



## Diesel Exhaust Fluid Tank Shields 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 shields is to protect the DEF tank assembly, including the welded tank shell and components, from external inputs. These include, but are not limited to:

- Dust.
- Dirt/mud.
- Road debris.
- Gravel.
- Thermal inputs.
- Convective air flow.
- Snow/Water/Ice.

The primary function of the DEF tank thermal blanket is to provide the DEF tank assembly, including the welded tank shell and components, with protection from thermal inputs and insulation to enable a desired freeze or thaw pattern.

**1.2 Applicability.** This specification applies only to diesel and bio-diesel fueled vehicles equipped with DEF System to meet nitrogen oxide (NOx) emissions.

**1.3 Remarks.** This document provides standard technical requirements for Diesel Exhaust Fluid (DEF) tank shields and thermal blankets. This document shall be used in conjunction with program-specific technical specifications, CG2139. 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 DEF tank shields and thermal blankets. This document shall be used in conjunction with and complement other requirement documents included in the Statement of Requirements (SOR).

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

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

**GM Confidential**

© Copyright 2018 General Motors Company All Rights Reserved

February 2018

Page 1 of 14



**Documents**  
Document Sharing Hub

- Agente Reductor Liquido Automotivo (ARLA 32).

## 2 References

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

### 2.1 External Standards/Specifications.

|            |             |             |             |
|------------|-------------|-------------|-------------|
| ASTM D903  | ISO 179/1eA | ISO 3167    | ISO 22241-4 |
| ASTM D4169 | ISO 527-1/2 | ISO 6603-2  | SAE J400    |
| DIN 45631  | ISO 1431-1  | ISO 16750-5 | SAE J1960   |

### 2.2 GM Standards/Specifications.

|          |          |          |          |
|----------|----------|----------|----------|
| GMW3059  | GMW14264 | GMW14911 | GMW15862 |
| GMW3091  | GMW14547 | GMW15272 | GMW16653 |
| GMW3097  | GMW14669 | GMW15570 |          |
| GMW8518  | GMW14872 | GMW15760 |          |
| GMW14234 | GMW14889 | GMW15784 |          |

### 2.3 Additional References.

- Appendix C2 of Electronic Statement of Requirements (eSOR): Exhaust Fluid Program Specific Component Technical Specifications (CTS)
- Appendix G2 of Electronic Statement of Requirements (eSOR): Diesel Emission Fluid (DEF) Validation Cross Reference Index (VCRI)
- CG2135 (ID)
- CG2139 (ID)
- CG2309 (ID)
- GM Ergonomics Design Guidelines for Shipping Caps/Plugs (ID)
- Statement of Requirements (SOR)

(ID) = This document is limited to internal use within General Motors and shall not be accessed outside this company. Contact the GM Lead Engineer for further instructions.

## 3 Requirements

### 3.1 System/Subsystem/Component/Part Definition.

**3.1.1 Appearance.** Unless otherwise specified the DEF tank shields and thermal blankets, in vehicle position for passenger vehicles, shall not be visible from the GM-defined vehicle specific sight lines.

**3.1.1.1 Dust/Debris/Impact Shields.** All DEF tank shields intended for preventing intrusion of dust, dirt, snow, gravel, etc, including shall be black in color (i.e., dust shields, road debris shields, structural shields, and skid plates). All visible components, including fasteners, shall be black.

**3.1.1.2 Heat Shields.** DEF tank heat shields for passenger vehicles shall not be visible. All heat shields are not required to be black, though it is preferred, where possible, to match the color of surrounding components.

**3.1.1.3 Thermal Blankets.** DEF tank thermal blankets for passenger vehicles shall not be visible. All thermal blankets are not required to be black, though it is preferred, where possible, to match the color of surrounding components.

### 3.1.2 Content.

#### 3.1.2.1 Physical Content.

**3.1.2.1.1 Dust/Debris/Impact Shields.** Dust/debris/impact shields shall fulfill the functional requirements outlined in 3.1.2.2, as well as including provisions for all necessary fasteners. Where the shield is installed prior to assembly of the tank to the vehicle, an access door shall be included to allow connection of plumbing and electrical components to the DEF tank assembly.

**GM Confidential**

© Copyright 2018 General Motors Company All Rights Reserved

February 2018

Page 2 of 14

**3.1.2.1.2 Heat Shields.** Heat shields shall provide the necessary thermal protection, from either hot or cold conditions as necessary, as well as provisions for all necessary fasteners. Where the heat shield is installed prior to assembly of the tank to the vehicle, there shall be no obstruction to electrical or plumbing connections unless jumper components are provided to relocate the connections to an accessible area.

**3.1.2.1.3 Thermal Blankets.** Thermal blankets shall provide the necessary thermal protection, from either hot or cold conditions as necessary, as well as provisions for all necessary fasteners or retention features. Where the thermal blanket is installed prior to assembly of the tank to the vehicle, there shall be no obstruction to electrical or plumbing connections unless jumper components are provided to relocate the connections to an accessible area.

### 3.1.2.2 Functional Content.

**3.1.2.2.1 DEF Tank Shields.** The DEF tank shields shall provide the following primary functions while meeting all specific requirements of the vehicle, subsystem, safety, and emissions standards:

- Limit ingress of dust.
- Limit ingress of dirt and mud.
- Limit ingress of water, snow, ice.
- Provide draining features to prevent collection of any external materials.
- Prevent entrapment of gravel.
- Protect the DEF tank assembly and its components from stone impingement.
- Provide transfer of external loads to the body/frame, where necessary.
- Protect the DEF tank assembly and DEF fluid from thermal inputs, both hot and cold.

**3.1.2.2.2 DEF Tank Thermal Blankets.** The DEF tank thermal blankets shall provide the following primary functions while meeting all specific requirements of the vehicle, subsystem, safety, and emissions standards:

- Provide draining features to prevent collection of any external materials
- Prevent entrapment of gravel
- Protect the DEF tank assembly and DEF fluid from thermal inputs, both hot and cold

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

**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 shields and thermal blankets 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. Especially for heat shields, proximity to exhaust components can result in significantly higher temperatures. Refer to the program-specific Component Technical Specifications (CTS) for any program-specific temperature conditions.

**3.1.3.1.1 Continuous Temperature.** The DEF tank shields and thermal blankets 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. Shield functionality and performance shall not be compromised under continuous thermal conditions.

**GM Confidential**

© Copyright 2018 General Motors Company All Rights Reserved

February 2018

Page 3 of 14



**Documents**  
Document Sharing Hub

The DEF tank heat shields and thermal blankets shall be designed to withstand the program-specific continuous operating temperature while providing the necessary thermal protection for the DEF tank shell and electronics. The program-specific continuous temperature shall be provided in the Appendix C2 program-specific CTS.

**Table 2: Dust/Debris/Impact Shields Operating Environment**

|                     |                             |
|---------------------|-----------------------------|
| Underbody           | -40 °C to 90 °C continuous  |
| Underhood           | -40 °C to 125 °C continuous |
| Relative Humidity   | 2% to 100%                  |
| Barometric Pressure | 56.9 kPa to 106.3 kPa       |
| Precipitation       | ≤ 4.6 mm/minute             |
| Grade/Inclination   | ≤ 15%                       |
| Electromagnetic     | GMW3091, GMW3097            |
| Ozone               | ≤ 0.40 ppm                  |
| Altitude            | -150 m to 4600 m            |

**3.1.3.1.2 Excursion Temperature.** The DEF tank shields and thermal blankets shall be designed to work without any durability issues for 120 h/800 cycles at 110 °C underbody or 150 °C underhood temperature during vehicle operation on an infrequent basis, based on Reliability Evaluation Point (REP) of the specific vehicle (refer to 3.2.3.1). If the vehicle 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.

The DEF tank heat shields and thermal blankets shall be designed to withstand the program-specific excursion temperature, while providing the necessary thermal protection for the DEF tank shell and electronics. The program-specific excursion temperature shall be provided in the Appendix C2, program-specific CTS.

**3.1.3.2 Non-Operating Environment.** The DEF tank shields and thermal blankets 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.

**3.1.3.3 Ultraviolet Radiation.** Ultraviolet (UV) radiation, accelerated weathering, applies for incomplete vehicles (i.e., cab chassis trucks, cutaway vans, etc.) and any exterior exposed components (i.e., brackets or shields mounted in such a manner that they are exposed to UV radiation during normal vehicle operation).

**3.1.3.3.1 Polymer Shields.** 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/m<sup>2</sup> 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 some complete vehicle applications where the DEF tank shield is not visible, this requirement does not apply.

**3.1.3.3.2 Coated Metal Shields.** Coated metal shields shall meet all accelerated weathering requirements per GMW14669.

**3.1.3.4 Robustness to Ozone.** This requirement applies to parts made of highly unsaturated materials (i.e., diene rubber (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).

**3.1.3.5 Type of Fluid and Material Compatibility.** The DEF tank shields and thermal blankets shall work with the fluid, as per ISO 22241-4 quality requirements. Materials used in the system shall be compatible with this fluid, and shall work in the operating environment listed in Table 2.

## GM Confidential

© Copyright 2018 General Motors Company All Rights Reserved

February 2018

Page 4 of 14



**Documents**

Document Sharing Hub

**3.1.3.6 Corrosives - Chloride Exposure.** Polymers exposed to the underbody and lower underhood atmosphere must be compared against Table 3 to determine the need for further testing. 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),<br>Polyethylene (PE),<br>Polyester Polybutylene or Polyethylene Terephthalate (PBT or PET),<br>Polypropylene (PP),<br>Polyphenylene Sulfide (PPS) |

**3.1.3.6.1 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 functional tests after exposure.

**3.1.3.6.2 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 functional tests after exposure.

**3.1.3.7 Stone Impingement.** The DEF tank shield 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 system in the driving direction. After the test components shall pass all functional checks. Following a teardown and a detail analysis of every exposed component there shall be no indication of perforation and no damage that could impact the functionality of the components.

**3.1.3.8 Gravel Entrapment.** The DEF tank shields 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 functional tests after exposure and have no visible damage to component that will contribute to noise and or vibration or squeak and rattle concerns.

**3.1.3.9 Automotive Fluids Compatibility.** The DEF tank shields and thermal blankets shall be designed to withstand prolonged exposure to automotive fluids, as outlined in ISO 16750-5 and exposure to DEF. Components must exhibit no visible cracking or crazing.

**3.1.3.10 Thermal Integrity.** The DEF tank shields and thermal blankets shall be designed to avoid auto-ignition conditions involving components of the DEF System, as evaluated per GMW14911. Material selection shall be approved by the GM materials engineer to ensure thermal integrity is maintained.

**3.1.4 Interfaces.** The entire DEF System implementation, including the DEF tank shields and thermal blankets, and operation in the vehicle must successfully accommodate the identified interfaces in the following paragraphs. These physical interface requirements are further detailed in the program specific documents.

**3.1.4.1 DEF Tank Assembly.** The DEF tank shields shall be fixed to the DEF tank assembly except where the shield is structural or a skid plate. All fasteners shall be globally approved fasteners, as defined by the fastener engineer. Fixation methods may be used individually or in combination and include, but are not limited to:

- Push pins
- Bolts or Screws
- Nuts
- Molded in Features

## GM Confidential

© Copyright 2018 General Motors Company All Rights Reserved

February 2018

Page 5 of 14