimum insulation length.
- > The thickness of the insulation has to be – depending on the relevant pipe to be sealed off – 20 mm, 30 mm, 40 mm or 50 mm (for details see Annex D-3, Annex D-4 and Annex G-3 of the ETA).
- > The mineral wool insulation (e.g. "Lamellenmatte ML 3") has to be fixed along the required minimum insulation length by a winding wire (steel wire with diameter  $\geq 0,8$  mm; 5 windings per meter, e.g. at a distance of 200 mm, 400 mm etc. – measured from the surface of the penetration seal) in place.
- > Branches or elbows also have to be insulated with mineral wool insulation (e.g. "Lamellenmatte ML 3") along the required insulation length ( $\geq 550$  mm – measured from the surface of the penetration seal) on both sides of the penetration seal.
- > For further details see technical literature of the manufacturer.

### 3.2.3 Installation of stone wool insulation (e.g. "Rockwool Klimarock")

- > The stone wool insulation (e.g. "Rockwool Klimarock") has to be wrapped around the pipe to be sealed off so that it protrudes the penetration seal on both sides by  $\geq 550$  mm (measured from the surface of the penetration seal) and that it is continuous along the required minimum insulation length.
- > The thickness of the insulation has to be – depending on the relevant pipe to be sealed off – 20 mm, 30 mm, 40 mm or 60 mm (for details see Annex G-4 of the ETA).
- > The stone wool insulation (e.g. "Rockwool Klimarock") has to be fixed along the required minimum insulation length by a winding wire (steel wire with diameter  $\geq 0,8$  mm; 5 windings per meter, e.g. at a distance of 200 mm, 400 mm etc. – measured from the surface of the penetration seal) in place.
- > Branches or elbows also have to be insulated with stone wool insulation (e.g. "Rockwool Klimarock") along the required insulation length ( $\geq 550$  mm – measured from the surface of the penetration seal) on both sides of the penetration seal.
- > For further details see technical literature of the manufacturer.

**FLAMRO KSL**

**- Details for installation -**

**ANNEX A-7**

### 3.2.4 Installation of „FLAMRO Variant N-RM“ in vertical separating elements

- > Two strips of “FLAMRO Variant N-RM” (thickness 1,5 mm, width 100 mm) have to be used.
- > For pipes insulated with “AF/Armaflex” two layers of “FLAMRO Variant N-RM” (for an overall thickness of 3 mm) have to be used.
- > For pipes insulated with mineral wool insulation (e.g. “Lamellenmatte ML 3”) or stone wool insulation (e.g. “Rockwool Klimarock”) one layer of “FLAMRO Variant N-RM” (for an overall thickness of 1,5 mm) has to be used.
- > The two strips of “FLAMRO Variant N-RM” have to be wrapped around the insulation of the pipe to be sealed off so that they protrude the penetration seal on both sides by 50 mm (measured from the surface of the penetration seal) and if needed additionally fixed by adhesive tape.
- > For details see Annex C-3 and Annex C-4 of the ETA.

### 3.2.5 Installation of „FLAMRO Variant N-RM“ in horizontal separating elements

- > One strip of “FLAMRO Variant N-RM” (thickness 1,5 mm, width 100 mm) has to be used.
- > The strip of “FLAMRO Variant N-RM” has only to be installed at the bottom side of the penetration seal (bottom side of the floor).
- > For pipes insulated with “AF/Armaflex” two layers of “FLAMRO Variant N-RM” (for an overall thickness of 3 mm) have to be used.
- > For pipes insulated with mineral wool insulation (e.g. “Lamellenmatte ML 3”) or stone wool insulation (e.g. “Rockwool Klimarock”) one layer of “FLAMRO Variant N-RM” (for an overall thickness of 1,5 mm) has to be used.
- > The strip of “FLAMRO Variant N-RM” has to be wrapped around the insulation of the pipe to be sealed off so that it protrudes the penetration seal on the bottom side of the floor by 25 mm (measured from the surface of the penetration seal) and if needed additionally fixed by adhesive tape.
- > For details see Annex F-4 and Annex F-5 of the ETA.

**FLAMRO KSL**  
**- Details for installation -**

**ANNEX A-8**



### **3.3 Plastic pipes and conduit bundles (including single penetrations) in vertical separating elements and horizontal separating elements**

- > Plastic pipes and conduit bundles have to be equipped with "FLAMRO Variant N II A".
- > The smallest pipe collar corresponding to the relevant outer diameter of the pipe or conduit bundle to be sealed off has to be used (see Annex B-1, Annex D-1, Annex D-5, Annex G-1 and Annex G-5 to Annex G-7 of the ETA).
- > For conduit bundles the annular gap between the conduit bundle and the active component of the pipe collar has to be maximum 15 mm (see Annex C-6 and Annex F-7 of the ETA).
- > Conduit bundles (minimum length on both sides of the penetration seal 200 mm; measured from the surface of the penetration seal) have to be fixed (bound together) on both sides of the penetration seal with at least one winding of e.g. self adhesive tape or plastic wire at maximum 100 mm (measured from the surface of the penetration seal).
- > In vertical separating elements the pipe collars have to be installed on both sides of the penetration seal.
- > In horizontal separating elements the pipe collars have to be installed at the bottom side of the penetration seal.
- > The pipe collars have to be fixed by threaded steel bolts (thread size M6 for type DN 32 to DN 75 or thread size M8 for type DN 90 to DN 160, corresponding to the diameter of the bores within the fixing lugs; length  $\geq$  thickness of the penetration seal) and on both sides of the penetration seal with washers and nuts (corresponding to the outer diameter of the threaded steel bolts).
- > The number of fixing lugs shall not be reduced.

### **3.4 Multi-layer composite pipes in vertical separating elements and horizontal separating elements**

- > Multi-layer composite pipes have to be insulated (local-sustained or continued-sustained) with prefabricated pipe shells (e.g. "ASTRATHERM® Steinwoll-Rohrschale alukaschiert") according to clause 1 of the ETA.
- > In vertical separating elements the prefabricated pipe shells (e.g. "ASTRATHERM® Steinwoll-Rohrschale alukaschiert") have to be installed centred in the opening of the penetration seal so that they protrude the penetration seal on both sides by  $\geq 450$  mm (measured from the surface of the penetration seal) and that they are continuous along the required minimum insulation length (see Annex C-7 of the ETA).

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**- Details for installation -**

**ANNEX A-9**



- > In horizontal separating elements the prefabricated pipe shells (e.g. "ASTRATHERM® Steinwool-Rohrschale alukaschiert") have to be installed centred in the opening of the penetration seal so that they protrude the penetration seal on both sides by  $\geq 425$  mm (measured from the surface of the penetration seal) and that they are continuous along the required minimum insulation length (see Annex F-8 of the ETA).
- > Branches or elbows also have to be equipped with prefabricated pipe shells (e.g. "ASTRATHERM® Steinwool-Rohrschale alukaschiert") along the required minimum insulation length ( $\geq 450$  mm in vertical separating elements or 425 mm in horizontal separating elements – measured from the surface of the penetration seal) on both sides of the penetration seal.
- > For further details see technical literature of the manufacturer.

#### **4 Minimum working clearances**

- > The minimum working clearances are defined in Annex C-1 and F-1 of the ETA.

#### **5 Subsequent addition (retrofitting) and removal**

- > Subsequent addition (retrofitting) and removal of cables, conduits / tubes, pipes and cable support constructions according to the ETA holder's installation instructions is permitted.
- > Retrofitting shall be done according to the ETA holder's installation instructions and the regulations of Annex A-3, clause 2 of the ETA.
- > If cables, conduits / tubes, pipes and cable support constructions are removed the remaining opening (hole) has to be completely closed with a fitting piece of "FLAMRO BSL" or "Hardrock 040" / "Hardrock II" (nominal thickness 50 mm) on both sides of the penetration seal according to the ETA-holder's installation instructions. Gaps and joints (maximum width 5 mm) between the adjusted piece of "FLAMRO BSL" or "Hardrock 040" / "Hardrock II" and the mineral wool boards have to be completely filled with "FLAMRO BML" or "FLAMRO BMS" / "FLAMRO BMK" on both sides of the penetration seal. The fitted piece of "FLAMRO BSL" or "Hardrock 040" / "Hardrock II" has to be coated on the visible surface with "FLAMRO BML" with a thickness of minimum 1 mm (total dry layer thickness) on both sides of the penetration seal.

**FLAMRO KSL**  
**- Details for installation -**

**ANNEX A-10**

- > Remaining openings (holes) with a maximum diameter of 10 mm can alternatively be completely filled with “FLAMRO BMS” / “FLAMRO BMK” or mineral wool (stone wool with classification A1 according to EN 13501-1, a minimum compacted apparent density of 50 kg/m³ and a melting point ≥ 1000 °C according to DIN 4102-17) which is impregnated with “FLAMRO BML” or “FLAMRO BMS” / “FLAMRO BMK”, and afterwards coated with “FLAMRO BML” with a thickness of minimum 1 mm (total dry layer thickness) on both sides of the penetration seal.

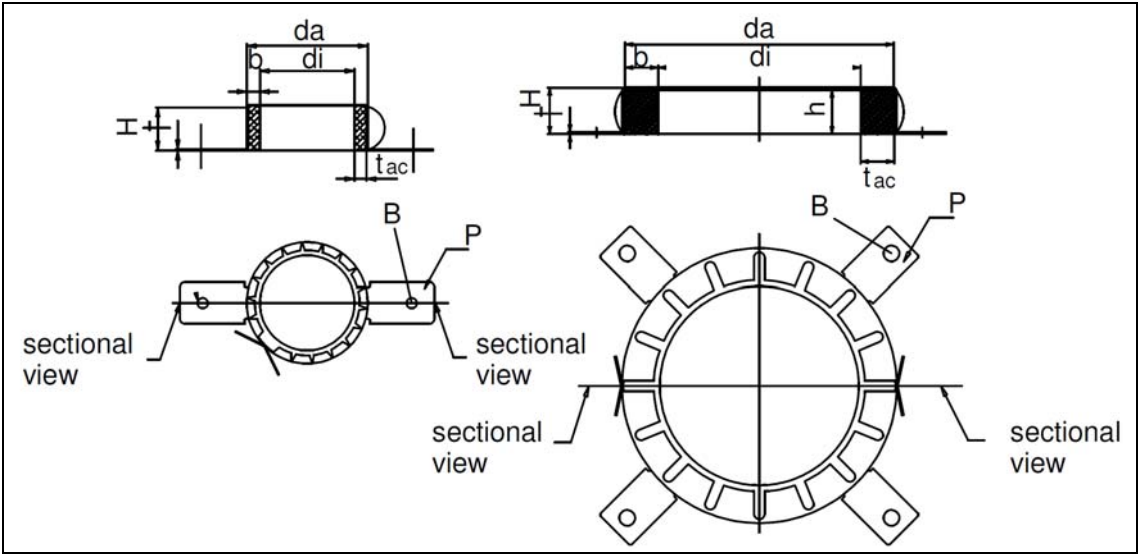
**6 Transport and storage**

- > The indications of the manufacturer regarding transport and storage (minimum and maximum storing temperature, maximum duration of storage) have to be followed.

**7 Use, maintenance and repair**

- > The fire resistance of the penetration seal shall not be negatively affected by future changes to buildings or building elements.
- > The assessment of the fitness for use is based on the assumption that necessary maintenance and repair if required is carried out in accordance with the manufacturer’s instructions during the assumed intended working life.

<p style="text-align: center;"><b>FLAMRO KSL</b> - Details for installation -</p>	<p style="text-align: center;"><b>ANNEX A-11</b></p>
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type (DN)	collar					active component		fixing lugs	
	di (mm)	da (mm)	H (mm)	t (mm)	b (mm)	t <sub>ac</sub> (mm)	h (mm)	P (pcs)	B (mm)
32	36	50	26,0	0,6	7,0	6,4 ± 0,5	25,4	2	6,0
40	44	58	26,0	0,6	7,0	6,4 ± 0,5	25,4	2	6,0
50	54	68	26,0	0,6	7,0	6,4 ± 0,5	25,4	2	6,0
63	67	94	26,0	0,6	13,5	12,8 ± 1,0	25,4	4	6,0
75	79	106	26,0	0,6	13,5	12,8 ± 1,0	25,4	4	6,0
90	94	132	26,6	1,1	18,3	19,2 ± 1,0	25,4	4	9,0
110	114	155	26,6	1,1	20,5	19,2 ± 1,5	25,4	4	9,0
125	129	172	40,0	1,1	20,5	25,6 -0/+2,0	38,1	4	9,0
140	144	200	40,0	1,1	28,0	25,6 -0/+2,0	38,1	6	9,0
160	164	220	40,0	1,1	28,0	25,6 -0/+2,0	38,1	6	9,0

di...inner diameter of collar  
da...outer diameter of collar  
H...height of collar  
t...thickness of sheet steel  
b...width of sheet steel  
t<sub>ac</sub>...thickness of active component  
h...height of active component  
P...number of fixing lugs  
B...diameter of bores  
dimensions of fixing lugs 35 mm x 20 mm (length x width)

**FLAMRO KSL**  
**- Description of "FLAMRO Variant N II A" -**

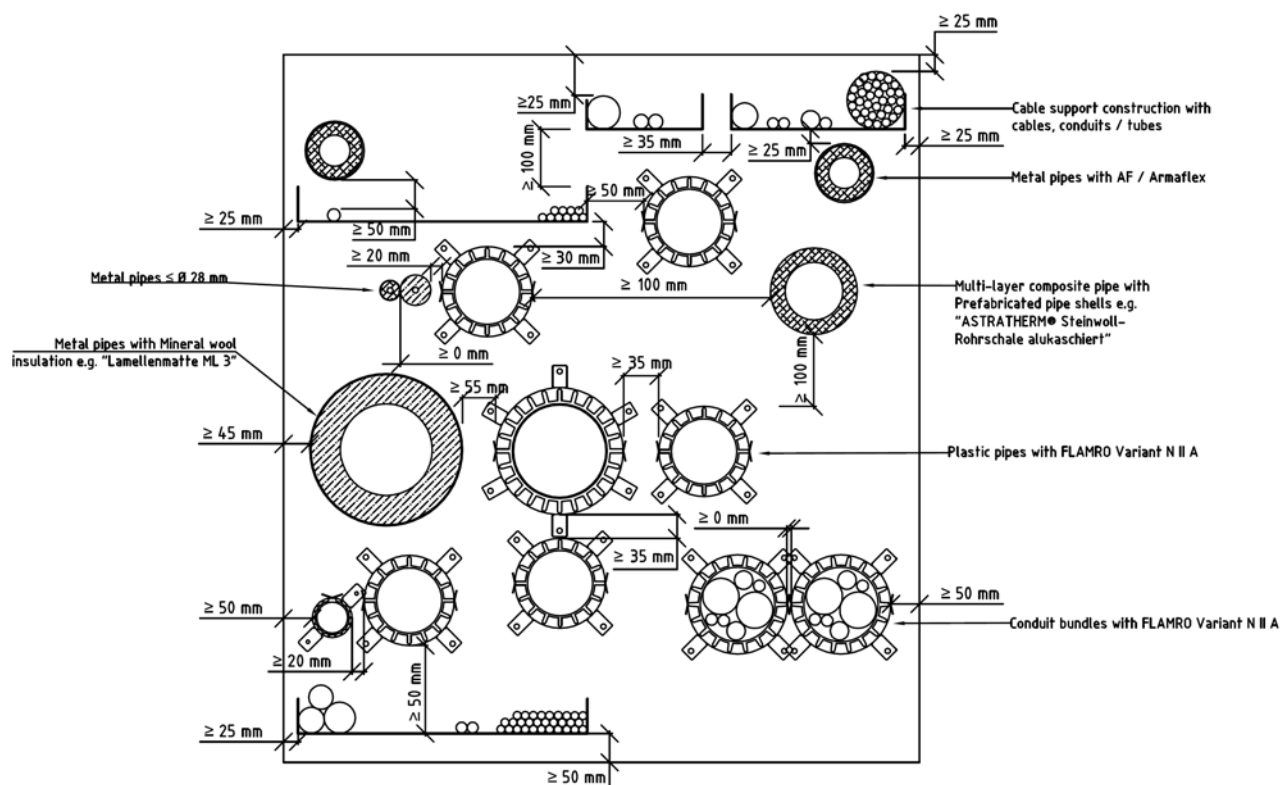
**ANNEX B-1**

Pipe max. outer diameter (mm)	AF/Armaflex (tubes)			
	Inner diameter (mm)	Insulation thickness ± tolerance (mm)	Type	Designation
10	11,0 - 12,5	11,0 ±1,0	AF-2	AF-2-010
12	13,0 - 14,5	11,0 ±1,0		AF-2-012
15	16,0 - 17,5	11,5 ±1,0		AF-2-015
18	19,0 - 20,5	11,5 ±1,0		AF-2-018
20	21,0 - 22,5	12,0 ±1,0		AF-2-020
22	23,0 - 24,5	12,0 ±1,0		AF-2-022
25	26,0 - 27,5	12,5 ±1,0		AF-2-025
28	29,0 - 30,5	12,5 ±1,0		AF-2-028
30	31,0 - 33,0	19,0 ±1,5	AF-4	AF-4-030
32	33,0 - 35,0	19,5 ±1,5		AF-4-032
35	36,0 - 38,0	19,5 ±1,5		AF-4-035
40	41,0 - 42,5	20,5 ±1,5		AF-4-040
42	43,5 - 45,5	20,5 ±1,5		AF-4-042
45	46,0 - 47,5	20,5 ±1,5		AF-4-045
48	49,5 - 51,5	21,0 ±1,5		AF-4-048
50	51,0 - 52,5	21,0 ±1,5		AF-4-050
54	55,0 - 57,0	21,0 ±1,5		AF-4-054
57	58,0 - 60,0	38,5 ±3,0	AF-6	AF-6-057
60	61,5 - 63,5	39,0 ±3,0		AF-6-060
64	65,0 - 67,5	39,5 ±3,0		AF-6-064
70	71,0 - 73,5	40,0 ±3,0		AF-6-070
76	77,0 - 79,5	40,5 ±3,0		AF-6-076
80	81,0 - 84,0	41,0 ±3,0		AF-6-080
89	90,5 - 93,5	41,5 ±3,0		AF-6-089

**FLAMRO KSL**  
- Description of "AF/Armaflex" -

**ANNEX B-2**

**FLAMRO KSL in flexible walls and rigid walls according to clause 2.1 of the ETA – Minimum working clearances / Installation drawing – top view**



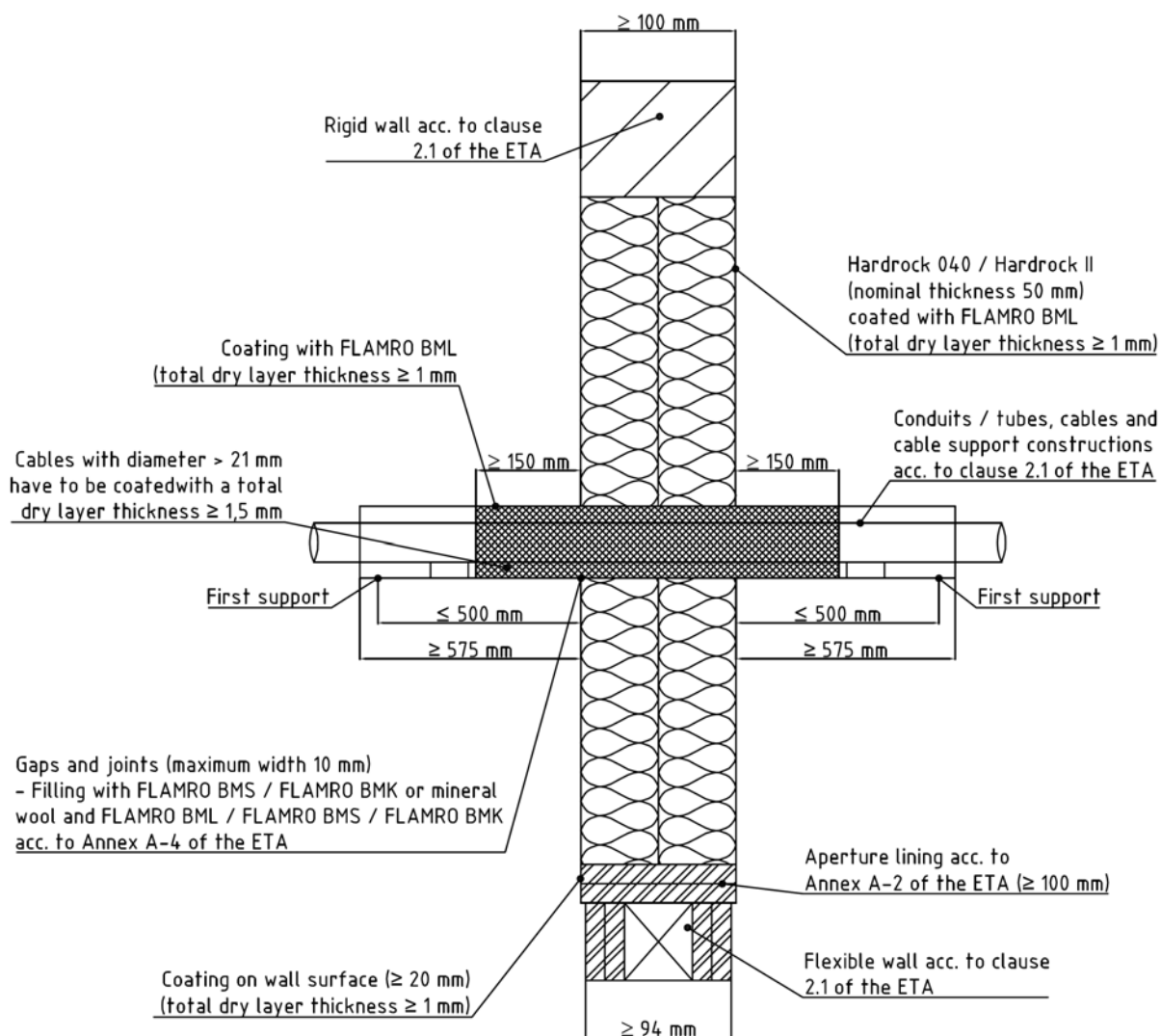
Horizontal and vertical distances / minimum working clearances – regarding penetrating elements – not given in the installation drawing have to be  $\geq 100$  mm in practice.

**FLAMRO KSL**

**- Installation in flexible wall and rigid wall -**

## ANNEX C-1

**FLAMRO KSL in flexible walls and rigid walls according to clause 2.1 of the ETA – penetrated by cables and conduits / tubes according to clause 2.1 of the ETA – Installation drawing – sectional view**

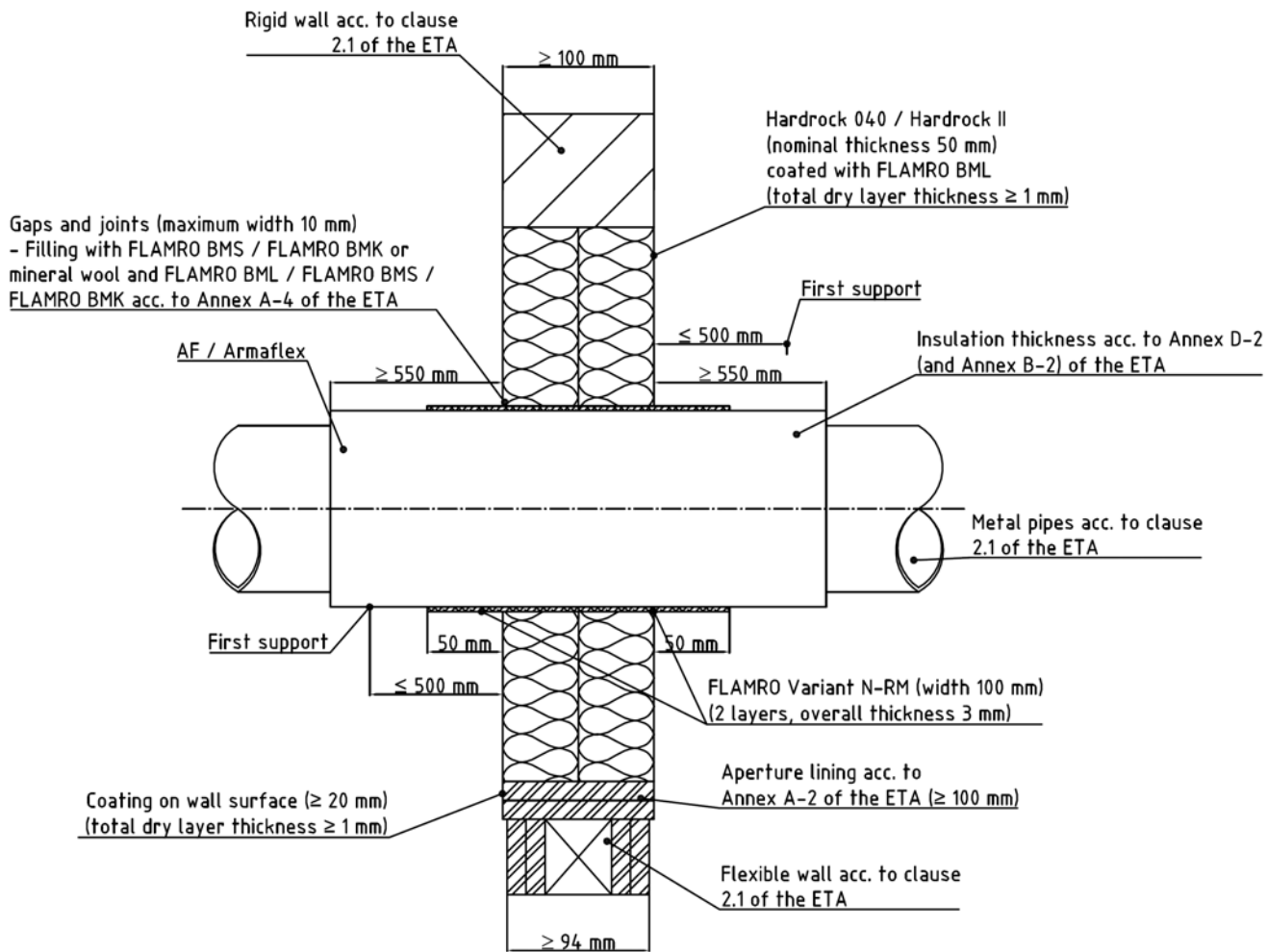


**FLAMRO KSL**

**- Installation in flexible wall and rigid wall -**

**ANNEX C-2**

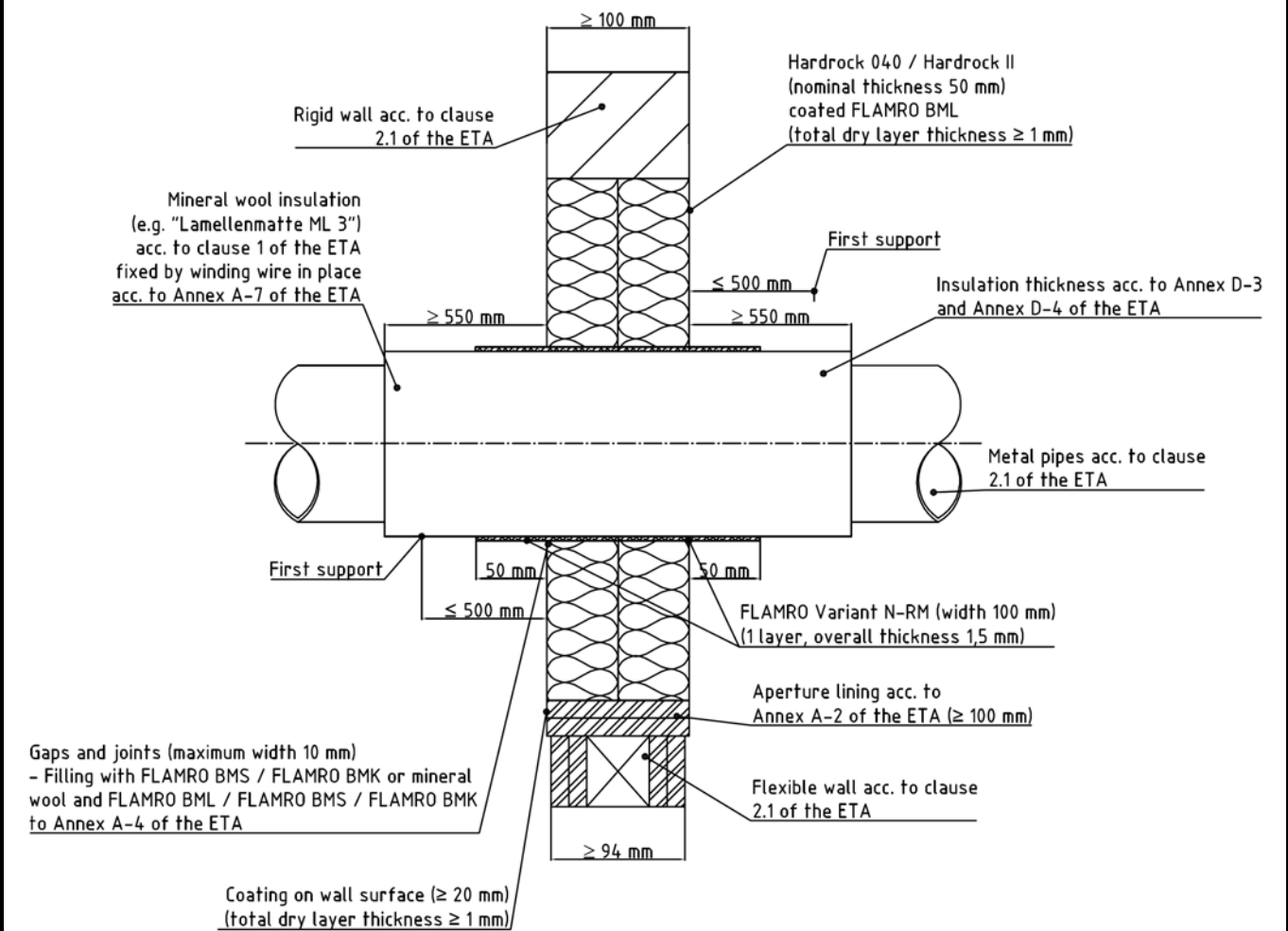
**FLAMRO KSL in flexible walls and rigid walls according to clause 2.1 of the ETA – penetrated by metal pipes according to clause 2.1 of the ETA insulated with “AF/Armaflex” and wrapped with “FLAMRO Variant N-RM” – Installation drawing – sectional view**



**FLAMRO KSL**  
- Installation in flexible wall and rigid wall -

**ANNEX C-3**

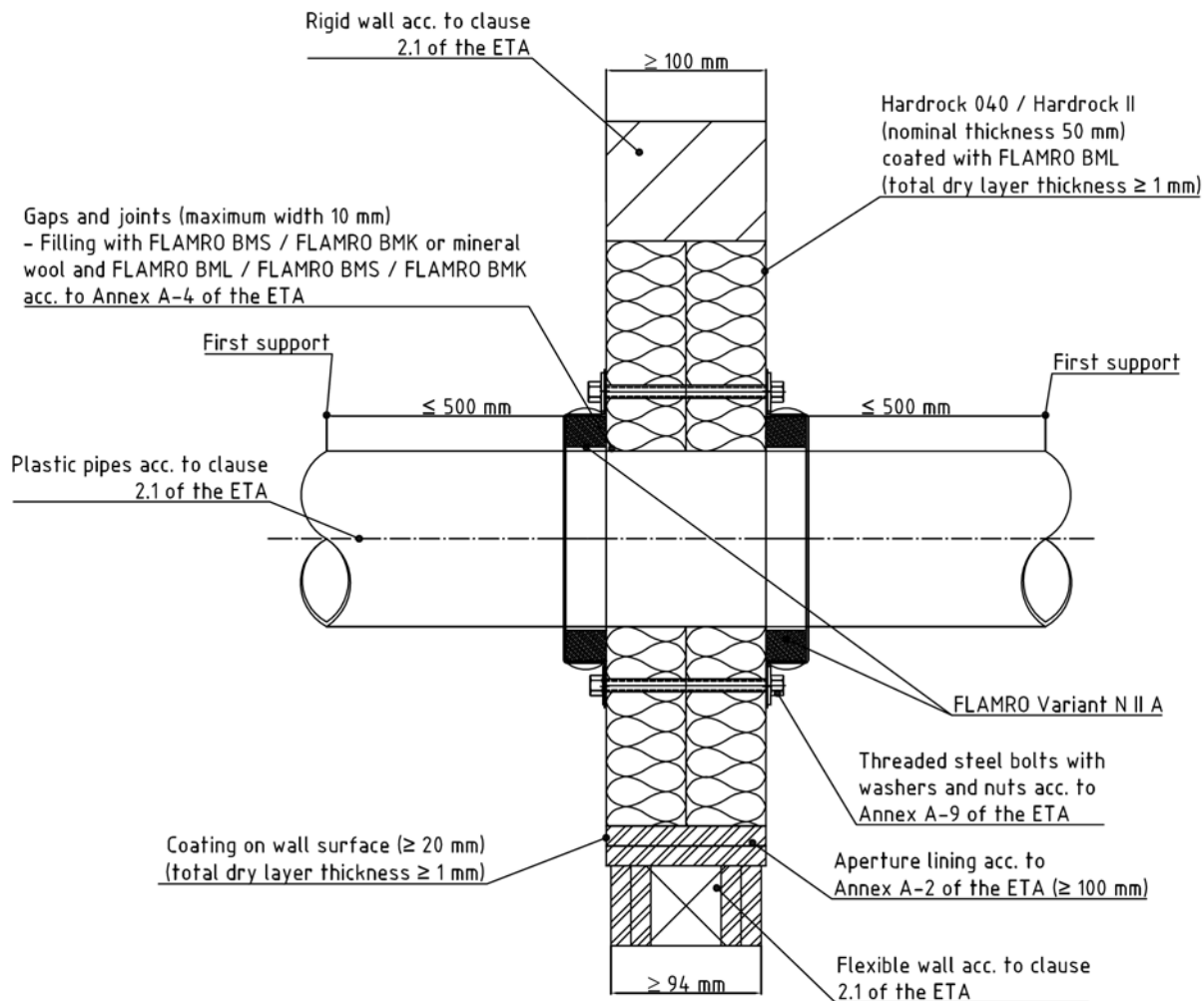
**FLAMRO KSL in flexible walls and rigid walls according to clause 2.1 of the ETA – penetrated by metal pipes according to clause 2.1 of the ETA insulated with mineral wool (e.g. “Lamellenmatte ML 3”) according to clause 1 of the ETA and wrapped with “FLAMRO Variant N-RM” – Installation drawing – sectional view**



<p align="center"><b>FLAMRO KSL</b></p> <p align="center"><b>- Installation in flexible wall and rigid wall -</b></p>	<p align="center"><b>ANNEX C-4</b></p>
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**FLAMRO KSL in flexible walls and rigid walls according to clause 2.1 of the ETA – penetrated by plastic pipes according to clause 2.1 of the ETA equipped with “FLAMRO Variant N II A” – Installation drawing – sectional view**



**FLAMRO KSL**

**- Installation in flexible wall and rigid wall -**

**ANNEX C-5**

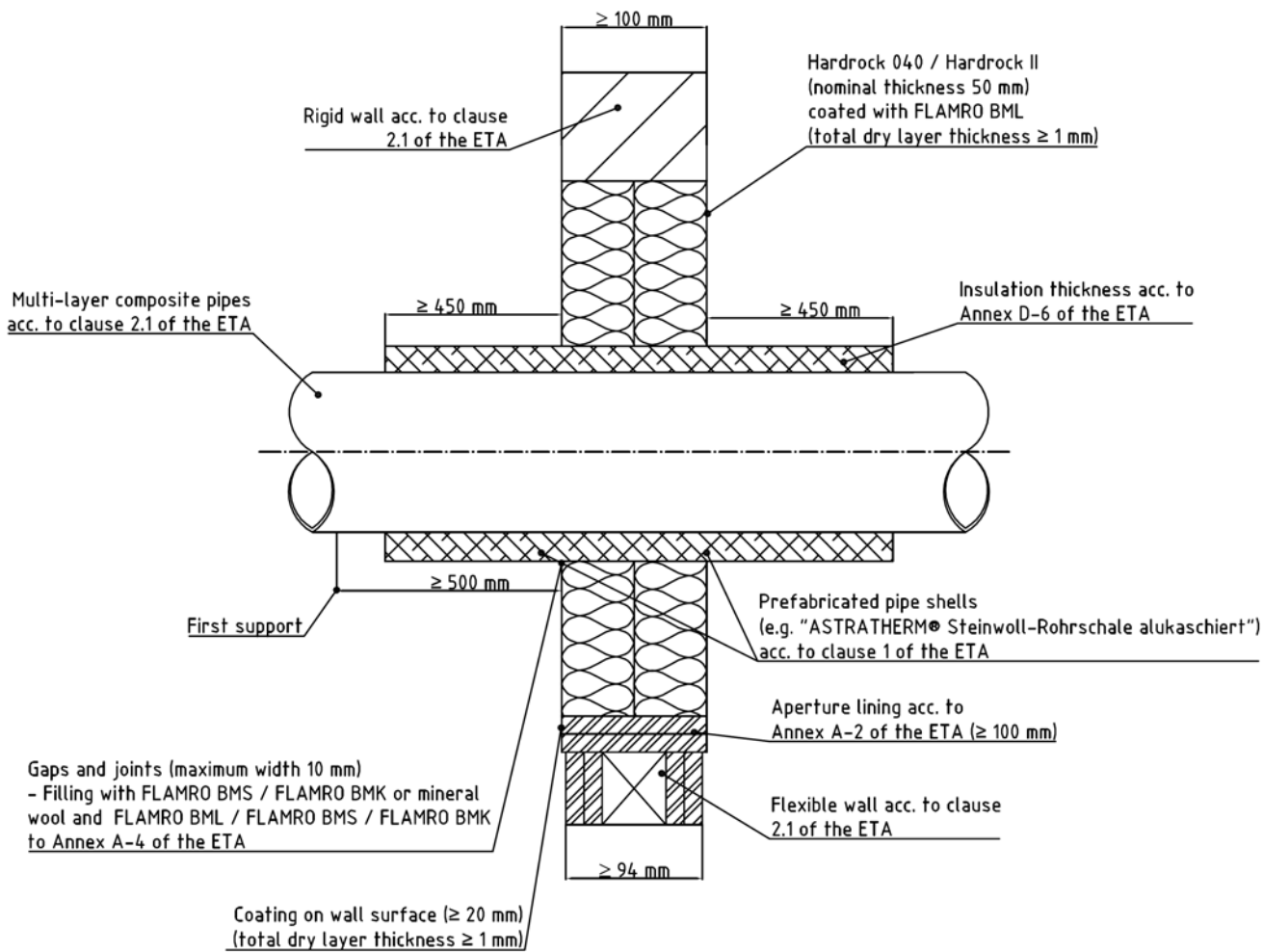
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**- Installation in flexible wall and rigid wall -**

## ANNEX C-6

**FLAMRO KSL in flexible walls and rigid walls according to clause 2.1 of the ETA – penetrated by multi-layer composite pipes according to clause 2.1 of the ETA insulated with prefabricated pipe shells (e.g. “ASTRATHERM® Steinwoll-Rohrschale alukaschiert”) according to clause 1 of the ETA – Installation drawing – sectional view**



**FLAMRO KSL**

**- Installation in flexible wall and rigid wall -**

**ANNEX C-7**

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<b>FLAMRO KSL penetrated by metal pipes acc. to cl. 2.1 of the ETA insulated on both sides of the penetration seal with "AF/Armaflex" (local-sustained LS or continued-sustained CS) and wrapped with "FLAMRO Variant N-RM" (two strips; width 100 mm – on both sides of the penetration seal; two layers – overall thickness 3,0 mm) – installed in flexible walls and rigid walls acc. to cl. 2.1 of the ETA</b>		
<b>Penetrating elements*</b>	<b>Additional precaution: "AF/Armaflex" and "FLAMRO Variant N-RM"</b>	<b>Fire resistance classification</b>
<b>Copper pipes:</b>		
Outer diameter 10 mm Wall thickness 1,0 mm to 14,2 mm	AF/Armaflex – AF-2 (tube): Length ≥ 550 mm**, on both sides of the penetration seal Thickness 11,0 mm	EI 90-C/U E 90-C/U
Outer diameter > 10 mm to 28 mm Wall thickness 1,0 mm to 14,2 mm	AF/Armaflex – AF-2 (tube): Length ≥ 550 mm**, on both sides of the penetration seal Thickness 11,0 mm to 12,5 mm	EI 90-C/U E 90-C/U
Outer diameter > 28 mm to 54 mm Wall thickness 1,5 mm to 14,2 mm	AF/Armaflex – AF-4 (tube): Length ≥ 550 mm**, on both sides of the penetration seal Thickness 19,0 mm to 21,0 mm	EI 90-C/U E 90-C/U
Outer diameter > 54 mm to 88,9 mm Wall thickness 2,0 mm to 14,2 mm	AF/Armaflex – AF-6 (tube): Length ≥ 550 mm**, on both sides of the penetration seal Thickness 38,5 mm to 41,5 mm	EI 90-C/U E 90-C/U
<p>* For interpolation between pipe diameters and wall thicknesses see Annex E-1 of the ETA. ** required minimum insulation length (measured from the surface of the penetration seal)</p>		
<b>FLAMRO KSL</b> <b>- Fire resistance classification -</b>		<b>ANNEX D-2</b>

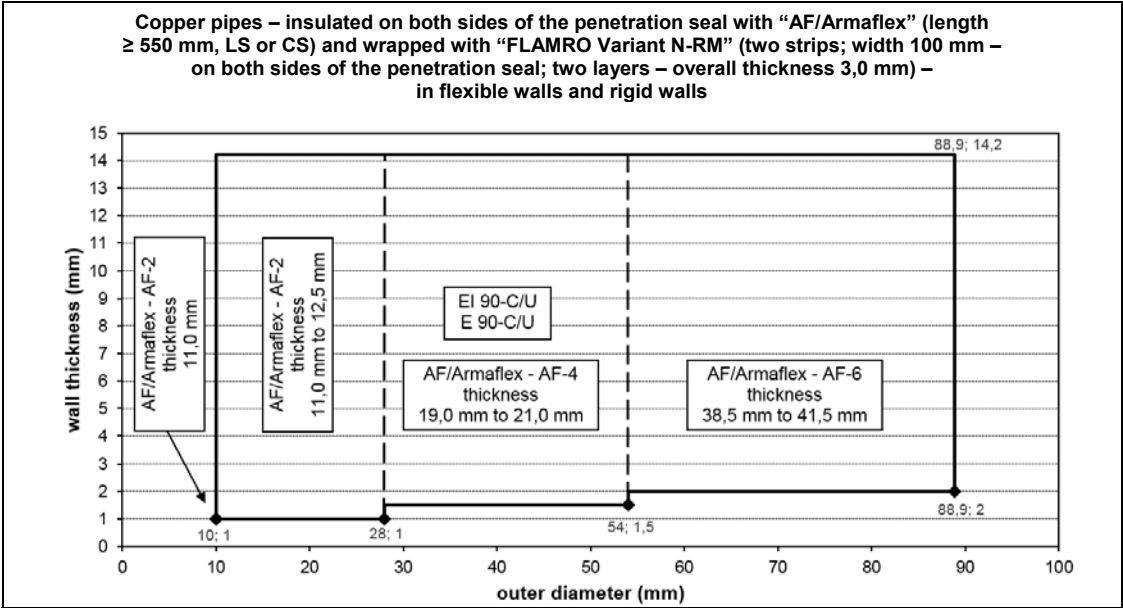
<b>FLAMRO KSL penetrated by metal pipes acc. to cl. 2.1 of the ETA insulated on both sides of the penetration seal with mineral wool (e.g. "Lamellenmatte ML 3") acc. to cl. 1 of the ETA (local-sustained LS) and wrapped with "FLAMRO Variant N-RM" (two strips; width 100 mm – on both sides of the penetration seal; one layer – overall thickness 1,5 mm) – installed in flexible walls and rigid walls acc. to cl. 2.1 of the ETA</b>		
<b>Penetrating elements*</b>	<b>Additional precaution: Mineral wool (e.g. "Lamellenmatte ML 3") acc. to cl. 1 of the ETA and "FLAMRO Variant N-RM"</b>	<b>Fire resistance classification</b>
<b>Steel pipes:</b>		
Outer diameter 10 mm Wall thickness 1,0 mm to 14,2 mm	Mineral wool: Length $\geq 550$ mm**, on both sides of the penetration seal Thickness 20 mm	EI 90-C/U E 90-C/U
Outer diameter > 10 mm to 76 mm Wall thickness 2,6 mm to 14,2 mm	Mineral wool: Length $\geq 550$ mm**, on both sides of the penetration seal Thickness 30 mm	EI 90-C/U E 90-C/U
Outer diameter > 76 mm to 160 mm Wall thickness 2,0 mm to < 4,0 mm	Mineral wool: Length $\geq 550$ mm**, on both sides of the penetration seal Thickness 50 mm	EI 60-C/U E 90-C/U
Outer diameter > 76 mm to 160 mm Wall thickness 4,0 mm to 14,2 mm	Mineral wool: Length $\geq 550$ mm**, on both sides of the penetration seal Thickness 50 mm	EI 90-C/U E 90-C/U
<b>Note:</b> The fire resistance class of "FLAMRO KSL" - when penetrated by steel pipes with classification EI 60-C/U / E 90-C/U - is <b>EI 60 / E 90</b>		
* For interpolation between pipe diameters and wall thicknesses see Annex E-2 of the ETA. ** required minimum insulation length (measured from the surface of the penetration seal)		
<b>FLAMRO KSL</b> <b>- Fire resistance classification -</b>		<b>ANNEX D-3</b>

<b>FLAMRO KSL penetrated by metal pipes acc. to cl. 2.1 of the ETA insulated on both sides of the penetration seal with mineral wool (e.g. "Lamellenmatte ML 3") acc. to cl. 1 of the ETA (continued-sustained CS) and wrapped with "FLAMRO Variant N-RM" (two strips; width 100 mm – on both sides of the penetration seal; one layer – overall thickness 1,5 mm) – installed in flexible walls and rigid walls acc. to cl. 2.1 of the ETA</b>		
<b>Penetrating elements*</b>	<b>Additional precaution: Mineral wool (e.g. "Lamellenmatte ML 3") acc. to cl. 1 of the ETA and "FLAMRO Variant N-RM"</b>	<b>Fire resistance classification</b>
<b>Steel pipes:</b>		
Outer diameter 10 mm Wall thickness 1,0 mm to 14,2 mm	Mineral wool: Length $\geq 550$ mm**, on both sides of the penetration seal Thickness 20 mm	EI 90-C/U E 90-C/U
Outer diameter > 10 mm to 76 mm Wall thickness 2,6 mm to 14,2 mm	Mineral wool: Length $\geq 550$ mm**, on both sides of the penetration seal Thickness 30 mm	EI 90-C/U E 90-C/U
Outer diameter > 76 mm to 160 mm Wall thickness 2,0 mm to 14,2 mm	Mineral wool: Length $\geq 550$ mm**, on both sides of the penetration seal Thickness 50 mm	EI 90-C/U E 90-C/U
<p>* For interpolation between pipe diameters and wall thicknesses see Annex E-2 of the ETA. ** required minimum insulation length (measured from the surface of the penetration seal)</p>		
<b>FLAMRO KSL</b> <b>- Fire resistance classification -</b>		<b>ANNEX D-4</b>

FLAMRO KSL penetrated by plastic pipes acc. to cl. 2.1 of the ETA equipped on both sides of the penetration seal with "FLAMRO Variant N II A" – installed in flexible walls and rigid walls acc. to cl. 2.1 of the ETA		
Penetrating elements*	Additional precaution: "FLAMRO Variant N II A" <small>[dimensions of intumescent inlay [thickness (t<sub>ac</sub>) x height (h)]]</small>	Fire resistance classification
<b>PVC-U pipes:</b>		
Outer diameter 32 mm to 50 mm Wall thickness 1,8 mm to 5,6 mm	6,4 mm x 25,4 mm	EI 90-U/U E 90-U/U
Outer diameter > 50 mm to 75 mm Wall thickness 1,8 mm to 12,3 mm	12,8 mm x 25,4 mm	EI 90-U/U E 90-U/U
Outer diameter > 75 mm to 110 mm Wall thickness 1,8 mm to 12,3 mm	19,2 mm x 25,4 mm	EI 90-U/U E 90-U/U
Outer diameter > 110 mm to 125 mm Wall thickness 2,5 mm to 11,4 mm	19,2 mm x 38,1 mm	EI 90-U/U E 90-U/U
Outer diameter > 125 mm to 160 mm Wall thickness 3,2 mm to 11,9 mm	25,6 mm x 38,1 mm	EI 90-U/U E 90-U/U
<b>Penetrating elements*</b>	<b>Additional precaution:</b> "FLAMRO Variant N II A" <small>[dimensions of intumescent inlay [thickness (t<sub>ac</sub>) x height (h)]]</small>	<b>Fire resistance classification</b>
<b>PE-HD pipes:</b>		
Outer diameter 32 mm to 50 mm Wall thickness 1,8 mm to 4,6 mm	6,4 mm x 25,4 mm	EI 120-U/U E 120-U/U
Outer diameter > 50 mm to 75 mm Wall thickness 1,9 mm to 10,0 mm	12,8 mm x 25,4 mm	EI 90-U/U E 90-U/U
Outer diameter > 75 mm to 110 mm Wall thickness 2,7 mm to 10,0 mm	19,2 mm x 25,4 mm	EI 90-U/U E 90-U/U
Outer diameter > 110 mm to 125 mm Wall thickness 3,1 mm to 11,4 mm	19,2 mm x 38,1 mm	EI 90-U/U E 90-U/U
Outer diameter > 125 mm to 160 mm Wall thickness 4,0 mm to 14,6 mm	25,6 mm x 38,1 mm	EI 90-U/U E 90-U/U
<b>Penetrating elements*</b>	<b>Additional precaution:</b> "FLAMRO Variant N II A" <small>[dimensions of intumescent inlay [thickness (t<sub>ac</sub>) x height (h)]]</small>	<b>Fire resistance classification</b>
<b>PP pipes:</b>		
Outer diameter 32 mm to 50 mm Wall thickness 1,8 mm to 4,6 mm	6,4 mm x 25,4 mm	EI 120-U/U E 120-U/U
Outer diameter > 50 mm to 75 mm Wall thickness 1,9 mm to 10,0 mm	12,8 mm x 25,4 mm	EI 90-U/U E 90-U/U
Outer diameter > 75 mm to 110 mm Wall thickness 2,7 mm to 10,0 mm	19,2 mm x 25,4 mm	EI 90-U/U E 90-U/U
Outer diameter > 110 mm to 125 mm Wall thickness 3,1 mm to 11,4 mm	19,2 mm x 38,1 mm	EI 90-U/U E 90-U/U
Outer diameter > 125 mm to 160 mm Wall thickness 4,0 mm to 14,6 mm	25,6 mm x 38,1 mm	EI 90-U/U E 90-U/U
<b>Note:</b> The fire resistance class of "FLAMRO KSL" - when penetrated by PE-HD pipes with classification EI 90-U/U / E 90-U/U - is <b>EI 90 / E 90</b> PP pipes with classification EI 90-U/U / E 90-U/U - is <b>EI 90 / E 90</b>		
* For interpolation between pipe diameters and wall thicknesses see Annex E-3 of the ETA.		
<b>FLAMRO KSL</b> - Fire resistance classification -		<b>ANNEX D-5</b>



<b>FLAMRO KSL penetrated by multi-layer composite pipes acc. to cl. 2.1 of the ETA insulated on both sides of the penetration seal with prefabricated pipe shells (e.g. "ASTRATHERM® Steinwoll-Rohrschale alukaschiert") acc. to cl. 1 of the ETA (local-sustained LS) – installed in flexible walls and rigid walls acc. to cl. 2.1 of the ETA</b>		
Penetrating elements	Additional precaution:	Fire resistance classification
Multi-layer composite pipes "Geberit Mepla Systemrohr":	Prefabricated pipe shells (e.g. "ASTRATHERM® Steinwoll-Rohrschale alukaschiert") acc. to cl. 1 of the ETA	
Outer diameter 16 mm Wall thickness 2,25 mm	Prefabricated pipe shells: Length ≥ 450 mm*, on both sides of the penetration seal Thickness 20 mm to 30 mm	EI 120-U/C E 120-U/C
Outer diameter 20 mm Wall thickness 2,5 mm	Prefabricated pipe shells: Length ≥ 450 mm*, on both sides of the penetration seal Thickness 20 mm to 30 mm	EI 120-U/C E 120-U/C
Outer diameter 26 mm Wall thickness 3,0 mm	Prefabricated pipe shells: Length ≥ 450 mm*, on both sides of the penetration seal Thickness 20 mm to 40 mm	EI 120-U/C E 120-U/C
Outer diameter 32 mm Wall thickness 3,0 mm	Prefabricated pipe shells: Length ≥ 450 mm*, on both sides of the penetration seal Thickness 20 mm to 50 mm	EI 120-U/C E 120-U/C
Outer diameter 40 mm Wall thickness 3,5 mm	Prefabricated pipe shells: Length ≥ 450 mm*, on both sides of the penetration seal Thickness 20 mm to 50 mm	EI 120-U/C E 120-U/C
Outer diameter 50 mm Wall thickness 4,0 mm	Prefabricated pipe shells: Length ≥ 450 mm*, on both sides of the penetration seal Thickness 20 mm to 50 mm	EI 120-U/C E 120-U/C
Outer diameter 63 mm Wall thickness 4,5 mm	Prefabricated pipe shells: Length ≥ 450 mm*, on both sides of the penetration seal Thickness 20 mm to 60 mm	EI 120-U/C E 120-U/C
Outer diameter 75 mm Wall thickness 4,7 mm	Prefabricated pipe shells: Length ≥ 450 mm*, on both sides of the penetration seal Thickness 20 mm to 80 mm	EI 120-U/C E 120-U/C
* required minimum insulation length (measured from the surface of the penetration seal)		
<b>FLAMRO KSL</b> <b>- Fire resistance classification -</b>		<b>ANNEX D-6</b>

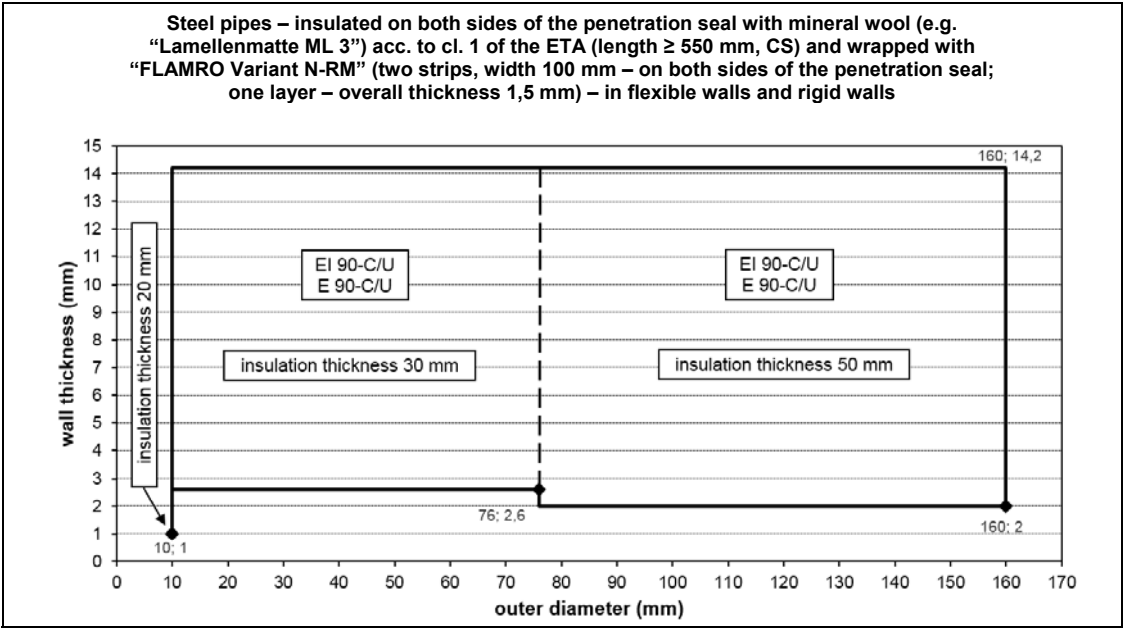
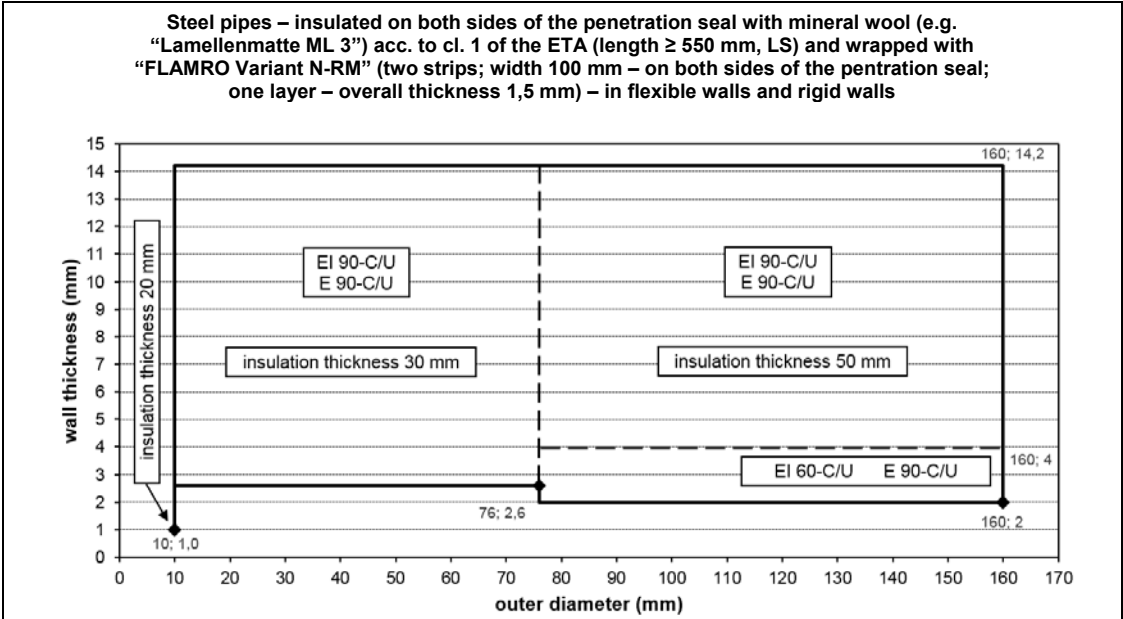


Note: The given graphs and therein enclosed fire resistance classes according to EN 13501-2:2007+A1:2009 are only valid for metal pipes according to clause 2.1 of the ETA.

Note: The dashed vertical lines mark the upper limits of the required insulation thickness.

Note: The dimensions of the graphs are not true to scale.

Interpolation between pipe diameters and wall thicknesses for metal pipes according to clause 2.1 of the ETA in flexible walls and rigid walls	ANNEX E-1
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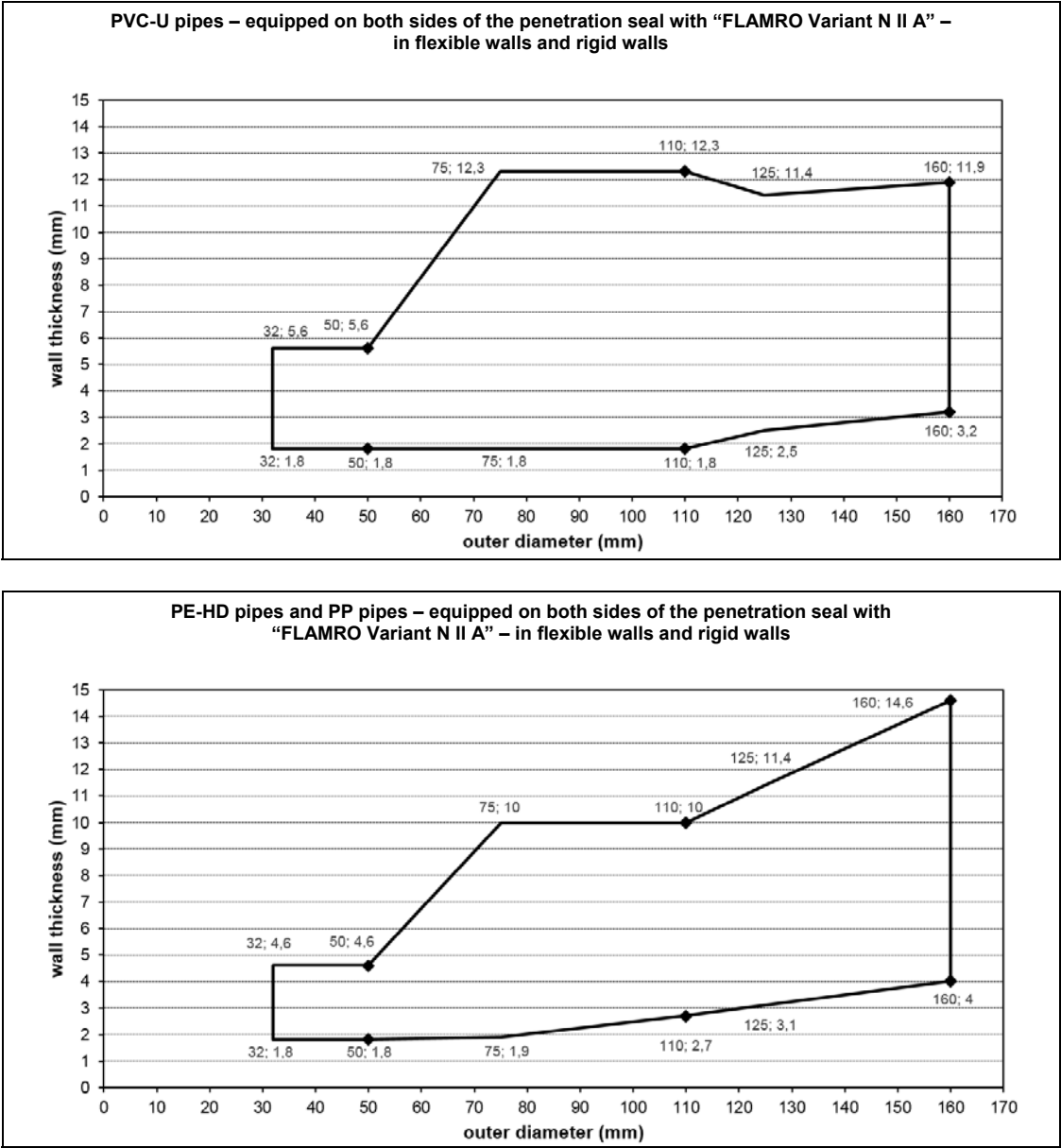


Note: The given graphs and therein enclosed fire resistance classes according to EN 13501-2:2007+A1:2009 are only valid for metal pipes according to clause 2.1 of the ETA.

Note: The dashed vertical lines mark the upper limits of the required insulation thickness. The dashed horizontal line marks the limit of the fire resistance classes.

Note: The dimensions of the graphs are not true to scale.

Interpolation between pipe diameters and wall thicknesses for metal pipes according to clause 2.1 of the ETA in flexible walls and rigid walls	ANNEX E-2
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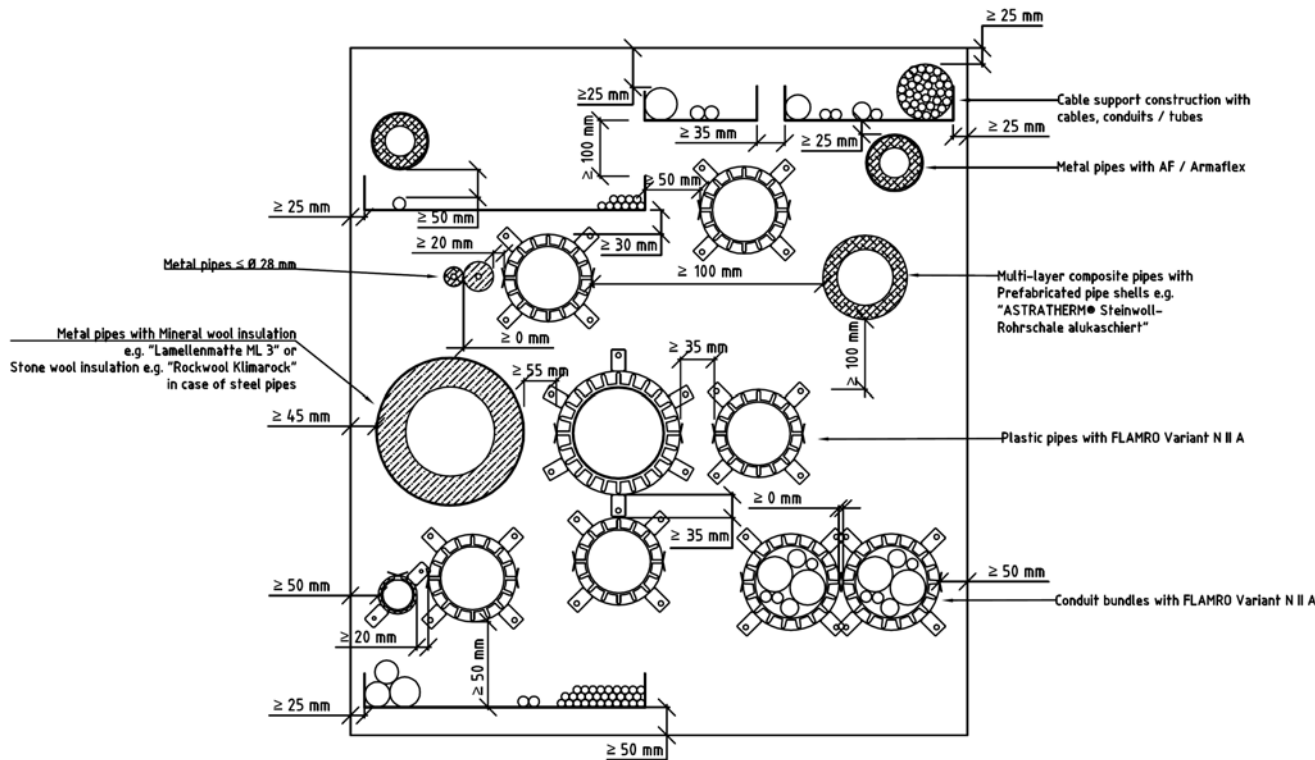


Note: The given graphs are only valid for plastic pipes according to clause 2.1 of the ETA.

Note: The dimensions of the graphs are not true to scale.

Interpolation between pipe diameters and wall thicknesses for plastic pipes according to clause 2.1 of the ETA in flexible walls and rigid walls	ANNEX E-3
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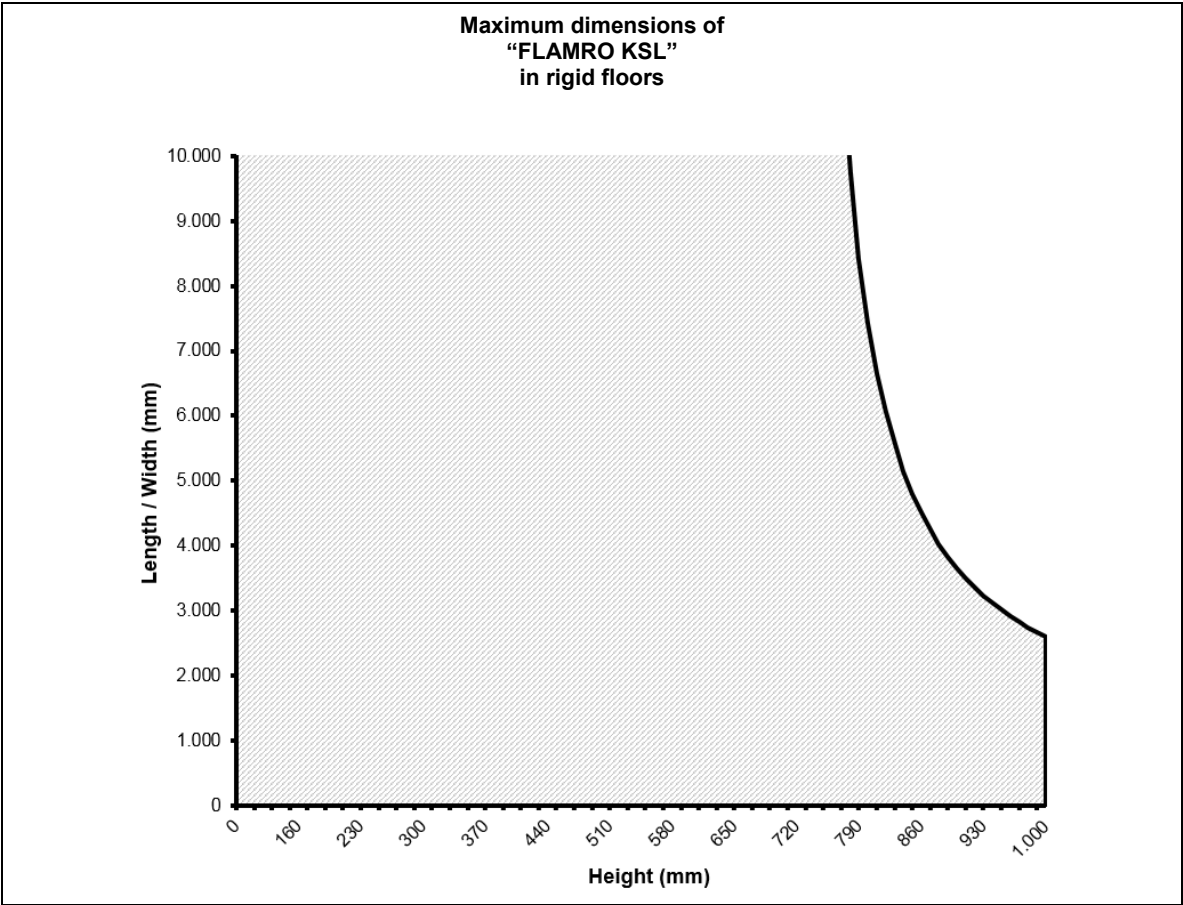
**FLAMRO KSL in rigid floors according to clause 2.1 of the ETA – Minimum working clearances**  
**/ Installation drawing – top view**



Horizontal and vertical distances / minimum working clearances – regarding penetrating elements – not given in the installation drawing have to be  $\geq 100$  mm in practice.

**FLAMRO KSL**  
**- Installation in rigid floor -**

**ANNEX F-1**



The maximum height of the penetration seal in rigid floors is 1000 mm.

The maximum length (width) of the penetration seal in rigid floors has to be calculated as follows:

$$Length\ (Width) = \frac{Height}{(((c_{tested} / 2) * Height) - 1)}$$

$$c_{tested} = \frac{Perimeter\ length_{tested}}{Seal\ area_{tested}} = 2,769\ m / m^2; resp.\ 0,002769\ mm / mm^2$$

The minimum perimeter length to seal area ratio of the penetration seal in rigid floors is 2,769 m/m², resp. 0,002769 mm/mm².

C<sub>tested</sub> was calculated from the dimensions of the tested penetration seal (2600 mm x 1000 mm).

The area on the left side of the graph gives an overview of all possible combinations of length (width) and height where the minimum perimeter length to seal area ratio is ≥ C<sub>tested</sub>.

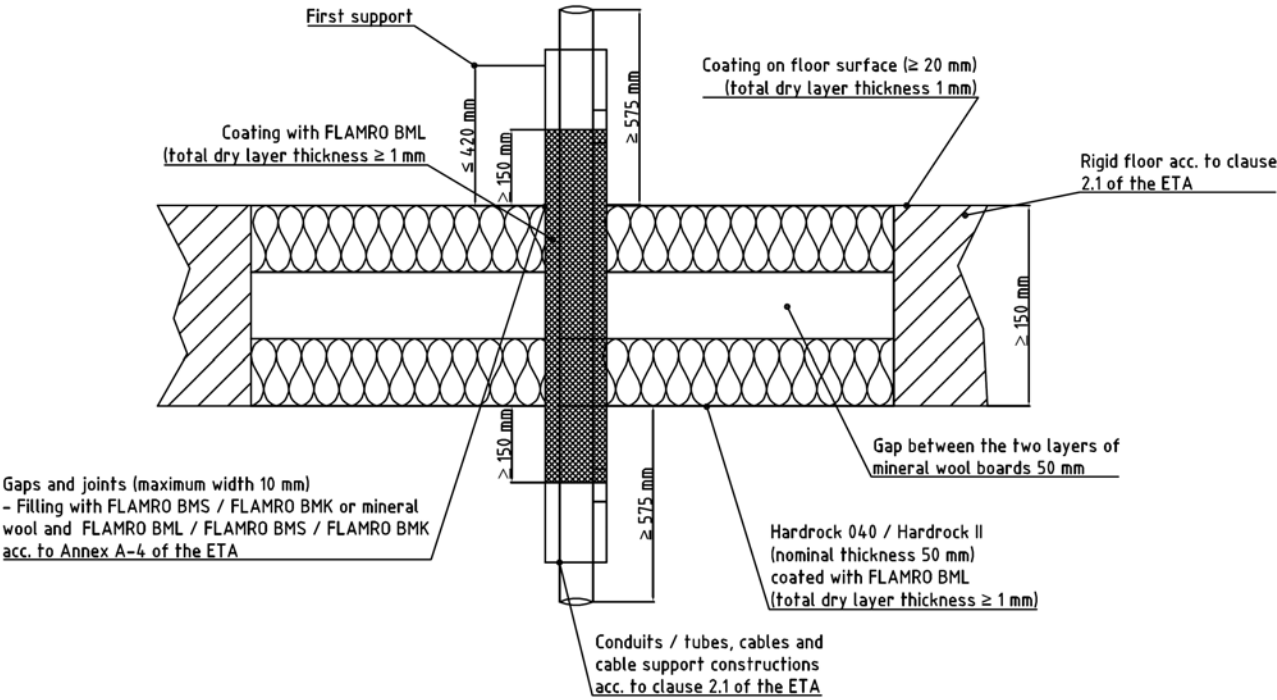
For a length (width) of e.g. 2600 mm the permitted height is 1000 mm; for a length (width) of e.g. 3500 mm the permitted height is 910 mm.

For a height smaller than 724 mm no limitation of length (width) is required.

Note: The dimensions of the graph are not true to scale.

<p><b>FLAMRO KSL</b></p> <p><b>- Installation in rigid floor – perimeter length to seal area ratio -</b></p>	<p><b>ANNEX F-2</b></p>
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**FLAMRO KSL in rigid floors according to clause 2.1 of the ETA – penetrated by cables and conduits / tubes according to clause 2.1 of the ETA – Installation drawing – sectional view**

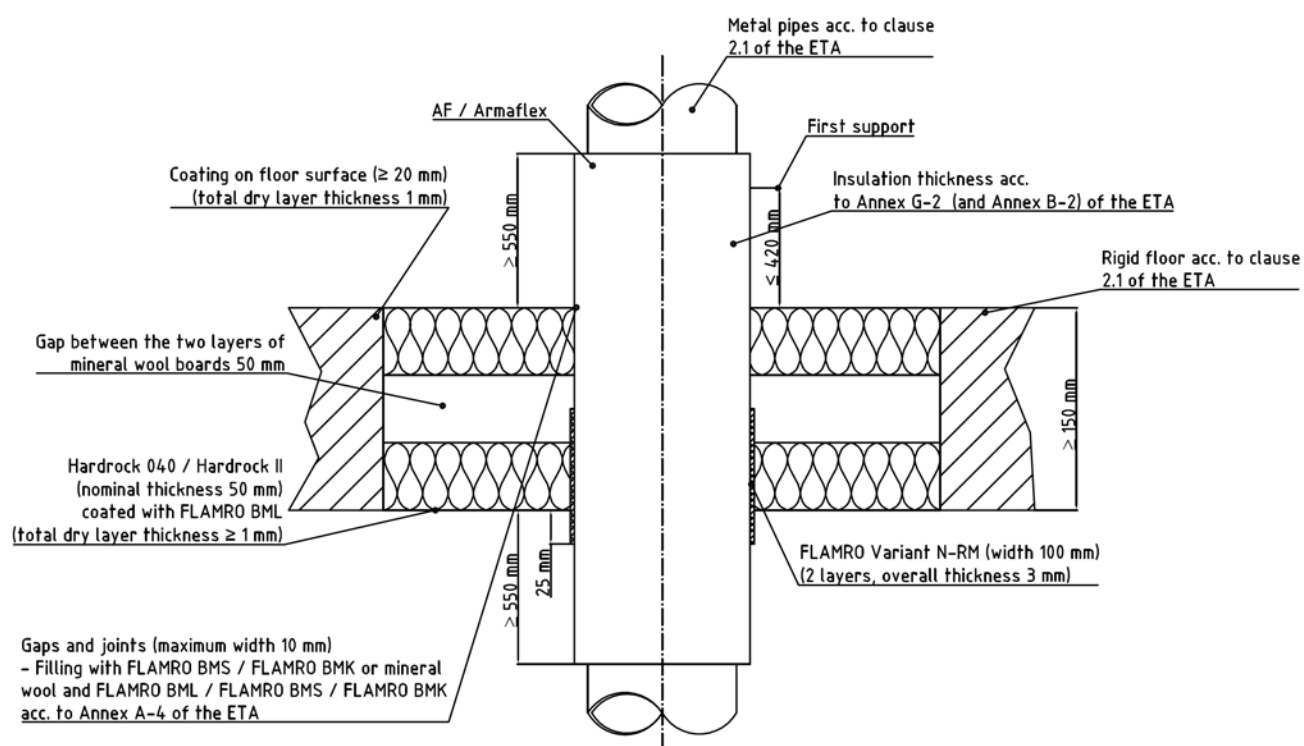


**FLAMRO KSL**  
- Installation in rigid floor -

**ANNEX F-3**



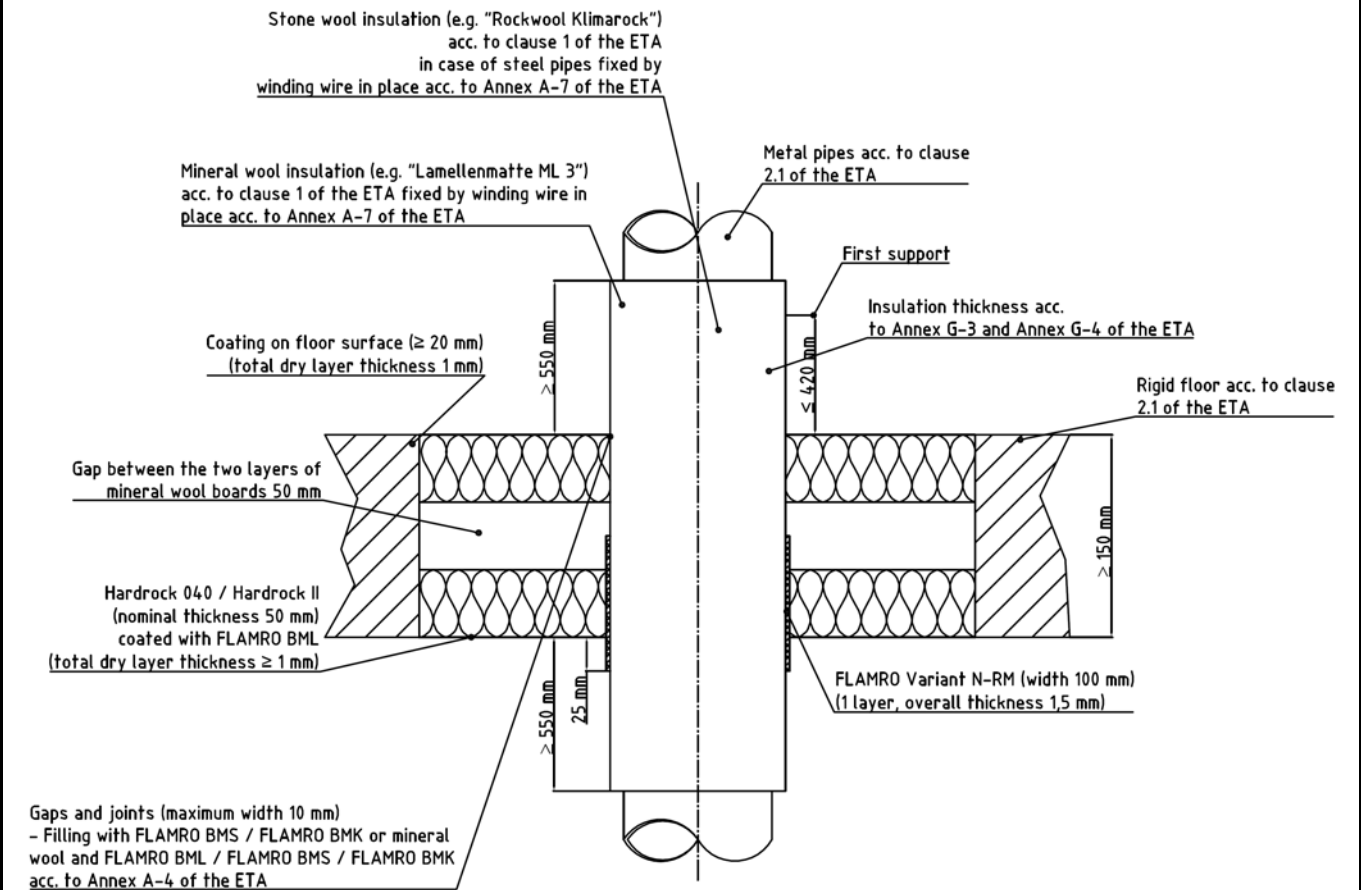
**FLAMRO KSL in rigid floors according to clause 2.1 of the ETA – penetrated by metal pipes according to clause 2.1 of the ETA insulated with “AF/Armaflex” and wrapped with “FLAMRO Variant N-RM” – Installation drawing – sectional view**



**FLAMRO KSL**  
**- Installation in rigid floor -**

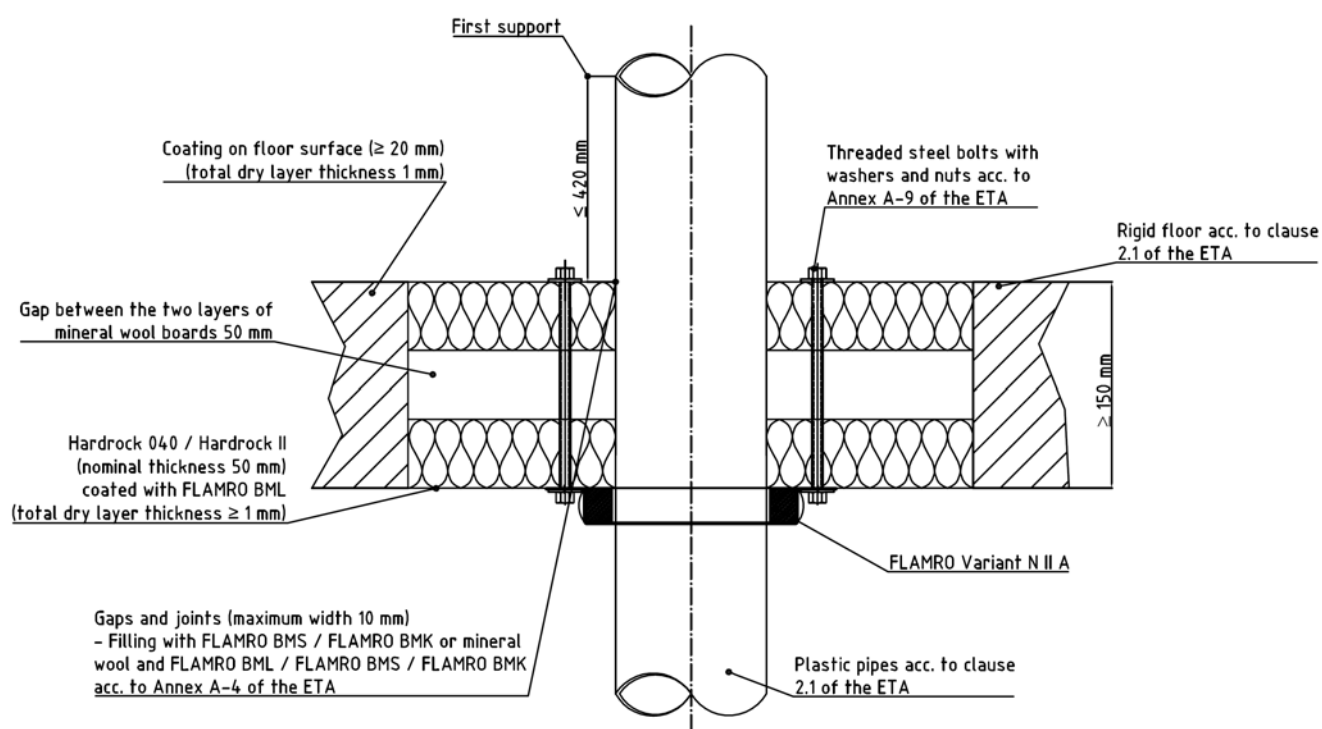
ANNEX F-4

**FLAMRO KSL in rigid floors according to clause 2.1 of the ETA – penetrated by metal pipes according to clause 2.1 of the ETA insulated with mineral wool (e.g. “Lamellenmatte ML 3”) according to clause 1 of the ETA or – in case of steel pipes (see Annex G-4 of the ETA) – with stone wool (e.g. “Rockwool Klimarock”) according to clause 1 of the ETA and wrapped with “FLAMRO Variant N-RM” – Installation drawing – sectional view**



<p><b>FLAMRO KSL</b></p> <p><b>- Installation in rigid floor -</b></p>	<p><b>ANNEX F-5</b></p>
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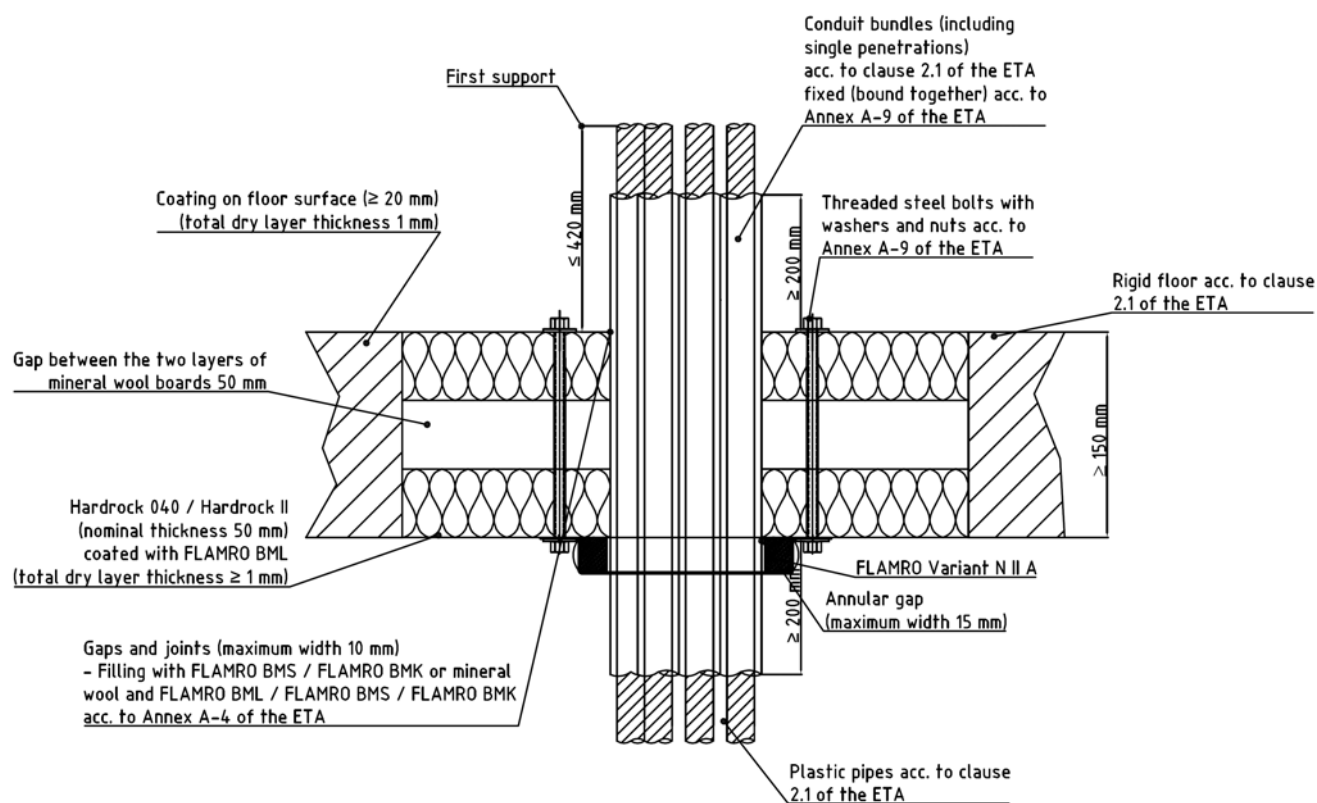
**FLAMRO KSL in rigid floors according to clause 2.1 of the ETA – penetrated by plastic pipes according to clause 2.1 of the ETA equipped with “FLAMRO Variant N II A” – Installation drawing – sectional view**



**FLAMRO KSL**  
**- Installation in rigid floor -**

## ANNEX F-6

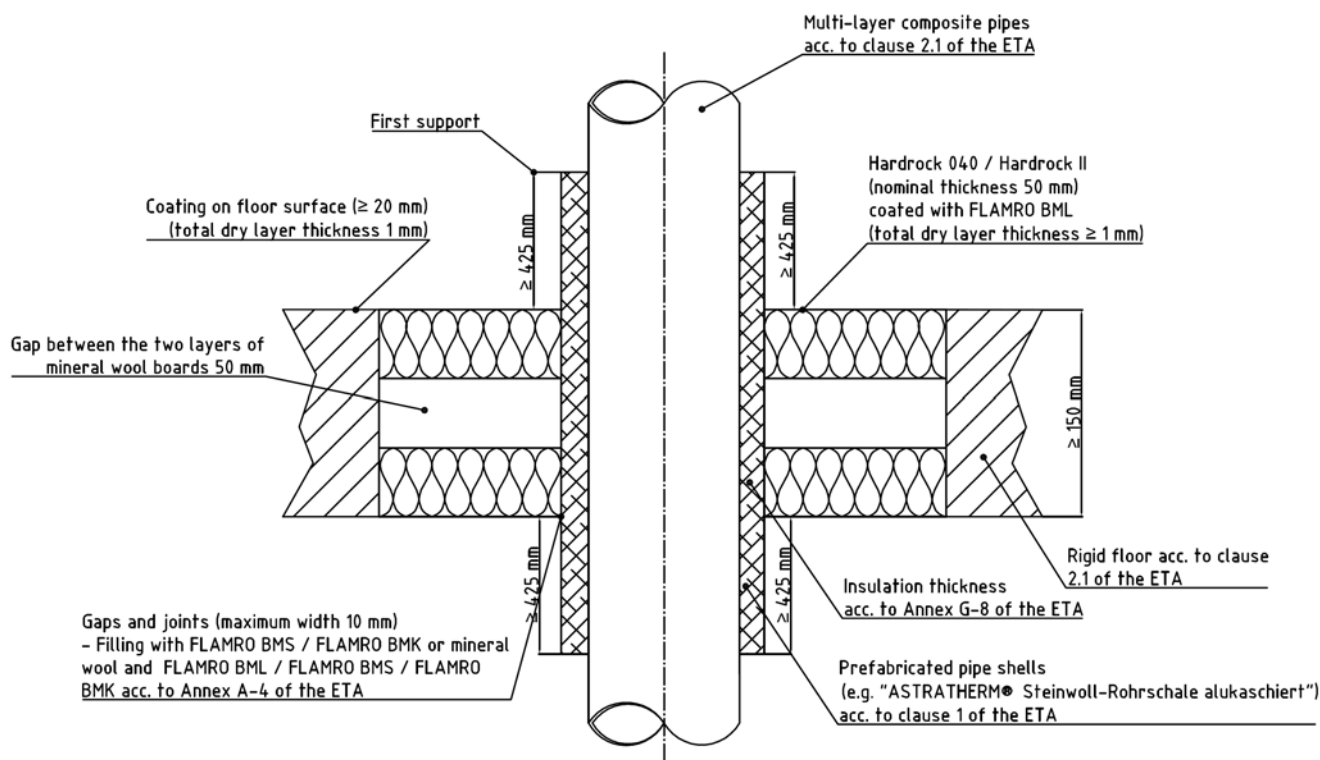
**FLAMRO KSL in rigid floors according to clause 2.1 of the ETA – penetrated by conduit bundles (including single penetrations) according to clause 2.1 of the ETA equipped with “FLAMRO Variant N II A” – Installation drawing – sectional view**



**FLAMRO KSL**  
**- Installation in rigid floor -**

ANNEX F-7

**FLAMRO KSL in rigid floors according to clause 2.1 of the ETA – penetrated by multi-layer composite pipes according to clause 2.1 of the ETA insulated with prefabricated pipe shells (e.g. “ASTRATHERM® Steinwoll-Rohrschale alukaschiert”) according to clause 1 of the ETA – Installation drawing – sectional view**



**FLAMRO KSL**  
- Installation in rigid floor -

**ANNEX F-8**

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FLAMRO KSL penetrated by metal pipes acc. to cl. 2.1 of the ETA insulated on both sides of the penetration seal with "AF/Armaflex" (local-sustained LS or continued-sustained CS) and wrapped with "FLAMRO Variant N-RM" (one strip; width 100 mm – at the bottom side of the penetration seal; two layers – overall thickness 3,0 mm) – installed in rigid floors acc. to cl. 2.1 of the ETA		
Penetrating elements*	Additional precaution: "AF/Armaflex" and "FLAMRO Variant N-RM"	Fire resistance classification
<b>Copper pipes:</b>		
Outer diameter 10 mm Wall thickness 1,0 mm to 14,2 mm	AF/Armaflex – AF-2 (tube): Length ≥ 550 mm**, on both sides of the penetration seal Thickness 11,0 mm	EI 120-C/U E 120-C/U
Outer diameter > 10 mm to 28 mm Wall thickness 1,0 mm to 14,2 mm	AF/Armaflex – AF-2 (tube): Length ≥ 550 mm**, on both sides of the penetration seal Thickness 11,0 mm to 12,5 mm	EI 120-C/U E 120-C/U
Outer diameter > 28 mm to 54 mm Wall thickness 1,5 mm to 14,2 mm	AF/Armaflex – AF-4 (tube): Length ≥ 550 mm**, on both sides of the penetration seal Thickness 19,0 mm to 21,0 mm	EI 120-C/U E 120-C/U
Outer diameter > 54 mm to 88,9 mm Wall thickness 2,0 mm to 14,2 mm	AF/Armaflex – AF-6 (tube): Length ≥ 550 mm**, on both sides of the penetration seal Thickness 38,5 mm to 41,5 mm	EI 90-C/U E 120-C/U
<b>Note:</b> The fire resistance class of "FLAMRO KSL" - when penetrated by copper pipes with classification EI 90 / E 120 - is <b>EI 90 / E 120</b>		
* For interpolation between pipe diameters and wall thicknesses see Annex H-1 of the ETA. ** required minimum insulation length (measured from the surface of the penetration seal)		
<b>FLAMRO KSL</b> <b>- Fire resistance classification -</b>		<b>ANNEX G-2</b>



FLAMRO KSL penetrated by metal pipes acc. to cl. 2.1 of the ETA insulated on both sides of the penetration seal with mineral wool (e.g. "Lamellenmatte ML 3") acc. to cl. 1 of the ETA (local-sustained LS or continued-sustained CS) and wrapped with "FLAMRO Variant N-RM" (one strip; width 100 mm – at the bottom side of the penetration seal; one layer – overall thickness 1,5 mm) – installed in rigid floors acc. to cl. 2.1 of the ETA		
Penetrating elements*	Additional precaution:	Fire resistance classification
<b>Copper pipes:</b>	Mineral wool (e.g. "Lamellenmatte ML 3") acc. to cl. 1 of the ETA and "FLAMRO Variant N-RM"	
Outer diameter 10 mm to 88,9 mm Wall thickness 2,0 mm to 14,2 mm	Mineral wool: Length ≥ 550 mm**, on both sides of the penetration seal Thickness 40 mm	EI 90-C/U E 90-C/U
<b>Penetrating elements*</b>	<b>Additional precaution:</b>	<b>Fire resistance classification</b>
<b>Steel pipes:</b>	Mineral wool (e.g. "Lamellenmatte ML 3") acc. to cl. 1 of the ETA and "FLAMRO Variant N-RM"	
Outer diameter 10 mm Wall thickness 1,0 mm to 14,2 mm	Mineral wool: Length ≥ 550 mm**, on both sides of the penetration seal Thickness 20 mm	EI 120-C/U E 120-C/U
Outer diameter > 10 mm to 76 mm Wall thickness 2,6 mm to 14,2 mm	Mineral wool: Length ≥ 550 mm**, on both sides of the penetration seal Thickness 30 mm	EI 90-C/U E 120-C/U
Outer diameter > 76 mm to 88,9 mm Wall thickness 2,0 mm to 14,2 mm	Mineral wool: Length ≥ 550 mm**, on both sides of the penetration seal Thickness 40 mm	EI 90-C/U E 90-C/U
Outer diameter > 88,9 mm to 160 mm Wall thickness 2,0 mm to 14,2 mm	Mineral wool: Length ≥ 550 mm**, on both sides of the penetration seal Thickness 50 mm	EI 60-C/U E 90-C/U
<b>Note:</b> The fire resistance class of "FLAMRO KSL" - when penetrated by steel pipes with classification EI 60-C/U / E 90-C/U - is <b>EI 60 / E 90</b> The fire resistance class of "FLAMRO KSL" - when penetrated by copper pipes and steel pipes with classification EI 90-C/U / E 90-C/U - is <b>EI 90 / E 90</b> The fire resistance class "FLAMRO KSL" - when penetrated by steel pipes with classification EI 90-C/U / E 120-C/U - is <b>EI 90 / E 120</b>		
* For interpolation between pipe diameters and wall thicknesses see Annex H-2 of the ETA. ** required minimum insulation length (measured from the surface of the penetration seal)		
<b>FLAMRO KSL</b> - Fire resistance classification -		<b>ANNEX G-3</b>

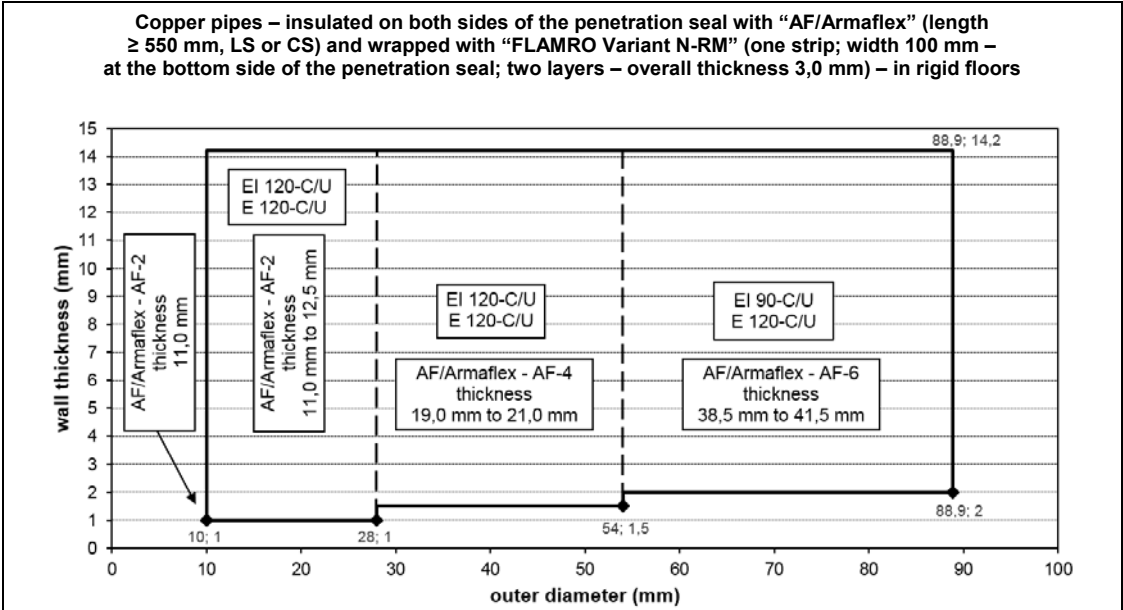
<b>FLAMRO KSL penetrated by metal pipes acc. to cl. 2.1 of the ETA insulated on both sides of the penetration seal with stone wool (e.g. "Rockwool Klimarock") acc. to cl. 1 of the ETA (local-sustained LS or continued-sustained CS) and wrapped with "FLAMRO Variant N-RM" (one strip; width 100 mm – at the bottom side of the penetration seal; one layer – overall thickness 1,5 mm) – installed in rigid floors acc. to cl. 2.1 of the ETA</b>		
<b>Penetrating elements*</b>	<b>Additional precaution: Stone wool (e.g. "Rockwool Klimarock") acc. to cl. 1 of the ETA and "FLAMRO Variant N-RM"</b>	<b>Fire resistance classification</b>
<b>Steel pipes:</b>		
Outer diameter 10 mm Wall thickness 1,0 mm to 14,2 mm	Stone wool: Length ≥ 550 mm**, on both sides of the penetration seal Thickness 20 mm	EI 120-C/U E 120-C/U
Outer diameter > 10 mm to 76 mm Wall thickness 2,6 mm to 4,0 mm	Stone wool: Length ≥ 550 mm**, on both sides of the penetration seal Thickness 30 mm	EI 90-C/U E 120-C/U
Outer diameter > 76 mm to 88,9 mm Wall thickness 2,0 mm to 14,2 mm	Stone wool: Length ≥ 550 mm**, on both sides of the penetration seal Thickness 40 mm	EI 90-C/U E 90-C/U
Outer diameter > 88,9 mm to 160 mm Wall thickness 4,0 mm to 14,2 mm	Stone wool: Length ≥ 550 mm**, on both sides of the penetration seal Thickness 60 mm	EI 120-C/U E 120-C/U
<b>Note:</b> The fire resistance class of "FLAMRO KSL" - when penetrated by steel pipes with classification EI 90-C/U / E 90-C/U - is <b>EI 90 / E 90</b> The fire resistance class of "FLAMRO KSL" - when penetrated by steel pipes with classification EI 90-C/U / E 120-C/U - is <b>EI 90 / E 120</b>		
* For interpolation between pipe diameters and wall thicknesses see Annex H-3 of the ETA. ** required minimum insulation length (measured from the surface of the penetration seal)		
<b>FLAMRO KSL</b> <b>- Fire resistance classification -</b>		<b>ANNEX G-4</b>

FLAMRO KSL penetrated by plastic pipes acc. to cl. 2.1 of the ETA equipped at the bottom side of the penetration seal with "FLAMRO Variant N II A" – installed in rigid floors acc. to cl. 2.1 of the ETA		
Penetrating elements*	Additional precaution: "FLAMRO Variant N II A" <small>[dimensions of intumescent inlay (thickness (t<sub>ac</sub>) x height (h))]</small>	Fire resistance classification
<b>PVC-U pipes:</b>		
Outer diameter 32 mm to 50 mm Wall thickness 1,8 mm to 5,6 mm	6,4 mm x 25,4 mm	EI 120-U/U E 120-U/U
Outer diameter > 50 mm to 75 mm Wall thickness 1,8 mm	12,8 mm x 25,4 mm	EI 120-U/U E 120-U/U
Outer diameter > 50 mm to 75 mm Wall thickness > 1,8 mm to 12,3 mm	12,8 mm x 25,4 mm	EI 90-U/U E 120-U/U
Outer diameter > 75 mm to 110 mm Wall thickness 1,8 mm	19,2 mm x 25,4 mm	EI 90-U/U E 90 U/U
Outer diameter > 75 mm to 110 mm Wall thickness > 1,8 mm to 12,3 mm	19,2 mm x 25,4 mm	EI 90-U/U E 90 U/U
Outer diameter > 110 mm to 125 mm Wall thickness 2,5 mm	19,2 mm x 38,1 mm	EI 90-U/U E 90 U/U
Outer diameter > 110 mm to 125 mm Wall thickness > 2,5 mm to 11,4 mm	19,2 mm x 38,1 mm	EI 90-U/U E 90 U/U
Outer diameter > 125 mm to 160 mm Wall thickness 3,2 mm to 11,9 mm	25,6 mm x 38,1 mm	EI 90-U/U E 90 U/U
<b>Note:</b> The fire resistance class of "FLAMRO KSL" - when penetrated by PVC-U pipes with classification EI 90-U/U / E 90-U/U - is <b>EI 90 / E 90</b> PVC-U pipes with classification EI 90-U/U / E 120-U/U - is <b>EI 90 / E 120</b>		
* For interpolation between pipe diameters and wall thicknesses see Annex H-4 of the ETA.		
<b>FLAMRO KSL</b> - Fire resistance classification -		<b>ANNEX G-5</b>

FLAMRO KSL penetrated by plastic pipes acc. to cl. 2.1 of the ETA equipped at the bottom side of the penetration seal with "FLAMRO Variant N II A" – installed in rigid floors acc. to cl. 2.1 of the ETA		
Penetrating elements*	Additional precaution: "FLAMRO Variant N II A" <small>[dimensions of intumescent inlay [thickness (t<sub>ac</sub>) x height (h)]]</small>	Fire resistance classification
<b>PE-HD pipes:</b>		
Outer diameter 32 mm to 50 mm Wall thickness 1,8 mm to 4,6 mm	6,4 mm x 25,4 mm	EI 120-U/U E 120-U/U
Outer diameter > 50 mm to 75 mm Wall thickness 1,9 mm to 10,0 mm	12,8 mm x 25,4 mm	EI 120-U/U E 120-U/U
Outer diameter > 75 mm to 110 mm Wall thickness 2,7 mm to 10,0 mm	19,2 mm x 25,4 mm	EI 120-U/U E 120-U/U
Outer diameter > 110 mm to 125 mm Wall thickness 3,1 mm to < 11,4 mm	19,2 mm x 38,1 mm	EI 120-U/U E 120-U/U
Outer diameter > 110 mm to 125 mm Wall thickness 11,4 mm	19,2 mm x 38,1 mm	EI 120-U/U E 120-U/U
Outer diameter > 125 mm to 160 mm Wall thickness 4,0 mm to < 14,6 mm	25,6 mm x 38,1 mm	EI 60-U/U E 90-U/U
Outer diameter > 125 mm to 160 mm Wall thickness 14,6 mm	25,6 mm x 38,1 mm	EI 60-U/U E 90-U/U
<b>Note:</b> The fire resistance class of "FLAMRO KSL" - when penetrated by PE-HD pipes with classification EI 60-U/U / E 90-U/U - is <b>EI 60 / E 90</b>		
* For interpolation between pipe diameters and wall thicknesses see Annex H-4 of the ETA.		
FLAMRO KSL - Fire resistance classification -		ANNEX G-6

FLAMRO KSL penetrated by plastic pipes acc. to cl. 2.1 of the ETA equipped at the bottom side of the penetration seal with "FLAMRO Variant N II A" – installed in rigid floors acc. to cl. 2.1 of the ETA		
Penetrating elements*	Additional precaution: "FLAMRO Variant N II A" <small>[dimensions of intumescent inlay (thickness (t<sub>ac</sub>) x height (h))]</small>	Fire resistance classification
<b>PP pipes:</b>		
Outer diameter 32 mm to 50 mm Wall thickness 1,8 mm to < 4,6 mm	6,4 mm x 25,4 mm	EI 120-U/U E 120-U/U
Outer diameter 32 mm to 50 mm Wall thickness 4,6 mm	6,4 mm x 25,4 mm	EI 120-U/U E 120-U/U
Outer diameter > 50 mm to 75 mm Wall thickness 1,9 mm to < 10,0 mm	12,8 mm x 25,4 mm	EI 90-U/U E 90-U/U
Outer diameter > 50 mm to 75 mm Wall thickness 10,0 mm	12,8 mm x 25,4 mm	EI 120-U/U E 120-U/U
Outer diameter > 75 mm to 110 mm Wall thickness 2,7 mm to < 10,0 mm	19,2 mm x 25,4 mm	EI 90-U/U E 90-U/U
Outer diameter > 75 mm to 110 mm Wall thickness 10,0 mm	19,2 mm x 25,4 mm	EI 120-U/U E 120-U/U
Outer diameter > 110 mm to 125 mm Wall thickness 3,1 mm to < 11,4 mm	19,2 mm x 38,1 mm	EI 90-U/U E 90-U/U
Outer diameter > 110 mm to 125 mm Wall thickness 11,4 mm	19,2 mm x 38,1 mm	EI 120-U/U E 120-U/U
Outer diameter > 125 mm to 160 mm Wall thickness 4,0 mm to 14,6 mm	25,6 mm x 38,1 mm	EI 120-U/U E 120-U/U
<b>Note:</b> The fire resistance class of "FLAMRO KSL" - when penetrated by PP pipes with classification EI 90-U/U / E 90-U/U - is <b>EI 90 / E 90</b>		
* For interpolation between pipe diameters and wall thicknesses see Annex H-4 of the ETA.		
FLAMRO KSL - Fire resistance classification -		ANNEX G-7

FLAMRO KSL penetrated by multi-layer composite pipes acc. to cl. 2.1 of the ETA insulated on both sides of the penetration seal with prefabricated pipe shells (e.g. "ASTRATHERM® Steinwoll-Rohrschale alukaschiert") acc. to cl. 1 of the ETA (local-sustained LS) – installed in rigid floors acc. to cl. 2.1 of the ETA		
Penetrating elements	Additional precaution:	Fire resistance classification
Multi-layer composite pipes "Geberit Mepla Systemrohr":	Prefabricated pipe shells (e.g. "ASTRATHERM® Steinwoll-Rohrschale alukaschiert") acc. to cl. 1 of the ETA	
Outer diameter 16 mm Wall thickness 2,25 mm	Prefabricated pipe shells: Length $\geq 425$ mm*, on both sides of the penetration seal Thickness 20 mm to 30 mm	EI 120-U/C E 120-U/C
Outer diameter 20 mm Wall thickness 2,5 mm	Prefabricated pipe shells: Length $\geq 425$ mm*, on both sides of the penetration seal Thickness 20 mm to 30 mm	EI 120-U/C E 120-U/C
Outer diameter 26 mm Wall thickness 3,0 mm	Prefabricated pipe shells: Length $\geq 425$ mm*, on both sides of the penetration seal Thickness 20 mm to 40 mm	EI 120-U/C E 120-U/C
Outer diameter 32 mm Wall thickness 3,0 mm	Prefabricated pipe shells: Length $\geq 425$ mm*, on both sides of the penetration seal Thickness 20 mm to 50 mm	EI 120-U/C E 120-U/C
Outer diameter 40 mm Wall thickness 3,5 mm	Prefabricated pipe shells: Length $\geq 425$ mm*, on both sides of the penetration seal Thickness 20 mm to 50 mm	EI 120-U/C E 120-U/C
Outer diameter 50 mm Wall thickness 4,0 mm	Prefabricated pipe shells: Length $\geq 425$ mm*, on both sides of the penetration seal Thickness 20 mm to 50 mm	EI 120-U/C E 120-U/C
Outer diameter 63 mm Wall thickness 4,5 mm	Prefabricated pipe shells: Length $\geq 425$ mm*, on both sides of the penetration seal Thickness 20 mm to 60 mm	EI 120-U/C E 120-U/C
Outer diameter 75 mm Wall thickness 4,7 mm	Prefabricated pipe shells: Length $\geq 425$ mm*, on both sides of the penetration seal Thickness 20 mm to 80 mm	EI 120-U/C E 120-U/C
* required minimum insulation length (measured from the surface of the penetration seal)		
FLAMRO KSL - Fire resistance classification -		ANNEX G-8



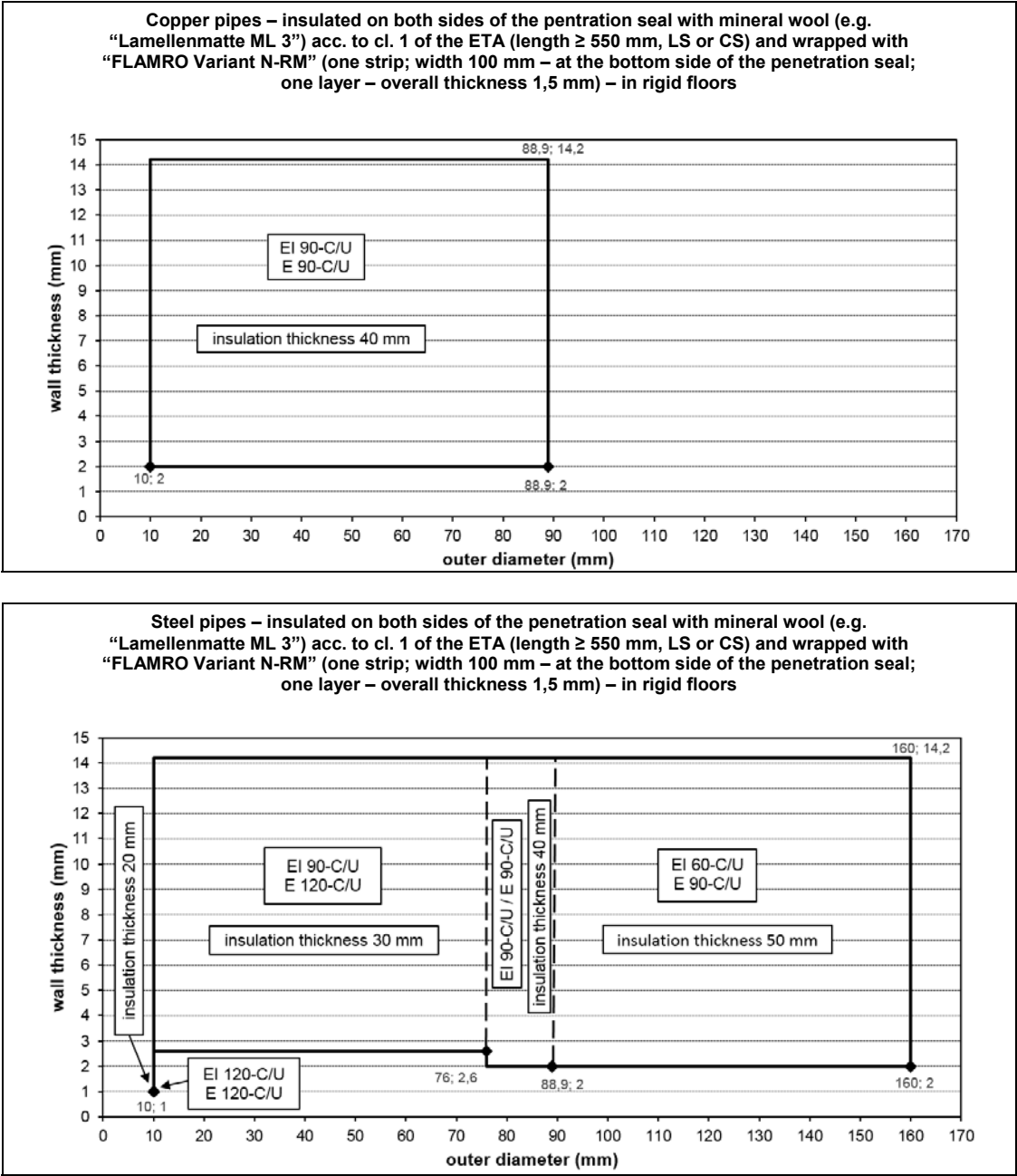
Note: The given graphs and therein enclosed fire resistance classes according to EN 13501-2:2007+A1:2009 are only valid for metal pipes according to clause 2.1 of the ETA.

Note: The dashed vertical lines mark the upper limits of the required insulation thickness as well as the limit of the fire resistance classes.

Note: The dimensions of the graphs are not true to scale.

Interpolation between pipe diameters and wall thicknesses for metal pipes according to clause 2.1 of the ETA in rigid floors	ANNEX H-1
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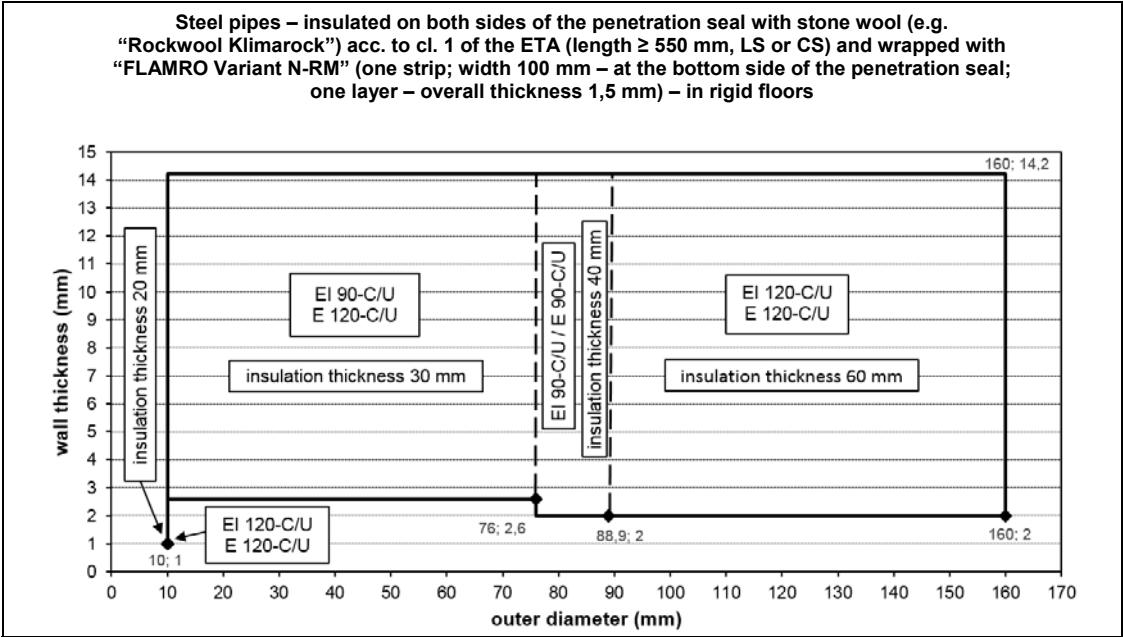


Note: The given graphs and therein enclosed fire resistance classes according to EN 13501-2:2007+A1:2009 are only valid for metal pipes according to clause 2.1 of the ETA.

Note: The dashed vertical lines mark the upper limits of the required insulation thickness as well as the limit of the fire resistance classes.

Note: The dimensions of the graphs are not true to scale.

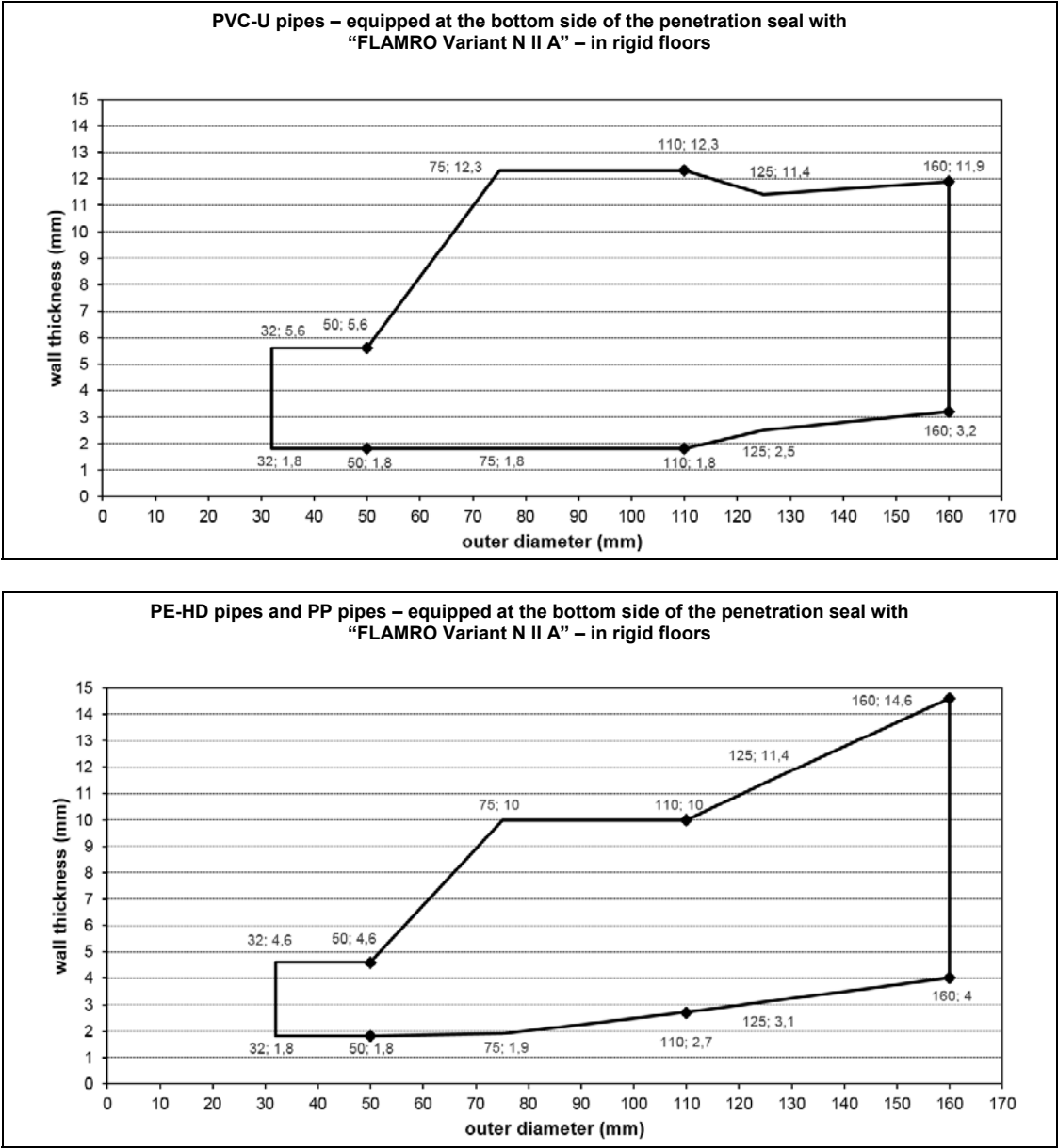
<p><b>Interpolation between pipe diameters and wall thicknesses for metal pipes according to clause 2.1 of the ETA in rigid floors</b></p>	<p><b>ANNEX H-2</b></p>
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Note: The given graphs and therein enclosed fire resistance classes according to EN 13501-2:2007+A1:2009 are only valid for metal pipes according to clause 2.1 of the ETA.

Note: The dashed vertical lines mark the upper limits of the required insulation thickness as well as the limit of the fire resistance classes.

Note: The dimensions of the graphs are not true to scale.



Note: The given graphs are only valid for plastic pipes according to clause 2.1 of the ETA.

Note: The dimensions of the graphs are not true to scale.

Interpolation between pipe diameters and wall thicknesses for plastic pipes according to clause 2.1 of the ETA in rigid floors	ANNEX H-4
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