



Snorkels for your 4WD

The operation of a snorkel

Snorkels have been in use for a long time on vehicles and craft. Before World War 1, they were used on tanks and later on submarines. After WW1 and the mechanisation of agriculture, they were fitted on tractors and transport vehicles with the unique purpose to supply the engine with air free of water and contaminants.

In more recent times, with the advent of leisure 4WD vehicles, snorkels are now mostly fitted to allow the crossing of rivers without causing damage to the engine. However, more benefits can be obtained from a well designed Snorkel. This is where the **Airflow Cold Air Induction System (ACAIS)** comes to the rescue.

ACAIS is much more

The **ACAIS** is designed to improve the fuel efficiency and power of your vehicle. These two goals may appear contradictory, but we have succeeded in combining them. In the process, we did not forget style; fitting like a glove, the Snorkel complements your vehicle. Once installed, your 4WD will be ready for new adventures and maybe some river crossings!

Not all snorkel body designs in the big wide world produce a **cold air induction effect**. This effect improves fuel efficiency while improving also engine power. Airflow Vector has been conducting airflow studies, friction loss assessments and performance testing in its laboratories for many years to achieve this effect.

In the past, physical presentation took a back-step to operation which was always foremost in the design. However, in recent years, our customer base has become more discerning about the appearance of Snorkels. This motivated us to refine the “look” and the “fit”.

Like many examples in nature, the study of airflow trajectory and pressure gave birth to shapes with “perfect fit to purpose” where elegance and efficiency are combined. A new range of **ACAIS** was born, one which increases the performance and efficiency of your 4WD.

How does it work

A combustion engine needs air and fuel to operate. The more air and oxygen flow into the intake manifold, the more efficient is the combustion.

The ACAIS harvests fresh air at roof level where it is the least disturbed. This air contains less contaminant and is cooler than air absorbed from the engine bay. When the air is cooler, it contains more oxygen.

Modern vehicles are fitted with engine management systems; these are computers which measure accurately in real-time all inputs available to the engine to improve its efficiency. Consequently, the availability of cooler air inflow results in more power and torque.

Three main parts constitute an **ACAIS**: a “hat” we call the “**Air Ram**”, a Snorkel tube we

call the “**Body**” and an air filter called the **PACC**. The three parts are designed to complement each other in their efficiency.

The Air Ram

Air entering the Air Ram swirls violently, creating a cyclonic effect. The heaviest particles are ejected by the centrifugal force to the periphery of the swirl. There, they hit the vertical ribs where air pressure takes over to eject them out of the four slots at the base of the Air Ram. At this point, the air pressure pushes them out. The finer particles that are not ejected are removed by the vehicle air filter.

Comparison: not all Air Rams are equal in performance.

It is preferable for the Air Ram to have an open face without a screen because the screen deflects the airflow.

The surface ratio of the open face to outlet aperture must be a minimum of 1.4:1. If the ratio is lesser, it will be insufficient to create the cyclone action that separates heavy contaminants effectively.

Approximately 30% of the incoming airflow (above 25kph / 15mph) is used in the separation process.

At Airflow Vector we ensure that the Airflow range uses a minimum of 1.4:1 for the 3” air ram, 1.7:1 for the 3.5” air ram and 2:1 for the cold air induction air ram.

Any deflection of the incoming airflow must be avoided since it dramatically affects efficiency. Deflections may be caused by:

- 1- Air Ram situated in close proximity to the bonnet/hood of the vehicle,
- 2- Air Ram with a curved or foiled roof,
- 3- Turning Air Ram away from travel direction,
- 4- Where Air Ram design makes the air go back on itself at an angle greater than 100 degrees.

If the Air Ram is turned away from the direction of travel, it will lessen the necessary positive pressure. In extreme situations, at higher speed, a vacuum may be generated causing irreversible engine damage!

Incorrect Air Ram design may cause excessive induction noise, lack of separation and air blocking by vortex at various speeds. This air blocking will limit airflow. This is a common occurrence when “looks” take priority over functionality.

If the Air Ram is moulded on the body of the snorkel (for aesthetic reasons) it does not provide particle separation, thus all contaminants need to be removed by the internal air filter. This increases the maintenance cycle of the air cleaner. Furthermore, this configuration may cause a vacuum into the snorkel, thus increasing the risk of engine damage

The Body

Now that the air is free of large particles, it starts travelling down the snorkel body in a straight line. The body may be of two types, induction or non-induction. In the induction case, the air slows down because it enters in a larger volume, the plenum chamber. The swirling created by the Air Ram diminishes, thus reducing friction losses. There, the air is buffered, immediately available for the air box at positive pressure. The engine management system can use it readily.

Comparison: not all bodies are equal in performance.

In the case of a non-induction body, the air passes down directly to the bonnet tubing and ducting into the air box. While this technique increases efficiency and engine performance, it is not as effective as the cold air induction type.

The PCAC

The PCAC is a replacement for the air filter: while it removes the smallest of particles, it compresses the air to make it available at even higher pressure than when it arrives from the body.

Comparison: not all air cleaners are equal in performance.

Commonly, there are two types of air cleaner fitted to cars by manufacturers: the Flat Air Cleaner and the Cyclonic Air Cleaner, both fitted with paper filters. While they conform to emission laws, they are not fuel or power efficient. The Cyclonic is the most effective of the two types.

Some after market suppliers replace the paper filter by a foam oil filter to further increase airflow and thus power to the engine. However, what is gained in power is lost in filtration. Generally, a paper filter will suppress particles down to 30 microns while foam oil filters will not filter below 40 to 50 microns. Larger particle sizes will increase exponentially the risk of damage to the power plant.

Airflow Vector's goal is to filter particles to less than 10 microns.

Airflow Vector has improved the already better Cyclonic Air Cleaner by creating the **Parabolic Cyclonic Air Cleaner**, the **PCAC**. The **PCAC** has the least friction losses while maintaining particles filtering to less than 10 microns at all engine speeds. When combined to the **ACAIS**, it further provides dramatic improvements in performance and efficiency across the total power range of the engine.

Conclusion

Purchasing an **ACAIS** ought to improve your car's performance at most engine speeds. Furthermore, it should reduce fuel consumption and make your engine run cleaner. This is future proofing your adventures.

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