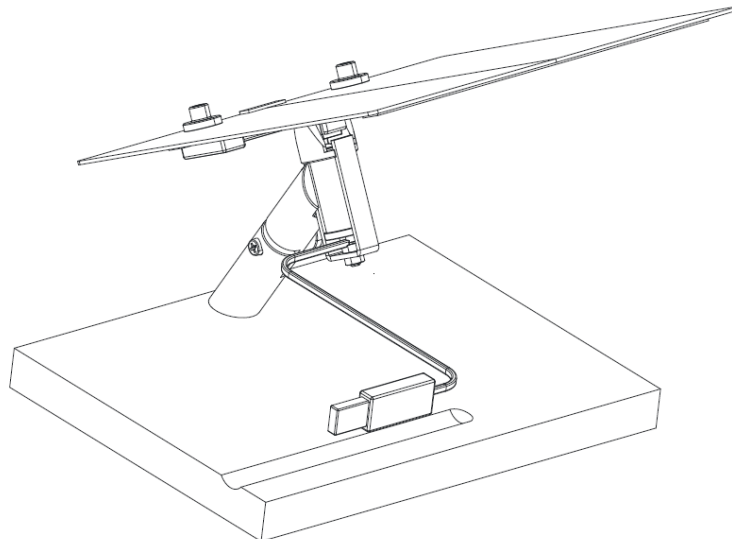


The magler® TFO.9 table fan compared to axial fans

The magler® TFO.9 table fan works just as a traditional handheld folding fan. This compilation of the characteristic values shows the advantages and disadvantages of such a waving table fan compared to rotating axial fans regarding relevant values of commercially available rotating axial fans.

The magler® TFO.9 table fan:

Fan blade 200mm x 200mm; $f_0=1.5$ Hz; 5V USB; 0.35W



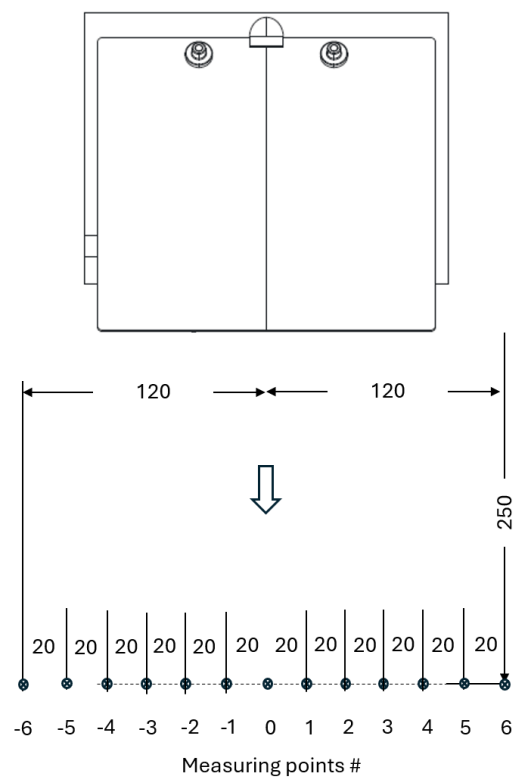
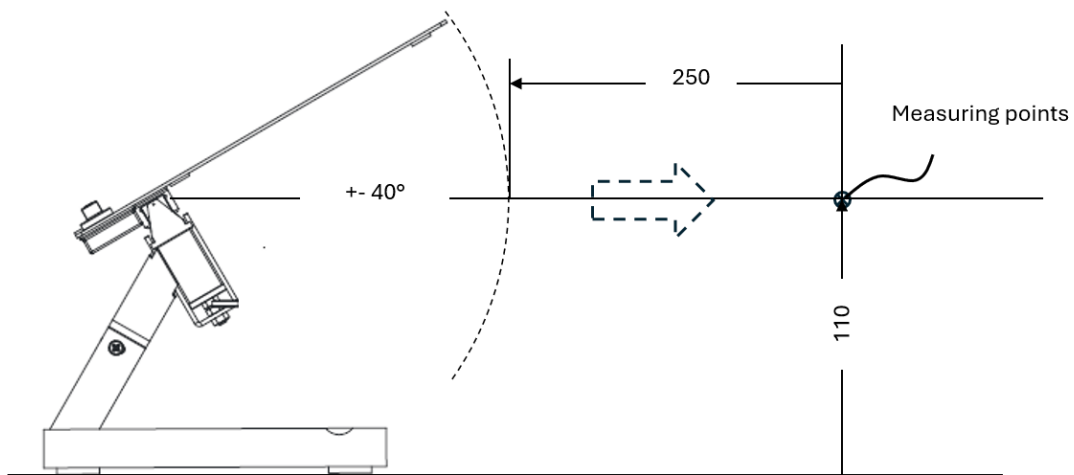
The axial fans

Model A: Handheld fan with protective cage (80mm diameter); battery-operated; approx. 2.5W; Manufacturer: A

Model B Handheld fan without protective cage (120mm diameter); battery-operated; approx. 2.5W; Manufacturer: B

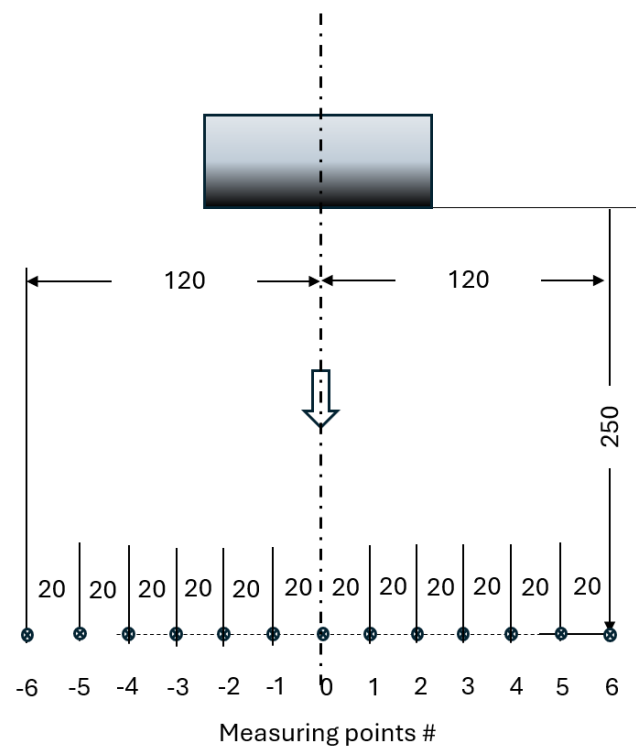
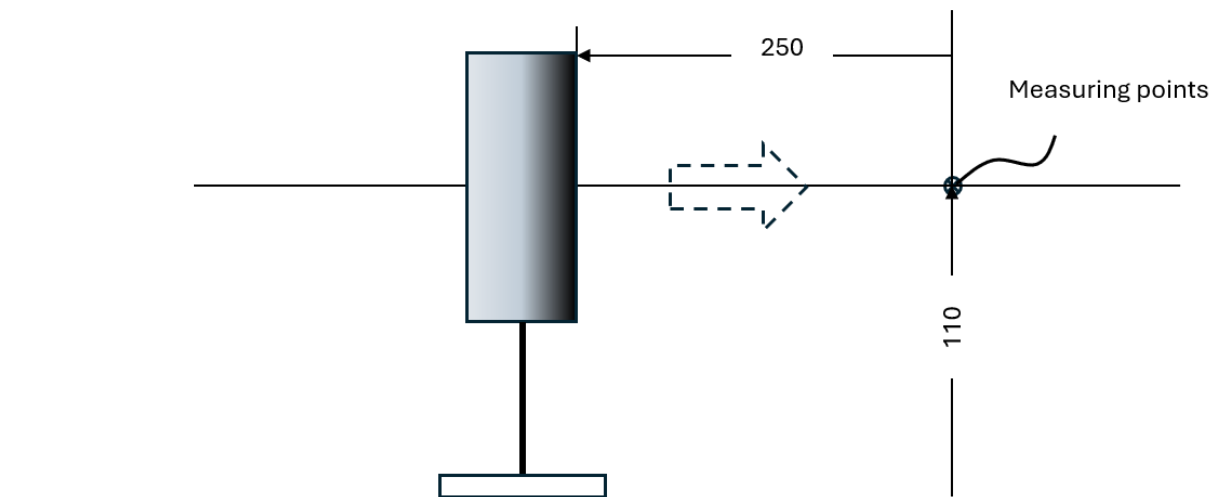
Definition of the positions of the measuring points for the airflow and sound measurements

1. magler® TFO.9

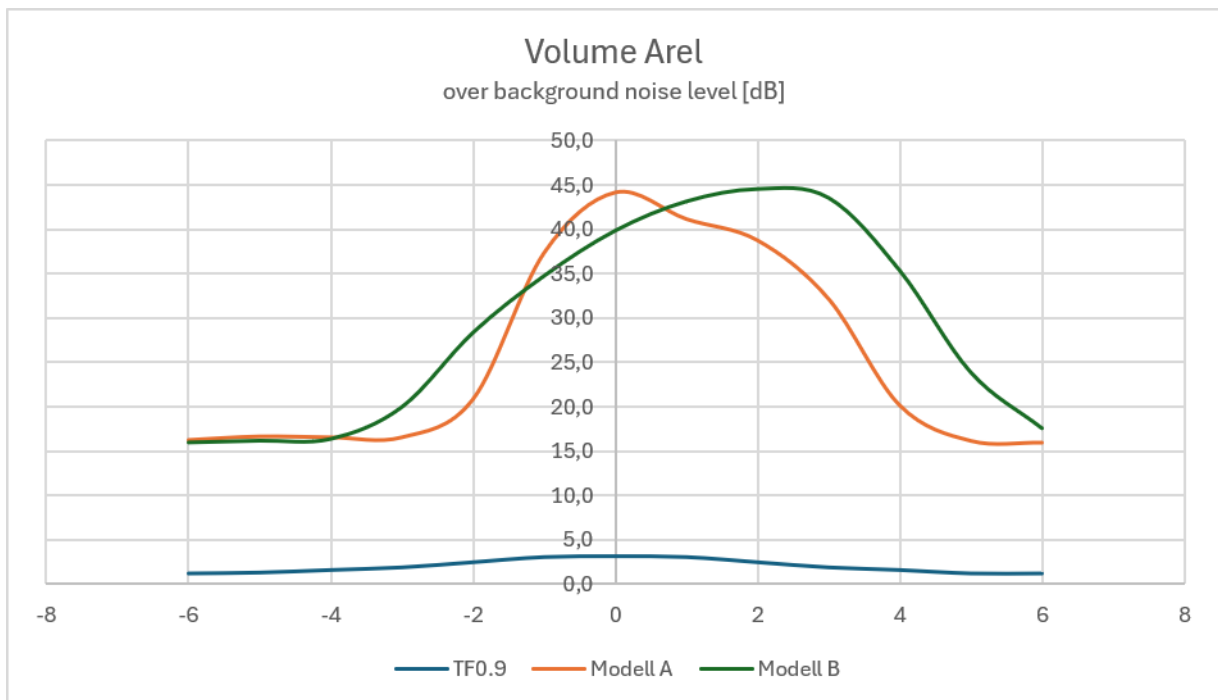


Definition of the positions of the measuring points for the airflow and sound measurements

b) Model A and Model B axial fans



Measured values of the volume in dB



		Average. Volume [dB]					
Measuring point		Table Fan TF0.9		Handheld fan			
MP		TF0.9		Modell A		Modell B	
		A _{abs}	A _{rel}	A _{abs}	A _{rel}	A _{abs}	A _{rel}
6		30,2	1,2	44,9	15,9	46,5	17,5
5		30,2	1,2	45,1	16,1	52,8	23,8
4		30,6	1,6	49,1	20,1	64,3	35,3
3		30,9	1,9	61,1	32,1	72,5	43,5
2		31,5	2,5	67,7	38,7	73,5	44,5
1		32,1	3,1	70,1	41,1	72,1	43,1
0		32,2	3,2	73,1	44,1	68,8	39,8
-1		32,1	3,1	66,3	37,3	63,7	34,7
-2		31,5	2,5	49,8	20,8	57,3	28,3
-3		30,9	1,9	45,5	16,5	48,9	19,9
-4		30,6	1,6	45,5	16,5	45,3	16,3
-5		30,3	1,3	45,6	16,6	45,1	16,1
-6		30,2	1,2	45,2	16,2	44,9	15,9

The background noise level is 29.0 dB

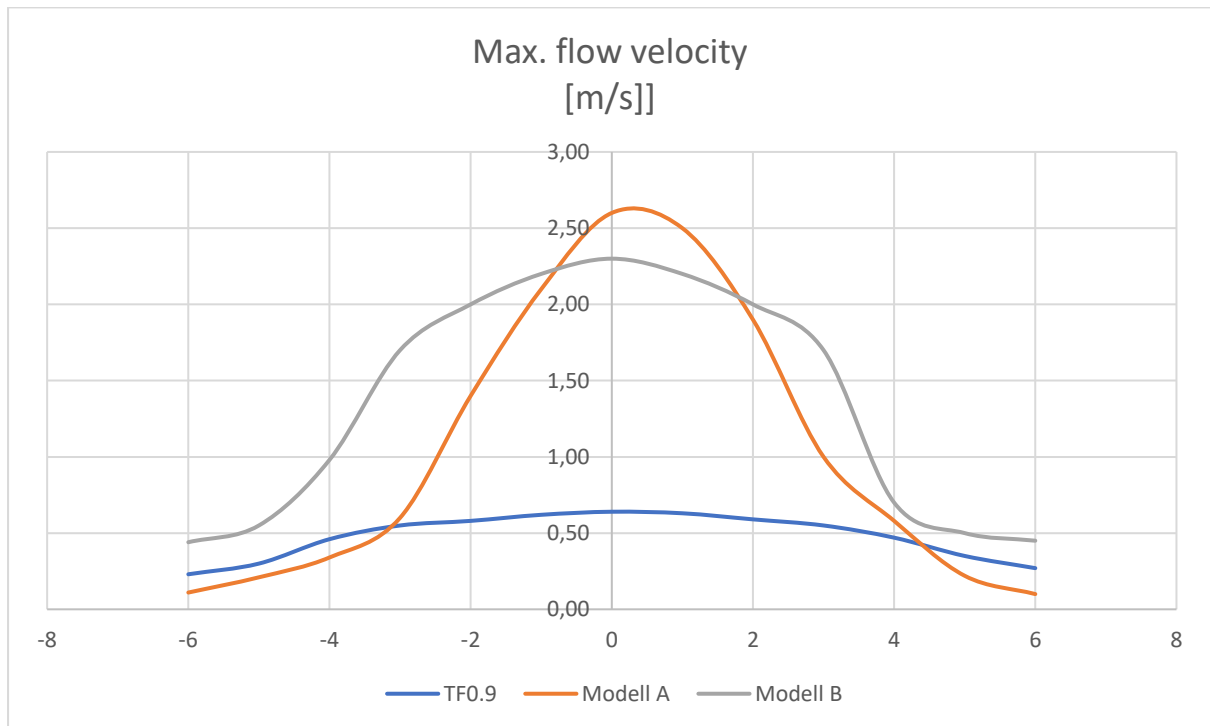
The volume in dB was measured with the Android app [Sound measurement dB-Meter from KTW](#) Apps version 11.5 on a Samsung smartphone Galaxy A55 5G at the measuring points #-6 to #+6.

This measurement of the average values from a measurement period of 60 seconds is not absolutely finely calibrated, but it allows a sufficiently accurate comparison. The app is extremely sensitive and the values were related to a quiet uninsulated room with an average noise of 29.0 dB. An elaborate comparative measurement in an anechoic chamber does not appear to be necessary at present. The user does not usually work in an anechoic chamber.

The magler® 0.9 table fan is about 40dB quieter over the entire width of the fan than the axial hand fans in their slowest setting.

A noise from the magler® 0.9 table fan is extremely quiet with a maximum of 3.2 dB and is practically imperceptible in the relaxation room level of 29.0 dB.

Measured values of the airflow in m/s



Max. flow velocity [m/s]			
Measuring point	Table Fan TF0.9		Handheld fan
MP	TF0.9	Modell A	Modell B
6	0,27	0,10	0,45
5	0,35	0,22	0,50
4	0,47	0,58	0,70
3	0,55	1,00	1,70
2	0,59	1,90	2,00
1	0,63	2,50	2,20
0	0,64	2,60	2,30
-1	0,62	2,10	2,20
-2	0,58	1,40	2,00
-3	0,55	0,60	1,70
-4	0,46	0,34	0,98
-5	0,30	0,21	0,55
-6	0,23	0,11	0,44

The airflow was measured with a very sensitive hot-wire anemometer of the type [Trotec BA30WP](#).

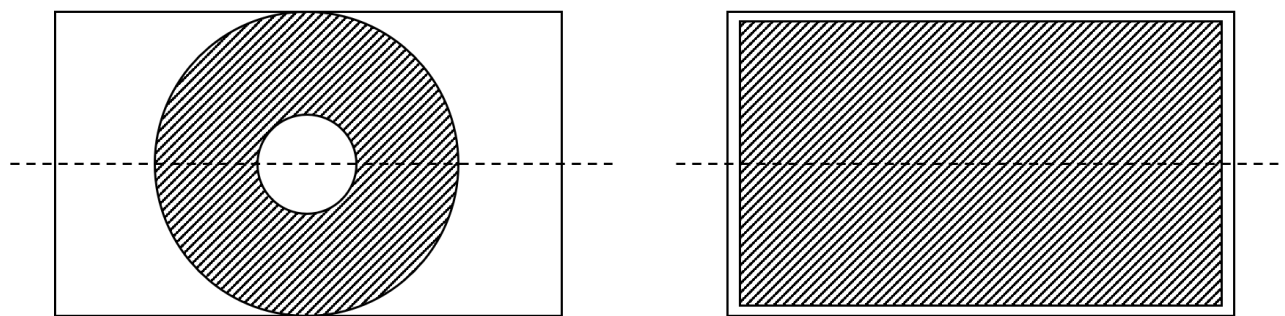
The measured values represent maximum values at the respective measuring points.

While in the waving fan, the air movement over the entire width of the fan- blade is caused by **turbulence with turbulent alternating counter-rotating air vortices** and thus strongly fluctuating amplitudes at about 0.5 m/s of the individual values, the axial fans in the central area generate a laminar blowing air flow with an amplitude maximum of about 2.5 m/s in the center of the drive.

It should be noted that the measured values along a straight line in the middle of the fans only represent a two-dimensional cross-section. However, from a three-dimensional point of view, the flow behavior of the waving fan would be distributed over an essentially rectangular surface, i.e. cuboid over a large area in space.

An axial fan, on the other hand, generates a spatially cylindrical flow profile, with a strongly focused airflow in the middle.

Active ventilation surface

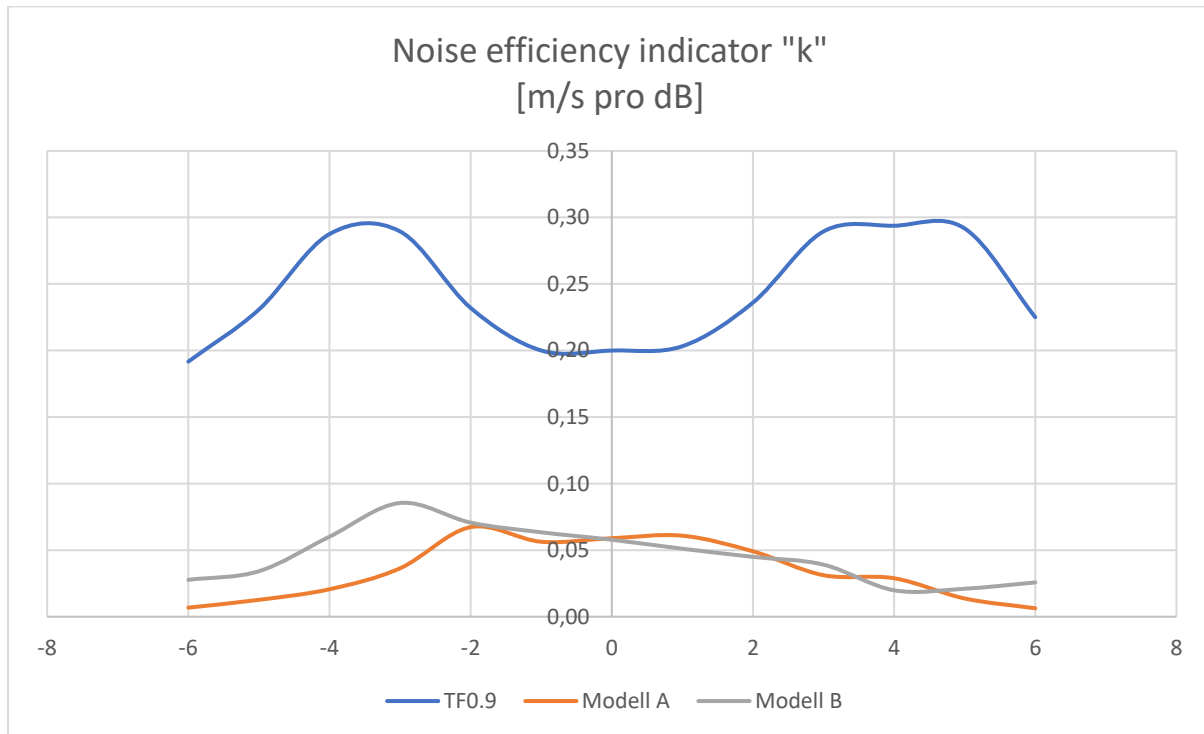


Radial fan

Fan- type ventilator

Characteristic indicator k for a "noise efficiency"

In order to represent, to put it bluntly, how much "wind per noise" is generated, a characteristic noise efficiency indicator k has been defined, which is supposed to reflect the flow velocity per noise level at a certain measuring point:



Noise Efficiency : Flow Rate / dB									
m/s per dB									
Measuring point	Table Fan TF0.9			Handheld fan					
	v	A	v / A	v	A	v / A	v	A	v / A
MP	TF0.9		TF0.9	Modell A		Modell A	Modell B		Modell B
6	0,27	1,20	0,23	0,10	15,90	0,01	0,45	17,5	0,03
5	0,35	1,20	0,29	0,22	16,10	0,01	0,50	23,8	0,02
4	0,47	1,60	0,29	0,58	20,10	0,03	0,70	35,3	0,02
3	0,55	1,90	0,29	1,00	32,10	0,03	1,70	43,5	0,04
2	0,59	2,50	0,24	1,90	38,70	0,05	2,00	44,5	0,04
1	0,63	3,10	0,20	2,50	41,10	0,06	2,20	43,1	0,05
0	0,64	3,20	0,20	2,60	44,10	0,06	2,30	39,8	0,06
-1	0,62	3,10	0,20	2,10	37,30	0,06	2,20	34,7	0,06
-2	0,58	2,50	0,23	1,40	20,80	0,07	2,00	28,3	0,07
-3	0,55	1,90	0,29	0,60	16,50	0,04	1,70	19,9	0,09
-4	0,46	1,60	0,29	0,34	16,50	0,02	0,98	16,3	0,06
-5	0,30	1,30	0,23	0,21	16,60	0,01	0,55	16,1	0,03
-6	0,23	1,20	0,19	0,11	16,20	0,01	0,44	15,9	0,03

This consideration highlights the advantage of the waving table fan that it blows less, but is much quieter. In addition, the waving table fan is extremely economical

electrically, which makes an additional contribution to efficiency that is not yet included in the figure.

Conclusion and comment

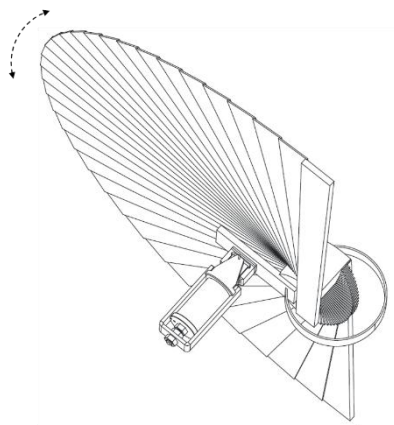
Cooling

For cooling on the human body, the alternating turbulent air movement is **subjectively perceived as much more pleasant than a laminar and uniform draught** of an axial fan, which continuously blows on the user and flows past him. A constant laminar air flow has a drying effect on the mucous membranes, has a drying effect on the sinuses and can lead to tension in the neck area. An axial fan, for example for the desk or for manual operation, was therefore not yet really able to establish itself in the market. An axial fan with reduced noise level would imply a large diameter on a desk and would be unwieldy, heavy and annoyingly audible. A small axial hand fan, on the other hand, has to work at a higher speed in order to be able to generate a comparable air flow and is also loud in addition to the laminar air movement blowing on the user.

The traditional handheld folding fan, on the other hand, has now established itself worldwide as a pleasant means of cooling the skin surfaces of humans and animals for over a thousand years, originating in Asia. In times of climate change, the need for cooling is sure to increase. Even in Scotland, traditional handheld folding fans were observed in use on buses last summer!

The fan blades shape could also be optimised, for example, a kidney-shaped fan blade towards the edge or a fan blade in the shape of a dolphin or whale fin could be used to create a more homogeneous air turbulence across the width of the waving fan with alternating vertebral rotation (keyword bionics).

Initial design studies for clamping conventional handheld folding fans on the magler®, which will enable the use of a mobile magler® drive on the foldable hand fan in the future, are promising.



The magler® TFO.9 table fan is in comparison

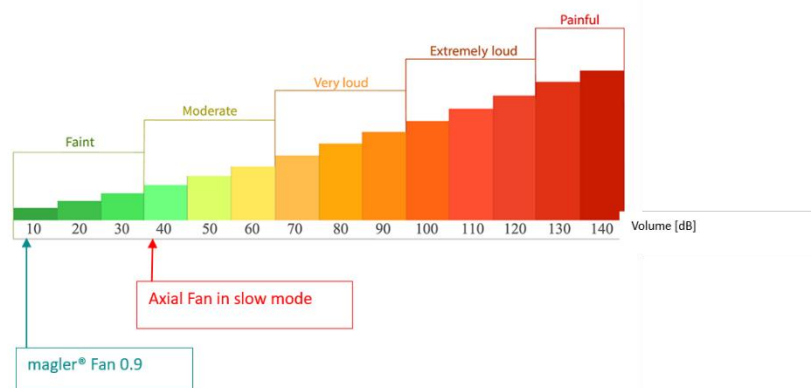
quiet and pleasant in noise emission

In the subjective perception of loudness, it is assumed in a [rule of thumb](#) that humans perceive an increase in the sound level by 10dB as a doubling of the volume. Accordingly, the above-mentioned difference of about 40dB would correspond to a

$$10 + 10 + 10 + 10 \text{ dB} = 40 \text{ dB}$$

$$2 * 2 * 2 * 2 = 16 \text{ times}$$

Noise perception of the axial fan compared to the magler® TFO.9, measured at a distance of 25 cm. In both cases, the subjective perception is within the acoustically quiet ranges of "Faint" and "Moderate" (see graphic below), but in the long run it becomes disturbing with the axial fan, especially in quiet environments on the PC, where, for example, a small, high-revving fan in the laptop can be perceived as very annoying. In addition, the axial fan generates an emission frequency spectrum between about 150Hz and 700Hz at an already reduced speed, while the waving fan has an emission frequency of only 1.5 Hz. High frequency components of the emission can have a disturbing effect on the user in the long run. In addition to use on the PC, the difference in volume and frequency is likely to be a decisive criterion in the future, for example in applications in the sleeping area, on the baby bed or in the portable fan, for example in the theater.



Source of the scale: <https://www.akustikform.ch/raumakustik/dezibel-skala>

efficient due to low power consumption

Even though an axial fan can already be operated economically with about 1.6W in its lowest setting, the magler® TFO.9 table fan is still about 4 times lower with only 0.35W power consumption. The high energy efficiency is achieved by the magler® oscillating drive.

With its low power consumption, the drive is also suitable for battery-powered or battery-powered mobile fan applications. For example, with one charge of a single AA-LiIon cell (approx. 22g), mobile use of over 10 hours is possible.

robust due to overload capacity and magnetic slip clutch

For the fan swinging on the desk or in the hand, where an intervention can happen any time the featured inherent overload protection without posing any risk of injury is a key unique selling point. The magler® - driven fan simply remains stationary for the duration of an intervention without causing damage or being overloaded and simply continues to run afterwards. The magler® drive is intrinsically safe.

An axial fan, on the other hand, usually requires a space consuming fan housing to prevent intervention to the fan wheel, which rotates with powerful torque, to thus injury to the user.

The magler® waving fan offers humans and animals
pleasant cooling of the skin
– without much wind!

There is a lack of a comparable drive in the segment of table fans or handheld fans - a gap in the market that can be served promisingly with the magler oscillating drive!