Why speed control fans and the importance of shaking hands?

The use of high efficiency fan systems is now common place. Driven by specific product regulations or the increase in electricity prices, the improvement of fan efficiency is on the radar of all end users.

So what can the industry do?

The fan industry now has a range of high efficiency motor and fan systems which it is marketing. From tried and tested high efficient EC motor systems to biomimetic systems, a confusion of answers is available in the market.

One answer to reducing power consumption that is based upon first principals is the advantage of speed control.

The physical fan laws define many variable and their inter relations. Two of the most useful to users of fans is the relations between fan speed and fan input power and fan speed and noise.

1. It reduces power

According to fan laws the power input to a fan is proportional to the speed of the fan raise to the power of three. This means that when speed reduction can be achieved substantial power savings can be achieved as shown in the table.

For instance if the fan speed is reduced by 25% down to 85% speed then the power is reduced by 68%!

Fan law / formula **~ fan speed** **~ (fan speed)^3** **50*log10(n1/n2)**

Fan Speed	Air Volume	Power	Noise / Sound in dB
100%	100%	100%	0.0
95%	95%	86%	-1.1
90%	90%	73%	-2.3
75%	75%	42%	-6.2
50%	50%	13%	-15
25%	25%	1.6%	-30

2. It reduces noise

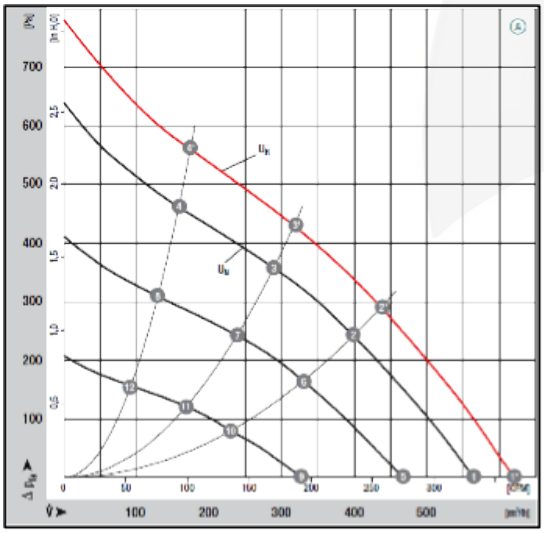
The effect of the 25% reduction in speed is to reduce the noise of the fan by 6.2dBa. In audible noise terms, a 3dBa reduction is the halving of the audible noise of a product – note: noise on the dBa scale is logarithmic.

Therefore of 6dBa reduction in noise is a halving and then halving again of the audible noise. This is very significant.

3. It gives the performance needed

The main reason for speed controlling fans is to change the performance. The graph below shows how the fan curve of an EC fan can be reduced by simply reducing the control. In this instance an EC fan has its level of control reduced and this has given a fixed output.

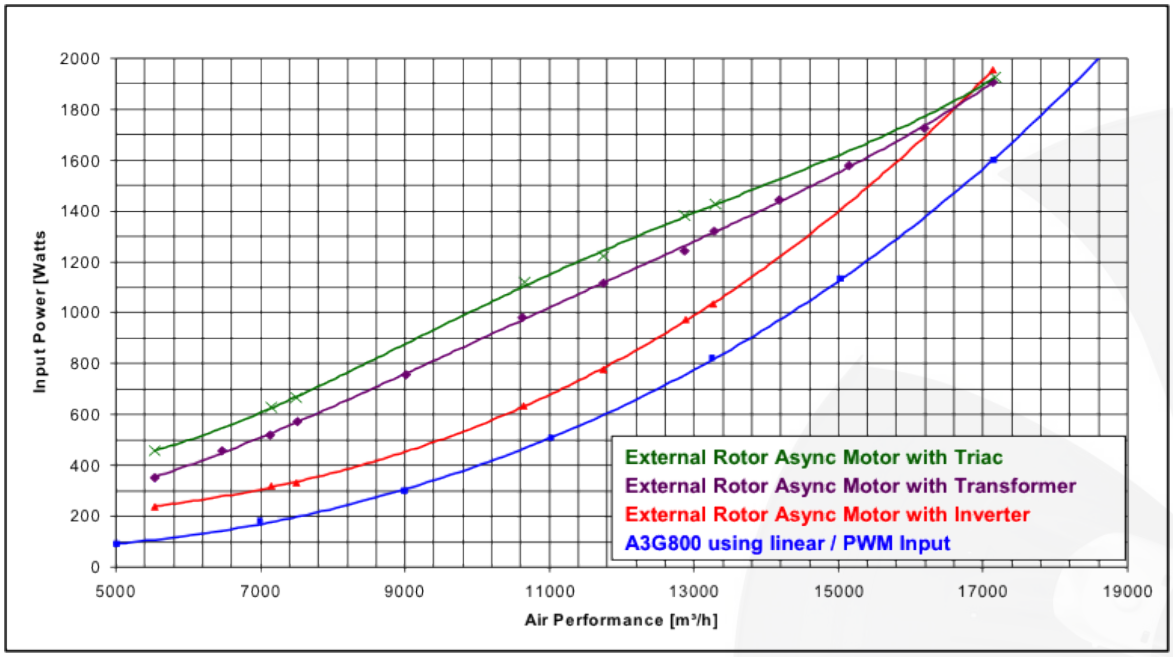
However, the fan can be simply controlled by fixing the fan speed to a given air volume or a given temperature say, and then the performance of the fan will be dynamic and the requirements of the system will always be maintained.



4. The importance of “hand shaking”

Having said all that has been said earlier in the piece, one truth should be stated: Fans don’t obey fan laws. Fan laws are derived from first principals and therefore assume that the system is not lossy and constant. This is never the case. For instance a 3~ AC motor reduces dramatically in efficiency as its speed is reduced.

Below in the graph, you can find a comparison of several methods of speed control of fan control. As can be seen the relationship between fan power and fan speed for AC fans which are controlled using a triac is linear. This is far from obeying fan laws.



Therefore, when I give a fan such as a high efficiency EC fan a driving voltage of 5V I am assuming that the performance is 50%. In reality this is never the case because we are assuming that we know the relationships between control and performance but we don't.

Therefore we need to "hand-shake control fans". This means that if we ask the fan to run at 50% speed then we would like the fan to tell us that it is doing 50% speed.

This is easily achieved using MODBUS RTU control of EC fans. This RS485 communication protocol allows full communication between the fan and the controller such the controller always knows the performance of the fan and indeed if the fan has a fault then the controller knows this as well. This is by far the best way of controlling fans and reduces their power consumption.

Find out more about EC technology on our website.