

# Setting the standard

Based in the heart of NASCAR country, the AeroDyn wind tunnel in Mooresville, North Carolina has been picked out to validate the figures for the new Generation 6 cars



The 2013 Lowe's Chevrolet SS during wind tunnel testing

The introduction of the Generation 6 cars to NASCAR has meant a reliance on the expertise of the wind tunnel specialists, and in particular the AeroDyn facility in North Carolina that was chosen by NASCAR to make the final verification for the bodies ahead of their introduction at Daytona.

AeroDyn will this year celebrate its 10th anniversary, having accepted its first paying client in April 2003. Since then, it has seen business expand rapidly in the first five years, before the financial crash in 2008 that led to a gradual decline in trade over the next two.

However, since 2010, business has picked up once again, and its reputation has strengthened considerably. In the company's early years, their main tunnel - which offers a boundary layer control, spinning wheels and an

automatic ride height adjustment that is accurate to the third decimal percentile - was in use 24 hours a day, five days a week, plus extra time on Saturday. They're now running 18 hours a day, five days a week, which is - says general manager Steve Dickert - a more comfortable position to be in, allowing engineers time to maintain the facility between sessions.

'AeroDyn was the first wind tunnel in the United States designed specifically for NASCAR race series,' says Dickert. 'Of late, we have been able to offer some testing capability to OEM manufacturers that they don't get in their own wind tunnel - very

controlled and accurate boundary layer system, and automated ride height control system that is accurate to the third decimal place. Those are functionalities that wind tunnels at GM, Ford and Chrysler don't have, all at the same time.'

The move to the new cars, coupled with the official sanction from NASCAR, has meant that the tunnel is busy enough, and the work is becoming more complicated. Teams have to start from scratch with their aero figures as there is no baseline from which to work with the Gen-6 cars. It has been six years since the last big rule change to stockcar racing, and the engineers are, from an aerodynamic point of view, pretty much starting afresh.

'The cup teams are extremely sensitive to security,' adds Dickert, 'so we can't have us be a conduit for one cup team's advantage to another cup team's advantage. We provide and operate a precision laboratory that meets or exceeds the needs of our customers.'

The Gen-6 cars have required much the same aerodynamic development as previous generations, but have to immediately be on the pace in a closely contested environment. Much as Formula 1 is looking ahead to the rule changes in 2014 with apprehension after one of its closest seasons ever in 2012, the pressure is on for the NASCAR teams to get it right first time out in 2013.

'It is interesting that the level of teamwork between NASCAR and manufacturers is unprecedented with the development of the new cars,'

**“The level of teamwork between NASCAR and manufacturers is unprecedented with the new cars”**



Wheels are not rotated in A2, the smaller alternative to the main tunnel

says Dickert. 'The development has always been driven by NASCAR, but this time it really is a team effort.'

The AeroDyn tunnel is built to accommodate full-scale cars only, with speeds up to 130mph. The loads from 130-200mph are linear with dynamic pressure. 'With scale model testing, there is a significant Reynolds number mismatch - for example a half-scale model must be tested at twice the full-scale speed. By using the full-scale car you can appreciate the deflections,' says aerodynamic consultant Gary Romberg. 'We think that gives a better simulation to what you get on the track. Our normal testing is 130mph, but we can run other speeds below that, and even a few speeds above it. The general speed is 130mph, which is almost 40lbs/sqft in kinetic energy.'

Also on site is the second wind tunnel - A2. This tunnel is a smaller, economical solution for customer teams that are involved in everything, from land speed record attempts to road racing, and karting. Available at \$490/hour, the company also offers aerodynamic expertise through its own dedicated staff says David Salazar, general manager of A2.

'It is a smaller tunnel, of

the same design as AeroDyn with an 85mph maximum wind speed. It does not have spinning wheels, active boundary layer control or ride height control,' says Salazar. 'What it does have is a greatly reduced rate, so that smaller teams and privateers - and by privateers I mean people who are attempting land speed records on salt flats, they come there quite regularly. They can get large gross aero advantages for very little money in a very controlled laboratory.' This can be essential to them, and, for a series were the winner gets a hat or a T-shirt, not prize money, this proves to be a great tool when on that kind of out of pocket budget.

Most of A2's customers come in as first time users and have never set foot inside a wind tunnel. As such, Aerodyn offers assistance for these teams to help point them in the right direction and teach them how to understand the wind tunnel data. This assistance is valuable because most people are intimidated by testing in a wind tunnel for the first time and don't normally know where to begin. Along with this help is the understanding that AeroDyn do not develop the cars or tell them what other customers are doing with their aero programmes. As many low budget teams don't have



A last generation car on the move in the main AeroDyn tunnel

an engineer, the firm can offer some assistance in guiding them along until they better understand the process.

**DEVELOPMENT PROGRAMME**

Since opening for business in April 2003, AeroDyn believes that it has tested more racecars than any other independent wind tunnel in the world. It has tripled the amount of data customers collect in a single test session, improved repeatability from

1 per cent to 0.8 per cent, and decreased fault-related down time by a factor of six.

In the period since 2006, AeroDyn has added the following upgrades to the facility:

**Ride Height System**

Installed in November 2006, the new system is completely computer operated. To increase testing efficiency, teams provide a complete map of heights they would like to run for a given

**CFD CAPABILITIES**

The management team at the AeroDyn facility do not consider the rise of Computational Flow Dynamics (CFD) to be a threat to its wind tunnel business, having investigated with teams and manufacturers the viability of providing in-house expertise. Most of the teams and manufacturers have their own capabilities, and even the smaller NASCAR teams on the grid have access to such data.

'Nasa has said that CFD and wind tunnels are not at odds,' says aerodynamic consultant Gary Romberg. 'They are complementary.'

**EXPANSION PROGRAMME**

Having developed a strong reputation within NASCAR, AeroDyn is now looking to expand beyond the confines of stockcar racing, and has started working with teams in Indycar, Grand-Am, and the American Le Mans Series, already with promising results.

'We've had some data with an Indycar team which correlates very closely with what was achieved on the track,' says general manager Steve Dickert. Although European tunnels are looking more to alternatives to motorsport, AeroDyn is looking more at OEMs. 'Manufacturers do have their own tunnels, but most of them don't have the capabilities of the rotating wheels, extensive boundary layers, and precise ride height settings, so we think this is the area we can expand into,' says Dickert.

There are no plans to build a third tunnel, however.

**"With NASCAR's new cars, the rules are so tight that teams look for microscopic changes"**



# A2 WIND TUNNEL



## AFFORDABLE PERFORMANCE



Two facilities, one mindset...

- A2WT: 99% of wind tunnel time is used by 1% of race teams, but that fact is now becoming fiction. Designed with cost savings in mind, we offer a full-scale tunnel \$490/hour.
- AeroDyn: The first commercially available full-scale race car wind tunnel when it opened in 2003. With a proven boundary layer control system & the most advanced automated ride height system, we are able to offer affordable rates while maintaining an extremely high standard in control, data & productivity. \$1820/hour



test. The height tables are imported into AeroDyn's system. This has dramatically increased the efficiency of ride height studies, as well as controlling heights within 0.001-inch.

**Automated Yaw System**

This system, added in January 2008, is completely computer operated and uses the latest in measurement technology to assure accuracy and repeatability. Standard yaw increments are pre-programmed, based on the customer test

schedule. Additional yaw increments can be input with resolution to 0.1 degrees. The accuracy and speed of establishing each yaw setting has increased testing productivity significantly.

**New Test Section Floor**

Based on the introduction of the Car of Tomorrow, the test section floor was redesigned in June 2008 to increase the performance of the floor boundary layer control. The splitter and front end under-body is an extremely sensitive area on

the car. As such, the boundary layer system was significantly improved and offers a very good simulation. The total power in the boundary system is now four times what it used to be.

**Active Boundary Layer control**

This system, added to the facility in January 2010, is completely computer controlled. By changing the boundary layer control from a 'passive' speed setting to an 'active' pressure setting, the system very accurately matches the boundary layer conditions to actual free-stream dynamic pressure in order to maintain a constant Cp ratio. As a result, the overall tunnel sensitivity is extremely high and the smallest, most subtle changes to a test model can be measured.

**HD Camera System**

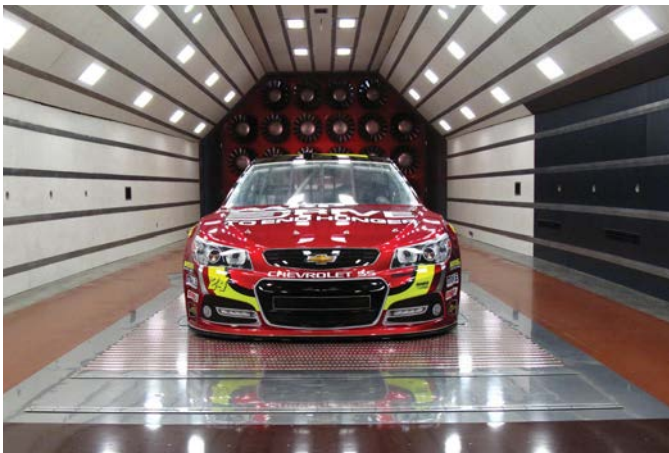
Incorporated in February 2010, this is a completely new system and again is 100 per cent computer controlled. Most tunnels simply provide viewing of the test model through a window, and often only one

side view of the model is available. AeroDyn's customers have the ability now to view the model in real-time, in HD (1080p) resolution, and eight different camera angles. This system is valuable for studying panel deflections, flow vis, and model integrity during a test. The data collection system is programmed to automatically capture a snapshot of all eight camera angles at the beginning and of each data point.

Additionally, the customer has the ability to record video in 1080p of any camera angle. The video is then downloaded to an external hard drive for the customer at the end of the test.

**Increase Yaw Sweep**

The original yaw system was +3 to -3 degrees. With the advent of the new car design, it became necessary to gather data to -5 degrees. This upgrade, added in November 2010, required significant modifications to the tunnel floor, balance, actuation system and data collection.



The test section floor was redesigned in 2008 to increase the performance of the floor boundary layer control

**THE OPPOSITION**

Windshear was formed in 2006 to provide full-scale rolling road wind tunnel access to North American and international teams. Their facility opened in September, 2008, the first facility of its kind in North America, and the third rolling road wind tunnel that operates on this scale. It was also the first full-width rolling road that supports full scale vehicle testing.

The project was funded by Haas Automation, the company that owns Windshear. Facility design and construction were overseen by Jacobs Technology, whose engineers manage the day-to-day operation of the tunnel.

The air in this closed-circuit wind tunnel covers an area of 160,000 square feet, its main fan is 22 feet in diameter and rated at 5,100 horsepower, capable of producing air speeds of up to 180mph. Air temperature is tightly controlled to within 1degF.

The MTS Flat-Trac Rolling Road measures 10.5 feet wide by 29.5 feet long. It easily keeps pace with the wind, accelerating from zero to 180mph in less than a minute. This 'road' is actually a continuous stainless-steel belt just one millimetre thick. During testing, the through-the-belt sensors precisely measure the aerodynamic downforce under each tyre.

The facility's 40-hour weekly operating schedule is filled with NASCAR and Indycar racing teams from all over North America. Teams from Europe and Asia are also bringing their wind tunnel testing to Windshear.

**NASCAR WIND TUNNELS**

**AERODYN**

Also known as 'Eaker's place', AeroDyn was built expressly for the purpose of testing stockcars, and its Mooresville, North Carolina location means that many teams frequent it primarily for the cataloguing of cars. 'We built the walls for stockcars, not for everything from Formula 1 to karts and everything in-between,' explains the tunnel's creator Gary Eaker. 'We originally defined that we deal with stockcars and trucks only - we lock these walls and leave them where they are at.'

**Opened:** 2003  
**Scale:** 100 per cent  
**Type:** Closed Jet with slotted walls  
**Rolling Road:** None, wheels spun on rollers  
**Max airspeed:** 130mph (147mph possible with recalibration)

**A2 Tunnel**

**Opened:** 2006  
**Scale:** 100 per cent  
**Type:** Closed Jet with adaptable ceiling  
**Rolling Road:** None  
**Max Airspeed:** 85mph

**ARC**

The most popular scale tunnel

for NASCAR teams is surprisingly not in North Carolina. In fact it is some distance away in Indianapolis. Auto Research Centre (ARC) not only provides its 50 per cent scale tunnel for use, but also makes many of the models used by teams, often in collaboration with C&R Racing.

**Scale:** 50 per cent  
**Type:** Open Jet  
**Rolling Road:** Belt

**WINDSHEAR**

Windshear (see also left) is a very large three-quarter open jet rolling road tunnel situated on the edge of Concord Airport in North Carolina.

The facility is capable of running at speeds of up to 180mph, and is climatically controlled. Emphasis has been placed on the full-scale tunnel being used by NASCAR teams though IRL and Formula 1 teams have also used the tunnel. Reliability and repeatability are the focus of the technical team behind the facility.

**Opened:** 2008  
**Scale:** 100 per cent  
**Type:** ¾ Open Jet  
**Rolling Road:** Steel belt  
**Max airspeed:** 180mph