



## **Technical Requirements for GM Aftermarket Diesel Fuel Detergent Additives**

### **1 Scope**

**1.1 Material Description.** The candidates for diesel detergent additive package shall be used primarily to clean-up injector deposits from compression ignition engines.

**Note:** The additives shall not contain any metallic content or methanol unless exclusively specified by GM Fuels Group.

**1.2 Symbols.** Not applicable.

**1.3 Applicability.** The additives should be able to clean any one (1) or all of the types of fuel injector/combustion chamber deposits caused by diesel and biodiesel blended fuels on all GM diesel engine applications including in-direct fuel injection systems and modern common rail fuel injection systems. (See **a** through **d**).

- a. Deposits produced by diesel fuel degradation.
- b. Deposits produced by oxidation of biodiesel fuels.
- c. Polymeric organic deposits related to specific additive chemistries.
- d. Alkali metal carboxylates deposits related to interactions of specific fuel additives with fuel contaminants.

**1.3.1** The types of deposits that the additives would be required to clean up are not limited to the ones described in 1.3 (**a** through **d**). However, the primary focus of this GMW specification is to provide the Global GM Service Network, GM Customer Care and Aftermarket, a chemical detergent tool to clean up existing deposits from low quality fuels. As such application of the additives is envisioned for limited time and shall be commonly used for one (1) tank cleanup of injector deposits.

The tests defined in Section 3, must be regarded as minimum requirements for compliance for diesel fuel detergent additives. Additional requirements may be defined based on the type of additive, its specific chemistry, and cleaning application. This specification applies to diesel and biodiesel blended fuels only.

**1.4 Remarks.** Program specific technical specifications may include additional requirements that are not referenced in this document and may supercede any requirements included in this document. In case of any conflicts between this document and the program specific technical specifications, the program specific technical specifications shall take precedence.

This specification describes the technical requirements for GM aftermarket diesel fuel detergent packages. The GM Powertrain (GMPT) Fuels Group will evaluate the technical merits of the additive package prior to being considered by GM Purchasing for the Customer Care and Aftersales Division. These specifications will cover requirements for performance as well as requirements for ensuring compatibility of the additives with fuel system, engine, and the after treatment catalyst system. The requirements are a combination of standardized fuel industry engine dynamometer cleanliness tests, chemical laboratory tests, and supplier specific vehicle performance demonstration tests, as a basis for consistent fuel additives performance evaluation.

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## 2 References

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

### 2.1 External Standards/Specifications.

|                |            |              |           |
|----------------|------------|--------------|-----------|
| 40 CFR Part 79 | ASTM D975  | ASTM D23015  | ISO 10370 |
| ASTM D93       | ASTM D2274 | DIN EN 116   | ISO 12156 |
| ASTM D130      | ASTM D2500 | DIN EN 590   | ISO 12205 |
| ASTM D412      | ASTM D6079 | DIN EN 12662 | SAE J2643 |
| ASTM D471      | ASTM D6217 | ISO 37       | TM0172    |
| ASTM D524      | ASTM D6371 | ISO 1817     |           |
| ASTM D664      | ASTM D7467 | ISO 2160     |           |
| ASTM D971      | ASTM D7501 | ISO 2719     |           |

### 2.2 GM Standards/Specifications.

|         |          |
|---------|----------|
| GMW3059 | GMW14914 |
|---------|----------|

### 2.3 Additional References.

- Akron Rubber Development Laboratories - 2887 Gilchrist Rd, Akron, OH 44305 – available at [www.ardl.com](http://www.ardl.com).
- Coordinating European Council (CEC) DF-79-07.
- Coordinating European Council (CEC) DW-10.
- Coordinating European Council (CEC) XUD-9.
- dexos® 2 approved brands for diesel engine oil available at [www.gmdexos.com](http://www.gmdexos.com).
- National Association of Corrosion Engineers (NACE) TM0172 available at [www.NACE.org](http://www.NACE.org).
- Program Specific Technical Specifications.
- TMC003 Material Safety Data Sheet guidance documents (available at [www.gmsupplypower.com](http://www.gmsupplypower.com)).

## 3 Requirements

**3.1 Performance Requirements.** The additive formulations must clearly demonstrate cleaning of fouled injectors to restore the performance of the fuel injection equipment to levels expected from the normal clean fuel injectors. Evidence of fuel injector cleaning on a standardized fuel industry engine dynamometer cleanliness tests or vehicle demonstration tests should be used as a basis for consistent fuel additives performance evaluations. Based on the type of fuel injection equipment, appropriate type of standardized industry test must be used to demonstrate injector cleaning performance as described in **a** through **e**.

- For indirect fuel injection equipment, Coordinating European Council (CEC) XUD-9, test procedure developed by CEC, must be used as reference test for evaluation of additive's injector cleaning performance.
- For common rail fuel systems, the latest version of CEC DW-10 injector fouling test developed by CEC must be used as reference test. In addition, performance data on CEC XUD-9 test should also be provided irrespective of additive's application for the common rail system.
- Additional additive performance data on standard tests (CEC DW-10 and CEC XUD-9) with market place fuels including biodiesel blends which are known to cause injector coking issues, could be provided to further confirm the claims of cleaning performance.
- Data from vehicle fleet demonstrations or field experiences could also be considered as further proof of additive's performance in real world consumer operation.
- If the additive is being sourced to clean up internal injector deposits associate with sodium or calcium carboxylates soaps, then the requirements listed in **a**, **b**, and **c**, in 3.1, should be considered mandatory while requirement in **d** should be considered highly desirable to make final assessment of the additive's performance.

**3.1.1** The criteria for expected performance from the standardized tests is shown in Table 1.

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Table 1: Performance Criteria

|                |                                                                                                                                                                                                                                                      |
|----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| CEC DW-10 Test | Demonstrate power loss of > 6% and then using "One Tank Clean Up" additive treat rate restore power loss to < 2%.                                                                                                                                    |
| CEC XUD-9 Test | Demonstrate injector fouling with dirty reference fuel as expressed in terms of average percent flow remaining at 0.1 mm needle lift to be < 25%. Demonstrate restoration of flow to > 90% within one (1) tank full of clean up additive treat rate. |

**Note:** Acceptable reference fuel to demonstrate additive performance is CEC DF-79-07 reference fuel doped with 1 ppm zinc as zinc neodecanoate.

**Note:** Vehicle demonstration or field experiences data does not replace the need for performance data on standardized industry tests.

The additive must also be approved by local regulatory agency in the country of use, for example, Environmental Protection Agency (EPA) in the United States.

**3.2 Compatibility with Diesel/Biodiesel Blended Fuels.** Diesel fuel or biodiesel blends after the treatment with the additive, at the prescribed treat rate, shall meet regional fuel quality specifications, such as ASTM D975; Standard Specifications for Diesel Fuel Oils, DIN EN 590; European Automotive Diesel Fuel Requirements, or ASTM D7467; Standard Specifications for Diesel Fuel Oil, Biodiesel Blend (B6 to B20).

**3.3 No-Harm Testing Requirements.** The requirements for no-harm testing should demonstrate suitability of the candidate additive with fuel system components as measured against the reference fuel. The acceptable reference fuels shall be the fuel meeting the ASTM D975 specifications or DIN EN 590 specifications. For each test, the additive shall be mixed at 3x the recommended concentration in the reference fuel and its performance will be compared to that of the relevant reference fuel. Tests defined in Table 2 shall be used to determine the candidate additive compatibility.

Table 2: Tests for Fuel Compatibility

| Properties                                                         | Standard                        | Unit    | Pass/Fail Criteria                                                                                            |
|--------------------------------------------------------------------|---------------------------------|---------|---------------------------------------------------------------------------------------------------------------|
| Fuel Contamination by Additive Precipitation                       | ASTM D6217                      | mg/L    | < 20                                                                                                          |
|                                                                    | or<br>DIN EN 12662              | mg/kg   | 24                                                                                                            |
| Cold Soak Filterability                                            | ASTM D7501                      | Seconds | < 360 s                                                                                                       |
| Gum Forming Potential                                              | ASTM D2274<br>or<br>ISO 12205   | mg/L    | < 25                                                                                                          |
| Carbon Residue (on 10% Distillation Residue), Mass%                | ASTM D524<br>or<br>ISO 10370    | %       | 0.35                                                                                                          |
| Cloud Point                                                        | ASTM D2500<br>or<br>ASTM D23015 | °C      | No change relative to reference fuel unless additive used to effect cold properties of fuel <sup>Note 1</sup> |
| Cold Filter Plugging Point                                         | ASTM D6371<br>or<br>DIN EN 116  | °C      | No change relative to reference fuel unless additive used to effect cold properties of fuel <sup>Note 1</sup> |
| Lubricity Test by High Frequency Reciprocating Rig (HFRR), Maximum | ASTM D6079<br>or<br>ISO 12156   | Microns | 460                                                                                                           |
| Copper Strip Corrosion (3 h at 50 °C), Maximum                     | ASTM D130<br>or<br>ISO 2160     | Rating  | No. 3                                                                                                         |

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