THERMAL INSULATION MANUFACTURERS
& SUPPLIERS ASSOCIATION

The Building Regulations 2000

TIMSA guidance for achieving compliance with Part L of the Building Regulations

DOMESTIC AND NON-DOMESTIC HEATING, COOLING AND VENTILATION GUIDE

COMPLIANCE WITH APPROVED DOCUMENTS

L1A: NEW DWELLINGS

L1B: EXISTING DWELLINGS

L2A: NEW BUILDINGS OTHER THAN DWELLINGS AND

L2B: EXISTING BUILDINGS OTHER THAN DWELLINGS

Edition March 2006

TIMSA
Thermal Insulation Manufacturers & Suppliers Association

Formed in 1978, TIMSA is a trade association comprising UK manufacturers, consultants, suppliers and distributors of the whole range of thermal insulation materials, ancillaries and services.

TIMSA is committed to raising standards and awareness of the need to insulate and the part insulation can play in the protection of the environment.

Further information is available on TIMSA's web site www.timsa.org.uk

Association House, 99 West Street, Farnham, Surrey GU9 7EN
Tel: 01252 739154   Fax: 01252 739140
timsa@associationhouse.org.uk

ISBN: 0 9533319 0 3

CONTENTS

1 FOREWORD 4
2 HOW TO USE THIS GUIDE 5
2.1 Who the Guide is for and which Sections are relevant to each audience 5
2.2 Scope of the Guidance 5
2.3 Summary 7
3 DEVELOPMENT OF METHODOLOGY 7
3.1 Linkage with the Part L Consultation and the Regulatory Impact Assessment Assumptions 7
3.2 Financial criteria - payback 8
3.3 Inclusion of the Social Cost of Carbon 10
3.4 Selection of Standardised Scenarios for Evaluating Compliance 10
4 CONSIDERATION OF PRACTICALITY 13
4.1 Linkage to Pipe Diameter 13
4.2 Selection of Reference Thermal Conductivities 13
5 WHERE TO INSULATE AND MINIMUM PERFORMANCE REQUIREMENTS 14
5.1 Dwellings 14
5.2 Buildings other than Dwellings 16
6 INDICATIVE INSULATION THICKNESSES 18
6.1 Dwellings 18
6.2 Buildings other than Dwellings 19
7 OTHER REASONS FOR INSULATING 26
7.1 Frost Protection 26
7.2 Condensation Control 30
7.3 Personnel Protection 31
8 FURTHER READING 31
9 CONTACTS WITH TIMSA 31
10 ANNEX 1 BACKGROUND TO THE DEVELOPMENT OF THE GUIDE 32
A-1.1 The UK's Climate Change Programme commitments 32
A-1.2 The importance of pipe and duct insulation in CO_2 terms 34
A-1.3 The Energy Performance in Buildings Directive 36
A-1.4 The resulting revision of the Building Regulations 38
A-1.5 Linkage with other Compliance Guides 38

1 FOREWORD

TIMSA has been active in assessing the contribution of insulation to the UK carbon emission reduction goals since these were re-established in 1997. The commitment to 20% reduction in CO_2 emissions by 2010 has always been recognised as ambitious and certainly not achievable without substantial contributions from the energy efficiency industry in general and thermal insulation in particular.

The development of the Energy Performance in Buildings Directive in the early part of this decade and its finalisation in January 2002 began to put shape on the likely future requirements for the built environment in the UK. TIMSA has been at the forefront of evaluating the implications for the industry; both by participation in the Part L Industry Advisory Groups (IAGs) and in the revision of standards which might influence the fulfilment of the Directive's objectives.

With respect to pipe and duct insulation specifically, a TIMSA Sub-Group was formed in early 2004 to assist in developing minimum requirements for the 2006 revision of Part L based on cost-effectiveness criteria being established at the time within the IAGs and later re-assessed during and after the consultation process that took place in mid-2005. Throughout this process, the Sub-Group has stuck firmly to its task of defining the minimum criteria for pipes and ducts in both domestic and non-domestic environments. This scope has included all hot water, heating and cooling applications. As Tier 2 Compliance Guides in both domestic and non-domestic sectors began to emerge in early 2005, the TIMSA Sub-Group also became engaged in ensuring that pipe and duct insulation was consistently and appropriately covered.

In all the Sub-Group has met over 20 times in pursuit of these objectives and TIMSA would like to use this opportunity thank each participant and their respective employers for the support provided to the process. The following participants and companies were involved:

Nick Ralph (Chair of Sub-Group)	Rockwool Limited
Pat Johnson	Armacell
Vance Brownhill	Armacell
Nikolaus Odenwald	Armacell
David Davies	ex-Armacell
John Robertson	NMC (UK) Limited
Les Johnson	Deeside Technical Services/Union Foam
Pat Testa	Sheffield Insulation
Geoff Wright	KingspanTarec Limited
Stephen Wise	Knauf Insulation

In addition, TIMSA would wish to acknowledge the co-ordination and secretarial role played by Paul Ashford of Caleb Management Services Limited, who was also responsible for the initial development of this document for TIMSA review and approval.

TIMSA will be continuing to support the requirements of the industry through the implementation of the 2006 Part L Revisions and is already looking at the implications of future revisions of Part L which will be scheduled for 2010. The continued inter-linkage with BS 5422 will be a further focus of future work.

Patrick Hall
Chairman TIMSA

March 2006

2 HOW TO USE THIS GUIDE

2.1 Who the Guide is for and which Sections are relevant to each audience

The primary purpose of the 'TIMSA HVAC Guidance for Achieving Compliance with Part L of the Building Regulations' is to provide a single point reference for all compliance issues related to the treatment of pipework and ductwork insulation within the 2006 version of Part L of the Building Regulations.

The Guidance is targeted at three different audiences:

1. Those seeking to understand the role and significance of pipework and ductwork insulation in the wider development of climate change policy within the built environment [Policy Significance]
2. Those seeking to understand the basis on which the current performance standards have been derived and needing to know how to replicate the calculations for other scenarios (e.g. products with thermal performance other than those listed) [Basis of Calculation]
3. Those seeking to know simply when to use this Guide and an indicative assessment of the thicknesses of insulation required [Guidance for Compliance]

The following table provides a directory of sections relevant to each of these audiences:

Table 1 – Sections of relevance to specific audiences

Section		Policy Significance	Basis of Calculation	Guidance for Compliance
2	How to use this Guide	X	X	X
3	Background to the development of the Guide	X		
4	Development of methodology		X	
5	Consideration of practicality		X	
6	Where to insulate and minimum performance		X	X
7	Indicative insulation thicknesses		X	X
8	Other reasons for insulating		X	X
9	Further reading	X	X	
10	Contact point at TIMSA	X	X	X

2.2 Scope of the Guidance

This guidance is specifically targeted at the implementation of the 2006 revision of Part L of the Building Regulations covering the *'conservation of heat and power'.* It does not provide specific guidance on other aspects of pipework and ductwork insulation performance and users of the Guide need to take account of other reasons for insulating which might be operative (see Section 7). Consideration also needs to be given to other aspects impacting product performance such as temperature of operation, exposure to foot traffic, environmental credentials etc. With respect to pipes, the Guidance applies to all pipe materials (i.e. steel, copper, plastic and other).

Guidance on compliance with the energy efficiency requirements of in the Building Regulations as amended April 2006 is conveyed in four Approved Documents: ADL-1A, ADL-1B, ADL-2A and ADL-2B. Detail on the derivation of these documents in found in Annex 1. The documents cover the following four scenarios:

Figure 1 – Applicability of Approved Documents

	Dwellings	Buildings other than Dwellings
New Build	ADL-1A	ADL-1B
Existing Buildings	ADL-2A	ADL-2B

These four Approved Documents are supported by two over-arching Compliance Guides entitled:

The Domestic Heating Compliance Guide

The Non-Domestic Heating, Cooling and Ventilation Compliance Guide

These *Tier 2* documents effectively act as Annexes to the Approved Documents and directly specify the minimum performance requirements for pipework and ductwork insulation. However, because there is insufficient room in the Compliance Guides themselves for a detailed explanation of pipework and ductwork related issues, this *Guidance* offers specific further information on aspects of compliance and, in particular, indicative thicknesses for insulation being applied at specified thermal conductivities. Since the TIMSA Guide is specifically referenced in both Compliance Guides, it is technically itself a *Tier 2* document and has been reviewed directly by ODPM on that basis.

The scope of this Guidance is expanded further in the sub-paragraphs below:

2.2.1 Dwellings and Buildings other than Dwellings (BoTD)

As described above, this *TIMSA HVAC Guidance* on pipework and ductwork supports Approved Documents and Compliance Guides relating to both dwellings and buildings other than dwellings. Sections 5 and 6 of this document are divided into dedicated sub-sections dealing specifically with each sector of the market. However, unlike the British Standard BS 5422, this *Guidance* does <u>not</u> cover the insulation of pipework and ductwork within the process sector.

For community heating systems, where the central heat source is within the overall building, it should be handled as part of a non-domestic provision and pipework and ductwork insulation should be applied accordingly. Where the community heating system breaks into a dwelling, it is considered as part of a dwelling and is subject to the requirements relevant to dwellings. Further information is available on this within the Domestic Heating Compliance Guide.

2.2.2 Pipework and Ductwork

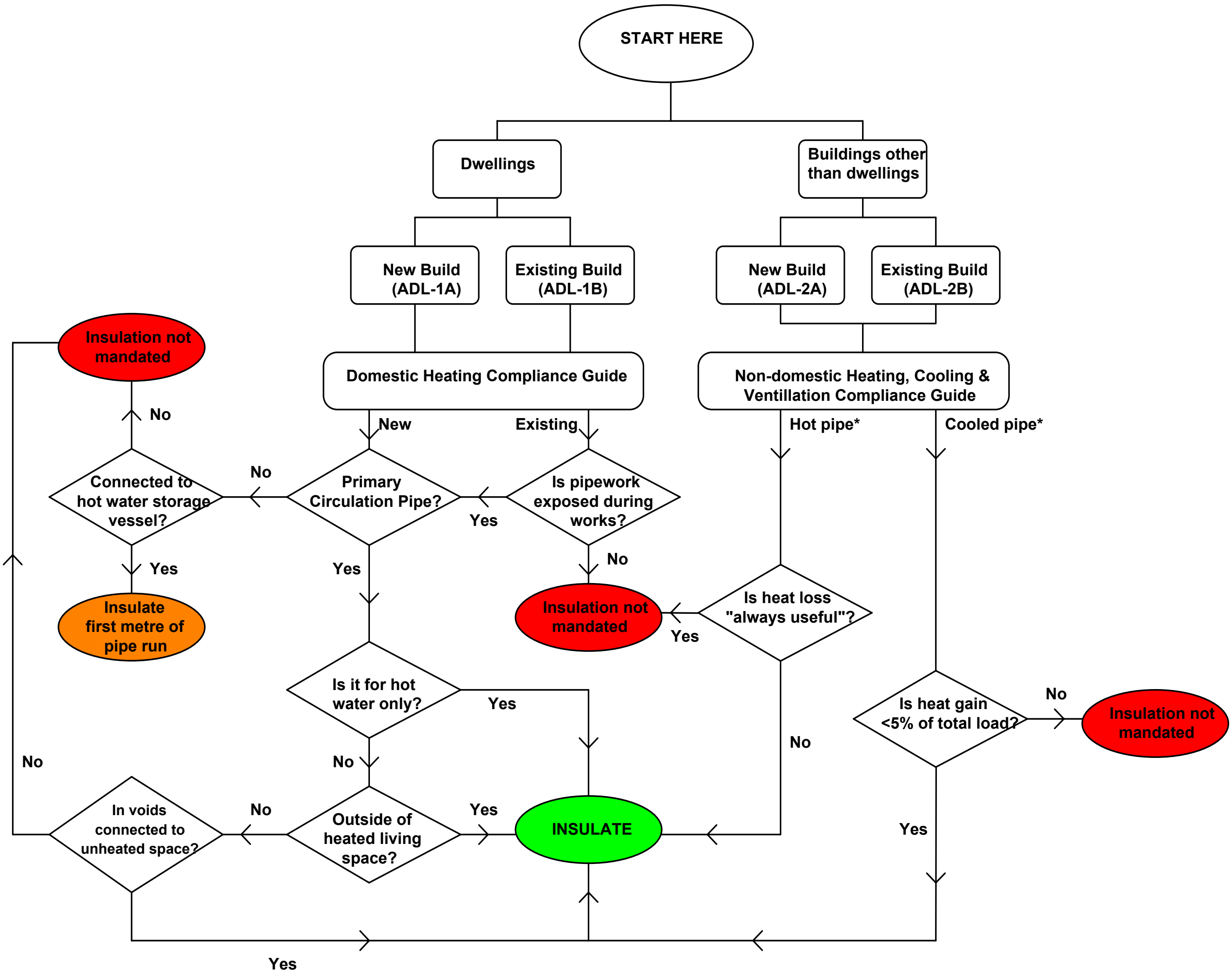
As with BS 5422, this *Guidance* deals with both pipework and ductwork. Although the fluid transported and typical temperature differentials vary considerably between the two types of structure, the analysis of heat losses or gains is essentially the same in both cases. It has therefore been possible to apply consistent assumptions across both sectors of the market in respect of important parameters such as cost-effectiveness limits. However, because there are no pre-specified sizes for a duct (in contrast to standardised pipe sizes), it has been most appropriate to quote the minimum performance criteria for duct in terms of maximum permissible heat losses/gains per unit area of duct wall rather than per linear metre of 'run' as is the case for pipework.

2.2.3 Hot water, Heating and Chilled Systems

This *Guidance* covers hot water, heating and cooling systems in both domestic and non-domestic environments. These six permutations are defined in terms of standardised temperatures, utilisation levels, fuel types and surface emissivity parameters. These scenarios are dealt with in more detail in Section 3.4. However, it is important to establish at this point that **all compliance calculations should be based on these standardised scenarios**. Accordingly, if a pipework installation is based on an alternative fuel type, a different operating temperature or even a different utilisation level, the thickness of insulation required should still be assessed by using the standardised conditions. Although this may seem counter-intuitive initially, and clearly will result in some variation of real heat losses and/or gains, it is the only practical way in which compliance can be readily assessed after the event. Indeed, such an approach makes it possible to follow product labelling protocols based on compliance – particularly in the dwellings sector.

2.3 Summary

The following flow-chart summarises the circumstances under which the pipework and ductwork provisions of the 2006 revision of Part L will apply:



Flowchart is indicative only: To ensure compliance always refer to the precise text in Section 6

* Both hot and cooled ducting should always be insulated

3 DEVELOPMENT OF METHODOLOGY

3.1 Linkage with the Part L Consultation and the Regulatory Impact Assessment Assumptions

During the consultation that took place on the amending of Part L of the Building Regulations in July 2004, the ODPM took advantage of specifying its considered assessment of key parameters which might be used in defining minimum performance criteria. These reflected earlier templates which had been circulated to industry via the Industry Advisory Groups (IAGs) and contained assumptions for fuel costs, target payback periods and other relevant factors. These were adopted at an early stage in TIMSA's work to develop appropriate minimum performance criteria and incorporated within appropriate Excel spreadsheets which drove the calculation methodology. An example of the way in which assumptions were incorporated is shown below:

Figure 2 – Example of assumptions adopted for heating and hot water pipework based in part on IAG inputs

COST EFFECTIVENESS ASSESSMENT

ASSUMPTIONS USED:

Target Payback Period:	(yrs)	**7**	
Fuel Type:		**Gas**	
Carbon Loading	(kg/kWh)	**0.1944**	IAG Cost Effectiveness Calculator
Utilisation Rates:			
- Domestic Hot Water	(hrs/yr)	**500**	
- Domestic Heating	(hrs/yr)	**1500**	
- Non-domestic Hot Water	(hrs/yr)	**2000**	
- Non-domestic Heating	(hrs/yr)	**1750**	
Fuel Price			
- Domestic	(£/kWh)	**0.0135**	IAG Cost Effectiveness Calculator
- Non-domestic	(£/kWh)	**0.0100**	IAG Cost Effectiveness Calculator
Insulation cost proportion	(%)	**28%**	
Lifetime of measure	(yrs)	**15**	
Social Cost of Carbon	(£/te)	**82.5**	
Discount Rate	(%/yr)	**3.50%**	IAG Cost Effectiveness Calculator
Pipe type		**Oxidised Copper**	

These IAG assumptions were also carried forward into the government's Regulatory Impact Assessment which took into account such aspects as:

- The potential for adverse impacts on other aspects of building performance
- Demanding construction details or techniques that are too challenging
- Creating disproportionate burdens on particular sectors of industry
- Making the regulations and associated technical guidance too complex

The Regulatory Impact Assessment concluded in favour of the proposed Building Regulation changes and this was broadly supported by the subsequent consultation process.

3.2 Financial criteria - payback

At the time of the Part L Consultation, the criteria for cost effectiveness were defined in terms of the service life of the measure as follows:

"Measures are considered justified if their capital cost is equal to or less than the net present value of future savings in direct fuel costs, future capital costs (such as boiler replacements), and the avoided social costs of carbon emissions, accrued over the service life of the measure"

The test discount rate attached to this assessment was 3.5% in line with the guidance contained in the Treasury Green Book on assessing long term environmental improvement measures.

Recognising the complexity of such a method for simpler investments, the draft versions of ADL-1B and ADL-2B contained within the consultation both reverted to the following simpler clause:

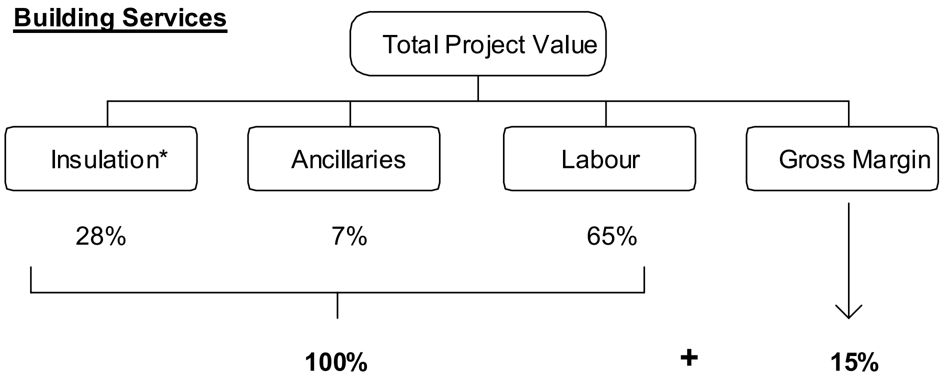
"A measure will be deemed to be cost effective if the simple payback is no longer than seven years, where simple payback is given as the marginal cost of the energy efficiency measure divided by the value of the fuel savings "

In view of the relatively simple functional units associated with pipe and duct insulation and the magnitude of pipe diameters to be assessed, it was decided to follow the simple seven year payback formula – albeit incorporating a correction for the discount rate ascribed to such measures by the Treasury.

In subsequent iterations of the Approved Documents, the simple payback allowance was increased from seven years to fifteen years. The potential of following this approach was considered for pipes and ducts, but it was recognised that this would create substantial practicality implications for most installations using traditional insulation types. Accordingly, TIMSA elected to maintain a seven year payback criterion even though a higher value would have led to a greater requirement for materials.

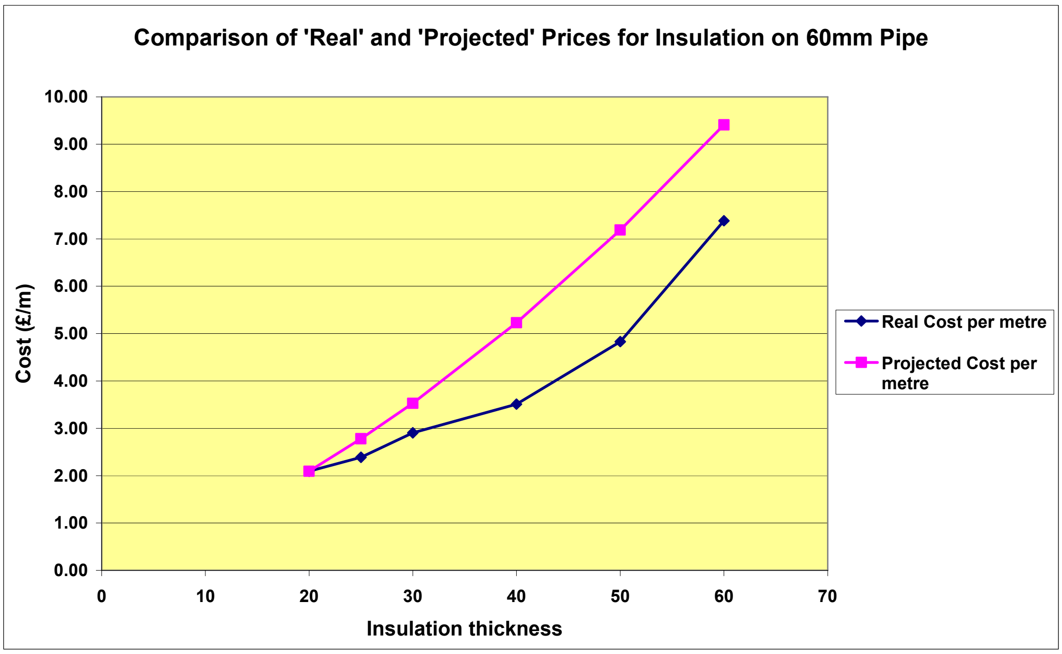
In order to define the marginal cost of these specific energy efficiency measures, it was assumed that the costs of insulation materials would represent 28% of the total project cost. This is in line with the assumptions previously made in the Summary Case submitted to DEFRA and the Treasury in 2000 and accepted as the basis for inclusion of pipe insulation in the Enhanced Capital Allowances Scheme the following year. The following schematic illustrates the principle:

Figure 3 – Allocation of Project Costs for the insulation of pipework & ductwork



In addition, there was a need to allocate insulation costs consistently across a wide range of products. One of the problems in doing this is that actual prices of insulation do not always follow volumetric relationships as is shown in Figure 4 below:

Figure 4 – Departure from volumetric cost relationships which can occur in real markets



After discussion within TIMSA, it was decided to follow a volumetric relationship for all insulation costs based on the cost (price to the contractor) of the most commonly used insulation material within a specific market sector. Again, this was viewed as maximising the first cost assessment and thereby keeping thickness requirements in check. Mineral wool at 25mm thickness on a 22mm pipe was taken as the reference point for volumetric cost in the non-domestic arena, while polyethylene foam at 19mm thickness on a 22mm pipe was taken as the reference for the domestic sector.

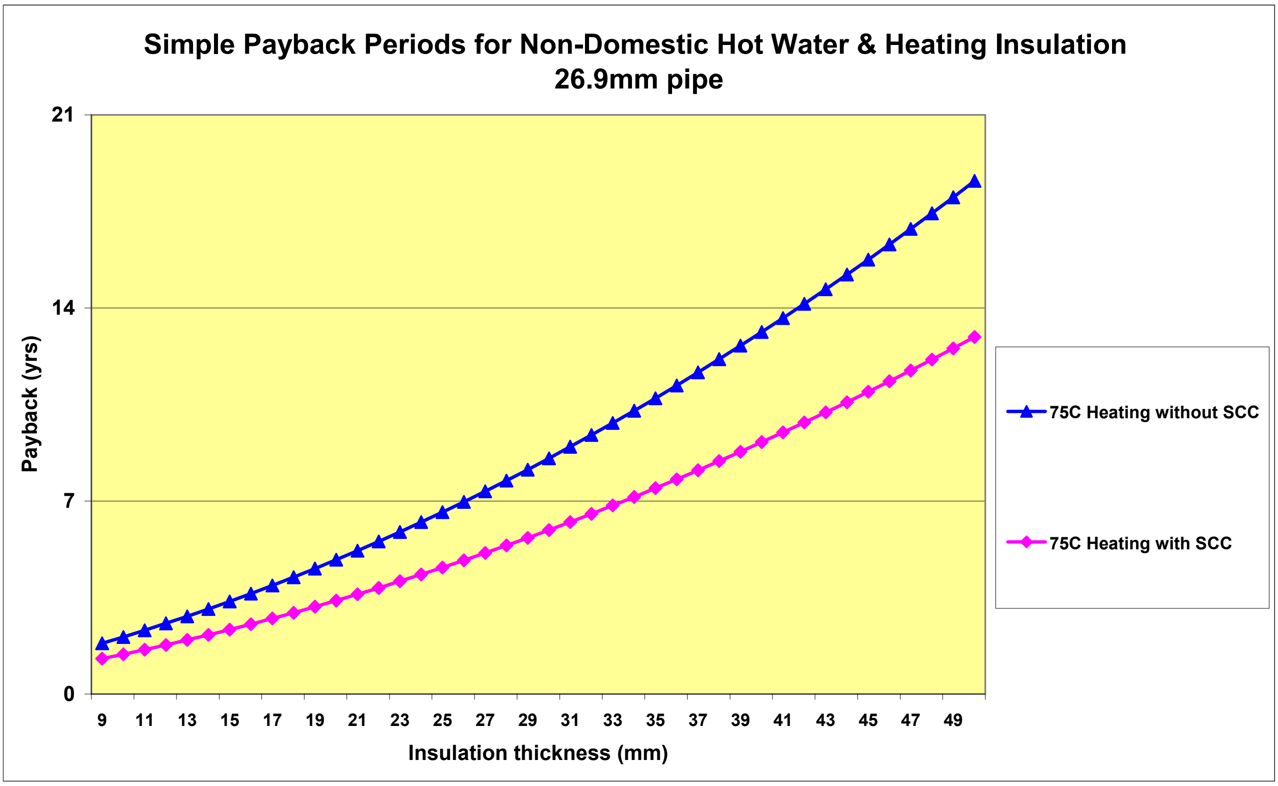
3.3 Inclusion of the Social Cost of Carbon

The Social Cost of Carbon is a parameter based on the perceived economic impact of carbon dioxide emissions in the future. The Treasury published a paper addressing this issue in 2002 and estimated the social cost at £70 per tonne of carbon in 2000 – increasing at £1 per year thereafter.

The Part L Consultation and subsequent embodiments have included this element in payback calculations and this practice has been taken up equally by TIMSA in its calculation methodology. Taking the base year as 2005 and assuming a 15 year lifecycle for pipework and ductwork, a 'lifetime' Social Cost of Carbon was established at £82.50 (£70 + £5 + [£15÷2]). This is as already shown in Figure 4.

The impact of the Social Cost of Carbon on payback assessments is shown below:

Figure 5 – Impact of the Social cost of Carbon on Simple Payback calculations



3.4 Selection of Standardised Scenarios for Evaluating Compliance

3.4.1 Operating Temperatures and Ambient Conditions

In developing relevant minimum performance criteria, it was recognised that there was a need to select meaningful assumptions for operating temperatures and the corresponding ambient conditions. Although values existed in BS 5422 (2001), it was recognised that many of these had been carried forward from the 1990 version of the standard. Bearing in mind the technological developments that had taken place since that time, it was agreed that further review was required.

For hot water and heating applications in dwellings, BSRIA and relevant members of the Domestic Heating Compliance Guide Committee were consulted. Although there was some evidence that operating temperatures had dropped in the intervening period, it was agreed that temperatures within the range of 55-60^{0}C were still typical. Accordingly, the decision was taken to maintain 60^{0}C as the operating temperature. Since many hot water systems in buildings other than dwellings are designed in similar fashion to systems in dwellings, the same operating temperature of 60^{0}C was transposed to the non-domestic sector.

Concerning ambient temperatures, it was agreed that there would be no justification to for discriminating between dwellings and buildings other than dwellings. Typically heating patterns and prevailing climatic conditions would be common to both across the range of buildings considered. However, it was agreed that some provision should be made to account for the impact of lower temperatures in voids within the building envelope – particularly those directly connected to an unheated space. It was therefore decided to adopt a standard ambient for all heating and hot water scenarios of 15^{0}C. This is reflected in all the subsequent Guidance.

For heating systems in buildings other than dwellings, it was recognised that there are three recognised categories of system (as cited in DEO Specification O36 and other documents). These are:

- Low temperature heating *≤ 95^oC*
- Medium temperature heating *96^oC-120^oC*
- High temperature heating *121^oC – 150^oC*

As noted in Annex 1, it is essential to adopt and maintain standardised scenarios to determine consistent minimum performance standards. Therefore, the decision was taken to use standardised operating temperatures of 75^0C, 100^0C and 125^0C for these three heating scenarios.

For cooled systems, it was clear to TIMSA that the assumed ambient should represent a reasonable potential temperature on a warm day. After some discussion this was agreed as 25°C. Again, there was no obvious reason to distinguish between dwellings and buildings other than dwellings. Some argued that there was more likelihood of air conditioned systems in buildings other than dwellings, but it was noted that this would be less relevant in voids within the building envelope where the air would not be conditioned other heat sources might also be present.

Standardised operating temperatures for cooled systems were selected as 0°C, 5°C and 10°C. These were seen as covering the likely range of temperatures met in practice – ranging from a minimum of 0°C to a maximum in excess of 10°C.

For ducts, the ambient temperature assumptions adopted for standardised calculations were as for pipes. However, operating temperatures were seen to be more modest based on typical values for air. For heated ducts, the assumed operating temperature is therefore 35°C and for cooled ducts the assumed operating temperature is 13°C.

Table 2 provides a summary in one place of these assumptions in support of the necessary standardised calculations

Table 2 – Summary of Temperature Assumptions used for Standardised Compliance Calculations

Sector	Building Type	Application	Sub-Application	Operating Temperature	Ambient Temperature
Pipework	Dwelling	Hot Water	-	60°C	15°C
		Heating	-	60°C	15°C
	BOTD	Hot Water	-	60°C	15°C
		Heating	Low Temp.	75°C	15°C
			Medium Temp.	100°C	15°C
			High Temp.	125°C	15°C
		Cooled	Refrigerated	0°C	25°C
			Chilled	5°C	25°C
			Cold	10°C	25°C
Ductwork	BOTD	Warm	-	35°C	15°C
		Cooled	-	13°C	25°C

3.4.2 Utilisation levels

The selection of utilisation levels was another matter of considerable discussion within TIMSA. The major problem in selecting representative values is that utilisation depends considerably more on a buildings use and occupancy than it does on design or category. Recognising that, particularly in buildings other than dwellings, it would be possible to find examples of continuous usage on the one hand and minimal utilisation on the other, it was agreed that reasonable mid-points should be used as the basis for standardised scenarios. These assumptions are shown in Table 3.

Table 3 – Assumed Utilisation Rates for Standardised Compliance Calculations			
Sector	**Building Type**	**Application**	**Utilisation (hrs/yr)**
Pipework	Dwelling	Hot Water	500
		Heating	1500
	BOTD	Hot Water	2000
		Heating	1750
		Cooled	2000
Ductwork	BOTD	Warm	1750
		Cooled	2000

3.4.3 Fuel types, carbon loadings and costs

As previously mentioned in Section 3.1, fuel costs were made available to TIMSA via the Industrial Advisory Group network and were contained within the IAG Cost Calculator circulated in early 2004. This set the cost of gas at 1.35p per kWh for domestic users and 1p per kWh for non-domestic users. Within the Part L Consultation, the cost of the latter had been increased to 1.1p per kWh, but no justification had been provided, so TIMSA maintained the original IAG Cost Calculator data. For electricity, the assumed cost for non-domestic users is 6p per kWh.

Gas is assumed to be the fuel of choice for all hot water and heating applications, while electricity is assumed to be the power source utilised for all cooling duties. It was not deemed appropriate to be deriving specific Standardised Compliance Calculations for each fuel type, since this would lead to a multiplicity of minimum performance requirements (and thicknesses) and would exclude the possibility of labelling. In addition, the Coefficient of Performance for chilled applications is assumed to be 3 with an associated electrical efficiency of 75%.

Carbon loadings for gas were provided within the IAG Cost Calculator as 0.1944kgCO_2 per kWh, while for electricity the value provided was 0.4140kgCO_2 per kWh. Table 4 summarises these various assumptions.

Table 4 –Assumed Fuel-related assumptions for Standardised Compliance Calculations						
Sector	**Building Type**	**Application**	**Fuel Type**	**Coefficient of Performance**	**Electrical Efficiency**	**Carbon Loading (kg CO_2/kWh)**
Pipework	Dwelling	Hot Water	Gas	-	-	0.1944
		Heating	Gas	-	-	0.1944
	BOTD	Hot Water	Gas	-	-	0.1944
		Heating	Gas	-	-	0.1944
		Cooled	Electricity	3	75%	0.4140
Ductwork	BOTD	Warm	Gas	-	-	0.1944
		Cooled	Electricity	3	75%	0.4140

3.4.4 Emissivities

The choices adopted for emissivities within the Standardised Compliance Calculations have been based largely on the most used materials in each application. For dwellings, the most popular products are flexible foams which typically have high emissivity surfaces. In the BOTD sector, the tendency is much more towards the use of products faced with low emissivity foils. Accordingly, high emissivity [emissivity of 0.95] has been assumed for all applications within dwellings, while a low emissivity [emissivity of 0.05] has been assumed for all applications in buildings other than dwellings – including ductwork. The emissivity of bare pipes (copper, steel & other) has been assumed to be 0.7 when assessing energy savings through insulation.

4 CONSIDERATION OF PRACTICALITY

It was recognised by TIMSA that there would be a need to consider practicality limits for insulation thicknesses. However, it was agreed that, as in BS 5422, it would be inappropriate for the thermal performance of competing products to be distorted by this requirement. Accordingly, there would be a need to identify a nominal thermal conductivity against which to apply any practicality limit. After some discussion, it was decided that this should be based on the most popular current product in the market for each sub-application and temperature range. These *'reference thermal conductivities'* were therefore adjusted to account for the mean temperature of the chosen insulation within that sub-application/range. One of the consequences of this decision was that, where practicality limits apply, higher temperature applications using the same product (e.g. mineral wool) are limited to lower thicknesses than the same product at lower temperatures. Although this may seem counter-intuitive, it is the only rational conclusion from the consistent application of the practicality methodology. Further information on specific reference thermal conductivities adopted is given in Section 4.2.

4.1 Linkage to Pipe Diameter

There was substantial discussion within TIMSA over the basis of setting practicality limits within the overall methodology set out above. Previous 'rules of thumb' had related insulation thicknesses to the pipe diameter for common insulation products of the time (i.e. thermal conductivities of 0.035W/mK or 0.04W/mK). Whilst this was felt to be an appropriate means of defining practicality, the ratio of practical thickness (1:1) was felt to offer a solution which was far too conservative for the intentions of the EPBD. The impacts of several ratios (2:1; 1.75:1 and 1.5:1) were reviewed with particular attention to the impact of practicality limits on smaller pipe diameters. After further analysis, it was concluded that a ratio of 1.5:1 was most appropriate. The thickness tables in Section 6 of this *Guide* indicate those pipe diameters for which practicality limits have been applied. Effectively, these pipe diameters are those in which required thickness to achieve a seven year payback, under standardised conditions, exceeds 1.5 times the pipe diameter at the reference thermal conductivity.

It was agreed that it would be irrational to set different practicality limits for dwellings and buildings other than dwellings, so both sectors operate to the same limiting ratio of 1.5:1.

4.2 Selection of Reference Thermal Conductivities

The rationale for the selection of reference thermal conductivities was discussed earlier in section 4. Table 5 below indicates the chosen thermal conductivities and the 'most popular' products to which they relate:

Table 5 – Selected Reference Thermal Conductivities for 'most popular' products in each sub-application

Sector	Building Type	Application	Sub-Application	Reference Thermal Cond. (W/mK)	Most popular insulation
Pipework	Dwelling	Hot Water	-	0.0400	Polyethylene
		Heating	-	0.0400	Polyethylene
	BOTD	Hot Water	-	0.0360	Mineral Wool
		Heating	Low Temp.	0.0375	Mineral Wool
			Medium Temp.	0.0400	Mineral Wool
			High Temp.	0.0420	Mineral Wool
		Cooled	Refrigerated	0.0350	Nitrile Rubber
			Chilled	0.0350	Nitrile Rubber
			Cold	0.0350	Nitrile Rubber
Ductwork	BOTD	Warm	-	N/A	Mineral Wool
		Cooled	-	N/A	Mineral Wool

Practicality limits, by their nature, set limits on the thickness of insulation applied to specific pipe diameters, irrespective of the cost-effectiveness criteria being applied. These limits often extend into the most popular pipe diameters which tend to be at the lower end of the range. If further improvements in energy efficiency are to be envisaged in future, there will either need to be changes in building practice to accommodate greater insulation thicknesses or a trend towards lower thermal conductivities within the most popular products used. The net effect of this would be to allow the application of lower reference thermal conductivities.

5 WHERE TO INSULATE AND MINIMUM PERFORMANCE REQUIREMENTS

In order to ensure full alignment with the text used in the respective Compliance Guides, the following sections are included here in precisely the same form as they have been included in the Compliance Guides themselves. In the case of Section 5.1 all text outside of Table 6 is additional to the material given in the Domestic Heating Compliance Guide.

5.1 Dwellings

Table 6 – Minimum provisions for dwellings as set out in the Domestic Heating Compliance Guide (Tables 3, 11, 14, 20, 25 & 33)

<table>
<tr><th>Minimum provision</th><th colspan="2">Supplementary information</th></tr>
<tr><td rowspan="13">In new systems pipes should, in the following cases, be insulated with insulation complying with the Domestic Heating Compliance Guide (in line with the maximum permissible heat loss indicated in the Supplementary information column) and labelled accordingly:
▪ Primary circulation pipes for heating and hot water circuits should be insulated wherever they pass outside the heated living space or through voids which communicate with and are ventilated from unheated spaces.
▪ Primary circulation pipes for domestic hot water circuits should be insulated throughout their length, subject only to practical constraints imposed by the need to penetrate joists and other structural elements.
▪ All pipes connected to hot water storage vessels, including the vent pipe, should be insulated for at least 1 metre from their points of connection to the cylinder (or they should be insulated up to the point where they become concealed).
▪ If secondary circulation is used, all pipes kept hot by that circulation should be insulated.
For replacement systems, whenever a boiler or hot water storage vessel is replaced in an existing system, any pipes (in the situations above) that are exposed as part of the work or are otherwise accessible should be insulated with insulation labelled as complying with the Domestic Heating Compliance Guide - or to some lesser standard where practical constraints dictate.</td><td colspan="2">Insulation for pipework in unheated areas
Extra provision may need to be made to protect central-heating and hot water pipework in unheated areas against freezing. Further guidance is available in:
▪ BS 5422:2001 Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range of -40°C to +700°C.
▪ BRE Report No 262 Thermal insulation: avoiding risks, 2002 Edition.</td></tr>
<tr><td colspan="2">Where insulation is labelled as complying with the Domestic Heating Compliance Guide it will not exceed the following heat loss levels:</td></tr>
<tr><td>Pipe Diameter (OD)
mm</td><td>Maximum permissible heat loss*
(W/m)</td></tr>
<tr><td>8 mm</td><td>7.06</td></tr>
<tr><td>10 mm</td><td>7.23</td></tr>
<tr><td>12 mm</td><td>7.35</td></tr>
<tr><td>15 mm</td><td>7.89</td></tr>
<tr><td>22 mm</td><td>9.12</td></tr>
<tr><td>28 mm</td><td>10.07</td></tr>
<tr><td>35 mm</td><td>11.08</td></tr>
<tr><td>42 mm</td><td>12.19</td></tr>
<tr><td>54 mm</td><td>14.12</td></tr>
<tr><td colspan="2">* In assessing the thickness of insulation required to meet the provision, standardised conditions should be used in all compliance calculations based in this instance on a horizontal pipe at $60^{o}C$ in still air at $15^{o}C$.
Further assistance in converting these heat loss limits to levels (thickness) of insulation for specific thermal conductivities is found in the “TIMSA HVAC Guidance for achieving compliance with Part L of the Building Regulations”.</td></tr>
</table>

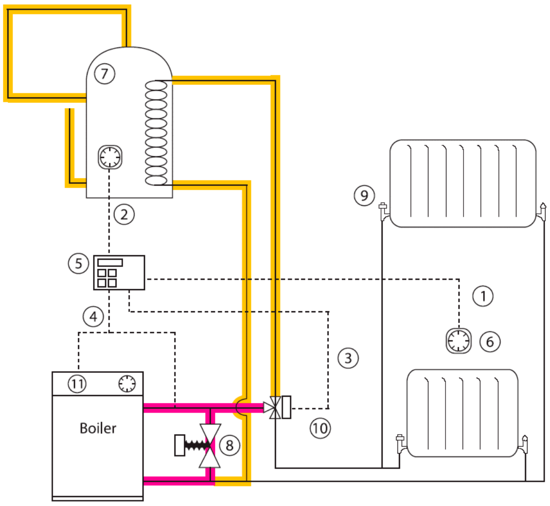
In order to accommodate the number of different fuel types covered in the Compliance Guide, the generic *Guidance* shown above is repeated for all of the following sections of the Domestic Heating Compliance Guide.

Section 1	Gas-fired space heating and hot water systems
Section 2	Oil-fired space heating and hot water systems
Section 3	Electric heating systems
Section 4	Solid fuel heating systems
Section 5	Community heating systems
Section 8	Solar water heating

Irrespective of fuel source, there is a need for further guidance related to typical pipe runs associated with commonly encountered configurations. Figures 6 & 7 show schematically what might be expected with typical fully pumped systems and combi boilers:

Figure 6 – Pipe runs requiring insulation for a typical Fully Pumped System

Fully pumped system

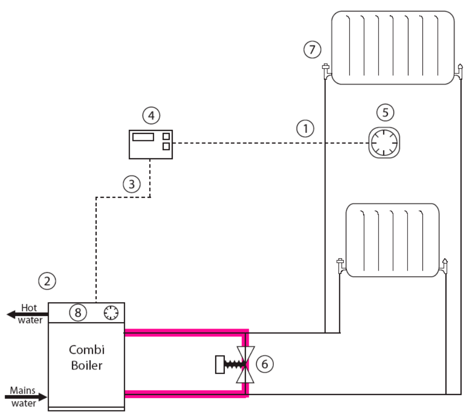


- Heating and hot water circulation (primary)
- Hot water circulation only (primary & secondary)

1	Time and temperature control to space heating
2	Time and temperature control for stored hot water
3	Switching of zone valve or valves
4	Boiler and pump interlock
5	Full programmer or two or more separate timers
6	Room (or programmable room) thermostat
7	Cylinder thermostat
8	Automatic by-pass valve to the system
9	TRVs on all radiators except rooms with a room (or programmable room) thermostat
10	Zone valve (or valves)
11	Boiler thermostat

Figure 7 – Pipe runs requiring insulation for a typical Combi System

Combi boiler system



- Heating and hot water circulation (primary)

1	Time and temperature control to space heating
2	Flow to hot water outlets
3	Time control to space heating and boiler interlock
4	Timer to heating area
5	Room (or programmable room) thermostat
6	Automatic by-pass valve to the system
7	TRVs on all radiators except rooms with a room (or programmable room) thermostat
8	Boiler thermostat

5.2 Buildings other than Dwellings

Pipework and Duct Insulation

The insulation of pipework and ducting is essential to minimise heat losses (for heated systems) and heat gains (for cooled systems). In addition, there is a need to ensure that the risk of condensation is adequately controlled for cooled systems. However, this section focuses only on the energy-specific requirements associated with the conservation of fuel and power as relevant to Part L of the Building Regulations. The 'TIMSA HVAC Guide for achieving compliance with Part L of the Building Regulations' offers additional information and assistance on all provisions, including any additional measures required to control condensation. The following paragraphs provide guidance on the approaches to be taken:

For pipes:

- Direct hot water pipework
- Low, medium and high temperature heating pipework
- Cooled pipework

For ducts:

- Heated ductwork
- Cooled ductwork
- Dual-purpose heated and cooled ductwork

Direct hot water and heating pipework

Hot water and heating pipework should be insulated in all areas outside of the heated building envelope. In addition, pipes should be insulated in all voids within the building envelope and even within normally heated spaces if there is a possibility that those spaces might be maintained at temperatures different to those maintained in other zones. The guiding principles are that control should be maximised and that heat loss from uninsulated pipes should only be permitted where the heat can be demonstrated as 'always useful'.

The maximum permissible heat losses for different pipe sizes and temperatures are shown in the following table:

Maximum permissible heat losses for different pipe sizes

Outside Pipe Diameter(mm)	Hot Water[1]	Low Temp. Heating[2]	Medium Temp Heating[3]	High Temp Heating[4]
		≤ 95°C	96°C-120°C	121°C – 150°C
17.2	6.60	8.90	13.34	17.92
21.3	7.13	9.28	13.56	18.32
26.9	7.83	10.06	13.83	18.70
33.7	8.62	11.07	14.39	19.02
42.4	9.72	12.30	15.66	19.25
48.3	10.21	12.94	16.67	20.17
60.3	11.57	14.45	18.25	21.96
76.1	13.09	16.35	20.42	24.21
88.9	14.58	17.91	22.09	25.99
114.3	17.20	20.77	25.31	29.32
139.7	19.65	23.71	28.23	32.47
168.3	22.31	26.89	31.61	36.04
219.1	27.52	32.54	37.66	42.16
273.0 & above	32.40	38.83	43.72	48.48

[1, 2, 3 ,4] To ensure compliance with maximum permissible heat loss criteria, proposed insulation thicknesses should be calculated according to BS EN ISO 12241 using standardized assumptions:

[1] Horizontal pipe at 60°C in still air at 15°C

[2] Horizontal pipe at 75°C in still air at 15°C

[3] Horizontal pipe at 100°C in still air at 15°C

4 Horizontal pipe at 125°C in still air at 15°C

Cooled Pipework

Cooled pipework should be insulated along its whole length in order to provide the necessary means of limiting heat gain. The guiding principles are that control should be maximised and that heat gain to uninsulated pipes should only be permitted where the proportion of the cooling load relating to distribution pipework is proven to be <5% of total load.

The maximum permissible heat gain for different pipe sizes and temperatures are shown in the following table. There may need to be additional provisions for the control of condensation. Users of this Guide are urged to ensure that any such requirements have been assessed in specifying a system.

Maximum permissible heat gain of insulated for cooled water supplies

Outside diameter of pipe on which insulation has been based mm	Maximum Permissible Heat Gain (W/m)		
	Temperature of contents (°C)		
	>10[5]	***4.9 to 10.0[6]***	***0 to 4.9[7]***
17.2	2.48	2.97	3.47
21.3	2.72	3.27	3.81
26.9	3.05	3.58	4.18
33.7	3.41	4.01	4.60
42.4	3.86	4.53	5.11
48.3	4.11	4.82	5.45
60.3	4.78	5.48	6.17
76.1	5.51	6.30	6.70
88.9	6.17	6.90	7.77
114.3	7.28	8.31	9.15
139.7	8.52	9.49	10.45
168.3	9.89	10.97	11.86
219.1	12.27	13.57	14.61
273.0 & above	14.74	16.28	17.48

NOTE:

Thicknesses derived solely against the criteria noted in this table may not necessarily satisfy other design requirements such as control of condensation.
The maximum permissible heat gain applies to all pipe materials (i.e. steel, copper, plastic and other).
For an intermediate pipe diameter not listed in the table, compliance calculations shall use the nearest larger diameter listed
For pipes of diameter greater than 273mm, the pipe shall be assumed to be 273mm for calculation purposes

5, 6, 7 To ensure compliance with maximum permissible heat gain criteria, proposed insulation thicknesses should be calculated according to BS EN ISO 12241 using standardized assumptions:

5 Horizontal pipe at 10°C in still air at 25°C

6 Horizontal pipe at 5°C in still air at 25°C

7 Horizontal pipe at 0°C in still air at 25°C

Hot and Cooled Ducting

Ducting should be insulated along its whole length in order to provide the necessary means of limiting heat gains and/or heat losses from ducts (heat gains are shown as negative values). Where ducting may be used for both heating and cooling duties at different periods during its lifecycle, the provisions for chilled ducting should be adopted, since these are the most onerous. The following table indicates the maximum heat loss/gain per unit area required to meet these provisions. As with pipes, additional insulation may be required to provide adequate condensation control (see Section 7).

Maximum permissible heat gain/loss for insulated ducts used to carry cooled air (including those heated ducts used periodically for cooled air)

	Heated Duct[8]	Dual Purpose[9]	Cooled Duct[10]
Maximum permissible heat transfer (W/m^2)	16.34	-6.45	-6.45

8, 9 10 To ensure compliance with maximum permissible heat transfer criteria, proposed insulation thicknesses should be calculated according to BS EN ISO 12241 using standardized assumptions:

8 Horizontal duct at 35°C, with 600mm vertical sidewall in still air at 15°C

9 Horizontal duct at 13°C, with 600mm vertical sidewall in still air at 25°C

10 Horizontal duct at 13°C, with 600mm vertical sidewall in still air at 25°C

6 INDICATIVE INSULATION THICKNESSES

It should be stressed that the maximum permissible heat losses/gains set out in Section 5 are the minimum performance criteria specified under the Compliance Guides. The following tables provide additional information on the minimum thicknesses of insulation materials required **where their thermal conductivities and surface emissivities are as represented in the tables**. However, in practice, most insulation types will fall between the thermal conductivities cited here at the mean temperatures quoted and, in some cases, may have differing surface emissivities. Unless the reader has particular knowledge that a given insulation material is properly represented by the tables, it is recommended that contact should be made with the manufacturer/supplier of the insulation to confirm the exact thermal conductivity of the product at the mean temperature dictated within a standardised scenario. Confirmation of the appropriate surface emissivity values should also be sought. In reality, most manufacturers and suppliers will also carry out the minimum thickness assessment for compliance as a free-of-charge service to their clients. Where pipe diameters to be insulated are intermediate between the values in the tables, the higher pipe diameter should be used as the basis for determining maximum permissible heat losses/gains. Additional information on vapour barriers may be needed for cooled systems and can be obtained from BS 5422 and BS 5970.

In the tables that follow, the cream coloured shading in the tables indicates those pipe diameters in which a limit of 1.5 times the pipe diameter has been applied for practicality reasons (see Section 4.1).

6.1 Dwellings

6.1.1 Insulation for Heating and Hot Water Pipes

Indicative thickness of insulation for domestic heating and hot water systems

Outside diameter of pipe on which insulation thickness has been based mm	Water temperatures of **60 °C** for hot water with ambient still air temperatures of **15 °C** (high emissivity facing: 0.95)					
	Thermal conductivity at 40 °C W/(m·K)					Maximum Permissible Heat loss
	0.025	0.030	0.035	0.040	0.045	
	Thickness of insulation (mm)					W/m
8.0	5	7	9	12	16	7.06
10.0	6	8	11	15	20	7.23
12.0	7	10	14	18	23	7.35
15.0	9	12	15	20	26	7.89
22.0	11	14	18	23	29	9.12
28.0	12	16	20	25	31	10.07
35.0	13	17	22	27	33	11.08
42.0	14	18	23	28	34	12.19
54.0	15	19	24	29	35	14.12

NOTES:

Heat loss relates to the specified thickness and temperature

The maximum permissible heat loss applies to all pipe materials (i.e. steel, copper, plastic and other).

For an intermediate pipe diameter not listed in the table, compliance calculations shall use the nearest larger diameter listed

For pipes of diameter greater than 54mm, the pipe shall be assumed to be 54mm for calculation purposes

6.2 Buildings other than Dwellings

6.2.1 Insulation for Hot Water Pipes

Indicative thickness of insulation for non-domestic hot water service areas to control heat loss

Outside diameter of pipe on which insulation thickness has been based mm	Water temperature of 60 °C; ambient temperature 15°C							
	Thermal conductivity at insulation mean temperature W/(m·K) (low emissivity facing: 0.05)							Maximum Permissible Heat loss
	0.025	0.030	0.035	0.040	0.045	0.050	0.055	
	Thickness of insulation mm							W/m
17.2	12	17	23	31	41	53	69	6.60
21.3	14	19	25	33	43	55	70	7.13
26.9	15	21	27	35	45	57	71	7.83
33.7	17	22	29	37	47	58	72	8.62
42.4	18	23	30	38	47	57	70	9.72
48.3	19	25	32	40	49	60	73	10.21
60.3	20	26	33	41	50	60	71	11.57
76.1	22	28	35	43	52	61	72	13.09
88.9	22	28	35	43	51	60	70	14.58
114.3	23	29	36	43	51	60	69	17.20
139.7	24	31	37	44	52	60	69	19.65
168.3	25	32	38	45	53	61	70	22.31
219.1	26	32	38	45	52	60	68	27.52
273.0 and above	27	33	39	46	53	60	68	32.40

NOTES:

Heat loss relates to the specified thickness and temperature
The maximum permissible heat loss applies to all pipe materials (i.e. steel, copper, plastic and other).
For an intermediate pipe diameter not listed in the table, compliance calculations shall use the neares larger diameter listed
For pipes or vessels of diameter greater than 273mm, the item shall be assumed to be 273mm for calculation purposes

6.2.2 Insulation for Heating Pipes

Indicative thickness of insulation for non-domestic low temperature heating service areas to control heat loss								
Outside diameter of pipe on which insulation thickness has been based mm	Water temperature of 75 °C; Ambient temperature 15°C							
	Thermal conductivity at insulation mean temperature W/(m·K) (low emissivity facing: 0.05)							Maximum permissible Heat loss
	0.025	0.030	0.035	0.040	0.045	0.050	0.055	
	Thickness of insulation mm							W/m
17.2	12	17	22	30	39	51	66	8.90
21.3	14	20	26	35	46	59	75	9.28
26.9	16	22	29	38	49	62	78	10.06
33.7	18	24	31	40	51	64	79	11.07
42.4	20	26	33	42	52	65	79	12.30
48.3	21	27	35	44	55	67	82	12.94
60.3	23	29	37	46	56	68	82	14.45
76.1	24	31	39	48	58	70	83	16.35
88.9	25	32	40	49	59	70	82	17.91
114.3	27	34	42	51	61	71	83	20.77
139.7	28	35	43	52	61	71	82	23.71
168.3	29	37	44	53	62	72	82	26.89
219.1	30	38	45	54	62	72	82	32.54
273.0 and above	31	38	46	54	62	71	80	38.83

NOTES

Heat loss relates to the specified thickness and temperature
The maximum permissible heat loss applies to all pipe materials (i.e. steel, copper, plastic and other).
For an intermediate pipe diameter not listed in the table, compliance calculations shall use the nearest larger diameter listed
For pipes or vessels of diameter greater than 273mm, the item shall be assumed to be 273mm for calculation purposes

Indicative thickness of insulation for non-domestic medium temperature heating service areas to control heat loss								
Outside diameter of pipe on which insulation thickness has been based mm	Water temperature of 100 °C; Ambient temperature 15°C							
	Thermal conductivity at insulation mean temperature W/(m·K) (low emissivity facing: 0.05)							Maximum Permissible Heat loss
	0.025	0.030	0.035	0.040	0.045	0.050	0.055	
	Thickness of insulation mm							W/m
17.2	11	15	20	26	34	44	56	13.34
21.3	14	18	25	32	42	54	69	13.56
26.9	17	24	31	41	53	67	85	13.83
33.7	21	28	37	48	62	78	98	14.39
42.4	24	32	41	52	66	83	103	15.66
48.3	25	33	42	53	67	83	102	16.67
60.3	27	36	46	57	71	87	106	18.25
76.1	30	39	49	60	74	89	107	20.42
88.9	31	40	51	62	76	91	108	22.09
114.3	34	43	54	65	79	93	110	25.31
139.7	36	46	57	68	82	96	112	28.23
168.3	38	48	59	70	83	98	113	31.61
219.1	40	50	61	72	85	98	113	37.66
273.0 and above	42	52	63	74	87	100	114	43.72

NOTES:

Heat loss relates to the specified thickness and temperature
The maximum permissible heat loss applies to all pipe materials (i.e. steel, copper, plastic and other).
For an intermediate pipe diameter not listed in the table, compliance calculations shall use the nearest larger diameter listed
For pipes or vessels of diameter greater than 273mm, the item shall be assumed to be 273mm for calculation purposes

Indicative thickness of insulation for non-domestic high temperature heating service areas to control heat loss

Outside diameter of pipe on which insulation thickness has been based mm	Water temperature of 125 °C; Ambient temperature 15°C							
	Thermal conductivity at insulation mean temperature W/(m·K) (low emissivity facing: 0.05)							Maximum Permissible Heat loss
	0.025	0.030	0.035	0.040	0.045	0.050	0.055	
	Thickness of insulation mm							W/m
17.2	10	13	18	24	31	39	50	17.92
21.3	12	17	22	29	38	48	61	18.32
26.9	16	22	28	37	47	60	76	18.70
33.7	20	27	36	46	59	74	93	19.02
42.4	26	35	45	59	74	93	117	19.25
48.3	28	37	48	61	77	97	120	20.17
60.3	31	41	52	66	83	102	125	21.96
76.1	34	45	57	71	88	107	129	24.21
88.9	36	47	60	74	91	110	132	25.99
114.3	40	51	64	79	96	115	136	29.32
139.7	43	55	68	83	100	118	139	32.47
168.3	46	58	71	86	103	121	141	36.04
219.1	49	62	75	90	106	124	144	42.16
273.0 and above	52	64	78	93	109	127	145	48.48

NOTES:

Heat loss relates to the specified thickness and temperature
The maximum permissible heat loss applies to all pipe materials (i.e. steel, copper, plastic and other).
For an intermediate pipe diameter not listed in the table, compliance calculations shall use the nearest larger diameter listed
For pipes or vessels of diameter greater than 273mm, the item shall be assumed to be 273mm for calculation purposes

6.2.3 Insulation for Chilled System Pipework

Indicative thickness of insulation for cooled water systems to control heat gain

Outside diameter of pipe on which insulation thickness has been based mm	Water temperatures of 10 °C for chilled water with ambient still air temperatures of 25 °C (low emissivity facing: 0.05)					
	Thermal conductivity at 15 °C W/(m·K)					Maximum Permissible Heat gain
	0.020	0.025	0.030	0.035	0.040	
	Thickness of insulation (mm)					W/m
17.2	6	8	11	15	20	2.48
21.3	7	9	12	16	21	2.72
26.9	7	10	13	17	22	3.05
33.7	8	11	14	18	23	3.41
42.4	9	12	15	19	24	3.86
48.3	9	13	16	20	25	4.11
60.3	10	13	16	20	25	4.78
76.1	11	14	17	21	26	5.51
88.9	11	14	18	21	26	6.17
114.3	12	15	19	22	27	7.28
139.7	12	15	19	22	27	8.52
168.3	12	15	19	22	26	9.89
219.1	12	15	19	22	26	12.27
273.0 and above	12	16	19	22	26	14.74

NOTES:

Heat gain relates to the specified thickness and temperature
The maximum permissible heat gain applies to all pipe materials (i.e. steel, copper, plastic and other).
For an intermediate pipe diameter not listed in the table, compliance calculations shall use the nearest larger diameter listed
For pipes or vessels of diameter greater than 273mm, the item shall be assumed to be 273mm for calculation purposes

Indicative thickness of insulation for chilled water systems to control heat gain

Outside diameter of pipe on which insulation thickness has been based mm	Water temperatures of 5°C for chilled water with ambient still air temperatures of 25 °C (low emissivity facing: 0.05)					
	Thermal conductivity at 15 °C W/(m·K)					Maximum Permissible Heat gain
	0.020	0.025	0.030	0.035	0.040	
	Thickness of insulation (mm)					W/m
17.2	7	11	15	20	28	2.97
21.3	8	12	16	21	28	3.27
26.9	9	13	18	23	30	3.58
33.7	10	14	19	24	31	4.01
42.4	11	15	20	25	32	4.53
48.3	12	16	21	26	33	4.82
60.3	13	17	22	27	34	5.48
76.1	14	18	23	28	35	6.30
88.9	14	19	24	29	36	6.90
114.3	15	19	24	29	35	8.31
139.7	16	20	25	30	36	9.49
168.3	16	20	25	30	36	10.97
219.1	16	21	25	30	36	13.57
273.0 and above	16	21	26	30	36	16.28

NOTES:

Heat gain relates to the specified thickness and temperature
The maximum permissible heat gain applies to all pipe materials (i.e. steel, copper, plastic and other).
For an intermediate pipe diameter not listed in the table, compliance calculations shall use the nearest larger diameter listed
For pipes or vessels of diameter greater than 273mm, the item shall be assumed to be 273mm for calculation purposes

Indicative thickness of insulation for chilled water systems to control heat gain

Outside diameter of pipe on which insulation thickness has been based mm	Water temperatures of 0 °C for chilled water with ambient still air temperatures of 25 °C (low emissivity facing: 0.05)					
	Thermal conductivity at 15 °C W/(m·K)					Maximum Permissible Heat gain
	0.020	0.025	0.030	0.035	0.040	
	Thickness of insulation (mm)					W/m
17.2	9	13	18	24	33	3.47
21.3	9	14	19	25	34	3.81
26.9	11	15	21	27	36	4.18
33.7	12	17	22	29	38	4.60
42.4	13	18	24	31	40	5.11
48.3	14	19	25	32	41	5,45
60.3	15	20	26	33	42	6.17
76.1	16	22	28	35	44	6.70
88.9	17	22	29	35	43	7.77
114.3	18	24	30	36	44	9.15
139.7	19	25	31	37	45	10.45
168.3	20	25	32	38	46	11.86
219.1	20	26	32	38	45	14.61
273.0 and above	21	26	32	38	45	17.48

NOTES:

Heat gain relates to the specified thickness and temperature
The maximum permissible heat gain applies to all pipe materials (i.e. steel, copper, plastic and other).
For an intermediate pipe diameter not listed in the table, compliance calculations shall use the nearest larger diameter listed
For pipes or vessels of diameter greater than 273mm, the item shall be assumed to be 273mm for calculation purposes

6.2.4 Insulation for Warm Ducts

Indicative thickness of insulation for warm ducting service areas to control heat loss							
Air temperature of 35 °C; ambient temperature 15°C							
Thermal conductivity at insulation mean temperature W/(m·K) (low emissivity facing: 0.05)							Maximum permissible heat loss
0.020	0.025	0.030	0.035	0.040	0.045	0.050	
Thickness of insulation mm							W/m²
17	21	25	29	33	38	42	16.34
NOTE Heat loss relates to the specified thickness and temperature							

6.2.5 Insulation for Chilled and Dual Purpose Ducts

Indicative thickness of insulation for chilled and dual-purpose ducting service areas to control heat gain							
Air temperature of 13 °C; ambient temperature 25°C							
Thermal conductivity at insulation mean temperature W/(m·K) (low emissivity facing: 0.05)							Maximum permissible heat gain
0.020	0.025	0.030	0.035	0.040	0.045	0.050	
Thickness of insulation mm							W/m²
31	39	47	55	62	70	78	6.42
NOTE Heat loss relates to the specified thickness and temperature							

7 OTHER REASONS FOR INSULATING

It must be noted that the insulation thicknesses indicated in Section 6 may not be sufficient to meet all other performance requirements of the installation. For example, it is common to use pipe and duct insulation to fulfil the objectives of frost protection, condensation control or personnel protection. The following sub-sections provide guidance on typical performance requirements/insulation thicknesses anticipated under these circumstances.

7.1 Frost Protection

Pipework cannot be protected indefinitely from freezing by the application of insulation. Inevitably there will be situations, notably after the sufficient passage of time, when the temperature of the water in a pipe will equilibrate with the outside ambient conditions. Accordingly, protection is usually quoted in terms of the time afforded before freezing takes place. The approach for dwellings is somewhat different than for buildings other than dwellings reflecting the differing operational circumstances. Accordingly, these are treated in separate sub-sections below:

7.1.1 Frost protection in dwellings

The following two tables provide information on the protection for 12 hour and 8 hour periods respectively:

Minimum thickness of insulation to protect against freezing for domestic cold water systems (12 h)											
Water temperature		7 °C					2 °C				
Ambient temperature		–6 °C					–6 °C				
Evaluation period		12 h					12 h				
Permitted ice formation		50 %					50 %				
Outside diameter	Inside Diameter (bore)	Normal					Extreme				
		Thermal conductivity at 0 °C W/(m·K)					Thermal conductivity at 0 °C W/(m·K)				
		0.020	0.025	0.030	0.035	0.040	0.020	0.025	0.030	0.035	0.040
mm	mm	Thickness of insulation mm					Thickness of insulation mm				
Copper pipes(1)											
15.0	13.6	20	30	43	62	88	23	35	53	78	113
22.0	20.2	9	12	16	20	24	10	14	18	23	28
28.0	26.2	6	8	10	12	14	7	9	11	13	16
35.0	32.6	5	6	7	9	10	5	7	8	10	11
42.0	39.6	4	5	6	7	8	4	5	6	7	9
54.0	51.6	3	4	4	5	6	3	4	5	5	6
76.1	73.1	2	3	3	4	4	2	3	3	4	4
Steel pipes(2)											
21.3	16.1	15	21	29	38	50	18	26	35	48	64
26.9	21.7	9	12	15	18	22	10	13	17	21	26
33.7	27.3	7	8	10	12	15	7	9	12	14	17
42.4	36.0	5	6	7	8	10	5	6	8	9	11
48.3	41.9	4	5	6	7	8	4	5	6	7	9
60.3	53.0	3	4	5	5	6	3	4	5	6	7
76.1	68.8	2	3	3	4	4	3	3	4	4	5

NOTE 1 Some of the insulation thicknesses given are too large to be applied in practice. The purposes of including very high thicknesses is to demonstrate that the application of a material of the given thermal conductivity is not able on the pipe size indicated to provide the degree of frost protection under the design conditions. Therefore in order to increase the degree of frost protection it is necessary to increase the pipe size, select an insulation with a lower thermal conductivity or use some means of putting heat back into the system.

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

NOTE 3 This table is based on the following assumed conditions:
Normal installation — inside the building inside the envelope of the insulation;
Extreme installation — inside the building but outside the envelope of the insulation.

(1) to Table 3 of BS EN 1057: 1996

(2) to Table 4 of BS1387: 1985

Minimum thickness of insulation to protect against freezing for domestic cold water systems (8 h)

Water temperature		7 °C					2 °C				
Ambient temperature		–6 °C					–6 °C				
Evaluation period		8 h					8 h				
Permitted ice formation		50 %					50 %				
Outside diameter	Inside diameter (bore)	Normal					Extreme				
		Thermal conductivity at 0 °C W/(m·K)					Thermal conductivity at 0 °C W/(m·K)				
		0.020	0.025	0.030	0.035	0.040	0.020	0.025	0.030	0.035	0.040
mm	mm	Thickness of insulation (in mm)					Thickness of insulation (in mm)				
Copper pipes (1)											
15.0	13.6	11	15	20	26	34	12	17	23	31	41
22.0	20.2	6	7	9	11	13	6	8	10	12	15
28.0	26.2	4	5	6	7	9	4	6	7	8	10
35.0	32.6	3	4	5	6	7	4	4	5	6	7
42.0	39.6	3	3	4	5	5	3	4	4	5	6
54.0	51.6	2	3	3	3	4	2	3	3	4	4
76.1	73.1	2	2	2	3	3	2	2	2	3	3
Steel pipes (2)											
21.3	16.1	9	12	15	19	24	10	14	18	23	29
26.9	21.7	6	7	9	11	13	6	8	10	12	15
33.7	27.3	4	5	7	8	9	5	6	7	9	10
42.4	36.0	3	4	5	5	6	3	4	5	6	7
48.3	41.9	3	3	4	5	5	3	4	4	5	6
60.3	53.0	2	3	3	4	4	2	3	3	4	4
76.1	68.8	2	2	2	3	3	2	2	3	3	3

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 This table is based on the following assumed conditions:
Normal installation — inside the building inside the envelope of the insulation;
Extreme installation — inside the building but outside the envelope of the insulation.

(1) to Table 3 of BS EN 1057: 1996

(2) to Table 4 of BS 1387: 1985

7.1.2 Frost protection in buildings other than dwellings

The following table provides information on the protection required in commercial and institutional buildings:

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

Outside diameter (mm)	Inside diameter (bore) (mm)	Thickness of insulation (mm)									
		Specified conditions 1					Specified conditions 2				
		λ = 0.020	λ = 0.025	λ = 0.030	λ = 0.035	λ = 0.040	λ = 0.020	λ = 0.025	λ = 0.030	λ = 0.035	λ = 0.040
Copper pipes ¹											
15.0	13.6	23	35	53	78	113	68	126	229	413	740
22.0	20.2	10	14	18	23	28	21	30	42	58	78
28.0	26.2	7	9	11	13	16	13	17	22	28	35
35.0	32.6	5	7	8	10	11	9	12	15	18	22
42.0	39.6	4	5	6	7	9	7	9	11	13	16
54.0	51.6	3	4	5	5	6	5	7	8	9	11
76.1	73.1	2	3	3	4	4	4	5	5	6	7
108.0	105.0	2	2	2	3	3	3	3	4	4	5
Steel pipes ²											
21.3	16.0	18	26	35	48	64	44	71	112	173	265
26.9	21.6	10	13	17	21	26	20	28	39	52	68
33.7	27.2	7	9	12	14	17	13	18	23	29	36
42.4	35.9	5	6	8	9	11	9	11	14	17	20
48.3	41.8	4	5	6	7	9	7	9	11	13	16
60.3	53.0	3	4	5	6	7	5	7	8	10	11
76.1	68.8	3	3	4	4	5	4	5	6	7	8
88.9	80.8	2	3	3	4	4	3	4	5	6	7

Key:

¹ to table 3 of BS EN 1057:1996

² to table 4 of BS 1387 :1985

Specified conditions 1:
water temperature 2 °C; ambient temperature –6 °C; evaluation period 12 h; permitted ice formation 50 %; indoor.

Specified conditions 2:
water temperature 2 °C; ambient temperature –10 °C; evaluation period 12 h; permitted ice formation 50 %; outdoor.

λ = thermal conductivity [W/(m·K)]

NOTE 1 Thicknesses given are calculated specifically against the criteria noted in the table. Adopting 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 are 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);

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

ρ copper = 8 900 kg/m³, c_p copper = 390 J/kg·K

7.2 Condensation Control

Levels of insulation required for condensation control depend on the surface emissivity of facing in use. The following two tables provide indicative thicknesses for a typical low and high emissivity surface. However, the manufacturer or supplier should be approached for information on specific thermal conductivities at the mean temperature in question and relevant emissivities of surface materials. In reality, most manufacturers and suppliers will also carry out the minimum thickness assessment for avoidance of condensation as a free-of-charge service to their clients. Additional information on vapour barriers may be needed for cooled systems and can be obtained from BS 5422 and BS 5970.

Minimum thickness of insulation for chilled and cold water supplies to prevent 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											
	+10				+5				0			
	Thermal conductivity at mean temperature of insulation, W/(m·K)											
	0.020	0.030	0.040	0.050	0.020	0.030	0.040	0.050	0.020	0.030	0.040	0.050
	Thickness of insulation mm											
21.3	6	8	10	12	8	11	14	17	10	14	17	21
33.7	6	9	11	14	9	12	15	19	11	15	19	23
60.3	7	10	13	15	10	14	17	21	12	17	22	26
114.3	8	11	14	17	10	15	19	24	13	19	25	30
168.3	8	11	15	18	11	16	21	25	14	20	26	32
273.0	8	12	16	19	12	17	22	27	15	22	28	35
508.0	9	13	17	21	12	18	24	29	16	23	30	37
610.0	9	13	17	21	12	18	24	30	16	24	31	38
Flat	9	13	17	21	12	18	24	30	16	24	32	39

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

Minimum thickness of insulation for chilled and cold water supplies to prevent 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											
	+10				+5				0			
	Thermal conductivity at mean temperature of insulation W/(m·K)											
	0.020	0.030	0.040	0.050	0.020	0.030	0.040	0.050	0.020	0.030	0.040	0.050
	Thickness of insulation mm											
21.3	11	16	20	25	15	22	28	34	19	28	36	43
33.7	13	18	24	29	18	25	32	39	22	32	41	50
60.3	15	22	28	34	21	30	39	47	27	38	49	60
114.3	18	26	34	41	25	36	47	57	32	46	60	73
168.3	20	29	38	46	28	40	52	64	36	51	67	82
273.0	22	33	43	53	31	46	60	74	40	59	77	94
508.0	26	38	50	62	37	54	71	87	47	69	91	112
610.0	27	40	52	65	38	56	74	91	49	73	95	117
Flat	26	39	52	65	38	56	75	93	49	73	97	122

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

7.3 Personnel Protection

Thermal insulation can be used to protect personnel from high pipe temperatures where the contents are running at elevated temperatures. The typical maximum surface temperature allowable in commercial and industrial circumstances is 55^0C. For most pipes in the temperature ranges used for HVAC purposes, the insulation levels required for energy saving are sufficient to reduce surface temperatures well below this maximum. However, specific circumstances should always be checked with the manufacturer or supplier.

In some cases (e.g. where there is widespread exposure to the general public – particularly the young or the elderly), the maximum surface temperature allowable may reduce to 45^0C or even 40^0C. In these cases, pipework being used for medium and high temperature heating systems need to be assessed to ensure that the maximum surface temperatures are not being exceeded. Again, manufacturers and suppliers can assist in this assessment.

In solar heating systems, there is a specific possibility that stagnant water in the system can reach higher temperatures than seen elsewhere in HVAC systems. Temperatures as high as 150^0C-175^0C are not unknown. In these circumstances, both the maximum operating temperature of the insulation and the anticipated surface temperature need to be assessed to ensure that all requirements of the insulation are being met.

8 FURTHER READING

The following documents are recommended as further reading in support of this Guidance:

- Approved Documents in support of Part L 2006 [ADL-1A, ADL-1B, ADL-2A, ADL2B]
- The Domestic Heating Compliance Guide (2006)
- The Non-Domestic Heating, Cooling and Ventilation Compliance Guide (2006)
- Current Environmental Benefits arising from BS5422 and the Identification of Areas for Further Gains – TIMSA (1999)

9 CONTACTS WITH TIMSA

TIMSA members will be happy to provide any further help required in using this Guidance. In the first instance, any enquiries should be addressed to:

Thermal Insulation Manufacturers and Suppliers Association
Association House,
99 West Street,
Farnham,
Surrey GU9 7EN

tel: 01252 739154 fax: 01252 739140

www.timsa.org.uk email: timsa@associationhouse.org.uk

10 ANNEX 1 BACKGROUND TO THE DEVELOPMENT OF THE GUIDE

A-1.1 The UK's Climate Change Programme commitments

The UK Government has consistently taken a proactive stance on the minimisation of greenhouse gases and their effect on climate change processes. Prior to the Labour Party's election to power in May 1997, it had espoused a 20% cut in UK carbon dioxide emissions by 2010, based on 1990 levels. This position was maintained in Government during the run-up to the Kyoto meeting in December 1997 and through the subsequent elections until this day.

Following the negotiation of the Kyoto Protocol and the enlargement of the basket of gases to include HFCs, PFCs and SF_6, the situation was reviewed. In its internal negotiations within the EU, the UK Government was able to commit to a 12.5% overall reduction in greenhouse gases by 2008-2012. This is ahead of the average for the EU which lies at 8%. The spread across the EU-15 as agreed in 1998 is shown in table 7.

Table 7 – Required % Change in EU Greenhouse Gas Emissions, 1990-2010	
EU Member	**Commitment (June '98)**
Austria	-13%
Belgium	-7.5%
Denmark	-21%
Finland	0%
France	0%
Germany	-21%
Greece	+25%
Ireland	+13%
Italy	-6.5%
Luxembourg	-28%
Netherlands	-6%
Portugal	+27%
Spain	+15%
Sweden	+4%
United Kingdom	-12.5%

Progress has been tougher since this point. In the early stages, the UK was able to hide behind the benefits of switching from coal to gas – a generally cleaner fuel with a lower carbon burden. However, more recently, the benefits of this switch have begun to subside and the stark reality of real greenhouse gas emission cuts has emerged. Although the UK is likely to meet its EU commitment of a 12.5% cut in all greenhouse gases, its political target of a 20% cut in CO_2 emissions by 2008-2012 seems likely to remain elusive.

Despite this, the UK Government continues to seek to take the lead internationally on the climate change issue and used its presidency of the G8 in 2005 to prioritise international attention in the hope of engaging the United States in further negotiation. This has been at least partially successful as signalled by the agreements reached in Montreal in December 2005. In addition, the UK has pioneered emissions trading concepts by setting up the first national emissions trading scheme. This has since been subsumed into the more structured EU scheme, but the UK voluntary approach remains a 'test bed' for new ideas and approaches, some of which may involve the construction industry and the built environment.

At the time of the 1997 Kyoto negotiations, the seventeen page briefing paper for the EU negotiators did not contain one specific reference to the potential of building energy efficiency as a means of reducing CO_2 emissions despite the fact that the built environment accounts for between 40% and 50% of emissions in most developed countries. Once the realisation of this fact struck home, the EU acted quickly and, at the time of writing, the Energy Performance in Buildings Directive (see Section A-1.3) remains the fastest piece of legislation to have passed through the EU's legislative machinery to date.

As a Directive, the legislation requires implementation at national level through national legislative instruments. The revision of the Building Regulations for England & Wales (see Section A-1.4) has become an important part of this process, although commentators have been quick to point out that implementation does not start and finish with these Regulations. Issues such as energy certification and display are all part of a larger market transformation which must take place if the Government is to secure the required savings from the sector. Inevitably interested stakeholders have been active behind the scenes, of which TIMSA has been one. While the response to the consultation on the legislation was surprisingly unanimous in its support for the measures proposed, the UK Government has been cautious (some would say over-cautious) in what it has proposed under the Building Regulation revision. Accordingly, there remains particular concern about the treatment of existing buildings which, by any measure of success, will have to make a substantial contribution to CO_2 savings in the next 20 years if the Government's objectives are to be met.

A-1.2 The importance of pipe and duct insulation in CO_2 terms

As far back as 1999, TIMSA commissioned a study to assess the contribution of pipe insulation to possible further energy saving in the United Kingdom. The study included both the use of pipe insulation in the built environment and in the process sector. It emerged that the use of pipe insulation was already saving in excess of 300Mtons of CO_2 equivalent annually. However, there remained considerable opportunities to make further savings by insulating otherwise uninsulated pipes and upgrading personnel protection levels to environmental thicknesses in the process sector. Figures 8 & 9 illustrate the potential identified at that time:

Figure 8 – The additional saving of ~17 Mtons CO_2-equiv available from pipe insulation

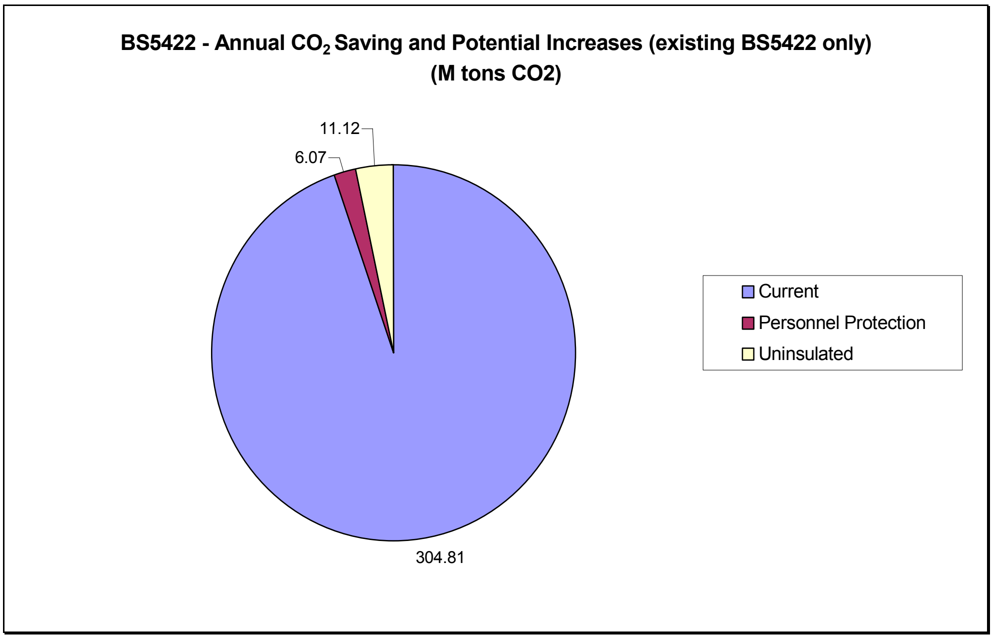
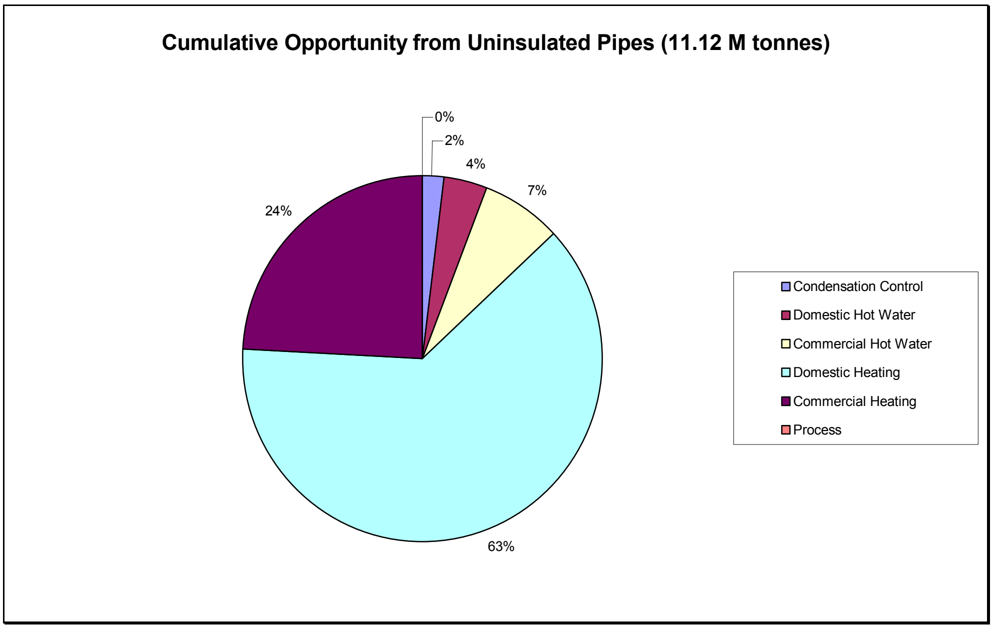


Figure 9 – Areas where the insulation of previously uninsulated pipes would contribute



In the TIMSA study, it was assumed that no process pipework was left uninsulated. However, the sensitivity of this assumption was highlighted by further analysis which showed that if only 5% of process pipework in the UK had been left uninsulated, the additional saving available would be 12-13 Mtons CO_2-equiv. With nearly 75% of the existing energy saving coming from the process sector (because of high operating temperatures in many cases), there was considerable focus on improving process pipework insulation levels during the revision of BS 5422 in 2001. However, the lack of regulatory support to the standard in the process sector has heavily limited the adoption of the standard – a matter which will be revisited in the 2006 revision.

For the built environment (both dwellings and buildings other than dwellings), Figure 9 illustrates that a considerable element of saving is available from uninsulated pipework in domestic and non-domestic heating systems. Whilst this has been a major TIMSA contention for over ten years, the counter-argument has always been that the loss of heat from heating pipework has contributed to the heating of the building at a time when heating is clearly demanded. This *'useful heat'* argument has been the behind successive decisions not to change the basic requirements for the insulation of pipework within the Building Regulations, although the 2002 version did stipulate for the first time that, in buildings other than dwellings (BOTD), there was a need to demonstrate that losses were *'always useful'*. As the design of buildings has become increasingly based on a zoned heating/cooling approach, this requirement to avoid unintended heat losses has become even more relevant and TIMSA maintains that it is *good practice* to insulate all pipework carrying fluids that are either heated or cooled.

A-1.3 The Energy Performance in Buildings Directive

The Energy Performance in Buildings Directive was adopted by the European Union on 4th January 2003 and came into force on 4th January 2006. It has induced a substantial response in the UK, both through the revision of Part L of the Building Regulations and beyond.

A summary of the Articles contained in the Directive are shown in Table 8.

Table 8 – Outline of the requirements of the Energy Performance in Buildings Directive (EPBD)

Energy Performance in Buildings Directive – Outline of Requirements	
Article 1 Objectives	Objective is to improve energy performance of a building by requiring: ▪ methodology to calculate integrated energy performance of buildings ▪ minimum energy performance requirements for new buildings ▪ minimum energy performance requirements for large existing buildings being renovated ▪ energy certification of buildings ▪ regular inspection of boilers and of air conditioning systems
Article 2 Definitions	Defines a 'building', the 'energy performance of a building', the 'energy performance certification of a building', 'CHP', 'air conditioning system', 'boiler', 'effective rate output expressed in kW' and 'heat pump'
Article 3 Methodology	Requirement for a methodology, developed by each Member State, for calculating thermal insulation, heating & air conditioning, application of Renewables and design of the building. Based on objective criteria, use of independent experts working to a common approach.
Article 4 Setting Energy Performance Requirements	Sets minimum energy performance requirements for buildings (based on agreed methodology) Differentiates between existing and new buildings Takes account of general indoor climate conditions Requirements reviewed on regular basis (not longer than 5 years) & updated to reflect technical progress in the building sector Certain exemptions (official monuments, temporary structures, small stand-alone buildings)
Article 5 New Buildings	All new buildings must meet the minimum energy performance requirements. For those with a useful floor area over 1000m^2 governments must ensure that, before construction starts, formal consideration is given to alternative heating systems (CHP; district or block heating or cooling; heat pumps; decentralised energy supply systems based on RE. Such assessments should consider technical, environmental and economic feasibility.
Article 6 Existing Buildings	Buildings with a useful floor area of over 1000m^2 and undergoing a major renovation should have energy performance upgraded to meet minimum requirements based on Article 4. Measures applied should be technically, functionally and economically feasible & not incompatible with existing function, quality or character. The requirements may be set either for the renovated building as a whole, or alternatively for the renovated system or components, but only when these are part of a renovation to be carried out within a limited time period.
Article 7 Energy Performance Certificate	When a building is constructed, refurbished, sold or rented out, a certificate dealing with its energy performance must be made available. The certificate is either provided to the owner, or by the owner, to the prospective buyer or tenant. No certificate may be older than 10 years. For apartments of for units designed for separate use in blocks, it is possible for certificates to be based on either a common certification of the whole building where a block has a common heating system, or upon the assessment of another representative apartment within the same block. Certificates much include reference values such as current legal standards or benchmarks. They also must include recommendations for cost effective investments which can be undertaken in the building and which will improve its energy performance. All buildings, either occupied by a public authority, or regularly visited by a large number of people, must display in a prominent place, clearly visible to the public, its current energy certificate. In addition, a range of recommended and current indoor temperatures and, when appropriate, other climatic factors may also be clearly displayed. This display provision applies only to buildings with a total useful floor area over 1000m^2.

Article 8 Inspection of Boilers	For **Boilers** two options are offered. The first option requires periodic mandatory inspections of boilers together with advice on replacements. The second option, favoured by the UK government, requires an adequate provision of advice to users on the replacement of the boilers, other modifications to the heating system and on alternative solutions, which may include assessment of the efficiency and appropriate size of the boiler. No regular timescale is required for such advice. However, if governments do choose this means of complying, they have to produce a report every two years showing how this achieves as much as implementing this Article under the first option given.
Article 9 Inspection of Air Conditioning Systems	For **Air Conditioning** governments must establish regular inspections of all air conditioning systems with an effective rated output of more than 12kW. Such an inspection must include an assessment of the efficiency and sizing of the air conditioning system, compared to the cooling requirements of the building. Appropriate advice must be provided to users o possible improvements or replacements, and on alternative solutions.
Article 10 Independent Experts	Governments must ensure that certification of buildings, the drafting of accompanying recommendations and the inspection of boilers and air conditioning systems are carried out in an independent manner. This must be by qualified and/or accredited experts. These can operate as sole traders or be employed by public or private bodies.
Article 11 Review	The Commission has to evaluate how effectively the directive is being implemented. It may make proposals with respect to: expanding Article 6 to cover renovation in buildings below 1000m^2 useful floor area; general incentives for further energy efficiency measures in buildings. Will have a Committee (see Article 14) to assist.
Article 12 Information	Commission must assist Member States if asked, by staging information campaigns regarding the best means of improving energy efficiency in building. This an be by Community programmes. But it is also up to governments whether they choose to undertake the information programmes to inform building users.
Article 13 – Adaptation of Framework	Parts 1 & 2 of the general framework for the calculation of energy performance in buildings (see Article 3) – must be reviewed regularly and at a maximum of every two years. Any Amendments necessary can be approved by the committee established under Article 14.
Article 14 Committee	The Commission has created a special committee to oversee implementation. It is made up of representatives of each EU government, both administrative and specialist, together with certain independent observers.
Article 15 Transposition	Every government must bring the laws, regulations and administrative provisions necessary to comply with bringing this Directive into force by 4th January 2006 at the latest. However, if MS believe that there are insufficient qualified or accredited experts anywhere within the EU to implement fully the provisions of Article 7, 8 & 9, they may delay these Articles for up to three further years. If they wish to cause this delay, governments must justify this to the Commission together with a schedule detailing when they do plan to fully implement the directive.

The shaded areas in grey indicate those Articles which are being implemented under the revision of Part L of the Building Regulations due for publication in April 2006. Section A-1.4 explains how these requirements are being met.

A-1.4 The resulting revision of the Building Regulations

The various articles of the Directive have been sub-divided between the Office of the Deputy Prime Minister (ODPM) and the Department of Environment, Food and Rural Affairs (DEFRA). The ODPM has taken the lead on Articles 2 to 6, recognising that these will be implemented primarily by revision of Part L of the Building Regulations (Conservation of Fuel and Power). A series of industry consultations took place during 2004 and 2005 in order to establish the basis for the implementation of the Directive. In accordance with the requirements of Article 4 of the Directive, Part L will need to be re-visited in 'not longer than 5 years'. Consequently, possible further steps are already being considered for the 2010 revision and are signalled, where appropriate, in the current Approved Documents.

The revision of Part L has been achieved in four separate documents:

- Approved Document L-1A - Work in New Dwellings
- Approved Document L-1B - Work in Existing Dwellings
- Approved Document L-2A - New Buildings other than Dwellings
- Approved Document L-2B - Work in Existing Buildings that are not Dwellings

These documents are generally considerably shorter than previous Approved Documents supporting Part L. The primary reason for this is that they are in turn supported by a series of further publications described as *Tier 2* documents. In discussion with ODPM, these documents have been described as effective 'annexes' to the Approved Documents themselves and therefore are deemed to contain minimum performance criteria as a means of compliance with the 2006 Regulations. All *Tier 2* documents are cited in the Approved Documents themselves. This ***TIMSA HVAC Guidance for achieving compliance with Part L of the Building Regulations*** is one such document and is cited in both Approved Documents L-2A and L-2B.

A-1.5 Linkage with other Compliance Guides

In order to limit the number of *Tier 2* reference documents required, a pair of Compliance Guides has been produced under ODPM's direct supervision to provide overall guidance on heating and cooling issues. These are entitled:

1. *Domestic Heating Compliance Guide – Compliance with Approved Documents ADL-1A & ADL-1B*
2. *Non-domestic Heating, Cooling and Ventilation Compliance Guide*

TIMSA has worked closely with other industry representatives and the ODPM to ensure consistency of approach to pipework and ductwork issues between both of these documents and this *TIMSA HVAC Guidance*. One of the purposes of maintaining this document as a separate publication is to provide a more in-depth discussion of the methods used to derive the minimum performance criteria expressed in the Compliance Guides themselves and to expand the level of information provided to include tables of typical insulation thicknesses required to meet the maximum permissible heat loss/gain criteria set out in the Compliance Guides. In summary, all three documents have *Tier 2* status and refer to the same minimum performance criteria.