



DESIGNER'S GUIDE

Thermal insulation - HVAC



TABLE OF CONTENTS

Technical and sustainability requirements - insulation material selection.	3
Selection of insulation thickness - applicable regulations	4
BS5422 thickness tables	5
Helpful software - PAROC Calculus.	10
How to use the software?	11
Pipework installations - recommended products and solutions	14
Ventilation ducts and equipment	16
Wide range of Paroc solutions.	18



TECHNICAL AND SUSTAINABILITY REQUIREMENTS - INSULATION MATERIAL SELECTION

Would you like to specify non-combustible insulation that will not contribute to a fire?
Would you like chemically inert insulation to help reduce the potential for pipework corrosion?

PAROC stone wool insulation satisfies these requirements, providing thermal, condensation, fire and acoustic benefits all in one product.

PAROC stone wool is CE marked, responsibly sourced and can be supplied with BES 6001 certification, Environmental Product Declaration and Eurofins Gold for Indoor Air Comfort.



SELECTION OF INSULATION THICKNESS - APPLICABLE REGULATIONS

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 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 Part L of the Building Regulations.

Pipework 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 guide shows a selection of the prescribed thicknesses

of 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.

TABLE 10

ACC. BS5422:2009

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

PAROC HVAC SECTION ALUCOAT T
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 15

ACC. BS5422:2009

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

PAROC HVAC SECTION ALUCOAT T
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 17

ACC. BS5422:2009

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

PAROC HVAC SECTION ALUCOAT T
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 12

ACC. BS5422:2009

Practical/available 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

PAROC HVAC LAMELLA MAT ALUCOAT

MINIMUM AIR TEMPERATURE INSIDE THE DUCT (°C)	Emissivity		
	0.05	0.44	0.90
	Thickness of insulation (mm)		
15	30	20	20
10	50	30	20
5	70	40	30
0	80	60	40

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	40	25	25
5	65	40	25
0	75	50	40

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.

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 13 - ACC. BS5422:2009

Practical/applicable thickness of insulation for ductwork carrying warm air to control heat loss

PAROC PRO LAMELLA MAT ALUCOAT

Emissivity		
0.05	0.44	0.90
Maximum Permissible Heat Loss (W/m²)		
16.34	16.34	16.34
Thickness of insulation (mm)		
60	60	60

ICEROCK DUCTWRAP, ICEROCK DUCTSLAB

Emissivity		
0.05	0.44	0.90
Maximum Permissible Heat Loss (W/m²)		
16.34	16.34	16.34
Thickness of insulation (mm)		
50	50	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 12241:1998 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.

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 14 - ACC. BS5422:2009

Practical/applicable thickness of insulation for chilled and dual-purpose ducting to control heat transfer

PAROC PRO LAMELLA MAT ALUCOAT

Emissivity		
0.05	0.44	0.90
Maximum Permissible Heat Gain (W/m²)		
6.45	6.45	6.45
Thickness of insulation (mm)		
100	100	100

ICEROCK DUCTWRAP, ICEROCK DUCTSLAB

Emissivity		
0.05	0.44	0.90
Maximum Permissible Heat Gain (W/m²)		
6.45	6.45	6.45
Thickness of insulation (mm)		
80	90	90

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.

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.

HELPFUL SOFTWARE - PAROC CALCULUS

In order to make it easier for designers to select the appropriate type and thickness of insulation for HVAC systems, as well as industrial insulations, Paroc provides a free-of-charge, specialist software for computing parameters of technical insulation, PAROC Calculus. It is a tool that enables the selection of an optimum solution for many types of structures, including heating pipelines, ventilation ducts, flat surfaces, and tanks.

PAROC Calculus conducts calculations on the basis of the formulas presented in the standard EN ISO 12241. The software makes it possible to take into account a number of design factors, such as material and physical dimensions of insulated elements (length, width, thickness, diameter), element type, and temperature of contents (including delivered final temperature), insulation material and thickness, as well as environmental conditions: ambient temperature, wind speed, and relative air humidity.

PAROC Calculus offers a couple of further unique functionalities. The software makes it possible, among other things, to calculate the energy consumption costs on the basis of specific energy sources and unit rates, estimate CO₂ emission reduction level owing to a given insulation, and calculate a freezing time or temperature decrease in cold ambient conditions.



PAROC Calculus

enables the selection of an optimum solution for many types of structures, including heating pipelines, ventilation ducts, flat surfaces and tanks.



<http://www.paroc.co.uk/tools-and-documents/calculators>

HOW TO USE THE SOFTWARE?

After starting the software, a window is displayed where you can enter information about the design calculations. The information entered here will be visible on the printout.



First, you should select an object to be insulated. We can perform calculations for: flat surfaces, pipelines, circular ducts, rectangular ducts, circular tanks and rectangular tanks.



After selecting the type of insulated object, for example, a pipe, we proceed to the following stage of calculation by pressing **2. Basic info**. Optionally, by ticking a relevant box, we indicate additional values to be calculated: content temperature change, content freezing, or energy consumption. In this tab, other data about the type of the material from which the element is made should be entered, as well as data about the medium and environment.



After pressing **3. Insulation** we go to a tab which enables us to define the type of insulation material and the insulation thickness. If we need more than one insulation layer, each subsequent layer can be added by pressing **+ Add insulation layer**. As a maximum, 5 layers can be used.



In certain cases, e.g. where a mat was selected as the insulation material, it is necessary to use a support structure for the cladding. In such a case, we can take into account the influence of the support structure, by ticking the box **Support of cladding** and defining its influence on the final parameters of the system. Usually, a support structure increases heat losses by approx. 15–20%. Cladding material choice is also very important, especially when defining a safe 'cold face' surface temperature. This is due to the influence of the emissivity of the cladding.



If the surface or operating temperature exceeds a limit value, a pop-up warning may be displayed. This indicates that the thickness of insulation should be enhanced or that another insulation type should be selected, or that the cladding should be changed.



Calculation results are presented on an ongoing basis on the right side of the screen. They inform, among other things, about the difference between insulated and non-insulated surfaces. Final results (for multiple objects if needed) may be saved project by project, and also into a PDF for easy attachment to email etc.

PIPEWORK INSTALLATIONS - RECOMMENDED PRODUCTS AND SOLUTIONS

HOT AND COLD PIPES

Fire retardant insulation sections of stone wool PAROC Hvac Section AluCoat T, or PAROC Hvac Section GreyCoat T meet all requirements for thermal insulation and condensation insulation of pipes operating between 0 °C and 250 °C. (Alternative products are available for higher service temperatures). The facing of aluminium foil protects against moisture penetration into the insulation material.

A self-adhesive fold on the longitudinal seam facilitates quick and easy sealing the installation and creates an additional barrier against moisture.

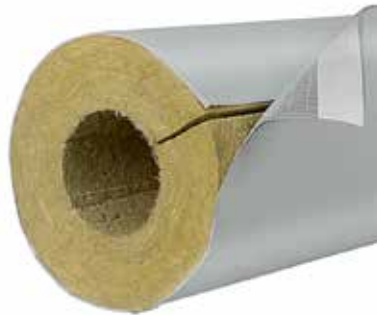


PAROC HVAC SECTION ALUOCOAT T



Sections designated for thermal and acoustic insulation of heating, central heating pipelines, air conditioning ducts, and some chimney ducts.

PAROC HVAC SECTION GREYCOAT T



Sections designated for thermal and acoustic insulation of heating, central heating pipelines, air conditioning ducts, and some chimney ducts. The product features an additional grey lacquer coat, which gives an attractive look where the installation is visible and requires an aesthetic surface finish – e.g. in shopping malls, sports halls, or other public facilities.

PIPELINE BENDS

When insulating elements of a heating or cooling installation, it is best to rely on systemic solutions which complement one another. Elbows can be protected by cutting straight insulation sections manually. However, this method has certain disadvantages, as it generates the risk of installation errors resulting in avoidable heat loss, and dust generation.

In order also to save time, it is best to use factory-made elements which ensure the best insulation solution for bends without cold bridges.

PAROC HVAC BEND ALUCOAT T



PAROC HVAC BEND GREYCOAT T



Insulation sections of stone wool covered with reinforced aluminium foil (AluCoat or GreyCoat) with integral self-adhesive tape. The solution enables precise fitting to 90 degree elbows of radius 1.5D, which significantly improves the efficiency of insulation works.

INSULATION SOLUTIONS FOR PIPELINES WITH THE USE OF PAROC PRODUCTS

SOLUTION	PAROC HVAC SECTION ALUCOAT T	PAROC HVAC SECTION GREYCOAT T	PAROC HVAC BEND ALUCOAT T	PAROC HVAC BEND GREYCOAT T
Thickness	20-120 mm	20-120 mm	20-100 mm	20-100 mm
Internal diameter	12-273 mm	12-273 mm	15-168 mm	15-168 mm
Length	1200 mm	1200 mm	n/a	n/a
Thermal conductivity at 10 °C	0.034 W/(mK)	0.034 W/(mK)	0.034 W/(mK)	0.034 W/(mK)
Thermal conductivity at 40 °C	0.036 W/(mK)	0.036 W/(mK)	0.036 W/(mK)	0.036 W/(mK)
Thermal conductivity at 50 °C	0.037 W/(mK)	0.037 W/(mK)	0.037 W/(mK)	0.037 W/(mK)
Thermal conductivity at 100 °C	0.044 W/(mK)	0.044 W/(mK)	0.044 W/(mK)	0.044 W/(mK)
Thermal conductivity at 150 °C	0.053 W/(mK)	0.053 W/(mK)	0.053 W/(mK)	0.053 W/(mK)
Thermal conductivity at 200 °C	0.064 W/(mK)	0.064 W/(mK)	0.064 W/(mK)	0.064 W/(mK)
Thermal conductivity at 250 °C	0.077 W/(mK)	0.077 W/(mK)	0.077 W/(mK)	0.077 W/(mK)



VENTILATION DUCTS AND EQUIPMENT

For the purposes of thermal and condensation insulation of rectangular and round ducts and ventilation equipment, mats or slabs are recommended. Paroc Ltd offers multiple options, including the highly regarded Icerock products and its own Hvac Mats. Where greater impact or compression resistance is needed, the option of PAROC Pro Lamella Mat, where the fibres are arranged perpendicularly to the protected surface, adds greater strength to the installation.



PAROC PRO LAMELLA MAT ALUCOAT



Stone wool lamella mat, covered with aluminium foil on one side, is designated for thermal and acoustic insulation of ventilation and air conditioning ducts, low-temperature boilers, small tanks and cylindrical surfaces. Owing to the perpendicular arrangement of fibres, it maintains the original insulation thickness on sharp edges and corners.

ICEROCK DUCTSLAB



Stone wool slab for thermal insulation and condensation protection of rectangular ventilation ducts and equipment. The slab is covered with aluminium foil.

ICEROCK DUCTWRAP



Stone wool mat for thermal insulation and condensation protection of ventilation ducts and equipment. The mat is covered with aluminium foil. Alternatively, PAROC Hvac Mat AluCoat.

INSULATION SOLUTIONS FOR VENTILATION DUCTS AND EQUIPMENT WITH THE USE OF PAROC PRODUCTS

SOLUTION	PAROC PRO LAMELLA MAT ALUCOAT	ICEROCK DUCTSLAB	ICEROCK DUCTWRAP
Thickness	20-120 mm	40, 50, 60, 80, 100 mm	25, 40, 50, 75 mm
Width	1000 mm	600 mm	900 mm
Length	2500-8000 mm	1200 mm	5000 - 10000 mm
Thermal conductivity at 10 °C	0.039 W/(mK)	0.035 W/(mK)	0.033 W/(mK)
Thermal conductivity at 50 °C	0.045 W/(mK)	0.039 W/(mK)	0.039 W/(mK)
Thermal conductivity at 100 °C	0.055 W/(mK)	0.048 W/(mK)	0.049 W/(mK)
Thermal conductivity at 150 °C	0.066 W/(mK)	0.060 W/(mK)	0.060 W/(mK)
Thermal conductivity at 200 °C	0.081 W/(mK)	-	-
Thermal conductivity at 250 °C	0.099 W/(mK)	-	-

WIDE RANGE OF PAROC SOLUTIONS

includes specialist products with integrated facing:

PAROC AluCoat

Insulations with standard aluminium foil



PAROC GreyCoat

Insulations with aluminium foil and an additional grey lacquer layer



PAROC Clad

Insulations with reinforced aluminium foil






Apart from controlling heat loss / gain and condensation control – other factors influence the choice of insulation and its thickness. These are such as fire resistance; corrosion control; and Legionella.

Paroc offers recognized CPD sessions covering all of these topics.

Contact us for further information.



Paroc is the leading manufacturer of energy-efficient insulation solutions in the Baltic Sea region. The cornerstones of our operations are customer and personnel orientation, constant innovation, profitable growth and sustainable development. Paroc products include building insulation, technical insulation, marine and offshore insulation, sandwich panels and acoustic products. The products are manufactured in Finland, Sweden, Lithuania, Poland and Russia. Paroc has sales and representative offices in 14 European countries.



BUILDING INSULATION

offers a wide range of products and solutions for all traditional building insulation. The building insulation products are mainly used for the thermal, fire and sound insulation of exterior walls, roofs, floors and basements, intermediate floors and partitions.



SOUND ABSORBING

ceilings and wall panels for interior acoustic control, as well as industrial noise control products, are available in the range



TECHNICAL INSULATION

products are used for thermal, fire and sound insulation in HVAC systems, industrial processes and pipe work, industrial equipment as well as shipbuilding and offshore industry.



The information in this brochure describes the conditions and technical properties of the disclosed products, valid at the time of publication of this document and until replaced by the next printed or digital version. The latest version of this brochure is always available on the Paroc website. Our information material presents applications for which the functions and technical properties of our products have been approved. However, the information does not mean a commercial guarantee. We do not assume liability of the use of third party components used in the application or the installation of our products. We cannot warrant the suitability of our products if used in an area or conditions which are not provided in our information material. As a result of constant further development of our products we reserve the right to make alterations to our information material at any time.

PAROC is a registered trademark of Paroc Group.

Published:
July 2017
© Paroc 2017
TIPO0716



PAROC LTD
Technical Insulation Division
Tel. +44 (0)780 759 1376
www.paroc.co.uk

A MEMBER OF PAROC GROUP