



Coolant Joint Pressure Vibration Temperature (PVT) Cycle Test

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. 该测试的目的是评估发动机冷却剂软管连接的密封能力，并通过对冷却剂软管及其附件进行热老化过程和压力、运动/振动循环来评估各个部件的连接。

1.1 Purpose. The purpose of this test is to evaluate the sealing capability of engine coolant hose connections and evaluate individual components of the hose connections by subjecting coolant hoses and their attachments to a thermal aging process and a pressure and motion/vibration cycle.

1.2 Applicability. This test is applicable to all vehicles and trucks utilizing glycol/water cooled internal combustion engines.

1.3 Remarks. Not applicable.

2 References

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

2.1 External Standards/Specifications.

None

2.2 GM Standards/Specifications.

GMW14870 (ID)

GMW16295

本标准仅限于通用汽车公司内部的发行，不得在公司以外发行。请与总工程师联系以获得进一步的指示

Note: (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.

- GM Materials and Processes – General, Coolant Hose, Applicable Material Specification, and Interior Cleanliness.
- GM Part Number (PN) 9985809, dexcool® Extended Life Engine Coolant.
- Pressure Vibration Temperature (PVT) User's Manual.
- PVT chamber drawing.
- Test Plan.
- Test Work Order, Activity Request (AR), or equivalent local authorizing documentation.

3 Resources

3.1 Facilities.

3.1.1 Calibration. The test facilities and equipment shall be in good working order and shall have a valid calibration label.

3.1.2 Alternatives. Alternative test facilities and equipment may also be used. However, all measuring variables as specified in this standard shall be determined correctly with respect to their physical definition.

3.1.3 A complete Pressure Vibration Temperature (PVT) facility to enclose the coolant joints and related fixturing.

The facility will include but is not limited to the following. 一个完整的压力-振动温度(P-V-T)设备，以包围冷却剂接头和相关的固定机器将包括但不限于

3.1.3.1 An environmental chamber capable of maintaining operating temperatures ranging from $-40\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ to $+121\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$ ($-40\text{ }^{\circ}\text{F} \pm 3\text{ }^{\circ}\text{F}$ to $+250\text{ }^{\circ}\text{F} \pm 3\text{ }^{\circ}\text{F}$). 一个环境箱，能够满足工作温度从 $-40\sim 121 \pm 2\text{ }^{\circ}\text{C}$ ($-40\sim 250 \pm 3\text{ }^{\circ}\text{F}$)。

3.1.3.2 A motion/vibration inducing system capable of ± 1.27 cm (± 0.5 in) displacement at a frequency of 60 cycles per minute. Displacement capability of up to ± 2.54 cm (± 1.0 in) or more is suggested to support exploratory testing. See Appendix D, Figure D1. 一套振动系统, 振幅 $\pm 12.7\text{mm}$ ($\pm 0.5\text{in}$), 建议振动系统振幅 $\pm 25.4\text{mm}$ ($\pm 2\text{in}$) 频率1Hz, (详见附录D, 图D1)

3.1.3.3 A variable displacement coolant circulation pump capable of flowing coolant through the hoses at a rate of 11.3 L/minute to 19.0 L/minute (2.98 gal/minute to 5.0 gal/minute) at room temperature. 一种可变排量冷却剂循环泵, 能够使冷却剂在室温下以11.3至19L/min(3.0至5.0GPM)的流量通过软管

3.1.3.4 A pressurization system capable of pressurizing the coolant to 0 kPa, 105 kPa, and 210 kPa with an allowable tolerance of ± 3.44 kPa for each stage (0 psig, 15 psig, and 30 psig with an allowable tolerance for each stage of ± 0.5 psig), at a rate of 8 kPa/s (1 psig/s) at ambient temperature. 一套压力系统能够在环境温度下, 将冷却剂以8kPa/s的升压速率将介质加压到0、105、210kPa(0、15和30psig), $\pm 0.5\text{psig}$

3.1.3.5 A coolant heater capable of heating the coolant to a maximum of $+121^\circ\text{C} \pm 2^\circ\text{C}$ ($+250^\circ\text{F} \pm 3^\circ\text{F}$).

3.1.3.6 An operating system (automatic or manual), with instrumentation, to control the test parameters listed from 3.1.3 thru 3.1.3.5. 3.1.1.5 一套介质加热器, 能够将冷却剂加热到最大 $121 \pm 2^\circ\text{C}$ ($250 \pm 3^\circ\text{F}$). 3.1.1.6 一套带仪表显示的操作系统 (自动或手动) 以控制上面列出的测试参数

3.2 Equipment.

3.2.1 Instrumentation.

No additional instrumentation required unless specified/indicated on Test Work Order (TWO), Activity Request (AR) or Test Plan.

Note: Instrumentation is to be calibrated per laboratory standard practice.

3.2.2 Test Equipment.

3.2.2.1 Torquing Device. A pneumatic or electric torquing tool with microprocessor-based torque/angle controller monitor, having a power rating of 0.25 kW ($\frac{1}{3}$ hp) or less, with free speed not to exceed 350 rpm. Optional: A digital hand torque wrench.

3.2.3 Fixturing. Miscellaneous fixturing, fasteners, manifolds, and other mounting provisions to accommodate the test material. 测试材料包括重现/模拟车内安装所需的所有软管和附件

3.3 Test Vehicle/Test Piece. Test material includes all hoses and attachments required to recreate/simulate in-vehicle installation. 完整的软管或软管组件, 包括夹子和/或快速连接。对于验证测试, 这些软管应由软管供应商提供经过认证的软管, 除非要求工程师另有规定。对于开发测试, 提出要求的工程师应该说明软管要求/允许的条件

3.3.1 Hoses/Assemblies. Complete hoses or hose assemblies including clamps and/or quick connects. For Validation testing, these shall be certified hoses provided by the hose supplier, unless otherwise specified by the Requesting Engineer. For Development testing, the Requesting Engineer shall specify hose conditions required/allowed.

3.3.2 Attachments. All attaching hardware, including retaining clips, brackets, etc., which constrain hose movement.

3.3.3 Fittings. One set of fittings for each hose/assembly to be tested simultaneously in the chamber, plus one additional set for Installation Force measurement. A set of fittings is comprised of one production fitting (or production representative fitting for each free end of the hose/assembly).

3.3.4 Coolant. To reduce the formation of steam, coolant mixture shall be 85% ethylene glycol per 9985809 and 15% distilled water by volume. 冷却剂组成: 85%的乙二醇和15%的水

3.3.5 Lubricant. Some fittings may require lubrication, per direction from test requestor. If required, apply lubricant specified by test requestor, approximately six (6) ml per fitting. Record lubricant part number in PVT Daily Test Log (Appendix B, Data Sheet B1). 时间取决于可以同时测试的样本数量。要求测试的样品数量应符合GMW16295的可靠性评估点(REP)标准, 威布尔的细节应与GM验证工程师核对, 下一个持续时间按测试的零件编号(PN)列出

3.4 Test Time. Times are dependent on the number of samples which can be tested simultaneously. The number of requested samples to test shall match the Reliability Evaluation Point (REP) criteria by GMW16295, the details about the Weibull shall be checked with the GM Validation Engineer, the next duration timing is listed per Part Number (PN) tested:

The following estimates are for a minimum of two (2) samples and maximum of six (6) samples.

Calendar time: 2.5 days (typical per PN). 总时间2.5天

Test hours: 55.8 h per PN. 测试时间55.8h

Coordination hours: Not applicable.

3.5 Test Required Information.

3.5.1 Test Work Order, Activity Request (AR), or equivalent local authorizing documentation.

3.5.2 Test Log Data, both manual and digital. (Appendix B)

3.5.3 Validation Test and Vehicle Review form. (See Appendix B, Data Sheet B2)

3.5.4 Hose assembly part numbers and installation layouts clearly describing the X, Y, Z mounting locations of all fittings, hoses, clips and brackets, as required. (See Appendix C.)

3.5.5 Test Plan. Provide a plan, including purpose/scope of test, material availability date, required completion date, etc., per local requirements.

3.5.6 PVT User's Manual.

3.6 Personnel/Skills. Not applicable.

4 Procedure

4.1 Preparation. 准备工作

4.1.1 Documentation. Procure the reference documents specified in 3.5. Record test information and test type, Test Work Order/Activity Request /Task Number, dates, sample part numbers, etc.

4.1.2 Facility Preparation. Procure the test facility as defined in 3.1.

Note: Refer to Test Plan to confirm motion/vibration displacement.

4.1.3 Equipment Preparation. Procure the test equipment, instrumentation, and fixturing described in 3.2.

4.1.4 Test Setup.

4.1.4.1 Review PVT User's Manual for system operation.

4.1.4.2 Number all hose test samples in sequential order and label each joint which is "on test", according to its fitting type, (e.g., engine, radiator, heater, surge tank, etc.) For example: The radiator connection of hose No. 1 would be labeled R1, engine connection E1, etc.

4.1.4.3 Measure fittings, hoses, and installation force, per GMW14870 and document results. This information will be helpful for root cause determination in the event of a leak, blow off or installation effort concern.

4.1.4.4 Install the test sample(s) on the test frame per installation assembly layout, (i.e., orientation of clamps and hoses). Installation of the hoses shall match the in-vehicle mounting dimensions and orientation. Any deviation from the installation assembly layout must be approved by the Requesting Engineer and/or Validation Engineer.

4.1.4.5 Typically, more than one hose assembly is tested in the chamber at the same time. Document the location of each hose assembly, relative to the other hoses in the chamber (i.e., top or bottom, front or rear position). Also, document the position of drip sensors (S1, S2, S3, S4, etc.)

4.1.4.6 If required, torque hose screw clamps to the desired torques (or torque ranges) using one of the tools defined in 3.2.2. Record the torque values obtained. If using a tool requiring rpm monitoring, also record actual tool speed.

Note that constant tension spring band hose clamps do not require any torquing.

4.1.4.7 If alignment marks are not present, create an "index" at the end of each hose after the clamps have been set/torqued. Use a permanent marker to draw a straight line the along the axis of the hose, from the clamp to the end of the hose and onto the fitting. The intent is to provide a reference to determine if the hose moves and how much. Do not use a scribe or any other marking device which could scratch or otherwise damage the surface of the hose or clamp.

4.2 Conditions.

4.2.1 Environmental Conditions.

4.2.2 Test Conditions. Deviations from the requirements of this standard shall have been agreed upon. Such requirements shall be specified on component drawings, test certificates, reports, etc.

Deviations from the requirements shall have been agreed upon by the Requesting Engineer and Validation Engineer before starting the test. Deviations shall be specified on component drawings, test certificates, reports, etc.

试验应在3.1.3中定义的已知条件下进行,将温度保持在1.6 °C (3 °F)以内,或根据设计规范的要求进行

4.2.2.1 Test Tolerances. Tests shall be conducted under known conditions as defined in 3.1.3, maintaining temperature within ± 1.6 °C (± 3 °F), or according to the design specification requirements.

4.2.2.1.1 Instrumentation shall be calibrated as required. Record date of calibration on facility test data sheet or PVT Daily Test Log.

测试设置和设备应能够保持测试参数(如负载、角度、温度等)在设计规范规定的范围内。

4.2.2.1.2 Test setup and equipment shall be capable of maintaining test parameters (e.g., load, angles, temperature, etc.) within the limits outlined by the design specifications.

4.2.3 Sample Size. Validation Test – six (6) samples or per Validation Engineer's request. 试件路数：6路

4.2.4 Performance Objectives. Performance objectives are as provided by the Test Plan.

4.2.5 Test Criteria. The following joint conditions are acceptable: 下列联合条件是可接受的

4.2.5.1 Permissible Hose Movement. Movement of the hose to the point where the clamps are up against the blow off bead, or the actual hose movement is less than that specified by the Validation Engineer and/or as indicated in the Test Plan. 允许软管运动：

4.2.5.2 Acceptable Leak Rate. See Table 1. 允许泄漏见表1

Table 1: PVT Cycle Segments PVT周期段

Segment Number	Temperature Range	PVT Test Criterion for Acceptance 验证接受标准
1	-40 °C to -36 °C (-40 °F to -32 °F)	Seepage Acceptable 允许泄漏
1	-36 °C to 0 °C (-32 °F to +32 °F)	0 drops
1	0 °C to +121 °C (+32 °F to +250 °F)	0 drops
2	+121 °C (+250 °F)	0 drops
3	+121 °C to +104 °C (+250 °F to +220 °F)	0 drops
4	+104 °C (+220 °F)	0 drops
5	+104 °C to 0 °C (+220 °F to +32 °F)	0 drops
5	0 °C to -36 °C (+32 °F to -32 °F)	0 drops
5	-36 °C to -40 °C (-32 °F to -40 °F)	Seepage Acceptable
6	-40 °C (-40 °F)	Seepage Acceptable
7	-40 °C (-40 °F)	Seepage Acceptable

4.3 Instructions.

4.3.1 Procedure.

4.3.1.1 Prior to testing, visually inspect all hoses for evidence of bloom, cuts/damage or residual oils or other residue from the manufacturing process. Record all observations. Discard any hoses that appear to be damaged and are not good candidates for use.

4.3.1.2 Pressure check the system and setup. Start the system with air regulators set at 105 kPa and 210 kPa (15 psig and 30 psig). An orifice or flow control valve in the main pressure line will allow for the following test pulse profile at ambient conditions: 检查系统并进行安装。启动系统时，将空气调节器设置为1.05 kPa和210 kPa (15 psig和30 psig)。在环境条件下，主压力管线上的孔板或流量控制阀可以实现以下测试脉冲曲线

- System pressure: 0 kPa to 105 kPa (0 psig to 15 psig) in 15 s. 系统压力：15秒内0到105kPa
- 105 kPa (15 psig) stabilized for 15 s. 105kPa 稳压15s
- 105 kPa to 210 kPa (15 psig to 30 psig) in 15 s. 15秒内压力从105kpa 升压到210kpa
- 210 kPa (30 psig) stabilized for 15 s. 210kpa保压15s
- Total Time: 1 minute. 总时间1分钟

梯形波

4.3.1.3 Examine the test setup for any of the following: 检查以下任何一项的测试设置

- Coolant leakage or seepage: Report pressure setting and amount of leakage (in drops per second). 冷却剂泄漏或渗出：报告压力设定和泄漏量 (以滴/秒计)
 - Hose movement: Report approximate amount of hose displacement (in millimeters). 软管运动：报告软管位移的大致数量 (毫米)
 - Separation of hose from fitting: Report hose and location where separation occurred. 软管与配件的分离：报告软管和发生分离的位置
- Note:** Flare at hose end due to clamp compression is permissible.
- Any other areas of potential concern.

4.3.1.4 Review pressure check results with Test Engineer.

Note: If any parts are replaced or repaired, the pressure check described in 4.3.1.2 must be repeated. 如果任何部件被更换/修理, 必须重复4.3.1.2节中描述的压力检查

4.3.1.5 Begin PVT test cycling as follows (see Appendix A, Figure A1 for a graphical representation of the profile).

开始P-V-T测试循环如下表A1

4.3.1.5.1 Segment 1. 55 minutes – Raise chamber temperature linearly from ambient to 121 °C (250 °F) and stabilize. 55分钟将室温从环境温度线性升高到121 °C (250°F)并稳定下来

- Coolant circulation pump: ON. 冷却剂循环泵:开
- System pressure: PUMP. 系统压力: 泵压
- Motion: ± 1.27 cm (± 0.5 in) at 60 cycles per minute. 振动: 1hz, 振幅 ± 1.27 cm
- Coolant heater: ON. 冷却剂加热: 开

4.3.1.5.2 Segment 2. 89 minutes – Maintain chamber temperature at 121 °C (250 °F) while pressure cycling at 210 kPa (30 psig) for 0.5 minute and 105 kPa (15 psig) for 0.5 minute. 89分钟, 保持室温在121 °C (250 °F), 压力循环在210 kPa (30 psig) 0.5分钟和105 kPa (15 psig) 0.5分钟。

- Coolant circulation pump: ON. 冷却剂循环泵: 开
- System pressure: 210 kPa and 105 kPa (30 psig and 15 psig). 系统压力: 210KPa和105KPa
- Motion: ± 1.27 cm (± 0.5 in) at 60 cycles per minute. 振动: 1hz, 振幅 ± 1.27 cm

- Coolant heater: ON increasing coolant temperature linearly to 120 °C and stabilize. 冷却剂加热器: 可将冷却剂温度直线升高至120 °C并稳定运行

4.3.1.5.3 Segment 3. 25 minutes – Reduce chamber temperature linearly from +121 °C to +104 °C (+250 °F to +220 °F) and stabilize. 降环境温度由121 °C 降到104 °C, 并保持25min

- Coolant circulation pump: ON. 冷却剂循环: 开
- System pressure: PUMP. 系统压力: 泵压
- Motion: ± 1.27 cm (± 0.5 in) at 60 cycles per minute. 振动: 1hz, 振幅 ± 1.27 cm
- Coolant heater: OFF. 冷却剂加热: 关

4.3.1.5.4 Segment 4. 30 minutes – Maintain chamber at +104 °C (+220 °F) while pressure cycling at 105 kPa (15 psig) for 0.5 minute and 0 kPa (0 psig) for 0.5 minute. 环境温度保持104 °C, 介质循环, 循环压力105kpa, 0kpa 各0.5min, 保持30min

- Coolant circulation pump: ON. 介质循环泵: 开
- System pressure: 105 kPa and 0 kPa (15 psig and 0 psig). 系统压力: 105kpa 0kpa
- Motion: ± 1.27 cm (0.5 in) at 60 cycles per minute. 振动: 1hz, 振幅 ± 1.27 cm
- Coolant heater: OFF. 介质加热: 关

4.3.1.5.5 Segment 5. 110 minutes – Reduce chamber temperature linearly from +104 °C to -40 °C (+220 °F to -40 °F) and stabilize. 将温度由104 °C 降低到-40 °C, 并保持110min

- Coolant circulation pump: OFF. 介质循环: 关
- System pressure: 105 kPa (15 psig). 系统压力: 105KPa
- Motion: OFF. 振动: 无
- Coolant heater: OFF. 介质加热: 无

4.3.1.5.6 Segment 6. 55 minutes – Maintain chamber at -40 °C (-40 °F). 保持环境温度-40 °C, 55分钟

- Coolant circulation pump: OFF. 介质循环: 关
- System pressure: 10 kPa (15 psig). 系统压力: 10kpa
- Motion: OFF. 振动: 无
- Coolant heater: OFF. 介质加热: 无

Note: Soak period will be dependent upon ramp rate of Segment 5. 浸泡时间将取决于第5段的斜坡率

4.3.1.5.7. Segment 7. 30 minutes – Maintain chamber at -40 °C (-40 °F). 保持环境温度-40 °C 30分钟

- Coolant circulation pump: ON. 介质循环: 开
- System pressure: 105 kPa and 0 kPa (15 psig and 0 psig). 系统压力: 105kpa, 0kpa
- Motion: ± 1.27 cm (± 0.5 in) at 60 cycles per minute. 振动: 1hz, 振幅 ± 1.27 cm
- Coolant heater: ON increasing coolant temperature to 100 °C and stabilize. 介质加热: 将介质升温至100 °C 并保持

4.3.1.5.7.1 Monitor test and visually inspect for leakage, hose movement, or any other abnormalities, and record observations on the PVT Daily Test Log (Appendix B, Data Sheet B1).

4.3.1.5.7.2 Return to "Segment 1" (4.3.1.5.1) for start of next cycle (Table A1). 回到“片段1”(4.3.1.5.1)开始下一个周期(表A1)

4.3.1.6 Repeat 4.3.1.5 based on type of test specified in Test Plan, e.g., Validation Test = 10 cycles total. 重复上述试验循环共10次

4.3.1.7 After the last test cycle has been completed, or at any other intervals as described in the Test Plan, measure hose samples as specified in the Test Plan, and record findings. 在最后一个测试周期完成后,或在测试计划中描述的任何其他时间间隔,按照测试计划中的规定测量软管样品,并记录测试结果

4.3.1.8 After completion of all segments, and when test samples and chamber have stabilized to room temperature, measure and document clamp diameters and hose movement. Disassemble hoses from mating fittings, and record all subjective observations regarding ease of hose removal/hose retention to fitting. 在所有管段完成后,当测试样品和腔室稳定到室温时,测量和记录夹径和软管运动。从配套连接件上拆卸软管,并记录关于软管拆卸/软管保持在连接件上的方便性的所有主观观察结果

5 Data

5.1 Calculations. Not applicable.

5.2 Interpretation of Results. Not applicable.

5.3 Test Documentation. Record information on computer test Data Sheets (See Appendix B, Data Sheets B1 and B2).

Note: Test data is to be considered GM Confidential. Data can only be released by Fastener or Design Engineer.

5.3.1 Certified Hose: Vendor to provide the following documentation for each hose: Hose inside diameter, hose outside diameter, wall thickness, durometer reading, rubber compound and type of cure, and procedure on their detergent wash cycle. 供应商应提供每个软管的以下文件:软管内径,软管外径,壁厚,硬度计读数,橡胶化合物和固化类型,以及洗涤循环的程序。

Reference GM Materials and Processes – General, Coolant Hose, Applicable Material Specification, and Interior Cleanliness. "Inside surfaces of hose (as received) shall be free of any soap, soapstone, talc or other substance, including silicone, which could interfere with attaining a satisfactory clamping load or which could act as a lubricant resulting in unsatisfactory retention on fittings."

As part of the certification process, the hose manufacturer will indicate, in writing, that the hose Inside Diameter (ID) is free of the aforementioned substances (including bloom) and that there is nothing to interfere with obtaining satisfactory clamping load.

6 Safety

This standard may involve hazardous materials, operations, and equipment. This standard does not propose to address all the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

7 Notes

7.1 Glossary.

Bloom: A discoloration or change in appearance of the surface of a rubber product caused by the migration of a liquid or solid to the surface. Examples: Sulfur bloom, wax bloom.

Installation Force (N): Reference GMW14870. **Note:** References to torque in this procedure always refer to dynamic torque.

Joint Adhesion: Subjective rating by technician on adhesion of test hose to fitting, e.g., 0 = Poor, 5 = Good.

Note: Rating is done at the end of the PVT test and is recorded at the bottom of the PVT Daily Test Log.

Seepage: Observation on the amount of coolant that spreads or permeates at hose/fitting interface. See Appendix E, Figure E1. 观察在软管/接头界面上扩散或渗透的冷却剂的数量。参见附录E,图E1。

Segment: One (1) of the seven phases of the PVT environmental cycling profile.

Validation Test: Runs a fixed number of 10 cycles and will always use the VALIDATION procedure file.

Zone: A physical location within the environmental chamber, e.g., for PVT No. 2 chamber there is a front, middle, and rear zone. For zone locations, reference PVT chamber drawing.

7.2 Acronyms, Abbreviations, and Symbols.

AR	Activity Request
Circ	Circulation
Engr.	Engineer
GSSLT	Global Subsystem Leadership Team
ID	Inside Diameter
Min	Minute
PN	Part Number
psig	pounds per square inch (gauge)
PVT	Pressure Vibration Temperature
REP	Reliability Evaluation Point
Resp.	Responsible
rpm	revolutions per minute
Temp	Temperature
TWO	Test Work Order
UPC	Uniform Product Classification

8 Coding System

This standard shall be referenced in other documents, drawings, etc., as follows:

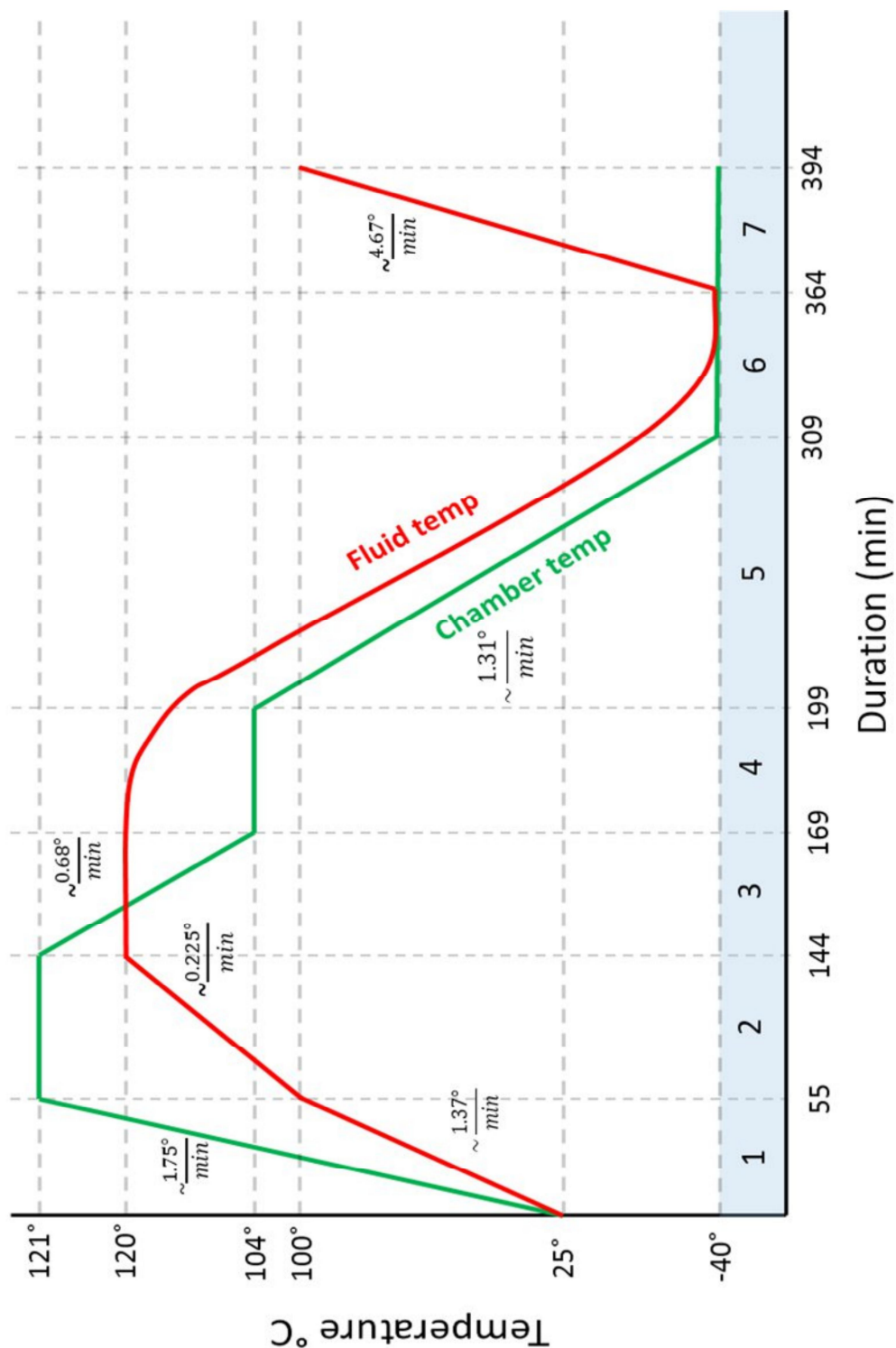
Test to GMW14785

9 Release and Revisions

This standard was originated in November 2005. It was first approved by the Plumbing Global Subsystem Leadership Team in March 2006. It was first published in March 2006.

Issue	Publication Date	Description (Organization)
1	MAR 2006	Initial publication.
2	AUG 2012	Update content for 5 Year Refresh. (Plumbing GSSLT)
3	OCT 2015	Updated content for 15 year REP. (HVAC - Coolant Plumbing Coolant Hoses)

Appendix A



Min Minute
Temp Temperature

Figure A1: PVT Cycle Profile

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Table A1: PVT Cycle

Segment	Cycle	Temperature	Motion (cycles per minute)	Circ	Coolant Heater (°C)	Pressure			
						0 kPa 0 psig	105 kPa 15 psig	210 kPa 30 psig	Alternating
1	1	Ambient to 121 °C (Ambient to 250 °F)	60	ON	100	ON			
1	> 1	-40 °C to 121 °C (-40 °F to 250 °F)	60	ON	100	ON			
2	ALL	121 °C (250 °F)	60	ON	120		ON	ON	ON
3	ALL	121 °C to 104 °C (250 °F to 220 °F)	60	ON	OFF	ON			
4	ALL	104 °C (220 °F)	60	ON	OFF	ON	ON		ON
5	ALL	104 °C to -40 °C (220 °F to -40 °F)	0		OFF		ON		
6	ALL	-40 °C (-40 °F)	0		OFF		ON		
7	ALL	-40 °C (-40 °F)	60	ON	100	ON	ON		ON

Circ = Circulation

Data Sheet B1: PVT Daily Test Log (see Table B1 for Completed Example)[illegible]

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Table B1: Data Sheet B1: PVT Daily Test Log (Completed Example)

Task /Sequence Number.		Test Title						Design Engineer			
NNNNN/SSSSS		Program XXXXX Hose Material Change Evaluation						Jeff Despard			
Machine Number:		Test Number:		Procedure Number:		Test Engineer		Technician			
PVT-3		XXXXXX		GMW14785		P. W. Tobakos		Dennis Welker			
Preheat: No preheat											
Sample Numbers		S1	L1	S2	L2	S3	L3				
Special Instructions:											
DRIP SENSOR LOCATION 1 = S1, 2 = L1, 3 = S2, 4 = L2											
Date	Time	Cycle	Minutes	Comments						Initial	
DDMMYY				Received Hoses						DJW	
DDMMYY				Measured Hoses						DJW	
DDMMYY	0955			Test Setup Complete						DJW	
				No Wax On Clamps, No Preheat Cycle						"	
DDMMYY	1250	1	0	Begin PVT Schedule GMW14785 for 10 Automatic Cycles						"	
	1446	1	116	Sensors OK Chamber Temperature @ 220 °F, Pressure = 0 psi						"	
DDMMYY	0612	4	36	Sensors OK Chamber Temperature @ 142 °F, Pressure = 0 psi						DJW	
	1457	5	227	Sensors OK Chamber Temperature @ 22 °F, Pressure = 15 psi							
		7	61	Tray Sensor Shut Down (Condensation) Reheat and Restart						DJW	
DDMMYY	0607	7	61	Sensors OK Chamber Temperature @ 250 °F, Pressure = 15 psi							
	1456	8	125	Sensors OK Chamber Temperature @ 216 °F, Pressure = 15 psi							
		10	335	Automatic Cycle Complete						DJW	
			Joint	S3 25.84 mm, Adhesion 5							
			Joint	L3 25.83 mm, Adhesion 5							
End of Test Measurements				Joint S1		Joint L1		Joint S2		Joint L2	
Clamp Set, Outside Diameter Before Removal				25.69 mm		25.75 mm		25.06 mm		25.58 mm	
Joint Adhesion Rating. 0 (poor), 5 (good)				5		5		5		5	
Pump Circulation Check		Cycle 1	Cycle 2	Cycle 3	Cycle 4	Cycle 5	Cycle 6	Cycle 7	Cycle 8	Cycle 9	Cycle 10

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Data Sheet B2: Validation Test and Vehicle Review

Test Task Number: _____ ☐ Validation ☐ Development ☐ Information ☐ Witness

Test Title: _____

Test Purpose: _____

_____Technical
Specification: _____

GMW Test Procedure: _____

Special Instructions: _____

_____Test Vehicle.
Number: _____Data Acquisition
Vehicle: _____Test Buck
Number: _____Test Material
Part NumberTest Material
Noun NameTest Material
Part NumberTest Material
Noun Name

The undersigned agree that the test setup, test method, test material, and when applicable, the test vehicle, data acquisition vehicle and test buck are appropriate for this test.

_____ /	_____ /	_____ /		
Test Engineer	Signature	Date	Supervisor Signature	Date
_____ /	_____ /	_____ /		
Design Resp. Engr.	Signature	Date	UPC	Part Content Description
_____ /	_____ /	_____ /		
Design Resp. Engr.	Signature	Date	UPC	Part Content Description
_____ /	_____ /	_____ /		
Design Resp. Engr.	Signature	Date	UPC	Part Content Description
_____ /	_____ /	_____ /		
Design Resp. Engr.	Signature	Date	UPC	Part Content Description

Engr. Engineer
Resp. Responsible
UPC Uniform Product Classification

Appendix C

C1 Hose Installation Requirements

In order to help the lab technician set up the test hardware as quickly and accurately as possible, several types of data are required. Until this information is provided, the PVT lab may need to make additional requests for clarification, which could delay the start of test, or they may refuse to schedule the test until all the necessary information is provided.

C1.1 Required Hardware.

- Number of samples requested should be checked with GM Validation Engineer to match the REP criteria on the GMW16295.
- Production fittings (or production representative fittings) for each end of the hose. Provide one set of fittings for each hose to be tested simultaneously in the chamber, plus one extra set for insertion force measurements.
- Production clamps/positions (and required torque/speeds, for screw type clamps) is not allowed change the position of the clamps during the test development or replace the clamps used in the hoses assemblies during the development of the test.
- Clips, brackets or other items which support or restrain the hoses.

C1.2 Required Supplemental Information. See examples shown in Figure C1 thru Figure C5.

- Overall view(s) – (photograph, drawing or other graphic) representation of the hose in its installed position (vehicular position) including fittings, clips, etc., showing how it fits in the vehicle.
- Hose assembly in at least two views (i.e., front, side, top), which show all important features.
- Fittings in at least two views showing:
 - X, Y, Z coordinates of the center point at the end of each fitting in vehicle position.
 - Straight line distance between center points of the various fittings.
 - Directional information showing the angle of the fitting axis relative to X/Y, X/Z, and/or Y/Z planes.
- Brackets and other constraining hardware.
 - X, Y, Z coordinates of the center point for each attachment hole, at the mating surface of the clip, etc., in vehicle position.
 - Diameter and cross section of each mounting hole/feature (i.e., required diameter and depth for push pins, "fir tree" fasteners, etc.)
 - Directional information showing the angle of the hole axis, relative to X/Y, X/Z, and Y/Z planes. This can be in the form of an angle shown in three standard views.
- Direction of movement. 定义应应用运动的方向(即, 在发动机最小和最大滚动条件下, 发动机配件末端的X、Y、Z坐标).
 - Define the direction in which motion should be applied (i.e., the X, Y, Z coordinates for the end of the engine fitting at the minimum and maximum engine roll conditions).

The test should be completed using only GM approved dexcool® GM PN 9985809, any deviation needs approval from the GM Validation Engineer and GM Design and Release Engineer.

Figure C1 thru Figure C5 demonstrate the information needed to do the setup.

C1.2.1 Example - Overall View. See Figure C1. 示例-整体视图。参见图C1。

Note: Points indicated on this graphic should be **end points of the fittings** and the center points of the attachment fasteners where they mate with the supporting surface.

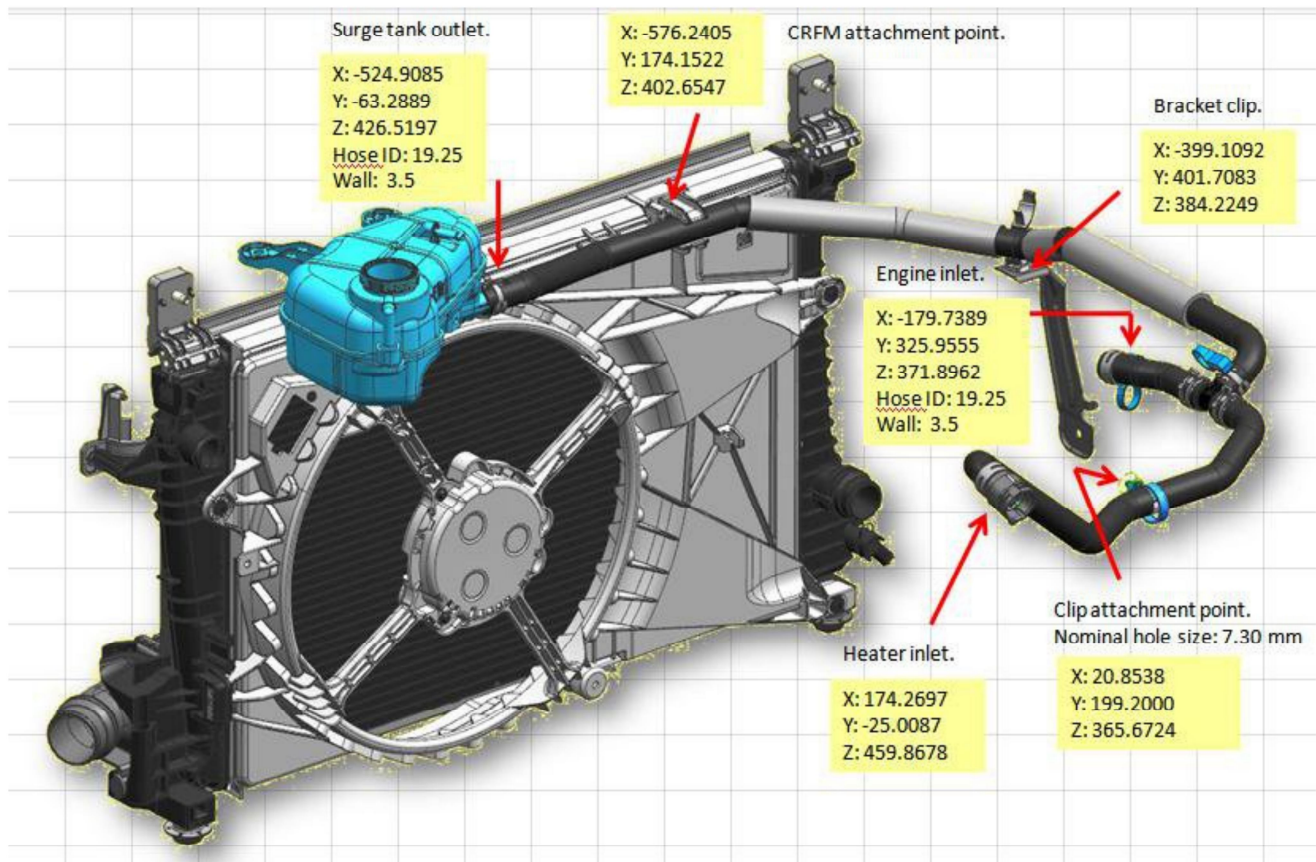


Figure C1: Example - Overall View

C1.2.2 Example - Hose Assembly with Standard Views. See Figure C2. 具有标准视图的软管总成

Include at least three views which show the hose assembly from front, side, top, and/or other views which make it clear how the hose is oriented in the vehicle and includes the hose dimensions for each end (Inside Diameter (ID) and wall thickness). This information shall be provided by the GM Design and Release Engineer.

至少包含三个视图，分别从前面、侧面、顶部和/或其他视图显示软管组件，以清楚地说明软管在车辆中的定位，并包括每个末端的软管尺寸（内径(ID)和壁厚）。这些信息应由总设计和放行工程师提供。

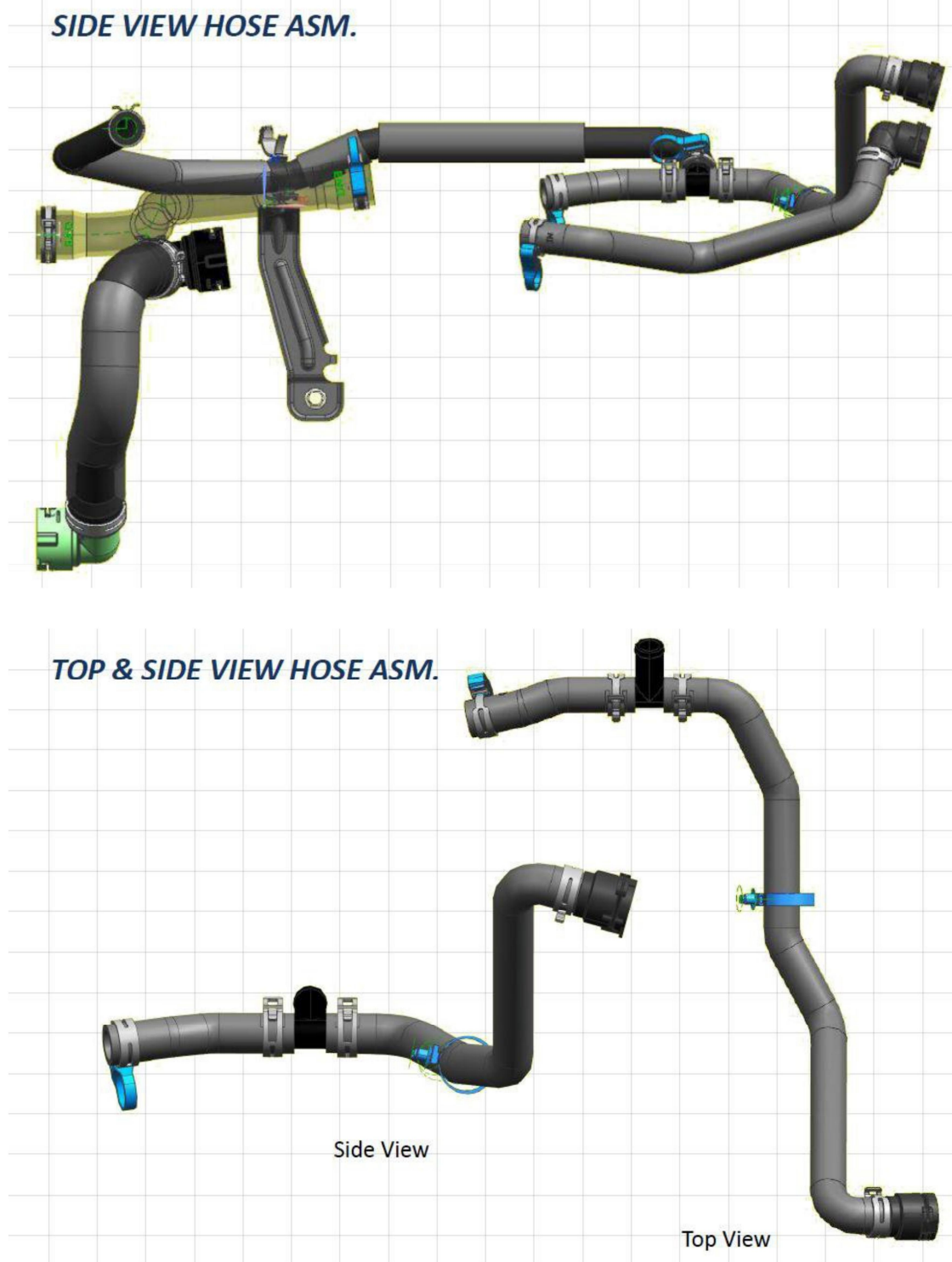


Figure C2: Example - Hose Assembly with Standard Views

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C1.2.3 Example – Hose Retention Points. See Figure C3.

Add close up views of clips and other attachment features including the X, Y, Z location with the mating surface/feature and the cross section of the mounting feature (e.g., a fir tree fastener needs a hole of a specific diameter, and a "lip" with a certain thickness to allow the fir tree feature to spread out and have a surface to hold against).

添加关闭视图的剪辑和其他附件功能包括X, Y, Z位置与啮合面/特性和越来越多的截面特性(例如,冷杉树紧固件需要一个洞的一个特定的直径,和一个“唇”一定厚度允许冷杉树特性展开和拥有一个表面)。

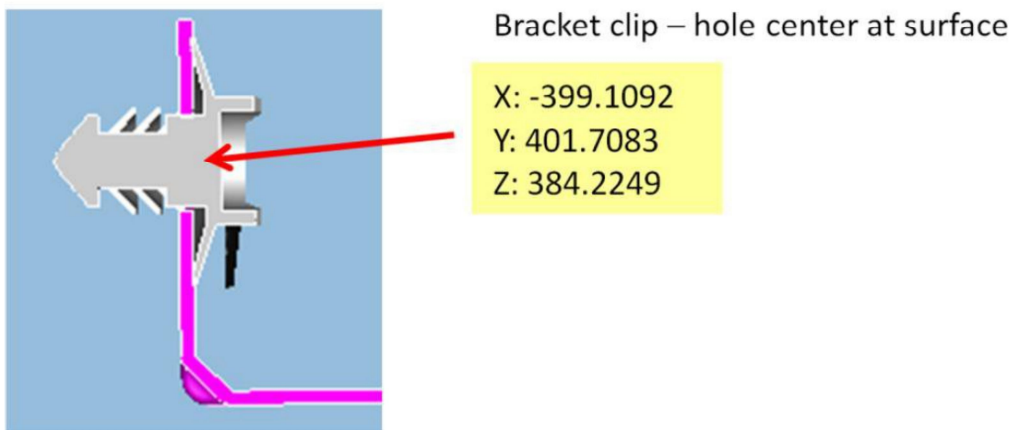


Figure C3: Example - Hose Retention Points

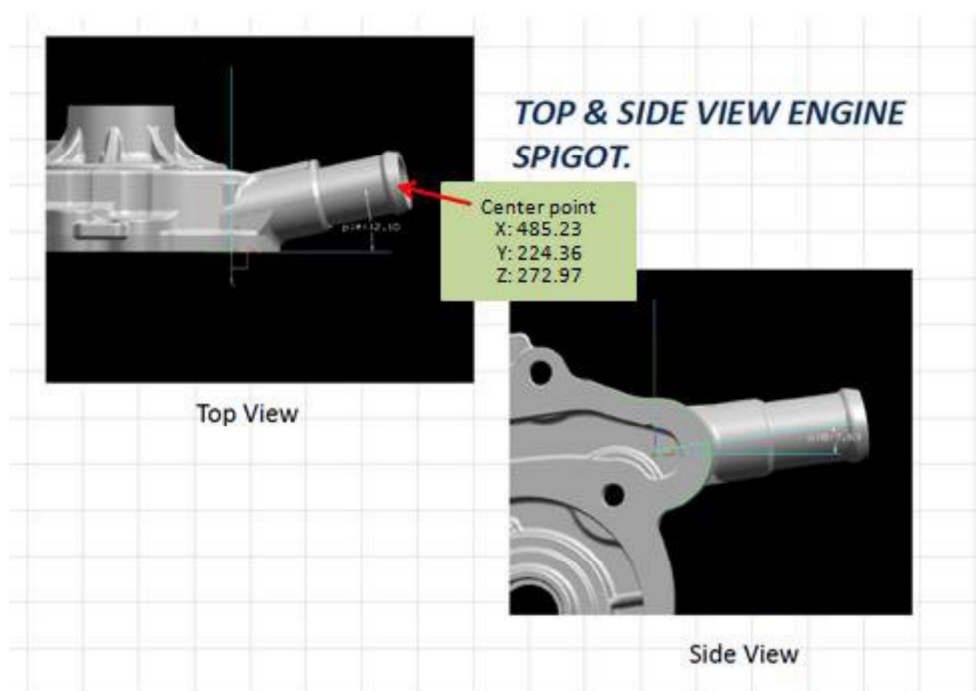
C1.2.4 Example – Fitting Details. See Figure C4 and Figure C5.

Figure C4: Example - Fitting Details

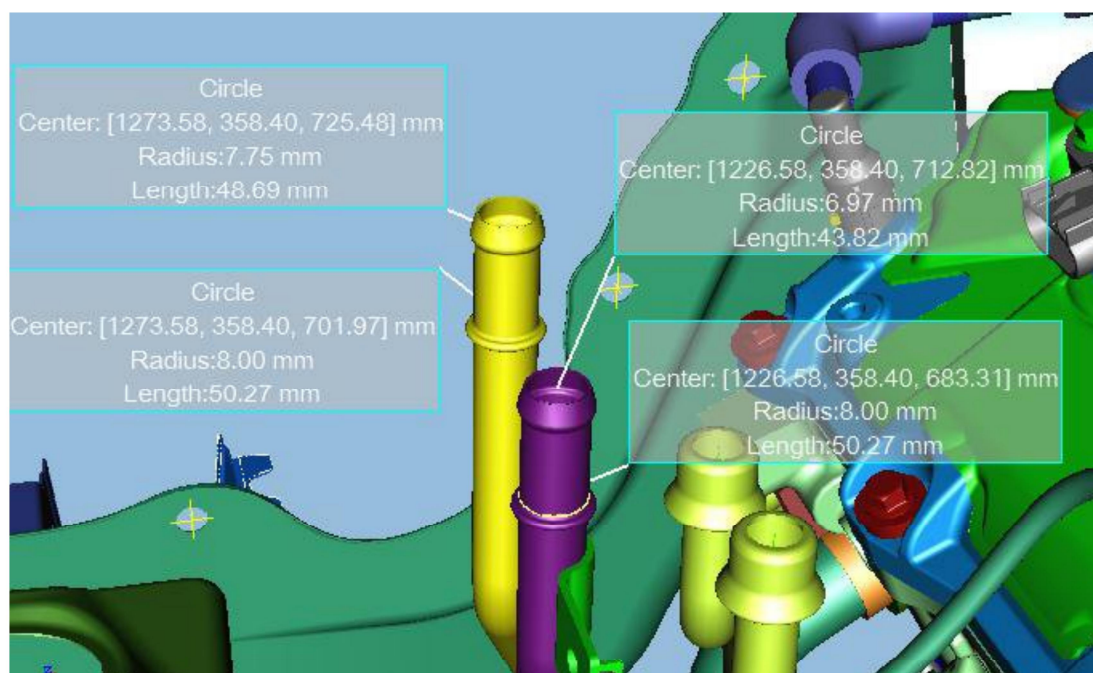


Figure C5: Fitting Details

Appendix D

Note: everything inside the yellow box moves together

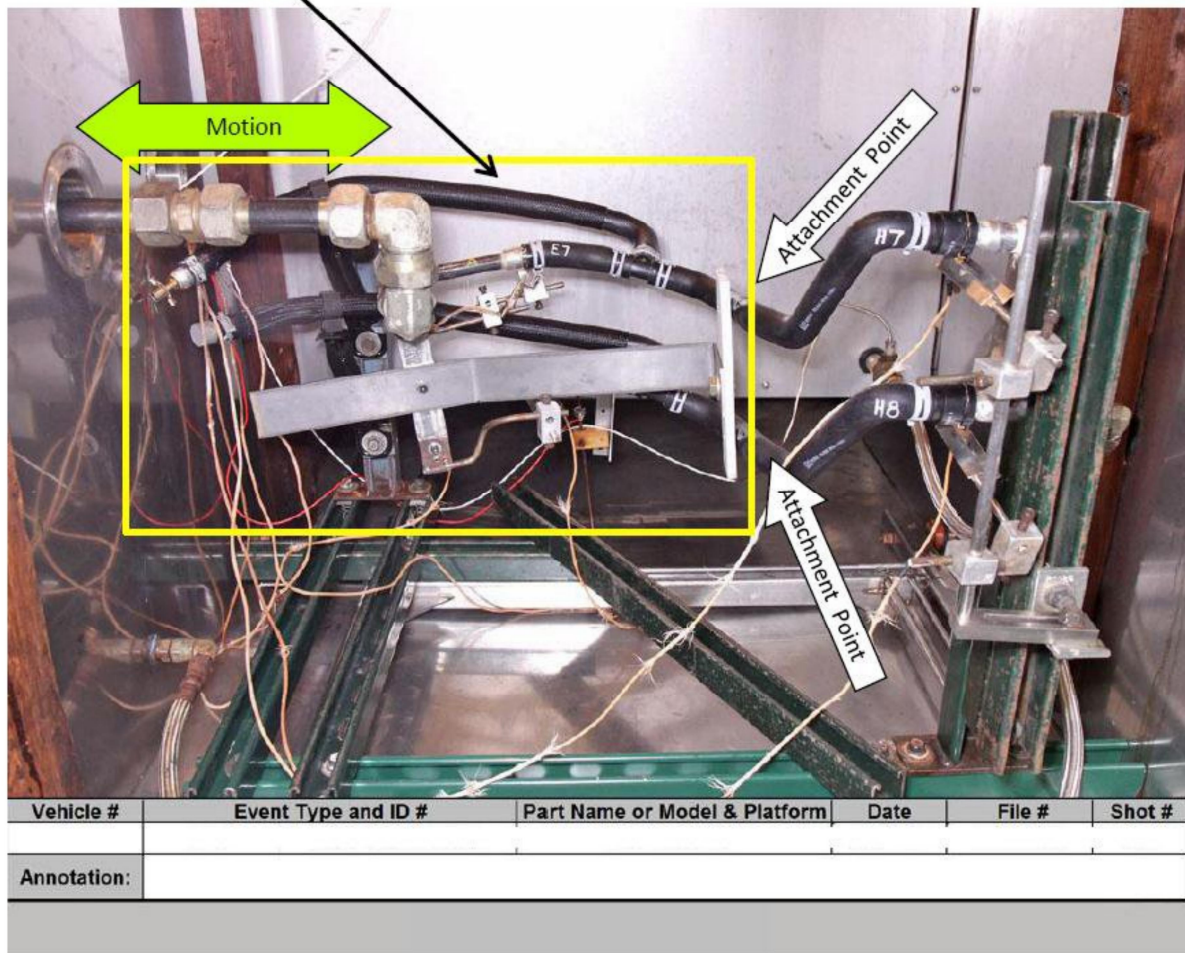


Figure D1: Example Test Chamber Setup

Appendix E



Figure E1: Example of Seepage