



Catalytic Converter Coating Adhesion 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. This Test Procedure exposes the Catalytic Coating to operational stresses induced by severe thermal aging and exposure to a high air pressure passed over the catalysts front face and through the monolith. This procedure measures the cohesiveness of the catalyst Washcoat (WC) itself in addition to the adhesion of the WC to the monolithic substrate walls.

1.2 Applicability. For all Catalytic Converter Coatings on monolithic metallic, Silicon Carbide (SiC) and cordierite (ceramic) flow through substrates.

1.3 Remarks. The Catalytic Converter Assembly and its subsystems are critical emission control components. The Catalytic Converter Assembly and its subsystems interact with the Powertrain Controls and Diagnostics Systems to provide exhaust after treatment and the performance diagnostics necessary to meet all legislated requirements. Loosing WC from the catalyst system can inhibit these performance characteristics. Further, WC lost into the exhaust after treatment system and surrounding components must be strictly limited to avoid detrimental abrasive/corrosive effects and lastly emission of lost WC to the ambient atmosphere is undesirable from an environmental/toxicological vantage point.

Under vehicle usage conditions WCs are subjected to rapid, thermal expansion and contraction forces. The thermal expansion and contraction forces of WC and monolith differ due to differences in their respective coefficients of thermal expansion. In addition, high temperature conditions result in the dehydroxylation and condensation of the WC leading to densification and possibly cracking of the WC layer.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW15947

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. Test setup example is shown in Appendix A, Figure A1.

3.1.3 Enclosed location within a test laboratory.

3.2 Equipment.

3.2.1 Static Furnace, capable of +1175 °C.

3.2.2 Top Loading balance.

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3.2.3 Desiccator (Nitrogen (N₂) purged from liquid Nitrogen source).

3.2.4 Plastic spacer (3 mm) for blower head alignment over test part.

3.2.5 Standardized Controlled Speed and Pressure High Shear Adhesion Tester equipped with an air knife with $\approx 0.6 \text{ mm} \times 95 \text{ mm}$ slit capable of maintaining $(4 \pm 0.2) \text{ bar}$ under full flow conditions.

3.2.6 Protective gloves, heat resistant.

3.2.7 Hearing Protection.

3.2.8 One-half ($\frac{1}{2}$) Face Respirator.

3.3 Test Vehicle/Test Piece. The test material is the coated catalyst according to part drawing. The manufacturing process of the test piece shall have been finalized by respective coating Supplier performing prior to testing.

3.4 Test Time.

Calendar time: 6 d

Test time: 1 h

Coordination time: 1 h

3.5 Test Required Information. The weight of removed WC is small. It is necessary to be aware of and to best possibly avoid moisture pick up prior to the weighing steps. Care shall be exercised to prevent any loss of WC prior to the weighing steps. Test parts should not be bumped as this may cause loss of WC prior to weighing.

3.6 Personnel/Skills. Test cell operator(s) trained in set up, use, and maintenance of herein described systems.

4 Procedure

4.1 Preparation.

4.1.1 Thermal Pre-Treatment.

4.1.1.1 Remove all WC from the outside skin of the test part prior to thermal pre-treatment.

4.1.1.2 Place the part(s) being tested into the furnace ($< +200 \text{ }^{\circ}\text{C}$) on its side parallel to the floor. The oven temperature is increased to the oven dwell temperature in a controlled manner at an oven ramp up that may not exceed $+20 \text{ }^{\circ}\text{C/minute}$.

4.1.1.3 Oven Dwell temperatures are:

- $(+1175 \text{ }^{\circ}\text{C} \pm 10 \text{ }^{\circ}\text{C})$ for all three (3) way gasoline catalysts
- $(+900 \text{ }^{\circ}\text{C} \pm 10 \text{ }^{\circ}\text{C})$ for all Diesel Oxidation (DOC), Particulate Filters (PF) and Selective Catalytic Reduction (SCR) catalysts as well as Nitrogen Oxide (NO_x) or Hydrocarbon Adsorbing Catalysts

4.1.1.4 The dwell duration is 3 h. After dwelling the oven temperature is decreased. The temperature ramp down may not exceed $20 \text{ }^{\circ}\text{C/minute}$. Part(s) are removed. The part is then taken from the furnace at a temperature of $(+175 \text{ }^{\circ}\text{C} \pm 25 \text{ }^{\circ}\text{C})$ and immediately placed into desiccator to prevent the uptake of water adsorption. The catalyst shall cool down on to the test part. The test sample is then cooled in the desiccator under a continuous purge with a dry N₂ nitrogen gas stream (from liquid N₂) until the catalyst reaches ambient temperature. The catalyst is then removed from the desiccator and weighed immediately. The mass of the cooled and dried part is recorded as the initial mass (Mi).

4.1.2 Blow Off Rig. Ensure the valves that control airflow to the blower head and bladder are fully closed. Adjust the inlet air pressure to the unit using the inlet air regulator until the inlet air pressure gauge to the tester reads the desired pressure. This value will depend upon air supply and ballast volume in air lines that feed the adhesion tester. Adjustments shall be made that ensure the pressure at the blower head is maintained at $(4 \text{ bar} \pm 0.2 \text{ bar})$ at full flow during blowing.

An appropriately sized holding fixture template shall be applied to hold the test part. This fixture (such as an inflated bladder) shall prevent the test part from shifting or tilting during testing.

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