Glossary

Symbol	Designation	Unit
c	Flow speed	m/s
D_2	Impeller diameter	m
A	Cross-sectional area	m^2
g	Acceleration	m/s^2
n	Speed	rpm
P	Fan power requirement (shaft)	kW
p_{st}	Static pressure	Pa
Δp_{st}	Static pressure difference	Pa
P_d	Dynamic pressure	Pa
ΔP_d	Dynamic pressure difference	Pa
P_t	Total pressure	Pa
ΔP_t	Total pressure difference	Pa
T	Temperature (Kelvin)	K
t	Temperature (Celsius)	°C
u_2	Circumferential speed of the impeller (outside)	m/s
V	Airflow or volume flow	l/s or m^3/h
ρ	Density	-
η	Efficiency	-
φ	Volume number	-
ψ	Pressure number	-
ζ	Coefficient of drag	-
λR	Coefficient of friction of channel or pipe	-
d	Pipe diameter	m
d_g	Equivalent diameter	m
l	Pipe or channel length	m
L_{WA2}	Sound power level to surround	dB
L_{WA5}	Sound power level in tube on inlet side	dB
L_{WA6}	Sound power level in tube on outlet side	dB

Glossary of Terms

AC - Alternating current

ach - Air changes per hour. The number of times the volume of air in a room needs to be changed in one hour depending on the activity in that space. Normally given as a range e.g. 15-20 ache based on the level of usage.

Amp FLC - Full Load Current. Current at normal fan/motor running speed.

Amp SC - Starting Current. This is higher than Amp FLC. Controllers and starters need to be sized accordingly.

Axial - Propeller Fan. Draws air from behind the blade to the front. Ideal for low pressure applications and expelling directly to the outside.

Building Regulations Documents - Documents approved by the Secretary of State as guidance to meeting the Building Regulations 1991. Part F: ventilation to the living space; Part C: the structure; and Part J: provision of air for fuel burning appliances; Part L: improvement to energy efficiency and reduction of CO_2 emissions.

CENELEC - European Committee for Electrical Standardisation

Centrifugal - Also known as radial fans Used where a high total pressure is required. Ideal for longer ducting runs.

Condensation - In Buildings. Small water droplets forming where air with high RH has contact with a cold surface (e.g. a mirror).

Conversion factor - Used to convert from one set of units to another e.g. 1 l/s x 3.6=m^3/h.

dB(A) - Unit of sound measurement based on pressure measurements taken at 8 octave bands. Sound diminishes as distances from the sound source increase.

DC Motor - Direct current motor. DC motors used in Xpelair fan products have an electronics interface which allows them to be connected to a normal ac supply. DC motors consume less electrical power, run cooler and therefore have an extended life expectancy.

Document F - Refers to approved Document F 'Means of Ventilation' in domestic and non-domestic building. F1: means of ventilation.

Document L - Refers to Approved Document L ' Conservation of fuel and power'. Compliance reduces the levels of natural air change.

FID - Free air discharge. Performance without any system resistance.

Filter classes -

Coarse filter	EU1 - EU4
Fine filter	EU5 - EU9
Absolute filter	EU10 - EU14

G.S.M. - Galvanised sheet metal

House Dust Mite Genus Dermatphagiodes - skin eater. Species: pteronyssinus. Arachnids about 0.2 - 0.3mm long. Habitat: bedrooms and family rooms where shed skin flakes and warm moist conditions are present. Because they are heavily contaminated with faecal pellets, dust mites are identified as allergenic material linked to asthmatic eczema, hayfever and other allergic conditions.

IEE Regulations - Publication of the Institute of Electrical Engineers. Also known as BS 7671. A safe and best practice document used throughout the electrical installation industry.

IP Rating - Classification of degrees of protection for an electrical product developed by CENELEC. First digit describes degree of protection from solids, the second from liquids. Examples: IP44 1st digit: protected against solid objects over 1mm. 2nd digit: protected against sprays from all directions. IPX7 1st digit not tested or not relevant. 2nd digit: protected against the effects of temporary immersion between 15cm and 1m of water.

l/s litres per second - Measurement of volume flow.

LoVolt - Term used to describe SELV 12V product.

m^3/h Cubic metres per hour - Measurement of volume flow rate

m^3/s Cubic metres per second - Measurement of volume flow rate

MEV - Mechanical extract ventilation. A central extract unit drawing air from several extract points and discharging though a single outlet.

Micron - Measurement equal to one millionth of a metre or one thousandth of a millimetre.

Mixed Flow - Radial impeller with a static pressure increase over an axial blade design. Ideal for short duct runs or direct extraction of air in exposed areas.

Motor Insulation Class - (B or F) Motor insulation system classification indicating the maximum motor working temperature for normal motor-life expectancy.

m/s - metres per second. Air velocity or speed.

MVHR - Mechanical ventilation with heat recovery.

Pa - Unit of pressure (Pascal) for measuring system resistance or static pressure. 1 Pa = 0.10mm H_2O.

PVS - Positive ventilation system Often referred to as positive pressure ventilation. Pressurises a building driving air out through gaps in the building envelope.

RH - Relative humidity. The ratio of the amount of water in the air at that temperature. Expressed as a % RH. UK outside humidity levels are regularly between 60-70%RH. Indoors with heating and appropriate ventilation a level of between 60 - 40% is most comfortable. See also Condensation.

r.p.m. - Revolutions per minute

Sensor Control - Fan switch activated by a change in selected ambient condition e.g. humidity, temperature etc.

SELV - Safety Extra Low Voltage Often referred to as separated low voltage. Used to describe fans operating under 50V (usually 12V).

Temperature - Shown in this publication in degrees Centigrade (or Celsius). Ideal target temperatures for ventilation design are:

Summer:	between 19 and 24°C
Winter:	between 18 and 23°C

Thermal Overload Protection - A safety component designed to interrupt the current to a motor before the windings exceed their design operating temperature. Types: One shot - acts like a fuse and cannot be reset. Self-resetting - reconnects the current when the temperature returns to an acceptable level. Manual reset - usually fitted to industrial fans and is a requirement for inline duct fans; requires manual resetting.

Transformer Control - Provides a number of fixed voltage output to vary the speed of speed controllable fan motors. Available in single phase and 3 phase.

UV stabilised - Additive or treatment designed to counter the deteriorating effects of ultraviolet radiation from strong sunlight.

VOC - Volatile Organic Compound An organic chemical. Used in a wide range of products: paints, varnishes, solvents, wax, disinfectants, cosmetics, aerosol sprays, insect repellents, air fresheners, dry cleaned clothing, degreasers and fuels. Can cause health effects from irritation to toxic.

Watt - Unit of power equal to one Joule per second. Power ratings of products are quoted in Watts. One kW is 1000W e.g. 1.2 kW = 1200W.

Xcell - Heat recovery cell made of thin membrane polymeric or non-ferrous materials. Allows two separated currents of air to pass through the cell, giving up extracted heat to the incoming fresh air flow, whilst reducing its relative humidity.

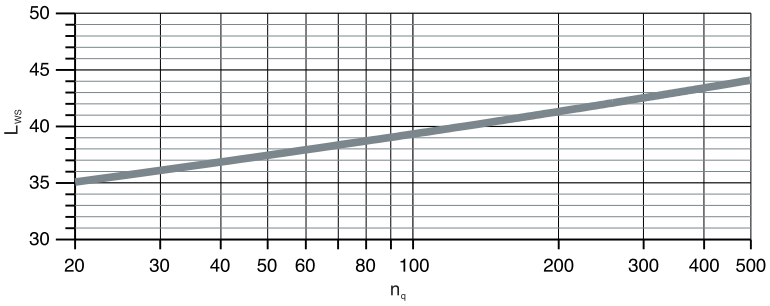
Noise levels

Noise produced by an axial flow fan is basically in a high frequency range. The sound power depends on careful selection of the fan with regard duty, efficiency, characteristics and above all quality of installation. There is a strong correlation between sound power and aerodynamic loss of the fan. Generally speaking, sound power of fans is a function of air volume and total pressure.
This can be confirmed by the following rough calculation formula:

$$L_{wG}[dB] = L_{ws} + 10\lg(V[m^3/s]) + 20\lg(\Delta p_{tot}[Pa]) \pm 5$$

whereby:
L_{WG} = total sound power
L_{WS} = specific sound power by the speed (see Fig. 1)

Fig. 1



$$n_q = n[rpm] \cdot \frac{\sqrt{V[m^3/s]}}{\left(\frac{\Delta p_t[Pa]}{\rho_m[kg/m^3] \cdot 9{,}81}\right)^{3/4}}$$

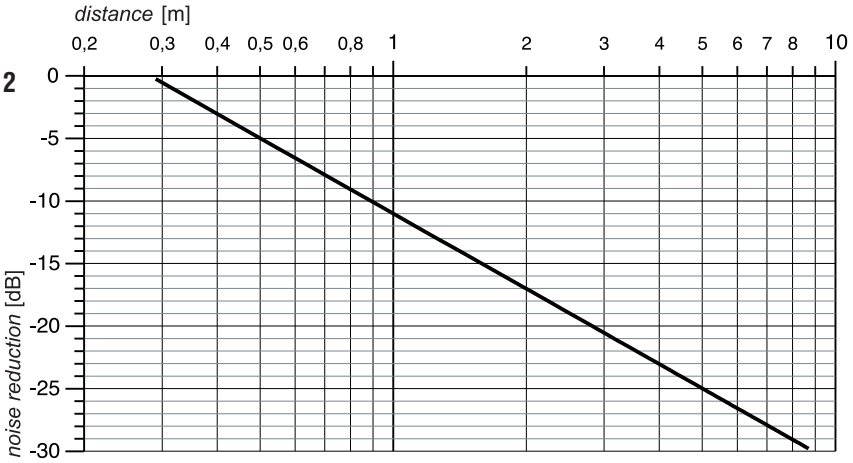
Sound power levels:

This is the amount of power which a source gives off as sound. Sound power levels are expressed in decibels with a reference level of 1 picoWatt. The sound power level of a source remains the same regardless the environment and the distance to the listener.

Sound pressure levels:

These are pressure fluctuations radiated by a source expressed in decibels with a reference level of 20 μPa. The sound pressure level varies according to the distance of source to the listener and its environment.

Fig. 2



Frequencies:

Sound is split into different frequencies. Frequencies of human hearing ranges from about 20 cycles per second (Hz) to 20000 cycles per second (Hz). For practical purposes Xpelair publishes noise data in eight octave bands with the centre frequencies of 63, 125, 250, 500, 1000, 2000, 4000 and 8000 Hz.
Each fan has its own specific correction factor which is to be deducted from sound power according to the octave band and is shown below each performance curve.

"A" weighted sound pressure levels (dB A)

The ear is more sensitive to sound in some frequencies than in others. The "A"-weighting is an attempt to reflect this natural attention of sound. The "A"- weighting is a set of figures which are applied to the sound pressure levels.
The levels in each of the octave band are added logarithmically to give a single figure.
"A"-weighting will be over octave band as follows:

Fig. 3

Frequency [Hz]	63	125	250	500	1000	2000	4000	8000
A-weighting [dB]	-26	-16	-9	-3	0	+1	+1	-1

Example:

Customer requires the dB(A) level at 3 m distance from a 630 diam. fan, 1440 rpm, 20 degr. pitch angle, duty 3.8 m^3/s at 50 Pa (static).
The chart in the example shows a sound power of 87 dB.
The calculation is:

63	125	250	500	1000	2000	4000	8000
87	87	87	87	87	87	87	87
-5	-6	-5	-6	-7	-10	-15	-21
-20	-20	-20	-20	-20	-20	-20	-20
-26	-16	-9	-3	0	1	1	-1
36	45	53	58	60	58	53	45

46 59 62 54
59 63
64 dB(A)

Frequency [Hz]
sound power level total
1) Deduct specific sound spectrum from curve
2) Reduction for 3m distance (Fig. 2)
3) Apply "A" weighting as Fig. 3
4) Add noise levels as given in Fig. 4 below

Fig. 4
Addition of sound level

Difference between two sound levels [dB]	*Add to the higher level* [dB]
0 - 1	3
2 - 3	2
4 - 9	1
≧10	0

$$L_\Sigma = 10 \cdot \lg\left(10^{0,1L_1} + 10^{0,1L_2} + ... + 10^{0,1L_n}\right)$$

whereby:
L_1 = sound level of a source 1
L_Σ = resulting level

Noise of several sources, equivalent in characteristic and level

$$L_\Sigma = L_1 + 10 \cdot \lg(z)$$

whereby:
z = number of sources
L_1 = sound level of a single source
L_Σ = resulting level

Please note: Xpelair offers a range of different silencers

Speed change - constant size

- Volume flow = rotational speed

$$\frac{V_2}{V_1} = \frac{n_2}{n_1}$$

- Pressure (all) = (rotational speed)^2

$$\frac{\Delta p_1}{\Delta p_2} = \left(\frac{n_1}{n_2}\right)^2 = \left(\frac{V_1}{V_2}\right)^2$$

- Pressure (all) = (rotational speed)^3

Size change - constant speed

$$\frac{P_1}{P_2} = \left(\frac{n_1}{n_2}\right)^3 = \left(\frac{V_1}{V_2}\right)^3$$

Density change - constant speed - constant size

- Volume flow no change

$$V = \text{constant}$$

- Pressure = Density

$$\frac{\Delta p_1}{\Delta p_2} = \frac{\rho_1}{\rho_2} = \frac{T_2}{T_1}$$

- Power absorbed = Density

$$\frac{P_1}{P_2} = \frac{\rho_1}{\rho_2} = \frac{T_2}{T_1}$$

(For geometrically similar fans only)

- Volume flow = (impeller Diameter)^3

$$\frac{V_2}{V_1} = \left(\frac{D_2}{D_1}\right)^3$$

- Pressure = (impeller Diameter)^2
- Power absorbed = (impeller Diameter)^5

$$\frac{\Delta p_1}{\Delta p_2} = \left(\frac{D_1}{D_2}\right)^2$$

$$\frac{P_1}{P_2} = \left(\frac{D_1}{D_2}\right)^5$$

Pressure

- Dynamic Pressure [Pa]

$$p_d = \frac{\rho}{2} \cdot v^2$$

whereby:
ρ = air density in [kg/m³]
v = air velocity in [m/s]

- Total pressure

$$p_t = p_{st} + p_d$$

Absorbed power - calculation in duty point

$$P_L[\text{kW}] = \frac{V[\text{m}^3/\text{s}] \cdot \Delta p_t[\text{Pa}]}{\eta \cdot 1000}$$