RETHINKING DUCTWORK

First Issue October 2007

A Duct is for Life...

AN INDEPENDENT ANALYSIS OF THE 'WHOLE LIFE' COSTS OF DIFFERING HVAC DUCT SPECIFICATIONS

Kingspan®
Ducting Solutions

Contents

Executive Summary

The *Kingspan* **Kool**Duct® System must be considered as the product of choice for HVAC ductwork systems in PFI and other projects where 'whole life' costing is a requirement as:

- installation of the *Kingspan* **Kool**Duct® System can save over 21% on capital cost; and
- over a 30 year life cycle the *Kingspan* **Kool**Duct® System can also make a saving of over 20% on operating costs.

Current Practice & The Alternatives

Current Practice

- HVAC ductwork systems are a common feature of new build and refurbishment construction projects.
- HVAC ductwork is traditionally constructed using galvanised sheet steel with mineral fibre lagging installed as a separate construction activity.
- The ductwork material is commonly not considered until late in a project's design process.
- Little or no attention is paid to the operating cost of the ductwork system or to its durability.

Assessing the Alternatives for Future Practice

In the construction industry, developers, funders and manufacturers, have historically focused on achieving a low capital cost to improve profits.

However, in the Private Finance Initiative (PFI) market, on–going maintenance is often part of the overall building package, and coupled with long lease periods, this mean that operating cost can be as important as capital cost.

'Whole life' costing takes account of the total cost of an item over its life, including durability, energy savings and maintenance, as well as initial purchase price.

One of the key differences with PFI projects is that clients and funders usually require a detailed 'whole life' cost model as part of their financial plan.

The purpose of this independent report is to examine the relative 'whole life' costs of lagged galvanised sheet steel ductwork and the *Kingspan* **Kool**Duct® System.

Research has already been published by Kingspan Insulation concerning the speed, weight, durability, capital cost and energy use benefits of the *Kingspan* **Kool**Duct® System. For more information on the above research, please contact the Kingspan Insulation Marketing Department (see rear cover).

**A copy of the Cyril Sweett Limited report is available upon request from the Kingspan Insulation Marketing Department (see rear cover).*

Review of the Alternatives

Kingspan Insulation commissioned independent consultants, Cyril Sweett Limited, to carry out an analysis of the 'whole life' costs of differing HVAC ductwork specifications*.

Cyril Sweett's initial work narrowed the analysis of 'whole life' cost down to costs associated with installation, durability, energy use, cleaning, risk of mechanical damage and damage repair.

The ***installed cost*** of ductwork fabricated from the *Kingspan* **Kool**Duct® System was found to be cheaper than that of galvanised sheet steel ductwork.

On ***durability***, they concluded that *Kingspan* **Kool**Duct® rigid phenolic insulation panels consist of a densely cross linked structure which does not readily break down. They also noted that independent testing (SGS United Kingdom Ltd.) has shown that the thermal performance of Kingspan Insulation rigid phenolic insulation panels are not prone to long term degradation and maintain their designed performance throughout the 'whole life' 30 year period.

On ***energy use***, Cyril Sweett endorsed the contents of a study carried out by independent consultants, Bucknall Austin, based on the results of research carried out by BSRIA to investigate the estimated effect on fan power of different duct air leakage rates. The research showed that the *Kingspan* **Kool**Duct® System can save over 30% on the annual electricity cost of running a fan compared with the performance of galvanised sheet steel ductwork.

On ***cleaning***, Cyril Sweett's research showed that ductwork fabricated from the *Kingspan* **Kool**Duct® System is marginally more expensive to clean than galvanised sheet steel ductwork.

Cyril Sweett's own research into ducting maintenance showed that ductwork fabricated from the *Kingspan* **Kool**Duct® System suffers minimal ***damage*** and thus requires minimal repairs, particularly where ductwork is installed within a ceiling void. In circumstances where a repair is required, it concluded that ductwork fabricated from the *Kingspan* **Kool**Duct® System can be repaired quickly by simply replacing the damaged area, whereas the entire section of sheet metal ductwork would need to be replaced, with the lagging as a second operation.

Once the above data had been analysed, the capital, operating and 'whole life' costs were calculated.

Results of the Analysis

Cyril Sweett based the comparison of capital cost on a system comprising 308 metres of ductwork of a wide variety of dimensions. The galvanised sheet steel ductwork was lagged with 40 mm mineral fibre.

The capital cost of lagged galvanised sheet steel ductwork was £47,154 versus £37,000 for ductwork fabricated from the *Kingspan* **Kool**Duct® System.

Thus the *Kingspan* **Kool**Duct® System can provide a capital cost saving of 21.5% (see Table 1).

Refer to Appendix 1 for a detailed breakdown of capital costs.

Cyril Sweett then calculated the operating cost of the two technologies over a 30 year period, taking into account energy use, maintenance, cleaning and changes due to wear and tear (churn).

Over a 30 year period, the system operating cost for lagged galvanised sheet steel technology was £85,058 versus £67,672 for the *Kingspan* **Kool**Duct® System.

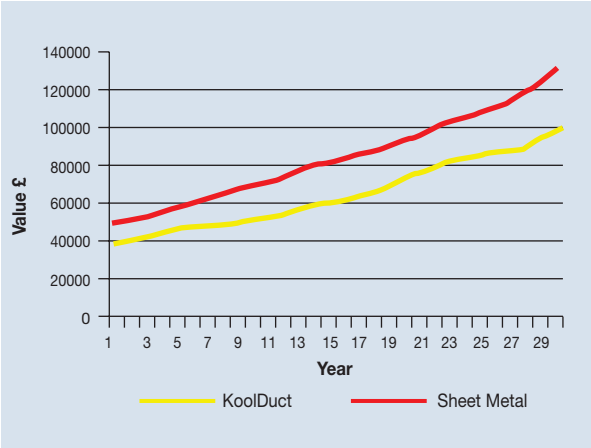
Thus the *Kingspan* **Kool**Duct® System can provide an operating cost saving of 20% (see Table 1).

Refer to Appendix 2 for a detailed breakdown of the operating costs.

Combining capital and operating costs to give a 'whole life cost' yields a total saving of £27,540. Thus the *Kingspan* **Kool**Duct® System can provide an overall 'whole life' cost saving of 21%.

Note: the costs detailed in this report are based on the use of the Kingspan **Kool**Duct® System *constructed of 22 mm rigid phenolic insulation panels and the aluminium grip flange jointing system versus 40 mm mineral fibre lagged galvanised sheet steel ducting. Kingspan Insulation has introduced a 33 mm rigid phenolic insulation panel to meet the requirements of the new Approved Document L2 to the Building Regulations in England & Wales and a 4–Bolt flange jointing system. Kingspan Insulation is currently updating this research for the 33 mm thick panel versus 55 mm mineral fibre lagged galvanised sheet steel ducting and the 4–Bolt flange jointing system.*

'Whole Life' Cost



Technology	Capital Cost (£)	Saving (%)	Operating Cost (Over 30 yrs) (£)	Saving (%)	'Whole Life' Cost (£)	'Whole Life' Saving (%)
Kingspan **Kool**Duct®	37,000	21.5	67,672	20.4	104,672	20.8
Lagged Galvanised Sheet Steel	47,154		85,058		132,212	

Table 1

Case Studies

Case Study 1 – Queen Mary College Hospital, London

System:
Kingspan **Kool**Duct® System

Volume:
3,000 m²

Building Use:
Medical School

M&E Consulting Engineer:
WSP

M&E Contractors:
Crown House Engineering

Installers Fabricators:
Hotchkiss Ductwork

The spectacular new medical school building, home to the Queen Mary University of London's Institute of Cell and Molecular Science, was designed to ensure that as much attention was paid to the functionality of the interior, as to its stylish external appearance.

Case Study 2 – Gartnavel Hospital, Glasgow

System:
Kingspan **Kool**Duct® System

Volume:
400 m²

Building Use:
Regional Radiotherapy Unit

M&E Consulting Engineer:
Davie and McCulloch

M&E Contractors:
Balfour Kilpatrick

Installers / Fabricators:
Ductform Ventilation UK Ltd

The stringent demands for high levels of hygiene to protect the 'clean room' environment at the new £5 million regional outpatients radiotherapy unit at Gartnavel Hospital, Glasgow, made *Kingspan* **Kool**Duct® an ideal choice.

Case Study 3 – Hospital Sterilisation and Decontamination Unit (HSDU), Hull

System:
Kingspan **Kool**Duct® System

Volume:
1,400 m²

Building Use:
Healthcare Facilities

M&E Consulting Engineer:
Hoare Lea

M&E Contractors:
Binks

Installers / Fabricators:
Solitaire Ventilation Management Ltd

A new £4.5 nillion purpose–built HSDU is part of a £150 million programme of improvement at Castle Hill Hospital in Hull which has benefited from the *Kingspan* **Kool**Duct® Pre–insulated Ducting System.

Case Study 4 – Cotman Centre, Norwich

System:
Kingspan **Kool**Duct® System

Volume:
1,800 m²

Building Use:
Hospital

M&E Consulting Engineer:
Integrated Building Services

M&E Contractors:
Environair Systems Ltd

Installers / Fabricators:
Environair Systems Ltd

The Cotman Centre, named after Norfolk artist John Sell Cotman, is a £7 million investment which has created the biggest single cervical screening service in the country.

Case Studies

Case Study 5 – Birmingham Treatment Centre

System:
Kingspan **Kool**Duct® System

Volume:
6,000 m²

Building Use:
Healthcare Facility

M&E Contractors:
Crown House Engineering

Installers / Fabricators:
Crown House Engineering

This striking NHS showcase healthcare facility provides a fast–track service for around 170,000 patients a year transforming the way they are diagnosed and treated. The three–storey building contains 6 operating theatres with recovery facilities for 34 patients, and oupatient clinics for specialities such as oncology and paediatrics.

Case Study 6 – James Paget, Great Yarmouth

System:
Kingspan **Kool**Duct® System

Volume:
1500 m²

Building Use:
NHS Healthcare Facilities

M&E Consulting Engineer:
Integrated Building Services Design Partnership

Installers / Fabricators:
Environair Systems Ltd

The 520 bed James Paget Hospital benefited from *Kingspan* **Kool**Duct® during the refurbishment of the intensive care unit. The hospital provides acute and community care for a population of 220,000 in Great Yarmouth, Lowestoft and Waveney areas.

Case Study 7 – Royal Victoria Infirmary, Newcastle-upon-Tyne

The Henry Wellcome Building for Neuroecology, a new £8.3 million purpose–built research institute, has become home to a team of psychologists and neurologists from Newcastle University's world-renowned Department of Psychology. They will use highly sophisticated scanning technology in a project to “map” the human brain.

System:	*Kingspan* **Kool**Duct® System
Volume:	60 m^2
Building Use:	Healthcare
M&E Consulting Engineer:	R W Gregory
M&E Contractors:	Balfour Kilpatrick
Installers / Fabricators:	Boyd Sheet Metal

Appendix 1

Capital Cost Comparison Between Galvanised Sheet Steel Ductwork and the *Kingspan* **Kool**Duct® System

Cost information for galvanised sheet steel ductwork came from Cyril Sweett's internal cost database and published data sources. The mineral fibre insulation price of £15.78 / m^2 (installed) came from Spon's Architects' and Builders' Price Book – 2005.

Cost information for the *Kingspan* **Kool**Duct® System was supplied by fabricator / installation contractors Sterling Thermal Ltd. and validated against previous research carried out by independent consultants Bucknall Austin.

Type	Unit Cross-section Dimensions (mm)	Unit Length (m)	Unit Surface Area (m^2)	No. of Units	Total Length (m)	Total Surface Area (m^2)	Cost Galvanised Sheet Metal (£/m)	Total Cost Galvanised Sheet Metal (£)	Cost of Lagging (£/m^2)	Total Cost of Lagging (£)
Straight	1,100 x 500	2.95	9.44	12	35.40	113.28	124.08	4,392.43	15.78	1,787.56
Straight	800 x 700	2.95	8.85	24	70.80	212.40	108.57	7,686.76	15.78	3,351.67
Straight	800 x 500	2.95	7.67	16	47.20	122.72	108.57	5,124.50	15.78	1,936.52
Straight	800 x 400	2.95	7.08	8	23.60	56.64	93.06	2,196.22	15.78	893.78
Straight	800 x 250	2.95	6.20	22	64.90	136.29	81.43	5,284.81	15.78	2,150.66
Straight	500 x 250	2.95	4.43	3	8.85	13.28	58.17	514.80	15.78	209.48
Straight	1,100 x 500	2.93	9.38	1	2.93	9.38	125.08	366.48	15.78	147.95
Straight	1,100 x 500	2.66	8.51	1	2.66	8.51	124.08	330.05	15.78	134.32
Straight	1,100 x 500	2.58	8.26	1	2.58	8.26	124.08	320.13	15.78	130.28
Straight	1,100 x 500	2.40	7.68	1	2.40	7.68	124.08	297.79	15.78	121.19
Straight	800 x 500	2.36	6.14	1	2.36	6.14	108.57	256.23	15.78	96.83
Straight	800 x 500	2.31	6.01	1	2.31	6.01	108.57	250.80	15.78	94.77
Straight	800 x 500	2.27	5.90	1	2.27	5.90	108.57	246.45	15.78	93.13
Straight	1,100 x 500	1.91	6.11	1	1.91	6.11	124.08	236.99	15.78	96.45
Straight	800 x 250	1.88	3.95	1	1.88	3.95	81.43	153.09	15.78	62.30
Straight	800 x 250	1.85	3.89	1	1.85	3.89	81.43	150.65	15.78	61.31
Straight	800 x 500	1.82	4.73	1	1.82	4.73	108.57	197.60	15.78	74.67
Straight	1,100 x 500	1.80	5.76	1	1.80	5.76	125.08	225.14	15.78	90.89
Straight	800 x 500	1.75	4.55	1	1.75	4.55	108.57	190.00	15.78	71.80
Straight	800 x 400	1.75	4.20	1	1.75	4.20	93.06	162.86	15.78	66.28
Straight	800 x 700	1.63	4.89	1	1.63	4.89	124.08	202.25	15.78	77.16
Straight	1,100 x 500	1.61	5.15	1	1.61	5.15	124.08	199.77	15.78	81.30
Straight	800 x 250	1.60	3.36	1	1.60	3.36	81.43	130.29	15.78	53.02
Straight	800 x 250	1.35	2.84	1	1.35	2.84	81.43	109.93	15.78	44.74
Straight	800 x 500	1.32	3.43	1	1.32	3.43	108.57	143.31	15.78	54.16
Straight	500 x 250	1.00	1.50	1	1.00	1.50	58.17	58.17	15.78	23.67
Straight	800 x 700	0.95	2.85	1	0.95	2.85	108.57	103.14	15.78	44.97
Straight	800 x 250	0.60	1.26	1	0.60	1.26	81.43	48.86	15.78	19.88
Straight	800 x 250	0.60	1.26	1	0.60	1.26	81.43	48.86	15.78	19.88
Straight	800 x 700	0.54	1.62	1	0.54	1.62	108.57	58.63	15.78	25.56
Straight	800 x 700	0.54	1.62	1	0.54	1.62	108.57	58.63	15.78	25.56
Straight	800 x 700	0.53	1.59	1	0.53	1.59	108.57	57.54	15.78	25.09
Straight	800 x 400	0.50	1.20	1	0.50	1.20	93.06	46.53	15.78	18.94
Straight	800 x 250	0.50	1.05	1	0.50	1.05	81.43	40.72	15.78	16.57
Straight	800 x 700	0.49	1.47	1	0.49	1.47	108.57	53.20	15.78	23.20
Straight	800 x 700	0.49	1.47	1	0.49	1.47	108.57	53.20	15.78	23.20
Type	**Unit Cross-section Dimensions (mm)**	**Unit Length (m)**	**Unit Surface Area (m^2)**	**No. of Units**		**Total Surface Area (m^2)**	**Cost Galvanised Sheet Metal (£/Unit)**	**Total Cost Galvanised Sheet Metal (£)**	**Cost of Lagging (£/m^2)**	**Total Cost of Lagging (£)**
90 Bend	1,100 x 500	1.10	3.52	5		17.60	225.35	1,126.75	15.78	277.73
Bend	800 x 700	0.80	2.40	1		2.40	153.47	153.47	15.78	37.87
Bend	800 x 500	0.80	2.08	1		2.08	132.88	132.88	15.78	32.82
Bend	800 x 500	0.80	2.08	1		2.08	132.88	132.88	15.78	32.82
Taper	800 x 500	0.43	1.12	9		10.04	88.49	796.41	15.78	158.41
E.O. Shoe	800 x 700	0.33	1.00	4		3.99	41.58	166.32	15.78	63.02
E.O. Cap	800 x 250	0	0.20	5		0.98	13.48	67.40	15.78	15.46
E.O. SD **	500 x 250	0	1.00	1		1.00	31.33	31.33	15.78	15.78
E.O. SD1	500 x 250	0	0.00	25		0.00	39.65	991.25	15.78	0.00
E.O. SD	500 x 250	0	0.00	2		0.00	168.93	337.86	15.78	0.00
E.O. SD1	500 x 250	0	0.00	2		0.00	168.93	337.86	15.78	0.00
Sub–total				308.36				34,271.20		12,882.65
Total									47,153.85	

Table 1A

Appendix 2

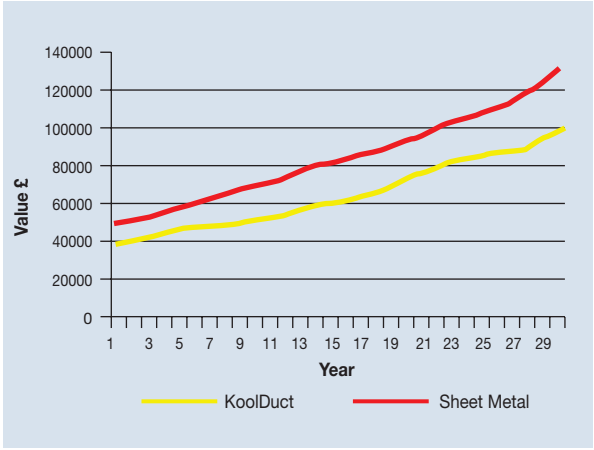
Estimated Whole Life Cost (30 years) Comparison Between Galvanised Sheet Steel Ducting and the *Kingspan* **Kool**Duct® System

The table below shows the assumptions used in the 'whole life' cost model and 'whole life' cost graphs.

In carrying out the 'whole life' cost analysis, Cyril Sweett made the following assumptions.

- Life cycle (years) = 30 years
- Life cycle preliminaries = 5%
- Discount rate = 3.5%
- Energy cost = 2.5p/kW·h
- Life cycle professional fees = 3%, M&E Consultancy fees @ 0%
- M&E commissioning costs = 3%
- Strip out / preparation = lump sum
- BWIC with services installations = 5%
- Access costs = lump sum, as necessary, with increased cost assumed for conventional
- Ducting due to weight / material handling requirements
- Interest rate (APR) = 0%
- Rate of inflation = 0%

'Whole Life' Cost



Cost Element	Start Year	Maintenance Frequencies (years) **Kool**Duct®	Sheet Metal
Changes to ducts due to churn (3%)[1]	10	2	2
Repairs to ducts – due to damage[2]	2	1 (1%)	2 (2%)
Cleaning costs[3]	2	2 (£5/m)	2 (£4.5/m)
Energy costs (£100pa)[4]			1

1 A nominal 3% replacement due to general wear & tear after 10 years has been assumed to cover all installations, applied to both options, along with a 1% allowance for damage. It is feasible that no replacements are needed during the lifetime of a specific installation.

2 1% every year for Kingspan **Kool**Duct® *and 2% alternate years for conventional.*

3 £5/m for Kingspan **Kool**Duct® *and £4.5/m conventional.*

4 The savings equate to 30% electrical power but the cost savings arising from this within this specific case study are minimal, totalling just over £100 per annum.

Table 2A

Contact Details

Customer Service

For quotations, order placement and details of despatches please contact the Kingspan Insulation Customer Service Department on the numbers below:

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Ireland – Tel: +353 (0) 42 97 54200
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– email: commercial.ie@insulation.kingspan.com

Technical Advice/Design

Kingspan Insulation supports all of its products with a comprehensive Technical Advisory Service for specifiers, stockists and contractors.

This includes a free computer–aided service designed to give fast, accurate technical advice. Simply phone the Kingspan Insulation Technical Service Department with your project specification. Calculations can be carried out to provide heat losses / gains, condensation / dew point risk, required insulation thicknesses etc… Thereafter any number of permutations can be provided to help you achieve your desired targets.

The Kingspan Insulation Technical Service Department can also give general application advice and advice on design detailing and fixing etc... Site surveys are also undertaken as appropriate.

Please contact the Kingspan Insulation Ducting Technical Service Department on the numbers below:

UK & Ireland
– Tel: +44 (0) 870 850 8333
– Fax: +44 (0) 1544 387 278
– email: techline.uk@insulation.kingspan.com

Literature & Samples

Kingspan Insulation produces a comprehensive range of technical literature for specifiers, contractors, stockists and end users. The literature contains clear ‘user friendly’ advice on typical design; design considerations; thermal properties; sitework and product data.

Available as a complete Design Manual or as individual product brochures, Kingspan Insulation technical literature is an essential specification tool. For copies please contact the Kingspan Insulation Marketing Department on the numbers below:

UK – Tel: +44 (0) 870 733 8333
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