ACH is the common air conditioning abbreviation for Air Changes per Hour. It is also used to describe the airflow in an animal cage.

How is it defined?

One air change in a room, cage or any enclosed space (Lets call it the “space”) is the volume of that space in air, flowing into and out of that space.

For example a room size in meters, 3W X 5L X 2H, has a volume of 30 Cubic Meters: One Air Change occurs when 30 cubic meters of air flows into and out of the room. If this occurs in one hour then it is one ACH. If it occurs in one minute then it is 60 ACH. Note that there is no regard for how or where the air flows in or out of the space. Mixing of the air is a complex issue and depends on where the entry and exits to the space are placed, and how the flow is diffused at the entry port. Clearly for best effect/benefit the air inlet and outlet should be well apart and should be diffused to encourage the air to mix evenly in all parts of the space. Air conditioning vents come in all shapes and sizes but are characterized by:

- Being of a reasonable size relative to the space
- Being a reasonable distance between inlet and outlet to optimize mixing.
- Having a means to diffuse the incoming air to again optimize mixing.

Air conditioning engineers will set the air flow or ACH, depending on the activity in the room. An office may be 5 ACH whereas a Gymnasium may be 20 ACH.

What is the purpose of changing air in a room?

- To keep the air fresh by removing CO2 and odours.
- To regulate the temperature
- To maintain an acceptable humidity
- To, if required, control particles/pathogens/other airborne contaminants.

Let’s translate this to a mouse cage.

A typical IVC mouse cage has a volume of 6 Litres.

Manufactures of cages claim a range from 12 to 75 ACH in their cages for optimum performance. This number in itself is not the issue. 12 ACH is probably too low and 75 may not be enough.

What is important is the condition inside a cage where the animals live and where they live is totally dependent on the conditions in the main animal room where the racks/cages are housed. The settings on the rack will determine what happens in each cage.

It is known that a mouse transpires about 3mlt of water per day. It is also known that water apparatus in cages (bottles, pouches, or auto fixtures) can drip and leak. For a cage with 3 adult mice this will be approximately 20 to 25mlt per day. This will be distributed by urination to a part of the bedding in the cage and the cage air by expiration.

There are 3 factors in drying anything.

- Temperature.
- Humidity.
- Air flow.

Mouse rooms ideally should be controlled to 19 to 22 deg. C and a Relative Humidity of 35% to 45%. In some areas this is expensive to achieve but is nevertheless essential.

The only parameter within the control of the room Animal Technician is air flow in the cage. This is generally set with regulators on or attached to the rack.

If the room RH is 35% then with 3 adult mice 25 ACH will maintain a good cage environment.

If the room RH is 65% then even 75 ACH may not be enough to keep the cages dry and there will be a growth of flora and fauna in the damp bedding that will produce ammonia and other harmful products.

Finally , we must consider how air is introduced into, and exhausted from a cage.

From air conditioning principles mentioned above large vents widely space with good diffusion would be ideal.

Ideal is not easy and there are many approaches by different Manufacturers and they all seem to work; at least when the systems are new! What is perhaps the differentiating issue is how we can be sure of what is happening in any one of say 150 cages in a rack over a period of time.

Small inlets and outlets (ports) can be a problem particularly if the small ports don't have filter devices. It is not likely that an inlet port will block but an outlet port is very vulnerable. If an outlet port blocks the cage pressure will rise and the air, if it keeps flowing, will flow out of the cage to the room. Safety ports with filters may maintain reasonable operation of the cage but odours in the room will be significant.

If the cage seals are compromised, then cage air will flow directly to the room. No racking system in the market can report or remedy this problem to the Animal Technicians. The only remedy for some racks, is a complete rack clean out with vacuum cleaners etc. This work is generally called a "Service Contract" which can be expensive and disruptive with non-animal personnel working in a room.

Airlaw and several other manufacturers have dealt with this by increasing the size of the air ports in the cage.

The Airlaw ports are 85 mm X 85 mm (72Sq. cm) and 67mm X 20mm (13.4Sq. cm) compared with 7mm tubes which are 0.38 Sq. cm!

For the same airflow to and from the cage the port velocity difference is 35X!

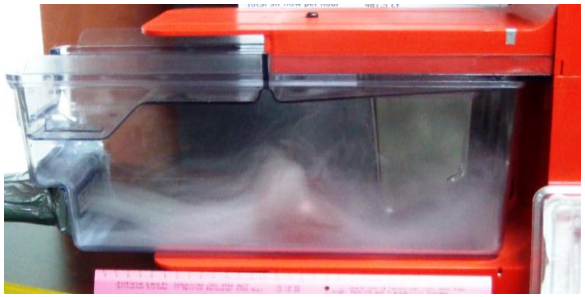
In the room described above there ports would be

- Airlaw 1Mt X 1Mt or 10,000 Sq.Cm and 804mm X 240mm or 1,929 Sq. mm
- Other cages 84 mm Dia or 57 Sq.cm Each!

Which is the better room?

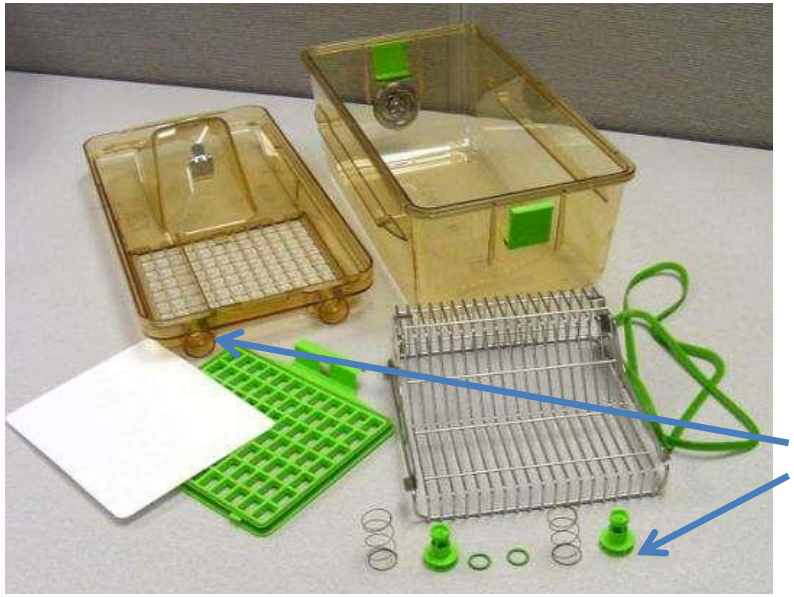
Features of airflow in cages

This cage has very large ports. One at each end of the cage



The above pictures are actual airflow in the Airlaw cage. These pictures were taken about 10 seconds after smoke was introduced. Note effect of the dome on the airflow. Cage pressure 1.7 Pascals.

Small ports mean higher pressure in the cage. This can be a problem as cages age. Note smoke leakage in several places



This cage has very small ports. Both ports at one end of the cage