FAN AIRFLOW AND PRESSURE

1.1. Airflow Q
A fan's airflow (Q) is the amount of air that it can displace per unit of time.
It is expressed in m3/h (1.7 m3/h = 1 CFM).

1.2. Dynamic pressure (Pd)
This is the force per unit of surface area produced by the movement of the air and it is exerted in the same direction as the direction of the airflow. This pressure is always positive.

1.3. Static Pressure (Pe)
This is the value of the force exerted by air on the duct walls, perpendicular to them. This pressure is positive when it is greater than atmospheric pressure. If the duct walls were elastic, we would see them dilate and bulge. (Overpressure). When it was negative, i.e. less than the atmospheric pressure, the walls would contract (underpressure).

1.4. Total pressure (Pt)
This is the sum of the static and dynamic pressure.
Pt = Pe + Pd
The unit of pressure used is mmH2O (mm of column of water) and it is equivalent to:
1mmH2O = 9.80665 Pa = 1mm.Wg
1 Pa (Pascal) = 1 N/m2

FAN TESTING

Fan testing aims to determine the airflow and pressure they provide, as well as all their electrical data and sound levels, in order to establish their characteristic curves.

2.1 Airflow/pressure testing
Airflow and pressure testing on SODECA fans is carried out at our fluid mechanics laboratory, in accordance with ANSI/AMCA STANDARD 210-85 and UNE 100-212-90. Fig. 1 shows the schematic of the ANSI/AMCA CHAMBER facility, with nozzles on the output and a variable system for the removal of air, used for axial fan measurement and testing. For testing centrifugal fans, regulation 7 of the above ANSI/AMCA standards is used.

2.2 Noise level testing
Due to the displacement of air and the movement of the impeller or turbine, the fan causes a certain level of noise, which is measured at our laboratory in accordance with standards ISO-3744 and ISO-3745. The values are determined according to free field measurements of pressure and sound levels, given in dB (A).

GRAPHICAL REPRESENTATION OF TESTS

A fan's characteristics curve is a graphical representation bringing together, on coordinate axes, all the values resulting from the tests. This curve will represent all the fan's possible working points. For any characteristics curve in this catalogue, we can see how the airflow (Q), plotted on the x-axis, drops as the static pressure (Pe) increases on the y-axis, and the airflow is at its maximum when the static pressure is 0, which is called free delivery. Thus we can see how the fan's curve gives us graphical information about the airflows that it can produce depending on the pressure that we require. Data given in our characteristics curves correspond to:

- Temperature - 20ºC

- Air density - 1.2046 kg/m3.

- Atmospheric pressure - 760 mm Hg.

FAN LAWS

The operation of a fan is governed by three basic parameters: specific weight of the air it impels d, angular (rotational) speed n and impeller diameter D. When these change, so do the characteristics of the fan. We will now consider each of the cases of changing one of the parameters while the other two remain constant:
4.1. Changing d, while n and D remain constant.
The characteristics of the fan are expressed for a specific weight d = 1.2 Kg/m3. Changes to this result in directly proportional changes to the pressures and to the power absorbed by the impeller. The airflow rate will remain unchanged.
If d' is the new specific weight, this gives:

$$Q' = Q \qquad P' = \frac{d'}{d} P \qquad N' = \frac{d'}{d} N$$

4.2. Changing n, while d and D remain constant.
Changing the impeller's rotational speed causes the characteristics to change as follows:

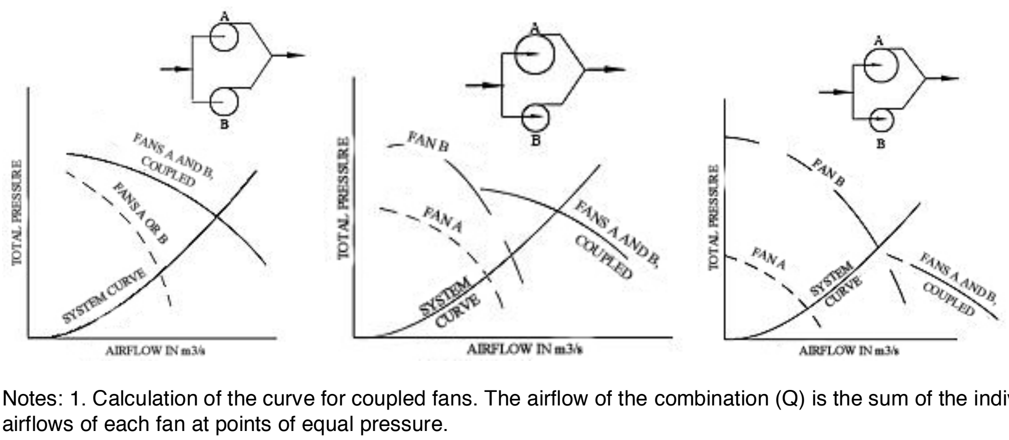
$$Q' = \frac{n'}{n} Q \qquad P' = \left(\frac{n'}{n}\right)^2 P \qquad N' = \left(\frac{n'}{n}\right)^3 N$$

n' is the value of the new speed.
4.3. Changing D, while d and n remain constant. This relationship is only valid for fans which are geometrically similar.
A new value, D' will give:

$$Q' = \left(\frac{D'}{D}\right)^3 Q \qquad P' = \left(\frac{D'}{D}\right)^2 P \qquad N' = \left(\frac{D'}{D}\right)^5 N$$

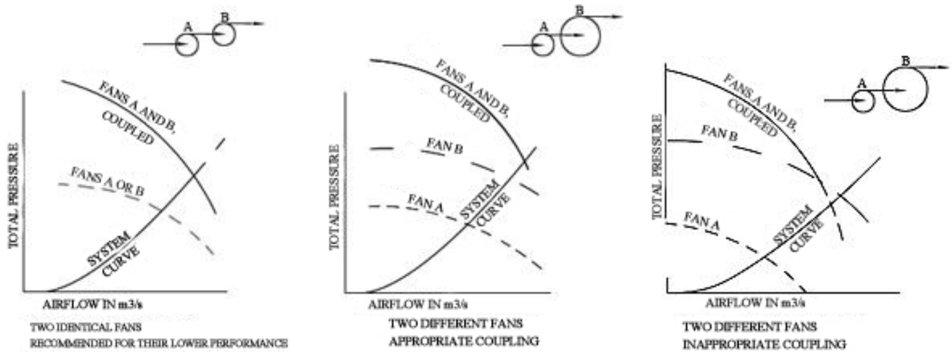
FAN COUPLING

5.1. Fans coupled in parallel



Notes: 1. Calculation of the curve for coupled fans. The airflow of the combination (Q) is the sum of the individual airflows of each fan at points of equal pressure.
2. When calculating the system curve, the losses in the individual connections to each fan must be included. 3. The system curve must cut the curve of the combination, otherwise the fan providing higher pressure, working alone, would give a higher airflow.
When the curve of the system does not cut the curve of the combination, or cut the prolongation of this curve before fan B, fan B will give a higher airflow than the coupling of A and B in parallel.

5.2. Fans coupled in series



Notes: 1. Calculation of the curve for coupled fans. The total pressure of the combination is the sum of the individual pressures, with the same airflow less the loss of head (or pressure) in the connection between fans. 2. The airflow through both fans will be the same because air is considered to be incompressible. 3. The system curve must cut the curve for the combination, otherwise the larger fan would give more airflow, working alone, than the combination of the two fans.