KOOLAIR

PAK

Rectangular silencers

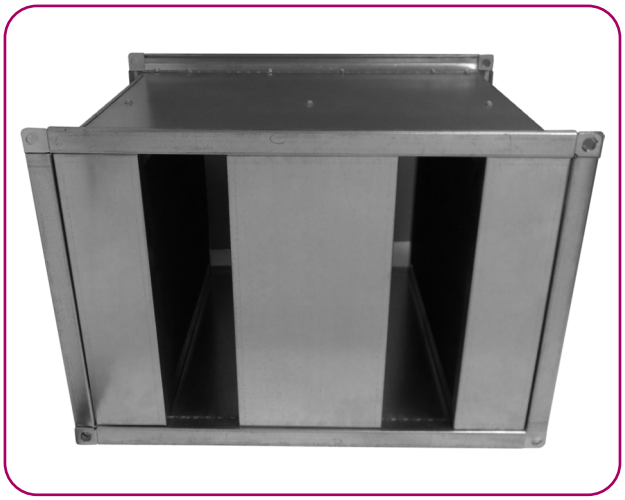
Acoustic

ISO 9001
ISO 14001
BUREAU VERITAS
Certification

www.koolair.com

INDEX

General characteristics



Description

Rectangular silencers are devices designed for noise control at medium and high frequencies in air-conditioning or ventilation installations. They work by absorbing most of the sound energy inside the duct.

They consist of internal baffles (the number varies depending on the size) and lateral panels that optimise airflow.

Applications

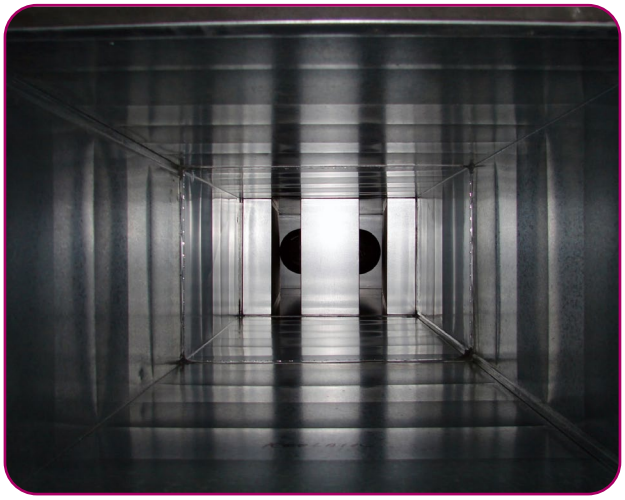
Ideal for air supply with low sound levels at the inlets/outlets of air-handling units, ventilation units, machine rooms, or autonomous units.

They are integrated into variable air volume devices (VAV boxes KS, KSL; RVV and JVR controllers) and constant air volume devices (KSV boxes; RCQK controllers) to reduce acoustic impact.

The rectangular PBK silencers, with internal perforated sheet metal, have been tested and certified by an independent external laboratory accredited according to European Directives (Test Ref.: 21/25105-750). They withstand the EN 1363-1:2020 standard fire curve up to 400 °C for 120 minutes (400 °C/2 h), without dimensional deformations exceeding 10%, maintaining their integrity.

Therefore, they are suitable for smoke extraction installations and fire-risk areas, such as:

- Air and smoke extraction in car parks.
- Tunnels.
- Industrial kitchens.
- Common smoke and air extraction networks in commercial premises.



Finishes and materials

Outer casing and internal perforated sheet metal in PBK and PBKM models: galvanised steel.

Acoustic material: rigid, non-combustible rock wool panel protected against erosion by a black mineral veil; materials harmless to health.

Options

The standard length can be increased, on request, to achieve greater attenuation.

Special constructions can also be manufactured to adapt to specific installations.

Models

PAK
Rectangular silencer with sound insulation protected against erosion from air flow by a flame-retardant protective layer. The unit is normally used for HVAC systems.

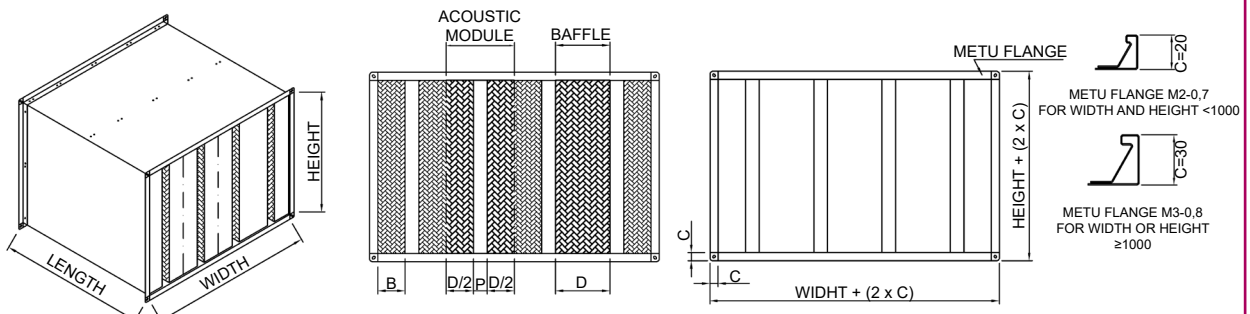
PBK
Same as PAK, but fitted with perforated plate. Recommended for high velocities.

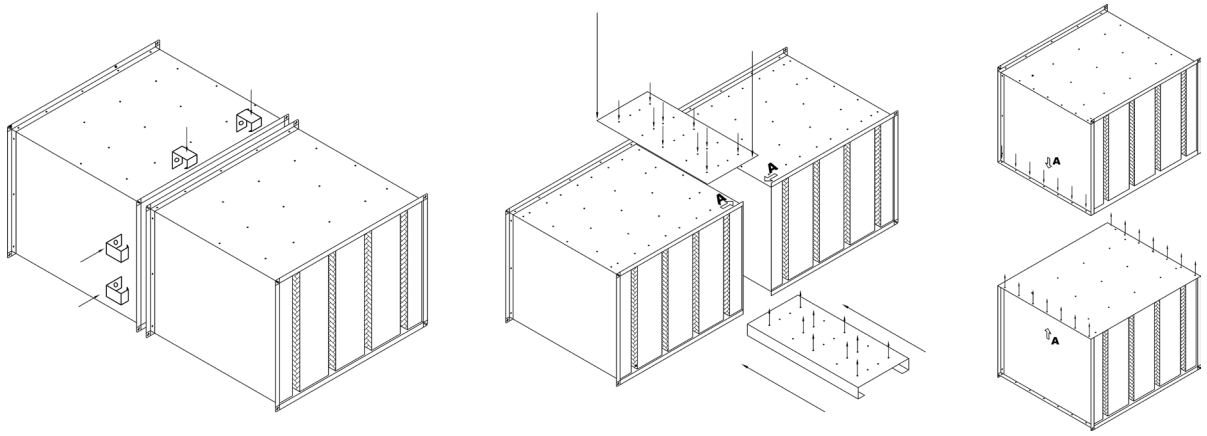
PAKM
Same as PAK, with additional polyester film (Melinex) coating. Used for applications with acidic, alkaline or oily gases, as it can be steam-cleaned. Recommended for hospitals, since bacterial colony formation is not possible.

PBKM
Same as PAKM, but fitted with perforated plate.

Dimensions

PAK





LONGITUDINAL CONNECTION

TRANSVERSAL CONNECTION

VERTICAL CONNECTION

Applications

The acoustic module widths, in mm, are: 250, 275, 300, 325, 350, 375 and 400. Multiply this width by the total number of modules to obtain the total width of the silencer.

The B200 silencer (200-mm baffle) with a width of 150 to 300 mm only has outer baffles configured; widths above 400 mm include inner baffles (number according to silencer width).

- The silencer length is defined according to the required attenuation, and may be: 600, 900, 1200, 1500, 1800, 2100 and 2400 mm.

- Depending on its total dimensions, the silencer is supplied as a single component or as several components for assembly.

Weight calculation

This method yields somewhat approximate values. Please enquire if you wish to know the exact weight.

1. Calculate the total surface area of the silencer (surface area of all six sides).
2. Multiply this surface area in m2 by 21.5. This gives the approximate weight in kg.

Attenuation

The acoustic attenuation values were obtained by laboratory tests conducted to UNE-EN ISO 7235 and UNE-EN ISO 11691.

L=600 [mm]								
P	f_m [Hz]							
	63	125	250	500	1000	2000	4000	8000
50	6	12	21	33	35	40	25	21
75	4	9	16	26	31	37	19	16
100	4	8	16	19	27	30	16	14
125	3	7	12	17	24	23	14	12
150	3	7	10	15	19	21	12	11
175	2	6	10	15	17	19	12	9
200	2	4	9	12	15	15	11	7

L=900 [mm]								
P	f_m [Hz]							
	63	125	250	500	1000	2000	4000	8000
50	7	16	30	45	49	50	42	28
75	5	11	23	37	47	50	32	23
100	5	10	21	29	42	42	26	19
125	4	9	19	26	34	36	22	16
150	4	8	16	23	29	31	20	14
175	3	7	15	21	26	27	18	12
200	3	7	14	18	23	22	16	12

L=1200 [mm]								
P	f_m [Hz]							
	63	125	250	500	1000	2000	4000	8000
50	10	21	41	50	50	50	45	31
75	7	15	31	50	50	50	43	31
100	6	12	28	40	50	50	35	26
125	5	11	25	35	45	47	28	21
150	5	11	20	34	38	40	28	20
175	4	10	18	27	36	37	25	18
200	3	9	17	23	30	31	22	17

L=1500 [mm]								
P	f_m [Hz]							
	63	125	250	500	1000	2000	4000	8000
50	11	25	48	50	50	50	50	38
75	8	17	39	50	50	50	50	34
100	8	16	36	50	50	50	45	32
125	6	13	32	45	50	50	36	26
150	6	11	26	41	47	50	35	25
175	4	10	24	35	44	45	31	22
200	4	9	22	29	38	38	27	21

L=1800 [mm]								
P	f_m [Hz]							
	63	125	250	500	1000	2000	4000	8000
50	13	28	48	50	50	50	50	39
75	9	20	47	50	50	50	50	37
100	9	18	43	50	50	50	50	37
125	7	16	37	50	50	50	44	32
150	7	13	30	49	48	50	41	29
175	5	11	27	40	46	50	37	26
200	5	10	26	36	45	45	33	26

L=200 [mm]								
P	f_m [Hz]							
	63	125	250	500	1000	2000	4000	8000
50	14	30	49	50	50	50	50	40
75	10	22	48	50	50	50	50	38
100	10	19	45	50	50	50	50	38
125	8	18	39	50	50	50	46	33
150	7	13	32	49	48	50	43	31
175	5	11	29	43	47	50	39	27
200	5	11	28	38	46	47	35	27

P: Distance between baffles.
f_m: Mean frequency per octave band, in Hz

*For more information on the attenuation of other models, refer to the data in the Koolair Quick Selection Tables 4.0 (TSR-4.0).

Attenuation

The acoustic attenuation values were obtained by laboratory tests conducted to UNE-EN ISO 7235 and UNE-EN ISO 11691.

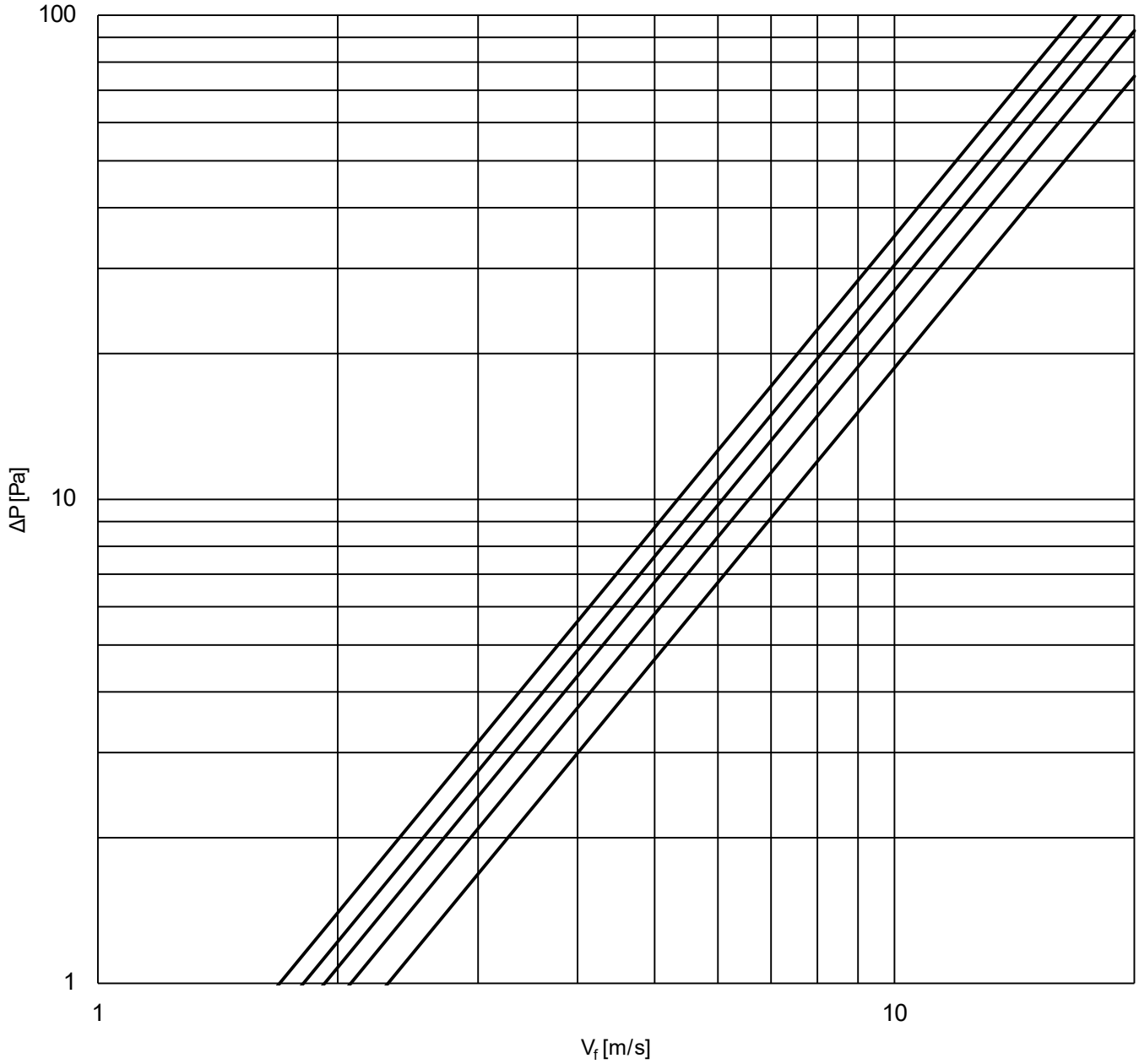
L=2100 [mm]								
P	f_m [Hz]							
	63	125	250	500	1000	2000	4000	8000
50	15	33	50	50	50	50	50	41
75	12	25	50	50	50	50	50	39
100	12	22	50	50	50	50	50	38
125	10	22	44	50	50	50	50	37
150	8	15	35	50	48	50	48	34
175	6	13	33	47	48	50	43	30
200	6	13	31	42	47	50	38	30

L=2400 [mm]								
P	f_m [Hz]							
	63	125	250	500	1000	2000	4000	8000
50	17	37	50	50	50	50	50	43
75	13	28	50	50	50	50	50	41
100	13	26	50	50	50	50	50	39
125	11	25	50	50	50	50	50	38
150	9	17	40	50	48	50	50	36
175	7	14	36	47	48	50	50	35
200	6	14	35	45	45	50	45	34

P: Distance between baffles.
f_m: Mean frequency per octave band, in Hz

*For more information on the attenuation of other models, refer to the data in the Koolair Quick Selection Tables 4.0 (TSR-4.0).

Pressure drop graphics



V_f [m/s]: Air veloicty based on BxH section.

For other lengths, the pressure drop is:

L [m]	600	900	1200	1500	1800	2100	2400
K_p	0,85	0,98	1,08	1,12	1,15	1,21	1,23

$\Delta P_L = \Delta P_{L=1000} * K_p$

Verification of the selection

Rules

Once the model is selected and its dimensions are determined, check that the selection is correct by checking that the silencer's own noise regeneration due to air flow through the silencer does not affect the resulting sound level.

The attached diagram gives the sound power level regenerated by the silencer according to its height and air flow velocity.

To this value, the value listed below must be added, according to the number of silencer modules selected:

2 modules + 3dB
3 modules + 5dB
4 modules + 6dB
5 modules + 7dB
6 modules + 8dB

The sound power levels at the various frequency bands are obtained from the following corrections:

Hz	125	250	500	1000	2000	4000
dB	-5	-5	-9	-12	-18	-24

When the difference between the sound power downstream of the silencer and the power regenerated by the silencer is above 10 dB, the calculation will be correct because the sum of two source sound power levels is performed logarithmically. When the value of the stronger one is 10 dB higher than the other, the result is as if the weaker source did not exist.

Example

We will use the example given in the “Fast Calculation Method” publication and continue assuming a 250-Hz band to simplify the calculation.

Data

- Air velocity = 14 m/s.
- Number of modules = 4.
- Silencer height = 1200 mm.

a) Sound power level regenerated by the silencer (attached diagram) **= 40 dB**

b) Correction according to the number of modules: **+ 6 dB**

c) Correction in 250-Hz band: **- 5 dB**

d) Sound power regenerated: **= 50 dB**

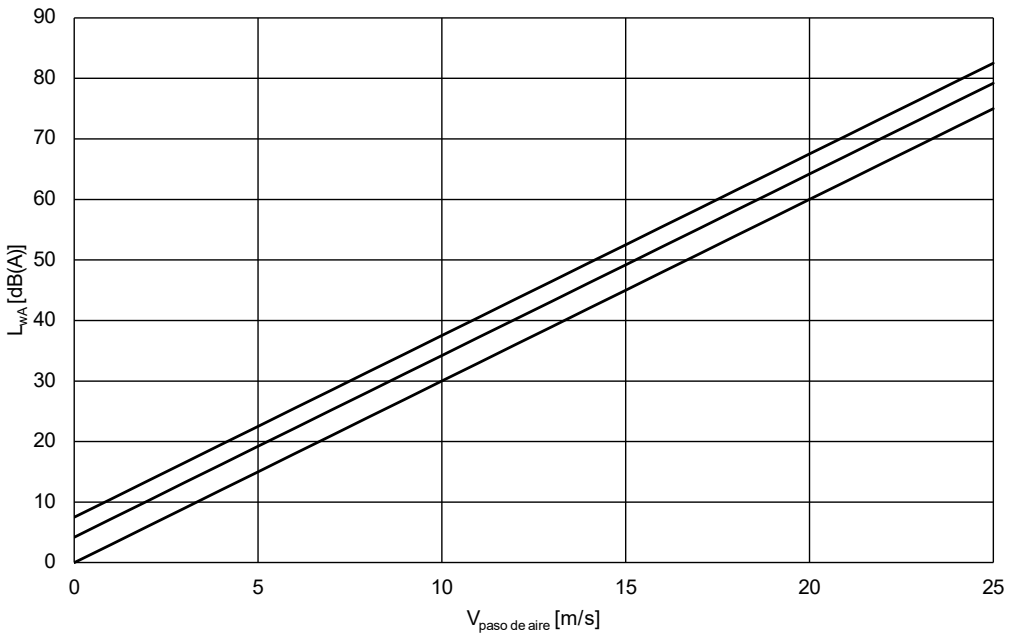
e) Sound power produced by the fan:: **94 dB**

f) PAK-150 silencer attenuation: **- 20 dB**

g) Sound power downstream from thesilencer: **= 74 dB**

g - d = 74 – 41 = 33 dB > 10 dB

Therefore, the selection is correct.



Silencer calculation, fast method

Required sound attenuation

Introduction

Because many factors must be taken into account, it is complicated and time-consuming to accurately calculate the sound level in a specific room due to fan noise and the silencer needed to lower this noise to the required level, depending on the type of room to be conditioned.
However, this calculation often cannot be done, sometimes due to time pressures and sometimes due to a lack of data.
A fast, simplified procedure to obtain sufficiently accurate results is described below.
Nevertheless, we recommend a more detailed study for the following applications:

a) Systems in which the required sound criterion is below NC 35.
b) High-velocity systems, where the pressures are high and the noise generated by the boxes should also be considered.

The calculation is done using the third octave band, i.e., the 250 Hz (cycles/s) frequency, as experience in most applications that achieve this required sound level at this band will also work at all other frequencies.

Description of the calculation method:

First, the sound power level at the system inlet must be known, based on the fan air flow and pressure.
The value of this sound power in the 250-Hz band will be obtained by subtracting the value obtained, the one listed in Table 1, according to the type of fan used.

Table 1 assumes the hypothesis that the fan and the first discharge outlet (diffuser or grille) has a duct length of 8 m. If this length is longer, the attenuation would be higher, in which case the corrections listed in Table 2 should be applied.

Table 3 assumes the percent of total air flow from the fan enters the room.
Lastly, Table 4 assumes the inherent sound absorption of the room, which depends on its dimensions.
Once all the corrections described above are made, the resulting sound pressure in the room will be obtained, which should be compared with the recommended noise level according to the type of room to be conditioned.
The difference between the two values is the attenuation that the silencer should produce in the 250-Hz band.

Tabel 1

Fan type	Correction
Action Centrifugal (forward curved vane type)	- 12 dB
Reaction Centrifugal (backward curved vane type).	- 7dB
Axial	- 6 dB

Tabel 2

Fan type	Correction
Up to 8 m	0 dB
From 8 to 16 m	- 5 dB
From 16 to 32 m	- 10 dB

Tabel 3

%	Correction
200	+ 3 + 2 + 1
100	0 - 1 - 2
50	- 3 - 4 - 5 - 6
20	- 7 - 8 - 9
10	- 10 - 11 - 12
5	- 13 - 14 - 15 - 16
2	- 17 - 18 - 19
1	- 20

Tabel 4

m^3	Correction
15	+ 3 + 2 + 1
25	0 - 1 - 2
50	- 3 - 4 - 5
100	- 6 - 7
150	- 8 - 9
200	- 10
250	- 11 - 12 - 13 - 14
500	- 15 - 16
1000	- 17 - 18 - 19
2000	- 20

Selection example

An action centrifugal fan for AC of offices yields an airflow of 50000 m3/h and a static pressure of 75 mm w.g. The most adverse duct length between the fan and the discharge outlet is 12 m.

Air flow into the room (acoustically worst case) is 1000 m^3/h.

1. Sound power of the fan **106 dB**

2. Correction according to fan used (table 1) **-12 dB**

3. Correction for duct length (table 2) **-5 dB**

4. Correction based on the percent flow generated by the fan that enters the room

$$\frac{1000}{50000} \times 100\ \% = 2\ \%$$ (tabla 3) **-17 dB**

5. Correction according to room volume (table 4) **-9 dB**

6. Level required in some offices db(A) 40 **= 45 dB**

Attenuation to be obtained with the silencer **= 23 dB**

This will achieve the necessary attenuation: **23 dB**
- With a PAK-150 rectangular silencer of 1600 x 1200 x 1500

Codification

PAK - 1600 - 1200 - 1500 - 3 - 200

1 2 3 4 5 6

1. Model:

PAK — Rectangular silencer
PBK — Rectangular silencer with perforated plate
PAKM — Rectangular silencer with Melinex film
PBKM — Rectangular silencer with perforated plate and Melinex film
ATC3 — Thightness class ATC3 (previous class C)

2. Silencer width:

150 a 5000 mm

3. Silencer height:

100 a 4200 mm

4. Silencer length:

600 mm
900 mm
1200 mm
1500 mm
1800 mm
2100 mm
2400 mm

5. Number of modules:

1 - 16

6. Baffle width:

50 mm
100 mm
150 mm
200 mm

KOOLAIR, S.L.
Calle Urano, 26
Poligono industrial nº 2 – La Fuensanta
28936 Móstoles - Madrid - (España)
Tel: +34 91 645 00 33
e-mail: info@koolair.com

www.koolair.com