



Air Conditioning Charge, Service and Switch/Pressure Transducer Port Valve Assemblies and Threaded Caps; R134a and R1234yf

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.

Note: Unless otherwise stated as gauge, pressures listed within this specification are absolute.

1.1 Purpose. This specification establishes the minimum requirements for Air Conditioning (A/C) charge, service and switch port valve assemblies and threaded/snap-on caps intended for use in GM automotive air conditioning systems with liquid and gaseous refrigerant.

- R134a (GM Part Number 9985751 or equivalent).
- R1234yf (GM Part Number 9986319 or equivalent). See Global Product Description System/Area Parts Manager (GPDS/APM).
- Polyalkylene Glycol (PAG) compressor oil (material specification 9986181 for R134a) for R1234yf - PAG oil specification, refer to the following:
 - Mahle (formerly Delphi) - PSD1 - 9986364.
 - Mitsubishi Heavy Industries (MHI), MHI - PAG46 - 9986365.
 - Denso - ND12 - 9986366.
 - Sanden - SP-A2 - 9273590.
- Polyol Ester Oil (POE) compressor oil (material specification 9986277).

The functions, performance, reliability, qualification tests and shipping requirements for A/C charge, service and switch port valve assemblies and threaded caps are defined in this document.

1.2 Applicability. Air Conditioning (A/C) charge, service and switch port valve assemblies and threaded/snap-on caps intended for use in GM automotive air conditioning systems with liquid and gaseous refrigerant.

1.3 Remarks. PAG and POE compressor oil formulations are unique to each A/C compressor manufacturer. In order to evaluate the entire spectrum of compressor oil formulations and refrigerants (R134a and R1234yf) used in GM vehicles, the A/C charge, service and switch port valve assemblies and threaded caps, suppliers shall perform the material compatibility tests with the compressor oil formulations and refrigerant type confirmed by the responsible Global Thermal Bill of Materials Family Owner (BFO).

2 References

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

2.1 External Standards/Specifications.

ARI 720 JRA 2009-1991 SAE J639

2.2 GM Standards/Specifications.

9986181	GMW3116	GMW14727	GMW17223
9986277	GMW3172	GMW15272	GMW17625
GMW3059	GMW8758	GMW15760	

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2.3 Additional References.

- CG2987 A/C Lines VCRI
- GM Part Number 9985751
- GM Part Number 9986319
- GM1738
- Industry Best Practices
- Mahle - Part Number 9986364 (www.mahle.com)
- Mitsubishi Heavy Industries - Part Number 9986365 (www.mhi-global.com)
- Recycled Content Report Form
- Sanden - Part Number 9273590 (www.sanden.com)
- Vehicle Technical Specification (VTS) Template Requirement Suffix G

3 Requirements

All requirements of this specification must be met in order to demonstrate compliance with Design Validation (DV), Product Validation (PV) and In-Process (IP) evaluations.

3.1 System/Subsystem/Component/Part Definition. There are three types of A/C ports and two main design types of caps covered by this specification (see 6.1 for definitions).

3.1.1 Appearance. Not applicable.

3.1.2 Content.

3.1.2.1 Physical Content. A typical A/C charge, service and switch port valve assembly consists of a fitting made of aluminum (one or two pieces) that is welded or brazed to an A/C line, and an internal valve core which contains the sealing element (made of rubber) and a pin that permits valve to open or close the A/C system.

A typical threaded sealing cap consists of a sealing element (flat or O-ring rubber) with ribs on the exterior surface and sometimes a hole on the top surface to help hold the cap properly during torque application (e.g., torque style feature).

The snap-on sealing cap consists of a sealing element with retainers which snap over the charge port and compress the sealing element while retaining the cap affixed to the port. The seal should not allow any exposure of plastic body to refrigerant in effort to eliminate permeation through plastic body.

3.1.2.1.1 A/C Valve Construction. There are two types of A/C valves utilized: Valve cores within a separate port (referred to as a one-piece valve) and integrated valve/port (referred to as a two-piece valve). In all cases, the exterior configuration of the charge and service ports are defined by SAE J639.

3.1.2.1.2 Valve Cores. There are several styles of valve cores available with different performance parameters. Valve selection should be based on system application needs and valve core performance parameters. The valve cores are (generally) constructed of brass or stainless steel and have either one or two rubber seals. Valve cores are screwed into ports which are generally fabricated of aluminum and brazed or welded onto the A/C assembly lines.

3.1.2.1.2.1 Japan Refrigeration Association (JRA) Valve Core. This is a low flow valve core with an external spring that is generally applied to the low side charge and service port. Sealing is comprised of an external rubber O-ring that seals the valve core to the interior surface of the port, and a molded rubber seal that seals the moveable poppet within the core (see Figure 1). The dimensions of this core are defined by JRA-2009-1991.

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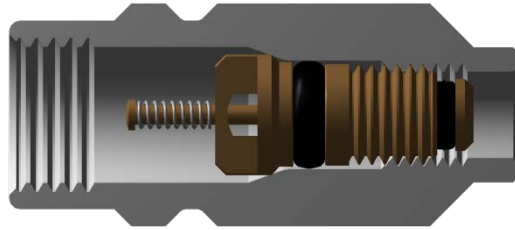
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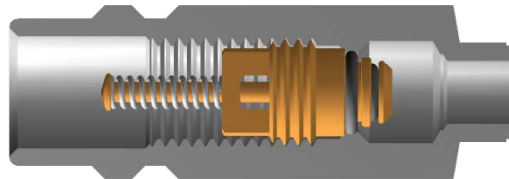
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**Figure 1: Typical JRA A/C Charge and Service Core in a High Side Port
(Image for Reference, Actual Design may vary from Supplier to Supplier)**



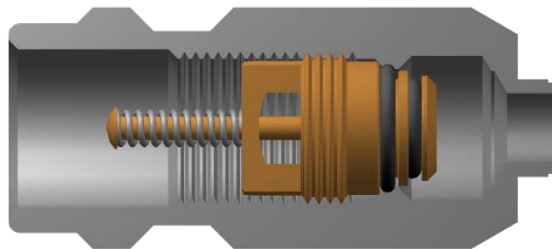
3.1.2.1.2.2 Valve Core: Eight (8) mm. This is a medium flow valve core with an external spring that is generally applied to the low side charge and service port. Sealing is comprised of an external O-ring that seals the valve core to the interior surface of the port, and an O-ring that seals the moveable poppet within the core. There is no industry standard for this core design (see Figure 2).

**Figure 2: Typical 8 mm A/C Charge and Service Core in a High Side Port
(Image for Reference, Actual Design may vary from Supplier to Supplier)**



3.1.2.1.2.3 Valve Core: Ten (10) mm. This is a high flow valve core with an external spring that can be applied only to the high side charge and service port. Sealing is comprised of an external O-ring that seals the valve core to the interior surface of the port, and an O-ring that seals the moveable poppet within the core. There is no industry standard for this core design (see Figure 3).

**Figure 3: Typical 10 mm A/C Charge and Service Core in a High Side Port
(Image for Reference, Actual Design may vary from Supplier to Supplier)**



3.1.2.1.2.4 Standard Core. This is a low flow valve core with an internal spring that is generally applied to switch ports, and in some cases to the low side charge and service port. Sealing is comprised of an external Teflon ring that seals the valve core to the interior surface of the port and a rubber seal that seals the moveable poppet within the core. The dimensions of this core are defined by standard: ARI 720 (See Figure 4).

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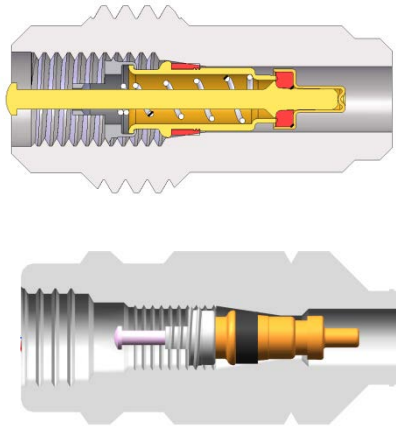
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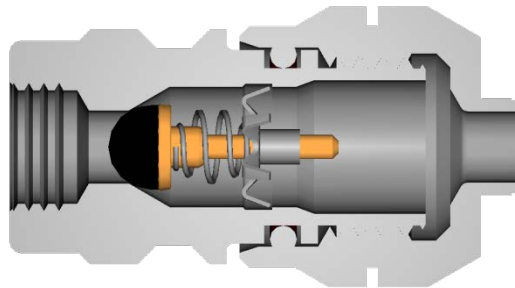
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Figure 4: Typical A/C Standard Service Cores in a Typical Switch Port and Low Side Port



3.1.2.1.2.5 Integrated Charge Valves. Charge and service ports with an integrated valve poppet are available for both high and low side charge and service applications. These are high-flow valves that are manufactured with the sealing poppet integral within the charge port; the integrated valve is attached to a threaded adapter that is brazed to the A/C line. A robust O-ring is used to seal the valve to the adapter. The external configurations of the ports comply with SAE J639 (see Figure 5).

Figure 5: Typical High Side Integrated Charge and Service Valve Attached to an Adapter (A Low Side Integrated Valve (not shown) is Also Available)



3.1.2.1.2.6 Threaded Cap. This is a plastic cap with a sealing element (flat O-ring rubber made from Ethylene Propylene Diene Monomer (EPDM) or Hydrogenated Nitrile Butadiene Rubber (HNBR)) which helps reduce A/C refrigerant leakage. The cap also has internal threads that interface with the A/C charge and service fitting threads to help with the sealant condition of the cap. Sizes of threads can be M8 (short post), M10 (long post) M9 (short post) or M10 (short post) (see Figure 6). In some cases, a plastic tether must be implemented to help retain the A/C cap close to the A/C fitting ports.

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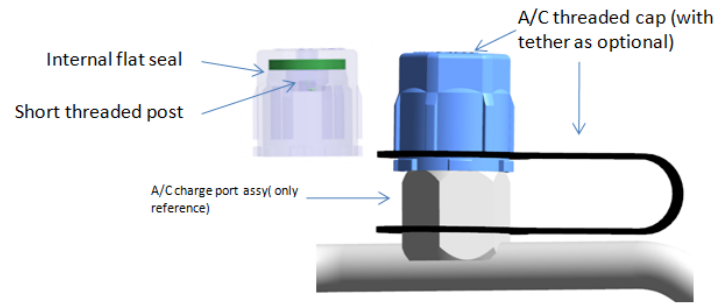
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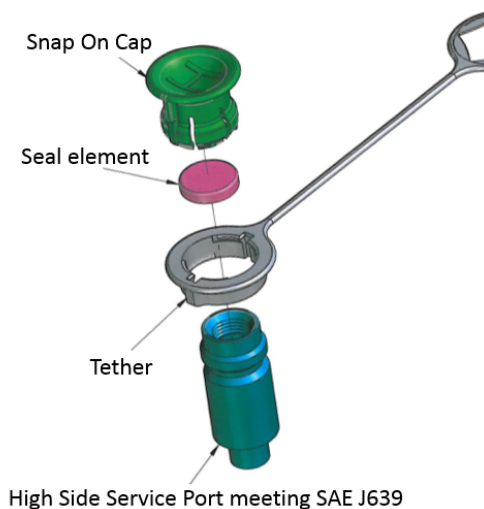
Figure 6: Typical High and Low Side A/C Threaded Cap



Note: An internal seal element provides the secondary seal to the A/C ports. Snap-on cap shall be similar.

3.1.2.1.2.7 Snap-on Cap (Figure 7). This is typically a plastic cap with a sealing disc rubber made from Ethylene Propylene Diene Monomer (EPDM) or Hydrogenated Nitrile Butadiene Rubber (HNBR) which helps reduce A/C refrigerant leakage. The cap shall require no threads to attach and its compression adherence is dependent upon the SAE charge port exterior dimensions. Snap-on cap must make an audible sound upon obtaining full retaining engagement. Audible sound must be approved by GM Engineering.

Figure 7: Typical High Side A/C Snap-on Cap



In some cases, a plastic tether may be implemented to assist retain the A/C cap during service.

3.1.2.2 Functional Content. Not applicable.

3.1.3 Ambient Environment. A/C charge, service and switch port valve assemblies are expected to be fully functional under the following ambient conditions:

- Ambient Temperature: (-40 to 125) °C for high and low side valve port assemblies and (-40 to 150) °C for switch ports.
- Relative Humidity: (0 to 100)%.

3.1.4 Interfaces. A/C charge, service and switch port valve assemblies interface in the fitting base with A/C aluminum lines, in some cases, A/C charge, service and switch port valve assemblies are welded in A/C blocks, A/C condensers. In the upper part, A/C charge, service and switch port valve assemblies interface with A/C production and service evacuation/filling and coupling adapters. Threaded caps interface with the internal threads of the A/C fitting ports and snap-on cap interface with outer surface of the A/C fitting ports design meeting SAE J639.

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3.1.5 Usage Definition. Not applicable.

3.2 Product Characteristics.

3.2.1 Performance Requirements. Validation of A/C charge, service and switch valve assemblies and A/C threaded/snap-on caps will be through vendor laboratory tests and vehicle durability and performance testing at GM Laboratory and Proving Ground facilities. See Appendix B, Figures B1, B2 and B3 for the Sequence Test Chart. Specific validation tests include, but are not limited to, the following tests.

3.2.1.1 Dimensional. Parts must meet dimensional limits specified in GM approved drawings when evaluated per 4.3.1.

3.2.1.2 Appearance. All exterior and interior surfaces shall be clean, free of rust, ridges, sharp edges, nicks, scratches, roughness and manufacturing debris (e.g., machining chips) and lubricants to assure positive sealing when evaluated per 4.3.2. Elastomeric materials (O-rings, flat seals, etc.) must be homogeneous and free of any internal or surface blisters, bloom, talc, mold release agents and flash should be within print specification so as to ensure consistent strength, and hardness characteristics. When tether is installed in the cap, the cap must be free-spinning within the tether; binding or other condition that prevents free-spinning is not acceptable for threaded cap. For snap-on cap tether must not interfere with installation or removal.

3.2.1.3 Leakage.

3.2.1.3.1 When tested per 4.3.3, a complete test fixture assembly must not exceed a leak rate equivalent to 0.5 g/year of R134a or R1234yf refrigerant when evaluated without a threaded or snap-on cap.

3.2.1.3.2 When tested per 4.3.3, a complete test fixture assembly must not exceed a leak rate equivalent to 0.1 g/year of R134a or R1234yf refrigerant when evaluated with a threaded or snap-on cap.

3.2.1.3.3 When testing per 4.3.3, a complete test fixture assembly must not exceed a leak rate equivalent to 1.0 g/year of R134a or R1234yf refrigerant when evaluating a threaded or snap-on cap, the testing is without valve core, just use the cap and valve housing.

3.2.1.4 Cleanliness. When tested per 4.3.4, the A/C charge, service, switch port valve assemblies, threaded cap and snap-on cap shall have no more than 1 mg of foreign material per assembly as evidenced by debris captured in the dried filter element. Size of the contaminants shall not exceed 0.2 mm in any dimension for contaminants with a Hardness Brinell < 95 and 0.05 mm maximum with Hardness Brinell > 95.

3.2.1.5 Moisture. Moisture content in A/C charge, service and switch port valve assemblies and threaded caps shall not exceed 5 mg when tested per 4.3.5.

3.2.1.6 Thermal Cycle. When tested per 4.3.6, the following requirements shall be met.

3.2.1.6.1 Maximum allowable leakage is 1.0 g total of specified refrigerant (see Note in 3.3.1.1.3), when evaluated without threaded or snap-on cap.

3.2.1.6.2 Maximum allowable loss of torque shall not exceed 30% of the initial torque.

3.2.1.6.3 A/C charge, service and switch port valve assemblies appearance must meet 3.2.1.2 and be considered as re-useable.

3.2.1.7 Heat Age. When tested per 4.3.7, the following requirements shall be met.

3.2.1.7.1 Maximum allowable leakage is 0.5 g total of specified refrigerant (see Note in 3.3.1.1.3), when evaluated without threaded or snap-on cap.

3.2.1.7.2 Maximum allowable loss of torque shall not exceed 30% of the initial torque.

3.2.1.7.3 A/C charge, service and switch port valve assemblies appearance must meet 3.2.1.2 and be considered as re-useable.

3.2.1.8 Cold Age. When tested per 4.3.8, the following requirements shall be met.

3.2.1.8.1 Maximum allowable leakage is 0.5 g total of specified refrigerant (see Note in 3.3.1.1.3) when evaluated without threaded or snap-on cap.

3.2.1.8.2 Maximum allowable loss of torque shall not exceed 30% of the initial torque.

3.2.1.8.3 A/C charge, service and switch port valve assemblies appearance must meet 3.2.1.2 and be considered as re-useable.

3.2.1.9 Vibration. When tested per 4.3.9, the following requirements shall be met.

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3.2.1.9.1 Maximum allowable leakage is 0.5 g total of specified refrigerant (see Note in 3.3.1.1.3) when evaluated without threaded or snap-on cap.

3.2.1.9.2 Maximum allowable loss of torque shall not exceed 30% of the initial torque for valve core.

3.2.1.9.3 Maximum allowable loss of torque shall not exceed 30% of the initial torque for threaded cap.

3.2.1.9.4 For Snap-on cap shall remain it is placed securely attached.

3.2.1.9.5 A/C charge, service port assembly, switch port valve assembly and cap appearance must meet 3.2.1.2 and be considered as re-useable.

3.2.1.10 Pressure Resistance. When tested per 4.3.10, all valve cores shall not experience any type of failure mode such as rupture, permanent deformation or physical/functional damage.

3.2.1.11 Corrosion Resistance. When tested per 4.3.11, the following requirements shall be met:

3.2.1.11.1 The A/C charge, service and switch port valve assemblies shall meet the Underhood (UH) cosmetic corrosion and Underbody (UB) functional corrosion requirements per GMW15272; Table A1 (Underhood, High Visibility, Vehicle Technical Specification (VTS) Template Requirement Suffix G) and Table B4.

3.2.1.11.2 A maximum leak for the charge valve is 0.5 g/year following the corrosion exposure, assessed at room temperature, measured without caps.

3.2.1.12 Valve Core Depress. When tested per 4.3.12, the following requirements shall be met:

3.2.1.12.1 Maximum allowable leakage is 0.5 g/year (see Note in 3.3.1.1.3).

3.2.1.12.2 Maximum allowable loss of torque shall not exceed 30% of the initial torque.

3.2.1.12.3 A/C valve core and aluminum body valve appearance must meet 3.2.1.2 and be considered as re-useable.

3.2.1.13 Thermal Resistance for Threaded or Snap-on Caps. When tested per 4.3.13, the following requirements shall be met.

3.2.1.13.1 Maximum allowable leakage is 0.1 g/year (see Note in 3.3.1.1.3).

3.2.1.13.2 Maximum allowable loss of torque shall not exceed 30% of the initial torque. This does not apply to snap-on caps.

3.2.1.13.3 Threaded or snap-on cap appearance must meet 3.2.1.2 and be considered as re-useable.

3.2.1.14 Service Removal Safety Venting. When tested per 4.3.14, there shall be at least one full turn of thread engagement between the initial venting and full removal of the valve from the test fixture. All dimensional requirements shall be met and there shall be no indication of thread damage at completion of test. During removal of snap-on caps when pressurized, the cap must retain adherence to the charge port and not become unattached until depressurization has occurred.

3.2.1.15 Torque. When tested per 4.3.15 the following requirements shall be met:

3.2.1.15.1 Valve Cores. The valve core shall remain serviceable without damage such as visible cracks, or permanent dimensional changes.

3.2.1.15.2 Threaded Caps. Caps shall remain serviceable without permanent dimensional changes such as damaged threads nor visible cracks affecting the sealing performance.

3.2.1.16 Valve Core Shaft Opening Force. The valve core shaft opening force shall be between (1 to 5) N ((0.225 to 1.124) lbf).

3.2.1.17 Tether Resistance. When tested per 4.3.17, the tether must remain securely attached to the threaded cap without any visual damage. In addition, the cap must be free spinning within the tether.

3.2.1.18 Material.

3.2.1.18.1 Material requirements for rubber seals for Refrigerant Applications are defined in GMW14727.

3.2.1.19 Installation Force (for Non-threaded Plastic Caps). When tested per 4.3.19, the following requirements shall be met.

3.2.1.19.1 Snap-on cap appearance must meet 3.2.1.2 and be considered as re-useable.

3.2.1.19.2 Acceptance Determination. Installation force not to exceed 45 N (10 lb) or the limit specified on the applicable detail drawing, whichever is lower, for snap-on cap, if a secure feature is used, it shall not exceed 62 N (14 lb) to meet this requirement.

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3.2.1.20 Removal Force (for Non-threaded Plastic Caps). When tested per 4.3.20, the following requirements shall be met.

3.2.1.20.1 Snap-on cap appearance must meet 3.2.1.2 and be considered as re-useable.

3.2.1.20.2 Acceptance Determination. No rupture or tearing of the cap is allowable as a result of removal. Removal force must be no > 54 N (12 lb), for snap-on caps.

3.2.1.21 Rupture/Tear (for Non-threaded Plastic Caps). When tested per 4.3.21, the following requirements shall be met.

3.2.1.21.1 Snap-on cap appearance must meet 3.2.1.2 and be considered as re-useable.

3.2.1.21.2 Acceptance Determination. No rupture or tearing of the cap is allowable as a result of installation. Special attention should be given to the tear away sections of any tear-off caps during visual inspection.

3.2.2 Physical Characteristics.

3.2.2.1 Dimensions and Capacity. Not applicable.

3.2.2.2 Mass Properties. Not applicable.

3.2.3 Reliability.

3.2.3.1 Reliability Evaluation Point. This specification as written provides a test exposure representing a Reliability Evaluation Point (REP) 15 years.

GM Global Thermal Bill of Materials Family Owner (BFO) will inform the A/C charge, service and switch port valve assemblies and threaded caps supplier which number (REP) must be met.

3.2.3.2 Reliability Requirements. This specification, as written, supports demonstration of the required minimum Reliability (R) of 97% at a Confidence (C) of 50%, (R97C50).

3.2.3.3 To assess reliability, GM requires certain parameters: test life, confidence level, sample size and slope of failure distribution. Slope can be based on actual test data, data from past test results, or expected engineering distribution for the type of failure mechanism. A slope of two (2) is used as a default value for mechanical system (value from historical data).

3.2.3.4 Accelerated Test Methods. GM encourages the use of appropriate accelerated test methods, wherever possible; for example, the use of accelerated stress testing to reduce test time (see GMW8758). GM Validation Engineering shall review and accept reliability demonstration test plans prior to the supplier submitting the Analysis Development Validation (ADV) Test Plan for approval.

3.2.4 Serviceability. Not applicable.

3.2.5 User System/Subsystem/Component/Part Interface. Not applicable.

3.3 Design and Construction.

3.3.1 Materials, Processes and Parts Selection Guidelines.

3.3.1.1 Material Guidelines. Not applicable.

3.3.1.1.1 Recycling Guidelines (GMW3116). No recycling guidelines for rubber parts. Rubber cannot be recycled as material. Materials developed to this specification shall be optimized to provide maximum end-of-life cycle value utilizing the recyclability checklist and GM Recycling Design Guidelines. Recycled content shall be reported to the approving and procuring Materials Engineering Department utilizing the Recycled Content Report Form. Reference the Recyclability/Recoverability Guidelines, GMW3116.

3.3.1.1.2 Restricted and Reportable Substances for Parts. All materials supplied to this specification must comply with the requirements listed in GMW3059.

3.3.1.1.3 Material Compatibility. See 1.4 for details on fluids selected for tests. The acceptance requirements are identical for any combination of refrigerant and compressor oil.

The compatibility test shall perform one (1) time for each combination of refrigerant type and compressor oil formulation.

Note: Pre-lube with hydrocarbon based or mineral oil is NOT PERMITTED for any type of Ethylene Propylene Diene Monomer (EPDM) seal element in the A/C charge, service and switch port valve assemblies including threaded or snap-on caps.

3.3.1.2 Processes Guidelines. All production A/C charge, service and switch port valve assemblies must be manufactured with the same materials and processes used to manufacture the originally approved sample port

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valve assemblies. No change is permissible without prior written approval from the responsible GM Global Thermal Bill of Materials Family Owner (BFO).

3.3.1.2.1 Suppliers shall use Statistical Process Control (SPC) and industry best practices for all manufacturing activities. The supplier shall work with the GM Design Responsible Engineer to comprehend this requirement.

3.3.1.3 Parts Guidelines. Not applicable.

3.3.2 Design Guidelines and Constraints.

3.3.2.1 Drawing Requirements. A/C charge, service and switch port valve assemblies, threaded caps and snap-on caps supplied under this specification must conform to released drawings approved by GM Global Thermal Bill of Materials Family Owner (BFO).

3.3.3 Identification and Marking.

3.3.3.1 Supplier Identification. A/C charge, service and switch port valve assemblies, threaded caps and snap-on caps supplied under this specification must be visually identified in a manner exclusive and unique to each supplier to permit rapid identification of each respective A/C charge, service and switch port valve assemblies threaded caps and snap-on caps manufacturer. Identification methods (for example color of O-rings, metal of valve core, etc.) must be submitted to and approved by the Global Thermal BFO, such that identification methods do not affect the function and/or performance of the part.

Identification methods must be submitted to and approved by the Global Thermal BFO.

3.3.4 Workmanship. Key Product Characteristics (KPC) will be defined on the GM approved engineering drawings. The A/C charge, service and switch port valve assemblies, threaded caps and snap-on caps shall have manufacturing capability such that all dimensions are targeted at print nominal. The supplier shall submit a detailed improvement plan which describes how their manufacturing process for each part/operation shall achieve a process distribution of ± 6 sigma, which must be less than or equal to the tolerance spread as specified on the detailed drawing. The improvement plan shall be submitted to the responsible Global Thermal BFO.

3.3.5 Interchangeability. Not applicable.

3.4 Documentation. Documentation released in DV and PV tests stage shall be approved by the GM Global Thermal BFO and GM Global Thermal Validation Engineer prior to start of delivery of production level parts. Documentation submitted for material qualification shall include:

- A/C charge, service and switch port valve assemblies threaded caps and snap-on part number.
- Tool Number.
- Elastomer Batch Number.
- Elastomer Date of Molding.
- Elastomeric Material Compound Number.
- Aluminum Body and Valve Core Metal Material.
- Type and Manufacturer of Refrigerant Used for Validation Performance.
- Type and Manufacturer of Compressor Oil Used for Validation Performance.

3.4.1 Failure Mode and Effects Analysis (FMEA). Detailed design and process FMEAs shall be submitted to the GM Global Thermal BFO and GM Global Validation Engineer and FMEAs will be maintained as part of the records of the Design and Product Validation. The FMEAs shall be updated each time a design or process change occurs. FMEAs shall be submitted with the GM Production Part Approval Process (PPAP) documentation.

3.4.2 Design Validation and Product Validation. Documentation of DV and PV test reports shall be through the normal PPAP process. Any non-compliance during Design Validation or Product Validation phases must be documented and resolved before validation is considered complete.

3.4.3 Revalidation Requirements. Any change in design, function, material, manufacturing process and/or location of manufacture facility from that previously approved for production, requires revalidation, as determined by the GM Global Thermal BFO and GM Global Validation Engineer.

3.4.3.1 If not otherwise agreed to, the entire validation test shall be repeated and documented by the supplier prior to start of delivery of the modified or changed product.

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