AVL Application Services

› CASE STUDY

PUMA Application for Hybrid Powertrain Testing

@ Internationally Operating OEMs

SUMMARY

The increasing development costs caused by tightening emissions legislation – specifically the reduction of CO_2 – is putting pressure on the automobile industry. Additional fleet emissions limits have made electrification essential for all major OEMs.

One idea for not increasing the development costs of electrification is the use of the vehicle's existing powertrain and integration of a hybrid module (e-motor and clutch) between the engine and the transmission – without any modifications on the existing components.

As this is a significant change within the powertrain design, additional, and specific tests are necessary. This case study describes the steps of developing a test to verify this impact on the durability of the original dual-mass-flywheel (DMF).

Fast Facts	
Customer / Department	Internationally operating OEM, Testing and Engineering Department
Region	Asia
Challenge	Define and execute fatigue relevant load cycles
Solution	1. Finding relevant driving conditions 2. Definition of all duty cycles. 3. Realization at the test cell
Duration	~ 2 weeks effort for step 3

CHALLENGE

One of the main challenges for the OEM was finding the driving conditions that generate additional loads on the DMF, which are caused by the added hybrid module. In addition, finding how often these conditions occur during the lifetime of the vehicle is relevant for the test.

In the next step, the resulting test requirements had to be achieved with the existing test system. The question was how to meet the required conditions at the testbed and at the right point in time, as defined in the test cycle.

SOLUTION

1.) Finding driving conditions with a high load on the DMF

After simulating offline different driving situations, it was soon clear that the start of the internal combustion engine (ICE) – executed by the added e-motor – was causing additional loads to the DMF, as compared to the original engine specification. Several different ICE start conditions were identified.

2.) Evaluating the number of ICE starts during the engine's lifetime

Defining how often each of the different ICE start conditions would occur during the vehicle lifetime was much more difficult. Based on the existing load profile of the vehicle and additional simulation results, it was possible to define certain boundary conditions and estimate these numbers. The OEM had no existing data for this kind of powertrain concept.

3.) Realizing the specific load situation at the testbed

Now, the defined conditions had to be realized at the testbed. To achieve all defined conditions (recuperation, charging via engine, pure electrical drive, etc.) it is important to consider the actual state of the charge (SOC) of the energy storage system (= battery). An additional demand value, for the Battery Simulator, was required to force the hybrid control unit (HCU) to react as desired. Additionally some more signals, as the brake light and the brake pressure have to be simulated and sent to the HCU to fulfill the conditions.

Further details - like monitoring of specific limits, restarting conditions and the entry points of the test and data collection - had to be discussed. Later on, the temperature conditioning of the oil became an additional requirement; cold oil has a significant impact on the loads during the ICE starts, by adding more complexity to the test.

RESULT

The main outcome of the Application Service Intervention at the OEM has been:

- A completely automated durability test
- An improved process to define the number of load cycles
- Knowledge gained in the use of specific PUMA functions for efficient test execution

The cooperation between the engineering department and AVL Application Services was very helpful for the definition of testing conditions, which provided the deep knowledge of the possibilities with the existing testing equipment.

OUTLOOK

AVL Application Services was recognized as a competent supporter of PUMA-related questions, and finding the correct way to define the most suitable test requirements for the existing equipment.

The next possible steps at the customer are:

- Improved flexibility of the testing operations
- Support for other test demands, like the calibration of the powertrain controller

As the outcome is not static, there needs to be a further realization of improvement potential and an introduction of new, upcoming boundary conditions for powertrains. AVL Application Services is a long-term partner for knowledge support and the introduction of new approaches towards development and testing.

FOR FURTHER INFORMATION PLEASE CONTACT:

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