

WIND TUNNEL REQUIREMENTS:

AN AUTOMOTIVE MANUFACTURER'S PERSPECTIVE

DR NICHOLAS OETTLE

TECHNICAL SPECIALIST: JAGUAR LAND ROVER VISITING RESEARCH FELLOW: LOUGHBOROUGH UNIVERSITY



OVERVIEW

AERODYNAMIC DEVELOPMENT PROCESS

Summary of overall process and how wind tunnels are used

WIND TUNNEL REQUIREMENTS

Key characteristics of wind tunnels used for automotive development and their drivers

UK CHALLENGE

Current gap between UK wind tunnel capability and the needs of an automotive manufacturer

THE FUTURE

Changes to demand in the future and opportunities to close the UK automotive wind tunnel gap

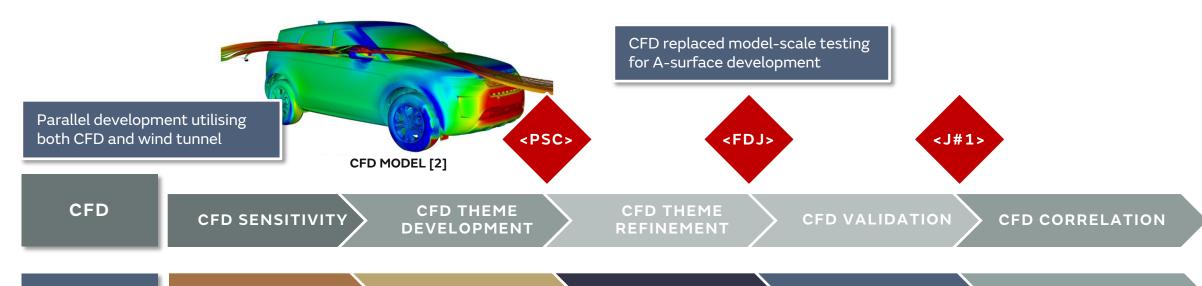
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AERODYNAMIC DEVELOPMENT PROCESS [5]



WIND TUNNEL **CONCEPT CLAY**

FSWT CLAY

AEROBUCK

PROTOTYPE

PRODUCTION

CERTIFICATION

Significant certification activity ahead of full production

Clay models for Design engagement

Majority of physical development using aerobuck



AEROBUCK [2]

Protypes used for verification and tuning

PROTOTYPE [2]

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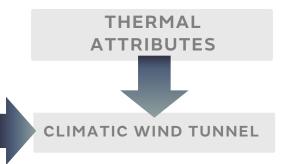


WIND TUNNEL REQUIREMENTS

AERODYNAMIC ATTRIBUTES

AERODYNAMICS AEROACOUSTICS

WATER & DIRT MANAGEMENT



FULL-SCALE AEROACOUSTIC WIND TUNNEL

- Facility to measure aerodynamic forces on a full-scale vehicle in a controlled environment
- Moving ground balance: typically a 5-belt design [1, 4, 8]
- Flow quality minimum requirement (WLTP)
- Acoustic treatment keeps background noise levels low to measure wind noise [6]
- Turntable to adjust yaw angle (turbulence generation)
- Binaural mannikins to record noise inside vehicle (exterior array to 'see' noise) [7]
- Additional instrumentation to measure the 'why' rather than just 'how much'
- Flow measurement, surface measurement, laser vibrometery...



MOVING GROUND AND TURNTABLE;
TRAVERSE; TURBULENCE GENERATION [1]



BEAMFORMING ARRAYS; ACOUSTIC TREATMENT [7]

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UK CHALLENGE

NO UK-BASED AERODYNAMIC FACILITIES TO MEET AN AUTOMOTIVE MANUFACTURER'S REQUIREMENTS

- No certification can take place in the UK: reliant on wind tunnels overseas
- Customer wind tunnels (examples presented), or tunnels from sister companies
- Capacity limitations drive the amount of development and R&D time after certification
- Limits to collaboration with other departments (design, engineering)
- Shipping impact prototype utilisation efficiency, paperwork
- Increased vulnerability to external factors





S2A[8]

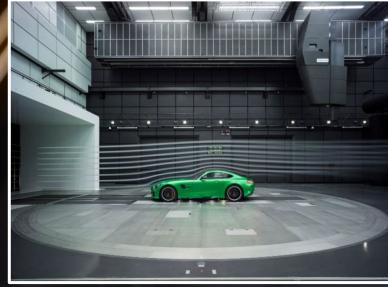


FKFS [1]



PININFARINA [4]

WIND TUNNEL REQUIREMENTS: AN AUTOMOTIVE MANUFACTURER'S PERSPECTIVE



MODERN, FULL-SCALE AUTOMOTIVE AEROACOUSTIC WIND TUNNEL [3]

THE FUTURE

DEMAND

- Increased demand driven by certification in increased number of markets
- More stringent targets efficiency, refinement drives increase in both CFD and wind tunnel usage
- Data output increased richness of data to support Al supported development

CURRENTLY A FACILITY GAP WITHIN THE UK

- Appetite for wind tunnels specified for needs of automotive manufacturer within other industry sectors?
- Other manufacturers?
- Academic interest in such a facility, potentially part of NWTF?
- FKFS as example: commercial facility part of university, located in automotive industrial region, PhD and internship programmes

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• Wider user base, wind engineering, sports?



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DR NICHOLAS OETTLE CENG FIMECHE

Technical Specialist | Aeroacoustics & Experimental Aerodynamics

EV-4KO* | Vehicle Efficiency | Vehicle Engineering & Attributes

M: +44 (0) 7824 085165

noettle@jaguarlandrover.com