



Compressed Natural Gas (CNG) Automatic Container Valve Component Technical Specification (CTS)

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 Compressed Natural Gas (CNG) automatic container valve.

1.2 Applicability. This standard applies to Bi-fuel or dedicated CNG vehicles (i.e., mono-fuel, mono-fuel plus). It includes requirements for both complete and incomplete vehicles (i.e., cab chassis).

2 References

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

2.1 External Standards/Specifications.

ABNT NBR 15754	INMETRO 301/11	ISO 16750-4	SAE J1645
ANSI NGV3.1	ISO 15500	SAE J1344	UN R110
ANSI PRD1			

2.2 GM Standards/Specifications.

GM1927	GMW3172	GMW14872	GMW15862
GMW3059	GMW3191	GMW15272	GMW16331
GMW3059	GMW14089	GMW15311	GMW16807
GMW3091	GMW14093	GMW15357	GMW17759
GMW3097	GMW14234	GMW15358	GMW17893
GMW3103	GMW14573	GMW15359	
GMW3116	GMW14665	GMW15570	

2.3 Additional References.

CG5508 Validation Cross Reference Index (VCRI)
PPEI_GM8774_Addendum C_FuelSystem_BiFuel_Gas_CNG

3 Requirements

3.1 System/Subsystem/Component/Part Definition. The CNG automatic container valve is to provide the capability to receive, store, and deliver fuel. The major component content and interfaces are illustrated in Figure 1.

Note: The location of the component is typically in the rear underbody vehicle or in the vehicle trunk, assembled in a container which is chassis mounted.

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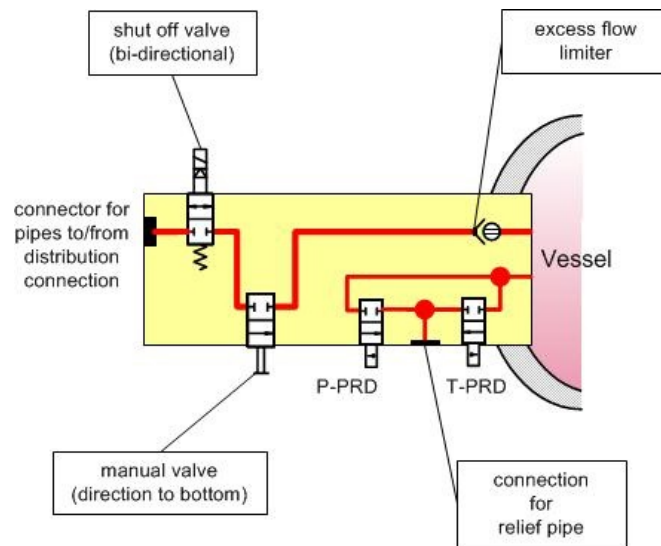


Figure 1: CNG Automatic Container Content

3.1.1 Appearance. Not applicable.

3.1.2 Content.

3.1.2.1 Physical Content. The CNG automatic container valve consists of:

- Automatic container shut off valve.
- Manual shut off valve.
- Excess flow limiter.
- Pressure Activated Pressure Relief Device (P-PRD) valve.
- Thermal Activated Pressure Relief Valve Device (T-PRD).
- Tank valve – container interface.
- Connection points for fill, supply, and relief piping and electrical power/control.

3.1.2.2 Functional Content.

3.1.2.2.1 The CNG automatic container valve is normally closed and prevents escape of pressurized gas from the container in the event of a system leak while engine is shut off or during a crash event.

3.1.2.2.2 The CNG automatic container valve shall include provision for safely discharging tank contents for service purposes.

3.1.2.2.3 The CNG automatic container valve shall provide mechanical connections to chassis mounted feed, fill, relief, purge lines, and harness connections.

3.1.2.2.4 The CNG automatic container valve shall provide provisions to mount P-PRDs and T-PRD.

3.1.2.2.5 The CNG automatic container valve shall provide provisions for an excess flow valve which limits or stops the flow of fuel in the event of a line breach.

3.1.2.2.6 The CNG automatic container valve shall have the means to be closed using the manual shut off valve.

3.1.2.2.7 The CNG automatic container valve shall be capable of meeting all specified CNG gas flow rates.

3.1.2.2.8 The CNG automatic container valve shall manage all generated noise as further described in this document.

3.1.2.2.9 The CNG automatic container valve shall enable the CNG subsystem requirements stated in GMW17759.

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3.1.3 Ambient Environment.

3.1.3.1 See requirements stated in GMW17759 including, but not limited to:

- Ambient and extreme operating conditions.
- Solar and ultraviolet radiation.
- Fuel storage system operating pressures.
- Fueling cycle temperatures and pressures (including fill and fast fill).
- Non-operating pressure and temperature.
- Fuel contamination.
- Road splash.
- Car wash and vehicle submersion.

3.1.3.2 Corrosion. CNG fuel subsystem components shall have no degradation of performance throughout the corrosion and durability target life, when exposed to the severe corrosive environments (e.g., Coastal areas or regions with high road salt usage).

3.1.4 Interfaces. The interface requirements to the component are described in the following paragraphs.

3.1.4.1 External-to-Vehicle to the CNG automatic container valve.

3.1.4.1.1 The manual shutoff valve of the CNG automatic container valve shall provide for manual shut off by means of a handle or accessibility of a hex tool. The manual shut off valve shall be oriented in the downward direction unless otherwise directed by the GM engineering representative.

3.1.4.2 The CNG Automatic Container Valve to Other Components/Subsystems.

3.1.4.2.1 The CNG automatic container valve shall provide a container interface with double O-ring that ensures radial sealing to the container. In some marketing regions, the interface shall be designed with the "Rattlesnake Effect" namely, when unscrewing the valve unknowingly on a pressurized container, the valve thread is still engaged when clearly audible inner pressure starts to relieve by the unsealing of the O-rings. Valve threads shall be sufficiently engaged to securely prevent dislodging the valve from the container as a service precaution indicating pressurized gas still in the container. This interface can be designed and adjusted with the container supplier.

3.1.4.2.2 The CNG automatic container valve head, namely, the portion that is outside of the container, shall have all functions integrated and shall not exceed a height of 21 mm outside of the container. A larger valve head height can be used if vehicle integration packaging allows subject to the GM engineering representative and Bill of Material (BOM) Family Owner (BFO).

3.1.4.2.3 The CNG automatic container valve shall provide two (2) gas interfaces (gas path through component for inlet/outlet) according to Appendix A, Figure A1 for 8 mm stainless steel pipes.

3.1.4.2.4 The CNG automatic container valve shall provide a male GM approved electrical interface (2 pin) for automatic container shutoff valve actuation with a connection location of < 45 degrees to the downward vertical position.

3.1.4.2.5 The CNG automatic container valve shall have a combined T-PRD and P-PRD activation port with the ability to release gas in the vehicle downward direction. This port shall have provisions to mount a pressure relief pipe. If no pressure relief pipe is required, the CNG automatic container valve shall be protected from the environment with a slotted plastic plug. The plug shall meet the requirements of GMW14093.

3.1.4.2.6 The CNG automatic container valve shall provide an electrical ground path between the container and valve body (maximum of 10 Ω). Additionally, the valve body shall be grounded to the pressure pipes through the fitting connections.

3.1.4.2.7 The CNG automatic container valve shall be able to operate with Peak and Hold signal. The Peak and Hold will be generated by a Pulse Width Modulation (PWM) signal in the vehicle controller. The complete PWM requirements for the component are stated in PPEI_GM8774_Addendum C_FuelSystem_BiFuel_Gas_CNG.

3.1.5 Usage Definition.

3.1.5.1 The CNG automatic container valve shall be designed to withstand 1650 gas impulses generated by vehicle refueling during the vehicle service life. Additionally, the CNG automatic container valve shall meet vehicle level usage requirements per GMW17759 as tested at a subsystem level.

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3.1.5.2 The CNG automatic container valve shall withstand total vehicle usage cycles plus vehicle start/stop duty cycles if applicable.

3.1.5.3 The manual shutoff valve function of the CNG automatic container valve shall meet 15 000 activations.

3.2 Product Characteristics. The required product characteristics for the CNG automatic container valve are identified in several different categories in the following paragraphs.

3.2.1 Performance Requirements. The CNG automatic container valve shall meet all the applicable legal standards and be certified to common industry standards in the region of sale. Further functional performance requirements are specified in the following paragraphs. All requirements apply to the conditions specified in 3.1.3, except where noted otherwise.

Note: All fuel flow measurement testing, unless otherwise specified, shall use a qualified calibration gas. The supplier shall define the test gas used, and provide correlation to actual gaseous fuel.

The CNG automatic container valve and test gas temperature for all CNG fuel flow measurements shall be measured at the CNG fuel component inlet and stabilized at $21\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for North America and at $15\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ for other regions of sale.

3.2.1.1 Minimum Fill Rate. The CNG automatic container valve shall accept fuel at ambient temperatures of $-40\text{ }^{\circ}\text{C}$ to $50\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F}$ to $122\text{ }^{\circ}\text{F}$) with an initial tank pressure of 0.5 MPa (73 psi) and a final tank pressure of 24.8 MPa (3600 psi) compensated for ambient temperature of $21\text{ }^{\circ}\text{C}$ ($70\text{ }^{\circ}\text{F}$) with an average fast fill rate of ≥ 6.0 Gasoline Gallon Equivalent (GGE) per minute for North America and a final container pressure of 20 MPa compensated for ambient temperature of $15\text{ }^{\circ}\text{C}$ with an average fast fill rate of ≥ 10 kg/minute for UN R110 regions. Other regions may require country specific fill rates. Please refer to the Program Specific Documents.

3.2.1.2 The CNG automatic container valve shall provide the following mass flow rate:

- for car application: 40 kg/h or as directed by program specific requirement.
- for truck application: 70 kg/h or as directed by program specific requirement.

3.2.1.3 The CNG automatic container valve shall be optimized to get the maximum pressure drop in the fuel subsystem during refueling meaning the CNG automatic container valve shall have the highest pressure drop of all refueling components. It is recommended to implement this function after the excess flow limiter function in refueling path.

3.2.1.4 All functions of the CNG automatic container valve shall be located within the valve body. The excess flow limiter can however be located as an externally attached element to valve body.

3.2.1.5 The CNG automatic container valve shall not experience loss of function or detectable leakage at 1.25 times the Service Pressure (SP) for components upstream of the first stage of pressure reduction or 1.25 times the Working Pressure (WP) for components downstream of the first stage of pressure reduction.

3.2.1.6 The CNG automatic container valve shall meet all requirements from UN-R110, ANSI NGV3.1, ANSI PRD1, and ISO 15500 standards.

3.2.1.7 External Leakage Tightness (100% Methane, $0\text{ }^{\circ}\text{C}$). Over total service life: 5×10^{-5} mbar $\times$ l/s.

3.2.1.8 Internal Leakage Tightness (100% Methane, $0\text{ }^{\circ}\text{C}$). New part: 5×10^{-5} mbar $\times$ l/s. After component durability testing according to the applicable standard shall be 1×10^{-4} mbar $\times$ l/s.

3.2.1.9 During refueling, the CNG automatic container valve and other refueling components shall not generate objectionable noise at the refueling operator's ear level. Refer to GMW17759 for specific requirements. Component to component connections shall minimize transmission of noise.

3.2.1.10 Vibration Resistance. The CNG automatic container valve shall meet all operational performance requirements, without loss of function or degradation of service life, when exposed to a spectrum of vibration load inputs for a duration representative of typical customer operation over its design service life. The magnitude and duration of the vibration loading inputs shall be determined by GMW15570 or by conducting platform specific Road Load Data Acquisition (RLDA) measurements based on proving ground vehicle durability schedules.

3.2.1.11 Drop Test. The CNG automatic container valve shall meet mechanical shock (pothole - sprung masses – 245.25 m/s^2 (25G)) according GMW3172.

3.2.1.12 The CNG automatic container valve shall meet the pulsation requirement test according to Appendix B.

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3.2.1.13 The T-PRD (glass bulb technology) and P-PRD (burst disc technology) of the CNG automatic container valve shall release the complete CNG tank volume within < 90 s for containers < 40L water volume or ≤ 11.5 minute for containers up to 300 L.

3.2.1.14 The CNG automatic container valve integrated T-PRD (glass bulb technology) shall be activated at $110\text{ }^{\circ}\text{C} \pm 10\text{ }^{\circ}\text{C}$ and according to UN-R110 or ANSI PRD1, as regulated for the specific region of sale.

3.2.1.15 The CNG automatic container valve integrated P-PRD (burst disc) shall be activated at 31.02 MPa (4500psi) according to UN-R110 and 37.2 MPa (5400psi) to ANSI PRD1 at temperatures of $-40\text{ }^{\circ}\text{C}$ to $85\text{ }^{\circ}\text{C}$ for European standard regions of sale and North American standard regions of sale respectively.

3.2.1.16 The CNG automatic container valve integrated manual shutoff valve and non-integrated manual shutoff valve if specified, shall be protected against unintended actuation due to environmental conditions or misuse.

3.2.1.17 The CNG automatic container valve integrated manual shutoff valve and non-integrated manual shutoff valve if specified, shall open and close with a 1/4 quarter turn (90 degrees) according NGV3.1 and UN- R110.

3.2.1.18 The CNG automatic container valve shall be a normally closed valve.

3.2.1.19 The CNG automatic container valve shall be designed with a one-piece solenoid piston bushing. Press fit assemblies shall not be used.

3.2.1.20 The electrical connection for the CNG automatic container valve shall be validated to meet GMW3191. The connector shall use the following classification: T3 (for $125\text{ }^{\circ}\text{C}$), V1 (chassis or frame mounted), and sealed S3 for underbody location or S2 for in trunk location.

3.2.1.21 The excess flow limiter activation of the CNG automatic container valve shall not be inhibited when assembled to a 6 mm, 8 mm, or other diameter pipe.

3.2.1.22 The CNG automatic container valve shall withstand the Boiling Calcium-Chloride Test for Stainless Steel Solenoid Bushings according to Appendix C.

3.2.1.23 Humidity Test. For CNG automatic container valves located underbody, use 3.2.1.23.1 through 3.2.1.23.10 to verify the interface tightness of the solenoid coil and its connector in a saltwater environment.

Note: The solenoid coil must meet all electrical and tightness requirements after testing.

3.2.1.23.1 Test Objects and Quantities. Fifteen (15) coils and wiring harness connectors.

3.2.1.23.2 Test Condition.

3.2.1.23.2.1 Climatic chamber at $-5\text{ }^{\circ}\text{C}$.

3.2.1.23.2.2 Test duration 480 h with 15 units individually numbered (see Figure 2).

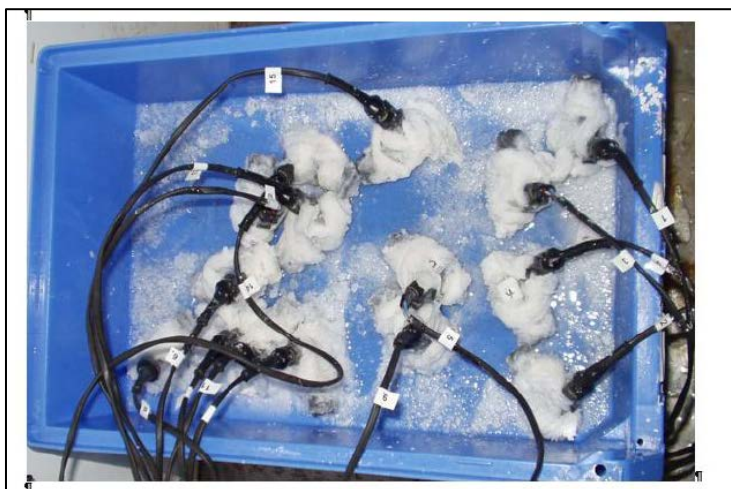


Figure 2: Numbered Coils Submerged in Salt Bath

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