



TEST CONDITIONS

Material:	Single Insulated Modular Coil Conductor, #1	Load Range Card:	NA
Matrix:	CTD-101K	Stroke Range Card:	NA
Reinforcement:	Kapton film interwoven w/ glass fabric attached to Cu Conductor		
Fiber Lay-up:	NA		
Nominal Specimen Dimensions:	26 mm L x 20 mm W x 17 mm T		
Material Reference:	7021-300		
Customer:	PPPL		
Load Rate:	NA		
Strain Measurement:	.125 inch Strain Gage Zero/90 Configuration	Specimen Conditioning:	NA
Strain Gage Type:	SK-06-125TM-350		
Test Fixture:	CTE Test Fixture	Test Temperature:	76-293 K
Test Date:	7/30/2003	Temperature Hold Time:	Natural Warm-up

TEST RESULTS

Specimen	Single Insulated Modular Coil Conductor Longitudinal Direction		
Temperature (Kelvin)	TE (microstrain)	Percent TE	CTE 10x-6 m/mK
76	-3563	-0.36	9.53
80	-3515	-0.35	9.84
90	-3413	-0.34	10.57
100	-3309	-0.33	11.74
110	-3194	-0.32	12.70
120	-3064	-0.31	13.10
130	-2931	-0.29	13.51
140	-2790	-0.28	14.62
150	-2636	-0.26	15.42
160	-2479	-0.25	15.76
180	-2156	-0.22	16.44
200	-1810	-0.18	17.64
220	-1447	-0.14	18.34
240	-1074	-0.11	18.86
260	-686	-0.07	19.40
280	-264	-0.03	21.66
293	0	0.00	22.35

Specimen	Single Insulated Modular Coil Conductor Transverse Direction		
Temperature (Kelvin)	TE (microstrain)	Percent TE	CTE 10x-6 m/mK
76	-3203	-0.32	9.41
80	-3163	-0.32	9.89
90	-3054	-0.31	10.97
100	-2944	-0.29	12.00
110	-2824	-0.28	12.85
120	-2689	-0.27	13.73
130	-2551	-0.26	14.53
140	-2405	-0.24	15.27
150	-2245	-0.22	15.94
160	-2081	-0.21	16.54
180	-1743	-0.17	17.53
200	-1388	-0.14	18.08
220	-1073	-0.11	18.92
240	-776	-0.08	19.77
260	-479	-0.05	20.63
280	-187	-0.02	21.49
293	0	0.00	22.00



COMPOSITE TECHNOLOGY DEVELOPMENT, INC.

ENGINEERED MATERIAL SOLUTIONS

TEST CONDITIONS

Material:	Modular Coil Turn Insulation, #1	Load Range Card:	NA
Matrix:	CTD-101K	Stroke Range Card:	NA
Reinforcement:	Kapton film interwoven w/ glass fabric		
Fiber Lay-up:	NA		
Nominal Specimen Dimensions:	44mm L x 14mm W x 2.3 mm T		
Material Reference:	7021-300		
Customer:	PPPL		
Load Rate:	NA		
Strain Measurement:	.125 inch Strain Gage Zero/90 Configuration	Specimen Conditioning:	NA
Strain Gage Type:	SK-06-125TM-350		
Test Fixture:	CTE Test Fixture	Test Temperature:	76-293 K
Test Date:	8/14/2003	Temperature Hold Time:	Natural Warm-up

TEST RESULTS

Specimen 1 Modular Coil Turn Insulation Longitudinal Direction			
Temperature (Kelvin)	TE (microstrain)	Percent TE	CTE 10x-6 m/mK
76	-3325	-0.33	7.33
80	-3271	-0.33	8.17
90	-3181	-0.32	9.67
100	-3077	-0.31	11.00
110	-2962	-0.30	12.16
120	-2837	-0.28	13.17
130	-2705	-0.27	14.05
140	-2563	-0.26	14.80
150	-2404	-0.24	15.43
160	-2254	-0.23	15.91
180	-1925	-0.19	16.74
200	-1584	-0.16	17.30
220	-1235	-0.12	17.71
240	-896	-0.09	18.05
260	-559	-0.06	18.43
280	-253	-0.03	18.95
293	0	0.00	19.36

Specimen 1 Modular Coil Turn Insulation Transverse Direction			
Temperature (Kelvin)	TE (microstrain)	Percent TE	CTE 10x-6 m/mK
76	-3221	-0.32	11.28
80	-3150	-0.32	11.62
90	-3049	-0.30	12.24
100	-2935	-0.29	12.78
110	-2809	-0.28	13.26
120	-2677	-0.27	13.67
130	-2537	-0.25	14.03
140	-2389	-0.24	14.34
150	-2228	-0.22	14.60
160	-2071	-0.21	14.81
180	-1714	-0.17	15.16
200	-1376	-0.14	15.43
220	-1073	-0.11	15.64
240	-782	-0.08	15.85
260	-488	-0.05	16.11
280	-183	-0.02	16.45
293	0	0.00	16.71



COMPOSITE TECHNOLOGY DEVELOPMENT, INC.

ENGINEERED MATERIAL SOLUTIONS

TEST CONDITIONS

Material:	Coil Ground Insulation, #1	Load Range Card:	NA
Matrix:	CTD-101K	Stroke Range Card:	NA
Reinforcement:			
Fiber Lay-up:	NA		
Nominal Specimen Dimensions:	44mm L x 14mm W x 2.3 mm T		
Material Reference:	7021-300		
Customer:	PPPL		
Load Rate:	NA		
Strain Measurement:	.125 inch Strain Gage Zero/90 Configuration	Specimen Conditioning:	NA
Strain Gage Type:	SK-06-125TM-350		
Test Fixture:	CTE Test Fixture	Test Temperature:	76-293 K
Test Date:	7/30/2003	Temperature Hold Time:	Natural Warm-up

TEST RESULTS

Specimen 1	Coil Ground Insulation		Longitudinal
	Direction		
Temperature (Kelvin)	TE (microstrain)	Percent TE	CTE 10x-6 m/mK
76	-3220	-0.3200	7.12
80	-3183	-0.3200	7.12
90	-3160	-0.3200	8.58
100	-3072	-0.3100	12.02
110	-2951	-0.3000	12.92
120	-2819	-0.2800	13.16
130	-2686	-0.2700	13.39
140	-2547	-0.2500	13.95
150	-2404	-0.2400	14.36
160	-2258	-0.2300	14.76
180	-1954	-0.2000	15.57
200	-1634	-0.1600	16.03
220	-1308	-0.1300	16.51
240	-972	-0.1000	17.10
260	-619	-0.0600	17.72
280	-240	-0.0200	19.54
293	0	0.0000	20.32

Specimen 1	Coil Ground Insulation		Transverse
	Direction		
Temperature (Kelvin)	TE (microstrain)	Percent TE	CTE 10x-6 m/mK
76	-2796.2084	-0.28	7.75
80	-2763.3104	-0.28	7.75
90	-2731.6746	-0.27	7.71
100	-2651.1994	-0.27	10.66
110	-2547.2391	-0.25	10.98
120	-2434.3359	-0.24	11.34
130	-2318.8869	-0.23	11.70
140	-2198.3458	-0.22	12.06
150	-2073.4047	-0.21	12.42
160	-1947.6757	-0.19	12.75
180	-1685.1116	-0.17	13.39
200	-1409.6817	-0.14	13.80
220	-1129.7571	-0.11	14.20
240	-840.37529	-0.08	14.75
260	-534.64056	-0.05	15.39
280	-224.26169	-0.02	17.30
293	0	0.00	20.16



TEST CONDITIONS

Material:	Single Insulated Modular Coil Conductor, #2	Load Range Card:	NA
Matrix:	CTD-101K	Stroke Range Card:	NA
Reinforcement:	Kapton film interwoven w/ glass fabric attached to Cu Conductor		
Fiber Lay-up:	NA		
Nominal Specimen Dimensions:	26 mm L x 20 mm W x 17 mm T		
Material Reference:	7021-300		
Customer:	PPPL		
Load Rate:	NA		
Strain Measurement:	.125 inch Strain Gage Zero/90 Configuration	Specimen Conditioning:	NA
Strain Gage Type:	SK-06-125TM-350		
Test Fixture:	CTE Test Fixture	Test Temperature:	76-293 K
Test Date:	8/6/2003	Temperature Hold Time:	Natural Warm-up

TEST RESULTS

Specimen 2 Single Insulated Modular Coil Conductor Longitudinal Direction			
Temperature (Kelvin)	TE (microstrain)	Percent TE	CTE 10x-6 m/mK
76	-3224	-0.32	8.87
80	-3195	-0.32	9.14
90	-3150	-0.31	9.79
100	-3108	-0.31	10.37
110	-3074	-0.31	11.01
120	-2983	-0.30	11.65
130	-2855	-0.29	13.39
140	-2718	-0.27	15.77
150	-2561	-0.26	15.97
160	-2400	-0.24	16.17
180	-2074	-0.21	16.57
200	-1724	-0.17	17.38
220	-1360	-0.14	17.72
240	-1001	-0.10	18.06
260	-631	-0.06	18.61
280	-245	-0.02	19.69
293	0	0.00	20.50

Specimen 2 Single Insulated Modular Coil Conductor Transverse Direction			
Temperature (Kelvin)	TE (microstrain)	Percent TE	CTE 10x-6 m/mK
76	-2923	-0.29	11.14
80	-2895	-0.29	11.28
90	-2853	-0.29	11.62
100	-2814	-0.28	11.92
110	-2790	-0.28	12.26
120	-2696	-0.27	12.59
130	-2558	-0.26	14.06
140	-2412	-0.24	15.15
150	-2254	-0.23	16.24
160	-2087	-0.21	16.71
180	-1749	-0.17	17.24
200	-1401	-0.14	17.43
220	-1085	-0.11	17.80
240	-784	-0.08	18.16
260	-485	-0.05	18.53
280	-183	-0.02	18.91
293	0	0.00	19.13



TEST CONDITIONS

Material:	Modular Coil Turn Insulation, #2	Load Range Card:	NA
Matrix:	CTD-101K	Stroke Range Card:	NA
Reinforcement:	Kapton film interwoven w/ glass fabric		
Fiber Lay-up:	NA		
Nominal Specimen Dimensions:	44mm L x 14mm W x 2.3 mm T		
Material Reference:	7021-300		
Customer:	PPPL		
Load Rate:	NA		
Strain Measurement:	.125 inch Strain Gage Zero/90 Configuration	Specimen Conditioning:	NA
Strain Gage Type:	SK-06-125TM-350		
Test Fixture:	CTE Test Fixture	Test Temperature:	76-293 K
Test Date:	8/14/2003	Temperature Hold Time:	Natural Warm-up

TEST RESULTS

Specimen 2 Modular Coil Turn Insulation Longitudinal Direction			
Temperature (Kelvin)	TE (microstrain)	Percent TE	CTE 10x-6 m/mK
76	-3321	-0.33	7.81
80	-3258	-0.33	8.59
90	-3172	-0.32	10.00
100	-3068	-0.31	11.29
110	-2952	-0.30	12.45
120	-2828	-0.28	13.49
130	-2695	-0.27	14.43
140	-2552	-0.26	15.26
150	-2243	-0.22	15.99
160	-1915	-0.19	16.57
180	-1591	-0.16	17.61
200	-1573	-0.16	18.36
220	-1226	-0.12	18.87
240	-887	-0.09	19.19
260	-549	-0.05	19.37
280	-242	-0.02	19.45
293	0	0.00	19.47

Specimen 2 Modular Coil Turn Insulation Transverse Direction			
Temperature (Kelvin)	TE (microstrain)	Percent TE	CTE 10x-6 m/mK
76	-3235	-0.32	10.58
80	-3172	-0.32	11.08
90	-3067	-0.31	11.98
100	-2952	-0.30	12.80
110	-2825	-0.28	13.52
120	-2690	-0.27	14.16
130	-2549	-0.25	14.72
140	-2400	-0.24	15.22
150	-2235	-0.22	15.64
160	-2077	-0.21	15.97
180	-1736	-0.17	16.56
200	-1414	-0.14	16.97
220	-1106	-0.11	17.25
240	-803	-0.08	17.45
260	-499	-0.05	17.61
280	-188	-0.02	17.77
293	0	0.00	17.89



COMPOSITE TECHNOLOGY DEVELOPMENT, INC.

ENGINEERED MATERIAL SOLUTIONS

TEST CONDITIONS

Material:	Coil Ground Insulation, #2	Load Range Card:	NA
Matrix:	CTD-101K	Stroke Range Card:	NA
Reinforcement:			
Fiber Lay-up:	NA		
Nominal Specimen Dimensions:	44mm L x 14mm W x 2.3 mm T		
Material Reference:	7021-300		
Customer:	PPPL		
Load Rate:	NA		
Strain Measurement:	.125 inch Strain Gage Zero/90 Configuration	Specimen Conditioning:	NA
Strain Gage Type:	SK-06-125TM-350		
Test Fixture:	CTE Test Fixture	Test Temperature:	76-293 K
Test Date:	8/6/2003	Temperature Hold Time:	Natural Warm-up

TEST RESULTS

Specimen 2	Coil Ground Insulation Direction		Longitudinal
	Temperature (Kelvin)	TE (microstrain)	Percent TE
			CTE 10x-6 m/mK
76	-3272	-0.3272	11.15
80	-3228	-0.3228	11.32
90	-3188	-0.3188	11.71
100	-3094	-0.3094	12.11
110	-2970	-0.2970	12.47
120	-2837	-0.2837	13.28
130	-2703	-0.2703	13.66
140	-2563	-0.2563	14.05
150	-2419	-0.2419	14.50
160	-2273	-0.2273	14.81
180	-1969	-0.1969	15.70
200	-1648	-0.1648	16.04
220	-1321	-0.1321	16.58
240	-984	-0.0984	17.16
260	-629	-0.0629	17.90
280	-247	-0.0247	19.91
293	0	0.0000	21.05

Specimen 2	Coil Ground Insulation Direction		Transverse
	Temperature (Kelvin)	TE (microstrain)	Percent TE
			CTE 10x-6 m/mK
76	-3009	-0.30	10.30
80	-2969	-0.30	10.45
90	-2931	-0.29	10.81
100	-2843	-0.28	11.17
110	-2729	-0.27	11.88
120	-2606	-0.26	12.18
130	-2484	-0.25	12.49
140	-2357	-0.24	12.79
150	-2225	-0.22	13.28
160	-2091	-0.21	13.62
180	-1811	-0.18	14.48
200	-1516	-0.15	14.76
220	-1215	-0.12	15.24
240	-905	-0.09	15.78
260	-578	-0.06	16.54
280	-238	-0.02	18.83
293	0	0.00	21.16