



Specification for Fuel System – Vapor Containment Valve

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 the fuel system Vapor Containment Valve (VCV). The Uniform Part Classification (UPC) is 8D and the Functional Name (FNA) shall be identified as follows:

- 03318B Valve – Fuel Vapor Containment.
- 0342A Valve Assembly – Evap Emissions Canister Vent Solenoid.
- 0342B Valve – Evap Emissions.

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 supersede 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.

1.2 Applicability. This specification establishes the requirements for the Onboard Refueling Vapor Recovery (ORVR)/Onboard Diagnostic (OBD) evaporative emissions VCV 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).

1.3 Remarks. The VCV seals the fuel tank vapor space and vapor handling system atmospheric vent path to minimize canister bleed emissions on low/no purge applications. It is opened for refueling and may be opened for canister purging and for on-vehicle evaporative diagnostic procedures.

2 References

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

2.1 External Standards/Specifications.

ISO 5011	SAE J2044	SAE J400	SAE/USCAR-2
ISO 1431-1	ISO 12103		

2.2 GM Standards/Specifications.

GMW3059	GMW3103	GMW15272	GMW16494
GMW3091	GMW3172	GMW15311	GMW16600
GMW3097	GMW14234	GMW15826	

2.3 Additional References.

- Bill of Material (BOM) 862.2 Power and Signal Distribution Component Technical Specification
- Carbon Canister Component Technical Specification (CTS)
- CG998
- CG3172: Vapor Containment Valve Validation Cross Reference Index (VCRI)
- GM Mechanical Stress Testing of Chassis Mounted Products

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July 2018

Page 1 of 15

- GM SupplyPower
- PR.18.1036.R04: GMPT Test procedure
- United States Council for Automotive Research USCAR 001 Tab Tip Drawing
- USCAR Molex drawing SD 34062-0028

2.3.1 Fuels.

- GMPT-4-002
- GMPT-6-019
- GMPT-6-022
- GMPT-6-030

Note 1: The supplier shall work with the GM DRE to comprehend this requirement.

3 Requirements

3.1 Component Definition. The OBD II/Vapor VCV is added to the fuel subsystem to minimize canister bleed emissions. A normally closed, electrically operated valve which keeps fuel vapor sealed in the fuel system. The VCV is open only for refueling. It may be opened for canister purge or leak check with Electronic Leak Check Pump (ELCP) during the Evaporative Diagnostic operation. It is also designed to allow sufficient airflow to meet canister purge and ORVR requirements.

3.1.1 Appearance.

3.1.1.1 Electrically actuated, normally closed valve.

3.1.1.2 Electrical connector interface.

3.1.1.3 Physical mounting feature.

3.1.1.4 ELCP airport.

3.1.1.5 Carbon Canister air port.

3.1.2 Functional Content.

3.1.2.1 Allow sufficient ORVR and purge airflow.

3.1.2.2 Seal the fuel system or a portion of the fuel system from the atmosphere and allow venting only on command.

3.1.3 Exposure to the Environment.

3.1.3.1 Ambient Environment. The ambient environmental conditions that the VCV may encounter during its life are defined in GMW15311, except for where noted.

3.1.3.2 Component operating temperature range: -20 °C to 90 °C.

3.1.3.3 Non-Operating Pressure and Temperature. The VCV 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.

3.1.3.4 Fuels. Test fluids shall be obtained from an approved supplier.

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

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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July 2018

Page 2 of 15

3.1.3.4.2 Other Fuels. The VCV shall be designed to have compatibility with fuels that it may be exposed to during the VCVs usable life. The fuels the VCV may be exposed to are listed in GMW15311.

3.1.3.5 Contamination. The VCV 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 VCV shall meet performance requirements for contaminants listed in Appendix A, Table A1.

3.1.3.5.1 Inlet Air. The VCV shall be designed to withstand dust exposure of inlet air which has been filtered. The inlet filter shall be designed and packaged with minimum dust efficiency of 98% when tested with 99.7% ISO 12103. Efficiency shall be tested in conjunction with the dust capacity test using ISO 12103 to 76.2 mm (3 in) of water pressure at a flow rate of 70 L/minute. Testing shall be performed according to ISO 5011.

3.1.3.6 Corrosives. The VCV shall meet the performance ratings for underbody, per GMW15272. For Salt Spray requirements, the 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 the following sections.

3.1.3.6.1 Sodium Chloride. Materials used for the VCV shall be selected to withstand exposure of Sodium Chloride. Sodium chloride exposure to be tested according to GMW3172.

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

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

3.1.3.6.4 Ultraviolet Radiation. Refer to GMW15311.

3.1.4 Interfaces. External to Vehicle to Subsystem and Component/Subsystem interface requirements. The VCV shall interface per the following descriptions.

3.1.4.1 External to Vehicle to Subsystem. The VCV assembly and interfacing seal(s) shall be designed to minimize air leakage to and from the atmosphere when the VCV is not 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 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 001 tab tip drawing for blade detail information. The preferred terminal attachment method shall be a welded on terminal. The VCV 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 VCV shall conform to GMW3172 according to the code, as specified in this VCV Component Technical Specification (CTS). GMW3172 requires the Component Environmental Test Plan to be approved by the GM Environmental/Durability (ENV/DUR) Expert and that the plan is submitted for review through the CEMENT database.

3.1.4.3 VCV: Vapor Port to Fuel System and Air Port to ELCP Interface – Remote Mounted VCV. The components shall be designed unless otherwise designated with snap lock; positive seal and quick connect features on both Fuel System and ELCP connections per SAE J2044.

3.1.4.3.1 Recommended Nominal Port Sizes for Canisters.

3.1.4.3.1.1 Both the Fuel System and Air Ports shall be 16.0 mm (5/8 inch). "F" dimension recommended 9.5 mm.

3.1.4.3.1.2 The ports shall be designed in the straight position in order to optimize airflow. In some cases, vehicle packaging constraints drive the necessity of a 90 degree bend. If a 90 degree bend cannot be avoided, then special care shall be taken to understand the effects of airflow through the 90 degree bend. Computer Aided Engineering (CAE) analysis shall be conducted by the supplier to analyze airflow for restriction, and for airflow disruptions or turbulence that can lead to excessive dust accumulation in the port. A 90 degree bend in the port shall be designed with a larger radius opening at the bend for optimal airflow.

3.1.4.4 Powertrain Control and Diagnostics.

3.1.4.4.1 Powertrain Control Module. The VCV shall be compatible with the specified Powertrain Control Module (PCM) Low Side Driver.

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July 2018

Page 3 of 15

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

3.1.4.4.3 Atmospheric Port Sealing. The VCV shall have the capability to unseal the atmospheric port of the Fuel System to the atmosphere when electrically commanded.

3.1.4.5 Fuel Storage and Handling.

3.1.4.5.1 Venting. The VCV shall allow fuel system venting and minimize ORVR flow restriction.

3.1.4.5.2 Normal State. The VCV shall be designed to be a normally closed valve.

3.1.4.6 Evaporative Subsystem.

3.1.4.6.1 Restriction. The VCV/purge air filter shall minimize canister purge airflow restriction to the carbon canister. The performance requirements stated in GMW16494 shall be met at a minimum in order to ensure the VCV functions as intended.

3.1.4.7 Noise.

3.1.4.7.1 Component Noise. Component to component connections shall minimize transmission of subsystem noise. The subsystem shall not produce objectionable noise due to solenoid operation. Refer to GMW15311.

3.1.5 Usage Definition. Refer to GMW15311.

3.2 Product Characteristics.

3.2.1 Performance.

3.2.1.1 Airflow. The VCV assembly shall meet the airflow requirements, when energized, over the life of the component, as specified in Table 2. The temperature range is 0 °C to 90 °C.

Table 2: Airflow

Voltage input	Maximum Pressure/Vacuum at Canister Interface (kPa)	Airflow
9 V to 16 V	0.34	Purge Direction: 70 slpm
9 V to 16 V	0.27	Refueling Direction: 60 slpm

Note: slpm = standard liters per minute

3.2.1.2 Seal Atmospheric Port. The VCV shall meet the sealing requirements as specified in Appendix A, Table A2 when energized according to Appendix A, Table A3.

3.2.1.3 VCV Assembly Physical Integrity (Leak). The VCV and/or canister/filter assembly, including any connecting hoses and hardware shall not allow water or dust to seep into the Evap emissions system through the housings or the connections. The VCV assembly, including any connecting hoses and hardware must be present during testing and shall meet the requirements according to GMW3172.

3.2.1.3.1 Enclosure Tests. The VCV shall meet the requirements for Enclosure Test according to GMW3172.

3.2.1.3.1.1 The VCV shall meet the specification for Dust according to Code 6K on the electrical connection. During testing, the ports shall have hoses or caps present, the electrical mating connector harness shall be in place. VCV is not powered on.

3.2.1.3.1.2 For the Water Splash Test, Code 8, the VCV shall be energized during temperature maximum (T-max) soak and de-energized.

3.2.1.3.1.3 For the Water Submersion test, Code 8, the ports are plugged. Energize during T-max soak and de-energize during temperature minimum (T-min) soak time. Mating connector harness is attached.

3.2.1.3.2 Physical Integrity (Production Leak) Audit. The VCV and/or canister/filter assembly shall demonstrate capability to 1.67 C_{pk} for physical integrity (leaks). An audit of the VCV assembly physical integrity shall be conducted after proven capability. The housing and seals shall have a maximum allowable 15 µm leak rate equivalent, tested at both ends. Validation of this requirement shall be performed according to 3.2.1.3.3.

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July 2018

Page 4 of 15



Documents
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3.2.1.3.3 Hydrocarbon Loss to Environment – Permeation and Leakage. The valve and housing shall prevent the escape of fuel and vapor through the seal(s), body and mounting interface to the atmosphere.

The valve shall not create any leak that causes the fuel subsystem to fail crashworthiness requirements while the valve interface to the fuel line remains sealed and the upper electrical connector/harness is pulled free from the sensor body. The sensor shall be designed to prevent disconnection and damage to adjacent components.

3.2.1.3.4 Valve Seat Leakage. The VCV internal seal(s) shall comply with leakage requirements in Appendix A, Table A2.

3.2.1.3.5 Leak at Pressure and Vacuum. The VCV assembly, including any connecting hoses and hardware, shall not allow water to seep into the Evaporative Emissions system through the housings or the connections.

3.2.1.3.5.1 With the atmospheric air inlet port of the VCV assembly plugged and a gauge pressure of -12 kPa applied to the fuel system interface port, the assembly air leakage shall be < 1 cm³/minute.

3.2.1.3.5.2 With the atmospheric air inlet port of the VCV assembly plugged and a gauge pressure of 24 kPa applied to the fuel system interface port, the assembly air leakage shall be < 1 cm³/minute.

3.2.1.4 Anti-Corking. With 0 V applied to the VCV assembly and 24.0 kPa minimum pressure applied to the fuel system port, the VCV assembly shall fully open within 500 ms of applying 9 V. It shall remain open sufficiently with 9 V applied to allow the pressure in a 65 L vessel to decay from 24 kPa to 0.25 kPa within 30 s.

3.2.1.5 Mechanical Relief. The valve shall have pressure and vacuum relief. The valve shall be designed with the ability to adjust the pressure and vacuum set points with minimal redesign between 55 kPa and -16 kPa. With the VCV assembly air inlet port open to atmosphere and the fuel system port connected to the gauge pressure as specified in 3.2.1.6.

3.2.1.6 Mechanical Pressure Relief Flow Requirement. The VCV shall have pressure and vacuum relief set points compliant to the following flow capabilities:

- Vacuum set point = -12 kPa: > 5 slpm at 3 kPa past the set point and > 30 slpm at 7 kPa past the set point.
- Pressure set point = 24 kPa: > 5 slpm at 3 kPa past the set point and > 30 slpm at 7 kPa past the set point.

3.2.1.6.1 Pressure/Vacuum Durability. The valve assembly shall be capable without loss of function of two (2) times the estimated life time durability cycles for the following pressure and vacuum relief set points:

- Pressure 10 950 cycles (one (1) time/day for 15 years x2)
- Vacuum: 98 500 cycles (nine (9) times/day for 15 years x2)

3.2.1.7 Mechanical Cycling. The valve assembly shall be capable without loss of function when cycled a minimum of 1.3×10^6 times. One (1) mechanical cycle will consist of one (1) full stroke open followed by one (1) full stroke closed regardless of the time spent open or closed. The solenoids shall be actuated between "On" (12 V) and "Off" (0 V) with the associated inductive kickback. The testing shall occur at standard temperature.

3.2.1.7.1 Mechanical Cycling (with clean air). VCV assemblies shall be capable of cycling at least 5475 Leak Check Cycles and 60 Extended Drive Cycles (equivalent to 15 years) in the presence of room temperature "clean air" per the profile described in Appendix A, Figure A1 to simulate life time usage. The cycling required for GMW3172 functional cycling mechanical fatigue may be utilized towards the 5475 required cycles for Mechanical Cycling with clean air. The flow through the VCV assembly shall be 50 L/minute $\pm$ 2.5 L/minute during the open power on cycle. The vacuum level shall be maintained a minimum of -12 kPa during the power off cycle. One (1) mechanical cycle will consist of two (2) separate closed to open valve operations where full stroke closed followed by one (1) full stroke open regardless of the time spent open or closed. The solenoids shall be actuated per the Functional Cycling profile described in Appendix A, Figure A2, using the appropriate electrical waveform, with the associated inductive kickback.

3.2.1.8 Mechanical Loads, Mechanical Fatigue. The VCV shall meet performance requirements after exposure to the requirements of GMW3172 per the GMW3172 code requirements stated in GMW15826. This requirement includes vibration, mechanical shock and free fall. Crush for housing elbow and foot load requirement may not be applicable due to VCV housing design, as agreed upon by GM.

3.2.1.8.1 Mechanical Shock (Pothole). Functionally cycle the VCV per Appendix A, Figure A2.

3.2.1.8.2 Vibration with Thermal. During the Vibration with Thermal and Post Thermal Fatigue Vibration, tests per GMW3172, the VCV shall be functionally cycled per Appendix A, Figure A2. Run the short cycle once per

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July 2018

Page 5 of 15



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