Aerodynamic Mudflaps

Go Green Without Breaking Your Budget - Part 3

Recent editions of *Fleet Affiliation* have addressed ways to improve the fuel efficiency of conventional trucks. This month's issue will focus on the role of vehicle aerodynamics. Remember that these suggestions are not all-inclusive and don't apply to every vehicle or application. If you have ideas or comments, please e-mail me at bobj@ntea.com.

Vehicle Aerodynamics
A moving vehicle must displace the air it passes through. The amount of horsepower needed to accomplish this task varies significantly depending on the vehicle's frontal cross section, coefficient of aerodynamic drag and speed.

Use the following formula to calculate the horsepower necessary to overcome this air resistance:

$$HP_A = \frac{F_A \times C_D \times (MPH)^3}{156{,}000}$$

Where: F_A = vehicle frontal area
C_D = Vehicle coefficient of drag

As you can see, vehicle speed has the greatest impact on aero horsepower demands, since the effect of vehicle speed is a cubed factor. This means that if speed is doubled, the demand horsepower is increased by a factor of eight (2 x 2 x 2). This also means that if a vehicle normally operates at a low speed (below 25 MPH), you shouldn't spend a lot of money trying to improve its aerodynamics.

Road Speed
If your vehicle mainly operates on the highway, one of the easiest ways to reduce fuel consumption is to limit its road speed. In the past, this was accomplished by using mechanical governors or by gear binding the vehicle. Unfortunately, these methods often had a negative impact on overall performance. Today, many vehicle powertrain control modules (PCMs) can limit the high gear road speed without otherwise impacting performance. It's simply a matter of determining what the maximum road speed should be to ensure vehicle safety and productivity and then setting it to this value.

Two other factors to consider in improving aerodynamics are vehicle frontal cross section and coefficient of drag.

Cross Section
The cross section is calculated by multiplying the maximum vehicle width by the maximum vehicle height minus .75'. If you are operating a box truck or a cube van, you can't do much about vehicle cross section other than ensuring the vehicle is no taller than necessary to perform its job and that there is nothing hanging on the outside of the body to increase the vehicle's effective width. However, many vocational vehicles, especially dump trucks and service bodies, are equipped with various accessories that effectively increase overall height. Even if these accessories have a relatively small overall width, they can significantly impact aerodynamics.

As a rough rule of thumb, if the overall width of items projecting above the nominal top of a truck cab or body equals half or more of the total vehicle width, you need to include the total height of these items in frontal cross section calculations. If they are less than half, use a value equal to one-half to one-fourth of their height (depending on total width) in your calculations.

What all of this actually means is that placement of accessory components can impact overall fuel economy. To minimize aero horsepower demands, try to keep accessory components below the nominal top of the truck's body. Seemingly insignificant items such as a spare tire on a rack above the cab; tubes or brackets for storing tools such as shovels and rakes across the front of a landscaper's body; and ladder racks can easily add 10% or more to the frontal cross section of a work truck.

Coefficient of Drag
The final aero factor to consider when designing vehicles is the coefficient of drag. There is no practical way to accurately determine the coefficient of drag for a specific vehicle without using a wind tunnel or complex computer modeling system. Numerous charts and tables are available to help you estimate a C_D factor, but the value you determine will still only be an estimate.

The aero horsepower formula at the beginning of this article is based on the assumption that a typical box truck will have a drag factor of "1". A high-quality aero package on a tractor-trailer with a close tractor-to-trailer gap (36") or a well-designed full nose cone on a straight truck can reduce the C_D factor to as little as .6 (or even less for some of the more elaborate full skirt systems). On the other hand, an aero-dirty truck can have a C_D as high as 1.5. It falls on the vehicle designer to use common sense when designing and placing components.

Little progress has been made on improving the aerodynamics of work truck components, such as cranes, aerial lifts, ladder racks, etc. To a large degree, the very nature of these components limits manufacturers in producing aero-clean configurations.

On the other hand, the past several years have brought significant improvements in the design of vehicles, truck second units and aftermarket accessory items to reduce aero drag. These include items such as low-drag rearview mirror systems, cleaner body designs and even aerodynamic mud flaps. You can see many of these items firsthand at The Work Truck Show 2010, March 10–12, 2010 at America's Center in St. Louis, MO.

Next Issue
Next month's *Fleet Affiliation* will address maximizing your engine and driveline efficiencies and controlling vehicle parasitic losses. Future issues will detail ways to reduce fuel consumption in other vocational truck drive cycles.

Contact Bob Johnson, NTEA fleet relations director, at bobj@ntea.com if you have suggestions for future Fleet Affiliation topics or for more information on how the NTEA can benefit your company.