



Diesel Exhaust Fluid Tank Component Technical Specification

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 primary function of the Diesel Exhaust Fluid (DEF) tank is:

- To store the DEF for access by the pump module.
- Enable refilling of the on-board DEF storage.

The DEF tank shall carry out these functions while meeting specific requirements of the customer, powertrain, other interfaces, mandated safety and emission standards, and company objectives.

1.2 Applicability. This document provides standard technical requirements for the Diesel Exhaust Fluid (DEF) tank. This document shall be used in conjunction with program-specific technical specifications, Diesel Exhaust Fluid Program Specific Component Technical Specifications (Appendix C2 of Electronic Statement of Requirements (eSOR)). References to the program-specific technical specifications are included in this document where program-specific requirements are expected to exist.

Note: Program-specific technical specifications may include additional requirements that are not referenced in this document and may supersede any requirements included in this document. In the case of any conflicts between this document and the program-specific technical specifications, the program-specific technical specifications take precedence.

This document establishes the component level requirements for the DEF Tank. This document shall be used in conjunction with and complement other requirement documents included in the Statement of Requirements (SOR).

1.2.1 Terminology. The DEF tank, as described in this document, has differing naming nomenclatures dependent on market. The DEF tank, as referred to in this document, stores and handles an aqueous mixture of 32.5% urea (AUS32). For the purpose of this document, it will be referred to as "DEF tank". It is alternatively referred to as:

- Selective Catalytic Reduction (SCR) Tank.
- AdBlue Tank (registered trademark of Verband der Automobilindustrie).
- Urea Tank.
- Emission Reduction Fluid Tank.

1.3 Remarks. This specification applies only to diesel and bio-diesel fueled vehicles equipped with DEF System to meet Nitrogen Oxide (NOx) emissions.

2 References

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

2.1 External Standards/Specifications.

ASTM D903	ISO 1431-1	SAE J400	SAE J2587
ASTM D4169	ISO 3167	SAE J1960	
ISO 179/1eA	ISO 16750-5	SAE J2044	
ISO 527-1	ISO 22241-1	SAE J2045	

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

August 2017

Page 1 of 17



Documents
Document Sharing Hub

2.2 GM Standards/Specifications.

GMW3059	GMW14291	GMW14911	GMW15760
GMW3110	GMW14547	GMW15010	GMW15784
GMW3172	GMW14681	GMW15272	GMW15862
GMW4710	GMW14842	GMW15450	GMW16194
GMW8518	GMW14872	GMW15451	GMW16434
GMW14264	GMW14889	GMW15570	GMW17152

2.3 Additional References.

- Appendix C2 of Electronic Statement of Requirements (eSOR): Exhaust Fluid Program Specific Component Technical Specifications
- Appendix G2 of Electronic Statement of Requirements (eSOR): Diesel Emission Fluid (DEF) Validation Cross Reference Index (VCRI)
- Appendix W7 of the Statement of Requirements (SOR): Process Control Documentation for Plastic Tank Manufacturing
- CG2456 Test Procedures for Diesel Exhaust Fluid System
- GM Ergonomics Design Guidelines for Shipping Caps/Plugs
- Statement of Requirements (SOR)

3 Requirements**3.1 System/Subsystem/Component/Part Definition.**

3.1.1 Appearance. The DEF tank and the visible components shall be black in color unless otherwise stated in the program-specific Component Technical Specification (CTS).

3.1.2 Content. Paragraphs 3.1.2.1 thru 3.1.2.2 describe the physical and functional content of the DEF tank.

3.1.2.1 Physical Content.

- Fluid Storage Tank.
- Tank Fill Spud.
- Tank Fill Limit Valve.
- DEF Pump Module Closing System (i.e., Mason jar, Cam-Lock or Welded).
- Tank Venting System.
- DEF Controller Mounting Hardware.
- Component Mounting and Restraint Hardware.
- Shield Mounting Provisions.

3.1.2.2 Functional Content. The DEF tank shall provide the following primary functions while meeting specific requirements of the vehicle and powertrain electrical and hydraulic interfaces, and while respecting the safety and emission standards:

- Store the DEF, preventing any leakage.
- Seal from water and dust intrusion when not filling to prevent contamination.
- Enable filling to replenish the DEF stored onboard, while preventing overfilling.
- Enable ventilation to avoid any over- and/or under-pressure, while minimizing evaporation.
- Allow for DEF expansion in freezing conditions with no damage.
- Isolate the DEF tank vibration energy transfer (where applicable).

3.1.3 Ambient Environment. The following paragraphs specify the environmental conditions that the DEF tank will be exposed to during its lifetime. The values in Table 1 should be used in the selection of materials and application of engineering judgment throughout the design process.

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

August 2017

Page 2 of 17

Table 1: Ambient Temperature

Region	Minimum Temperature	Maximum Temperature
Worldwide Default	-48 °C (-55 °F)	52 °C (125 °F)
Russia (Siberia)	-51 °C (-60 °F)	Not applicable
Middle East	Not applicable	55 °C (130 °F)

3.1.3.1 Operating Environment. The DEF tank shall be capable of exposure to temperatures for their sales regions as defined in Table 1 and operating in the environments described in Table 2 without adverse effect to functional performance.

3.1.3.2 Continuous Temperature. The DEF tank shall be designed to work without any performance or durability issues for 3020 h/30 000 cycles as per the temperatures in Table 2 during continuous vehicle operation, based on 321 900 km (200 000 mi) vehicle life. Component functionality and performance shall not be compromised under continuous thermal conditions.

Table 2: Operating Environment

Underbody	-40 °C to 90 °C continuous
Relative Humidity (RH)	2% to 100%
Fluid Temperature in Tank (Bulk Fluid)	-40 °C to 65 °C continuous
Barometric Pressure	56.9 kPa to 106.3 kPa
Precipitation	≤ 4.6 mm/minute
Grade/Inclination	≤ 15%
Ozone	≤ 0.40 ppm
Altitude	-150 m to 4600 m

3.1.3.3 Excursion Temperature. The DEF tank shall be designed to work without any durability issues for 120 h/800 cycles at 110 °C underbody or 150 °C under hood temperature, during vehicle operation on an infrequent basis (based on 321 900 km (200 000 mi) vehicle life). If the vehicle Reliability Evaluation Point (REP) is other than 321 900 km (200 000 mi), then scale the required cycles accordingly. No single excursion event shall be longer than 20 minutes. Occupant safety shall not be compromised during excursion thermal conditions.

3.1.3.4 Non-Operating Environment. The DEF tank shall meet all operating performance requirements, without loss of function or degradation of service life, after exposure to the following non-operating conditions:

- Transport by airplane at altitudes up to 13 700 m, validated according to ASTM D6653-01.

3.1.3.5 Ultraviolet Radiation. Ultraviolet radiation, accelerated weathering, applies for incomplete vehicles (e.g., cab chassis trucks, cutaway vans, etc.) and any exterior exposed components (i.e., fill caps in fill pocket, etc.) The exposed materials shall retain 75% of the original properties for Tensile Strength (ISO 527-1/2) and Notched Charpy Impact (ISO 179/1eA) after 2500 kJ/m² of accelerated exposure, using Xenon arc weathering apparatus as described in SAE J1960. Tensile bars shall be prepared using ISO 3167, 4 mm thick Type A. Charpy Impact bars shall be 80 mm × 10 mm × 4 mm Machined V notch, r = 0.25 mm. For complete vehicle applications, this requirement does not apply.

3.1.3.6 Robustness to Ozone. This requirement applies to parts made of highly unsaturated materials, such as diene rubber (i.e., polyisoprene, styrene-butadiene rubber, etc.), that have exposure to the external ambient environment. The parts shall be checked for stabilization against ozone per ISO 1431-1 (100 pphm, test duration 336 h).

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

August 2017

Page 3 of 17

3.1.3.7 Type of Fluid and Material Compatibility. The DEF tank shall work with the fluid as per ISO 22241-1 quality requirements. Materials used in the system shall be compatible with this fluid, and shall work in the operating environment listed in Table 2.

The DEF tank shall be compatible with the byproducts of DEF fluid formed during degradation/aging.

3.1.3.8 Corrosives - Chloride Exposure. Polymers exposed to the underbody and lower under hood atmosphere must be compared against Table 3 to determine the need for further testing (defined below). If the polymer is not identified within the list, GM Materials Engineering shall be consulted to determine the appropriate disposition.

Table 3: Chloride Exposure

Testing Required	Testing Not Required
Polyamide (PA6, PA66, PA12, etc.), Polyketone (PK)	Polyacetal (POM), Polyethylene (PE), Polyester Polybutylene or Polyethylene Terephthalate (PBT or PET), Polypropylene (PP), Polyphenylene Sulfide (PPS)

3.1.3.9 Resistance to Calcium Chloride. This requirement applies to components with external exposure. The sample shall be fixtured during the test such that a simulated 44 N side load is applied to the part, representative of the part's usage in the assembly. The external surfaces of the fixtured assembly are immersed in a 50% aqueous solution (by weight) of calcium chloride for 200 h at 60 °C ± 2 °C with the ports sealed. The sample is then stored out of solution for 200 h at 60 °C ± 2 °C. The sample may be rinsed with fresh water to clear salt residue. There shall be no cracking, crazing, or other damage to the plastic parts. Parts need to pass leak and functional tests after exposure.

3.1.3.10 Resistance to Zinc Chloride. This requirement applies to components with external exposure. The sample shall be fixtured during the test such that a simulated 44 N side load is applied to the part, representative of the part's usage in the assembly. The external surfaces of the fixtured assembly are immersed in a 50% aqueous solution (by weight) of zinc chloride for 200 h at 23 °C ± 2 °C with the ports sealed. The sample may be rinsed with fresh water to clear salt residue. There shall be no cracking, crazing, or other damage to the plastic parts. Parts need to pass leak and functional tests after exposure.

3.1.3.11 Stone Impingement. The DEF tank components exposed to impingement due to packaging location shall be capable of withstanding stone and gravel impact, as tested per SAE J400, at an angle of attack of 45 degrees below the bottom surface of the DEF tank in the driving direction. After the test components shall meet leak requirements and functional checks. Following a teardown and a detailed analysis of every exposed component there shall be no indication of perforation and no damage that could impact the functionality of the components.

3.1.3.12 Gravel Entrapment. The DEF tank shall successfully comply with the criteria for vehicle-level gravel entrapment test when tested per GMW14889 with no degradation to component functions or visible damage. Parts need to pass leak tests after exposure and have no visible damage to components that will contribute to noise and vibration or squeak and rattle concerns.

3.1.3.13 Automotive Fluids Compatibility. The DEF tank shall be designed to withstand prolonged exposure to automotive fluids as outlined in ISO 16750-5 and continuous exposure to DEF. Components must meet leak test requirements posttest and must exhibit no visible cracking or crazing.

3.1.3.14 Thermal Integrity. The DEF tank shall be designed to avoid auto-ignition conditions involving components of the DEF System, as evaluated per GMW14911.

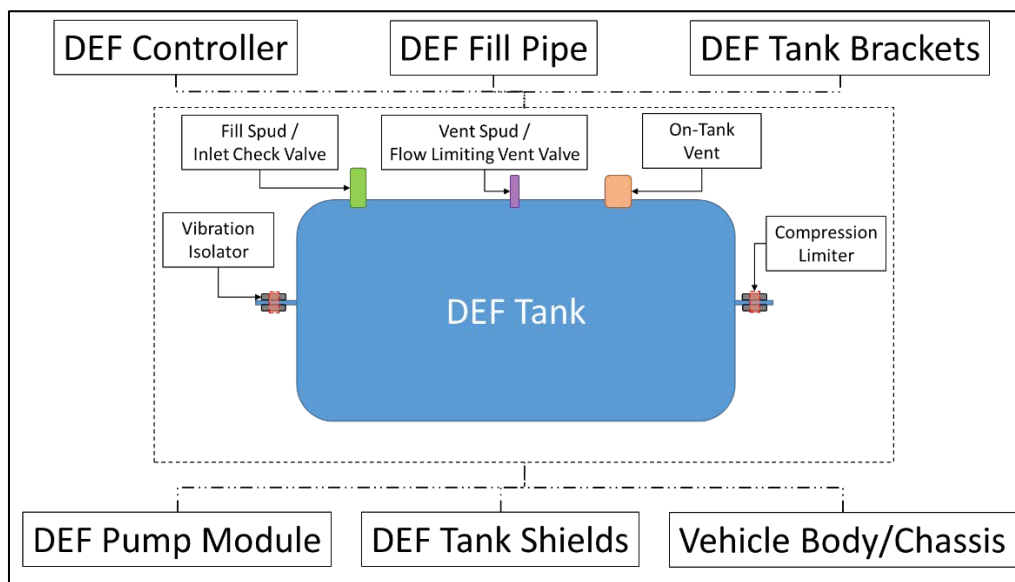
3.1.4 Interfaces. Interfaces between the DEF tank and other subsystem components are depicted at a high level in Figure 1. These interfaces may constrain or drive the design of the tank and, therefore, must be addressed during design and development. The entire DEF System implementation and operation in the vehicle must also successfully accommodate the identified interfaces. These physical interface requirements are further detailed in the program specific documents.

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

August 2017

Page 4 of 17



Note: All items within the dashed box are within the scope of this document.

Figure 1: DEF Tank Interaction with Other Subsystem Components

3.1.4.1 DEF Tank to Fill Pipe. The tank to fill pipe interface shall be a 24 mm SAE J2044 quick connect design, unless otherwise indicated in the program specific CTS. Quick connectors shall meet SAE J2044 requirements, with DEF fluid as the test medium.

3.1.4.2 DEF Tank to Vent Lines. Vent line interface shall be a 12 mm SAE J2044 quick connect design, unless otherwise indicated in the program specific CTS. Quick connectors shall meet SAE J2044 requirements, with DEF fluid as the test medium.

3.1.4.3 DEF Tank to DEF Pump Module. The DEF tank shall enable the program-specific DEF pump module interface, including mason jar interface, Encapsulated and Locking (E&L) ring, and weld-in pump module applications.

3.1.4.4 DEF Tank to DEF Controller. The DEF tank shall provide, as necessary, retention features for the DEF controller. Where fasteners are the method of retention, the fasteners shall be GM approved fasteners. The controller shall be retained, with no loss of retention performance, through all applicable validation tests and through the reliability evaluation point of the vehicle, at a minimum.

3.1.4.5 DEF Tank to DEF Tank Brackets. The tank shall include fixation features sufficient for the use of M8 or larger bolts to connect the tank to the DEF tank brackets, where applicable. For body-frame-integral applications, the fixation shall include vibration isolating features. In all cases, metal bushings shall be used in the tank features to prevent torque loss due to polymer relaxation.

3.1.4.6 DEF Tank to Vehicle Body/Frame. The tank shall include fixation features sufficient for the use of M8 or larger bolts to connect the tank to the body or frame, where applicable. For body-frame-integral applications, the fixation shall include vibration isolating features. In all cases, metal bushings shall be used in the tank features to prevent torque loss due to polymer relaxation.

3.1.4.7 DEF Tank to Assembly Plant Tooling/Fixtures. The DEF tank shall be designed such that the components clear GM assembly plant tools and fixtures.

3.1.5 Usage Definition. The DEF tank is used on all diesel vehicles which require active SCR in order to meet applicable emissions regulations.

3.2 Product Characteristics. The required product characteristics for the DEF tank are identified in 3.2.1 thru 3.2.1.3.21.

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

August 2017

Page 5 of 17



Documents

Document Sharing Hub

3.2.1 Performance Requirements.

3.2.1.1 Component Performance Requirements. Unless otherwise specified, the requirements in this section are valid for the whole product life. Unless otherwise specified, the system must meet the performance requirements in the static and dynamic (driving) states.

3.2.1.1.1 DEF System Performance. The DEF tank shall be designed to enable all subsystem and system performance requirements, per GMW15784.

3.2.1.1.2 DEF Refill Performance. The DEF tank shall be capable of refill rates of 40 L/minute for North America, 10 L/minute for Europe, and plant filling, as defined in the SOR, unless otherwise stated in the program-specific CTS. For the rest of the world the tank shall be capable of the fill rate as defined in the program-specific CTS. Fill performance shall be assessed in accordance with GMW16194.

3.2.1.1.3 DEF Tank Thermal Performance. The DEF tank shall be designed to ensure a maximum bulk fluid temperature in the tank of 65 °C. Where this cannot be achieved by the tank alone, shielding shall be applied.

3.2.1.2 DEF Tank Durability and Resistance Requirements.

3.2.1.2.1 Production Checks.

3.2.1.2.1.1 Leak Test. The tank leak test must be performed at a minimum, on all tanks, before they are shipped to the GM assembly plant. This is evaluated by water bath testing at 35 kPa $\pm$ 10%, per GMW17152, during validation and 100% helium leak check in production. Pass/fail criteria for water bath shall be as described in GMW17152. Helium leak check for production shall be tested per SAE J2587, showing a leakage rate lower than 1×10^{-3} mbar $\times$ l/s when tested with Helium at a differential pressure of 10 kPa.

3.2.1.2.2 Corrosion Resistance. The DEF tank shall meet corrosion requirements per GMW15272 as tested per GMW14872 for Underbody (UB) and under hood (UH) components. Functional corrosion resistance requirements are to be evaluated for UB and UH components to Exposure E. Where applicable, cosmetic corrosion resistance requirements are to be evaluated for UB components to Exposure 0 and A. Where applicable, cosmetic corrosion resistance requirements are to be evaluated for UH components to Exposure 0 and B.

3.2.1.2.3 Crash Worthiness. For a DEF tank packaged in the interior or trunk compartment, a restraint system must be in place to ensure that the tank remains restrained for all frontal, rear and side impact test conditions.

3.2.1.2.4 Refill Robustness. The DEF tank shall be capable of enabling refilling under all ambient conditions, including frozen and/or partially frozen conditions and at 15% nose up/down grade, 12% side to side grade.

3.2.1.2.5 Vehicle Wash. The DEF tank shall be designed to meet the vehicle wash requirements when tested on a vehicle per GMW14547.

3.2.1.2.6 Low Fluid Handling. The DEF tank shall make DEF available to the pickup point of the DEF pump module when filled to 12% usable capacity and when subjected to normal customer usage around corners, on grades (up to 15% front up and down and 12% side to side).

3.2.1.2.7 Fluid Available When Vehicle at Maximum Nose Up Tilt. The unusable volume when vehicle is at maximum nose up tilt (15% grade) must not exceed 0.5 L and must not create inconsistencies in the driver warning inducement strategy.

3.2.1.2.8 Water Submersion/Fording. The DEF tank shall meet the water submersion/fording requirements when tested on a vehicle per GMW14547. The DEF tank shall pass the component test for evaluation of the seal capabilities of the system, as defined in GMW3172 for seal performance conforming to IP6K8 sealing class.

3.2.1.2.9 Drop Resistance (Drop Test). The DEF tank assembly shall be dropped onto a level concrete floor from 1 m height. This drop test shall be repeated such that the tank is dropped on each of its six (6) sides. The test and results shall characterize damage to the tank, such that it can be used as reference data.

3.2.1.2.10 Vibration Resistance. The DEF tank shall withstand random vibration testing when tested at 23 °C using the vehicle-specific vibration profile. The vibration profile shall be calculated from the road load data collected from vehicle at the location of tank. If the road load data is non-existent at the time of start of test, the generic profile described in GMW15570 should be used as a substitute. The components shall withstand a minimum of 2.4 lives with a minimum sample size of six (6) where one life is defined as the REP, outlined in section 3.2.3.1. Alternative sample sizes may be used if it is demonstrated to meet reliability requirements per section 3.2.3.3. After the completion of testing, all components shall meet leak requirements and functional checks.

GM Confidential

© Copyright 2017 General Motors Company All Rights Reserved

August 2017

Page 6 of 17