



# **A GUIDE TO PAROC STONE WOOL THICKNESSES**

BS5422:2009



**PAROC**<sup>®</sup>

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# BS5422:2009

BS5422:2009: "Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork & equipment operating within temperature range minus 40 °C to plus 700 °C."

BS5422:2009 was issued in January 2009 to replace the previous version of the standard issued in 2001. The latest version of the standard shows some changes to the previous version, the insulation thicknesses shown in the various tables which now reflect more the "practical limits" for the applications given. The 2009 version of this standard is now more relevant to H&V and Process Plant insulation work carried out in the UK and is in accordance with the Part L of Building Regulations (England /Wales & Northern Ireland) – Domestic & Non-domestic Heating, Cooling & Ventilation Guide.

Pipe-work insulated with the appropriate insulation thicknesses shown in this standard is eligible for consideration under the ECA (Enhanced Capital Allowances) Scheme.

The standard itself is intended to cover a range of thermal insulating materials that can be used in these applications. This particular booklet shows the prescribed thicknesses of Paroc Stone Wool Insulation that Paroc Stone Wool Insulation that should be used to conform to this standard.

It should be recognised that BS5422 is not a prescriptive document and there may be several reasons why insulation of such equipment as described above is required. The criteria involved in any particular case may not conform exactly to those shown in the tables and specifiers should take care to interpret the information accordingly. Please refer to our "Multi-Layer Pipe Section Solutions" guide for more information when fitting more than a single layer of pipe section insulation (available on [www.paroc.co.uk](http://www.paroc.co.uk)).

## Emissivity of a Surface

The surface in question is that of the material which is used to cover the insulation at the time of installation. Some insulation products may require no additional covering in which case the surface emissivity is that of the insulation or its "as supplied" covering (eg Aluminium foil).

Emissivity is a dimension-less number & is defined as the ratio of energy radiated from a material's surface to that radiated from a "blackbody" (a perfect emitter with  $e$  value = 1) under the same conditions. The emissivity depends not only on the material itself but the nature of the surface (smooth or rough, clean or oxidised (if a metal) – for example). It is also somewhat temperature dependent. It is necessary to have some

information of surface emissivity when doing Heat Transfer Calculations.

In general terms, typically clean metallic surfaces have low emissivity ( $e$ ) values and are lower the more polished the surface. Other surface materials – eg cloths, plastics will typically have higher  $e$  values. For any particular combination of pipe size, operating temperature & ambient conditions, a low emissivity surface will result in a higher surface temperature than if a high emissivity covering was used. This difference in surface temperature can be significant. On the other hand the difference in the actual heat loss is not so dependent on this surface emissivity. It can be slightly reduced when a low emissivity surface is used but the heat loss itself is much more dependent on the "thermal resistance" of the insulating layer.

## Surface emissivity ( $\epsilon$ ) table

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.*

# TABLE 6

## ACC. 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%

**PAROC Hvac Section**  
**PAROC Pro Section 100**

Outside diameter of steel pipe on which insulation has been based (mm)	Temperature of the content (°C)		
	10	5	0
	Thickness of insulation (mm)		
17,2	20	20	20
21,3	20	20	20
26,9	20	20	20
33,7	20	20	20
42,4	20	20	20
48,3	20	20	25
60,3	20	20	25
76,1	20	20	25
88,9	20	20	25
114,3	25	25	30
139,7	25	25	30
168,3	25	25	30
219,1	30	30	30
273,0	30	30	30
323,9	30	30	30
355,6	30	30	30
406,4	30	30	30
457,0	30	30	30
508,0	30	30	30
610,0	40	40	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: Actual thickness required may be lower than shown in table, however the thickness shown is the nearest practically available thickness for that pipe size.*

*NOTE 3: Thicknesses can be interpolated for copper pipe sizes, and if necessary verified with Technical Support.*

**TABLE 8****ACC. 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%

**PAROC Hvac Section**  
**PAROC Pro Section 100**

Outside diameter of steel pipe on which insulation has been based (mm)	Temperature of the content (°C)		
	10	5	0
	Thickness of insulation (mm)		
17,2	20	30	30
21,3	20	30	40
26,9	25	30	40
33,7	25	30	40
42,4	30	40	40
48,3	30	40	50
60,3	30	40	50
76,1	30	40	50
88,9	30	40	50
114,3	40	50	60
139,7	40	50	60
168,3	40	50	60
219,1	40	60	70
273,0	40	60	70
323,9	50	60	80
355,6	50	70	80
406,4	50	70	80
457,0	50	70	90
508,0	50	70	90
610,0	60	70	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.*

*NOTE 2: Actual thickness required may be lower than shown in table, however the thickness shown is the nearest practically available thickness for that pipe size.*

*NOTE 3: Thicknesses can be interpolated for copper pipe sizes, and if necessary verified with Technical Support.*

# TABLE 10

## ACC. BS5422:2009

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

**PAROC Hvac Section**  
**PAROC Pro Section 100**

Outside diameter of steel pipe on which insulation thickness has been based  (mm)	Temperature of the content (°C)					
	10		5		0	
	Thickness of insulation (mm)	Maximum permissible heat gain (W/m)	Thickness of insulation (mm)	Maximum permissible heat gain (W/m)	Thickness of insulation (mm)	Maximum permissible heat gain (W/m)
17.2	20	2.48	20	2.97	25	3.47
21.3	20	2.72	20	3.27	25	3.81
26.9	20	3.05	25	3.58	25	4.18
33.7	20	3.41	25	4.01	30	4.60
42.4	20	3.86	25	4.53	30	5.11
48.3	20	4.11	25	4.82	30	5.45
60.3	20	4.78	25	5.48	40	6.17
76.1	25	5.51	30	6.30	40	6.70
88.9	25	6.17	30	6.90	40	7.77
114.3	25	7.28	30	8.31	40	9.15
139.7	25	8.52	30	9.49	40	10.45
168.3	25	9.89	30	10.97	40	11.86
219.1	30	12.27	30	13.57	40	14.61
273.0	30	14.74	40	16.28	40	17.48

NOTE 1: Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal pipe at  $t$  °C in still air at 25 °C, 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.

NOTE 4: Actual thickness required may be lower than shown in table, however the thickness shown is the nearest practically available thickness for that pipe size.

# TABLE 11

## ACC. BS5422:2009

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

### PAROC Hvac Section PAROC Pro Section 100

Outside diameter of steel pipe on which insulation thickness has been based (mm)	Temperature of the content (°C)					
	10		5		0	
	Thickness of insulation (mm)	Heat Gain (W/m)	Thickness of insulation (mm)	Heat Gain (W/m)	Thickness of insulation (mm)	Heat Gain (W/m)
17.2	20	2.48	25	2.97	25	3.47
21.3	20	2.72	25	3.27	30	3.81
26.9	25	3.05	25	3.58	30	4.18
33.7	25	3.41	30	4.01	40	4.60
42.4	25	3.86	30	4.53	40	5.11
48.3	25	4.11	30	4.82	40	5.45
60.3	25	4.78	40	5.48	40	6.17
76.1	25	5.51	40	6.30	40	6.70
88.9	30	6.17	40	6.90	40	7.77
114.3	30	7.28	40	8.31	50	9.15
139.7	30	8.52	40	9.49	50	10.45
168.3	30	9.89	40	10.97	50	11.86
219.1	30	12.27	40	13.57	50	14.61
273.0	30	14.74	40	16.28	50	17.48

NOTE 1: Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal pipe at  $t$  °C in still air at 25 °C, 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.

NOTE 4: Actual thickness required may be lower than shown in table, however the thickness shown is the nearest practically available thickness for that pipe size.

# TABLE 12

## ACC. BS5422:2009

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

### Icerock Ductwrap Icerock Ductslab

Minimum air temperature inside the duct (°C)	Emissivity		
	0.05	0.44	0.90
	Thickness of insulation (mm)		
15	25	25	25
10	50	25	25
5	70	40	25
0	90	50	30

### PAROC Hvac Mat, PAROC Hvac Slab

Minimum air temperature inside the duct (°C)	Emissivity		
	0.05	0.44	0.90
	Thickness of insulation (mm)		
15	30	30	30
10	50	30	30
5	70	40	30
0	90	50	30

### PAROC Pro Lamella Mat

Minimum air temperature inside the duct (°C)	Emissivity		
	0.05	0.44	0.90
	Thickness of insulation (mm)		
15	30	25	25
10	50	30	25
5	80	40	25
0	90	50	30

NOTE 1: Thicknesses given are calculated in accordance with BS EN ISO 12241:1998 based on 0.6 m 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 - ACC. BS5422:2009

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

### Icerock Ductwrap, Icerock Ductslab

Emissivity		
0.05	0.44	0.90
Max Heat Loss 16.34 W/m <sup>2</sup>		
Thickness of insulation (mm)		
<b>40</b>	<b>40</b>	<b>50</b>

### Paroc Hvac Mat, Paroc Hvac Slab, Paroc Pro Lamella Mat

Emissivity		
0.05	0.44	0.90
Max Heat Loss 16.34 W/m <sup>2</sup>		
Thickness of insulation (mm)		
<b>40 (50 Lamella)</b>	<b>50</b>	<b>50</b>

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 12241:1998 using standardized 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 - ACC. BS5422:2009

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

### Icerock Ductwrap, Icerock Ductslab

Emissivity		
0.05	0.44	0.90
Max Heat Gain 6.45 W/m <sup>2</sup>		
Thickness of insulation (mm)		
<b>60</b>	<b>60</b>	<b>65</b>

### Paroc Hvac Mat, Paroc Hvac Slab

Emissivity		
0.05	0.44	0.90
Max Heat Gain 6.45 W/m <sup>2</sup>		
Thickness of insulation (mm)		
<b>60</b>	<b>70</b>	<b>70</b>

### Paroc Pro Lamella Mat

Emissivity		
0.05	0.44	0.90
Max Heat Gain 6.45 W/m <sup>2</sup>		
Thickness of insulation (mm)		
<b>70</b>	<b>70</b>	<b>80</b>

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 12241:1998 using standardized 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.

NOTE 3: Thicknesses derived solely against the criteria noted in this table may not necessarily satisfy other design requirements such as control of condensation.available thickness for that pipe size.

# TABLE 15

## ACC. BS5422:2009

Indicative thickness of insulation for non-domestic heating services to control heat loss – Low emissivity outer surfaces  $e = 0.05$

**PAROC Hvac Section**  
**PAROC Pro Section 100**

Outside diameter of steel pipe on which insulation thickness has been based (mm)	Temperature of the content (°C)					
	75		100		125	
	Thickness of insulation (mm)	Max heat loss (W/m)	Thickness of insulation (mm)	Max heat loss (W/m)	Thickness of insulation (mm)	Max heat loss (W/m)
17.2	20	8.90	20	13.34	20	17.92
21.3	30	9.28	30	13.56	25	18.32
26.9	30	10.06	40	13.83	40	18.70
33.7	40	11.07	50	14.39	50	19.02
42.4	40	12.30	50	15.66	60	19.25
48.3	40	12.94	50	16.67	60	20.17
60.3	40	14.45	50	18.25	70	21.96
76.1	50	16.35	60	20.42	70	24.21
88.9	50	17.91	60	22.09	70	25.99
114.3	50	20.77	60	25.31	80	29.32
139.7	50	23.71	70	28.23	80	32.47
168.3	50	26.89	70	31.61	100	36.04
219.1	50	32.54	70	37.66	100	42.16
273.0	50	38.83	70	43.72	100	48.48

NOTE 1: Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal pipe in still air at 15 °C at t °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.

NOTE 4: Actual thickness required may be lower than shown in table, however the thickness shown is the nearest practically available thickness for that pipe size.

# TABLE 16

## ACC. BS5422:2009

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

**PAROC Hvac Section**  
**PAROC Pro Section 100**

Outside diameter of steel pipe on which insulation thickness has been based (mm)	Temperature of the content (°C)					
	75		100		125	
	Thickness of insulation (mm)	Max heat loss (W/m)	Thickness of insulation (mm)	Max heat loss (W/m)	Thickness of insulation (mm)	Max heat loss (W/m)
17.2	30	8.90	30	13.34	30	17.92
21.3	40	9.28	40	13.56	40	18.32
26.9	40	10.06	40	13.83	40	18.70
33.7	40	11.07	50	14.39	50	19.02
42.4	40	12.30	50	15.66	60	19.25
48.3	50	12.94	60	16.67	70	20.17
60.3	50	14.45	60	18.25	70	21.96
76.1	50	16.35	60	20.42	80	24.21
88.9	50	17.91	70	22.09	80	25.99
114.3	50	20.77	70	25.31	80	29.32
139.7	50	23.71	70	28.23	100	32.47
168.3	60	26.89	70	31.61	100	36.04
219.1	60	32.54	80	37.66	100	42.16
273.0	60	38.83	80	43.72	100	48.48

NOTE 1: Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized assumptions: horizontal pipe in still air at 15 °C at t °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.

NOTE 4: Actual thickness required may be lower than shown in table, however the thickness shown is the nearest practically available thickness for that pipe size.

# TABLE 17

## ACC. BS5422:2009

Indicative thickness of insulation for non-domestic hot water service areas to control heat loss – Low emissivity outer surfaces  $e = 0.05$

**PAROC Hvac Section**  
**PAROC Pro Section 100**

Outside diameter of steel pipe on which insulation thickness has been based (mm)	Thickness of insulation (mm)	Maximum Permissible Heat loss (W/m)
17.2	25	6.60
21.3	25	7.13
26.9	30	7.83
33.7	30	8.62
42.4	30	9.72
48.3	40	10.21
60.3	40	11.57
76.1	40	13.09
88.9	40	14.58
114.3	40	17.20
139.7	40	19.65
168.3	40	22.31
219.1	40	27.52
273.0	40	32.40

*NOTE 1: Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized 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: Actual thickness required may be lower than shown in table, however the thickness shown is the nearest practically available thickness for that pipe size.*

# TABLE 18

## ACC. BS5422:2009

Indicative thickness of insulation for non-domestic hot water service areas to control heat loss – High emissivity outer surfaces  $e = 0.9$

PAROC Hvac Section  
PAROC Pro Section 100

Outside diameter of steel pipe on which insulation thickness has been based (mm)	Thickness of insulation (mm)	Maximum Permissible Heat loss (W/m)
17.2	25	6.60
21.3	30	7.13
26.9	40	7.83
33.7	40	8.62
42.4	40	9.72
48.3	40	10.21
60.3	40	11.57
76.1	40	13.09
88.9	40	14.58
114.3	50	17.20
139.7	50	19.65
168.3	50	22.31
219.1	50	27.52
273.0	50	32.40

NOTE 1: Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized 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: Actual thickness required may be lower than shown in table, however the thickness shown is the nearest practically available thickness for that pipe size.

## TABLE 19 - ACC. BS5422:2009

Indicative thickness of insulation for domestic hot water systems having low emissivity outer surfaces  $e = 0.05$

**PAROC Hvac Section**  
**PAROC Pro Section 100**

Outside diameter of steel pipe on which insulation thickness has been based (mm)	Thickness of insulation (mm)	Maximum Permissible Heat loss (W/m)
8.0	–	7.06
10.0	–	7.23
12.0	20	7.35
15.0	20	7.89
22.0	20	9.12
28.0	20	10.07
35.0	20	11.08
42.0	20	12.19
54.0	25	14.12

## TABLE 20 - ACC. BS5422:2009

Indicative thickness of insulation for domestic hot water systems having high emissivity outer surfaces  $e = 0.9$

**PAROC Hvac Section**  
**PAROC Pro Section 100**

Outside diameter of steel pipe on which insulation thickness has been based (mm)	Thickness of insulation (mm)	Maximum Permissible Heat loss (W/m)
8.0	–	7.06
10.0	–	7.23
12.0	20	7.35
15.0	20	7.89
22.0	20	9.12
28.0	20	10.07
35.0	25	11.08
42.0	25	12.19
54.0	25	14.12

*NOTE 1: Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized 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.*

*NOTE 4: Actual thickness required may be lower than shown in table, however the thickness shown is the nearest practically available thickness for that pipe size.*

# TABLE 21

## ACC. BS5422:2009

Minimum insulation thickness for process pipework and equipment to control heat loss

PAROC Pro Section 100

PAROC Pro Section 140

Outside diameter of steel pipe on which insulation has been based (mm)	Hot face temperature (°C)													
	100		200		300		400		500		600		700	
	Thickness of insulation (mm)	Max. Heat loss (W/m)	Thickness of insulation (mm)	Max. Heat loss (W/m)	Thickness of insulation (mm)	Max. Heat loss (W/m)	Thickness of insulation (mm)	Max. Heat loss (W/m)	Thickness of insulation (mm)	Max. Heat loss (W/m)	Thickness of insulation (mm)	Max. Heat loss (W/m)	Thickness of insulation (mm)	Max. Heat loss (W/m)
<b>17.2</b>	30	12.79	40	28.67	60	47.12	70	69.08	90	96.08	110	126.93	120	163.60
<b>21.3</b>	30	14.04	50	30.72	60	50.54	80	74.10	90	103.00	110	135.40	120	174.50
<b>26.9</b>	30	15.42	50	33.73	70	54.97	80	80.06	100	110.72	110	145.58	130	186.90
<b>33.7</b>	40	17.25	50	37.11	70	59.90	80	87.16	100	119.80	120	156.77	130	201.20
<b>42.4</b>	40	19.15	60	40.76	70	65.79	90	95.05	110	130.57	120	170.00	140	217.30
<b>48.3</b>	40	20.42	60	43.24	70	69.42	90	99.66	110	136.95	130	178.30	140	227.80
<b>60.3</b>	40	23.17	60	48.44	80	76.66	100	109.91	110	149.28	130	194.30	150	247.20
<b>76.1</b>	40	26.21	60	54.20	80	85.08	100	121.21	120	164.62	140	213.22	160	270.20
<b>88.9</b>	40	28.73	60	58.66	80	92.02	100	130.15	120	176.67	140	227.69	160	288.40
<b>114.3</b>	40	33.89	70	67.25	90	104.55	110	146.83	130	198.17	150	254.18	180	320.70
<b>139.7</b>	40	38.74	70	75.74	90	116.62	110	163.60	130	218.23	160	279.81	180	351.40
<b>168.3</b>	50	43.99	70	84.85	90	129.46	120	180.38	140	240.54	160	305.53	190	383.80
<b>219.1</b>	50	53.38	70	101.24	100	152.70	120	209.59	140	277.77	180	350.96	200	437.20
<b>273.0</b>	50	62.87	80	117.64	100	175.73	130	239.40	150	315.35	190	386.92	200	495.10

Please refer to our "Multi-Layer Pipe Section Solutions" guide for more information when fitting more than a single layer of pipe section insulation (available on [www.paroc.co.uk](http://www.paroc.co.uk)).

NOTE 1: Insulation thicknesses in this table have been calculated according to BS EN ISO 12241:1998 using standardized 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 deducted 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: Actual thickness required may be lower than shown in table, however the thickness shown is the nearest practically available thickness for that pipe size.

# TABLE 22

## ACC. BS5422:2009

Minimum insulation thickness to control the surface temperature of a non-metallic surface with a surface emissivity of 0.9 and design cold face temperature of 59 °C

**PAROC Pro Section 100**

**PAROC Pro Section 140**

Outside diameter of steel pipe (mm)	Temperature of the content (°C)						
	100	200	300	400	500	600	700
	Thickness of insulation (mm)						
17.2	20	20	20	30	40	50	70
21.3	20	20	20	30	40	60	70
26.9	20	20	20	30	50	60	80
33.7	20	20	25	40	50	60	80
42.4	20	20	25	40	50	70	90
48.3	20	20	25	40	50	70	90
60.3	20	20	25	40	60	70	90
76.1	20	20	25	40	60	80	100
88.9	20	20	30	40	60	80	100
101.6	20	20	30	50	60	80	110
114.3	25	25	30	50	60	90	110
139.7	25	25	30	50	70	90	110
168.3	25	25	30	50	70	90	120
219.1	30	30	40	50	70	100	130
244.5	30	30	40	50	80	100	130
273.0	30	30	40	60	80	100	130
323.9	30	30	40	60	80	110	140
355.6	30	30	40	60	80	110	140
406.4	30	30	40	60	80	110	140
457.0	30	30	40	60	90	110	150
508.0	30	30	40	60	90	120	150
610.0	40	40	40	60	90	120	160
<b>Flat surfaces</b>	20	20	30	50	70	100	140

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

NOTE 2: Actual thickness required may be lower than shown in table, however the thickness shown is the nearest practically available thickness for that pipe size.

NOTE 3: Slabs, mats, etc are available for flat surfaces



# TABLE 23

## ACC. 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

PAROC Pro Section 100

PAROC Pro Section 140

Outside diameter of steel pipe (mm)	Temperature of the content (°C)						
	100	200	300	400	500	600	700
Thickness of insulation (mm)							
17.2	20	25	40	70	100	130	180
21.3	20	25	50	70	100	140	200
26.9	20	25	50	80	110	150	200
33.7	20	30	50	80	120	160	220
42.4	20	30	60	90	120	170	230
48.3	20	30	60	90	130	180	240
60.3	20	40	60	100	140	190	250
76.1	20	40	70	100	150	220	270
88.9	20	40	70	110	150	220	280
101.6	20	40	70	110	160	220	290
114.3	25	40	80	120	170	230	300
139.7	25	50	80	120	180	250	320
168.3	25	50	90	130	190	260	340
219.1	30	50	90	140	210	280	370
244.5	30	50	100	150	220	300	380
273.0	30	50	100	150	220	300	390
323.9	30	60	100	160	230	320	410
355.6	30	60	110	160	240	330	430
406.4	30	60	110	180	250	340	450
457.0	30	60	110	180	260	350	460
508.0	30	60	120	190	270	370	480
610.0	40	70	120	200	280	390	500
<b>Flat surfaces</b>	20	40	80	120	200	300	400

Please refer to our "Multi-Layer Pipe Section Solutions" guide for more information when fitting more than a single layer of pipe section insulation (available on [www.paroc.co.uk](http://www.paroc.co.uk)).

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

NOTE 2: Actual thickness required may be lower than shown in table, however the thickness shown is the nearest practically available thickness for that pipe size.

NOTE 3: Slabs, mats, etc are available for flat surfaces

# TABLE 24

## ACC. 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

**PAROC Pro Section 100**  
**PAROC Pro Section 140**

Outside diameter of steel pipe (mm)	Temperature of the content (°C)						
	100	200	300	400	500	600	700
	Thickness of insulation (mm)						
17.2	20	20	25	40	50	70	90
21.3	20	20	25	40	60	70	90
26.9	20	20	30	40	60	80	100
33.7	20	20	30	50	60	80	100
42.4	20	20	30	50	70	90	110
48.3	20	20	30	50	70	90	110
60.3	20	20	40	50	70	90	120
76.1	20	20	40	60	80	100	130
88.9	20	20	40	60	80	100	130
101.6	20	20	40	60	80	110	140
114.3	25	25	40	60	80	110	140
139.7	25	25	40	60	90	120	150
168.3	25	25	40	70	90	120	150
219.1	30	30	50	70	100	130	160
244.5	30	30	50	70	100	130	170
273.0	30	30	50	70	100	130	180
323.9	30	30	50	70	100	140	180
355.6	30	30	50	80	110	140	190
406.4	30	30	50	80	110	150	190
457.0	30	30	50	80	110	150	200
508.0	30	30	50	80	110	150	200
610.0	40	40	50	80	120	160	210
<b>Flat surfaces</b>	20	30	40	70	100	140	210

Please refer to our “Multi-Layer Pipe Section Solutions” guide for more information when fitting more than a single layer of pipe section insulation (available on [www.paroc.co.uk](http://www.paroc.co.uk)).

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

NOTE 2: Actual thickness required may be lower than shown in table, however the thickness shown is the nearest practically available thickness for that pipe size.

NOTE 3: Slabs, mats, etc are available for flat surfaces

# TABLE 25

## ACC. BS5422:2009

Heat loss from bare surfaces calculated in accordance with BS EN ISO 12241:1998 (black steel pipes)

Outside diameter of steel pipe (mm)	Operating temperature (°C)													
	50	100	150	200	250	300	350	400	450	500	550	600	650	700
	Heat loss (W/m for pipes and W/m <sup>2</sup> for flat surfaces)													
<b>12.0</b>	17	57	110	176	257	356	476	620	791	993	1231	1509	1832	2206
<b>15.0</b>	20	69	133	214	313	435	582	758	969	1220	1514	1859	2260	2723
<b>17.2</b>	23	78	150	241	353	491	658	859	1099	1384	1720	2113	2571	3100
<b>21.3</b>	27	93	180	290	427	594	798	1043	1337	1687	2099	2583	3146	3798
<b>22.0</b>	28	96	186	299	439	611	821	1074	1378	1738	2164	2662	3243	3916
<b>26.9</b>	33	114	221	356	525	732	985	1291	1658	2095	2611	3217	3923	4742
<b>28.0</b>	35	118	229	369	544	759	1022	1340	1721	2175	2711	3341	4075	4926
<b>33.7</b>	41	139	269	435	641	897	1209	1588	2042	2585	3226	3979	4859	5878
<b>42.0</b>	49	168	326	528	781	1094	1478	1944	2505	3175	3968	4901	5990	7254
<b>42.4</b>	50	169	329	532	788	1104	1491	1961	2527	3203	4004	4945	6045	7320
<b>48.3</b>	56	190	369	598	885	1242	1679	2212	2853	3619	4527	5595	6843	8292
<b>54.0</b>	61	209	407	660	979	1374	1860	2452	3165	4018	5029	6220	7612	9228
<b>60.3</b>	68	230	448	728	1081	1519	2058	2715	3508	4456	5582	6908	8458	10258
<b>67.0</b>	74	253	492	800	1188	1672	2268	2994	3871	4921	6167	7636	9354	11350
<b>76.1</b>	83	283	551	896	1333	1878	2550	3370	4360	5548	6958	8621	10566	12827
<b>80.0</b>	87	295	576	938	1395	1966	2670	3530	4569	5815	7298	9041	11084	13459
<b>88.9</b>	95	324	632	1031	1535	2165	2943	3894	5044	6424	8064	9998	12263	14897
<b>101.6</b>	107	365	712	1162	1733	2447	3330	4410	5718	7287	9155	11358	13940	16942
<b>108.0</b>	113	385	752	1228	1832	2588	3523	4668	6056	7721	9703	12042	14782	17969
<b>114.3</b>	119	405	791	1292	1929	2726	3714	4922	6387	8147	10241	12713	15609	18979
<b>139.7</b>	142	484	947	1549	2316	3279	4474	5939	7716	9853	12399	15406	18932	23036
<b>168.3</b>	167	571	1119	1833	2746	3894	5321	7072	9200	11760	14812	18420	22653	27582
<b>219.1</b>	212	722	1419	2330	3498	4971	6806	9063	11809	15117	19065	23736	29220	35609
<b>273.0</b>	258	880	1731	2848	4283	6098	8362	11152	14550	18647	24221	30135	37067	45134
<b>323.9</b>	301	1027	2021	3331	5016	7151	10254	13667	17813	22798	28737	35754	43978	53549
<b>Flat surfaces</b>	285	1212	2405	3949	5897	8317	11286	14890	19226	24396	30515	37700	46081	55794



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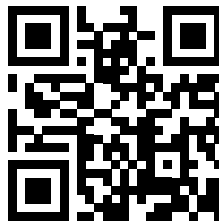
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