

INCA-FLOW at Ford

AUTHORS

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Efficiency gains in diesel aftertreatment systems calibration

For all types of diesel vehicles, US Environmental Protection Agency (EPA) regulations require strategies that induce drivers of vehicles with selective catalytic reduction (SCR) exhaust aftertreatment systems to keep diesel exhaust fluid (DEF) on board and ensure that aftertreatment systems remain functional. In practice, the inducement takes the form of a performance penalty applied by the electronic control unit to the engine in certain circumstances.

These circumstances include a low level of diesel exhaust fluid, incorrect fluid in the DEF tank, or the occurrence of SCR faults. To prevent activation of an SCR inducement, a number of alerts, such as warning lights in the instrument cluster, are provided to draw the driver's attention to low DEF levels or the wrong fluid, for example. Numerous SCR inducement tests have to be performed to ensure the functionality of SCR systems.

Automation of SCR inducement tests

ETAS INCA-FLOW is used to automate the SCR inducement audit tests. Once the INCA-FLOW script (see figure 1) has been started, the test inserts the relevant vehicle functions into the warning chain. It then runs through all the messages in that chain, enters the SCR inducement chain, and exits it at the end of the test.

Here is how INCA-FLOW guides the calibrator in the car: first, INCA-FLOW asks the calibrator to start the engine. Once the script detects that the engine has started, it asks the calibrator if the cluster is displaying

a warning message saying that vehicle speed will be limited to 50 mph. It then requests that the calibrator turns the engine off, waits for an ECU reset, and turns the engine on again. INCA-FLOW automatically detects the ECU reset and asks the calibrator if speed is again limited to 50 mph. It then detects a series of warning messages such as *engine idled soon, put on the parking brake, or engine idled, see manual* and guides the calibrator through all of them (see figure 2). At the end of the test, INCA-FLOW automatically undoes all the changes the user has made by copying the reference page to the working page in the ECU memory and ensuring that all cluster warnings are reset.

INCA-FLOW automates the complete SCR inducement test series. It makes sure that every test is executed with the correct presets and automatically generates the complete documentation required in parallel. Test results are stored automatically in an Excel template provided by the user, with each change in the warning and inducement state recorded there as well. The certification process itself is documented

in INCA-FLOW and can be easily extended if required. The resulting report can be presented to agencies or other stakeholders who need to verify the compliance of the tests.

Benefits of INCA-FLOW

The growing number of vehicle variants, extensive diagnostic requirements, decrease in test vehicles, and increasingly ambitious quality goals require the standardization of measurement and calibration procedures in diesel systems. Calibration and validation efforts can be largely reduced by employing automation, numerical optimization, and simulation methods. INCA-FLOW provides solutions that make in-vehicle calibration and validation more efficient. The software facilitates simple graphical specification of measurement and calibration procedures to address the demand for automation, guidance, and documentation of calibration and validation processes. And despite all the benefits it offers, the tool does not require any special programming skills.

INCA-FLOW aims to reduce manual calibration errors, and its results are easily reproducible for each control

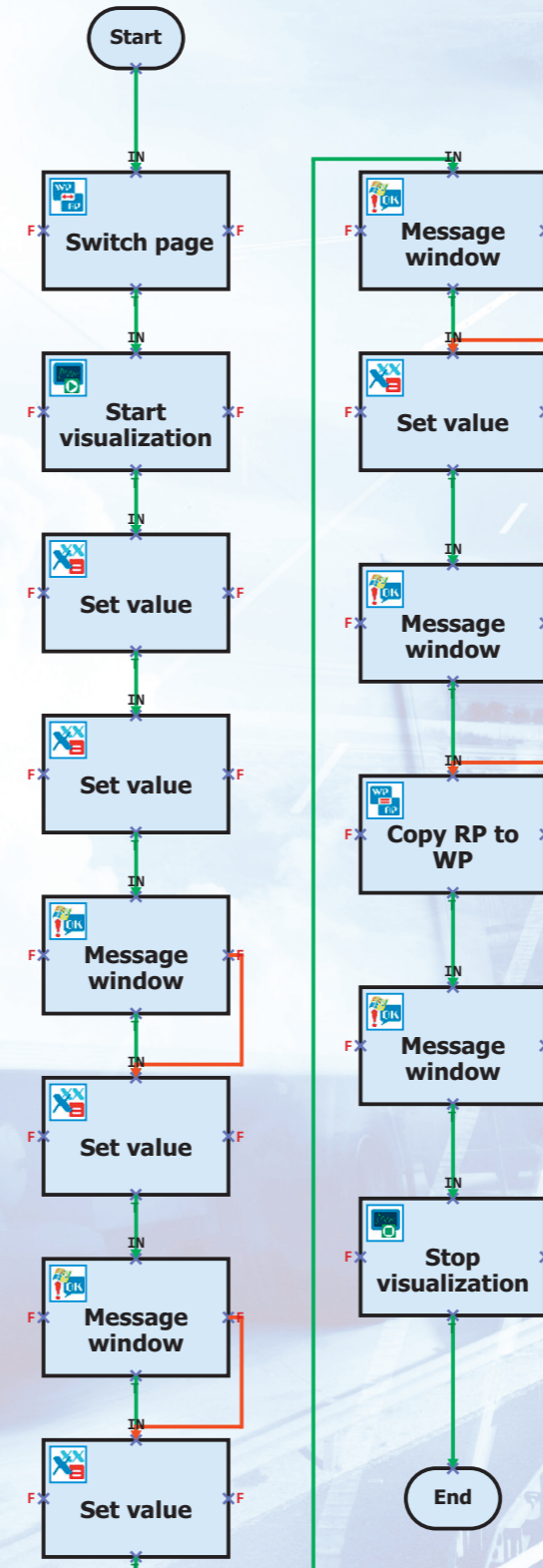


Figure 1: INCA-FLOW SCR inducement test flow chart.

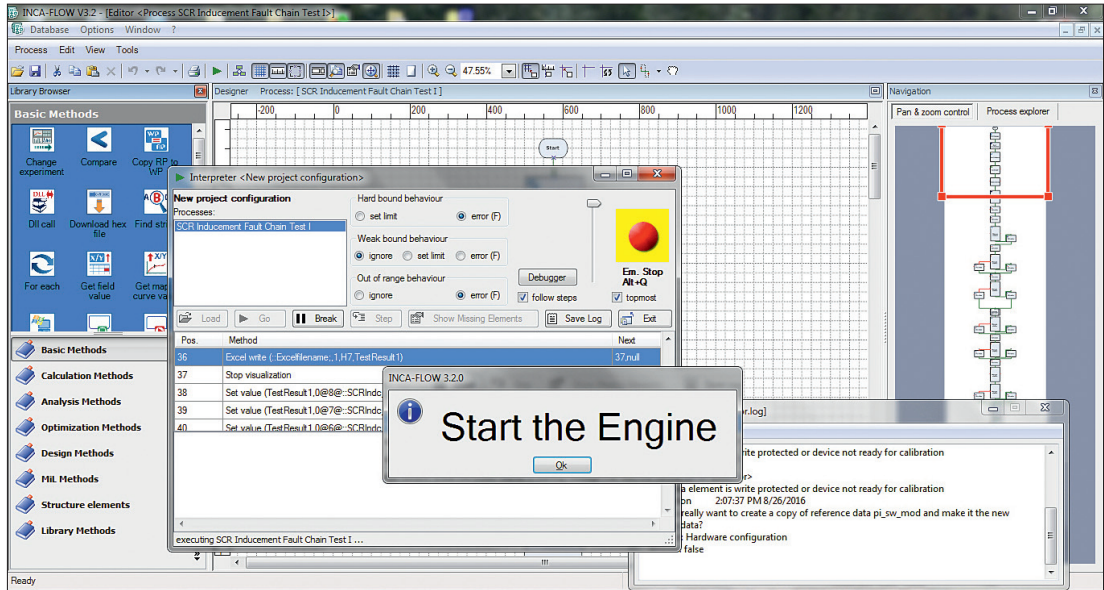


Figure 2: Guided testing of SCR inducements in the vehicle with INCA-FLOW.

function and variant. User-defined variables such as counters, Boolean values, and timers employed in the INCA-FLOW calibration procedure are viewable in the INCA experiment through the XCP gateway (see figure 3). Through this mechanism, user-defined values in INCA-FLOW are stored in the same MDF file as ECU data acquired with INCA.

The XCP gateway enables the user to analyze the MDF data easily should any problems occur.

Conclusion

Engineers can plan the calibration tasks at their desk in the office, in order to make the most of their time in the test vehicle. Other important benefits include the improved up-

skilling phase for new calibrators and the fact that best practice in calibration can be established throughout the company. In addition to SCR inducement testing, INCA-FLOW is used for other auto-calibration and validation tests at the Ford Motor Company such as emission control, onboard diagnostics (OBD), and drivability.

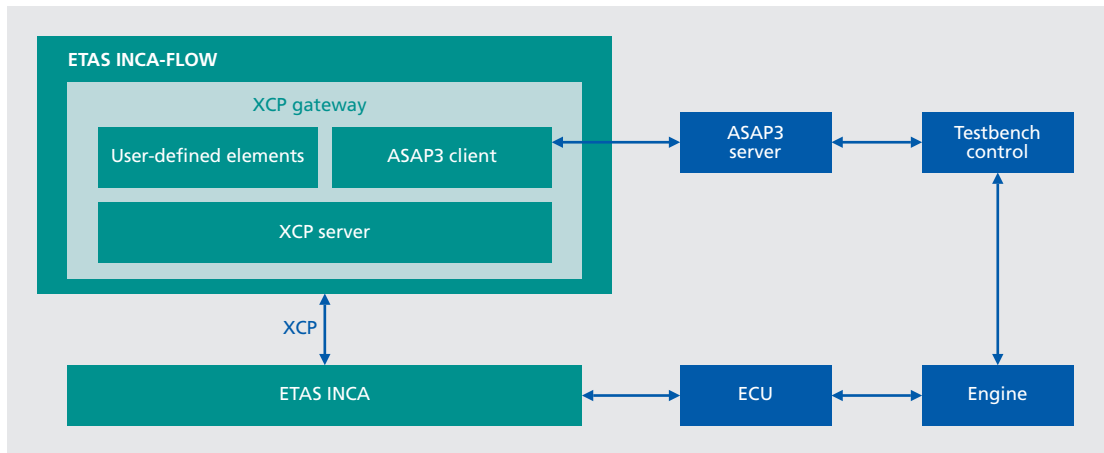


Figure 3: The XCP gateway integrated into INCA-FLOW allows INCA to access values of variables that have been defined by the user in INCA-FLOW as a function of time. When INCA-FLOW is connected to the test-bench control via ASAP3 or CAN, the values of testbench parameters such as load or speed can also be accessed by INCA through the XCP gateway. INCA integrates all required data into one measurement file.