

TEST REPORT

THERM-A-GAP GEL 120 Reliability Report

TR1012 Oct 2025 Rev. C

Chomerics Division Asia and Pacific
Parker Hannifin Corporation
280 Yunqiao Road, Pudong District, Shanghai, China 201206
Phone: 0086-21-28995000
Fax: 0086-21-28995146

WARNING – USER RESPONSIBILITY

FAILURE OR IMPROPER SELECTION OR IMPROPER USE OF THE PRODUCTS DESCRIBED HEREIN OR RELATED ITEMS CAN CAUSE DEATH, PERSONAL INJURY AND PROPERTY DAMAGE.

This document and other information from Parker-Hannifin Corporation, its subsidiaries and authorized distributors provide product or system options for further investigation by users having technical expertise. The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application, follow applicable industry standards, and follow the information concerning the product in the current product catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors. To the extent that Parker or its subsidiaries or authorized distributors provide component or system options based upon data or specifications provided by the user, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the components or systems.

Executive Summary

Gel120 is a high performance, cured thermal gap filler. The cross-linked structure provides superior performance and long-term thermal stability over conventional high modulus thermal gel. This material is designed to be used in applications requiring minimal thermal resistance for optimized thermal performance. This document outlines the examination of the physical and thermal reliability of this high-performance gap filler.

GEL120 was installed in a simulated application fixture in vertical. The thermal properties measurements were taken each step of reliability tests. The reliability tests include Heat Aging Humidity Aging, Temperature Cycling and Random Vibration Tests. The test methods according to IEC and GMW standards. These standards apply to Electrical/Electronic (E/E) components for passenger or commercial vehicles and trucks. The standards describe the environmental and durability tests for E/E components based on mounting location.

The thermal performance of GEL120 was examined after being subjected to multiple environmental stress tests. The thermal impedance of GEL120 was not significantly affected by long term heat aging, humidity aging, temperature cycling and high-frequency vibrations.

GEL120 exhibits superior long-term physical and thermal reliability. This material also displays excellent thermal reliability under various physical stresses. The test flow chart as below:

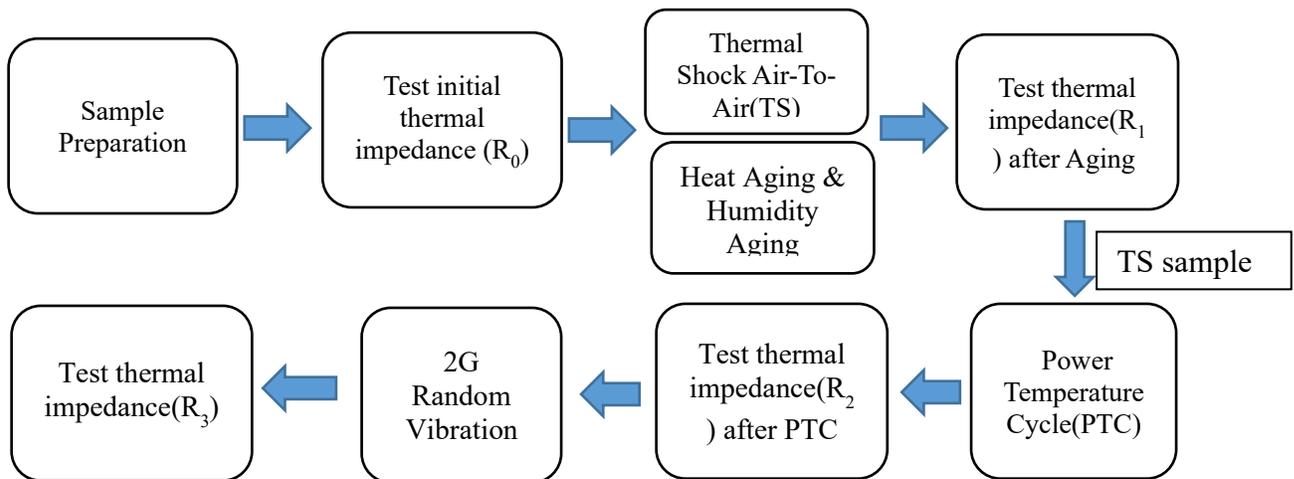


TABLE OF CONTENTS

1. Introduction
 - 1.1 Purpose
 - 1.2 Sample Set-Up Summary
2. Thermal Shock Air-To-Air(TS)
 - 2.1 Introduction and Reference
 - 2.2 Equipment and test setup
 - 2.4 Procedure
 - 2.4.1 Sample Preparation
 - 2.4.2 Test Procedure
 - 2.5 Test Result
3. Power Temperature Cycle (PTC)
 - 3.1 Introduction and Reference
 - 3.2 Equipment and test setup
 - 3.4 Procedure
 - 3.4.1 Sample Preparation
 - 3.4.2 Test Procedure
 - 3.5 Test Result
4. Random Vibration
 - 4.1 Introduction and Reference
 - 4.2 Equipment and test setup
 - 4.4 Procedure
 - 4.4.1 Sample Preparation
 - 4.4.2 Test Procedure
 - 4.5 Test Result
5. Constant environmental aging Test
 - 5.1 Heat Aging
 - 5.2 Humidity Aging
6. Summary and Conclusion

1. Introduction

1.1 Purpose

The purpose of the document is to examine the physical and thermal reliability of this high-performance gap filler. Samples of manufacturing batches of GEL120 were subjected to thermal shock test, thermal cycling test and vibration test.

1.2 Sample Set-Up Summary

GEL120 was installed in a simulated application fixture in vertical position. The thermal properties measurements were taken each step of reliability tests. The reliability tests include Heat Aging Humidity Aging, and Tests. The test methods according to IEC and GMW standards. These standards apply to Electrical/Electronic (E/E) components for passenger or commercial vehicles and trucks. The standards describe the environmental and durability tests for E/E components based on mounting location.

2. Thermal Shock Air-To-Air (TS)

2.1 Introduction and Reference

Thermal Shock Air-To-Air (TS) according to GMW 3172 9.4.2. This test in combination with Power Temperature Cycling (PTC) shall verify that the component is immune to thermal fatigue and contact degradation that is caused by temperature changes and possible miss-matching of the CTE of materials.

2.2 Equipment and test setup

Specimens tested from -40 °C to 85 °C, and the dwell time at high temperature and low temperature is 15min. The temperature range conducted in the Thermal Shock test shall be adjusted for components that generate significant internal heat to compensate for the lost temperature change with a non-energized component as figure 1.

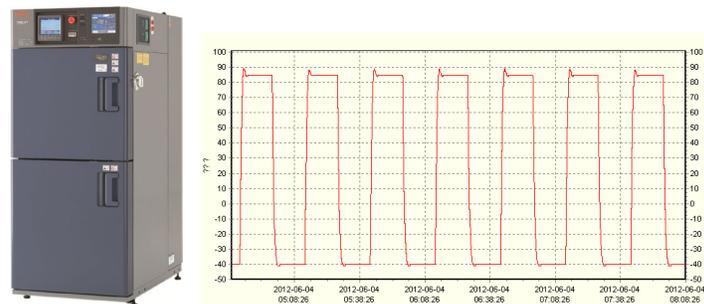


Fig.1. Espec thermal shock chamber and temperature curve

The number of thermal cycles according to GMW 3172 9.4.2 Table 33, Position

Code Letter For Temperature	Location In The Vehicle	Combined Number of TS + PTC Cycles	Number Of TS Cycles	Number Of PTC Cycles
A, B, C, and D	Inside the passenger compartment, luggage compartment, or attached to the exterior of the vehicle but not under the hood or above the exhaust system	843	632	211
E and F	Under the hood of the vehicle	1236	927	309
G, H, and I	Attached to or inside the engine (total cycles = 2248)	1248	1000	248
		Cyclic Humidity and Constant Humidity		
		1000	1000	0

ABCD as table1.

Table1. Number of thermal cycles

2.3 Procedure

Use the test methods according to ISO 16750-4, Temperature cycling. The temperature cycle testing be performed according to IEC 60068-2-14, Test Na, Change of temperature. The thermal properties measurements be taken before and after aging per ASTM D5470 at 30psi. Thermal Impedance tester as figure2.



Fig.2. TIM tester

2.3.1 Sample Preparation

2.3.1.1 Dispense GEL120 sample onto the center of 1.0inch x 1.0inch convex aluminum surface as a drop-shaped dot.

2.3.1.2 Apply 4 PTFE shims to the corners and cover with a 7inch x 7-inch sapphire glass gently to avoid sidesway. (As figure3)

2.3.1.3 Tighten the 4 PEEK screws to make sure reach a required gap thickness.

2.3.1.4 Roughness of the aluminum plate is ra1.6 and sapphire glass is ra0.02.

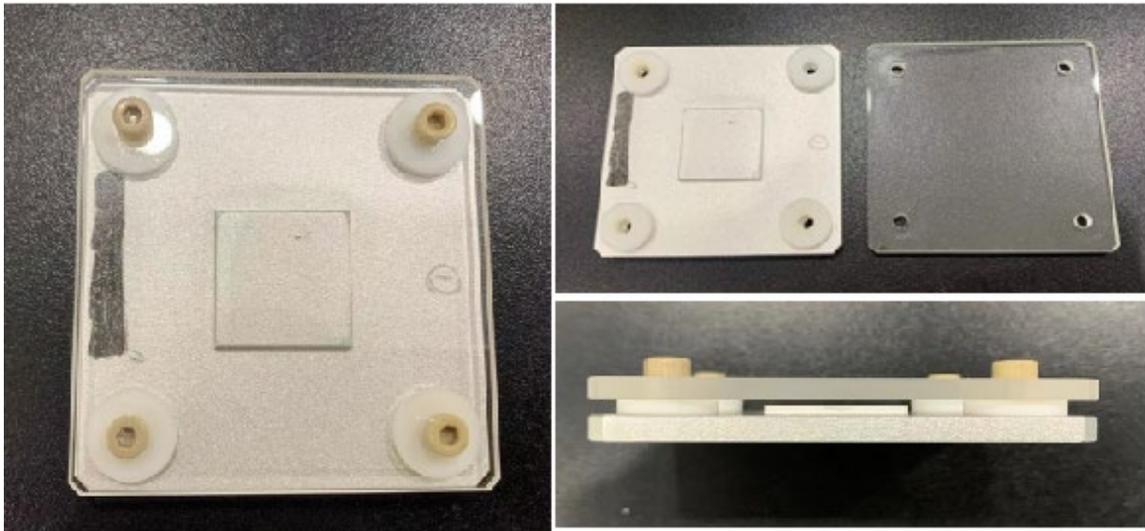


Fig.3. Simulated application fixture

2.3.2 Test Procedure

2.32.1 Test initial thermal Impedance and make record- R_0 ($K \cdot \text{in}^2/\text{W}$);

2.3.2.2 Put fixtures into Thermal shock chamber for 632cycles in vertical position.

2.3.2.3 After 632cycles remove specimens from thermal shock chamber and let specimens equilibrate to room temperature for 2 hours prior to testing.

2.3.2.4 Test thermal Impedance and make record- R_1 ($K \cdot \text{in}^2/\text{W}$), and monitor specimens appearance though glass.

2.4 Results

2.4.1 Result Summary Table

Samples	Specimen thickness	Initial Thermal Impedance ($K \cdot \text{in}^2/\text{W}$)	Thermal Impedance after Thermal Shock ($K \cdot \text{in}^2/\text{W}$)	Thermal Impedance Change
GEL120	0.3mm	0.296	0.298	0.68%
	1.0mm	0.522	0.535	2.49%
	2.0mm	0.846	0.859	1.54%
	3.0mm	1.168	1.178	0.86%

Table2. Test result of Thermal shock test

3. Temperature Cycling Test

3.1 Introduction and Reference

Temperature Cycling Test according to IEC 60068-2-14, Test Nb. This test shall verify that the component is immune to thermal fatigue and contact degradation that is caused by temperature changes and possible miss-matching of the CTE of materials.

3.2 Equipment and Test Setup

Specimens test from -40 °C to 125 °C at a 10 °C /min speed and 15min dwell time at -40°C and 125°C.

The number of thermal cycles according to IEC 60068-2-14, Test Nb.

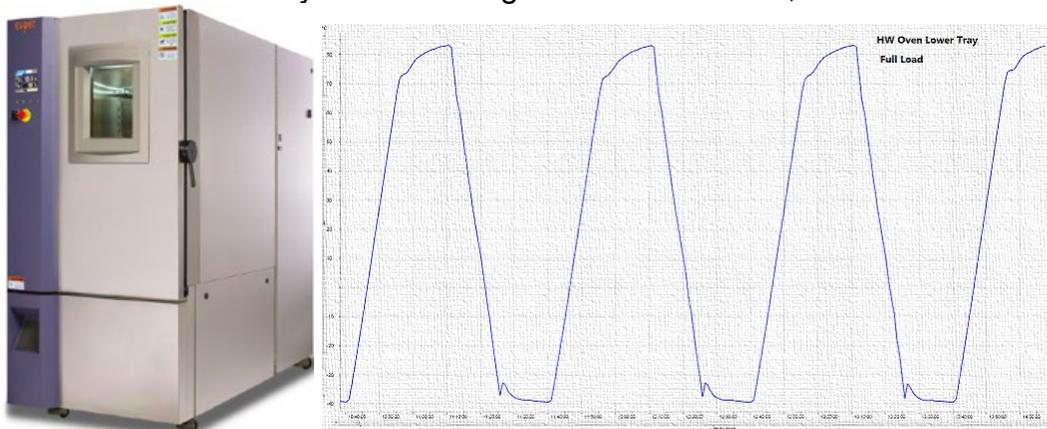


Fig.5. Espec temperature cycling chamber and Temperature curve

3.3 Procedure

Use the test methods according to ISO 16750-4, Temperature cycling. The temperature cycle testing shall be performed according to IEC 60068-2-14, Test Nb, Change of temperature. The thermal properties measurements be taken before and after TS per ASTM D5470 at 30psi. Thermal Impedance tester as figure2

3.3.1 Sample Preparation

Sample Preparation as 2.3.1

3.3.2 Test Procedure

- 3.3.2.1 After measured the thermal impedance R_1 , then put the specimens into thermal cycling chamber in vertical position.
- 3.3.2.2 After 211 cycles, remove specimens from thermal cycling chamber and let specimens equilibrate to room temperature for 2 hours prior to testing.
- 3.3.2.3 Test thermal impedance and make record- R_2 ($K \cdot \text{in}^2/W$) and monitor specimens' appearance through glass.

3.4 Results

3.4.1 Result Summary Table

Samples	Specimen thickness	Initial Thermal Impedance ($K \cdot \text{in}^2/W$)	Thermal Impedance after Temperature Cycling ($K \cdot \text{in}^2/W$)	Thermal Impedance Change
GEL120	0.3mm	0.296	0.311	5.07%
	1.0mm	0.522	0.546	4.60%
	2.0mm	0.846	0.887	4.85%
	3.0mm	1.168	1.205	3.17%

Table3. Test result of PTC

4. Random Vibration (Sprung Masses 2G Effective Acceleration)

4.1 Introduction and Reference

The GMW3172 9.3.1.2 Random Vibration was designed for automotive application.

A random vibration test was performed strictly according to GMW 3172 to evaluate the stability of the materials under high acceleration and high temperature.

4.2 Equipment and test setup

Sample preparation and test procedure according to IEC 60068-2-64, the test parameters and profile as figure6. Effective Acceleration= $19.6 \text{ m/s}^2 = 2.0 \text{ GRMS}$ 3 directions. 8 hours per direction

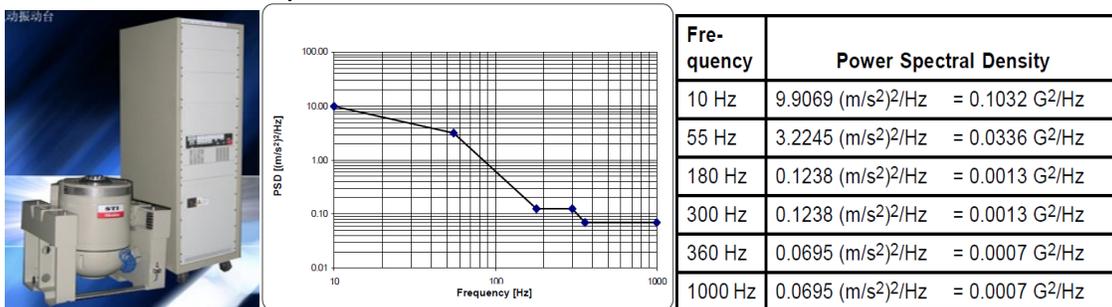


Fig.6. Vibration Stand , Test parameters and profile

4.3 Acceptance Criteria

Minimal visible decomposition will be allowed. The acceptable level of decomposition is to be defined.

Mechanical decomposition is allowed as long as the material still remains within specification after testing.

Thermal decomposition is allowed as long as the material still remains within specification after testing.

4.4 Procedure

Use the test methods according to IEC 60068-2-64, Test Fh, Vibration, broad-band random (digital control) and guidance. The thermal properties measurements be taken before and after Vibration per ASTM D5470 at 30psi.

4.4.1 Sample Preparation

Sample Preparation as 2.3.1

4.4.2 Test Procedure

4.4.2.1 After measured the thermal impedance R_2 , then fixed specimens onto vibration tester.

4.4.2.2 Set up the parameters and do the Random Vibration test.

4.4.2.3 Test thermal impedance and make record- R_3 ($K \cdot \text{in}^2/W$)

4.5 Results

4.5.1 Result Summary Table

Samples	Specimen thickness	Initial Thermal Impedance ($K \cdot \text{in}^2/W$)	Thermal Impedance after Vibration ($K \cdot \text{in}^2/W$)	Thermal Impedance Change
GEL120	0.3mm	0.296	0.309	4.39%
	1.0mm	0.522	0.538	3.07%
	2.0mm	0.846	0.875	3.43%
	3.0mm	1.168	1.197	2.48%

Table4. Test result of random vibration

4.6 Appearance of specimens (after TS TC & Vibration)



0.3mm sample



1.0mm sample



2.0mm sample



3.0mm sample

Specimens after thermal shock, temperature cycling and vibration test

4.7 Result Discussion

Thermal performance of Gel120 remaining in good condition after 632 cycles of thermal shock test, 211 cycles of thermal cycling test and 2G random vibration test.

Specimens are still in good condition.

No cracking was observed.

No sliding was observed.

5. Constant environmental aging Test

5.1 Procedure

Use the test methods according to IEC 60068-2-2 and IEC60068-2-67, The thermal properties measurements be taken before and after aging per ASTM D5470 at 30psi. Thermal Impedance tester as figure2.



UA-2079 Humidity Chamber

5.2 Sample Preparation

Sample Preparation as 2.3.1

5.3 Test Procedure

- 5.3.1 Test initial thermal Impedance and make record- R_0 ($K \cdot in^2/W$);
- 5.3.2 Put fixtures into 125°C air oven and 85°C/85R.H.% chamber for 1000 hours in vertical position.
- 5.3.3 After aging remove specimens from chambers and let specimens equilibrate to room temperature for 2 hours prior to testing.

5.4 Results

5.4.1 Result Summary Table

Samples	Thermal Impedance ($K \cdot in^2/W$)				Change
	Initial	250h	600h	1000h	
1	0.45	0.488	0.504	0.485	7.8%
2	0.486	0.513	0.526	0.527	8.4%

Table5. Test result of Heat Aging

Samples	Thermal Impedance ($K \cdot in^2/W$)				Change
	Initial	250h	600h	1000h	
1	0.471	0.474	0.477	0.486	3.2%
2	0.468	0.473	0.475	0.484	3.4%

Table6. Test result of Humidity Aging

6.0 Summary and Conclusion

GEL120 demonstrates superior stability of thermal properties, thermal impedance is not significantly affected by thermal shock, temperature cycling and vibration and long term humidity and heat aging tests.

No cracking and no sliding were observed after long term reliability aging.

Footnote:

The user, through its own analysis and testing, is solely responsible for making the final selection of the system and components and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application, follow applicable industry standards, and follow the information concerning the product in the current product catalog and in any other materials provided from Parker or its subsidiaries or authorized distributors.