



Thermal Shock Cycle Test for Exhaust System Tuning Elements

1 Introduction

Note: Nothing in this standard supercedes applicable laws and regulations.

Note: In the event of conflict between the English and domestic language, the English language shall take precedence.

1.1 Purpose. To prove the structural durability of tuning elements against thermal cycling caused by varying exhaust gas temperatures as well as by external water splash on the hot tuning element surface.

1.2 Applicability. This test procedure is applicable to all exhaust system tuning elements. It may also be applied to other exhaust system components (e.g., heat shields attached to exhaust pipes and exhaust gas heat recovery units). In such a case, required modifications of the test setup, test conditions and test criteria shall be defined in the Component Technical Specification.

2 References

Note: Only the latest approved standards are applicable unless otherwise specified.

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14555

GMW15261

GMW16372

2.3 Additional References.

- Component Technical Specification (CTS)
- Exhaust Subsystem Technical Specification (SSTS)

3 Resources

3.1 Facilities.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.1.3 Hot gas test bench with thermal control cycle and controllable water-spray unit.

3.2 Equipment.

3.2.1 Hot Gas Burner. A switchable hot gas burner capable of providing the required gas mass flow rate at the gas temperature as specified in 3.5.1.

3.2.2 Water Spray Device. A water spray device capable of providing the required water flow rate and water spray distribution on the test sample. Required water flow rate per nozzle is 3 L/minute.

3.2.3 Sensors.

3.2.3.1 Temperature Sensors. The temperature sensor shall cover the expected temperature range at an accuracy of $\pm 1\%$. Recommended are thermocouples Type K, Tolerance Class 2, or equivalent.

3.2.4 Data Acquisition Equipment.

3.2.5 Restriction Measurement Test Bench. A cold flow test bench is required to determine the tuning element's restriction. A GM-approved specification for the test bench is described in GMW16372. Alternative test facilities may also be used but require the approval of the GM validation engineer or GM Design Release Engineer (DRE).

3.3 Test Vehicle/Test Piece. New test samples shall be used. For product validation testing, it is mandatory that test parts be produced at the production location, utilizing production tools and following the production process. Any deviation from this needs to be approved by GM DRE and Validation engineer.

3.4 Test Time.

Calendar time: 3 days
Test hours: 50 hours
Coordination hours: 2 hours

3.5 Test Required Information.

3.5.1 Test Temperature.

3.5.1.1 Surface Temperature Measurement Location. The temperature shall be measured on the outer surface of the tuning element. In particular the temperature shall be determined in the area that is expected to see the highest surface temperatures. The measurement location shall be selected under consideration of the tuning element internal design. The GM design release engineer or validation engineer shall agree to the selected location.

3.5.1.2 Surface Test Temperatures. The maximum surface test temperature during the heating cycle shall be equal to the maximum surface temperature that is being measured at the specified location during any continuous driving condition according to GMW14555. Excursion driving events in GMW14555 shall not be considered. If the above described temperature measurement is not readily available the maximum surface test temperature shall be defined based on experimental thermal data from previous applications that are most similar with regard to exhaust gas temperature, exhaust gas mass flow and exhaust system design. Alternatively, exhaust system thermal predictive analysis may be used to define the most appropriate test temperature.

The minimum surface temperature during cooling cycle shall be $\leq +100\text{ }^{\circ}\text{C}$.

DRE and validation engineer shall mutually agree on the test temperatures.

3.5.1.3 Inlet Gas Temperature. The heating cycle tuning element inlet gas temperature shall be based on the same driving schedule the maximum surface test temperature is based on. It shall be equal to the maximum exhaust gas temperature at the tuning element inlet measured during this driving schedule. If this information is not available for the specified vehicle application, the temperature shall be defined based on data of a comparable vehicle application or on exhaust system thermal predictive analysis.

The cooling cycle tuning element inlet gas temperature shall be $\leq +50\text{ }^{\circ}\text{C}$.

3.5.1.4 Gas Flow. The test gas flow shall be $\geq 250\text{ kg/h}$. For reproducible test results the test gas flow shall be kept constant when testing several samples of the same part.

3.5.2 Tuning Element Location and Orientation. Math data, showing tuning element location and orientation in the vehicle, shall be provided to the test engineer.

3.5.3 Leakage Requirements. Allowable leakage of the test piece per Exhaust Subsystem Technical Specification (SSTS).

3.6 Personnel/Skills. Technician basic skills needed:

- Ability to perform exhaust component changes
- Skilled in test bench usage

4 Procedure

4.1 Preparation.

4.1.1 Test Setup. Figure 1 illustrates the test setup.