



Thermal Integrity: Vehicle Autoignition Sensitivity Review

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 provide a procedure for inspecting a mock-up, vehicle, or vehicle math data for potential sensitivity to hot surface ignition of combustible fluids and materials on hot vehicle surfaces in non-collision situations.

1.2 Applicability. Passenger vehicles.

1.3 Remarks. Evaluations using this procedure may provide an early warning and reduce the potential for vehicle fires. The specific nature of combustible fluid leaks in vehicle use may be difficult to predict due to the customer's in-use service and maintenance habits. This test has no absolute pass/fail guidelines. Complete elimination of all likelihood of hot surface ignition is virtually impossible.

2 References

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

2.1 External Standards/Specifications.

FMVSS 302

2.2 GM Standards/Specifications.

None

2.3 Additional References.

- Best Practice HVACPTC-285. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.
- Best Practice THMINT-14. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.
- Clash-Berg method.
- Evaluation report.
- Issue reports (e.g., Problem Resolution Tracking System (PRTS+)).
- Lube and Vent System - Bill of Design.
- Pass/fail guidelines.

3 Resources

3.1 Facilities. Any location with facilities suitable to review the underhood and underbody components of a vehicle or mock-up either in hardware or using a math data review.

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.

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August 2016

Page 1 of 8

3.2 Equipment. A vehicle hoist may be required for reviewing under the vehicle. A computer terminal with capability of reviewing the vehicle math data.

3.3 Test Vehicle/Test Piece. This procedure requires a representative vehicle/mock-up or representative math data of the vehicle design.

3.4 Test Time.

Calendar time: 1 days

Test hours: 2 h

Coordination hours: 2 h

3.5 Test Required Information. Not applicable.

3.6 Personnel/Skills. The program thermal engineer initiates, coordinates, and documents the activity. A person proficient in this procedure leads the review. Review participants may include thermal engineers, design release engineers of affected components, and vehicle fire experts familiar with hot surface ignition fire origin and cause assessment.

4 Procedure

4.1 Preparation.

This procedure can be conducted virtually on the vehicle math data or in hardware on a physical vehicle or mockup. In either case the review procedure applied should be the same. For math data reviews, it will be necessary to have a computer with software available to load the math data. Because loading the math data can be time consuming, it may be necessary to load the appropriate parts of the vehicle math prior to the meeting to make reviewing the math data more efficient. For vehicle reviews, it will be necessary to obtain an appropriate vehicle and have it put on a vehicle hoist prior to the review.

4.2 Conditions.

4.2.1 Environmental Conditions. Not applicable.

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. The hot surface ignition vehicle sensitivity review consists of the activities designated in the following subsections (4.3.1 through 4.3.2). Reducing the potential for hot surface ignition is addressed by examining areas of the vehicle for factors related to hot surface ignition sensitivity. A checklist, provided in Appendix A, Table A1 should be used as an aid to examine the vehicle.

4.3.1 Hot Surface Ignition Sensitivity Factors. Many common terms associated with vehicle fires can be found in the Glossary. A fire event may be characterized by two phases: Fire initiation and fire propagation. Fire initiation may be caused by hot surface ignition or piloted ignition. The focus of this review is on hot surface ignition. Except under conditions of extreme misuse, the temperatures required to hot surface ignite a combustible fluid or material in a vehicle can only be achieved by contact with a high temperature surface. If fire initiation occurs, the fire may self-extinguish or the fire may propagate. The factors that determine whether the fire may propagate are the proximity of secondary fuels from the fire initiation point and the amount of primary fuel in contact with the high temperature surface. The following factors should be considered when reviewing the vehicle:

- Is there potential for combustible fluid or material to contact the hot surface?
- How much of the material may potentially contact the hot surface?
- At the location where contact may occur, are there potential secondary fuel sources, especially above the location?
- Potentially how much secondary fuel may be available?

4.3.2 Examination of Component Configuration with Hot Surfaces. The primary hot surface in the vehicle is typically the exhaust system surfaces. When exhaust systems exist in a vehicle, they should always be reviewed. Other hot surfaces should also be reviewed. A hot surface is defined as a surface with the potential for temperatures > 370 °C (698 °F) during city traffic type driving or > 600 °C (1112 °F) under any driving condition including the conditions of GMW14555. Features in the surfaces should be identified that could potentially act

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August 2016

Page 2 of 8

as accumulators for small volumes of combustible fluids. If fluid could come into contact with the manifold/exhaust beneath shields, manifold temperature, not shield temperature, should be used.

Also, geometries of the exhaust system which would cause significant local airflow stagnation need to be identified. Examples would include: Close proximity heat shields or manifolds extending downward along the engine block surface.

4.3.2.1 Examination of Underhood/Underbody Component Packaging. Areas adjacent to hot surfaces should similarly be examined. Identify areas with the potential to accumulate a quantity of combustible fluid if a fluid leak were to occur. In particular, areas which might spill this combustible fluid toward a hot surface during vehicle acceleration, cornering, or braking should be identified.

4.3.2.1.1 Examination of Components near the Hot Surfaces in Low Airflow Locations.

In the virtual analysis reviews, the velocity of the air should be reviewed near the hot surfaces when available. Special attention should be paid to the ability of fluid or other debris in low velocity areas ability to contact the high temperature surfaces. Low velocity areas are defined as < 1.1 m/s in low to moderate load driving (e.g., city traffic) or < 2.2 m/s under high load conditions (e.g., trailer towing).

4.3.2.2 Examination of Combustible Materials in Areas Adjacent to Hot Surfaces. Combustible materials in areas adjacent to the exhaust system hot surfaces should be evaluated to be sure they meet their temperature requirements. Hoses, tubes and fittings that carry combustible fluids should be carefully evaluated in this regard. Plastic boxes, fluid reservoirs, wiring conduits, and plastic coated cables should also be examined. In addition, all plastic panels (e.g., bellypans, splash shields) should be assessed to be sure they are compliant with the hot surface ignition elements of the Best Practice HVACPTC-285 (the supplier shall work with the GM Design Responsible Engineer to comprehend this requirement). Consideration should also be given to the potential for an incorrect or incomplete service procedure to be used. Consideration should also be given to the potential for the parts to be misassembled during the vehicle build (e.g., missing attachments, slack in wires or hoses). For conditions of incorrect service or build, contact with the exhaust would be the primary consideration.

4.3.2.3 Examination of Potential Combustible Fluid Leakage Areas. This consists of engineering analysis of the underhood environment to ascertain potential areas for combustible fluid leakage as a result of poor maintenance, service or misuse. Some examples of possible fluid leakage areas are:

- Cooling system hoses, joints, and switches/senders.
- Power steering hoses, joints, and switches/senders.
- Transmission fluid cooler line hoses, joints, and switches/senders, vents.
- Engine and/or transmission gasket joints and switches/senders.
- Hose and pipe routing (oil, fuel).
- Leakage caused by customer inattention or abuse.
- Engine oil cooler system.
- Engine mechanical failure.

Note that customer inattention or abuse includes fluid overflows, or overfills, oil fill cap left off, improper service and/or abuse of the product. The test engineer should make a determination as to which potential leak sources would be most critical considering the hot surface component and underhood packaging evaluated in previous paragraphs.

4.3.2.4 Examination of Customer Fill/Refill Locations. Customer fill/refill locations shall be evaluated for the potential for fluid to be spilled onto a hot surface. The assessment should consider whether the fluid spill has a path to ground. The possibility of fluid spilling or boiling from a fill tube onto a hot surface shall be evaluated. If the possibility exists, the consequences of fluid contacting the hot surfaces must be assessed. The recommendation is for the fluid to have a clear path to ground. Additional information can be found in the Best Practice THMINT-14 (the supplier shall work with the GM Design Responsible Engineer to comprehend this requirement).

The potential of engine oil spillage during fill to drain onto a hot surface may be evaluated by spilling oil during fill (water may be used as a substitute) and watching if the fluid contacts a potential hot surface. The person leading the review should determine the best method for spillage. Review Lube and Vent System – Bill of Design. The powertrain Lube and Vent technical specialist can be consulted when needed.

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August 2016

Page 3 of 8