



Conventional Coolant Pressure Caps

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.

This specification applies to the quality, reliability, durability, and performance requirements for high temperature coolant pressure caps and acts as a supplement to the GM authorized drawings.

1.1 Purpose. This standard establishes the requirements for a Coolant Pressure Caps. The functions, performance, design constraints, and validation required of the component are defined in this document. All requirements of this specification must be met in order to demonstrate design and production validation.

1.2 Applicability. Bill of Material (BOM) Row 313 Coolant Plumbing and Hardware.

1.3 Remarks. The Coolant Pressure Cap provides the regulation and the safety function in the engine cooling system. Its design is critical to the operation of the powertrain as it must maintain a full, deaerated coolant system. The engineering test schedule contained within this specification defines the minimum performance and durability criteria necessary for design and production validation. In addition, the minimum requirements for in process testing of on-going production are outlined. The schedule is intended as a supplement to normal material inspections, dimensional checking and in process controls, and should in no way adversely influence adherence to other inspection operations.

2 References

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

2.1 External Standards/Specifications.

ISO 37	ISO 815	ISO 7500-1	SAE J1344
ISO 48	ISO 1817	ISO 9513	
ISO 188	ISO 2781	ISO 23529	

2.2 GM Standards/Specifications.

GMW3059	GMW8758	GMW14747	GMW15862
GMW3116	GMW14156 (ID)	GMW15758	GMW16955
GMW3420	GMW14157 (ID)	GMW15760	

(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.

- GM1738
- GM Part Number 13500354 Filler Neck-Surge Tank
- Pantone 116 Yellow
- Test_Device_Sticking_behavior_2.pdf

3 Requirements

3.1 Component/Part Definition.

3.1.1 Appearance. The cap shall not have any noticeable dents, scratches, twists or warpage. Cap cover color, grain and gloss shall be shown on the GM authorized drawing. The pad print warning shall conform to Pantone 116 Yellow.

3.1.2 Content.

3.1.2.1 Physical Content. The Pressure Cap includes a valve housing (containing the main pressure and vacuum valves plus a path to an overflow port) and an external cap, which retains the valve housing within the filler neck, provides the human interface for installation and removal of the assembly, and provides a surface for imprinting identification information and other symbols, which may be required.

3.1.2.2 Functional Content. Not applicable.

3.1.2.3 Material Tests. Gaskets and Seals material must meet the requirements as defined in Appendix C. Other material test as specified on the GM released drawing.

3.1.2.4 Material Test Machine. The test machine shall fulfill the following requirements: The force-measuring device of the test machine shall correspond to ISO 7500-1 Class 1; the deflection measuring device shall correspond to ISO 9513 Class 0.2. The test machine shall be such that the required test velocity can be maintained.

3.1.3 Ambient Environment. The following is the ambient environment in which the Pressure Cap must operate.

- Normal Operating Range: -40 °C to +125 °C.
- Maximum Under-Hood Temperature Excursions: -50 °C to +150 °C.
- Humidity Range: 0% to 100%.
- Altitude: -150 m to +4600 m.

Engine Compartment: The Pressure Cap and all components may be exposed and shall be resistant to all typical, in car used fluids and substances listed below:

- Coolant to GMW3420.
- De-ionized water.
- Fuels: Gasoline, Ethanol, Diesel, Bio-Diesel B5, B20.
- Oils/Fluids available on market: for engine, transmission, power steering, brakes.
- Engine degreasers and cleaners available on market.
- Salt Water Solution 5% by mass.

3.1.4 Interfaces. Mandatory matching to filler neck as GM released drawing 13500354.

3.1.5 Usage Definition. Not applicable.

3.1.6 Failure Mode and Effects Analysis (FMEA). Detailed design and process FMEAs shall be submitted to the GM Release Engineer and Validation Engineer upon request and shall be maintained as part of the vendor records of the Design and Product Validation. The FMEAs shall be updated each time a design change occurs.

3.1.7 Finish. The Pressure Cap shall be free of burrs or any sharp edges, which may be detrimental to satisfactory assembly or safe handling.

3.1.8 Identification and Marking. The coolant pressure cap shall have the following markings to GMW15862 clearly displayed on the outside/underside of the part and not on a surface that is noticeable to the customer. Additionally followed information are required:

- Tool/Cavity Number.
- Material Content (required for all parts).
- Recycling Symbol per SAE J1344.

3.1.9 Internal/External Dryness/Cleanliness. All assemblies shall be thoroughly dry, prior to shipment. Parts shall not include any debris and not be exposed contaminations or durable lubes. Oil, grease or any contaminants may interfere with proper handling, cause plugging, or have a detrimental effect on the material and function properties.

3.2 Product Characteristics.

3.2.1 Performance Requirements.

- Validation of pressure caps will be through vendor laboratory tests and vehicle durability and performance testing at GM Laboratory and Proving Ground facilities (see Table A1 in Appendix A for the Sequence Test Chart). Specific validation tests include, but are not limited to, the following tests defined in this specification.

- The pressure cap shall work filled during the bench tests with coolant to the cold fill level comprised of 50% by volume water and by 50% volume anti-freezing agent to GMW3420.
- Temperature tolerances for all bench test values: $\pm 2^\circ\text{C}$.
- Pressure tolerances for all bench test values: $\pm 2\text{ kPa}$.
- Flow rate tolerance: $\pm 1.0\text{ cm}^3/\text{minute}$ (mL/minute).
- Volume tolerance: $\pm 5.0\text{ cm}^3$.
- Torque tolerance: $\pm 0.25\text{ N}\cdot\text{m}$.

3.2.1.1 Pre-test and Post-test. The following controls comprise the Acceptance Criteria for, and shall be performed on all samples before and after the following test: 3.2.1.3 Valve Sticking Test; 3.2.1.4 Vacuum Valve Leakage Test; 3.2.1.6 Overflow Test; 3.2.1.7 Thermal Cycle Test; 3.2.1.8 Pressure Cycle Test; 3.2.1.9 Thread and O-Ring Durability Test.

3.2.1.1.1 Main Valve Opening Pressure. Main valve opening pressure shall be called out on the GM authorized drawing.

3.2.1.1.2 Vacuum Valve Operation.

3.2.1.1.2.1 Opening Pressure Surge Tank Caps. The Vacuum Valve shall open at a maximum vacuum of 10.0 kPa and provide a minimum of 60 $\text{cm}^3/\text{minute}$ (mL/minute) airflow.

3.2.1.1.2.2 Closing Flow-Rate Radiator Caps. The Vacuum Valve shall close at a minimum flow-rate of 3.0 $\text{dm}^3/\text{minute}$ (L/minute) airflow.

3.2.1.1.3 Hold Pressure. The Hold Pressure must not be less than 10.0 kPa below the recorded Main Valve Opening Pressure.

3.2.1.1.4 Flow Rate. Flow rate shall be a minimum of 200 cm^3/s (mL/s) under pressure relief conditions (65 kPa above Main Valve Opening Pressure).

3.2.1.1.5 Valve Assembly Leakage Radiator Caps. When a vacuum of 50 kPa (use air as test medium) is applied at the over-flow port for a duration of 5 minutes, the valve assembly shall leak at a rate of less than 5.0 $\text{cm}^3/\text{minute}$ (mL/minute). This includes leakage between the valve assembly and valve assembly cover.

3.2.1.1.6 Torque Test. After test completion, all test caps shall be torqued to 3 N·m on a filler neck conforming to GM Part Number 13500354.

3.2.1.2 Drop Test. Six (6) samples shall be subjected to the Drop Test Procedure.

3.2.1.2.1 Test Conditions.

- Soak cap at 0°C for 24 h in a cold chamber.
- Remove cap from cold chamber and immediately drop from a height of 2 m onto a smooth, level concrete surface.
- Drop six samples in each orientation, as shown in Figure 1.

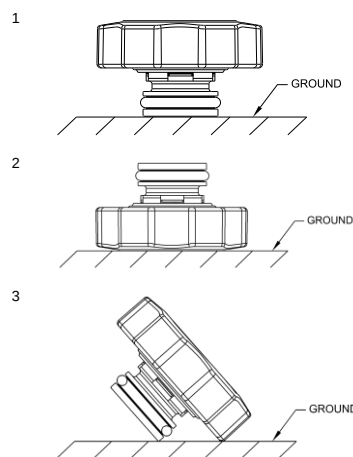


Figure 1: Pressure Cap Orientations for Drop Test

© Copyright 2014 General Motors Company All Rights Reserved

3.2.1.2.2 Acceptance Criteria. After the drop test, the cap shall not exhibit any external cracks fractured-off pieces, separation of the cover from the valve body or inability of the cap to freely rotate on the valve body.

3.2.1.3 Valve Sticking Test. Six (6) test samples shall complete the Valve Sticking Test Procedure.

3.2.1.3.1 Test Conditions. Repeat the test for 5 cycles.

- Immerse cap, cover side up, in coolant mixture at 130 °C and 170 kPa for 24 h.
- Turn the cap cover side down and immerse the cap in the specified coolant mixture for 2 minutes.
- Turn cap cover side up and subject it to 110 °C dry air for 24 h.

3.2.1.3.2 Acceptance Criteria. After completion of this test, all test caps shall meet the functional performance requirements specified in 3.2.1.1 and on the GM authorized drawing. O-rings may be cleaned for compliance with the test. The pressured cap shall not show any disturbing internal valves and seals.

3.2.1.4 Vacuum Valve Leakage Test. Six (6) test samples shall complete the Vacuum Valve Leakage Test Procedure.

3.2.1.4.1 Test Conditions.

- Install test caps on a filler neck conforming to GM Part Number 13500354. Torque to 3.0 N·m, at room temperature 23 °C.
- Slowly pressurize the fixture with air to 15 kPa.
- Maintain the pressure at 15 kPa, and measure the volumetric flow rate of either the supply air or air discharged out the overflow fitting.

3.2.1.4.2 Acceptance Criteria. All test samples shall leak less than 5.0 cm³/minute (mL/minute) of air. After completion of this test, all test caps shall meet the functional performance requirements specified in 3.2.1.1 and on the GM authorized drawing. O-rings may be cleaned for compliance with the test. The pressured cap shall not show any disturbing internal valves and seals.

3.2.1.5 Cover Pull Test. Six (6) test samples shall complete the Cover Pull Test Procedure.

3.2.1.5.1 Test Conditions.

- Fixture test cap in test machine (see 3.1.2.4) capable of measuring tensile force.
- Slowly (< 25 mm/minute) pull the cover from the valve housing.
- Record the maximum observed tensile force.

3.2.1.5.2 Acceptance Criteria. All test samples shall separate at a minimum of 400 N.

3.2.1.6 Overflow Test. The purpose of the overflow test is to simulate hot engine overflow and requires a closed system fixture. Twenty three (23) test samples shall complete the Overflow Test Procedure. Repeat the test for 100 times. The test fixture will have:

- A reservoir capable of holding 10.0 dm³ (L) of specified coolant,
- Rapid heating elements for the reservoir,
- A 2.0 dm³ (L) coolant reservoir connected to a specified filler neck,
- A pump calibrated to 1.0 dm³/minute (L/minute) circulation and associated plumbing to simulate the engine and coolant container.

3.2.1.6.1 Test Conditions (Single Cycle).

- Install sample cap on a filler neck conforming to GM Part Number 13500354 and containing 1.0 dm³ (L) coolant-water mixture.
- Fill reservoir with 10.0 dm³ (L) of the specified coolant mixture and seal the reservoir. Connect the reservoir to the base of the filler neck.
- Turn on the pump to provide coolant circulation.
- Heat reservoir until 1.0 dm³ (L) liquid overflow is caused to flow through the cap into the 2.0 dm³ (L) coolant overflow container. Record the liquid temperature and the pressure of the coolant container onto a data sheet.
- Cool reservoir until a system pressure just below the cap pressure valve closing rating is achieved. Empty the contents of the coolant overflow container into the large 10.0 dm³ (L) reservoir.

- Cooling coils are permissible to speed the process.
- Measure Engineering Drawing Performance Requirements, and proceed to 3.2.1.7, Thermal Cycle Test.

3.2.1.6.2 Acceptance Criteria. After completion of this test, all test caps shall meet the functional performance requirements specified in 3.2.1.1 and on the GM authorized drawing. O-rings may be cleaned for compliance with the test. The pressured cap shall not show any disturbing internal valves and seals.

3.2.1.7 Thermal Cycle Test. Twenty three (23) samples shall complete the Thermal Cycle Test Procedure, Repeat the test for 2500 cycles.

3.2.1.7.1 Test Conditions.

- Place the pressure cap in a calibrated thermal test chamber. Heat the test chamber and cap to 90 °C and hold for 5 minutes.
- Decrease chamber temperature to -40 °C within 45 minutes maximum time and hold for 5 minutes.
- Increase chamber temperatures to 90 °C within 15 minutes maximum and 2 minutes minimum time.
- Measure Engineering Drawing Performance Requirements, and proceed to 3.2.1.8 Pressure Cycle Test.

3.2.1.7.2 Acceptance Criteria. After completion of this test, all test caps shall meet the functional performance requirements specified in 3.2.1.1 and on the GM authorized drawing. O-rings may be cleaned for compliance with the test. The pressured cap shall not show any disturbing internal valves and seals.

3.2.1.8 Pressure Cycle Test. Twenty three (23) test samples shall complete The Pressure Cycle Test Procedure. Repeat at a rate of one cycle per minute for 150 000 cycles.

3.2.1.8.1 Test Conditions (Single Cycle).

- Install the coolant pressure cap on the test stand. The test stand shall be connected to a pressure regulated steam supply and a vacuum pump. Steam supply and vacuum pump shall have different ports and individual shut-off valves.
- Pressurize the assembly with 125 °C steam to a pressure of +35 kPa above the rated cap opening pressure.
- Allow the pressure to drop to the rated valve closing pressure while maintaining constant temperature then close the steam supply and apply a vacuum of 2 kPa to 6 kPa.
- Pressurize cap once to 350 kPa with steam at 125 °C and hold for 30 s.
- Measure Engineering Drawing Performance Requirements, and proceed to 3.2.1.9 Thread and O-Ring Durability Test.

3.2.1.8.2 Acceptance Criteria. After completion of this test, all test caps shall meet the functional performance requirements specified in 3.2.1.1 and on the GM authorized drawing. O-rings may be cleaned for compliance with the test. The pressured cap shall not show any disturbing internal valves and seals.

3.2.1.9 Thread and O-Ring Durability Test. Twenty three (23) test samples shall complete the Thread and O-Ring Durability Test Procedure. Repeat for 250 times.

3.2.1.9.1 Test Conditions.

- Condition test samples by soaking them in a mixture of 85% GMW3420 coolant/15% water for 200 h at 125° C.
- Remove test samples from coolant soak, and rinse with water.
- Install and remove test cap at an ambient temperature of 20 °C on a filler-neck conforming to GM Part Number 13500354.

3.2.1.9.2 Acceptance Criteria. After completion of this test, all test caps shall meet the functional performance requirements specified in 3.2.1.1 and on the GM authorized drawing. O-rings may be cleaned for compliance with the test. The pressured cap shall not show any disturbing internal valves and seals.

3.2.1.10 Functional Requirements. Pressurized cap must comply with the following functional requirements:

- The pressurized cap shall be capable of withstanding a torque of 12.0 N·m without failure, damage or loss of function.
- The disassembling break loose torque after all tests shall not be higher than 3.0 N·m.

3.2.2 Physical Characteristics. Not applicable.

3.2.2.1 Dimensions and Capacity. Refer to released Engineering Drawing.