# THERM-A-GAP™ HCS10

## Reliability Test Report

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Test Report Number:

Chomerics Approved Signatory:



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.

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## List of Acronyms and Initials

| | |
|---|---|
| TIM | Thermal Interface Materials |
| HSP | Heat Spreader Materials |
| SPR | Standard Product Requirements |
| IEC | International Electrotechnical Commission |

## List of Definitions

| | |
|---|---|
| Laboratory Environment | A temperature between 20 and 25 $^{o}$C and a relative humidity between 40 and 60% |
| Room Temperature | A temperature between 20 and 25 $^{o}$C |
| Normal Performance | Fulfillment of specified performance requirement |
| Thermal Decomposition: | Allowed as long as the material still remains in spec. after testing |
| Mechanical Decomposition | Allowed as long as the material still remains in spec. after testing |
| Visible Decomposition | Minimal visible decomposition is allowed. This will be further defined at a later date. |

## 1.0 Introduction

### 1.1 Purpose

The purpose of the document is to explain the mechanical and environmental tests and the corresponding measurements that were performed on samples of Chomerics thermally conductive gap filler THERM-A-GAP™ HCS10G.

### 1.2 Sample Set-Up Summary

The samples were tested at a thickness of 0.100 inches (2.5 mm). The thermal impedance and compression as a factor of pressure were measured for each sample. The measurements were taken initially and after heat aged processes. The heat aged processes were steady temperature at 70°C, 125°C and damp heat 85°C/85%RH.

## 2.0 Steady Temperature Test

### 2.1 Introduction and Reference

The purpose of the steady temperature test is to ensure the reliability of the samples after exposure to a range of air temperatures.

### 2.2 Procedure

The samples were placed into the test chambers at 70°C, 125°C and 85°C/85%RH and held for 1000 hours. After the first 96 hours, the first set of samples were taken out of the 70°C and 125°C and left at room temperature. Measurements of three of the samples were taken after a minimum of 2 hours. The process was repeated after 240, 504, and 1000 hours. Damp heat at 85°C/85%RH was tested only after 1000 hours. After the two hour recovery period, the final measurements were taken in a laboratory environment to test for the normal performance of the samples.

### 2.3 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.

## 3.0 Test Procedure

### 3.1 Sample Preparation

The thermal impedance samples were cut to 1 $in^2$ (6.45 $cm^2$) discs before aging and the deflection samples were cut to 0.5 inch diameter discs or 0.196 $in^2$ (1.26 $cm^2$) before aging. Liners were left on and the samples were spread out and not stacked during aging.

### 3.2 Thermal Impedance

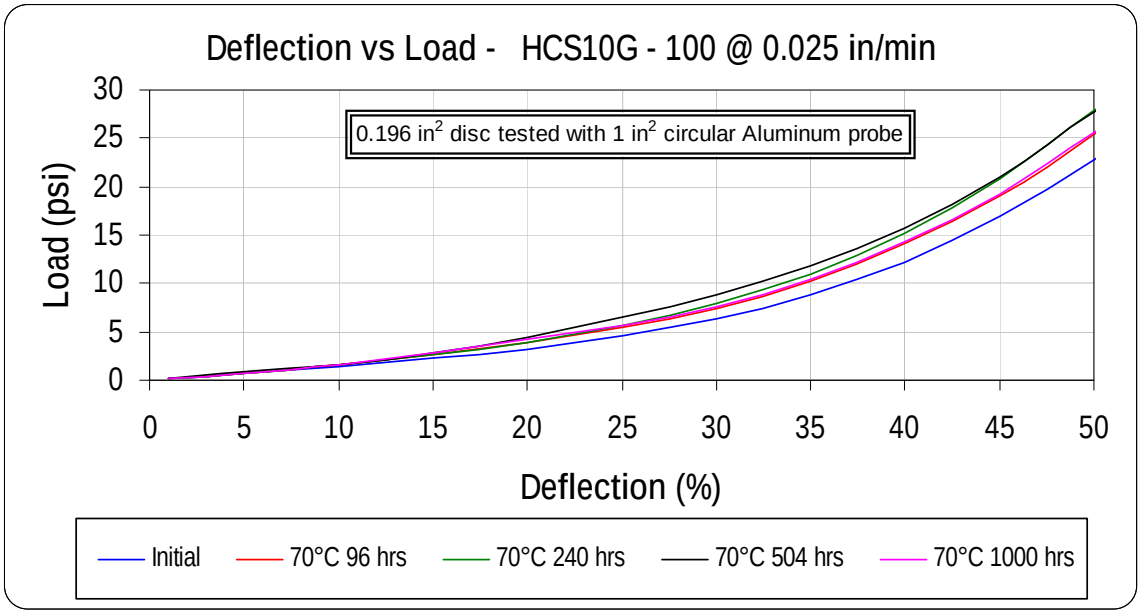
Three samples were tested at 50°C and 10 PSI (0.069 MPa) of pressure at each aging condition per ASTM D5470.

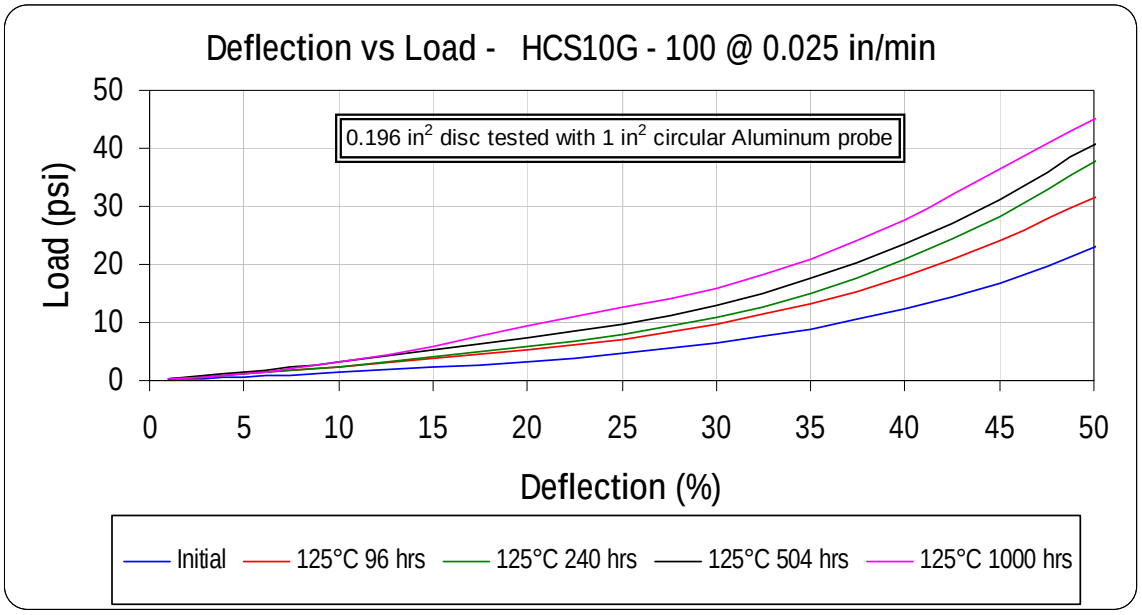
### 3.3 Compression Deflection

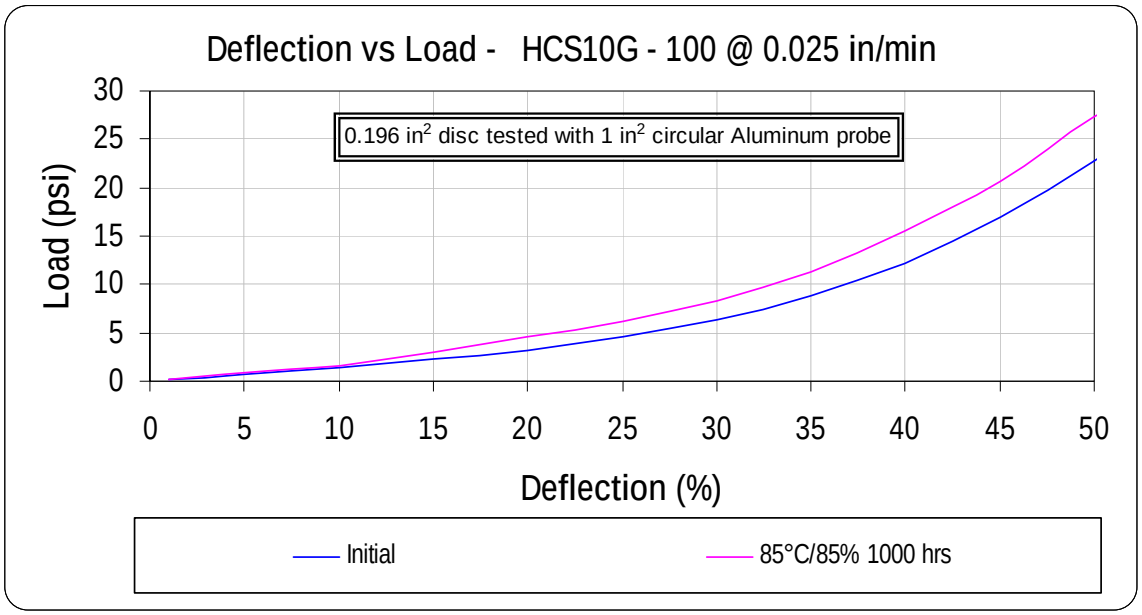
Samples were tested in a laboratory environment on a Texture Analyzer (from Texture Technologies) per Chomerics NBD-001, which is a modified version of ASTM C165. Three samples were tested at each aging condition. Samples were tested at 0.025 inches/min (0.01 mm/sec) up to 50% deflection or 50kg, the limit of the load cell.

## 4.0 Results

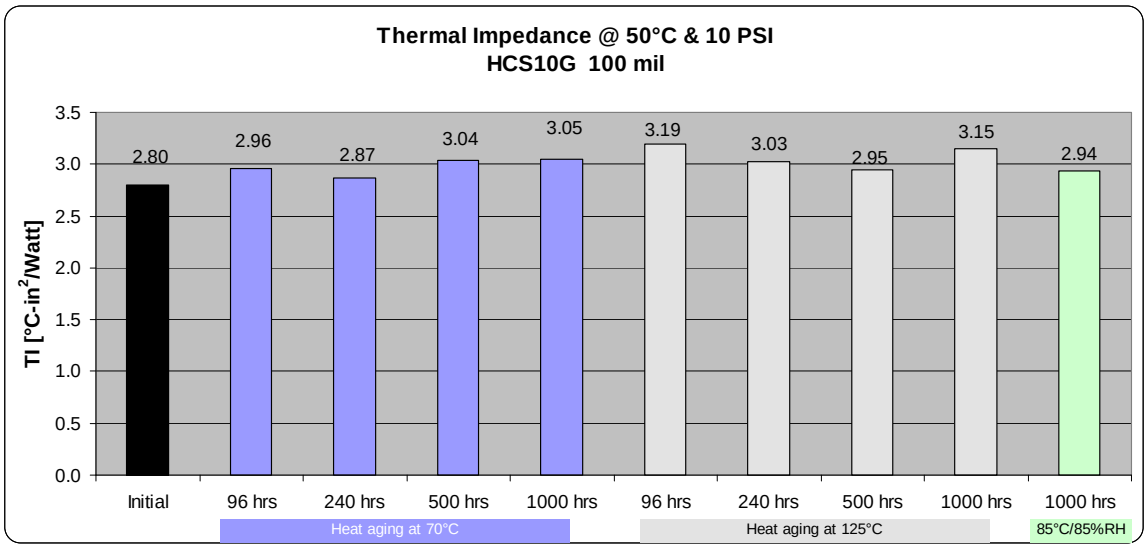
4.1 Compression Deflection





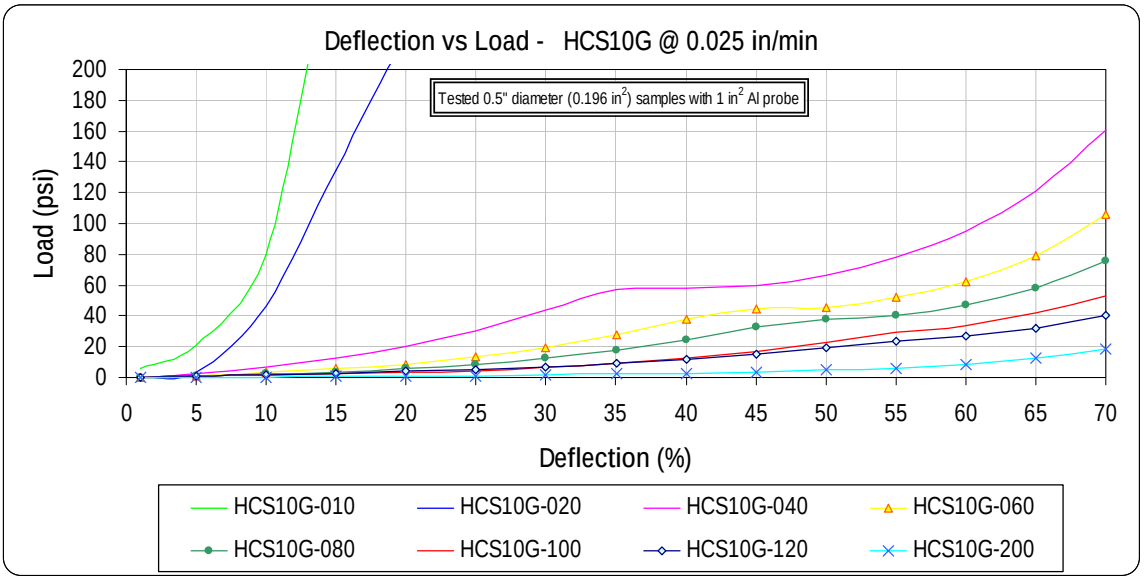

4.2 Thermal Impedance



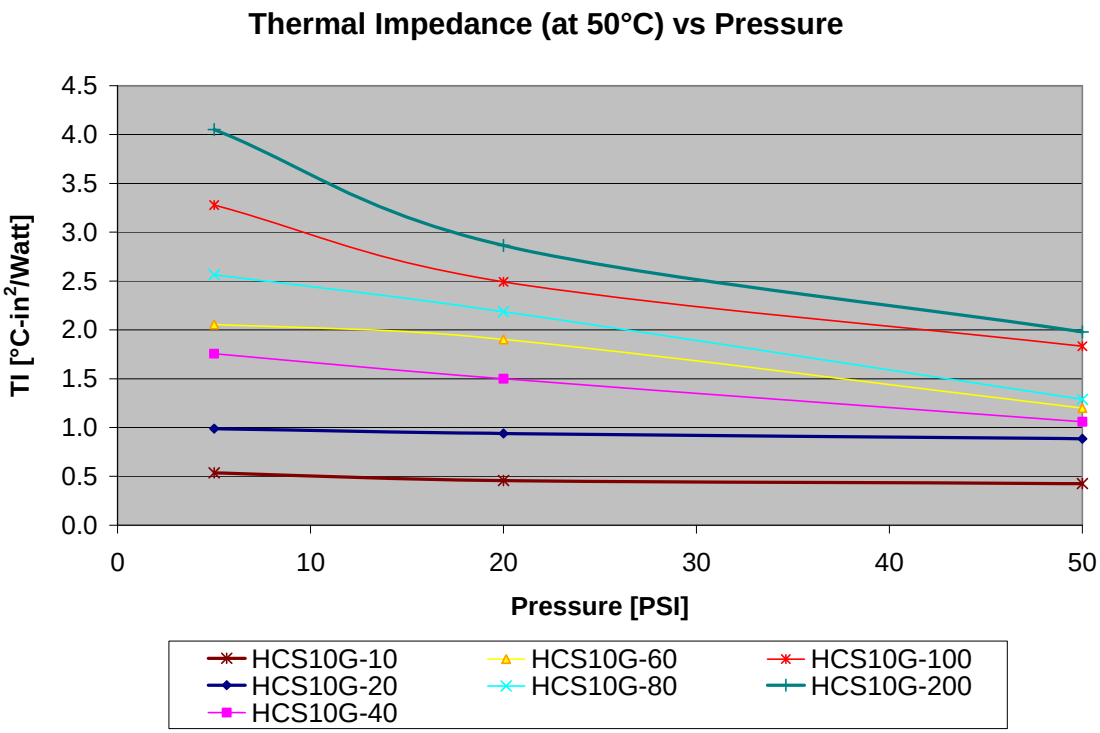
## Appendix A: Typical Properties

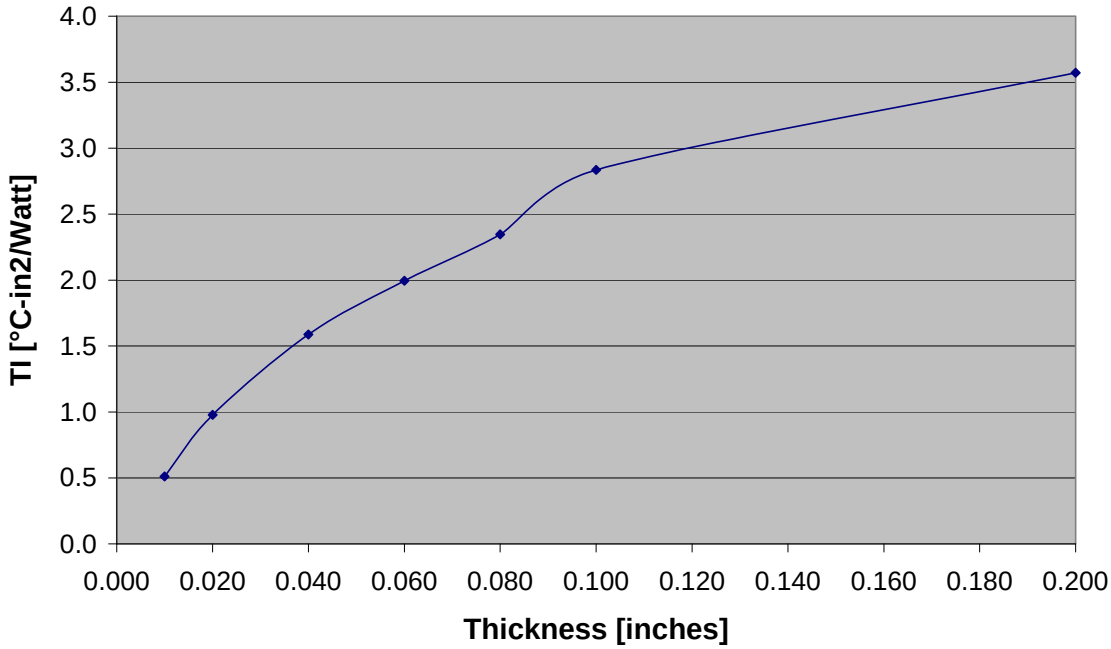
| | Typical Properties | HCS10 | Test Method |
|---|---|---|---|
| Physical | Color | Orange | Visual |
| | Carriers | G – Woven glass | |
| | Standard Thicknesses, inch (mm) | 0.02 to 0.200 (0.5 to 5.0) | ASTM D374 |
| | Specific Gravity | 2 | ASTM D792 |
| | Hardness, Shore 00 | 5 | ASTM D2240 |
| | Percent Deflection @ Various Pressures, % | | |
| | @ 34 kPa (5 psi) | 26 | ASTM C165 MOD (0.120 in G type 0.50 in diameter disc, 0.025 in/min rate) |
| | @ 69 kPa (10 psi) | 36 | |
| | @ 172 kPa (25 psi) | 49 | |
| | @ 345 kPa (50 psi) | 58 | |
| | Extractable Silicones. % | | Chomerics |
| | Continuous Use Temperature, °C (°F) | -55 to 200°C (-67 to 392) | -- |
| Thermal | Thermal Impedance, °C-cm$^2$/W (°C-in$^2$/W) @ 69 kPa (10 psi) 1 mm (0.040) thick | 9.7 (1.5) | ASTM D5470 (mod) |
| | Apparent Thermal Conductivity, W/m-K | 1 | ASTM D5470 (mod) |
| | Heat Capacity, J/g-K | 1 | ASTM E1269 |
| | Coefficient of Thermal Expansion, ppm/K | 439 | ASTM E831 |
| Electrical | Dielectric Strength, KVac/mm (Vac/mil) | 78 (200) | ASTM D149 |
| | Dielectric Constant @ 1000 kHz | 5.3 | ASTM D150 |
| | Volume Resistivity, Ohm-cm | >$10^{14}$ | ASTM D257 |
| Regulatory | Flammability Rating (See UL File E140244 for Details) | V-0 | UL 94 |
| | RoHS Compliant | Yes | Chomerics Self-Certification |
| | Outgassing, %TML (% CVCM) | 0.44 (0.13) | ASTM E595 |
| | Shelf Life, years from date of manufacture | 1 | Chomerics |

## Appendix B: Compression Deflection – All Thicknesses



## Appendix C:


Thermal Impedance (at 50°C) vs Pressure
TI [°C-in²/Watt]
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
50
Pressure [PSI]
HCS10G-10
HCS10G-20
HCS10G-40
HCS10G-60
HCS10G-80
HCS10G-100
HCS10G-200




## Appendix D:
Compression Deflection – All Data

HCS10G-100
(0.100" thick / 0.5" diameter sample)

| | Initial | | | 70°C 1000 hrs | | | 125°C 1000 hrs | | | 85°C/85% 1000 hrs | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | lbs | psi | psi* | lbs | psi | psi* | lbs | psi | psi* | lbs | psi | psi* |
| % | | | | | | | | | | | | |
| 1 | 0.04 | 0.20 | 0.20 | 0.04 | 0.22 | 0.22 | 0.05 | 0.28 | 0.27 | 0.05 | 0.23 | 0.23 |
| 5 | 0.13 | 0.68 | 0.64 | 0.15 | 0.78 | 0.75 | 0.27 | 1.39 | 1.32 | 0.18 | 0.93 | 0.88 |
| 10 | 0.30 | 1.51 | 1.36 | 0.34 | 1.72 | 1.55 | 0.72 | 3.68 | 3.31 | 0.37 | 1.86 | 1.67 |
| 15 | 0.52 | 2.63 | 2.24 | 0.64 | 3.24 | 2.75 | 1.37 | 6.96 | 5.91 | 0.70 | 3.56 | 3.03 |
| 20 | 0.80 | 4.07 | 3.26 | 1.02 | 5.21 | 4.17 | 2.34 | 11.92 | 9.54 | 1.11 | 5.66 | 4.53 |
| 25 | 1.20 | 6.09 | 4.57 | 1.47 | 7.50 | 5.63 | 3.30 | 16.79 | 12.59 | 1.63 | 8.28 | 6.21 |
| 30 | 1.79 | 9.09 | 6.37 | 2.12 | 10.82 | 7.57 | 4.43 | 22.56 | 15.79 | 2.35 | 11.95 | 8.36 |
| 35 | 2.68 | 13.63 | 8.86 | 3.13 | 15.94 | 10.36 | 6.28 | 31.98 | 20.78 | 3.42 | 17.42 | 11.32 |
| 40 | 4.01 | 20.43 | 12.26 | 4.65 | 23.68 | 14.21 | 9.02 | 45.94 | 27.56 | 5.06 | 25.79 | 15.47 |
| 45 | 6.02 | 30.65 | 16.86 | 6.86 | 34.93 | 19.21 | 12.99 | 66.19 | 36.40 | 7.39 | 37.66 | 20.71 |
| 50 | 8.96 | 45.66 | 22.83 | 10.05 | 51.20 | 25.60 | 17.62 | 89.74 | 44.87 | 10.74 | 54.69 | 27.34 |
| 55 | 12.82 | 65.30 | 29.38 | 13.64 | 69.50 | 31.27 | 22.17 | 112.93 | 50.82 | 13.88 | 70.71 | 31.82 |
| 60 | 16.53 | 84.20 | 33.68 | 17.77 | 90.51 | 36.20 | 29.65 | 151.03 | 60.41 | 17.94 | 91.41 | 36.56 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 65 | 23.67 | 120.57 | 42.20 | 24.84 | 126.54 | 44.29 | 40.67 | 207.20 | 72.52 | 25.49 | 129.84 | 45.44 |
| 70 | 34.66 | 176.58 | 52.97 | 37.39 | 190.45 | 57.14 | 59.52 | 303.23 | 90.97 | 38.27 | 194.97 | 58.49 |

*Column 1 (lbs) represents force, column 2 is the calculated pressure from (1) assuming a constant sample diameter of 0.50" throughout the test, column 3 represents the calculated pressure from (1) correcting for the change in sample diameter (and surface area) as a function of percent deflection. Note that column 3 assumes the sample is 100% incompressible, which is generally true for materials like this with a Poisson's Ratio approaching 0.5