

RETHINKING DUCTWORK

Making an Impact?

AN INDEPENDENT ANALYSIS OF THE EMBODIED ENVIRONMENTAL
IMPACT OF DIFFERING HVAC DUCTWORK SPECIFICATIONS



*Low Energy -
Low Carbon Buildings*

Summary

Introduction

Kingspan Insulation commissioned BRE Global to carry out an embodied environmental impact assessment of two differing HVAC ductwork specifications, both designed to meet the same performance standard.

BRE Global used its 2008 Environmental Profiles Methodology to compare the overall environmental impact, over a 60 year life, of ductwork fabricated from the *Kingspan KoolDuct® System*, with that of galvanised sheet steel insulated with rock mineral fibre.

Details of the ductwork specifications analysed are shown in Appendices B & C.

The functional unit used in the analysis was a one metre long rectangular ductwork section, with internal dimensions of 1250 mm x 800 mm, constructed to operate at a static pressure of 500 Pa, and insulated such that it complies with the insulation thickness¹ requirements for “chilled and dual purpose ducting to control heat gain”, as set out in BS 5422: 2009² (Table 14) and the TIMSA HVAC Guide³ (Section 6.2.5).

An appropriate duct support and hanger system was also included.

Results

The results, presented in the form of Ecopoints, are shown in the table below - the lower the Ecopoints score the lower the environmental impact.

Ductwork Specification	Ecopoints Score
Ductwork fabricated from the <i>Kingspan KoolDuct® System</i>	0.45
Galvanised sheet steel ductwork insulated with rock mineral fibre	1.31

Key Findings

The findings show that the embodied environmental impact of ductwork fabricated from the *Kingspan KoolDuct® System* can be 65% lower than that of ductwork fabricated from galvanised sheet steel and insulated with rock mineral fibre.

Furthermore, 86% of the impact of the ductwork fabricated from galvanised sheet steel, and insulated with rock mineral fibre, is accounted for by the galvanised sheet steel.

Conclusion

It is clear that, as a result of the findings described above, the *Kingspan KoolDuct® System* should be considered the product of choice for HVAC ductwork systems where low embodied environmental impact is a key requirement.

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Separate research, into the effects of ductwork air leakage on HVAC system energy consumption, has shown that the air leakage rate of ductwork fabricated from the *Kingspan KoolDuct® System* can be a fraction of that of insulated galvanised sheet steel – up to 80%⁴ less, and that the energy required to run a fan with a typical design flow rate of 7.5 m/s, can be reduced by up to 30%⁵.

Thus, the *Kingspan KoolDuct® System* should also be considered the product of choice for HVAC ductwork systems where low operational environmental impact is a key requirement.

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¹For the purposes of reflecting standard industry practice, the study compared practical insulation thicknesses ‘as sold’, i.e. the closest commonly available commercial thickness required to match or exceed the calculated thickness, which is determined by using standardised assumptions and the thermal conductivity of the insulant.

²BS 5422: 2009 (Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C).

³Thermal Insulation Manufacturers and Suppliers Association - Domestic and Non-Domestic Heating, Cooling and Ventilation Guide.

⁴Kingspan Insulation Ltd. 2011. Luther Home of Mercy: Case Study; www.insulation.kingspan.com.

⁵Kingspan Insulation Ltd. 2005. Overeating Resources? www.insulation.kingspan.com.

Appendix A

The 2008 BRE Environmental Profiles Methodology

The 2008 BRE Environmental Profiles Methodology complies with ISO 20930: 2007, the international standard for analysing the environmental impacts of building products.

The Methodology provides standardised and independent information about building products, taking into consideration a range of environmental impacts across their entire lifecycle, from cradle to grave, over a 60 year building lifetime. It does not consider operational impacts or benefits.

Key environmental impacts such as climate change, ozone depletion, acidification, consumption of minerals and water, emissions of pollutants to air and water, in addition to the quantity of waste sent for disposal, are considered by the Methodology.

The end result is an Ecopoints score - the lower the Ecopoints score the lower the environmental impact.

Appendix B

Ductwork Specification - The *Kingspan KoolDuct*[®] System

Source Data

Description	Measurement	Value	Total Mass (kg)
Rectangular Ductwork Section Sides (<i>Kingspan KoolDuct</i>[®] Panel)			
	Section Height x Width x Length (mm)	800 x 1250 x 1200	
	Internal Perimeter Length (mm)	4100	
	Wall Thickness (mm)	30	
	Mass per Square Metre (kg/m ²)	1.9	
	Total Surface Area (m ²)	5.208	9.895
Galvanised Steel 4-bolt Flange Coupling System			
Flange Profile	Units (No.)	2	
	Total Length (mm)	4020	
	Mass per Linear Metre (kg/m)	0.75	6.030
Corner Pieces	Units (No.)	8	
	Unit Mass (kg)	0.080	0.640
Galvanised Steel Duct Support & Hanger System* (At 2400 mm Centres)			
Supports (Hilti MV-30)	Total Length (mm)	730	
	Mass per Linear Metre (kg/m)	0.49	0.358
Threaded Bar Hangers (M8)	Unit Diameter (mm)	8	
	Total Length (mm)	1060	
	Mass per Linear Metre (kg/m)	0.31	0.329
Aluminium Reinforcement System**			
Negative Reinforcement Bars	Units (No.)	1	
	Total Length (mm)	798	
	Mass per Linear Metre (kg/m)	0.163	0.130
Positive Reinforcement Bars	Units (No.)	1	
	Total Length (mm)	875	
	Mass per Linear Metre (kg/m)	0.136	0.119
Reinforcements Discs	Units (No.)	4	
	Unit Mass (kg)	0.017	0.068
Speed Clips	Units (No.)	2	
	Unit Mass (kg)	0.002	0.004
Aluminium Foil Vapour Barrier Tape (Aluminium)			
	Total Length (mm)	10600	
	Mass per Linear Metre (kg/m)	0.0092	0.098
Adhesive			
	Total Length (mm)	4800	
	Mass per Linear Metre (kg/m)	0.061	0.295
Silicone Sealant			
	Total Length (mm)	13000	
	Mass per Linear Metre (kg/m)	0.0155	0.202
*In accordance with the manufacturer's recommendations.			
**In accordance with the duct design parameters.			

Total Mass of Materials

Material	Mass per Linear Metre (kg/m)	Mass (kg)
<i>Kingspan KoolDuct</i> [®] Panel	8.25	9.895
Galvanised Steel	6.13	7.357
Aluminium	0.35	0.418
Adhesive	0.25	0.295
Silicone Sealant	0.17	0.202

Appendix C

Ductwork Specification - Galvanised Sheet Steel Ductwork Insulated with Rock Mineral Fibre

Source Data

Description	Measurement	Value	Total Mass (kg)
Rectangular Ductwork Section Sides (Galvanised Steel Sheet)*			
	Section Height x Width x Length (mm)	800 x 1250 x 1250	
	Internal Perimeter Length** (mm)	4146	
	Wall Thickness (mm)	1.0	
	Mass per Square Metre (kg/m ²)	7.8426	
	Total Surface Area (m ²)	5.188	40.644
Galvanised Steel Flange Coupling System			
Flange Profile (Doby EP130/11)	Units (No.)	2	
	Total Length (mm)	3980	
	Mass per Linear Metre (kg/m)	0.869	6.917
Corner Pieces (Doby S30/12)	Units (No.)	8	
	Unit Mass (kg)	0.076	0.608
Self Piercing Rivets (At 300 mm Centres)	Units (No.)	14	
	Unit Mass (kg)	0.001	0.014
Galvanised Steel Duct Support & Hanger System* (At 2500 mm Centres)			
Supports (Hilti MQ-41)	Total Length (mm)	750	
	Mass per Linear Metre (kg/m)	2.08	1.560
	Unit Diameter (mm)	10	
Threaded Bar Hangers (M10)	Total Length (mm)	1100	
	Mass per Linear Metre (kg/m)	0.49	0.539
Galvanised Steel Reinforcement System*			
Stiffener (Back to Back with Bolted Corners)	Units (No.)	1	
	Thickness (mm)	1.6	
	Height (mm)	40	
	Width (mm)	100	
	Total Length (mm)	4420	
	Surface Area (m ²)	0.442	
	Mass per Square Metre (kg/m ²)	12.5481	5.546
	Pop Rivets (At 150 mm Centres)	Units (No.)	28
	Unit Mass (kg)	0.001	0.028
Water Based Sealant			
	Total Length (mm)	1350	
	Mass per Linear Metre (kg/m)	0.016	0.021
Insulation (Rock Mineral Fibre)			
	Density (kg/m ³)	45	
	Thickness (mm)	50	
	Surface Area (m ²)	5.375	
	Volume (m ³)	0.26875	12.094
Aluminium Foil Vapour Barrier Facing to Insulation (Aluminium)			
	Surface Area (m ²)	5.375	
	Surface Area Density (kg/m ²)	0.069	0.371

* In accordance HVCA DW/144 (Heating and Ventilation Contractors' Association – Specification for Sheet Metal Ductwork).

** Including Additional 46 mm Required for Longitudinal Pittsburgh Lock Seam.

Total Mass of Materials

Material	Mass per Linear Metre (kg/m)	Mass (kg)
Galvanised Steel	44.69	55.86
Rock Mineral Fibre	9.68	12.09
Mastic	0.02	0.02
Aluminium	0.30	0.37

NB Vapour barrier tape, insulation pins in addition to the reinforcing scrim and backing to the aluminium foil facing were omitted from the analysis.

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Front cover: whilst ductwork fabricated from the Kingspan KoolDuct® System was installed in the building (Atlantis, The Palm, Dubai, UAE) pictured, this does not necessarily denote that the embodied environmental impact of ductwork materials was a key consideration in the actual ductwork specification.



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