CHOMERICS Parker

TEST REPORT
Reliability Testing
CHO-FORM™
5541

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SUMMARY OF CHO-FORM 5541 TYPICAL PROPERTIES

Property	**TYPICAL PHYSICAL PROPERTIES**	**Test Method**
Specific Gravity	2.40	ASTM D792
Hardness, Shore A	79	ASTM D2240
Volume Resistivity, initial (ohm-cm)	0.02	MAT-1002[1]
Volume Resistivity, heat aged (ohm-cm)	0.04	MAT-1002[1]
Tensile Strength (psi)	450	ASTM D412
Tensile Elongation (%)	150	ASTM D412
Compression Set (%) (22h, 85°C)	40	ASTM D395, Method B
Thermal Conductivity (W/m-K)	1.3	ASTM D5470
Flammability Rating (UL-94)	V-0	UL94, file E140244
Bead Adhesion, shear (N/cm)	>12	WI-038[1]
Corrosion Resistance mg wt loss	12	CHO-TM100[1]
Transfer Impedance (dB) (20MHz – 1.2GHz)	>110	SAE ARP1705
Shielding Effectiveness (dB) (200MHz-16GHz)	>70	CHO-TP08[1]

1. Copies of test method available upon request from Chomerics.

Related Documents:

Technical Data Sheet
Corrosion Test Report
Material Safety Data Sheet (MSDS)

Scope:

Cho-Form 5541 gaskets were subjected to a range of environmental stresses to simulate lifetime aging and exposure conditions. Electrical performance and shielding effectiveness of the gaskets was measured before and after environmental conditioning. These conditions were selected as a means of verifying gasket performance under conditions selected to simulate applications with 15-year lifetimes. Specific conditions were chosen by referencing ETSI and Tellcordia specifications targeting telecommunication infrastructure equipment.

Summary:

Random production samples of Cho-Form 5541 EMI gasketing material were subjected to various environmental conditions and tested for electrical performance.

These tests include visual inspection, shielding effectiveness, and electrical resistance measurements.

Shielding effectiveness measured after each stress condition, 85°C aging, 85°C 85%RH, urban gas exposure, and multiple deflections showed a minimum attenuation of 70dB in the 100 MHz to 16 GHz frequency range. No visual deterioration of the gasket or the mating flange (6061T6 untreated aluminum) was seen in any case.
Testing on galvanic corrosion is summarized in a separate report.

Procedure:

A) **Shielding Effectiveness** measured by Chomerics TP08. Drawings of plates used appended at end.

B) **Electrical Testing**: Through flange resistance was measured attaching 2 leads to the upper plate and 2 leads to the lower plate. mohm resistance was measured using a digital ohm meter with a measuring range of 10^{-4} to 10^{4} ohms and an accuracy of ±0.02 percent of the reading.

C) **Visual**: Each sample was inspected for any sign of gasket deterioration.

Exposure Methods

(1.0) **Flanged Heat Aging exposure at 70°C, 85°C, 100°C, 125°C.**

Apparatus: Forced convection Blue M ovens were set at 70°C, 85°C, 100°C, 125°C. Temperature uniformity was ± 5°C within oven.

Procedure: 1.2 mm thick slabs of 5541 were prepared and cured for 30 minutes at 140°C. Circular sample buttons (n=20) of 18 mm diameter were randomly diecut from these slabs, compressed 25% between two 75mm diameter unplated 6061T6 aluminum discs and placed in a forced convection hot air oven (5 assemblies at each temperature). Assemblies were removed periodically and allowed to cool to 23°C, 50% R.H. (acclimate) for two hours minimum before evaluation. Assemblies were again placed into the ovens for additional exposure. Assemblies were not taken apart during the duration of the test.
1 mm beads were dispensed on untreated 6061T6 Al and cured for 30 minutes at 140ºC. Shielding effectiveness was measured at 30% deflection according to Chomerics TP08. This assembly (plates with the gaskets deflected 30%) was placed in an environmental chamber maintained at 85 ±2°C. Samples were removed from the chamber after 1000 hours and allowed to acclimate for two days minimum before evaluation.

(1.1) **High temperature/Humidity Resistance 1000 hours, 85° C 85% RH.**

Apparatus: A Tenney Versa Tenn II humidity chamber maintained at 85°C (±2°C) at a relative humidity of 85% (± 5%).

Procedure: 1 mm beads were dispensed on untreated 6061T6 Al and cured for 30 minutes at 140ºC. Shielding effectiveness was measured at 30% deflection according to Chomerics TP08. This assembly (plates with the gaskets deflected 30%) was placed in an environmental chamber maintained at 85 ±2°C and 85% (± 5%) RH. Samples were removed from the chamber after 1000 hours and allowed to acclimate for two days minimum before evaluation.

(1.2) **Urban Gas exposure 21 days IEC 68-2-60 Part 2: Tests –**
Test Ke: Flowing mixed gas corrosion test, Method 2 IEC 68-2-60 urban gas environment.

Apparatus: An environmental chamber held at 30°C ±5°C and 70% R.H. ± 3% and filled with an atmospheric gas composition according to IEC 68-2-60, Method 2 urban gas specification. (H_2S = 10 x 10^{-9} vol/vol, NO_2 = 200 x10^{-9} vol/vol, Cl_2 = 10 x 10^{-9} vol/vol)

Procedure: 1 mm beads were dispensed on untreated 6061T6 Al and cured according to the recommended cure schedule. Shielding effectiveness was measured at 30% deflection according to Chomerics TP08 for three independently prepared samples. These assemblies (plates with the gaskets deflected 30%) were placed in an environmental chamber filled with the urban gas atmosphere as specified in IEC 68-2-60. Samples were removed from the chamber after 21 days and allowed to acclimate for two days minimum before evaluation. Data is reported as the average for the three samples.

(1.3) Multiple Deflection (Open-Close Cycle) Resistance: 25 deflections of 30%

Procedure: Following exposure to the urban gas conditioning (Method 1.2) the gaskets were repeatedly deflected 30% and shielding effectiveness measured after multiple deflections.
1 mm beads were dispensed on untreated 6061T6 Al and cured according to the recommended cure schedule. Shielding effectiveness was measured at 30% deflection according to Chomerics TP08 for three independently prepared samples. These assemblies (plates with the gaskets deflected 30%) were placed in an environmental chamber filled with the urban gas atmosphere as specified in IEC 68-2-60. Samples were removed from the chamber after 21days and allowed to acclimate for two days minimum before evaluation. Shielding effective performance was measured. The three assemblies were then taken apart and re-assembled compressing the gasket 30%. After 25 such open and close cycles, the shielding effectiveness was again determined for the three samples. Data is reported as the average for the three samples.

Flanged Heat Aging, Method 1.0.

Results

Visual: No visual deterioration or change was observed in the gaskets after exposure to the aging conditions.

Electrical Performance: The before and after conditioning through-flange resistances are given in Tables 1 - 4. Shielding Effectiveness is shown in Figure 1 for 85ºC aging. This data shows that there is an increase in the through-flange resistance with heat aging, and an average decrease of 17dB for Cho-Form 5541 (200MHz to 10GHz) in shielding effectiveness after conditioning in accordance with 1.0 method. The trend lines for through-flange resistance and shielding effectiveness are consistent with data taken with conductive elastomer EMI gaskets used in commercial programs with long term environmental shielding.

Raw Data

Table 1 Electrical Performance for Cho-Form 5541. Sampled in accordance with 1.0 method at 70ºC

Test fixture #	Before Exposure mohm	After Exposure, mohm				
		96 hours	336 hours	1000 hours	3000 hours	10 000 hour
M1	0.54	0.73	1.01	2.88	5.12	8.12
M2	0.62	0.81	1.13	5.47	7.92	11.43
M3	0.62	0.81	1.28	3.11	4.52	5.99
M4	0.70	1.04	1.18	6.25	11.24	23.03
M5	0.84	1.1	1.86	4.71	9.34	23.0
Average	0.67	0.90	1.29	4.48	7.63	14.32

Table 2 Electrical Performance for Cho-Form 5541. Sampled in accordance with 1.0 method at 85ºC

Test fixture #	Before Exposure mohm	After Exposure, mohm				
		96 hours	336 hours	1000 hours	3000 hours	10 000 hour
M6	0.11	0.98	1.92	9.99	6.50	31.62
M7	0.11	0.73	1.43	12.99	4.01	8.84
M8	0.24	0.65	1.25	8.04	2.35	5.66
M9	0.22	0.64	1.36	10.03	4.11	24.98
M10	0.16	0.86	1.77	11.39	3.40	13.48
Average	0.17	0.77	1.55	10.49	4.05	16.92

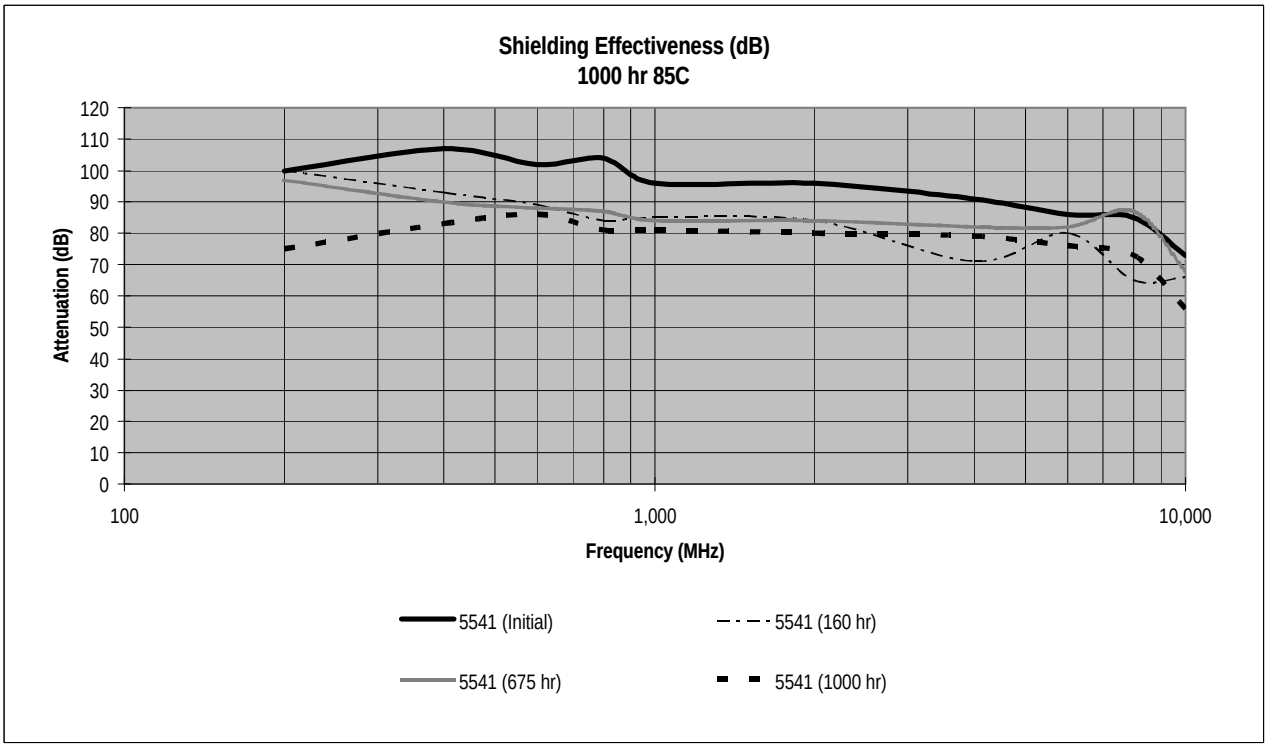
Table 3 Electrical Performance for Cho-Form 5541. Sampled in accordance with 1.0 method at 100ºC

Test fixture #	Before Exposure mohm	After Exposure, mohm				
		96 hours	336 hours	1000 hours	3000 hours	10 000 hour
M11	0.68	1.37	3.72	35.83	19.04	52.21
M12	0.39	0.86	1.98	25.43	22.56	54.55
M13	0.49	0.82	1.92	23.62	22.02	48.28
M14	0.65	0.7	1.74	31.12	17.08	55.2
M15	0.53	0.76	1.88	32.80	24.18	50.48
Average	0.55	0.90	2.25	29.76	20.98	52.13

Table 4 Electrical Performance for Cho-Form 5541. Sampled in accordance with 1.0 method at 125ºC

Test fixture #	Before Exposure mohm	After Exposure, mohm				
		96 hours	336 hours	1000 hours	2750 hours	10 000 hour
M16	0.44	0.70	1.87	4.51	17.54	77.69
M17	0.44	0.67	1.68	4.03	16.69	49.68
M18	0.39	0.66	1.60	3.79	15.90	54.02
M19	0.42	0.69	1.81	3.67	14.92	24.10
M20	0.77	1.11	2.90	6.17	22.25	27.45
Average	0.49	0.77	1.97	4.43	17.46	49.68

Figure 1: Shielding effectiveness Performance for Cho-Form 5541. Sampled in accordance with 1.0 method at 85ºC 1000 hours.



High Humidity Aging, 85°C 85% RH, 1000 hours, Method 1.1.

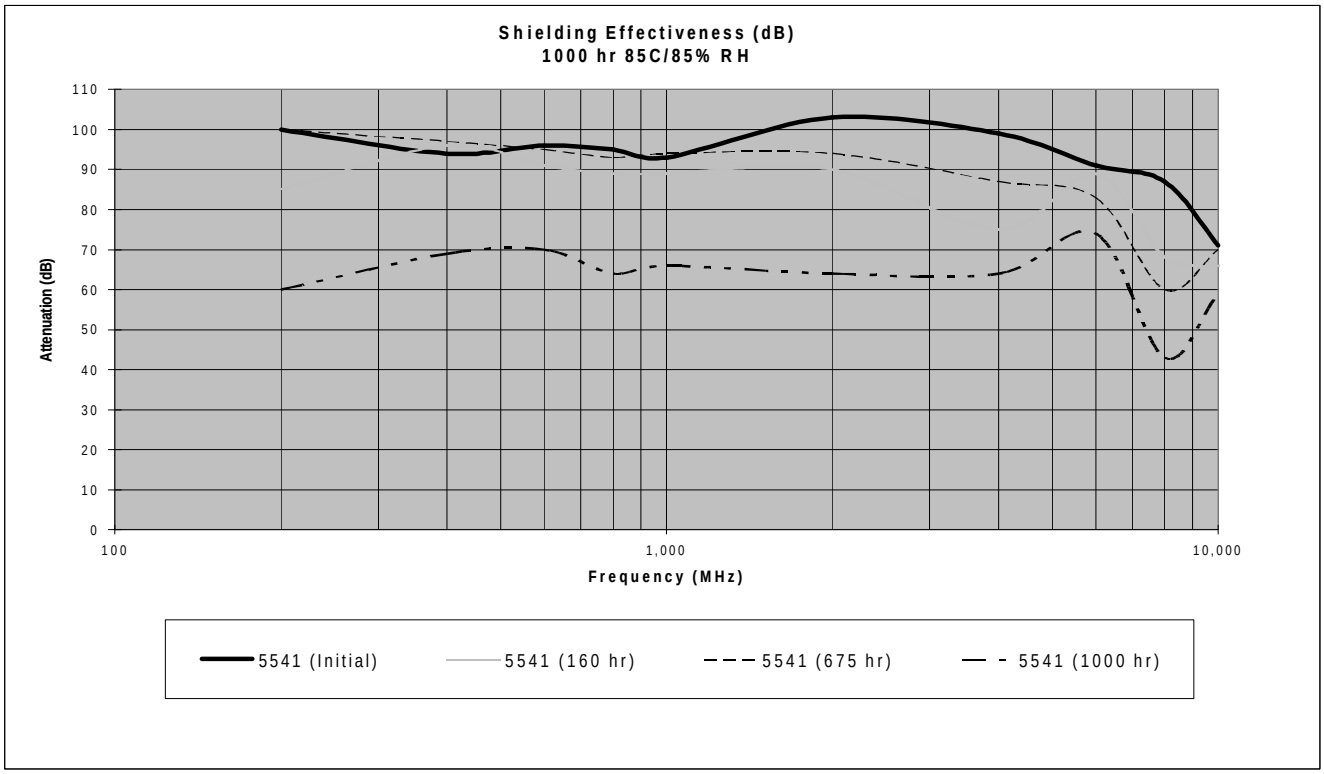
Results

Visual: The exposed material did not exhibit any apparent visual change after exposure to this environmental test condition.

Electrical Performance: The before and after conditioning shielding effectiveness values are given in Figure 2. This data shows that there is an 30 dB reduction in shielding for Cho-Form 5541 (200 MHz to 10 GHz) after 1000 hour exposure to 85ºC and 85% RH. The reduced level of shielding effectiveness after exposure is commensurate with the typical levels of shielding effectiveness expected and reported for these materials.

Raw Data

Figure 2 Shielding Effectiveness Performance for Cho-Form 5541. Sampled in accordance with 1.1 method.



Urban Gas Exposure, Method 1.2.

Results

Visual: No signs of visual changes or corrosion were apparent in the gaskets following exposure to this condition.

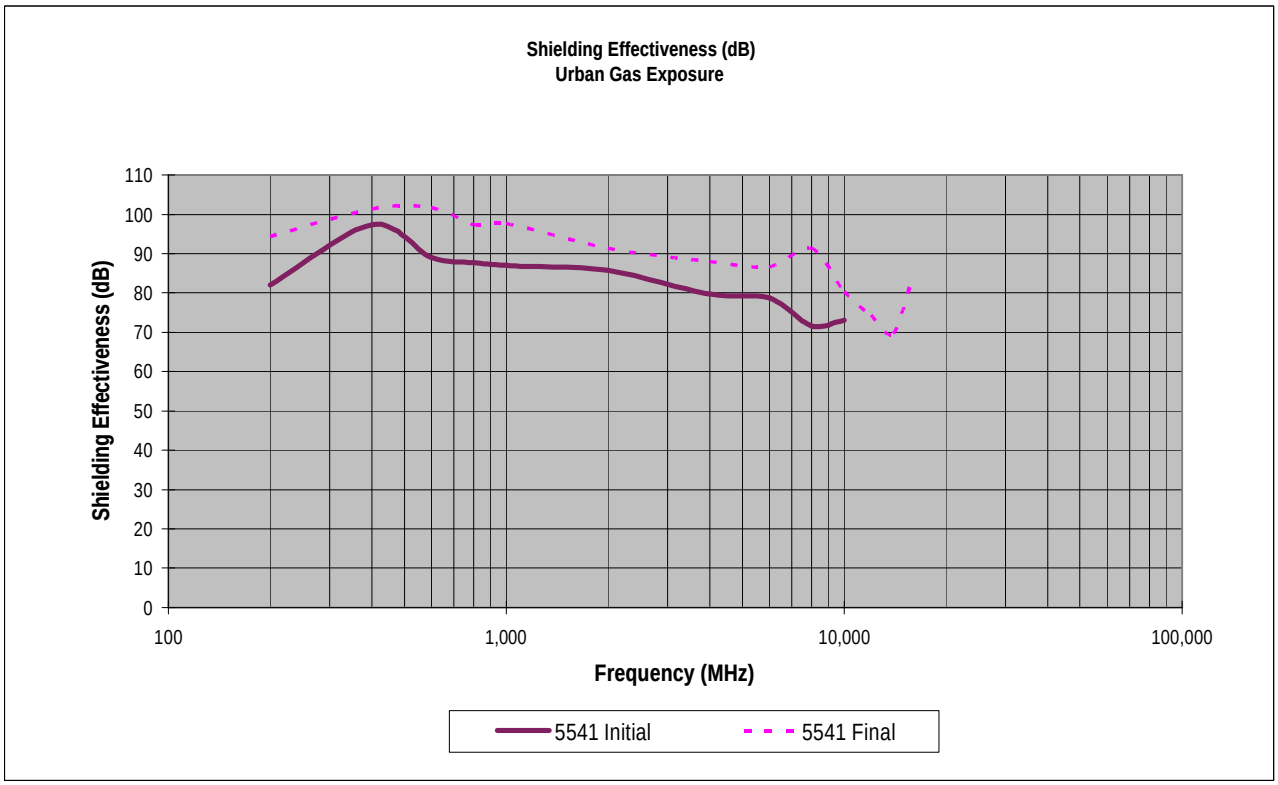
Electrical Performance: The through-flange gasket resistance data is given in Table 5. This data shows that there is an increase in the measured through-flange resistance of the gasket following exposure to the urban gas conditioning, but that this is not reflected in the gasket shielding effectiveness, Figure 3. In fact, the shielding effectiveness shows a slight, but statistically insignificant increase in shielding following conditioning by method 1.2.
Note: The post-conditioning samples shielding effectiveness was measured up to 16 GHz, as shown in Figure 3.

Raw Data

Table 5. Electrical Performance for Cho-Form 5541. Sampled in accordance with 1.2 method

	Average Resistance, mohm
Initial	0.07
Final	0.25

Figure 3 Shielding Performance of Cho-Form 5541 before and after conditioning in accordance with 1.2 method.



Multiple Deflections Resistance, Method 1.3.

Results

Visual: No signs of visual changes or delamination of the gasket were apparent following exposure to this condition.

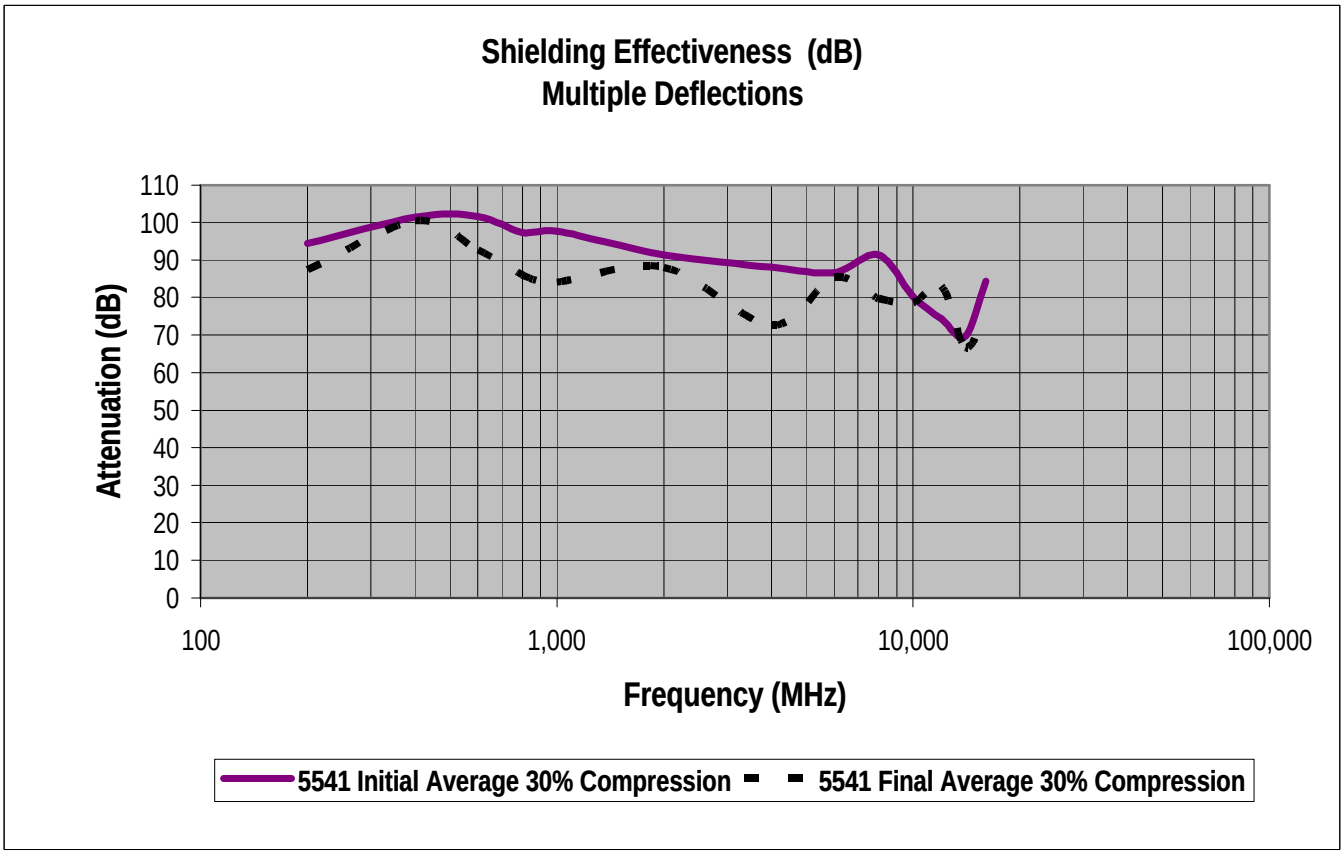
Electrical Performance: The through-flange gasket resistance data is given in Table 6. This data shows that there is a slight decrease in the measured through-flange resistance of the gasket following exposure to the urban gas conditioning. However, the shielding effectiveness, Figure 4, shows a slight, but statistically insignificant decrease in shielding following conditioning by method 1.3.
Note: The post-conditioning samples shielding effectiveness was measured up to 16 GHz, as shown in Figure 4.

Raw Data

Table 6. Electrical Performance for Cho-Form 5541. Sampled in accordance with 1.3 method

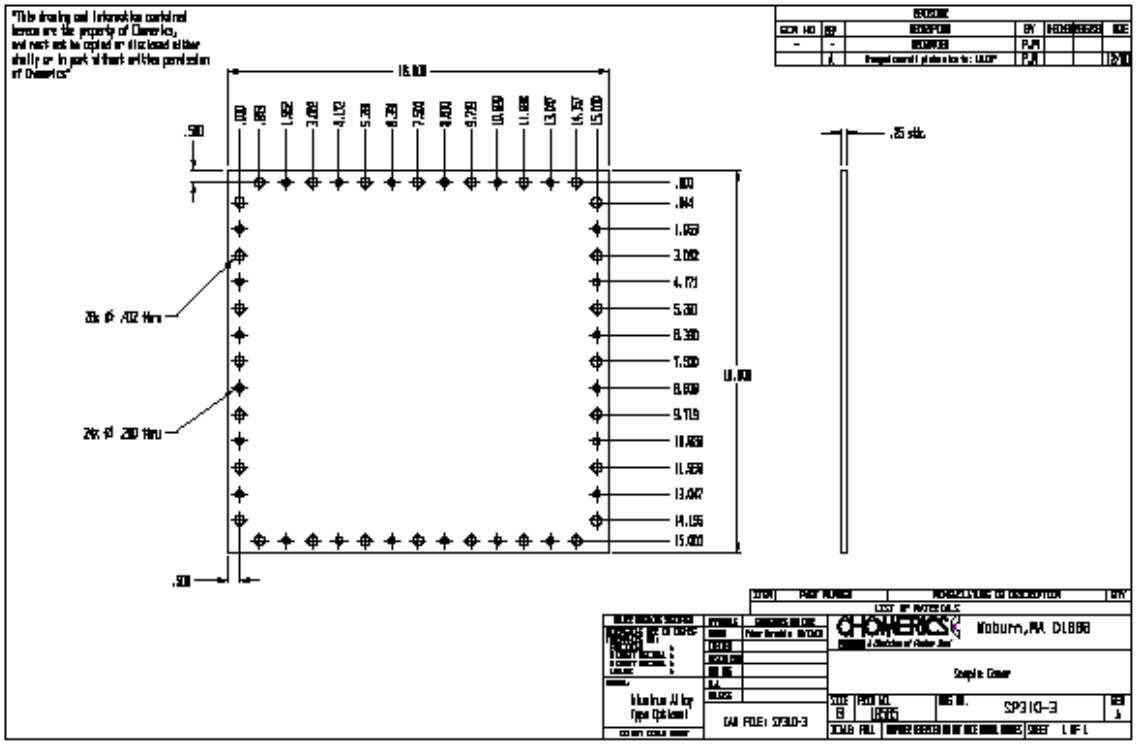
	Average Resistance, mohm
Initial	0.25
Final	0.19

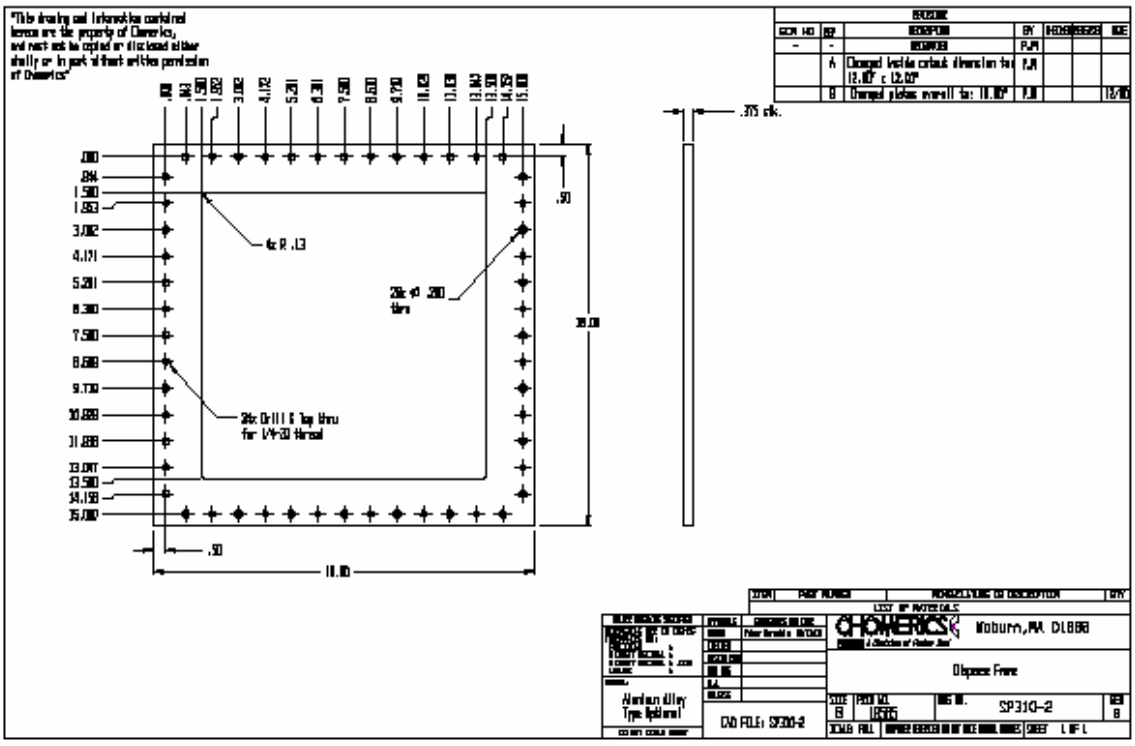
Figure 4 Shielding Performance of Cho-Form 5541 before and after conditioning in accordance with 1.3 method.

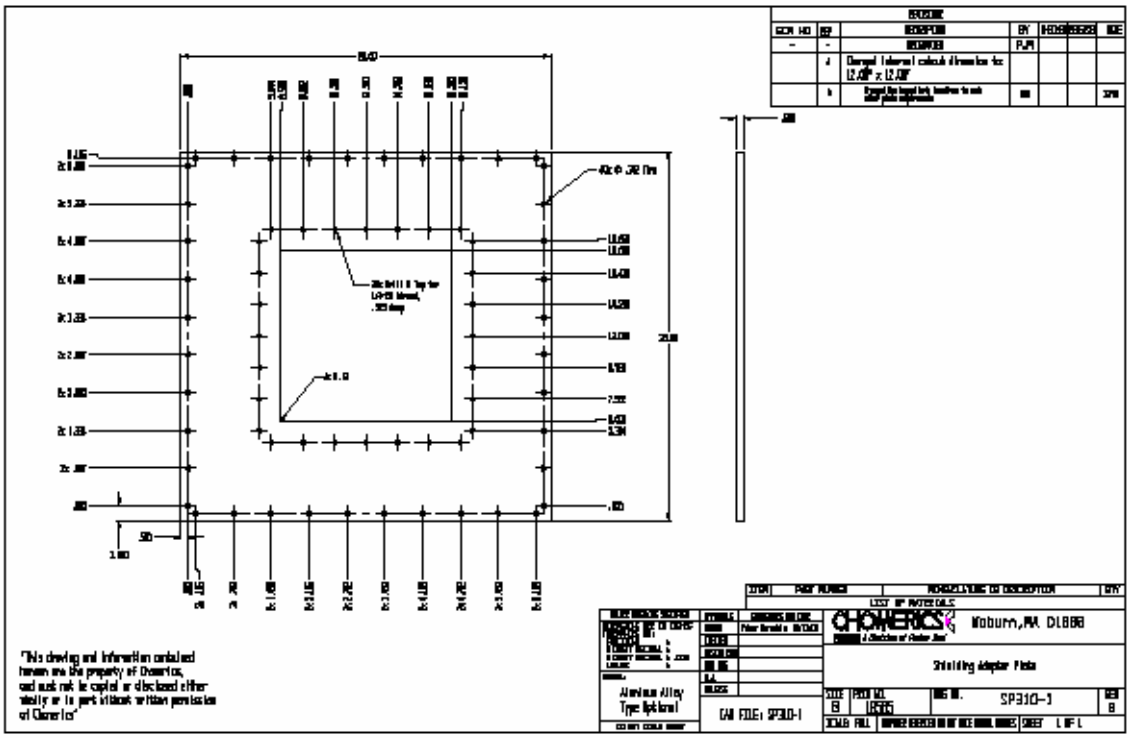


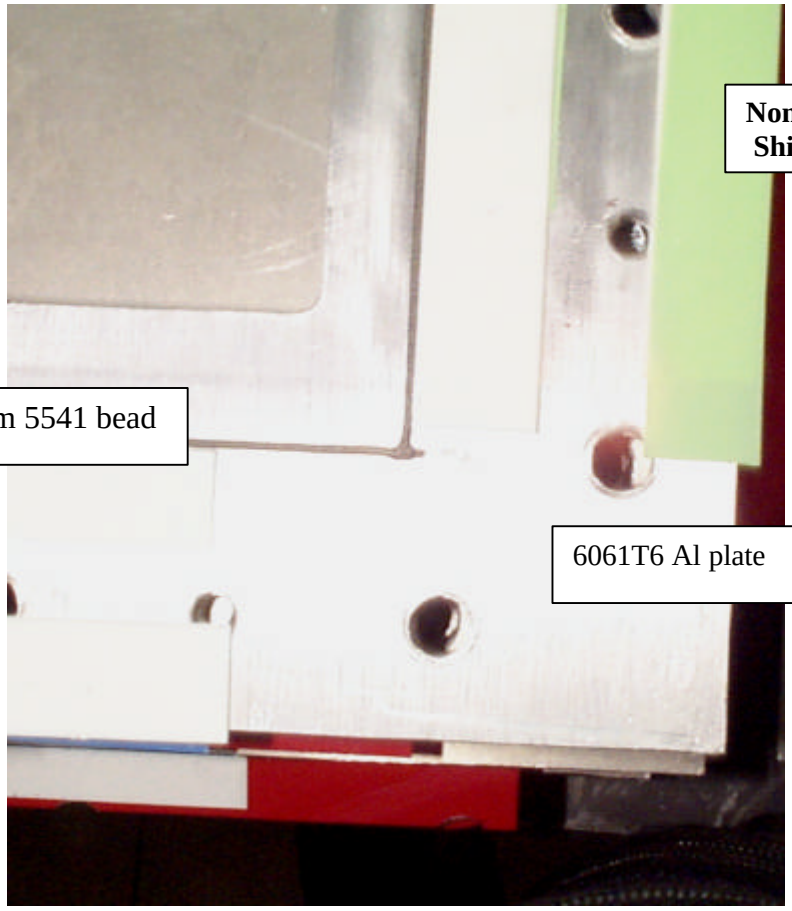
Appendix:

Drawings of Plate assemblies used for Shielding Effectiveness testing per Chomerics TP08.




.375 dia.
.50
18.00
4x R .13
28x Drill & Tap thru
for 1/4-20 thread
Aluminum Alloy
Type Optional
DXD FILE: SP310-2
CHOMERICS
Woburn, MA 01888
Dispense Frame
SP310-2


40x Ø .262 thru
28x Drill & Tap for
1/4-20 thread,
.325 deep
.50
Aluminum Alloy
Type Optional
CAD FILE: SP310-1
CHOMERICS
Woburn, MA 01888
Shielding Adaptor Plate
SP310-1

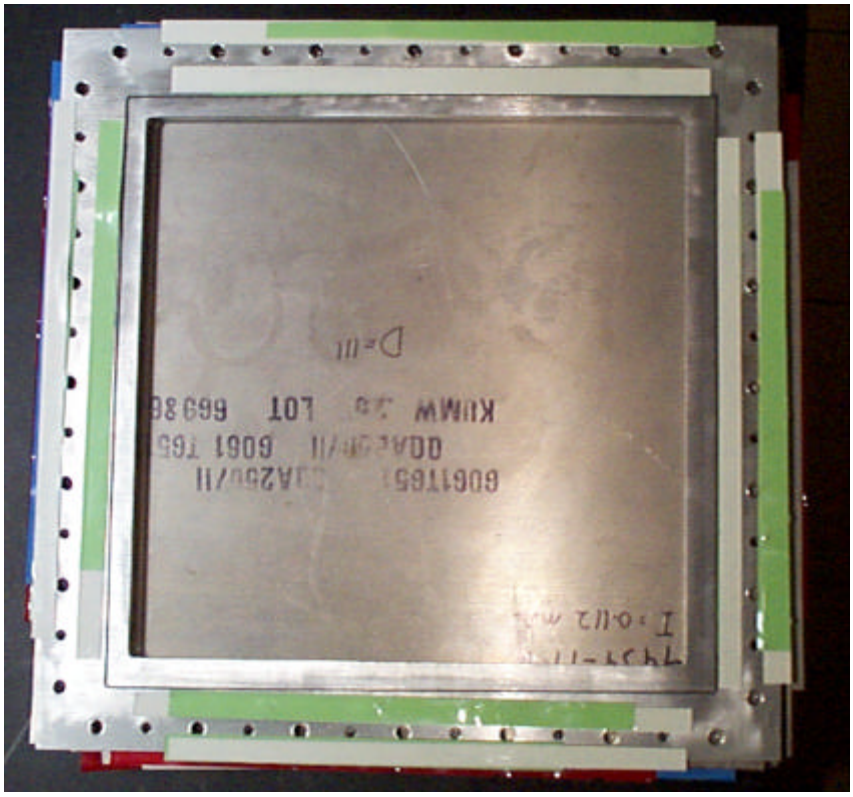


Non-conductive Shim

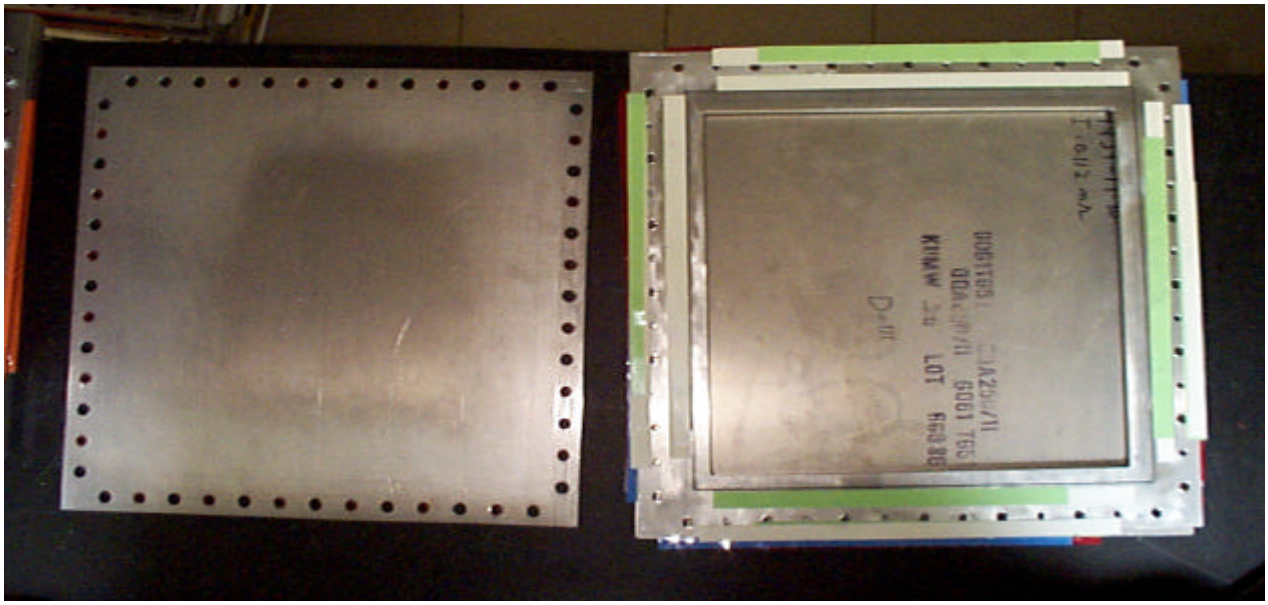
Choform 5541 bead

Close up view of 5541 bead on test plate

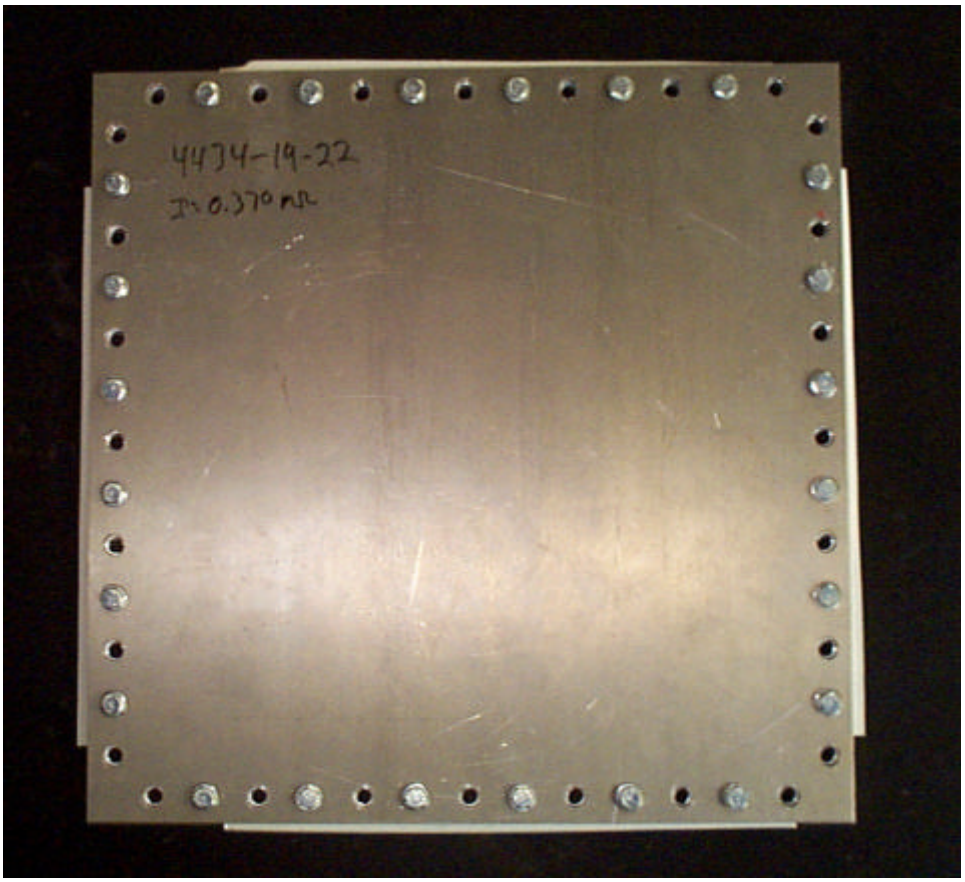
6061T6 Al plate



View of test plate showing 5541 bead non-conductive shims and bolt hole spacing



View of test fixture showing top and bottom plates. 5541 bead and non-conductive shims are on the right side plate.



View of assembled shielding plate. 5541 bead and non-conductive shims are between the two plates. Compression is supplied by steel bolts electrically isolated from the plates using nonconductive sleeves and washers.