



## **Specification for Air Conditioning Pressure Transducer - Low Side**

### **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 describes the quality, reliability, durability, and performance requirements of the solid-state air conditioning pressure sensor, herein referred to as the pressure transducer, transducer or pressure sensor, to sense refrigerant pressure in an automotive air-conditioning (A/C) system. This sensor contains an Application Specific Integrated Circuit (ASIC) as a subcomponent. The transducer shall be located on the low-pressure side of the air conditioning system. The sensor is to be used in R-134a (GM Part Number (P/N) 9985751 or equivalent) and HFO1234yf (GM P/N 9986319 or equivalent), Compressor oil (polyalkylene glycol (PAG)) type (GM P/N 12378526 or equivalent) or polyolester (POE) type (GM P/N 88862657 or equivalent). Reference SOR Appendix C for details.

**1.2 Applicability.** This standard applies for the low side pressure sensor where required.

#### **1.3 Remarks.**

**1.3.1** The pressure transducer is used to detect the operating pressure of the A/C system to determine operating conditions and many system failures.

**1.3.2** The transducer can be assembled at the manufacturing plant or be delivered as a subassembly on another component.

### **2 References**

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

#### **2.1 External Standards/Specifications.**

IATF 16949                      SAE D1703

#### **2.2 GM Standards/Specifications.**

|         |         |         |          |
|---------|---------|---------|----------|
| 9985670 | GMW3091 | GMW3116 | GMW16331 |
| 9985751 | GMW3097 | GMW3172 |          |
| GMW3059 | GMW3103 | GMW3191 |          |

#### **2.3 Additional References.**

ASTM Number 3 Oil

ASTM reference Fuel C+ Methanol

GM Harness Connector Drawing Number 12186689

GM Harness Connector Drawing Number 15344137

GM Housing Drawing Number 52458178

GM O-ring Drawing Number 25872390

GM P/N 1543537, Arizona Dust

GM P/N 9986319, see SOR Appendix C

GM P/N 12378526, see SOR Appendix C

GM P/N 88862657, see SOR Appendix C

**GM Confidential**

© Copyright 2018 General Motors Company All Rights Reserved

August 2018

Page 1 of 12



**Documents**

Document Sharing Hub

GM Pressure Transducer Drawing Number 13587698  
GM Schrader Valve Drawing Number 25872392  
Statement of Requirements (SOR) Appendix C and C2

### 3 Requirements

**3.1 System/Subsystem/Component/Part Definition.** The part shall meet all requirements specified in the document as well as meet all requirements in the released outline drawing. The pressure transducer shall transmit a voltage ratio proportional to the measured absolute pressure and the 5 V reference voltage. The pressure transducer shall interface to the A/C system through a Schrader Valve (GM Drawing Number 25872392) to the high-pressure side of the A/C system. The interface to the wiring shall be through a three-wire connector the system controller.

**Note:** Unless noted otherwise, all pressures listed are to be considered the system pressure as detected by the sensor.

**3.1.1 Appearance.** The transducer shall meet all appearance requirements stated on the outline drawing.

#### 3.1.2 Content.

**3.1.2.1 Physical Content.** The pressure transducer shall be made of a connector with three terminals, a pressure sensing element, the electronics to translate the pressure to the correct voltage, and the physical shell to hold the parts.

**3.1.2.2 Functional Content.** The pressure transducer shall translate the pressure that is read through the Schrader Valve (see 2.3) into a percentage of the reference voltage. The transducer shall operate with an A/C pressure from 0 kPa to 770 kPa absolute. The mounting position/orientation should have no influence on the electrical characteristic or tolerance of the transducer output. The controller shall determine that there is a failure if it reads voltage outside this range. The pressure transducer output voltage signal shall remain within the signal range (as defined in 3.2.1.2.1.3.1) during normal operating conditions.

#### 3.1.3 Ambient Environment.

**3.1.3.1 Outside Vehicle Ambient Temperature.** During operation of the pressure transducer, the free air temperature shall be -48 °C to 52 °C.

**3.1.3.2 Operating Temperature.** The pressure transducer shall operate normally from -40 °C to 135 °C. The pressure transducer shall operate normally at 140 °C for at least 15 minutes without damage or loss of function.

**3.1.3.3 Storage Temperature.** The pressure transducer shall operate normally after being stored in temperatures from -40 °C to 155 °C.

**3.1.3.4 Relative Humidity (RH).** The pressure transducer shall operate from 0% RH to 100% RH.

**3.1.3.5 Altitude.** The pressure transducer shall operate at any altitude with 0.0% shift due to altitude in a sealed A/C system.

**3.1.3.6 Dust.** The pressure transducer shall operate normally after being exposed to "Arizona Dust" (GM P/N 1543537) for 24 h installed on an A/C line with the electrical connector in place.

**3.1.3.7 Fluid Compatibility.** The pressure transducer shall not be affected (detectable changes to the sensor and its interfaces) by reasonable exposure to (per test procedure) any of the following automobile fluids:

- ASTM Number 3 oil
- ASTM reference Fuel C + Methanol, 15% by volume
- Current GM automatic transmission fluid (ATF)
- SAE D1703 Brake Fluid
- Windshield washer solvent (reference GM Optikleen® 9985670)
- Saturated salt water solution
- Gasoline
- Diesel Fuel
- Battery Acid

**GM Confidential**

© Copyright 2018 General Motors Company All Rights Reserved

August 2018

Page 2 of 12

**Documents**  
Document Sharing Hub

### 3.1.4 Interfaces.

**3.1.4.1 A/C Port Interface.** The pressure transducer shall be installed to the A/C system with a M12 × 1.5 female thread and depressor for a Schrader Valve (see 2.3).

### 3.1.4.2 Electrical Interfaces.

**3.1.4.2.1 Electrical Connector.** The pressure transducer shall be a three-pin connector as shown on the outline drawing. The pressure transducer electrical connector shall be designed to mate with different harness connector including Packard Connectors: GM P/N 12186689, GM P/N 15344137, and their equivalent.

**3.1.5 Usage Definition.** The transducer shall be used on all vehicles with an R-134a and HFO-1234yf refrigerant A/C system that are Powertrain Platform Electrical Interface (PPEI) compliant.

## 3.2 Product Characteristics.

### 3.2.1 Performance Requirements.

**3.2.1.1 Pressure Requirements.** The pressure transducer shall function under the following pressure requirements.

**3.2.1.1.1 Operating Pressure Range.** The normal operating pressure for the transducer shall be between 155 kPa and 760 kPa absolute.

- Excursions to 0 kPa absolute are experienced during system evacuations
- Excursions to 770 kPa absolute can be expected under certain operating conditions

**3.2.1.1.2 Maximum Pressure Range.** The pressure transducer shall not be damaged (it will meet all requirements after exposure) when subjected to pressures between 0 kPa and 2200 kPa absolute. This shall be confirmed by testing the sensors for ten cycles of alternating from 0 kPa to 2200 kPa for 60 s at each pressure.

**3.2.1.1.3 Ambient (Barometric) Pressure.** The pressure transducer output shall be unaffected, allowed error of 0.0% by change in barometric pressure such as changes in altitude or seasonal variation. This shall be confirmed by placing the transducer in a chamber and changing the ambient pressure from 100 kPa to 76 kPa and holding each pressure for 5 minutes.

**Note:** The sensor shall be mounted in a closed loop system. The electronics shall not be influenced by the ambient changes.

**3.2.1.1.4 Pressure Life Cycling.** The pressure transducer shall withstand 2 000 000 full scale normal operating pressure cycles (range as defined in 3.2.1.1.1), while simultaneously being thermal cycled from 0 °C to 135 °C at 3 to 5 cycles per day to complete a minimum of 200 thermal cycles. At the end of cycle, the pressure transducer shall meet all electrical, output signals, leakage, and burst test requirements.

**3.2.1.1.5 Proof Pressure Cycling.** The pressure transducer shall withstand 1000 proof pressure cycles from 100 kPa to 2200 kPa absolute, holding the 2200 kPa for 30 s each time. At the end of cycle, the pressure transducer shall meet all electrical, output signals, leakage, and burst test requirements.

**3.2.1.1.6 Long Term Pressure Cycling Reliability.** The pressure transducer shall maintain the requirements of the output signal, leakage, and burst test requirements during and after a transducer is tested to one of the following two conditions in 3.2.1.1.6.1 or 3.2.1.1.6.2. The pressure sensor shall maintain the requirements of the output signal, leakage, and burst test requirements during and after the tests. After successful completion, parts shall be continued on process to failure. Weibull analysis shall be performed and then be submitted to the GM Lead Engineer and Validation Engineer.

**3.2.1.1.6.1** The pressure transducer shall be tested a minimum of 20 000 000 pressure cycles from 100 kPa to 800 kPa absolute at an ambient temperature between 16 °C and 35 °C.

**3.2.1.1.6.2** The pressure transducer shall be tested a minimum of 12 000 000 pressure cycles from 100 kPa to 800 kPa absolute at an ambient temperature of 135 °C.

**3.2.1.1.7 Burst Pressure.** The pressure transducer shall not rupture or show signs of leakage when subjected to a pressure of 3500 kPa absolute for 30 s at 135 °C. The transducer need not operate after this condition, but shall meet the leak requirements (see 3.2.1.2.6.4).

## GM Confidential

© Copyright 2018 General Motors Company All Rights Reserved

August 2018

Page 3 of 12



Documents

Document Sharing Hub

**3.2.1.2 Electrical Performance.****3.2.1.2.1 Output Signal.**

**3.2.1.2.1.1 Transfer Function.** The pressure transducer calibration shall meet the following transfer function, within the allowable error defined in Appendix A, Figure A1, for all new and end-of-life parts:

$$V_{out} = V_{cc} \times [0.001446 \times P - 0.14796]$$

Where:

- $V_{out}$  = Signal Output Voltage (V)  
 $V_{cc}$  = Reference Voltage (V)  
 $P$  = Pressure (kilopascal(s) (kPa) absolute)

- The pressure sensor shall show compliance to the transfer function (within allowable error) when tested at 25 °C ambient. The transducer shall be initially tested at the following points in air, refrigerant, PAG oil and 95% refrigerant/5% PAG oil mix.

Container Pressures

|         |         |         |
|---------|---------|---------|
| 100 kPa | 150 kPa | 200 kPa |
| 250 kPa | 300 kPa | 350 kPa |
| 400 kPa | 450 kPa | 500 kPa |
| 550 kPa | 600 kPa | 650 kPa |
| 700 kPa | 750 kPa |         |

- Additional transfer function testing shall be at 250 kPa and 600 kPa using only one medium.

**3.2.1.2.1.1.1 Pressure-Voltage Output Characteristic.** Apply pressure transducer tolerances and applicable subsystem tolerances to the pressure-voltage transfer function to define the minimum and maximum output voltage, percent output ( $V_{out}/V_{cc}$ ) and output equivalent pressure (pressure error). Supplier shall fill-in and submit Table 1.

**Table 1: Pressure-Voltage Output Characteristic Tolerance Stack-up**

| Transfer Function |                      | Output Voltage $V_{out}$ (V) |             |             | Output P-V Characteristic         |                                   |
|-------------------|----------------------|------------------------------|-------------|-------------|-----------------------------------|-----------------------------------|
| Sensed P (kPa)    | Output $V_{out}$ (V) | Minimum (V)                  | Nominal (V) | Maximum (V) | Minimum Output Equivalent P (kPa) | Maximum Output Equivalent P (kPa) |
| Low Rail          |                      |                              |             |             |                                   |                                   |
| 155               |                      |                              |             |             |                                   |                                   |
|                   |                      |                              |             |             |                                   |                                   |
|                   |                      |                              |             |             |                                   |                                   |
| 760               |                      |                              |             |             |                                   |                                   |
| High Rail         |                      |                              |             |             |                                   |                                   |

**GM Confidential**

© Copyright 2018 General Motors Company All Rights Reserved

August 2018

Page 4 of 12



**Documents**

Document Sharing Hub