

Attenuator Brochure

Rectangular attenuators with splitters
Rectangular attenuators with linings
Modular rectangular attenuators
Splitter element attenuators
Circular attenuators
Bend attenuators
Fire rated attenuators

16th August 2012

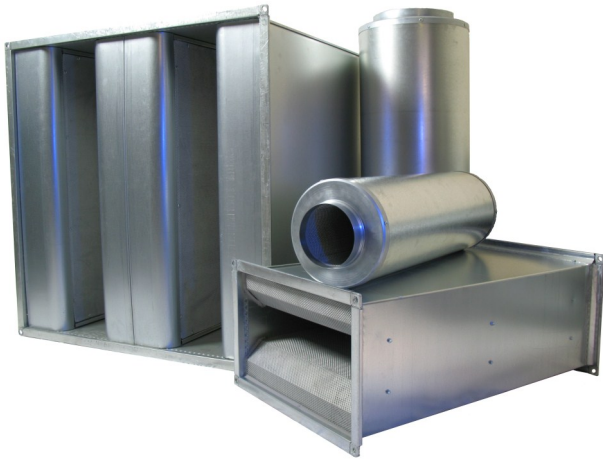


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Introduction



CAICE supply more attenuators in the UK than any other company, and we have reached this position by delivering quality products, on time, and at the right price. This is achieved through a professional and friendly team of acoustic engineers and support staff that are available across the UK to provide clients with a first class service.

The CAICE Attenuator Brochure provides comprehensive details on a wide range of standard products, that should meet most requirements. However if you can't find it here then CAICE has the expertise to research, develop, test and construct almost any attenuator product you can think of, so please give us a call.

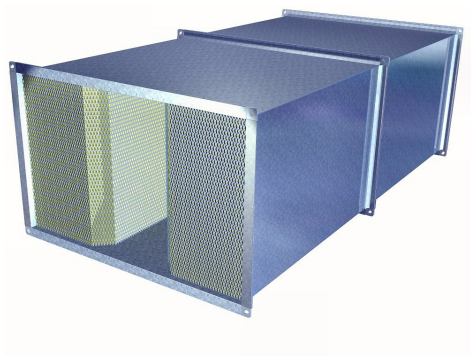
Some of the things that make CAICE attenuator products stand apart from our competitors are detailed below.

- **Construction** - CAICE have undertaken rigorous destruction testing on the products to ensure that they are fit for purpose. Attenuator casings have been pressure tested up to 2000 Pa to ensure that flanges do not deflect beyond the limits specified within DW/TM1. Our largest splitter elements have been stacked in modules up to 7m high to ensure they do not deform under their own weight. Splitter attenuators have been tested with airway velocities up to 25 m/s to ensure splitter facing deformation and mineral wool fibre egress is within acceptable limits.
- **Performance** - CAICE are the only company in the UK that has a UKAS accredited attenuator testing laboratory capable of measuring static and dynamic performance fully in accordance with BS EN ISO 7235: 2009 "Acoustics - laboratory measurement procedures for ducted silencers and air terminal units - insertion loss, flow noise and total pressure loss". This has enabled an extensive testing programme to be undertaken that has provided us with more accurate performance data for our products, than was previously possible.
- **Manufacturing technology** - our Production Centre utilises a range of highly specialised machinery that largely automates the attenuator manufacturing process. A duct line produces attenuator casings with integral 20 or 30mm profile flanges. Expanded metal for splitter facings is de-coiled and fibre glass tissue is bonded as part of the process. A splitter line de-coils and roll-forms all the splitter frame parts and all the parts finally come together on the Attenuator Assembly Line. Consequently we can make attenuator products quicker, more cost effectively and to a higher quality than any other UK manufacturer.
- **The Aristas Attenuator Selector** - has been written by Aristas our software development division, who are a Microsoft Certified Partner. The selector brings together all the constructional and performance elements of the attenuator range that we have gained through our extensive research and development programme. It enables us to select the right product to suit the application at the right price. In addition the selector is now available to clients, making it easy to quickly compile attenuator schedules that are based on the latest attenuator performance data.

We hope this brochure provides all the information that you need on the CAICE attenuator range. However if there are any further details that you require then please do not hesitate to call us or arrange an appointment to see your local CAICE acoustic engineer.

The screenshot shows the 'Aristas Attenuator Selector' software interface. It includes a 'Requirements' section with a table of values, a 'Construction' section with a table of values, and a 'Physical parameters' section with a table of values. The interface is branded with the Aristas logo and a Microsoft Certified Partner logo.

Range Overview

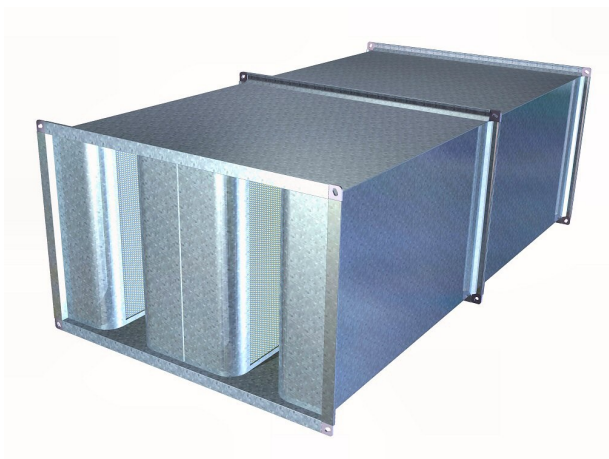


LG - Lining Attenuators

For smaller applications - a rectangular duct attenuator constructed from galvanised sheet steel, with lining type acoustic elements. Provided with 30mm profile flanges as standard, which are compatible with MEZ, DOBY or METU flanging systems. Also available with 20mm profile flanges, internal flanges or spigot ends up to certain sizes if required.

Size Range

Element Orientation	Minimum (mm)		Maximum (mm)		Lengths (mm)
	Width	Height	Width	Height	
Vertical	100	100	800	1200	450 to 4800
Horizontal	100	100	1200	800	

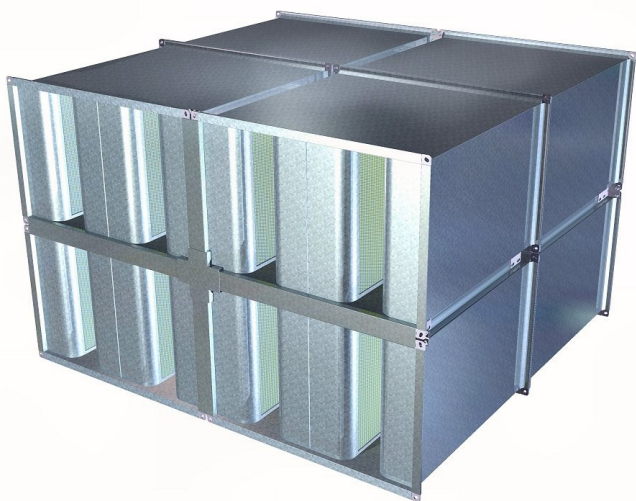


SG - Splitter Attenuators

For medium applications - a rectangular duct attenuator constructed from galvanised sheet steel, with splitter type acoustic elements. Provided with 30mm profile flanges as standard, which are compatible with MEZ, DOBY or METU flanging systems. Also available with 20mm profile flanges, internal flanges or spigot ends up to certain sizes if required.

Size Range

Element Orientation	Minimum (mm)		Maximum (mm)		Lengths (mm)
	Width	Height	Width	Height	
Vertical	250	250	2500	2000	450 to 4800
Horizontal	250	250	2000	2500	



MG - Modular Attenuators

For larger applications - a modular rectangular duct attenuator constructed from galvanised sheet steel, with splitter type acoustic elements. Provided with 30mm profile flanges as standard, which are compatible with MEZ, DOBY or METU flanging systems. Modular parts kit provided for easy on site assembly. Larger units may require supporting steelwork by others, depending on the particular application.

Size Range

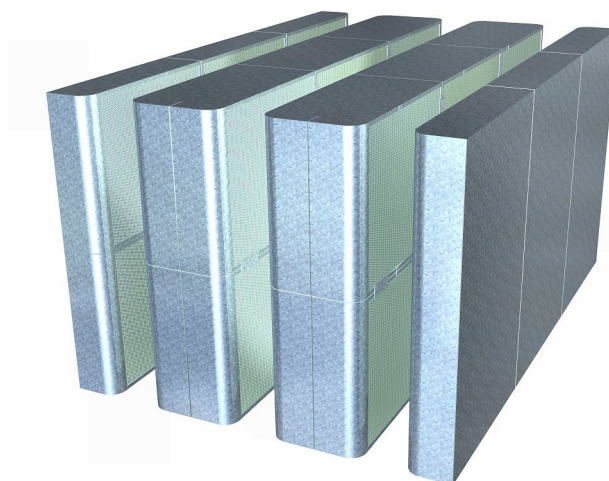
Element Orientation	Minimum (mm)		Maximum (mm)		Lengths (mm)
	Width	Height	Width	Height	
Vertical	1266	250	100000	20000	450 to 4800
Horizontal	250	1266	100000	20000	

EG - Element Attenuators

For installation within apertures - a set of attenuator splitter elements, constructed from galvanised sheet steel. Provided loose for installation into builders work openings, or within plant such as air handling units. Multiple piece splitters provided with easy fix assembly brackets. Optional brackets for fixing within apertures can also be supplied if required.

Size Range

Element Orientation	Minimum (mm)		Maximum (mm)		Lengths (mm)
	Width	Height	Width	Height	
Vertical	250	250	100000	7000	450 to 4800
Horizontal	250	250	7000	100000	

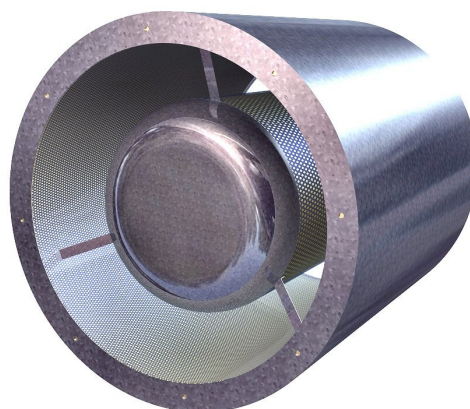


CG - Circular Attenuators

For circular duct or plant applications - a circular duct attenuator constructed from galvanised sheet steel, with a peripheral, out of air stream acoustic lining. Larger units also available with a central acoustic pod. End connections can either be spigots or end ring flanges with threaded inserts (as shown) for direct connection to plant, such as axial flow fans.

Size Range

Minimum Internal Diameter (mm)	Maximum Internal Diameter (mm)	Lengths (mm)
100	2000	300 to 3000

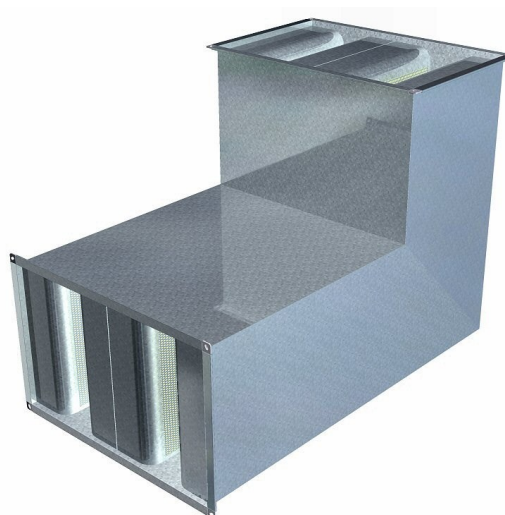


RG or BG - Bend Attenuators

For applications with limited space - a bend duct attenuator constructed from galvanised sheet steel, with lining type acoustic elements (RG), or splitter type acoustic elements (BG as shown). Provided with 30mm profile flanges as standard. Also available with 20mm flanges or spigot ends up to certain sizes if required. Bend attenuators are generally only used when a straight unit cannot be accommodated, as they have higher pressure losses.

Size Range

Element Orientation	Minimum (mm)		Maximum (mm)		Centre Line Lengths (mm)
	Width	Height	Width	Height	
Vertical	150	150	2500	2000	450 to 4800
Horizontal	150	150	2000	2500	



Construction Codes Explained



Typical Construction Code

Example: SG02V / 3C / B / SM / B2 / X

A rectangular attenuator with splitter elements, constructed from galvanised sheet steel.

The unit shall be delivered to site split in two sections in length, and splitters shall be installed in the vertical plane.

The unit casing shall have a high pressure rating, with 30mm profile flanges at both ends. The attenuator shall be protected by bubble wrap.

The attenuator shall be provided with side splitters and the infill shall be protected by Melinex polyester film. The unit shall have a base colour polyester powder paint finish on external surfaces only. The unit shall also have a special feature.

Construction Code Format

The first three sections of the construction code, up to and including the packing are always shown:

Example: SG02V / 3C / L

Optional features, paint options and special features are only shown if applicable, and in the order as they are shown in the construction codes layout on the previous page.

Further examples:

- SG02V / 3C / B / S / B2
- SG02V / 3C / H / SM / X
- SG02V / 3C / L / X

Other Materials

This brochure only provides details on attenuators constructed from galvanised sheet steel. However CAICE can also provide attenuators constructed from a range of other materials where required:

Stainless steel - for duct systems handling corrosive chemically laden air, or with high standards of cleanliness, or for external applications, etc.

Plastic - for duct systems handling corrosive chemically laden air, etc. Various types of plastic are available depending on the application.

Heavy duty galvanised steel - for industrial applications, or where casings need to be welded for very high pressure duct systems, etc. Rolled steel angle (RSA) flanges would normally be provided for these types of application.

Generally attenuators can be constructed in these materials to the same sizes as the standard galvanised sheet steel products that are detailed in this brochure. However if you require more detailed information on attenuators constructed in alternative materials then please contact our sales personnel for further assistance.

Fire Rating

All CAICE attenuators detailed within this brochure are capable of maintaining their internal air circulating area when subjected to an internal temperature of 300° C for a period of 120 minutes.

These attenuators are therefore suitable for installation within smoke or heat exhaust systems, providing the internal temperature does not exceed 300° C for a period longer than 120 minutes.

Warrington Fire Research have undertaken an independent assessment and compiled a report that supports this statement.

For more onerous conditions or where proprietary systems, such as Flameshield are specified, matching attenuators can also be provided by enhancing the constructional specification of the products.

Fire rating is a diverse topic, and therefore if you do require more details on the attenuator options that we can provide then please contact our sales personnel for further assistance.



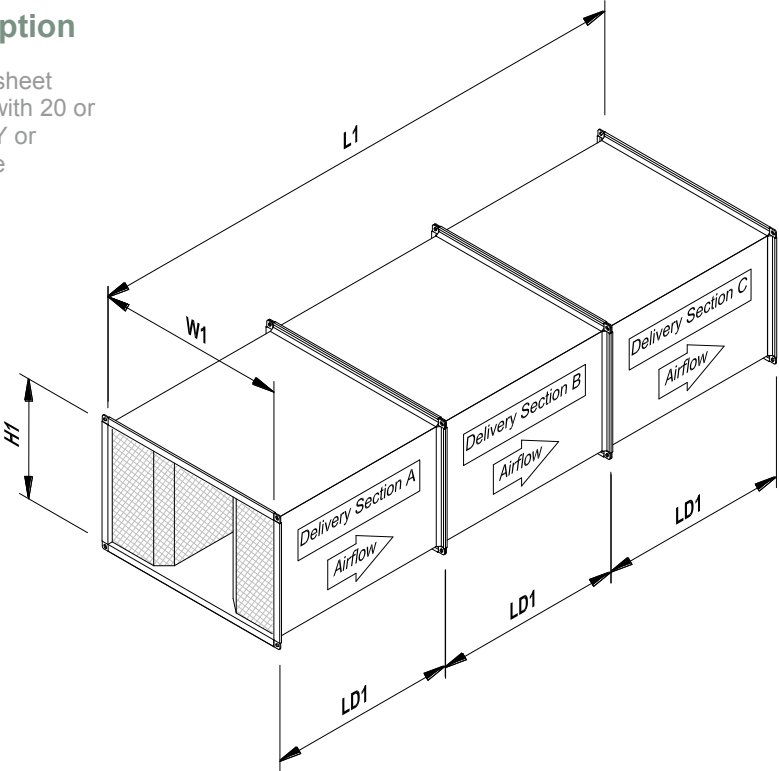
LG - Lining Attenuators

With Profile Flanges - most popular LG option

Rectangular duct attenuator, constructed from galvanised sheet steel, with lining type acoustic elements. Casing provided with 20 or 30mm profile flanges at both ends, suitable for MEZ, DOBY or METU flanging systems. For ease of handling, units can be delivered to site split in up to four sections in length.

Options available:

- 50, 75, 100, 125, 150, 175 or 200 wide linings
- Vertical or horizontal lining orientation
- Melinex wrapped infill
- Thermal or acoustic double skinning
- Internal and external paint finish
- Integral inlet or outlet plenums



Available Widths and Heights:

End Connection Type	Element Orientation	High Pressure Casings				Medium Pressure Casings			
		W1 min	H1 min	W1 max	H1 max	W1 min	H1 min	W1 max	H1 max
30mm profile flanges Preferred	Vertical	150	150	800	1000	150	1001	800	1200
	Horizontal	150	150	1000	800	1001	150	1200	800
20mm profile flanges Alternative	Vertical or Horizontal	150	150	600	600	150 or 601		800	800

For medium pressure casings with 20mm profile flanges, either the width or the height dimension must be at least 601.

Attenuators can be provided in 1mm increments within the width and height ranges shown above, although 25mm increments are standard. Maximum aspect ratio should not exceed 6:1.

Available Lengths:

End Connection Type	Number of Delivery Sections in Length	L1
30mm profile flanges Preferred	1	450, 600, 750, 900, 1050, 1200, 1500, 1800, 2100, 2400
	2	900, 1200, 1500, 1800, 2100, 2400, 3000, 3600, 4200, 4800
	3	1350, 1800, 2250, 2700, 3150, 3600
	4	1800, 2400, 3000, 3600, 4200, 4800
20mm profile flanges Alternative	1	500, 650, 800, 950, 1100, 1250, 1600, 1900, 2200, 2500
	2	1000, 1300, 1600, 1900, 2200, 2500, 3200, 3800, 4400, 5000
	3	1500, 1950, 2400, 2850, 3300, 3750
	4	2000, 2600, 3200, 3800, 4400, 5000

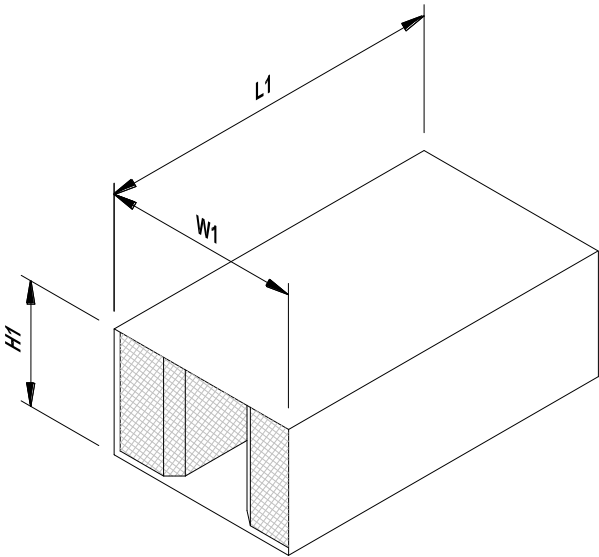
LG - Lining Attenuators

With Spigot Ends

Rectangular duct attenuator, constructed from galvanised sheet steel, with lining type acoustic elements. Casing provided with spigot connections at both ends, suitable for slip jointing into adjoining ductwork.

Options available:

- 25, 50, 75, 100, 125, 150, 175 or 200 wide linings
- Vertical or horizontal lining orientation
- Melinex wrapped infill
- Internal and external paint finish



Available Widths and Heights:

End Connection Type	Element Orientation	High Pressure Casings				Zero Pressure Casings			
		W1 min	H1 min	W1 max	H1 max	W1 min	H1 min	W1 max	H1 max
Spigot ends	Vertical or Horizontal	100	100	400	400	100 or 401		600	600

For non-rated zero pressure casings, either the width or the height dimension must be at least 401mm.

Attenuators can be provided in 1mm increments within the width and height ranges shown above, although 25mm increments are standard.

Available Lengths:

End Connection Type	L1
Spigot ends	465, 615, 765, 915, 1065, 1215, 1365



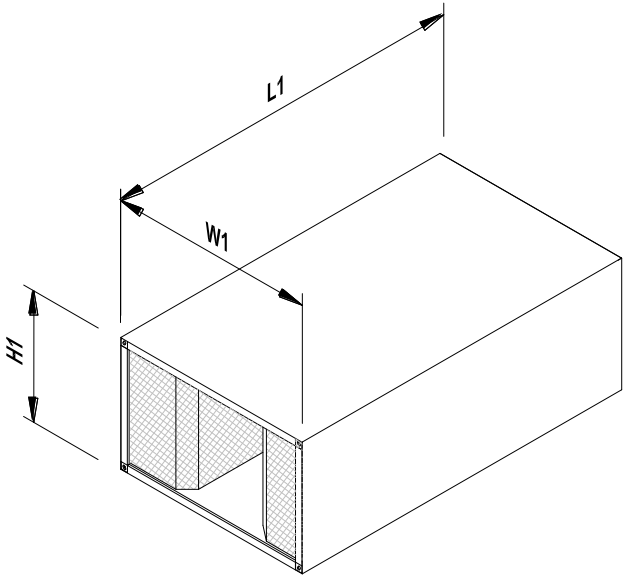
LG - Lining Attenuators

With Internal Flanges

Rectangular duct attenuator, constructed from galvanised sheet steel, with lining type acoustic elements. Casing provided with 30mm internal flanges at both ends, suitable for MEZ, DOBY or METU flanging systems. Flange corner holes fitted with M8 nutserts to enable easy connection.

Options available:

- 50, 75, 100, 125, 150, 175 or 200 wide linings
- Vertical or horizontal lining orientation
- Melinex wrapped infill
- Internal and external paint finish



Available Widths and Heights:

End Connection Type	Element Orientation	High Pressure Casings				Medium Pressure Casings			
		W1 min	H1 min	W1 max	H1 max	W1 min	H1 min	W1 max	H1 max
30mm internal flanges	Vertical or Horizontal	250	250	400	400	250 or 401		800	800

For medium pressure casings either the width or the height dimension must be at least 401mm.

Attenuators can be provided in 1mm increments within the width and height ranges shown above, although 25mm increments are standard.

Available Lengths:

End Connection Type	L1
30mm internal flanges	620, 770, 920, 1070, 1220, 1370

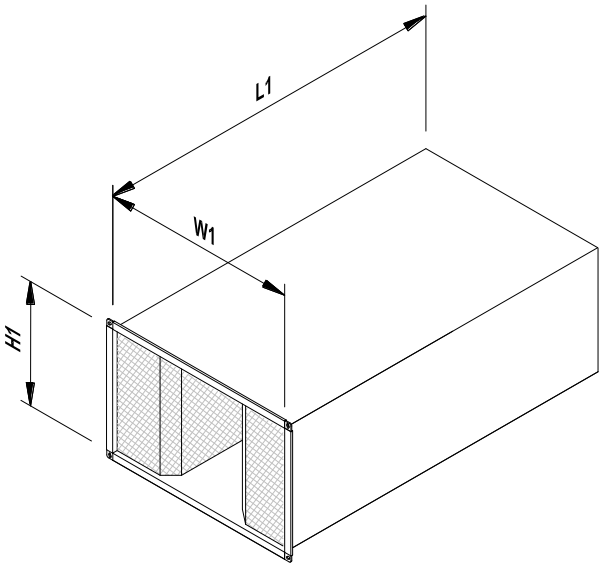
LG - Lining Attenuators

With Profile Flange / Spigot End

Rectangular duct attenuator, constructed from galvanised sheet steel, with lining type acoustic elements. Casing provided with 20 or 30mm profile flange at one end, suitable for MEZ, DOBY or METU flanging systems. At the other end a spigot connection is provided, suitable for slip jointing into adjoining ductwork.

Options available:

- 50, 75, 100, 125, 150, 175 or 200 wide linings
- Vertical or horizontal lining orientation
- Melinex wrapped infill
- Internal and external paint finish



Available Widths and Heights:

End Connection Type	Element Orientation	High Pressure Casings				Zero Pressure Casings			
		W1 min	H1 min	W1 max	H1 max	W1 min	H1 min	W1 max	H1 max
20mm or 30mm profile flange / spigot end	Vertical or Horizontal	150	150	400	400	150 or 401		600	600

For non-rated zero pressure casings, either the width or the height dimension must be at least 401mm.

Attenuators can be provided in 1mm increments within the width and height ranges shown above, although 25mm increments are standard.

Available Lengths:

End Connection Type	L1
20mm profile flange / spigot end	560, 710, 860, 1010, 1160, 1310
30mm profile flange / spigot end	535, 685, 835, 985, 1135, 1285

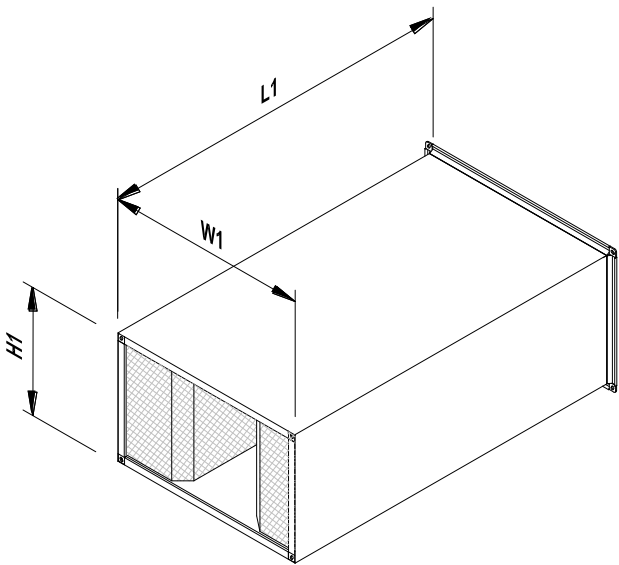
LG - Lining Attenuators

With Profile Flange / Internal Flange

Rectangular duct attenuator, constructed from galvanised sheet steel, with lining type acoustic elements. Casing provided with 30mm profile flange at one end, and 30mm internal flange at the other end. Flanges suitable for MEZ, DOBY or METU flanging systems. Internal flange corner holes fitted with M8 nutserts to enable easy connection.

Options available:

- 50, 75, 100, 125, 150, 175 or 200 wide linings
- Vertical or horizontal lining orientation
- Melinex wrapped infill
- Internal and external paint finish



Available Widths and Heights:

End Connection Type	Element Orientation	High Pressure Casings				Medium Pressure Casings			
		W1 min	H1 min	W1 max	H1 max	W1 min	H1 min	W1 max	H1 max
30mm profile flange / 30mm internal flange	Vertical or Horizontal	250	250	400	400	250 or 401		800	800

For medium pressure casings, either the width or the height dimension must be at least 401mm.

Attenuators can be provided in 1mm increments within the width and height ranges shown above, although 25mm increments are standard.

Available Lengths:

End Connection Type	L1
30mm profile flange / 30mm internal flange	535, 685, 835, 985, 1135, 1285

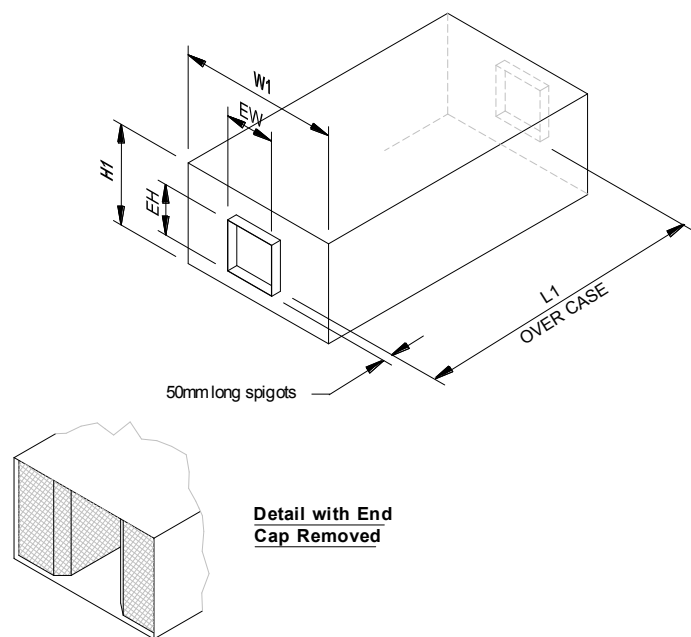
LG - Lining Attenuators

With Rectangular Spigot End Caps

Rectangular duct attenuator, constructed from galvanised sheet steel, with lining type acoustic elements. Casing provided with end caps at both ends, with rectangular spigot connections suitable for slip jointing into adjoining ductwork. Elements are often provided out of air stream to minimise pressure loss.

Options available:

- 50, 75, 100, 125, 150, 175 or 200 wide linings
- Vertical or horizontal lining orientation
- Melinex wrapped infill
- Internal and external paint finish



Available Widths and Heights:

End Connection Type	Element Orientation	Low Pressure Casings				Zero Pressure Casings			
		W1 min	H1 min	W1 max	H1 max	W1 min	H1 min	W1 max	H1 max
Rectangular spigot end caps	Vertical	150	150	400	400	150 or 401	600	1200	
	Horizontal	150	150	400	400	150 or 401	1200	600	

For non-rated zero pressure casings, either the width or the height dimension must be at least 401mm.

Attenuators can be provided in 1mm increments within the width and height ranges shown above, although 25mm increments are standard. Maximum aspect ratio should not exceed 6:1.

Spigot connections EW by EH are made to suit the adjoining duct, with a minimum size of 100 x 50mm. EW and EH can both be smaller than W1 and H1, as shown above, or one can be sized to match the outer case dimension.

Available Lengths:

End Connection Type	L1
Rectangular spigot end caps	470, 620, 770, 920, 1070, 1220, 1370

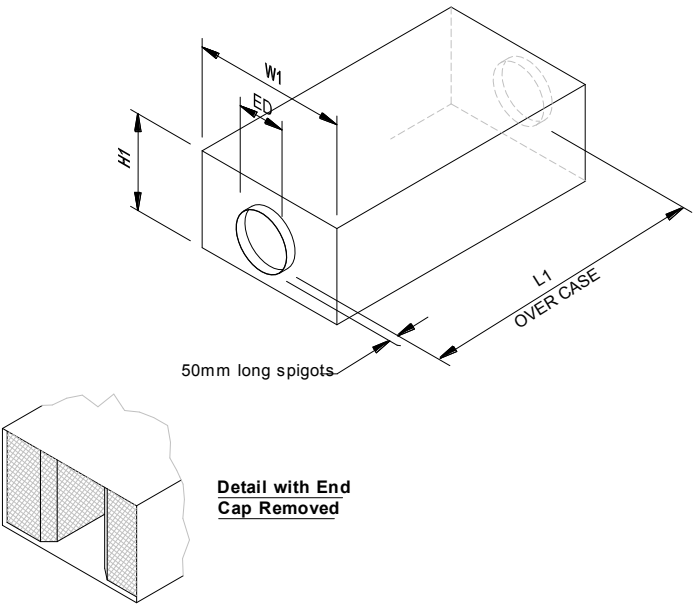
LG - Lining Attenuators

With Circular Spigot End Caps

Rectangular duct attenuator, constructed from galvanised sheet steel, with lining type acoustic elements. Casing provided with end caps at both ends, with circular spigot connections suitable for slip jointing into adjoining ductwork. Elements are often provided out of airstreams to minimise pressure loss.

Options available:

- 50, 75, 100, 125, 150, 175 or 200 wide linings
- Vertical or horizontal lining orientation
- Melinex wrapped infill
- Internal and external paint finish



Available Widths and Heights:

End Connection Type	Element Orientation	Low Pressure Casings			
		W1 min	H1 min	W1 max	H1 max
Circular spigot end caps	Vertical	150	150	600	1200
	Horizontal	150	150	1200	600

Attenuators can be provided in 1mm increments within the width and height ranges shown above, although 25mm increments are standard. Maximum aspect ratio should not exceed 6:1.

Spigot connection ED is made to suit the adjoining duct, with a minimum size of 100mm diameter. ED must be smaller than W1 and H1, as shown above.

Available Lengths:

End Connection Type	L1
Circular spigot end caps	470, 620, 770, 920, 1070, 1220, 1370

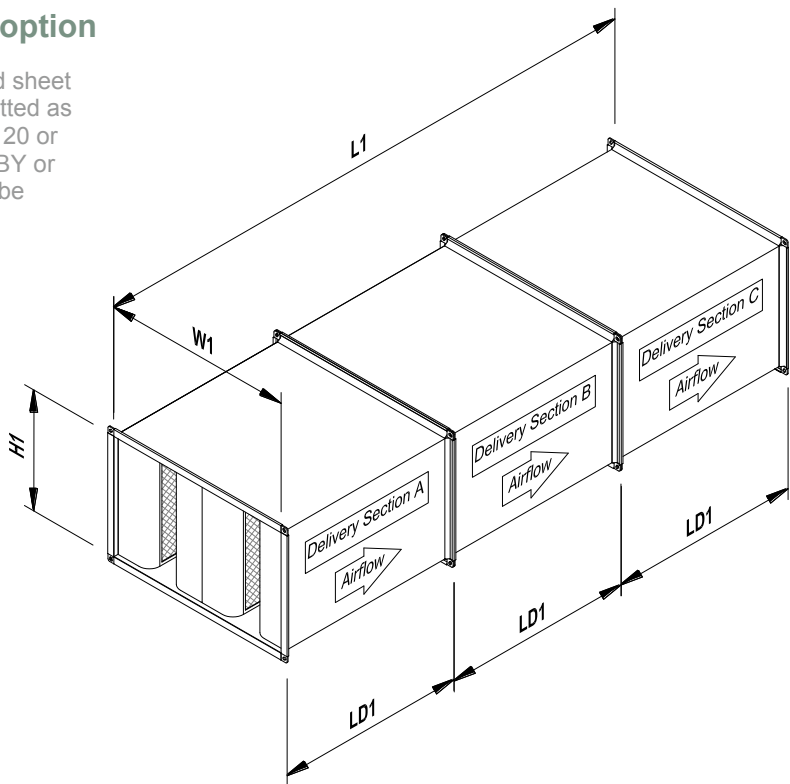
SG - Splitter Attenuators

With Profile Flanges - most popular SG option

Rectangular duct attenuator, constructed from galvanised sheet steel, with splitter type acoustic elements. Side splitters fitted as standard to reduce noise breakout. Casing provided with 20 or 30mm profile flanges at both ends, suitable for MEZ, DOBY or METU flanging systems. For ease of handling, units can be delivered to site split in up to four sections in length.

Options available:

- 200, 250, 300, 350 or 400 wide centre splitters
- Vertical or horizontal splitter orientation
- Melinex wrapped infill
- Thermal or acoustic double skinning
- Internal and external paint finish
- Integral inlet or outlet plenums



Available Widths and Heights:

End Connection Type	Element Orientation	High Pressure Casings				Medium Pressure Casings			
		W1 min	H1 min	W1 max	H1 max	W1 min	H1 min	W1 max	H1 max
30mm profile flanges Preferred	Vertical	250	250	2500	1500	250	1501	2500	2000
	Horizontal	250	250	1500	2500	1501	250	2000	2500
20mm profile flanges Alternative	Vertical	250	250	1500	1000	250	1001	1500	1200
	Horizontal	250	250	1000	1500	1001	250	1200	1500

For ease of handling attenuators above 6600mm periphery and 1200mm long will be delivered to site split in length.

Attenuators can be provided in 1mm increments within the width and height ranges shown above, although 25mm increments are standard. Maximum aspect ratio should not exceed 6:1.

Available Lengths:

End Connection Type	Number of Delivery Sections in Length	L1
30mm profile flanges Preferred	1	450, 600, 750, 900, 1050, 1200, 1500, 1800, 2100, 2400
	2	900, 1200, 1500, 1800, 2100, 2400, 3000, 3600, 4200, 4800
	3	1350, 1800, 2250, 2700, 3150, 3600
	4	1800, 2400, 3000, 3600, 4200, 4800
20mm profile flanges Alternative	1	500, 650, 800, 950, 1100, 1250, 1600, 1900, 2200, 2500
	2	1000, 1300, 1600, 1900, 2200, 2500, 3200, 3800, 4400, 5000
	3	1500, 1950, 2400, 2850, 3300, 3750
	4	2000, 2600, 3200, 3800, 4400, 5000

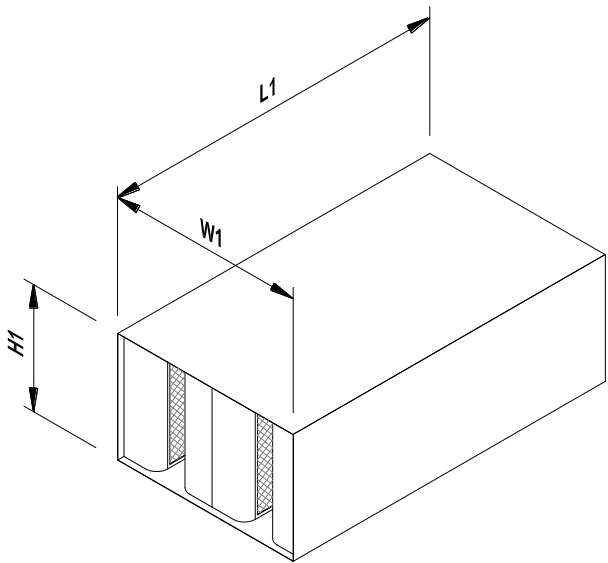
SG - Splitter Attenuators

With Spigot Ends

Rectangular duct attenuator, constructed from galvanised sheet steel, with splitter type acoustic elements. Side splitters fitted as standard to reduce noise breakout. Casing provided with spigot connections at both ends, suitable for slip jointing into adjoining ductwork.

Options available:

- 100, 125, 150, 175 or 200 wide side splitters only on smaller units, with 200 or 250 wide centre splitters on larger units
- Vertical or horizontal splitter orientation
- Melinex wrapped infill
- Internal and external paint finish



Available Widths and Heights:

End Connection Type	Element Orientation	High Pressure Casings				Zero Pressure Casings			
		W1 min	H1 min	W1 max	H1 max	W1 min	H1 min	W1 max	H1 max
Spigot ends	Vertical or Horizontal	250	250	400	400	250 or 401		600	600

For non-rated zero pressure casings, either the width or the height dimension must be at least 401mm.

Attenuators can be provided in 1mm increments within the width and height ranges shown above, although 25mm increments are standard.

Available Lengths:

End Connection Type	L1
Spigot ends	465, 615, 765, 915, 1065, 1215, 1365

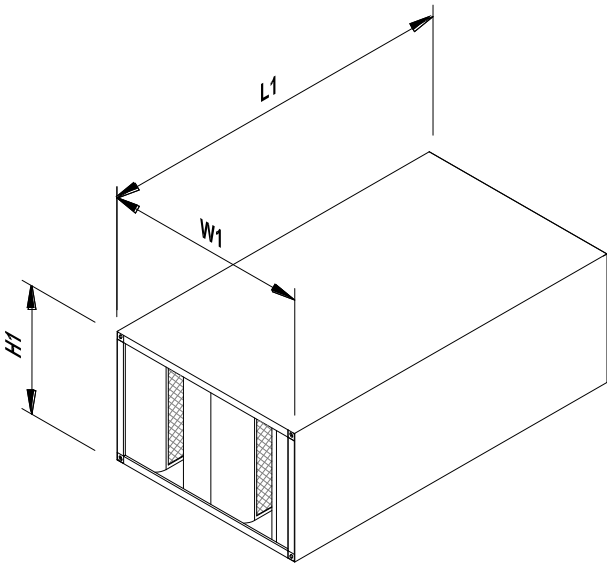
SG - Splitter Attenuators

With Internal Flanges

Rectangular duct attenuator, constructed from galvanised sheet steel, with splitter type acoustic elements. Side splitters fitted as standard to reduce noise breakout. Casing provided with 30mm internal flanges at both ends, suitable for MEZ, DOBY or METU flanging systems. Flange corner holes fitted with M8 nuts to enable easy connection.

Options available:

- 100, 125, 150, 175 or 200 wide side splitters only on smaller units, with 200, 250 or 300 wide centre splitters on larger units
- Vertical or horizontal splitter orientation
- Melinex wrapped infill
- Internal and external paint finish



Available Widths and Heights:

End Connection Type	Element Orientation	High Pressure Casings				Medium Pressure Casings			
		W1 min	H1 min	W1 max	H1 max	W1 min	H1 min	W1 max	H1 max
30mm internal flanges	Vertical or Horizontal	250	250	400	400	250 or 401		800	800

For medium pressure casings either the width or the height dimension must be at least 401mm.

Attenuators can be provided in 1mm increments within the width and height ranges shown above, although 25mm increments are standard.

Available Lengths:

End Connection Type	L1
30mm internal flanges	620, 770, 920, 1070, 1220, 1370

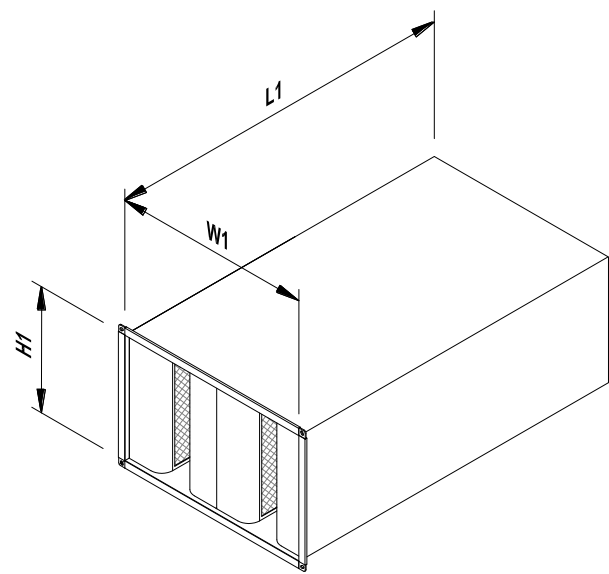
SG - Splitter Attenuators

With Profile Flange / Spigot End

Rectangular duct attenuator, constructed from galvanised sheet steel, with splitter type acoustic elements. Side splitters fitted as standard to reduce noise breakout. Casing provided with 20 or 30mm profile flange at one end, suitable for MEZ, DOBY or METU flanging systems. At the other end a spigot connection is provided, suitable for slip jointing into adjoining ductwork.

Options available:

- 100, 125, 150, 175 or 200 wide side splitters only on smaller units, with 200 or 250 wide centre splitters on larger units
- Vertical or horizontal splitter orientation
- Melinex wrapped infill
- Internal and external paint finish



Available Widths and Heights:

End Connection Type	Element Orientation	High Pressure Casings				Zero Pressure Casings			
		W1 min	H1 min	W1 max	H1 max	W1 min	H1 min	W1 max	H1 max
20mm or 30mm profile flange / spigot end	Vertical or Horizontal	250	250	400	400	250 or 401	600	600	600

For non-rated zero pressure casings, either the width or the height dimension must be at least 401mm.

Attenuators can be provided in 1mm increments within the width and height ranges shown above, although 25mm increments are standard.

Available Lengths:

End Connection Type	L1
20mm profile flange / spigot end	560, 710, 860, 1010, 1160, 1310
30mm profile flange / spigot end	535, 685, 835, 985, 1135, 1285

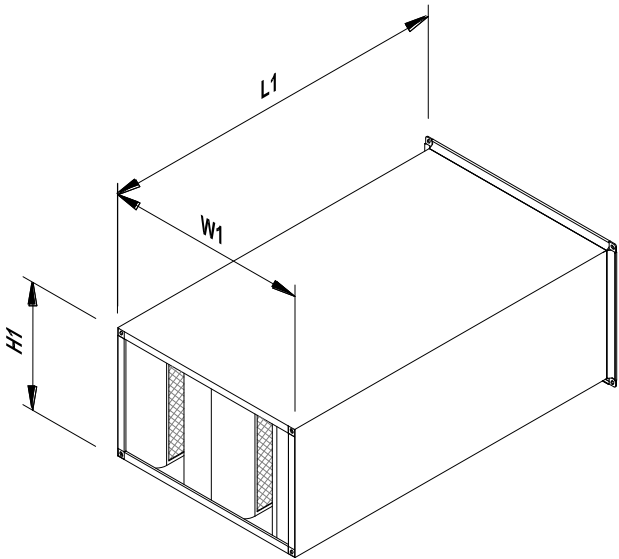
SG - Splitter Attenuators

With Profile Flange / Internal Flange

Rectangular duct attenuator, constructed from galvanised sheet steel, with splitter type acoustic elements. Side splitters fitted as standard to reduce noise breakout. Casing provided with 30mm profile flange at one end, and 30mm internal flange at the other end. Flanges suitable for MEZ, DOBY or METU flanging systems. Internal flange corner holes fitted with M8 nutserts to enable easy connection.

Options available:

- 100, 125, 150, 175 or 200 wide side splitters only on smaller units, with 200, 250 or 300 wide centre splitters on larger units
- Vertical or horizontal splitter orientation
- Melinex wrapped infill
- Internal and external paint finish



Available Widths and Heights:

End Connection Type	Element Orientation	High Pressure Casings				Medium Pressure Casings			
		W1 min	H1 min	W1 max	H1 max	W1 min	H1 min	W1 max	H1 max
30mm profile flange / 30mm internal flange	Vertical or Horizontal	250	250	400	400	250 or 401		800	800

For medium pressure casings, either the width or the height dimension must be at least 401mm.

Attenuators can be provided in 1mm increments within the width and height ranges shown above, although 25mm increments are standard.

Available Lengths:

End Connection Type	L1
30mm profile flange / 30mm internal flange	535, 685, 835, 985, 1135, 1285



MG - Modular Attenuators

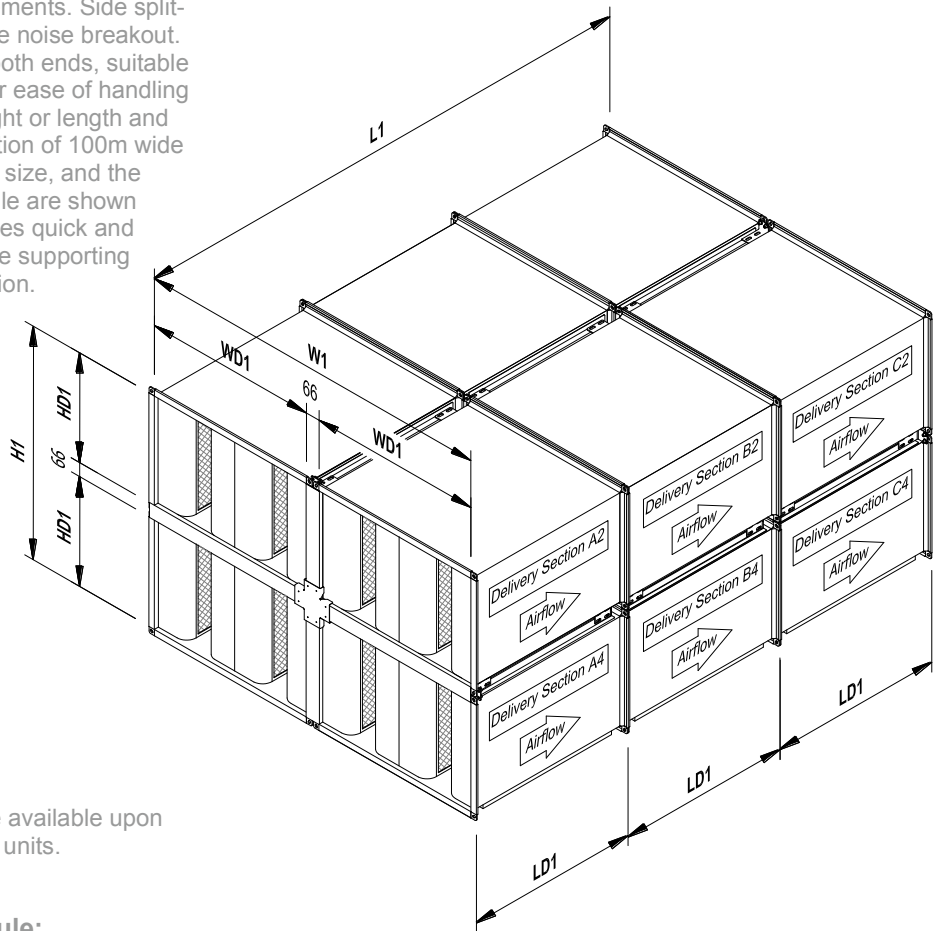
With Profile Flanges

Modular rectangular duct attenuator, constructed from galvanised sheet steel, with splitter type acoustic elements. Side splitters fitted to each module as standard to reduce noise breakout. Casing provided with 30mm profile flanges at both ends, suitable for MEZ, DOBY or METU flanging systems. For ease of handling units can be delivered to site split in width, height or length and can be assembled up to a maximum cross section of 100m wide by 20m high. Each module must be identical in size, and the available widths, heights and lengths per module are shown below. A unique modular bracket system enables quick and easy on site assembly. Larger units may require supporting steelwork by others, depending on the application.

Options available:

- 200, 250, 300, 350 or 400 wide centre splitters
- Vertical or horizontal splitter orientation
- Melinex wrapped infill
- Thermal or acoustic double skinning
- Internal and external paint finish
- Integral inlet or outlet plenums

Modular Attenuator Joining Instructions are available upon request, and are issued to site with all modular units.



Available Widths and Heights - per Module:

End Connection Type	Element Orientation	High Pressure Casings				Medium Pressure Casings			
		WD1 min	HD1 min	WD1 max	HD1 max	WD1 min	HD1 min	WD1 max	HD1 max
30mm profile flanges	Vertical	600	250	2500	1500	600	1501	2500	2000
	Horizontal	250	600	1500	2500	1501	600	2000	2500

For ease of handling modules above 6600mm periphery and 1200mm long will be delivered to site split in length.

Attenuators can be provided in 1mm increments within the width and height ranges shown above, although 25mm increments are standard. Maximum aspect ratio per module should not exceed 6:1.

Available Lengths:

End Connection Type	Number of Delivery Sections in Length	L1
30mm profile flanges	1	450, 600, 750, 900, 1050, 1200, 1500, 1800, 2100, 2400
	2	900, 1200, 1500, 1800, 2100, 2400, 3000, 3600, 4200, 4800
	3	1350, 1800, 2250, 2700, 3150, 3600
	4	1800, 2400, 3000, 3600, 4200, 4800

MG - Modular Attenuators

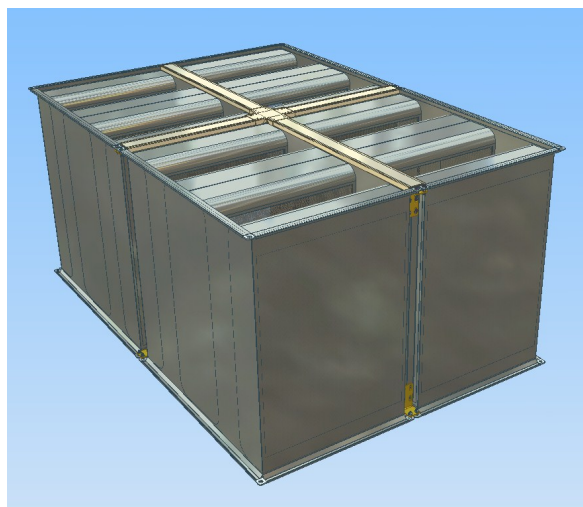
On-site Assembly

The modular concept allows attenuators to be supplied to site in more manageable sections/modules, with the final assembly being carried out at the required location.

Each modular section has rails fitted at the base, to aid support and movement.

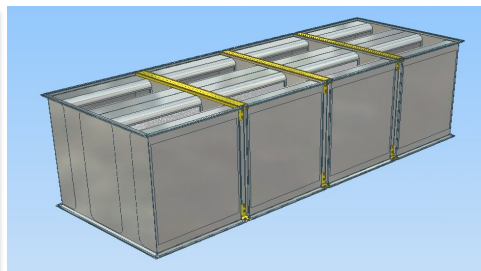
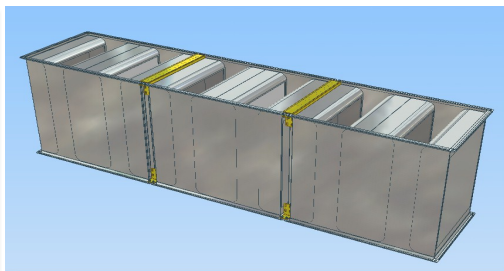
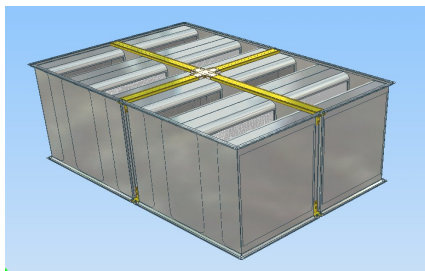
The same type of rails are also fitted to the mating faces of adjacent sections, but these incorporate threaded inserts (nutserts) ready to accept the required fixings.

Steel brackets are used to join adjacent modular sections, with M8 countersunk allen screws being driven through the brackets into the nutserts in the rails.



Examples of Modular Assemblies

The same general assembly methodology applies to all other assemblies whether they be split in width or height. Some examples are shown below.



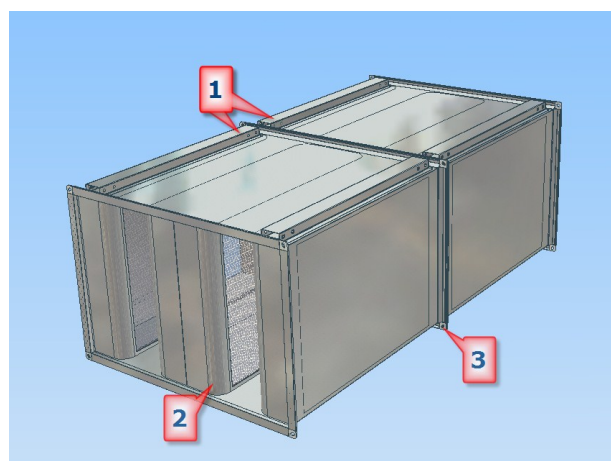
Basic Guidelines

The instructions that follow show the example of a four piece modular attenuator, split into two sections in width and two in height, as this illustrates all of the possible fixing options. For full instructions please refer to the Modular Attenuator Joining Instructions.

1) Join sections in length

Where sections are supplied to site split in length, these must be joined together first:

1. Lay out and align the sections so that the external rails on each section are on the correct and matching faces (1).
2. Ensure that any flat faced splitter elements meet in the middle, leaving the rounded, 'bullnose' faced splitter elements at each end of the section to be joined (2).
3. Use butyl sealant tape (or other appropriate duct seal), M10 corner bolt fixings (3) and flange cleats at 400 centres and join sections in accordance with appropriated ductwork standards.

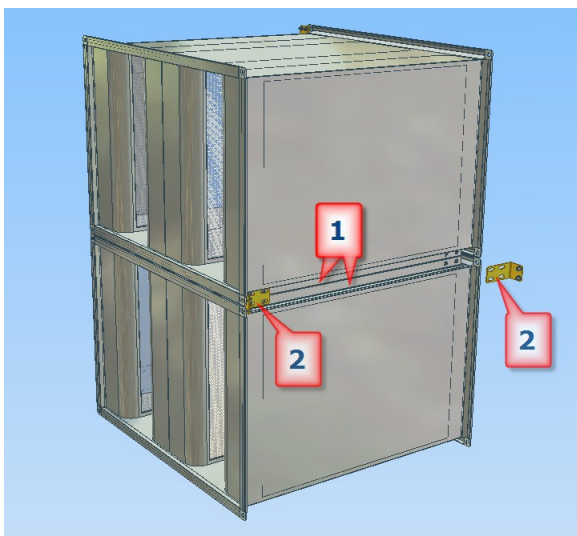


MG - Modular Attenuators

Basic Guidelines Cont.

2) Joining adjacent sections

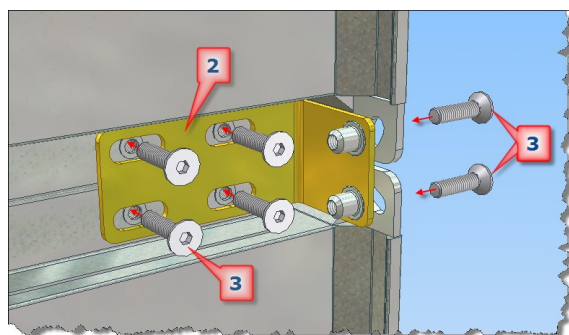
1. Lay out and align the sections so that the external rails on each section are on the correct and matching faces (1).
2. Bring adjacent modules together, with the rails abutting. Use speedclamps or G-Clamps or similar as required to ensure a tight fit.



3. The Modular Joining Brackets (2) can then be fixed to the rails and to the flanges of adjacent modules using the supplied M8 countersunk allen screws (3).
4. Fixings are made through the brackets into nutserts in each of the mating rails on the adjacent attenuator modules. Two fixings are then made through the flange corner holes into the nutserts in the bracket.

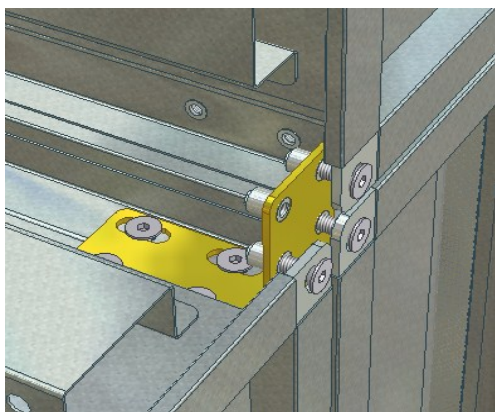
Each Modular Joining Bracket (2) incorporates slots for four fixings and nutserts for two fixings. This allows for fixings into the rails and through the flanges of adjacent modules as shown.

Fix the screws loosely first until all fixings are in and the units have been correctly positioned and aligned. The screws should then be tightened.



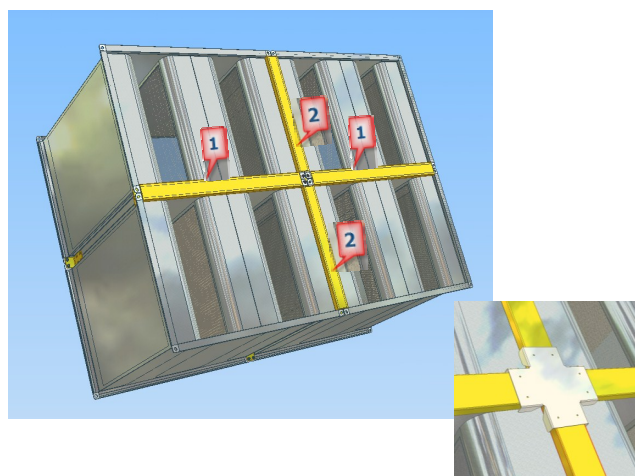
3) Joining centre sections

The views below give an enlarged view of a Modular Centre Joining Bracket in position. This bracket has a larger front face incorporating four nutserts to allow the joining through four separate attenuator module flanges.



4) Completing

Once all of the sections are joined together, as shown in the view below, then a system of capping channel sections and pieces (1 and 2) can be fitted. These are used to close off the gaps between the flanges in the inner sections of the modular attenuator.



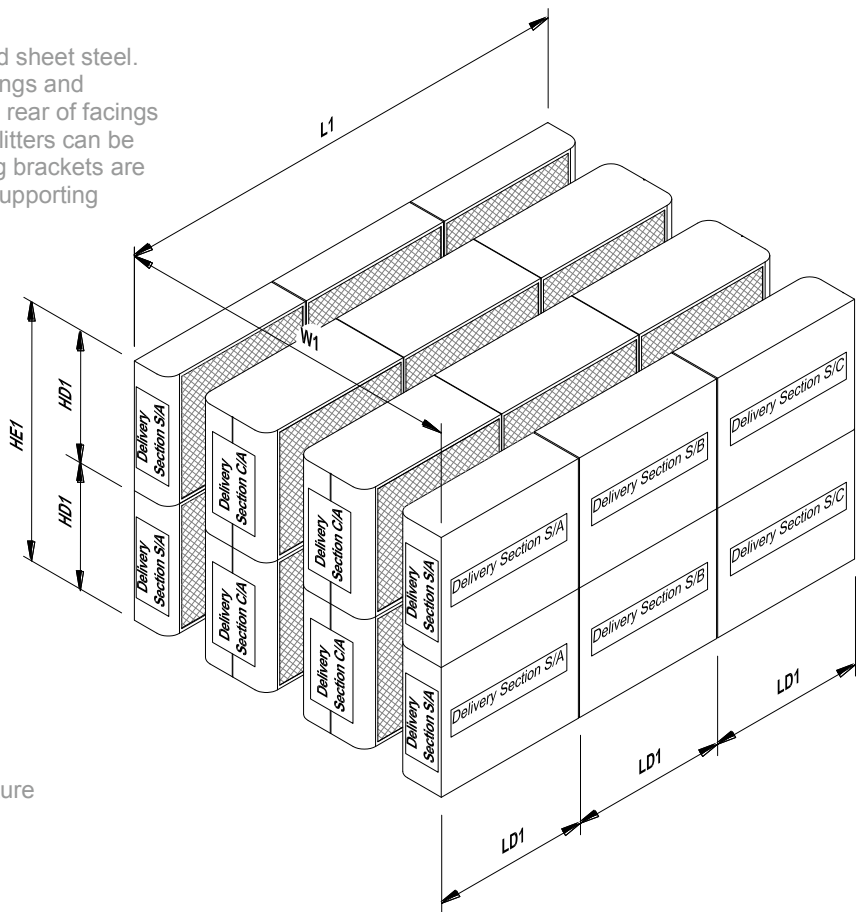
EG - Splitter Element Attenuators

For Installation within Apertures

A set of splitter elements, constructed from galvanised sheet steel. Each splitter provided with bullnose aerodynamic fairings and expanded metal facings. Fibre glass tissue bonded to rear of facings to minimise infill fibre egress. For ease of handling splitters can be delivered, split in height or length, and quick fix joining brackets are then provided accordingly. Larger units may require supporting steelwork by others, depending on the application.

Options available:

- 200, 250, 300, 350 or 400 wide centre splitters
- 100, 125, 150, 175 or 200 wide side splitters fitted with steel backing to enclose infill
- Vertical or horizontal splitter orientation
- Melinex wrapped infill
- Paint finish
- Integral inlet or outlet plenums on units with side splitters, by reducing length of centre splitters
- Fixing brackets for securing splitters into the aperture



Available Aperture Widths and Heights:

Element Orientation	High Pressure Casings			
	W1 min	H1 min	W1 max	H1 max
Vertical	250	250	100000	7000
Horizontal	250	250	7000	100000

EG splitter element attenuators can be provided in 1mm increments within the aperture width and height ranges shown above, although 25mm increments are standard.

Available Lengths:

Number of Delivery Sections in Length	L1
1	450, 600, 750, 900, 1050, 1200, 1500, 1800, 2100, 2400
2	900, 1200, 1500, 1800, 2100, 2400, 3000, 3600, 4200, 4800
3	1350, 1800, 2250, 2700, 3150, 3600
4	1800, 2400, 3000, 3600, 4200, 4800

Standard lengths are shown in the table above, but where required EG splitter element attenuators can be provided in 1mm increments between 450 and 4800mm long.

Splitter elements will be factory assembled up to a maximum size of 2200mm high by 2400mm long, unless requested otherwise.

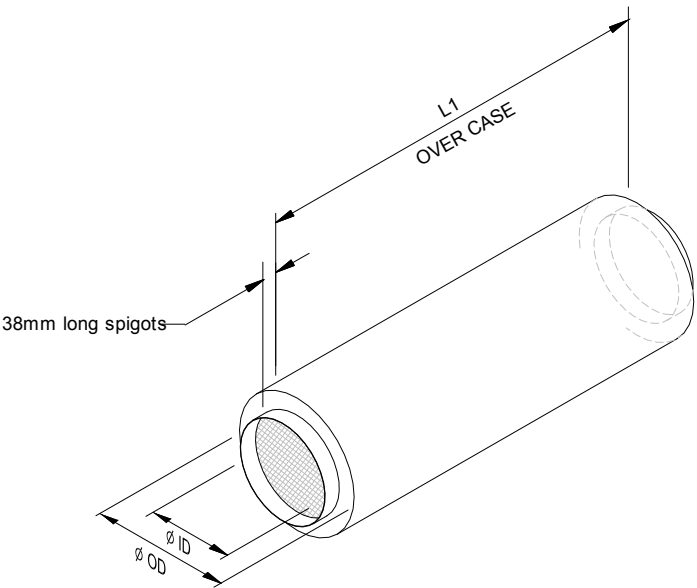
CG - Circular Attenuators

With Spigot Ends

Circular duct attenuator, constructed from galvanised sheet steel, with a peripheral out of airstreams acoustic lining. Casing provided with circular spigot connections for slip jointing into adjoining ductwork.

Options available:

- Melinex wrapped infill
- Internal and external paint finish



Available Sizes

Internal Diameter ID	Outside Diameter OD	Available Lengths L1							
100	205	475	625	775	925	1075	1225	1375	1525
125	230								
150	255								
160	265								
200	305								
250	355								
300	405								
315	420								
355	460								
400	505								
450	555								

All units suitable for low pressure systems.

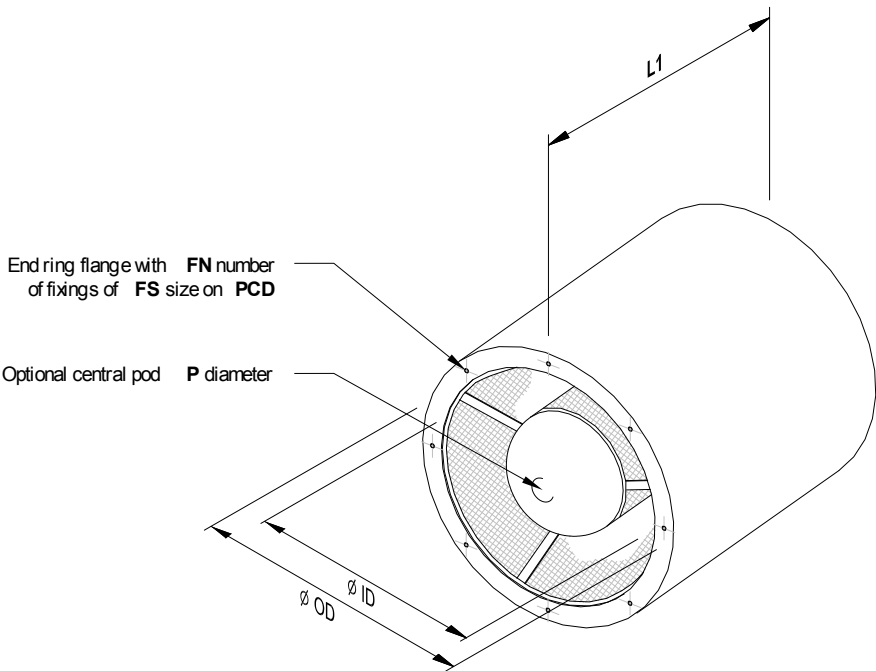
CG - Circular Attenuators

With Flanged Ends

Circular duct attenuator, constructed from galvanised sheet steel, with a peripheral out of airstreams acoustic lining. Casing provided with end ring flanges suitable for direct connection to circular fans or flanged ducts. Flanges have threaded insert fixings to enable quick assembly.

Options available:

- Melinex wrapped infill
- Central pod for increased performance



Available Sizes

Internal Diameter ID	Outside Diameter OD	Pod Diameter P	Standard Lengths L1								Non-Standard Lengths L1			Flange Details			
														FN	FS	PCD	
315	435	170	470	620	770	920	1070	1220	1370	1520	315	473	630	8	M8	355	
355	475	170	470	620	770	920	1070	1220	1370	1520	355	533	710	8	M8	395	
400	520	210	470	620	770	920	1070	1220	1370	1520	400	600	800	8	M10	450	
450	600	210	470	620	770	920	1070	1220	1370	1520	450	675	900	8	M10	500	
500	650	265		620	770	920	1070	1220	1370	1520	500	750	1000	12	M10	560	
560	710	265		620	770	920	1070	1220	1370	1520	560	840	1120	12	M10	620	
630	780	335			770	920	1070	1220	1370	1520	630	945	1260	12	M10	690	
710	860	335			770	920	1070	1220	1370	1520	710	1070	1420	16	M10	770	
800	950	420				920	1070	1220	1370	1520	800	1200	1600	16	M10	860	
900	1100	420					920	1070	1220	1370	900	1350	1800	16	M12	970	
1000	1200	500						1070	1220	1370	1520	1000	1500	2000	16	M12	1070

All units suitable for low pressure systems.

Larger sizes up to 2000mm diameter are available, details upon request.

These units are also available with an end ring flange on one end and a 50mm long spigot on the other end.

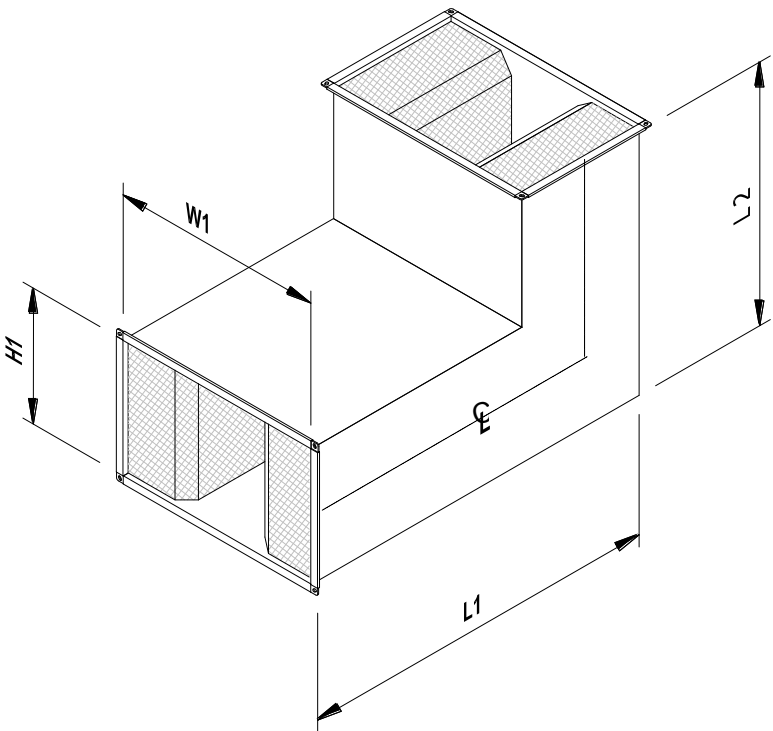
RG - Bend Attenuators with Linings

With Profile Flanges

Bend attenuator, constructed from galvanised sheet steel, with lining type acoustic elements. Casing provided with 30mm profile flanges at both ends, suitable for MEZ, DOBY or METU flanging systems.

Options available:

- 50, 75, 100, 125, 150, 175 or 200 wide linings
- Vertical or horizontal lining orientation
- Melinex wrapped infill
- Internal and external paint finish



Available Widths and Heights:

End Connection Type	Element Orientation	High Pressure Casings				Medium Pressure Casings			
		W1 min	H1 min	W1 max	H1 max	W1 min	H1 min	W1 max	H1 max
30mm profile flanges	Vertical	150	150	800	1000	150	1001	800	1200
	Horizontal	150	150	1000	800	1001	150	1200	800

Attenuators can be provided in 1mm increments within the width and height ranges shown above, although 25mm increments are standard. Maximum aspect ratio should not exceed 6:1.

Available Lengths:

End Connection Type	Centre Line Length
30mm profile flanges	From 450 to 2400

Although bend attenuators are constructed to a standard design, they are generally made to suit. Therefore if you require a bend attenuator beyond the size range shown, please contact one of our acoustic engineers.

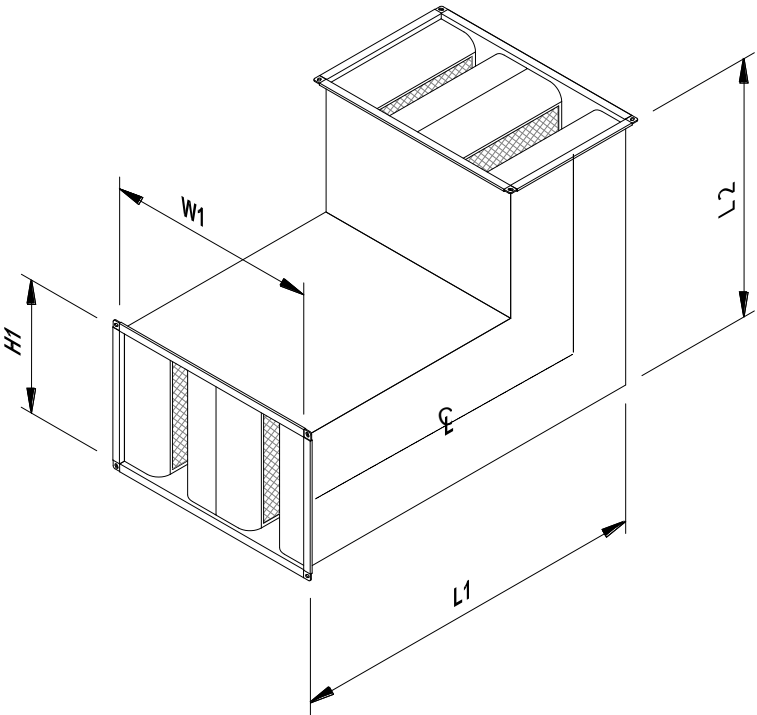
BG - Bend Attenuators with Splitters

With Profile Flanges

Bend attenuator, constructed from galvanised sheet steel, with splitter type acoustic elements. Side splitters fitted as standard to reduce noise breakout. Casing provided with 30mm profile flanges at both ends, suitable for MEZ, DOBY or METU flanging systems.

Options available:

- 200, 250, 300, 350 or 400 wide centre splitters
- Vertical or horizontal splitter orientation
- Melinex wrapped infill
- Internal and external paint finish



Available Widths and Heights:

End Connection Type	Element Orientation	High Pressure Casings				Medium Pressure Casings			
		W1 min	H1 min	W1 max	H1 max	W1 min	H1 min	W1 max	H1 max
30mm profile flanges Standard	Vertical	250	250	2500	1500	250	1501	2500	2000
	Horizontal	250	250	1500	2500	1501	250	2000	2500

Attenuators can be provided in 1mm increments within the width and height ranges shown above, although 25mm increments are standard. Maximum aspect ratio should not exceed 6:1.

Available Lengths:

End Connection Type	Centre Line Length
30mm profile flanges	From 550 to 3600

Although bend attenuators are constructed to a standard design, they are generally made to suit. Therefore if you require a bend attenuator beyond the size range shown, please contact one of our acoustic engineers.



Caice/Flameshield Fire Rated Attenuators

Fire Rating

The risk of fire in any type of building is an ever present concern and so all measures must be taken at the design stages to ensure the risks are minimised.

Where a fire strategy is to be adopted, it is usual for certain parts of the ventilation ductwork to be fire rated, in order to offer the necessary protective measures for the finished development.

For each individual development, the degree of fire rating required will depend on a number of variables. The employment of a specialist sub-contractor to advise on the required fire rating treatment is therefore essential to ensure that all relevant current standards and legislation are complied with.

Fire Rated Attenuators

Attenuators form part of the ventilation systems and must therefore meet the fire rating requirements for the ductwork in which they are installed.

There are various specialist fire rating sub-contractors all offering different systems, however one such company is Flameshield Ltd.

Flameshield

As one of the UK's leading providers of fire-rated ductwork, Flameshield offer the UK's first non-coated fire-rated ductwork system that receives LPCB certification.

Made from galvanised sheet steel, the system withstands fire tests to BS476 Part 24 and BS5588 Part 9, without the need for additional spray to be applied to the external surface.



Caice / Flameshield Alliance

Caice have worked closely with Flameshield, and are now able to offer a full range of rectangular galvanised steel fire rated attenuators. This key strategic alliance offers a number of benefits to our clients:

1. Attenuators manufactured by Caice are fully approved and certified for use with the Flameshield range of fire rated ductwork, removing any doubts over compatibility issues.
2. Both Caice and Flameshield use the same manufacturing technique, where integral flanges are formed from the parent material of the duct casing. This provides integral strength and reduced air leakage when compared to conventional flanging systems such as Doby or MEZ.
3. Caice attenuators and Flameshield duct sections are visually similar, so there is no mismatch when aesthetics are a consideration.
4. No spray means no application or curing time, and no risk of damaging expensive coatings once the product is on site. Attenuators and ductwork can be produced with the quickest possible turnaround times at competitive prices.

Standards and Certification

Flameshield ductwork and Caice/Flameshield attenuators meet all current standards:

- BS 476: Part 24: 1987 (ISO 6944)
- BS 9999 (formerly BS 5588)
- DW/144
- DW/172
- Document B1 (means of escape)
- Document B3 (internal fire spread structure)

Flameshield ductwork has been tested by BRE and has also been certified by the LPCB (Loss Prevention Certification Board).

Types of Fire Rated System

Intended use

When considering fire-rated systems, it is important to identify the intended use of the system under emergency conditions.

An Operational System is one that must remain capable of operating under emergency conditions (e.g. smoke extract systems).

A Non-Operational System is one that is designed for containment purposes and does not need to be operational under emergency conditions (e.g. kitchen extract).

Period of Protection

The majority of operational systems are usually rated for a temperature of 300°C, although some systems can be rated at 400°C. Typical timescales for operation at this temperature would be 2 hours. For an operational system, the rating of the ductwork should match or exceed the rating of the fan.

Non-operational systems may be required to withstand higher temperatures and/or longer time periods.

Stability, Integrity and Insulation

The “stability” of a system refers to its ability to retain its position, shape and form for a given time.

The “Integrity” of a system refers to the fire-stopping properties (e.g. through structural penetrations).

“Insulation” is applied to a system to minimise the effect of radiant heat.

Fire Rated Attenuator Options

Caice/Flameshield Standard Fire-Rated Attenuators

All Caice/Flameshield standard fire rated attenuators would be suitable for use in operational smoke extract systems with a rating up to 300°C for 2 hours.

Enhanced Fire-ratings

Where attenuators are to be installed in any of the following fire-rated systems, please contact us for further details as the products will require an enhanced construction:

- Kitchen Extract
- Stair Pressurisation
- Smoke Extract in excess of 300°C / 2hours
- Other fire-rated rectangular ventilation duct systems

Circular Attenuators

Circular attenuators are not suitable for use in Flameshield fire rated ductwork systems.

Compatibility with other fire-rated systems

We are aware that some other manufacturers of specialist fire-rated ductwork systems may be reluctant to approve the use of Caice/Flameshield attenuators in their systems, stating either aesthetic or technical reasons. However, there is no technical reason why Caice/Flameshield attenuators cannot be used in other systems.

As various fire-rated systems may differ in appearance and construction, it is suggested that approval is sought from the relevant parties before installing Caice/Flameshield attenuators in any other fire rated system.

In the event that Caice / Flameshield attenuators are not approved for use, then Caice can offer attenuator products to match the constructional requirements of any other fire-rated system at additional cost.

Manufacturing

CAICE have invested over £2m in machinery and software systems to develop attenuator manufacturing facilities that are amongst the most advanced in the world. These facilities are one of the key strengths of our business and enable us to produce high quality attenuator products at the lowest manufacturing costs in the UK. The processing speed through our factory also provides large production capacity and short lead times, which can be of significant benefit to our clients.

The key elements of our attenuator manufacturing facilities are detailed below:

Software Systems

Aristas are the software development division of CAICE. They are accredited by Microsoft and have written bespoke systems to control many elements of the attenuator manufacturing process.

When production orders are emailed from the sales office these are decoded to produce a detailed Bill of Materials (BOM) and Labour Times for each attenuator. This data is stored within a Production Schedule, which manages the production process and also provides labour and material requirements planning. When attenuators are loaded onto the shop floor a series of Batch Instructions are compiled that contain all the necessary information to produce that group of items. Some of these instructions are fed via a fibre optic network directly to the automated machines, and others are printed as checklists for the operators at various stages of production. A unit label is also printed for each attenuator that clearly shows key identification and manufacturing details, such as the project name, item reference and description, model code, size, weight, etc,

As an attenuator batch moves through production its progress is tracked on the Production Schedule, which can be viewed from our sales office. This enables us to provide very accurate feedback to clients on the anticipated delivery date for their order. When a batch is completed a further package of documentation is produced to control dispatch and delivery of the attenuators.

- A Pallet Label is affixed to each pallet of goods, which shows project name, delivery address and pallet number.
- A Consignment List is also affixed to each pallet to display the list of items that have been packed on that pallet.
- A Dispatch Note is used to record the pallet number that each item has been packed upon, and the number of pallets that have been loaded on the lorry for that project. This is signed by the lorry driver to confirm that the goods have been loaded.
- A Delivery Note is sent with the lorry driver that confirms the list of items and number of pallets to be delivered for that project. This is signed by the client upon receipt of the delivery to confirm acceptance of goods and proof of delivery (POD).

The documentation that we use throughout the attenuator production process is an integral part of our Quality Management System. The batch checklists and unit labels provide traceability and accountability for each attenuator, so that we know when it was produced and who inspected it. The dispatch and delivery documentation ensures that we send the right items to the right projects, and gives us an audit trail for the client that proves the items were sent and received. Clear pallet labelling also helps the client to easily identify which items are on the pallets so that the goods can be correctly distributed around the site.

These systems contribute significantly in helping us to produce and deliver attenuators as efficiently and quickly as we can. The systems should also give clients confidence in our ability to deliver quality goods on time.

Machine Technology

Attenuators are not high technology products, and comprise a simple steel duct casing, with internal acoustic baffles that contain mineral wool infill for absorbing the sound. It is therefore often surprising to our clients the extent of high technology machinery that we utilise to manufacture attenuators. However we concluded that the only way to mass produce a high quality product at low cost was to introduce automated machines that took skilled sheet metal work out of the production process and also minimised material waste and cost.

Unfortunately you cannot just go out and buy an off the shelf package of attenuator manufacturing machinery. The vast majority of equipment that we use is unique and has been developed in conjunction with highly specialised machinery manufacturers. This also means that we have to employ in-house maintenance staff that undertake regular preventative maintenance, and are capable of fixing machine breakdowns very quickly to avoid production delays.



Duct Line

Attenuator casings are produced on the Duct Line shown opposite, which comprises four elements, de-coiling, flanging, folding and assembly. Manufacturing instructions are fed directly to the machine for each casing, and labels are printed locally for each part with bar codes to enable easy identification at later stages of production.

The de-coiler holds seven coils of galvanised sheet steel, each weighing up to three tonnes. The width of each coil relates to the finished length of the attenuator casings, and we therefore have seven standard casing lengths that are available. This machine de-coils the steel for a casing, cuts it to length, notches it and roll-forms a Pittsburgh seam for subsequently joining the two ends of the sheet into a case.

The sheet is then fed through the flanging machine, which roll-forms either a 20 or 30mm profile flange onto each edge of the sheet, making the flange an integral part of the case. Profile flanges are compatible with MEZ, DOBY or METU flanging systems.

The folder then takes the sheet and folds it, and finally it is assembled by closing the Pittsburgh seam to form an airtight joint, and fitting flange corners to make the finished casing.

Because the entire width of a coil is used to produce a casing, material wastage is less than 5%, which occurs mostly at coil ends as the material is fed on and off the machine.

Expanded Metal (XPM) Line

Facings for attenuator splitters and linings are produced on an expanded metal de-coiler. Manufacturing instructions are fed directly to the machine, which de-coils and cuts each sheet to length and at the same time bonds fibre glass tissue to the XPM.

The sheets are then taken to a guillotine for cutting to the correct size for each part. Nesting software is utilised when the manufacturing instructions are compiled to ensure parts are cut economically from each sheet, keeping wastage below 20%. Any sizable pieces of scrap are also kept for later use to further reduce material wastage. Labels are again applied to each part to enable easy identification at later stages of production.

Splitter Line

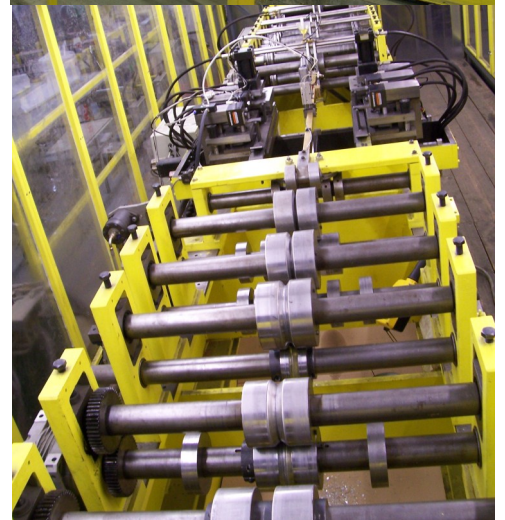
All the frame parts for splitters are produced on the splitter line shown opposite, which comprises de-coiling, roll-forming and folding. Again manufacturing instructions are fed directly to the machine and labels are applied locally to the parts for easy identification.

The de-coiler and roll-forming machine is over thirty metres long and holds six coils of galvanised sheet steel, each weighing up to two tonnes. The width of each coil relates to the finished width of the splitter parts. The steel for each part is de-coiled, cut to length, notched and the edges are roll-formed into a rigid channel, which will retain the XPM splitter facing. The ends of each part are then folded to enable them to be joined.

Assembly Line

All the parts finally come together on the attenuator assembly line. Splitter frames are joined, mineral wool is packed into the frames and the XPM facings are fitted to complete the splitters.

Attenuator casings are then fitted with splitters and the finished product is then labelled, wrapped and packed onto pallets for dispatch.



Attenuator Constructional Specification

Construction Codes

CAICE construction codes are used to confirm the physical properties of each attenuator, and this specification is therefore based around these construction codes. All CAICE attenuator quotations, schedules, order acknowledgements and drawings are issued with a list of the applicable construction codes and their definitions to confirm the scope of products that has been allowed.

Attenuator Range

The CAICE attenuator range comprises the following base models:

LG - Lining Attenuator for smaller applications - a rectangular duct attenuator constructed from galvanised sheet steel, with lining type acoustic elements. Provided with 30mm profile flanges as standard, with options of 20mm profile flanges, internal flanges or spigot ends up to certain sizes if required.

SG - Splitter Attenuator for medium applications - a rectangular duct attenuator constructed from galvanised sheet steel, with splitter type acoustic elements. Provided with 30mm profile flanges as standard, with options of 20mm profile flanges, internal flanges or spigot ends up to certain sizes if required.

MG - Modular Attenuator for larger applications - a modular rectangular duct attenuator constructed from galvanised sheet steel, with splitter type acoustic elements. Provided with 30mm profile flanges as standard. A modular parts kit is provided for easy on site assembly. Larger units may require supporting steelwork by others, depending on the particular application.

EG - Element Attenuator for installation within apertures - a set of attenuator splitter elements, constructed from galvanised sheet steel. Provided loose for installation into builders work openings, or within plant such as air handling units. Multiple piece splitters provided with easy fix assembly brackets. Fixing brackets can also be supplied if required.

CG - Circular Attenuator for circular duct or plant applications - a circular duct attenuator constructed from galvanised sheet steel, with a peripheral, out of air stream acoustic lining. Larger units also available with a central acoustic pod. End connections can either be spigots or end ring flanges with threaded inserts for direct connection to plant, such as axial flow fans, etc.

RG - Bend Attenuator with Linings for smaller applications with limited space - a bend duct attenuator constructed from galvanised sheet steel, with lining type acoustic elements. Provided with 30mm profile flanges as standard, with options of 20mm profile flanges or spigot ends up to certain sizes if required.

BG - Bend Attenuator with Splitters for larger applications with limited space - a bend duct attenuator constructed from galvanised sheet steel, with splitter type acoustic elements. Provided with 30mm profile flanges as standard.

These attenuators are all capable of maintaining their internal air circulating area when subjected to an internal temperature of 300° C for a period of 120 minutes, and are therefore suitable for installation within smoke or heat exhaust systems within these limits. CAICE attenuators are also available in stainless steel or plastic, and where appropriate special attenuators can also be designed to suit any application. Please contact CAICE for details.

Attenuator Casings

Attenuator casings are manufactured on an automated duct line from galvanised sheet steel coil. All longitudinal joints in rectangular and circular casings are made using the Pittsburgh Seam method, which provides a firm mechanical joint. High-pressure duct sealant is applied inside the casing along the length of each seam, and for rectangular casings behind each flanged corner that coincides with a seam, to provide an airtight seal.

Casings can be provided with the following range of end connections, and the attenuator models that are applicable for each type of connection are shown in brackets.

A - Plain Rectangular Spigots matching the casing width and height (LG, SG, RG).

B - 20mm Profile Flanges formed on an automated duct line from the parent metal of the casing, and fitted with one or two piece flange corners (LG, SG - RG models also available but fitted with 20mm MEZ flanges).



C - 30mm Profile Flanges formed on an automated duct line from the parent metal of the casing, and fitted with one or two piece flange corners (LG, SG, MG - RG and BG models also available but fitted with 30mm MEZ flanges).

D - Rectangular Spigot End Caps fitted to each end of the attenuator, where the rectangular spigot is generally smaller than the casing width and height. This enables elements to be provided out of air stream if required to minimise pressure loss (LG).

E - Circular Spigot End Caps fitted to each end of the attenuator, where the circular spigot is smaller than the casing width and height. This enables elements to be provided out of air stream if required to minimise pressure loss (LG).

F - 20mm Profile Flange at one end and **Plain Rectangular Spigot** at the other, matching the casing width and height (LG, SG)

G - 30mm Profile Flange at one end and **Plain Rectangular Spigot** at the other, matching the casing width and height (LG, SG)

H - 30mm Profile Flange at one end and **30mm Internal MEZ Flange** at the other with M8 nutserts fitted to corners (LG, SG)

I - 30mm Internal MEZ Flanges with M8 nutserts fitted to corners (LG, SG).

K - Circular Spigots matching the internal diameter of the circular attenuator (CG).

L - Circular End Ring Flanges with nutserts (CG).

Spigot connections are suitable for slip jointing inside connecting ductwork. Profile flanges and internal flanges are suitable for connecting to ductwork that is fitted with DOBY, MEZ or METU flanging systems.

CAICE profile flanges are unique as they are formed on a special flanging machine that takes the end of the plain casing and roll forms it into a flange. As the flange is an integral part of the case it adds strength and rigidity to the casing, and air leakage is also minimal when compared to conventional slide on flanging systems, such as DOBY, MEZ or METU.

Attenuator casings will comply with one of following pressure classifications:

3 - High Pressure for Class C ductwork systems operating at static pressures between - 750 and + 2000 Pa.

2 - Medium Pressure for Class B ductwork systems operating at static pressures between - 750 and + 1000 Pa.

1 - Low Pressure for Class A ductwork systems operating at static pressures between - 500 and + 500 Pa.

0 - Zero Pressure for static or very low velocity applications where attenuators do not require a pressure classification.

Rectangular attenuator casings do not comply strictly to the case thickness and external stiffener requirements of DW/144, as this is a standard for ductwork not attenuators. The acoustic elements that are fitted within attenuator casings act as internal tie bars and add significant strength and rigidity to the case, which makes them very different to plain ductwork. However DW/144 refers to DW/TM1 for certain performance requirements, and our casings do comply with the flange deflection limits and maximum air leakage rates for the pressure classifications above, as specified within DW/TM1. This has been certified from independent tests undertaken by BSRIA.

Attenuators can be delivered to site split in sections, for ease of handling, with final assembly on site.

01 upwards - Number of Delivery Sections that will be delivered to site to make up the final assembly.

LG, SG and MG attenuators with profile flanges, which are 900mm long or above, can be split in length if access space on site is restricted, or just to make them easier to handle. Attenuators over 6600mm periphery and 1200mm long are split in length as standard.

Modular attenuators can be provided above certain dimensional parameters, and casings can be split in width, height or length to form the final assembly size on site. Modular rails are fitted longitudinally along the case, wherever an adjacent casing is to be joined in width or height as part of the assembly. They are also fitted on the underside of the bottom casings within an assembly to act as a bearing surface for support or lifting. A range of brackets and other fixings enable the modular rails to be connected together, which thereby joins the casings.

Attenuator Constructional Specification

Attenuator Acoustic Elements

LG and RG attenuator casings are fitted with internal side linings that are constructed from galvanized sheet steel mesh (XPM). The air inlet and outlet ends of the linings are chamfered to minimise pressure loss.

SG, MG and BG attenuator casings are fitted with internal centre and side splitters, although smaller units can be provided with side splitters only. Each splitter has a four part peripheral frame comprising a top and bottom channel, and bullnose sections on the air inlet and outlets ends that have aerodynamically rounded profiles to minimise pressure loss. The channel and nose parts are constructed from galvanised sheet steel. Splitter facings are fixed to the sides of the peripheral frames, and continuously retained to form a closed box. The facings are constructed from galvanized sheet steel mesh (XPM).

Channel stiffeners are fitted to the rear of linings and splitter facings at pre-determined centres to ensure that they remain uniform, and avoid bowing particularly when installed in the horizontal plane. The airways between the linings and splitters should therefore be consistent along the length of the attenuator to ensure that the acoustic and aerodynamic performance is achieved.

Linings and splitters are assembled and fixed to the casings with TEK screws, which provide an airtight seal. The linings and splitters are normally set back slightly from the ends of the casings, as this helps prevent damage to the elements during handling.

EG attenuators are a set of splitters only, without a casing, for installation into apertures. The splitters are constructed identically to those fitted within SG, MG and BG attenuators, and where required they can be provided in sections for ease of handling or where space restrictions are applicable. Easy fit assembly brackets are provided as standard whenever splitters are provided in sections.

CG circular attenuators are fitted with a peripheral lining that is out of air stream, and larger models can be provided with a central cylindrical pod. The lining and pod are constructed from galvanized sheet steel mesh (XPM), and the pod is provided with aerodynamically profiled noses on the air inlet and outlet, which are constructed from galvanised sheet steel. Pods are fixed securely in place using three brackets at each end.

Linings, splitters and pods are filled with mineral wool acoustic media, which is over packed to a controlled density to avoid settlement. Fibre glass tissue is then bonded to the rear of the linings, splitter facings and pods to reduce fibre egress from the infill.

The following types of acoustic elements can be provided, and the models that are applicable for each type are shown in brackets:

V - Vertical Elements that are installed in the vertical plane (LG, SG, MG, RG and BG).

H - Horizontal Elements that are installed in the horizontal plane (LG, SG, MG, RG and BG).

U - Unpodded where a central pod is not fitted (CG)

P - Podded where a central is fitted (CG).

Attenuator Packing and Labelling

Attenuators will be provided to site with one of the following protective packing options:

L - Lightweight Pallet Wrapping applied around each end of the attenuator casings and taped in place where required, to protect against ingress of dirt. For EG attenuators the splitter elements are palletised first and wrapped collectively on the pallet.

H - Heavy Duty Polythene Wrapping applied around each end of the attenuator casings and taped in place where required, to protect against ingress of dirt.

B - Bubble Wrapping applied around externally painted attenuator casings and taped in place where required, to protect the finish. For EG attenuators that are painted, the splitter elements are individually bubble wrapped first and taped, then palletised using cardboard where required for additional protection.

All attenuator products are generally packed onto pallets and securely banded in place, so they can be safely dispatched to site and offloaded by fork lift truck or crane. Pallet labels are affixed to clearly identify the items that have been packed on each pallet.



Unit labels are affixed to all attenuator products to confirm the item reference, description, construction code, size, weight and contact details for CAICE. Where attenuators are split for assembly on site, the unit label also confirms the section reference, so that the products can be easily assembled in accordance with drawings.

Attenuator Optional Features

Attenuators can be provided with the following range of optional and special features:

S - Side Elements are standard on LG and RG models and are normally provided as standard for SG and MG models, as they help to reduce noise breakout from the attenuator casings, and they also promote smoother airflow through the attenuator. Side elements are optional on EG models, but where they are provided they are fitted with a galvanised sheet steel backing to retain the mineral wool infill.

M - Melinex Protected Infill is an option available for all attenuator models, where fibre egress must be negligible for clean applications, such as clinical areas in hospitals, pharmaceutical clean rooms, laboratories, etc. Melinex should also be used when the attenuator will be handling moisture or chemically laden air, or when cleaning will be required, so that the infill is protected. Melinex is a polyester film, and when this is used the fibre glass tissue that is normally bonded to the rear of the XPM is omitted.

T - Thermal Double Skin Casing is an option available for LG, SG and MG models, but they must have casings fitted with profile flanges at both ends. Side elements are provided to the full length of the casings, rather than with the normal set backs, and top and bottom thermal panels containing mineral wool are fitted internally within the casing. This provides nominal thermal insulation, but can also be used to give the attenuator casing the following sound reduction index for noise breakout situations:

Sound Reduction Index (R)	(dB) in each Octave Band centre frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Thermal double skin casing	18	16	19	36	47	53	54	59
Acoustic double skin casing	22	21	28	24	30	41	50	57

A - Acoustic Double Skin Casing is an option available for LG, SG and MG models, but they must have casings fitted with profile flanges at both ends. Acoustic panels are fitted internally within the casing, on the top, bottom and sides, and to the full length of the case. This provides the sound reduction index shown above for noise breakout situations:

N - Non Standard Element Configuration is an option for LG, SG, MG, EG, RG and BG models. Attenuator acoustic elements can be set back to form integral inlet or outlet plenums within the attenuator. Elements can also be provided with square ends, rather than aerodynamically profiled. This option is particularly useful when attenuators are connecting directly to fan products.

F - Fixing Brackets are only applicable for EG models and can be used to secure the splitters into an aperture.

Attenuator Paint Options

B1, B2 or B3 Base Colour Paint Finish for internal, external, or internal and external surfaces respectively. These are available for all models, except EG attenuators, which can only have a B2 external finish applied. The attenuators are polyester powder painted to a standard stock colour BS 00 A 05 goose grey with a satin finish, to provide protection against corrosive atmospheres, such as swimming pools, coastal locations, etc.

C1, C2 or C3 Client Specified Colour Paint Finish for internal, external, or internal and external surfaces respectively. These are available for all models, except EG attenuators, which can only have a C2 external finish applied. The attenuators are polyester powder painted to a client specified colour, which is normally provided for aesthetic purposed to match ductwork, or plant.

Special Features

X - Special Feature is applicable to all attenuator models, and denotes anything beyond the standard optional features. This could include fire rating, special construction, special labelling, bolt on components such as dampers or filters, etc, etc.

Attenuator Performance

ISO 7235 Attenuator Testing Laboratory

Attenuator testing is undertaken in the purpose built facility shown below, which is located in Sturminster Newton, Dorset, and operated by Lee Cunningham Partnership, the acoustic consultancy division of CAICE.

The facility is designed in accordance with BS EN ISO 7235: 2009 "Acoustics - Laboratory measurement procedures for ducted silencers and air terminal units - insertion loss, flow noise and total pressure loss".



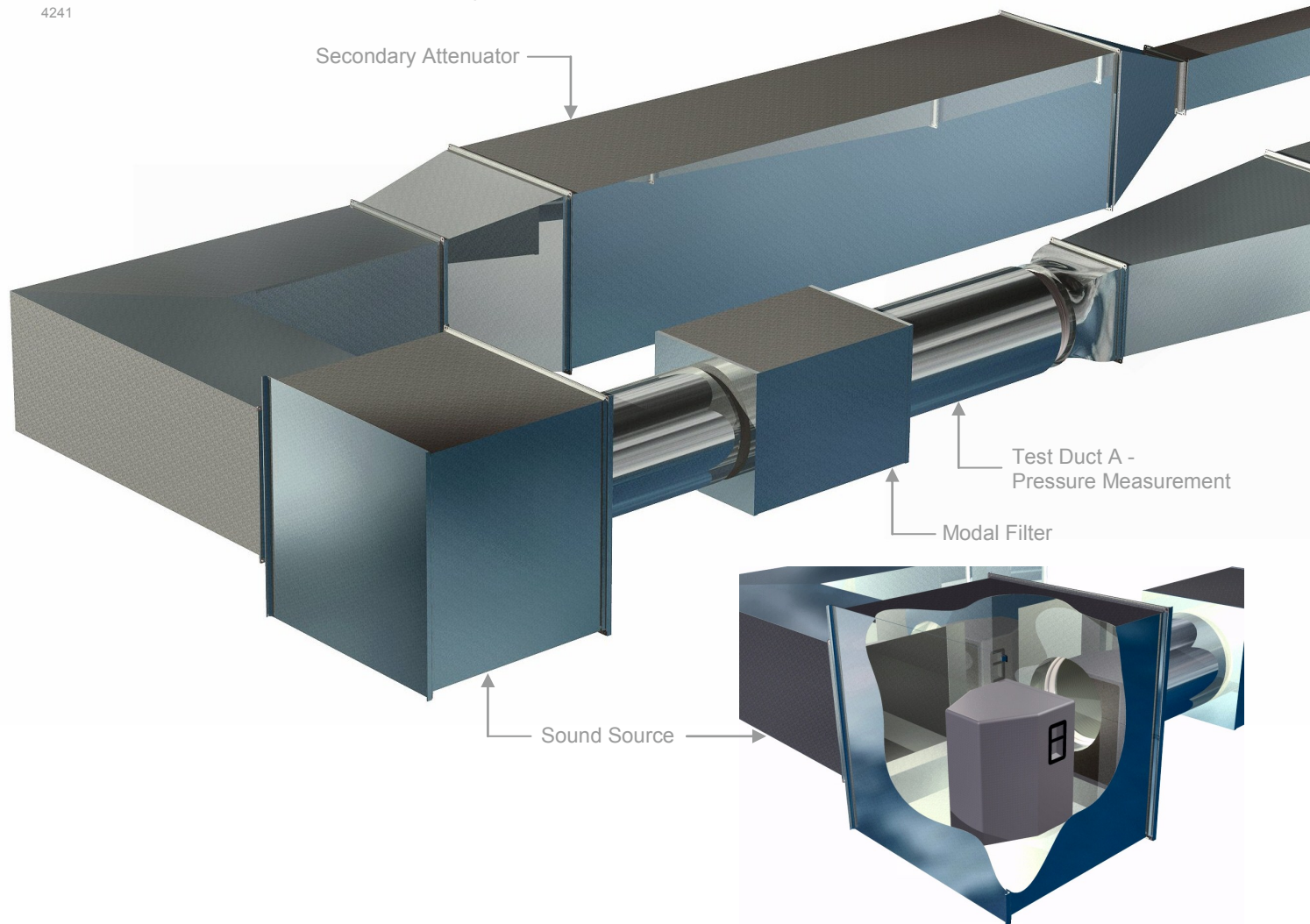
To underline our commitment to provide quality performance data the facility is a UKAS accredited testing laboratory (No. 4241) for attenuator testing in accordance with ISO 7235: 2009.

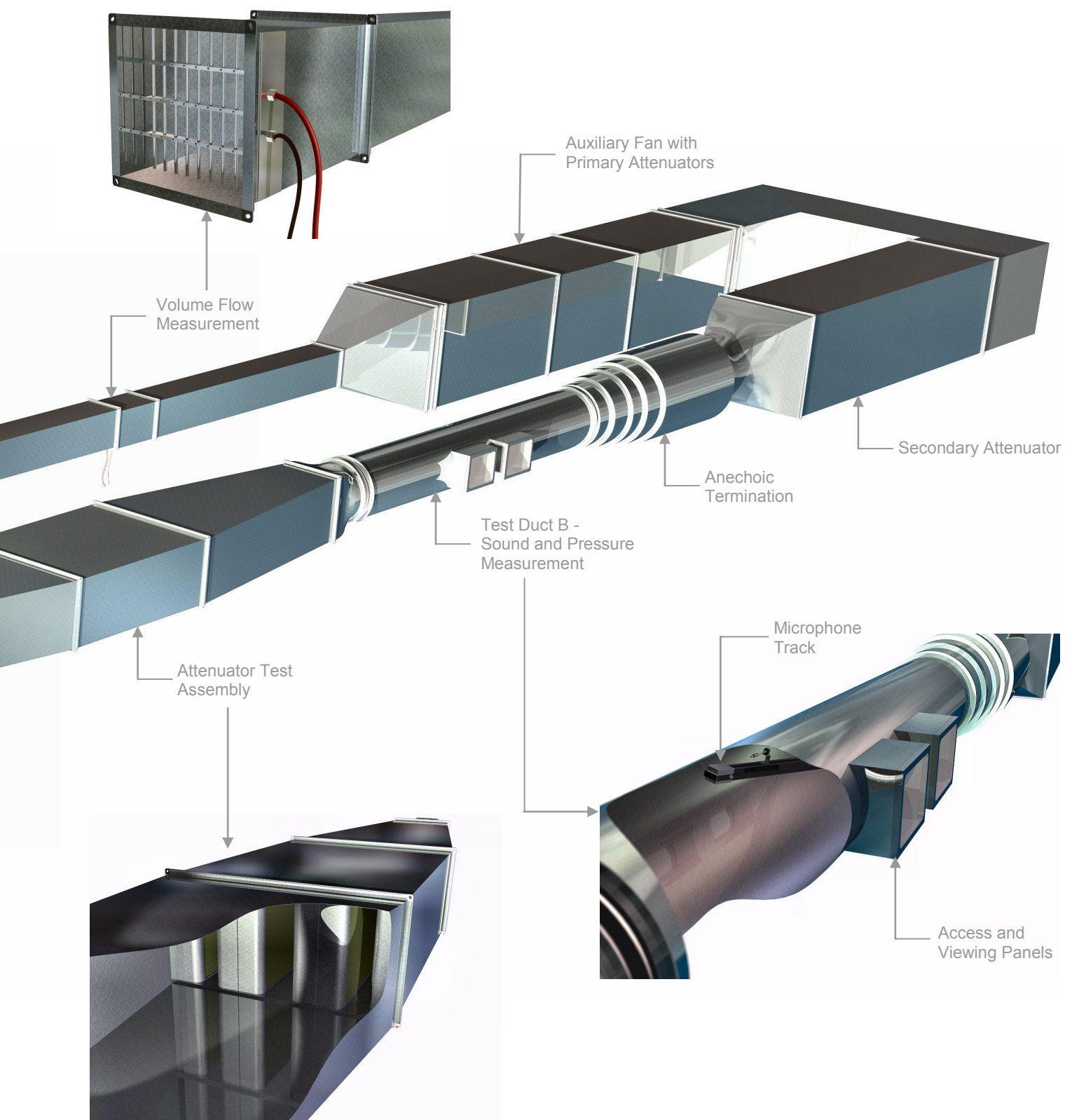
A range of attenuator performance properties can be determined within the facility.

- Static insertion losses
- Dynamic insertion losses in forward or reverse flow
- Forward or reverse flow generated sound power levels
- Total pressure loss

Insertion loss and flow generated data can be provided in octave bands from 63 to 8000Hz, or in one third octave bands from 50 to 10000Hz.

Rectangular attenuators can be tested between 280 and 1200mm square with a maximum length of 4800mm, and circular attenuators from 300 to 1200mm diameter.





Attenuator Performance

Test Facility Layout and Components

The test facility is essentially a closed loop ductwork system constructed from galvanised sheet steel, with a number of integral components. The main Test Duct sections A and B, are 630mm diameter, and the total length of the loop is over 50m.

Attenuator Test Assembly

This consists of two transitions and the test object - which is either the test attenuator or an identically sized substitution duct, that replaces the attenuator.

Sound Source and Test Duct A

Random noise is generated by a speaker that is located within the sound source chamber. The modal filter exists to damp any higher order modes generated within the sound source chamber thus creating a plane wave sound field within Test Duct A. Pressure and temperature measurement stations are also located within this section.

Test Duct B

A microphone is automatically moved along a diagonal track within Test Duct B to measure the noise level in five different positions, which determines the average sound pressure level.

An anechoic termination helps to reduce noise reflections back down the duct that could interfere with the noise measurements.

Another pressure measurement station is located in this section.

Auxiliary Fan and Volume Flow Measurement

An auxiliary fan system is located within the ductwork loop to provide airflow up to $2\text{m}^3/\text{s}$.

High performance primary and secondary attenuators are installed on both sides of the fan to minimise noise transmission to the microphone position.

The fan can be rotated through 180 degrees, which enables air to be moved across the test object in either forward or reverse flow modes.

The volume flow measurement section uses a Wilson Flow Grid to measure the airflow that is generated by the auxiliary fan. Further pressure and measurement stations are also located within this section.

Test Data Acquisition

All data is gathered at a control station and recorded using an in-house software programme, which automatically produces a comprehensive Attenuator Test Report for each test object.

Attenuator Performance Properties

In order to explain attenuator performance properties, it is helpful to understand the basic testing procedures.

The same test procedures must be carried out firstly on the attenuator itself and then secondly on an empty replacement or substitution duct. The substitution duct has exactly the same geometric properties as the test attenuator and both are referred to as the test object when under test.

Static Insertion Loss

This is determined by subtracting the noise levels measured with an attenuator installed from the noise levels measured with the substitution duct installed. It is referred to as static because there is no air passing through the test object.

Dynamic Insertion Loss

Again this is determined by subtracting the noise levels measured with an attenuator installed from the noise levels measured with the substitution duct installed. However it is referred to as dynamic as there is air passing through the test object.

Dynamic insertion losses can be measured with either forward or reverse airflow across the test object, and with up to five different airflow rates for each direction.

Flow Generated Sound Power Levels

When air passes through an attenuator it generates noise. This is defined as attenuator flow generated noise, regenerated noise or self-noise.

Attenuator flow generated sound power levels can be determined with either forward or reverse airflow across the test object, and again with up to five different airflow rates for each direction.

Noise levels also need to be measured under the same conditions with the substitution duct installed to ensure that flow noise generated through the ductwork loop itself is not additive to the attenuator flow generated noise.

Total Pressure Loss

This is determined by subtracting the differential pressure across the attenuator from the differential pressure across the substitution duct.

A total pressure loss coefficient is calculated for each attenuator by measuring the total pressure loss at five different airflow rates.



Scope of Attenuator Testing

The full extent of performance data that can be provided for a single test attenuator is therefore as follows:

- Static insertion loss
- Dynamic insertion loss at 5 forward flow rates
- Dynamic insertion losses at 5 reverse flow rates
- Flow generated sound power level at 5 forward flow rates
- Flow generated sound power level at 5 reverse flow rates
- Total pressure loss coefficient

A total of 43 tests would be required to obtain this data for a single attenuator, and each test requires noise levels to be obtained in five measurement positions. This is a total of 215 measurement sets, which takes about 4 hours to complete.

Although not all tests have been undertaken in this detail, CAICE have tested over 200 different attenuators in order to establish performance data for their range, which further underlines our investment and commitment to quality data.

Repeatability of Test Data

UKAS require periodic audits to take place to check repeatability of test data. The following tables show typical performance data from a number of re-tests that have been undertaken on the same specimen attenuator to monitor consistency of results.

Static Insertion Loss repeatability

Test	(dB) in each Octave Band centre frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
1	8.5	11.1	19.2	37.2	47.9	46.0	34.0	26.8
2	8.6	11.0	19.0	36.9	47.9	46.1	34.3	27.0
3	7.7	11.0	19.2	37.5	47.8	45.3	33.4	27.1
Diff	0.9	0.1	0.2	0.6	0.1	0.8	0.9	0.3

Dynamic Insertion Loss repeatability

Test	(dB) in each Octave Band centre frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
1	2.9	10.0	17.9	34.4	43.9	44.6	32.6	29.3
2	2.5	10.9	18.6	34.7	43.2	44.6	32.8	29.0
3	2.7	10.4	17.9	34.2	42.7	44.8	32.8	29.1
Diff	0.4	0.9	0.7	0.5	1.2	0.2	0.2	0.3

Flow Generated Sound Power Level repeatability

Test	(dB) in each Octave Band centre frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
1	52.0	46.8	44.0	43.7	44.7	39.3	30.8	16.0
2	51.6	47.8	43.8	44.0	44.5	38.5	30.1	16.1
3	51.1	47.6	43.6	43.4	44.5	38.4	29.7	15.2
Diff	0.9	1.0	0.4	0.6	0.2	0.9	1.1	0.9

It can be seen that the test data is remarkably consistent, and in particular static insertion loss never varies by more than 0.9dB in any octave band.

Whilst this shows good repeatability of results, we also need to consider the accuracy of the test data.

Measurement Uncertainty of Test Data

ISO 7235 makes the statement that “exact information on the precision achievable cannot be given at this time”. However it does provide the following estimates for insertion losses only:

ISO 7235 Estimates	50 to 100 Hz	125 to 500 Hz	630 to 1250 Hz	1600 to 10000 Hz
Standard deviation of reproducibility (dB)	1.5	1.0	2.0	3.0
Expanded measurement uncertainty (dB)	3.0	2.0	4.0	6.0

The **standard deviation of reproducibility** is the maximum amount of variance expected if the same specimen attenuator was tested across a number of different ISO 7235 laboratories. Their estimate is made based on a range of tests undertaken on a 1m long attenuator.

The **expanded measurement uncertainty** is for a coverage probability of 95% and this takes into account the huge variety of attenuator types and sizes that could be tested within an ISO 7235 facility. In the absence of more specific data their estimate is taken as twice the standard deviation of reproducibility.

How Accurate is the Test Data?

When the standard itself only provides estimates of accuracy, this does not particularly promote confidence.

However it must be understood that there are only a handful of ISO 7235 laboratories in the world, and most of these are operated by attenuator manufacturers who do not provide access to their confidential test data. It is therefore difficult to make definitive statements on accuracy.

Attenuator Performance

What we do know is that ISO 7235 has gone to extraordinary lengths to ensure that every element of the test facility complies with very stringent requirements. All sound, temperature, pressure and airflow measurement instrumentation has to perform to the highest standards of precision, and carry UKAS accredited calibration certificates. There are also numerous commissioning procedures that have to be undertaken to ensure various components fully meet the performance requirements of the standard.

The previous attenuator test standard was BS 4718 and this contained very few stringent requirements. The current American standard ASTM E477 is more detailed than BS 4718, but it is still far less stringent than ISO 7235.

Through our extensive knowledge of ISO 7235 and the close scrutiny of UKAS during the accreditation process we are confident that the test data is more accurate than the estimates given within ISO 7235. This is supported by the excellent repeatability that we have seen across a vast testing programme and a variety of different attenuator types and sizes. Our estimated measurement uncertainties are shown below:

CAICE Estimates of Expanded Measurement Uncertainty	(dB) in each Octave Band centre frequency (Hz)						
	63	125	250	500	1k	2k	4k
Static insertion loss	2	2	2	2	3	3	3
Dynamic insertion loss	2	2	2	2	3	3	3
Flow generated Lw	3	3	3	3	4	4	4
Total pressure loss	Within 5 Pa						

Test Attenuator Quality

The single most important factor in obtaining good test data is the constructional quality of the attenuator being tested.

A highly sophisticated ISO 7235 test facility is completely undermined unless the dimensional tolerances of the test attenuator are closely controlled. All test attenuator casings, splitter widths and airway widths are therefore constructed to a tolerance of +/- 1mm.

This constructional accuracy ensures that when the test data is subsequently extrapolated to provide data for the range, the expanded data remains accurate.

There are three other constructional factors that must also be closely controlled and inspected.

Gaps between the splitters and casing - can dramatically reduce mid and high frequency insertion loss. Our high build quality ensures that all splitters fit tightly into the casing and gaps are therefore minimised.

Inconsistently packed splitter infill - can again undermine performance. If it is under packed then the mineral wool infill can settle leaving gaps at the top of the splitter, which will reduce mid to high frequency insertion loss. If it is excessively over packed it will actually increase performance. It could also cause the splitter facing to bulge thereby reducing the airway and increasing pressure loss and flow generated noise. Mineral wool slabs must therefore be pre-cut to the correct size before packing, to ensure consistency and to avoid settlement or over packing.

Splitter facing deformation - can cause large variations in airway width along the length of the splitter. This will cause inconsistencies with insertion loss, flow generated noise and pressure loss test data. We provide channel stiffeners that are fixed to the rear of the expanded steel mesh splitter facings. These are fitted at pre-determined centres to minimise splitter facing deformation.

Deriving Performance for the Entire Range

The SG splitter attenuator with 30mm flanges has 18 standard lengths, uses 5 different centre splitter widths and each width of splitter can be provided in 17 standard free area configurations from 20 to 60% in 2.5% increments. This one model therefore has 1530 standard permutations, although we often deviate from these and there are also numerous models in the CAICE range.

Consequently the attenuator configuration permutations across the entire range are almost limitless.

This provides tremendous flexibility in terms of selection options, but it does mean that it is impossible to test every possible permutation of attenuator within the range.

CAICE have therefore devised a sophisticated technique that for a particular splitter width can accurately predict the full range of static insertion loss performance from a relatively small set of sample tests.

Hence it is imperative that test attenuators are constructed to the highest standards otherwise expanded data will not be accurate.

The table below illustrates the principle of the prediction technique where we test three different attenuator lengths, and for each length we test a range of three free areas.

The Range of Sample Tests

Attenuator Length	% Free Area				
	20.0	27.5	37.5	45.0	50.0
1	✓		✓		✓
2	✓	?	✓	?	✓
3	✓		✓		✓

We also test two random attenuators, shown in the table by the ? and compare the test data to the predicted data. Typical results are shown below that highlight the accuracy of this technique.

Static Insertion Loss at 27.5%FA

	(dB) in each Octave Band centre frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Predicted	6.4	9.4	17.1	34.7	49.2	38.2	23.9	18.8
Measured	5.7	9.2	16.9	35.6	50.0	39.3	24.2	19.4
Diff	0.7	0.2	0.2	-0.9	-0.8	-1.1	-0.3	-0.6

Static Insertion Loss at 45.0%FA

	(dB) in each Octave Band centre frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Predicted	4.5	5.7	11.7	25.9	32.6	19.1	12.4	9.3
Measured	3.9	5.5	11.8	26.2	32.4	18.8	13.6	9.7
Diff	0.6	0.2	-0.1	-0.3	0.2	0.3	-1.2	-0.4

Performance Data you can Trust

Attenuator performance is an immensely complex topic and CAICE are very much on the leading edge of development work in this field of acoustics.

Our research work is ongoing as we constantly look to improve our methods and accuracy of performance data.

We hope that this again underlines our position as the leading UK attenuator manufacturer and helps to provide our clients with performance data that you can trust.

Attenuator Performance in the Real World

Attenuator testing to ISO 7235 provides performance data that is achieved in ideal laboratory conditions.

How is this performance data affected when attenuators are installed in non-ideal conditions?

Dynamic Insertion Loss is meant to account for the change in performance that occurs as the airflow increases through an attenuator.

However ISO 7235 states that where the airway velocity falls short of 20m/s airflow will hardly have an effect on the insertion loss. Therefore up to this velocity the difference between Static Insertion Loss and Dynamic Insertion Loss is negligible, and this has been proven during our test programme.

An airway velocity of 20m/s would correspond to an attenuator pressure loss of between 100 to 200Pa, depending on the free area of the attenuator.

Attenuators are generally selected to a maximum pressure loss of 50Pa, and therefore Dynamic Insertion Losses are of little use for day to day attenuator applications.

CAICE have therefore adopted a policy to use Static Insertion Losses for selection of attenuators, although we can provide Dynamic Insertion Losses if required.

Two other problems exist with Dynamic Insertion Losses:

1. Dynamic Insertion Losses are determined in the laboratory under ideal airflow conditions. What happens when the attenuator is subjected to the sort of turbulent airflow conditions that often exist on site? ISO 7235 points out that a design airway velocity of 10 to 15m/s may give you 20m/s on site due to non-uniform airflow distribution. It is impossible to predict how evenly the air will flow through the attenuator on site, which again makes Dynamic Insertion Losses questionable.
2. Even if attenuator manufacturers can provide Dynamic Insertion Losses, how accurate are they? CAICE are currently the only attenuator manufacturer in the UK that can provide both Static and Dynamic Insertion Losses in accordance with ISO 7235: 2009 and our latest very stringent test procedures provide good accuracy. We would seriously question data derived from other, older test standards, or where manufacturers have not ensured that the test attenuators are constructed to the highest standards.

Attenuator pressure loss and flow generated noise can be adversely affected by poor airflow conditions on site. Attenuators should therefore be installed as far away as possible from bends, change of sections, fan discharges, etc, to ensure that airflow is uniformly distributed across the attenuator.

Where poor airflow conditions do exist across attenuators, the site pressure loss can be up to two or three times the expected laboratory pressure loss. Flow generated noise through the attenuator will also increase considerably.

If In Doubt Test It

We hope that this section of the brochure has provided a good overview of the complexities of Attenuator Performance.

However if you have any doubts at all over attenuators that are required for a particular project then we would be pleased to provide further advice accordingly.

The CAICE Attenuator Testing Laboratory is also available to our clients to substantiate performance data where required, and our advice would generally be that if you have any doubt at all then test it.

Aristas Attenuator Selector

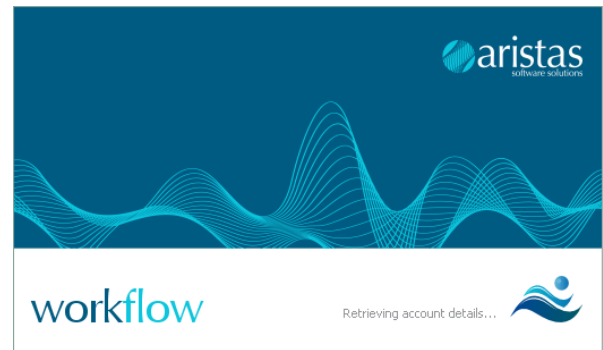


The Attenuator Selector software package has been developed to bring together all CAICE's attenuator construction and performance knowledge into one place. Working in collaboration with our software development division, Aristas, we are able to offer our clients a suite of software, which is unique in our industry.

Aristas Workflow

Workflow is a dedicated product scheduling and project management package enabling our clients to:

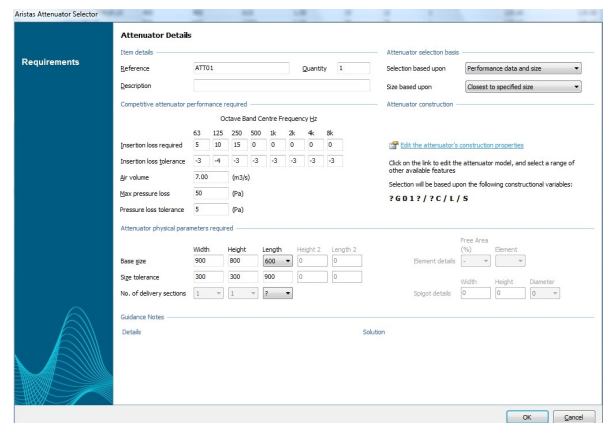
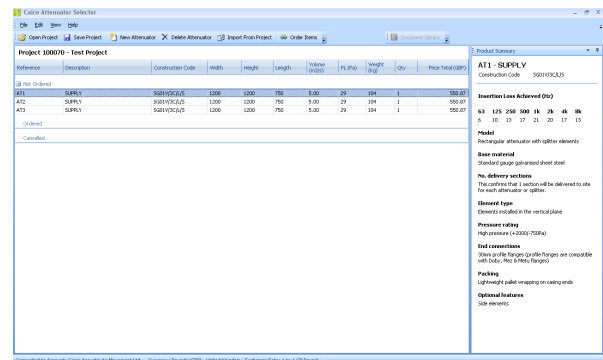
- Create projects and add attenuator selections.
- Save the projects as files and share them with work colleagues using the program.
- Add, modify, copy, paste or delete attenuator selections within a project as well as importing items from other projects.
- Compile attenuator schedules and obtain attenuator drawings in PDF, Word or Excel compatible formats.
- Additional functionality is available to Reseller clients for creating quotations and ordering attenuators on-line from CAICE.



Aristas Attenuator Selector

Hosted within Workflow, the Attenuator Selector provides the opportunity for clients to:

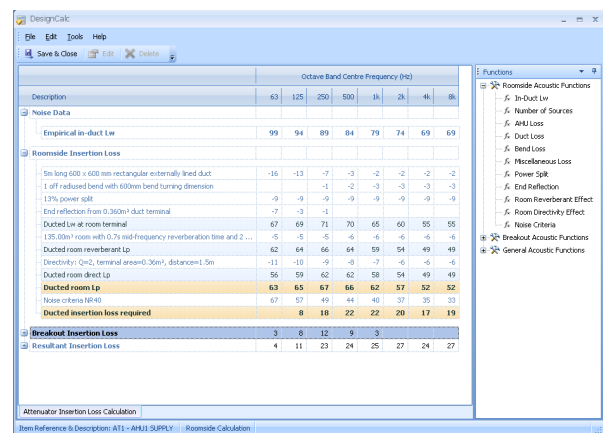
- Select attenuators from the CAICE range, and choose constructional features and options for each attenuator, such as end connections, Melinex, double skinning, etc.
- Select attenuators based on various permutations of input data, such as attenuator or duct size, air volume, pressure loss, insertion loss, etc.
- Choose the most appropriate attenuator from a list of selections that meet the input criteria and are shown in price order.



Aristas DesignCalc and QuickCalc

DesignCalc and QuickCalc are part of the Aristas Acoustic Calculation Suite, which is integrated within the Attenuator Selector.

- DesignCalc delivers a range of acoustic calculations for determining accurate attenuator insertion loss requirements. Calculations include: ductwork system analysis for room side and atmosphere, crosstalk analysis, flow generated noise, etc.
- QuickCalc allows our clients to very quickly estimate their attenuator insertion loss requirements.



For more details on this software please visit our web site or contact our sales personnel.



Crosstalk Selection Guide

Guide to Crosstalk Attenuation Selection

The following guide is intended to provide a quick method for selection of crosstalk attenuators in a common ducted system or ceiling void return air path. For accurate selection, or where attenuators are intended for use in sensitive locations such as high acoustically rated partitions (typically in excess of Rw40), please refer to one of our acoustic engineers.

When making selections for crosstalk attenuators, it is necessary to consider the following aspects:

1. The level of speech reaching the receiving room:

The source of crosstalk nuisance is assumed to be raised speech, for which the average sound pressure level (500-4kHz) is 70dB*.

The room to room acoustic loss for a typical common ductwork system or via the ceiling void is approximately 7dB, therefore the average speech level within the receive room is taken to be $70 - 7 = 63$ dB.

2. The noise criteria for the design of mechanical services in each space being considered:

If crosstalk is being assessed between two adjacent room areas with different noise criteria, then the lowest criteria should be used.

Subtract the required NR level from the received speech level to give the additional average insertion loss requirement.

Sizing of Crosstalk Attenuators

For CG type attenuators, it is acceptable to size these units to correspond to the duct cross-section, since the attenuation takes place out of the air stream, and hence pressure drop is negligible.

For ducted LG type units, the attenuator cross-section should ideally be sized to maintain a maximum pressure drop of 10Pa. This requires a limiting velocity of 1.5m/s for a 32.5% free area attenuator.

For non-ducted LG type units, the attenuator cross-section should ideally be sized to maintain a maximum pressure drop of 5Pa. This requires a limiting velocity of 1.0m/s for a 32.5% free area attenuator.

* Note: Average level for raised speech derived from raised speech sound pressure level (ref: Parkin Humphries & Cowell).

The following tables provide a guide to rectangular crosstalk attenuator selection, based on a 32.5% free area LG type unit.

Attenuator Length	Average Insertion Loss (500 - 4kHz) dB
600	22
900	28
1200	34
1500	40
1800	46

Crosstalk Path	Room NR	Received speech level minus lowest NR	Attenuator Length Required
Conference room to conference room	30 to 30	$63 - 30 = 33$	1200
Conference room to cellular office	30 to 35	$63 - 30 = 33$	1200
Open plan office to cellular office	35 to 38	$63 - 35 = 28$	900
Cellular office to corridor	38 to 45	$63 - 38 = 25$	900
Male to female toilet	45 to 45	$63 - 45 = 18$	600

Example

Air volume 0.09m³/s. Ducted crosstalk attenuation required between NR45 toilet areas.

Attenuator cross-section required to maintain 1.5m/s is calculated by (volume / face velocity) = $0.09 / 1.5 = 0.06\text{m}^2$

Typical attenuator cross-sections for 0.06m² face area: 300 x 200, 400 x 150.

For NR 45 areas, insertion loss requirements = $63 - 45 = 18\text{dB}$, therefore 600mm long attenuator is selected.

