AIRTAB®: A DISCUSSION PAPER

With the rapid rise in fuel prices the Airtab® product is beginning to attract more attention, including speculation on how they actually perform. This paper intends to shed more light on our product.

The Airtab® shape is based on the National Advisory Committee on Aeronautics (NACA) submerged air inlet duct. (see Figure 1) The NACA Duct has been successfully used on aircraft fuselages and racing vehicles for decades. The impetus for the creation of the NACA duct came from the need to pull attached airflow into required spaces for various reasons (cooling, air conditioning, tank pressurization etc.) without using a high profile drag ram air scoop. Need for this innovative inlet duct became more urgent as aircraft and vehicle speeds increased.

The Airtab® adopted the same shape as a NACA Duct but is three-dimensional and protrudes into the airflow. Aeroserve Technologies modified and streamlined the shape to perform at its optimum within typical highway speeds ranges. Airtabs™ are all about free stream, near wake airflow modification and have nothing whatever to do with boundary layer modification, wing stall issues, road vehicle to aircraft wing size ratios or any other classical aerodynamic application of traditional vane style vortex generators used to enhance wing performance in the lower speed regimes. Airtabs™ come from the aviation world, but they are neither used nor needed in that world. Modern aircraft fuselages are highly streamlined and travel far too fast for a protruding Airtab® to be of use. They also lack the gaps, nooks, crannies and blunt aft ends that make up the greatest drag regions on highway vehicles.

If this were a highly technical paper, it might be named:

"High Profile Transport Vehicle Stability Enhancement, Base Pressure Drag Reduction and Fuel Economy Improvement through Forced, Arrayed, Stream-Wise, Near Wake Vorticity."

But we'd rather just say: "Stick these things on your rig…they work."

Given an ample supply of relatively undisturbed airflow, the Airtab® works precisely as claimed, and has done so since our first wind tunnel tests. This test involved a full sized hatchback style vehicle in an accredited wind tunnel and yielded a reduction in power required to maintain 55mph. It is noteworthy that our test vehicle produced such results with Airtabs™ only on the sides and none on the top (see Figure 2 below). These first wind tunnel trial results have been reinforced with test track data, client testimonials and anecdotal results to the present date. That is; a base pressure drag reduction factor and resultant fuel economy improvement in the 2 to 4% range. The size of the vehicle does not appear to matter. The physics and aerodynamics involved remain constant. For more information visit www.airtab.com under "tested".

Originally marketed solely as a fuel saver, the Airtab® quickly revealed other noteworthy benefits. All users, regardless of vehicle type, have remarked almost immediately on increased vehicle stability, especially in gusty wind conditions, when passing or being passed on multi lane roads and when buffeted by large on-coming vehicles on two lane roads. This increased vehicle stability provides an improved safety margin by reducing driver workload, stress and fatigue. The stability observation has been especially noted in the RV world where, due to their high volume and low GVW nature, they are especially vulnerable to high winds or buffeting from nearby traffic. Users also report less spray in rain or snow, much improved rear view mirror visibility and safer lane changes. We have been provided with several photographs (See Figure 3) of client trucks that have just driven through snowstorms and that show a remarkably clean back end when compared to other rigs that have driven through the same storm. This offers further evidence that Airtabs™ reduce the vacuum at the back or base area of the vehicle and therefore reduce drag a like amount. Neither the vehicle stability enhancements nor the visibility improvements can be proven in any wind tunnel.

"The wind comes in gusts." -Landau-

Long term clients have remarked that their tires are lasting longer than before the installation of Airtabs™. This has not been documented, but the observation constitutes a rational result of improved vehicle stability and reduced sway. It is a fact that many of our clients believe the increased vehicle stability alone is worth the modest cost of Airtabs™ and view fuel savings as an added bonus. Intuitively, if a highway vehicle is more stable and requires less corrective steering inputs, there is less tire scrubbing, deformation and wear. It follows that such a vehicle will require less fuel because there is reduced rolling friction. This benefit is in addition to the aerodynamic benefits.

Each Airtab® generates two vigorous counter-rotating vortices 4 to 5 times the height of the Airtab® and several feet in length before bursting NASA tests have shown that for the strength of its vortices, the Airtab® shape is the lowest parasitic drag vortex generators that they have ever tested. Indeed, NASA uses the same Airtab® vortex generator technology to reduce turbulence in their wind tunnel in Langley Virginia. See www.Airtab.com under photo gallery.

Most of the benefits for the user are due to increased vehicle stability. Airtabs™ mounted on a tractor faring also reduce the amount of turbulent air that enters the gap between the tractor and trailer, especially in cross wind situations. This reduces drag between the power unit and load and reduces buffeting. This energetic stream-wise vorticity also encourages the airflow to remain "attached" as it flows down the sides of the trailer. The reported reduced side spray in rain is evidence of this streamlining effect. Also, truckers who haul "soft", or "curtain sided" trailers remark on how much less flapping the tarps do with Airtabs™ installed. This is further evidence of attached flow. LongHaul Trucking in Albertville, MN has equipped its entire soft-sided fleet with Airtabs™. See website under "**News**" and for a paper on " Airflow White Paper".

At the rear or any trailer or square backed vehicle, the alternating formation and shedding of the large random vertical eddies that form, cross the back of the trailer and shed off the opposite side contributes to vehicle sway, unwanted lane wandering and tire scrubbing. Airtabs™ replace these large vertical eddies with a tight array of vigorous horizontal vortices and this airflow alteration settles the vehicle and reduces sway.

The base pressure drag reduction mechanics at the back end of the vehicle are much more difficult to quantify. We know how Airtabs™ work, but in this area we are not positive why they work.

To quote the inventor of the Wheeler Wishbone Vortex Generator:
"Correctly analyzing the fluid dynamics of a free stream vortex is a bit of a black art…and anyone who claims that they can explain it may not fully grasp the problem."

To quote Sir Horace Lamb, (1932), one of the founding fathers in the study of fluid dynamics: "When I die and go to heaven, there are two matters on which I hope for enlightenment; one is quantum electrodynamics and the other is turbulent motion of fluids. And about the former, I am really optimistic."

Aeroserve Technologies support two likely theories concerning the mechanics of the reduction in base pressure drag through free stream near wake vorticity;

1. That the modification of airflow from large random eddies to a vigorous array of horizontal vortices formed at the sides and roof at the rear of the trailer form a virtual tail cone, similar to that on an aircraft, to reduce the drag at the base area. That is, Airtabs™ alter the wake to cause it to behave as if the base area was slightly smaller then it actually is, with the resultant drag reduction and fuel savings. The benefits from this drag reduction outweigh the low parasitic drag Airtabs™ create.

2. That the continuous forming and bursting of the array of vortices adds energy and pressure to the base area, reducing the partial vacuum that forms at highway speeds. The reduction of vacuum reduces base pressure drag and fuel consumption. The actual mechanics of this phenomenon remain a mystery, something that classical aerodynamics, wind tunnels or Computational Fluid Dynamics have not yet been able to satisfactorily explain.

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Figure 1: NACA Duct.

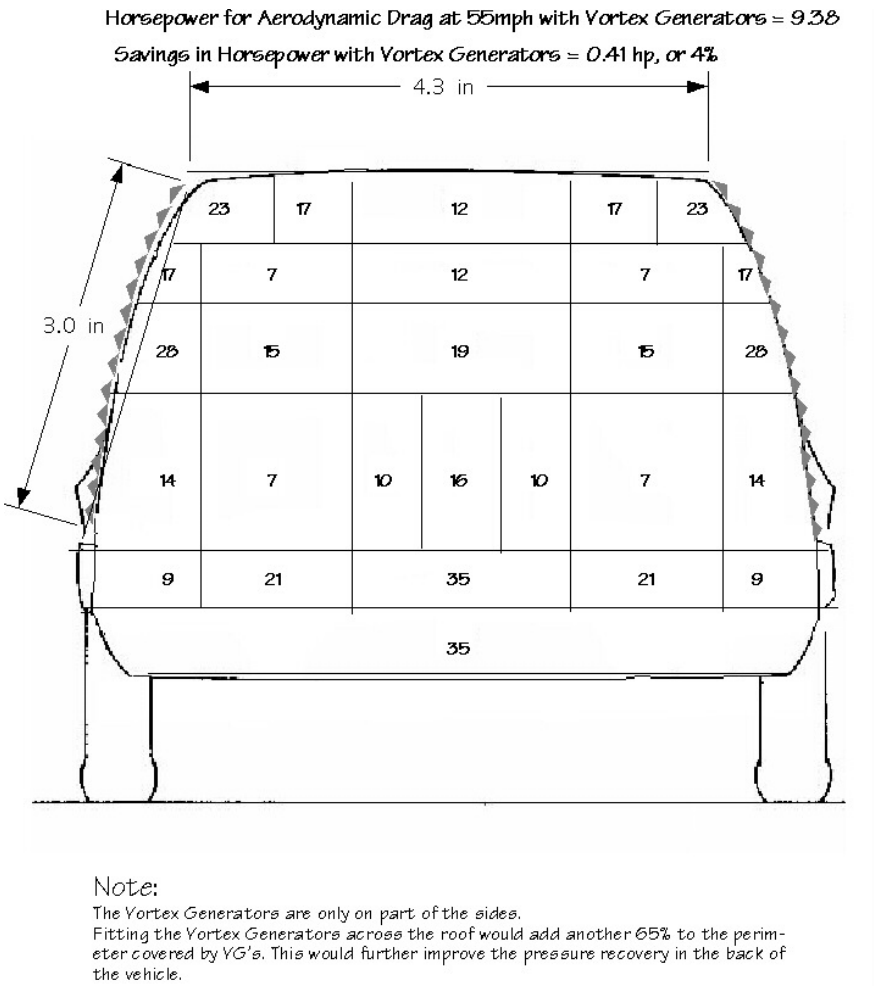

Figure 2: Honda Civic in Georgia Tech Wind Tunnel.

Figure 3: Clean doors on Trailer after driving in snow storm.