AIR AMPLIFICATION EXPLAINED AND HOW IS IT MEASURED

THE HONEST APPROACH TO COMPRESSED AIR BLOW OFF AND COOLING

The industry providing air amplification technology consists of few producers of any consequence and many small firms producing often poor quality or cheap knock-offs with little in-house technical support or knowledge. The technology may seem relatively simple as a concept but it is not always easy to maintain a high quality product.

What is even more important is the technical support that is provided and accurate verifiable data that a designer and user can apply confidently. Nex Flow™ Air Products Corp. attempts to provide the necessary education, support and "verifiable" data the customer needs. Always be wary of data provided when it seems unreasonable (and unverifiable), and especially when you see the data just copied from one source to the next with no explanation of what it means when they may not even have produced any in house tests.

WHAT IS AIR AMPLIFICATION ?

Air amplifiers, also called air movers, are energy "converters". They convert the higher pressure of compressed air (usually between 60 to 120 PSIG or 4 to 6 bar) to a high flow rate at lower pressure utilizing the "Coanda effect". The Coanda effect is the tendency of a jet of fluid (in this case air) to stay attached to an adjacent curved surface that is very well shaped. The principle was named after aerodynamics pioneer Henri Coanda. It does not create energy from nothing. It "converts" energy and would probably be better called an energy converter. Some results of this effect are much less energy loss from pressure drop, lower noise levels in air flow, and a high velocity "laminar" flow. This allows for a more efficient and strong blowoff force and cooling effect than if the compressed air exited a simple hole or nozzle not using the coanda effect. The larger the amplifier physically, the more efficient it becomes as a flow amplifier. This is why nozzles are not as efficient as larger Air Jets and annular amplifiers.

HOW IS AIR AMPLIFICATION MEASURED ?

Before you can assess "how much" air amplification is (also called the "amplification ratio"), you need to know how it can be measured. In addition to air amplification due to the coanda effect, there is "additional" air amplification downstream of the entrained air caused by the "coanda" angles. For our Standard Air Amplifiers, actual tests were done utilizing a complex testing rig consisting of orifice plates and manometer tubes and a tubular fixture with an anemometer that measured output velocity. The velocity was measured at the exit and downstream after air entrainment. The velocity figure as measured at the exit "before"downstream entrainment is significantly higher as the entrainment will slow down the velocity dramatically. The amplified air from the "coanda effect" is amplified many times in increasing volume as you move further downstream away from the amplifier outlet. At even a small 6" distance away, the amplification ratio can go up approximately by a factor of 3. These measurements must be made under standard conditions because, if the entrained air is warmer, it will actually move faster and the amplification ratio and velocities could be greater. So realistically, the "air amplification" ratio is always a gross estimate in real life applications. Similar logic should be used on published velocity figures. You may measure a velocity figure of 5000 feet per minute and see a published figure several times that number but it may only be an approximation or estimation "before" considering downstream entrainment. Nex Flow™ provides only verifiable data that can be used. The measured and verifiable figure is the most useful and realistic. Be very wary of extremely high velocity claims that you may not even be able to approximate in real life applications.

WHAT AMPLIFICATION MEANS ?

Note that the figures used in our data for amplification ratio for Air Amplifiers is the nearest realistic estimate between 60 psig (4.2 bar) and 120 psig (8.4 bar). Amplification ratio will depend on volume, pressure, atmospheric conditions and geometric design of the product itself. It can actually be a bit "higher" at lower pressures but we utilize the figures between 60 psig (4.2 bar) and 120 psig (8.4 bar) as this is the usability range for most applications. Annular Air Amplifiers peak out at about an air amplification ratio of 16 at an inlet pressure of 100 psig (7.0 bar) to 120 psig (8.4 bar). This is at the outlet before downstream entrainment. At lower pressures 20psig (1.4 bar) to 30 psig (2.1 bar)amplification ratios can reach as much as 20. Be wary of extremely high air amplification ratio claims. Downstream entrainment can be estimated at 3 times the amplified air at the outlet at a distance of 6" to 12" depending on the size of the amplifier. Downstream amplification will depend on "actual" velocity at that point as well as the dimensions of the amplifier itself. So when you see figures that do not seem logical, by all means ask for an explanation. For Air Blade™ Air Knives, the efficiency for amplification will be less than it would be for a mid-size "annular" Air Amplifier. The general estimate for air amplification is 9 to 10 times in the industry for the standard version, before downstream entrainment. It is about 13 times for the X-stream™ design versions because of the secondary surface for entrainment (30% boost is estimated). This again is based on the geometry of the Air Knives themselves and by interpolation using measurable force figures and air consumption figures. It is difficult to get an accurate measurement of velocity of an air knife without this downstream entrainment because of its geometry as compared to the annular shaped air amplifiers. For Air Knives with two exit slots, again, be wary of high amplification ratio claims.

At 6" from the exit of an Air Knife, convention estimates that the amplification ratio will go up by a factor of 3 which represents an amplification ratio of approximately 30 for a Standard Air Blade™ Air knife and 40 for an X-stream™ version. Again, these are estimates and can vary with both compressed air and atmospheric air conditions. Some firms have used an amplification ratio of 25 times which is just as reasonable an estimate. For products essentially the same dimensionally, great variations should not occur. At a distance greater than 6", the amplification ratio will go up but not linearly because the velocity slows down with further air entrainment. So at 12" the air amplification does not suddenly double and in fact will go up maybe another 30% and decrease further after that. Remember these are estimates. Estimates provided by Nex Flow™ are realistic estimates.

DUCTING AMPLIFIERS

Air Knives are not normally ducted. However air amplifiers can be ducted to convey fumes, gases & light materials. Because Air Amplifiers are highly subject to back pressure, the "amplification ratio" will go down dramatically if an Air Amplifier is ducted. Nex Flow™ technical support can advise on the actual amplified flows for any specific application you may have for "ducted" Air Amplifiers if this is required for any specified projects.

HOW TO COMPARE PRODUCTS

Nex Flow™ strives to maintain verifiability in technical data provided and not "stretch" data to an unrealistic degree. Data provided is obtained by direct measurement and / or reasonable interpolations. All charts and graphs provided are "best fit" information made from actual data & interpolations usable for engineering purposes. This information is usable and accurate within reasonable variation from any normal errors from any measurement. If you suspect a competitive claim as unrealistic, we can provide a realistic explanation and even provide a comparable product on loan to do a "comparative" performance test. The easiest comparison is to set the two similar products at the same pressure, and measure the force utilizing a sensitive scale. Realistically, if they are similar in design they will perform almost the same. Claims of small changes in things like shims rarely have any major effect on amplification ratios and performance when compared on exactly the same basis. If velocity is important velocity meters are also readily available for a relatively qualitative measurement. Be wary of extremely high velocity claims.

WHAT YOU WANT

The most important thing is that the product does the job it was purchased for and that it provides the performance and savings you want. For this, both accuracy and the knowledge of the provider are of utmost importance. It is clear that Nex Flow™ Air Products Corp. has the experience to provide the technical support required for this unique and important technology. For this reason, so few returns of our products occur. We do not just send something to "try" wasting valuable time. We want both us and the customer to have utmost confidence in our products.

AMPLIFICATION PRODUCTS

The products that can be classified as Air Amplifiers are as per the following sections:

Section B :- Air Blade™ Air Knives- linear amplification to replace rows of nozzles, slots and drilled pipe.

Section C :- Ring Blade™ Air Wipes- split amplifiers for use in extrusion processes.

Section D :- Air Amplifiers- the traditional annular amplification products which are the most efficient for many blow off and cooling applications as well as for venting and conveying of light materials.

Section E :- Air Nozzles and Jets- smaller amplifiers, and although not as efficient as larger amplifiers, they do save on air, improve safety and reduce noise levels, and because of the laminar flow produced, have a greater effective distance for blow off.

Section F :- Air Guns utilize mainly the air nozzles and jets for effective energy and noise reduction as well as for safety.