Aldes ME Flash

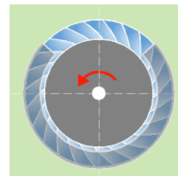
N°12 – November 2010

Technical Information

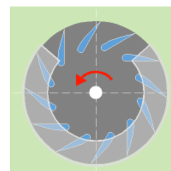
Fans with forward-curved and backward-curved blades

Definition

▪ **With forward-curved blades:**
The fan wheel is composed of many small blades that are angled in the same direction as wheel rotation.
Aldes: VEC, CVEC, VEKITA, VIK, TVEC, ALIZONE, CYCLONE.

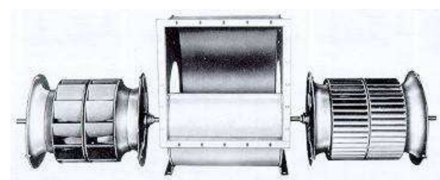



▪ **With backward-curved blades:**
The fan wheel is composed of fewer, bigger blades than those on the forward-curve fan. They are angled in the opposite direction to wheel rotation.
Aldes: VELONE, VDA, VEKITA SILENCE, VEKITA SILENCE-O.



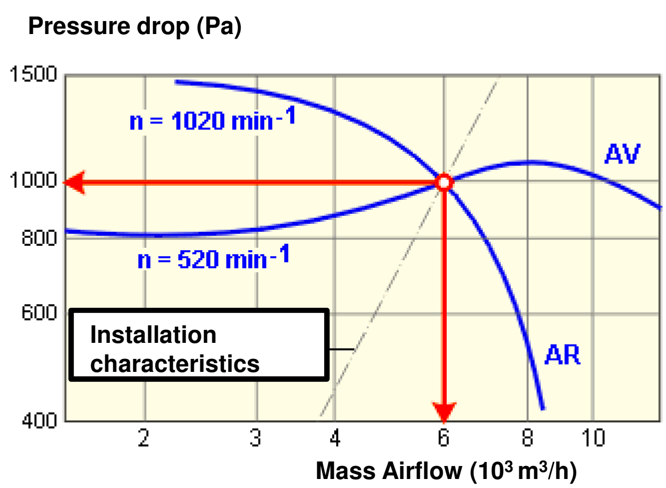

Forward or backward?

Most fans chosen for ventilation in housing and commercial premises are centrifugal fans. The choice of forward or backward-curved blades is based on many criteria including:
▪ application area (curve shape for an operating range)
▪ cost
▪ energy consumption (efficiency)



Forward or backward?

Fans with forward-curved blades have flat characteristic curves. This means the airflow strongly varies whilst pressure changes.
Contrary to forward-curved blades, fans with backward-curved blades have sloping characteristic curves. This means airflow does not vary a lot whilst pressure changes.



Characteristic curves for fans with forward-curved and backward-curved blades, for the same operating point.

Comparison

	 Backward-curved blades	 Forward-curved blades
Efficiency	Up to **85**%	Up to **70**%
Max total pressure	From **2000 to 3000** Pa	From **1000 to 1500** Pa
Wheel speed	**High** ▪ between 3000 and 6000 tr/min for small sizes ▪ between 1500 and 3000 tr/min for big sizes → *Problem of bearing usury for small sizes: too high speed*	**Low** ▪ between 1000 and 2500 tr/min for small sizes ▪ between 500 and 1000 tr/min for big sizes → *Problem of low frequency vibration for big sizes: too low speed*
Acoustic	**Higher**	**Lower**
Consumed power	**Low**	**High**
Curve shape	**Sloping**	**Flat**
Cost	**High** **The cost will be balanced between forward and backward-curved blades on big sizes**	**Low** **The cost will be balanced between forward and backward-curved blades on big sizes**

Fans with forward-curved blades and backward-curved blades are complementary on many criteria, and are used for different applications.

The following two examples demonstrate different applications for each one.

Comparison: constant airflow application

The first application is based on a supply ductwork equipped with final filter.

The total initial pressure is **400 Pa** and airflow is **5 000 m3/h**. The operating point corresponds to **point A** (cf. *Appendix 1: forward-curved blades* page 6 and *Appendix 2: backward-curved blades* page 7).
After a period of time, the final filter is clogging and creates a pressure increase of **300 Pa**, with the final total pressure registering up to **700 Pa**. The ductwork curve moves to the left however the fan speed stays constant as the system is a belt drive system without variation.

The new operating point will run to **point B**, at the intersection of the fan curve and the new ductwork curve.

Comparison between a COMEFRI fan with forward-curved blades (TLZ) with a COMEFRI fan with backward-curved blades (T-HLZ) with the same wheel size (315 mm) :

Fan with forward-curved blades – Point B data (*Appendix 1*) :
Total pressure: 355 Pa
Airflow: 3 500 m^3/h

Fan with backward-curved blades – Point B data (*Appendix 2*) :
Total pressure: 500 Pa
Airflow: 4 400 m^3/h

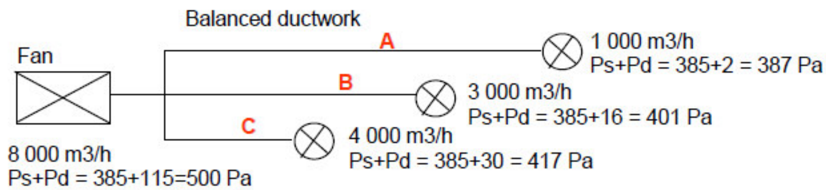
The initial goal is to maintain a constant airflow. Thus, the fan with backward-curved blades is more adapted than the fan with forward-curved blades.

The airflow drop is only 12% with backward-curved blades and the total pressure provided by the fan is 500Pa (higher than the initial pressure). The fan with backward-curved blades is more suitable to maintain constant airflow and will create resistance against additional pressure in the ductwork.

The fan with forward-curved blades is less suitable to create resistance against pressure increase. The airflow drop is 30% and the total pressure also falls. The goal is eventually not achieved.

Comparison: constant pressure application

This particular ventilation system is composed of many branches. Fan speed is constant given the system is a belt drive system without variation.
The airflow is **8 000 m³/h** with a total pressure of **500 Pa**. The corresponding operating point is **point 1** (cf. *Appendix 1: forward-curved blades* page 6 and *Appendix 2: backward-curved blades* page 7).
The schematic drawing below gives and overview of the system's workings.

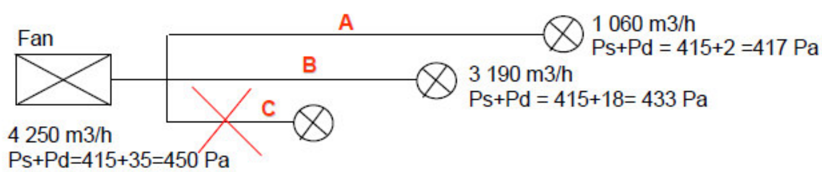


<u>Experience:</u> the C branch is artificially closed (using a damper). As per the ductwork physical modification, the fan operating point will develop to find a balance with the other branches that are still open.

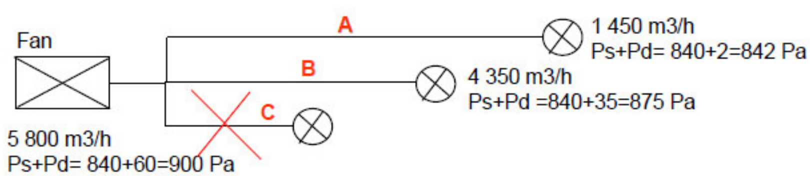
The operating point will slide along the fan curve until the intersection with the new ductwork curve. The new operating point is **point 2.**

<u>Comparison between a COMEFRI fan with forward-curved blades (TLZ) to a COMEFRI fan with backward-curved blades (T-HLZ) with the same wheel size (315mm):</u>

For a **fan with forward-curved blades**, the new balance point will be as follows:



For a **fan with backward-curved blades**, the new balance point will be as follows:



In the case of a multi-area system, the system's main goal is to maintain a relatively constant pressure and airflow in each branch for any ductwork modification.

The forward-curved fan is suitable as pressure and airflow remain quite close to the initial measurements (airflow: 6% increase / pressure: 8% increase).

The backward-curved fan will be a source of noise because pressure and airflow in each branch are too high (airflow: 45% increase / pressure: 118% increase).

Comparison: conclusion

Based on the previous two examples, the following conclusion ca be drawn: fans with backward-curved blades should not be favored when compared to fans with forward-curved blades (and vice versa).

The fan choice should be lead by the desired application:
- to maintain a constant airflow in a ductwork with constant geography but variable pressure drop,
- to maintain a constant airflow and pressure in each branch end in ductwork with variable geography.

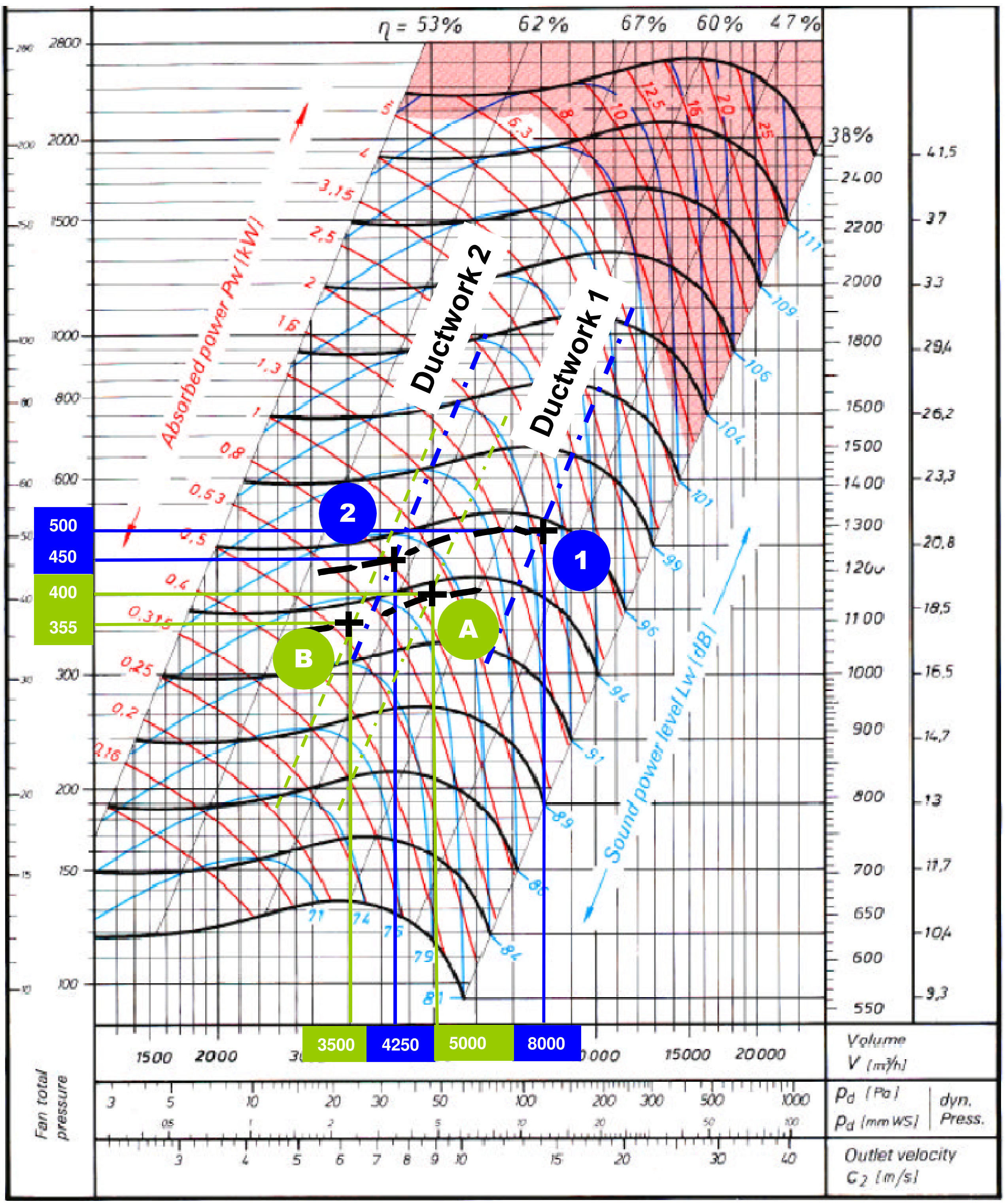
In individual and collective housing and commercial premises, these two applications are often used.
For example, our range of exhaust fans for cookerhoods are fans with backward-curved blades (type VELONE). The goal is to maintain a constant airflow in the ductwork despite of the cookerhood filter clogging.
Our exhaust fan range for collective housing are fans with forward-curved blades (type VEC, CVEC, TVEC). The goal is to maintain a constant pressure and airflow in each ductwork's branch for any state of the exhaust grilles.

Comparison: notions of characteristics

Below is the comparative technical data for the different sizes of COMEFRI fans.

DN (mm)	Wheel Type	Airflow (m^3/h)	Total pressure (Pa)	Dynamic pressure (Pa)	Speed (tr/min)	Acoustic power (dB)	Consumed power (kW)	Effic. (%)
180	Backward	1500	500	40	4100	82.2	0.3	75
	Forward				2050	79.5	0.35	58.5
250	Backward	3000	500	40	2700	85	0.56	75
	Forward				1420	82.3	0.67	64
355	Backward	6000	500	40	1850	87	1.08	77
	Forward				1000	85.8	1.3	68
500	Backward	12000	500	40	1300	89.5	2.2	77.5
	Forward				690	88.5	2.45	69.5
710	Backward	24000	500	40	920	93	4.3	78
	Forward				480	91	4.5	71.5
1000	Backward	48000	500	40	650	96	8.3	77.5
	Forward				340	94.2	9.2	73.5

Appendix 1: Fan with forward-curved blades



Appendix 2: Fan with backward-curved blades