



Fuel Fill Pipe Assembly

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. This document provides the standard technical requirements for Fuel Fill Pipe (FFP) and establishes the quantitative requirements for a generic assembly. Appendix A provides additional requirements for a FFP assembly with mechanical seal. Appendix B provides additional requirements for a FFP assembly that is capless.

1.2 Applicability. This document applies to gasoline (gasoline and all legal gasoline-based fuel blends approved for use in gasoline vehicles), ethanol flex-fuel (gasoline-ethanol blend from 0% to 100% ethanol in gasoline), and diesel (diesel and all legal diesel fuel blends approved for use in diesel vehicles).

1.3 Remarks. This document must only be used when invoked by a program-specific technical specification. References to the program-specific technical specification are included in this document where program-specific requirements are expected to exist. The program specific technical specification may include additional program-specific requirements that are not referenced in this document and may supercede any requirements included in this document. In the case of any conflicts between this document and the program-specific technical specification, the program-specific technical specification takes precedence.

The FFP assembly shall provide the capability to receive and transfer liquid fuel from dispensing nozzle to the fuel tank, to take part in controlling fuel vapor to the canister, and to function as a ground path between the fill nozzle and vehicle electrical ground. The component is to carry these functions while meeting specific requirements of the customer, fuel subsystem interfaces, mandated safety standards, emission standards, and company objectives.

To ensure commonality for General Motors globally, the top level FFP assembly shall have the following Uniform Parts Code (UPC) and Functional Naming Address (FNA) assigned to it; UPC: 8A FNA: 1526A (Fuel Filler Pipe with Fill Hose Assembly) or UPC: 8A FNA: 1525A (Fuel Filler Pipe without Fill Hose Assembly). For architectures having multiple FFP assemblies, all shall have the UPC/FNA, but shall be descriptive enough to differentiate between them (i.e., Front, Rear, Auxiliary, etc.)

2 References

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

2.1 External Standards/Specifications.

ASTM A249	EN 14214	ISO/TS 16949	SAE J1645
ASTM A269	FMVSS 301	JIS D 0207	SAE J2027
ASTM A918	ISO 1431-1	SAE J285	SAE J2044
ASTM D1193	ISO 9158	SAE J398	SAE J2260
AWS A5.8	ISO 9159	SAE J1114	SAE J2599
California Air Resource Board (CARB) Title 13, Section 2290	ISO 13331	SAE J1140	SAE/USCAR-21
EN 590	ISO 22628	SAE J1508	UN R34

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January 2018

Page 1 of 42



Documents
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2.2 GM Standards/Specifications.

9986521	GMW14573	GMW15101 (ID)	GMW15862
GMW3059	GMW14638	GMW15272	GMW15971
GMW3059	GMW14700	GMW15311	GMW15983
GMW3116	GMW14844	GMW15349	GMW15986
GMW14057	GMW14849	GMW15450	GMW16654
GMW14089	GMW14854 (ID)	GMW15451	GMW16776
GMW14149	GMW14856	GMW15570	GMW17536
GMW14234	GMW14859 (ID)	GMW15573	GMW17537
GMW14291	GMW14872	GMW15605	
GMW14508	GMW15100 (ID)	GMW15852 (ID)	

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

2.3 Additional References.

- Appendix C2 of the Statement of Requirement (SOR), Fuel Fill Pump Assembly Component Technical Specification (CTS)
- Best Practice FSH-182
- Best Practice K-PAC ELEC86-84
- CG1752 (ID)
- CG1936 (ID)
- GMPT-5-020
- GMPT-5-036
- GMPT-6-019
- GMPT-6-022
- GMPT-6-030
- GMPT-6-037

2.3.1 GM Drawings.

- GM Drawing 9981704 – Lubricant – Fuel Injection fuel Rail Seal
- GM Drawing 11609585 – Screw Assembly (Asm) – Tap Hex Head Thread Roll
- GM Drawing 12783802 – Guide – Non-ORVR Petrol w/steel filler pipe
- GM Drawing 12783803 – Guide – Retail Diesel w/steel filler pipe
- GM Drawing 13294102 – Nozzle Guide Assembly – Commercial Diesel w/steel filler pipe – Nozzle Diameter above 25 mm
- GM Drawing 13389984 – Refueling Funnel for emergency filling – Fuel Fill (capped w/Mis-fuel Inhibitor (MFI)) Diesel
- GM Drawing 13409090 – Guide – Non-ORVR Gas w/Plastic Filler pipe
- GM Drawing 13409088 – Guide – Retail Diesel w/Plastic Filler pipe
- GM Drawing 13436911 – MFI for Retail Diesel
- GM Drawing 13580741 – Refueling Funnel for emergency filling – Fuel Fill (Capless) Petrol
- GM Drawing 13581531 – Capless Insert Asm –Black (1st Generation E10 Capless Insert Assembly without MFI)
- GM Drawing 13519824 – Capless Insert Asm –(2nd Generation with CARB compliant improvement)
- GM Drawing 13519363 – Capless Insert Asm –(2nd Generation with CARB compliant with flow guide)
- GM Drawing 13595912 – Capless Insert Asm –(2nd Generation Non-ORVR gas with pressure relief)

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January 2018

Page 2 of 42



Documents

Document Sharing Hub

- GM Drawing 13595914 – Capless Insert Asm –(2nd Generation Mechanical seal)
- GM Drawing 13519706 – Capless Insert Asm –(2nd Generation conventional diesel with MFI)
- GM Drawing 15708574 – Lubricant – Fuel Tank Fill Hose
- GM Drawing 9981704 - Lubricant – Fuel Tank Fill Hose
- GM Drawing 20850560 – Retainer Cup Gas (Company Managed Solution (CMS) Interface Gas)
- GM Drawing 84064194 – Retainer Stainless steel 304L Cup Gas CMS Interface Gas
- GM Drawing 20850561 – Retainer Cup Diesel (CMS Interface Conventional Diesel)
- GM Drawing 20962125 – Inlet – CMS Interface Gas
- GM Drawing 22799917 – Label – Capless Refueling
- GM Drawing 23187549– Capless Insert Asm – Mechanical Seal Capless Insert
- GM Drawing 23203486– Capless Insert Asm – Mechanical Seal PHEV Capless Insert
- GM Drawing 25640395 – Weld Nut, Round, three (3) Projection
- GM Drawing AKY72569 – Fill Pipe Inlet Assembly (NA Short Expand)
- GM Drawing AMR45531 – Fill Pipe Inlet Assembly Stainless steel 304L(Short Expand)
- GM Drawing AKY89441 – Fill Pipe Inlet Assembly (Euro Gas/Diesel Long Expand)
- GM Drawing AMN74899 – DRAWING: Pipe Asm- Fuel Tank Fil (w/Fil Hose)
- GM Drawing AMH79088 – Pipe – 1st Generation Capless Expand Geometry
- GM Drawing AMH80509 – Restrictor – CMS Full Turn Cap Interface Geometry

2.3.2 Other References.

- E2KS K-PAC ELEC86-84 (The supplier shall work with the GM Design Release Engineer (DRE) to comprehend this requirement.)
- ERG1.2 Manufacturing Ergonomic Requirements
- Global Legal Database
- Global Preferred Materials Catalog
- GM1747 Continuous Improvement Procedure
- Statement of Requirements (SOR) Appendix D7/E7
- Vehicle Technical Specification (VTS)

3 Requirements

3.1 Component Definition. The FFP assembly is to provide the following functions:

- High quality fuel fill characteristics, allowing no Premature Shutoff (PSO) or spitback.
- Contain fuel and vapor, along with the rest of the fuel system and evaporative system.
- Receive and transfer dispensed fuel from fuel nozzle to the fuel tank for storing per GMW14508 and SAE J398.
- Accept test fuel fill nozzles identified in GMW14508 and SAE J285 in various state of repair.
- An unobstructed environment for the nozzle aspirator.
- A physical interface between nozzle and the FFP assembly to limit air entrainment during refueling event.
- A sealing Inlet Check Valve (ICV) at the base of the FFP or in the tank FFP extension if not in the tank itself, is required for Onboard Refueling Vapor Recovery (ORVR) systems.
- Seal surface and locking mechanism for the cap (excluding capless systems).
- Lock for fuel nozzle.
- An electrical conductive ground path between nozzle and vehicle body.

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January 2018

Page 3 of 42



Documents

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- Recirculate vapor from the tank to the top of the FFP during refueling event to reduce vapor generation and canister loading (gasoline only).
- Control noise and fuel odor.
- An overfill relief, managing overfilled fuel to avoid damage to fuel system components.

3.1.1 Appearance.

3.1.2 Content. The required physical and functional content for the FFP assembly are identified in the following paragraphs.

3.1.2.1 Physical Content. See Appendix C2 of the Statement of Requirement (SOR), Fuel Fill Pump Assembly Component Technical Specification (CTS).

3.1.2.2 Functional Content. The FFP assembly is to provide the following primary functions:

3.1.2.2.1 The component shall receive and transfer received fuel to be stored in the fuel tank assembly.

3.1.2.2.2 For ORVR only: The component shall restrict air entrainment to reduce refueling vapor generation.

3.1.2.2.3 The component shall sufficiently dissipate electrostatic charge during a refueling event.

3.1.2.2.4 The component shall allow for roadside refueling. For Capless Systems, a GM-approved roadside refueling funnel will be required.

3.1.2.2.5 The component shall not have any leak that causes the fuel system to fail crashworthiness, applicable leak diagnostics, or applicable emissions requirements.

3.1.3 Ambient Environment. The ambient environmental conditions to which the component may be exposed within its useful life are defined in 3.1.3.1 thru 3.1.3.4.2.

3.1.3.1 Ambient Air Temperature. Per GMW15311.

3.1.3.2 Operating Environment. Per GMW15311. See Appendix C2 of the SOR, Fuel Fill Pump Assembly CTS.

3.1.3.3 Non-Operating Conditions. The FFP assembly shall meet all operating performance requirements under the operating environment defined in 3.1.3.2 without loss of function or degradation of service life after exposure to the following non-operating conditions:

3.1.3.3.1 Transport by airplane at altitudes up to 13 700 m.

3.1.3.3.2 Ambient air temperature of -48 °C to 93 °C.

3.1.3.3.3 Transport by ground via haul-away carriers, ship and/or train.

3.1.3.4 Fuels. Test fuels must be purchased from a GM approved test fuel supplier.

3.1.3.4.1 Soak Fuels. The FFP assembly shall be capable of withstanding exposure to the fuels identified in Table 1. Reference GMW15311 for the complete list of fuels applicable to the fuel subsystem and its components.

Note: GMW15311 will be updated to include world fuels.

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January 2018

Page 4 of 42



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Table 1: Soak Fuels

Fuel Number	Fuel Name
GMPT-5-020	US Ultra Low Sulfur B20 Biodiesel
GMPT-5-036	Severe Bio-Diesel 80/20 Soy Methyl Ester Acidic bio-diesel/diesel
GMPT-6-019	Oxidized gasoline
GMPT-6-022	Corrosive E-22 gasoline with corrosive salts and water
GMPT-6-030	Conventional Gasoline
GMPT-6-037	Conductive E100

3.1.3.4.2 Permeation Fuels. Table 2 identifies the fuel that shall be used for permeation tests.

Table 2: Permeation Fuels

Fuel Number	Fuel Name
GMPT-3-005	California Phase 2 Certification Fuel (Partial Zero Emissions Vehicle (PZEV) only)
GMPT-6-025	CE10 Fuel C with ethanol (non-PZEV, LEV III)

Note: LEV = Low Emission Vehicle; PZEV = Partial Zero Emissions Vehicle

3.1.3.5 Potential Contaminants. The following list identifies the potential contaminants that the FFP assembly shall withstand prolonged exposure to or be located, packaged, or protected from to assure no degradation from its design function.

- Engine oil.
- Transmission fluid.
- Power steering fluid.
- Coolant/Antifreeze.
- Brake fluid.
- Windshield washer fluid, ammonia glass cleaner.
- Gasoline, other fuels.
- Transaxle or differential lube.
- Wheel bearing lube.
- Air Conditioning (A/C) refrigerant.
- Battery acid.
- Water.
- Snow, ice.
- Acid rain.
- Deicing and dust control chemicals, Sodium Chloride (NaCl)
- Calcium Magnesium Acetate (CMA).

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January 2018

Page 5 of 42



Documents
Document Sharing Hub

- Calcium Lignosulfonate.
- Dirt, grit, sand.
- Dust.
- Mud.
- Road tar, oil.
- Rust proofing/undercoating.
- Ozone.
- Biological (sap, leaves, insects, bird droppings).
- Biological (mold, fungus).
- Car wash chemicals, detergents, tar remover.
- Waxes, paint sealants.
- Steam cleaning.
- Tire cleaners.
- Engine cleaners.
- Diesel exhaust fluid.

3.1.3.6 Corrosives. Reference GMW15311.

3.1.3.7 Ultraviolet Radiation. Reference GMW15311.

3.1.4 Interfaces. The component interfaces with several physical entities that will affect or constrain its functionality and designs. These interfaces are described in 3.1.4.1 thru 3.1.4.2.8.

3.1.4.1 External to Vehicle to Component.

3.1.4.1.1 Refueling Stations. The component will interface with refueling station pumps during refueling. The design and operation of the component shall address and satisfy 3.1.4.1.1.1 thru 3.1.4.1.1.4.

3.1.4.1.1.1 The component shall not cause the automatic shutoff feature of the pump nozzle to be inoperative or prematurely activated.

3.1.4.1.1.2 The component shall be compatible with vapor recovery (gasoline only) and non-vapor recovery type service station nozzles with and without retaining springs. These nozzles are defined in SAE J1140, SAE J285, ISO 9158 and ISO 9159. The component shall also prevent insertion and latching of a Diesel nozzle into a gasoline FFP.

3.1.4.1.1.3 The component shall demonstrate capability of retaining nozzles defined by SAE J1140, SAE J285, ISO 9158 and ISO 9159 without being held in by the vehicle operator.

3.1.4.1.1.4 FFPs without Mechanical Seal shall demonstrate capability to accommodate liquid fuel flow out of the Fill Pipe inlet during a failed nozzle event at the conditions specified in GMW14508. Sufficient venting shall be provided to limit pressure at the nozzle tip under the specified test conditions to no greater than 16.9 kPa (68 in H₂O) positive pressure. Failed nozzle requirements for Mechanical Seal are given in Appendix A.

3.1.4.1.2 Assembly Plant Usages. The design and operation of the component shall accommodate the assembly plant fuel fill and installation requirements.

3.1.4.1.3 Restricted Fuel Flow. The design and operation of the component must account for usual road debris to avoid damages that may cause reduction/loss of flow or leakage.

3.1.4.1.4 Roadside Refueling. The design and operation of the component shall demonstrate compatibility with commercially available refueling containers using commonly available tools (e.g., a funnel) except for capless refueling systems. Capless refueling systems must use a GM-approved roadside refueling funnel during container refueling.

3.1.4.1.5 Fuel Treatments and Additives. The design and operation of the component shall demonstrate compatibility with commercially available fuel treatments and additives using commonly available tools (e.g., a funnel) except for capless refueling systems. Capless refueling systems must use the GM-approved roadside refueling funnel.

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January 2018

Page 6 of 42



Documents

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3.1.4.1.6 Nozzle Grounding. The portion of the FFP in contact with the fuel dispensing nozzle shall provide an electrically conductive and grounded path, as specified in SAE J1645. The remainder of the FFP assembly shall comply with the applicable portions of SAE J1645.

3.1.4.2 Component to Component. Generic and specific component to component interface requirements for the FFP assembly are identified in 3.1.4.2.1 thru 3.1.4.2.8.

3.1.4.2.1 Crashworthiness. The FFP assembly and the components that it interfaces with shall not create any leak that causes the system not to meet crashworthiness requirements. Components shall be designed to prevent disconnection and damage to adjacent components. Components shall meet GMW15100, GMW15101 and GMW15852.

3.1.4.2.2 Noise. Component to component connections shall minimize transmission of noise.

3.1.4.2.3 Electrostatic Discharge. Components shall not create Electrostatic Discharge (ESD) related failures in adjacent or downstream components.

3.1.4.2.4 Corrosion. The interfaces between components shall satisfy the VTS representative paragraphs relative to corrosion.

3.1.4.2.5 FFP Assembly to Fuel Cap Interface. For capped FFP designs, the choice of FFP assembly to fuel cap interface is determined by the type of fuel system and vehicle evaporative system On Board Diagnostics (OBD).

3.1.4.2.5.1 Company Managed Solution Full-Turn Thread Interface. Gasoline and flex fuel systems for vehicles having evap system OBD leak detection shall use the CMS fuel cap with full-turn thread. The FFP side of the interface is defined in GM drawing AMH80509. This interface may also be used for diesel and non-OBD gasoline or flex fuel vehicles. The CMS fuel cap interface requirements are valid for steel as well as plastic fuel filler assembly designs.

3.1.4.2.5.2 SAE Interface (Optional). Vehicles without evap system OBD leak detection may alternatively use a fuel cap and FFP interface that complies with SAE J1114 (do not use alternate shape). The interface may be either formed into the FFP or a separate piece attached to the FFP, as shown in SAE J1114.

3.1.4.2.6 FFP Assembly to Fuel Tank Assembly Interface.

3.1.4.2.6.1 FFP assembly to fuel tank assembly interface shall have a leak free mechanical connection.

3.1.4.2.6.2 The interface shall be designed to prevent twisting or kinking to the coupling (fill hose) or side loading the connector (quick connect style joint if applicable).

3.1.4.2.7 FFP Assembly to Fuel Fill Door and Pocket Interface. For North American applications, the interface shall provide access to the FFP opening to satisfy the requirements of the CARB; referenced in GMW14859. For regions, nozzle clearance zones should comply with Fuel Systems Best Practice FSH-182.

3.1.4.2.8 FFP Assembly to Canister Vent Solenoid and/or Fresh Air Line. When the Canister Vent Solenoid (CVS) and/or the fresh air line are part of the FFP assembly, the interface shall satisfy 3.1.4.2.1 and 3.1.4.2.2.

3.1.5 Usage Definition. Reference GMW15311.

3.1.5.1 Underbody Wash. Reference GMW15311.

3.1.5.2 Vehicle Wash. Reference GMW15311.

3.1.5.3 Road Splash. Reference GMW15311.

3.1.5.4 Water Submersion/Fording. Reference GMW15311.

3.2 Product Characteristics.

3.2.1 Performance Requirements. The functional performance requirements of a FFP assembly are specified in 3.2.1.1 thru 3.2.1.32. All requirements apply for the conditions specified in 3.1.3 and 3.1.5, except where noted otherwise. Special vehicle, operational or ambient conditions may be identified in the performance requirement paragraphs.

3.2.1.1 Receive Fuel. Reference GMW15311.

3.2.1.2 Capture Refueling Vapor. (Gasoline Applications Only) Reference GMW15311.

3.2.1.3 Manage Fuel Vapor.

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January 2018

Page 7 of 42



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3.2.1.3.1 Leak Detection. For leaks to the atmosphere, the assembly shall satisfy the leak requirements found in GMW15311. The capless refueling system identified in Appendix B shall also satisfy this requirement both as an independent component (when assembled into a receptacle that represents the interface with the FFP) and as part of the complete FFP assembly.

In-process leak testing of capless FFP designs prior to installation of the capless refueling system may be performed with air under water at 69 kPa (10 psi). However, the final assembly must meet the requirements of GMW15311 as described above.

Only for validation testing, pretest and posttest leak checks of a capped FFP assembly may be performed with air under water at 69 kPa (10 psi). Leak checks of a FFP assembly with a Capless Refueling System may be performed with air at 11.2 kPa (1.63 psi). The requirements of Appendix B, Table B2 must be met for the leak check of a capless FFP.

3.2.1.3.2 Vapor Emissions (Gasoline Applications only). Unless specified in Appendix C2 of the SOR, Fuel Fill Pump Assembly CTS, the emission requirements when tested per GMW16776 are shown in Table 3.

Table 3: General Permeation Fuels and Emission Requirements ^{Note 1}

Emission Level	Test Fuel	Maximum Allowable Emissions (mg/day)
LEV II, China 6 w/Cap or Capless	GMPT-6-025, CE10 Fuel C with ethanol	40
LEV III, KLEVIII w/Cap or Capless	GMPT-6-025, CE10 Fuel C with ethanol	18
Euro VI w/Cap or Capless	GMPT-3-027-A	125 (total of 2 days)
Euro V and ROW w/Cap or Capless	GMPT-3-027-A	250

Note 1: Passenger Car data shown. Verify application specific information in Appendix C2 of the SOR, Fuel Fill Pump Assembly CTS. For regions not listed, refer to Fuel System Subsystem Technical Specification (SSTS) GMW15311.

3.2.1.4 Manage Noise. Reference GMW15311.

3.2.1.5 Crashworthiness.

3.2.1.5.1 FFP assembly shall not create any leak that causes the fuel system to fail crashworthiness requirements.

3.2.1.5.2 FFP assembly shall pass all crashworthiness requirements in GMW15100, GMW15101 and GMW15852.

3.2.1.6 Leak Integrity. Reference GMW15311.

3.2.1.7 Siphon Capability The component shall allow a siphon hose made of low density polyethylene with an outside diameter of 12.7 mm to reach the outlet end of the FFP. The siphon hose shall be allowed to push through the component a minimum of ten (10) times out of 20 attempts.

Note: This requirement is not applicable to ethanol flex-fuel vehicles having an anti-siphon device or flame arrestor.

The siphon hose shall be allowed to be pulled out of the fill pipe inlet after each insertion attempt without damage to the component.

3.2.1.8 Electrostatic Charge Dissipation.

3.2.1.8.1 Electrical resistance between the inserted refueling nozzle and the vehicle body (via ground path) shall be less than 1 MΩ.

3.2.1.8.2 Electrical resistance between the inlet restrictor and the fuel tank assembly connection (via fill hose Inside Diameter (ID)) shall be less than 10 MΩ.

3.2.1.9 Nozzle Insertion. For capped FFP designs with a component that is displaced by nozzle insertion (i.e., grounding tab, mis-fuel inhibitor, etc.), a standard SAE J285 or SAE J1140 nozzle inserted 2100 times, per GMW14856, shall not cause a failure in fuel filling performance, dissipating electrostatic charge, or function of

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January 2018

Page 8 of 42



Documents

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the component displaced by nozzle insertion. See Appendix A for nozzle insertion requirements for Mechanical Seal. See Appendix B for nozzle insertion requirements for Capless Refueling systems.

3.2.1.10 Inlet Torque Resistance.

3.2.1.10.1 Cap System. The cap retainer threads and sealing surface shall withstand 2100 fuel cap tightening and removal torques, as defined in GMW15983, without affecting fit, form, or function. In addition, the cap retainer joint to the FFP shall withstand 2100 torques of 20 Nm, clockwise and counter-clockwise, without affecting fit, form, or function.

3.2.1.10.2 Capless System. The installed Capless Refueling system shall withstand ten (10) simulated torques of 20 N m, clockwise and counter-clockwise, at the capless insert cover without affecting fit, form, or function.

3.2.1.11 Pressure and Vacuum Cycling. The FFP with its program-specific installed fuel cap or Capless Refueling system shall be able to withstand Pressure and Vacuum (P/V) cycling, per GMW16654, without affecting fit, form, or function. No stress crack shall be allowed. P/V cycling is conducted for 18 000 cycles (15 year equivalent). This test is part of a test sequence (see Appendix C).

3.2.1.12 Nozzle Insertion and Removal Forces. SAE J285, SAE J1140, ISO 9158 and ISO 9159 define the nozzles for which the following requirements apply:

3.2.1.12.1 The force needed to insert pump nozzle into a capped FFP assembly with a component that is displaced upon nozzle insertion (i.e., grounding tab, mis-fuel inhibitor, etc.) shall not exceed 22 N in excess of the weight of the nozzle. Requirements for Mechanical Seal are given in Appendix A. For capless system requirements, see Appendix B.

3.2.1.12.2 The force needed to remove a gas station pump nozzle from a capped FFP assembly with a component that is displaced upon nozzle insertion (i.e., grounding tab, mis-fuel inhibitor, etc.) shall not exceed 22 N in excess of the weight of the nozzle. Requirements for Mechanical Seal are given in Appendix A. For capless system requirements, see Appendix B.

3.2.1.13 Nozzle Loading. Analyze and test the FFP assembly according to GMW15573. Requirements for deflection and durability are specified in 3.2.1.13.1 thru 3.2.1.13.1.3.

3.2.1.13.1 Deflection under Nozzle Load. Deflection criteria include the combined deflection of the FFP assembly and body bracket attachment for FFP.

3.2.1.13.1.1 Vertical Load. For a 222 N (50 lb) vertical load applied as specified in GMW15573, deflection of fill head centerline from the original position shall be 2.5 degrees or less when evaluated in Computer Aided Engineering (CAE).

For the 445 N (100 lb) vertical load in GMW15573 testing, no portion of the nozzle shall contact the body. Contact with an unpainted fill housing is acceptable.

3.2.1.13.1.2 Combined Axial and Vertical Load (North America gasoline/ethanol only). For the combined load of 222 N (50 lb) axial plus 111 N (25 lb) vertical, as specified in GMW15573, no portion of the nozzle shall contact the body or the fill housing.

3.2.1.13.1.3 Spill Prevention Angle Post Load Removal. After removal of any of the loads described in 3.2.1.13.1.1 or 3.2.1.13.1.2, the FFP must have a minimum spill prevention angle of 34 degrees from the horizontal. For GMW15573 physical testing, if the change in angle is more than 2.5 degrees from the pretest state, fuel fill tests are to be performed as specified in GMW15573 to determine if fill performance requirements are met after the permanent deformation.

3.2.1.13.2 Nozzle Load Durability. Durability requirements are for both the FFP assembly and the attachment bracket(s) on the vehicle body. Use separate FFP assemblies for the vertical and axial/vertical cyclic load tests. Do not perform both tests on a test sample.

3.2.1.13.2.1 Vertical Load. After cyclic load testing in the vertical direction, as specified in GMW15573, the FFP assembly shall have no visible cracks, leaks, or loss of fit, form, or function. Leak test per 3.2.1.3.1.

3.2.1.13.2.2 Combined Axial and Vertical Load (North America gasoline/ethanol only). After cyclic load testing with the combined axial and vertical load, as specified in GMW15573, the FFP assembly shall have no visible cracks, leaks, or loss of fit, form, or function. Leak test per 3.2.1.3.1.

3.2.1.13.2.3 Spill Prevention Angle Post Cyclic Loading. After completion of any cyclic load tests described above, the FFP must have a minimum spill prevention angle of 34 degrees from the horizontal with loads removed. For GMW15573 physical testing, if the change in angle is more than 2.5 degrees from the pretest

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state, fuel fill tests are to be performed as specified in GMW15573 to determine if fill performance requirements are met after the permanent deformation.

3.2.1.14 Mechanical Attachment. The attachment features shall meet the retention, installation, torque, break away requirements as defined in 3.2.1.14.1 to 3.2.1.14.2.

3.2.1.14.1 Line to Clip Attachment.

3.2.1.14.1.1 The minimum clip to line retention requirement shall meet the requirements specified in GMW15986.

3.2.1.14.1.2 Line insertion efforts shall meet the requirements specified in GMW15986.

3.2.1.14.2 Fastening Attachment.

3.2.1.14.2.1 Fasteners shall meet the requirements of GMW14149.

3.2.1.14.2.2 An attachment used for an electrical ground path to the vehicle body or frame shall consist of weld nut 25640395 (unthreaded) and bolt 11609585 (thread-forming and GMW3059 compliant). This attachment point to the vehicle or frame must be dedicated for the filler pipe grounding path only. The grounding bolt must be identified as a grounding fastener on the Master Process Document (MPD) so the vehicle assembly plant will control and monitor installation torque.

3.2.1.14.2.3 Fastening attachments shall meet the torque requirements that are specific to the nut and bolt sizes used. The FFP assembly shall provide anti-rotation features such that torquing the fastener at vehicle installation shall not cause the component to be moved from its design intent position.

3.2.1.14.3 Break Away (Plastic FFP only).

3.2.1.14.3.1 The minimum break away force for the welded clips and other attaching parts not intended to access the component interior shall be > 500 N applied in shear and shall not be capable of pulling parent material; whereby creating a leak path when break away forces are applied.

3.2.1.14.3.2 Clips and other attaching parts not specifically intended to access the component interior, shall not be capable of pulling parent material, creating a leak path, when breakaway forces are applied.

3.2.1.15 Thermal Integrity.

3.2.1.15.1 The FFP assembly shall not siphon fuel from the tank when the fuel system is tested per GMW14849 or UN R34. Any protective sleeve on either a fuel fill hose or a plastic FFP must comply with SAE J2027.

3.2.1.15.2 Materials in the FFP assembly shall be compatible with the vehicle thermal environment, as predicted by GM Thermal CAE. No leak shall occur on the FFP assembly in vehicle-level testing, including GMW14854.

3.2.1.16 Fill Hose and Joint Integrity. Soak the fuel fill hose and the joints with both the fill pipe and the fuel tank inlet at a temperature of 40 °C using the fuels (as applicable) and the following durations:

- Oxidized Gasoline (GMPT-6-019). 1000 h. For gasoline and ethanol fuel systems.
- Corrosive E-22 (GMPT-6-022). 1000 h. For gasoline and ethanol fuel systems.
- Conventional Gasoline (GMPT-6-030). 2500 h. For gasoline and ethanol fuel systems.
- U.S. Ultra-Low Sulfur B20 Biodiesel (GMPT-5-020). 1000 h. For Diesel fuel systems.
- Severe Biodiesel 80/20 SME (GMPT-5-036). 1000 h. For Diesel fuel systems.

Replace fuel every 168 h. Use the production-intent fuel tank fitting and fill pipe fitting for the test. During the soak, apply an internal pressure of 17.4 kPa (2.5 psi). After the soak, test the fuel fill hose and the joints using 10 psi internal pressure. No leaks shall occur. Leak test per 3.2.1.3.1.

3.2.1.17 Drop Test.

3.2.1.17.1 Ensure the assembly has stabilized at 23 °C (ambient, room temperature). The assembly shall withstand a 1.0 m drop to a concrete floor. The test is to be performed in all six (6) directions (front, back, left, right, top, and bottom) at 23 °C (ambient, room temperature) with a new FFP used for each drop direction. Upon completion of each drop, fit, form and function of the assembly shall not be affected. Perform a leak test with production intent sealing interfaces per 3.2.1.3.1.

3.2.1.18 Cleanliness. The component shall not exceed 0.05 g maximum solid and soluble contaminants per GMW15450. Cleanliness evaluations are made after all manufacturing operations of the component have been completed.

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January 2018

Page 10 of 42



Documents

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3.2.1.19 Corrosion Integrity. Prior to corrosion testing, subject the portions of the FFP assembly that are exposed to stone impingement to GMW14700 Method B. The FFP assembly shall meet the corrosion performance and validation requirements of GMW15272. At the component level, cosmetic corrosion performance shall meet GMW15272 Appendix A, Table A1, Suffix J. Testing shall be to GMW14872, UB, Method 1/2, Exposure A. Testing for functional corrosion performance shall be to GMW14872, UB, Method 1/2, Exposure E. The FFP assembly shall not leak after corrosion testing when tested per 3.2.1.3.1. This test is part of a test sequence – see Appendix C.

3.2.1.20 Vehicle Fording Exposure. Reference GMW15311.

3.2.1.21 Water/Snow/Dust Exposure. Reference GMW15311.

3.2.1.22 Slush/Mud Exposure. Reference GMW15311.

3.2.1.23 Ingestion of Salts, Contaminants. Reference GMW15311.

3.2.1.24 Ozone Exposure (With Polymer Parts Only). Highly unsaturated materials, such as diene rubber (polyisoprene, styrene-butadiene rubber, etc.), shall be checked for stabilization against ozone per ISO 1431-1 with the following test conditions (refer to Section 8 in the spec):

- 100 ppm ozone.
- $40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$.
- 20% strain.
- $3362\text{ h} \pm 2\text{ h}$ soak duration.

Test samples will be visually inspected under 7x magnification to confirm no cracks. Parts that have been exposed to fuel may be conditioned at $60\text{ }^{\circ}\text{C}$ or lower temperature to evaporate hydrocarbons, if necessary, prior to ozone exposure testing.

3.2.1.25 Temperature Cycling. The component shall be subjected to the time and temperature profile shown in Figure 1 for 120 cycles, followed by a fuel soak in TF1 fuel at $65\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for 80 h. The component shall remain intact and leak free. This test is part of a test sequence (see Appendix C).

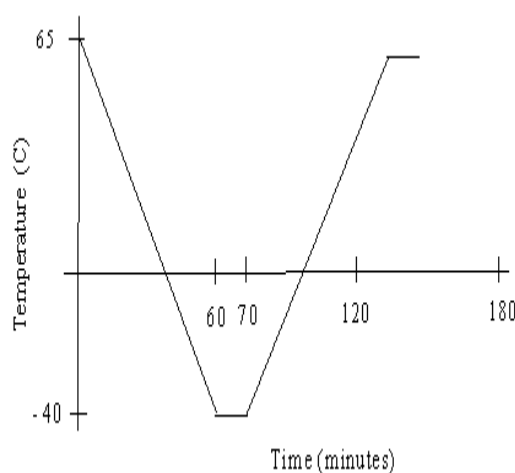


Figure 1: Thermal Cycle

3.2.1.26 Vibration. The entire FFP assembly, including the program-specific fuel cap, if applicable, shall remain intact and leak free after being subjected to GMW15570. Components attached to the FFP shall remain in their original location and show no significant wear or degradation. Leak test per 3.2.1.3.1. This test is part of a test sequence (see Appendix C).

3.2.1.27 Shock (FFP Assembly with Integrated ICV Only). With the component mounted in a simulated vehicle position and subjected to a shock event in each of three (3) directions (up, down, and sideways (see Figure 2)), the component shall remain intact and leak free.

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January 2018

Page 11 of 42



Documents

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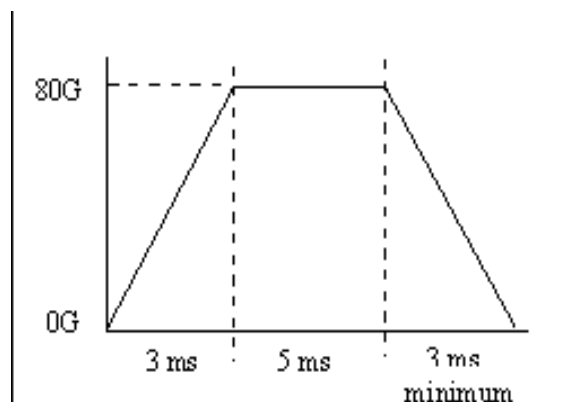


Figure 2: Shock Test Profile

3.2.1.28 Pressure Spike (FFP Assembly with Integrated ICV Only). The component shall be mounted in a fixture representative of the vehicle application, a 250 kPa hydraulic pressure is applied within < 35 ms, and held for a minimum duration of 100 ms to the tank side of the component, the component shall remain leak free and intact.

3.2.1.29 Production Circularity Check (Metallic FFP). To maintain a consistent circular ID throughout the bends of the FFP, perform a test at the beginning of each shift and immediately after tool startup that passes a ball (90% diameter of the pipe ID) through the FFP tubing (after the completion of the tube bending process).

3.2.2 Physical Characteristics.

3.2.2.1 Dimensions and Capacity. See Appendix C2 of the SOR, Fuel Fill Pump Assembly CTS.

3.2.2.1.1 Fill Pipe Inlet Dimensions. For North America gasoline/ethanol applications, the inlet access zone shall conform to CARB Specification for Fill Pipes and Openings of Motor Vehicle Fuel Tanks (Title 13, Section 2290) so as to be compatible with unleaded fuel nozzles and California vapor recovery nozzles. Nozzle dimensions are given in SAE J285, SAE J1140, ISO 9158 and ISO 9159.

3.2.2.1.2 Dimensional Tolerances. Unless otherwise specified, tolerances on linear dimensions are determined in the following sections.

3.2.2.1.2.1 Rigid Parts.

- 0 mm to 300 mm $\pm$ 1 mm.
- 300.1 mm to 600 mm $\pm$ 1.5 mm.
- 600.1 mm to 1200 mm $\pm$ 3 mm.
- Over 1200 mm $\pm$ 4.5 mm.

3.2.2.1.2.2 Non-Rigid Parts.

- 0 mm to 305 mm $\pm$ 3.18 mm.
- 305 mm to 610 mm $\pm$ 4.8 mm.
- 610 mm to 915 mm $\pm$ 6.4 mm.
- 915 mm to 1220 mm $\pm$ 9.5 mm.
- 1220 mm to 1830 mm $\pm$ 12.7 mm.
- > 1830 mm $\pm$ 1% of length.

3.2.2.2 Mass Properties. See Appendix C2 of the SOR, Fuel Fill Pump Assembly CTS.

3.2.3 Reliability. The dependability requirements for the component are given in paragraphs 3.2.3.1 thru 3.2.3.3.

3.2.3.1 Reliability Evaluation Point. Refer to GMW15311. The component shall be subjected to the evaporative emission requirements shown in GMW15311 (section titled Vapor Emissions) for the vehicle's useful life of 15 years.

3.2.3.2 Reliability Requirements. Reference GMW15311.

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January 2018

Page 12 of 42



Documents

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3.2.3.3 Reliability Requirements. The component shall meet requirements of the Vibration, Pressure and Vacuum Cycling, and Nozzle Insertion sections of this specification with a sample size and duration sufficient to demonstrate a minimum reliability of 0.98 and 50% confidence. For Vibration, test with a combination of sample size and number of "lives" that will demonstrate the required reliability. A minimum of six (6) samples tested to 2.4 lives is typical for the Vibration test. For P/V Cycling, test a minimum of six (6) samples for the specified test duration. For Nozzle Insertion, test a minimum of eight (8) samples to the specified duration. In addition, to satisfy this requirement, all vehicle validation shall be conducted without fuel system incident caused by the component.

3.2.4 Serviceability. Paragraphs 3.2.4.1 thru 3.2.4.4 define the constraints and requirements associated with serviceability of the FFP Assembly subsystem. Serviceability is the ease and cost of performing the maintenance, diagnosis, and repair operations necessary to preserve the original performance level of the vehicle throughout its target life.

3.2.4.1 Service Infrastructure.

3.2.4.1.1 Essential Tools. The subsystem should not require the development of any new essential tools as defined below, for the performance of diagnosis, maintenance, and repair procedures.

Note: Essential tool is a tool called out in the manufacturer's service manual diagnosis or repair procedure, which is required to perform that operation.

3.2.4.1.2 Fasteners/Fittings/Connectors/Seals.

3.2.4.1.2.1 Fasteners with a service specification of torque plus angle should be avoided in the areas where customer performed maintenance or service is recommended (i.e., wheel lug nuts, oil pan drain plug, etc.)

3.2.4.1.2.2 Effort should be made to avoid the use of torque to yield fasteners in areas where fasteners are typically reused, or in areas where an adjustment point is located.

3.2.4.1.2.3 All serviceable fasteners that are considered reusable shall withstand a minimum of five (5) remove and replace procedures.

3.2.4.1.2.4 Fasteners requiring a backup wrench for removal shall have adequate clearance for backup tools.

3.2.4.1.2.5 The system shall use fasteners that are readily available from GM.

3.2.4.1.2.6 Dynamic torque values shall be provided for service publications.

3.2.4.1.2.7 Quick connectors/fittings and seals should be reusable and serviceable separately.

3.2.4.2 Maintenance.

3.2.4.2.1 Performance of Scheduled/Unscheduled Maintenance. System components shall not interfere with normal maintenance procedures.

3.2.4.2.1.1 The FFP Assembly subsystem shall not require scheduled maintenance during its target life.

3.2.4.2.2 Lubricants and Chemical Products. Lubricants and chemical products should be compatible with current products already released by GM.

3.2.4.2.2.1 The FFP Assembly subsystem shall not require the use of any lubricants to maintain operational performance during its target life.

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January 2018

Page 13 of 42



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