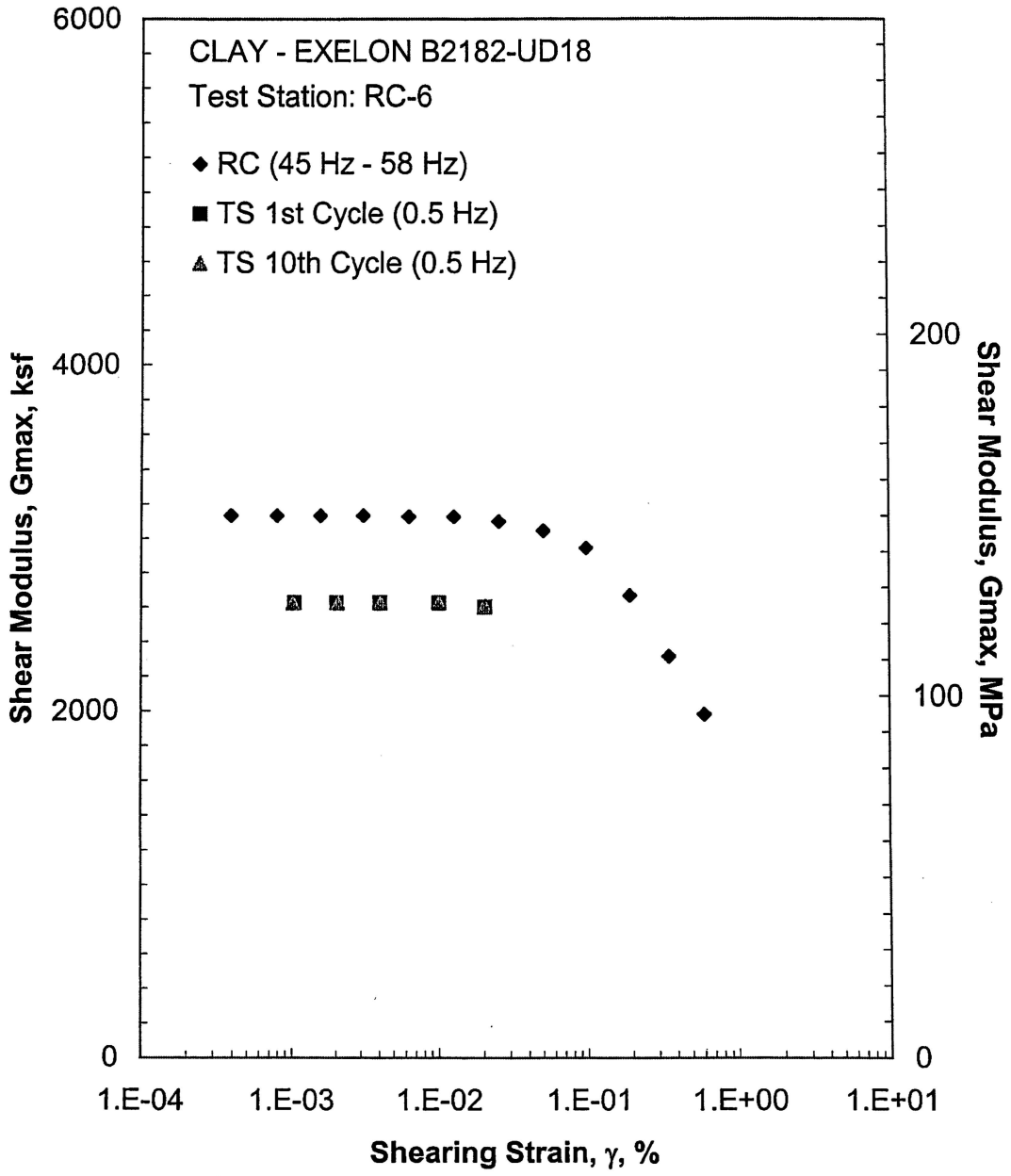

Figure D.16 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 310 psi from the Combined RCTS Tests

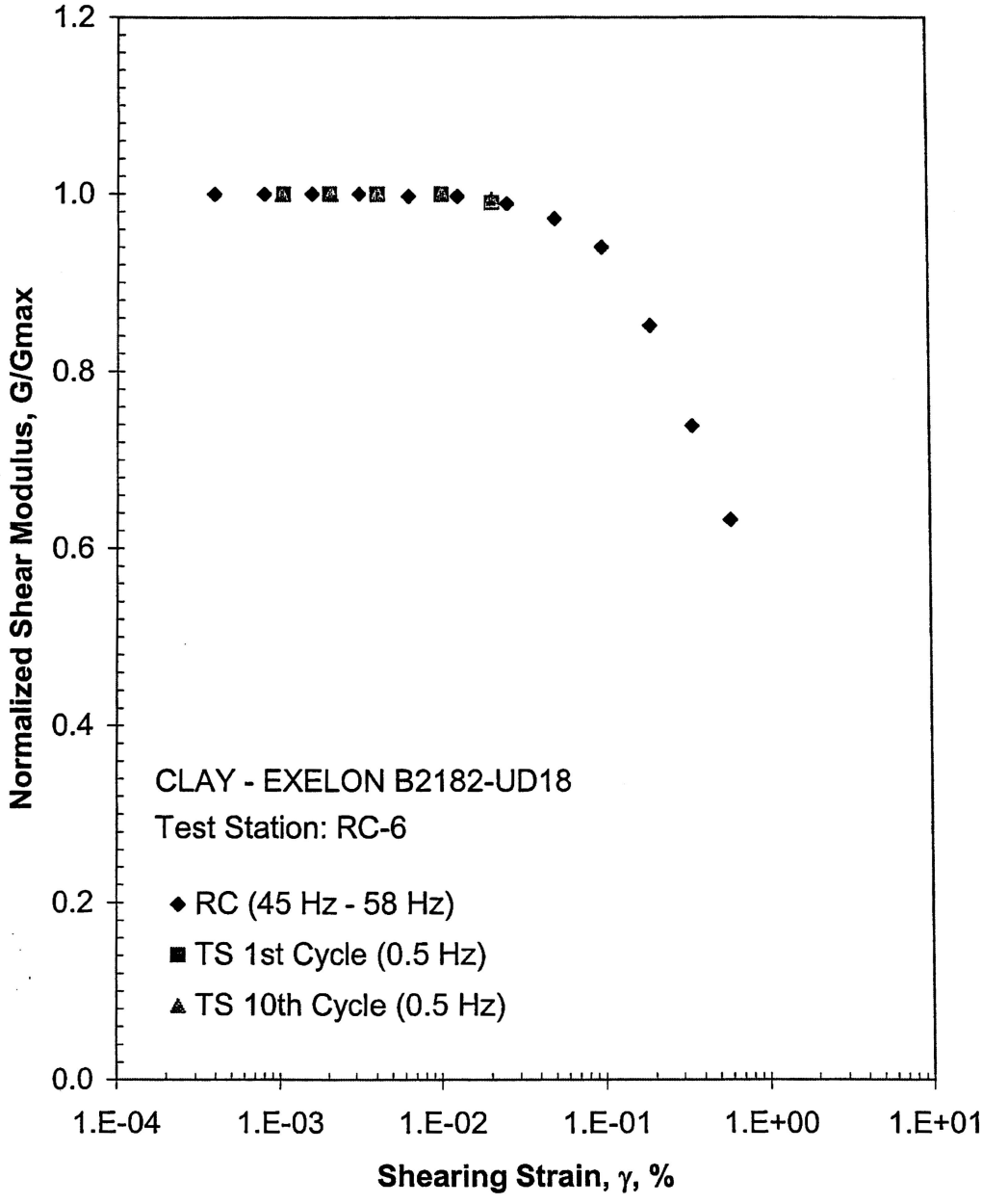

Figure D.17 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 310 psi from the Combined RCTS Tests

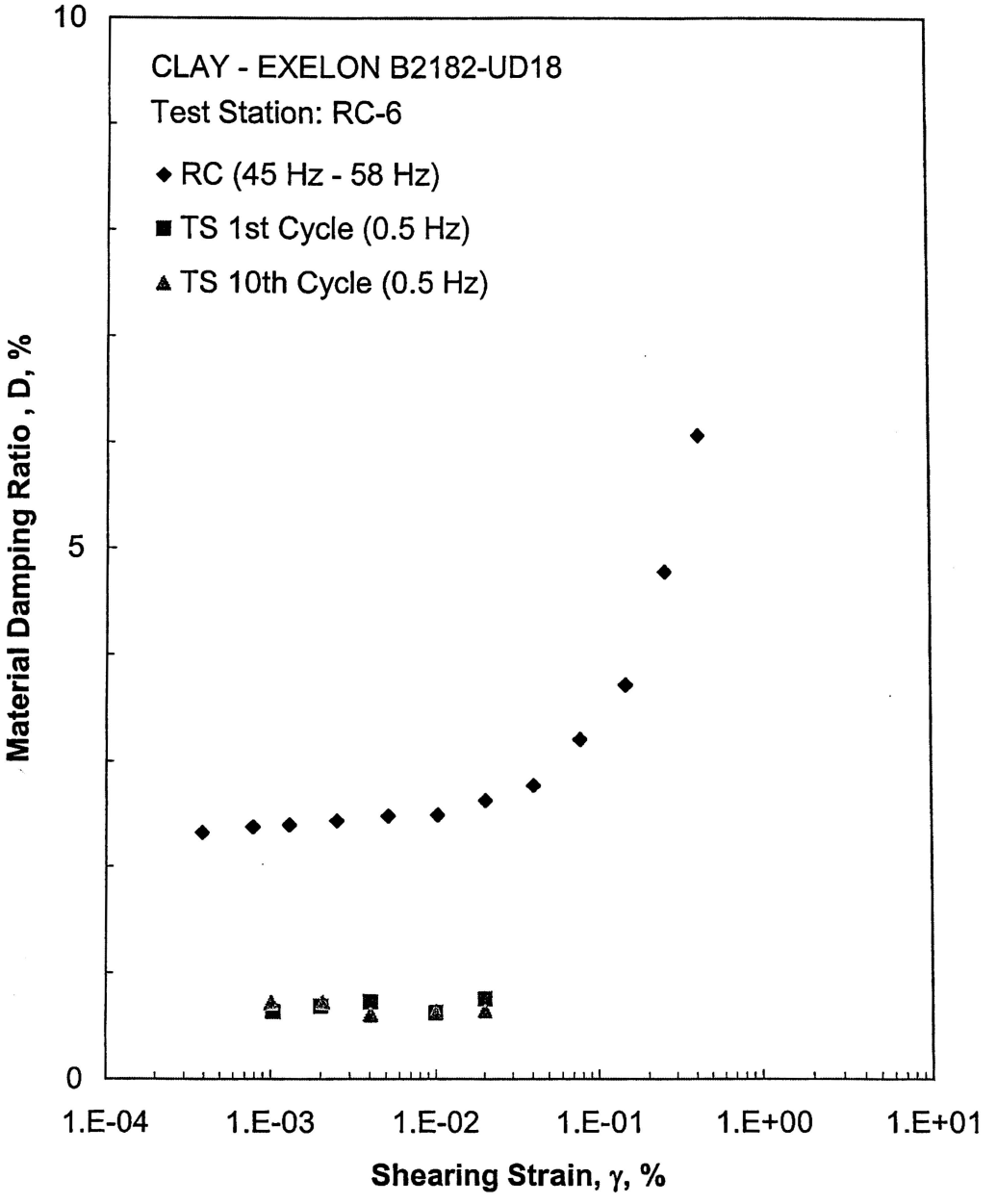

Figure D.18 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 310 psi from the Combined RCTS Tests

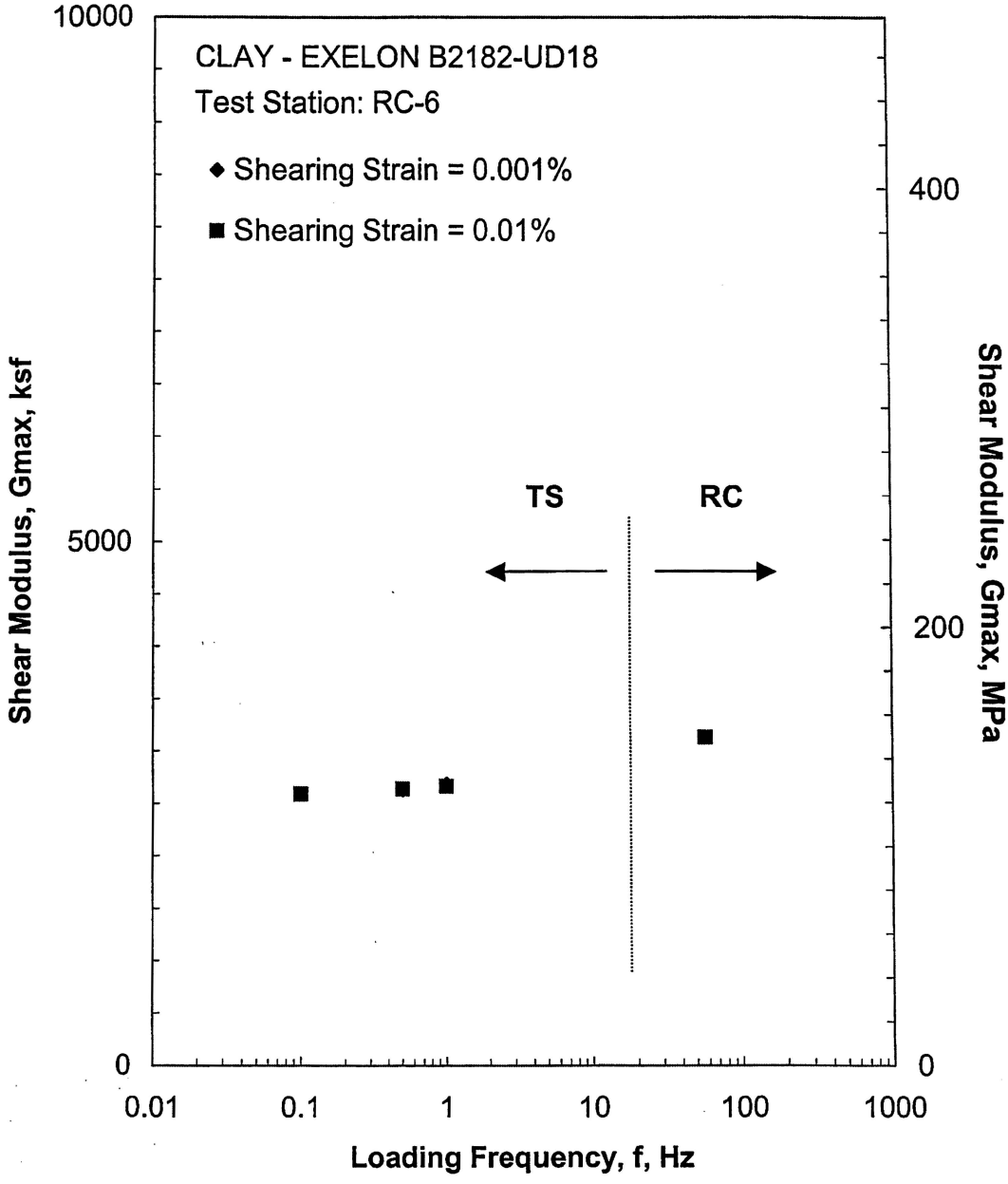

Figure D.19 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 310 psi from the Combined RCTS Tests

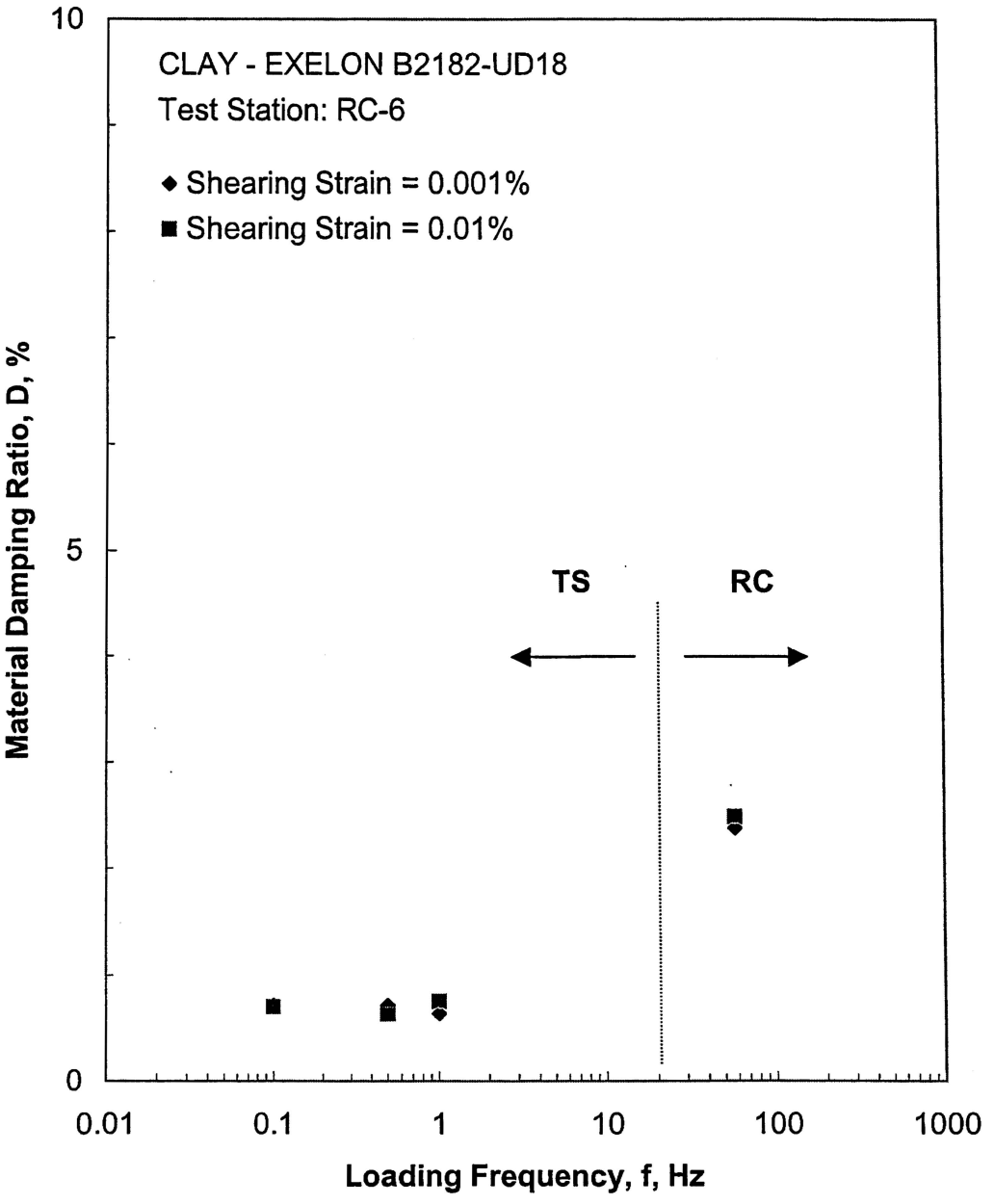

Figure D.20 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 310 psi from the Combined RCTS Tests

Table D.1 Variation in Low-Amplitude Shear Wave Velocity, Low-Amplitude Shear Modulus, Low-Amplitude Material Damping Ratio and Estimated Void Ratio with Isotropic Confining Pressure from RC Tests of Specimen EXELON B2182-UD18

Isotropic Confining Pressure, σ_o			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, Vs	Low-Amplitude Material Damping Ratio, Dmin	Estimated Void Ratio, e
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	
19	2736	131	2002	96	746	2.81	1.01
39	5616	269	2138	103	770	2.64	1.00
78	11232	537	2238	107	785	2.48	0.98
155	22320	1068	2566	123	836	2.37	0.96
310	44640	2136	3002	144	887	2.28	0.89

Table D.2 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen EXELON B2182-UD18; Isoptropic Confining Pressure, σ_o=78 psi (11.2 ksf = 537 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average+ Shearing Strain, %	Material Damping Ratio×, D, %
2.66E-04	2272	1.00	2.66E-04	2.43
5.48E-04	2272	1.00	5.48E-04	2.46
1.08E-03	2260	0.99	1.08E-03	2.48
2.18E-03	2260	0.99	2.18E-03	2.56
4.39E-03	2260	0.99	3.51E-03	2.62
8.79E-03	2261	0.99	7.03E-03	2.74
1.76E-02	2238	0.99	1.46E-02	2.89
3.49E-02	2238	0.98	2.79E-02	3.13
6.95E-02	2154	0.95	5.35E-02	3.61
1.34E-01	1963	0.86	1.00E-01	4.21
2.31E-01	1734	0.76	1.64E-01	5.21
3.73E-01	1529	0.67	2.54E-01	6.38

+ Average Shearing Strain from the First Three Cycles of the Free Vibration Decay Curve

× Average Damping Ratio from the First Three Cycles of the Free Vibration Decay Curve

Table D.3 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen EXELON B2182-UD18; Isotropic Confining Pressure, σ_o= 78 psi (11.2 ksf =537 kPa)

First Cycle				Tenth Cycle			
Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
1.01E-03	1854	1.00	0.56	1.00E-03	1851	1.00	0.46
2.02E-03	1854	1.00	0.61	2.04E-03	1851	1.00	0.50
3.97E-03	1854	1.00	0.59	4.00E-03	1851	1.00	0.60
1.02E-02	1854	1.00	0.70	1.02E-02	1851	1.00	0.79

Table D.4 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen EXELON B2182-UD18; Isoptropic Confining Pressure, σ_o= 310 psi (44.6 ksf = 2136 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
3.89E-04	3135	1.00	3.89E-04	2.32
7.88E-04	3135	1.00	7.88E-04	2.38
1.57E-03	3135	1.00	1.30E-03	2.40
3.10E-03	3135	1.00	2.51E-03	2.43
6.27E-03	3128	1.00	5.14E-03	2.48
1.25E-02	3128	1.00	1.03E-02	2.49
2.52E-02	3100	0.99	2.04E-02	2.63
5.02E-02	3046	0.97	4.06E-02	2.77
9.79E-02	2947	0.94	7.73E-02	3.20
1.93E-01	2669	0.85	1.47E-01	3.72
3.55E-01	2315	0.74	2.56E-01	4.78
6.03E-01	1982	0.63	4.22E-01	6.06

[+] Average Shearing Strain from the First Three Cycles of the Free Vibration Decay Curve

[x] Average Damping Ratio from the First Three Cycles of the Free Vibration Decay Curve

Table D.5 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen EXELON B2182-UD18; Isotropic Confining Pressure, σ_o=310 psi (44.6 ksf = 2136 kPa)

First Cycle				Tenth Cycle			
Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
1.04E-03	2627	1.00	0.63	1.01E-03	2626	1.00	0.72
2.02E-03	2627	1.00	0.68	2.06E-03	2626	1.00	0.72
4.04E-03	2627	1.00	0.72	4.04E-03	2626	1.00	0.60
9.98E-03	2627	1.00	0.62	1.00E-02	2626	1.00	0.63
2.03E-02	2602	0.99	0.75	2.02E-02	2610	0.99	0.64

APPENDIX E

Specimen B2182-UD9
(Index Properties Not Available)

Borehole B2182
Sample UD9
Depth = 85.8 ft (26.2)
Total Unit Weight = 115.0 lb/ft^3
Water Content = 35.1 %
Estimated In-Situ Ko = 0.5
Estimated In-Situ Mean Effective
Stress = 39 psi

FUGRO JOB #: 0401-1686
Testing Station: RC5

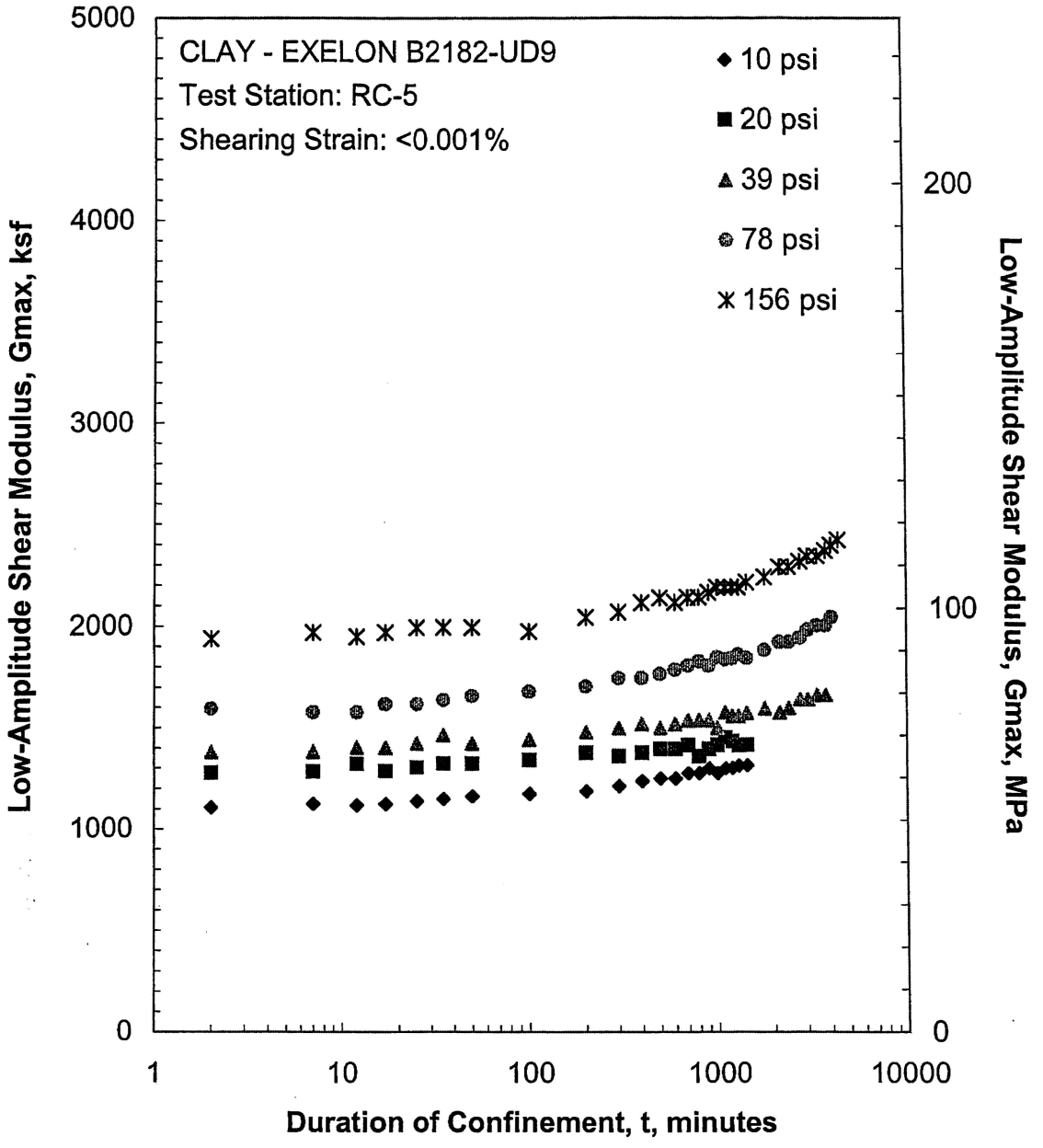

Figure E.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

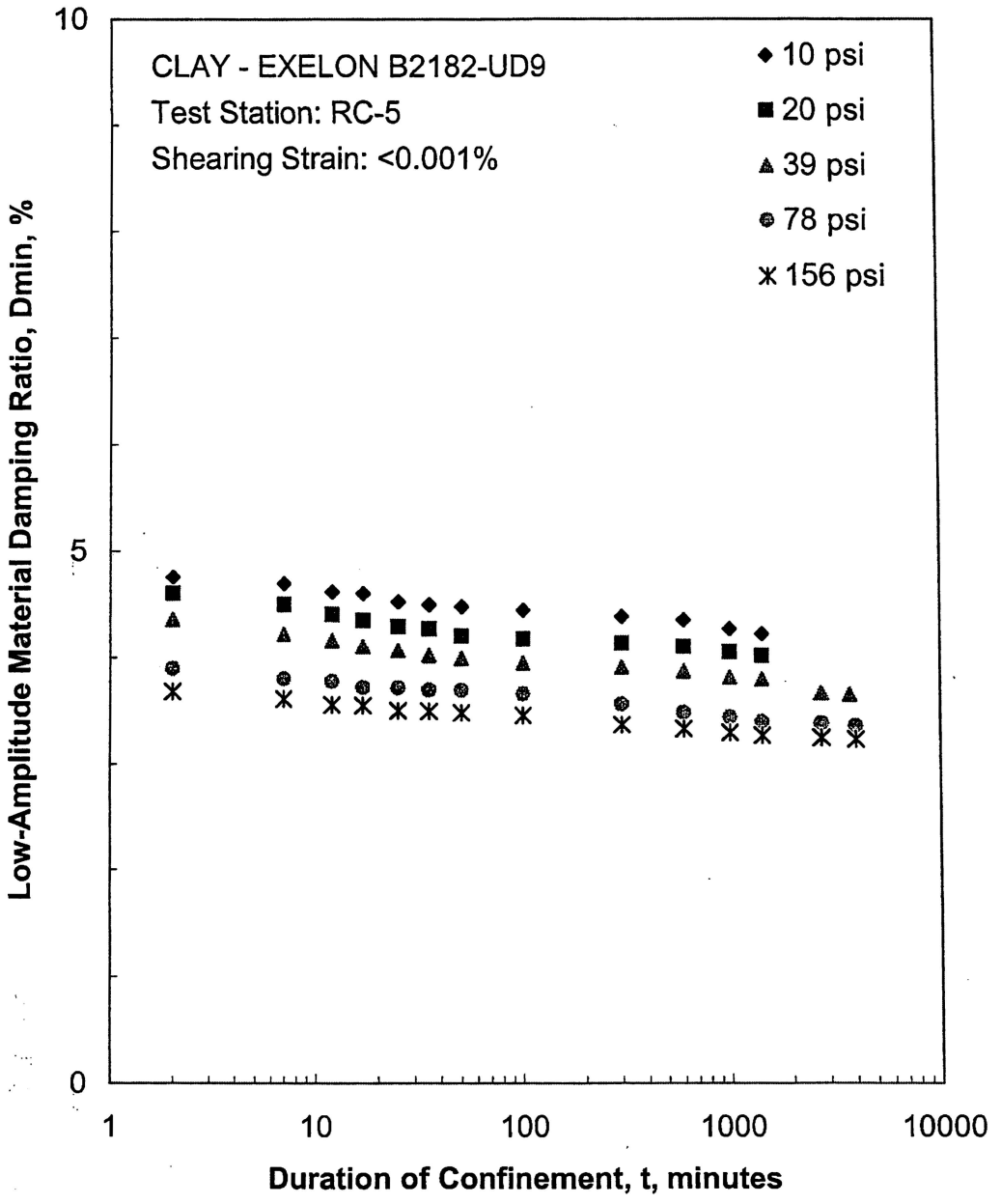

Figure E.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

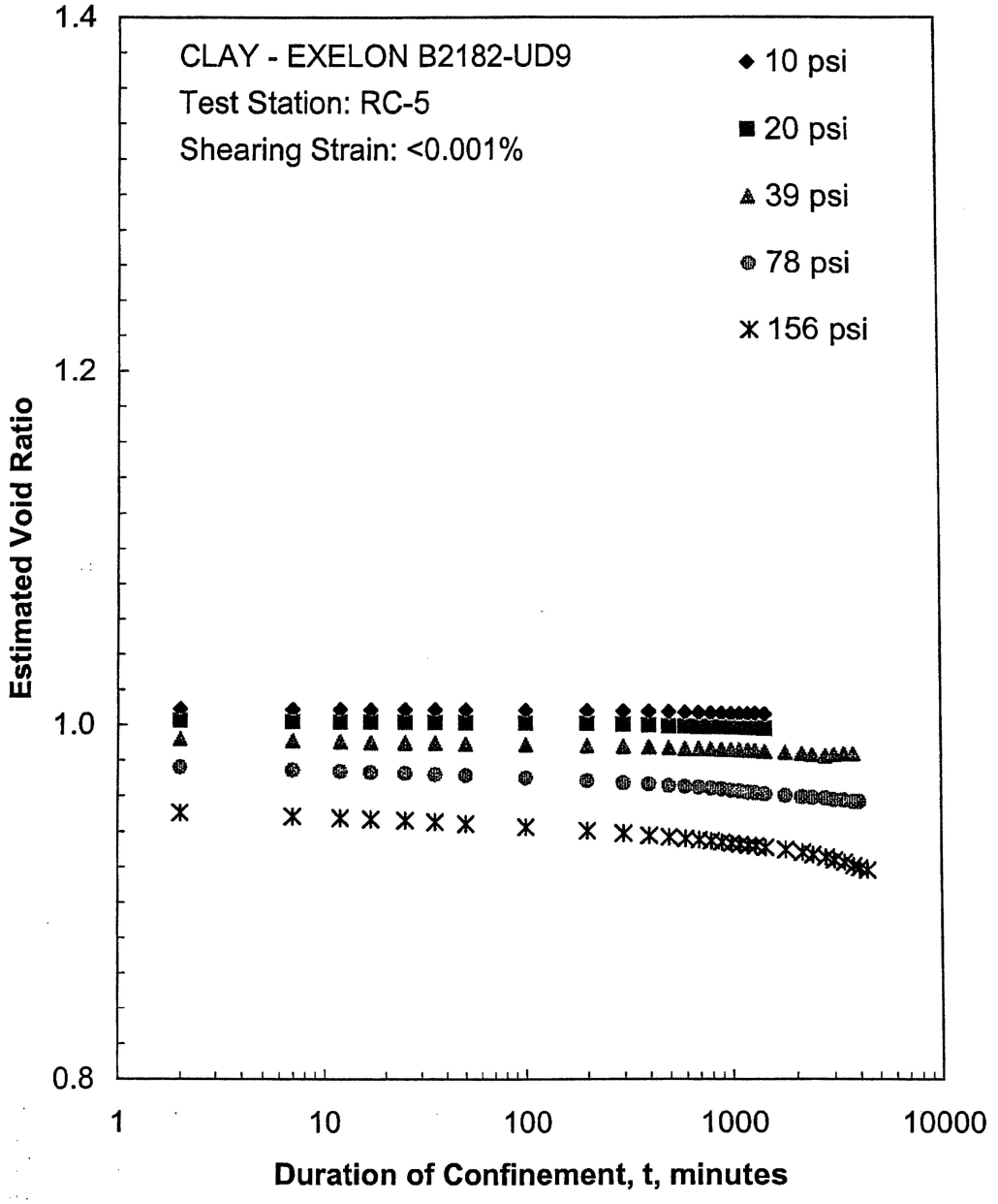

Figure E.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

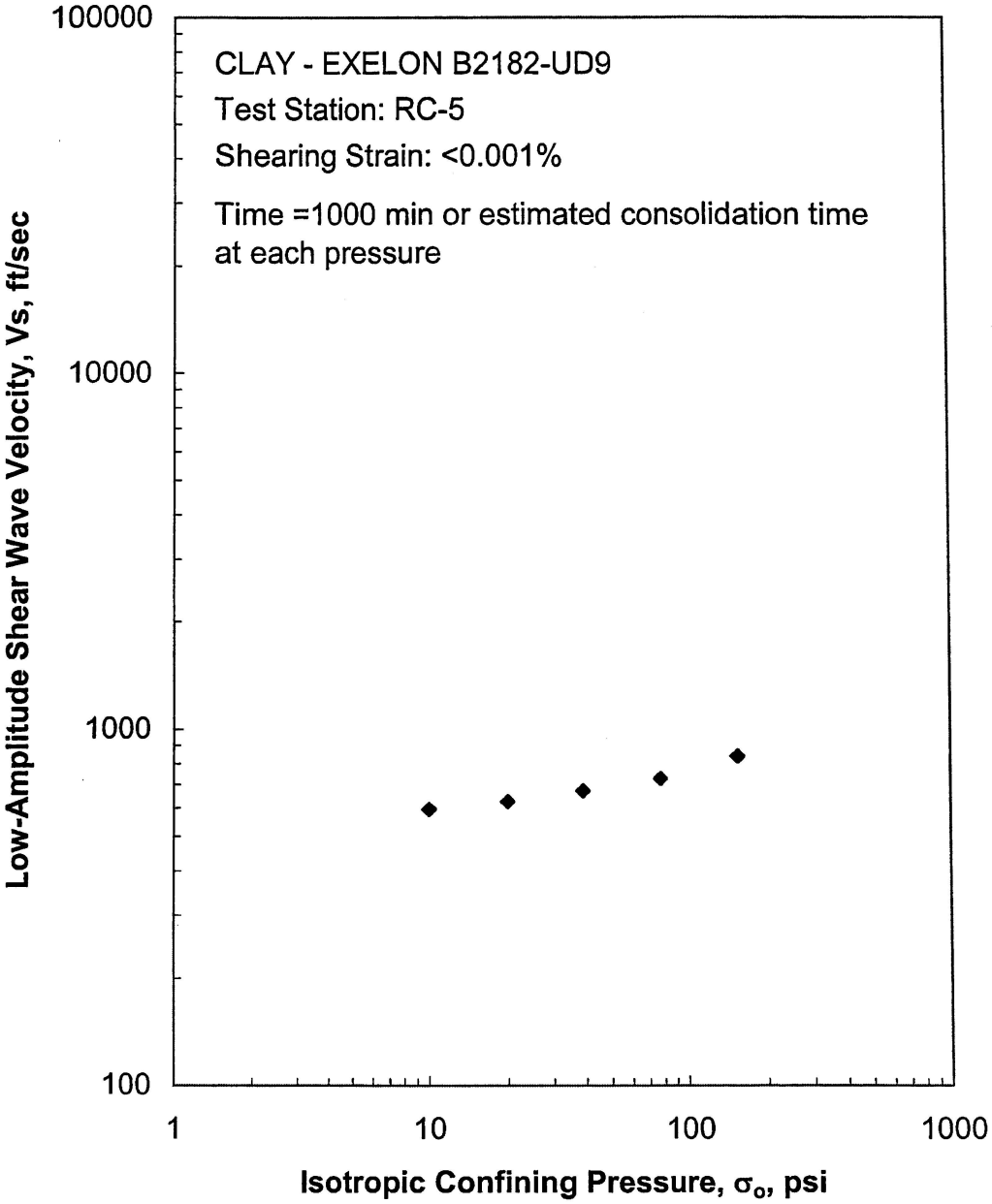

Figure E.4 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests

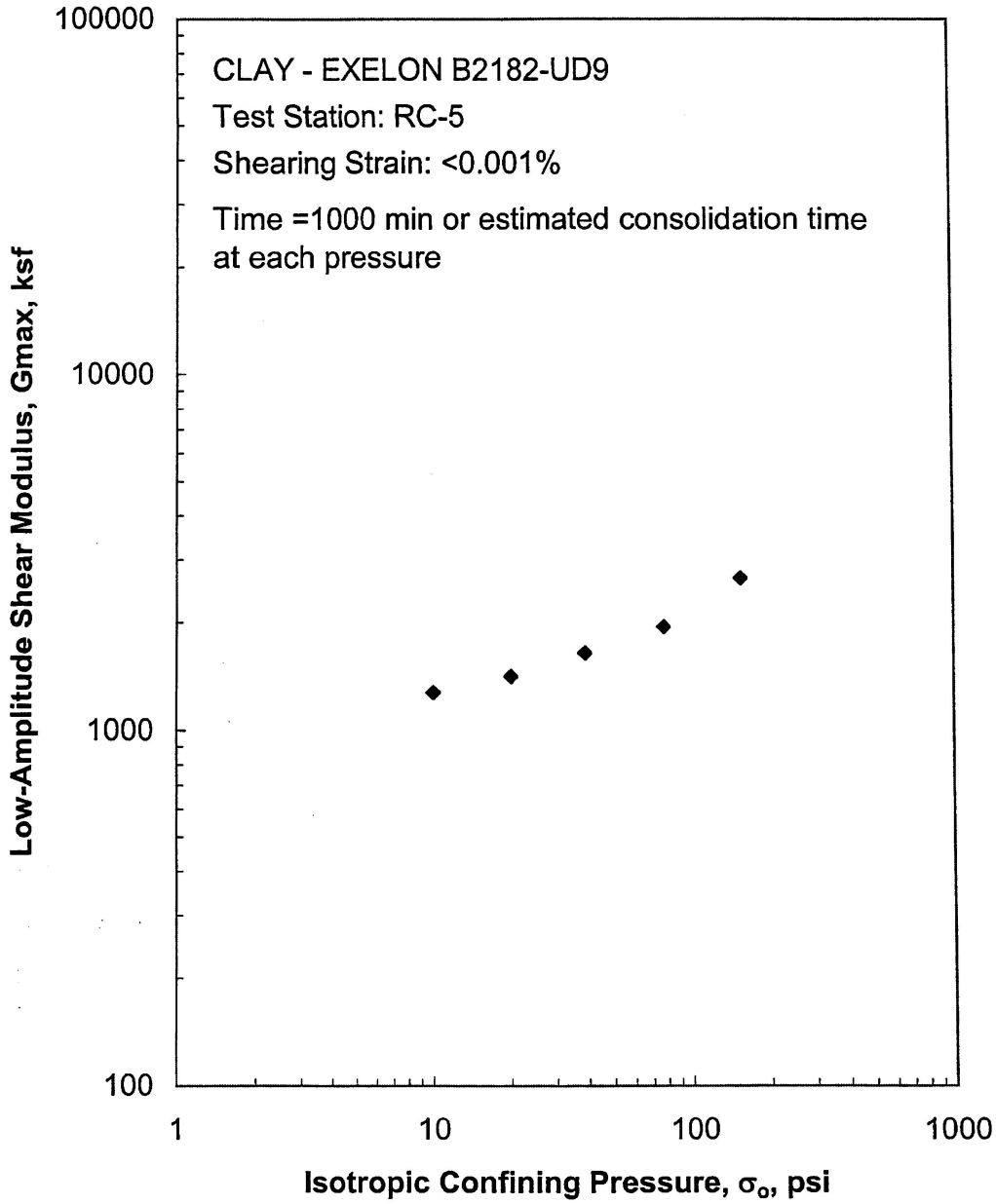

Figure E.5 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Tests

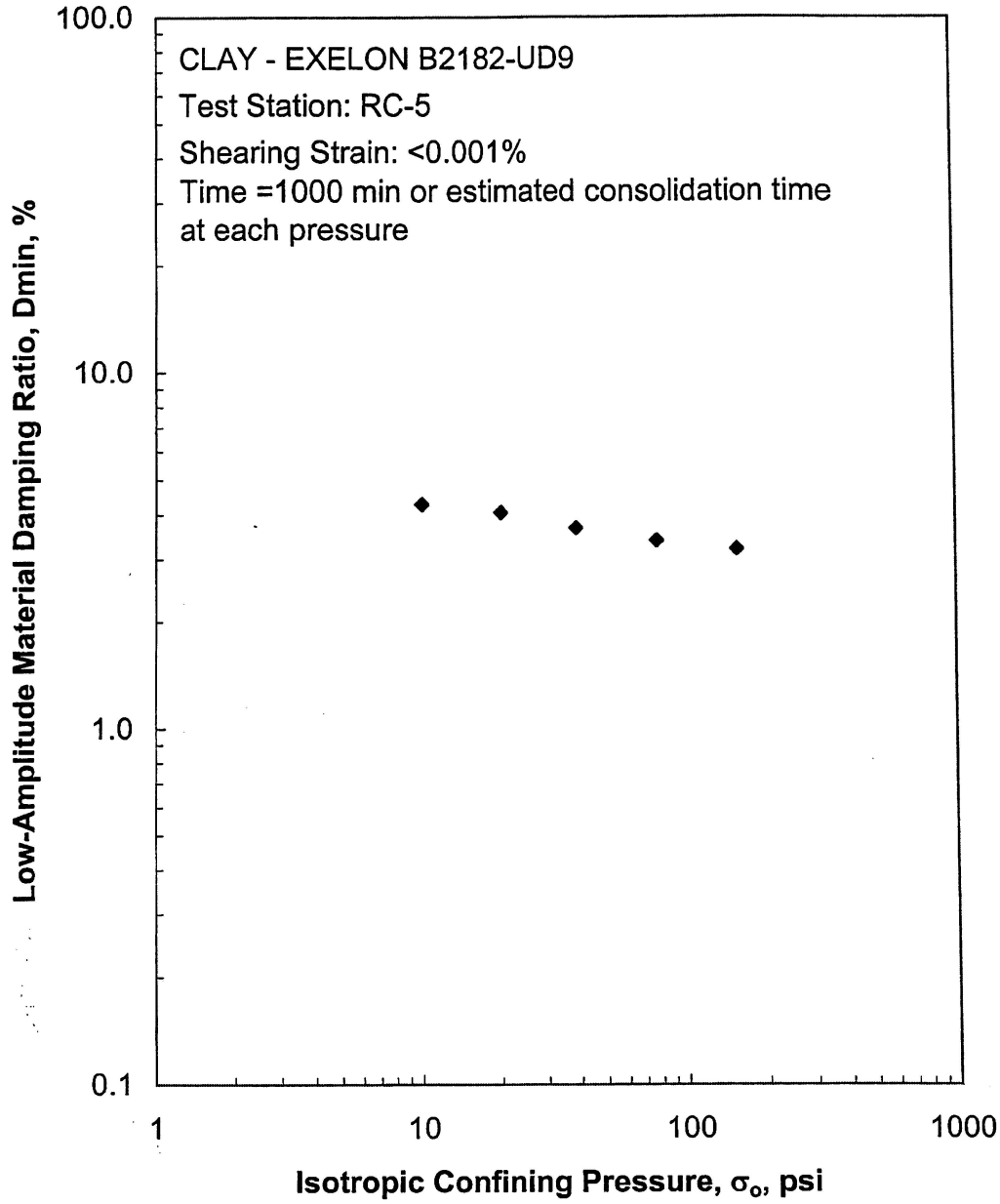

Figure E.6 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests

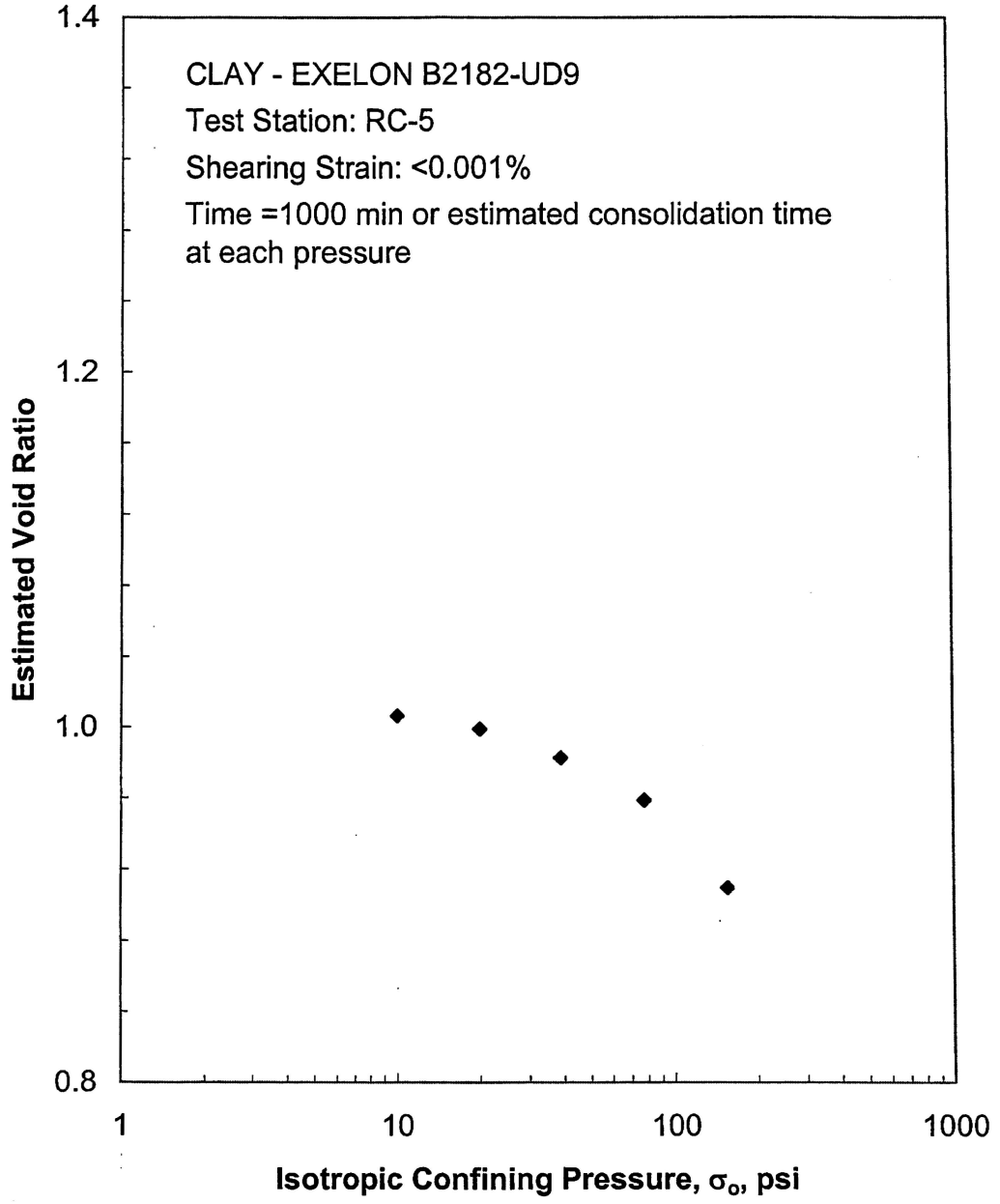

Figure E.7 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests

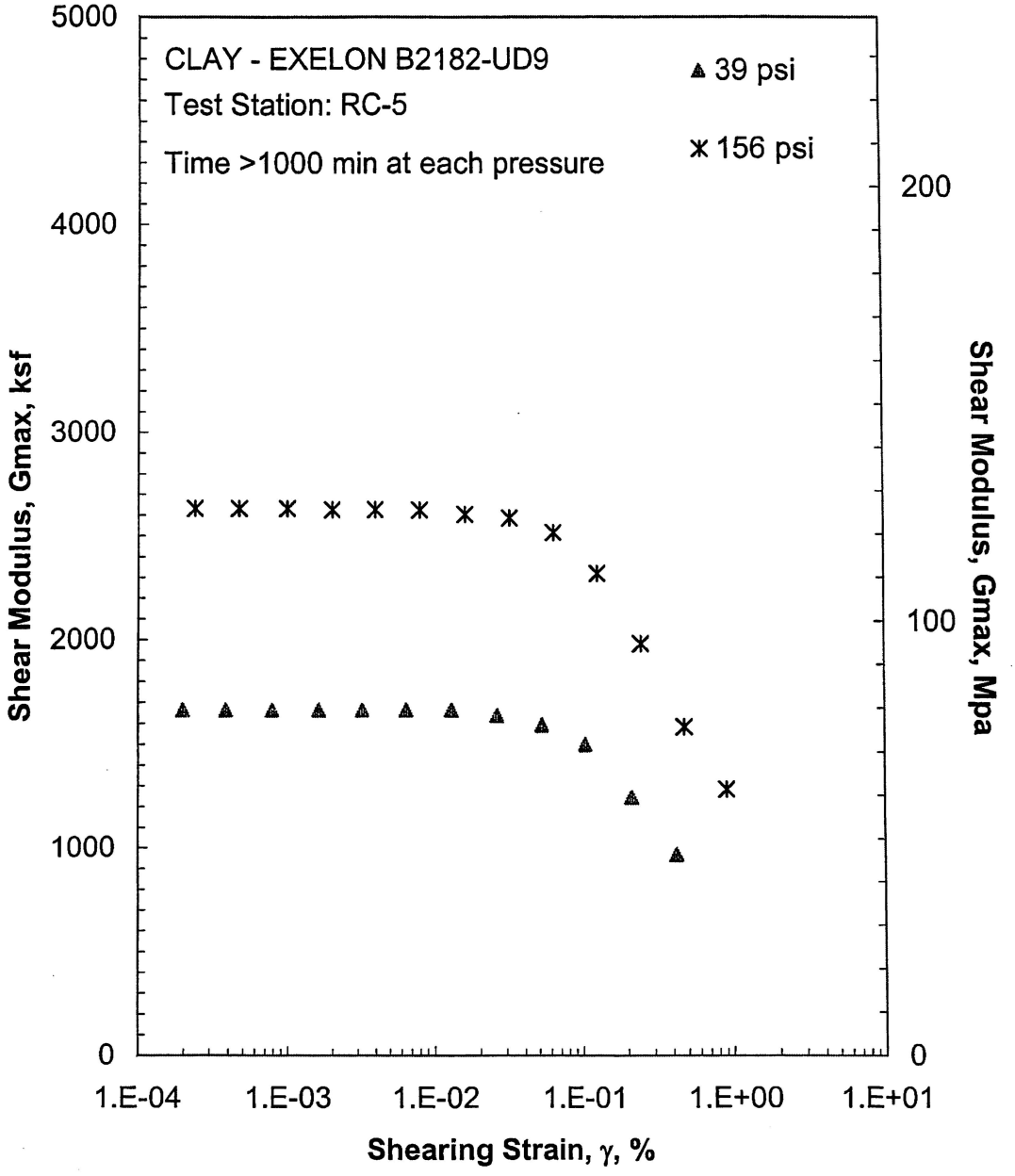

Figure E.8 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

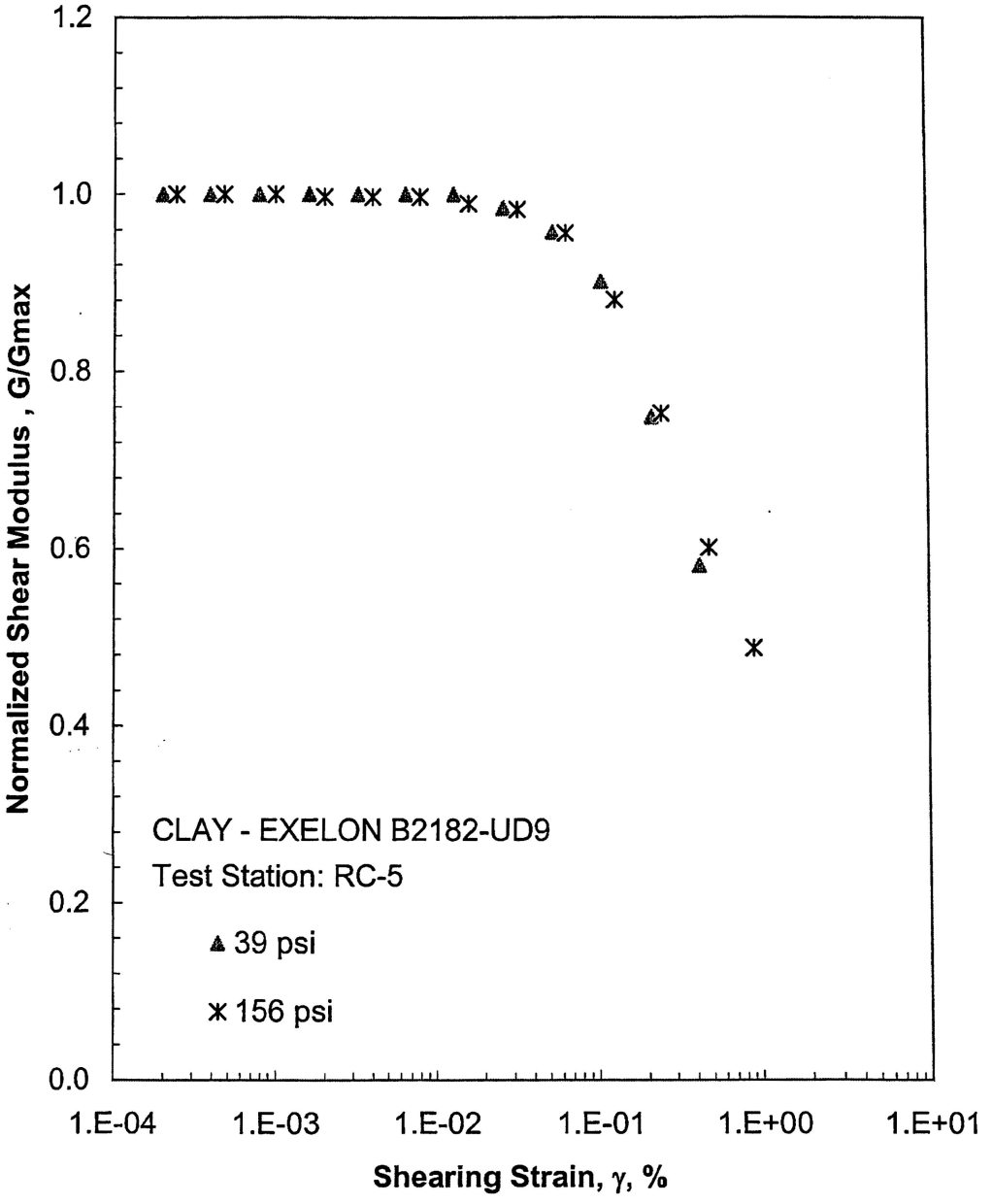

Figure E.9 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

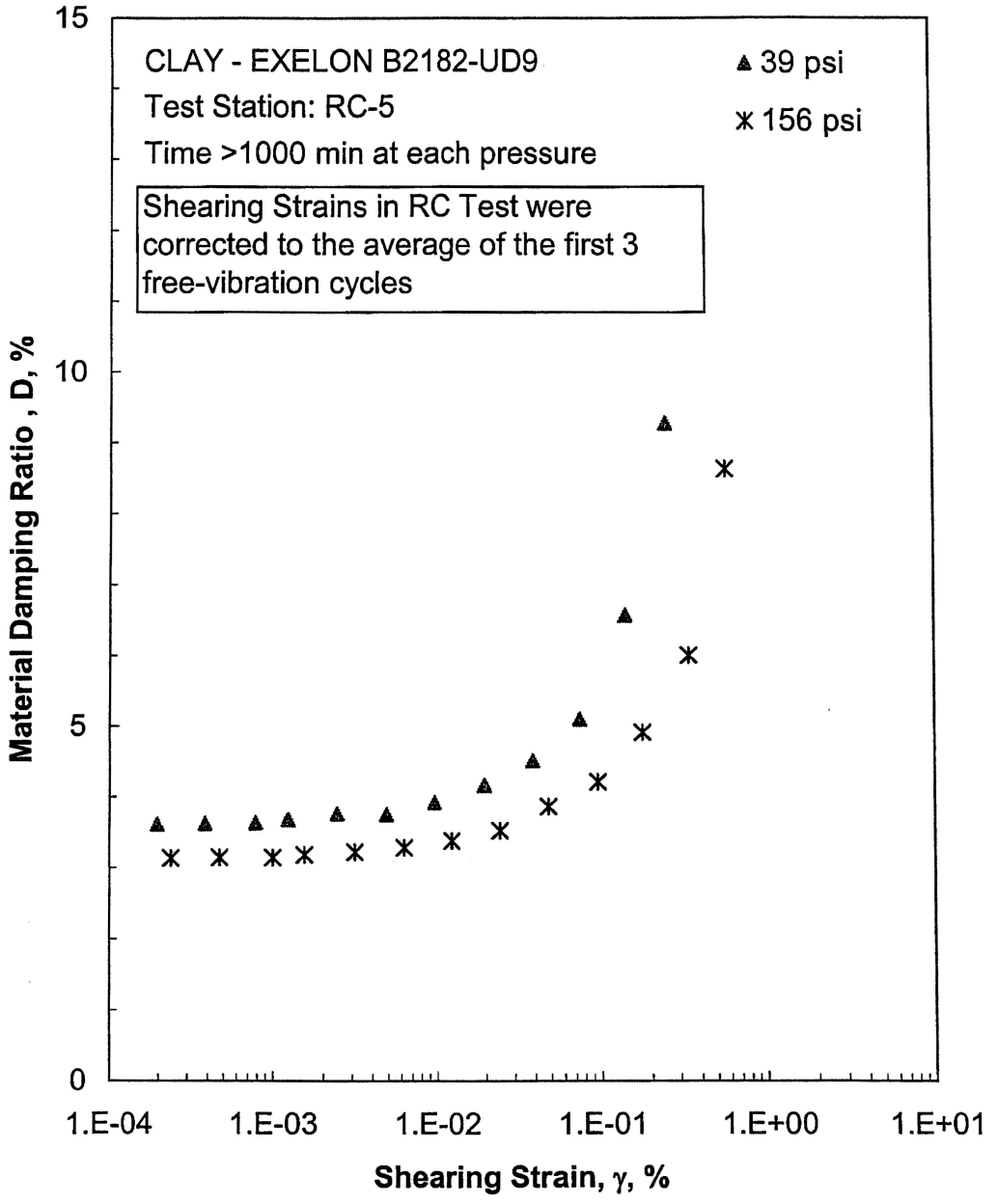

Figure E.10 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

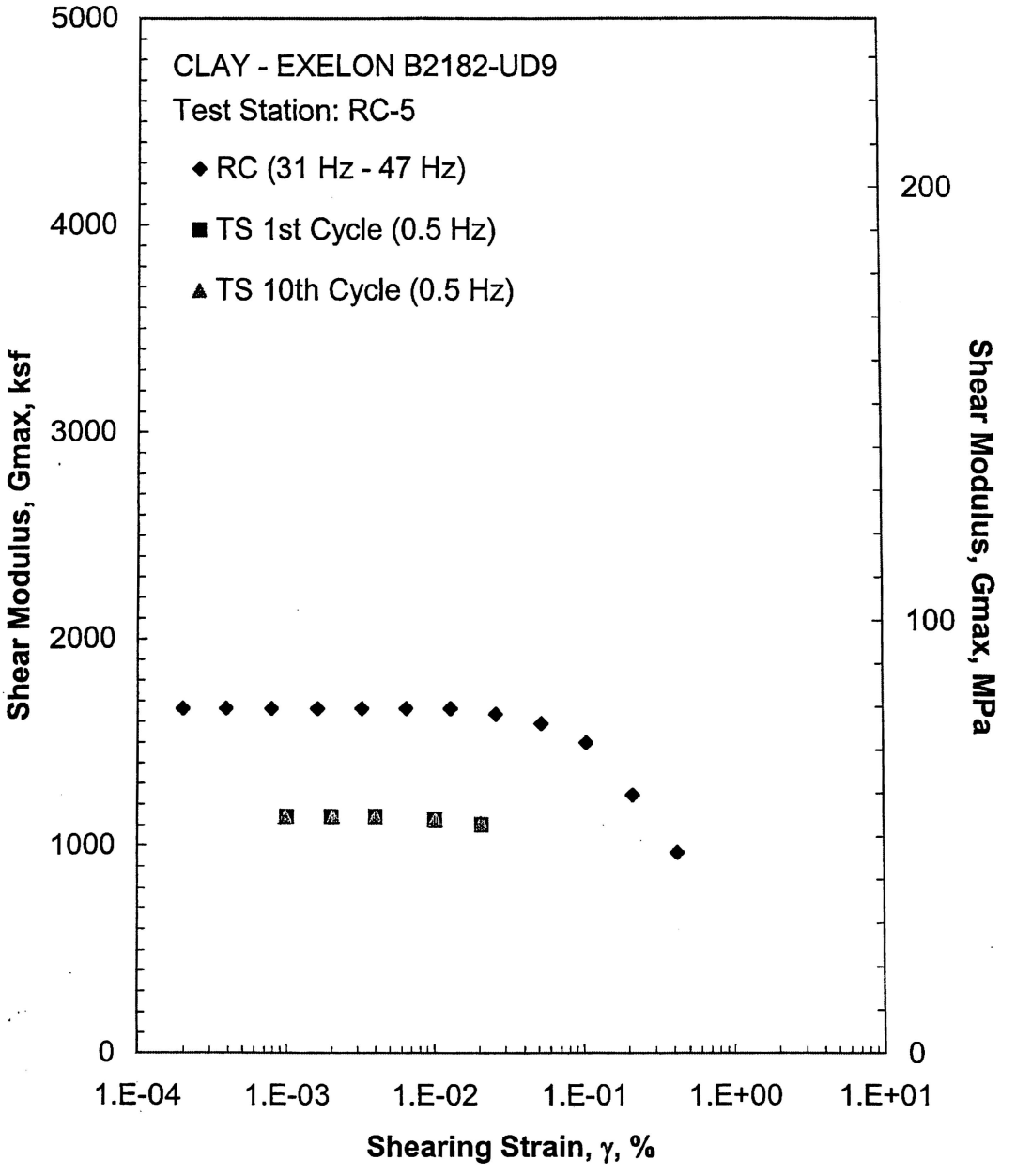

Figure E.11 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 39 psi from the Combined RCTS Tests

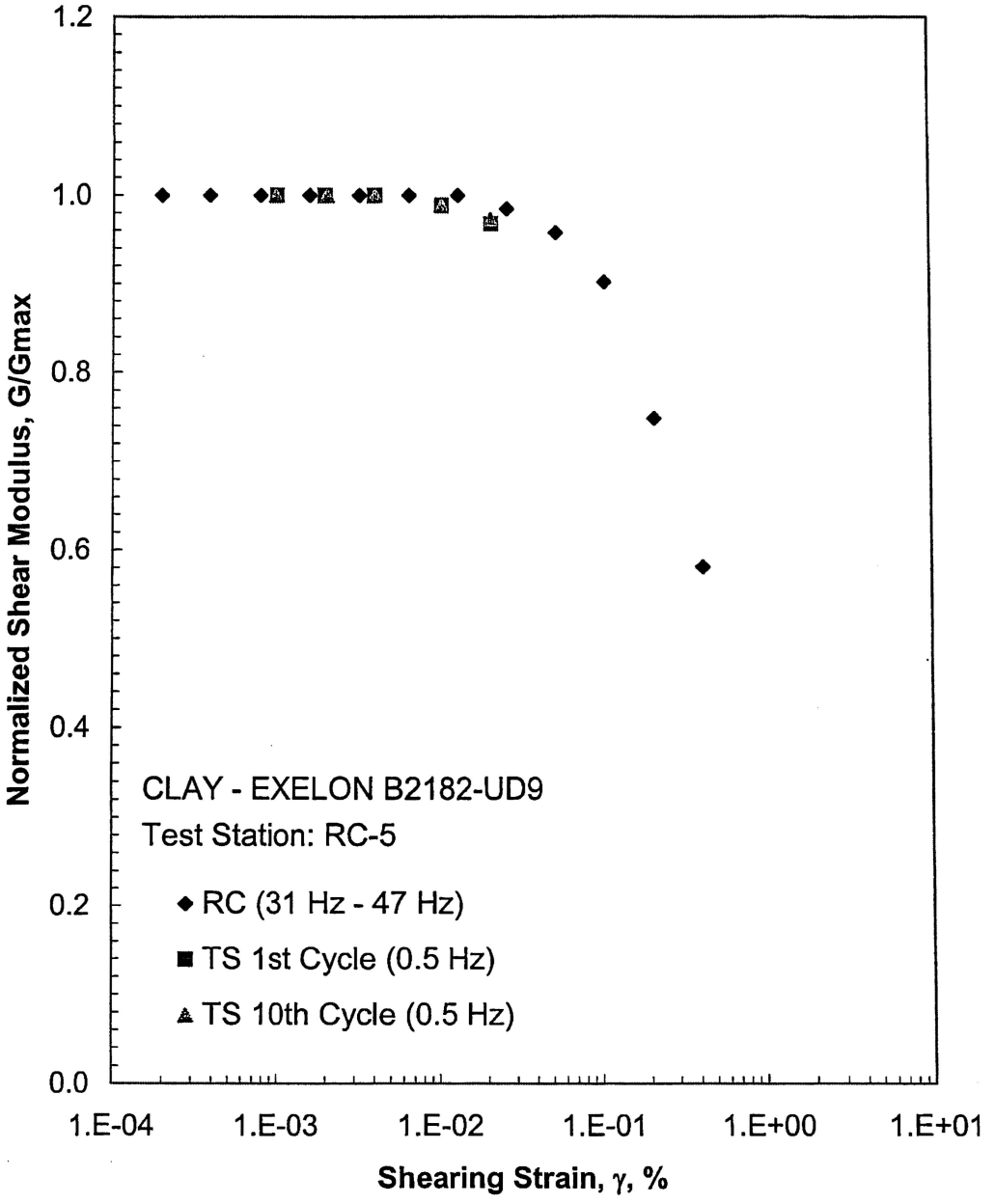

Figure E.12 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 39 psi from the Combined RCTS Tests

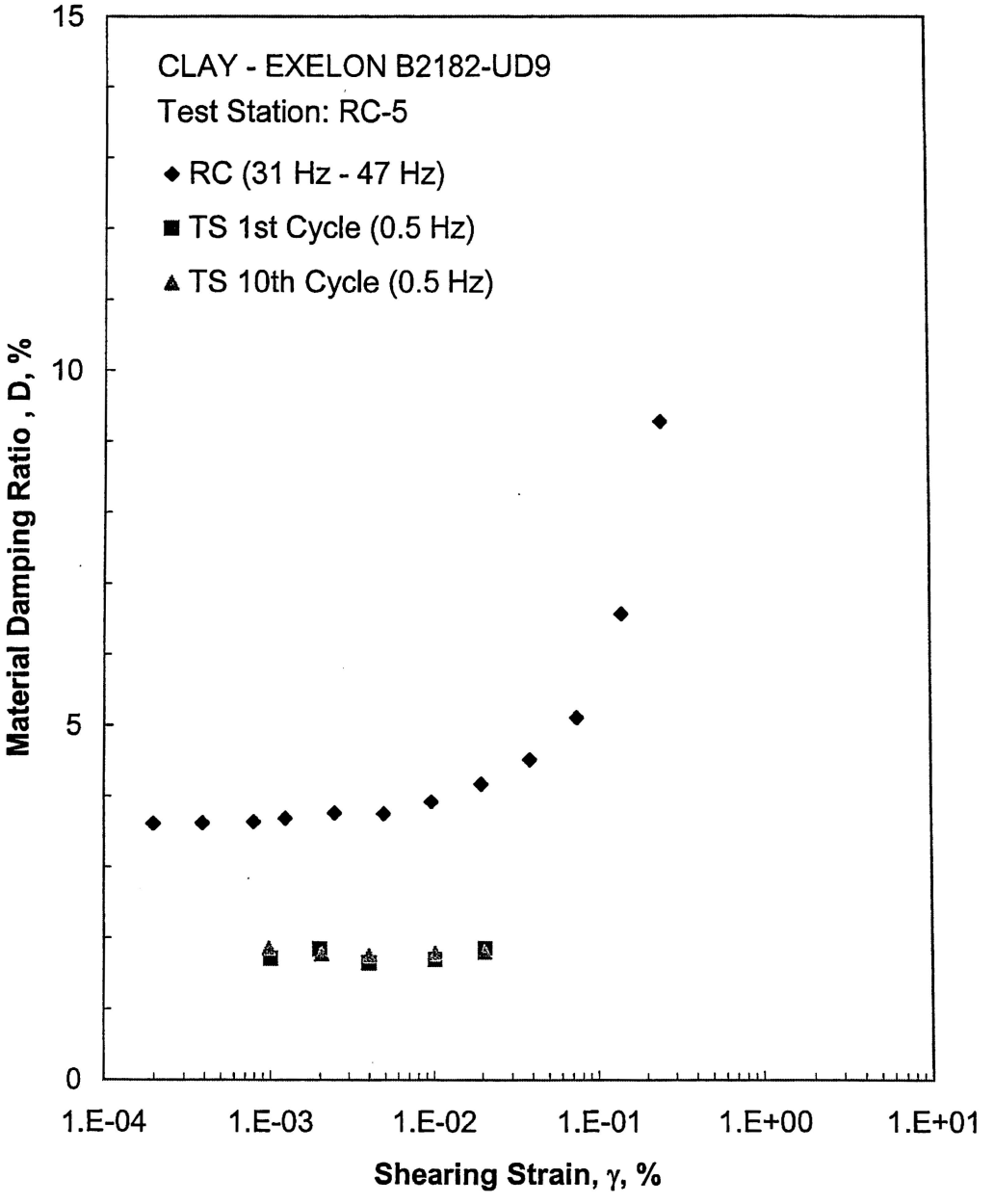

Figure E.13 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 39 psi from the Combined RCTS Tests

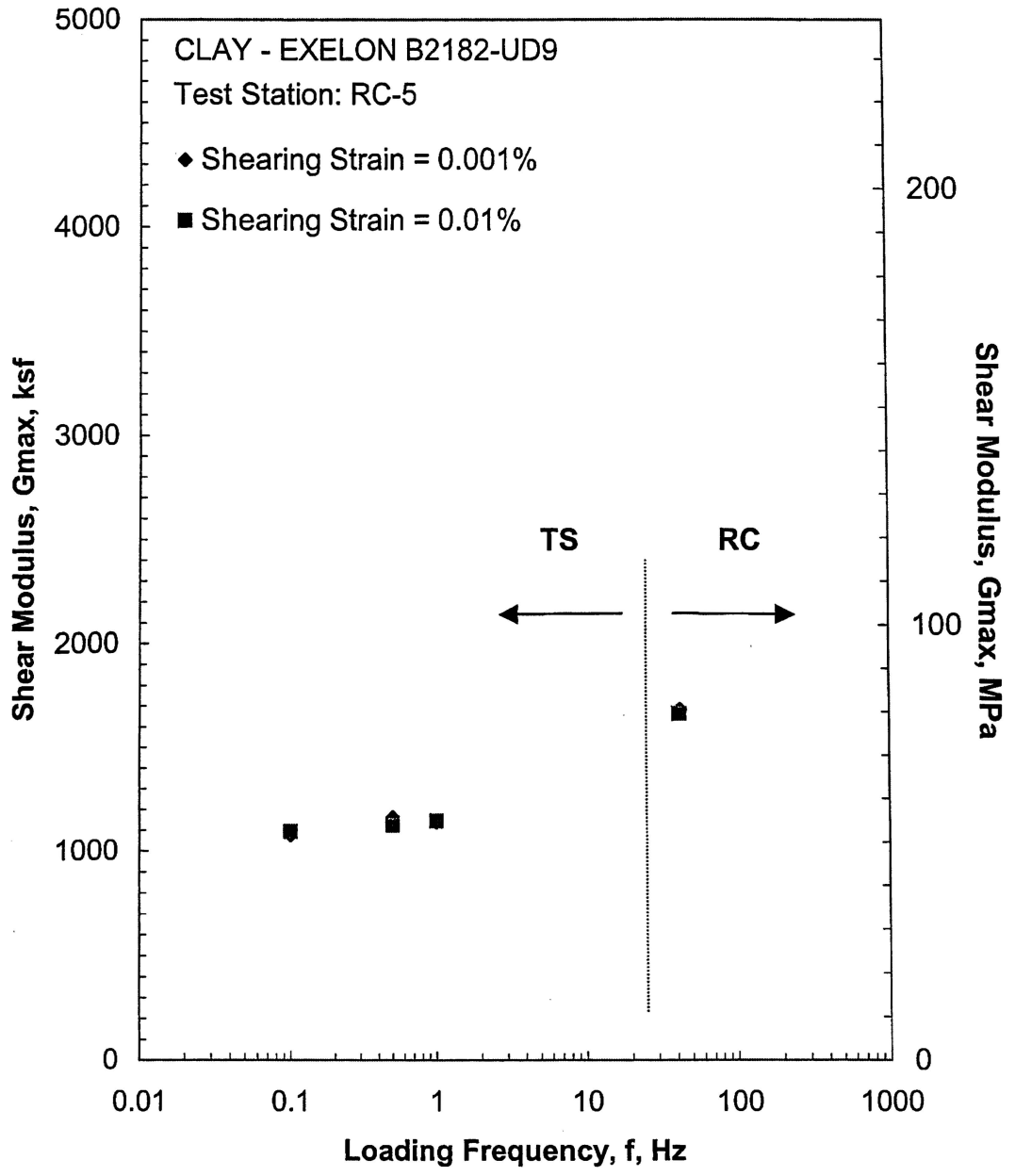

Figure E.14 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 39 psi from the Combined RCTS Tests

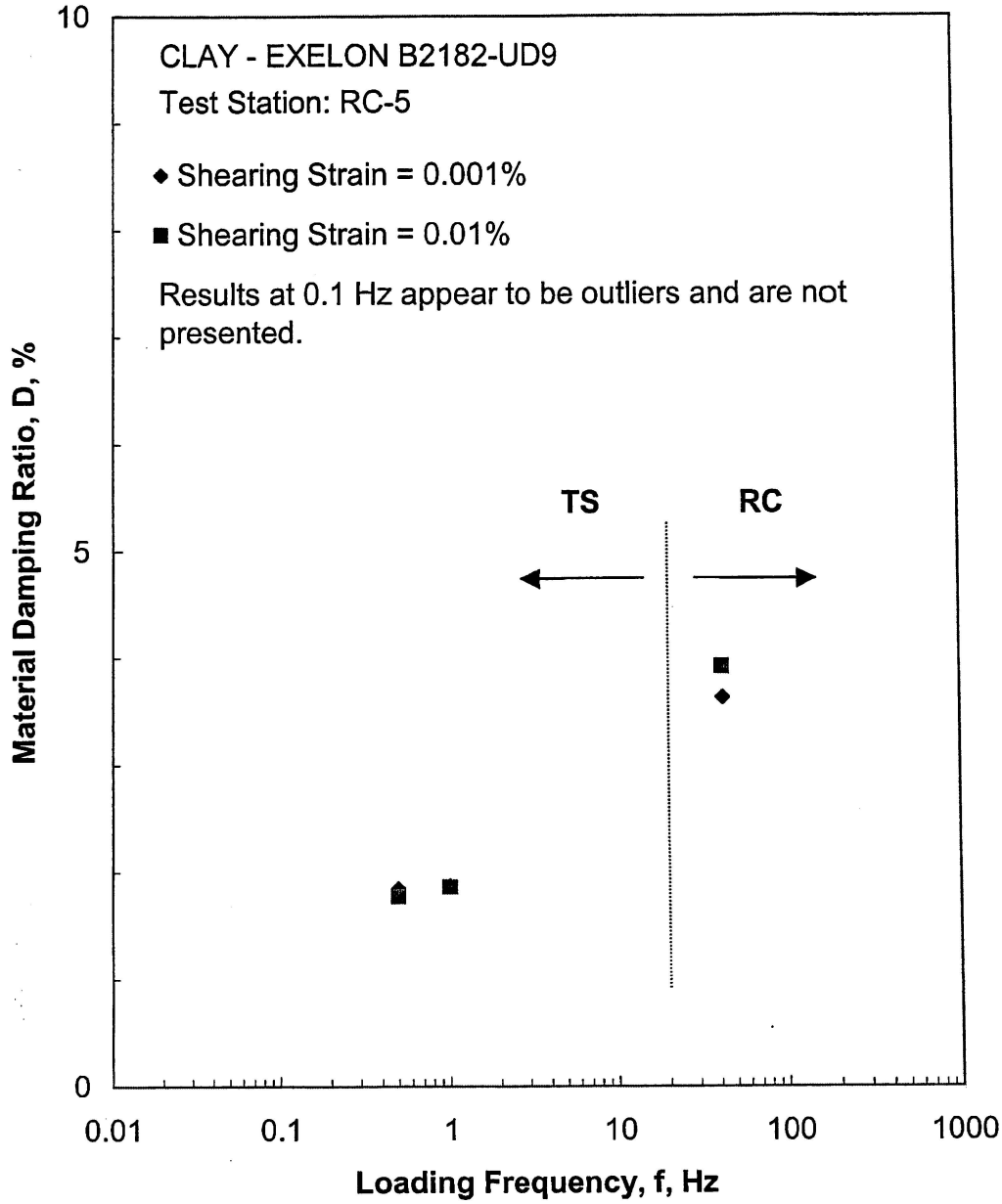

Figure E.15 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 39 psi from the Combined RCTS Tests

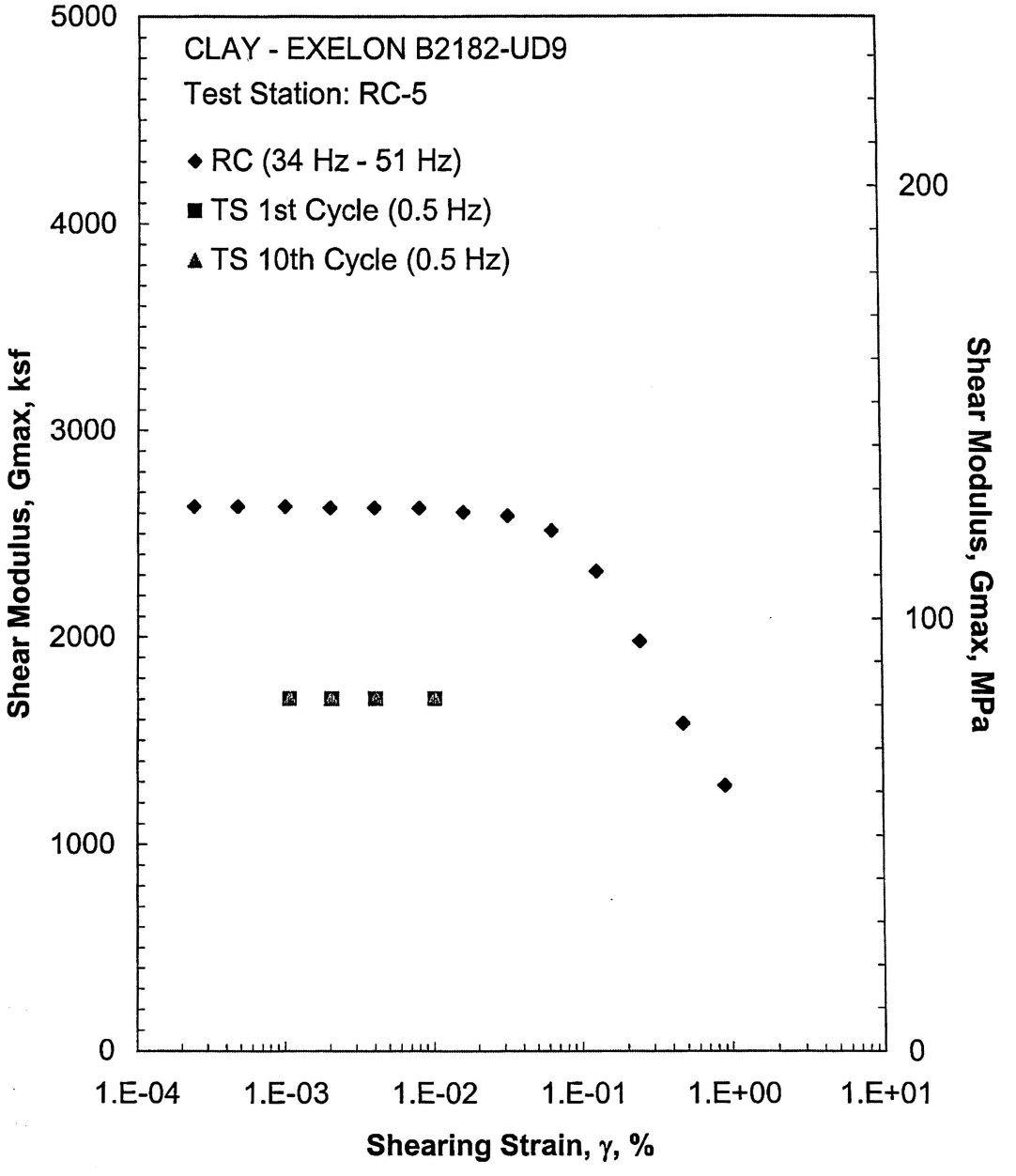

Figure E.16 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 156 psi from the Combined RCTS Tests

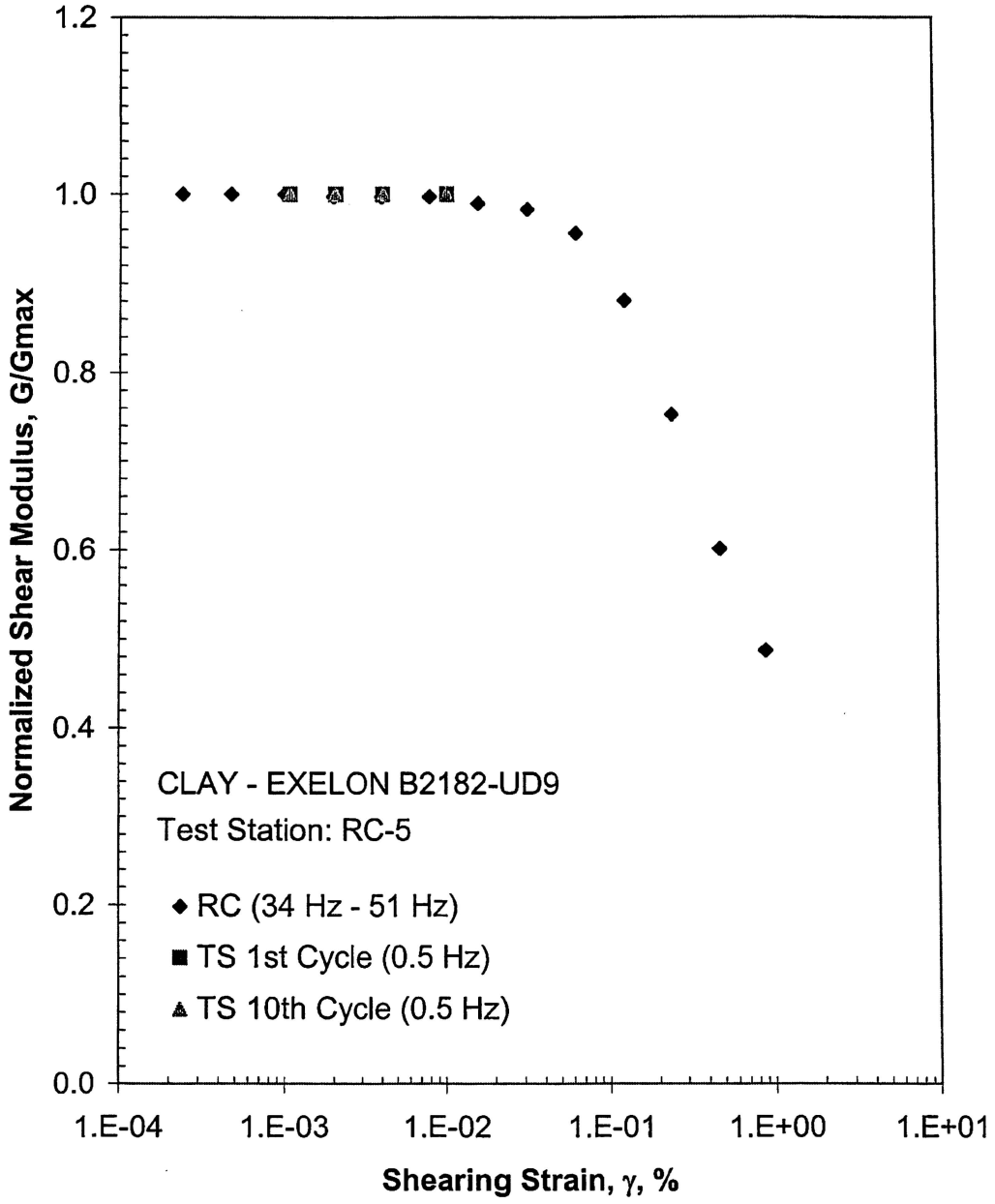

Figure E.17 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 156 psi from the Combined RCTS Tests

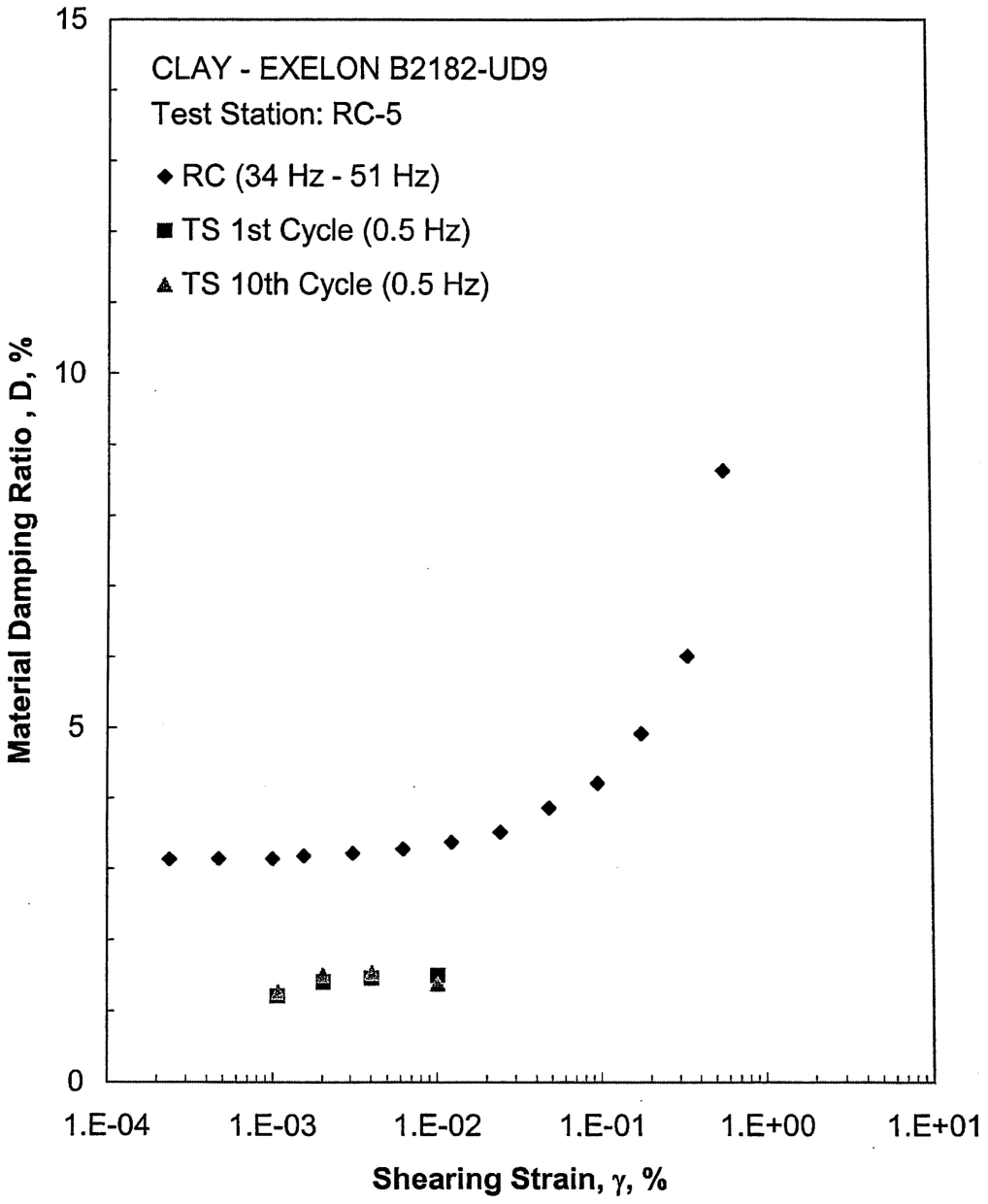

Figure E.18 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 156 psi from the Combined RCTS Tests

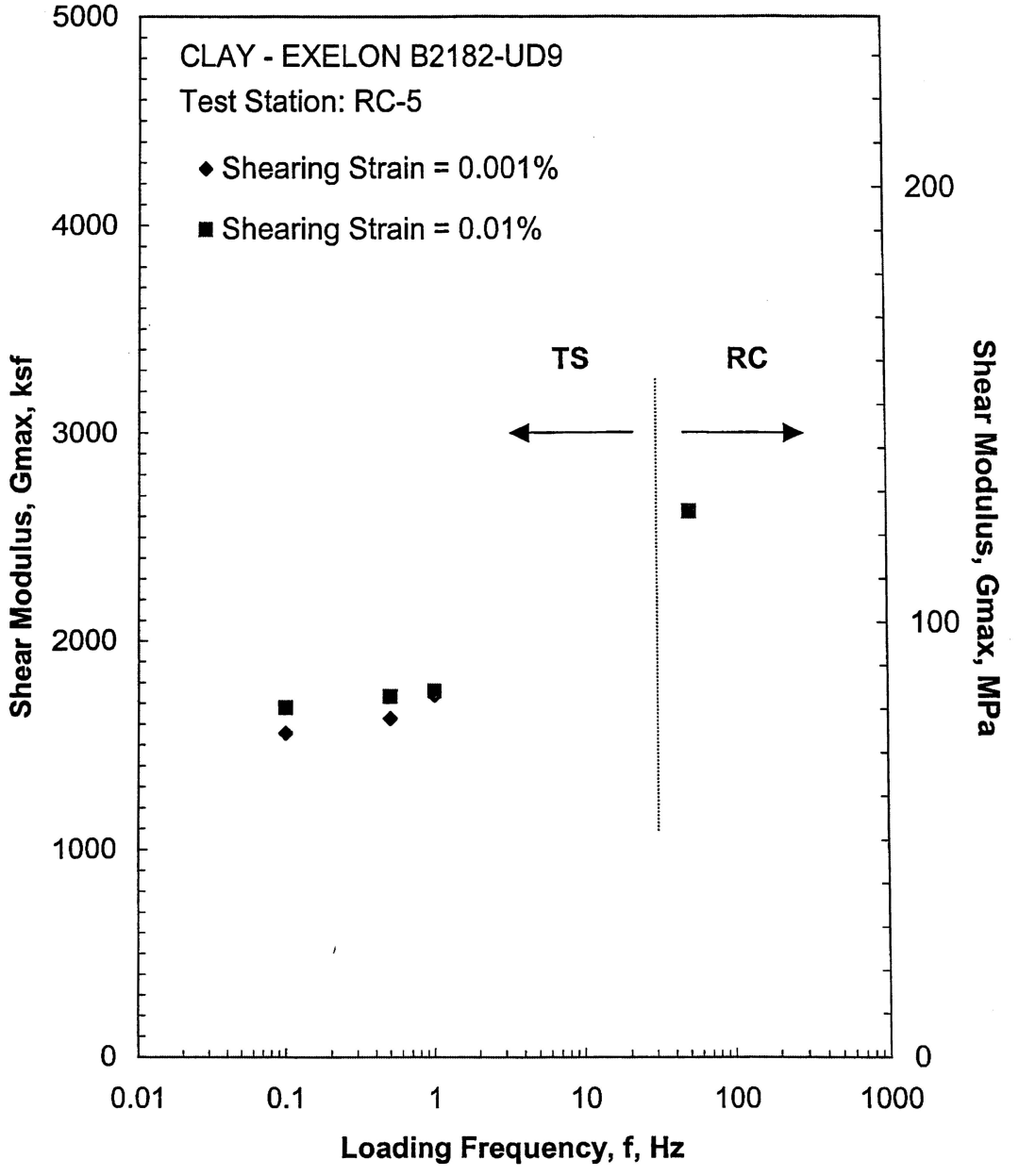

Figure E.19 Comparison of the Variation in Shear Modulus with Loading Frequency at an Isotropic Confining Pressure of 156 psi from the Combined RCTS Tests

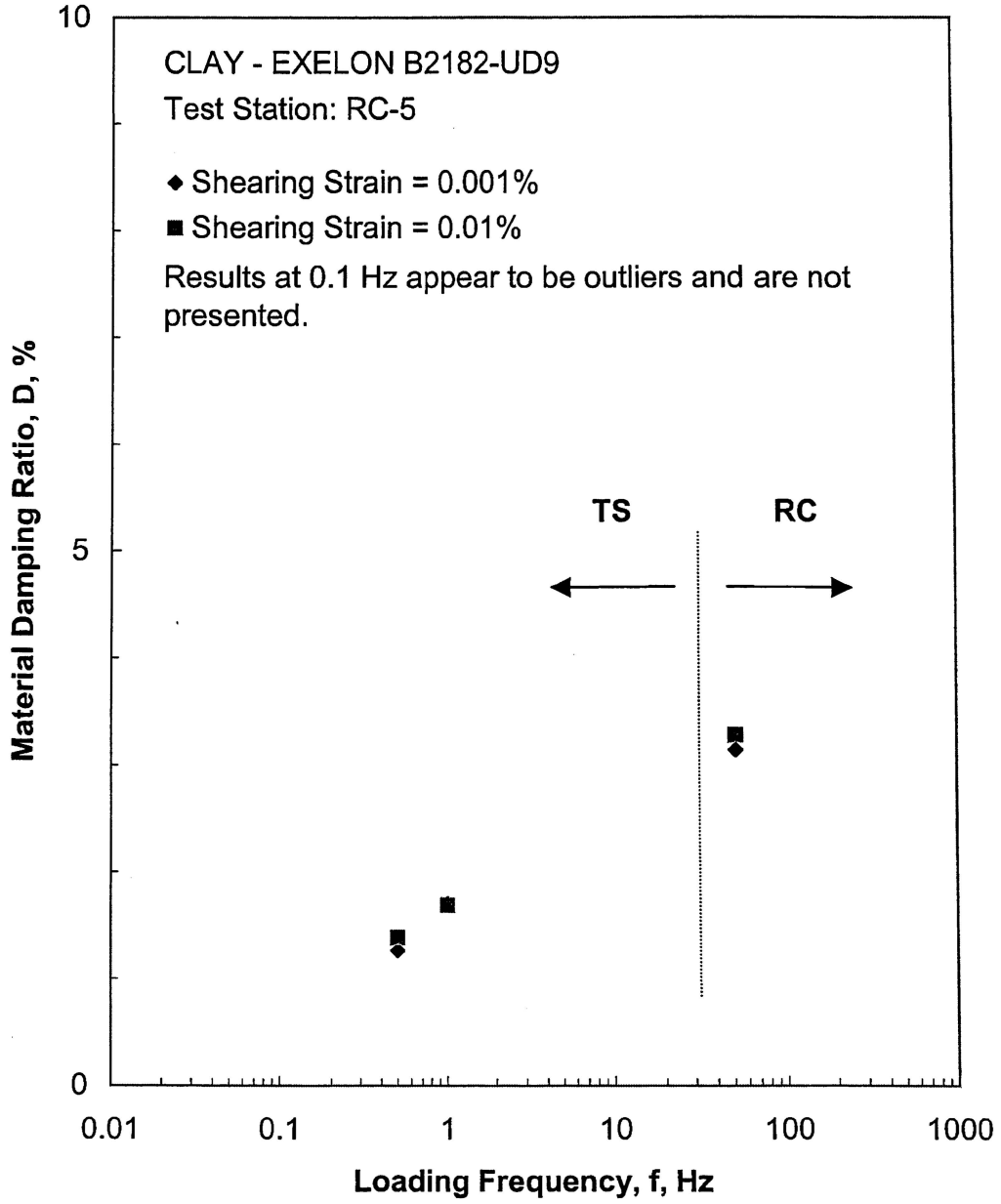

Figure E.20 Comparison of the Variation in Material Damping Ratio with Loading Frequency at an Isotropic Confining Pressure of 156 psi from the Combined RCTS Tests

Table E.1 Variation in Low-Amplitude Shear Wave Velocity, Low-Amplitude Shear Modulus, Low-Amplitude Material Damping Ratio and Estimated Void Ratio with Isotropic Confining Pressure from RC Tests of Specimen B2182-UD9

Isotropic Confining Pressure, σ_o			Low-Amplitude Shear Modulus, G_{max}		Low-Amplitude Shear Wave Velocity, Vs	Low-Amplitude Material Damping Ratio, Dmin	Estimated Void Ratio, e
(psi)	(psf)	(kPa)	(ksf)	(MPa)	(fps)	(%)	
10	1440	69	1276	61	596	4.27	1.01
20	2880	138	1416	68	627	4.05	1.00
39	5616	269	1642	79	672	3.67	0.98
78	11232	537	1944	93	727	3.38	0.96
156	22464	1075	2665	128	840	3.20	0.91

Table E.2 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen EXELON B2182-UD9; Isoptropic Confining Pressure, σ_o=39 psi (5.6 ksf = 269 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
1.97E-04	1663	1.00	1.97E-04	3.61
3.86E-04	1663	1.00	3.86E-04	3.62
7.87E-04	1663	1.00	7.87E-04	3.63
1.61E-03	1663	1.00	1.24E-03	3.68
3.22E-03	1663	1.00	2.44E-03	3.76
6.44E-03	1663	1.00	4.89E-03	3.75
1.28E-02	1663	1.00	9.63E-03	3.92
2.59E-02	1637	0.98	1.97E-02	4.17
5.25E-02	1592	0.96	3.88E-02	4.52
1.05E-01	1499	0.90	7.44E-02	5.11
2.14E-01	1245	0.75	1.41E-01	6.58
4.21E-01	966	0.58	2.49E-01	9.28

[+] Average Shearing Strain from the First Three Cycles of the Free Vibration Decay Curve

[x] Average Damping Ratio from the First Three Cycles of the Free Vibration Decay Curve

Table E.3 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen B2182-UD9; Isotropic Confining Pressure, σ_o= 39 psi (5.6 ksf =269 kPa)

First Cycle				Tenth Cycle			
Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
1.01E-03	1140	1.00	1.71	9.82E-04	1139	1.00	1.85
1.99E-03	1140	1.00	1.85	2.05E-03	1139	1.00	1.77
3.99E-03	1140	1.00	1.65	3.99E-03	1139	1.00	1.75
1.02E-02	1127	0.99	1.69	1.02E-02	1126	0.99	1.78
2.07E-02	1103	0.97	1.85	2.07E-02	1108	0.97	1.80

Table E.4 Variation in Shear Modulus and Material Damping Ratio with Shearing Strain from RC Tests of Specimen B2182-UD9; Isoptropic Confining Pressure, σ_o= 156 psi (22.5 ksf = 1075 kPa)

Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Average[+] Shearing Strain, %	Material Damping Ratio[x], D, %
2.39E-04	2632	1.00	2.39E-04	3.14
4.74E-04	2632	1.00	4.74E-04	3.14
9.98E-04	2632	1.00	9.98E-04	3.14
1.99E-03	2625	1.00	1.55E-03	3.18
3.97E-03	2625	1.00	3.13E-03	3.22
7.92E-03	2625	1.00	6.26E-03	3.28
1.59E-02	2605	0.99	1.24E-02	3.38
3.17E-02	2587	0.98	2.44E-02	3.53
6.34E-02	2516	0.96	4.82E-02	3.86
1.28E-01	2318	0.88	9.58E-02	4.22
2.47E-01	1981	0.75	1.78E-01	4.92
4.81E-01	1583	0.60	3.42E-01	6.01
9.08E-01	1283	0.49	5.72E-01	8.63

[+] Average Shearing Strain from the First Three Cycles of the Free Vibration Decay Curve

[x] Average Damping Ratio from the First Three Cycles of the Free Vibration Decay Curve

Table E.5 Variation in Shear Modulus, Normalized Shear Modulus and Material Damping Ratio with Shearing Strain from TS Tests of Specimen B2182-UD9; Isotropic Confining Pressure, σ_o=156 psi (22.5 ksf = 1075 kPa)

First Cycle				Tenth Cycle			
Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %	Peak Shearing Strain, %	Shear Modulus, G, ksf	Normalized Shear Modulus, G/G_{max}	Material Damping Ratio, D, %
1.07E-03	1702	1.00	1.21	1.08E-03	1703	1.00	1.26
2.04E-03	1702	1.00	1.40	2.03E-03	1703	1.00	1.50
4.04E-03	1702	1.00	1.46	4.06E-03	1703	1.00	1.53
1.02E-02	1702	1.00	1.50	1.01E-02	1703	1.00	1.38

APPENDIX F

Specimen B2274-UD14
(Index Properties Not Available)

Borehole B2274
Sample UD14
Depth = 267.5 ft (81.5 m)
Total Unit Weight = 130.0 lb/ft^3
Water Content = 18.5 %
Estimated In-Situ Ko = 0.5
Estimated In-Situ Mean Effective
Stress = 91 psi

FUGRO JOB #: 0401-1686
Testing Station: RC5

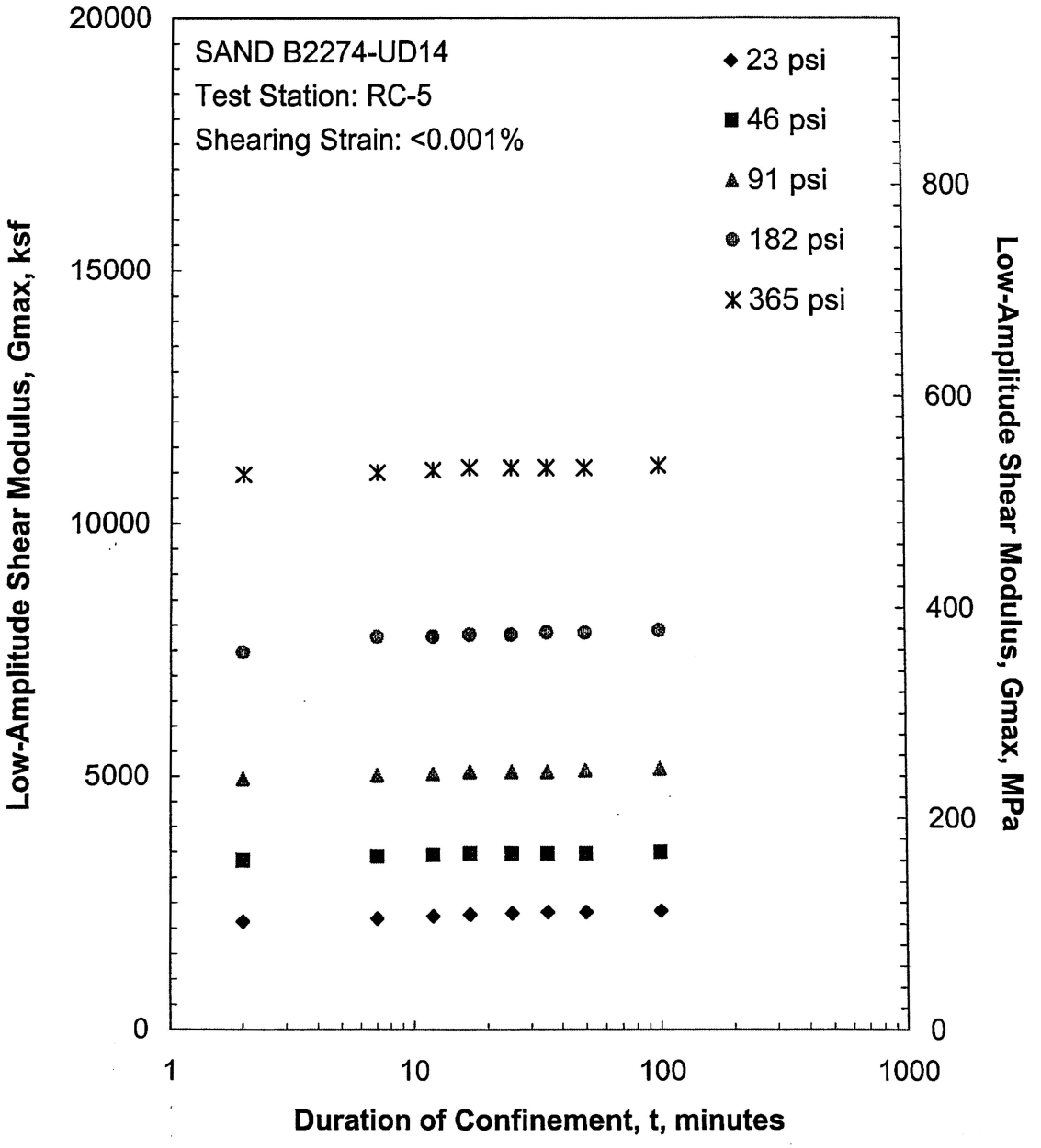

Figure F.1 Variation in Low-Amplitude Shear Modulus with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

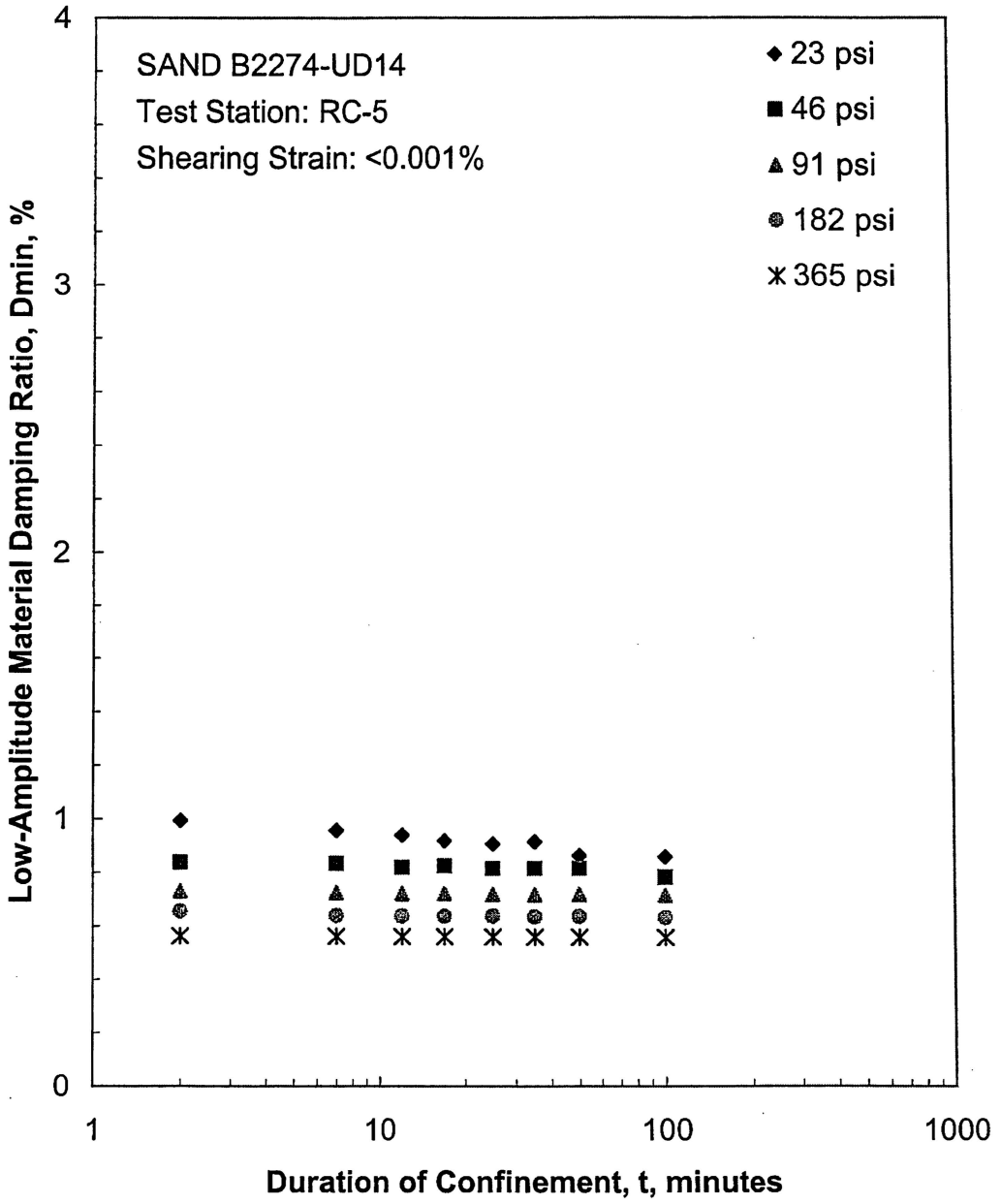

Figure F.2 Variation in Low-Amplitude Material Damping Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

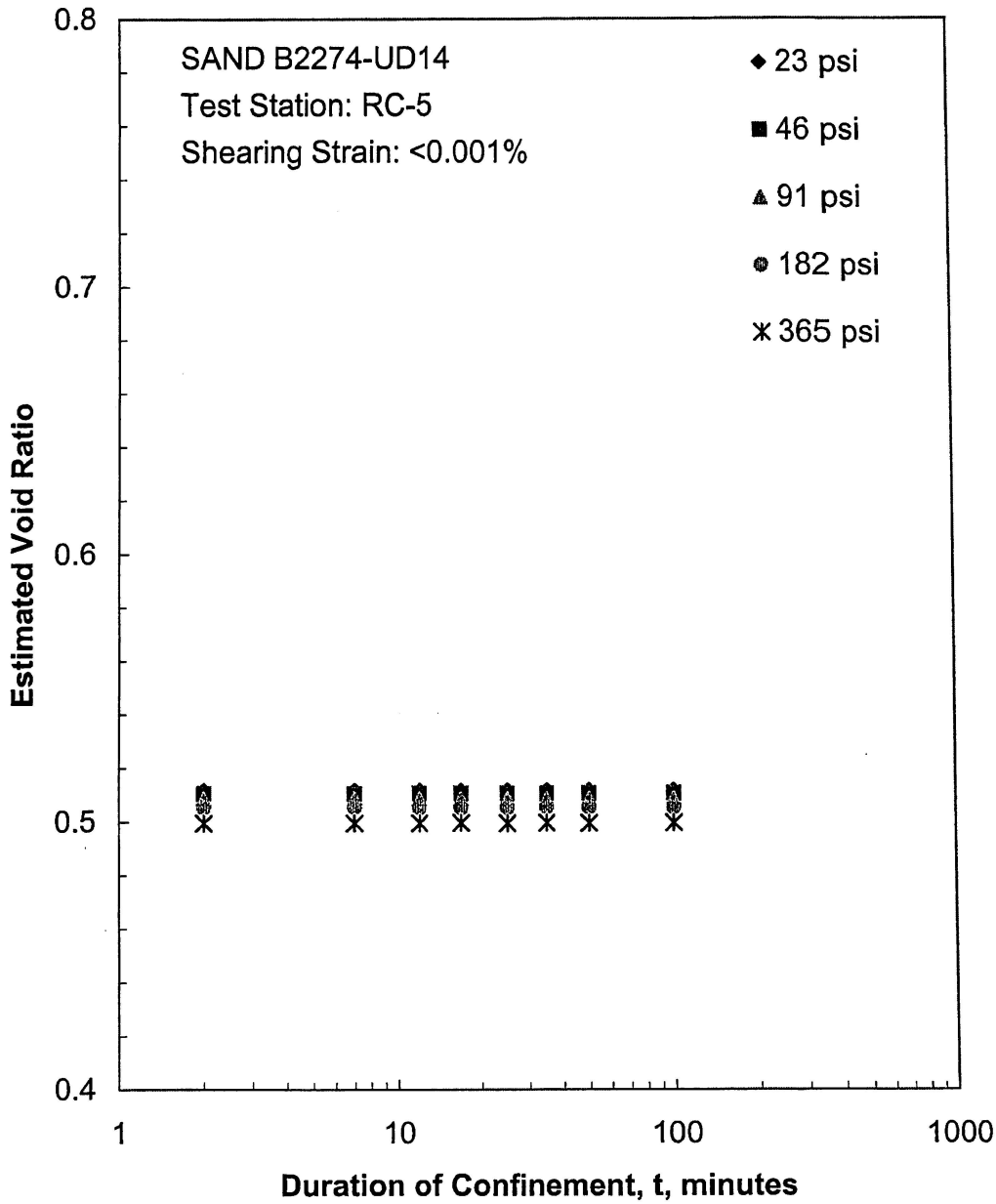

Figure F.3 Variation in Estimated Void Ratio with Magnitude and Duration of Isotropic Confining Pressure from Resonant Column Tests

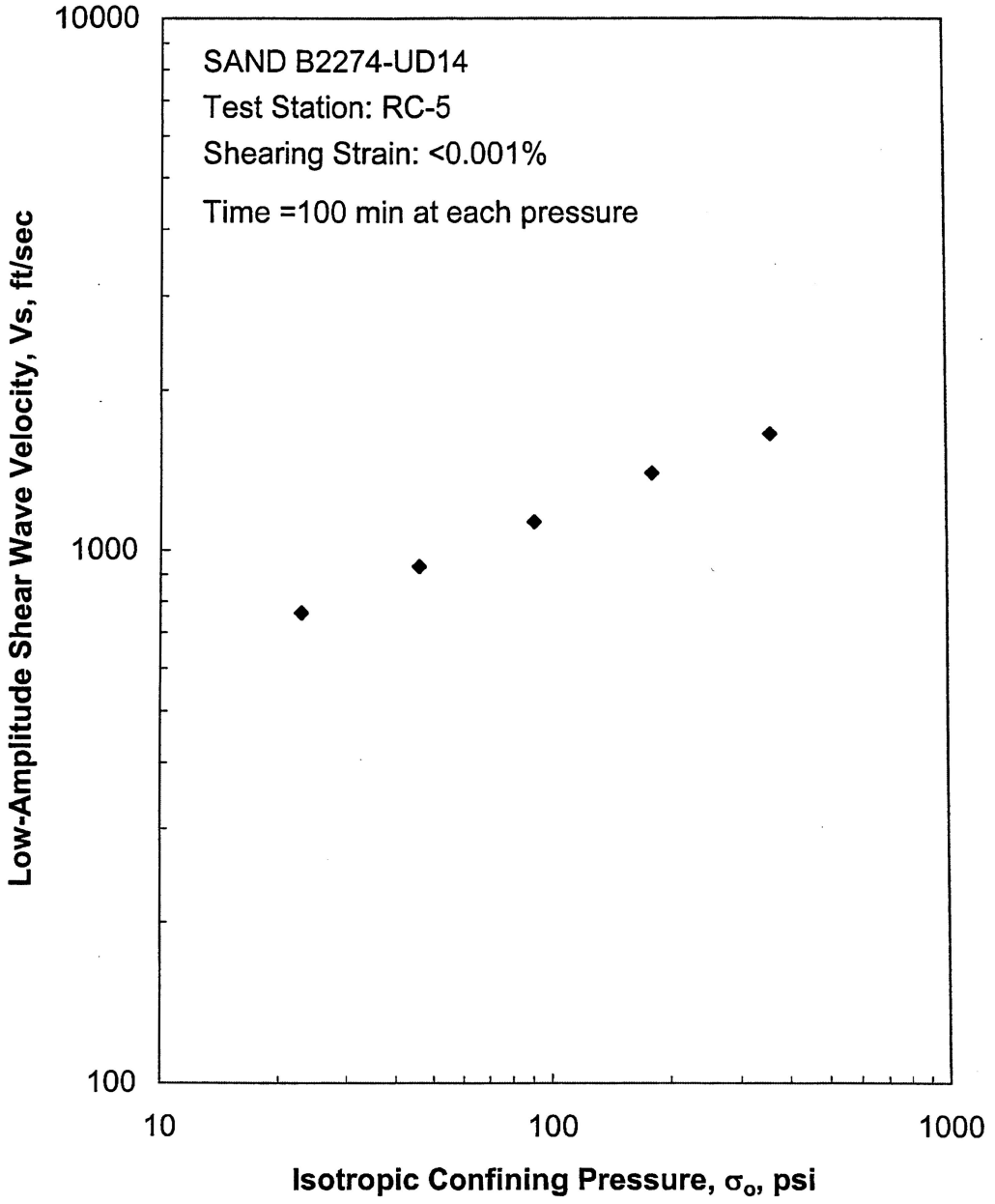

Figure F.4 Variation in Low-Amplitude Shear Wave Velocity with Isotropic Confining Pressure from Resonant Column Tests

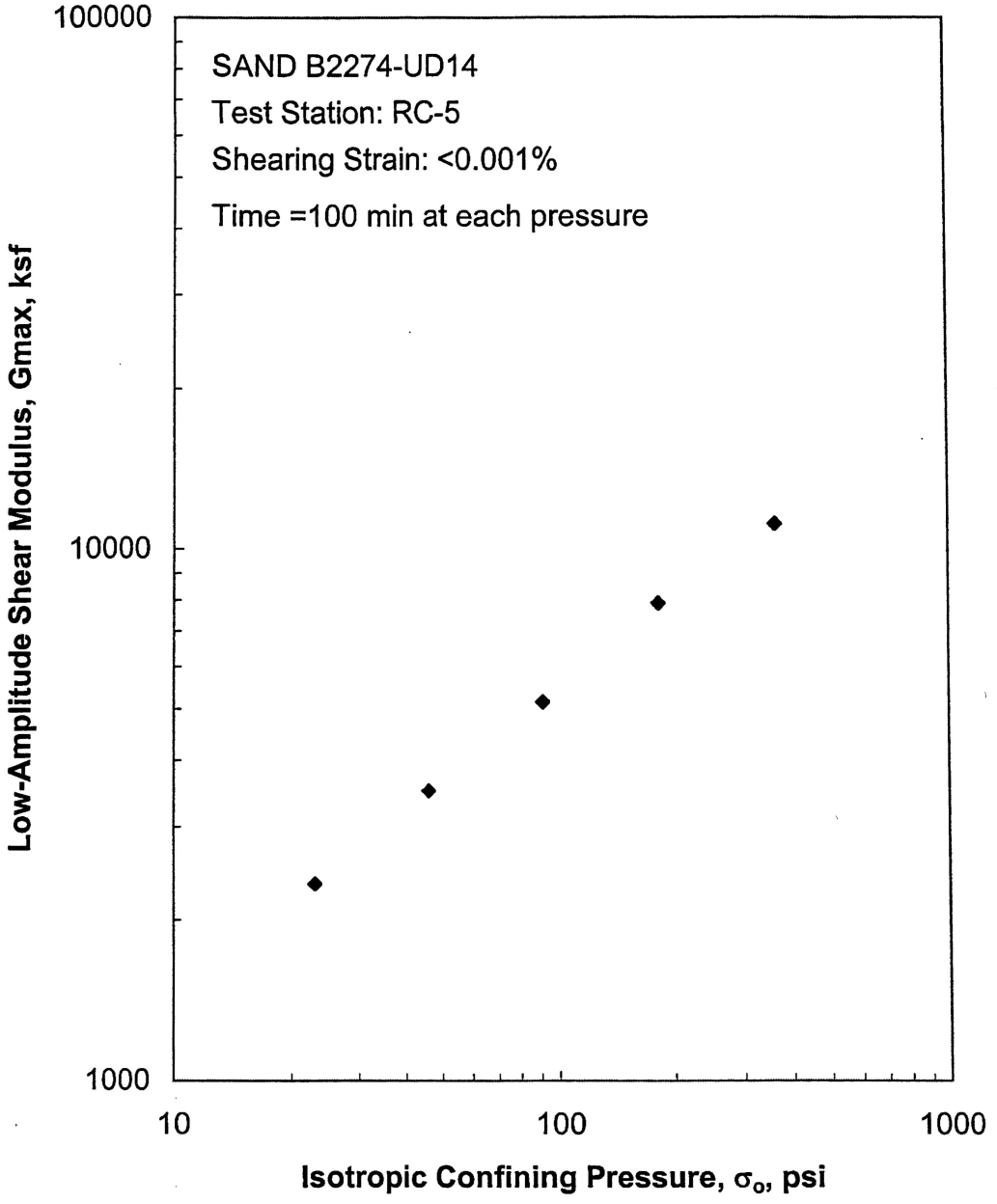

Figure F.5 Variation in Low-Amplitude Shear Modulus with Isotropic Confining Pressure from Resonant Column Tests

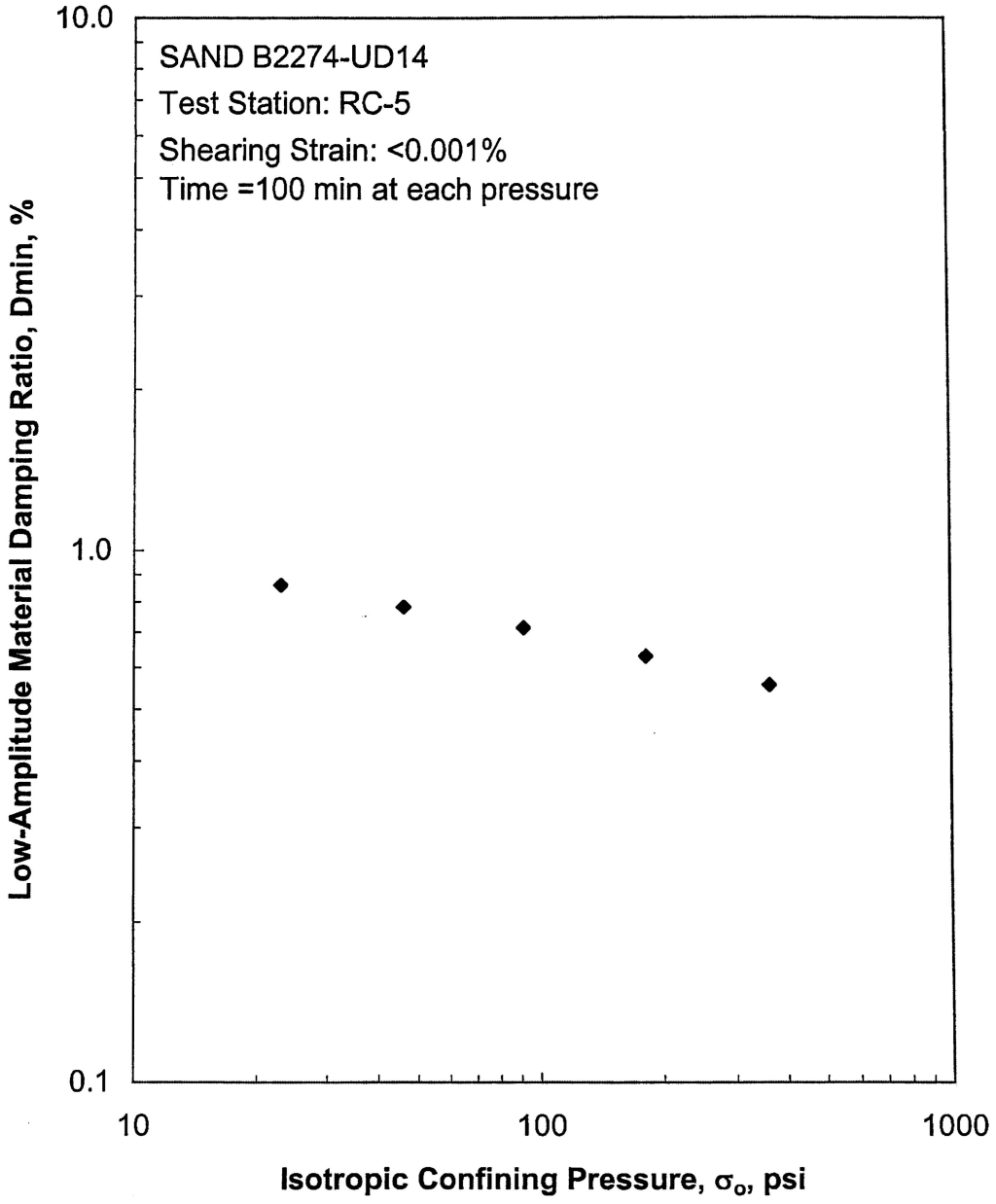

Figure F.6 Variation in Low-Amplitude Material Damping Ratio with Isotropic Confining Pressure from Resonant Column Tests

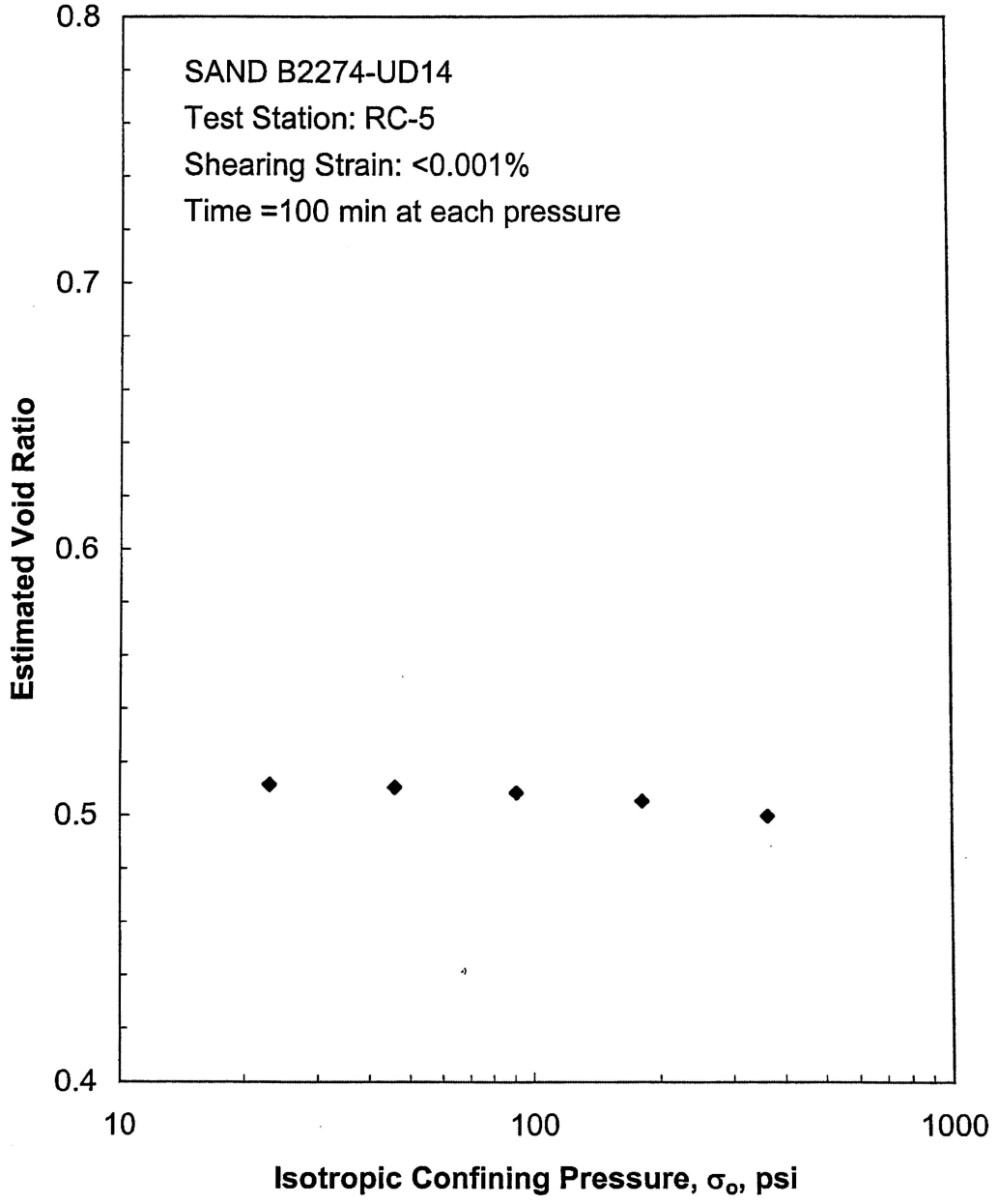

Figure F.7 Variation in Estimated Void Ratio with Isotropic Confining Pressure from Resonant Column Tests

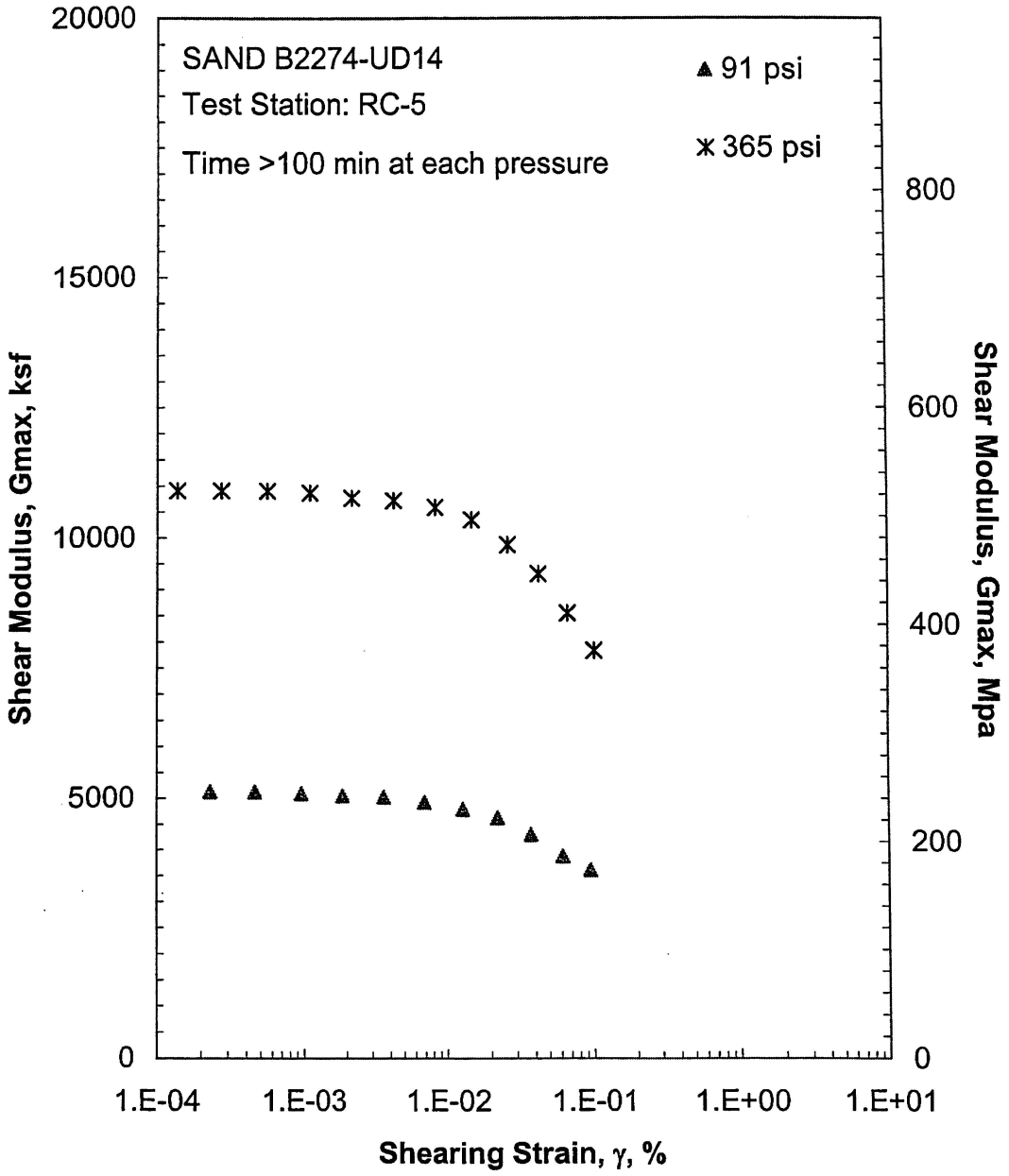

Figure F.8 Comparison of the Variation in Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

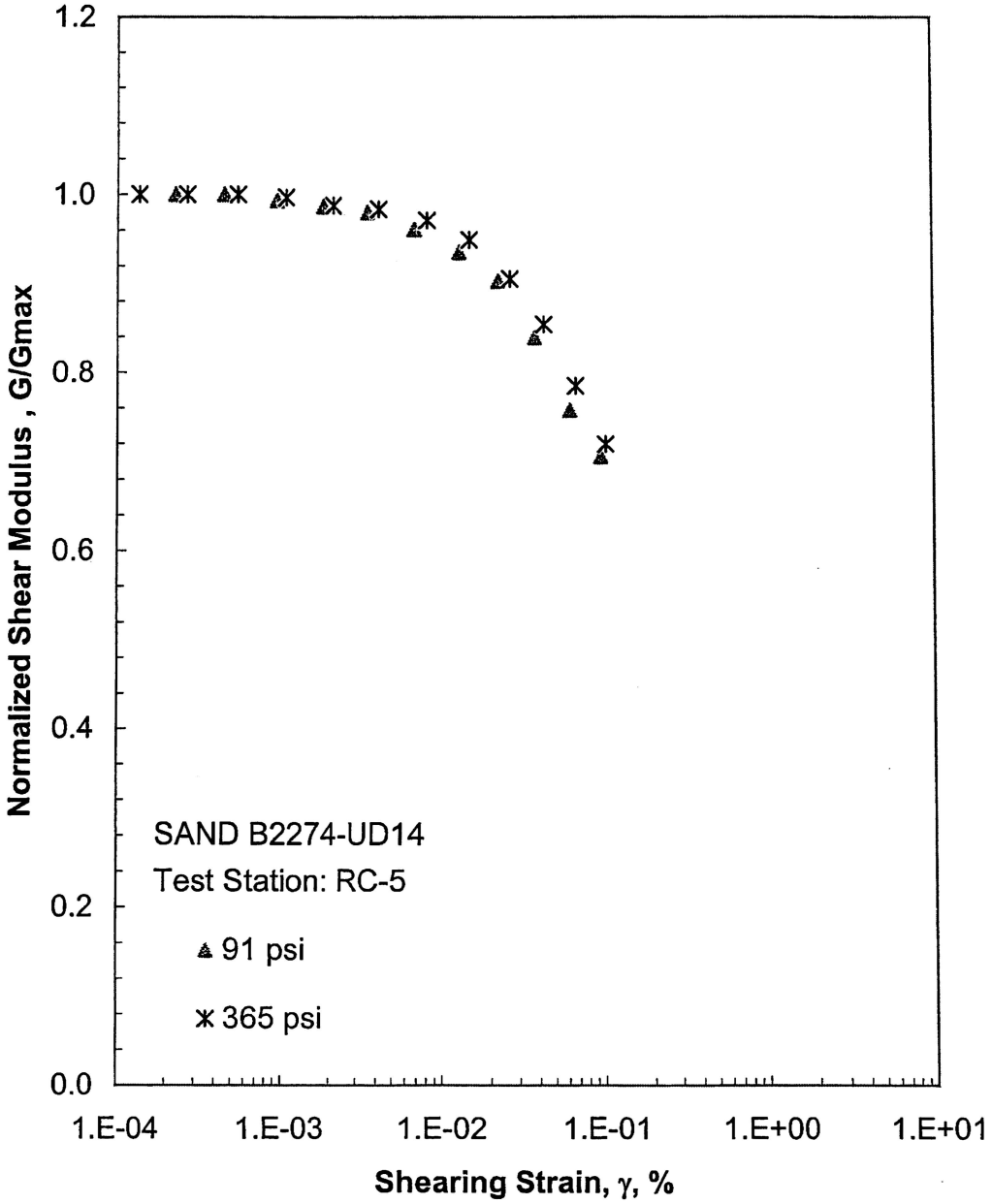

Figure F.9 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

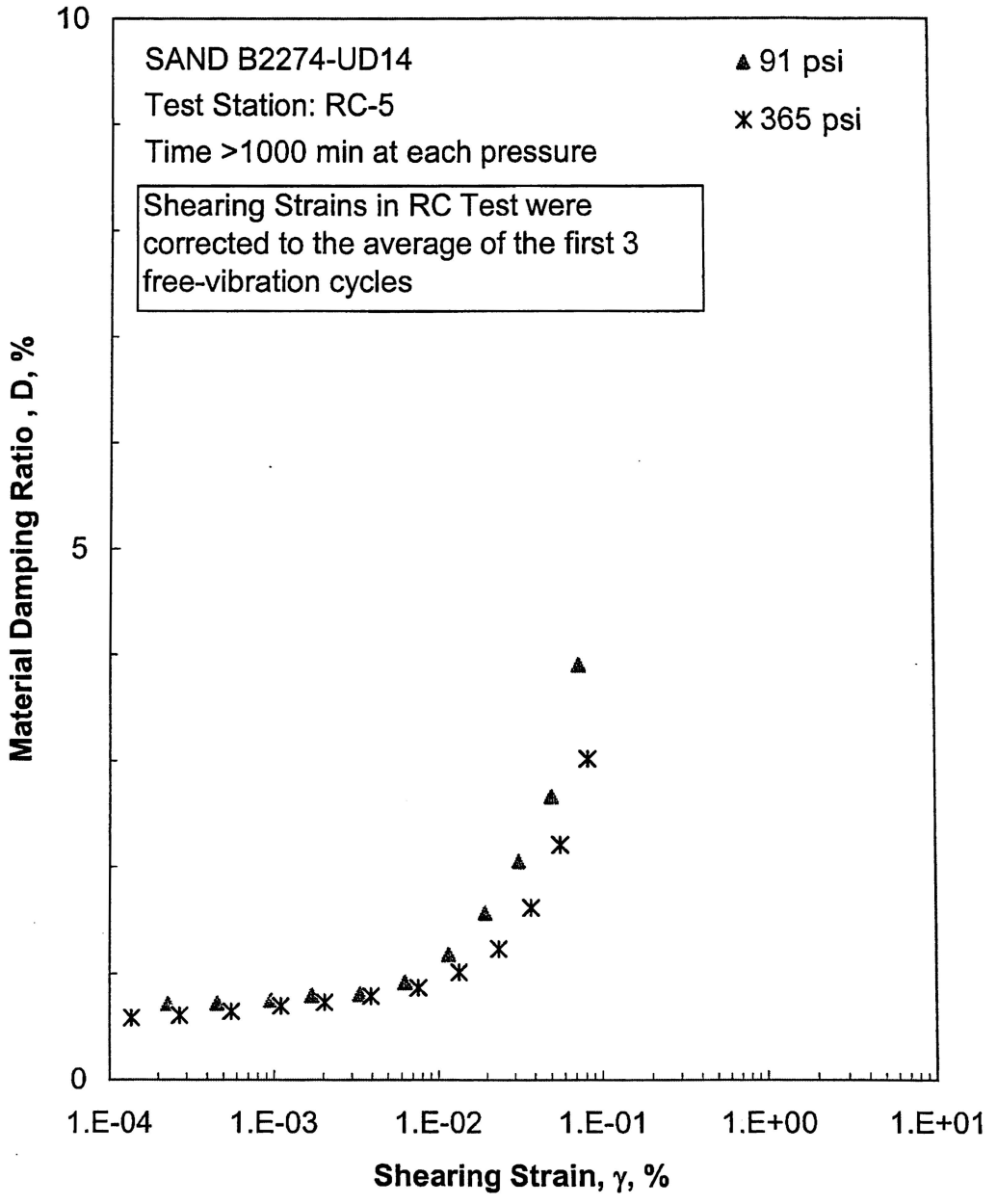

Figure F.10 Comparison of the Variation in Material Damping Ratio with Shearing Strain and Isotropic Confining Pressure from the Resonant Column Tests

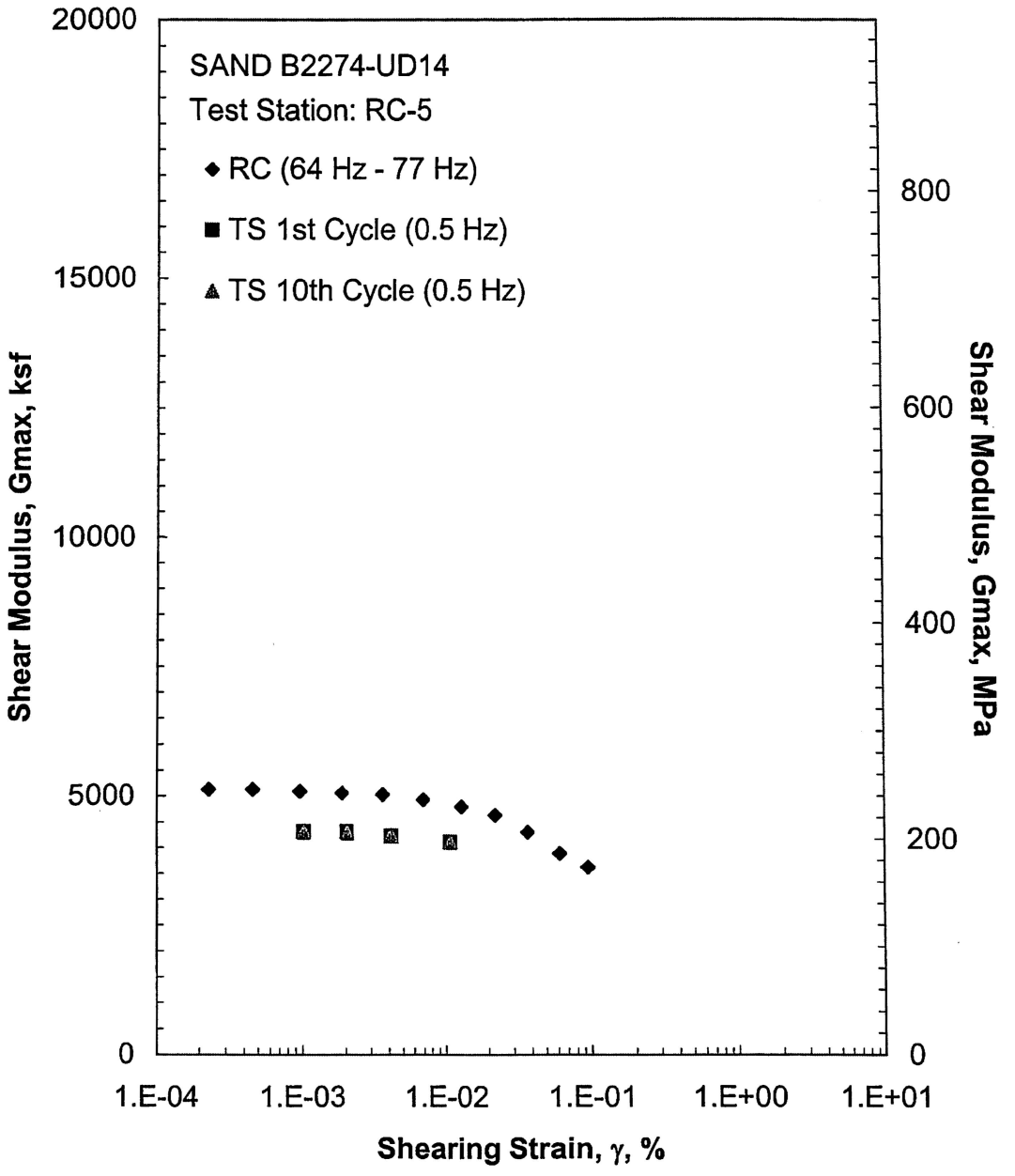

Figure F.11 Comparison of the Variation in Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 91 psi from the Combined RCTS Tests

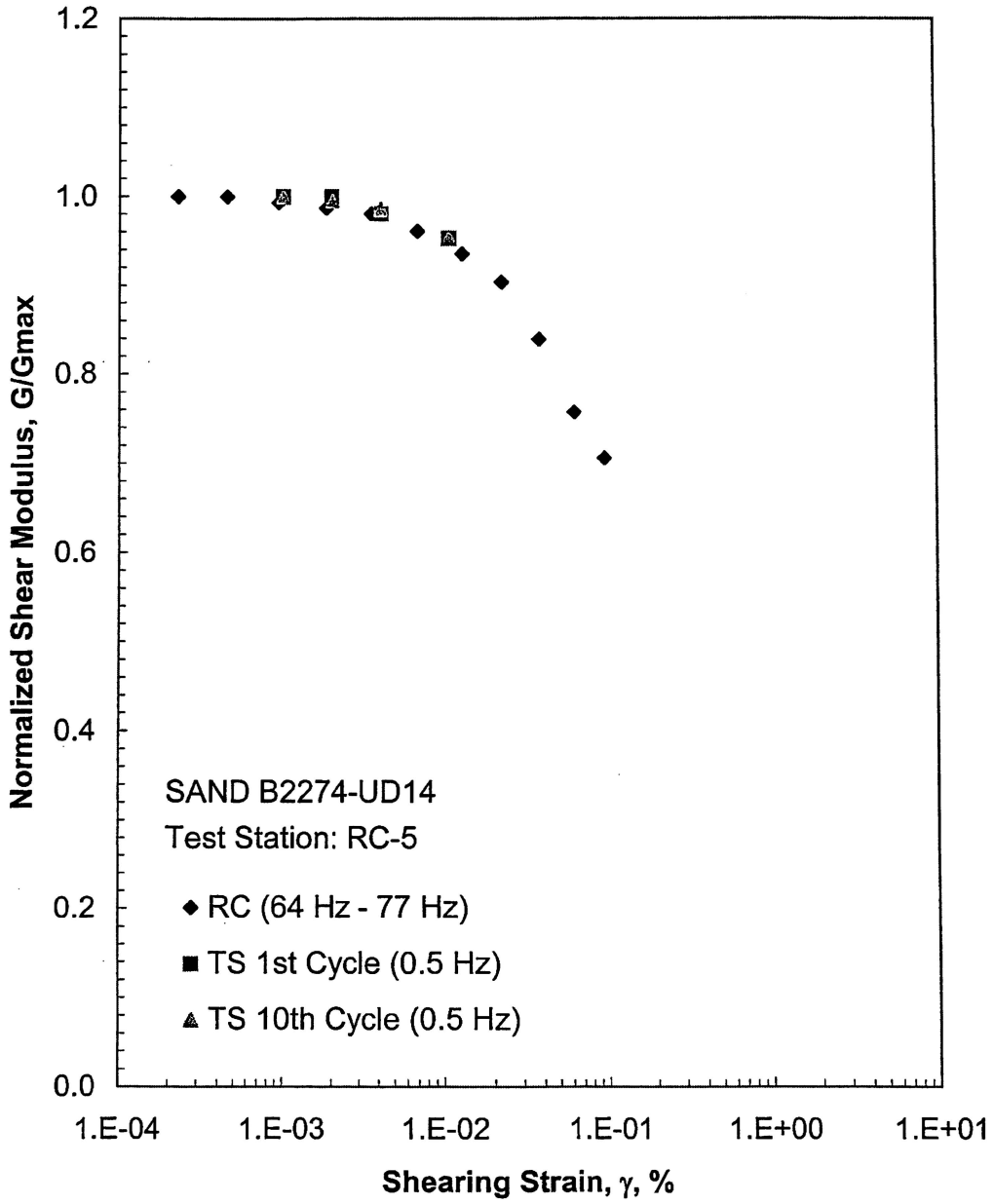

Figure F.12 Comparison of the Variation in Normalized Shear Modulus with Shearing Strain at an Isotropic Confining Pressure of 91 psi from the Combined RCTS Tests

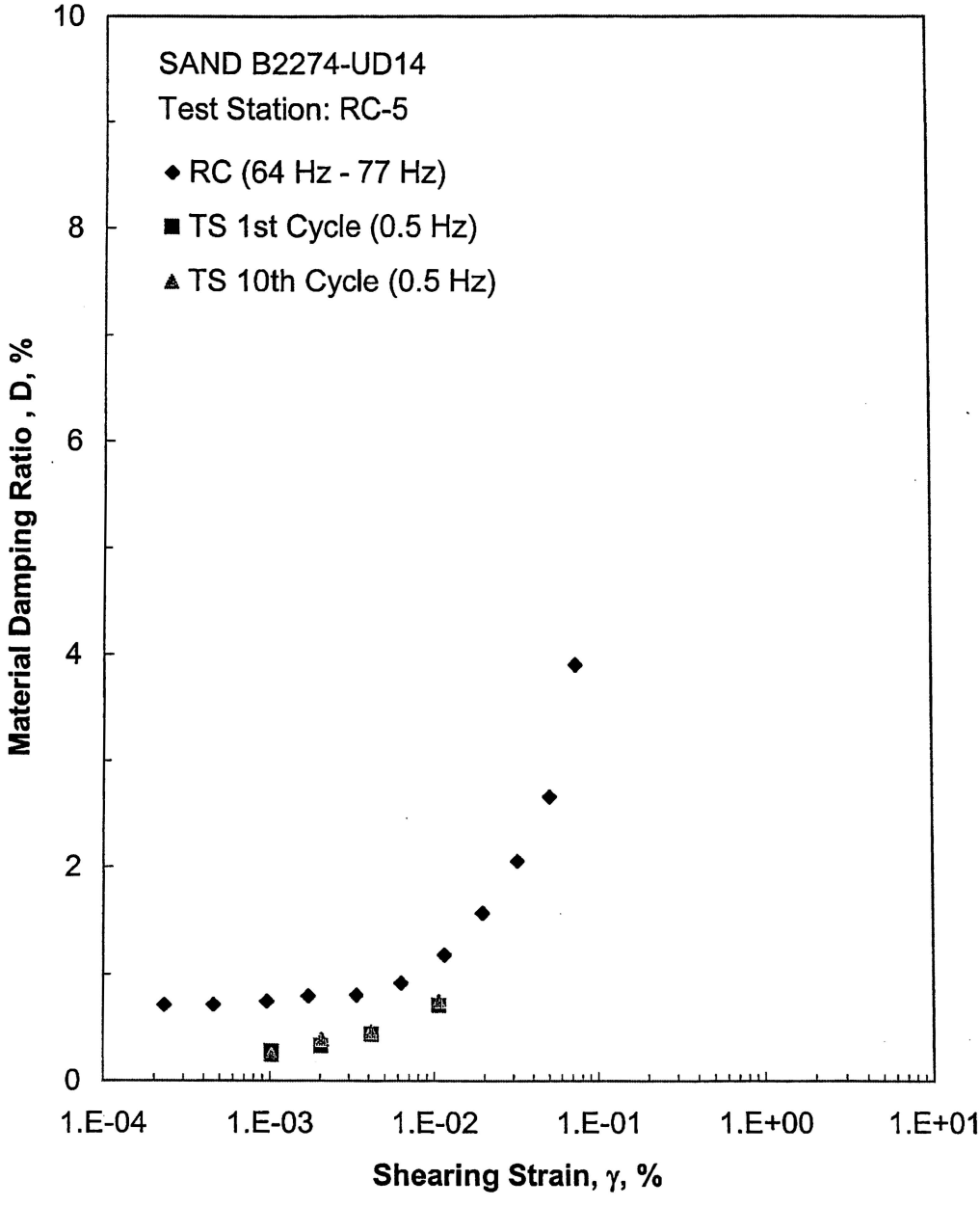

Figure F.13 Comparison of the Variation in Material Damping Ratio with Shearing Strain at an Isotropic Confining Pressure of 91 psi from the Combined RCTS Tests