



Specification for Canister Vent Solenoid and Purge Air Filter Component

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 specification establishes the requirements for the Onboard Refueling Vapor Recovery/Onboard Diagnostic (ORVR/OBD) Evaporative (Evap) Canister Vent Solenoid (CVS) and the Purge Air Filter. The functions, performance, design constraints, and validation required of the components are defined in this document. In addition, this document is meant to supplement the requirements listed in the GMW15311 Fuel Subsystem Technical Specification (SSTS).

1.2 Applicability. The CVS seals the fuel tank vapor space and vapor handling system atmospheric vent path during on-vehicle evaporative diagnostic procedures.

1.3 Remarks. This document provides the standard technical requirements for the CVS/Purge Air Filter. The Uniform Parts Classification (UPC) is 8D and the Functional Name Analysis (FNA) shall be identified as follows:

- 4800A Solenoid Canister Vent Valve.
- 0660A Valve Assembly – Evap Emission Canister Purge Solenoid CVS (with filter integrated).
- 0310A Filter Assembly – Evap Emission Canister (filter without the CVS integrated).
- 0065 Filter – Evap Emission Canister Purge Solenoid.

Assembly of hose or pipe or grommet as follows:

- 0732G Grommet Evap Emission Canister Purge Pipe.
- 0730A Pipe Assembly – Evap Emission Canister Purge.
- 4900A Hose Assembly – Evap Emission Canister Vent.

A program-specific technical specification that is used in conjunction with this document 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.

2 References

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

2.1 External Standards/Specifications.

ISO 1431-1	SAE J400	SAE J2044	USCAR2
ISO 5011	SAE J726	USCAR EWCAP 001	

2.2 GM Standards/Specifications.

GMW3059	GMW3172	GMW15311	GMW16600
GMW3097	GMW15272	GMW16494	

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2.3 Additional References.

- Bill of Material (BOM) Row Number 862.2 Power and Signal Distribution Component Technical Specification (CTS)
- Canister Vent Solenoid (CVS) Component Technical Specification (CTS)
- Carbon Canister Component Technical Specification (CTS)
- CG998
- Global Propulsion Systems Test Procedure for Inductive Load Devices Number PR.18.1036.R04
- USCAR Molex drawing SD 34062-0028

3 Requirements

3.1 System/Subsystem/Component/Part Definition. The On Board Diagnostics (OBD) II/Evap CVS is added to the fuel subsystem to accommodate the Evap diagnostic. A normally open, electrically operated valve seals the fuel tank vent at the carbon canister atmospheric port during the Evap diagnostic operation. It is also designed to allow sufficient airflow to meet canister purge and ORVR requirements.

3.1.1 Appearance. Not applicable.

3.1.2 Content.

3.1.2.1 Physical Content.

3.1.2.1.1 Electrically actuated, normally open valve.

3.1.2.1.2 Electrical connector interface.

3.1.2.1.3 Physical mounting feature.

3.1.2.1.4 Atmospheric air port.

3.1.2.1.5 Carbon Canister air port.

3.1.2.1.6 Means of filtering purge air.

3.1.2.2 Functional Content.

3.1.2.2.1 Allow sufficient ORVR and purge airflow.

3.1.2.2.2 Seal carbon canister atmospheric port from the atmosphere on command.

3.1.2.2.3 Filter purge air.

3.1.3 Ambient Environment. The ambient environmental conditions that the CVS may encounter during its life are defined in the GMW15311 Fuel SSTs, except for where noted in 3.1.3.1 and 3.1.3.2.

3.1.3.1 Component Operating Temperature. Range: -20 °C to 90 °C.

3.1.3.2 Non-Operating Pressure and Temperature. The CVS shall meet all operating performance requirements in 3.2.1, without loss of function or degradation of service life, under the operating environment defined in GMW15311 Specification for Fuel Storage and Handling Subsystem.

3.1.3.3 Fuels. Test fluids must be obtained from an approved supplier.

3.1.3.3.1 Component Test Fuels. The CVS shall be evaluated using the fuels as listed in Table 1. Reference GMW15311 appendix for additional test fuel description.

3.1.3.3.2 Other Fuels. The CVS shall be designed to have compatibility with fuels that it may be exposed to during the CVS's usable life. The fuels the CVS may be exposed to are listed in the GMW15311 Fuel SSTs.

Table 1: Soak Fuels

Fuel Formulation	Fuel Label	Fuel Description
GMPT-6-030	FAM B	Gasoline-Methanol Ethanol blend
GMPT-6-022	Corrosive E-22	E22 with corrosive water
GMPT-6-019	Peroxide	540 ppm peroxide, in gasoline
GMPT-4-002	E-85 General Purpose - Summer	E85

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3.1.3.4 Contamination. The CVS shall be designed to resist degradation in performance when subjected to prolonged exposure to the potential contaminants. Refer to GMW15311 for a complete list of potential contaminants. The CVS shall meet performance requirements for contaminants listed in Table A1, Appendix A.

3.1.3.4.1 Ozone Exposure (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 (A100, B336, R0) as defined in 4.3.7 Ozone Exposure.

3.1.3.5 Corrosives. The CVS shall meet the performance ratings shall be to underbody requirements per GMW15272. For salt spray requirements, GMW3172 supercedes all other specifications referenced in this document or elsewhere. Typical corrosive agents and concentrations relevant to lower body/underbody exposure are described in 3.1.3.5.1 through 3.1.3.5.3.

3.1.3.5.1 Sodium Chloride. Materials used for the CVS shall be selected to withstand exposure of sodium chloride. Sodium chloride exposure shall be tested according GMW3172 salt spray.

3.1.3.5.2 Calcium Chloride. Exposure and testing shall be performed according to GMW16600.

3.1.3.5.3 Resistance to Zinc Chloride: Exposure and testing shall be performed according to GMW16600.

3.1.3.6 Ultraviolet Radiation. Refer to GMW15311.

3.1.4 Interfaces. External to vehicle to subsystem and component/subsystem interface requirements. The CVS shall interface per the descriptions in 3.1.4.1 through 3.1.4.7.

3.1.4.1 External to Vehicle to Subsystem. The CVS assembly and interfacing seal(s) shall be designed to minimize air leakage to and from the atmosphere when the CVS is activated and closed.

3.1.4.2 Occupant and Vehicle Electrical/Electronic.

3.1.4.2.1 Electrical Interface Requirements. The mating connector interface shall conform to the United States Council for Automotive Research (USCAR) 1.5 mm, 2-way, sealed dimensional standards, USCAR Molex drawing SD 34062-0028 Key Type D, for partially shrouded mating connector interface. Reference the USCAR Electrical Wiring Component Applications Partnership (EWCAP) 001 tab tip drawing for blade detail information. The preferred terminal attachment method shall be a welded on terminal. The CVS supplier may use an alternate terminal to wire attachment method with prior GM agreement and proof of robust design through GMW3172 testing.

3.1.4.2.2 Electrical Connection. The CVS shall conform to the GMW3172 General Specification for Electrical/Electronic Components – Environmental/Durability, according to the code as specified in this CVS Component Technical Specification (CTS). GMW3172 requires the component environmental test plan to be approved by the GM environmental/durability expert.

3.1.4.3 CVS to Carbon Canister Interface – Externally Mounted CVS. For either a directly mounted to the external canister housing, or remotely mounted with a line connecting the canister and CVS, the CVS port leading to the Evap emissions carbon canister shall be designed with a triple barb. The triple barb shall fit a 15.88 mm (0.625 in) line for a remotely mounted CVS. Refer to the Carbon Canister CTS for canister interface detail. Alternate interfaces may be needed in cases where a carryover canister is used or larger 19 mm line is required for platform specific restriction issues. The CVS supplier and the canister supplier shall work together with the GM Design Engineer (DE) to ensure the interfaces of the components are robust in fit and function.

3.1.4.4 CVS to Carbon Canister Interface – Integrally Mounted CVS. The CVS may be mounted inside the canister or canister filter-box as an integral part of the canister assembly. The CVS shall be designed with a bi-directional twist lock feature inside the canister and an anti-rotational tab adjacent to the electrical connector feature, as shown GM Geometric Dimension and Tolerance (GD&T) drawing to be provided by GM Product Engineering.

3.1.4.5 Powertrain Control and Diagnostics.

3.1.4.5.1 Powertrain Control Module. The CVS shall be compatible with the specified Powertrain Control Module (PCM) low side driver.

3.1.4.5.2 Powertrain Control and Diagnostics. The powertrain control and diagnostics shall provide electrical power and ground to the CVS.

3.1.4.5.3 Atmospheric Port Sealing. The CVS shall have the capability to seal the atmospheric port of the carbon canister from the atmosphere when electrically commanded.

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3.1.4.6 Fuel Storage and Handling.

3.1.4.6.1 Venting. The CVS/purge air filter shall allow fuel system venting and minimize ORVR flow restriction.

3.1.4.6.2 Normal State. The CVS shall be designed to be a normally open valve.

3.1.4.7 Evaporative Subsystem.

3.1.4.7.1 Restriction. The CVS/purge air filter shall minimize canister purge airflow restriction while filtering contaminants to the carbon canister. The performance requirements for the filter stated in this GMW15826 shall be met at a minimum in order to ensure the CVS/purge air filter functions as intended.

3.1.5 Usage Definition. Refer to GMW15311 Fuel SSTs.

3.2 Product Characteristics.**3.2.1 Performance Requirements.**

3.2.1.1 Airflow. The CVS/Filter assembly shall meet the airflow requirements over the life of the component, as specified in Table 2. The temperature range is -20 °C to 90 °C.

Table 2: Airflow

Voltage Input (Volts)	Pressure/Vacuum at Canister Interface (kilopascals)	Airflow (Standard Liter Per Minute)
0 V	- 0.34 kPa (at 0 g dust) - 0.55 kPa (at maximum capacity (grams) at end of dust test)	70 SLPM
0 V	+0.27 kPa (at 0 g dust) +0.5 kPa (at maximum capacity (grams) at end of dust test)	60 SLPM

Note: (+) represents pressure, (-) represents vacuum.

3.2.1.2 Seal Atmospheric Port. The CVS shall meet the sealing requirements as specified in Table A2 when energized according to Table A3 (refer to Appendix A).

3.2.1.3 CVS Filter Assembly Physical Integrity (Leak). The filter and CVS assembly, including any connecting hoses and hardware shall not allow water to seep into the Evap emissions system through the housings or the connections. The filter and CVS assembly, including any connecting hoses and hardware, shall meet the GMW3172 requirements, Code Letter 8 for International Protection by Enclosures (water).

3.2.1.4 Physical Leak Integrity. The CVS and filter and/or canister assembly shall demonstrate measure of process capability (CPK) to 1.67 CPK for physical integrity (leaks). An audit of the CVS assembly physical integrity shall be conducted after proven capability. The atmospheric air inlet port of the filter assembly shall be plugged. The gauge shall be attached to the canister interface port. A pressure of 14 kPa shall be applied to the assembly, air leakage shall be less than 9.5 standard cubic centimeters per minute (scm). The CVS/filter housing shall not leak when tested as follows. Atmospheric air inlet port of the filter assembly shall be plugged and a gauge vacuum of -2.5 kPa applied to the canister interface port. The assembly air leakage shall be ≤ 50 scm.

3.2.1.4.1 One Hundred Percent (100%) in Process Leak Verification. The CVS (as manufactured) supplier shall conduct 100% leak verification at 23 °C ± 5 °C with 9 V and -2.5 kPa pressure applied to canister port, the leak shall be less than 2.0 scm.

3.2.1.5 Anti-Corking. With 9 V to 16 V applied to the CVS and 2.0 kPa minimum pressure applied to the canister port, the CVS shall fully open within 500 ms of voltage termination.

3.2.1.6 Air Contaminants. The CVS assembly shall be capable of leak requirements after exposure to air from carbon canister containing carbon particulates of < 300 µm diameter. The average leak of 10 pieces must be ≤ 15 scm at -2.5 kPa for seat leak as tested in 4.3.1.4.

3.2.1.7 Filter Air. For air filter serviceability requirements, refer to CG998.

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3.2.1.7.1 Filter Efficiency. This specification applies to purge air filters that are internally mounted inside the canister or to filters that are mounted elsewhere external to the canister housing. The purge air filter efficiency shall be $\geq 80\%$ tested with ISO fine test dust per ISO 5011 with the details listed in 4.3.1.

3.2.1.7.2 Filter Capacity. Maximum filter capacity shall be defined in the program specific requirements (CG998). The filter and/or CVS/filter assembly at the end of test shall meet the requirements as specified in Table 2 with details listed in 4.3.1. The filter shall be resistant to degradation due to water intrusion.

3.2.1.8 Electrical Characteristics.

3.2.1.8.1 Electrical Performance. The complete CVS assembly shall be used for GMW3172 testing and shall meet all CVS performance requirements according to GMW15826 and GMW3172. The CVS is classified under GMW3172 Performance Requirements Code.

a. The Externally mounted CVS is classified as: **C H D J F IP6K8.**

- **C** Electrical Load.
- **H** Mechanical Load.
- **D** Temperature Load.
- **J** Climatic Load.
- **F** Chemical Load.
- **6K** Dust Protection Code.
- **8** Water Protection Code.

b. The Integrated style CVS is classified as: **C Z D J F IP6K8.**

- **C** Electrical Load.
- **Z** Mechanical Load (= Code H without Crush for Housing).
- **D** Temperature Load.
- **J** Climatic Load.
- **F** Chemical Load.
- **6K** Dust Protection Code.
- **8** Water Protection Code.

3.2.1.8.2 Electrical Requirements. The CVS shall be designed to meet the following requirements without exception.

3.2.1.8.2.1 Steady state voltage with ignition on: 9 V to 16 V (at component).

3.2.1.8.2.2 Steady state voltage with ignition off: 9 V to 14 V (at component).

3.2.1.8.2.3 Worst case voltage: +26.5 V for 2 minutes.

3.2.1.8.2.4 Environmental Durability. The CVS shall meet the electrical requirements of the GMW3172, environmental durability.

3.2.1.8.2.5 Load Resistance. Load resistance shall take into consideration the piece-to-piece process variation. The load resistance shall be $15.0\ \Omega$ minimum at component, at $-20\ ^\circ\text{C}$ and $90\ ^\circ\text{C}$.

3.2.1.8.2.6 Inductance. Specific to the CVS, the CVS inductance (Millihenry) shall be 70 mH maximum at 1 kHz in a series circuit.

3.2.1.8.2.7 Inductive Energy. Maximum 26 mJ at 18 V and $-40\ ^\circ\text{C}$ as determined on Global Propulsion Systems Test Procedure for Inductive Load Devices Number PR.18.1036.R04. Provide curve of current vs. time for the load operated in its normal discrete mode starting at the minimum operating temperature.

3.2.1.8.3 Solenoid Driver Speed of Response. The solenoid shall be designed to close and reopen within the time constraints specified in Table A4, Appendix A, when controlled by an Engine Control Module (ECM) low side driver. The driver shall provide $> 9\ \text{V}$ to the solenoid and shall turn the solenoid off ($< 1\ \text{mA}$ leakage) within 2.1 ms from a 16 V fully charged condition.

3.2.1.8.4 Electromagnetic Compatibility (EMC). The CVS assembly shall be tested at the component level in accordance with GMW3097. It describes component level EMC requirements, and component level EMC test procedures. Data shall be provided to the ECM group at GM.

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Compatibility demonstration is not required unless a suppression diode would be required to be installed in the solenoid or its wiring. The addition of a diode would then be a case of controlling the solenoid with a traditional electromechanical relay.

3.2.1.8.5 Conducted Transient Emissions. This procedure evaluates conducted emissions of transients generated by the Device Under Test (DUT) and imposed back upon the battery (B+), or switched ignition feeds of the DUT.

3.2.1.8.6 Maximum Voltage. The maximum voltage magnitude, measured according to GMW3097 shall not exceed -150 V and/or +150 V peak referenced to the DUT negative terminal. Three (3) samples shall be tested.

3.2.1.8.7 Conducted Transient Immunity, Jump Start and Reverse Polarity. This conducted transient immunity requirement shall not apply to the CVS if, in its vehicle level application, the CVS is controlled directly by an electronic control module (e.g., ECM, PCM, etc.), which by design (hardware and/or software) prevents operation of the CVS when the boosted jump start or reverse polarity battery voltage levels are present.

Note: If there is a possibility that the CVS solenoid coil may be exposed to these voltage levels, then the requirements shall be met. The CVS shall exhibit no performance degradation during or after a 1 minute exposure to the jump start test voltage level specified in GMW3172. The CVS shall **not** exhibit performance degradation after a 2 minute exposure to the reverse polarity battery test voltage level specified in GMW3172. Three (3) samples shall be tested.

3.2.1.8.8 Test Circuit for Validation Testing of Conducted Transient Emissions and Conducted Transient Immunity. The CVS shall be tested in such a way that when the sample DUT is switched to the on/active state (e.g., electrical current is flowing through the solenoid coil), the coil current shall be controlled through the electronic control module (e.g., ECM, PCM) which is intended to control the solenoid in its vehicle level application. If a sample of the entire electronic control module is unavailable, then in its place shall be used a facsimile of the solid state switching circuit(s) (e.g., which controls the solenoid and is contained within the electronic control module). This facsimile circuit must incorporate the identical solid-state switching device(s) used in the electronic control module and any passive electronic components which are directly connected to the terminals of the switching device(s). The voltage, current, and edge rise/fall time characteristics of the switching device control signal(s) (e.g., transistor base or gate signal(s)) must also be the same as those for the actual electronic control module. The purpose of incorporating the electronic control portion of the CVS circuit in the EMC tests is to include the circuit protection and transient suppression effects of the electronics; this protection/suppression may not be physically contained within the solenoid package, but it serves the same purpose.

3.2.1.9 Non-Operating Storage Environment. When exposed to temperatures ranging from -48 °C to +93 °C for 12 h duration, the CVS/filter assemblies shall meet the performance requirements in the CVS CTS. The performance requirements shall be evaluated after the parts have returned to the appropriate temperatures. Additionally the CVS shall also meet the free fall (drop) requirement.

3.2.1.10 Compatible with Fuel. Perform material analysis to determine internal CVS/filter assembly materials are compatible with the fuels listed in the GMW15311 Fuel SSTs; as well as the E-85 fuel. Provide rationale for stating CVS is fuel compatible, through material supplier testing and/or analysis, component supplier testing and/or field experience. A signed letter summarizing the analysis will serve as verification for compliance to relevant requirements specified in the CVS CTS. The CVS/filter assemblies design verification shall meet the stated performance requirements when exposed to the specified test fuels as defined in 4.3.4.

3.2.1.11 Compatible Material. Perform material analysis to determine the compatibility of internal/external solenoid/filter materials with the chemical corrosives listed in the GMW15311 Fuel SSTs, Chemical Corrosives. A signed letter summarizing this analysis will serve as verification for meeting this requirement.

3.2.1.12 Mechanical Fatigue. The complete CVS assembly shall be used for GMW3172 testing and shall meet all CVS performance requirements according to GMW15826 and GMW3172. The CVS is classified under GMW3172 Performance Requirements Code, specified in 3.2.1.8.1. The mechanical cycling shall be conducted with clean air and dusty air as defined in 4.3.2 and 4.3.3.

3.2.2 Physical Characteristics.

3.2.2.1 Dimensions and Capacity. Not applicable.

3.2.2.2 Mass Properties. Not applicable.

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