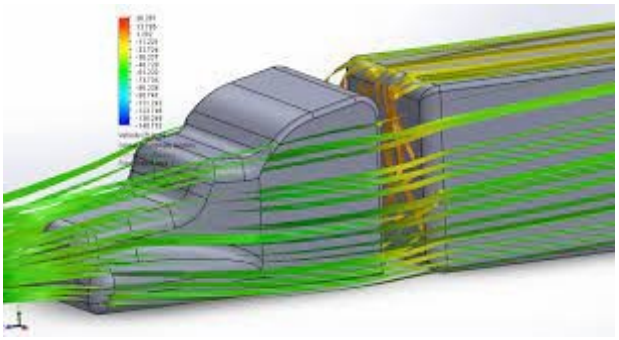
Application Note

Aerodynamic Optimisation – creating fuel savings for the long haul



THE CHALLENGE

APPLICATION: TRUCK AERODYNAMIC OPTIMISATION

The Application:

Almost 50% of the fuel consumption of the trucks that use our highways, every hour of every day, is used in overcoming aerodynamic drag. For the operator this directly impacts profitability through fuel cost, additional noise, handling issues, emissions, and driver fatigue, but also impacts others road users, through excessive turbulence, creating challenging driving conditions, especially in rain.

Aerodynamic drag is a function of velocity, air density and frontal area of the vehicle and such is the effect of drag, as it increases exponentially with speed, that the power required to overcome it is proportional to the cube of the speed – double the speed and you need 8x the power to overcome it – it's easy to see why there's a lot of research going into improving truck aerodynamic efficiency!

One of the key principles of reducing drag is keeping the air flow attached to the surfaces, which results in smooth airflow, reduced turbulence and noise and enhanced fuel efficiency. The basic shape of a truck, determined by its payload and therefore overall size, is inherently block-like in shape and aerodynamically inefficient, necessary appendages, like mirrors, sun visors and even an open window, contribute percentage points of drag to the vehicle.

Everyone from the truck and trailer manufacturer to the operator who is paying for the fuel, wants the drag coefficient of the truck to be reduced and significant research goes into this endeavour.

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The Measurement Challenge:

In order to address the source of the drag, it's important to measure it. With CFD techniques, the engineer can model the truck geometry and get an insight into the airflow over, under and around the truck. Models are often constructed and tested in the wind tunnel to determine attributes such as drag, downforce/lift and stability, as well as assessing truck safety in a likely cross-wind conditions.

The true test of vehicle performance comes when the full-scale truck is built as a prototype and tested in real-world conditions, on a test track, with measurements made on-board the truck. Tests such as Coast Down and High-Speed runs are used to assess vehicle performance and comprehensive quantitive as well as qualitative data is gathered.

Testing is expensive and the challenge is to collect accurate meaningful data and make every second of test-time count, whether that be in the wind tunnel or on the full-size truck. Engineers work to gather as much data as possible in the available time and use this measured data to assess overall aerodynamic performance and look to make improvements, for example in surface shapes, to minimise their resistance and turbulence.

Typical models are fitted with numerous small pressure tappings that allow the localised pressure to be measured at a multitude (often many hundreds) of points on the aerodynamic surfaces. Often pressure patches are used on the surfaces as well as multi-hole probes. The tubes that these feed, connect directly to the in-model/On-truck pressure scanners for conversion to pressure measurements, which are then time-stamped, synchronised and communicated to the computer systems via Ethernet or CANbus for mapping and further analysis.

Tubing lengths should be kept as short as possible, whilst striving to collect data from the furthest extremities. Often the pressure scanner can easily be cab- or trailer- mounted, but often to enhance measurement performance fitting pressure scanners as close as possible to the point of measurement is ideal. Data collection rate is also a challenge, to ensure that as many measurements as possible, often thousands per channel per second, are gathered in the available time.

Typical Users:

Vehicle development teams run their own wind tunnels, but some sub-contract the testing programme to an external wind tunnel operator, who may also provide design consultancy, in addition to gathering and presenting the data from the model test runs. Further data is gathered directly from the full-scale truck to ensure that the full picture is seen. The truck manufacturers strive to create the most efficient vehicles to help the user select the right vehicle for their service requirements. Additionally, many companies are dedicated to creating after-market drag reduction devices, such as roof fairings, wheel covers and side skirts (which together can save a further 15% of fuel consumption). and these are extensively tested and measured.

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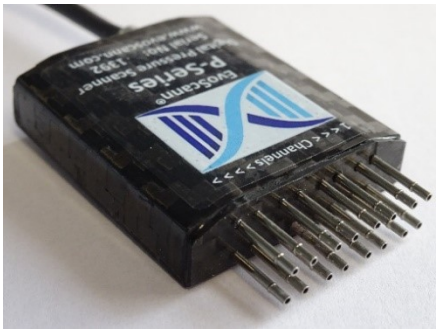
THE SOLUTIONS

EVOLUTION MEASUREMENT OFFERS MULTIPLE SOLUTIONS FOR THE APPLICATION

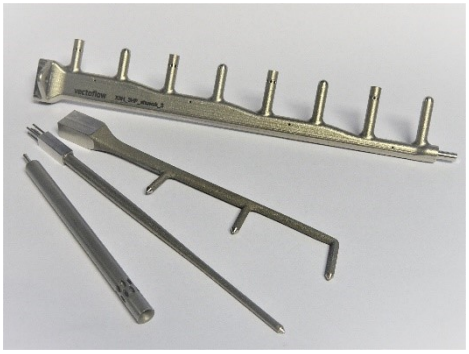
Scanivalve MPS 4264 pressure scanners are mounted within the model or in the truck cabin to collect the huge amount of data being generated under test. Ethernet outputs and power supplies can be supplied that allow for plug-and-play installation and synchronisation of many scanners to handle real-time data of over many hundreds of fast, responsive, accurate pressure measurements.

In this application, the pressures can quite low, so low-pressure range availability is critical, whilst achieving high accuracy, repeatability and sensitivity.

Removable headers on the scanner mean that 64 tubes may be conveniently connected before the scanner is installed in the model or truck and adds to the versatility of using one scanner on multiple models or locations, to reduce downtime during test periods. The headers can remain fitted to tappings for later use.



EvoScann Aerodynamic pressure scanners are often used in remote locations where the tubing should be kept as short as possible to enhance measurement performance. These are usually connected directly to the vehicle via the CANbus network, or can be connected to loggers or laptops to gather real-time, live data.



Our range of **Vectoflow Multihole probes and rake arrays** are used to provide local velocity, pitch and yaw measurements, as well as being able to gather reference static measurements. Everything from a simple single Kiel probe for local velocity measurement through to complex custom rakes can be supplied.

In addition to a versatile range of pressure scanners, Evolution Measurement offer the widest range of accessories including pressure tubulations, pressure patches, tubing and pneumatic connectors to connect the whole system for ease of installation and commissioning.

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We'd love to tell you more -

Download the datasheets and find out a lot more about our range for this application:

http://www.evolutionmeasurement.com

Or speak with us about your requirements:

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