



AVL Fuel Cell Production Test Solutions

Overview

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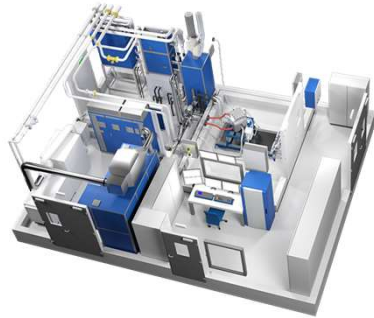
Fuel Cell Production Testing Solutions

Overview

The Challenge

The Solution

The Added Value



Testing Solutions for Research & Development

- Flexible, to meet R&D needs
- Cutting-edge instrumentation
- Integrated into R&D toolchain

Research & Development

Production

Commercialization, ramp-up of production



Testing Solutions for Low-volume Production

- Up to 1,000s of units p.a.
- Low degree of automation
- Derived from R&D testing



Testing Solutions for High-volume Production

- Integrated into assembly line
- Fast, highly automated
- Reliable & robust testing solutions

Fuel Cell Production Testing Solutions

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The Added Value

Development of dedicated testing methodologies

for reliable and fast End-of-Line (EoL) Cold & Hot testing, Quality Assurance (QA) and Conformity of Production (CoP) testing



Reduction of cycle times

ramp-up of production requires shorter cycle times, to be achieved via testing methodology and high degree of automation



Development of robust test systems

dedicated production test systems instead of re-using equipment previously developed for R&D testing



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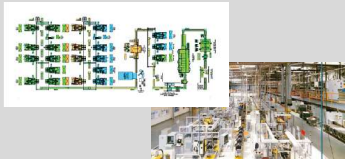
The experience of AVL's **comprehensive FC R&D toolchain**, from cell to vehicle



AVL's experience with **production test systems** for engines, batteries & e-axes



AVL's **experience in developing** cells, stacks, FC systems and powertrains



The experience of AVL's proven **plant and production engineering** team

AVL Fuel Cell Production Test System

In-process Verification (IPV)

End-of-Line (EoL) Cold

End-of-Line (EoL) Hot

Quality Assurance (QA)

Conformity of Production (CoP)

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Manual (10s or 100s of units p.a.)

Semi-automatic (1,000s of units p.a.)

Fully-automatic (10,000s of units p.a.)

In-Process
Verification (IPV)

End-of-Line
Cold Testing

End-of-Line
Hot Testing



Fuel Cell Stack

Leak tests at stack
press, for instance

Electrical safety
Leak tests

Membrane activation
Basic performance
Electrical functions



Fuel Cell System

Leak tests after
assembling balance-of-
plant components, for
instance

Diagnostic / FCCU tests
Electrical safety
Leak tests

Quality Assurance (QA)
Conformity of
Production (CoP)

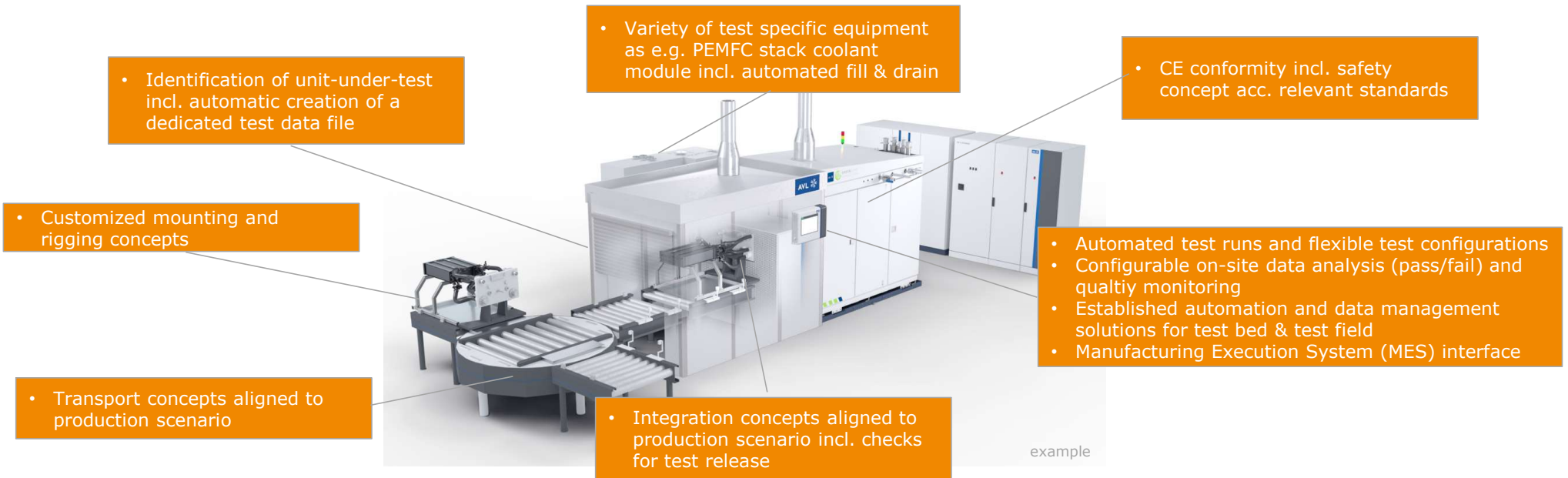
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- Customized test solution design for flexible integration into production facility
- High process quality due to automated routines and reduction of manual labor
- High availability based on reliable hardware and definition of further success factors (maintenance-, spare-&-wear-plan)

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AVL production testing solutions designed with the know how of Fuel Cell developers



Proven AVL solutions for low-volume production applications readily available



AVL is the perfect partner for bridging the gap to future high-volume production applications



Thank you



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