ROCKWOOL®

The thickness of ROCKWOOL insulation

In accordance with BS5422:2009

BS5422:2009 An explanatory note

BS5422:2009 Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C

BS 5422 is arguably the most important industry-wide standard for determining and specifying the requirements for thermal insulation used on pipe-work and equipment.

Importantly, the appropriate insulation thicknesses taken from BS 5422 and used on pipe-work will be eligible for enhanced capital allowances (ECAs).

In January 2009, BS 5422:2001 was superseded by BS 5422:2009. The new version of this standard is relevant to H&V and process work undertaken on sites across the UK, although additional factors may apply to building works undertaken in accordance with the Building (Scotland) Regulations, which still refer to BS5422:2001 as outlined below.

One of the most significant changes to BS 5422 is that the thicknesses of insulation shown for pipe-work, ducts, plant and equipment are based on 'practical limits' for all applications. For H&V applications, BS 5422 has adopted the thicknesses of insulation published by TIMSA (Thermal Insulation Manufacturers and Suppliers Association) as part of its 'guidance for achieving compliance with Part L of the Building Regulations - DOMESTIC AND NON-DOMESTIC HEATING, COOLING AND VENTILATION GUIDE' (relevant to England, Wales and Northern Ireland).

It should be noted that the Scottish Building Standards Authority (SBSA) Editions of the Technical Handbooks (Domestic & Non–Domestic) to the Building Standards (Scotland) Regulations 2015, Sections 6, Energy, refer directly to BS 5422:2009.

BS 5422 is not a prescriptive document and recognises that there are many reasons why the insulation of pipes, tanks, vessels, ductwork and equipment may be required. It is therefore important that specifiers state the criteria or specific clause or reference in this standard in any specification. Insulation thicknesses are given for a range of thermal conductivities appropriate to the usual materials used for the application; thicknesses for intermediate thermal conductivities and pipe sizes may be deduced by calculation or interpolation. For guidance in selecting appropriate types of insulation and suitable methods of application, reference should be made to BS 5970.

ROCKWOOL stone wool does not thermally age and therefore the thicknesses shown can be relied upon to provide the required insulation performance for the lifetime of the host structure.

CE Marking
With the introduction of the Construction Products Regulation (CPR), CE marking has become mandatory for all construction products covered by a harmonised technical specification as of 1st July 2013.

This regulation is an EU law and has been adopted by all member states including the United Kingdom. It is now illegal to sell any products covered by a harmonized European standard which are not CE marked accordingly.

This new approach standardises the key features of technical insulation materials (e.g. thermal conductivity, reaction to fire, mechanical characteristics etc.) and ensures an accurate comparison of products across the market .

ROCKWOOL has been CE marking products for the construction industry in the UK since 2002, constantly introducing more and more of its product range each year as requirements change. The exceptions are those products which are not currently covered by a harmonised European Standard.

ROCKWOOL is committed to gaining all the necessary certification and accreditation of its products to comply with the regulations set by the EU law.

pH Neutrality
ROCKWOOL insulation is chemically compatible with all types of pipes, equipment and fittings. (Guidance is given in BS5970 regarding the treatment of austenitic stainless steel pipework and fittings). Stone wool insulation is chemically inert. A typical aqueous extract of ROCKWOOL insulation is neutral or slightly alkaline (pH 7 to 9.5).

Durability
ROCKWOOL stone wool insulation products have been proven in service for over 60 years, in a wide range of climates and degrees of exposure. ROCKWOOL insulation will generally perform effectively for the lifetime of the building, plant or structure.

Biological
ROCKWOOL stone wool is a naturally inert and rot-proof material that does not encourage or support the growth of fungi, moulds or bacteria, or offer sustenance to insects or vermin.

Surface emissivity (ε) table

Material	Emissivity (ε)
Aluminium, bright	0.05
Aluminium, oxidized	0.13
Aluminium foil, bright reinforced	0.05
Aluminium foil, polyester faced reinforced	0.40
Alu-zinc	0.18
Austenitic steel	0.15
Brass, dull tarnished	0.61
Brass, unoxidized	0.035
Cast iron (and iron)	0.35
Cast iron, rusted and oxidized	0.65
Chrome, polished	0.10
Cloth	0.90
Copper, commercial scoured to a shine	0.07
Copper, oxidized	0.70
Copper, polished	0.02
Fire brick	0.75
Galvanised steel, blank	0.26
Galvanised steel, dusty	0.44
Paint, black	0.95
Paint, other colours	0.90
Paint, white	0.85
Paint, aluminium weathered	0.55
Paint, aluminium new	0.30
Roofing felt	0.94
Rubber black	0.95
Rubber, grey	0.85
Steel	0.35
Steel, black painted	0.90
Steel, oxidized	0.80
White lacquer	0.95

NOTE 1 The above values provide a useful guide to surface emissivity. However, it should be noted that the emissivity of a material varies with temperature and surface finishes. Therefore, the precise emissivity should be ascertained where a high degree of accuracy is required.

Surface emissivity

Emissivity is defined as the ratio of the energy radiated from a material's surface to that radiated from a blackbody (a perfect emitter) under the same conditions.
It is a dimensionless number between 0 (for a perfect reflector) and 1 (for a perfect emitter). The emissivity of a surface depends not only on the material but also on the nature of the surface. For example, a clean and polished metal surface will have a low emissivity, whereas a roughened and oxidised metal surface will have a high emissivity. The emissivity also depends on the temperature of the surface.

Knowledge of surface emissivity is important for accurate heat transfer calculations.

So what does this mean to me?
Low emissivity surfaces (e.g. aluminium, stainless steel etc.) produce a higher surface temperature but lower heat loss than high emissivity surfaces (e.g. painted steel, cloth etc.) when compared at the same operating conditions and insulation thickness.

Consider a 169 mm O.D. hot water pipe running at 75°C with an ambient temperature of 15°C insulated with 50 mm thick RockLap H&V Pipe Section:

Cladding type	Emissivity (ε)	Other surface temp (°C)	Heat loss (W/m)
Aluminium	0.05	28.8	25
Cloth	0.90	24.0	27

Based on ambient temperature 20°C (still air), horizontal pipe.

For personnel protection applications, high emissivity claddings are best.

For heat conservation, low emissivity claddings are best.

Guide to tables

If the design/operating conditions of your particular application/scheme does not correspond to those detailed in the tables, please contact ROCKWOOL Technical Solutions for calculations to meet your specific design criteria.

Table 6 (BS5422:2009)

Minimum insulation thickness for chilled and cold water steel pipes to control condensation on a high emissivity outer surface (0.9) with an ambient temperature of +25°C and a relative humidity of 80%

Outside diameter of steel pipe on which insulation has been based (mm)	Temperature of contents (°C)					
	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)					
	+10		+5		0	
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
17	8	20	11	20	14	20
21	9	20	12	20	15	20
27	9	20	13	20	16	20
33	10	20	13	20	16	20
42	10	20	14	20	17	20
48	10	20	14	20	18	20
60	11	20	15	20	18	20
76	12	25	16	25	20	25
89	12	25	16	25	21	25
102	12	25	17	25	21	25
114	12	25	17	25	22	25
140	13	25	18	25	23	25
169	13	25	18	25	24	25
219	13	25	19	25	24	25
245	14	25	19	25	24	25
273	14	25	19	25	24	25
324	14	25	20	25	25	25
356	14	30	20	30	25	30
406	14	30	20	30	26	30
456	14	40	20	40	26	40
508	15	40	20	40	26	40
558	15	40	21	40	26	40
610	15	40	21	40	27	40

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements. In situations where the ambient air temperature is greater than 25°C and/or the relative humidity exceeds 80%, these thicknesses will not be sufficient to control condensation.

NOTE 2 These thicknesses only apply where the vapour barrier has a dark, matt finish.

Table 7 (BS5422:2009)

Minimum insulation thickness for chilled and cold water copper pipes to control condensation on a high emissivity outer surface (0.9) with an ambient temperature of +25°C and a relative humidity of 80%

Outside diameter of steel pipe on which insulation has been based (mm)	Temperature of contents (°C)					
	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)					
	+10		+5		0	
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
10	7	-	10	-	12	-
12	8	-	10	-	13	-
15	8	-	11	-	14	-
22	9	20	12	20	15	20
28	9	20	13	20	16	20
35	10	20	13	20	17	20
42	10	20	14	20	17	20
54	11	20	14	20	18	20
76	12	25	16	25	20	25
108	12	25	17	25	21	25

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements. In situations where the ambient air temperature is greater than 25°C and/or the relative humidity exceeds 80%, these thicknesses will not be sufficient to control condensation.

NOTE 2 These thicknesses only apply where the vapour barrier has a dark, matt finish.

Table 8 (BS5422:2009)

Minimum insulation thickness for chilled and cold water steel pipes to control condensation on a low emissivity outer surface (0.05) with an ambient temperature of +25°C and a relative humidity of 80%

Outside diameter of steel pipe on which insulation has been based (mm)	Temperature of contents (°C)					
	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)					
	+10		+5		0	
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
17	16	20	22	25	28	30
21	17	20	24	25	30	30
27	19	20	26	30	32	35
33	20	20	27	30	34	35
42	21	25	29	30	37	40
48	22	25	31	35	39	40
60	24	25	33	35	41	45
76	26	30	36	40	46	50
89	28	30	38	40	48	50
102	29	30	40	40	50	50
114	30	30	41	45	52	60
140	31	35	43	45	55	60
169	33	35	46	50	58	60
219	35	35	49	50	62	70
245	36	40	51	60	64	70
273	37	40	52	60	66	70
324	39	40	55	55	70	70
356	40	40	56	60	71	80
406	41	45	58	60	74	80
456	43	45	60	60	76	80
508	44	45	61	70	78	80
558	45	45	63	70	80	80
610	46	50	64	70	82	90

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements. In situations where the ambient air temperature is greater than 25°C and/or the relative humidity exceeds 80%, these thicknesses will not be sufficient to control condensation.

Table 9 (BS5422:2009)

Minimum insulation thickness for chilled and cold water copper pipes to control condensation on a low emissivity outer surface (0.05) with an ambient temperature of +25°C and a relative humidity of 80%

Outside diameter of steel pipe on which insulation has been based (mm)	Temperature of contents (°C)					
	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)					
	+10		+5		0	
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
10	14	N/A	19	N/A	24	N/A
12	15	N/A	20	N/A	25	N/A
15	16	N/A	22	N/A	27	N/A
22	18	20	24	25	30	30
28	19	20	26	30	33	35
35	20	20	28	30	35	35
42	21	25	29	30	37	40
54	23	25	32	35	40	40
76	26	30	36	40	46	50
108	29	30	40	40	51	60

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements. In situations where the ambient air temperature is greater than 25°C and/or the relative humidity exceeds 80%, these thicknesses will not be sufficient to control condensation.

Table 10 (BS5422:2009)

Indicative thickness of insulation for cooled and chilled water systems to control heat gain – Low emissivity outer surfaces (ε= 0.05)

Outside diameter of steel pipe on which insulation has been based (mm)	Temperature of contents (ºC)								
	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)								
	+10			+5			0		
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	HEAT GAIN (W/m)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	HEAT GAIN (W/m)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	HEAT GAIN (W/m)
17.2	13	20	2.48	17	20	2.97	21	25	3.47
21.3	14	20	2.72	18	20	3.27	22	25	3.81
26.9	15	20	3.05	20	20	3.58	24	25	4.18
33.7	16	20	3.41	21	25	4.01	25	25	4.60
42.4	17	20	3.86	22	25	4.53	27	30	5.11
48.3	18	20	4.11	23	25	4.82	28	30	5.45
60.3	18	20	4.78	24	25	5.48	29	30	6.17
76.1	20	25	5.51	27	30	6.30	36	40	6.70
88.9	20	25	6.17	28	30	6.90	33	35	7.77
114.3	21	25	7.28	28	30	8.31	34	35	9.15
139.7	21	25	8.52	29	30	9.49	35	35	10.45
168.3	21	25	9.89	29	30	10.97	37	40	11.86
219.1	22	25	12.27	29	30	13.57	37	40	14.61
273.0	22	25	14.74	29	30	16.28	37	40	17.48

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:2008 using standardised assumptions: horizontal pipe in still air at 25ºC, emissivity of outer surface of insulated system as specified.

NOTE 2 Thicknesses derived solely against the criteria noted in this table may not necessarily satisfy other design requirements such as control of condensation.

NOTE 3 Heat gain relates to the specified thickness and temperature.

Table 11 (BS5422:2009)

Indicative thickness of insulation for cooled and chilled water systems to control heat gain – High emissivity outer surfaces (ε= 0.9)

Outside diameter of steel pipe on which insulation has been based (mm)	Temperature of contents (ºC)								
	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)								
	+10			+5			0		
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	HEAT GAIN (W/m)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	HEAT GAIN (W/m)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	HEAT GAIN (W/m)
17.2	18	20	2.48	23	25	2.97	26	30	3.47
21.3	19	20	2.72	24	25	3.27	27	30	3.81
26.9	20	20	3.05	27	30	3.58	29	30	4.18
33.7	22	25	3.41	27	30	4.01	31	35	4.60
42.4	23	25	3.86	28	30	4.53	33	35	5.11
48.3	24	25	4.11	29	30	4.82	35	35	5.45
60.3	24	25	4.78	31	35	5.48	36	40	6.17
76.1	27	30	5.51	34	35	6.30	43	45	6.70
88.9	27	30	6.17	35	35	6.90	40	40	7.77
114.3	28	30	7.28	35	35	8.31	42	45	9.15
139.7	29	30	8.52	36	40	9.49	43	45	10.45
168.3	29	30	9.89	37	40	10.97	44	45	11.86
219.1	29	30	12.27	37	40	13.57	45	45	14.61
273.0	30	30	14.74	37	40	16.28	45	45	17.48

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:2008 using standardised assumptions: horizontal pipe in still air at 25ºC, emissivity of outer surface of insulated system as specified.

NOTE 2 Thicknesses derived solely against the criteria noted in this table may not necessarily satisfy other design requirements such as control of condensation.

NOTE 3 Heat gain relates to the specified thickness and temperature.

Table 12 (BS5422:2009)

Minimum insulation thickness for condensation control on ductwork carrying chilled air in ambient conditions: indoor still air temperature +25°C, relative humidity 80%, dewpoint temperature 21.3°C

Table 12 - Ductwrap

Minimum temperature inside duct (°C)	External surface emissivity					
	Minimum thickness of ROCKWOOL Ductwrap (mm)					
	0.05 (eg bright aluminium foil)		0.44 (eg dusty galvanised steel)		0.90 (eg black paint)	
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
15	26	30	13	25	9	25
10	45	50	23	25	15	25
5	64	70	33	40	21	25
0	83	90	42	50	27	30

Table 12 - Ductslab

Minimum temperature inside duct (°C)	External surface emissivity					
	Minimum thickness of ROCKWOOL Ductslab (mm)					
	0.05 (eg bright aluminium foil)		0.44 (eg dusty galvanised steel)		0.90 (eg black paint)	
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
15	26	30	14	25	9	25
10	47	50	24	25	15	25
5	67	70	34	40	22	25
0	86	90	44	50	28	30

NOTE 1 Thicknesses given are calculated in accordance with BS EN ISO 12241:2008 based on 0.6m vertical flat surface of rectangular duct but are also adequate for horizontal surfaces.

NOTE 2 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements.

NOTE 3 Refer to Annex B, Table B. 1 for surface emissivities of common finishing materials. In situations where the ambient air temperature is greater than 25°C and/or the relative humidity exceeds 80%, these thicknesses will not be sufficient to control condensation.

Table 13 (BS5422:2009)

Indicative thickness of insulation for ductwork carrying warm air to control heat loss.

Table 13 - Ductwrap

Max Heat Loss (W/m^2)	External surface emissivity					
	Minimum thickness of ROCKWOOL Ductwrap (mm)					
	0.05 (eg bright aluminium foil)		0.44 (eg dusty galvanised steel)		0.90 (eg black paint)	
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
16.34	31	40	37	40	39	40

Table 13 - Ductslab

Max Heat Loss (W/m^2)	External surface emissivity					
	Minimum thickness of ROCKWOOL Ductslab (mm)					
	0.05 (eg bright aluminium foil)		0.44 (eg dusty galvanised steel)		0.90 (eg black paint)	
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
16.34	32	40	38	40	41	50

NOTE 1 Heat loss relates to the specified thickness and temperature.

NOTE 2 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:2008 using standardised assumptions: horizontal duct at 35°C, with 600 mm vertical sidewall in still air at 15°C, emissivity of outer surface of insulated system as specified

Table 14 (BS5422:2009)

Indicative thickness of insulation for chilled and dual-purpose ducting to control heat transfer

Table 14 - Ductwrap

Max Heat Loss (W/m^2)	External surface emissivity					
	Minimum thickness of ROCKWOOL Ductwrap (mm)					
	0.05 (eg bright aluminium foil)		0.44 (eg dusty galvanised steel)		0.90 (eg black paint)	
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
6.45	50	50	58	60	61	70

Table 14 - Ductslab

Max Heat Loss (W/m^2)	External surface emissivity					
	Minimum thickness of ROCKWOOL Ductslab (mm)					
	0.05 (eg bright aluminium foil)		0.44 (eg dusty galvanised steel)		0.90 (eg black paint)	
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
6.45	52	60	59	60	63	70

NOTE 1 Heat loss relates to the specified thickness and temperature.

NOTE 2 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:2008 using standardised assumptions: horizontal duct at 13°C, with 600 mm vertical sidewall in still air at 25°C, emissivity of outer surface of insulated system as specified.

Table 15 (BS5422:2009)

Indicative thickness of insulation for non-domestic heating services to control heat loss – low emissivity outer surfaces (ε=0.05)

Outside diameter of steel pipe on which insulation has been based (mm)	Hot face temperature (°C)								
	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)								
	75			100			125		
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	HEAT LOSS (W/m)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	HEAT LOSS (W/m)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	HEAT LOSS (W/m)
17.2	24	25	8.90	24	25	13.34	24	25	17.92
21.3	28	30	9.28	30	30	13.56	30	30	18.32
26.9	31	35	10.06	37	40	13.83	37	40	18.70
33.7	33	35	11.07	44	45	14.39	46	50	19.02
42.4	35	35	12.30	48	50	15.66	64	70	19.25
48.3	37	40	12.94	49	50	16.67	67	70	20.17
60.3	39	40	14.45	57	60	18.25	71	70	21.96
76.1	44	45	16.35	60	60	20.42	76	80	24.21
88.9	45	45	17.91	62	70	22.09	79	80	25.99
114.3	47	50	20.77	65	70	25.31	85	90	29.32
139.7	48	50	23.71	68	70	28.23	89	90	32.47
168.3	49	50	26.89	70	70	31.61	92	100	36.04
219.1	50	50	32.54	72	80	37.66	96	100	42.16
273.0	50	50	38.83	74	80	43.72	99	100	48.48

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:2008 using standardised assumptions: horizontal pipe in still air at 15°C, emissivity of outer surface of insulated system as specified.

NOTE 2 Heat loss relates to the specified thickness and temperature.

NOTE 3 The thicknesses in this table are applicable to pipes serving commercial solar hot water panels.

Table 16 (BS5422:2009)

Indicative thickness of insulation for non-domestic heating services to control heat loss – High emissivity outer surfaces (ε= 0.9)

Outside diameter of steel pipe on which insulation has been based (mm)	Hot face temperature (°C)								
	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)								
	75			100			125		
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	HEAT LOSS (W/m)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	HEAT LOSS (W/m)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	HEAT LOSS (W/m)
17.2	28	30	8.90	28	30	13.34	28	30	17.92
21.3	33	35	9.28	33	35	13.56	33	35	18.32
26.9	36	40	10.06	41	45	13.83	41	45	18.70
33.7	38	40	11.07	49	50	14.39	55	60	19.02
42.4	40	40	12.30	57	60	15.66	69	70	19.25
48.3	42	45	12.94	58	60	16.67	72	80	20.17
60.3	44	45	14.45	62	70	18.25	77	80	21.96
76.1	49	50	16.35	65	70	20.42	82	90	24.21
88.9	50	50	17.91	67	70	22.09	84	90	25.99
114.3	53	60	20.77	71	80	25.31	91	100	29.32
139.7	54	60	23.71	74	80	28.23	95	100	32.47
168.3	55	60	26.89	76	80	31.61	98	100	36.04
219.1	56	60	32.54	79	80	37.66	102	120	42.16
273.0	57	60	38.83	81	90	43.72	106	120	48.48

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:2008 using standardised assumptions: horizontal pipe in still air at 15°C, emissivity of outer surface of insulated system as specified.

NOTE 2 Heat loss relates to the specified thickness and temperature.

NOTE 3 The thicknesses in this table are applicable to pipes serving commercial solar hot water panels.

Table 17 (BS5422:2009)

Indicative thickness of insulation for non-domestic hot water service areas to control heat loss – Low emissivity outer surfaces

Outside diameter of steel pipe on which insulation thickness has been based (mm)	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)		Heat Loss (W/m)
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	
17.2	23	25	6.60
21.3	25	25	7.13
26.9	27	30	7.83
33.7	29	30	8.62
42.4	30	30	9.72
48.3	32	35	10.21
60.3	33	35	11.57
76.1	35	35	13.09
88.9	35	35	14.58
114.3	38	40	17.20
139.7	39	40	19.65
168.3	40	40	22.31
219.1	40	40	27.52
273.0	41	45	32.40

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:2008 using standardised assumptions: horizontal pipe at 60°C in still air at 15°C, emissivity of outer surface of insulated system as specified.

NOTE 2 Heat loss relates to the specified thickness and temperature.

Table 18 (BS5422:2009)

Indicative thickness of insulation for non-domestic hot water service areas to control heat loss – high emissivity outer surfaces

Outside diameter of steel pipe on which insulation thickness has been based (mm)	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)		Heat Loss (W/m)
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	
17.2	27	30	6.60
21.3	29	30	7.13
26.9	32	35	7.83
33.7	33	35	8.62
42.4	35	35	9.72
48.3	37	40	10.21
60.3	35	35	11.57
76.1	43	45	13.09
88.9	43	45	14.58
114.3	44	45	17.20
139.7	45	45	19.65
168.3	46	50	22.31
219.1	47	50	27.52
273.0	48	50	32.40

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:2008 using standardised assumptions: horizontal pipe at 60°C in still air at 15°C, emissivity of outer surface of insulated system as specified.

NOTE 2 Heat loss relates to the specified thickness and temperature.

Table 19 (BS5422:2009)

Indicative thickness of insulation for domestic heating and hot water systems having low emissivity outer surfaces

Outside diameter of steel pipe on which insulation thickness has been based (mm)	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)		Heat Loss (W/m)
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	
8.0	-	-	7.06
10.0	-	-	7.23
12.0	-	-	7.35
15.0	-	-	7.89
22.0	15	20	9.12
28.0	17	20	10.07
35.0	18	20	11.08
42.0	19	20	12.19
54.0	20	20	14.12

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:2008 using standardised assumptions: horizontal pipe at 60°C in still air at 15°C, emissivity of outer surface of insulated system as specified.

NOTE 2 Heat loss relates to the specified thickness and temperature.

NOTE 3 This table is applicable to pipes serving solar hot water panels.

Table 20 (BS5422:2009)

Indicative thickness of insulation for domestic heating and hot water systems having high emissivity outer surfaces

Outside diameter of steel pipe on which insulation thickness has been based (mm)	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)		Heat Loss (W/m)
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	
8.0	-	-	7.06
10.0	-	-	7.23
12.0	-	-	7.35
15.0	-	-	7.89
22.0	19	20	9.12
28.0	21	25	10.07
35.0	22	25	11.08
42.0	24	25	12.19
54.0	25	25	14.12

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:2008 using standardised assumptions: horizontal pipe at 60°C in still air at 15°C, emissivity of outer surface of insulated system as specified.

NOTE 2 Heat loss relates to the specified thickness and temperature.

NOTE 3 This table is applicable to pipes serving solar hot water panels.

Table 22 (BS5422:2009)

Minimum insulation thickness to control the surface temperature of a non-metallic surface with a surface emissivity of 0.90 and design cold face temperature of 59°C

Outside diameter of steel pipe on which insulation has been based (mm)	Hot face temperature (°C)							
	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)							
	100		150		200		250	
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
17	3	20	6	20	10	20	13	20
21	3	20	7	20	10	20	14	20
27	3	20	7	20	11	20	15	20
33	3	20	7	20	11	20	16	20
42	4	20	8	20	12	20	17	20
48	4	20	8	20	12	20	17	20
60	4	20	8	20	13	20	18	20
76	4	25	9	25	14	25	20	25
89	4	25	9	25	15	25	21	25
102	4	25	9	25	15	25	21	25
114	4	25	9	25	15	25	22	25
140	4	25	10	25	16	25	23	25
169	4	25	10	25	16	25	23	25
219	5	25	10	25	17	25	24	25
245	5	25	10	25	17	25	25	25
273	5	25	11	25	17	25	25	25
324	5	25	11	25	18	25	26	25
356	5	30	11	30	18	30	26	30
406	5	30	11	30	18	30	27	30
456	5	40	11	40	19	40	27	40
508	5	40	11	40	19	40	27	40
558	5	40	11	40	19	40	28	40
610	5	40	12	40	19	40	28	40
flat	5	40	12	40	18	40	27	40

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:2008 using standardised assumptions: horizontal pipe in still air at 20°C. Surface emissivity corresponding to outer surface specified.

NOTE 2 Maximum heat loss values for intermediate operating temperatures may be deduced by interpolation.

NOTE 3 Heat loss measured in Watts per metre (W/m) relates to the specified thickness and temperature.

NOTE 4 The thermal conductivity of insulation materials increases with mean temperature and for any given material. The use of a different thermal conductivity can be required for each operating temperature.

NOTE 5 These thicknesses may not satisfy other design requirements, in particular those for control of surface temperature (see Table 22, Table 23 and Table 24).

NOTE 6 To simplify the use of this table the values shaded have been adjusted to avoid the specification of apparently anomalous results given by the calculation method in BS EN ISO 12241, due to the transition from turbulent to laminar flow.

Table 23 (BS5422:2009)

Minimum insulation thickness to control the surface temperature of a metallic surface with a surface emissivity of 0.05 and design cold face temperature of 50°C

Outside diameter of steel pipe on which insulation has been based (mm)	Hot face temperature (°C)							
	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)							
	100		150		200		250	
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
17	7	20	14	20	22	25	31	35
21	8	20	15	20	24	25	33	35
27	8	20	17	20	26	30	36	40
33	9	20	18	20	27	30	38	40
42	10	20	19	20	29	30	41	45
48	10	20	20	20	31	35	43	45
60	10	20	21	25	33	35	46	50
76	12	25	24	25	37	40	52	50
89	12	25	25	25	39	40	55	60
102	13	25	26	30	41	45	57	60
114	13	25	27	30	42	45	59	60
140	14	25	28	30	45	45	63	60
169	14	25	30	30	47	50	67	70
219	15	25	32	35	51	60	72	80
245	16	25	33	35	52	60	74	80
273	16	25	34	35	54	60	77	80
324	17	25	35	35	56	60	80	80
356	17	30	36	40	58	60	83	90
406	18	30	37	40	60	60	86	90
456	18	40	39	40	62	70	88	90
508	19	40	40	40	64	70	91	100
558	19	40	41	45	65	70	91	100
610	19	40	41	45	65	70	91	100
flat	19	40	41	50	62	70	82	90

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:2008 using standardised assumptions: horizontal pipe in still air at 20°C. Surface emissivity corresponding to outer surface specified.

NOTE 2 Maximum heat loss values for intermediate operating temperatures may be deduced by interpolation.

NOTE 3 Heat loss measured in Watts per metre (W/m) relates to the specified thickness and temperature.

NOTE 4 The thermal conductivity of insulation materials increases with mean temperature and for any given material. The use of a different thermal conductivity can be required for each operating temperature.

NOTE 5 These thicknesses may not satisfy other design requirements, in particular those for control of surface temperature (see Table 22, Table 23 and Table 24).

NOTE 6 To simplify the use of this table the values shaded have been adjusted to avoid the specification of apparently anomalous results given by the calculation method in BS EN ISO 12241, due to the transition from turbulent to laminar flow.

Table 24 (BS5422:2009)

Minimum insulation thickness to control the surface temperature of a non-metallic surface with a surface emissivity of 0.90 and design cold face temperature of 50°C

Outside diameter of steel pipe on which insulation has been based (mm)	Hot face temperature (°C)							
	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)							
	100		150		200		250	
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
17	5	20	9	20	13	20	18	20
21	5	20	9	20	14	20	19	20
27	5	20	10	20	15	20	20	20
33	5	20	10	20	15	20	21	25
42	5	20	11	20	16	20	22	25
48	6	20	11	20	17	20	23	25
60	6	20	11	20	18	20	24	25
76	6	25	13	25	19	25	27	30
89	6	25	13	25	20	25	28	30
102	7	25	13	25	21	25	29	30
114	6	25	13	25	21	25	30	30
140	7	25	13	25	22	25	31	30
169	7	25	14	25	23	25	32	30
219	7	25	15	25	23	25	33	35
245	7	25	15	25	24	25	34	35
273	7	25	15	25	24	25	35	35
324	8	25	16	25	25	25	35	35
356	8	30	16	30	25	30	36	40
406	8	30	16	30	26	30	37	40
456	8	40	16	40	26	40	37	40
508	8	40	16	40	26	40	38	40
558	8	40	17	40	27	40	38	40
610	8	40	17	40	27	40	39	40
flat	8	40	17	40	27	40	39	40

NOTE 1 Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:2008 using standardised assumptions: horizontal pipe in still air at 20°C. Surface emissivity corresponding to outer surface specified.

NOTE 2 Maximum heat loss values for intermediate operating temperatures may be deduced by interpolation.

NOTE 3 Heat loss measured in Watts per metre (W/m) relates to the specified thickness and temperature.

NOTE 4 The thermal conductivity of insulation materials increases with mean temperature and for any given material. The use of a different thermal conductivity can be required for each operating temperature.

NOTE 5 These thicknesses may not satisfy other design requirements, in particular those for control of surface temperature (see Table 22, Table 23 and Table 24).

NOTE 6 To simplify the use of this table the values shaded have been adjusted to avoid the specification of apparently anomalous results given by the calculation method in BS EN ISO 12241, due to the transition from turbulent to laminar flow.

Table 24 (BS5422:2009)

Minimum insulation thickness to control the surface temperature of a metallic surface with a surface emissivity of 0.05 and design cold face temperature of 55°C

Outside diameter of steel pipe on which insulation has been based (mm)	Hot face temperature (°C)							
	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)							
	100		150		200		250	
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
17	6	20	12	20	18	20	26	30
21	6	20	13	20	20	20	27	30
27	7	20	14	20	21	25	30	30
33	7	20	14	20	23	25	32	35
42	7	20	15	20	24	25	34	35
48	8	20	16	20	25	25	35	35
60	8	20	17	20	27	30	38	40
76	9	20	19	25	31	35	43	45
89	9	20	20	25	32	35	46	50
102	10	20	21	25	33	35	48	50
114	10	25	21	25	34	35	49	50
140	10	25	23	25	37	35	52	60
169	11	25	24	25	39	40	55	60
219	12	25	26	30	41	45	59	60
245	12	25	26	30	43	45	61	70
273	12	25	27	30	44	45	63	70
324	13	25	28	30	46	50	66	70
356	13	30	29	30	47	50	68	70
406	13	30	30	30	49	50	71	80
456	14	40	31	40	50	50	73	80
508	14	40	32	40	52	60	75	80
558	14	40	32	40	52	60	75	80
610	15	40	32	40	52	60	75	80
flat	15	40	32	40	52	60	75	80

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table, Adopting these thicknesses may not necessarily satisfy other design requirements.

NOTE 2 To simplify the use of this table the values shaded have been adjusted to avoid the specification of apparently anomalous results given by the calculation method in BS EN ISO 12241, due to the transition from turbulent to laminar flow.

Table 24 (BS5422:2009)

Minimum insulation thickness to control the surface temperature of a metallic surface with a surface emissivity of 0.18 and design cold face temperature of 55°C

Outside diameter of steel pipe on which insulation has been based (mm)	Hot face temperature (°C)							
	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)							
	100		150		200		250	
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
17	5	20	11	20	16	20	23	25
21	6	20	11	20	18	20	24	25
27	6	20	12	20	19	20	26	30
33	6	20	13	20	20	20	28	30
42	7	20	14	20	21	25	30	30
48	7	20	14	20	22	25	31	35
60	7	20	15	20	24	25	33	35
76	8	25	16	25	27	30	38	40
89	8	25	18	25	28	30	39	40
102	8	25	18	25	29	30	41	45
114	9	25	19	25	30	30	42	45
140	9	25	20	25	31	35	45	45
169	9	25	20	25	33	35	47	45
219	10	25	22	25	35	35	50	50
245	10	25	22	25	36	40	52	60
273	10	25	23	25	37	40	53	60
324	11	25	24	25	38	40	55	60
356	11	30	24	30	39	40	57	60
406	11	30	25	30	40	40	58	60
456	11	40	25	40	41	45	60	60
508	12	40	26	40	42	45	61	70
558	12	40	26	40	43	45	61	70
610	12	40	26	40	43	45	61	70
flat	12	40	26	40	43	50	61	70

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table, Adopting these thicknesses may not necessarily satisfy other design requirements.

NOTE 2 To simplify the use of this table the values shaded have been adjusted to avoid the specification of apparently anomalous results given by the calculation method in BS EN ISO 12241, due to the transition from turbulent to laminar flow.

Table 24 (BS5422:2009)

Minimum insulation thickness to control the surface temperature of a metallic surface with a surface emissivity of 0.26 and design cold face temperature of 55°C

Outside diameter of steel pipe on which insulation has been based (mm)	Hot face temperature (°C)							
	Thickness of ROCKWOOL Rocklap H&V Pipe Section (mm)							
	100		150		200		250	
	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
17	5	20	10	20	16	20	22	25
21	5	20	11	20	17	20	23	25
27	6	20	11	20	18	20	25	25
33	6	20	12	20	19	20	26	30
42	6	20	13	20	20	20	28	30
48	6	20	13	20	21	25	29	30
60	7	20	14	20	22	25	31	35
76	7	25	16	25	25	25	35	35
89	8	25	16	25	26	30	37	40
102	8	25	17	25	27	30	38	40
114	8	25	17	25	28	30	39	40
140	8	25	18	25	29	30	41	45
169	9	25	19	25	30	30	43	45
219	9	25	20	25	32	35	46	50
245	9	25	20	25	33	35	47	50
273	9	25	21	25	34	35	48	50
324	10	25	21	25	35	35	50	50
356	10	30	22	30	36	40	51	60
406	10	30	22	30	37	40	53	60
456	10	40	23	40	37	40	54	60
508	11	40	23	40	38	40	55	60
558	11	40	24	40	39	40	55	60
610	11	40	24	40	39	40	55	60
flat	11	40	24	40	39	40	55	60

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table, Adopting these thicknesses may not necessarily satisfy other design requirements.

NOTE 2 To simplify the use of this table the values shaded have been adjusted to avoid the specification of apparently anomalous results given by the calculation method in BS EN ISO 12241, due to the transition from turbulent to laminar flow.

Table 25 (BS5422:2009)

Heat loss from bare surfaces calculated in accordance with BS EN ISO 12241:2008 (black steel pipes)

Outside diameter of steel pipe mm	Operating temperature (°C)				
	50	100	150	200	250
	Heat loss (W/m pipes, W/m² flat)				
12.0	17	57	110	176	257
15.0	20	69	133	214	313
17.2	23	78	150	241	353
21.3	27	93	180	290	427
22.0	28	96	186	299	439
26.9	33	114	221	356	525
28.0	35	118	229	369	544
33.7	41	139	269	435	641
42.0	49	168	326	528	781
42.4	50	169	329	532	788
48.3	56	190	369	598	885
54.0	61	209	407	660	979
60.3	68	230	448	728	1081
67.0	74	253	492	800	1188
76.1	83	283	551	896	1333
80.0	87	295	576	938	1395
88.9	95	324	632	1031	1535
101.6	107	365	712	1162	1733
108.0	113	385	752	1228	1832
114.3	119	405	791	1292	1929
139.7	142	484	947	1549	2316
168.3	167	571	1119	1833	2746
219.1	212	722	1419	2330	3498
273.0	258	880	1731	2848	4283
323.9	301	1027	2021	3331	5016

Operating conditions:
Ambient still air: 20°C
Surface emissivity: 0.90
Height of flat surfaces: 0.6m
Surface orientation: horizontal

Table 26 (BS5422:2009)

Heat loss from bare surfaces calculated in accordance with BS EN ISO 12241:2008 (copper pipes – commercial grade, scoured to a shine)

Outside diameter of copper pipe (mm)	Operating temperature (°C)			
	50	100	150	200
	Heat loss (W/m pipes, W/m² flat)			
12.0	11	36	66	100
15.0	12	43	79	119
17.2	14	47	87	132
21.3	16	56	103	156
22.0	17	57	105	160
26.9	19	66	123	186
28.0	20	69	127	192
33.7	23	79	146	222
42.0	27	93	173	263
42.4	28	94	174	265
48.3	31	104	192	292
54.0	33	113	210	319
60.3	36	123	228	347
67.0	39	134	248	377
76.1	43	148	273	416
80.0	45	153	284	432
88.9	49	166	308	469
101.6	54	184	341	520
108.0	57	193	358	545
114.3	59	202	374	570
139.7	69	236	437	666
168.3	80	272	505	770
219.1	98	334	619	946
273.0	116	396	735	1123
323.9	133	452	840	1284
flat	119	647	1244	1938

Operating conditions:
Ambient still air: 20°C
Surface emissivity: 0.07
Height of flat surfaces: 0.6m
Surface orientation: horizontal

Table 27 (BS5422:2009)

Heat loss from bare surfaces calculated in accordance with BS EN ISO 12241:2008 (copper pipes – oxidised)

Outside diameter of copper pipe (mm)	Operating temperature (°C)			
	50	100	150	200
	Heat loss (W/m pipes, W/m² flat)			
12.0	15	52	99	158
15.0	18	63	120	191
17.2	21	70	135	215
21.3	25	84	162	258
22.0	25	87	166	265
26.9	30	103	197	315
28.0	31	106	204	326
33.7	36	124	239	383
42.0	44	150	289	464
42.4	44	151	292	468
48.3	50	169	326	524
54.0	55	186	359	578
60.3	60	205	395	636
67.0	66	224	433	698
76.1	73	250	484	781
80.0	77	261	505	816
88.9	84	286	554	895
101.6	94	321	623	1007
108.0	99	339	657	1063
114.3	104	356	691	1118
139.7	124	424	824	1336
168.3	146	499	971	1577
219.1	184	629	1226	1997
273.0	224	763	1491	2432
323.9	261	888	1737	2837
flat	245	1076	2125	3464

Operating conditions:
Ambient still air: 20°C
Surface emissivity: 0.70
Height of flat surfaces: 0.6m
Surface orientation: horizontal

Table 28 (BS5422:2009)

Minimum insulation thickness to protect steel pipes against freezing under selected industrial process conditions

Outside diameter of pipe (mm)	Inside diameter of pipe (bore) (mm)	Initial temperature: +5°C Minimum ambient air temperature: -10°C Evaluation period: 12 hours Permitted ice formation nil		Initial temperature: +5°C Minimum ambient air temperature: -10°C Evaluation period: 12 hours Permitted ice formation 10%	
		Thickness of ROCKWOOL RockLap H&V Pipe Section (mm)			
		CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
21.3	16.0	-	-	-	-
26.9	21.6	-	-	-	-
33.7	27.2	-	-	251	-
42.4	35.9	-	-	89	90
48.3	41.8	452	-	59	60
60.3	53.0	173	-	34	35
76.1	68.8	87	90	23	25
88.9	80.8	62	70	19	20
114.3	105.3	40	40	13	25
168.3	158.6	23	25	9	25
219.1	207.9	17	25	6	25

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements.

NOTE 2 Some of the insulation thicknesses given are too large to be applied in practice but a selection is included to highlight the difficulty in protecting small diameter pipes against freezing. To provide the appropriate degree of frost protection to certain sizes of pipes, it may be necessary to provide additional heat to the system, for example by circulating the water or heat tracing.

NOTE 3 Assumed densities (ρ) and heat capacities (c_p) are as follows:

— ρ water = 1,000 kg/m^3, c_p water = 4,200 J/kg.K;

— ρ steel = 7,840 kg/m^3, c_p steel = 455 J/kg.K

Table 29 (BS5422:2009)

Minimum insulation thickness required to give protection against freezing under specified commercial and institutional conditions

Outside diameter of pipe (mm)	Inside diameter of pipe (bore) (mm)	Initial temperature: +2°C Minimum ambient air temperature: -6°C (indoor unheated) Evaluation period: 12 hours Permitted ice formation 50%		Initial temperature: +2°C Minimum ambient air temperature: -10°C (outdoor) Evaluation period: 12 hours Permitted ice formation 50%	
		Thickness of ROCKWOOL RockLap H&V Pipe Section (mm)			
Copper pipes		CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
15.0	13.6	66	-	315	-
22.0	20.2	19	20	47	50
28.0	26.2	12	20	24	25
35.0	32.6	9	20	16	20
42.0	39.6	7	20	12	20
54.0	51.6	5	20	8	20
76.1	73.1	4	25	6	25
108.0	105.0	3	25	4	25
Steel pipes		CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
21.3	16.0	40	40	142	-
26.9	21.6	19	20	43	45
33.7	27.2	13	20	25	25
42.4	35.9	8	20	15	20
48.3	41.8	7	20	12	20
60.3	53.0	5	20	9	20
76.1	68.8	4	25	6	25
88.9	80.0	3	25	5	25

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements.

NOTE 2 Some of the insulation thicknesses given are too large to be applied in practice but a selection is included to highlight the difficulty in protecting small diameter pipes against freezing. To provide the appropriate degree of frost protection to certain sizes of pipes, it may be necessary to provide additional heat to the system, for example by circulating the water or heat tracing.

NOTE 3 Assumed densities (ρ) and heat capacities (c_p) are as follows:

— ρ water = 1,000 kg/m^3, c_p water = 4,200 J/kg.K;

— ρ steel = 7,840 kg/m^3, c_p steel = 455 J/kg.K

Table 30 (BS5422:2009)

Minimum insulation thickness to protect against freezing for domestic cold water systems [12 h]

Outside diameter of pipe (mm)	Inside diameter of pipe (bore) (mm)	Normal installation inside the building inside the envelope of the insulation Initial temperature +7°C Minimum ambient air temperature -6°C Evaluation period 12 hours Permitted ice formation 50%		Extreme installation - inside the building but outside the envelope of the insulation Initial temperature +2°C Minimum ambient air temperature -6°C Evaluation period 12 hours Permitted ice formation 50%	
		Thickness of ROCKWOOL RockLap H&V Pipe Section (mm)			
Copper pipes		CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
15.0	13.6	49	-	66	-
22.0	20.2	17	20	19	20
28.0	26.2	11	20	12	25
35.0	32.6	8	20	9	20
42.0	39.6	6	20	7	20
54.0	51.6	5	20	5	20
76.1	73.1	3	25	4	25
108.0	105.0	2	25	3	25
Steel pipes		CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
21.3	16.0	32	40	40	40
26.9	21.6	16	20	19	20
33.7	27.2	11	20	13	20
42.4	35.9	7	20	8	20
48.3	41.8	6	20	7	20
60.3	53.0	5	20	5	20
76.1	68.8	4	25	4	20
88.9	80.0	3	25	3	25

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements.

NOTE 2 Some of the insulation thicknesses given are too large to be applied in practice but a selection is included to highlight the difficulty in protecting small diameter pipes against freezing. To provide the appropriate degree of frost protection to certain sizes of pipes, it may be necessary to provide additional heat to the system, for example by circulating the water or heat tracing.

NOTE 3 Assumed densities (ρ) and heat capacities (c_p) are as follows:

— ρ water = 1,000 kg/m³, c_p water = 4,200 J/kg.K;

— ρ steel = 7,840 kg/m³, c_p steel = 455 J/kg.K

Table 31 (BS5422:2009)

Minimum insulation thickness to protect against freezing for domestic cold water systems [8 h]

Outside diameter of pipe (mm)	Inside diameter of pipe (bore) (mm)	Normal installation inside the building inside the envelope of the insulation Initial temperature +7°C Minimum ambient air temperature -6°C Evaluation period 8 hours Permitted ice formation 50%		Extreme installation - inside the building but outside the envelope of the insulation Initial temperature +2°C Minimum ambient air temperature -6°C Evaluation period 8 hours Permitted ice formation 50%	
		Thickness of ROCKWOOL RockLap H&V Pipe Section (mm)			
Copper pipes		CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
15.0	13.6	22	not available	26	not available
22.0	20.2	10	20	11	20
28.0	26.2	7	20	7	20
35.0	32.6	5	20	6	20
42.0	39.6	4	20	4	20
54.0	51.6	3	20	3	20
76.1	73.1	2	25	2	25
108.0	105.0	2	25	2	25
Steel pipes		CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)	CALCULATED THICKNESS (mm)	ADVISED THICKNESS (mm)
21.3	16.0	17	20	20	20
26.9	21.6	10	20	11	20
33.7	27.2	7	20	8	20
42.4	35.9	5	20	5	20
48.3	41.8	4	20	5	20
60.3	53.0	3	20	4	20
76.1	68.8	3	25	3	25
88.9	80.0	2	25	2	25

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table. These thicknesses may not satisfy other design requirements.

NOTE 2 Some of the insulation thicknesses given are too large to be applied in practice but a selection is included to highlight the difficulty in protecting small diameter pipes against freezing. To provide the appropriate degree of frost protection to certain sizes of pipes, it may be necessary to provide additional heat to the system, for example by circulating the water or heat tracing.

NOTE 3 Assumed densities (ρ) and heat capacities (c_p) are as follows:

— ρ water = 1,000 kg/m^3, c_p water = 4,200 J/kg.K;

— ρ steel = 7,840 kg/m^3, c_p steel = 455 J/kg.K

ROCKWOOL Properties

Sustainability

As an environmentally conscious company, ROCKWOOL promotes the sustainable production and use of insulation and is committed to a continuous process of environmental improvement.

All ROCKWOOL products provide outstanding thermal protection as well as four added benefits:

- **Fire resistance**
- **Acoustic comfort**
- **Sustainable materials**
- **Durability**

Health and safety

The safety of ROCKWOOL stone wool is confirmed by current UK and Republic of Ireland health & safety regulations and EU directive 97/69/EC: ROCKWOOL stone wool fibres are not classified as a possible human carcinogen. A Material Safety Data Sheet is available and can be downloaded from www.rockwool.co.uk to assist in the preparation of risk assessments, as required by the Control of Substances Hazardous to Health Regulations (COSHH).

In accordance with REACH health and environment regulations, there are no hazardous classifications associated with ROCKWOOL stone wool in respect to physical, health and environmental considerations.

Environment

Made from a renewable and plentiful naturally occurring resource, ROCKWOOL insulation saves fuel costs and energy in use and relies on trapped air for its thermal properties.

ROCKWOOL does not contain (and has never contained) gases that have ozone depletion potential (ODP) or global warming potential (GWP).

ROCKWOOL stone wool insulation is approximately 97% recyclable. For waste ROCKWOOL material that may be generated during installation or at end of life, we are happy to discuss the individual requirements of contractors and users considering returning these materials to our factory for recycling.

Interested?

ROCKWOOL offer a full technical advice service to assist the appropriate selection of products, their correct application and to discuss any special considerations necessary at the design stage to ensure trouble free installation and use.

For further information and technical advice please visit www.rockwool.co.uk or contact our Technical Solutions team on 01656 868490 or technical.solutions@rockwool.co.uk.

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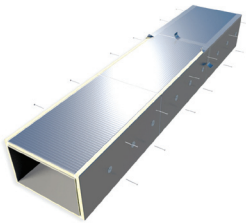
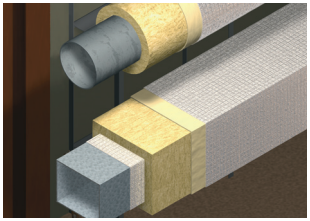
HVAC products available from ROCKWOOL

RockLap H&V Pipe Sections
For rapid, efficient pipework insulation. RockLap H&V Pipe Sections are strong lengths of pre-formed insulation with a one piece, factory applied foil facing with integral self-adhesive lap. The integral lap ensures fast and easy installation: just snap the Sections onto the pipe, peel off the backing tape and smooth down for a completely sealed joint.

Ductwrap and Ductslab
For the thermal insulation of ductwork and water storage tanks. ROCKWOOL Ductwrap and Ductslab provide thermal insulation for air conditioning, warm air and extract ducts used in the internal and external environment generally within plant rooms and boiler houses.

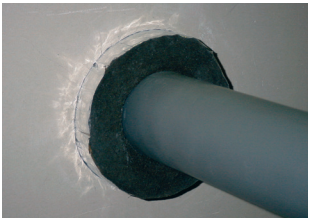


Fire Duct Systems (previously Conlit® Ductwork Systems)
Single layer fire protection for rectangular, circular and oval ducts. As part of the comprehensive ROCKWOOL FIREPRO® range of fire protection products, Fire Duct Systems (previously Conlit® Ductwork Systems) provide fire protection and thermal and acoustic insulation for circular and rectangular steel ductwork.



Techwrap2 and Techtube
High performance acoustic solutions for pipes and equipment. ROCKWOOL Techwrap2 and Techtube form part of a range of high performance ROCKWOOL acoustic insulation products.

Lamella Mat
Lamella Mat is particularly suitable for the insulation of heating and ventilation pipework and ductwork and as an overlay to upgrade existing insulation.



Insulated Fire Sleeves
Fire stopping for insulated pipe penetrations. As part of the comprehensive ROCKWOOL FIREPRO® range of fire protection products, ROCKWOOL Insulated Fire Sleeves are a unique combination of stone wool and graphite intumescent. They provide all the ROCKWOOL thermal, noise and fire benefits with an added intumescent effect.

ROCKWOOL Limited reserves the right to alter or amend the specification of products without notice as our policy is one of constant improvement. The information contained in this data sheet is believed to be correct at the date of publication.

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