

SURFACE VEHICLE INFORMATION REPORT

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Passenger Car and Light Truck Fuel Containment

Foreword—The integrity of the fuel containment system has been a longstanding concern of automotive engineers throughout the industry and has been specifically addressed by government regulatory authorities in the U.S., Europe, and Japan. This document is intended to point out design aspects that are important and thus offer an opportunity for overall improvement in system design.

- a. Vehicle manufacturers should conduct proving ground and customer fleet tests to confirm their fuel system design will meet the regulated time or mileage requirements. The proving ground durability tests should include stone pecking (gravel impingement) and ground clearance tests as appropriate. Any fuel-system shielding should be evaluated to the same durability standards (including corrosion resistance) that apply to the fuel containment components.
- b. Failure Mode and Effects Analysis (FMEA)—As a useful tool for design, manufacturing, and assembly evaluation, FMEA or a similar methodology is suggested for application during the development of the fuel containment system.
 1. In addition to meeting government standards, consideration should be given to all reasonably likely "real world" causes of fuel containment failure including reasonably foreseeable crashes, long term corrosion effects, and other abnormalities such as failure of other vehicle components, assembly or service errors, and failures or abnormalities on other vehicles which might be involved in a crash situation.
 2. It would not be reasonable or practical to design fuel containment systems that would completely eliminate all risks of failure in any condition identified in a FMEA study, however, a disciplined FMEA approach can eliminate many "real world" failure modes and reduce the frequency of many others.

1. **Scope**—The scope of this SAE Information Report is the liquid fuel containment system for gasoline or flexible fuels (up to 85% methanol in gasoline), along with their associated vapors, as designed for use on passenger cars and light trucks. For purposes of this document, fuel containment addresses the fuel tank and components that are directly attached to the fuel tank. These components may include the filler neck, tank, fill vent tube, fuel cap, pump-sender, and rollover control valve closure seals, insofar as they act as closure or containment mechanisms. Emphasis will be on fuel containment and the required system closures. Furthermore, emphasis will be placed on design recommendations as they relate to performance. Mounting and shielding of the "system" components are only included to the extent they affect the containment aspects.

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1.1 Purpose—The purpose of this document is to suggest design practices for automotive fuel tanks and any related components that directly close the fuel tank. This document incorporates the consensus of the SAE Fuel Containment Standards Committee as to those practices that are reasonable, practicable, and appropriate.

2. References

2.1 Applicable Publications—The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATION—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1681—Gasoline Methanol Mixtures for Materials Testing

2.1.2 ASTM PUBLICATION—Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 117—Method of Salt Spray (Fog) Testing

2.1.3 FEDERAL PUBLICATION—Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

FMVSS 301

2.1.4 ECE PUBLICATION—Available from Commission of the European Communities, 200, Rue de La Loi, B-1049 Brussels, Belgium.

ECE 34

2.1.5 NHTSA PUBLICATION—Available from U. S. Government, DOD SSP, Subscription Service Division, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094

"Fires and Burns in the Towed Light Vehicle Crashes," 1992, Susan Partyka

2.2 Related Publications—The following publications are provided for information purposes only and are not a required part of this document.

EPA Evaporative Regulation 40 CFR Part 86

CARB Regulation Evaporative Emission - Title 13 California Code of Regulations Sect 1976

3. Principles—This section details the general principles suggested by the Fuel Containment Standards Subcommittee. If the Guidelines in Section 6 are incomplete, or if there appears to be inconsistency or ambiguity in the application of the Guidelines, the Principles should be applied to resolve the uncertainty.

3.1 Normal Use Principle—The fuel containment system should provide for a lifetime of customer service without maintenance or fuel leakage and with continuing compliance to applicable emission or safety regulations.

3.1.1 Furthermore, current Environmental Protection Agency (EPA) requirements for fuel system useful life are 10 years or 100 000 miles, whichever comes first for all passenger cars and light trucks below 3750 lb gross vehicle weight and 11 years or 120 000 miles for all other light-duty trucks. No fuel leaks or increase in evaporative emissions above those allowed by regulation are permitted throughout the useful life.

3.2 Abnormal Use Principle—The fuel containment system should be designed in anticipation of certain abnormalities which could occur in customer usage so as to prevent, to the extent practicable, the release of fuel even in such abnormal conditions. Each design should be subjected to a FMEA to identify abnormal failure modes and to suggest approaches to eliminate, to the extent practicable, system failures or misuse that could release fuel.

3.3 Collision Damage Principle—An automotive vehicle and its fuel containment system are subject to collision damage in an infinite variety of situations including various angles, speeds, and fixed or moving objects impacted, multiple impacts, and rollovers with or without preceding or subsequent impacts. A FMEA should be performed and consideration given to vehicle package and fuel containment system design in order to eliminate or minimize collision-related fuel spillage to the extent practicable.

4. Guidelines

4.1 Durability Guideline—Laboratory bench tests and proving-ground vehicle-durability tests under conditions representative of worst-case customer use should be performed to confirm fuel-system life-time capability.

4.2 Corrosion Guideline—The fuel-containment system must be robust with respect to exterior corrosion so as to provide high confidence in passing expected use over the vehicle's life time.

Attention should be given to not only material selection but also protective coatings and galvanic interactions between dissimilar metals.

4.2.1 Some manufacturers utilize accelerated vehicle proving-ground corrosion tests that subject vehicles to a fairly corrosive environment over several months as a simulation of life-time corrosion exposure. A minimum of 2000 h salt-spray test (per ASTM B 117) is suggested for evaluating exterior-corrosion protection. In addition, various fuel soaks and laboratory exposure tests are suggested for determining interior-corrosion performance of fuel-containment components, as discussed in more detail as follows:

4.2.2 Provisions should also be made through proper material selection and, if necessary, the use of protective coatings for the fuel containment interior surfaces to provide appropriate corrosion and fuel resistance, including resistance to additives, water, or other contaminants.

4.2.3 There should be no component-related contribution to fuel contamination from lead, silicone, phosphorus, aluminum, plasticisers, barrier treatments, or from material-corrosion by-products.

4.2.4 Verification of successful performance of internal- and external-corrosion protection should take place after completing proving ground durability or corrosion tests and laboratory soak tests using recommended fuels from SAE J1681. A minimum of 4000 h of internal component exposure to these SAE fuels is suggested. Note that for some applications, corrosion requirements may need revision to meet more stringent situations (e.g., worldwide use).

4.2.5 Verification should include component visual inspection inside and out plus system testing for evaporative emissions using a full vehicle size Sealed Housing for Evaporative Determination (SHED) or a mini-SHED large enough to contain the fuel system. Tests should be conducted according to California or Federal evaporative regulations.

NOTE—The fuel constituents (particularly alcohol levels used during durability or soak tests) can affect SHED test results.