ACOUSTIC ASSESSMENT

KITCHEN EXTRACT SYSTEM

CYCLE HIRE AND CAFÉ, DIKES LANE, GRIBDALE, TS9 6HL

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CYCLE HIRE AND CAFÉ, DIKES LANE, GRIBDALE, TS9 6HL ACOUSTIC ASSESSMENT - KITCHEN EXTRACT SYSTEM

Preamble

The report is intended for an acoustically qualified readership and consequently detailed explanation of noise parameters and standards have been excluded for the sake of brevity and clarity.

Application for Planning Permission has been made to convert a stables at Dikes Lane to a cycle hire shop and café – Figure 1. The original application proposed that the premises would be 'off grid' which necessitated the installation of a diesel generator. Concerns regarding potential noise issues associated with the generator have led to revision of the proposal so that the premises will now be connected to the National Grid. This assessment is therefore concerned solely with the noise issues relating to the kitchen extract vent system – Figure 2.

The extract fan is to be located on the inside of the building and inlet and casing noise have not therefore been included in this assessment. The extracted air is ducted to the outside of the building and runs to roof level in a ~300 mm diameter 24 gauge steel duct. The proposed duct route runs relatively close to windows in the holiday lets on the first floor of the premises. These rooms are regarded as the most sensitive locations.

This report uses British Standard 4142 - 'Methods for rating and assessing industrial and commercial sound' to assesses the impact of noise emission from the duct and from the discharge on the nearby habitable rooms.

Figure 1 Location of premises and kitchen extract duct

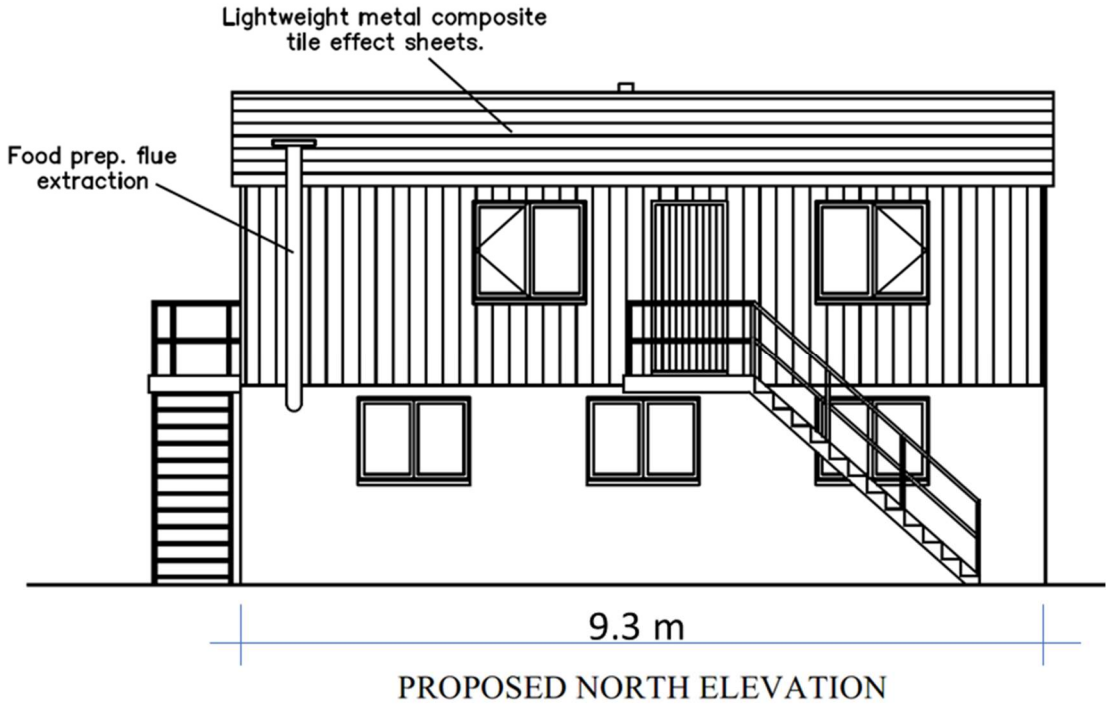


Figure 2 Extract duct location

Background Noise Measurement

Figure 3 displays the 1 second time history measured during the day time at Dikes Lane and the 1 hour L90 level.

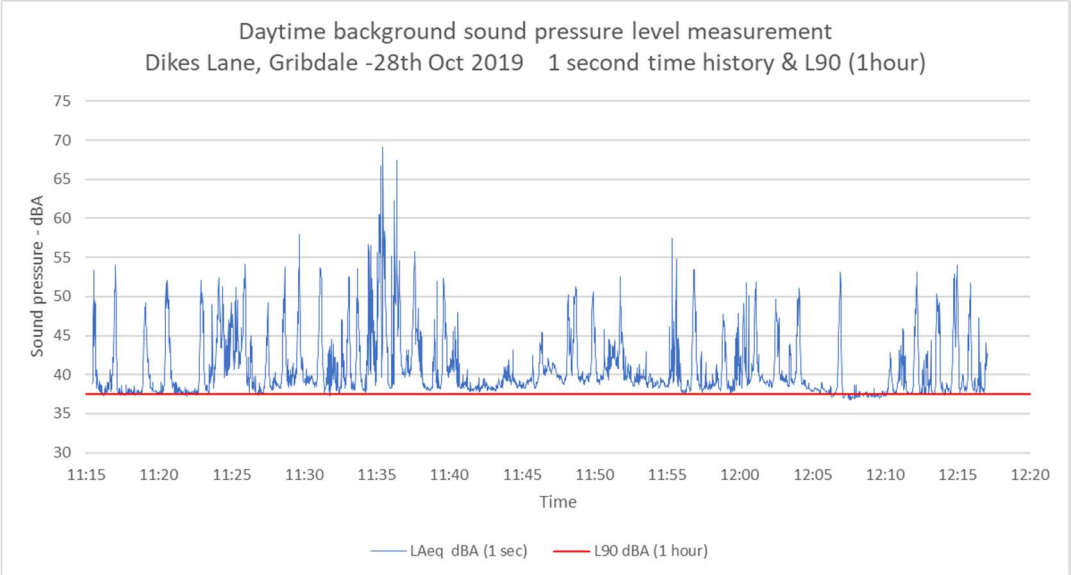


Figure 3 Background noise measurement

The measured levels over 1 hour were:

Ambient:	LAeq	45.0 dBA
Background	L90	37.5 dBA.

Noise Source

Technical specifications for the proposed fan are provided in the Appendix. The information includes the 1/3 octave in duct sound power levels (A weighted) and the sound power emitted by the casing. In addition a sound pressure level @ 3m is quoted as 42.7 dBA although the conditions of measurement are not entirely clear.

Sound power level		63	125	250	500	1k	2k	4k	8k	Tot
Inlet	dB(A)	54	63	62	64	66	64	61	57	72
Outlet	dB(A)	57	59	65	63	67	67	61	58	73
Surrounding	dB(A)	25	32	37	44	42	46	40	31	50

Inlet and fan casing noise emissions are within the kitchen and do not affect the external areas.

Noise Emission – Discharge

Calculations of the sound pressure levels at the first floor windows indicated that, as designed and with no silencer fitted, the sound levels would not lead to a satisfactory BS4142 assessment. However, by fitting a silencer to the discharge and slightly extending the vent (approximately 0.5m) such that the distance to the nearest window is increased to 3m then the noise levels are acceptable. The final calculations with the silencer and extended vent are appended.

Vent directivity calculations in accordance with Bies and Hansen (Ref 2) indicate that at 0 degrees to the discharge axis the directivity index is + 5 dB whereas at 90 degrees to the duct axis the directivity index is -5.5 dB. In this installation the window will be 120 degrees round from the vent axis so the 90 deg index, which has been adopted in the calculations, is conservative. (The Bies and Hansen procedures do not extend beyond 90 degrees but from published data a further reduction of several dB would be expected.)

Noise Emission – Duct

An estimation of the breakout noise from the circular duct has been made using the German Standard VDI3733 – see calculation appended. A check of the attenuation provided by the wall of the duct showed reasonable agreement with data measured in a similar duct by Cummins - Ref 1.

Initial calculations indicated that duct breakout noise would be problematic without the inclusion of a silencer. Since the noise from the discharge proved to be the most significant, the duct emission noise has been calculated using the attenuation data for the silencer required to minimise the discharge noise.

Impact Assessment to BS4142

Assessment to BS4142			
PROJECT CYCLE HIRE SHOP AND CAFÉ			
RESULTS	DUCT ONLY	DISCHARGE ONLY	TOTAL
Measured ambient sound level	45	45	45
Residual sound level	45	45	45
Background sound level	37.5	37.5	37.5
Reference time interval	1 Hour	1 Hour	1 Hour
Specific sound level	26.9	35.4	36.0
Acoustic feature	None	None	None
Rating level	26.9	35.4	36.0
Excess of rating over background sound level	-10.6	-2.1	-1.5
Indications	Since the rating levels are below the background level no adverse impact is expected.		
Uncertainty	No penalty has been applied for tonality as none is expected but there is a margin for error in the conservative directivity index used in the calculations. In the event of any noise issues there is scope to redirect the discharge over the roof.		

Recommendations

This assessment details only the external noise impact but it is recommended that consideration be given to the installation of a silencer on the inlet side of the fan to minimise the noise impact within the premises. If no silencer is fitted then at least the inlet duct should of sufficient length to provide for the installation of a silencer at a later date.

Summary and Conclusions

This assessment has been based on the use of the following equipment and conditions:

Systemair K 315 SILEO fan
Lindab SLU-315-900-100 silencer located on fan discharge.
Extension of the discharge by ~0.5m to increase the distance from tip to window to 3m.

Assessment to BS4142 shows that no adverse noise impact is expected.

Geoff Taylor BEng PhD CEng MIMechE MIOA
GT Acoustics

Calculation sheets

Vent discharge calculations

VENT DIRECTIVITY CALCULATION											
		Frequency	125	250	500	1000	2000	4000	8000	Total	
Source power		dBA(W)	59	65	63	67	67	61	58	72.5	
Silencer attenuation		dB	6	13	20	19	10	6	7		
Source power		dBA(W)	53.0	52.0	43.0	48.0	57.0	55.0	51.0	61.4	
vel of sound	344	m/s									
duct dia	0.3	m									
Strouhal number			0.11	0.22	0.44	0.87	1.74	3.49	6.98		
	WHAT IF DATATABLE -		**DIRECTIVITY INDEX**								
		9.45	0.11	0.22	0.44	0.87	1.74	3.49	6.98		
Strouhal	3.25	0	0.87	1.74	3.49	5.49	7.49	9.59	10.50		
Angle	0	15	0.44	0.87	1.74	2.74	3.74	4.65	4.56		
		30	0.00	0.00	0.00	0.00	0.00	-0.30	-1.39		
		45	0.00	0.00	0.00	0.00	0.00	-0.40	-2.77		
		60	-0.15	-0.31	-0.61	-1.00	-1.80	-3.39	-5.39		
		75	-0.45	-0.89	-1.79	-3.17	-5.29	-8.33	-10.84		
		89.99	-0.74	-1.48	-2.96	-5.33	-8.78	-13.27	-16.29		
Effective Directivity Index (DI) Calculations										sum	
		Hz	125	250	500	1000	2000	4000	8000		
Calc effective DI on axis		LWA	55.8	54.3	48.8	42.0	45.2	51.0	46.9	59.8	
		10^(LWA/10)	381078.89	270705.9	75024.1	15848.93	33126.07	124859.9	48478.51	949122.3	
		DI @ 0	0.87	1.74	3.49	5.49	7.49	9.59	10.50		
		LWA @ 0	56.7	56.1	52.2	47.5	52.7	60.6	57.4	64.7	
		10^(LWA/10)	465826.5	404498	167509	56083.77	185783.5	1136908	543937.8	2960546	
							Effective DI on axis			**4.9**	dB
Calc effective DI @ 90deg		LWA	52.3	50.5	40.0	42.7	48.2	41.7	34.7	56.0	
		10^(LWA/10	168225.46	112663.5	10082.47	18478.05	66388.57	14881.79	2956.845		
							Effective DI 90 deg to axis			**-5.5**	dB
Vent Discharge Calculations											
Distance to window = d		3.00	m								
Angle vent axis to window		120.00	deg								
Area of sphere rad d		113.10	m^2								
10 Log A		20.53									
Sound pressure at d		40.88	dBA	not corrected for directivity							
Sound pressure at d		**35.4**	dBA	corrected for directivity							

Duct break out noise calculations

Pipe noise calculation according to VDI 3733												
Calculation	**Cycle Hire & Café - Dikes Lane, Gribdale**											
Machine data												
Speed	2783	rpm										
Characteristic (No blades?)	8											
Source acoustic data			63	125	250	500	1000	2000	4000	8000	Lin	'A'
In duct power		dBW	83	79	71	67	66	63	60	59	85	72
In duct sound pressure		dB	95	91	82	79	77	74	71	71	96	83
Gas data					**CHECK TABLE FOR TONAL COMPONENTS**							
Velocity of sound	343	m/s	Tones		0	371.07	742.13	1113.2	1484.3	1855.3	2226.4	1E+09
Density	1.18	kg/m^3	Mode no		0	1	2	3	4	5	6	7
Dynamic viscosity	1.84E-05	kg/ms	Mode constant			1.9	3.2	4.6	5.3	6.3		
(kg/m.s = cP/1000)			Gas mode cut on freq			680.59	1146.2	1647.7	1898.5	2256.7		
Pipe data			Index			1	3	4	5	6		
Length	5	m	Next tone below			371.07	1113.2	1484.3	1855.3	2226.4		
Bore	0.3048	m	Next tone above			742.13	1484.3	1855.3	2226.4	1E+09		
Wall thickness	0.56	mm	Check proximity			0	1	1	1	1		
Mean diameter	0.305	m				1	0	0	0	0		
Wall material density	7800	kg/m^3										
Wave velocity in pipe wall	5400	m/s		**WARNING - TONAL COMPONENTS MAY BE PRESENT**								
Ring frequency	5629	Hz		**CHECK ABOVE WHERE 1 IS DISPLAYED**								
First pass frequency	681	Hz										
Duct break out calculation (VDI3733)												
Average insulation (mid freq's Rr)	31.8	dB										
Duct section area factor 10log(area	-11.369											
Octave band centre frequencies		Hz	63	125	250	500	1000	2000	4000	8000	Lin	'A'
Transmission loss		dB	46	42	38	34	32	32	32	35		
Pure tone adjustments (estimate)		dB										
Final transmission loss		dB	46	42	38	34	32	32	32	35		
Surface sound pressure - unlagged		dB	49	49	44	45	46	42	40	36	55	50
Propagation (line source)												
Distance	2	m										
Attenuation	-11.56347											
Sound pressure due to duct			37	37.401	32.886	33.459	33.99	30.789	28.026	24.092	42.978	38.147
Silencer attenuation			2	6	13	20	19	10	6	7	Lin	'A'
Sound pressure due to duct			35.5	31.4	19.9	13.5	15.0	20.8	22.0	17.1	37.3	26.9

Appendix

References

1 Sound Transmission Through Duct Walls. A Cummins. Journal of Sound and Vibration (2001) 239(4), 731}765

2 Engineering Noise Control – D A Bies & C H Hansen. Pub Unwin Hyman

Addendum

Instrumentation:

All instrumentation used in the assessment is of Type 1 and within its calibration period. Check calibrations were carried out before and after measurement.

Weather:

All external measurements were made in appropriate weather conditions i.e. low wind speed and dry.

K 315 SILEO

Item no. 27424

Version: 50 Hz

Document type: **Product card**
Document date: **2019-11-05**
Generated by: **Systemair Online Catalogue**

Description

- Speed-controllable
- Quiet-running
- Increased efficiency
- Integral thermal contacts
- Can be installed in any position
- Can be installed outdoors
- Maintenance-free and reliable

The K Sileo series is designed for installation in ducts. All K-fans have a minimum 25 mm long spigot connections.

The fans have backward-curved blades and external rotor motors. To simplify the installation the K Sileo fan has a fixing bracket together with screws for mounting the bracket included as standard. The FK mounting clamp facilitates easy installation and removal, and prevents the transfer of vibration to the duct. The fans can be speed-controlled via a stepless thyristor or a 5-step transformer.
To protect the motor from overheating the fan has integral thermal contacts with manual reset.

The casing is manufactured from galvanised sheet steel and folded which gives the fan a close to air tight casing. Duct connected outdoor and wet room applications of the fan are possible due to the air tight casing. The K-fans have corrosion class C3.

Technical parameters

Nominal data		
Voltage	230	V
Frequency	50	Hz
Phase	1	~
Input power (P1)	231	W
Current	1,01	A
Max. airflow	1224	m³/h
Fan impeller speed	2783	r.p.m.
Capacitor	5	µF
Weight	6,6	kg

Temperature data		
Max. temperature of transported air	70	°C
Max. temperature of transported air when voltage-controlled	70	°C

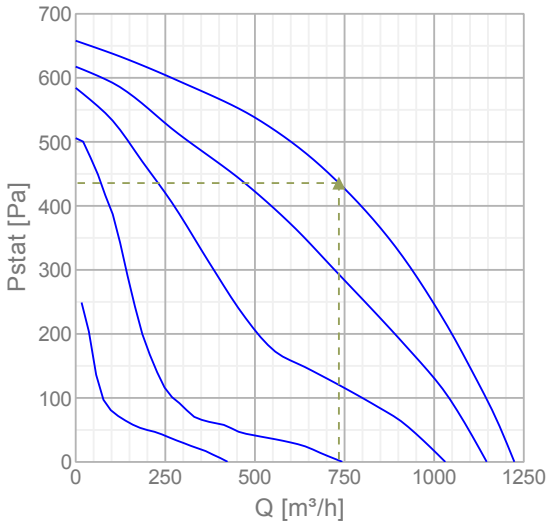
Sound data		
Sound pressure level at 3 m (20m² Sabin)	42,7	dB(A)

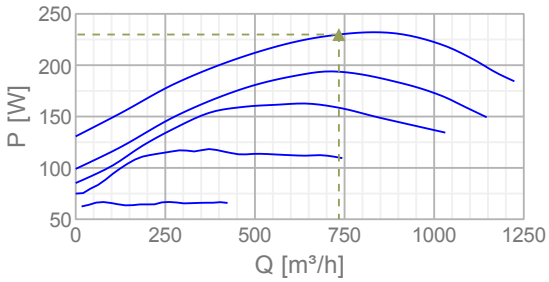
Protection / Classification	
Insulation class	F
Enclosure class, motor	IP44

ErP	
ErP ready	ErP 2016/ErP 2018

Performance

Diagrams



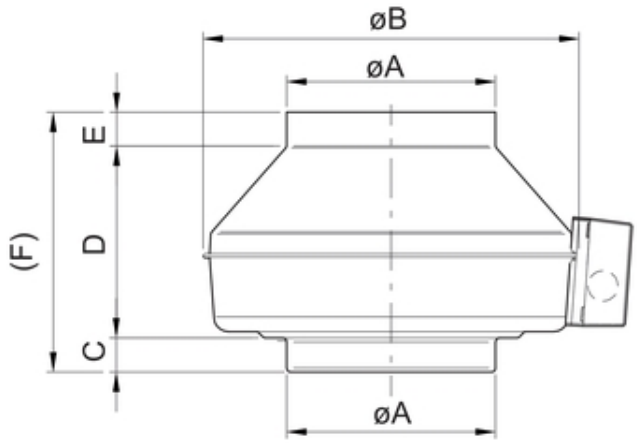


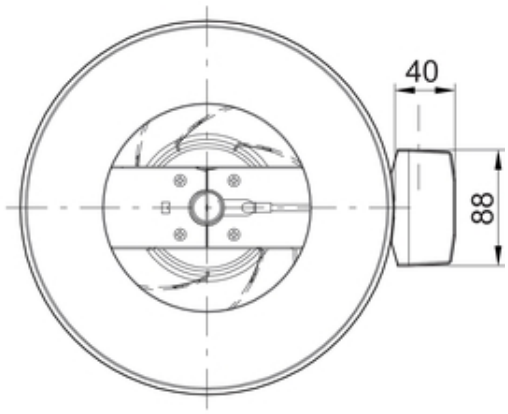
Max efficiency

Hydraulic data		
▲ Working air flow	734	m³/h
▲ Working static pressure	436	Pa
▲ Power	230	W
Speed	2787	r.p.m.
Current	1	A
SFP	1,13	kW/(m³/s)
Voltage	230	V

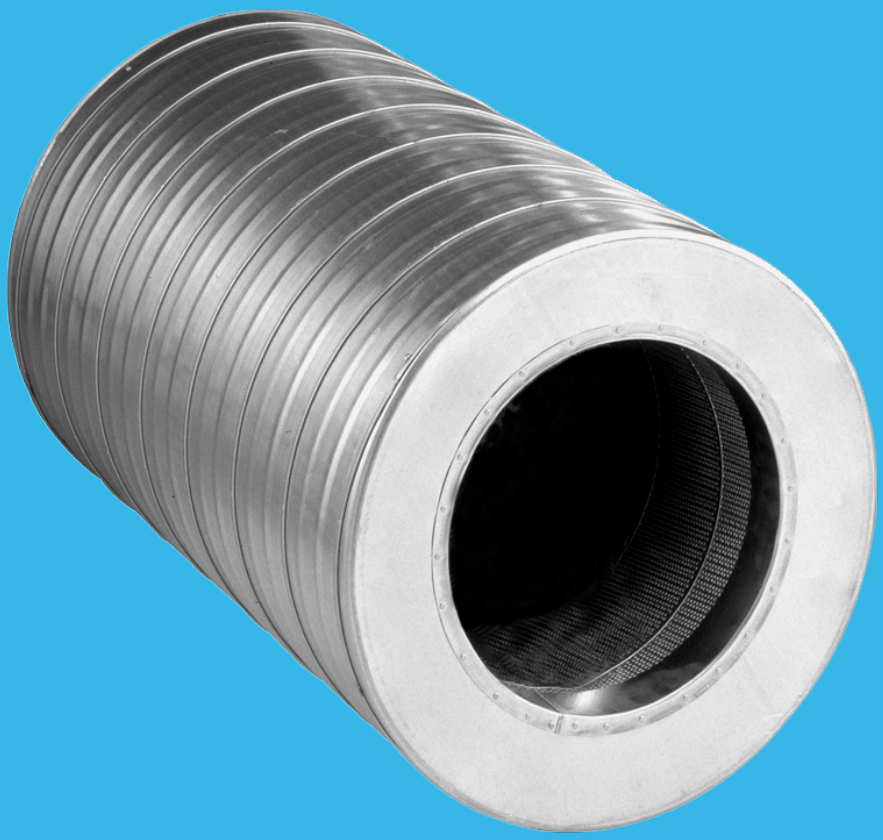
Sound power level		63	125	250	500	1k	2k	4k	8k	Tot
Inlet	dB(A)	54	63	62	64	66	64	61	57	72
Outlet	dB(A)	57	59	65	63	67	67	61	58	73
Surrounding	dB(A)	25	32	37	44	42	46	40	31	50

Dimensions





K	øA	øB	C	D	E	F
100 M	99	218	26	166	26	218
100 XL	99	246	26	161	26	213
125 M	124	218	27	142	27	196
125 XL	124	246	26	151	26	203
160 M	159	286	25	147	26	198
160 XL	159	336	29	166	26	221
200 M	199	336	30	148	27	205
200 L	199	336	30	174	27	231
250 M	249	336	30,5	119,5	27	177
250 L	249	336	30,5	144,5	27	202
315 sileo/315 M	314	408	32,5	160,5	27	220
315 L	314	408	38	161	27	225



SLU100

Circular straight silencer

Circular straight silencer SLU100

Description

SLU 100 is a circular straight silencer with a connection diameter available between 315 - 800 mm. For smaller sizes, see SLU 50.

Nominal insulation thickness 100 mm. Attenuation material is mineral wool. The SLU's are made of an outer spiral seemed tube and an inner tube made of perforated sheet steel. The space between them is filled with mineral wool and a fibre cloth is inserted between the perforated sheet metal and the attenuation material, to prevent damage to the insulation material and fibers from getting into the duct system.

Tested according to ISO 7235 standard.

Special materials and sizes, please contact Lindab sales.

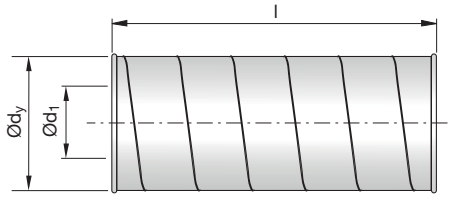
To select the appropriate silencer and optimize connection size and length for the best performance you can use our online tool lindQST or our free to download software DIMsilencer.

Order

Product	SLU	aaa	bbbb	100
SLU				
Connection dim. $Ød_{1nom}$				
315 - 800 mm				
Length in mm (l_{nom})				
600 - 1500				
Insulation thickness				
100 mm				

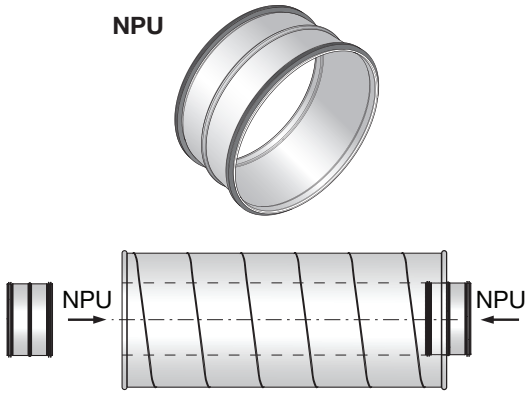
Example: SLU - 315 - 1200 - 100

Dimensions and sound data



$Ød_{1\,nom}$ [mm]		l_{nom} [mm]	Insertion loss [dB] for centre frequency [Hz] 63	125	250	500	1k	2k	4k	8k	$Ød_y$ [mm]	l [mm]	m [kg]
315	*	600	2	5	9	14	12	6	4	5	510	600	12,0
315	*	900	3	6	13	20	19	10	6	7	510	900	18,0
315	*	1200	4	8	16	27	25	15	9	10	510	1200	24,0
400		600	4	5	8	10	7	4	4	6	625	600	16,0
400		900	4	5	10	17	13	6	6	8	625	900	22,0
400		1200	6	6	13	24	18	8	7	10	625	1200	32,0
500		900	4	4	10	14	8	4	6	6	735	900	26,0
500		1200	3	5	11	21	12	6	7	9	735	1200	39,0
630		900	2	3	7	12	5	4	4	5	880	900	44,0
630		1200	2	4	8	17	7	4	5	7	880	1200	56,0
800		1200	2	3	8	11	5	4	5	6	1030	1200	69,0
800		1500	2	3	10	16	6	5	6	7	1030	1500	86,0

*Size 315 is supplied with preinstalled Safe-connectors. Other sizes are supplied with loose NPU-couplings, see below.



Technical data