



Technical Requirements for GM Aftermarket Diesel Maintenance Additive

1 Scope

1.1 Material Description. This document provides standard technical requirements for the GM aftermarket Diesel Maintenance Additive which is a multifunctional middle distillate fuel additive package that provides enhanced lubricity, corrosion protection and keeps engine and fuel injectors clean. It is specifically formulated for low sulfur and ultra-low sulfur applications including biodiesel blends up to B20 (20% biodiesel blends).

1.2 Symbols. Not applicable.

1.3 Applicability. The additives can be used in all GM diesel engine applications including in-direct fuel injection systems and modern common rail fuel injection systems.

1.3.1 This Diesel Maintenance additive is expected to provide following benefits:

- Improves fuel lubricity thereby preventing fuel pump failures.
- Prevents fuel system corrosion due to contamination of water or other corrosive compounds in the fuel.
- Keep injector and engine clean to maintain power, performance and fuel cleanliness.
- The diesel fuel conditioner is expected to provide protection against following types of fuel system deposits.

As such, the diesel maintenance additive is envisioned to be used on a regular basis by addition to the fuel tank during the fuel fills in order to protect the diesel engines and fuel systems and insure the integrity of their design and performance. The tests defined in 3.1 through 3.4, must be regarded as minimum requirements for compliance for this additive. Additional requirements may be defined based on the type of additive, its specific chemistry, and 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 Global Propulsion Systems (GPS) 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 D971	ASTM D7467	ISO 1817
ASTM D93	ASTM D975	ASTM D7501	ISO 2160
ASTM D130	ASTM D2274	ASTM D23015	ISO 2719
ASTM D412	ASTM D2500	DIN EN 116	ISO 10370
ASTM D471	ASTM D6079	DIN EN 590	ISO 12156
ASTM D524	ASTM D6217	DIN EN 12662	SAE J2643
ASTM D664	ASTM D6371	ISO 37	

2.2 GM Standards/Specifications.

GMW3059	GMW14270	GMW14914
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2.3 Additional References.

- Akron Rubber Development Laboratories - 2887 Gilchrist Rd, Akron, OH 44305 – available at www.ardl.com.
- Coordinating European Council (CEC) DF-79-07.
- Coordinating European Council (CEC) DW-10.
- Coordinating European Council (CEC) F-98-08.
- Coordinating European Council (CEC) F-110-16.
- Coordinating European Council (CEC) RF-06-03
- dexos® 2 approved brands for diesel engine oil available at www.gmdexos.com.
- GMPT-5-014.
- GMPT-5-019.
- GMPT-5-020.
- GMPT-5-034.
- National Association of Corrosion Engineers (NACE) TM0172 available at www.NACE.org.
- Program Specific Technical Specifications.

3 Requirements

3.1 All materials supplied to this standard must comply with GMW3059, **Restricted and Reportable Substances**, including the requirement to submit a full material composition disclosure to GM via the International Material Data System (IMDS) or via a completed GMW3059 report form.

3.2 Performance Requirements. The additive formulation should be used in diesel/biodiesel blended fuels which meets relevant country/regional fuel standards (such as ASTM D975 for diesel fuel and ASTM D7467 for biodiesel blends from B6 to B20 in the United States).

3.2.1 Lubricity. Good lubricity of diesel fuel is important to minimize friction and damage in diesel fuel system components, especially in the fuel pumps. A position statement by the Diesel Fuel Injection Manufacturers of 2012 suggests that the lubricity of the fuel as measured by the HFRR according to ASTM D6079 must have a lubricity value of 460 microns maximum. Fuel with lubricity exceeding 460 microns can adversely affect the lifetime of some of the fuel lubricated injection system components.

3.2.1.1 Test Method. The lubricity of the diesel fuel should be measured by the High Frequency Reciprocating Rig (HFRR) method which measures the wear scar on the test specimen ball as per the procedure described in ASTM D6079.

3.2.1.2 Demonstration of Performance. The additive must demonstrate improvement in lubricity performance as measured by HFRR at +60 °C wear scar diameter in a base diesel fuel which has lubricity of > 600 µm to < 460 µm with the use of additive.

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It is recommended to use GM test fuel, GMPT-5-034, Ultra Low Sulfur Diesel Fuel – Low Lubricity, as a reference test fuel for demonstration of the performance. Details on fuel suppliers for the test fuels can be found in 3.5.

3.3 Detergent Performance Standard. All performance testing and fuel composition analysis shall be conducted by an Independent Laboratory. Initial deposit control performance shall be demonstrated using the following tests.

3.3.1 Diesel Injector Nozzle Deposit Test.

3.3.1.1 Test Method. Diesel Injector nozzle keep clean performance shall be demonstrated using CEC F-98-08 (DW-10B) Diesel injector nozzle fouling. In the preceding test, the base reference fuel minimum deposit level and additive performance shall be conducted using the same engine block and cylinder head. For the CEC F-98-08 (DW-10B), performance data shall be reported in terms of torque loss for each cycle of the test. The final result shall be reported as loss of engine power as measure of injector fouling performance. Reported results should be within the stated reproducibility of the test procedure.

3.3.1.2 Base Fuel. For the CEC F-98-08 (DW-10B) test, the base fuel shall conform to the specifications as per CEC RF-06-03 (European Certification test fuel) reference fuel to break in the fuel injectors. For the key part of the CEC F-98-08 (DW-10B) test to induce external nozzle deposits, one part per million (ppm) of zinc (Zn) in form of zinc neodecanoate should be added to the reference fuel as defined in CEC F-98-08 test procedure.

3.3.1.3 Demonstration of Performance. The base fuel from 3.3.1.2 treated with additive at the concentration meeting the standard found in 3.3.1.1 shall not result in more than 2% power loss while the power loss for the base fuel with Zn neodecanoate and without detergent additive should exceed 6% ($\pm 1\%$) power loss.

3.3.2 Internal Diesel Injector Deposits Test.

3.3.2.1 Test Method and Demonstration of Performance. Demonstrate dirty-up for internal diesel injector deposits caused by carboxylates salts of calcium and sodium in an engine test method using a common rail fuel system engine and then demonstrate keep clean performance with use of the detergent additives in the same engine test using same reference fuel. Additional demonstration of keep clean performance of additive in presence of any other contaminants that can cause internal injector deposits is optional but would be valuable for demonstrating effectiveness of additive formulation to prevent formation of different deposit types. Following engine tests could be regarded as acceptable proof to prevent internal injector deposits by use of the additives:

- Modified DW-10B with Base Fuel + Sodium Carboxylates to form IDID & demonstrate keep clean in presence of additive
- John Deere Powered Generator IDID Test (Referenced in CRC DPG Deposit Panel Reports)
- IDID test for soap contamination with ISB 07 (2007) Cummins engine with CRIN3 injectors (Referenced in CRC DPG Deposit Panel Reports)

3.3.2.2 Test Method and Demonstration of Performance. CEC F-110-16 (DW-10C), Internal Diesel Injector Deposits test using a common rail fuel system engine must be used to demonstrate dirty up performance with use of contaminated reference fuel containing sodium compound and then keep clean performance must be demonstrated in the same test using and additive with the base fuel.

Additional demonstration of keep clean performance of additive in presence of any other contaminants that can cause internal injector deposits is optional but would be valuable for demonstrating effectiveness of additive formulation. In addition, any test data demonstrating effectiveness of the detergent additive to prevent deposit formations in vehicle tests or fleet tests should be submitted for evaluation. Reported results should be within the stated reproducibility of the test procedure.

3.3.2.3 DW-10 C Test Method (This test is optional): Internal Diesel Injector deposit test keep clean performance shall be demonstrated using CEC F-110-16 (DW-10C), Internal Diesel Injector Deposits. In the preceding test, the base reference fuel minimum deposit level and additive performance shall be conducted using the same engine block and cylinder head. For CEC F-110-16 (DW-10C) test performance data shall be reported in terms of global rating system derived from complex demerit scale for operational issues. Reported results should be within the stated reproducibility of the test procedure.

3.3.2.4 Base Fuel. For the CEC F-110-16 (DW-10C) test, the base fuel shall conform to the specifications as per CEC DF-79-07 reference fuel to break in the fuel injectors. For the key part of the CEC F-110-16 (DW-10C) test to induce internal nozzle deposits, sodium compound and Dodecenylsuccinin Anhydride (DDSA) should be added to the fuel as per the procedure requirement described in the CEC F-110-16 test procedure.

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