



Exhaust System Component and Joint Leakage

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 procedure is to determine the static leakage, pull-apart load and the torque specification on each attachment of the exhaust system - joint interface.

1.2 Applicability. These tests apply to exhaust systems.

Note: Pull-apart load test does not apply to flange joints.

1.3 Remarks. This document contains four procedures: torque angle to ultimate, hand torque to seal and leakage, static leakage check, and pull-apart load. These tests can be conducted individually.

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

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 Approved Fastener Laboratory for this test procedure.

3.1.4 Testing may also be completed at the following, but not limited to:

3.1.4.1 Supplier or supplier laboratory.

3.1.4.2 GM vehicle or engine plants.

3.1.4.3 GM transmission plants.

3.1.4.4 GM component part plants.

3.1.4.5 Satellite General Motors facilities.

3.2 Equipment.

3.2.1 Standard laboratory slot table.

3.2.2 Microprocessor based data acquisition system.

3.2.3 Torque transducer.

3.2.4 Angle encoder/decoder.

3.2.5 Pressure transducer.

3.2.6 Flow meter.

- 3.2.7 Tensile tester.
- 3.2.8 Digital function generator.
- 3.2.9 Control unit.
- 3.2.10 Controller.
- 3.2.11 Linear Variable Displacement Transducer (LVDT).
- 3.2.12 Force transducer.
- 3.2.13 Amplifier.
- 3.2.14 Air regulator with filter.
- 3.2.15 Break wire.
- 3.2.16 Power tools adequate to torque the fasteners.
- 3.2.17 Sockets, assorted angle supports, adapters.
- 3.2.18 Special rubber plugs to seal the pipe ends.
- 3.2.19 Furnace or oven capable of 649 °C (1200 °F).

Note: All instrumentation is to be calibrated as required. Record document instrumentation details and date of calibration, unless the information is otherwise preserved in the laboratory records.

3.3 Test Vehicle/Test Piece.

3.3.1 Complete exhaust system or specific components being investigated. This could include any or all of the following items:

- 3.3.1.1 Front and intermediate exhaust pipes.
- 3.3.1.2 Catalytic converter with required hangers.
- 3.3.1.3 Muffler and tailpipe assembly with required hangers.
- 3.3.1.4 Exhaust manifolds.
- 3.3.1.5 All required fasteners and clamps.

3.3.2 Recommended sample size is eight (8) for Test 1, eight (8) for Test 2, and (8) eight for Test 3. Completed samples from Test 3 are used to run Test 4.

3.4 Test Time.

Calendar time: 2 days to 10 days
Test time: 16 h for 8 samples
Coordination time: 8 h for 8 samples

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. Not applicable.

4 Procedure

4.1 Preparation.

4.1.1 Cut the exhaust system components into appropriate lengths. Enough material should be retained adjacent to the joint to insure that the pipe has not been weakened.

4.1.2 The following preparation is only required for those samples that will be used for the joint leakage test.

- 4.1.2.1 Plug or weld the pipe ends as necessary to prevent leakage from unmonitored interfaces.
- 4.1.2.2 Drill and tap welded pipe end for pressure adapter.
- 4.1.2.3 Coat welded areas with epoxy to prevent minute air leakage through welds.

4.2 Conditions.

4.2.1 Environmental Conditions. All measurements are taken at lab ambient temperatures.

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.

4.3 Instructions.

4.3.1 Test No. 1, Torque Angle to Ultimate (Optional). This portion of the procedure may be conducted when fastener torque specifications do not exist for the joints being tested.

4.3.1.1 Review part quantities and condition.

4.3.1.2 Secure test part to T-slot table or fixture.

4.3.1.3 Select proper tool(s) and torque transducer(s) with angle encoder.

4.3.1.4 Configure data acquisition system to collect torque and angle data (reference Manufacturers Operating Procedure).

4.3.1.5 Align tool(s) and torque transducer(s) to prevent side loading.

4.3.1.6 Unless otherwise specified, test requestor is to approve test setup.

4.3.1.7 Take photograph or digital image of test configuration.

4.3.1.8 Measure and document tool free spinning speed.

4.3.1.9 Dynamically tighten the nut of the clamp or nuts/bolts of a flanged joint until torque fall-off occurs. Use the same tool speed and the number of spindles as used in production.

4.3.1.10 Measure and record torque and angle.

4.3.1.11 Document the failure mode of the joint.

4.3.1.12 Submit plots of torque/angle data to the Test Engineer.

4.3.2 Test No. 2, Hand Torque to Seal and Leakage (Optional). This portion of the procedure may be conducted when fastener torque specifications do not exist for the joints being tested.

4.3.2.1 Pressurize the system per 4.3.3.2 to a pressure specified by the requestor. Using a digital hand torque wrench, alternately tighten the nut of the clamp or nuts/bolts of a flanged joint in 2 Nm increments unless otherwise specified by the requestor. Record leak rate in Standard Liters per Minute (SLPM), at the specified pressure, after each fastener in the joint has been tightened to its 2 Nm or specified increment. Continue until joint failure, recording leak rate after each tightening increment.

4.3.2.2 Document the failure mode of the joint.

4.3.3 Test No. 3, Static Leakage Check.

4.3.3.1 Obtain the minimum dynamic torque specification for the joint from the test requestor. Tighten the joint to the minimum torque value using production tightening strategy and setup.

4.3.3.2 Seal-off the ends of the joint using special rubber plugs.

4.3.3.3 Pressurize the system to 15.0 kPa (2.2 psi) and record the flow rate with the static flow meter. Repeat for 34.5 kPa (5.0 psi) and for any other pressure(s) specified by the requestor.

4.3.3.4 Place samples in the oven at room temperature.

4.3.3.5 Heat to 399 °C (750 °F) over a 2 h period or heat to required temperature from requestor.

4.3.3.6 Stabilize at 399 °C +0/-14 °C (750 °F +0/-25 °F) or at required temperature from requestor for 30 minutes.

4.3.3.7 Remove samples and air cool to ambient temperature.

4.3.3.8 After heat treat, repeat the static leakage check (4.3.3.2 and 4.3.3.3).

4.3.3.9 Optional: Repeat 4.3.3.4 thru 4.3.3.8 for an oven temperature of 649 °C +0/-14 °C (1200 °F +0/-25 °F).

4.3.3.10 Measure and record joint fastener audit torque to evaluate heat treat effects.

4.3.3.11 Submit plots of torque/angle data to the Test Engineer.

4.3.4 Test No. 4, Pull-apart Load (Optional).

4.3.4.1 If pull-apart load is required by the test requestor, three joints from the 4.3.3 test should be equipped with a single conductor wire epoxied across the two pipes and used as part of 5 V circuit. Breakage of wire will indicate slippage of the pipes.

4.3.4.2 Install assemblies into tensile machine with a ramp rate of 1.5 kN/s with a load cell.

4.3.4.3 Pull joint apart, recording load vs. displacement.

4.3.4.4 Document date, time, part numbers, sizes, etc.

4.3.4.5 Photograph test setups.