Fire technical assessment

Name of sponsor:	**SAINT-GOBAIN ISOVER**		
Product name:	Circular steel ventilation duct systems insulated with U Protect Wired Mat 4.0		
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Introduction

This report presents an appraisal of the fire resistance performance of ISOVER insulated horizontal and vertical circular steel ventilation duct systems for internal duct diameters up to 1000 mm, and for other modifications and alternative construction details as listed in the following.

Standard solution to circular fire resistant ventilation ducts:

- Steel duct
  - Duct sections
  - Stiffening system
  - Duct joints.

- Insulation
  - Type
  - Fixation
  - Aluminum facings

- Penetration
  - Standard rigid wall penetration
  - Standard flexible wall penetration
  - Standard penetration for vertical circular ducts

Alternative solutions to circular fire resistant ventilation ducts:

- Simplified penetration for horizontal and vertical circular ducts up to a resistance to fire time of 60 minutes.
- Use of double layer insulation solution
- Additional insulation on top of fire resistance insulation
- Circular ducts installed close to walls or floors

Solution to circular smoke extraction ventilation ducts

Alternative solutions to circular smoke extraction ventilation ducts

The proposed duct assemblies are required to provide a fire resistance of up to 120 minutes in terms of the integrity [E], insulation [I] and smoke leakage [S] criteria, in horizontal [ho] and vertical [ve] direction for the fire scenarios *fire from inside to outside* and *fire from outside to inside* [i ↔ o] as specified in EN 1366-1:2014 *Fire resistance for service installations - Part 1. Ventilation ducts*.

For the fire from outside to inside scenario, the system is applicable for an under-pressure up to 300 Pa.

The proposed duct assemblies can also be used for multi-compartment smoke extraction ducts as specified in EN 1366-8:2004 *Fire resistance for service installations - Part 8. Smoke extraction ducts,* as specified under the chapter *Solutions to circular smoke extraction ventilation ducts*

This appraisal consists of a main part, that describes the fire resistant ventilation system and the possible variations, technical drawings and specifications, and an annex A that presents the technical arguments for the appraised variations.

Standard system for fire resistant circular ducts

Steel duct sections

Duct: Duct sections made of spiral folded hot dipped galvanised steel plates
With tightness class D, according to EN 12237.

Minimum steel thickness 0.7 mm.

Duct joint: The circular duct sections should be connected using steel nipples. The nipple should in both ends be fitted with a sealing strip of EPDM-rubber and a 20 x 3 mm inorganic chemistry tape.

The duct sections should be fixed to the nipples using self tapping screws c/c 150 mm.

Duct stiffening: For the scenario fire from outside to inside (duct A) a steel duct stiffening shall be added for 120 minutes resistance to fire.

The exterior of the steel duct is stiffened using steel flanges with minimum dimensions 40 x 5 mm. The flanges are positioned around the duct, midway between the hangers. It is not needed to fix the flanges mechanically to the steel duct in any way.

Suspension system

Hangers: Steel drop rods. The tension in the rods in cold condition should not exceed:

9 N/mm² for resistance to fire times equal to or lower than 60 minutes and
6 N/mm² for resistance to fire times higher than 60 minutes.

The maximum distance between the suspensions should not exceed 1500 mm.

Support profile: Profiles made from minimum 2 x 25 mm galvanized steel plates.

Cladding

Insulation: Mineral wool mat designated U Protect Wired Mat 4.0 with nominal density 66 kg/m^3.

The minimum thickness needed for the different application is:

Ducts penetrating rigid supporting construction:

Horizontal or vertical duct B, EI xx (ve ho i → o)

Insulation Thickness [mm]	35	50	60	75	95	115
RF -time [minutes]	15	30	45	60	90	120

Horizontal or vertical duct A, EI xx (ve ho o → i)

Insulation Thickness [mm]	30	30	30	60	90	100*
RF -time [minutes]	15	30	45	60	90	120

Ducts penetrating flexible supporting construction:

Horizontal, duct B, EI xx (ho i → o)

Insulation Thickness [mm]	35	50	60	80	100	125
RF -time [minutes]	15	30	45	60	90	120

Horizontal, duct A, EI xx (ho o → i)

Insulation Thickness [mm]	30	30	30	60	90	100*
RF -time [minutes]	15	30	45	60	90	120

*Steel ducts must be fitted with flanges

Ducts penetrating rigid or flexible supporting construction (all applications)

Horizontal or vertical direction, duct type A or B, EI xx (ve ho o ↔ i)

Insulation Thickness [mm]	35	50	60	80	100	125
RF -time [minutes]	15	30	45	60	90	120

For all resistance to fire times the smoke criterion (S) is also fulfilled with the thicknesses listed above.

Fixing: The insulation is fixed by winding steel wire around the edges of the wire net.

or

by using C-rings or hooks made of galvanized steel with a diameter 2 mm on condition that the distance between fixation points is set to maximum 6 wire net masks (a distance of approx. 150 mm).

Facing: Black reinforced aluminium foil type Alu1 or Glass tissue type V1 can be added to the surface of the insulation.

The insulation with aluminium foil is named U Protect Wired Mat 4.0 Alu1

The insulation with glass tissue is named U Protect Wired Mat 4.0 V1

Joints between wired mats can be covered with ISOVER Protect Black Tape.

Penetration through rigid walls

Distance:	The distance from the steel duct to the penetrated wall cannot exceed 50 mm but can be decreased.
Wall:	Rigid walls with density higher than 575 kg/m³ and a resistance to fire equal to or greater than the resistance to fire of the ducts. For ducts with fire resistance equal to or lower than 90 minutes, the wall thickness must be minimum 100 mm. For ducts with fire resistance of 120 minutes, the wall thickness must be minimum 150 mm.
Drawing:	The penetration must be constructed as shown on enclosure 1.1 and the part list on enclosure 1.0

Penetration through flexible walls

Distance:	The distance from the steel duct to the penetrated wall can not exceed 50 mm but can be decreased.
Wall:	Flexible walls consisting of steel studs with boards on both sides with a resistance to fire equal to or greater than the resistance to fire of the ducts.
Drawing:	The penetration must be constructed as shown on enclosure 1.1 and the part list on enclosure 1.0

Penetration through rigid floors

Distance:	The distance from the steel duct to the penetrated floor can not exceed 50 mm but can be decreased.
Floor:	The duct can penetrate rigid floors with density higher than 575 kg/m³ and a resistance to fire equal to or greater than the resistance to fire of the duct and a thickness equal to or greater than 150 mm.
Drawing:	The penetration must be constructed as shown on enclosure 1.2 and the part list on enclosure 1.0

Alternative solutions for circular fire resistant duct system

This chapter describes alternative solutions that can be used in combination with the standard system for circular ducts, on the conditions required for each of the solutions.

Simplified penetration seals for horizontal and vertical circular ducts
The simplified penetration seals described in the following two tables and shown on enclosure no. 1.3 and 1.4 can be used for insulated circular steel duct with fire resistance up to and including 60 minutes. The duct can be installed in horizontal direction or vertical direction, penetrating a rigid supporting construction.

Simplified penetration through rigid walls

Distance:	The distance from the steel duct to the penetrated wall cannot exceed 20 mm but can be decreased.
Wall:	Rigid walls with density higher than 575 kg/m³ and a resistance to fire equal to or greater than the resistance to fire of the ducts. The wall thickness must be minimum 100 mm.
Drawing:	The penetration must be constructed as shown on enclosure 1.3 and the part list on enclosure 1.0

Simplified penetration through rigid floors

Distance:	The distance from the steel duct to the penetrated floor can not exceed 20 mm but can be decreased.
Floor:	The duct can penetrate rigid floors with density higher than 575 kg/m³ and a resistance to fire equal to or greater than the resistance to fire of the duct and a thickness equal to or greater than 150 mm.
Drawing:	The penetration must be constructed as shown on enclosure 1.4 and the part list on enclosure 1.0

Use of double layer insulation
A double insulation layer solution can be used for the insulation described under Cladding for Standard system for fire resistant circular ducts on the following conditions:

- The total thickness of the double layer is equal to or larger than the thickness of the single layer.
- A distance of minimum 200 mm is used between the joints in the two layers.

Additional insulation on top of the fire protection insulation
Additional insulation can be added on top of the fire protection insulation for the standard system under the following conditions:

- The additional insulation fulfils the requirements for an A2-s1,d0 material.
- The additional insulation is mounted independently of the fire protection insulation.
- The weight of the additional insulation shall not subject the suspension devices to a higher tensile or shearing stress than specified for the hangers as described under the standard system.

Circular ducts installed close to walls or floors
The specific installations described in the following should be used when the distance to the wall or floor is less than 200 mm which prevents the standard installation for circular ducts.

The solution for circular ducts installed close to walls or floors is divided into two options.
Option 1, when the distance from the wall or floor is between 200 mm to insulation thickness (with this distance it is still possible the wrap the insulation all the way around the duct) and option 2, when the distance from the wall or floor is equal to or less than insulation thickness.

Option 1 Distance from the wall or floor between 200 mm to insulation thickness
The drawings for this solution are shown in enclosure 1.5 and 1.6.

For ducts with internal diameter more than 400 mm the solution shown on enclosure 1.5 should be used.

The duct is fixed to the aperture wall using two sets of suspension profiles with steel angles fixed to the duct with self drilling screws (not screwed to the wall but only to the duct).

If it is possible to work from the inside of the duct, the duct can be fixed to the aperture wall as shown on enclosure 1.9 using M8 x 50mm bolts and nuts, casted into the mortar.

For ducts with diameter equal to or less than 400 mm, the fixation from the mortar is sufficient to hold the duct, and the suspension profile and steel angles can therefore be omitted.
The solution is shown on enclosure 1.6.

The insulation is fixed to the aperture wall using ISOVER Protect BSK for all duct diameters.

Because of lack of installation space, situations can occur, where the insulation joints perpendicular to the duct direction can not be stitched together all the way around. In this situation, the joint shall be stitched together for the length possible. In this case, it shall be secured that the wall and floor surface have reaction to fire properties as minimum classification B-s1,d0.

Option 2 Distance from the wall or floor equal to or less than the insulation thickness
The drawings for this solution are shown in enclosure 1.7 and 1.8.

For ducts with internal diameter more than 400 mm, the solution shown on enclosure 1.7 should be used.

The duct is fixed to the aperture wall using two sets of suspension profiles with steel angles fixed to the duct with self drilling screws.

If it is possible to work from the inside of the duct, the duct can be fixed to the aperture wall as shown on enclosure 1.9 using M8 x 50mm bolts and nuts, casted into the mortar.

For ducts with diameter equal to or less than 400 mm, the fixation from the mortar is sufficient to hold the duct, and the suspension profile and steel angles can therefore be omitted.
The solution is shown on enclosure 1.8.

Because the distance to the wall or floor may not allow the insulation to be warped all around the duct, it should be glued to the wall or floor as shown on enclosure 1.7 and 1.8. The width of the glue band should be equal to minimum the thickness of the insulation. The insulation should be fixed to the duct using steel welding pins positioned with c/c 300 mm in the longitudinal direction of the ducts. This apply for all duct diameters.

The insulation is fixed to the aperture wall using ISOVER Protect BSK for all duct diameters.

Because a part of the steel duct is uninsulated, the wall and floor "seeing" the steel duct must have a minimum resistance to fire EI classification equal to that of the duct.

In addition to the fixations methods shown on enclosure no. 1.5 – 1.8, the suspension profiles used can be exchanged with internally fixed bolts as shown on enclosure 1.9.

Standard system for circular smoke extraction ducts

This chapter describes a standard system for circular multi-compartment smoke extraction ducts with pressure level 2.
The smoke extraction duct equals the standard system for fire resistant ducts with the exception that the flanges shall be used for all resistance to fire times.

Duct stiffening: The exterior of the steel duct is stiffened using steel flanges with minimum dimensions 40 x 5 mm. The flanges are positioned around the duct, midway between the hangers. It is not needed to mechanical fix the flanges to the steel duct in any way.

Alternative solutions for circular smoke extraction ducts

This chapter describes alternative solutions that can be used in combination with the standard system for circular multi-compartment smoke extraction ducts, on the conditions required for each of the solutions.

All the alternative solutions described for fire resistant circular ducts apply to circular smoke extraction ducts with the exception of.

- Circular ducts installed close to walls or floors

Remarks

This assessment is issued on the basis of test data and information to hand at the time of issue. If contradictory evidence becomes available to the assessing authority the assessment will be unconditionally withdrawn and the applicant will be notified in writing. Similarly the assessment is invalidated if the assessed construction is subsequently tested since actual test data is deemed to take precedence over an expressed opinion. This assessment is only valid for a period of 5 years, after which time it is recommended that it be submitted to the assessing authority for re-appraisal.

This assessment is only valid for the country where it is produced and as far as national rules are satisfied. Validity in other countries is subject to acceptance by the relevant national authorities/regulations.

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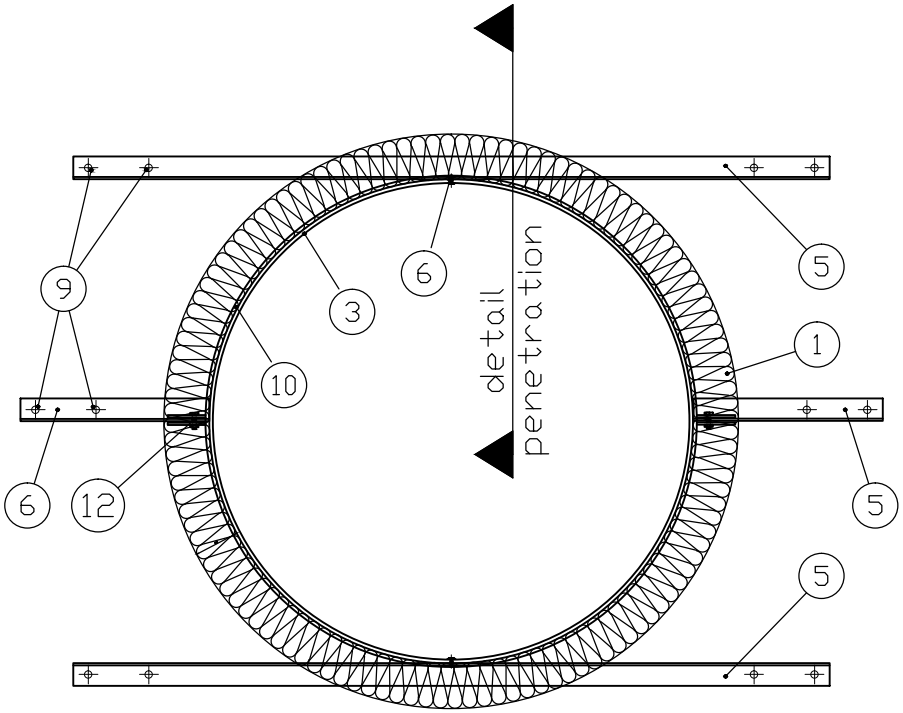
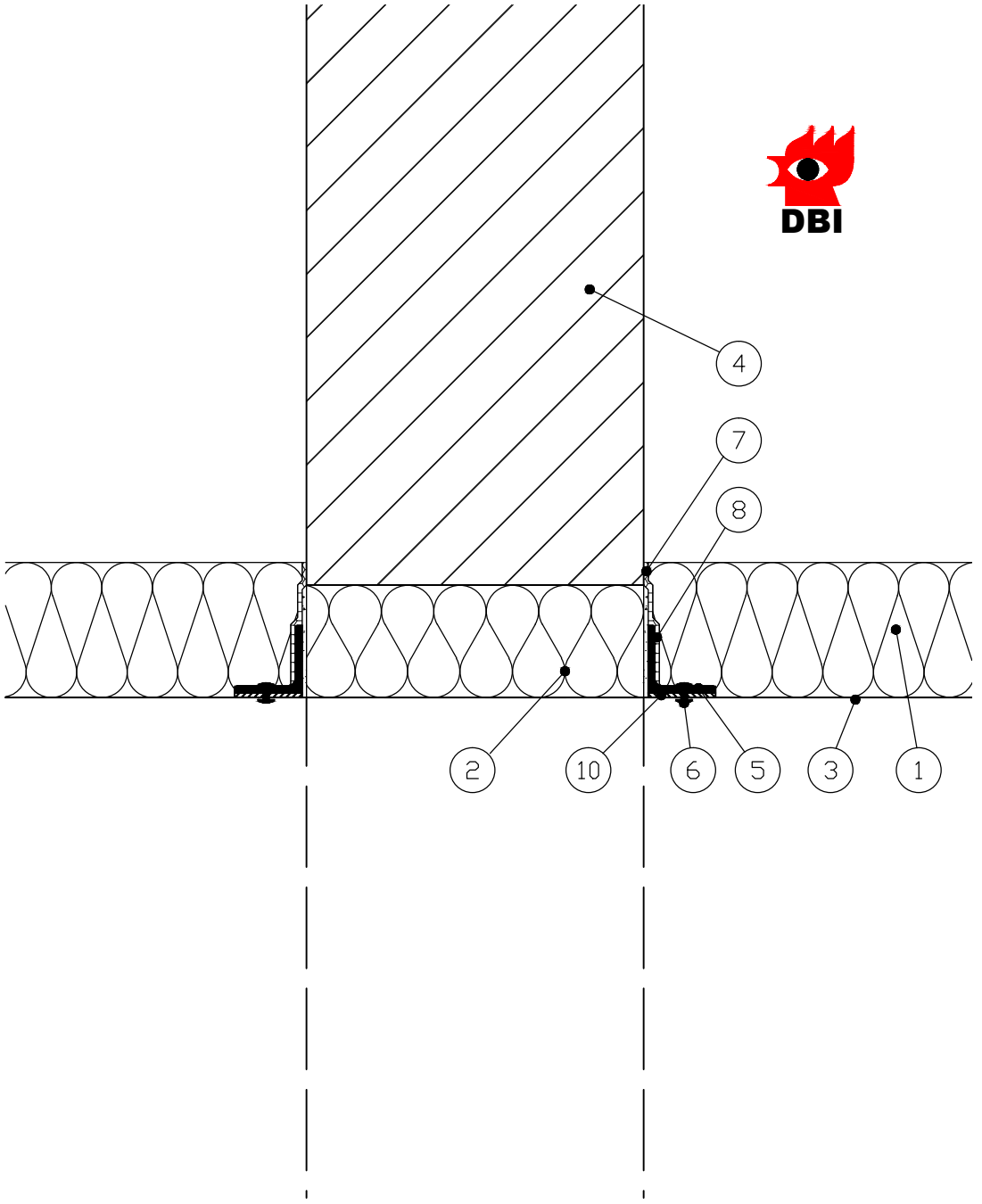
Part list for circular duct system

Part list for drawings1.1 – 1.4

Number	Description	Specification
1	Insulation	U Protect wired mat 4.0, nominal density 66kg/m^3
2	Insulation	U Protect wired mat 4.0, nominal density 66kg/m^3 Compressed
3	Ventilation duct	Steel duct, thickness 0.7 mm
4	Wall	Rigid wall: Rigid wall construction density higher than 575 kg/m^3 and a resistance to fire equal to or greater than the resistance to fire of the ducts. For ducts with fire resistance equal to or lower than 90 minutes the wall thickness must be minimum 100 mm. For ducts with fire resistance of 120 minutes the wall thickness must be minimum 150 mm. Or Flexible wall: Flexible walls complying with type A, B or C as defined in EN 1363-1:2012 and with a resistance to fire equal to or greater than the resistance to fire of the ducts.
5	L-profile	Steel, 30 × 30 × 3 mm
6	Rivet/Screw	Steel, 3.2 ×10 mm or Self drilling screws
7	Intumescent paint	ISOVER Protect BSF Application thickness ≥ 2 mm
8	Glue	ISOVER Protect BSK
9	Screw	Steel, 7.5 × 60 mm (for rigid walls) or Hollow wall anchor, M6 x 65/34 mm, steel (for flexible walls)
10	Support profile	2 x 25 mm galvanized steel plates
11	floor	The duct can penetrate rigid floors with density higher than 575 kg/m^3 and a resistance to fire equal to or greater than the resistance to fire of the duct and a thickness equal to or greater than 150 mm
12	Bolts	M8 Steel bolt





All measurements are in mm

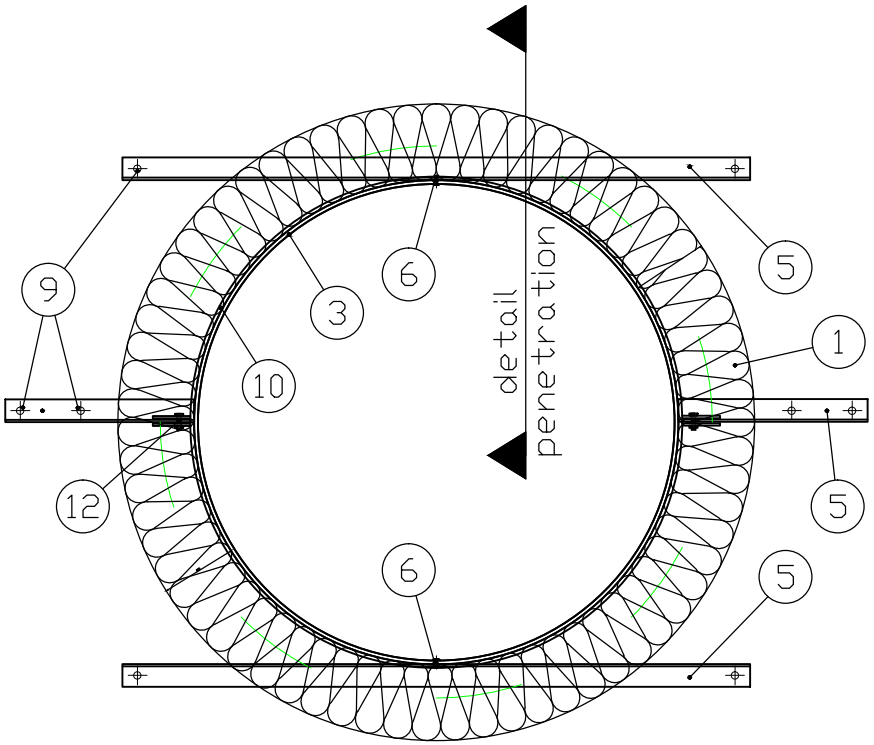
Danish Institute of Fire and security Technology

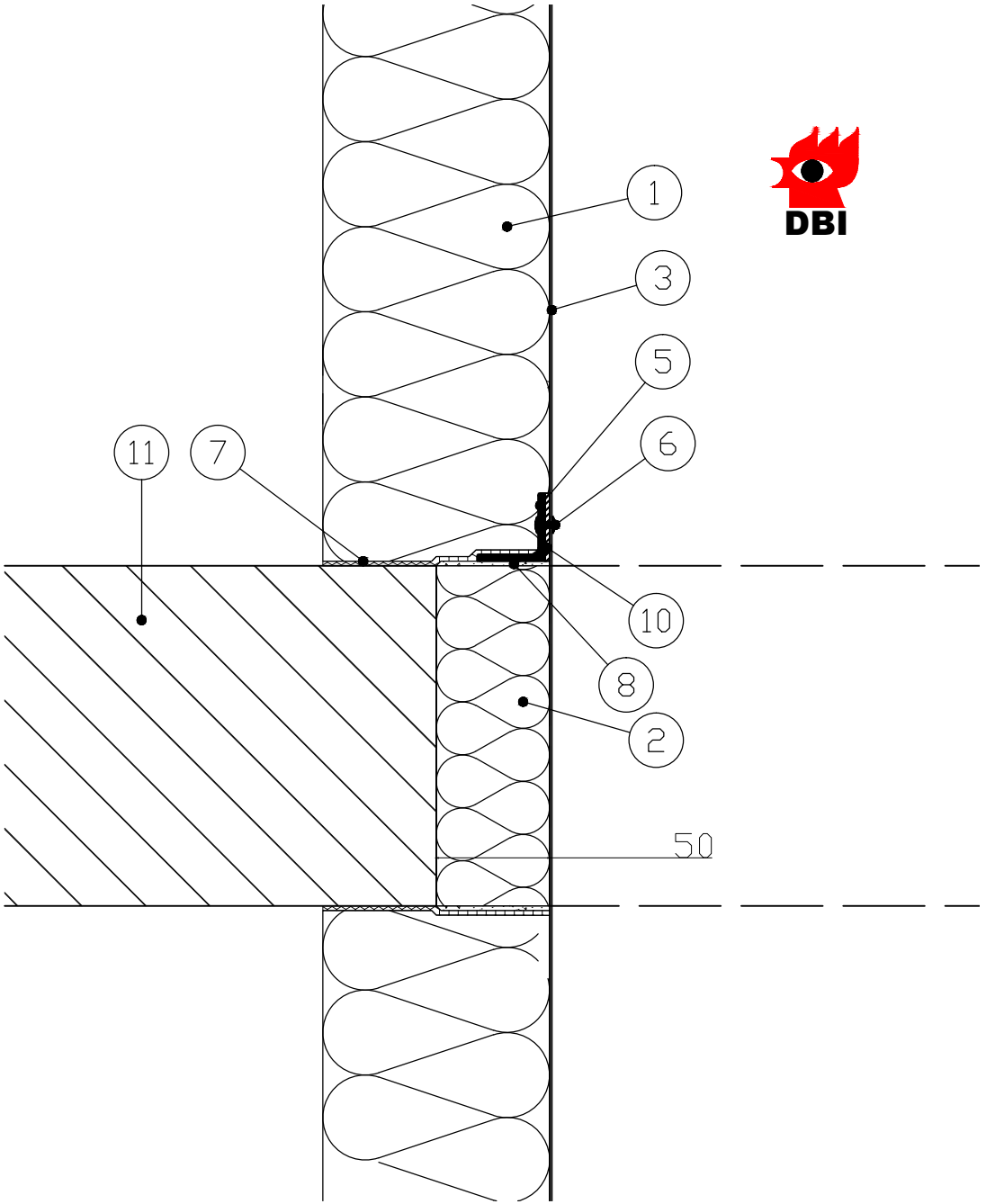
File No.: PHA10683B

Sponsor: Saint Gobain Isover

Subject: Penetration seal for horizontal ducts

Enclosure: 1.1





All measurements are in mm

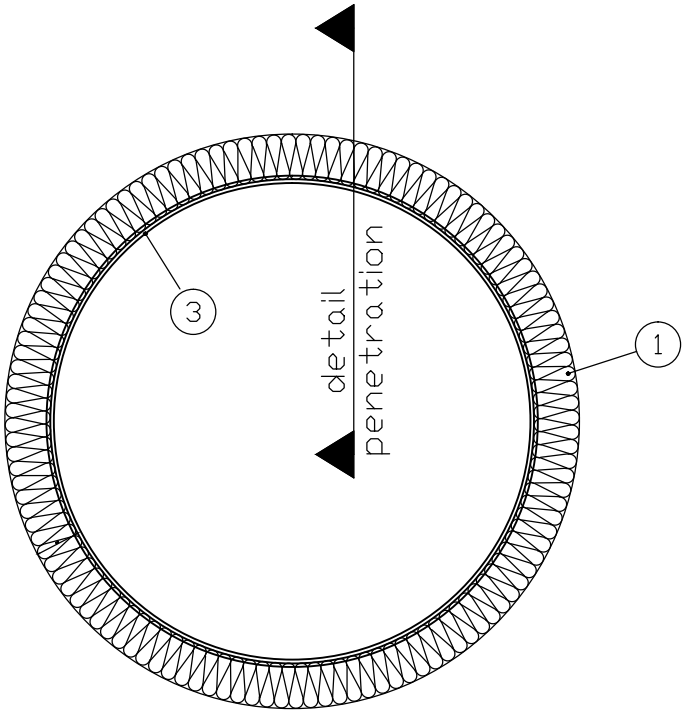
Danish Institute of Fire and security Technology

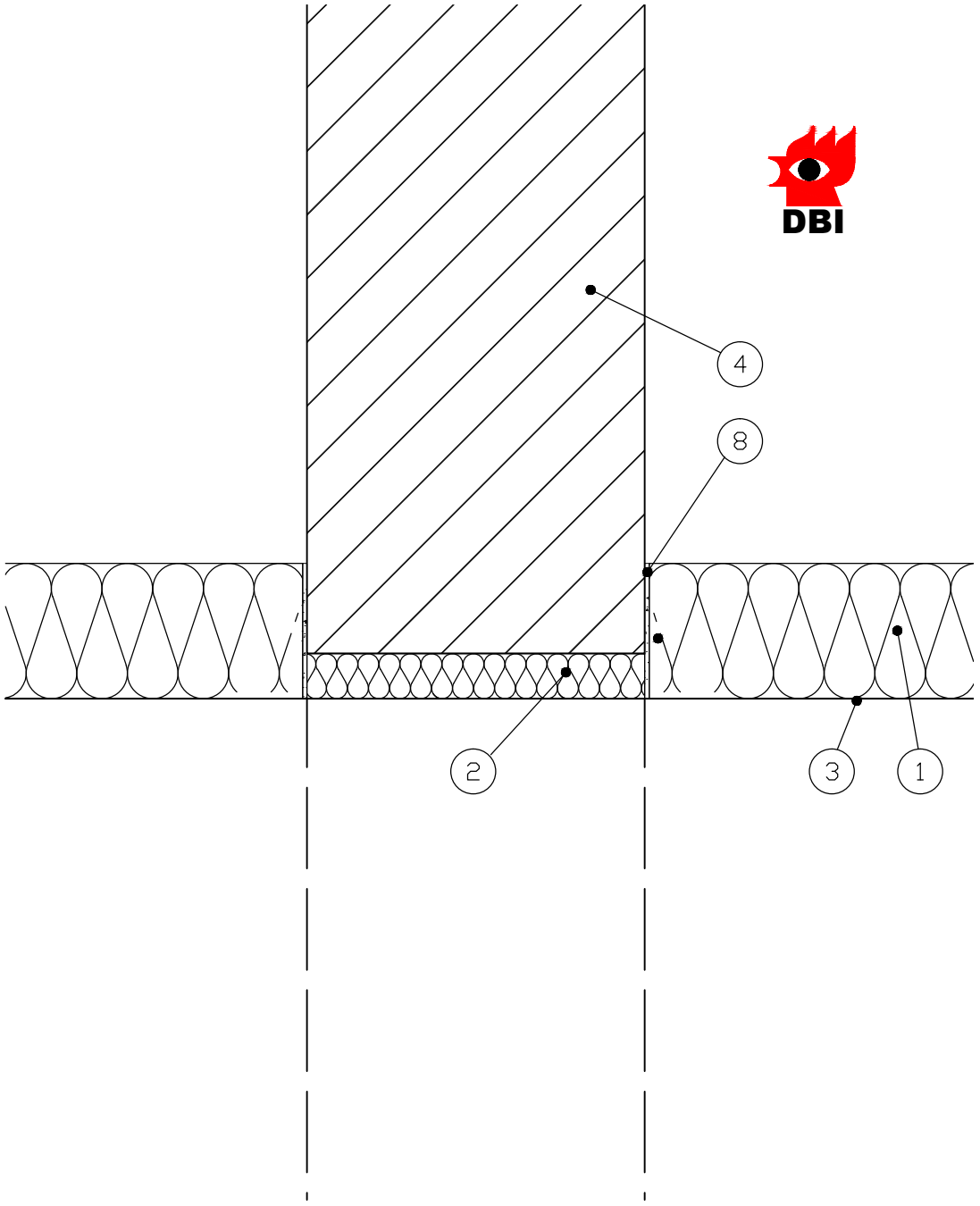
Sponsor: Saint Gobain Isover

Subject: Penetration seal for vertical ducts

File No.: PHA10683B

Enclosure: 1.2





All measurements are in mm

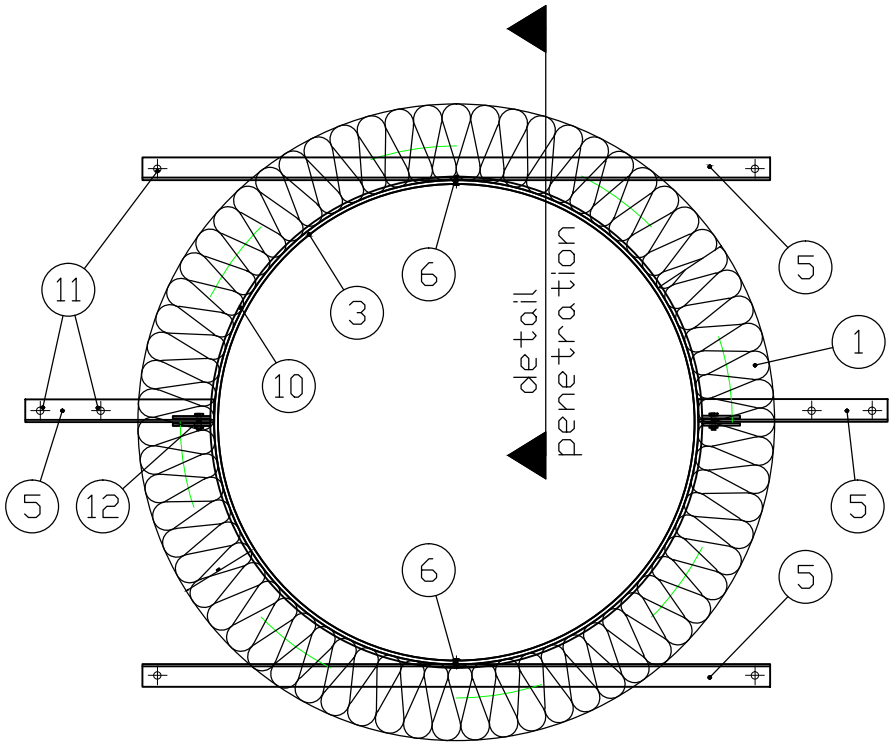
Danish Institute of Fire and security Technology

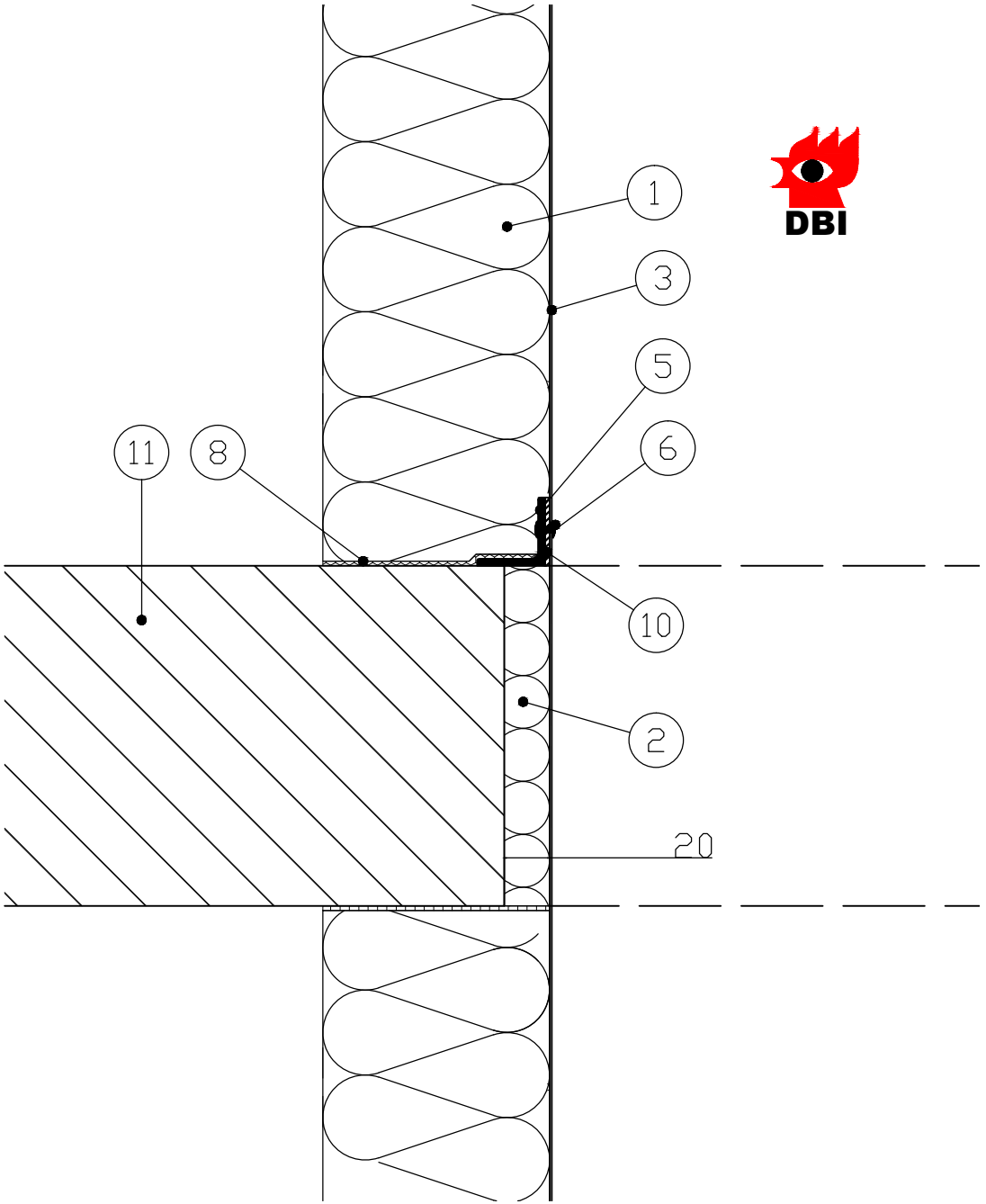
File No.: PHA10683B

Sponsor: Saint Gobain Isover

Subject: Simplified penetration seal for horizontal ducts

Enclosure: 1.3





All measurements are in mm

Danish Institute of Fire and security Technology

Sponsor: Saint Gobain Isover

Subject: Simplyfied penetration seal for vertical ducts

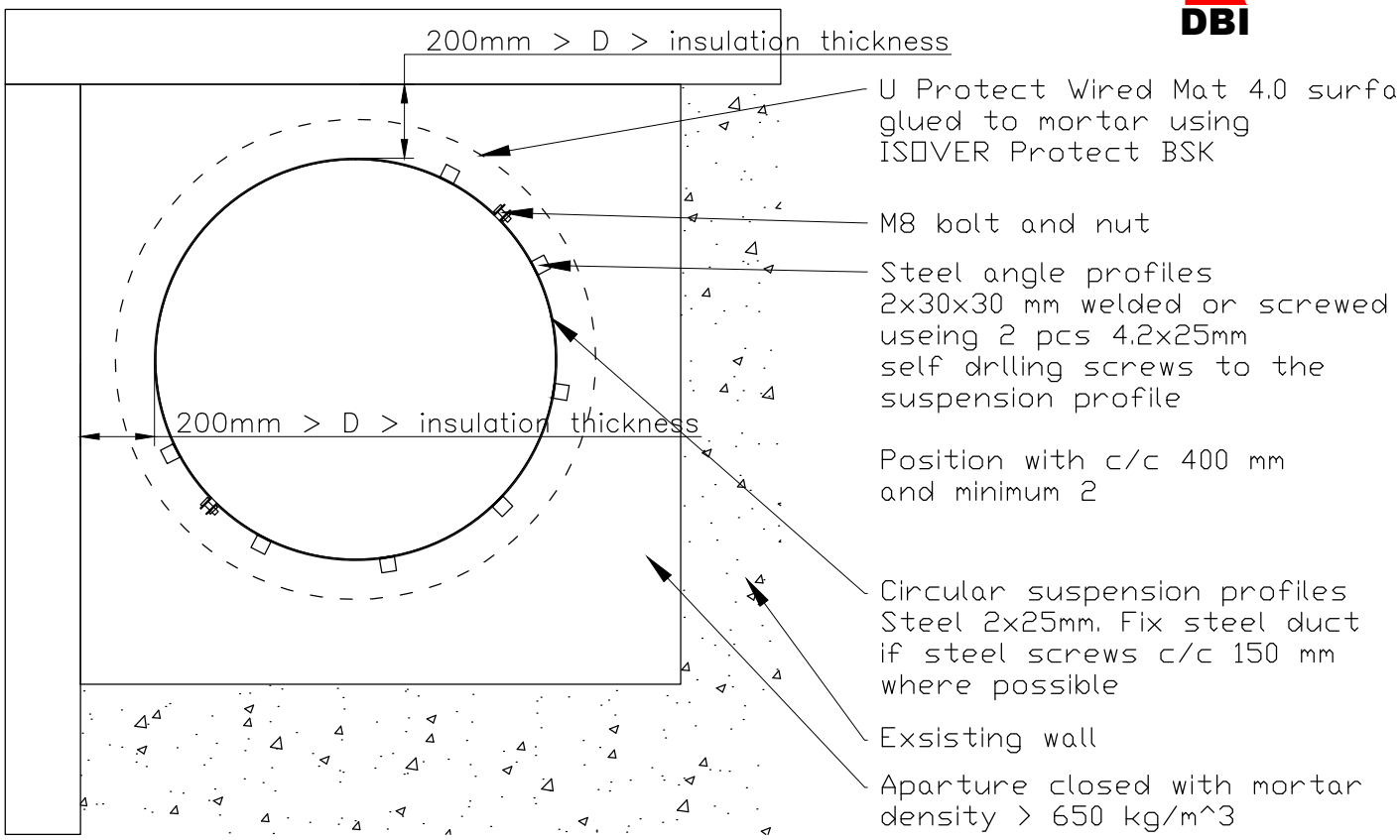
File No.: PHA10683B

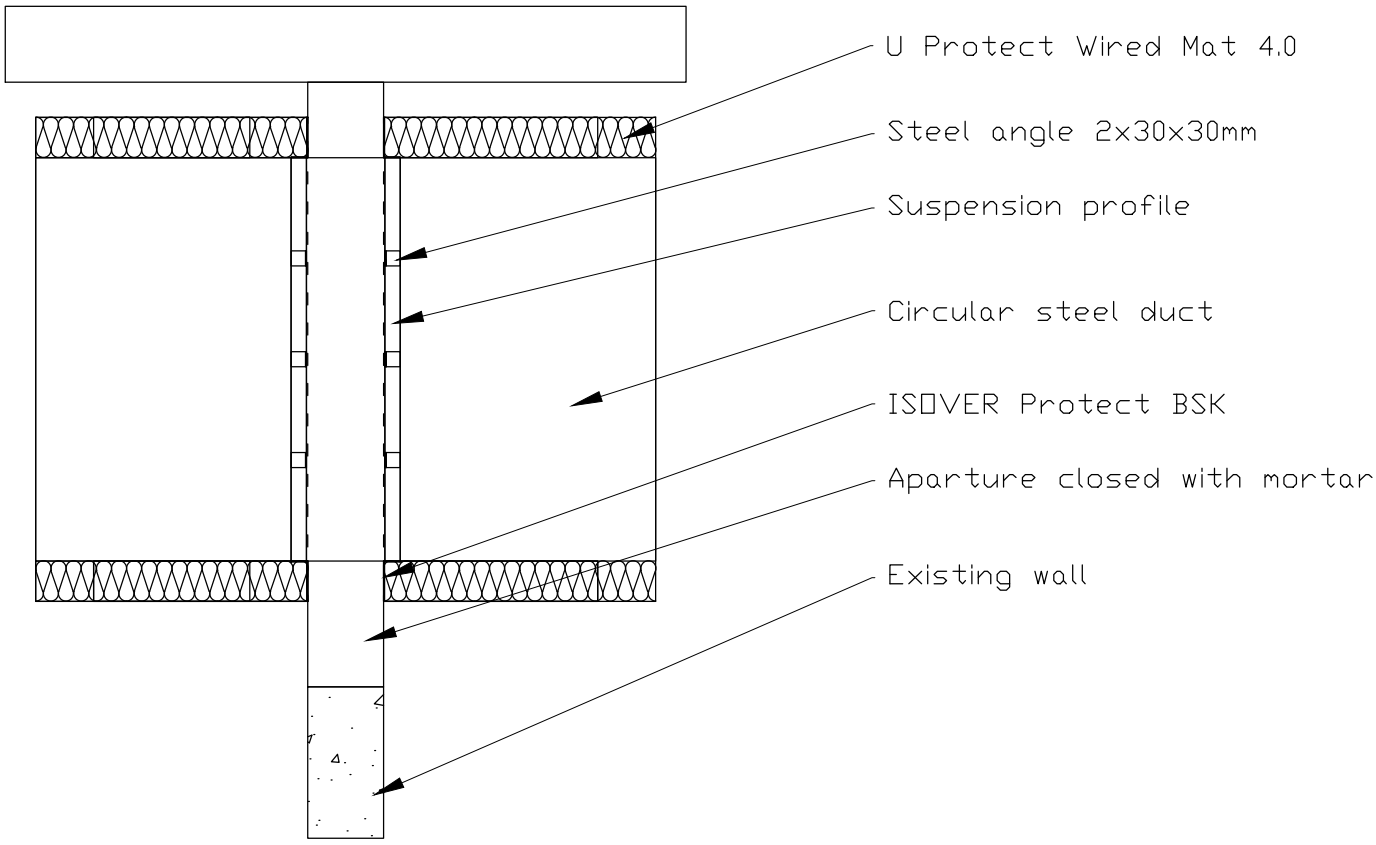
Enclosure: 1.4

Circular duct: Option 1a

Applicable for ducts with diameter Ø > 400 mm

And distances to wall and floor between 200mm and insulation thickness



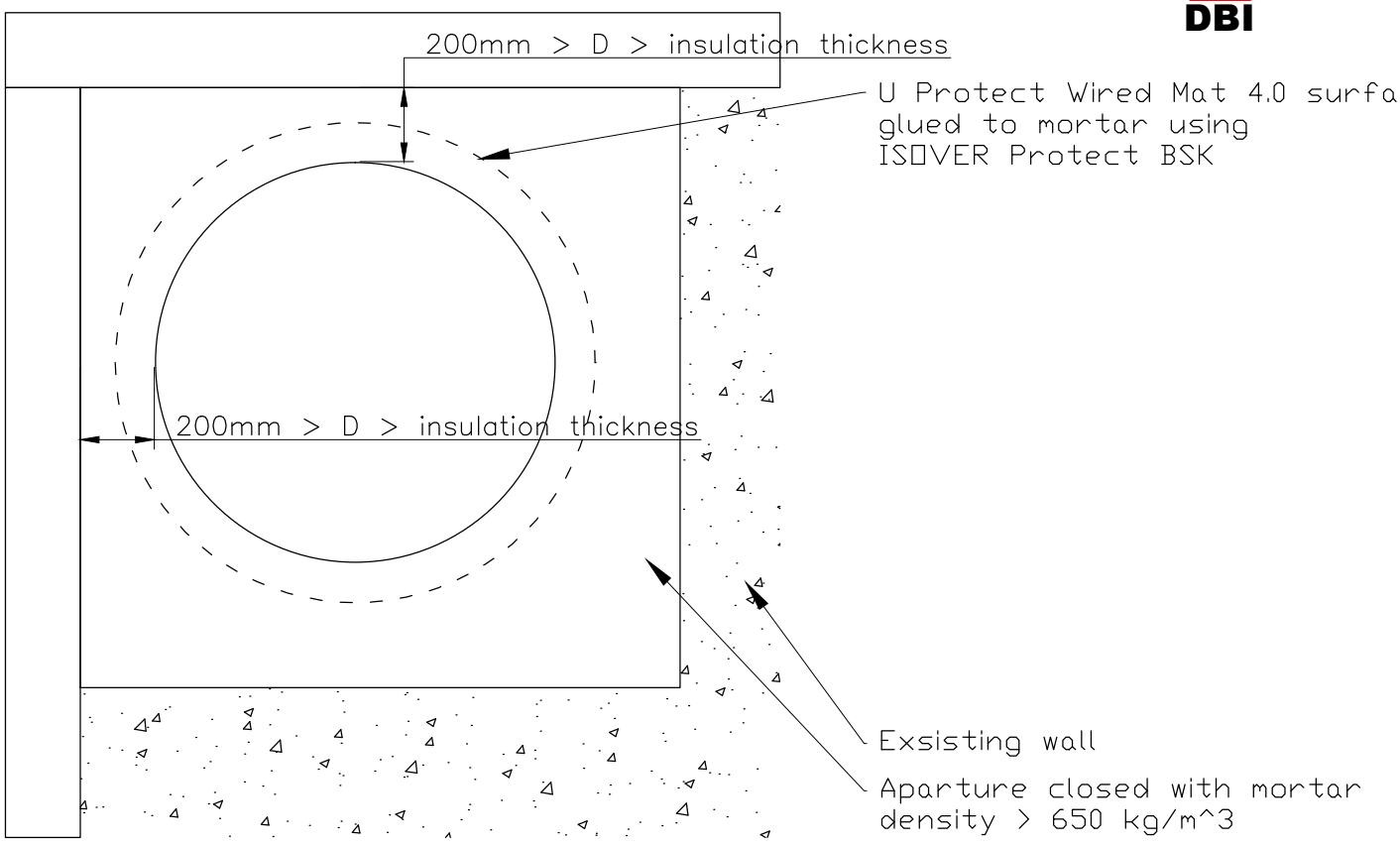


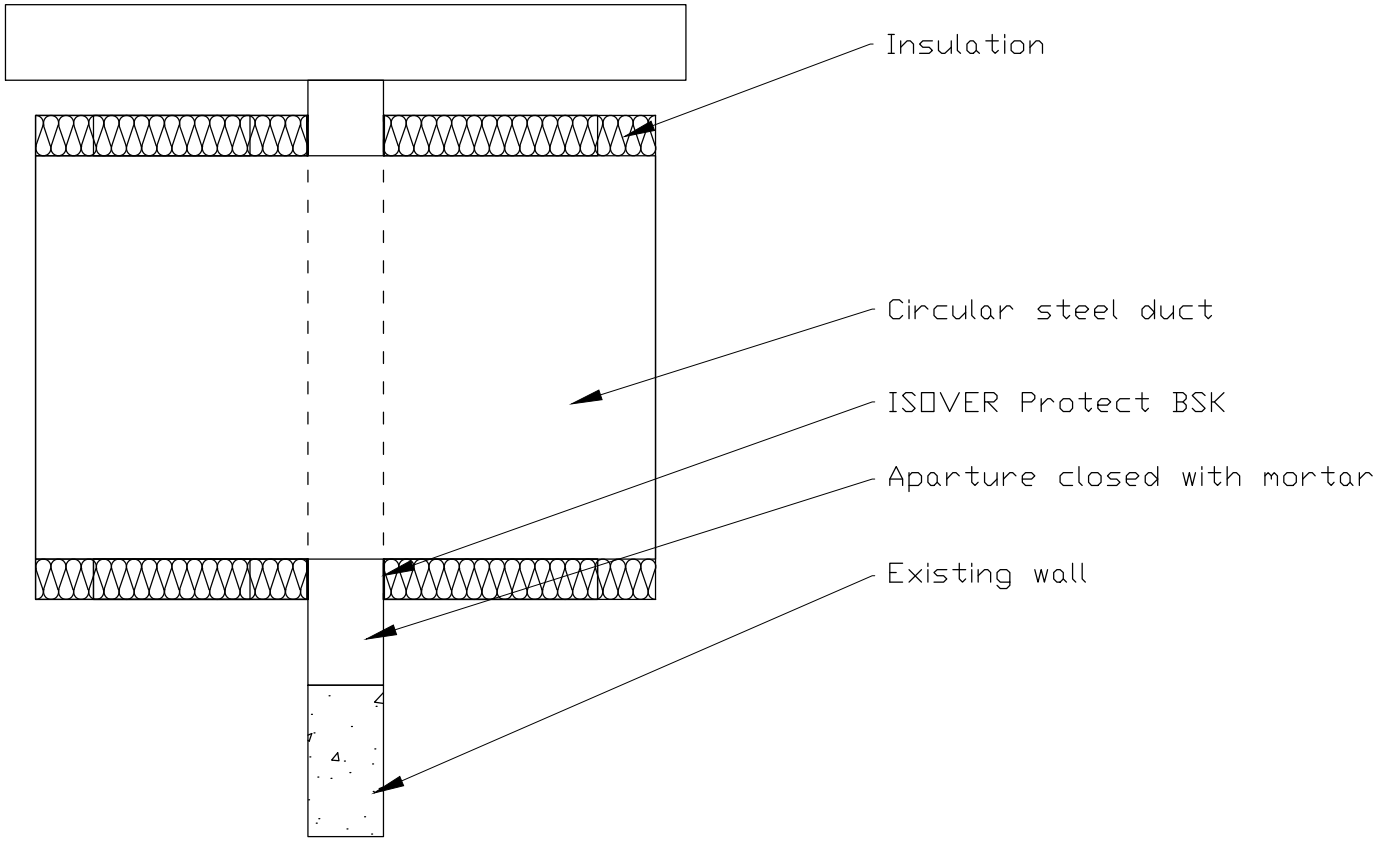
All measurements are in mm

Circular duct: Option 1b

Applicable for ducts with diameter Ø ≤ 400 mm

And distances to wall and floor between 200mm and insulation thickness





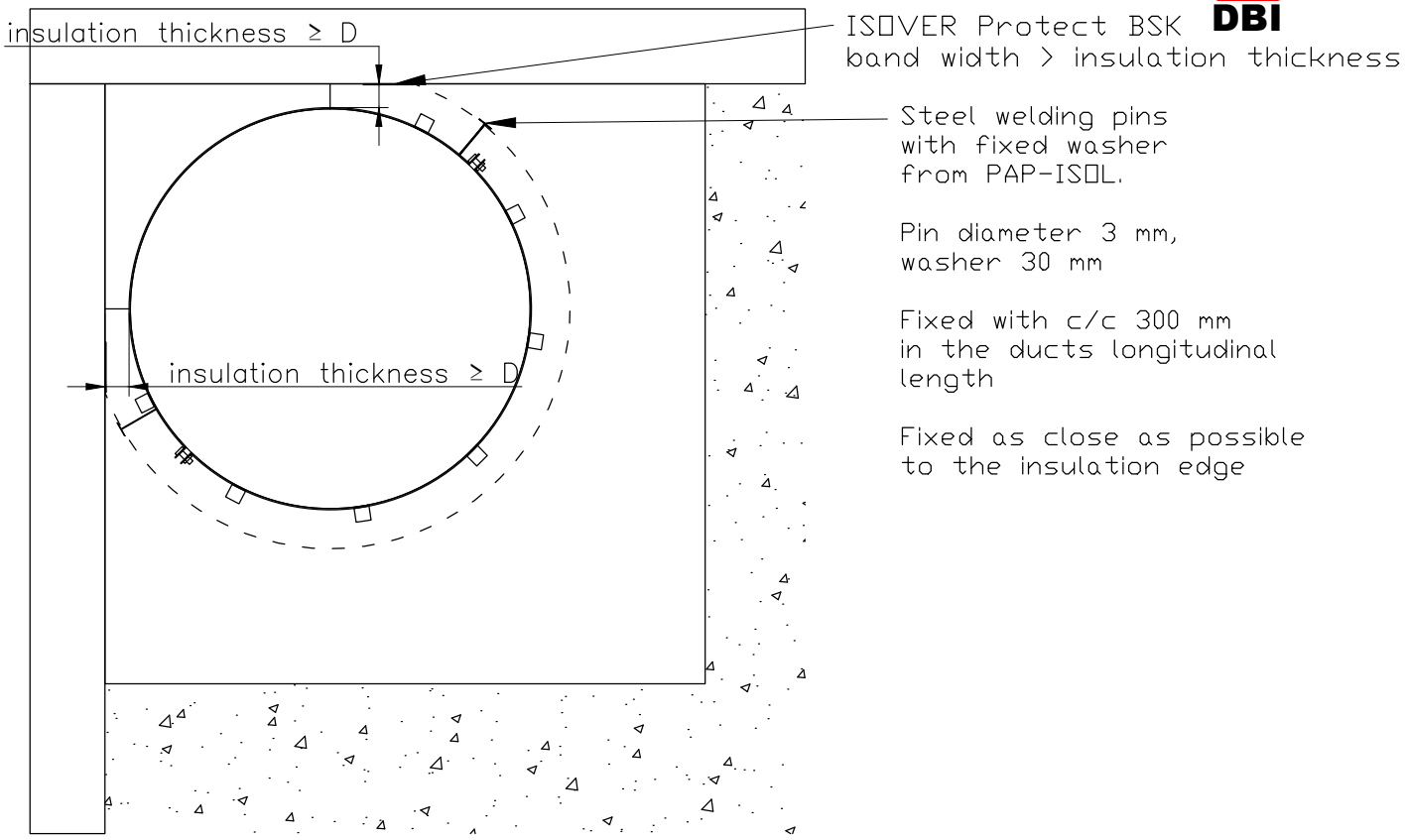
All measurements are in mm

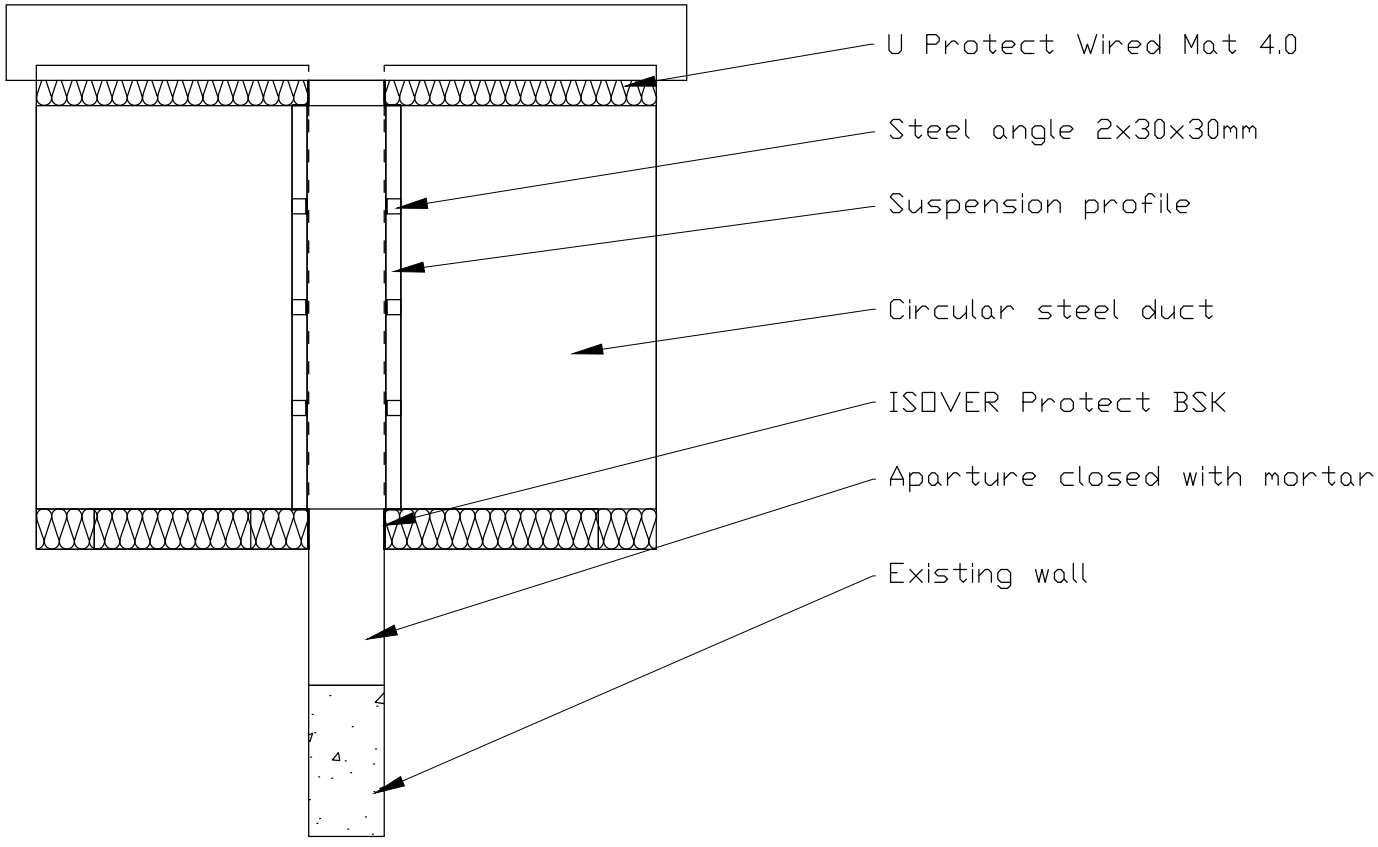
Circular duct: Option 2a

Applicable for ducts with diameter Ø > 400 mm

And distances to wall or floor less than insulation thickness

Assembly as for Option 1a, with the listed changes





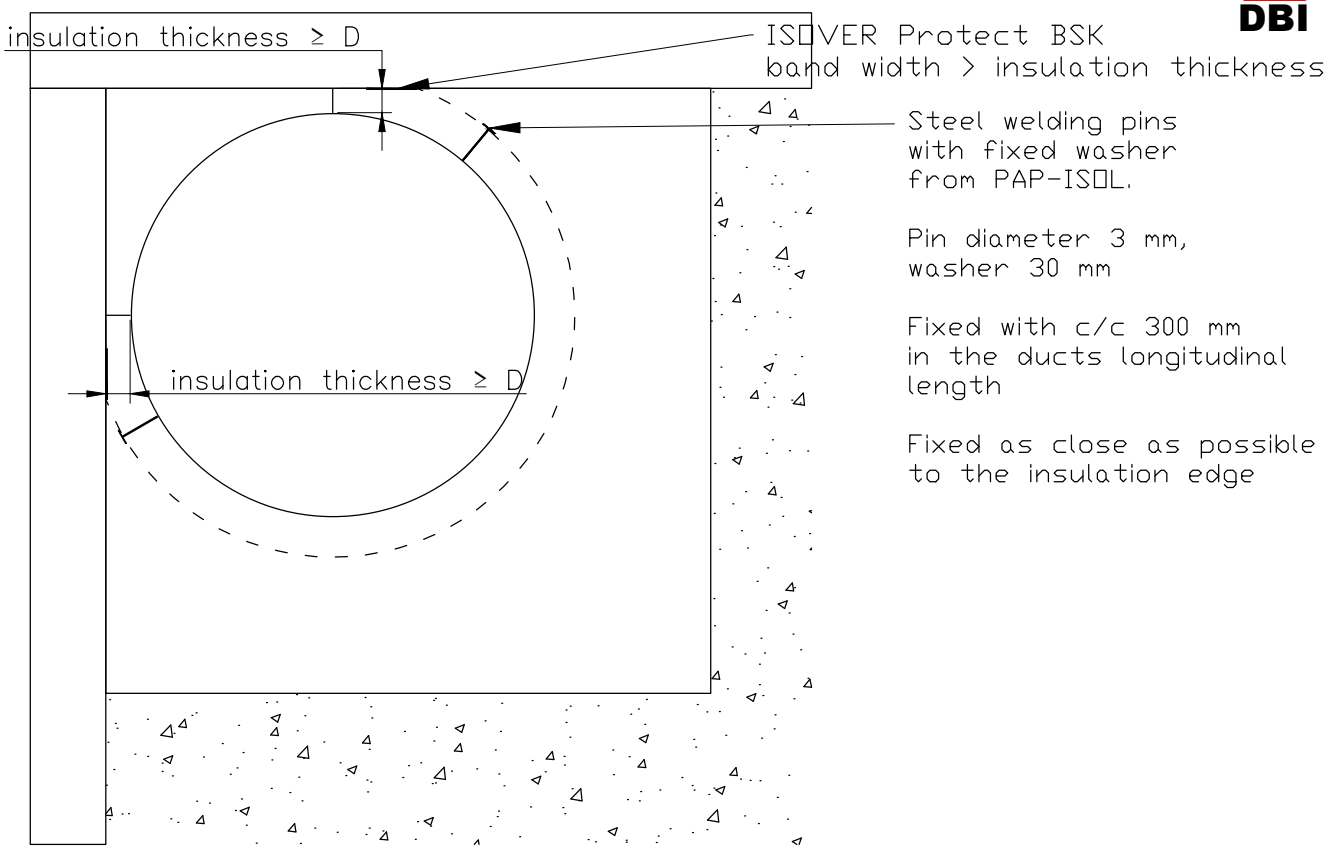
All measurements are in mm

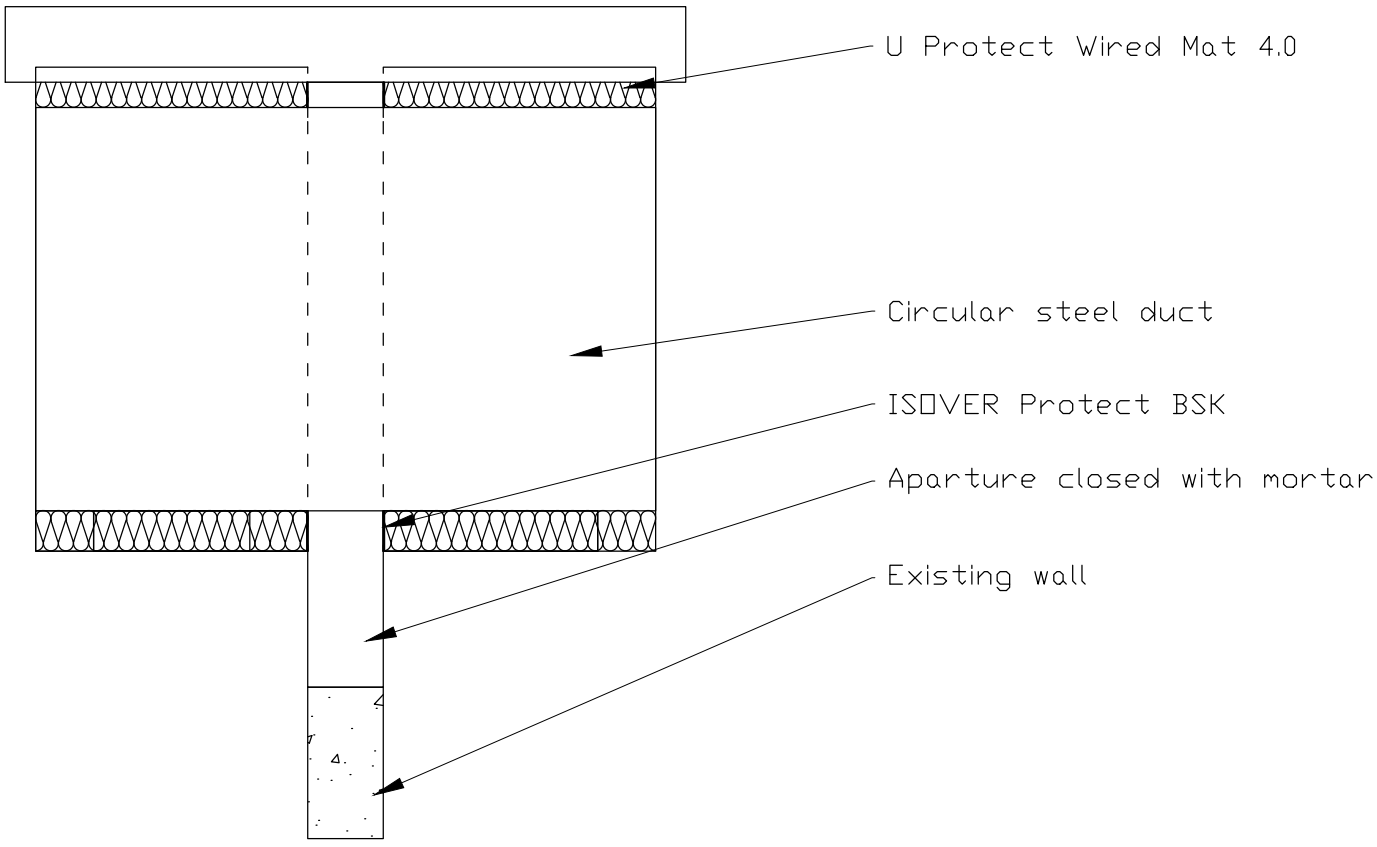
Circular duct: Option 2b

Applicable for ducts with diameter Ø ≤ 400 mm

And distances to wall and floor less than insulation thickness

Assembly as for Option 1b, with the listed changes

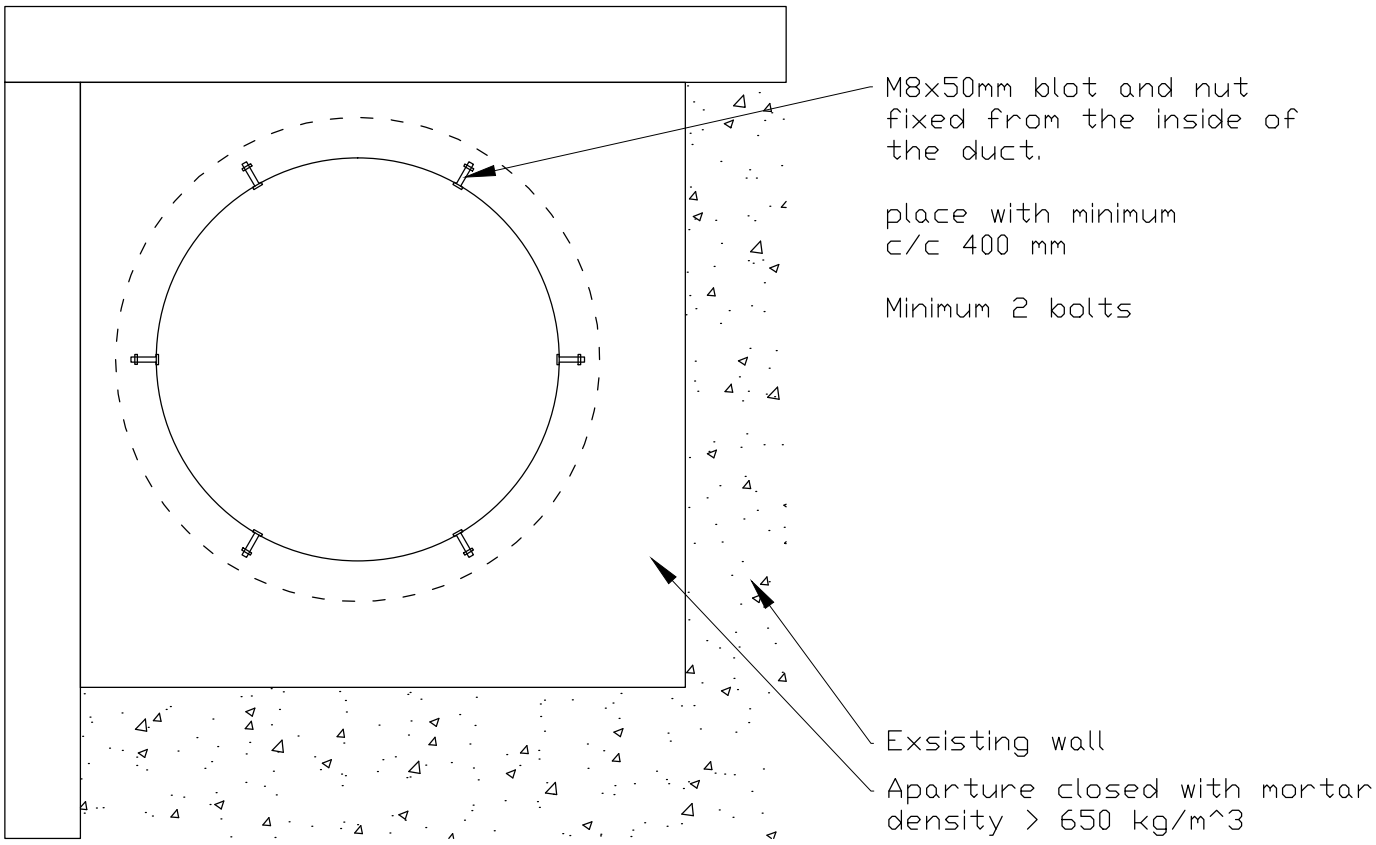


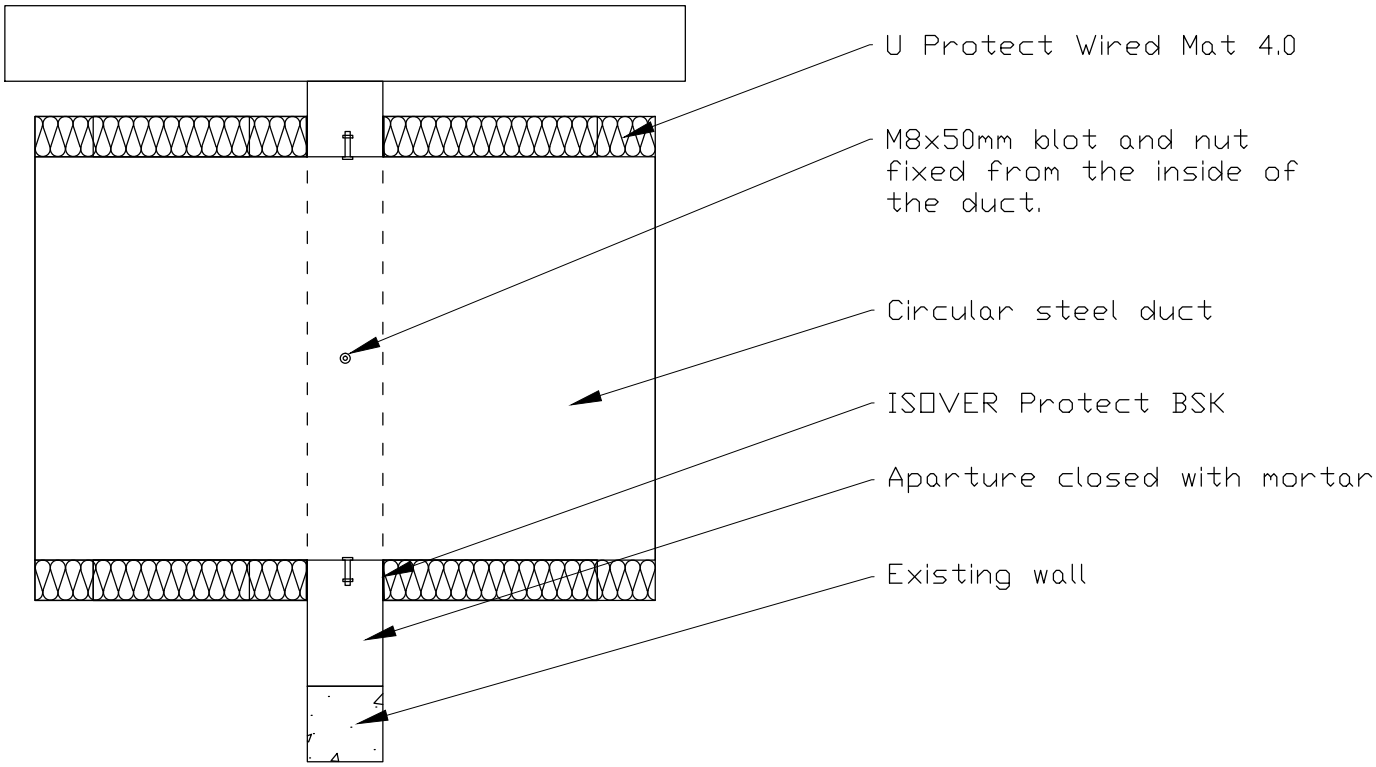


All measurements are in mm

Circular duct: Alternative fixation of steel duct

If it is possible to fix bolts as shown on the drawing below. This method of fixation can be used instead of the suspension profiles and steel angles shown on option 1a and 2a





All measurements are in mm

Annex A

Standard system for fire resistant circular ducts

Technical argumentation

Standard system for fire resistant circular ducts
Technical argumentation

- Assessment PH13234 - 23/07/2008 Assessment circular horizontal & vertical ducts B"
  - Report: PG11814 - 10/04/2008 Test report CHB 30mm, E60 - I22, Flexible wall
  - Report: PG11817 - 07/05/2008 Test report CHB 60mm, E90 - I45
  - Report: PG11841 - 05/05/2008 Test report CHB 120mm (30+90), E149 - I137
  - Report: PG11811 - 28/05/2008 Test report CVB 30mm, E45 - I12
  - Report: PG11813 - 16/06/2008 Test report CVB 100mm (60+40), E140 - I130

- Assessment PH13235 - 23/07/2008 Assessment circular horizontal & vertical ducts A"
- Assessment PH13235-2 - 10/07/2009 Assessment smoke leakage circular ducts"
  - Report: PG11815 - 15/07/2008 Test report CHA 30mm, E60 - I50, Flexible wall
  - Report: PG11818 - 16/07/2008 Test report CHA 90mm, E95 - I95
  - Report: PG11855 - 21/07/2008 Test report CHA 100mm (30+70), E152 - I152
  - Report: PG11810 - 06/05/2008 Test report CVA 30mm, E121 - I58

No pins needed when mounting insulation on vertical circular ducts
Technical argumentation

- Assessment: PH13660 - 02/05/2011: No pins needed when mounting insulation on vertical circular ducts
  This assessment was given as expert judgement (not based on a test). Now we have test PGA10276 on a vertical duct without use of pins to confirm the judgement.

Use of stitching, C-rings or hooks for fixing wired mats
Technical argumentation

- Assessment: PHA10146 - 29/03/2012: Allowing use of stitching, C-rings or hooks for wired mats

Penetration of circular ducts through flexible walls
Technical argumentation

- Assessment: PHA10317 – 21/12/2012: Circular ducts through flexible walls
  - Report: PGA10162 - 12/10/2012 CHB 100mm, E122 - I96, Flexible wall
  - Report: PG11814 - 10/04/2008 CHB 30mm, E60 - I22, Flexible wall

Use of Aluminum facings on wire net mats
Technical argumentation

- Assessment: PH13613v1 - 23/03/2012 Aluminum facings
  - Report: PG12245 - 04/10/2010 Test report RVB 90mm
  - Report: PG12259 - 05/10/2010 Test report RVB 90mm

Increase in suspension distance for horizontal duct from 1200 mm to 1500 mm
Technical argumentation
Tests have been conducted with distance above 1500 mm.

- Report: PG11816 – 26/05/2008 CHB 60 mm up to 1560mm

Alternative solutions for circular fire resistant duct system

Simplified penetration for horizontal and vertical circular ducts up to EI 60
Technical argumentation

- Assessment: PH13603v1 - 16/05/2011: Simplified penetration for horizontal and vertical circular ducts
  Report: PG12272 - 07/12/2010 Test report CHB 75mm, E121 - I72

Use of double layer insulation
Technical argumentation

- Assessment: PHA10364 - 24/04/2013: Use of double layer insulation - circular ducts

Additional insulation on top of the fire protection insulation
Technical argumentation

- Assessment: PHA10177 - 03/05/2012: Additional insulation on top of ULTIMATE

Circular ducts installed close to walls or floors
Technical argumentation

- Assessment: PH13620a - 04/12/2012: "Circular ducts installed close to walls or floors"

Standard system for circular smoke extraction ducts

Standard system for fire resistant circular smoke extraction ducts
Technical argumentation

- Assessment: PH13632a - 19/01/2012 Assessment circular ducts type A with 500Pa
  Report: PG11815 - 15/07/2008 Test report CHA 30mm, E60 - I50, Flexible wall
  Report: PG11818 - 16/07/2008 Test report CHA 90mm, E95 - I95
  Report: PG11855 - 21/07/2008 Test report CHA 100mm (30+70), E152 - I152
  Report: PG12378 - 21/11/2011 Test report CHA 90mm, E133 - I133
  500Pa underpressure - Flat bar flanges
  PG11814 - 10/04/2008 Test report CHB 30mm, E60 - I22, Flexible wall
  PG11817 - 07/05/2008 Test report CHB 60mm, E90 - I45
  PG11841 - 05/05/2008 Test report CHB 120mm (30+90), E149 - I137
  PGA10041 - 22/12/2011 Test report CHC level 2 90mm, E133 - S134, Flat bar flanges