



Tipping the Scales?

A WEIGHT COMPARISON OF DIFFERING INSULATED HVAC DUCTWORK SPECIFICATIONS



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Executive Summary

The *Kingspan KoolDuct™* System must be considered as the product of choice for projects where there are load bearing constraints as:

- Ductwork fabricated from The *Kingspan KoolDuct™* System can weigh up to 75% less than ductwork constructed from galvanised sheet steel and insulated with mineral fibre.



Current Practice & The Alternatives

Current Practice

- Air conditioning and ventilation systems are commonly added to built environments, which have not previously incorporated such systems;
- Existing building structures commonly have inadequate load capacities for new service loads;
- Traditionally, HVAC ductwork is constructed from galvanised sheet steel, which is installed first and then insulated separately as a second operation;
- Time constraints mean that projects may commence before their design is complete;
- The ductwork material is commonly not considered until late in a project's design process;
- Those who are not intimate with a project's constraints commonly select the ductwork material;
- Detailed surveys of existing structures to the level required to plan service layouts are commonly not available before construction commences;
- Services design co-ordination commonly occurs concurrently with construction;
- Delays are commonly caused by unforeseen items, only discovered once construction commences and full exposure of the structure occurs; and
- Delays are commonly caused by design changes that are required during the construction period.

Assessing the Alternatives

The purpose of this report is to examine insulated sheet metal ductwork and The *Kingspan KoolDuct™ System*, their relative performance with regards to weight and the benefits this can incur.

Traditionally, the majority of ductwork is manufactured using galvanised sheet steel, which is installed first and then insulated separately as a second operation. The selection of ductwork material is therefore generally assumed. Additionally, the construction project client's specification for ductwork is normally limited to a set of performance criteria rather than a specific material.

The actual selection of the ductwork material is made by the mechanical services sub-contractor or, more often, its ductwork sub-sub-contractor. Indeed, because of existing manufacturing set-ups, it may be disadvantageous to move away from the existing specification norms and use The *Kingspan KoolDuct™ System*.

With the selection of material so removed from those dealing with the specific project constraints, it is not surprising that the selection of the most appropriate material often occurs well into the design process or, to the client's disadvantage, not at all.

Nevertheless, The *Kingspan KoolDuct™ System* eliminates the problem of weight associated with galvanised sheet steel, whilst, at the same time, offering additional advantages to the specifying engineer, the architect, the M&E contractor, the fabricator, the facilities manager, the property developer and the building owner.

The *Kingspan KoolDuct™ System* comprises premium performance *Kingspan KoolDuct™* panels, fabrication methods, coupling systems and a complete line of accessories to produce pre-insulated rectangular ductwork in sections up to 3.93 m long.

Kingspan KoolDuct™ panels comprise a fibre-free rigid thermoset phenolic insulation core faced with silver aluminium foil on one side and either silver or black coated aluminium foil on the other side.



Review of the Alternatives

For some projects the main reason for the selection of The *Kingspan KoolDuct™ System* would be that it can overcome severe constraints on structural loadings. In these circumstances, the selection of The *Kingspan KoolDuct™ System*, over a galvanised sheet steel ductwork system, would often be the only realistic choice, the alternative normally being the introduction, at potentially significant additional cost, of secondary steel supports to transfer service loads back to the structure. In some projects, even this option may not be available e.g. where buildings contain listed features that can not be obscured by the introduction of new structural members.

In addition, the lightweight nature of The *Kingspan KoolDuct™ System* can also make the installation process easier. A further, more direct result of the lightweight properties, is that the material has a much reduced hazard potential. Risk assessments, required for all construction operations, can be less onerous than those associated with installing the far heavier alternative materials and hence the safety strategies and protection measures that were adopted were also less onerous.

The easier installation process can also mean faster installation speeds. The reduced weight of The *Kingspan KoolDuct™ System* means less labour is required to install it. Both of these aspects reduce the impact of the ductwork installation operation on other site activities and the cost of installation.

Results of the Analysis

A comparison of weights, per linear metre of ductwork, between pre-insulated ductwork fabricated from The *Kingspan KoolDuct™ System*, and galvanised sheet steel ductwork insulated with mineral fibre is shown in Table 1. The report concentrates on cooling and dual purpose ductwork, as the demand for dual purpose air conditioning in buildings is common practice today.

The functional unit used in the comparison was: a 1200 mm long rectangular ductwork section; with internal dimensions of 1250 x 800 mm (plus an additional 46 mm for one longitudinal Pittsburgh Lock seam on the sheet steel duct); constructed to operate at a static pressure of 500 Pa; and insulated such that it complies with the insulation thickness requirements of BS 5422: 2009 and the Non Domestic Building Services Compliance Guide, for the insulation thickness requirements and the maximum heat gain of -6.45 W/m² recommended for cooling and dual purpose ductwork.

The weights were calculated to include the mass of aluminium in the facings of the insulation for all insulants. An appropriate duct support and hanger system was also included.

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

NB If required for load calculations, a schedule of weights for straight ductwork sections fabricated from The Kingspan KoolDuct™ System using the aluminium grip flange, 4-bolt flange and Tiger Clip coupling systems is contained in 'The Kingspan KoolDuct™ System Fabrication Manual'. All weights given in the tables are for guidance purposes only and may not denote actual weights. Weights shall always be independently determined by the fabricator and / or installer.

It is clear that, as a result of the findings, The *Kingspan KoolDuct™ System* should be considered the product of choice for HVAC ductwork systems where low weight insulated ductwork is a key requirement.

Specification	Insulation Thickness (Practical)		Mass per Linear Metre		Weight Reduction %
	<i>Kingspan KoolDuct™</i>	Mineral Fibre	<i>Kingspan KoolDuct™</i> & Aluminium Grip Flange	Mineral Fibre Insulated Galvanised Sheet Steel	
Cooling & Dual Purpose Ductwork	30 mm	50 mm	13.55 kg	54.69 kg	75

Table 1: Weight Comparison between Pre-insulated Ductwork Fabricated from The *Kingspan KoolDuct® System* with Aluminium Grip Flange & Galvanised Sheet Steel Ductwork Insulated with Mineral Fibre

Specification	Insulation Thickness (Practical)		Mass per Linear Metre		Weight Reduction %
	<i>Kingspan KoolDuct™</i>	Mineral Fibre	<i>Kingspan KoolDuct™</i> & 4-Bolt Flange	Mineral Fibre Insulated Galvanised Sheet Steel	
Cooling & Dual Purpose Ductwork	30 mm	50 mm	14.98 kg	54.69 kg	72

Table 2: Weight Comparison between Pre-insulated Ductwork Fabricated from The *Kingspan KoolDuct™ System* with 4-Bolt Flange & Galvanised Sheet Steel Ductwork Insulated with Mineral Fibre

NB All ductwork specifications used in the above comply with BS 5422: 2009, TIMSA HVAC Guide and B&ES DW/144.

Appendix A

Ductwork Specification - The *Kingspan KoolDuct™* System with Aluminium Grip Flange

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
Aluminium Grip Flange Coupling System			
Internal Grip Flange	Units (No.)	2	
	Total Length (mm)	4080	
	Mass per Linear Metre (kg/m)	0.275	2.244
External Aluminium Grip Flange	Units (No.)	2	
	Total Length (mm)	4340	
	Mass per Linear Metre (kg/m)	0.224	1.942
Aluminium Bayonet Cleat	Units (No.)	2	
	Total Length (mm)	4343	
	Mass per Linear Metre (kg/m)	0.178	0.770
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)	2400	
	Mass per Linear Metre (kg/m)	0.0092	0.022
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	0.074
*In accordance with the manufacturer's recommendations.			
**In accordance with the duct design parameters.			

Total Mass of Materials

Material	Mass per Linear Metre of Ductwork (kg/m)	Mass (kg)
<i>Kingspan KoolDuct™</i> Panel	8.25	9.895
Galvanised Steel	0.57	0.687
Aluminium	4.42	5.299
Adhesive	0.25	0.295
Silicone Sealant	0.06	0.074

Appendix B

Ductwork Specification - The *Kingspan KoolDuct*[™] System with 4-Bolt Flange

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
4-Bolt Flange Coupling System			
4-Bolt Flange	Units (No.)	2	
	Total Length (mm)	4020	
	Mass per Linear Metre (kg/m)	0.75	6.030
4-Bolt Flange Corner	Units (No.)	8	
	Total Length (mm)	4340	
	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)	2400	
	Mass per Linear Metre (kg/m)	0.0092	0.022
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	0.074
* In accordance with the manufacturer's recommendations.			
** In accordance with the duct design parameters.			

Total Mass of Materials

Material	Mass per Linear Metre of Ductwork (kg/m)	Mass (kg)
<i>Kingspan KoolDuct</i> [™] Panel	8.25	9.895
Galvanised Steel	6.13	7.357
Aluminium	0.29	0.343
Adhesive	0.25	0.295
Silicone Sealant	0.06	0.074

Appendix C

Ductwork Specification - Galvanised Sheet Steel Ductwork Insulated with 50 mm 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
Threaded Bar Hangers (M10)	Unit Diameter (mm)	10	
	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 with B&ES DW/144 (Building & Engineering Services Association Specification for Sheet Metal Ductwork, 1998 Edition).			
**Including additional 46 mm required for longitudinal Pittsburgh Lock seam.			

Total Mass of Materials

Material	Mass per Linear Metre of Ductwork (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.		

Example Refurbishment Projects

Project Name: Cadogan Hall
Location: Sloane Square, London
Building Use: Theatre
Client: Cadogan Estates
Structural Engineer: Adams Kara Taylor
M&E Consulting Engineer: Voce Case
M&E Contractors: Gratte Manley
Installers/Fabricators: Sterling Thermal Ltd



Project Name: Luther Home of Mercy
Location: Ohio, USA
Building Use: Multi-residential - Care Facility
Developer: Commercial Comfort Systems Inc.



Project Name: Brunel University
Location: London, UK
Building Use: Education
Builder: Ductform Ventilation



Project Name: House of Fraser
Location: King William Street, London
Building Use: Retail Outlet
Client: House of Fraser Plc
Main Contractor: Havelock Europa
M&E Consulting Engineer: Slender Winter Partnership
M&E Contractors: Jackson Rich Ltd
Installers/Fabricators: Sterling Thermal



Project Name: National Theatre
Location: London, UK
Building Use: Leisure - Theatre
Architect: Haworth Tompkins
Installer: Airtech Ductwork Systems Ltd



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