

DE

# LEISTUNGSERKLÄRUNG

gemäss Anhang III der Richtlinie (EU) Nr. 305/2011 (Bauproduktenrichtlinie)

## Hilti Brandschutzbandage CFS-B

No. Hilti CFS "1121-CPD-J0010"

**1. Eindeutiger Kenncode des Produkttyps:**

Hilti Brandschutzbandage CFS-B

**2. Verwendungszweck:**

Abschottungen für feuerwiderstandsfähige Wände und Decken in Gebäuden, siehe ETA-10/0212 (06.05.2014)

Rohrdurchführungen	Metallrohre mit brennbarer Isolierung	<b>Das Anwendungsfeld muss mit dem Inhalt der entsprechenden ETA 10/0212 übereinstimmen.</b>
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**3. Hersteller:**

Hilti Aktiengesellschaft, Feldkircherstrasse 100, 9494 Schaan, Liechtenstein

**4. System oder Systeme zur Bewertung und Überprüfung der Leistungsbeständigkeit:**

System 1

**5. Europäisches Bewertungsdokument:**

ETAG Nr. 026-1 und ETAG 026-2

**Europäische Technische Bewertung:**

ETA-10/0212 (07.04.2014)

**Technische Bewertungsstelle:**

Warrington Certification Ltd

**Notifizierte Stelle:**

Warrington Certification Ltd, Nr. 1121

**6. Erklärte Leistung:**

Wesentliche Merkmale	Leistung/ Harmonisierte technische Spezifikation
Brandverhalten	Klasse E gemäss EN 13501-1
Feuerwiderstand	Feuerwiderstand und Anwendungsfeld in Übereinstimmung mit EN 13501-2. Siehe Anhang
Gefährliche Stoffe	Siehe Anhang
Dauerhaftigkeit und Gebrauchstauglichkeit	Z <sub>2</sub> , in Übereinstimmung mit EOTA Technischer Report - TR024.
Anderes	Nicht relevant / keine Leistung festgestellt

Die Leistung des vorstehenden Produkts entspricht der erklärten Leistung/den erklärten Leistungen. Für die Erstellung der Leistungserklärung im Einklang mit der Verordnung (EU) Nr. 305/2011 ist allein der obengenannte Hersteller verantwortlich.

Unterzeichnet für den Hersteller und im Namen des Herstellers von:

Jingyan Zhou  
Product Manager  
Business Unit Fire Protection  
Hilti Corporation

Martin Althof  
Head of Quality  
Business Unit Fire Protection  
Hilti Corporation

Schaan, 12 April 2018

### **3.5 Dangerous substances**

The applicant is required to submit a written declaration stating whether or not the fire stopping and fire sealing product contains dangerous substances according to European and national regulations, when and where relevant in the Member States of destination, and shall list these substances.

Hilti Corporation declare that product Hilti Firestop Bandage CFS-B is in compliance with Council Directive 76/769/EEC of 27th July 1976 on the approximation of the laws, regulations and administrative provisions of the Member States relating to restrictions on the marketing and use of certain dangerous substances and preparations (incl. all amendments and adaptations).

Confirmation has further been declared that all dangerous chemical substances  $\geq 1.0$  % w/w as well as all toxic, carcinogenic, toxic for reproduction and mutagenic chemical substances  $\geq 0.1$  % w/w (Status: 29. adaption – 2004/73/EG – of the EU directive 67/548/EEC - classification, packaging and labelling of dangerous substances) are stated in the Hilti Firestop Bandage CFS-B material safety data sheets (according to 91/155/EEC including amendments) and have been considered for the classification of the products according to the directive 1999/45/EG (classification of preparations, including amendments).

All dangerous chemical substances are below the classification limits of 67/548/EEC.

## ANNEX C

### RESISTANCE TO FIRE CLASSIFICATION OF PENETRATION SEALS MADE OF HILTI FIRESTOP BANDAGE CFS-B

**Intended use of pipes and reference to relevant section.**

Typical Application	Pipe Material	Flexible and rigid wall ≥ 100 mm	Rigid wall ≥ 200 mm	Floor ≥ 150mm
Heating	Copper	see 2.1.2	see 2.2.2	see 2.3.2
	Steel	see 2.1.3	see 2.2.3	see 2.3.3
	Alu Composite Pipes	see 2.1.4	see 2.2.4	see 2.3.4
	Plastic Pipes	see 2.1.5	-	see 2.3.5
Potable Water	Stainless Steel	see 2.1.3	see 2.2.3	see 2.3.3
	Alu Composite Pipes	see 2.1.4	see 2.2.4	see 2.3.4
	Plastic Pipes	see 2.1.5	-	see 2.3.5
Cooling	Copper	see 2.1.2	see 2.2.2	see 2.3.2
	Steel / Stainless Steel	see 2.1.3	see 2.2.3	see 2.3.3
	Alu Composite Pipes	see 2.1.4	see 2.2.4	see 2.3.4
	Plastic Pipes	see 2.1.5		see 2.3.5
Various	Copper	see 2.1.2	see 2.2.2	see 2.3.2
	Steel	see 2.1.3	see 2.2.3	see 2.3.3
	Alu Composite Pipes	see 2.1.4	see 2.2.4	see 2.3.4
	Plastic Pipes	see 2.1.5		see 2.3.5

# 1 General Information Hilti Firestop Bandage CFS-B

## 1.1 Penetration seal and bandage installation

Pipes insulated with elastomeric combustible insulation (see Annex D) fire-stopped by wrapping the Hilti Firestop Bandage CFS-B twice around the insulation material.

Steel wire is utilised to hold the Hilti Firestop Bandage CFS-B together, positioned approximately in the first quarter measured from the flank.

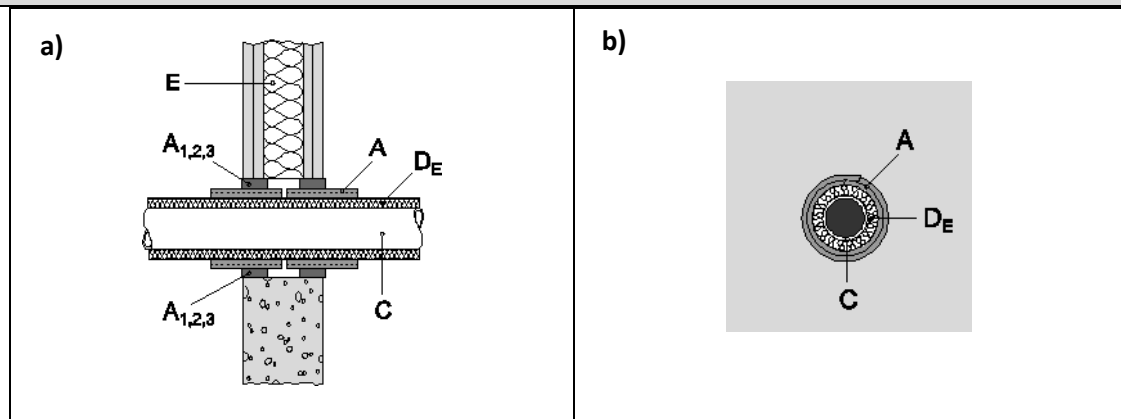
The Hilti Firestop Bandage CFS-B is mounted on both sides of the penetration.

The Hilti Firestop Bandage CFS-B is then pushed into the penetration in line with the designated marking shown on center of the Hilti Firestop Bandage CFS-B. In case of 100 mm thick walls the Hilti Firestop Bandage CFS-B was placed 50 mm inside and 75 mm outside the flexible wall.

### 1.1.1 Single penetration seal

Single insulated pipes running through the penetration are sealed utilising two layers of Hilti Firestop Bandage CFS-B.

**Installation scheme of bandage**  
a) side view      b) front view

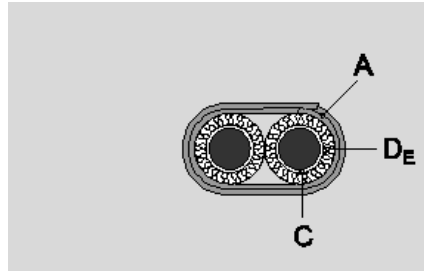


### 1.1.2 Bundled penetration

Small aluminium composite pipes ( $\leq \varnothing 16\text{mm}$ ) can be wrapped together in a double penetration with the Hilti Firestop Bandage CFS-B.

Hilti Firestop Bandage CFS-B is wrapped over both insulated pipes. Fixing and positioning of the bandage is as described above.

**Installation scheme of bandage**  
**Front view of two pipes wrapped together with bandage**



**1.2 Pipe insulation with combustible and mineral wool insulation**

Specific insulation thickness with corresponding classification class is shown at each section below.

**1.2.1 Elastomeric combustible insulation**

Pipes insulated with elastomeric butyl rubber based insulation material are varying in thickness from 7,7 mm up to 45 mm in configuration (CS) Continued Sustained. See also table of butyl rubber based insulation at appendix D ( p. 50).

Thicknesses display generally measured values and correspond to nominal values with tolerances.

Results were displayed considering E.2.7.5.2 and E.2.7.8.2 allowing interpolation of wall thickness and diameter between tested specimens and insulation thickness, respectively.

Metallic pipes from diameter 323.9mm on were insulated by a fixed thickness of 25mm elastomeric butyl rubber based insulation.

Metallic pipes were tested in C/U configuration, plastic and aluminum composite pipes in U/C configuration.

**1.2.2 Glass-fiber mineral wool insulation**

Instead of elastomeric butyl rubber based insulation glass-fiber mineral wool insulation (MW EN 14303-T4-ST(+))260-MV2, e.G. Isover ML-3) could be used for direct insulation of copper and steel pipes. Specific application please see corresponding chapters.

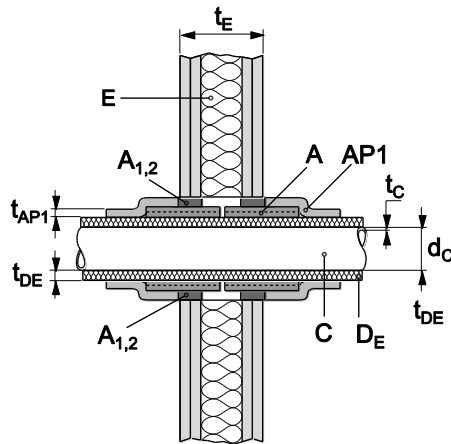
**1.2.3 Mineral wool insulation**

Insulation of mineral wool (melting point > 1000°C) has a density of at least 45kg/m<sup>3</sup> (e.g. Rockwool Klimarock, RS 800). Insulation thickness depends on pipe diameter. Local Interrupted (LI).

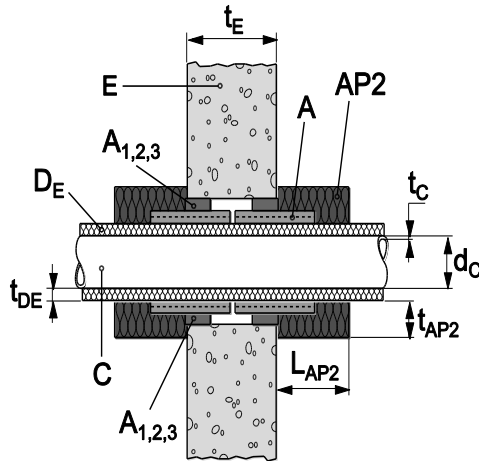
**1.3 Additional Protection**

Additional insulation material (AP) is utilised for some applications and comprises of the following:

**AP1:** Armaflex AF elastomeric material for thermal insulation, 19 mm thick and 300 mm in length (LI) Local Interrupted

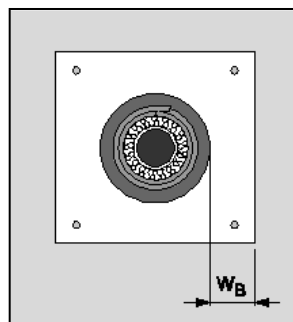


**AP2:** Mineral wool, Rockwool Klimarock, 40mm thick, 250 mm in length; density approximately 45kg/m<sup>3</sup> (LI) Local Interrupted



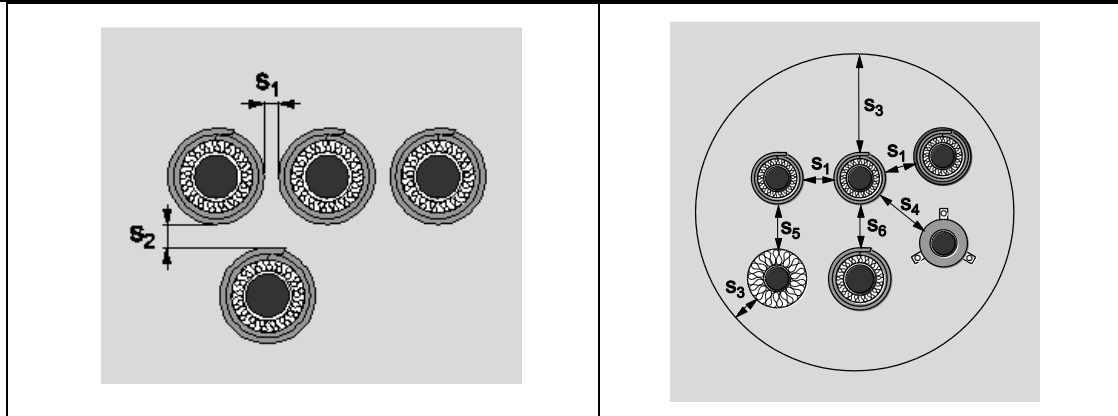
**AP3:** Beading / Outside Framing

Beading for flexible wall (100 mm) is applied by adding boards on both sides in two layers (2x12,5 mm Type F board) fixed with drywall screws. The resulting strips around the pipe whole are at least 50 mm in width ( $W_B$ ). Final penetration seal thickness is 150 mm.



## 1.4 Distance to insulated pipes and other fire-stopped services

**Distance of services to each other – references see below 1.4.1 to 1.4.5**  
**These distances are valid for flexible, rigid wall and floor.**



Sketches refer to round-shaped openings and their typical annular space

### 1.4.1 Distance to pipes firestopped by bandage in linear configuraton - S<sub>1</sub>

Distance is  $\geq 0$  mm to each other for insulated pipes wrapped by bandage CFS-B and in some cases to additional protection according classification.

### 1.4.2 Distance to pipes firestopped by bandage in cluster configuraton – S<sub>2</sub>

Distance is  $\geq 0$  mm to each other for insulated pipes wrapped by bandage CFS-B and in some cases to additional protection according classification.

### 1.4.3 Distances to seal edge - S<sub>3</sub>

In round openings distance to seal edge are up to 40mm. In case where no gap is left between construction and bandage, smoke tightness has to be secured.

### 1.4.4 Distance to Hilti Firestop Collar CFS-C EL - S<sub>4</sub>

Distance to Hilti Firestop Collar is shown to be zero. Please refer for detailed results the corresponding ETA 14/0085.

### 1.4.5 Distance to Mineral Wool Insulation - S<sub>5</sub>

Insulated pipes fire-stopped with Hilti Firestop Bandage CFS-B are tested to have a distance of zero to adjacent mineral wool ( $\geq 1000$  C°, 45 kg/m<sup>3</sup>) insulated penetrations (see 1.2.2) or respectively to additional protection.

### 1.4.6 Distance to PE-HD / PE-Xa and PP-R pipes- S<sub>6</sub>

Distance is  $\geq 0$  mm to each other for insulated pipes wrapped by bandage CFS-B and in some cases to additional protection according classification.

## 1.5 Annular Gap

In flexible and rigid wall Hilti Acrylic Firestop CFS-S ACR and gypsum is used to fill annular space. Mortar and gypsum is used in rigid walls and floors in full depth.

Hilti Acrylic Firestop CFS-S ACR is applied for gaps from 0 mm -15 mm at about 25 mm in depth.

Mortar and gypsum is used in rigid walls and floors, annular space is allowed from approximately 3 up to 40 mm.

## 1.6 Pipe Support

Pipes are supported in wall application at a distance of 400 mm.

In floors first support was in 400 mm distance installed from surface.

## 2 Testing of fire resistance in different constructions

### 2.1 Flexible and rigid walls ( $\geq 100$ mm)

#### 2.1.1 Set up of walls.

Installation variations of insulated pipes protected by Hilti Firestop Bandage CFS-B

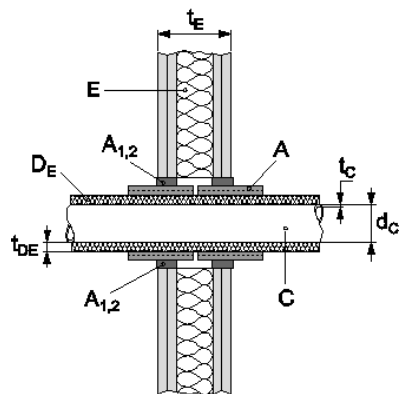
**Installation examples for dry wall and rigid walls:**

**a) Standard installation**

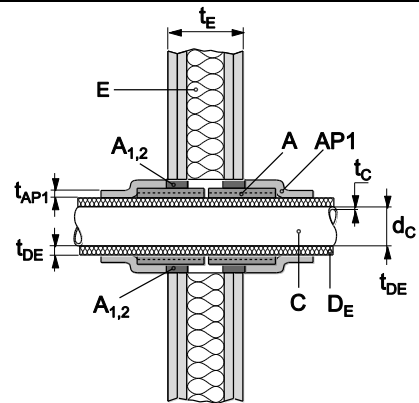
**b) Installation with additional protection AP1**

**c) Installation with additional protection beading/outside framing (AP3)**

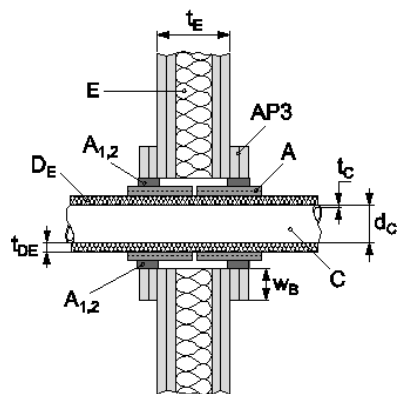
a)



b)



c)





### 2.1.2 Copper pipes

The field of application given is also valid for other metal pipes with lower heat conductivity than copper (approx.. 350W/m.K at 20°C) and a melting point of minimum 1050°C

#### 2.1.2.1 Copper pipes are insulated with elastomeric butyl rubber based insulation ranging in thickness [mm] from 7,5mm till up to 36,5mm.

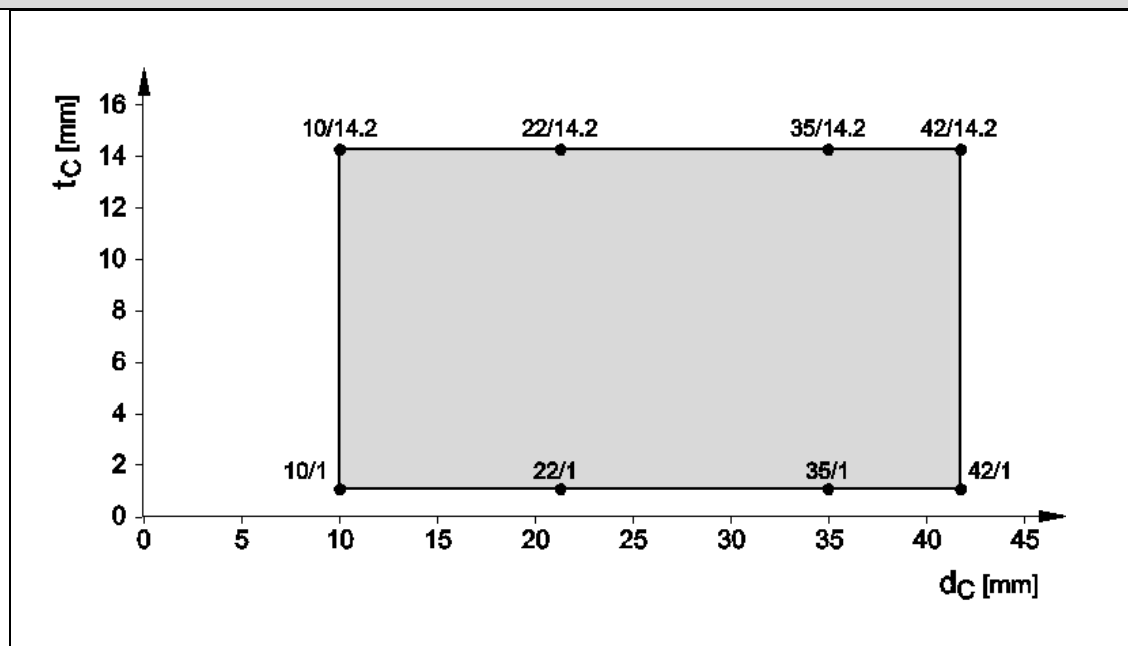
Service	Pipe diameter $d_c$ [mm]	Pipe wall thickness $t_c$ [mm]	Insulation thickness $t_{DE}$ [mm]		Classification C/U		
			from	to	addition. protection		
					-	AP 1	AP 3
Copper	10 - 18	1 - 14,2	7,5	32,0	EI 90	-	-
Copper	18 - 42	1 - 14,2	8,0	36,5	EI 60	EI 90	-
Copper	18 - 42	1 - 14,2	14,0	36,5	EI 90		-
Copper	18 - 42	1 - 14,2	8,0	36,5			EI 90
Copper	10 - 35	1 - 14,2	7,5	35,0			EI 120
<sup>1a,2</sup> Copper	10 - 54	1 - 14,2	30	30	EI 90		
<sup>1a,1,2</sup> Copper	28 - 88,9	1/2 - 14,2	10/30	100		EI 90	
<sup>2</sup> Copper	88,9	2 - 14,2	100	100		EI 120	

<sup>1a</sup> zero separation of pipes from 30 mm insulation to each other and 100mm to other services

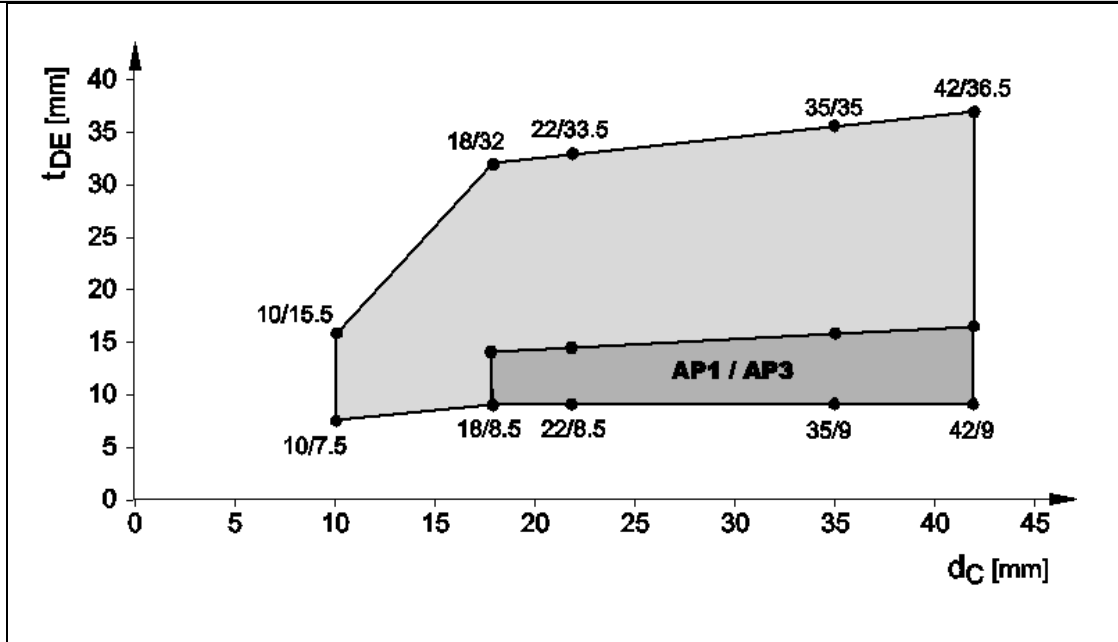
<sup>1</sup>separation of pipes to each other or other services 100 mm

<sup>2</sup> alternative glass fiber wool insulation according Annex C/1.2.2

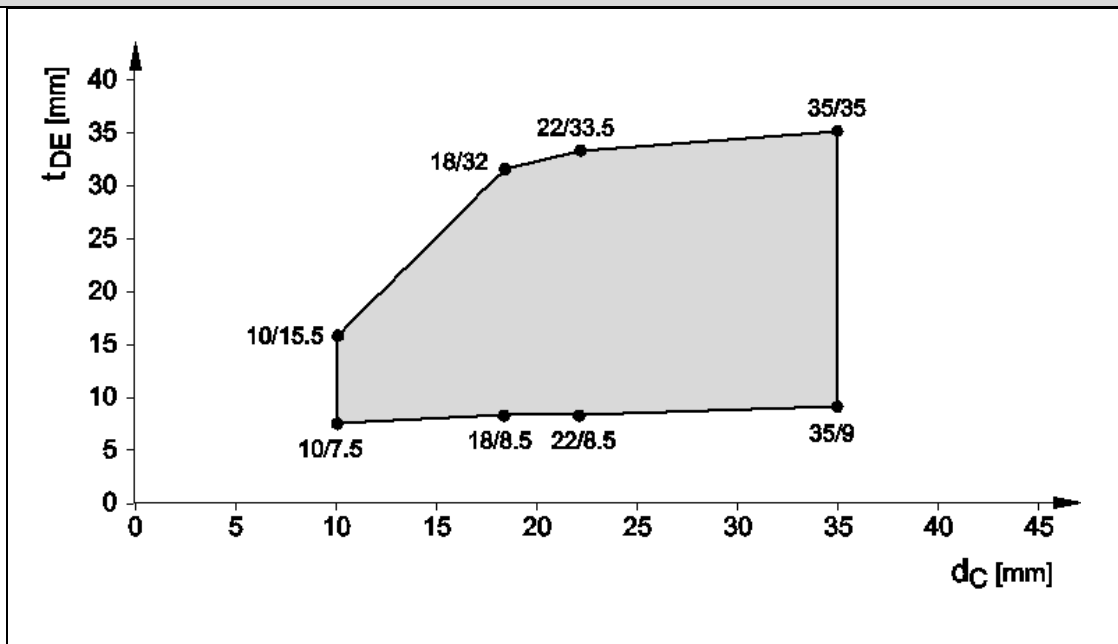
**Copper pipe – relation wall thickness towards pipe diameter**  
Graph shows pipe wall thickness (II) towards pipe diameter ( $\emptyset d_c$ )



**Copper pipes, wall ( $\geq 100$  mm) – EI 90, C/U (plus AP1 or AP3)**  
**Thin insulation thickness acquires at higher pipe diameter additional protection (AP1 or AP3; dark area)**  
**Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )**



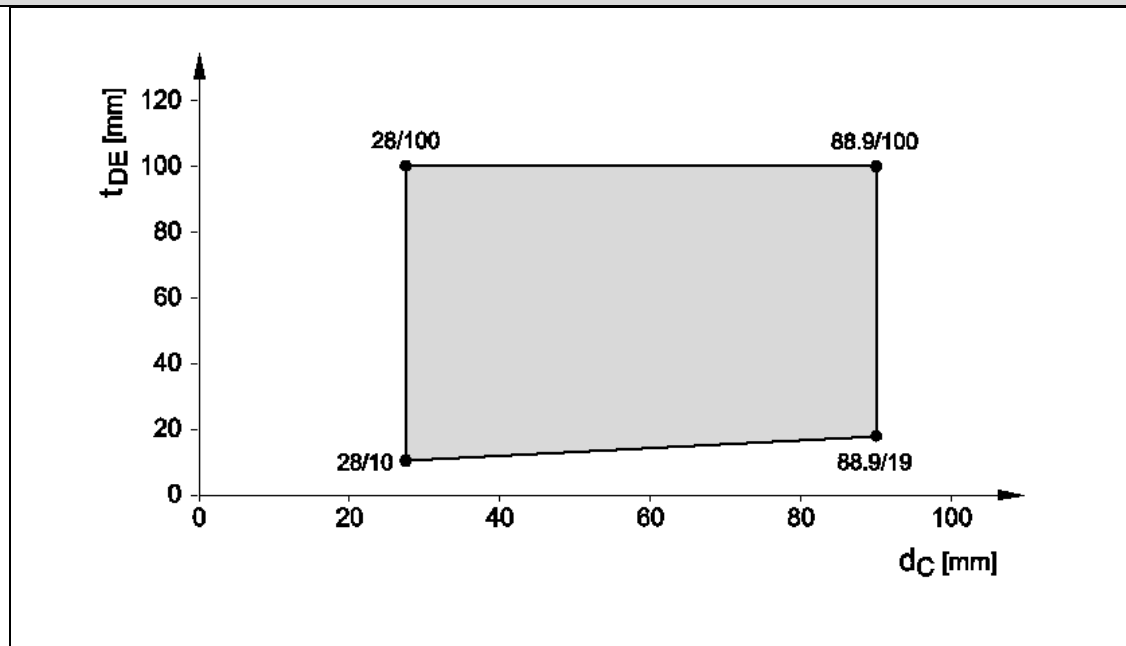
**Copper pipes, wall ( $\geq 100$  mm) – EI 120, C/U plus AP3**  
**Additional protection AP3 – penetration seal thickness 150 mm**  
**Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )**



**Copper pipes (Ø 28- 88,9), wall (≥100 mm) – EI 90 C/U**

Butyl rubber based flexible foam insulation or glass-fiber mineralwool insulation according Annex C/1.2.2

Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter (Ø  $d_C$ )



### 2.1.2.2 Copper pipes with preinstalled Wicu Flex PE Insulation

Copper pipes are pre-insulated with PE insulation (CS) ranging in thickness [mm] from 12 mm till up 22 mm.

Copper Service	Pipe diameter $r d_C$ [mm]	Pipe wall thickness $t_c$ [mm]	Insulation thickness $t_{DE}$ [mm]		Classification C/U	
			from	to	-	AP 3
PE Insulation Wicu flex	12 - 22	1,0/1,5 - 14,2	6	6	EI 60	EI 120-

### 2.1.2.3 Copper pipes with PUR insulation

Copper pipes are insulated with PUR insulation of density 39,4kg/m<sup>3</sup> ranging in thickness [mm] from 12 mm till up 54 mm (CS).

Copper Service	Pipe diameter $r d_C$ [mm]	Pipe wall thickness $t_c$ [mm]	Insulation thickness $t_{DE}$ [mm]		Classification C/U	
			from	to	-	AP 3
PUR Insulation	12 - 54	1,0/1,5 - 14,2	10	50	EI 60	EI 90-

### 2.1.3 Steel Pipes

Applying Annex E1.3.2 of DIN EN 1366-3:2009 the field of application given above for copper pipes is also valid for other metal pipes with lower heat conductivity than copper and a melting point of minimum 1050°C, e.g. unalloyed steel, low alloyed steel, cast iron, stainless steel, Ni alloys (NiCu, NiCr, NiMo alloys) and Ni.

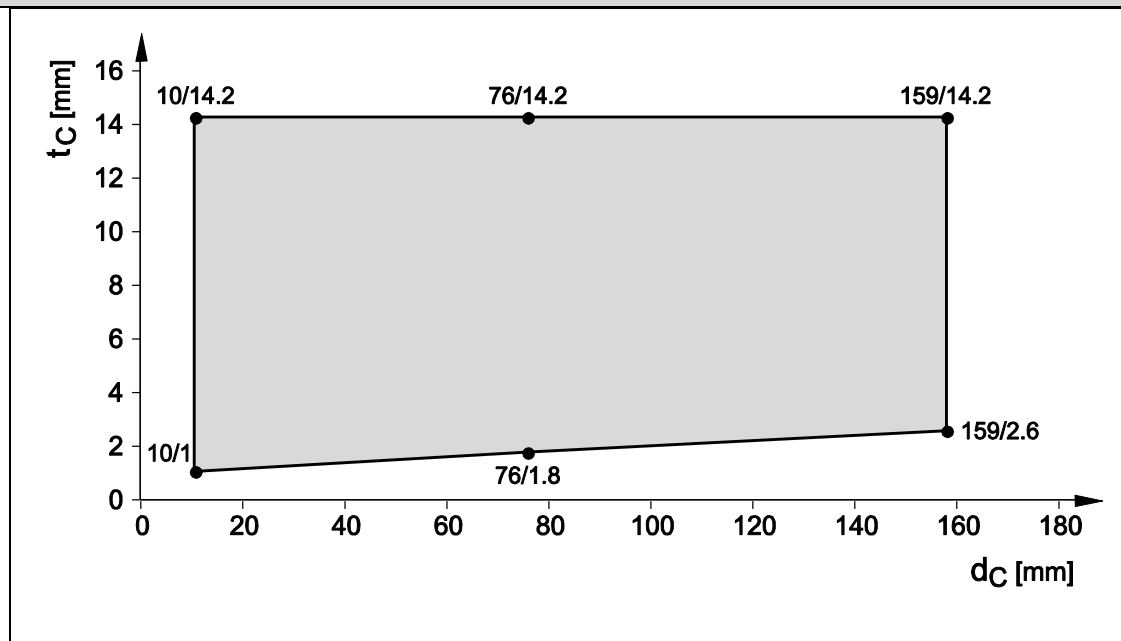
Service	Pipe diameter $d_c$ [mm]	Pipe wall thickness $t_c$ [mm]	Insulation thickness $t_{DE}$ [mm]		Classification C/U		
			from	to	-	AP 1	AP 3
Steel	10,2 - 18	1 - 14,2	7,5	33,5	EI 90		
Steel	10,2 - 60	1 - 14,2	7,5	39			EI 120
Steel	18 - 42	1 - 14,2	8,5	36,5	EI 60	EI 90	
Steel	18 - 42	1 - 14,2	14,0	36,5	EI 90		
Steel	42,4 - 76	1,4 - 14,2	16,5	40,5	EI 90		
Steel	42,4 - 76	1,4 - 14,2	9,0	40,5		EI 90	
Steel	10,2 - 76	1 - 14,2	7,5	40,5		EI 90	
Steel	76 - 159	1,8/2,6 - 14,2	40,5	45	EI 120		
Steel <sup>1a,1,2</sup>	28 - 88,9	1/2 - 14,2	10/30	100		EI 90	
Steel <sup>1,2</sup>	88,9 - 114,3	2,0 - 14,2	40	40		EI 90	

<sup>1a</sup> zero separation of pipes from 30 mm insulation on to each other and 100mm to other services

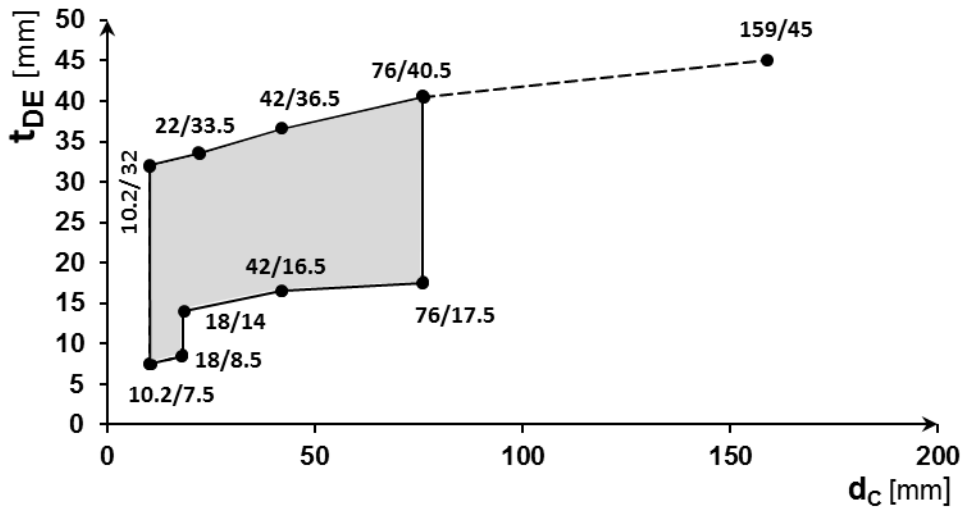
<sup>1</sup>separation of pipes to each other or other services 100 mm

<sup>2</sup> alternative glass fiber wool insulation according Annex C/1.2.2

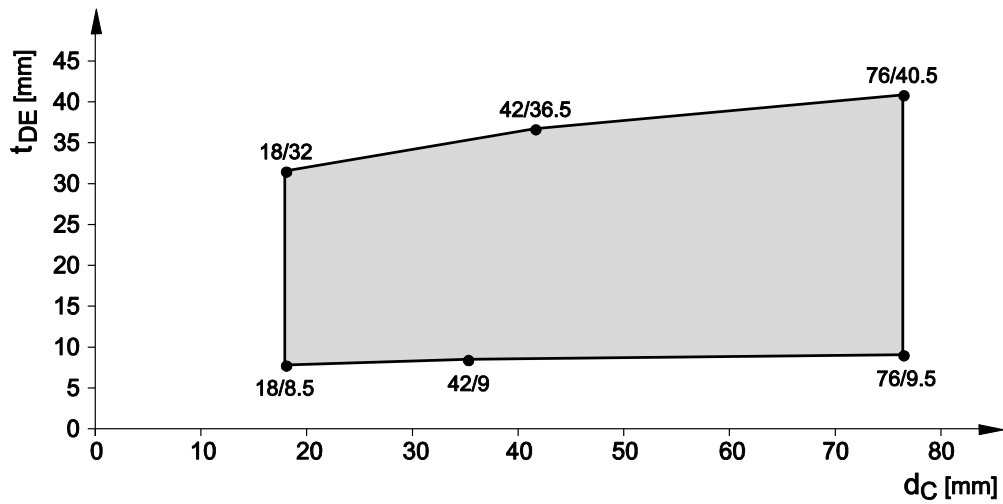
**Steel pipe, flexible wall ( $\geq 100$  mm) – relation wall thickness towards pipe diameter**  
Graph shows pipe wall thickness ( $t_c$ ) towards pipe diameter ( $\varnothing d_c$ )



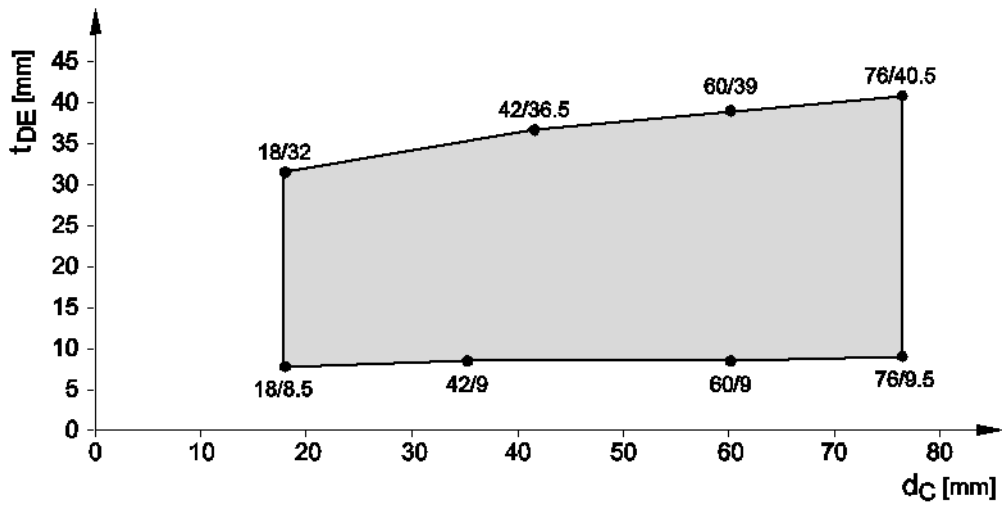
**Steel pipes, flexible wall ( $\geq 100$  mm) – EI 90, / EI 120 (dotted line) C/U**  
**Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )**



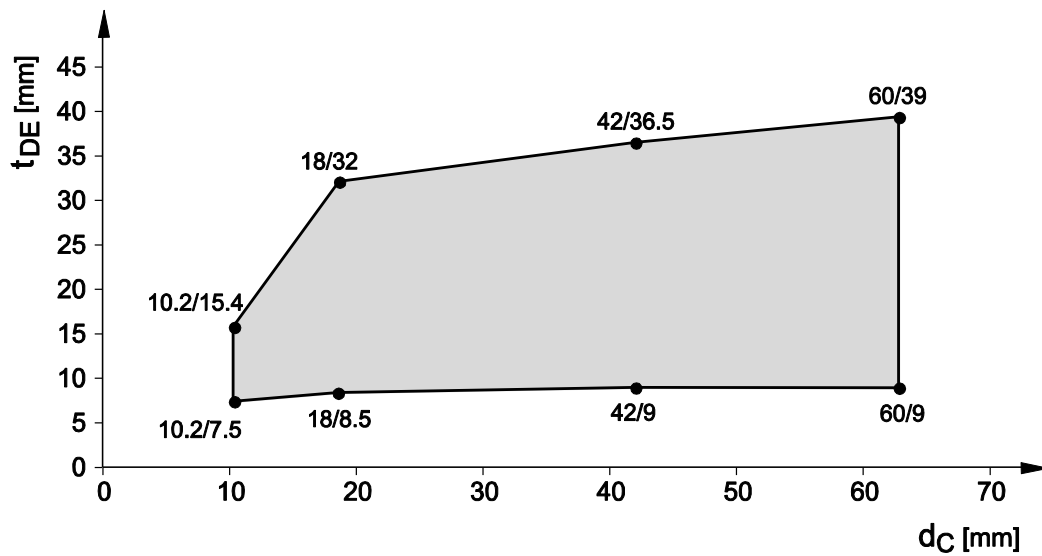
**Steel pipes, wall ( $\geq 100$  mm) – EI 90, C/U plus AP1**  
**Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )**



**Steel pipes, wall ( $\geq 100$  mm) EI 60, C/U**  
**Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )**



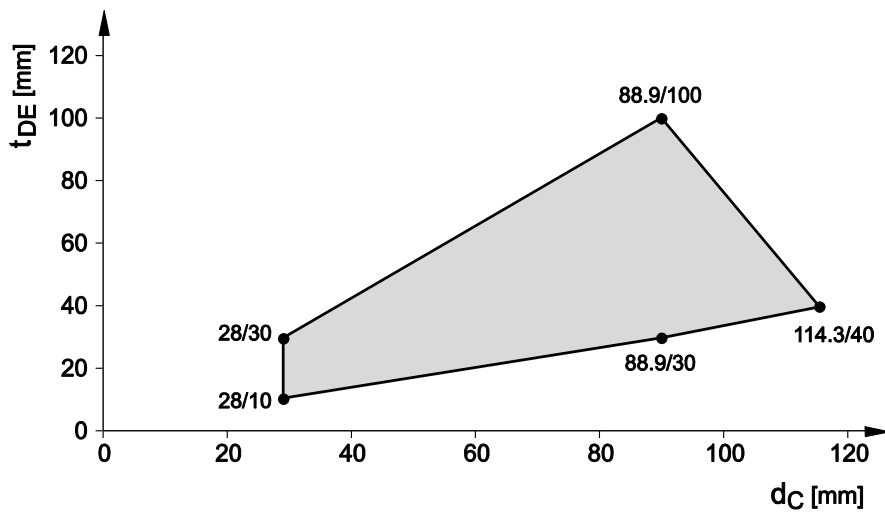
**Steel pipes, wall ( $\geq 100$  mm) – EI 120, C/U plus beading (AP3)**  
**Additional protection AP3, thickness of penetration seal 150 mm**  
**Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )**



**Steel pipes, walls ( $\geq 100$  mm) – EI 90 with AP1, C/U**

Butyl rubber based flexible foam insulation or glass-fiber mineral wool insulation according Annex C/1.2.2

Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\emptyset d_C$ )



#### 2.1.4 Aluminium Composite Pipes

Aluminium composite pipes were available only at one pipe thickness for each diameter.

## 2.1.4.1 Aluminium Composite Pipes insulated with butyl rubber based flexible foam

Manufacturer	Product name	Pipe diameter dc (mm)	Insulation thickness (mm)		Classification U/C	
			From	To		AP3
Fränkische Rohrwerke	Alpex F50 Profi	16 - 32	8,0	35,0	EI 90	
		32 - 40	9,0	36,5	EI 60	
		32 - 50	9,0	37,5		EI 120
		50 - 75	9,0	40,5	EI 60	
		50 - 75	37,5	40,5	EI 120	
Geberit*	Mepla	16 - 32	0	0	EI 90 <sup>2</sup>	
		16 - 32	8,0	35,0	EI 90	
		32 - 40	9,0	36,5	EI 60	
		32 - 50	9,0	37,5		EI 120
		50 - 75	9,0	40,5	EI 60	
		50 - 75	37,5	40,5	EI 120	
Georg Fischer	Sanipex	16 - 32	8,0	35,0	EI 90	
		32 - 40	9,0	36,5	EI 60	
		32 - 50	9,0	37,5		EI 120
		50 - 63	9,0	39,5	EI 60	
IVT	PRINETO Stabilrohr	17 - 52	8,0	37,5	EI 90	
		52 - 63	9,0	39,5	EI 60	
		17 - 63	32	39,5	EI 120	
KeKelit	KELOX KM 110	16 - 75	8,0	40,5	EI 90	
		16 - 75	32	40,5	EI 120	
Rehau	Rautitan stabil	16 - 40	8,0	36,5	EI 90	
		16 - 40	32,0	36,5	EI 120 <sup>1</sup>	
TECE	TECEflex Verbundrohr	16 - 50	8,0	37,5	EI 90	
		63	9,0	39,5	EI 60	
		16 - 63	32	40,5	EI 120	
Uponor	Unipipe plus	16 - 32	8,0	32,0	EI 120 <sup>1</sup>	
	Unipipe MLC	40 - 63	9,0	39,5		EI 90 <sup>2</sup>
Viega	SANIFIX Fosta-Rohr	16 - 32	8,0	33,0	EI 120 <sup>1</sup>	
		32 - 63	9,0	39,5	EI 60	
		32 - 50	9,0	37,5		EI 120
		16 - 63	32	39,5	EI 120	
	Raxofix	16 - 40	8,0	35,0	EI 120 <sup>1</sup>	
		40 - 63	9,0	39,5	EI 60	EI 120

<sup>1</sup> EI 90 for zero distance, 400 mm first support

<sup>2</sup> first pipe support 250 mm, distance to next service 100 mm

Small pipes ( $\leq \varnothing 16$  mm) can be wrapped in a twin manner with bandage and perform EI 120

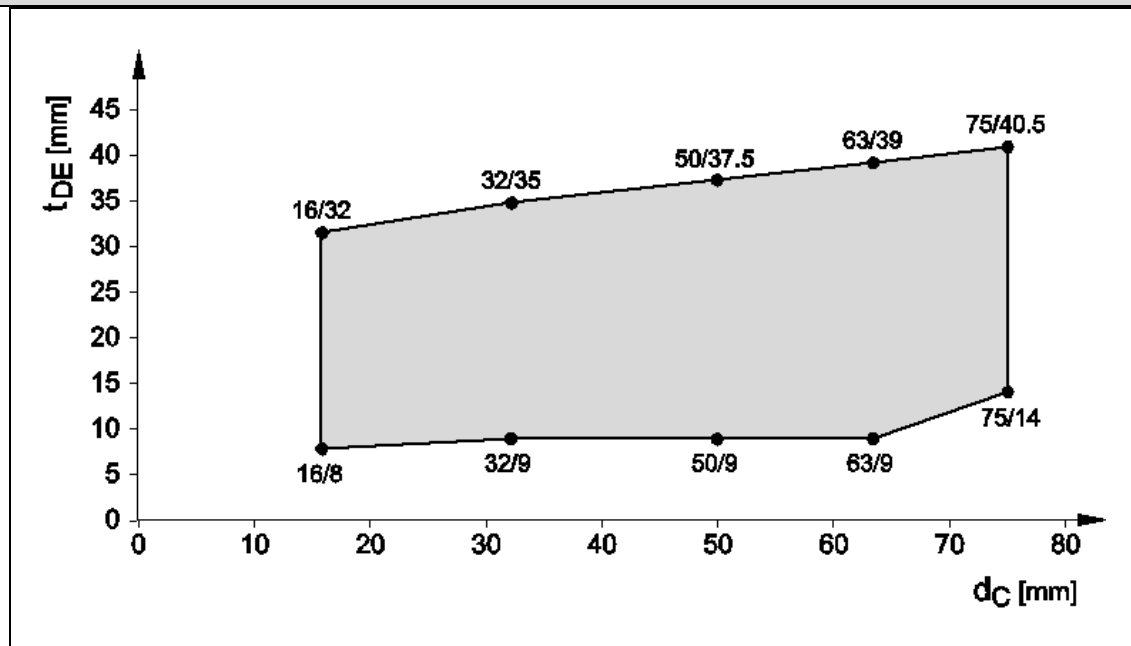


Graph shows results simplified, for all details see table above.

**Aluminium Composite Pipes, wall ( $\geq 100$  mm) - EI 60, U/C**

All specimens listed

Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )

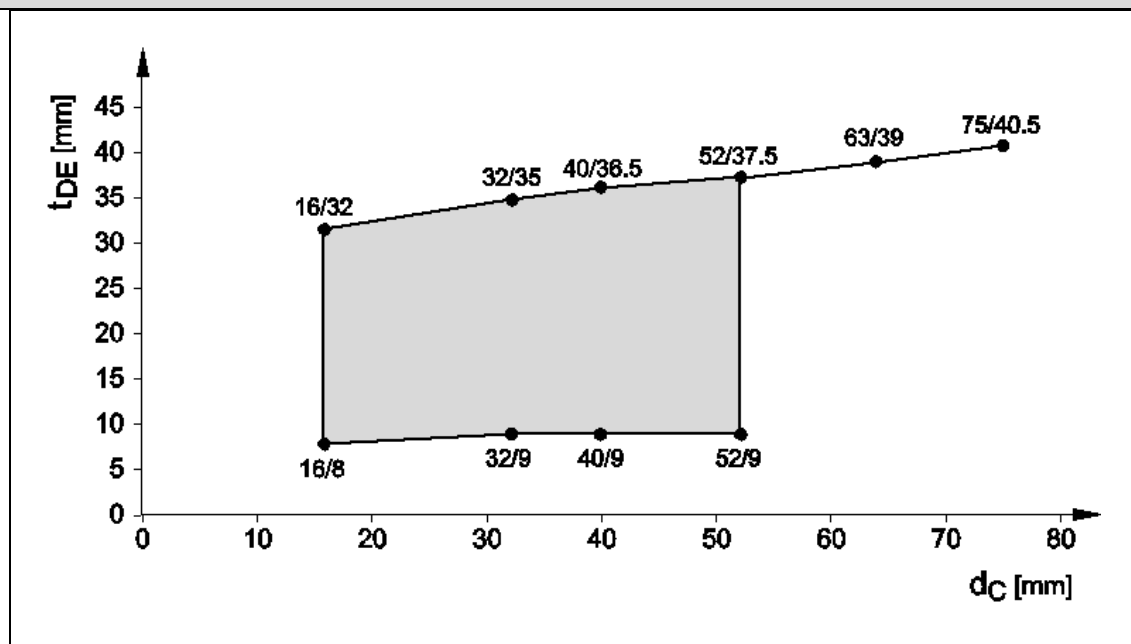


Group 1 of composite pipes (grey shaded) – Brand: Kekelit (Kelox), IVT (Prineto Stabil Rohr), Rehau ( $\leq 40$  mm)(Rautitan stabil), TECEflex

**Aluminium Composite Pipes, wall ( $\geq 100$  mm) - EI 90, U/C**

All pipes of group 1

Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )

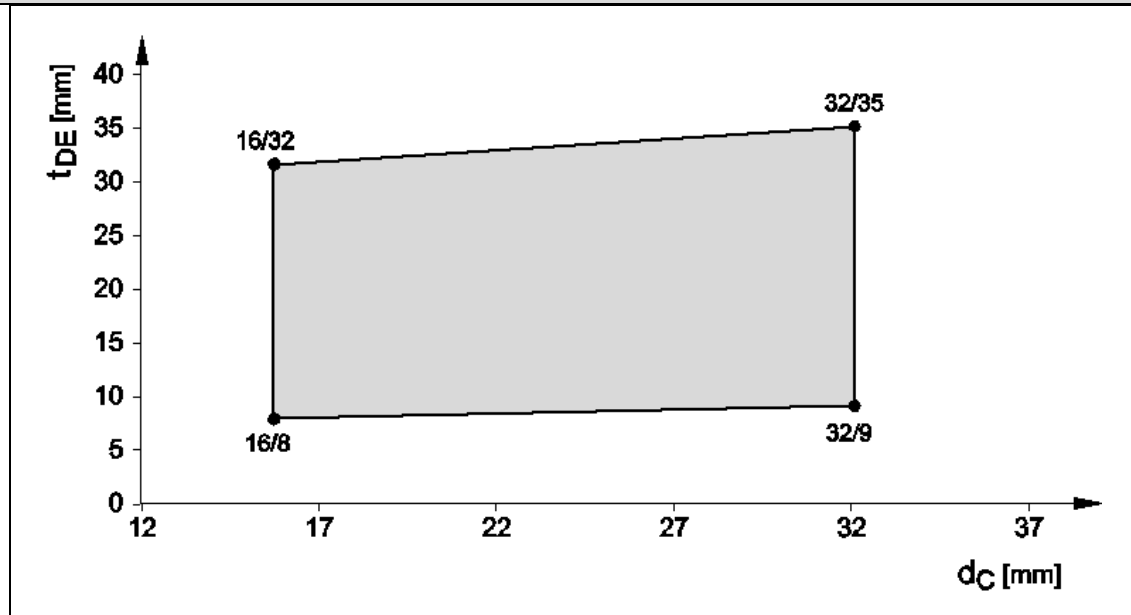


Group 2 of composite pipes - Brand: Fränkische Rohrwerke (Alpex System), Geberit (Mepla), Georg Fischer (Sanipex) Viega (Sanifix Fosta), Uponor(Unipipe Plus)

**Aluminium Composite Pipes, wall ( $\geq 100$  mm) - EI 90, U/C**

All pipes of group 2

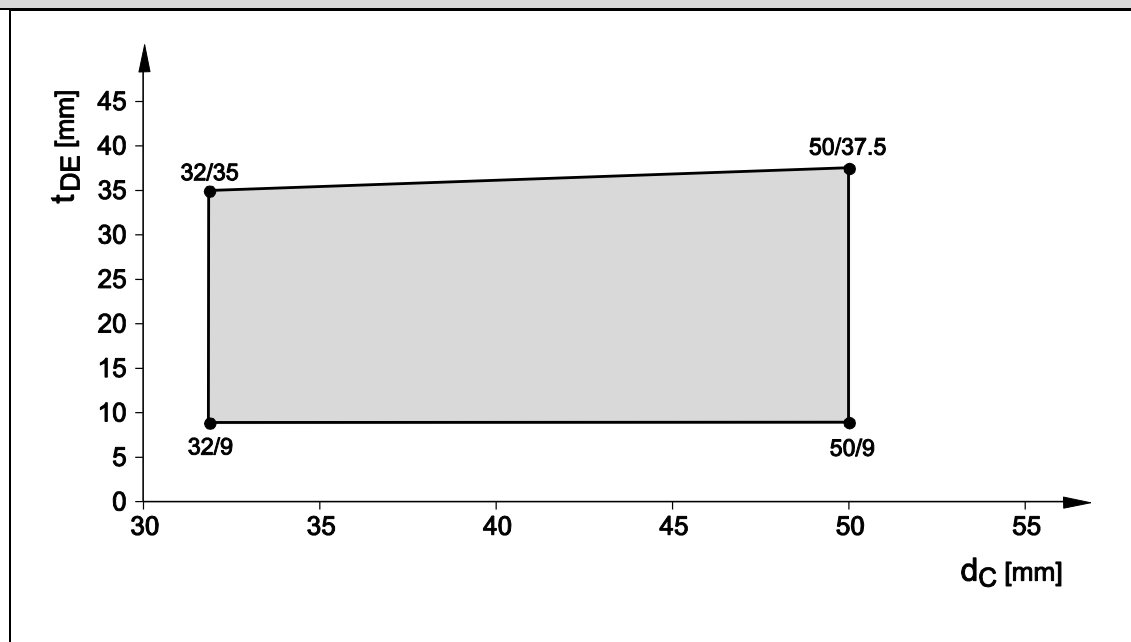
Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )



**Aluminium Composite Pipes, wall ( $\geq 100$  mm) - EI 120, U/C plus beading**

All pipes of group 2 \*

Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )



\* Uponor MLC - EI 90

## 2.1.4.2 Aluminium Composite Pipes with protection pipe and or pre-insulated closed-cell PE foam

Manufacturer	Product name	Pipe diameter dc (mm)	Insulation thickness (mm)		Classification U/C
			From	To	
<b>Geberit</b>	Mepla pre-insulated	16 - 26	6,0	13,0	EI 120
<b>KeKelit Kelox<sup>1</sup></b>	Pro KM 130	14 - 32	9,0	9,0	EI 120
	Plus KM 134	14 - 32	4,0	9,0	EI 120
	Pro KM 140	16 - 20	PE HD	tube	EI 120
	Plus KM 144	16 - 20	4+ PE	HD tube	EI 120
<b>Uponor<sup>1</sup></b>	Unipipe plus	16 - 25	4,0	10,0	EI 120
	Unipipe MLC	16 - 20	PE HD	tube	EI 120

<sup>1</sup>PE Foam has fire resistance classified according EN 13501-1 as E

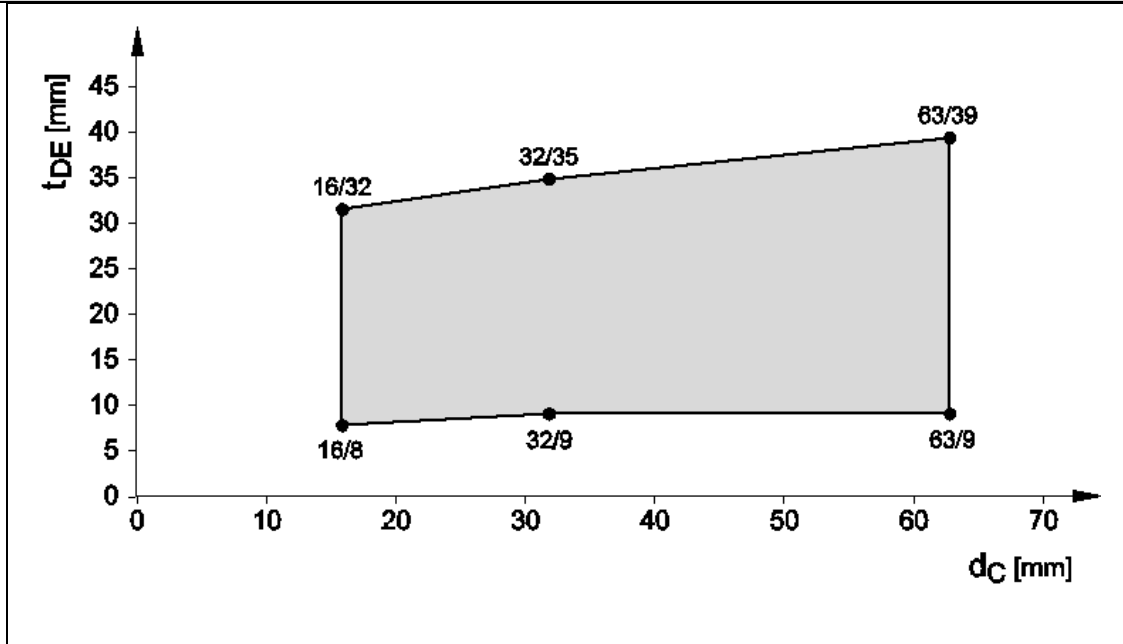
## 2.1.5 Plastic pipes

### 2.1.5.1 Plastic pipes made of PE-Xa (EN ISO 15875) and PE (EN 12201-2)

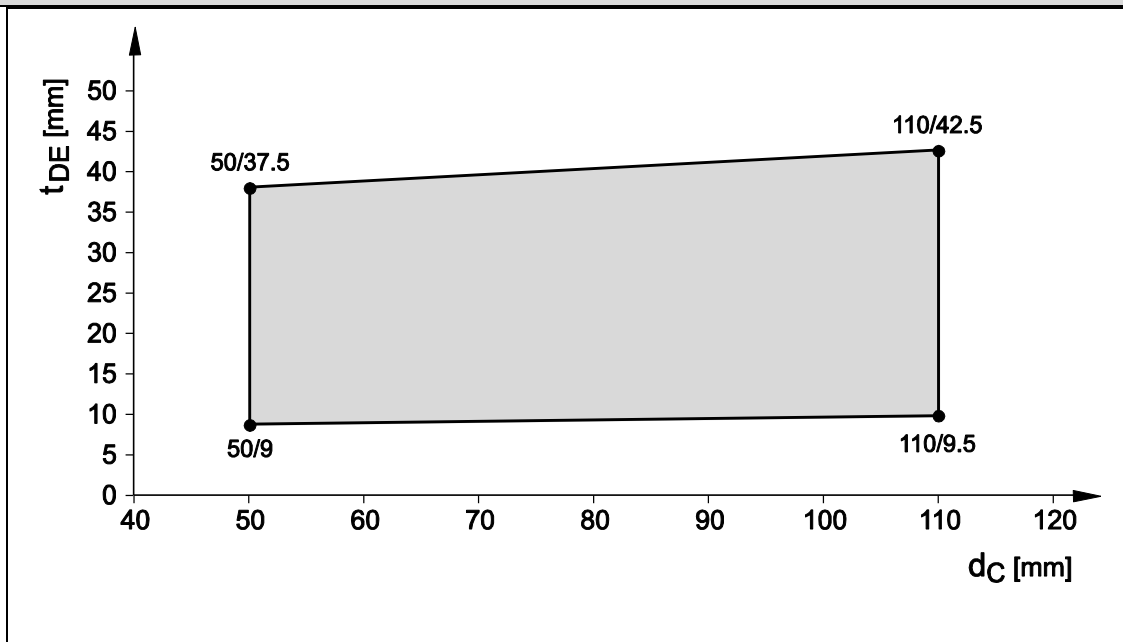
Pipe insulation was butyl rubber based flexible foam

Service	Pipe diameter dc [mm]	Pipe wall thickness tc [mm]	Insulation thickness t <sub>DE</sub>		Classification U/C-
			from	to	
PE-Xa Rautitan Flex	16 - 63	2,2 - 8,6	8,0	39,0	EI 120
PE / XSC 50 Wavin TS PE 100	50 - 110	4,6 - 10	9,0	42,5	EI 120

Plastic pipes PE-X according EN ISO 15875, wall ( $\geq 100$  mm) - EI 120, U/C  
Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )



Plastic pipes PE-HD according EN 12201-2, wall ( $\geq 100$  mm) - EI 120, U/C  
Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )



## 2.1.5.2 Plastic pipes made of PP-R (EN 15874 / DIN 8077/78 / ISO 21003)

Plastic pipes are insulated with butyl rubber based flexible foam

Manu- facturer	Product name	Pipe diameter dc (mm)	Wall thickness (mm)	Insulation thickness (mm)		Classification U/C
				From	To	
Aquatarm	Green <sup>1,3</sup>	20 - 110	1,9 - 10	8,0	40,5	EI 120*
	Blue <sup>1,3</sup>	20 - 110	1,9 - 10	8,0	40,5	EI 120*
Poloplast	Polo-Polymutan ML5 <sup>2</sup>	20 - 75	2,8 - 10,3	8,5	40,5	EI 120*
	Polo-Polymutan <sup>3</sup>	20 - 75	1,9 - 6,8	8,0	40,5	EI 90
	Polo-Tersia <sup>3</sup>	20 - 75	1,9 - 12,5	8,0	40,5	EI 90
Kekelit Ketrix	Cryolen Polyolefinblend <sup>1</sup>	20 - 75	1,9 - 6,8	8,0	40,5	EI 90

\* for zero distance and / or 400 mm first pipe support classification is EI 90 U/C

<sup>1</sup> according EN 15874

<sup>2</sup> according ISO 21003

<sup>3</sup> according DIN 8077/78

## 2.2 Rigid Wall (≥ 200 mm)

### 2.2.1 Set-up of rigid wall

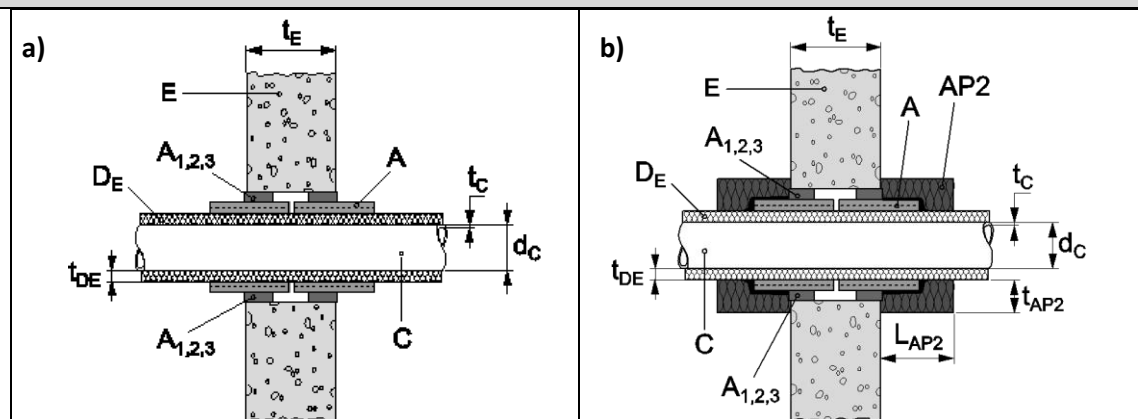
The wall must have a minimum thickness of 200 mm and comprise of concrete, aerated concrete or masonry, with a minimum density of 550 kg/m<sup>3</sup>

Installation variants of insulated pipes protected by Hilti Firestop Bandage CFS-B

#### Installation examples:

##### a) Standard installation

##### b) Installation with additional protection AP2



## 2.2.2 Copper Pipes

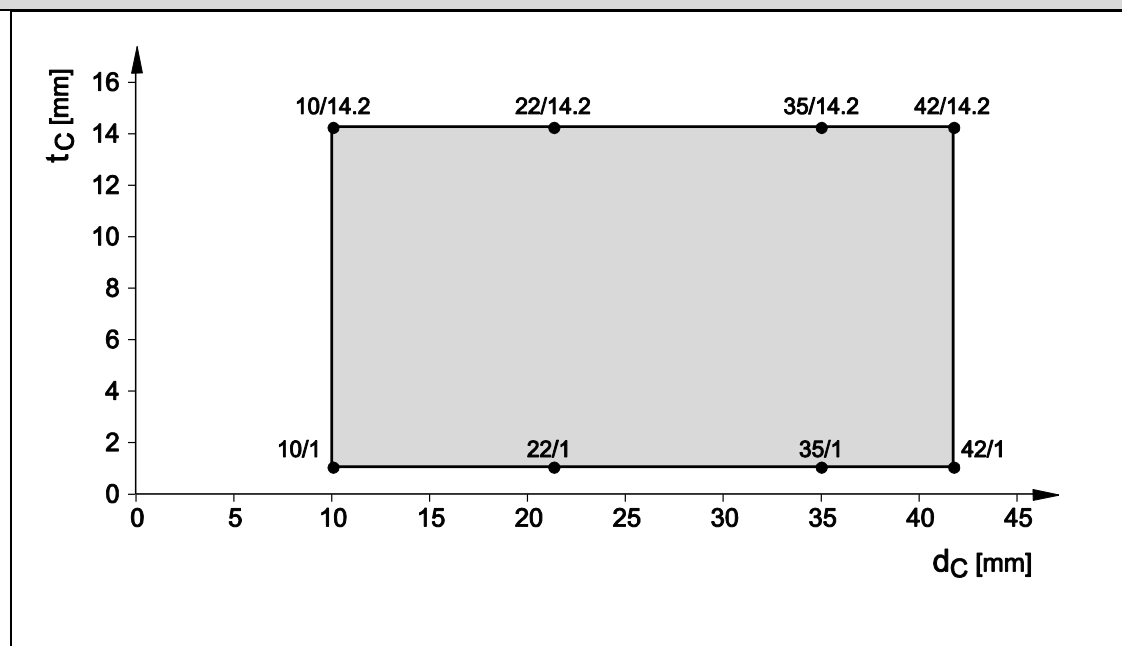
### 2.2.2.1 Copper Pipes with butyl rubber based insulation or glass wool insulation

Service	Pipe diameter $r_{dc}$ [mm]	Pipe wall thickness $t_c$ [mm]	Insulation thickness $t_{DE}$ [mm]		Classification C/U
			from	to	
			$\varnothing$ small	$\varnothing$ big	-
Copper	10 - 42	1 - 14,2	7,5	36,5	EI 90
Copper	10 - 35	1 - 14,2	7,5	35,0	EI 120
<sup>1,2</sup> Copper	28 - 88,9	1/2 - 14,2	10/19	100	EI 90

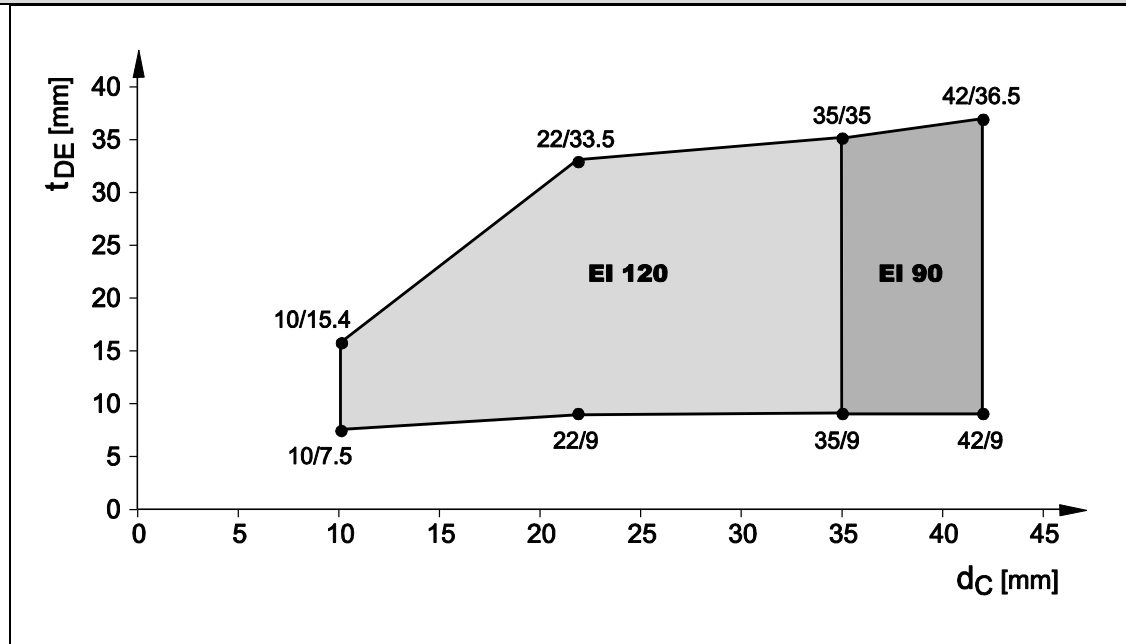
<sup>1</sup>separation of pipes to each other or other services 100 mm

<sup>2</sup> alternative glass fiber wool insulation according Annex C/1.2.2

**Copper pipe, rigid wall ( $\geq 200$  mm) – relation wall thickness towards pipe diameter  
Graph shows pipe wall thickness ( $t_c$ ) towards pipe diameter ( $\varnothing d_c$ )**



**Copper pipes, rigid wall ( $\geq 200$  mm) – EI 120 / EI 90, C/U**  
**Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_c$ )**



### 2.2.3 Steel Pipes

Applying Annex E1.3.2 of DIN EN 1366-3:2009 the field of application given in 2.2.2 for copper pipes is also valid for other metal pipes with lower heat conductivity than copper and a melting point of minimum 1050°C, e.g. unalloyed steel, low alloyed steel, cast iron, stainless steel, Ni alloys (NiCu, NiCr, NiMo alloys) and Ni.

Service	Pipe diameter $d_c$ [mm]	Pipe wall thickness $t_c$ [mm]	Insulation thickness $t_{DE}$ [mm]		Classification C/U	
			from	to	-	AP 2
Steel	10,2 - 60	1 - 14,2	7,5	39	EI120	
Steel	76 - 159	1,8 - 14,2	17,5	45	EI 90	
Steel	159	2 - 14,2	16	45	EI 120	
Steel	159 - 813	2 - 14,2	25	25		EI 120
Steel <sup>1a,1,2</sup>	28 - 88,9	1/2 - 14,2	10/30	30	EI 90	
Steel <sup>1,2</sup>	88,9 - 159	2,0 - 14,2	40	80	EI 90	

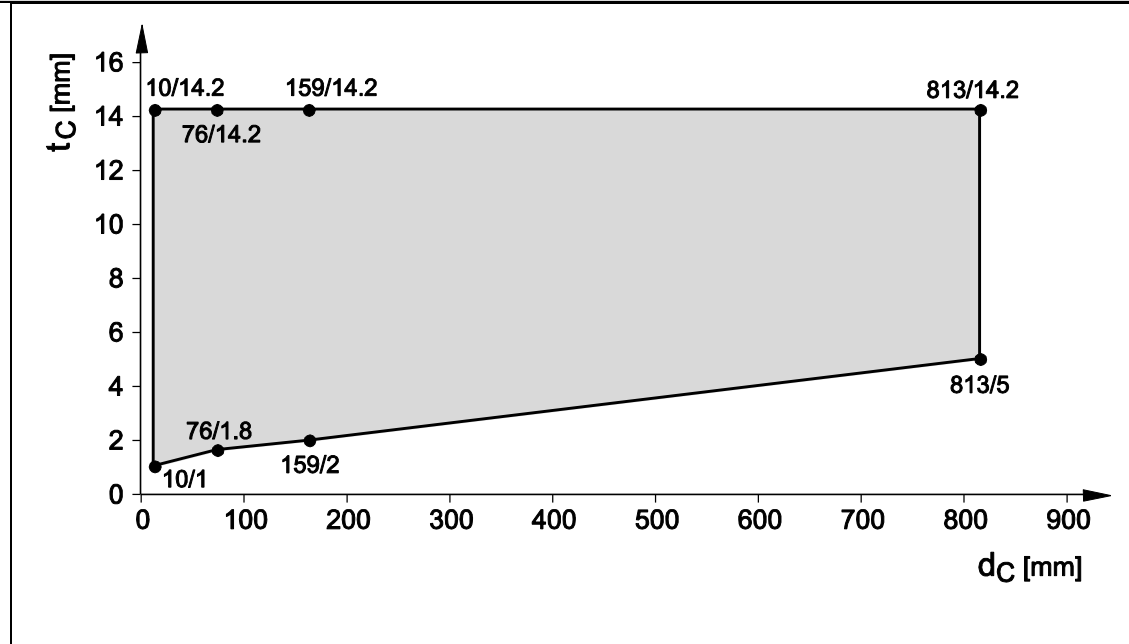
<sup>1a</sup> EI 120; zero separation of pipes at 30 mm insulation to each other and 100mm to other services

<sup>1</sup>separation of pipes to each other or other services 100 mm

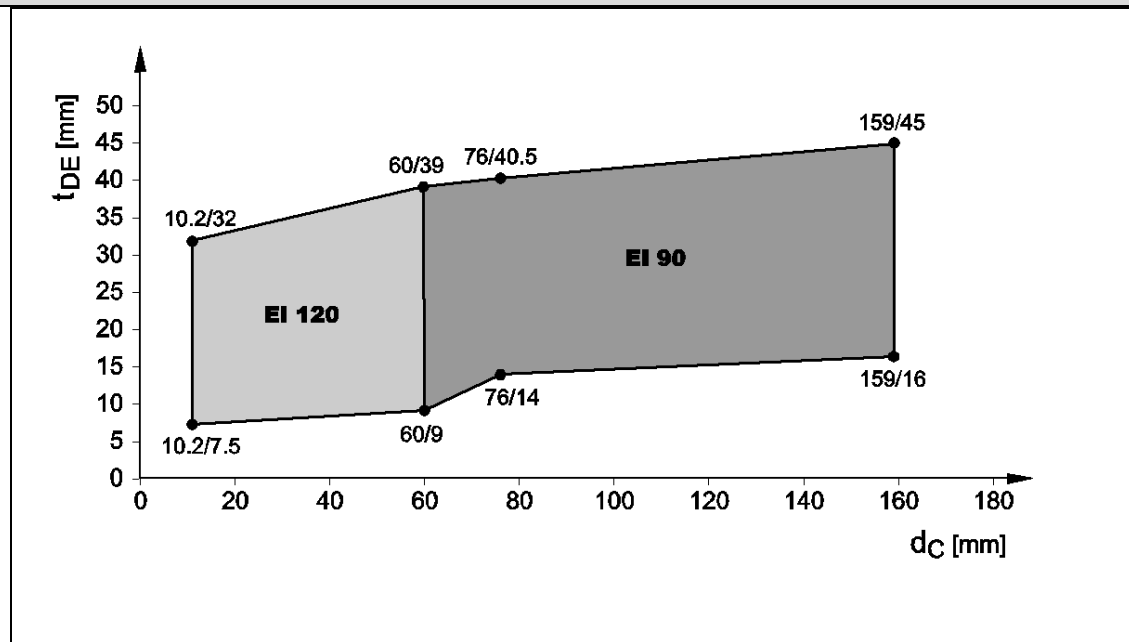
<sup>2</sup> alternative glass fiber wool insulation according Annex C/1.2.2

AP 2 insulation was applied in a length of 500 mm for pipe  $\varnothing 813$ . Therefore this is valid for pipe range from  $\varnothing 159$  to  $\varnothing 813$  mm.

**Steel pipe, rigid wall ( $\geq 200$  mm) – relation wall thickness towards pipe diameter**  
**Graph shows pipe wall thickness ( $t_c$ ) towards pipe diameter ( $\varnothing d_c$ )**

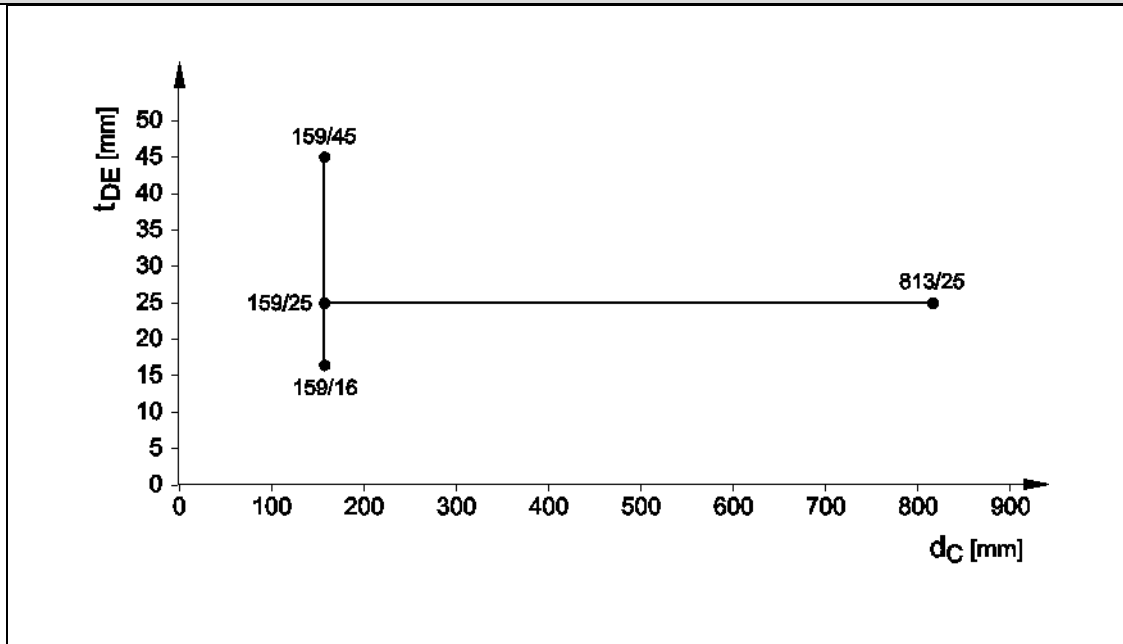


**Steel pipes, C/U, rigid wall ( $\geq 200$  mm) – EI 120 /90, C/U**  
**Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_c$ )**





**Steel pipes, rigid wall ( $\geq 200$  mm) – EI 120, C/U**  
**Insulated large pipes from  $\varnothing$  159 up to 813 mm**  
**Elastomeric insulation plus additional protection mineralwool (AP2, Klimarock 40mm)**  
**Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_c$ )**



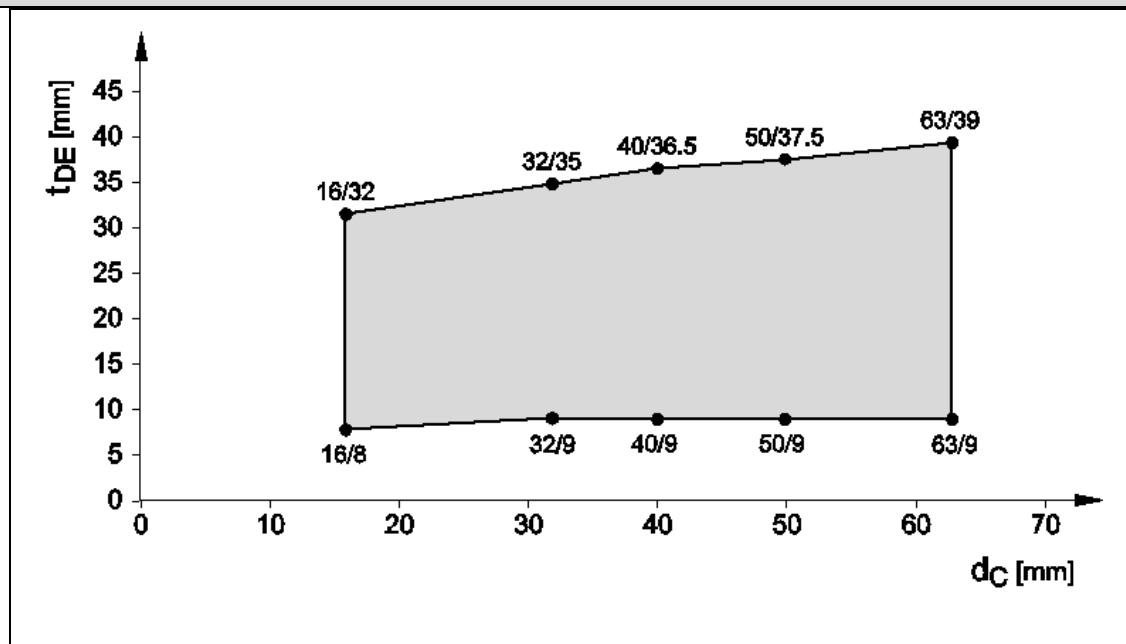
#### 2.2.4 Aluminium Composite Pipes

Aluminium composite pipes were available only at one pipe thickness for each diameter.

Manufacturer	Product name	Pipe diameter $d_c$ (mm)	Insulation thickness (mm)		Classification U/C
			from	to	
<b>Fränkische Rohrwerke</b>	Alpex F50 Profi	16 - 63	8,0	39,0	EI 120
<b>Geberit</b>	Mepla	16 - 63	8,0	39,0	EI 120
<b>Georg Fischer</b>	Sanipex	16 - 63	8,0	39,0	EI 120
<b>IVT</b>	PRINE-Stabilrohr	16 - 63	8,0	39,0	EI 120
<b>KeKelit</b>	KELOX KM 110	16 - 63	8,0	39,0	EI 120
<b>Rehau</b>	Rautitan stabil	16 - 63	8,0	39,0	EI 120
<b>TECE</b>	TECEflex Verbundrohr	16 - 63	8,0	39,0	EI 120
<b>Viega</b>	SANIFIX Fosta-Rohr	16 - 63	8,0	39,0	EI 120

Result is valid for composite pipes group\_1 and 2 with exception Uponor (see 2.1.4.; note<sup>2,3</sup>)

**Aluminium Composite Pipes, rigid wall ( $\geq 200$  mm) - EI 120 , U/C**  
**All specimens group 1 and group 2 (not proven for Uponor)**  
**Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )**



## 2.3 Floor

### 2.3.1 Set-up of floor ( $\geq 150$ mm)

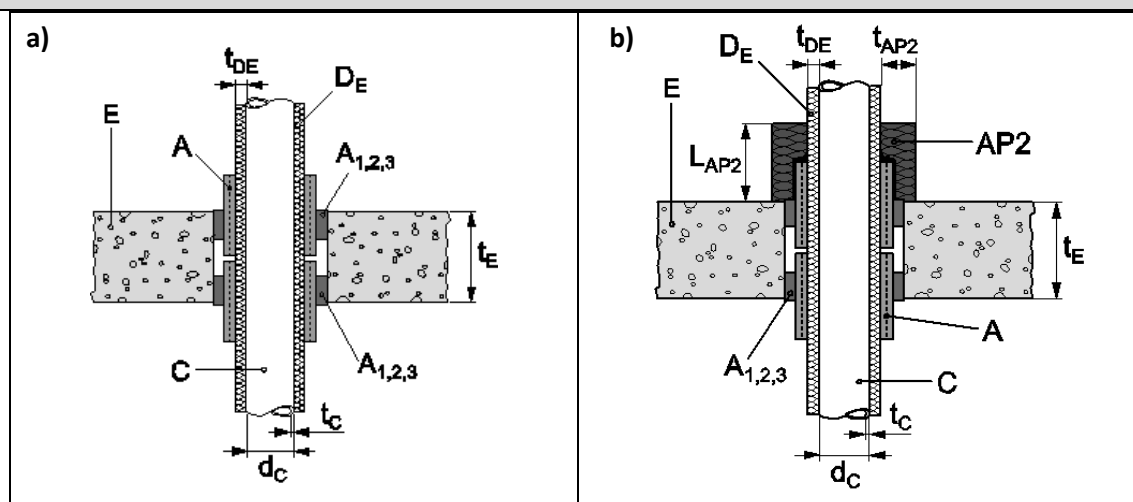
The supporting construction is build according EN 1355-3:2009 of at least lightweight concrete slabs of a thickness of 150 mm and a density of  $550 \text{ kg/m}^3$ .

Installation variants of insulated pipes protected by Hilti Firestop Bandage CFS-B

**Installation examples:**

**a) Standard installation**

**b) Installation with additional protection AP2**



## 2.3.2 Copper Pipes

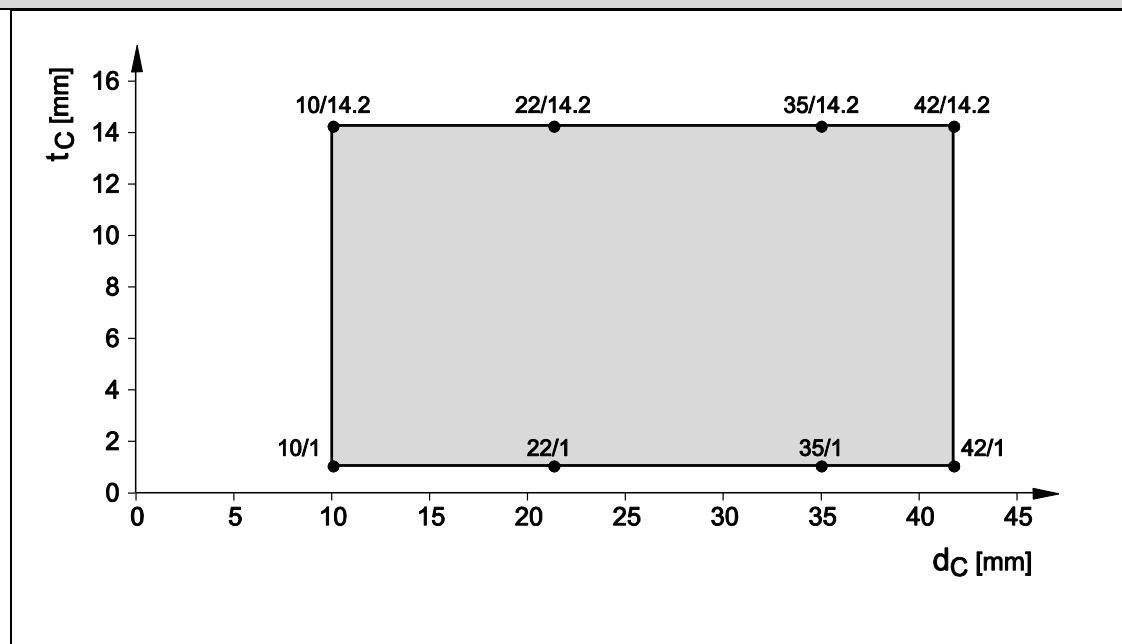
### 2.3.2.1 Copper Pipes with butyl rubber based flexible foam insulation

Service	Pipe diameter $d_c$ [mm]	Pipe wall thickness $t_c$ [mm]	Insulation thickness $t_{DE}$ [mm]		Classification C/U		
			from	to	C/U		
					-	AP 1	AP 2
Copper	10 - 35	1 - 14,2	7,5	35,0	EI 120	-	-
Copper	35 - 42	1 - 14,2	9,0	36,5	EI 60		EI 120
Copper	42	1,2	9,0	35	EI 120		
<sup>1,2</sup> Copper	28 - 88,9	1/2 - 14,2	10	100	EI 90		

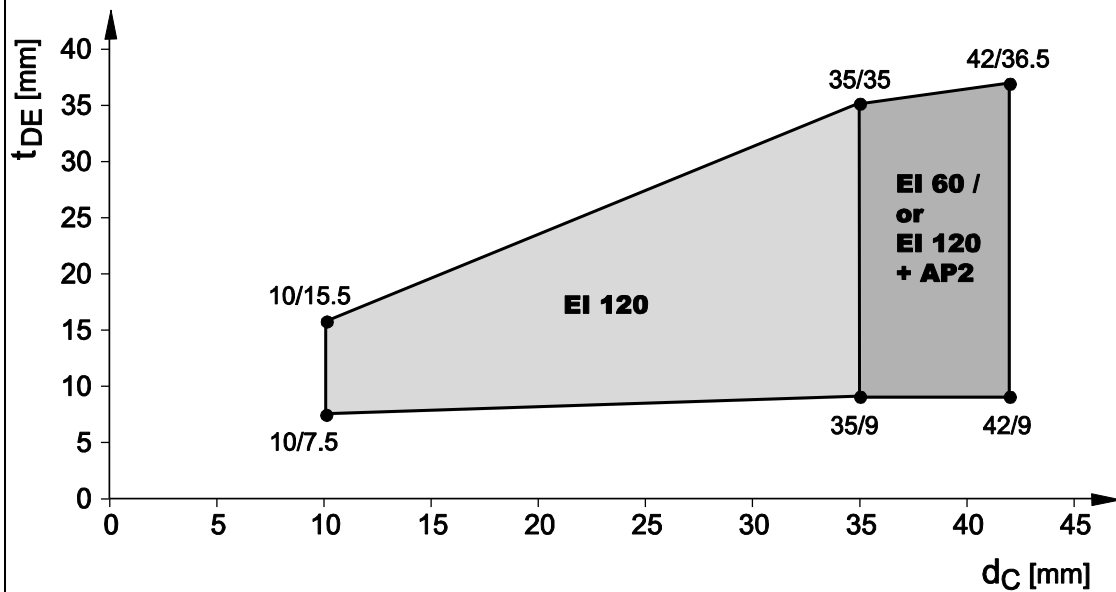
<sup>1</sup>separation of pipes to each other or other services 100 mm

<sup>2</sup> alternative glass fiber wool insulation according Annex C/1.2.2

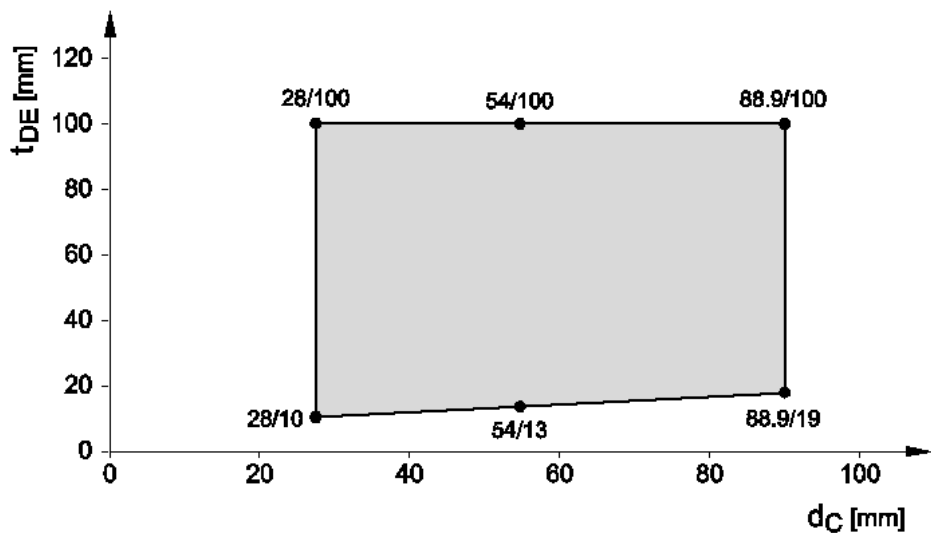
**Copper pipe, rigid floor ( $\geq 150$  mm) – relation wall thickness towards pipe diameter  
Graph shows pipe wall thickness ( $t_c$ ) towards pipe diameter ( $\varnothing d_c$ )**



**Copper pipes, floor ( $\geq 150$  mm) – EI 120 / EI 60 / EI 120 plus AP2, C/U**  
**Additional protection AP2 (mineral wool) is required from  $\varnothing$  35 to 42 mm to reach EI 120**  
**Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )**



**Copper pipes ( $\varnothing$  28- 88,9), floor ( $\geq 150$  mm) – EI 90 C/U**  
**Butyl rubber based flexible foam insulation or glass-fiber mineralwool insulation according Annex C/1.2.2**  
**Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )**



### 2.3.2.2 Copper pipes with preinstalled Wicu Flex PE Insulation

Copper pipes are pre-insulated with PE insulation (CS) ranging in thickness [mm] from 12 mm till up 22 mm.

Copper Service	Pipe diameter $d_c$ [mm]	Pipe wall thickness $t_c$ [mm]	Insulation thickness $t_{DE}$ [mm]		Classification C/U-
			from	to	
Wicuflex*	22	1,0 - 14,2	6,0	6,0	EI 180

\*distance to next penetration  $\geq 150$  mm; first pipe support  $\geq 250$  mm

### 2.3.2.3 Copper pipes with PUR insulation

Copper pipes are insulated with PUR insulation of density  $39,4\text{kg/m}^3$  ranging in thickness [mm] from 12 mm till up 54 mm (CS).

Copper Service	Pipe diameter $d_c$ [mm]	Pipe wall thickness $t_c$ [mm]	Insulation thickness $t_{DE}$ [mm]		Classification C/U-
			from	to	
PUR insulation *	12 - 54	1,5 - 14,2	10,0	50,0	EI 120

\*distance to next penetration  $\geq 150$  mm; first pipe support  $\geq 250$  mm

### 2.3.3 Steel Pipes

Service	Pipe diameter $d_c$ [mm]	Pipe wall thickness $t_c$ [mm]	Insulation thickness $t_{DE}$ [mm]		Classification C/U	
			from	to	-	AP 2
Steel	10,2 - 60	1 - 14,2	7,5	39,0	EI120	
Steel	60 - 76	1 - 14,2	9,0	40,5	EI 90	EI 120
Steel	76 - 108	1,8 - 14,2	14,0	42,5	EI 90	
Steel	10,2 - 114,3	1 - 14,2	15,5	42,5	EI 120	
Steel <sup>3</sup>	76 - 159	1,8 - 14,2	9,5	45		EI 120
Steel <sup>3</sup>	159 - 323,9	1,8 - 14,2	25	25		EI 120
Steel <sup>4</sup>	76 - 159	1,8 - 14,2	9,0	45	EI 60	
Steel <sup>1,2</sup>	88,9 - 159	2,0 - 14,2	25	80	EI 90	
Steel <sup>1,2,5</sup>	28 - 54	1/2 - 14,2	10	40	EI 90	

<sup>1</sup> separation of pipes to each other or other services 100 mm

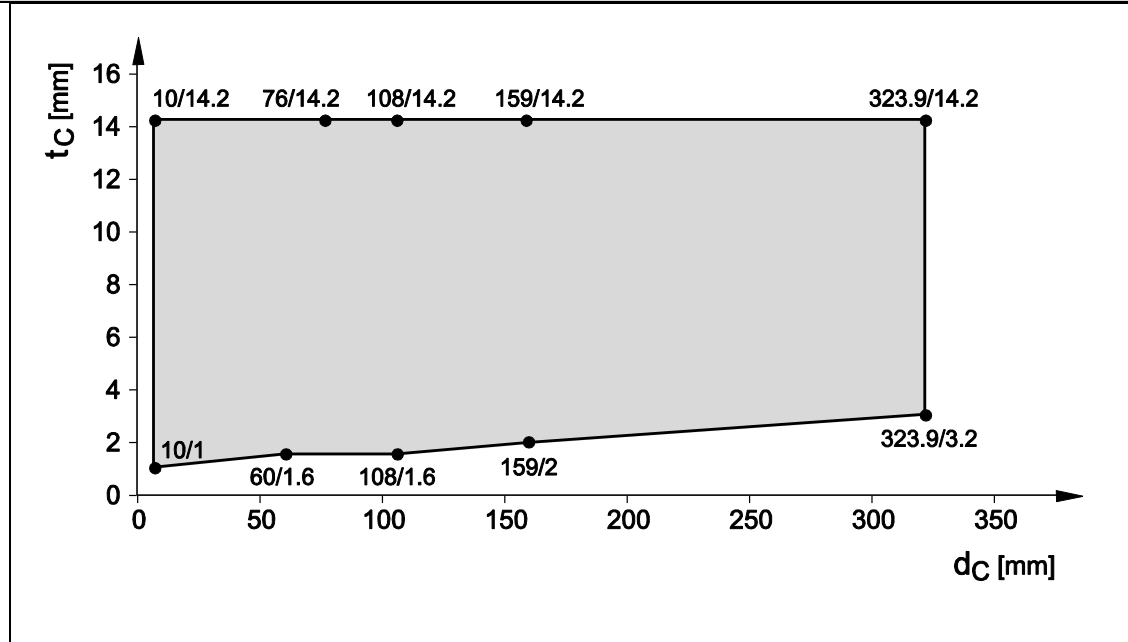
<sup>2</sup> alternative glass fiber wool insulation according Annex C/1.2.2

<sup>3</sup> till  $\varnothing 159$  mm insulation thickness is up to 45mm; pipe diameters above butyl rubber based insulation is 25 mm. AP 2 – Klima Rock Insulation 40mm at a length of 500 mm.

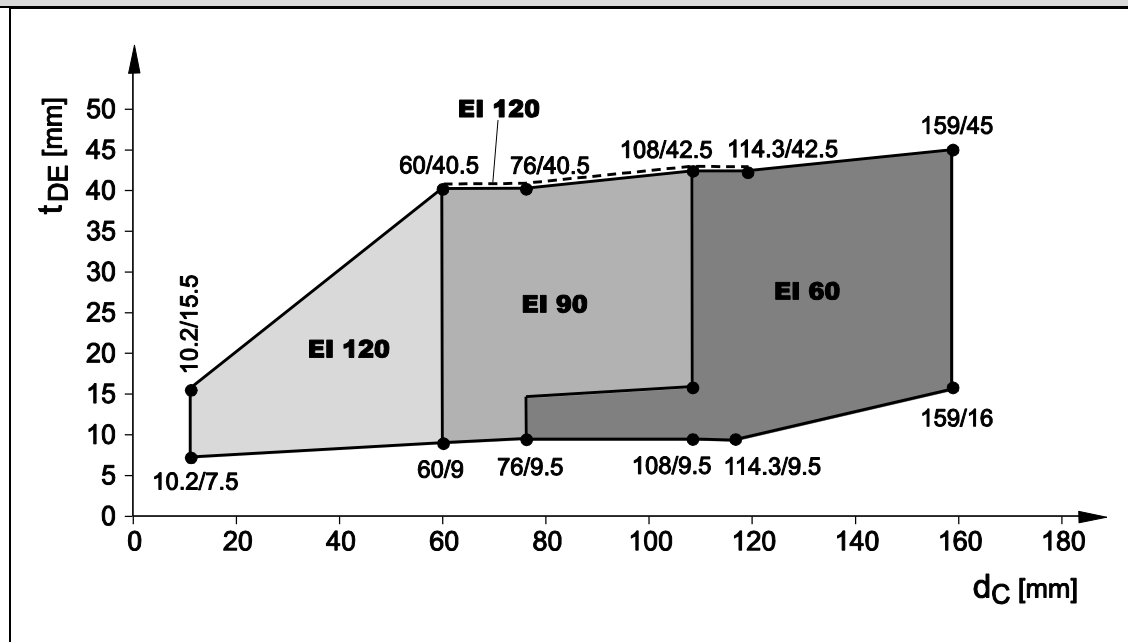
<sup>4</sup> minimal insulation thickness above  $\varnothing 114,3$  mm is increased to 16 mm

<sup>5</sup> with only one wrapping

**Steel pipe, floor ( $\geq 150$  mm) – relation wall thickness towards pipe diameter**  
 Graph shows pipe wall thickness ( $t_c$ ) towards pipe diameter ( $\varnothing d_c$ )



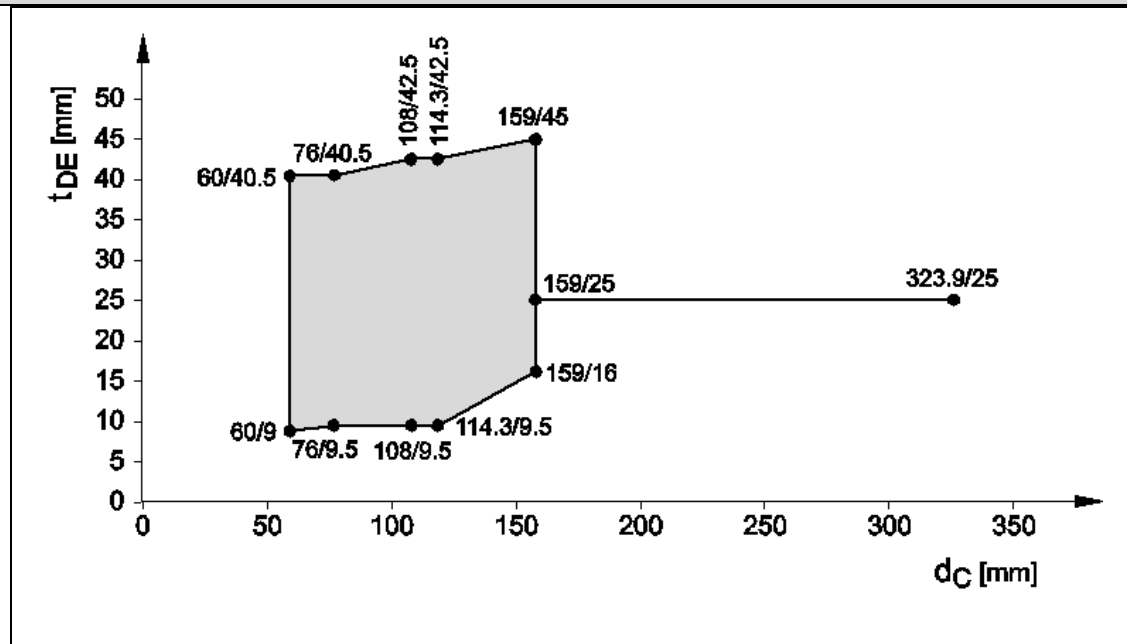
**Steel pipes, floor ( $\geq 150$  mm) – EI 120 / EI 90 / EI 60, C/U**  
 Different insulation thickness results in distinct classifications  
 EI 120 classification is valid for highest insulation thickness up to  $\varnothing 114$  mm (dotted line)  
 Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_c$ )



**Steel pipes, floor ( $\geq 150$  mm) – EI 120, C/U plus AP2**

Pipes insulated with elastic butyl rubber based insulation are additionally protected by AP2 (Klimarock 40 mm)

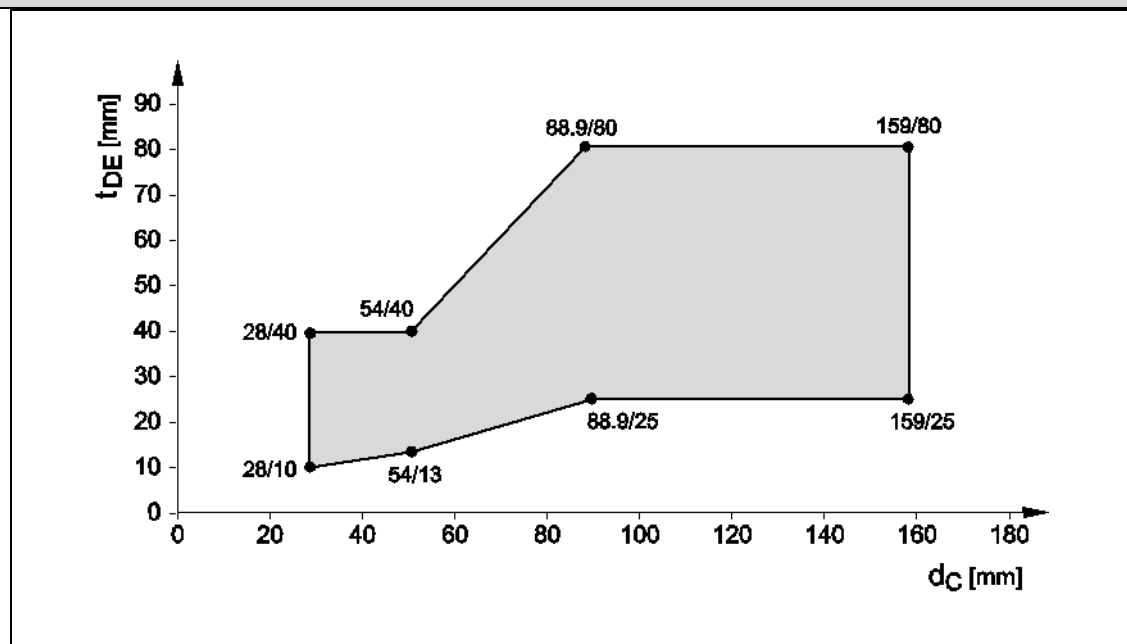
Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )



**Steel pipes ( $\varnothing 28- 88,9$ ), floor ( $\geq 150$  mm) – EI 90, C/U**

Butyl rubber based flexible foam insulation or glass-fiber mineral wool insulation according Annex C/1.2.2

Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )



## 2.3.4 Aluminium Composite Pipes

Aluminium composite pipes were available only at one pipe thickness for each diameter.

### 2.3.4.1 Aluminium Composite Pipes insulated with butyl rubber based flexible foam

Manufacturer	Product name	Pipe diameter dc (mm)	Insulation thickness (mm)		Classification U/C
			from	to	
Fränkische Rohrwerke	Alpex F50 Profi	16 - 40	8,0	36,5	EI 120
		40 - 75	9,0	40,5	EI 90
		75	40,5	40,5	EI 180
Geberit	Mepla	16 - 32	0	0	EI 240 <sup>1</sup>
		16 - 75	8,0	39,5	EI 120
		75	40,5	40,5	EI 180
Georg Fischer	Sanipex	16 - 63	8,0	39,5	EI 120
IVT	PRINETO Stabilrohr	17 - 63	8,0	39,5	EI 120
KeKelit	KELOX KM 110	16 - 75	8,0	40,5	EI 120 <sup>2</sup>
		75	9,5	40,5	EI 180 <sup>2</sup>
Rehau	Rautitan Stabil	16 - 40	8,0	38,5	EI 90
TECE	TECEflex Verbundrohr	16 - 63	8,0	39,5	EI 120
Uponor	Unipipe Plus	16 - 32	8,0	35,0	EI 240 <sup>1</sup>
	Unipipe MLC	16 - 63	8,0	39,0	EI 120
Viega	SANIFIX Fosta-Rohr	16 - 63	8,0	39,5	EI 120
			9,0		
	Raxofix	16 - 63	8,0	39,5	EI 240*

<sup>1</sup> EI 120 for zero distance, 400 mm first support

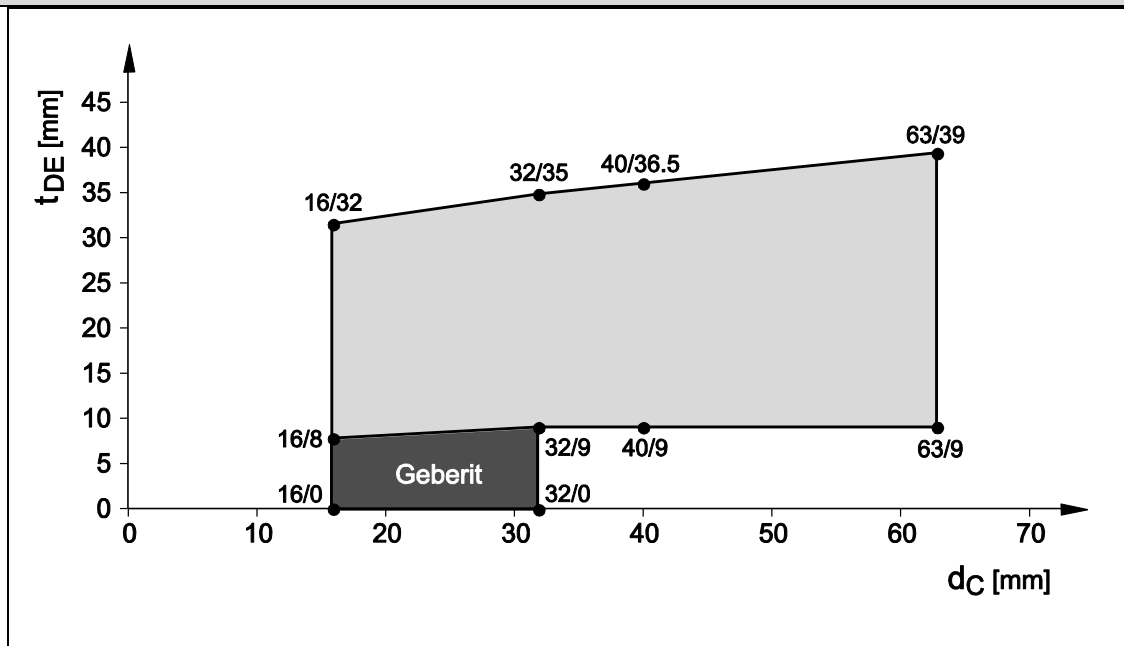
<sup>2</sup> EI 90 for zero distance, 400 mm first support



**Aluminium Composite Pipes, floor ( $\geq 150$  mm) - EI 120, U/C**

**All specimens listed\***

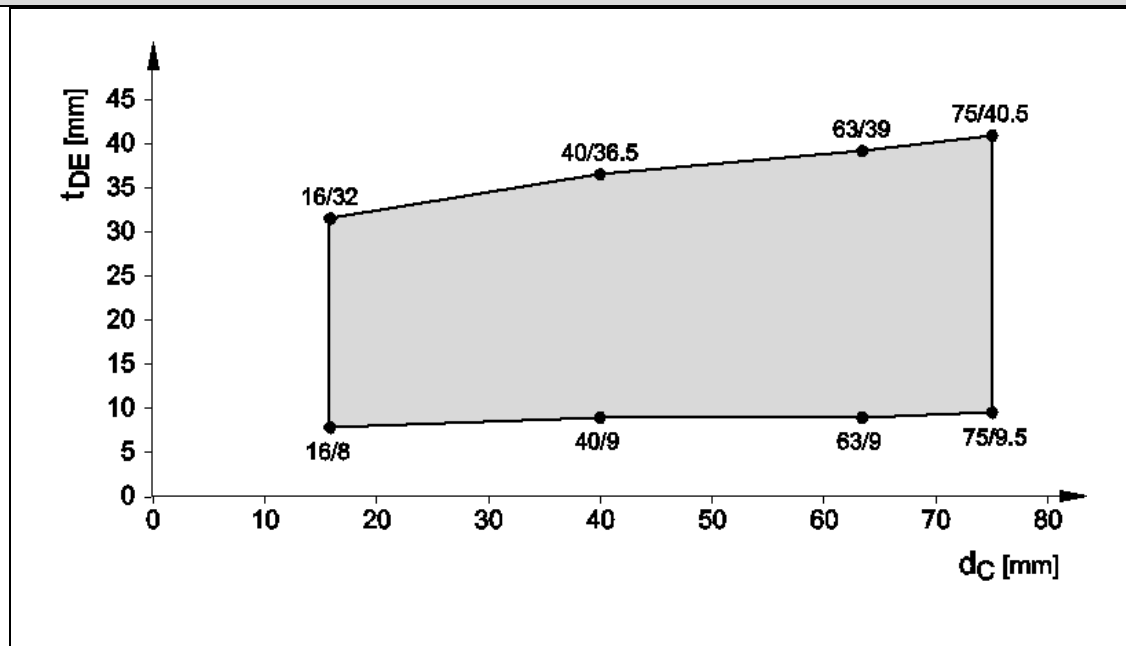
**Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )**



\*Fränkische Rohrwerke only up to  $\varnothing 40$  mm

Graph shows results simplified, for all details see table.

**Aluminium Composite Pipes, floor ( $\geq 150$  mm) EI 90, U/C**  
**for Fränkische Rohrwerke, Geberit, Kekelit**  
**Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_C$ )**



### 2.3.4.2 Aluminium Composite Pipes insulated with protection pipe and or pre-insulated closed-cell PE foam

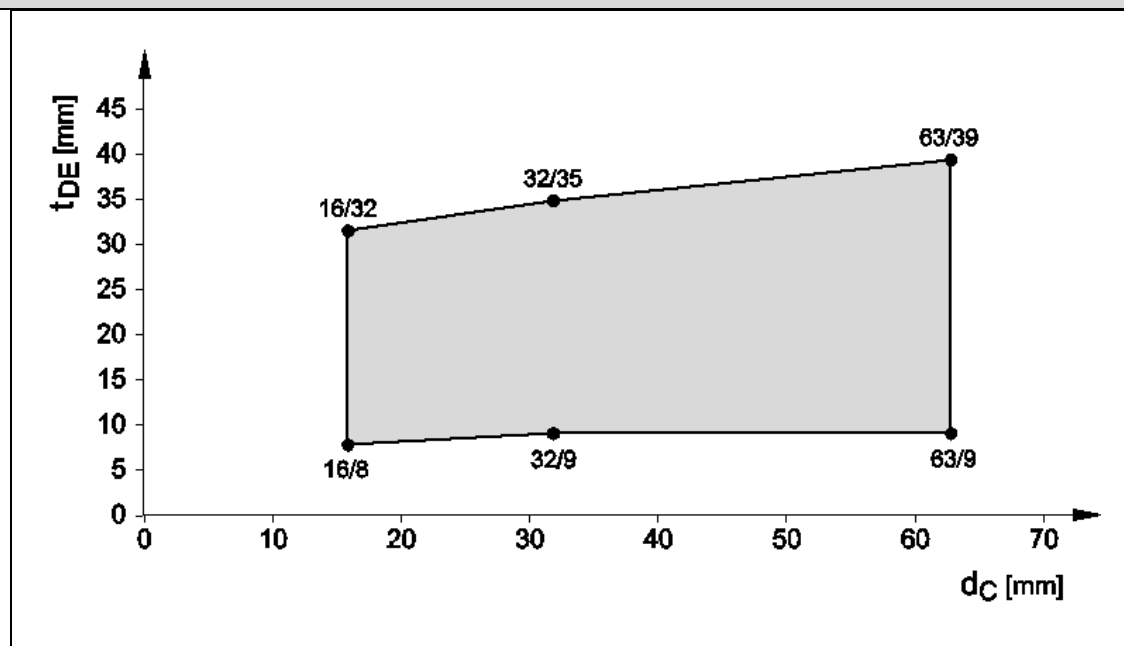
Manufacturer	Product name	Pipe diameter $r$ $d_C$ (mm)	Insulation thickness (mm)		Classification U/C
			From	To	
<b>Geberit*</b>	Mepla pre-insulated	16 - 26	6,0	13,0	EI 120
<b>KeKelit Kelox</b>	Pro KM 130	14 - 32	9,0	9,0	EI 120
	Plus KM 134	14 - 32	4,0	9,0	EI 120
	Pro KM 140	16 - 20	PE HD	tube	EI 120
	Plus KM 144	16 - 20	4+ PE	HD tube	EI 120
<b>Uponor</b>	Unipipe plus	16 - 25	4,0	10,0	EI 120
	Unipipe MLC	16 - 20	PE HD	tube	EI 120

## 2.3.5 Plastic pipes

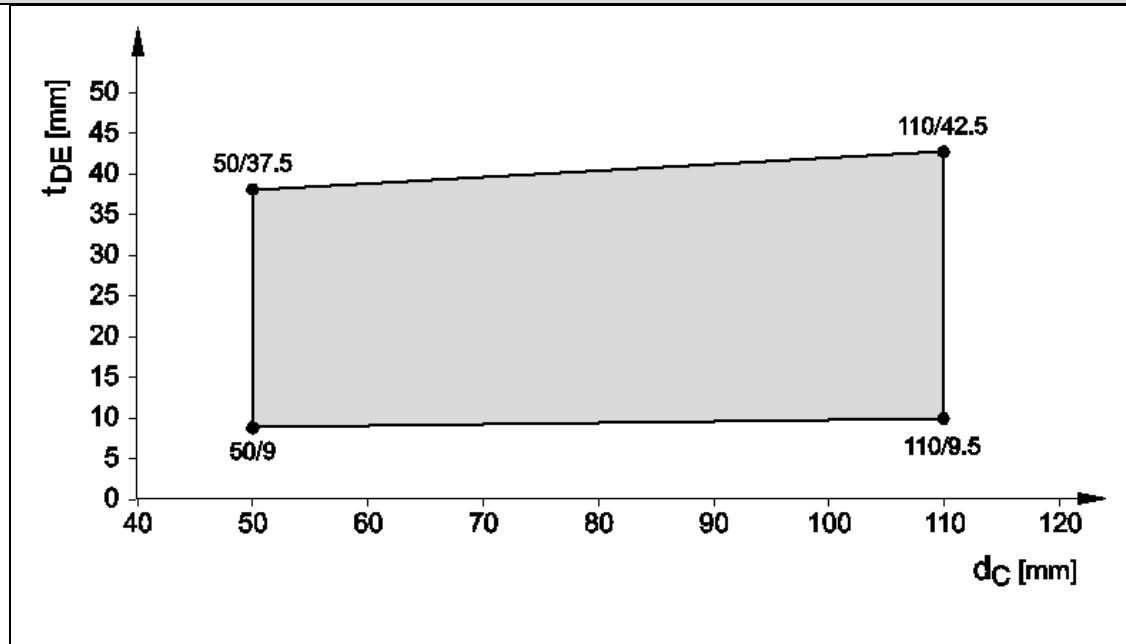
### 2.3.5.1 Plastic pipes made of PE-Xa (EN ISO 15875) and PE (EN 12201-2)

Service	Pipe diameter $d_c$ [mm]	Pipe wall thickness $t_c$ [mm]	Insulation thickness $t_{DE}$ [mm]		Classification
			from	to	
PE-Xa Rautitan Flex	16 - 63	2,2 - 8,6	8,0	39,0	EI 180
PE / XSC 50 Wavin TS PE 100	50 - 110	4,6 - 10	9,0	42,5	EI 180

Plastic pipes PE-X according EN ISO 15875, floor ( $\geq 150$  mm) - EI 180, U/C  
Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\emptyset d_c$ )



**Plastic pipes PE-HD according EN 12201-2, floor ( $\geq 150$  mm) - EI 180, U/C**  
**Graph shows approved insulation thickness ( $t_{DE}$ ) at certain pipe diameter ( $\varnothing d_c$ )**



### 2.3.5.2 Plastic pipes made of PP-R

Plastic pipes are continued, sustained (CS) insulated with elastomeric thermal foam

Manu- facturer	Product name	Pipe diameter $d_c$ (mm)	Wall thickness (mm)	Insulation thickness (mm)		Classification U/C
				From	To	
Aquatarm	Green <sup>1,3</sup>	20 - 110	1,9 - 10	8,0	40,5	EI 240*
	Blue <sup>1,3</sup>	20 - 110	1,9 - 10	8,0	40,5	EI 240*
Poloplast	Polo-Polymutan ML5 <sup>2</sup>	20 - 75	2,8 - 10,3	8,0	40,5	EI 240*
	Polo-Polymutan <sup>3</sup>	20 - 75	1,9 - 6,8	8,0	40,5	EI 240*
	Polo-Tersia <sup>3</sup>	20 - 75	1,9 - 12,5	8,0	40,5	EI 240*
Kekelit Ketrix	Cryolen Polyolefinblend <sup>1</sup>	20 - 75	1,9 - 6,8	8,0	40,5	EI 240*

\* for zero distance and / or 400 mm first pipe support classification is EI 120 U/C

<sup>1</sup> according EN 15874

<sup>2</sup> according ISO 21003

<sup>3</sup> according DIN 8077/78

# Annex D

## Abbreviations used in drawings

Abbreviation	Description
A	Hilti Firestop Bandage CFS-B
A <sub>1</sub>	Annular gap seal with Hilti Firestop Acrylic Sealant CFS-S ACR
A <sub>2</sub>	Annular gap seal with gypsum plaster
A <sub>3</sub>	Annular gap seal with cementitious mortar acc. EN 998-2, group at least M2
C	Service (metal, composite, plastic pipes)
D <sub>E</sub>	Pipe insulation, combustible, butyl based elastomeric foamed material
d <sub>c</sub>	Pipe diameter (nominal outside diameter)
E	Building element (wall, floor)
S <sub>1</sub>	Minimum distance between single insulated pipes
S <sub>2</sub>	Minimum distance between clustered pipes
S <sub>3</sub>	Minimum distance between penetrating pipe and building element
S <sub>4</sub>	Minimum distance between single insulated pipes and Collar CFS-C SL
S <sub>5</sub>	Minimum distance between single insulated pipes and Conlit shell or Klimarock
t <sub>C</sub>	Pipe wall thickness
t <sub>DE</sub>	Insulation thickness
t <sub>E</sub>	Thickness of the building element
L <sub>D</sub>	Length of Insulation
AP1	Additional protection by elastomeric, butyl rubber based insulation
AP2	Additional protection by mineralwool (Klimarock)
AP3	Additional protection by beading / outside framing

## List of approved elastomeric butyl rubber based foam insulations:

Producer	Approved Type of foamed elastomeric thermal isolation
Armacell GmbH	<ul style="list-style-type: none"> <li><sup>2</sup>Armaflex AF, <sup>3,4</sup>Armaflex SH, <sup>1</sup>Armaflex Ultima, <sup>6</sup>Armaflex HT</li> </ul>
NMC Group	<ul style="list-style-type: none"> <li><sup>3</sup>Insul-Tube (nmc), <sup>3</sup>Insul-Tube H-Plus (nmc),</li> </ul>
Kaimann GmbH	<ul style="list-style-type: none"> <li><sup>2</sup>Kaiflex KK plus, <sup>4</sup>Kaiflex KK,</li> </ul>
L'Isolante K-Flex	<ul style="list-style-type: none"> <li><sup>1</sup>Isolante K-Flex HT, <sup>5</sup>Isolante K-Flex ECO, <sup>2</sup>Isolante K-Flex ST, <sup>3</sup>Isolante K-Flex H, <sup>2</sup>Isolante K-Flex ST Plus</li> </ul>

<sup>1</sup>B<sub>L</sub>-s1, d0; <sup>2</sup>B<sub>L</sub>-s2, d0; <sup>3</sup>B<sub>L</sub>-s3, d0; <sup>4</sup>C<sub>L</sub>-s3, d0; <sup>5</sup>D<sub>L</sub>-s2, d0; <sup>6</sup>D<sub>L</sub>-s3, d0 according EN 13501-1