SINTEF AS
P.O.Box 124 Blindern
NO-0314 Oslo, Norway
certification@sintef.no

Designated according to Article 29 of Regulation (EU) No 305/2011

Member of EOTA

www.eota.eu

European Technical Assessment

ETA-10/0109
of 11.01.2023

General Part

Technical Assessment Body issuing the European Technical Assessment	SINTEF AS by its institute SINTEF Community
Trade name of the construction product	Hilti Firestop Foam CFS-F FX
Product family to which the construction product belongs	Fire Stopping and Sealing Products. Penetration Seals
Manufacturer	HILTI Corporation Feldkircherstrasse 100 9494 Schaan Liechtenstein www.hilti.com
Manufacturing plant	HILTI Werk 4a
This European Technical Assessment contains	116 pages including 5 Annexes 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	EAD 350454-00-1104, September 2017 Fire Stopping and Sealing Products. Penetration Seals
This version replaces	ETA 10/0109-2015-04-17

Table of Content

1 Technical description of the product

Hilti Firestop Foam CFS-F FX is a two-component foam, composed essentially of expanding substances and binder. For further information, see Annex 1.

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

2.1 General description of the use of Hilti Firestop Foam CFS-F FX

Hilti Firestop Foam CFS-F FX is intended to form a penetration seal, which is used to maintain the fire resistance of a separating element (wall or floor) when and where services pass through.

The specific structures where Hilti Firestop Foam CFS-F FX may be used to provide a penetration seal are:

- flexible walls, rigid walls, cross-laminated timber (CLT) walls
- rigid floors, cross-laminated timber (CLT) floors

The seal is formed by applying Hilti Firestop Foam CFS-F FX into the opening around the penetrating services.

Hilti Firestop Foam CFS-F FX may be used to provide a penetration seal with the following specific services in single or multiple applications as well as in mixed application of these service types (mixed):

Blank seal	8.3, 8.4, 8.5, 8.6, 8.7
Cables / cable trays	8.3, 8.4, 8.5, 8.6, 8.7
Conduits	8.3, 8.4, 8.5, 8.6, 8.7
Metal pipes	8.3, 8.4, 8.5, 8.6, 8.7
Plastic pipes	8.3, 8.4, 8.5, 8.6, 8.7
Mixed	8.3, 8.4, 8.5, 8.6

Further details on the type of services covered by the declared classifications and other parameters to be considered are given in Annex 2.

Hilti Firestop Foam CFS-F FX is intended for environmental conditions as defined by use category Y_2 (intended for use at temperatures between -20 °C and + 70°C, but with no exposure to rain nor to UV) according to EOTA TR 024.

The provisions made in this European Technical Assessment are based on an assumed working life of this "Fire Stopping and Sealing Product" of 25 years, provided that the conditions relating to manufacturing, installation, use and repair, are met. In normal use conditions the real working life might be considerably longer.

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 used as a means for selecting the appropriate product in relation to the expected economically reasonable working life of the works.

2.2 Additional components for pipe penetrations

In some cases (see sec.8) of plastic pipes and metal pipes with combustible insulations (reaction to fire class B to E according to EN 13501-1) a Hilti Firestop Bandage CFS-B (see ETA-20/0993) is wrapped around the pipe.

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

3.1 Summary of the performance of the product

The assessment of fitness for use has been made in accordance with EAD 350454-00-1104 (September 2017), summarized as follows:

EAD Clause No.	Characteristic	Assessment method, section in EAD	Assessment of characteristic Reference to relevant sections within this ETA
Basic Works Requirement 2: Safety in case of fire			
1	Reaction to fire	2.2.1	Class E (cured state), according to EN 13501-1, see section 3.2
2	Resistance to fire	2.2.2	According to EN 13501-2, see section 3.3 and section 8
Basic Works Requirement 3: Hygiene, Health and the Environment			
3	Air permeability	2.2.3	According to EN 1026, see section 3.6
4	Water permeability	2.2.4	No performance determined
5	Content, emission and/or release of dangerous substances	2.2.5	No indication, see section 3.4
Basic Works Requirement 4: Safety and accessibility use			
6	Mechanical resistance and stability	2.2.6	Zone type I to IV according to EOTA TR 001, see section 3.5
7	Resistance to impact/movement	2.2.7	See section 3.5
8	Adhesion	2.2.8	See section 3.7
9	Durability	2.2.9	Environmental Condition Type $Y_{2,\ (-20/+70)^{o}C}$

			Compatibility with coatings, see section 3.8
Basic Works Requirement 5: Protection against noise			
10	Airborne sound insulation	2.2.10	See section 3.9
Basic Works Requirement 6: Energy, Economy and Heat Retention			
11	Thermal properties	2.2.11	No performance determined
12	Water vapour permeability	2.2.12	No performance determined

3.2 Reaction to fire

CFS-F FX has been classified according EN 13501-1 to material class E.

3.3 Resistance to fire

The resistance to fire performance according to EN 13501-2 of penetration seals incorporating Hilti Firestop Foam CFS-F FX is given in Annex 2.

Information on ancillary products which were tested within the framework of this European Technical Assessment for evaluating resistance to fire is given in Annex 1.

Other parts or support constructions than given in Annex 2 must not penetrate the seal. Provisions shall be taken such that floor penetration seals cannot be stepped on or are not subjected to forces higher than the limit taken from the impact tests, e.g. by covering with a wire mesh.

3.4 Emission of dangerous substances or radiation

According to the manufacturer's declaration, the product specification has been compared with the list of dangerous substances of the European Commission to verify that that it does not contain such substances 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 EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

An additional VOC-test acc. DIN EN 16516: 2018-01 has been conducted with a loading factor of 0,007m²/m³. The following results have been achieved:

Total volantile organic compound	Concentration after 3 days (µg/m³)	Concentration after 28 days (µg/m³)
Sum of total VOC	97	25
Sum of SVOC (semi-volantile)	< 5	< 5

3.5 Mechanical resistance and stability

In impact tests according to EOTA TR001 the requirements for the highest risk zone type (Type IV) have been fulfilled as defined for internal walls in EOTA TR 001 A.1 for safety in use (500 Nm soft body impact, 10 Nm hard body impact) as well as serviceability (120 Nm soft body impact, 6 Nm hard body impact).
The results are valid for a maximum dimension of the penetration seal equal or lower to 0.4 m x 0.4 m.

3.6 Air permeability, and permeability regarding some other gases

The permeability has been tested according to EN 1026.

The following two flow rates (**q**) per area (**A**) for air permeability were achieved for the given air pressure differences (∆**p**):

∆p [Pa]	**q / A [$m^3/(h^* m^2)$]**	**Layer thickness [mm]**
50	0,0007	174
250	0,0033	174

The permeability regarding the gases N_2, CO_2 and CH_4 (methane) has been determined as follows for foam layer with thickness 174 mm, and where the flow rate index q indicates the type of gas:

∆p [Pa]	**q_{N_2} / A [$m^3/(h \cdot m^2)$]**	**q_{CO_2} / A [$m^3/(h \cdot m^2)$]**	**Q_{CH_4} / A [$m^3/(h \cdot m^2)$]**
50	0,0006	0,0004	0,0007
250	0,0031	0,0021	0,0035

The declared values refer to a penetration seal made from Hilti Firestop Foam CFS-F FX without any penetrating installation.

3.7 Adhesion

It is assumed that verification of adequate adhesion is covered by the impact tests shown in clause 3.5.

3.8 Durability

Hilti Firestop Foam CFS-F FX fulfils the requirements of use category Y_2:

Products intended for use at temperatures between -20 °C and + 70°C, but with no exposure to rain nor UV in accordance with EAD 350454-00-1104, Section 1.2.

Since the requirements for type Y_2 are met, also the requirements for type Z_1 and Z_2 are fulfilled.

Hilti Firestop Foam CFS-F FX has been tested in combination with coatings based on an acrylic dispersion, alkyd resin, polyurethane/acrylic and epoxy resin. The results of the test have demonstrated suitability of penetration seals made from Hilti Firestop Foam CFS-F FX for being painted over by those types of coatings.

3.9 Airborne sound insulation

Test reports concerning noise reduction measurements according to EN ISO 10140-1:2010+A1:2012, EN ISO 10140-2:2010 and EN ISO 717-1: 2013 have been provided.

According to these tests reports the single number ratings are:

Weighted sound reduction index: $R_w(C;C_{tr})$ = 61(-2;-6) dB

Weighted element-normalized level difference: $D_{n,e,w}(C;C_{tr})$ = 69(-2;-7) dB

Regarding the value $D_{n,e,w}$ $(C;C_{tr})$: A_o = 10 m^2 reference area

The acoustic measurement test results apply to the test specimen as described in the following.

The total thickness of the wall element described in the table below: t_{wall} = 155 mm. The outer dimensions of the same wall: W x H = 1200 mm x 1480 mm. This wall element was penetrated by a square opening of w x h = 200 mm x 200 mm which was filled with Hilti Firestop Foam CFS-F FX. The total thickness of the penetration seal was 200 mm, i.e., 45 mm thicker than the wall element. This was made possible by 3 layers of plasterboard strips mounted around the opening on each side.

Description of the wall element, in layers
2 x 12,5 mm plasterboard
50 mm steel frame with 40 mm mineral wool
5 mm air gap, i.e. distance
50 mm steel frame with mineral wool
2 x 12,5 mm plasterboard

The given results apply to the measurement where the seal was not penetrated by any cables ("blank seal"). Based on the relevant measurements the penetration seal does not have any acoustic influence on wall elements with R_{w}-values up to about 61 dB; assuming same dimensions on "the penetration seal cube" through a wall with a thickness close to 155 mm. Other results must be expected for installations where cable trays, pipes, tubes, etc. are passing through the penetration seal.

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 1999/455/EC[1] of the European Commission, as amended, 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	**Intended use**	**Resistance to fire** **Level(s) or class(es)**	**AVCP system**
Fire Stopping and Fire Sealing Products See section I: General Part	For fire compartmentation and/or fire protection or fire performance, as given in section II, clause 2	See clause 3.1, and Annex 1 and 2	1

Note! References given in the table are made to this ETA document only.

The AVCP system referred to in the table above is described as follows:

Tasks for the manufacturer:

- factory production control (FPC),
- further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan.

Tasks for the Notified Product Certification Body:

- determination of the product type on the basis of type testing (including sampling), type calculation, tabulated values or descriptive documentation of the product
- initial inspection of factory and of factory production control (FPC),
- continuous surveillance, assessment and evaluation of FPC

[1] Official Journal of the European Communities L178/52 of 14/7/1999

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at SINTEF.

Issued in Oslo on 11.01.2023

By

SINTEF AS by its institute SINTEF Community

Anne-Jorunn Enstad
Certification Manager

6 ANNEX A - REFERENCE DOCUMENTS

6.1 References to standards mentioned in the ETA:

DIN 8061 Unplasticized polyvinyl chloride (PVC-U) pipes - General quality requirements and testing

DIN 8062 Unplasticized polyvinyl chloride (PVC-U) pipes - Dimensions

DIN 8074 Polyethylene (PE) - Pipes PE 63, PE 80, PE 100, PE-HD - Dimensions

DIN 8075 Polyethylene (PE) pipes - PE 63, PE 80, PE 100, PE-HD - General quality requirements, testing

EN 1026 Windows and doors – Air permeability – Test method

EN 1366-3:2009 Fire resistance tests for service installations - Part 3: Penetration seals

EN 1519 Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure - Polyethylene (PE)

EN 13238 Reaction to fire tests for building products: Conditioning procedures and general rules for selection of substrates

EN 13501-1 Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to fire tests

EN 13501-2 Fire classification of construction products and building elements – Part 2: Classification using test data from fire resistance tests

EN 13823:2002 Reaction to fire tests for building products – Building products excluding floorings exposed to the thermal attack by a single burning item

EN ISO 140-3 Acoustics – Measurement of sound insulation in buildings and of building elements – Part 3: Laboratory measurements of airborne sound insulation of building elements

EN ISO 140-10 Acoustics – Measurements of sound insulation in buildings and of building elements – Part 10: Laboratory measurement of airborne sound insulation of small building elements

EN ISO 717-1 Acoustics – Rating of sound insulation of buildings and of building elements – Part 1: Airborne sound insulation

EN ISO 1452-2 Plastics piping systems for water supply and for buried and above-ground drainage and sewerage under pressure - Unplasticized poly(vinyl chloride) (PVC-U) - Part 2: Pipes

EN ISO 11925-2 Reaction to fire tests – Ignitability of building products subjected to direct impingement of flame – Part 2: Single-flame source test

EN ISO 15493 Plastics piping systems for industrial applications - Acrylonitrile-butadiene-styrene (ABS), unplasticized poly(vinyl chloride) (PVC-U) and chlorinated poly(vinyl chloride) (PVC-C) - Specifications for components and the system; Metric series

EN ISO 15494 Plastics piping systems for industrial applications - Polybutene (PB), polyethylene (PE) and polypropylene (PP) - Specifications for components and the system; Metric series

HD 22.4 Cables of rated voltages up to and including 450/750 V and having crosslinked insulation – Part 4: Cords and flexible cables

HD 640.5 0.6/1kV Power cables with special fire performance for use in power stations – Part 5: single core and multicore halogen-free cables

6.2 Other reference documents

EOTA TR 001 Determination of impact resistance of panels and panel assemblies

EOTA TR 024 Characterisation, Aspects of Durability and Factory Production Control for Reactive Materials, Components and Products

Safety Data Sheet according to 1907/2006/EC, Article 31, for Hilti Firestop Foam CFS-F FX

7 ANNEX B – The Product CFS-F FX

7.1 Description of the product and Ancillary Product(s)

7.1.1 Hilti Firestop Foam CFS-F FX

A detailed specification of the product is contained in document “Identification / Product Specification relating to the European Technical Assessment ETA-10/0109 - Hilti Firestop Foam CFS-F FX” which is a non-public part of this ETA.

The Control Plan is defined in document "Control Plan” relating to the European Technical Assessment ETA-10/0109 - Hilti Firestop Foam CFS-F FX” which is a non-public part of this ETA.

Foil pack 325ml

Mixing nozzle

7.1.2 Use of small, cured oddments /cured pieces of CFS-F FX

Small scale cured pieces of CFS-F FX may be used as a floating barrier or to fill bigger gaps in other seals. There is an excellent adhesion of the fresh, liquid foam and cured CFS-F FX-foam pieces. Used oddments should be covered completely with freshly applied foam.

7.1.3 Dispenser

Hilti Firestop Foam CFS-F FX may be applied with a Hilti MD 2000 / HDM 330 (manual) or Hilti ED 3500 / HDE 500-A22 dispenser (battery). See also the installation instruction in sec.9.

MD 2000

ED 3500

HDM 330

HDE 500-A22

7.1.4 Technical product literature

- Technical Datasheet Hilti Firestop Foam CFS-F FX including instructions for the use of Hilti Firestop Foam CFS-F FX (including all components as shown in 1.1 and 1.2)
- Instruction for Use (see sec. 9)
- Material Safety Data Sheet (MSDS)

7.1.5 Ancillary components

7.1.5.1 Hilti Firestop Bandage CFS-B

For specification and further details see ETA-20/0993.

The bandage is positioned with half of its width (62.5 mm) within the seal (central marking line at the surface of the seal), secured by means of adhesive tape and fixed with metallic wire. For necessary number of layers of the bandage see the relevant chapter in sec. 8

Supporting documents:

Technical Datasheet Hilti Firestop Bandage CFS-B including instructions for use Hilti Firestop Bandage CFS-B.

8 ANNEX C - Resistance to fire classification of Hilti Firestop Foam CFS-F FX

8.1 Intended Use of Penetrants and Reference to Relevant Sections

Intended use of penetrations and reference to relevant section (list not exhaustive, other uses of pipes may be possible)					
Application	Penetration material	Flexible & rigid wall ≥ 100 mm	Rigid floor ≥ 150 mm	Cross-laminated timber wall ≥ 80 mm	Cross-laminated timber floor ≥ 80 mm
Cables	Sheeted Wires tied bundles	8.3.1.3	8.5.4	8.4.5	8.6.5
Electrical conduits	PVC, PO	8.3.1.5	8.5.5	8.4.6	8.6.6
Heating pipes Potable water pipes	Copper	8.3.1.7 and 8.3.2.4	8.5.6.1 and 0	8.4.7	8.6.7
	Steel, stainless	8.3.1.6 and 8.3.2.3	8.5.7 and 8.5.6 and 8.5.8	8.4.7	8.6.7
	Al-composite	8.3.1.14	8.5.9	8.4.9	n.a.
Chilled water pipes	Steel, stainless	8.3.2.3 and 8.3.2.3	8.5.8 and 8.5.7	n.a.	n.a.
	PE PVC	8.3.1.15	8.5.10	8.4.8	8.6.8
Air condition	Clima Split pipe bundles	8.3.1.19	8.5.12	0	8.6.9

8.2 General Information Hilti Firestop Foam CFS-F FX

8.2.1 Penetration seal and penetrant orientation

Single penetration seal if not other indicated. The foam should be applied over the entire wall/floor thickness. The penetrants should penetrate the wall/floor seal in a perpendicular situation only, if not other indicated.

8.2.2 Suitable building structures, where CFS-F FX may be used

Hilti Firestop Foam may be used to seal penetration in flexible and rigid walls, in rigid floors, in cross-laminated timber walls and floors. For details refer to section 8.3, 8.4, 8.5, 8.6.

8.2.3 Seal Thickness increase / Aperture framing and beading

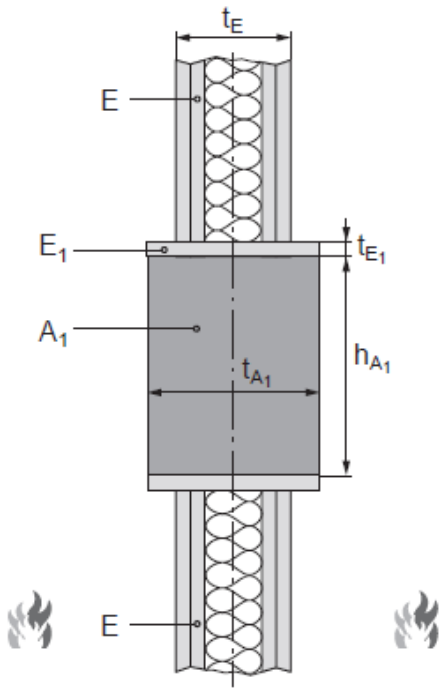
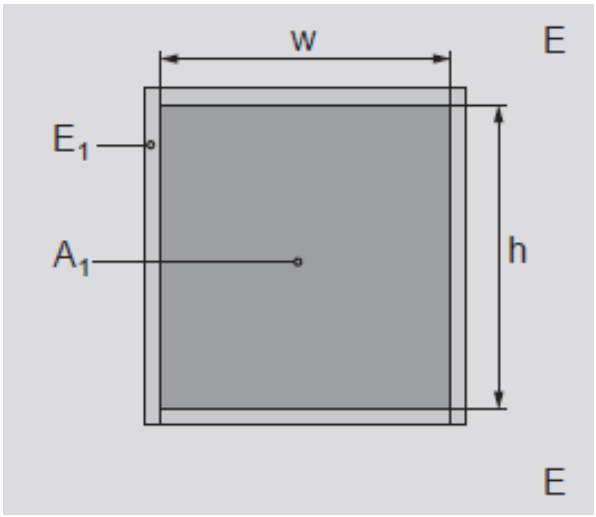
Where the required seal thickness t_A given in *8. Annex C - Resistance to fire classification of Hilti Firestop Foam CFS-F FX* is higher than the wall or floor thickness t_E, a support frame (E_1) – aperture framing or beading - shall be installed to support the Hilti Firestop Foam CFS-F FX as illustrated in Fig. 8.2.3. A -G.

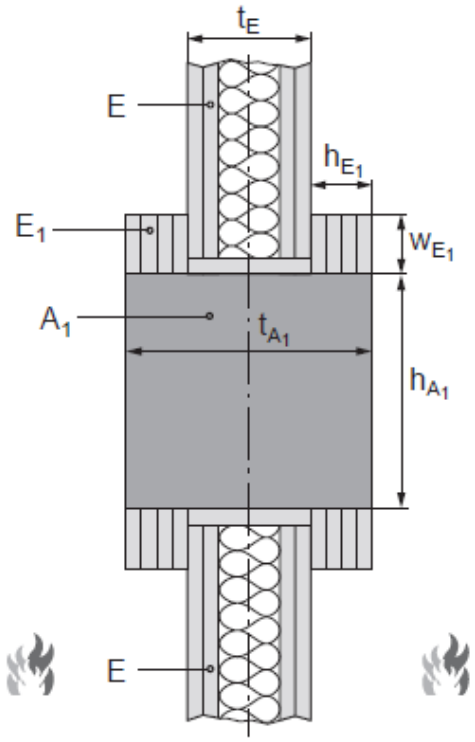
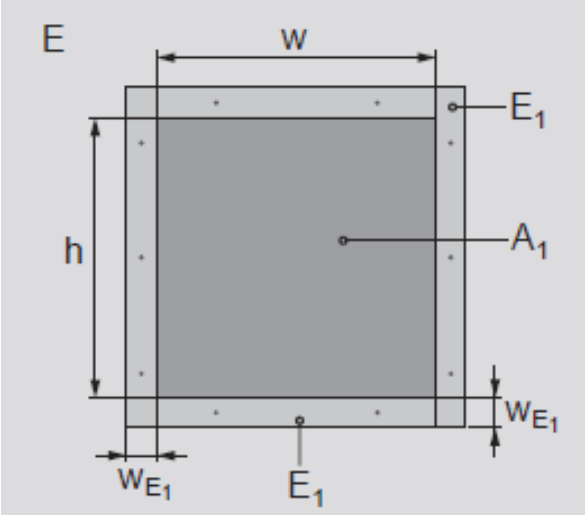
For flexible/rigid walls with aperture framing (refer to fig.8.2.3. A, B):

- Centred position related to wall
- Framing depth related to requested seal thickness t_{A1}
- Possible (not mandatory) seal between framing and wall with Hilti Firestop Acrylic Sealant CFS-S ACR
- Material for aperture framing: material of class A1 or A2 according to EN 13501-1 (e.g. gypsum board acc. EN 520)

For flexible/rigid/cross-laminated timber walls with outside framing (beading) (refer to fig.8.2.3. C, D):

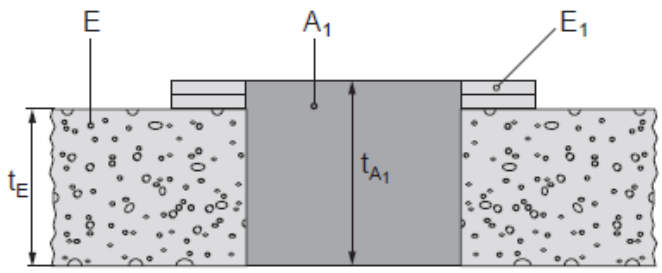
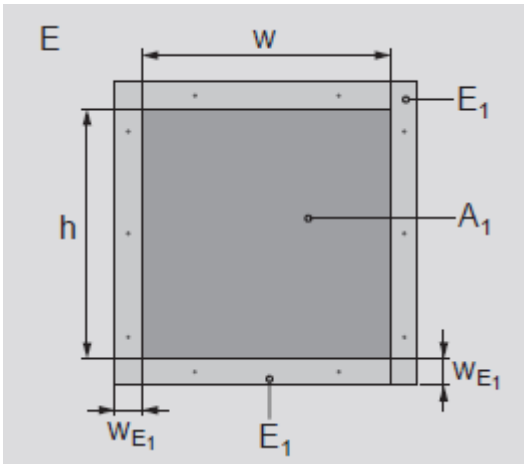
- Identical framing set-up on both sides of the wall
- Framing depth related to requested seal thickness t_{A1}
- Framing width $w_{E1} \geq 50$ mm for wall applications
- Fixing of framing parts with at least 2 metal screws
- Max. distance between fixing screws: 150mm
- Possible (not mandatory) seal between framing and wall with Hilti Firestop Acrylic Sealant CFS-S ACR
- Framing in cross-laminated timber walls to be made from timber boards/strips

	8.2.3. A: Wall penetration (empty seal) with installed aperture framing E_1. (Applicable for rigid or flexible walls)
	8.2.3. B: Wall penetration (empty seal) with installed aperture framing E_1. (Applicable for rigid or cross-laminated timber walls too)

	8.2.3.C: Wall penetration (empty seal) with installed outside framing (beading) (Applicable for rigid or cross-laminated timber walls too) The shown aperture framing within the wall is not mandatory, but helpful in cases, where no mineral wool is inside the wall)
	8.2.3.D: Wall penetration (empty seal) with installed outside framing (beading) (Applicable for rigid or cross-laminated timber walls too)

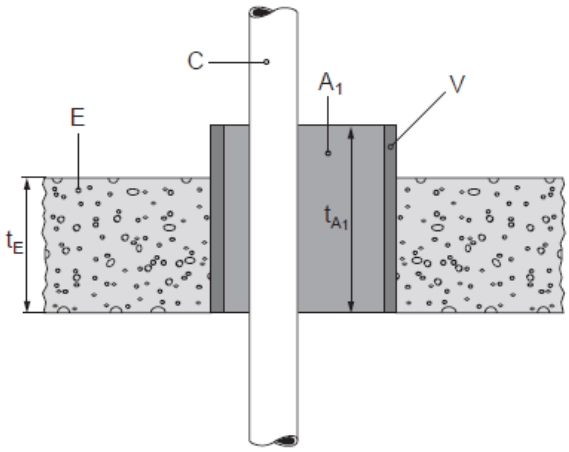
For rigid/cross-laminated timber floors with outside framing (beading) (refer to fig.8.2.3. E, F):

- Framing set-up on top side of floor only
- Framing depth related to requested seal thickness t_{A1}
- Framing width $w_{E1} \geq 50$ mm for rigid/cross-laminated timber floor applications
- Fixing of each framing parts with at least 2 metal screws
- Max. distance between fixing screws: 150mm
- Possible (not mandatory) seal between framing and wall with Hilti Firestop Acrylic Sealant CFS-S ACR
- Framing material in rigid floor: material of class A1 or A2 according to EN 13501-1 (e.g. gypsum board acc. EN 520)
- Framing material in cross-laminated timber floor: to be made from timber boards/strips

	8.2.3. E: Floor penetration with installed outside framing (Applicable for cross-laminated timber floors too)
	8.2.3. F: Floor penetration with installed outside framing on top side only (Applicable for cross-laminated timber floors too) (View from top side)

In some cases of floor penetration in rigid floors a sleeve V could be used as framing, refer to fig. 8.2.3. G:

- PVC-sleeve casted into the rigid floor, flush with bottom side of floor
- Sleeve length = seal thickness t_{A1}

	8.2.3. G: Floor penetration with sleeve V

8.2.4 Seal Size

For the approved seal size and E/I-classification in wall and floor (empty and penetrated seal) refer to section 8.3, 8.4, 8.5 and 8.6.

8.2.5 First support for pipe penetrants

The distances for support constructions away from the construction elements are:

	Flexible and Rigid Wall (identical on both sides of the wall):	**Rigid Floor** (topside only)
Pipes	300 mm	250 mm
Cables	500 mm	415 mm
	Cross-laminated timber Wall (identical on both sides of the wall):	**Cross-laminated timber Floor** (topside only)
Pipes	350mm	350mm
Cables	350mm	350mm

8.2.6 Foamed elastomeric insulation products for pipe insulation

The following types of foamed elastomeric insulation products may be used as pipe insulation:

Manufacturer	Product designation
Armacell International GmbH	Armaflex AF, SH, Ultima, XG, NH, HT
NMC Group	Insul-Tube (nmc), Insul-Tube H-Plus (nmc),
Kaimann GmbH	Kaiflex KK plus, Kaiflex KK, EPDM Plus, HF plus
L'Isolante K-Flex	l'Isolante K-Flex ECO, K-Flex ST Frigo,
Aeroflex	Aeroflex HF
Conel	Conel Flex HAT
Eurobatex	HF
ISIDEM	Coolflex AF
3i	Isopipe HAT
ODE Insulation	ODE R-Flex RPM
Würth	Flexen Kälteschlauch

Named material may be used in make of an insulation hose, bandage/wrap or plates. If a protect insulation DP is used, it should be made from the same elastomeric material as the thermal pipe insulation itself.

8.2.7 Sound decoupling insulation

No sound decoupling insulation has been tested and has been approved on plastic pipes. Based on the soft and flexible mechanical structure of CFS-F FX normally there is no need for additional decoupling.

8.2.8 Mineral wool pipe insulation

Mineral wool pipe insulation, installed in CS (continued sustained) – if not other indicated in specific section 8.3, 8.4, 8.5, 8.6. Type: Rockwool RS800 or equal.

Reaction to Fire class: $A2_{L\text{-}s1}$, d0 acc. EN 13501-1 or better

Melting Point: > 1000°C acc. DIN 4102-17

8.2.9 Metal pipes

The field of application given in 8. Annex C (Resistance to fire) for copper pipes is also valid for other metal pipes with lower heat conductivity than copper and a melting point of at least equal

to the material tested, so copper – pipe testing includes steel pipes, cast iron, stainless steel, Ni-alloys and Ni too.

8.2.10 Polyethylene-based insulation

The following foamed polyethylene based thermal insulation material can be considered to be identical according to their behaviour in fire acc. EN 1366-3:

- Flex PE Conel
- Thermocompact TF
- Climaflex stabil Abfluß nmC
- Kaiflex PE-DWS Abwasserschlauch
- Tubolit Fonowave
- Kaifoam PE-RO
- Wicuflex PE
- Misselsystem Abwasser MSA
- Nmc Klimaflex PE -Schaum
- Nmc Klimaflex stabil PE-Schaum
- Frigoline MKM PE Dämmung
- Frigoline Thermocompact

8.2.11 General rules for penetrating items

The seals may only be penetrated by the services described in 8. Annex C (Resistance to fire). Other parts or support constructions must not penetrate the seal.
The service support construction must be fixed to the building element containing the penetration seal or a suitable adjacent building element, on both sides of the penetration in such a manner that in the case of fire, no additional load is imposed on the seal. Furthermore, it is assumed that this support is maintained on the unexposed side, for the required period of fire resistance.
Specific considerations:

- For tied cable bundles the space between the cables needs not be sealed.
- The total cross section of the cables (including cable supporting systems like cable trays etc.) must not be more than 60% of the total seal (opening) size.
- Pipes must be perpendicular to the seal surface.
- The function of the pipe seal in case of pneumatic dispatch systems, pressurized air systems etc. is guaranteed only when the systems are shut off in case of fire.
- The assessment does not address any risks associated with leakage of dangerous liquids or gases caused by failure of the pipe(s) in case of fire.
- The durability assessment does not take account of the possible effect of substances permeating through the pipe on the penetration seal.
- The classifications for metal and plastic pipes relate to C/U (capped inside the furnace/uncapped outside), U/C (uncapped inside the furnace/capped outside) and U/U (uncapped inside the furnace/uncapped outside). For further information refer to national regulations.

For evaluating resistance to fire of the penetration seal using "Hilti Firestop Foam CFS-F FX" as specified in Annex 2 it is assumed that

- the installation of the penetration seal does not affect the stability of the adjacent building elements – even in case of fire,
- the installations are fixed to the adjacent building elements (not to the seal) in accordance with the relevant regulations in such a way that, in case of fire, no additional mechanical load is imposed on the seal,
- the support of the installations is maintained for the classification period required and
- pneumatic dispatch systems, compressed air systems, etc. are switched off by additional means in case of fire.

The classification of the resistance to fire performance has been carried out in accordance with clause 7.5.8 in EN 13501-2:2007.
The classifications require that the rules for installation shown in sec.9 are followed.
The separating elements must be classified in accordance with EN 13501-2 for the required fire resistance period or fulfil the requirements of the relevant Eurocode.
The classifications are not valid for sandwich panel constructions.
Single Penetration seals require a minimum distance of 100mm.
For minimum distance of cable and pipe first support constructions with wall and floor seals see 8.2.5.

8.3 Flexible and rigid walls with seals made of Hilti CFS-F FX

All test results from flexible wall testing ($t_e \geqq 100$mm) are applicable for rigid walls ($t_e \geqq 100$mm) too.

8.3.1 Specific characteristics for flexible and rigid walls with $t_E \geqq 100$mm

For flexible walls:

The wall must have a minimum thickness of 100 mm and comprise timber or steel studs lined on both faces with minimum 2 layers of 12,5 mm thick boards.

For timber stud walls there must be a minimum distance of 100 mm of the seal to any stud and the cavity between stud and seal must be closed. A minimum 100 mm insulation of Class A1 or A2 (in accordance with EN 13501-1) has to remain in the cavity between stud and seal. In steel stud construction the space between linings has not to be completely filled with insulation material, especially in the neighbourhood to the seal. Nevertheless, the wall construction has to be set up according to requirements given in EN 1366-3:2009 or the construction itself has been classified according EN 13501-2.

The wall comprises timber or steel studs lined on both faces with minimum 2 layers of minimum 12,5 mm thick boards. A higher number of board layers is accepted if the overall board layer thickness is equal or bigger than tested. A higher overall board layer thickness is accepted, if the number of board layers is equal or bigger than tested.

The boards are according EN 520 type F or according to the specification of the tested and approved flexible wall construction system according EN 13501-2.

For Rigid walls, the wall must comprise concrete, aerated concrete or masonry, with a minimum density of 650 kg/m^3.

8.3.1.1 Maximum seal size / Blank seals in rigid/flex. Wall

Construction details:

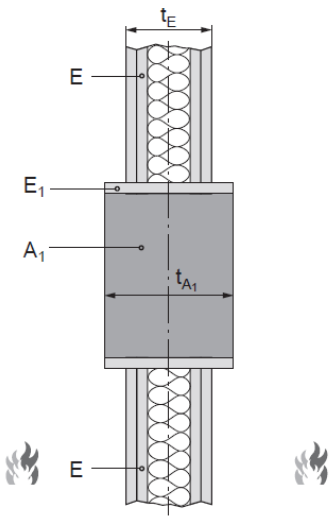
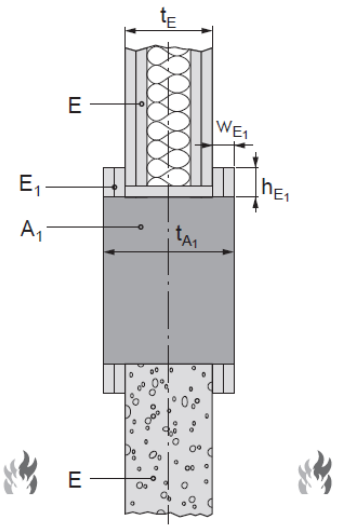
- Hilti Firestop Foam CFS-F FX (A) of thickness t_A centred regarding the thickness of the building element (E).
- In case of seal thickness t_A > building element thickness t_E, Fig. 8.3.2.A and Fig. 8.3.2.B

For symbols and abbreviations see sec.10, Annex E.

Maximum seal size (with and without penetrants):

	Classification blank seal:	seal size: w x h	Ø	seal thickness: t_{A1}
Wall penetrations	EI 90	≤ 600 x 600 mm	≤ 600 mm	≥ 100 mm
	EI 120	≤400 x 400 mm	≤400 mm	≥ 150 mm

Provided that the total amount of services (including insulation) is equal or lower than 60% of the penetration surface.

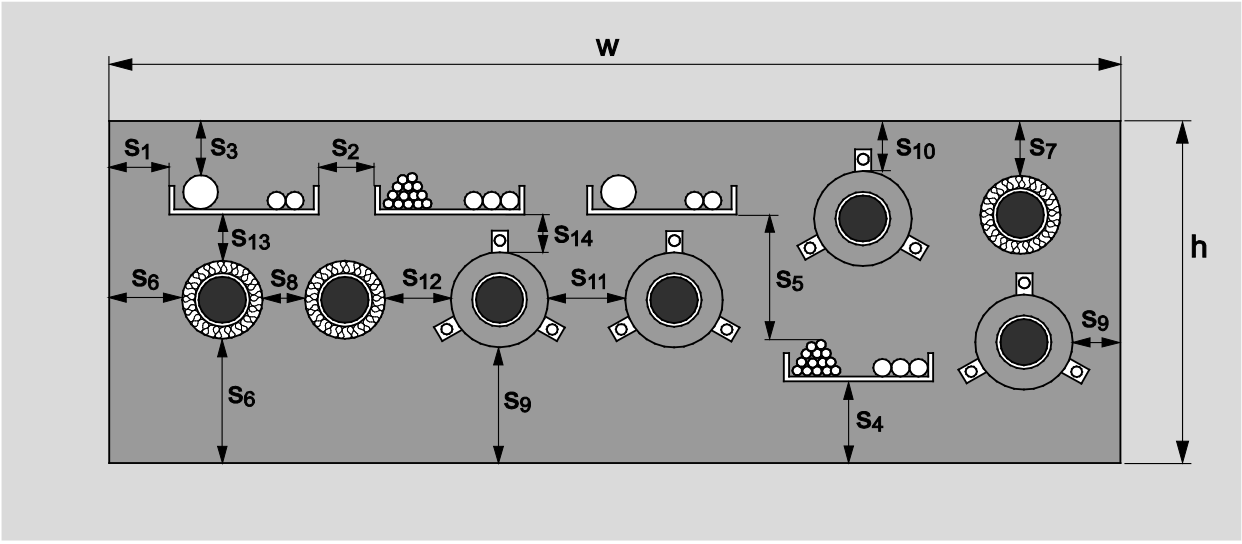
	8.3.2 A: Blank Seal in flexible wall using aperture framing, where t_{A1} exceed t_E For details refer to sec. 8.2.3
	8.3.2 B: Blank Seal in flexible or rigid wall using additional framing, where t_{A1} exceed t_E

For first support refer to 8.2.5

8.3.1.2 Minimum distances for penetrations ≥≥

The distances are valid for single, multiple and mixed penetrations in flexible/rigid walls only.

	Valid for flexible/rigid walls only.	Minimum distance (mm)
s_1	(distance between cables/cable supports and seal edge)	0
s_2	(distance between cable supports)	0
s_3	(distance between cables and upper seal edge)	25
s_4	(distance between cable supports and bottom seal edge)	0
s_5	(distance between cables and cable support above)	50
s_6	(distance between metal pipes and seal edge)	0
s_7	(distance between metal pipes and upper seal edge)	20
s_8	(distance between metal pipes) linear arrangement	0
s_8	(distance between metal pipes) grouped arrangement	40
s_9	(distance between plastic pipes/pipe closure devices and seal edge)	0
s_{10}	(distance between plastic pipes/pipe closure devices and upper seal edge)	20
s_{11}	(distance between plastic pipes/pipe closure devices)	35
s_{12}	(distance between metal pipes and plastic pipes/pipe closure devices)	35
s_{13}	(distance between cables/cable supports and metal pipes)	50
s_{14}	(distance between cables/cable supports and plastic pipes/pipe closure devices)	50

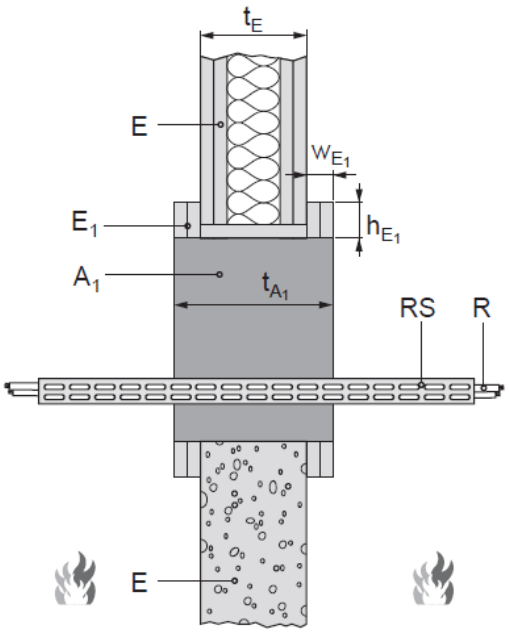
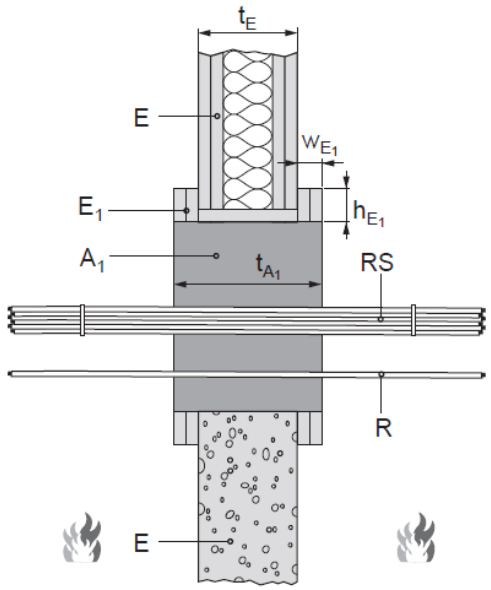


8.3.1.3 Cable seal in flexible or rigid wall

Construction details:

- Hilti Firestop Foam CFS-F FX (A) of thickness t_A centred regarding the thickness of the building element t_E.
- In case of seal thickness t_A > building element thickness t_E, see sec.8.2.3.

For symbols and abbreviations see 10.

	8.3.4.1.A: CFS-F FX seal, penetrated with a cable tray RS in flexible or rigid wall Cable support construction: Perforated metal cable trays with a melting point higher than 1100°C (e.g. galvanised steel, stainless steel). Trays with organic coatings are covered if their overall classification is minimum A2 according to EN 13501-1.
	8.3.4.1.B: CFS-F FX seal, penetrated with a single (R) or bunched cables (RB) in flexible or rigid wall

8.3.1.4 Cable penetrants in flexible and rigid wall constructions

Cables within flexible and rigid wall constructions according to sec.8.3.1:

Penetration seal / Services	Classification (multiple)	(mixed)
Seal thickness	$150 \leq t_A \leq 200$	$t_A \geq 200$
All sheathed cable types currently and commonly used in building practice in Europe (e.g. power, control, signal, telecommunication, data, optical fibre cables, with a diameter of:		
Ø ≤ 21 mm	EI 60	EI 120
21 ≤ Ø ≤ 50 mm	EI 60	EI 90
50 ≤ Ø ≤ 80 mm	EI 60	EI 90
All sheathed single core cables		
Ø ≤ 21 mm	EI 120	EI 120
Sheathed multi-core halogen free cables according to HD 604.5		
Ø ≤ 50 mm	EI 90	
Single sheathed multi-core rubber cables according to HD 22.4		
Ø ≤ 80 mm	EI 120	
Tied cable bundle, maximum diameter of single cable 21 mm		
Ø ≤ 100 mm,	EI 60	EI 120
Non sheathed cables		
Ø ≤ 24 mm,	-	EI 90

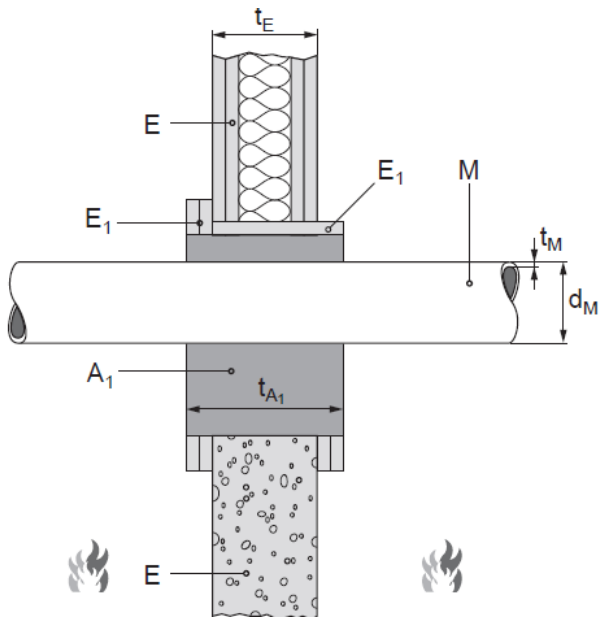
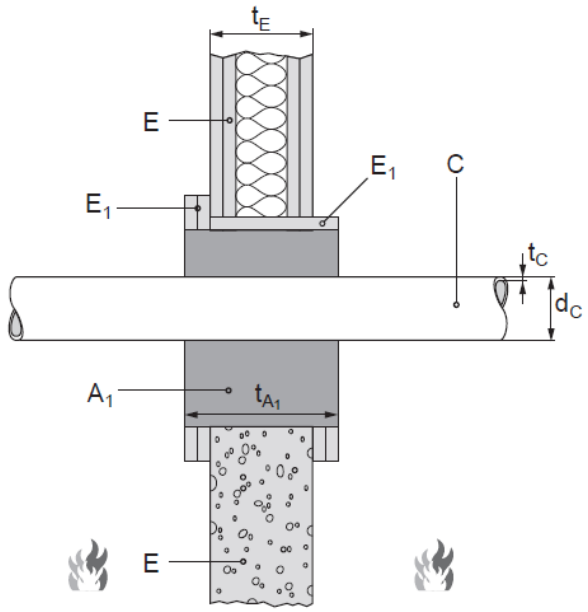
8.3.1.5 Conduits and tubes with flexible and rigid wall constructions

Construction details:

- For construction details and drawings refer to fig.8.3.1.5. A and B.
- Steel conduits: for material refer to 8.2.9, copper excluded
- Plastic conduits material: all types of plastic approved
- For conduit bundle: max. Ø of single conduit in bundle: 32mm

Penetration seal / Services	**Classification** (with and without cables)	
	(multiple)	(mixed)
seal thickness	$t_A \geq 100$	$t_A \geq 200$
Steel conduits and tubes, Ø ≤16 mm	EI 90 C/U	EI 120 C/U
For field of application: refer to sec.8.2.11		
Plastic conduits and tubes, Ø ≤16 mm	EI 120 U/U	EI 120 U/U
Flexible plastic conduits, 16mm ≤ Ø ≤ 32 mm	-	EI 120 U/U
Rigid plastic conduits, 16mm ≤ Ø ≤ 32 mm	-	EI 120 U/U
Bundle of plastic conduits, conduits flexible or rigid,16mm ≤ Ø ≤ 32 mm Bundle diameter: Ø ≤ 100 mm	-	EI 120 U/U

For symbols and abbreviations see 10.

	8.3.1.5.A: Metal conduit in flexible/rigid wall, sealed with CFS-F FX
	8.3.1.5.B: Plastic conduit in flexible/rigid wall, sealed with CFS-F FX

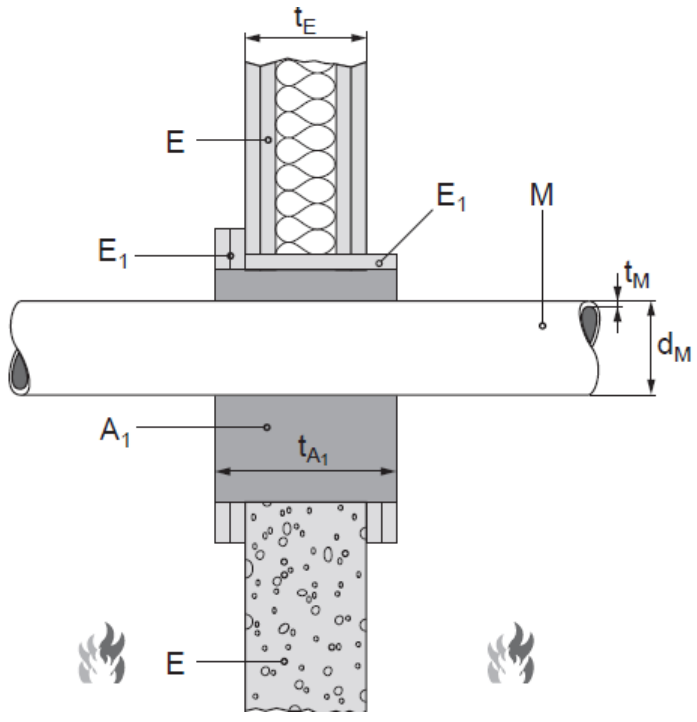
8.3.1.6 Metal pipes without insulation in flexible and rigid wall construction

Construction details :

- Hilti Firestop Foam CFS-F FX (A_1) of thickness t_{A1} centred regarding the thickness of the building element (t_E).
- In case of seal thickness t_{A1} > building element thickness t_E, see sec.8.2.3.
- For distances to other penetrants: min. 100 mm
- For copper and others, for pipe material, refer to 8.2.9

seal thickness t_{A1}: $t_{A1} \geq 200$ mm		Classification (mixed seal)
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	
≦ 28	1,0 – 14,2	EI 90-C/U

For symbols and abbreviations see 10.



8.3.6.1:

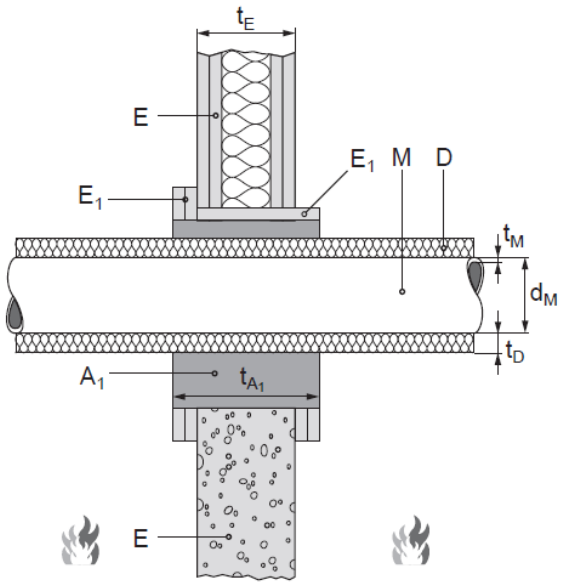
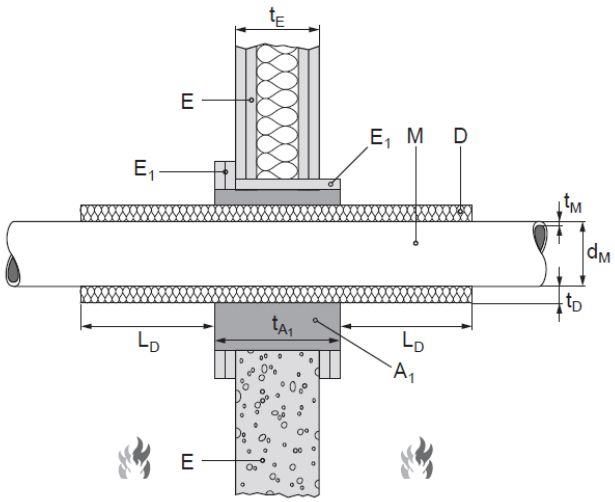
Uninsulated metal pipes in flexible/rigid wall, sealed with CFS-F FX

8.3.1.7 Metal pipes with insulation in flexible and rigid wall construction

Construction details :

- Hilti Firestop Foam CFS-F FX (A_1) of thickness t_{A1} centred regarding the thickness of the building element (E).
- In case of seal thickness t_A > building element thickness t_E, see sec.8.2.3
- For distances refer to sec.8.3.1.2
- For pipe-material field of application: refer to sec. 8.2.9. For symbols and abbreviations see Annex 5.

For symbols and abbreviations see 10.

	8.3.1.7.A: Insulated metal pipes in flexible/rigid wall, sealed with CFS-F FX, insulation in CS-situation
	8.3.1.7.B: Insulated metal pipes in flexible/rigid wall, sealed with CFS-F FX, insulation in LS-situation

8.3.1.8 Steel pipes with mineral wool insulation

Approved field of application for EI 120-C/U in seal thickness $t_{A1} \geqq 150$mm with identical setup on both sides of the wall:

- For type of mineral wool insulation – refer to sec. 8.2.8.
- For thickness of mineral wool insulation: $t_D \geqq 40$mm
- insulation situation: CS (Continues Sustained) or LS (Local Sustained) with ($l_D > 500$mm)
- For metal pipe material: steel and others – refer to sec. 8.2.9, copper excluded
- For metal pipe dimension: refer to fig. 8.3.8.1. below

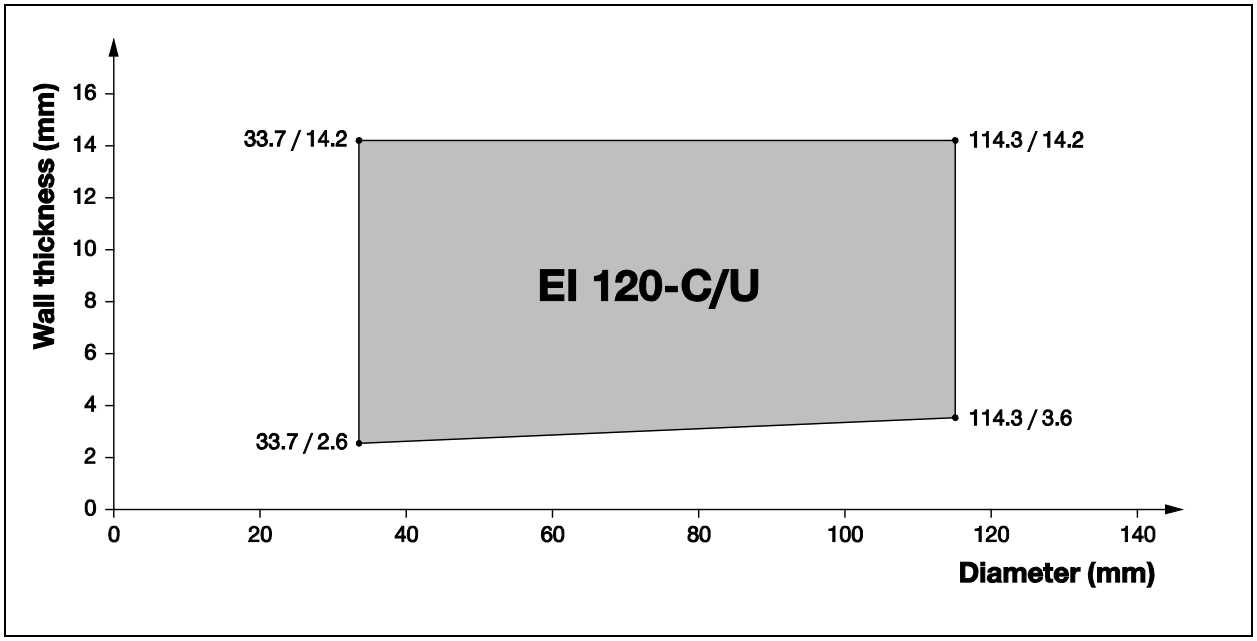


Fig. 8.3.8.1

Additional approved field of application for EI 120-C/U in seal thickness $t_{A1} \geqq 150$mm:

- For type of mineral wool insulation – refer to sec. 8.2.8
- For thickness of mineral wool insulation: $t_D \geqq 30$mm
- insulation situation: LS (Local Sustained) with ($l_D > 500$mm)
- For metal pipe material: steel and others – refer to sec.8.2.9, copper excluded
- For metal pipe dimension: diameter $d_M \leqq 33{,}7$mm, wall thickness: ($2{,}6 \leqq t_m \leqq 14{,}2$) mm

8.3.1.9 Copper pipes with mineral wool insulation

Construction details:

- Arranged linear or in a cluster with sustained insulation made from Rockwool RS800 or equal (refer to sec.8.2.8)
- For type of mineral wool insulation – refer to sec. 8.2.8.
- For thickness of mineral wool insulation: refer to table below
- insulation situation: CS (Continues Sustained) or LS (Local Sustained) with (l_D > 500mm)
- For metal pipe material: steel and others – refer to sec.8.2.9,
- For metal pipe dimension and classifications: refer to table below

For symbols and abbreviations see 10.

seal thickness			t_{A1} ≥150 mm	t_{A1} ≥200 mm
Pipe diameter (d_M) [mm]	Pipe wall thickness (t_C) [mm]	Insulation thickness (t_D) [mm]	Classification (multiple)	(mixed)
28 – 88,9	1,0/2,0 – 14,2 [1]	20	EI 60 C/U	-
88,9	2,0 – 14,2	20	EI 90 C/U	-
12 – 48	1,0/1,5 – 14,2 [2]	20	-	EI 120-C/U
48 – 88,9	1,5/2,0 – 14,2 [3]	40	-	EI 120-C/U

[1] Interpolation of minimum wall thickness between 1,0 for diameter 28 and 2,0 for diameter 88,9 for pipe diameters in between

[2] Interpolation of minimum wall thickness between 1,0 for diameter 12 and 1,5 for diameter 48 for pipe diameters in between.

[3] Interpolation of minimum wall thickness between 1.5 for diameter 48 and 2.0 for diameter 88.9 for pipe diameters in between

8.3.1.10 Copper pipes with foamed elastomeric insulation

Construction details:

- Arranged linear or in a cluster with insulation (D) made from foamed elastomeric insulation according to sec.8.2.6.
- For type of elastomeric insulation – refer to sec.8.2.6.
- For thickness of elastomeric insulation: refer to table below
- insulation situation: CS (Continues Sustained) or LS (Local Sustained) with (l_D > 500mm)
- For metal pipe material: steel and others – refer to sec.8.2.9,
- For metal pipe dimension and classifications: refer to table below

For symbols and abbreviations see 10.

seal thickness: t_{A1} ≥200 mm			
Pipe diameter (d_M) [mm]	Pipe wall thickness (t_M) [mm]	Insulation thickness (t_D) [mm]	Classification (mixed)
6 – 42	1,0/1,2 – 14,2	7,0/9,0	EI 90-C/U
6 – 18	1,0– 14,2	7,0/8,0	EI 120-C/U

8.3.1.11 Zero distance between metal pipes insulated with mineral wool

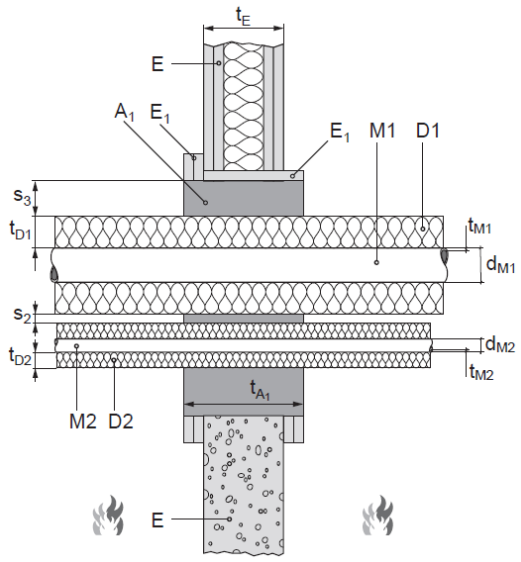
Construction details:

- Seal thickness $t_{A1} \geq 150$mm
- Max. Seal size inside the wall: 400 x 200mm
- Number of pipes: unlimited
- Only linear arrangement, no cluster arrangements
- Zero distance between insulated pipes ($s_2 \geq 0$mm)

Specific conditions:

- Applicable to metal pipes as indicated below
- For pipe material interpretation: refer to sec. 8.2.9
- Pipe insulation: mineral wool, for material refer to sec. 8.2.8
- Pipe insulation in LI and CI
- Minimum insulation length L_D on both sides of the wall: 500mm

Penetrating service				
Pipe Material	Max. Pipe diameter (mm)	Max. Pipe wall thickness (mm)	Insulation thickness (mm)	Classification
Steel	≤ 114,3	3,6 – 14,2	≥ 40	EI 120-C/U
Copper	≤ 42	1,5 – 14,2	≥ 20	
Copper	≤ 88,9	2,0 – 14,2	≥ 40	



8.3.1.11

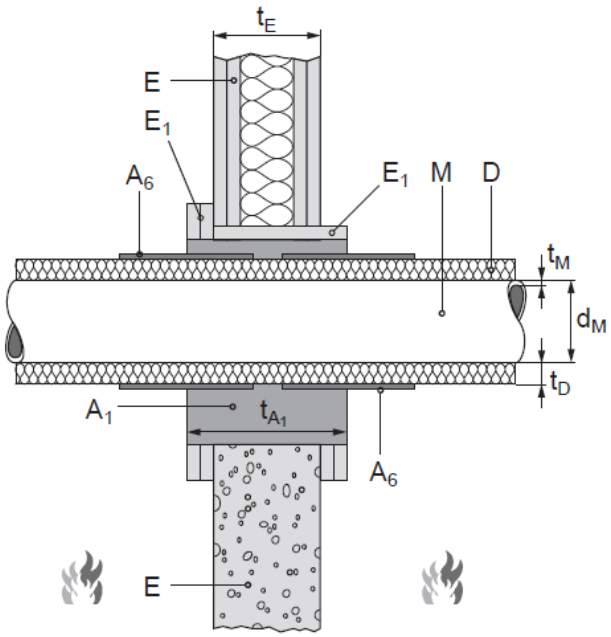
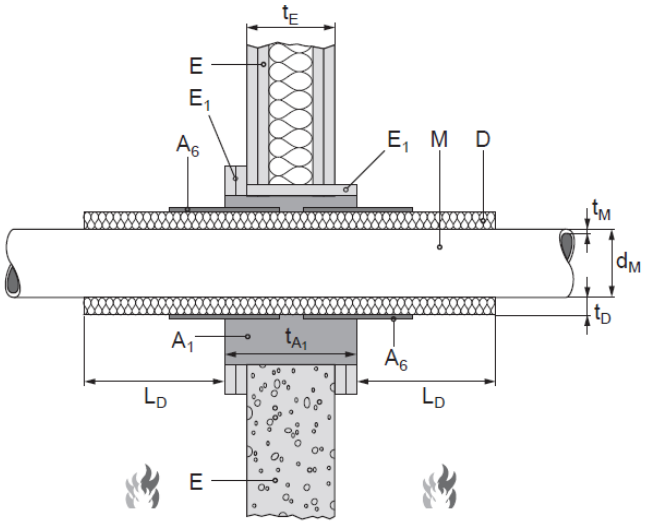
Mineral wool (D1, D2) insulated metal pipes (M1, M2) side by side ($s_2 \geq 0$mm) penetrate a flexible/rigid wall with aperture/additional framing E_1, sealed with CFS-F FX (A_1)

8.3.1.12 Metal pipes with foamed elastomeric insulation and Firestop Bandage CFS-B

Construction details

- Identical CFS-B seal installation on both sides of the wall
- Always two layers of Hilti Firestop Bandage CFS-B for one seal
- CFS-B positioned with its centre- line flush to the seal surface, installed half in wall.
- Every bandage to be secured twice by metallic wire.

For symbols and abbreviations see sec.10

	8.3.1.12. A: Metal pipe (M) with insulation (D) in CS-situation, penetrating a flexible/rigid wall, sealed by means of CFS-B (A_6) and CFS-F FX (A_1). For the flexible wall both types of increasing the seal thickness t_{A1} have been shown.
	8.3.1.12 B: Metal pipe (M) with insulation (D) in LS-situation for insulation length L_D, penetrating a flexible/rigid wall, sealed by means of CFS-B (A_6) and CFS-F FX (A_1). For the flexible wall both types of increasing the seal thickness t_{A1} have been shown.

8.3.1.13 Copper pipes with foamed elastomeric insulation

Construction details:

- Arranged linear or in a cluster
- For insulation material refer to sec.8.2.6.
- Insulation in CS or LS situation (L_D > 500mm)
- For metal pipe material refer to sec.8.2.9, copper excluded

			seal thickness t_{A1} ≥200 mm
Pipe diameter (d_M) [mm]	Pipe wall thickness (t_M) [mm]	Insulation thickness (t_D) [mm]	Classification (mixed)
28 – 54	1.0/1.5 – 14.2 [4]	8.5/9.0 – 35.0/38.0 [6]	EI 90-C/U
28 – 54	1.0/1.5 – 14.2 [5]	8.5 – 35.0/38.0 [6]	EI 120-C/U

[4] Interpolation of minimum wall thickness between 1,0 mm for diameter 28 mm and 1,5 mm for diameter 54 mm for pipe diameters in between

[5]Interpolation of minimum wall thickness between 1,0 for diameter 28 and 1,5 for diameter 54 for pipe diameters in between.

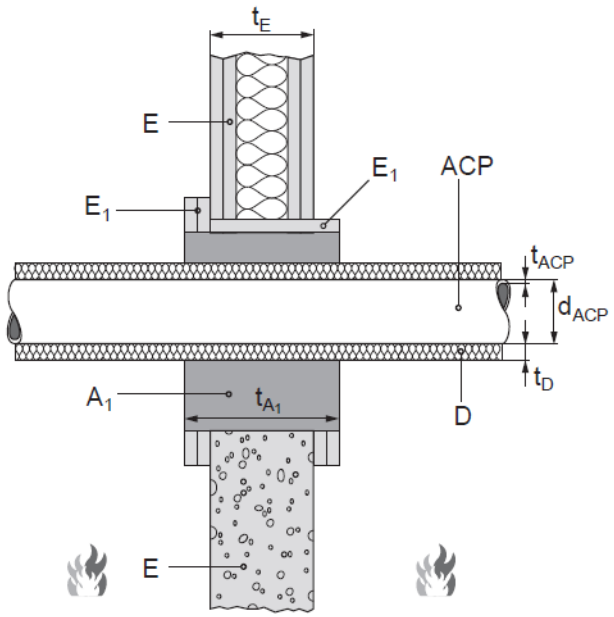
[6]The slash indicates minimum insulation thickness for 28 mm pipe and 54 mm pipe, followed by maximum insulation thickness for 28 mm pipe and 54 mm pipe.

8.3.1.14 Aluminium-composite pipes with foamed elastomeric insulation flexible and rigid wall

Construction details:

- Hilti Firestop Foam CFS-F FX (A_1) of thickness t_{A1} centred regarding the thickness of the building element (tE).
- In case of requested seal thickness t_{A1} > building element thickness t_E, see sec.8.2.3.
- For distances refer to sec.8.3.1.2

For symbols and abbreviations see sec.10



8.3.1.14:

Aluminium-composite pipe (ACP) with insulation (D) in CS-situation, penetrating a flexible/rigid wall, sealed by means of CFS-F FX (A_1).

For the flexible wall both possibilities of increasing the seal thickness t_{A1} have been shown in parallel.

8.3.1.14.1 Aluminium- composite pipes «Geberit *Mepla*» with foamed elastomeric insulation

- For insulation material – refer to sec.8.2.6.
- Insulation situation: CS

Al composite pipes *Geberit Mepla* with foamed elastomeric insulation			
seal thickness: $t_{A1} \geq 200$ mm			
Pipe diameter (d) [mm]	Pipe wall thickness (t_A) [mm]	Insulation thickness (t_D) [mm]	Classification (mixed)
16 – 32	2.0 – 3.0	8.0 – 9.0	EI 120-U/C

8.3.1.14.2 Aluminium- composite pipes «Alpex duo» with foamed elastomeric insulation

- For insulation material – refer to sec.8.2.6.
- Insulation situation: CS

Al composite pipes «*Alpex duo*» from *Fränkische Röhrenwerke* (ACP) with foamed elastomeric insulation			
seal thickness: $t_{A1} \geq 200$ mm			
Pipe diameter (d) [mm]	Pipe wall thickness (t) [mm]	Insulation thickness (t_D) [mm]	Classification (mixed)
16 – 32	2.0 – 3.0	8.0 – 9.0	EI 120-U/C

8.3.1.14.3 Aluminium- composite pipes «*Viega Raxofix and Sanfix Fosta*» with foamed elastomeric insulation

Construction details:

- If seal thickness $t_{A1} \geqq t_E$ consider additional framing, refer to sec.8.2.3
- With insulation and without insulation, in CS, for material: refer to sec.8.2.6
- Insulation thickness: see approved thickness below in table
- Gap width between penetrating isolated/non insulated pipe and seal edge/framing: ($0 \leqq s_3 \leqq 55$) mm, to be sealed with CFS-F FX over the entire thickness t_{A1}

Al composite pipes *Viega Sanfix Fosta* from *Viega* (ACP) with foamed elastomeric insulation - seal thickness: $t_{A1} \geq 200$ mm			
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Insulation thickness (t_D) [mm]	Classification
16	2,2	8,0 – 17,5	EI 120-U/C
20	2,8	8,5 – 18,0	EI 120-U/C
25	2,7	8,5 – 18,5	EI 120-U/C
32	3,2	9,0 – 19,5	EI 120-U/C
16	2,2	No insulation	EI 120-U/C
20	2,8	No insulation	EI 120-U/C
25	2,7	No insulation	EI 120-U/C
32	3,2	No insulation	EI 120-U/C

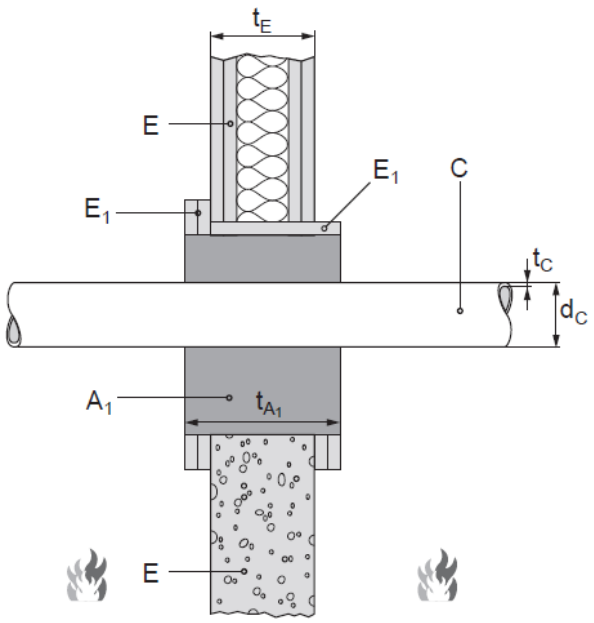
Al composite pipes *Viega Raxofix* from *Viega* (ACP) with foamed elastomeric insulation (D) — continuous sustained (CS) –U/C pipe end configuration - seal thickness: $t_{A1} \geq 200$ mm			
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Insulation thickness (t_D) [mm]	Classification (mixed)
16	2,2	8,0 – 17,5	EI 120-U/C
20	2,8	8,5 – 18,0	EI 120-U/C
25	2,7	8,5 – 18,5	EI 120-U/C
32	3,2	9,0 – 19,5	EI 120-U/C
16	2,2	No insulation	EI 120-U/C
20	2,8	No insulation	EI 120-U/C
25	2,7	No insulation	EI 120-U/C
32	3,2	No insulation	EI 120-U/C

8.3.1.15 Plastic pipes penetrating flexible and rigid wall, sealed with CFS-F FX

Construction details

- Hilti Firestop Foam CFS-F FX (A) of thickness t_A, centred regarding t_E,
- If seal thickness $t_{A1} \geqq t_E$ consider additional framing, refer to sec.8.2.3

For symbols and abbreviations see sec.10

	8.3.1.15: Plastic pipe penetrating a flexible/rigid wall, sealed by means of CFS-F FX (A_1). For the flexible wall both possibilities of increasing the seal thickness t_{A1} have been shown in parallel.

8.3.1.16 PE pipes flexible and rigid wall constructions

8.3.1.16.1 PE pipes (C) according to EN ISO 15494 and DIN 8074/8075 – U/U

PE pipes (C) according to EN ISO 15494 and DIN 8074/8075 – U/U		
seal thickness: t_{A1} ≥200 mm		
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification (mixed)
≤ 40	2.3 – 3.7	EI 120-U/U

8.3.1.16.2 PE pipes (C) according to EN 1519-1 and DIN 8074/8075 – U/C

PE pipes (C) according to EN 1519-1 and DIN 8074/8075 – U/C arranged linear			
seal thickness:		t_A ≥150 mm	t_{A1} ≥150 mm
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification	
		(multiple)	(mixed)
50	2.9 – 4.6	EI 120-U/C	EI 60-U/C

8.3.1.17 PVC-U pipes in flexible and rigid wall constructions

8.3.1.17.1 PVC-U pipes (C) according to EN ISO 1452-2, EN ISO 15493 and DIN 8061/8062 – U/U

PVC-U pipes (C) according to EN ISO 1452-2, EN ISO 15493 and DIN 8061/8062 – U/U		
seal thickness: t_{A1} ≥200 mm		
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification (mixed)
≤ 40	1.9 – 3.0	EI 120-U/U

8.3.1.17.2 PVC-U pipes (C) according to EN 1452-2 and DIN 8061/8062 – U/U

PVC-U pipes (C) according to EN 1452-2 and DIN 8061/8062 – U/U arranged linear			
seal thickness		t_{A1} ≥150 mm	t_{A1} ≥150 mm
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification	
		(multiple)	(mixed)
50	3.7	EI 120-U/U	-

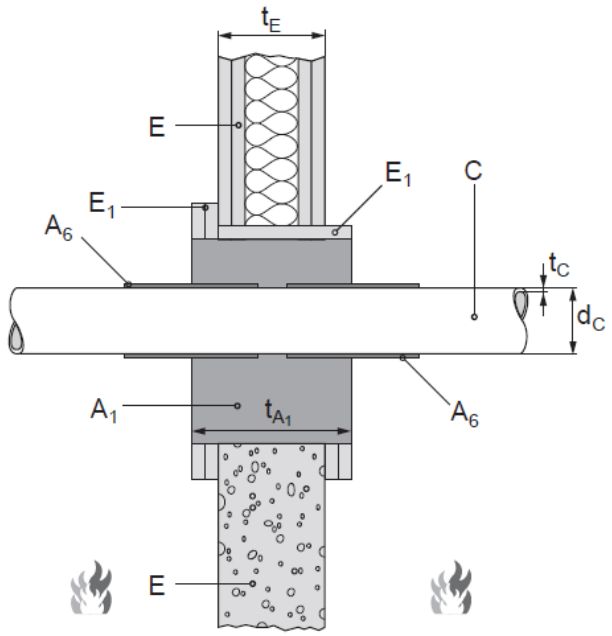
8.3.1.17.3 PVC-U pipes (C) according to EN 1452-2 and DIN 8061/8062 – U/U

PVC-U pipes (C) according to EN 1452-2 and DIN 8061/8062 – U/C arranged linear			
seal thickness**Error! Bookmark not defined.**		t_{A1} ≥150 mm	t_{A1} ≥150 mm
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification	
		(multiple)	(mixed)
50	3.7 – 5.6	EI 120-U/C	EI 60-U/C

8.3.1.18 Plastic pipes penetrating flexible and rigid wall, sealed with CFS-F FX and CFS-B

Construction details

- Framing (beading) or aperture framing to be finished bevor installing the firestop
- CFS-B Firestop bandage has to be wrapped around the pipe two times (two layers),
- CFS-B secured by means of adhesive tape and fixed (two times) by using metal wire
- CFS-B (A_6) to be installed half of its length into the seal, identical on both sides of the wall
- Formwork/sheeting to be installed for CFS-F FX foam application, refer to sec.8.2.3
- Fill opening around the bandage/around pipe with foam A_1 over entire thickness t_{A1}.



8.3.18:

Plastic pipe (C), penetrating a flexible/rigid wall, sealed by means of CFS-F FX (A_1), sealed additionally with CFS-B (A_6).

For the flexible wall both possibilities of increasing the seal thickness t_{A1} have been shown in parallel.

8.3.1.18.1 PE pipes (C) with Hilti Firestop Bandage CFS-B

PE pipes (C) according to EN ISO 15494 and DIN 8074/8075 – U/U with Hilti Firestop Bandage CFS-B		
seal thickness: t_{A1} ≥200 mm		
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification (mixed)
50 - 110	2.9/2.7 – 10.0	EI 120-U/U

See Fig. 8.3.1.18A

8.3.1.18.2 PVC-U pipes (C) with Hilti Firestop Bandage CFS-B

PVC-U pipes (C) according to EN 14493 and DIN 8061/8062 with Hilti Firestop Bandage CFS-B		
seal thickness: t_A ≥200 mm		
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification (mixed)
50 - 110	1.8/2.2 – 12.3	EI 120-U/U

See Fig. 8.3.1.18A

8.3.1.18.3 PVC-U pipes in CFS-F FX

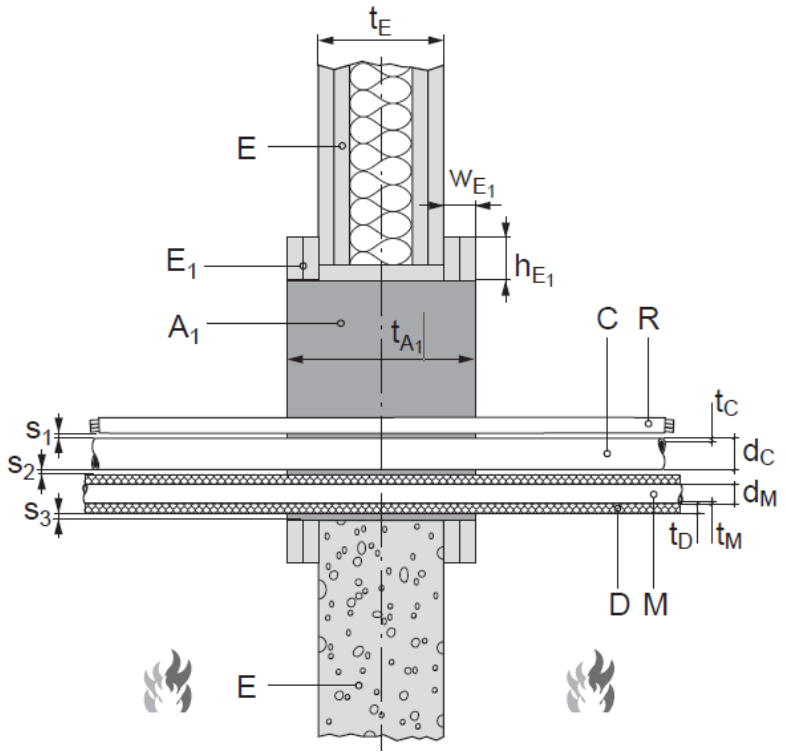
PVC-U pipes (C)		
seal thickness: t_A ≥200 mm		
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification (mixed)
16	3,7	EI 90-U/U
25	4,3	EI 90-U/U
40	2,4	EI 90-U/U

See Fig. 8.3.1.18B

8.3.1.19 Mixed pipe and cable penetration in flexible and rigid walls, sealed with CFS-F FX

Construction details for “Clima split” – application with elastomeric insulation:

- Penetrating service is a tight bundle of isolated metal pipes, plastic pipes and cables
- Distances : see below
- Metal pipes: max. 2 parallel copper pipes, isolated
- Type of metal: copper and others (refer to 8.2.9)
- Dimension of metal pipes - refer to 8.3.14.2
- Type of insulation (CS-situation): foamed elastomeric – refer to 8.2.6
- Insulation thickness: 9mm
- One penetrating non-insulated plastic pipe
- Max. two parallel cables
- Seal thickness with CFS-F FX: over entire thickness t_{A1},
- In case of seal thickness t_A > building element thickness t_E, refer to sec.8.2.3

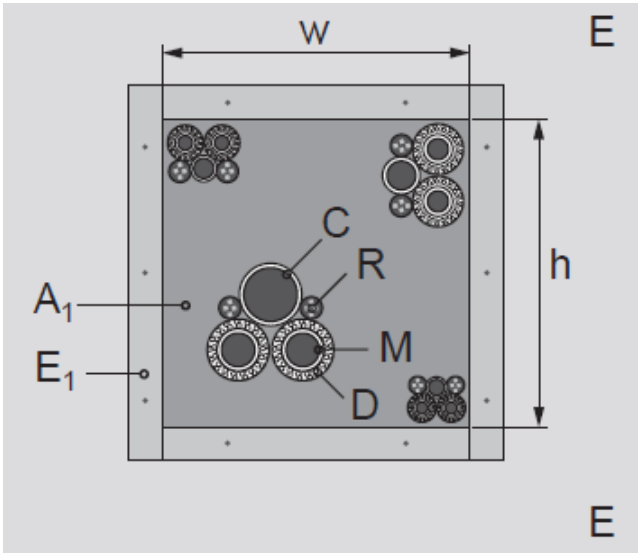


8.3.1.19 A:

Clima split – Application with foamed elastomeric thermal insulation on metal pipes penetrating a flexible/rigid floor.

For symbols and abbreviations see Annex 5 in sec.10.

Distance position	Minimum distances (mm):
between services and seal edge (s_3):	0
between all services inside Clima split bundle (s_2):	0
between services and upper seal edge	20



8.3.1.19 B:

Clima split – Application with foamed polyethylene thermal insulation on metal pipes penetrating a flexible/rigid wall

Seal done with CFS-F FX (A_1)
and CFS-B (A_6)

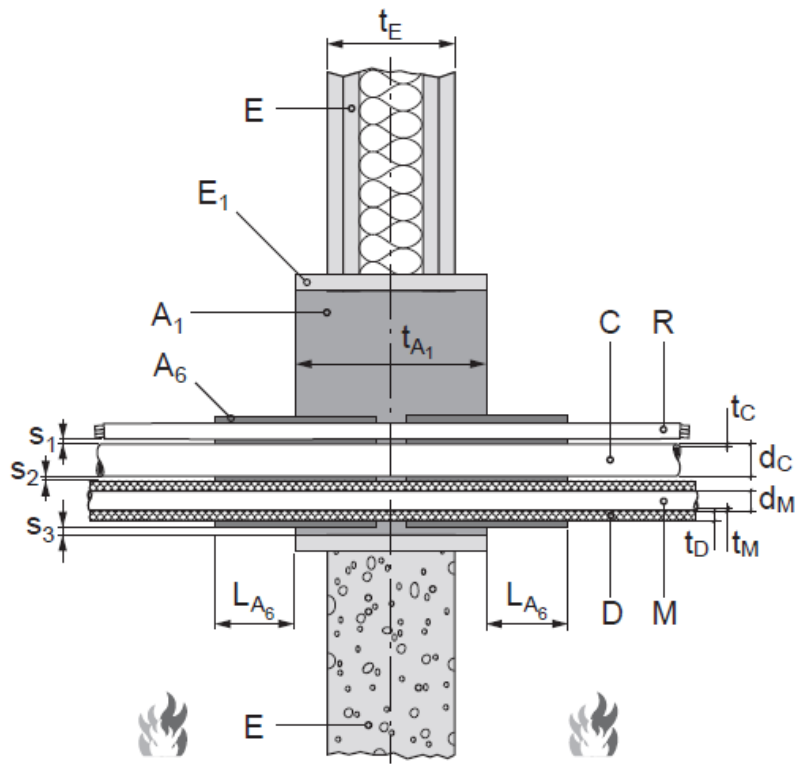
Distance position	Minimum distances (mm):
between services and side seal edge (s_3):	0
between all services inside Clima split bundle (s_2):	0
between services and upper seal edge	0
between Clima split application in one seal	100

seal thickness: t_{A1} ≥200 mm				
Pentrant	**Type / diameter** (d) [mm]	**wall thickness** (t) [mm]	**pipe end**	**Classification (mixed)**
copper pipes (M)	6 - 42	1.0	C/U	EI 90
cables (R)	5 x 1.5mm² 5 x 6mm²		n.a.	
PVC pipes (C)	16	3.7	U/U	
	25	4.3		
	40	2.4		
copper pipes (M)	6 – 18	1.0	C/U	EI 120
cables (R)	5 x 1.5mm² 5 x 6mm²		n.a.	
PVC pipes (C)	16	3.7	U/U	
	25	4.3		
	40	2,4		

8.3.1.20 Mixed pipe and cable penetration in flexible and rigid walls, sealed with CFS-F FX and Hilti Firestop Bandage CFS-B

Construction details:

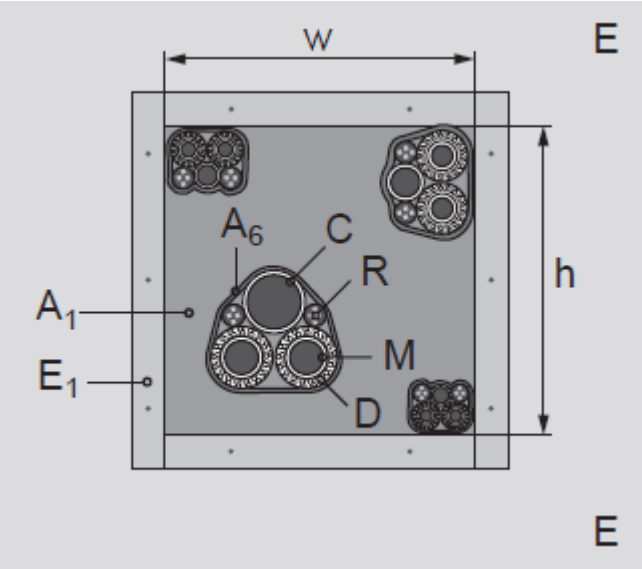
- Penetrating service is a tight bundle of isolated metal pipes, plastic pipes and cables
- Distances: see below
- Metal pipes: max. 2 parallel copper pipes, isolated
- Type of metal: copper and others - refer to 8.2.9
- Type of insulation (CS-situation): foamed PE (polyethylene)
- One penetrating non-insulated plastic pipe
- Max. two parallel cables, for details refer to 8.3.15.2
- Seal thickness with CFS-F FX: over entire thickness tA1
- In case of seal thickness tA > building element thickness tE, refer to sec.8.2.3
- Number of devices CFS-B: two, each from each side
- Number of windings of CFS-B (A6): one
- Installation depth CFS-B: half into the wall opening



8.3.1.20 A:

Clima split – Application with foamed polyethylene thermal insulation on metal pipes penetrating a flexible/rigid wall.

For symbols and abbreviations see Annex 5 in sec.10.



8.3.1.20 B:

Clima split – Application with foamed polyethylene thermal insulation on metal pipes penetrating a flexible/rigid wall

Seal done with CFS-F FX (A_1)
and CFS-B (A_6)

Distance position	Minimum distances (mm):
between services and side seal edge (s_3):	0
between all services inside Clima split bundle (s_2):	0
between services and upper seal edge	0
between Clima split application in one seal	100

seal thickness				t_{A1} ≥150 mm
Pentrant	**Type / diameter** (d_M) [mm]	**wall thickness (minimum)** (t_M) [mm]	**pipe end**	**Classification (mixed)**
copper pipes (M) [13]	6,4 – 15,9	0,8	C/U	EI 120
cables (R)	5 x 1.5mm²		n.a.	
PVC pipes (C), flexible	13 - 24	1,5 – 2,0	U/U	

[13] Copper pipes have to be insulated with polyethylene-insulation (CS) thickness 9mm

8.3.2 Specific characteristics for flexible and rigid walls with $t_E \geqq 112mm$

For flexible walls:

The wall must have a minimum thickness of 112 mm and comprise timber or steel studs lined on both faces with minimum 2 layers of 12,5 mm thick boards.

For timber stud walls there must be a minimum distance of 100 mm of the seal to any stud and the cavity between stud and seal must be closed. A minimum 100 mm insulation of Class A1 or A2 (in accordance with EN 13501-1) has to remain in the cavity between stud and seal. In steel stud construction the space between linings has not to be completely filled with insulation material, especially in the neighbourhood to the seal. Nevertheless, the wall construction has to be set up according to requirements given in EN 1366-3:2009 or the construction itself has been classified according EN 13501-2.

The wall comprises timber or steel studs lined on both faces with minimum 2 layers of minimum 12,5 mm thick boards. A higher number of board layers is accepted if the overall board layer thickness is equal or bigger than tested. A higher overall board layer thickness is accepted, if the number of board layers is equal or bigger than tested.

The boards are according EN 520 type F or according to the specification of the tested and approved flexible wall construction system according EN 13501-2.

For Rigid walls, the wall must comprise concrete, aerated concrete or masonry, with a minimum density of 650 kg/m^3.

All test results from flexible wall testing ($t_e \geqq 112mm$) are applicable for rigid walls ($t_e \geqq 112mm$) too.

8.3.2.1 Maximum seal size / Blank seals in rigid/flexible wall

For maximum seal size / blank seal size refer to sec. 8.3.1.1.

8.3.2.2 Minimum distances for penetrations

For minimum distances between penetrations refer to sec.8.3.1.2.

8.3.2.3 Steel pipes with foamed elastomeric insulation and Hilti Firestop Bandage CFS-B in flexible and rigid wall construction, $t_E \geq 112$ mm

- Arranged linear or in a cluster
- For insulation material refer to sec.8.2.68.2.6.
- Insulation in CS or LS situation (L_D > 500mm)
- For metal pipe material refer to sec.8.2.9 copper excluded

seal thickness: t_{A1} ≥150 mm				
Pipe diameter (d_M) [mm]	Pipe wall thickness (t_M) [mm]	Insulation thickness (t_D) [mm]	Classification (multiple)	Classification (mixed)
33.7 – 114.3	2.6/3.6 – 14.2 [7]	19	EI 60-C/U	EI 60-C/U
33.7 – 114.3	2.6/3.6 – 12.5 [8]	19	EI 90-C/U	n.a.

[7] Interpolation of minimum wall thickness between 2,6mm for diameter 33,7mm and 3,6 mm for diameter 114,3mm for pipe diameters in between

[8] Interpolation of minimum wall thickness between 2,6 for diameter 33,7mm and 3,6 for diameter 114,2for pipe diameters in between.

8.3.2.4 Copper pipes with foamed elastomeric insulation in flexible/rigid wall $t_E \geqq 112$mm

- Arranged linear or in a cluster
- For insulation material refer to sec.8.2.6.
- Insulation in CS or LS situation (L_D > 500mm)
- For metal pipe material refer to sec.8.2.9
- Foamed elastomeric insulation – for material refer to sec.8.2.6.

seal thickness: t_{A1} ≥ 150 mm				
Pipe diameter (d_M) [mm]	Pipe wall thickness (t_M) [mm]	Insulation thickness (t_D) [mm]	Classification (multiple)	Classification (mixed)
28 – 88,9	1,0/2,0 – 14,2 [9]	19	EI 60-C/U	EI 60-C/U
28	1,0 – 14,2	19	EI 120-C/U	-

[9] Interpolation of minimum wall thickness between 1,0 mm for diameter 28 mm and 2,0 mm for diameter 88,9 mm for pipe diameters in between

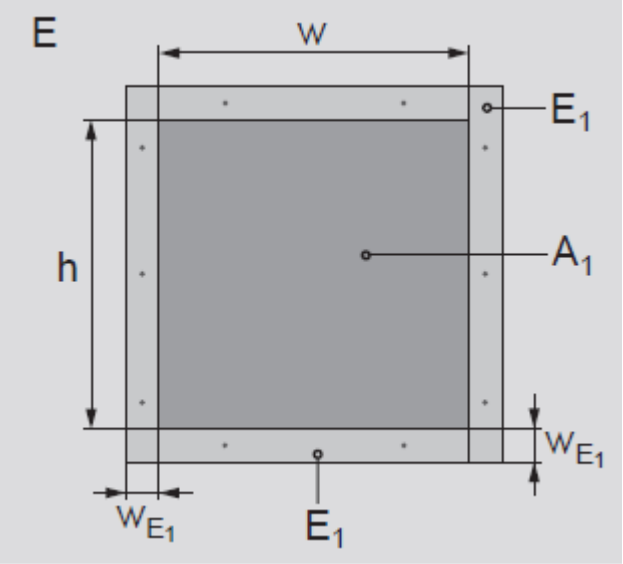
8.4 Cross-laminated timber walls - Construction details

Characterization for the cross-laminated timber walls:

- ETA Binderholz BBS XL (cross-laminated timber)
- Number of cross-laminated timber layers: $\geqq$ 3 (for wall thickness $t_E \geqq$ 80mm)
- Number of cross-laminated timber layers: $\geqq$ 5 (for wall thickness $t_E \geqq$ 100mm)
- PU / MUF adhesives permitted
- Edge glue not required
- Minimum thickness of outer cross-laminated timber layers $t_l \geqq$ 20mm,
- Symmetrical wall-layer set-up,

Cross-laminated timber walls do have a symmetrical construction set-up related to a vertical running axis of symmetry. Individual thickness of layers may vary or be identical.

8.4.1 Blank seals of CFS-F FX in cross-laminated timber walls



8.4.1:

Blank seal of CFS-F FX (A_1) in a cross-laminated timber wall made of X-lam. Cross-laminated timber framing E_1 installed.

Max. height h (mm)	Max. width w (mm)	Wall thickness t_E (mm)	Seal depth t_{A1} (mm)	Classification
400	400	≥ 80	≥ 150	EI 60
400	400	≥ 100	≥ 150	EI 90

8.4.2 Additional Framing in cross-laminated timber walls

If requested seal thickness t_{A1} is bigger than available wall thickness t_E an additional framing E_1 is requested. For details refer to sec.8.2.3

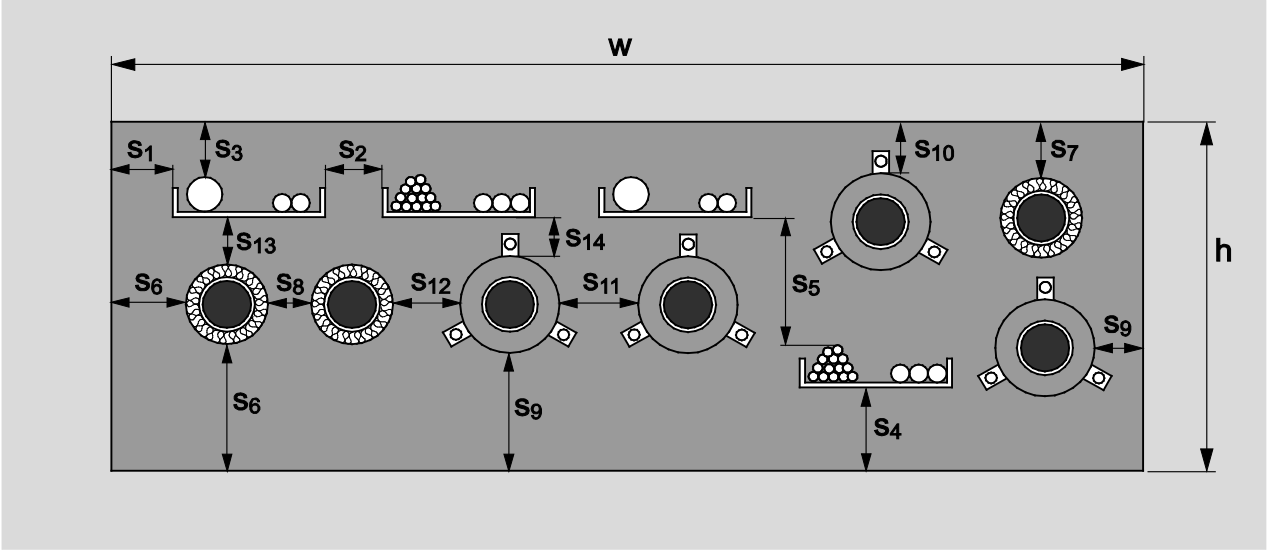
8.4.3 First support in cross-laminated timber wall

First support for any kind of penetrants in cross-laminated timber wall is 350mm.

8.4.4 Minimum distances for penetrations in cross-laminated timber wall construction

The distances are valid for single, multiple and mixed penetrations in cross-laminated timber wall construction made of cross-laminated timber walls.

Valid for cross-laminated timber walls only		**Minimum distance (mm)**
s_1	distance between single cables and side seal edge	20
	distance between cables support and side seal edge	20
	distance between cable bundle or conduit bundle /single conduit and side seal edge	50
	distance between Clima split and side seal edge	50
s_2	distance between cable supports	0
	distance between single cables	0
	distance between single conduits/conduit bundle and edge of the seal on side	50
	distance between Clima split and single cable /cable bundle	100
s_3	distance between single cables or conduits and upper seal edge	20
	distance between bunched cables or conduits and upper seal edge	
s_4	distance between cable supports and bottom seal edge	100
s_5	distance between cables and cable support above	50
s_6	distance between metal pipes and side seal edge	100
	distance between Clima split and downside seal edge	50
	distance between single or bunched conduits and downside seal edge	50
s_7	distance between metal pipes and upper seal edge	100
s_8	distance between metal pipes in linear arrangement	0
s_9	distance between plastic pipes/pipe closure devices and side seal edge	100
s_{10}	distance between plastic pipes/pipe closure devices and upper seal edge	100
s_{11}	distance between plastic pipes/pipe closure devices	100
s_{12}	distance between metal pipes and plastic pipes/pipe closure devices	100
s_{13}	distance between cables/cable supports and metal pipes	100
s_{14}	distance between cables/cable supports and plastic pipes/pipe closure devices	100


w
h
s1
s3
s2
s10
s7
s13
s14
s6
s8
s12
s11
s5
s9
s6
s9
s4

8.4.5 Cables in cross-laminated timber wall construction

General conditions:

For penetrating cables:

- Type of cable: All sheathed cable types currently and commonly used in building practice in Europe (e.g. power, control, signal, telecommunication, data, optical fibre cables
- Cable size: see table below
- First support: refer to 8.6.3

Size of cables Max. Cable Diameter	Cross-laminated timber wall thickness t_E	Requested Seal thickness t_{A1}	Cable Carrier system	Classification
Up to 21mm	≧ 80 mm	≧ 150 mm	With and without	EI 60
Up to 50 mm	≧ 80 mm	≧ 150 mm	With and without	EI 60
Up to 21mm	≧ 100 mm	≧ 150 mm	With and without	EI 60 and E90
Up to 50 mm	≧ 100 mm	≧ 150 mm	With and without	EI 60 and E90

For cable carrier systems:

- Cable carrier penetrating the wall
- Only open cable carrier systems approved, non-perforated steel cable trays
- For carrier material: steel
- Max. carrier width: 200mm
- Max. carrier high: 60mm
- Carrier material thickness: ≧ 1,5mm
- For distances refer to 8.4.4
- Other carries to be stopped 150mm before the seal

8.4.6 Conduits and tubes in cross-laminated timber wall construction

General conditions:

- First support: refer to 8.5.4
- Conduit end configuration: U/C,
- Conduit end seal: sealed with CFS-S ACR, sealing depth: ≥ 15mm
- Projecting length (identical on both sides of the wall): ≧ 500mm
- Single conduits and bunched conduits
- With or without cables in
- All plastic material for flexible and rigid conduits approved

Size and type of conduits	Cross-laminated timber wall thickness t_E	Requested Seal thickness t_{A1}	Classification
Single conduits, rigid plastic conduits Ø ≤ 32 mm	≧ 80 mm	≧ 150 mm	EI 60-U/C
	≧ 100 mm	≧ 150 mm	EI 90-U/C
Single conduits, flexible, pliable, and plastic conduits Ø ≤ 32 mm	≧ 80 mm	≧ 150 mm	EI 60-U/C
	≧ 100 mm	≧ 150 mm	EI 60-U/C
Bundle of rigid plastic conduits, bundle diameter Ø ≤ 100mm, max. single conduit within this bundle is Ø ≤ 32 mm	≧ 80 mm	≧ 150 mm	EI 60-U/C
	≧ 100 mm	≧ 150 mm	EI 90-U/C
Bundle of flexible/pliable plastic conduits, bundle diameter Ø ≤ 100mm, max. single conduit within this bundle is Ø ≤ 32 mm	≧ 80 mm	≧ 150 mm	EI 60-U/C
	≧ 100 mm	≧ 150 mm	EI 60-U/C
Bundle of mixed plastic conduits, (flexible/pliable/rigid), bundle diameter Ø ≤ 100mm, max. single conduit within this bundle is Ø ≤ 32 mm	≧ 80 mm	≧ 150 mm	EI 60-U/C
	≧ 100 mm	≧ 150 mm	EI 60-U/C

8.4.7 Metal pipes with PE-insulation in cross-laminated timber wall construction

General conditions:

- First support: refer to 8.4.3
- Minimum wall thickness: $t_E \geq 100$mm
- Minimum seal thickness: $t_{A1} \geq 200$mm
- For distances refer to 8.4.4

8.4.7.1 Copper pipes with PE-insulation sealed with CFS-F FX in cross-laminated timber wall construction

Construction details:

- Insulated copper pipes,
- Insulation: 9mm PE in CS-position
- For insulation material refer to sec.8.2.10.
- Distances between both insulated pipes $\geq$ 0mm

	cross-laminated timber wall thickness	seal thickness t_{A1}	Classification
insulated copper pipe, max. ∅ = 18mm, wall thickness $\geq$ 1mm	$t_E \geq 80$ mm	$t_{A1} \geq 150$ mm	EI 60-C/U
insulated copper pipe, max. ∅ = 18mm, wall thickness $\geq$ 1mm	$t_E \geq 100$ mm	$t_{A1} \geq 150$ mm	EI 60-C/U

8.4.8 Plastic pipes in cross-laminated timber wall construction

Construction details:

- First support: refer to 8.4.3
- For distances refer to 8.4.4.
- Single penetration seal

8.4.8.1 PP- pipes without insulation sealed with CFS-F FX in cross-laminated timber wall construction

PP pipes (C) according to EN 1451-1, in CLT wall construction, t_E ≥100 mm		
seal thickness:t_{A1} ≥ 200 mm		
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification
50	1.8	EI 90-U/U

8.4.8.2 PVC- pipes without insulation sealed with CFS-F FX in cross-laminated timber wall construction

PVC pipes according to EN 1452-2, EN 1451-1, EN 1329-1 and EN1566-1 In CLT wall construction, t_E ≥100 mm		
seal thickness: t_{A1} ≥ 200 mm		
Pipe diameter (dC) [mm]	Pipe wall thickness (tC) [mm]	Classification
50	1,8 – 5,6	EI 90-U/U

PVC pipes flexible, pliable, rigid In CLT wall construction, t_E ≥ (80 – 100) mm		
seal thickness: t_{A1} ≥ 200 mm		
Pipe diameter (dC) [mm]	Pipe wall thickness (tC) [mm]	Classification
25	4,3	EI 60-U/U

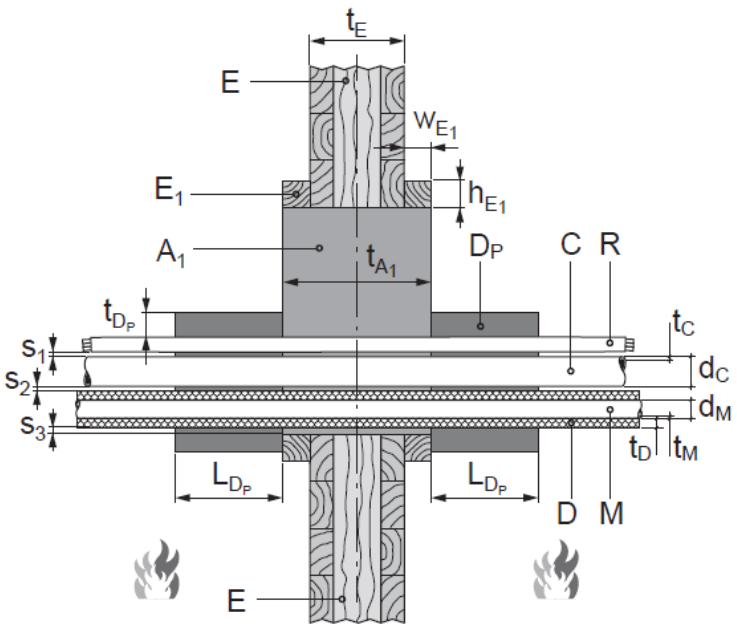
8.4.9 Aluminium-composite pipes without insulation sealed with CFS-F FX in cross-laminated timber wall construction

Geberit Mepla pipe (ACC), non-regulated, in CLT wall construction, t_E ≥100 mm		
seal thickness: t_{A1} ≥ 200 mm		
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification
32	3,0	EI 90-U/C

8.4.10 Mixed pipe and cable penetration in cross-laminated timber wall with elastomeric insulation

Clima split application - Construction details:

- Penetrating service is a tight bundle of isolated metal pipes, plastic pipe and cables
- Metal pipes: max. 2 parallel copper pipes, isolated, in C/U pipe-end configuration
- Type of metal: copper and others (refer to 8.2.9)
- Type of insulation (CS-situation): foamed PE (polyethylene), refer to 8.2.10
- Max. two cables
- Max.one plastic pipe, non-insulated, in U/U pipe-end configuration
- In case of seal thickness tA1 > building element thickness tE, refer to sec.8.2.3
- An additional protect insulation made from elastomeric foam (refer to 8.2.6), thickness tDP = 9mm, length LDP = 250mm has to be installed don both sides of the wall in LI or CI situation.



8.4.10

Clima split application (penetrant C, R, M) penetrating a cross-laminated timber wall, sealed with CFS-F FX (A_1) over seal thickness t_{A1}.

An addition framing made of wood (E_1) has been installed due to the fact, that wall thickness t_E was smaller than requested seal thickness t_{A1}.

For distances: ($s_1 = s_2 = s_3$) ≧ 0mm

Metal pipes:	• Metal pipes maximum diameter: 18mm • Wall thickness = (1,0-14,2) mm • PE-insulation thickness: 9 mm • Type: Tubolit, Frigoline
Plastic pipe:	• PVC pipe, flexible, pliable or rigid • Plastic pipe diameter: max.25mm • Plastic pipe wall thickness: max. 4,3mm
Cables:	• Max. size: 5x1,5mm² • Cable diameter: maximum 14mm

"Clima split" bundles acc. Fig.8.4.10	seal thickness t_{A1}	Classification
In wall thickness t_E ≥80 mm	t_{A1} ≥150 mm	EI 60
In wall thickness t_E ≥100 mm	t_{A1} ≥150 mm	EI 60

8.5 Rigid floors

8.5.1 Specifics for Rigid Floors

The floor must have a minimum thickness of 150 mm and comprise aerated concrete or concrete with a minimum density of at least 2200 kg/m³. This ETA does not cover use of this product as a penetration seal in sandwich panel constructions.

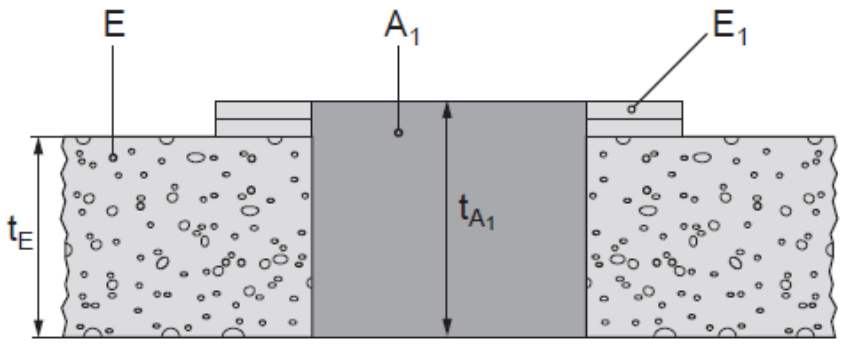
8.5.2 Maximum seal size / Blank seals in rigid floors

Construction details:

Hilti Firestop Foam CFS-F FX (A_1) of thickness t_{A1} flush with soffit of the building element (E).

In case of seal thickness t_A > building element thickness t_E, see sec.8.2.3 with. Fig. 8.2.3.E, F for additional framing.

For symbols and abbreviations see Annex 4 in sec.10.



8.5.2A:

Blank Seal in rigid wall using aperture framing, where t_{A1} exceed t_E

For details refer to sec. 8.2.3

For first support refer to sec. 8.2.5

Maximum opening size for blank or penetrated seal:

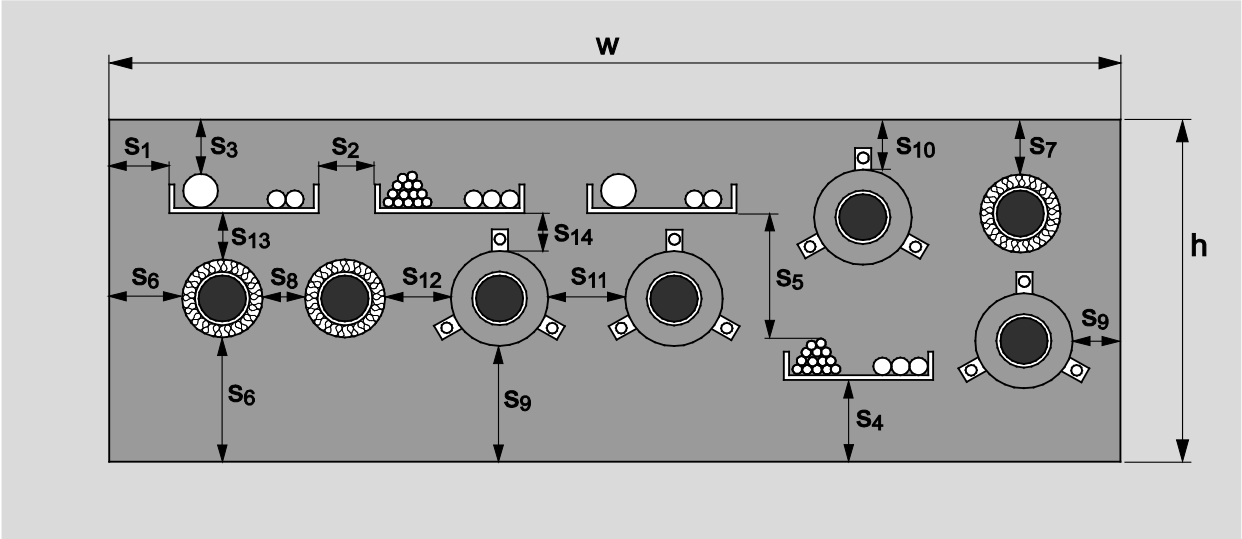
	Classification	seal size:		seal thickness:
		w x h	Ø	t_{A1}
Rigid floor penetrations	EI 120	≤400 x 400 mm”	≤400 mm	≥ 150 mm

Provided that the total amount of services (including insulation) is equal or lower than 60% of the penetration surface.

8.5.3 Minimum distances for penetrations

The distances are valid for single, multiple and mixed penetrations in rigid floors.

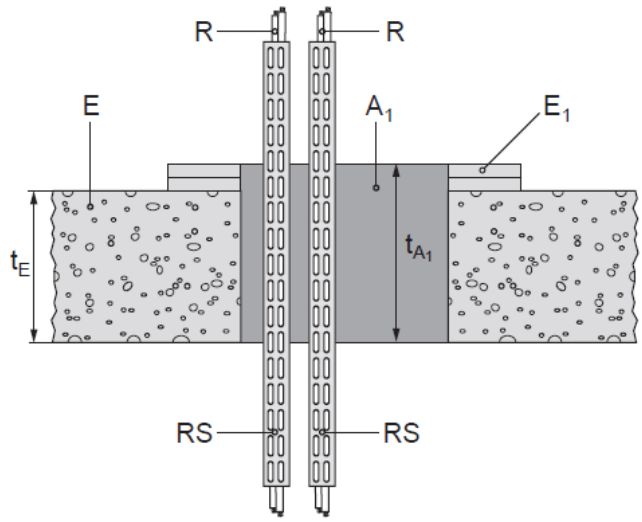
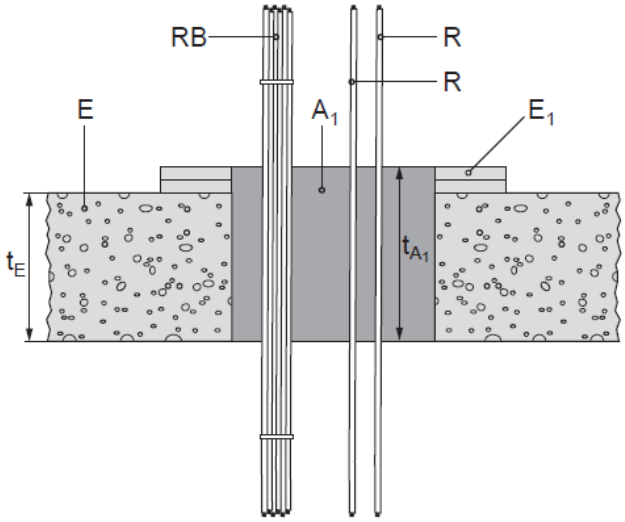
	Valid for rigid floors only.	**minimum distance (mm)**
s_1	(distance between cables/cable supports and seal edge	0
s_2	(distance between cable supports)	0
s_3	(distance between cables and upper seal edge)	n.a.
s_4	(distance between cable supports and bottom seal edge)	n.a.
s_5	(distance between cables and cable support above)	50
s_6	(distance between metal pipes and seal edge)	20
s_7	(distance between metal pipes and upper seal edge)	n.a.
s_8	(distance between metal pipes) linear arrangement	15
s_8	(distance between metal pipes) grouped arrangement	20
s_9	(distance between plastic pipes/pipe closure devices and seal edge)	20
s_{10}	(distance between plastic pipes/pipe closure devices and upper seal edge)	n.a.
s_{11}	(distance between plastic pipes/pipe closure devices)	20
s_{12}	(distance between metal pipes and plastic pipes/pipe closure devices)	20
s_{13}	(distance between cables/cable supports and metal pipes)	80
s_{14}	(distance between cables/cable supports and plastic pipes/pipe closure devices)	80



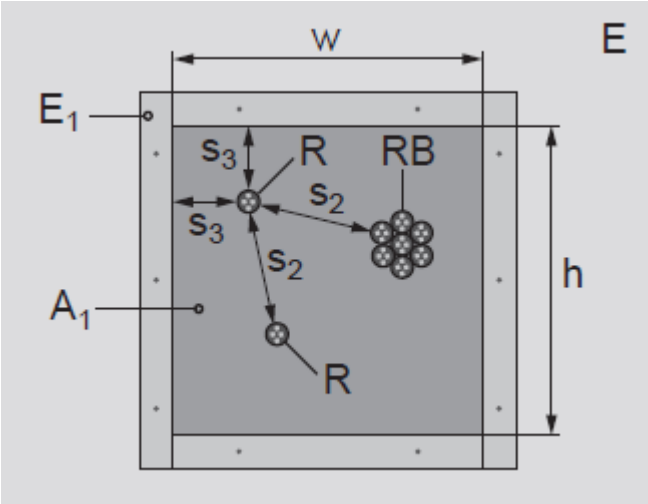
8.5.4 Cable seals in rigid floor

Construction details:

For symbols and abbreviations see Annex 5.

	8.5.4A: CFS-F FX seal, penetrated with a cable tray RS in rigid floor Cable support construction: Perforated metal cable trays with a melting point higher than 1100°C (e.g. galvanised steel, stainless steel). Trays with organic coatings are covered if their overall classification is minimum A2 according to EN 13501-1.
	8.5.4.B: CFS-F FX seal, penetrated with single (R) or bunched cables (RB) in rigid floor

8.5.4.1 Minimum distance in floor penetration:



8.4.3.2.A:

Distances in cable/bunched cable seals

Cable to seal edge (s_3): ≧ 0 mm

Cable to cable (s_2): ≧ 0 mm

Cable to cable bundle (s_2): ≧ 33 mm

For minimum distances to other penetrants, support systems or insulation refer to sec.8.2.5.

8.5.4.2 Cable penetrants in rigid floor constructions

Cables within rigid floor constructions according to sec.8.5.1.

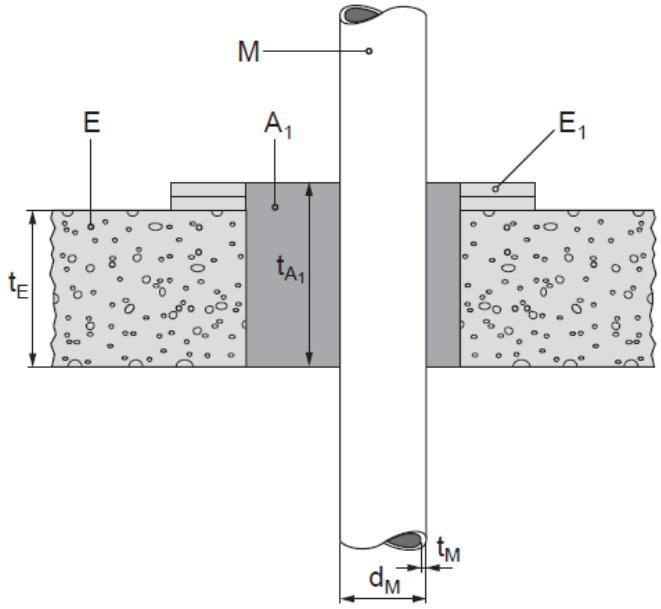
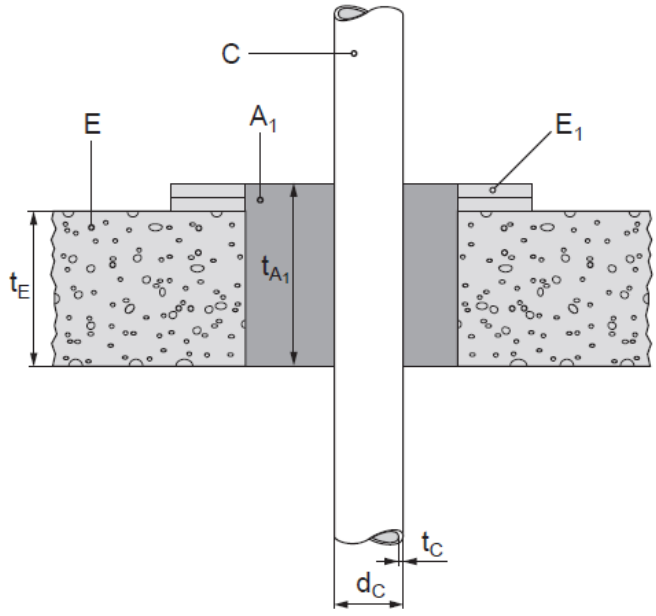
Penetration seal / Services	Classification		
	(multiple)[10]		(mixed)[11]
Seal thickness	$150 \leq t_A \leq 250$	$t_A \geq 250$	$t_A \geq 200$
All sheathed cable types currently and commonly used in building practice in Europe (e.g. power, control, signal, telecommunication, data, optical fibre cables, with a diameter of:			
Ø ≤ 21 mm	EI 60	EI 120	EI 120
21 ≤ Ø ≤ 50 mm	EI 60	EI 90	EI 90
50 ≤ Ø ≤ 80 mm	EI 60	EI 90	EI 90
Tied cable bundle, maximum diameter of single cable 21 mm			
Ø ≤ 100 mm,	EI 60	EI 120	EI 120
Non sheated cables			
Ø ≤ 24 mm,	-	-	EI 90

[10] multiple seals: combination of single cables, bunched cables or cable support constructions within one seal

[11] mixed seals: combination of single cables, bunched cables or cable support constructions with metal or plastic pipes, conduits within one seal.

8.5.5 Conduits and tubes in rigid floor constructions

Construction details:

	8.5.5 A: Metal conduit in rigid floor, sealed with CFS-F FX
	8.5.5..B: Plastic conduit in rigid floor, sealed with CFS-F FX

Penetration seal / Services	**Classification** (with and without cables)	
	multiple	mixed
seal thickness (mm)	$t_{A1} \geq 150$	$t_{A1} \geq 200$
Steel conduits and tubes, Ø ≤16 mm	EI 120 U/U	EI 120 C/U
For field of application: refer to sec.8.2.11		
Plastic conduits and tubes, Ø ≤16 mm	EI 120 U/U	EI 120 U/U
Flexible plastic conduits (Polyolefin, PVC), 16mm ≤ Ø ≤ 32 mm	-	EI 120 U/U
Rigid plastic conduits (Polyolefin, PVC), 16mm ≤ Ø ≤ 32 mm	-	EI 120 U/U
Bundle of plastic conduits (Polyolefin, PVC), conduits flexible or rigid,16mm ≤ Ø ≤ 32 mm Ø ≤ 100 mm	-	EI 120 U/U

For construction details and drawings refer to fig.8.5.5. A and B.

8.5.6 Metal pipes without insulation in rigid floor construction

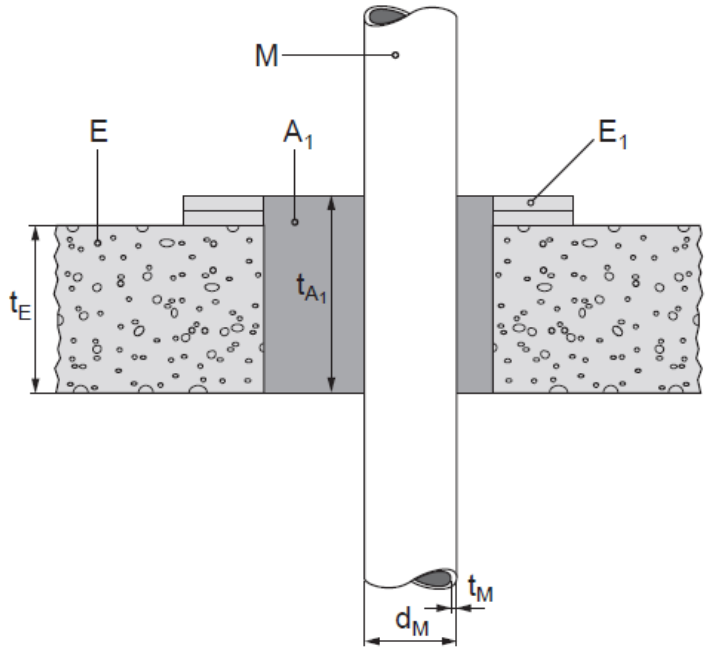
Construction details :

Hilti Firestop Foam CFS-F FX (A_1) of thickness t_{A1} flush with soffit of building element (E).

In case of seal thickness t_{A1} > building element thickness t_E, see sec.8.2.3.

For distances refer to sec.8.2.5

For symbols and abbreviations see Annex 5 in sec.10.



8.5.6 A:

Uninsulated metal pipes in rigid floor, sealed with CFS-F FX

8.5.6.1 Copper pipes without insulation in rigid-floor

seal thickness: t_{A1} ≥200 mm		In flexible walls and solid walls
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification (mixed)
≤ 28	1,0 – 14,2	EI 90-C/U

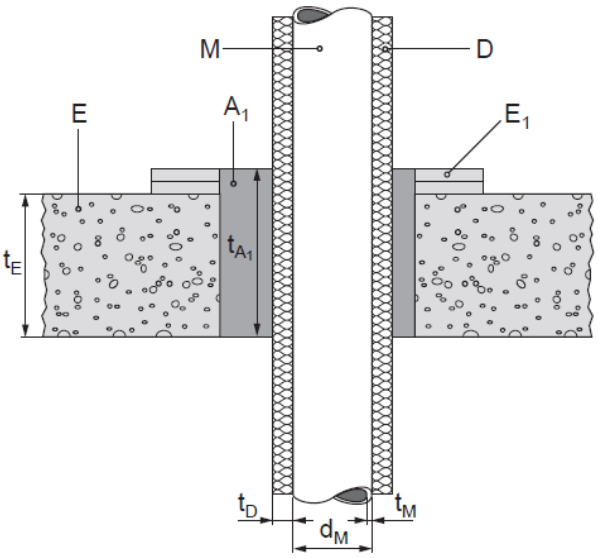
For pipe-material field of application: refer to sec.8.2.9

8.5.7 Metal pipes with insulation in rigid floor construction

Construction details:

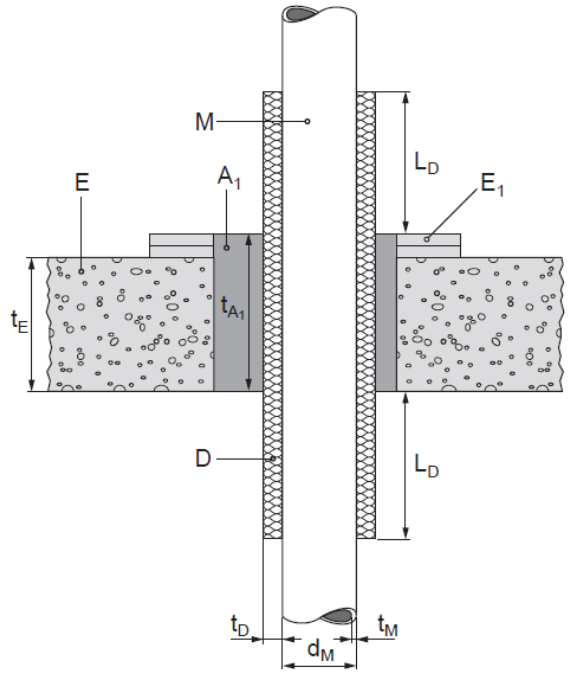
- Hilti Firestop Foam CFS-F FX (A_1) of thickness t_{A1} flush with soffit of the building element (E).
- In case of seal thickness t_A > building element thickness t_E, see sec.8.2.3
- For distances refer to sec.8.5.3

For symbols and abbreviations see Annex 4 in sec.10.



8.5.7 A:

Insulated metal pipes in rigid floor, sealed with CFS-F FX, insulation in CS-situation



8.5.7.B:

Insulated metal pipes in rigid floor, sealed with CFS-F FX, insulation in LS-situation

8.5.7.1 Steel pipes with mineral wool insulation in rigid floor

8.5.7.1.1 Steel pipes with mineral wool insulation in CS-situation

Approved field of application for EI 120-C/U in seal thickness $t_{A1} \geqq 150$mm with identical setup on both sides of the floor:

- For type of mineral wool insulation – refer to sec. 8.2.8
- For thickness of mineral wool insulation: $t_D \geqq 40$mm
- insulation situation: CS (continues sustained) or LI (Local Interrupted) with ($l_D > 500$mm)
- For metal pipe material: steel and others – refer to sec.8.2.11, copper excluded
- For metal pipe dimension: refer to fig.8.5.7.1.1.A below

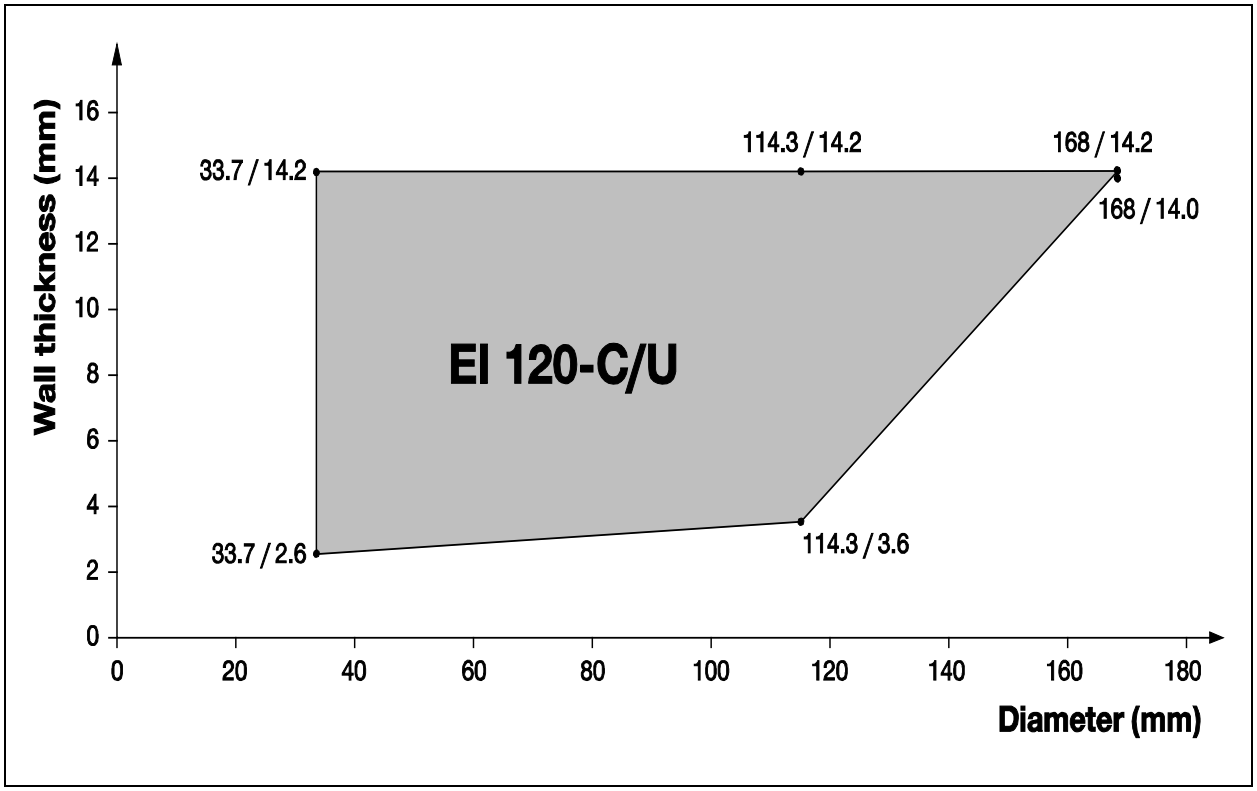


Fig.8.5.7.1.1.A

Additional approved field of application for EI 120-C/U in seal thickness $t_{A1} \geqq 150$mm with identical setup on both sides of the floor:

- For type of mineral wool insulation – refer to sec. 8.2.8
- For thickness of mineral wool insulation: $t_D \geqq 30$mm
- insulation situation: CS (continues sustained)
- For metal pipe material: steel and others – refer to sec.8.2.9, copper excluded
- For metal pipe dimension: diameter $d_M \leqq 33{,}7$mm, wall thickness: ($2{,}6 \leqq t_m \leqq 14{,}2$) mm

8.5.7.1.2 Steel pipes with mineral wool insulation in LS-situation

Approved field of application for EI 120-C/U in seal thickness $t_{A1} \geqq 150$mm with identical setup on both sides of the floor:

- For type of mineral wool insulation – refer to sec.8.2.8
- For thickness of mineral wool insulation: $t_D \geqq 40$mm
- insulation situation: LS (Local Sustained) with ($l_D > 500$mm)
- For metal pipe material: steel and others – refer to sec.8.2.9, copper excluded
- For metal pipe dimension: refer to fig. 8.5.7.1.2. below

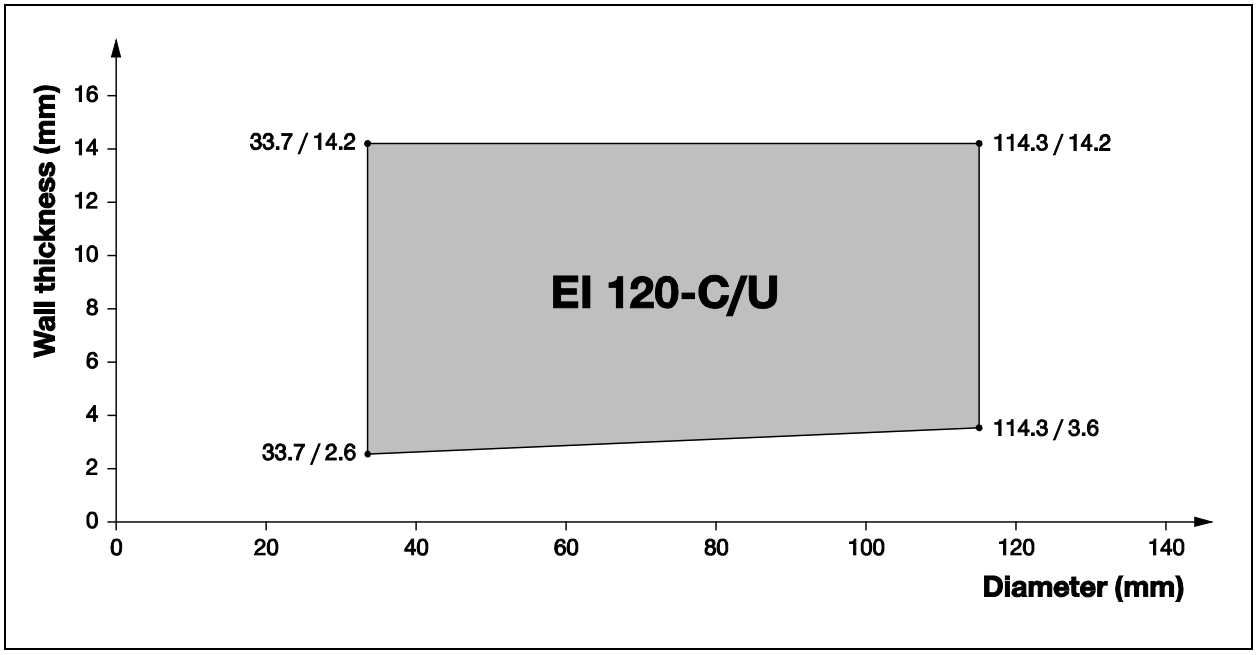


Fig.8.5.7.1.2.

Additional approved field of application for EI 120-C/U in seal thickness $t_{A1} \geqq 150$mm with identical setup on both sides of the floor:

- For type of mineral wool insulation – refer to sec. 8.2.8
- For thickness of mineral wool insulation: $t_D \geqq 30$mm
- insulation situation: LS (Local Sustained) with ($l_D \geqq 500$mm)
- For metal pipe material: steel and others – refer to sec.8.2.9, copper excluded
- For metal pipe dimension: diameter $d_M \leqq 33{,}7$mm, wall thickness: ($2{,}6 \leqq t_m \leqq 14{,}2$) mm

8.5.7.2 Copper pipes with mineral wool insulation in rigid floor

- Arranged linear or in a cluster
- Insulation made from Rockwool RS800 or equal - refer to sec.8.2.8
- For metal pipe material: copper and others – refer to sec.8.2.9

Copper pipes (M) with continued insulation (D) – sustained (CS)				
seal thickness			t_{A1} ≥150 mm	t_{A1} ≥200 mm
Pipe diameter (d_M) [mm]	Pipe wall thickness (t_C) [mm]	Insulation thickness (t_D) [mm]	Classification (multiple)	(mixed)
28 – 88,9	1,0/2,0 – 14,2 [12]	20	EI 120 C/U	-
12 – 48	1,0/1,5 – 14,2 [13]	20	-	EI 90-C/U
48 – 88,9	1,5/2,0 – 14,2 [14]	40	-	EI 120-C/U

Copper pipes (C) with local insulation (D) – sustained (LS)					
seal thickness				t_{A1} ≥150 mm	t_{A1} ≥200 mm
Pipe		Insulation		Classification	
diameter (d_M) [mm]	wall thickness (t_C) [mm]	thickness (t_D) [mm]	length (L_D) [mm]	(multiple)	(mixed)
28 – 88,9	1,0/2,0 – 14,2 [12]	20	≥ 500	EI 120 C/U	-
12 – 48	1,0/1,5 – 14,2 [13]	20	≥ 500	-	EI 90-C/U
48 – 88,9	1,5/2,0 – 14,2 [14]	40	≥ 500	-	EI 120-C/U

[12]Interpolation of minimum wall thickness between 1,0 for diameter 28 and 2,0 for diameter 88,9 for pipe diameters in between

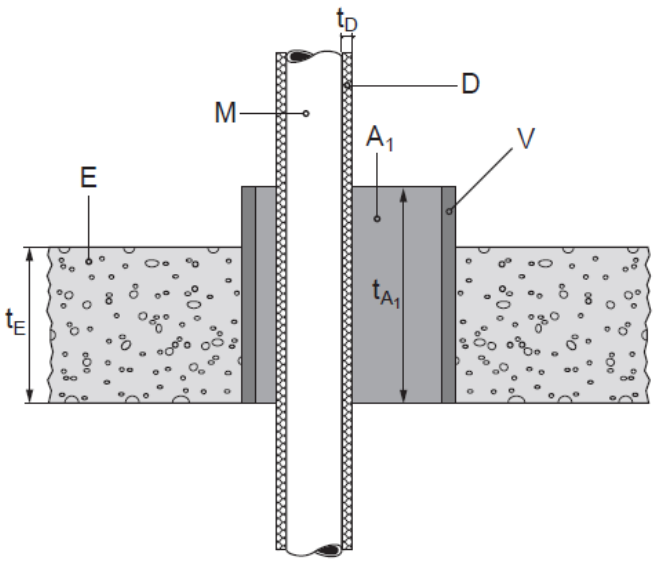
[13] Interpolation of minimum wall thickness between 1,0 for diameter 12 and 1,5 for diameter 48 for pipe diameters in between.

[14]Interpolation of minimum wall thickness between 1.5 for diameter 48 and 2.0 for diameter 88.9 for pipe diameters in between

8.5.7.3 Copper/steel pipes with insulation in sleeves in rigid floor constructions

Construction details:

- Hilti Firestop Foam CFS-F FX (A) in PVC sleeves,
- Sleeve diameter 75 mm – 110 mm, sleeve length of sleeve 200 mm,
- build in flush to bottom side of the building element (E). Refer to sec.8.2.3.

	8.5.7.3 Isolated Metal Pipe M penetrating a rigid floor through a plastic sleeve V, sealed with CFS-F FX (A_1)

Metal pipes (M) with local mineral wool insulation (D) – local sustained (LS) + continuous sustained (CS)				
seal thickness				t_{A1} ≥200 mm
Pipe		Insulation		Classification
diameter (d_C) [mm]	wall thickness (t_C) [mm]	thickness (t_D) [mm]	length (L_D) [mm]	(multiple)
28	1,0 – 14,2	20	≥ 500	EI 120-C/U

For field of application: copper and other metal, refer to 8.2.9

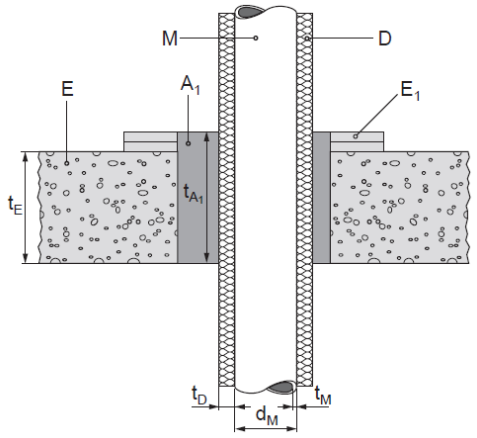
Metal pipes (M) with local mineral wool insulation (D) – local sustained (LS) + continuous sustained (CS)				
seal thickness:				t_{A1} ≥200 mm
Pipe		Insulation		Classification
diameter (d_C) [mm]	wall thickness (t_C) [mm]	thickness (t_D) [mm]	length (L_D) [mm]	(multiple)
33,7	2,6 – 14,2	10	≥ 500	EI 120-C/U

For field of application: steel and other metal, copper excluded, refer to 8.2.9

8.5.7.4 Copper pipes with foamed elastomeric insulation in rigid floor construction

Construction details:

- Pipes arranged as single pipe or in linear or in a cluster arrangement
- with insulation (D) made from foamed elastomeric insulation according to sec.8.2.6.

	8.5.7.4 Isolated metal pipe (M) penetrating a foam seal made of CFS-F FX (A1) in a rigid floor construction

Copper pipes (C) with continued foamed elastomeric insulation (D) – sustained (CS) – in C/U pipe end configuration			
seal thickness: t_{A1} ≥200 mm			
Pipe diameter (d_M) [mm]	Pipe wall thickness (t_M) [mm]	Insulation thickness (t_D) [mm]	Classification (mixed)
6 – 42	1,0/1,2 – 14,2	7,0/9,0	EI 120-C/U

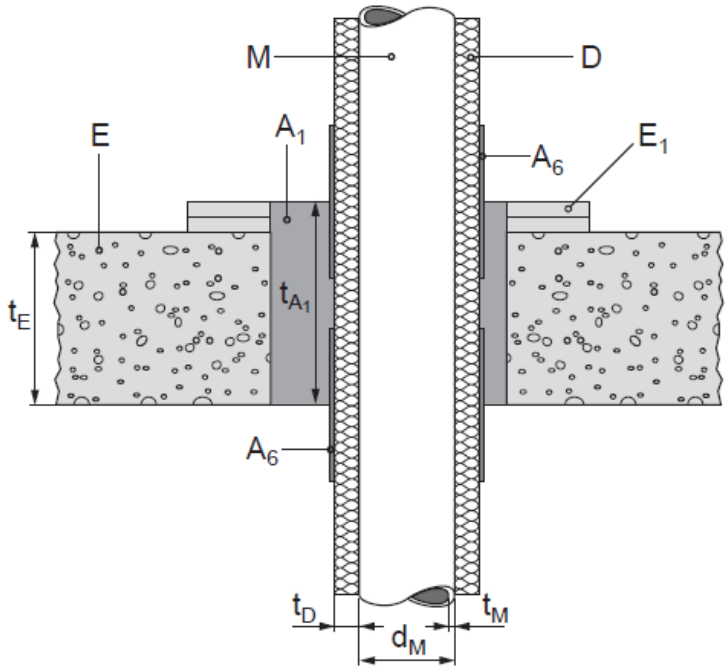
For metal pipe material: copper and others – refer to sec.8.2.9.

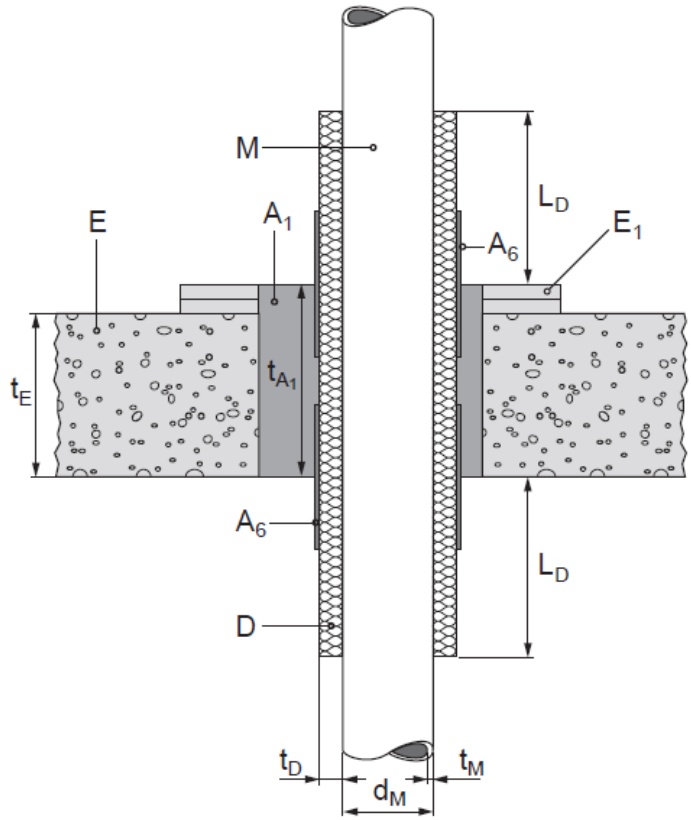
8.5.8 Metal pipes with foamed elastomeric insulation and Firestop Bandage CFS-B in rigid floor construction

Construction details:

- Services covered by two layers of Hilti Firestop Bandage CFS-B identical on both sides of the floor
- bandage CFS-B is positioned with its centre- line flush to the seal surface
- bandage CFS-B to be secured twice by metallic wire.

For symbols and abbreviations see Annex 4 in sec.10.

	8.5.8 A: Metal pipe (M) with insulation (D) in CS-situation, penetrating a flexible/rigid wall, sealed by means of CFS-B (A_6) and CFS-F FX (A_1).



8.5.8 B:

Metal pipe (M) with insulation (D) in LS-situation for insulation length L_D, penetrating a flexible/rigid wall, sealed by means of CFS-B (A_6) and CFS-F FX (A_1).

8.5.8.1 Steel pipes with foamed elastomeric insulation and CFS-B in rigid floor

- Arranged linear or in a cluster
- with elastomeric insulation (D) – for material refer to sec.8.2.6.
- Insulation in LS and CS case
- For metal pipe material: steel and others – refer to sec.8.2.9, copper excluded.

Steel pipes (C) with continued sustained (CS) foamed elastomeric insulation (D)				
seal thickness: t_{A1} ≥150 mm				
Pipe diameter (d_M) [mm]	Pipe wall thickness ™ [mm]	Insulation thickness (t_D) [mm]	Classification (multiple)	Classification (mixed)
33.7 – 114.3	2.6/3.6 – 14.2 [15]	19	EI 90-C/U	EI 60-C/U
33.7 – 114.3	2.6/3.6 – 12.5 [16]	19	EI 120-C/U	n.a.

Steel pipes (C) with local sustained (LS) foamed elastomeric insulation (D)					
seal thickness: t_{A1} ≥150 mm				t_{A1} ≥150 mm	
Pipe		Insulation		Classification	
diameter (d_C) [mm]	wall thickness (t_C) [mm]	thickness (t_D) [mm]	length (L_D) [mm]	(multiple)	(mixed)
33.7 – 114.3	2.6/3.6 – 14.2 [15]	19	≥ 500	EI 90-C/U	EI 60-C/U
33.7 – 114.3	2.6/3.6 – 12.5 [16]	19	≥ 500	EI 120-C/U	n.a.

[15] Interpolation of minimum wall thickness between 2,6mm for diameter 33,7mm and 3,6 mm for diameter 114,3mm for pipe diameters in between

[16]Interpolation of minimum wall thickness between 1,0 for diameter 12 and 1,5 for diameter 48 for pipe diameters in between.

8.5.8.2 Copper pipes with foamed elastomeric insulation and CFS-B in rigid floor

- Arranged linear or in a cluster
- With foamed elastomeric insulation – for material refer to sec.8.2.6.
- Insulation in LS (Length $L_D \geqq 500$mm), and CS case
- For metal pipe material: copper and others – refer to sec.8.2.9

Copper pipes (C) with continued sustained (CS) foamed elastomeric insulation (D					
			seal thickness		
			t_{A1} ≥150 mm		t_{A1} ≥200 mm
Pipe diameter (d_M) [mm]	Pipe wall thickness (t_M) [mm]	Insulation thickness (t_D) [mm]	Classification seal		
			multiple	mixed	
28 – 88,9	1,0/2,0 – 14,2 [17]	19	EI 90- C/U	EI 60- C/U	n.a.
28	1,0 – 14.2	19	EI 120- C/U	n.a.	n.a.
28 – 54	1,0/1,5 – 14,2[18]	8,5/9,0- 35,0/38,0[19]	n.a.	n.a.	EI 90- C/U
28 – 54	1,0/1,5 – 14,2[18]	8,5 - 35,0/38,0[19]	n.a.	n.a.	EI 120- C/U
Copper pipes (C) with local sustained (LS) foamed elastomeric insulation (D)					
			seal thickness		
			t_{A1} ≥150 mm		t_{A1} ≥200 mm
Pipe diameter (d_M) [mm]	Pipe wall thickness (t_M) [mm]	Insulation thickness (t_D) [mm]	Classification seal		
			multiple	mixed	
28 – 88,9	1,0/2,0 – 14,2 [17]	19	EI 90- C/U	EI 60- C/U	n.a.
28	1,0 – 14.2	19	EI 120- C/U	n.a.	n.a.
28 – 54	1,0/1,5 – 14,2[18]	8,5/9,0- 35,0/38,0[19]	n.a.	n.a.	EI 90- C/U
28 – 54	1,0/1,5 – 14,2[18]	8,5 - 35,0/38,0[19]	n.a.	n.a.	EI 120- C/U

[17] Interpolation of minimum wall thickness between 1,0 mm for diameter 28 mm and 2,0 mm for diameter 89 mm for pipe diameters in between

[18] Interpolation of minimum wall thickness between 1,0 for diameter 28mm and 1,5 for diameter 54mm for pipe diameters in between.

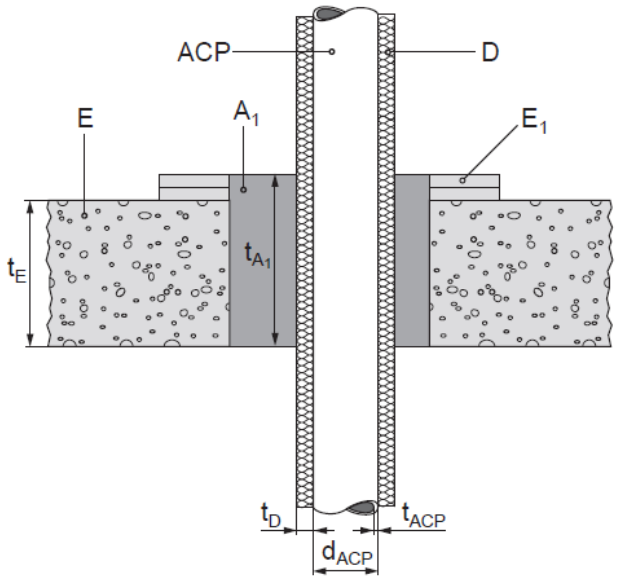
[19] The slash indicates minimum insulation thickness for 28 mm pipe and 54 mm pipe, followed by maximum insulation thickness for 28 mm pipe and 54 mm pipe.

8.5.9 Aluminium-composite pipes with foamed elastomeric insulation in rigid floor construction

Construction details:

- Hilti Firestop Foam CFS-F FX (A_1) of thickness t_{A1} flush with the soffit of the building element (E).
- In case of seal thickness t_{A1} > building element thickness t_E, see sec.8.2.3.
- For distances refer to sec.8.5.3.
- Foamed elastomeric insulation – for material refer to sec.8.2.6
- Insulation case: CS

For symbols and abbreviations see Annex E in sec.10.

	8.5.9.: Aluminium-composite pipe (ACP) with insulation (D) in CS-situation, penetrating a rigid floor, sealed by means of CFS-F FX (A_1).

8.5.9.1 Aluminium-composite pipes «*Mepla*» with continued foamed elastomeric insulation

Al composite pipes *Geberit Mepla* (ACP) with foamed elastomeric insulation			
seal thickness: t_{A1} ≥ 200 mm			
Pipe diameter (d_{ACP}) [mm]	Pipe wall thickness (t_{ACP}) [mm]	Insulation thickness (t_D) [mm]	Classification (mixed)
16 – 32	2.0 – 3.0	8.0 – 9.0	EI 120-U/C

8.5.9.2 Aluminium-composite pipes «Alpex duo» with continued foamed elastomeric insulation

Al composite pipes «*Alpex duo*» from *Fränkische Röhrenwerke* (ACP) with foamed elastomeric insulation			
seal thickness: t_{A1} ≥ 200 mm			
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Insulation thickness (t_D) [mm]	Classification (mixed)
16 – 32	2.0 – 3.0	8.0 – 9.0	EI 120-U/C

8.5.9.3 Aluminium-composite pipes «*Sanfix Fosta and Viega Raxofix*» with and without continued foamed elastomeric insulation

Al composite pipes *Viega Sanfix Fosta* from *Viega* (ACP) with foamed elastomeric insulation			
seal thickness: t_{A1} ≥ 200 mm			
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Insulation thickness (t_D) [mm]	Classification
16	2,2	8,0 – 17,5	EI 120-U/C
20	2,8	8,5 – 18,0	EI 120-U/C
25	2,7	8,5 – 18,5	EI 120-U/C
32	3,2	9,0 – 19,5	EI 120-U/C
16	2,2	No insulation (naked pipe)	EI 120-U/C
20	2,8	No insulation (naked pipe)	EI 120-U/C
25	2,7	No insulation (naked pipe)	EI 120-U/C
32	3,2	No insulation (naked pipe)	EI 120-U/C

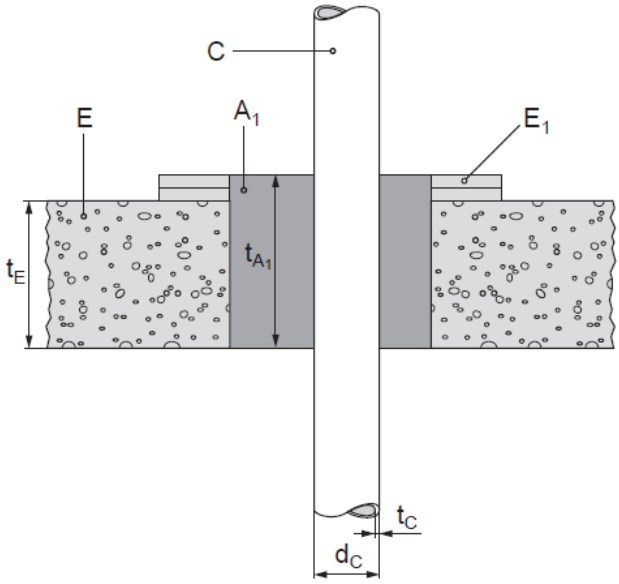
Al composite pipes *Viega Raxofix* from *Viega* (ACP) with foamed elastomeric insulation			
seal thickness: t_{A1} ≥ 200 mm			
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Insulation thickness (t_D) [mm]	Classification
16	2,2	8,0 – 17,5	EI 120-U/C
20	2,8	8,5 – 18,0	EI 120-U/C
25	2,7	8,5 – 18,5	EI 120-U/C
32	3,2	9,0 – 19,5	EI 120-U/C
16	2,2	No insulation (naked pipe)	EI 120-U/C
20	2,8	No insulation (naked pipe)	EI 120-U/C
25	2,7	No insulation (naked pipe)	EI 120-U/C
32	3,2	No insulation (naked pipe)	EI 120-U/C

8.5.10 Plastic pipes penetrating a rigid floor, sealed with CFS-F FX

Construction details

- Hilti Firestop Foam CFS-F FX of thickness t_A flush with the soffit of the building element
- If seal thickness t_A > building element thickness t_E, refer to sec.8.2.3.

For symbols and abbreviations see Annex E in sec.10.

	8.5.10 Plastic pipe (C), penetrating a rigid floor, sealed by means of CFS-F FX (A_1).

8.5.10.1 PE pipes in rigid floor constructions

PE pipes (C) according to EN ISO 15494 and DIN 8074/8075		
seal thickness: t_{A1} ≥200 mm		
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification (mixed)
≤ 40	2.3 – 3.7	EI 120-U/U

PE pipes (C) according to EN 1519-1 and DIN 8074/8075 – arranged linear			
seal thickness: t_A ≥150 mm			
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification	
		(multiple)	(mixed)
≤ 50	2.9 – 4.6	EI 120-U/C	EI 60-U/C

8.5.10.2 PVC-U pipes in rigid floor constructions

PVC-U pipes (C) according to EN ISO 1452-2, EN ISO 15493 and DIN 8061/8062		
seal thickness: t_{A1} ≥200 mm		
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification (mixed)
≤ 40	1.9 – 3.0	EI 120-U/U

PVC-U pipes (C) according to EN 1452-2 and DIN 8061/8062 - arranged linear			
seal thickness: t_{A1} ≥150 mm			
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification	
		(multiple)	(mixed)
≤ 50	3.7	EI 120-U/U	n.a.

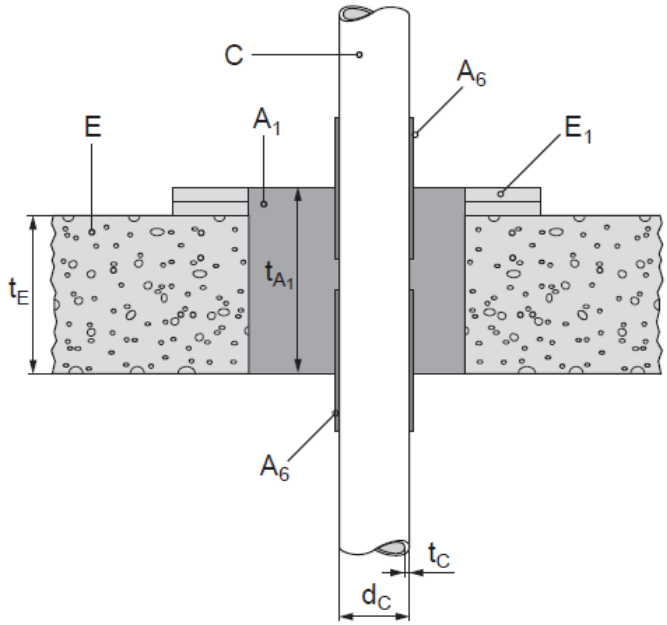
PVC-U pipes (C) according to EN 1452-2 and DIN 8061/8062 – arranged linear			
seal thickness: t_{A1} ≥150 mm			
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification	
		(multiple)	(mixed)
≤ 50	3.7 – 5.6	EI 120-U/C	EI 60-U/C

8.5.11 Plastic pipes penetrating a rigid floor, sealed with CFS-F FX and CFS-B

Construction details:

- Hilti Firestop Foam CFS-F FX of thickness t_{A1} flush with the soffit of the building element
- In case of seal thickness t_A > building element thickness t_E, refer to sec.8.2.3.

For symbols and abbreviations see Annex E in sec.10.

	8.5.11 Plastic pipe (C), penetrating a rigid floor, sealed by means of CFS-F FX (A_1), sealed additionally with CFS-B (A_6).

Further details to be considered:

- Framing (beading) on topside of floor to be finished before installing the firestop
- CFS-B Firestop bandage has to be wrapped around the pipe two times (two layers), secured by means of adhesive tape and fixed (two times) by using metal wire
- CFS-B to be installed half of its length into the seal, half of seal stays outside above and below the seal
- Formwork/sheeting to be installed below the floor-seal
- Fill opening around the bandage/around pipe with foam A_1

8.5.11.1 PE pipes in rigid floor, sealed with CFS-F FX and Bandage CFS-B

PE pipes (C) according to EN ISO 15494 and DIN 8074/8075		
seal thickness: t_{A1} ≥200 mm		
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification (mixed)
50 - 110	2.9/2.7 – 10.0	EI 120-U/U

8.5.11.2 PVC-U pipes in rigid floor, sealed with CFS-F FX and Bandage CFS-B

PVC-U pipes (C) according to EN 14493 and DIN 8061/8062 – U/U		
seal thickness: t_A ≥200 mm		
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification (mixed)
50 - 110	1.8 – 12.3	EI 120-U/U

PVC-U pipes (C) according to EN 1452-2, EN ISO 15493 and DIN 8061/8062		
seal thickness: t_A ≥200 mm		
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification (mixed)
≤ 40	1.9 – 3,0	EI 120-U/U

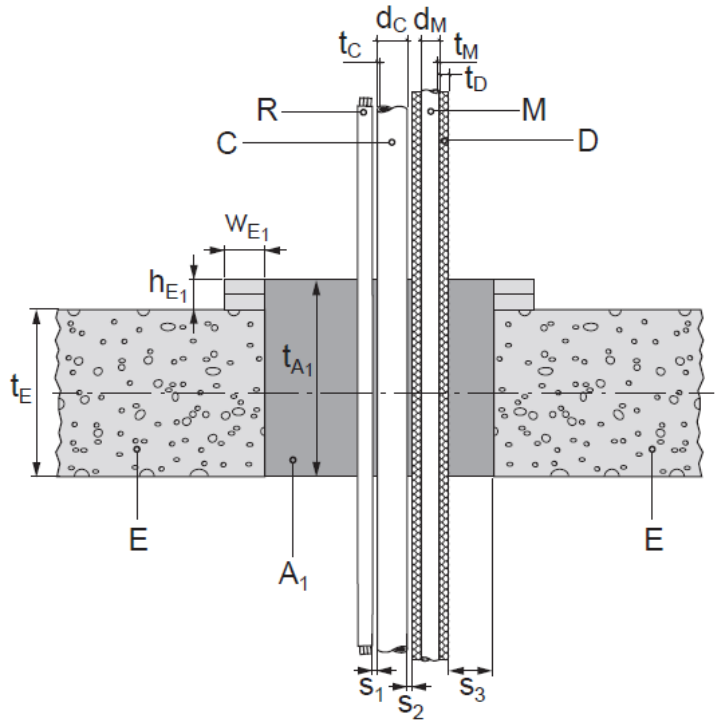
PVC-U pipes (C) according to EN 1452-2, EN ISO 15493 and DIN 8061/8062		
seal thickness: t_A ≥150 mm		
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification (multiple)
≤ 50	3,7	EI 120-U/U

PVC-U pipes (C) according to EN 1452-2, EN ISO 15493 and DIN 8061/8062			
seal thickness: t_A ≥150 mm			
Pipe diameter (d_C) [mm]	Pipe wall thickness (t_C) [mm]	Classification (multiple)	 (mixed)
≤ 50	3,7 – 5,6	EI 120-U/C	EI 60-U/C

8.5.12 Mixed pipe and cable penetration in rigid floors, sealed with CFS-F FX

Construction details:

- Penetrating service is a tight bundle of insulated metal pipes, plastic pipe and cables
- Distances : see below
- Metal pipes: max. 2 parallel copper pipes, insulated
- Type of metal: copper and others (refer to 8.2.9)
- Type of insulation foamed elastomeric – for material refer to 8.2.6
- Insulation thickness: 9mm, type: CS-situation
- One penetrating non-insulated plastic pipe
- Max. two parallel cables
- Seal thickness with CFS-F FX: over entire thickness t_{A1}
- In case of seal thickness t_A > building element thickness t_E, refer to sec.8.2.3



8.5.12:

Clima split – Application with foamed elastomeric thermal insulation on metal pipes penetrating a flexible/rigid floor.

For symbols and abbreviations see Annex E in Sec.10.

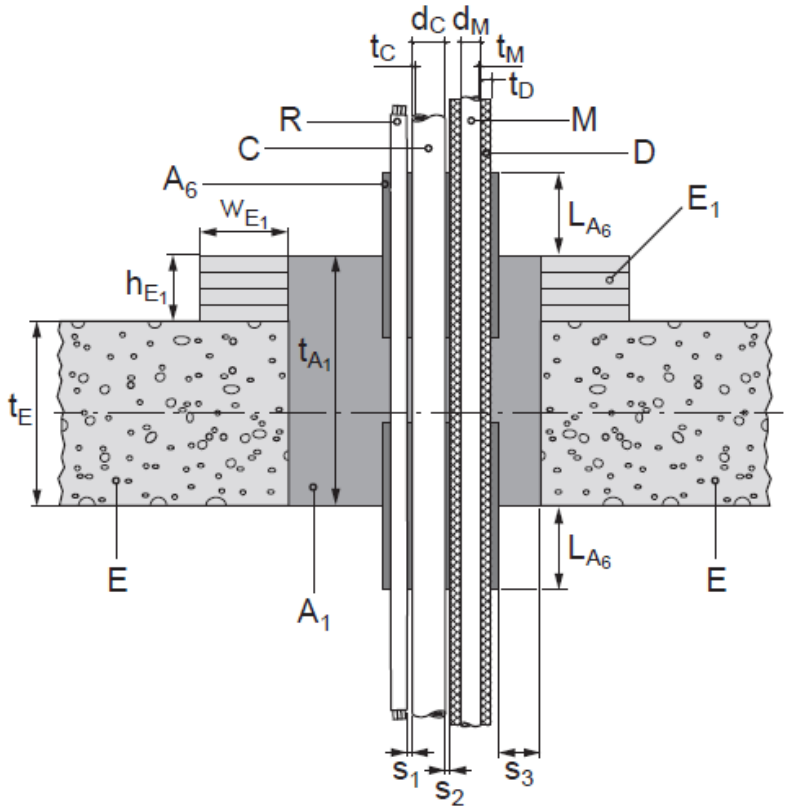
Distance position	Minimum distances (mm):
between services and seal edge (s_3):	20
between all services inside Clima split bundle (s_1, s_2):	0
between services and upper seal edge	n.r.

seal thickness: t_{A1} ≥200 mm				
Pentrant	**Type / diameter** (d) [mm]	**floor thickness** (t) [mm]	**pipe end**	**Classification (mixed)**
copper pipes (M), insulated	6 - 42	1.0	C/U	EI 90
cables (R)	5 x 1.5mm² 5 x 6mm²		n.a.	
PVC pipes (C)	16	3.7	U/U	
	25	4.3		
	40	2.4		

8.5.13 Mixed pipe and cable penetration in rigid floors with PE-insulation and CFS-B Firestop Bandage

Construction details:

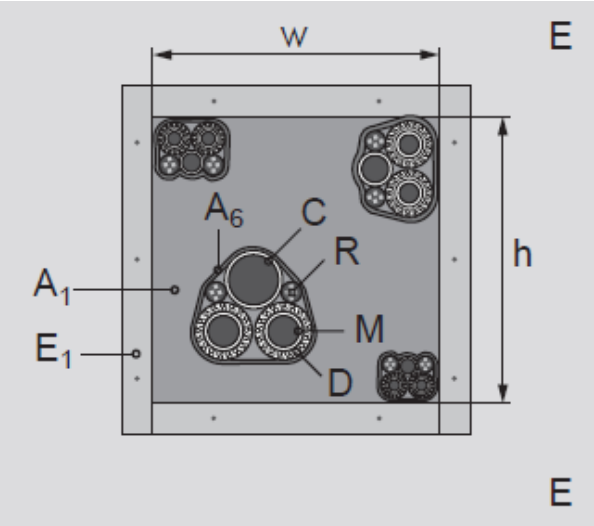
- Penetrating service is a tight bundle of insulated metal pipes, plastic pipe and cables
- Distances: see below
- Metal pipes: max. 2 parallel copper pipes, insulated
- Type of metal: copper and others - refer to 8.2.9
- Type of insulation foamed PE – for material refer to 8.2.10, Type: CS-situation
- One penetrating non-insulated plastic pipe
- Max. two parallel cables
- Seal thickness with CFS-F FX: over entire thickness tA1, see fig.8.5.13A
- In case of seal thickness tA > building element thickness tE, refer to sec.8.2.3
- CFS-B to be installed on both sides of the seal, half inside the seal, see fig.8.5.13A
- Number of windings of CFS-B Firestop Bandage (A6): one



8.5.13 A

Clima split – Application with foamed thermal insulation made of PE on metal pipes penetrating a rigid floor.

For symbols and abbreviations see Annex 5.

	8.5.13. B: Clima split – Application with foamed thermal insulation on metal pipes penetrating a rigid floor, sealed with CFS-F FX (A_1) and CFS-B (A_6). Mixed penetration may be positioned directly into the corner.

Distance position	Minimum distances (mm):
between services and seal edge (s_3):	0
between all services inside clima split bundle (s_2):	0
between services and upper seal edge	n.a.

Seal thickness t_{A1} ≥150 mm				
Pentrant	**Type / diameter** (d_M) [mm]	**wall thickness (minimum)** (t_M) [mm]	**pipe end**	**Classification (mixed)**
copper pipes (M) [13]	6,4 – 15,9	0,8	C/U	EI 120
cables (R)	5 x 1.5mm²		n.a.	
PVC pipes (C), flexible	13 - 24	1,5 – 2,0	U/U	

8.6 Cross-laminated timber floors – System Binderholz - Construction details

Characterization for the cross-laminated timber floors:

- Binderholz BBS XL (CLT)
- Number of cross-laminated timber layers: ≧ 3 (for floor thickness t_E ≧ 80mm)
- Number of cross-laminated timber layers: ≧ 5 (for floor thickness t_E ≧ 100mm)
- PU / MUF adhesives permitted
- Edge glue not required
- Minimum thickness of outer cross-laminated timber layers t_l ≧ 20mm,

8.6.1 Additional Framing in cross-laminated timber floors

If required seal thickness t_{A1} is bigger than available floor thickness t_E an additional framing E_1 is required. For details refer to sec.8.2.3.

8.6.2 Blank seals of CFS-F FX in cross-laminated timber floors

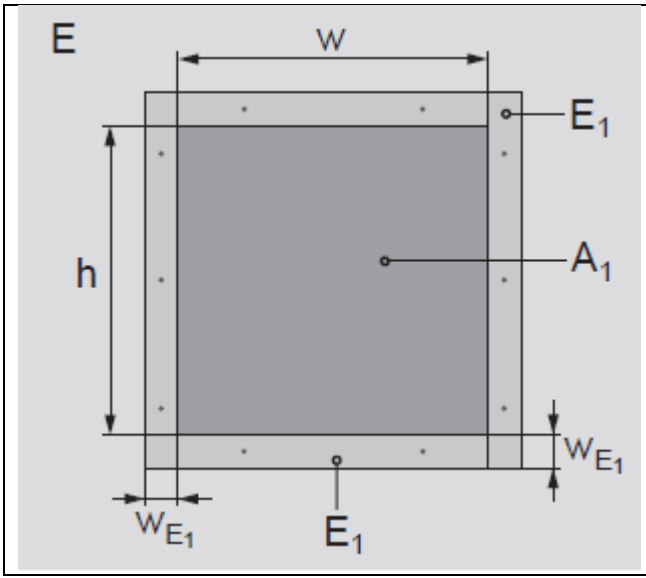


Fig. 8.6.2:

Blank seal of CFS-F FX (A_1) in a cross-laminated timber wall made of CLT. Cross-laminated timber framing E_1 installed around the opening.

View from topside.

Max. height h (mm)	Max. width w (mm)	Min. Floor thickness t_E (mm)	Min. seal depth t_{A1} (mm)	Classification
400	400	80	80	EI 30
400	400	100	150	EI 90
400	400	140	200	EI 90

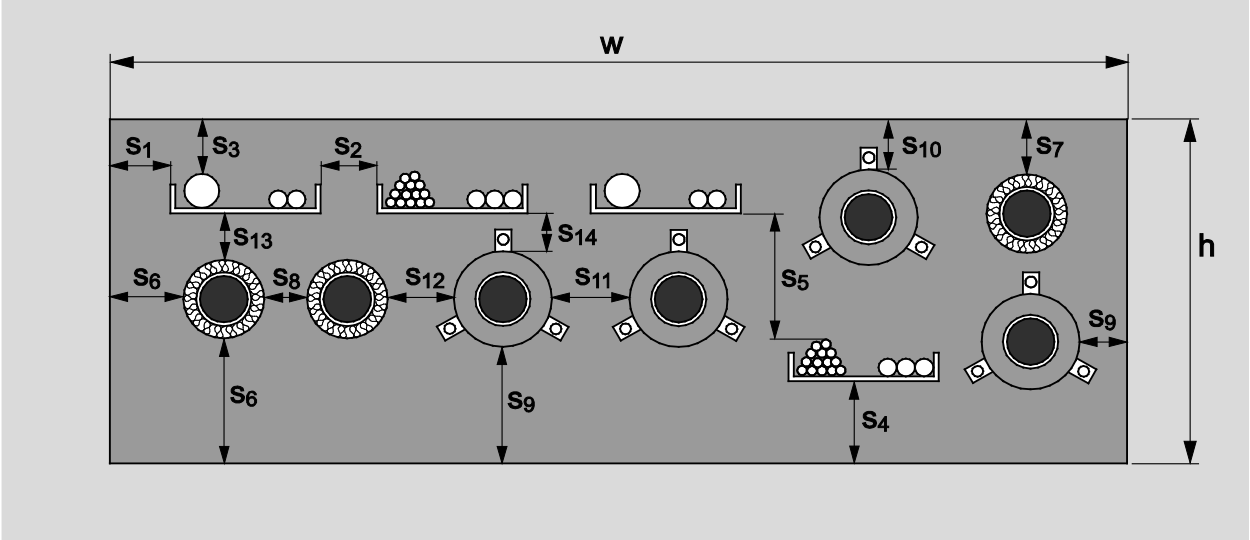
8.6.3 First support in cross-laminated timber floor

First support for any kind of penetrants in cross-laminated timber floor should be ≦ 350mm, independent from cross-laminated timber floor thickness.

8.6.4 Minimum distances for penetrations in cross-laminated timber floor construction– System Binderholz

The distances are valid for single, multiple and mixed penetrations in cross-laminated timber floor construction.

Valid for cross-laminated timber floors only		**Minimum distance (mm)**
s_1, s_3, s_4	distance between cable supports and seal edge	20
	distance between cables or conduits to seal edge	20
	distance between Clima split or conduit bundle to seal edge	50
	distance between cable and conduit, and between conduit to conduit, between conduit and conduit bundle	50
	distance between cable to Clima split	100
	distance between conduit to Clima split	50
	distance between cables to cable (with or without cable support)	100
s_2, s_5	distance between cable supports or bunched cables and another cable support	100
s_6	distance between metal pipes and seal edge	100
s_7	distance between metal pipes and seal edge	100
s_8	distance between metal pipes linear arrangement	0
s_9, s_{10}	distance between plastic pipes/pipe closure devices and seal edge	100
s_{11}	distance between plastic pipes/pipe closure devices	100
s_{12}	distance between metal pipes and plastic pipes/pipe closure devices	100
s_{13}	distance between cables/cable supports and metal pipes	100
s_{14}	distance between cables/cable supports and plastic pipes/pipe closure devices	100



8.6.5 Cables in cross-laminated timber floor constructions– System Binderholz

For penetrating cables:

- Type of cable: All sheathed cable types currently and commonly used in building practice in Europe (e.g. power, control, signal, telecommunication, data, optical fibre cables
- Cable size: see table below
- First support: refer to 8.5.15

Size of cables Max. Cable Diameter	Cross-laminated timber floor thickness t_E	Requested Seal thickness t_{A1}	Cable Carrier system	Classification
≤ 21mm	≧ 80 mm	≧ 80 mm	With and without	EI 30
≤ 50 mm	≧ 80 mm	≧ 80 mm	With and without	EI 30
≤ 21mm	≧ 100 mm	≧ 150 mm	With and without	EI 60 and E90
≤ 50 mm	≧ 100 mm	≧ 150 mm	With and without	EI 45 and E90
≤ 21mm	≧ 140 mm	≧ 200 mm	With and without	EI 90
≤ 50 mm	≧ 140 mm	≧ 200 mm	With and without	EI 90

For cable carrier systems:

- Cable carrier penetrating the floor
- Only open cable carrier systems approved,
- For carrier material: non – perforated steel
- Max. carrier width: 200mm
- Max. carrier high: 60mm
- For distances refer to 8.6.4
- Carrier material thickness: ≥ 1,5mm

8.6.6 Conduits and tubes in cross-laminated timber floor construction– System Binderholz

General conditions:

- First support: refer to 8.6.3
- Conduit end configuration: U/C,
- Conduit end seal: sealed with CFS-S ACR, sealing depth: ≥ 15mm
- Projecting length (identical on both sides of the wall): ≧ 500mm
- Single conduits and bunched conduits
- With or without cables in
- All plastic material for flexible and rigid conduits approved

Size and type of conduits	Cross-laminated timber wall thickness t_E	Requested Seal thickness t_{A1}	Classification
Single conduits, rigid plastic conduits Ø ≤ 32 mm	≧ 80 mm	≧ 80 mm	EI 30-U/C
	≧ 100 mm	≧ 150 mm	EI 90-U/C
Single conduits, flexible, pliable and plastic conduits Ø ≤ 32 mm	≧ 80 mm	≧ 80 mm	EI 30-U/C
	≧ 100 mm	≧ 150 mm	EI 90-U/C
Bundle of rigid plastic conduits, bundle diameter Ø ≤ 100mm, max. single conduit within this bundle is Ø ≤ 32 mm	≧ 80 mm	≧ 80 mm	EI 30-U/C
	≧ 100 mm	≧ 150 mm	EI 90-U/C
Bundle of flexible/pliable plastic conduits, bundle diameter Ø ≤ 100mm, max. single conduit within this bundle is Ø ≤ 32 mm	≧ 80 mm	≧ 80 mm	EI 30-U/C
	≧ 100 mm	≧ 150 mm	EI 90-U/C
Bundle of mixed plastic conduits, (flexible/pliable/rigid), bundle diameter Ø ≤ 100mm, max. single conduit within this bundle is Ø ≤ 32 mm	≧ 80 mm	≧ 80 mm	EI 30-U/C
	≧ 100 mm	≧ 150 mm	EI 90-U/C

8.6.7 Metal pipes in cross-laminated timber floor– System Binderholz

Construction details:

- One or two isolated metal pipes
- Insulation in CS position
- Distance in between both isolated pipes s ≧ 0 mm
- Pipe material: copper and others, refer to sec.8.2.9
- Metal pipes diameter: d ≧ 18mm
- Metal pipe wall thickness = (1,0-14,2) mm
- Pipe insulation, for material refer to 8.2.10
- Pipe insulation thickness: 9mm

	seal thickness t_{A1}	Classification
In floor thickness t_E ≥ 80 mm	≥80 mm	EI 30-C/U
In floor thickness t_E ≥ 100 mm	≥150 mm	EI 90-C/U
In floor thickness t_E ≥ 140 mm	≥200 mm	EI 90-C/U

8.6.8 Plastic pipes in cross-laminated timber floor– System Binderholz

Construction details:

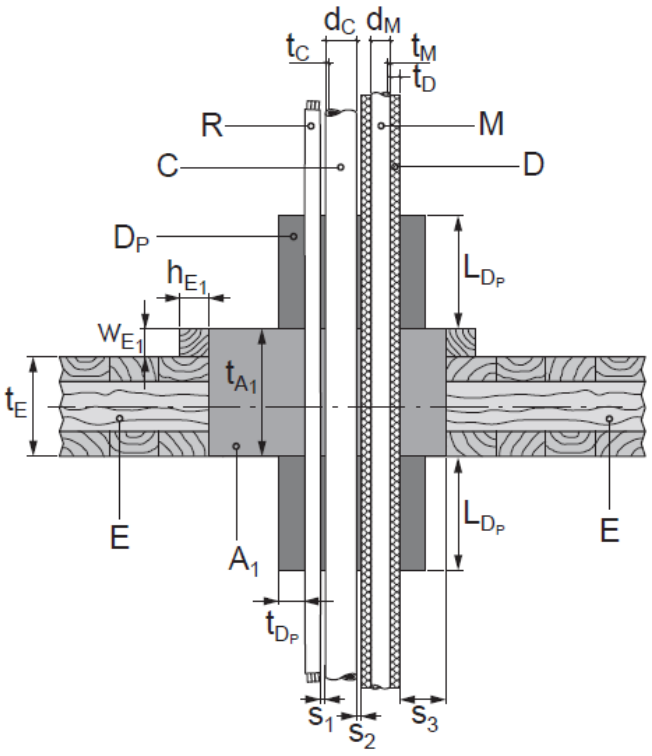
- One non isolated plastic pipe
- Pipe in U/U pipe-end configuration
- Pipe made of PVC
- For flexible, pliable and rigid pipes
- Plastic pipe diameter: max.25mm
- Plastic pipe wall thickness: max. 4,3mm

Clima split bundles acc. Fig.8.5.7.1.A	seal thickness t_{A1}	Classification
In floor thickness t_E ≥80 mm	≥80 mm	EI 30-U/U
In floor thickness t_E ≥100 mm	≥150 mm	EI 90-U/U
In floor thickness t_E ≥140 mm	≥200 mm	EI 90-U/U

8.6.9 Mixed pipe and cable penetration in cross-laminated timber floors with PE-insulation and CFS-B Firestop Bandage– System Binderholz

Clima split - construction details:

- Penetrating service is a tight bundle of insulated metal pipes, plastic pipes and cable
- Distances: see below Fig.8.5.16:
- Metal pipes: max. 2 parallel copper pipes, insulated,
- Type of metal: copper and others - refer to 8.2.9
- Type of insulation (CS-situation): foamed PE (polyethylene), refer to 8.2.10
- One penetrating non-insulated plastic pipe
- Max. two cables max. diameter = 14mm
- Seal thickness with CFS-F FX: over entire thickness tA1, see Fig.8.6.9
- In case of seal thickness tA1 > building element thickness tE, refer to sec.8.2.3
- Above and below the floor there should be an LDP = min. 250mm long additional protect insulation DP made of foamed elastomer (refer to 8.2.6), thickness tDP = 9mm, in LI or CI situation



8.6.9

Clima split application (penetrant C, R, M) penetrating a cross-laminated timber wall, sealed with CFS-F FX (A_1) over seal thickness t_{A1}.

An addition framing made of wood (E_1) has been installed due to the fact, that wall thickness t_E was smaller than requested seal thickness t_{A1}.

For distances: ($s_1 = s_2 = s_3$) $\geq$ 0mm

Metal pipes:	• Metal pipes maximum diameter: 18mm • Wall thickness = (1,0-14,2) mm

	• PE-insulation thickness: 9 mm
Plastic pipe:	• PVC pipe, flexible, pliable or rigid • Plastic pipe diameter: max.25mm • Plastic pipe wall thickness: max. 4,3mm
Cables:	• Max. size: 5x1,5mm² • Cable diameter: maximum 14mm

	seal thickness t_{A1}	Classification:
In floor thickness t_E ≥80 mm	≥ 80 mm	EI 30
In floor thickness t_E ≥100 mm	≥ 150 mm	EI 90
In floor thickness t_E ≥140 mm	≥ 200 mm	EI 90

8.7 Cross-laminated timber floors – System Lignotrend - Construction details

Characterization for the cross-laminated timber rib element floors:

- LIGNO Rib Q2 Acoustic Z2 196 – EI90, floor thickness t_E = 196mm
- LIGNO Rib Q2 Acoustic Z2 169 – EI60, floor thickness t_E = 169mm

8.7.1 Additional Framing in cross-laminated timber floors – System Lignotrend

If required seal thickness t_{A1} is bigger than available floor thickness t_E an additional framing E_1 is required. For details refer to sec.8.2.3.

8.7.2 Blank seals of CFS-F FX in cross-laminated timber floors – System Lignotrend

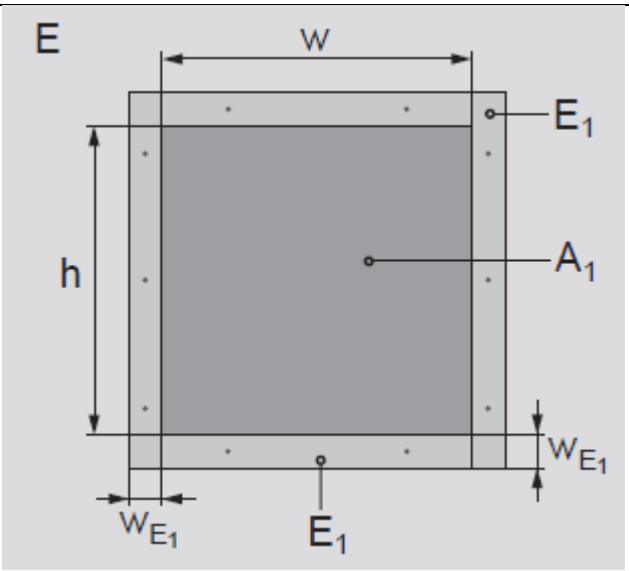


Fig. 8.6.2:

Blank seal of CFS-F FX (A_1) in a cross-laminated timber wall – System Lignotrend. Cross-laminated timber framing E_1 installed around the opening.

View from topside.

Max. height h (mm)	Max. width w (mm)	Min. Floor thickness t_E (mm)	Min. seal depth t_{A1} (mm)	Classification
400	400	169	150	EI 90
400	400	196	200	EI 90

8.7.3 Max.seal size of CFS-F FX in cross-laminated timber floors – System Lignotrend

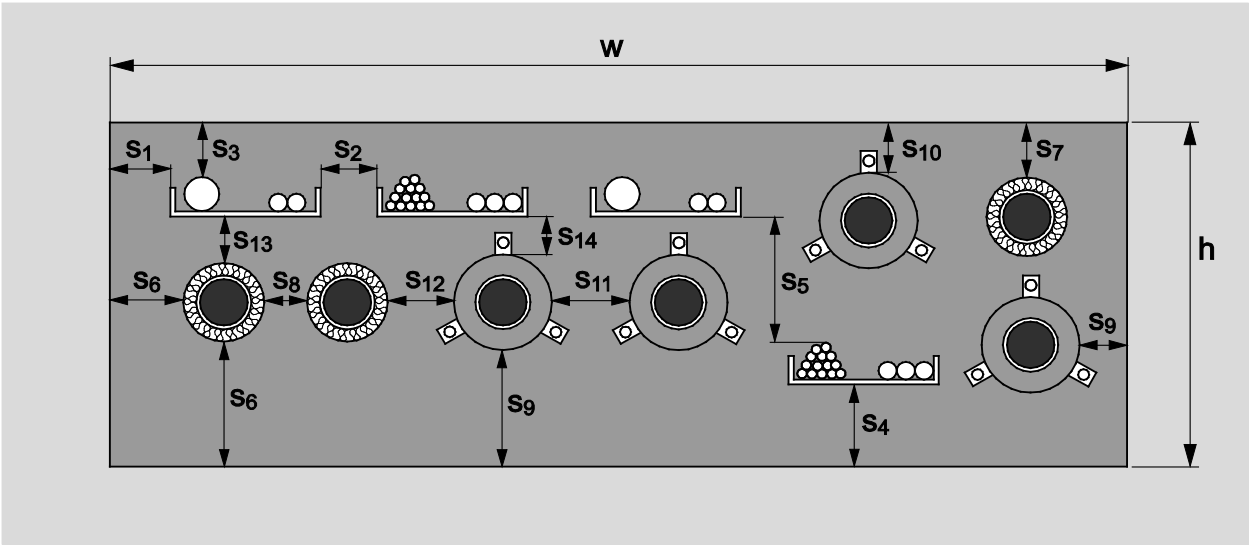
- Max.400mm by 400mm (or diameter 400mm)
- Min.seal depth t_{A1} = 169mm /196mm (over entire floor thickness t_E)

8.7.4 First support in cross-laminated timber floor – System Lignotrend

First support for any kind of penetrants in cross-laminated timber floor should be ≤ 350mm, independent from cross-laminated timber floor thickness.

8.7.5 Minimum distances for penetrations in cross-laminated timber floor construction – System Lignotrend

		Minimum distance (mm)
s_3	distance between cables to seal edge	20
	distance between cables, optical fibre cables, telecommunication cables without cable support structures	0
s_2, s_5	distance between cable, optical fibre cables, telecommunication cables to cable bundle	50
s_6, s_7	distance between metal pipes and seal edge	20
s_{13},s_{14}, s_5	distance between plastic pipe closure devices/metal pipes/cable bundles to cable	50
s_8	distance between metal pipes in linear arrangement	20
s_9, s_{10}	distance between plastic pipes/pipe closure devices and seal edge	20
s_{11}	distance between plastic pipes/pipe closure devices	50
s_{12}	distance between metal pipes and plastic pipes/pipe closure devices	50
s_{13}	distance between cables and metal pipes	50
s_{14}	distance between cables and plastic pipes/pipe closure devices	50



8.7.6 Cables in cross-laminated timber floor constructions – System Lignotrend

For penetrating cables:

- Type of cable: All sheathed cable types currently and commonly used in building practice in Europe (e.g. power, control, signal, telecommunication, data, optical fibre cables
- Cable size: see table below
- First support: refer to 8.6.3

Size of cables Max. Cable Diameter	Cross-laminated timber floor thickness t_E	Requested Seal thickness t_{A1}	Classification
≤ 21mm single cables	≧ 169 mm	≧ 169 mm	EI 60
bunched cables ≤ 21 mm, max. ∅ bundle = 100mm,	≧ 169 mm	≧ 169 mm	EI 60
≤ 21mm single cables	≧ 196 mm	≧ 196 mm	EI 90
bunched cables ≤ 21 mm, max. ∅ bundle = 100mm,	≧ 196 mm	≧ 196 mm	EI 90

For cable carrier systems:

- Not allowed

8.7.7 Metal pipes in cross-laminated timber floor – System Lignotrend

Construction details:

- One non-insulated metal pipe
- Pipe material: steel (galvanized) and others, refer to sec.8.2.9
- Metal pipes diameter: d ≦ 160mm
- Metal pipe wall thickness = (0,5-14,2) mm
- With product TS18 Wildeboer installed on underside of ceiling
- For first support: refer to 8.6.3

	seal thickness t_{A1}	Classification
In floor thickness t_E ≥ 169 mm	≥ 169 mm	EI 60-U/U
In floor thickness t_E ≥ 196 mm	≥ 196 mm	EI 90-U/U

8.7.8 Plastic pipes in cross-laminated timber floor – System Lignotrend

Construction details:

- Single insulated or non-insulated plastic pipe
- Pipe in U/C pipe-end configuration
- Pipe type Aquatherm PP-R pipes “Blue Pipe” and “Green Pipe”
- Plastic pipe diameter: 20 – 40mm
- Plastic pipe wall thickness: max. 2,8 – 3,7mm
- Insulation (if applicable): Armaflex AF3, CS (14mm / 16,5mm)
- For first support: refer to 8.6.3
- One layer Hilti Firestop Bandage CFS-B to be wrapped around the insulated pipe only, half inside the floor, below and above the ceiling

	seal thickness t_{A1}	Classification
In floor thickness t_E ≥ 169 mm	≥ 169 mm	EI 60-U/C
In floor thickness t_E ≥ 196 mm	≥ 196 mm	EI 90-U/C

9 ANNEX D – Installation of the Product (Instruction for use)

The application (appropriate installation) of Hilti Firestop Foam CFS-F FX is described and illustrated in chapter 8 – Annex C.

The folder *Instruction for use* is available at Hilti's website. (Link to website: see this ETA's front page).

For safe handling the provisions of the Material Safety Data Sheet for the product shall be followed.

10 ANNEX E - ABBREVIATIONS

Abbreviations used in drawings

Abbreviation	Description
A_1	Hilti Firestop Foam CFS-F FX
A_10	Hilti Firestop Collar Endless CFS-C EL with oddment
A_2	Annular gap seal with Hilti Firestop Acrylic Sealant CFS-S ACR
A_3	Annular gap seal with Hilti CFS-FIL
A_4	Annular gap seal with gypsum plaster
A_5	Annular gap seal with cementitious mortar acc. EN 998-2, group M10
A_6	Hilti Firestop Bandage CFS-B
ACP	Aluminium Composite Pipe
B	Backfilling material (mineral wool)
C	Plastic Pipe
C_1	Sound decoupling insulation
CLT	Cross Laminated Timber – specific cross-laminated timber floor and wall set-up
D	Pipe insulation
D_W	Pipe insulation, incombustible, based on mineral wool
D_E	Pipe insulation, combustible, based on elastomeric foamed material
D_P	Pipe insulation - Protect insulation
D_{PE}	Pipe insulation, combustible, based on polyethylene foam
d_A	Aperture diameter in supporting construction E
d_C	Pipe diameter (nominal outside diameter) for plastic pipes
d_M	Pipe diameter (nominal outside diameter) for metal pipes
d_{ACP}	Pipe diameter (nominal outside diameter) for Aluminum composite pipes
d_{RC}	Pipe diameter (nominal outside diameter) for Cable conduits
E	Building element (wall, floor)
E_1	Aperture framing / beading / additional framing
F	Hooks (long or short) for fixing of the collar
h	High
h_{E1}	High of aperture framing / beading / additional framing
L	Length
L_D	Length of Insulation
L_{A6}	Length of CFS-B Firestop bandage outside the seal = 125mm minus installation depth of A_6
L_{DP}	Length of Protect Insulation
L_{RC}	Projecting Length for electric conduits, filled or unfilled
n	amount, number of pieces
n.a.	Not applicable

n.r.	Not relevant
M, M1, M2, …	Metal pipe
PG	Pipe group
R	Electric Cables, optical cables
RC	Conduit for electric/optical cables
RB	Bundle of electric/optical cables
RS	Cable support system
s_1	Minimum distance between single penetration seals
s_2	Minimum distance between clustered pipes or other penetrants within one penetration
s_3	Minimum distance between penetrating pipe and building element
t_A	Total seal thickness
t_{A2}	Thickness of Hilti Firestop Acrylic Sealant CFS-S ACR
t_{A3}	Thickness of Hilti CFS-FIL
t_{ACP}	Aluminium composite pipe wall thickness
t_C	Plastic Pipe wall thickness
t_{C1}	Thickness of acoustic sound decoupling insulation
t_D	Insulation thickness
t_E	Thickness of the building element
t_l	Thickness of individual layer thickness within cross-laminated timber constructions
t_{DP}	Thickness of Additional Protect Insulation
t_M	Metal Pipe wall thickness
t_{RC}	Wall thickness / Wave high for electric conduits
V	Sleeve
w	Width
w_{E1}	Width of aperture framing / beading / additional framing
ρ_E	Density of the building element