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1 - AERODYNAMICS

Figure 1 below shows the evolution of total pressure for an extractor; figure 2 for a blower fan.

■ Extractor fan

Notion of total pressure

For an extractor, the air is initially drawn from the atmosphere where it is, by definition, at atmospheric pressure. It undergoes a brutal pressure drop on entry to the circuit, then continues to lose pressure throughout the length of the circuit.

At the fan inlet, the total air pressure is therefore equal to the atmospheric pressure less the total pressure drop over the circuit. A partial vacuum or depression is therefore said to exist at the entrance to the fan and the total depression is defined as the difference between the atmospheric pressure and the total pressure prevailing at this point. The total depression is therefore the supplement to be added to the total pressure to obtain the atmospheric pressure.

Notion of static depression

In the same way, the static depression is defined as the supplement to be added to the static pressure to obtain the atmospheric pressure.

Conclusion

The total pressure is the sum of the static pressure and the dynamic pressure. The static pressure is therefore less than the total pressure. It is therefore necessary to add a greater supplement to it than to the total pressure to obtain the atmospheric pressure.

- Static depression is therefore greater than the total depression.
- Total depression is equal to the total pressure drop of the circuit.
- Static depression is equal to the total pressure drop of the circuit, plus the dynamic pressure at the fan inlet.

The static depression cannot, therefore, be used in its entirety.

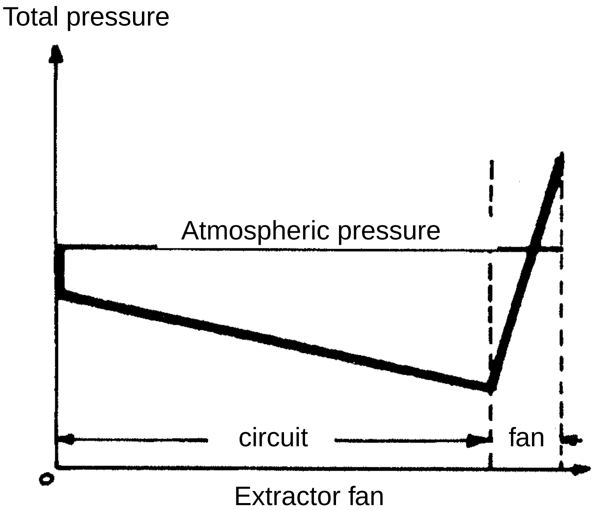
The selection of an extractor with a static depression equal to the pressure drop to be overcome leads to a flow rate lower than that expected.

Taking a static depression equal to the pressure drop instead of taking the total depression does not provide a safety margin, but has the opposite effect.

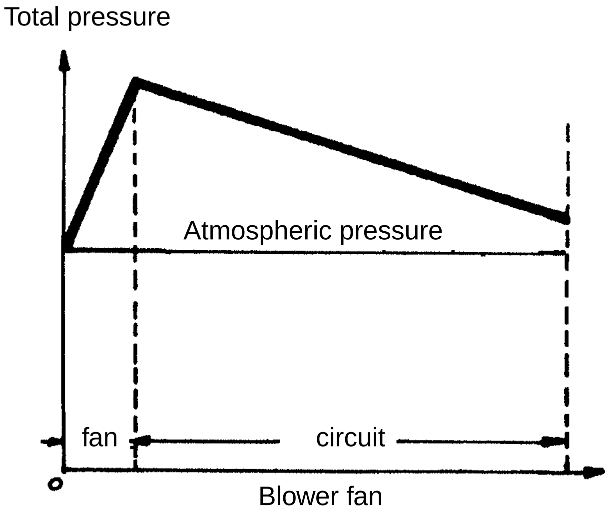
■ Blower fan

For the blower fan, the air is drawn from the atmosphere, at atmospheric pressure. After it has passed through the fan, the air is at a total pressure equal to the total pressure generated by the fan. It then undergoes a pressure drop throughout the length of the circuit, then a brutal pressure drop equal to the dynamic pressure on exit from the circuit.

At the fan outlet, the total pressure is equal to the static pressure plus the dynamic pressure. To obtain the required flow rate, this total pressure must be equal to the total pressure drop of the circuit. If a static pressure equal to the total pressure drop is taken instead of the total pressure, this provides a safety margin equal to the dynamic pressure at the fan outlet.



Extractor fan
Fig. 1



Blower fan
Fig. 2

■ **General conclusion**

Customers know from experience that to take the static pressure of a blower fan to overcome the pressure drop over a circuit provides a safety margin. Mistakenly, they believe that to take the static depression for an extractor to overcome the pressure drop over a circuit also provides a safety margin. Consequently, the greater the dynamic pressure at the fan inlet, the greater is their error.

We therefore decided, to avoid being seen in an unfavourable light relative to the majority of our competitors who use the notion of static depression, to graduate our pressure scales in static depression at the fan inlet.

In the event that the customer, through ignorance, does not wish to recognise the above arguments, we will therefore find ourselves with the same terminology as our competitors. We will not therefore put ourselves in an unfavourable position.

In the event that the customer concedes to the evidence, the straight line on the graphs indicating the dynamic pressure at the fan inlet makes it possible, by contrast, to calculate the total depression and to equalise it with the pressure drop to be overcome.

2 - ACOUSTICS

A knowledge of the acoustic characteristics of roof-mounted extractors is of interest for two reasons, as it allows the evaluation:

- either of the discomfort it causes in the vicinity, i.e. outside the building on which the fan has been installed,
- or the discomfort suffered inside the building, if the fan is the main cause of disturbance in this respect.

It is therefore worthwhile to make a distinction between the acoustic characteristics outside the building and those inside it.

2.1 Acoustic characteristics outside the building

2.1.1 General

At a given point, the auditory discomfort caused by noise is a function of the acoustic pressure level prevailing at that point. It is therefore necessary for the manufacturer of roof-mounted extractors to provide the means to determine this level of acoustic pressure.

On account:

- on one hand, of roof-mounted installation, whereby the fan is at a distance from the vicinity,
- and on the other, of the rapid decrease in acoustic pressure with distance,

the acoustic pressure level around the extractor, where the latter may be a nuisance, i.e. in a relatively distant vicinity, will always be low. It is therefore advisable to express this level of acoustic pressure, on account of its relatively low order of magnitude, in dB (A), in order to be aware of the physiological impression felt by the ear.

2.1.2 Overall level Lp (A)

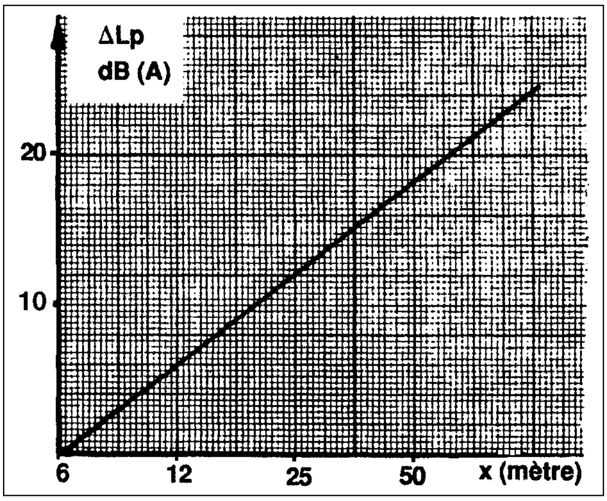
The average level of acoustic pressure in a free field around the extractor can be read on every characteristic curve in the catalogue and for every operating point.

This average level of acoustic pressure corresponds to what is heard directly by a person located in the proximity of the extractor, at a distance assumed to be equal to 6 metres.

The unit used is the **decibel** response curve (A) of sound level meters.

2.1.3 Average level of acoustic pressure in dB (A) at any distance from the extractor

This average level is obtained by subtracting the correction "ΔLp", given in the graph below, from the acoustic pressure level at 6 m.



Lp = Lp - ΔLp
at xm 6m xm

2.1.4 Spectrum of acoustic pressure in dB (A) at any distance from the fan

The average level of acoustic pressure around the extractor does not always provide an accurate representation of the auditive discomfort caused by the fan to those present in the vicinity.

The spectrum of acoustic pressure around the fan, octave band by octave band, is calculated from acoustic pressure level "Lp" (at x metres) by adding to "Lp" the corrections in the table below.

		Centre of frequency bands							
EC	Corrections	63	125	250	500	1000	2000	4000	8000
		-20	-17	-13	-6	-4	-5	-14	-19
EH	Corrections	-15	-9	-11	-6	-6	-8	-11	-14
EHV	Corrections	-27	-18	-12	-6	-4	-7	-11	-18

2.1.5 Example

Let us find the average level of acoustic pressure for extractor EH 60 T 6.

n = 1000 tr/mn
Q = 5000 m^3/h
Δp = 170 Pascals

On the corresponding curve in the catalogue, we read:

Lp = 52

The correction for 25 m is given by the graph on page 2:

Δ Lp = 12 dB (A)

The level sought is therefore:

Lp = 52-12 = 40 dB (A) à 25 m

The spectrum of acoustic pressure in dB (A) at 25 m around the extractor is given by the table below.

		Lp dB (A)	Correc-tions	Pressure spectrum in dB (A)
Centre of frequency bands	63	40	-15	25
	125	40	-9	31
	250	40	-11	29
	500	40	-6	34
	1000	40	-6	34
	2000	40	-8	32
	4000	40	-11	29
	8000	40	-14	26

2.2 Acoustic characteristics inside the building

2.2.1 General

As the extractor may either be connected to a duct or extract open-mouthed from a room, it is not possible to give the acoustic pressure levels inside the building in the way that we have done for the outside. It is however possible to give the sound power spectrum at the mouth, i.e. the spectrum of sound power emitted by the air admission. From this spectrum, the user can calculate the sound power radiated by the cross-section of the entrance to the circuit, taking account of the various causes of damping on this circuit. Armed with a knowledge of this radiated power and the characteristics of the premises, he can then calculate the sound power level at any point of the latter.

2.2.2 Determining the overall sound power

The overall sound power level is given in dB (ref. 10^{-10} W), response curve (A) of the sound level meters, by adding the constant value 27 to the value of "Lp" average level of acoustic pressure around the extractor, read directly on the characteristic curves:

Example :

An EC 50 T 4 extractor:

- Flow rate in m^3/h = 13000
- Static depression in mm WC = 15

Average level of acoustic pressure
at 6 m from the fan (Lp) in dB (A) = 64

The level of sound power in dB (A) is therefore:

Lw = 64 + 27 = 91 dB

2.2.3 Determining the sound power spectrum

To determine the most appropriate silencer for a specific installation, it is often more worthwhile to know the level of sound power per octave band; this value is referred to as the "sound power spectrum".

This sound power spectrum is obtained by adding to the average acoustic pressure level at 6 m around the extractor "Lp", a correction "ΔLw" given by the tables below.

Lw = Lp+Δ Lw

The pressure level Lp is read directly on the characteristic curves of the extractors according to the airflow rate and the rotational speed of the fan.

Centre of frequency bands		Corrections EC	Corrections EH	Corrections EHV
	63	+7	+12	0
	125	+10	+18	+9
	250	+14	+16	+15
	500	+21	+21	+21
	1000	+23	+21	+23
	2000	+22	+19	+20
	4000	+13	+16	+16
	8000	+8	+13	+9

2.2.4 Example

The sound power spectrum at the mouth of extractor EH 60 T 6, taken as an example earlier, is given below:

		Lp in dB (A) at 6 m	Correc-tion ΔLw	Sound power spectrum dB (A)
Centre of frequency bands	63	52	12	64
	125	52	18	70
	250	52	16	68
	500	52	21	73
	1000	52	21	73
	2000	52	19	71
	4000	52	16	68
	8000	52	13	65