



Exhaust Valve Freezing Test

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. The purpose of this test procedure is to check for no engine start associated with frozen condensate accumulation around an exhaust valve.

1.2 Applicability.

1.2.1 This procedure applies to vehicles with **passive** exhaust valves.

1.2.2 This procedure can be conducted at any point in the development process.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

None

2.3 Additional References.

Exhaust System Subsystem Technical Specification (SSTS), paragraph titled: Local Environment Operating Condition

3 Resources

3.1 Facilities. Cold chamber capable of accommodating an idling vehicle at $-29\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ ($-20\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$).

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.

3.1.2.1 Procedure may be run without a cold chamber if outside ambient temperature is $-29\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$ ($-20\text{ }^{\circ}\text{F} \pm 5\text{ }^{\circ}\text{F}$).

3.2 Equipment.

3.2.1 Thermocouples and temperature read-out (optional).

3.2.2 Fan.

3.2.3 Bore camera (optional).

3.2.4 Standard hand tools.

3.3 Test Vehicle/Test Piece.

3.3.1 The test vehicle shall be design of record, representative for engine calibration and air intake system.

3.3.2 The test piece (exhaust system) shall be design of record, representative for routing, dimensions influencing flow and exhaust valve(s).

3.4 Test Time.

Calendar time: 1.5 days (approximately)
Test hours: 20 hours (approximately) (overnight soak and approximately 8 hours test time)
Coordination hours: 2 hours (cold chamber reservation and technician coordination)

3.5 Test Required Information.

 Not applicable.

3.6 Personnel/Skills.

3.6.1 Engineer: Test request writing, test execution and test report writing.

3.6.2 Chamber Technician: Cold chamber operation and vehicle set up in cold chamber.

3.6.3 Garage Technician: Thermocouple installation and bore camera installation.

4 Procedure

4.1 Preparation.

4.1.1 Obtain test vehicle.

4.1.2 Verify that exhaust system, engine calibration and air induction system represent the design of record.

4.1.3 Reserve cold chamber (preferably greater than one (1) week ahead of testing).

4.1.4 Install bore camera (optional). See Figure A1, Appendix A.

4.1.4.1 Drill a hole (diameter depending on camera probe dimensions) for camera access approximately 300 mm downstream from the valve or per engineer direction (optional).

4.1.4.2 For valves located inside mufflers, drill hole for camera per engineer direction (optional).

4.1.5 Install thermocouples on the outer pipe surface approximately 50 mm upstream and downstream from each valve (optional). See Figure A2, Appendix A.

4.1.5.1 For valves located inside mufflers, place thermocouples approximately 50 mm upstream and downstream of the mufflers (optional).

4.1.6 Install thermocouple readout such that it is visible to the driver (optional). See Figure A3, Appendix A.

4.1.7 Park test vehicle in cold chamber.

4.1.7.1 Prior to parking the test vehicle in the cold chamber, run it for 32 km (20 mi) on test track at 97 km/h (60 mph) to ensure consistent required test start condition.

4.1.7.2 Ensure all safety precautions are followed.

4.1.7.2.1 Including, but not limited to, vehicle anchoring, exhaust gas evacuation and fire, or per chamber technician direction.

4.1.8 Cool cold chamber to $-29^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($-20^{\circ}\text{F} \pm 5^{\circ}\text{F}$).

4.1.9 Direct a portable fan(s) toward the exhaust valve(s) at a distance of approximately 1 m to 2 m as needed. See Figure A4, Appendix A.

4.1.9.1 For valves located inside the muffler(s), direct the fan toward the muffler(s) at a distance of approximately 1 m.

4.1.9.2 Run the fan during the soak and engine running portions of the test.

4.2 Conditions.

4.2.1 Environmental Conditions. The cold chamber air temperature shall be $-29^{\circ}\text{C} \pm 3^{\circ}\text{C}$ ($-20^{\circ}\text{F} \pm 5^{\circ}\text{F}$) for the duration of the test.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

4.2.2.1 The test shall be conducted with the test vehicle stationary and the engine running at or near idle speeds.

4.3 Instructions.

4.3.1 Soak the test vehicle for a minimum of 2 h (overnight soak is typical to ensure readiness of test first thing in the morning).

4.3.2 Start the test vehicle and idle the engine for 20 minutes to generate condensate.

4.3.3 Stop engine and allow vehicle to soak for a minimum of 17 minutes.

4.3.4 Start the engine and idle for 4 minutes.

4.3.5 Stop engine and allow vehicle to soak for a minimum of 16 minutes.

4.3.6 Use bore camera to inspect valve area for ice crystal growth at 10 cycles, 15 cycles and 20 cycles, or per engineer direction (optional).

Note: Steps 4.3.2 through 4.3.5 complete the first cycle.

4.3.7 Repeat 4.3.4 through 4.3.6 until twenty (20) idle/soak cycles are complete.

4.3.7.1 Record the cycle number of each stall

4.3.7.2 Once a no start or stall occurs, the test stops.

4.3.8 After 20 cycles are complete, soak the test vehicle for 60 minutes at -29 °C (-20 °F).

4.3.9 Start the engine and idle the vehicle.

4.3.9.1 Observe drain hole and tail pipe discharge performance.

4.3.9.1.1 Record time until condensate discharge is noted.

4.3.10 Remove vehicle from cold chamber.

4.3.11 Remove instrumentation.

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results. Twenty (20) idle/soak cycles without an engine no-start or stall satisfies the SSTS requirement.

5.3 Test Documentation. Engineer shall write an Evaluation Report (ER) containing pictures and documenting results, equipment, test material and the test vehicle number with Odometer (ODO) reading. Use check sheet as applicable, see Table B1, Appendix B.

6 Safety

This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

7 Notes

7.1 Glossary. Not applicable.

7.2 Acronyms, Abbreviations, and Symbols.

ER	Evaluation Report
GSSLT	Global Subsystem Leadership Team
No.	Number
Nos.	Numbers
ODO	Odometer
SSTS	Subsystem Technical Specification

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

Test to GMW17209