GI 3.3 Series Qualification Test with New Receptacle Contact

1. INTRODUCTION

1.1. Purpose

Testing was performed on the TE Connectivity (TE) Next Generation GRACE INERTIA* (GI) 3.3 Series receptacle contact P/N 2318950-1 to determine its conformance to the requirements of 108-106094, Revision D.

1.2. Scope

This report covers the electrical, mechanical, and environmental performance of Next Generation GRACE INERTIA* (GI) 3.3 Series Connectors. Testing was performed at the Shanghai Electrical Components Test Laboratory between 17Sep18 and 27Nov18. The test file number for this testing is on file and maintained at the TE Shanghai Electrical Components Test Laboratory under TP-18-02530-RECORD, TP-18-02837-RECORD (derating curve), TP-18-02861-RECORD (derating curve), TP-19-00455-RECORD and TP-19-00582-RECORD.

1.3. Conclusion

All part numbers listed in paragraph 1.5 conformed to the electrical, mechanical, and environmental performance requirements of Product Specification 108-106094, Revision D.

1.4. Product Description

The New Generation GRACE INERTIA* 3.3 Series Connectors are designed to accept 20-24 AWG wires and are available in 4-14 position configurations.

1.5. Test Specimens

The test specimens were representative of normal production lots, and the following part numbers were used for testing (See Table 1).

Table 1 – Specimen Identification

Test Group	Qty	Part Number	Description
1	10	2318950-1	Receptacle Contact 3.3 Pitch Next Generation GI Connector 3.3, 20 AWG
	10	2318950-1	Receptacle Contact 3.3 Pitch Next Generation GI Connector 3.3, 22 AWG
	10	2318950-1	Receptacle Contact 3.3 Pitch Next Generation GI Connector 3.3, 24 AWG
2	20	2318950-1	Receptacle Contact 3.3 Pitch GI Connector 3.3, 22 AWG
	5	1-1971905-2	4P Plug Housing (latch disabled), GI Connector 3.3
	5	1-1971906-2	4P Header Receptacle, GI Connector 3.3
4	24	2318950-1	Receptacle Contact 3.3 Pitch Next Generation GI Connector 3.3, 22 AWG
	6	1-1971905-2	4P Plug Housing, GI Connector 3.3
5	9	1-1971905-6	12P Plug Housing, GI Connector 3.3
	9	1-1971906-6	12P Header Receptacle, GI Connector 3.3
	36	2318950-1	Receptacle Contact 3.3 Pitch Next Generation GI Connector 3.3, 22 AWG
	36	2318950-1	Receptacle Contact 3.3 Pitch Next Generation GI Connector 3.3, 24 AWG
7	3	1-1971905-6	12P Plug Housing, GI Connector 3.3
	3	1-1971906-6	12P Header Receptacle, GI Connector 3.3
	36	2318950-1	Receptacle Contact 3.3 Pitch Next Generation GI Connector 3.3, 24 AWG
8	3	1-1971905-2	4P Plug Housing, GI Connector 3.3
	3	1-1971906-2	4P Header Receptacle, GI Connector 3.3
	12	2318950-1	Receptacle Contact 3.3 Pitch Next Generation GI Connector 3.3, 24 AWG
9	3	1-1971905-2	4P Plug Housing, GI Connector 3.3
	3	1-1971906-2	4P Header Receptacle, GI Connector 3.3
	12	2318950-1	Receptacle Contact 3.3 Pitch Next Generation GI Connector 3.3, 22 AWG
11	3	1-1971905-6	12P Plug Housing, GI Connector 3.3
	3	1-1971906-6	12P Header Receptacle, GI Connector 3.3
	36	2318950-1	Receptacle Contact 3.3 Pitch Next Generation GI Connector 3.3, 22 AWG
12	3	1-1971905-6	12P Plug Housing, GI Connector 3.3
	3	1-1971906-6	12P Header Receptacle, GI Connector 3.3
	36	2318950-1	Receptacle Contact 3.3 Pitch Next Generation GI Connector 3.3, 22 AWG
13	3	1-1971905-6	12P Plug Housing, GI Connector 3.3
	3	1-1971906-6	12P Header Receptacle, GI Connector 3.3
	36	2318950-1	Receptacle Contact 3.3 Pitch Next Generation GI Connector 3.3, 22 AWG
14	3	1-1971905-6	12P Plug Housing, GI Connector 3.3
	3	1-1971906-6	12P Header Receptacle, GI Connector 3.3
	36	2318950-1	Receptacle Contact 3.3 Pitch Next Generation GI Connector 3.3, 22 AWG
15	3	1-1971905-6	12P Plug Housing, GI Connector 3.3
	3	1-1971906-6	12P Header Receptacle, GI Connector 3.3
	36	2318950-1	Receptacle Contact 3.3 Pitch Next Generation GI Connector 3.3, 22 AWG

1.6. Qualification Test Sequence

Table 2 – Test Sequence

Test or Examination	Test Group (a)																		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	Test Sequence (b)																		
Confirmation of Product	1, 3	1, 4	1, 3	1, 3	1, 3	1, 4	1, 7	1, 7	1, 4	1, 4	1, 4	1, 4	1, 4	1, 4	1, 4	1, 3	1, 3	1, 3	1, 4
Termination Resistance (Low Level)							2, 4, 6	2, 6	2, 5	2, 5	2, 5	2, 5	2, 5	2, 5	2, 5				2, 5
Dielectric Withstanding Voltage						3				7									
Insulation Resistance						2				6									
Temperature Rising					2														
Vibration (Low Frequency)							5												
Physical Shock							3												
Connector Mating Force								3											
Connector Unmating Force								4											
Receptacle Contact Insertion Force				2															
Contact Mating Force		2																	
Contact Unmating Force		3																	
Crimping Tensile Strength	2																		
Durability (Repeated Mating/Unmating)								5											
Housing Locking Strength			2																
sNH_3															3				
Humidity-Temperature Cycling										3									
H_2S														3					
Thermal Shock									3										
Salt Spray											3								
Resistance to Cold													3						
Receptacle Contact Retention Force						5													
Heat Aging												3							
Post Retention Force																2			
Solderability																	2		
Resistance to Soldering Heat																		2	
Hammering Shocks																			3

NOTE

(a) See Paragraph 1.5

(b) Numbers indicate sequence which tests were performed.

1.7. Environmental Conditions

Unless otherwise stated, the following environmental conditions prevailed during testing:

Temperature: 15°C to 35°C
Relative Humidity: 20% to 80%

2. SUMMARY OF TESTING

2.1. Confirmation of Product – All Test Groups

All specimens submitted for testing were representative of normal production lots. A Certificate of Conformance was issued by Product Assurance. Where specified, specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

2.2. Termination Resistance (Low Level) – Groups 7 thru 15

Refer to Qualification Test Report 501-106094 for results for Test Group 19.

All specimens met the 10 milliohm (mΩ) initial resistance requirement or 20 milliohm (mΩ) initial resistance requirement. LLCR summary data for each interval is shown in Table 3 through Table 10.

Table 3 – Group 7, Termination Resistance (mΩ)

	Test Data		
	Initial	**After Physical Shock**	**After Vibration**
Minimum	4.44	4.58	4.98
Maximum	5.27	5.84	9.45
Average	4.85	5.15	6.12
N	36	36	36
Requirement	10 (max)	20 (max)	20 (max)

Table 4 – Group 8, Termination Resistance (mΩ)

	Test Data	
	Initial	**Final**
Minimum	4.55	4.61
Maximum	5.29	5.88
Average	4.93	5.13
N	12	12
Requirement	10 (max)	20 (max)

Table 5 – Group 9, Termination Resistance (mΩ)

	Test Data	
	Initial	**Final**
Minimum	4.69	4.63
Maximum	5.09	5.06
Average	4.83	4.85
N	12	12
Requirement	10 (max)	20 (max)

Table 6 – Group 11, Termination Resistance (mΩ)

	Test Data	
	Initial	**After Salt Spray**
Minimum	4.34	4.52
Maximum	4.99	5.52
Average	4.66	4.87
N	36	36
Requirement	10 (max)	20 (max)

Table 7 – Group 12, Termination Resistance (mΩ)

	Test Data	
	Initial	**After Heat Age**
Minimum	4.33	4.63
Maximum	4.93	5.40
Average	4.67	4.98
N	36	36
Requirement	10 (max)	20 (max)

Table 8 – Group 13, Termination Resistance (mΩ)

	Test Data	
	Initial	**After Cold Storage**
Minimum	4.55	4.63
Maximum	4.98	5.19
Average	4.76	4.88
N	36	36
Requirement	10 (max)	20 (max)

Table 9 – Group 14, Termination Resistance (mΩ)

	Test Data	
	Initial	**After H_2S/Mixed Flowing Gas**
Minimum	4.62	4.78
Maximum	5.07	5.46
Average	4.89	5.08
N	36	36
Requirement	10 (max)	20 (max)

Table 10 – Group 15, Termination Resistance (mΩ)

	Test Data	
	Initial	**After NH_3**
Minimum	4.65	4.67
Maximum	5.19	5.61
Average	4.95	5.03
N	36	36
Requirement	10 (max)	20 (max)

2.3. Dielectric Withstanding Voltage – Group 6 and 10

Refer to Qualification Test Report 501-106094 Rev C for results for Test Group 6 and 10.

2.4. Insulation Resistance – Group 6 and 10

Refer to Qualification Test Report 501-106094 Rev C for results for Test Group 6 and 10.

2.5. Temperature Rising – Group 5

All specimens met the 30°C maximum requirement for temperature rise when tested at their rated current. Temperature rising test summary data is shown in Table 11.

Table 11 – Group 5, Temperature Rising (°C)

	Test Data		
	20 AWG	**22 AWG**	**24 AWG**
Minimum	19.3	11.73	12.23
Maximum	25.98	15.72	14.17
Average	22.56	13.54	13.08
N	6	6	6
Requirement	30 (max)	30 (max)	30 (max)

2.6. Vibration (Low Frequency) – Group 7

No evident of physical damage was visible on any specimen after exposure to vibration.

2.7. Physical Shock – Group 7

No discontinuities greater than 1 µs were detected during physical shock testing. Following physical shock testing, no cracks, breaks, or loose parts on the specimens were visible.

2.8. Connector Mating Force – Group 8

All mating force measurements were less than maximum requirement of 23.52 N. Connector mating force data is shown in Table 12.

Table 12 – Group 8, Connector Mating Force (N)

	Test Data	
	Initial	**30th Mating**
Minimum	11.10	14.62
Maximum	13.66	17.81
Average	12.30	16.51
N	3	3
Requirement	23.52 (max)	23.52 (max)

2.9. Connector Unmating Force – Group 8

All unmating force measurements were greater than the minimum requirement of 2.32 N (initial unmating) and 1.16 N (30th unmating). Connector unmating force data is shown in Table 13.

Table 13 – Group 8, Connector Unmating Force (N)

	Test Data	
	Initial	**30th Unmating**
Minimum	11.23	9.46
Maximum	13.31	10.66
Average	12.49	9.74
N	3	3
Requirement	2.32 (min)	1.16 (min)

2.10. Receptacle Contact Insertion Force – Group 4

All receptacle contact insertion force values were less than the maximum requirement of 8.82 N. Receptacle contact insertion force data is shown in Table 14.

Table 14 – Group 4, Receptacle Contact Insertion Force (N)

	Test Data
Minimum	2.27
Maximum	3.24
Average	2.71
N	10
Requirement	8.82 (max)

2.11. Receptacle Contact Retention Force – Group 4

All receptacle contact retention force values were greater than the minimum requirement of 19.6 N. Receptacle contact retention force data is shown in Table 15.

Table 15 – Group 4, Receptacle Contact Retention Force (N)

	Test Data
Minimum	20.73
Maximum	26.82
Average	24.51
N	10
Requirement	19.6 (max)

2.12. Contact Mating Force – Group 2

All mating force values per pin were less than the maximum requirement of 5.88 N per pin. Contact mating force summary data is shown in Table 16.

Table 16 – Group 2, Contact Mating Force (N)

	Test Data	
	Initial Mating	**30th Mating**
Minimum	11.01	11.20
Maximum	17.77	17.43
Average	13.00	13.75
N	5	5
Requirement	23.52 (max)	23.52 (max)

2.13. Contact Unmating Force – Group 2

All unmating force values per pin were more than the minimum requirement of 0.34 N (first unmating) and 0.25 N (30th unmating). Contact unmating force summary data is shown in Table 17.

Table 17 – Group 2, Contact Unmating Force (N)

	Test Data	
	Initial Unmating	**30th Unmating**
Minimum	10.59	12.25
Maximum	12.06	14.75
Average	11.31	13.18
N	5	5
Requirement	1.36 (min)	1.00 (min)

2.14. Crimping Tensile Strength – Group 1

All specimens met the minimum crimp tensile strength requirement. Crimp tensile strength summary data is shown in Table 18.

Table 18 – Group 1, Crimping Tensile Strength (N)

	Test Data		
	20 AWG	**22 AWG**	**24 AWG**
Minimum	58.92	55.00	45.91
Maximum	72.06	68.78	52.31
Average	67.19	63.40	49.27
N	10	10	10
Requirement	58.8 (min)	49 (min)	29.4 (min)

2.15. Durability (Repeated Mating/Unmating) – Group 8

No evidence of physical damage detrimental to product performance was visible as a result of repeated mating and unmating for 30 cycles.

2.16. Housing Locking Strength – Group 3

Refer to Qualification Test Report 501-106094 Rev C for results for Test Group 3.

2.17. NH3 – Group 15

No evidence of physical damage was visible on any specimen after exposure to NH_3.

2.18. Humidity-Temperature Cycling – Group 10

Refer to Qualification Test Report 501-106094 Rev C for results for Test Group 10.

2.19. H_2S – Group 14

No evidence of physical damage detrimental to product performance was visible as a result of exposure to H_2S.

2.20. Thermal Shock – Group 9

No evidence of physical damage was visible after thermal shock testing.

2.21. Salt Spray – Group 11

No evidence of physical damage detrimental to product performance was visible as a result of exposure to salt spray solution.

2.22. Resistance to Cold – Group 13

No evidence of physical damage detrimental to product performance was visible as a result of exposure to cold storage at –30°C for 96 hours

2.23. Heat Aging – Group 12

No evidence of physical damage detrimental to product performance was visible as a result of exposure to heat aging at 105°C for 96 hours.

2.24. Post Retention Force – Group 16

Refer to Qualification Test Report 501-106094 Rev C for results for Test Group 16.

2.25. Solderability – Group 17

Refer to Qualification Test Report 501-106094 Rev C for results for Test Group 17.

2.26. Resistance to Soldering Heat – Group 18

Refer to Qualification Test Report 501-106094 Rev C for results for Test Group 18.

2.27. Hammering Shocks – Group 19

Refer to Qualification Test Report 501-106094 Rev C for results for Test Group 19.

3. TEST METHODS

3.1. Confirmation of Product

Testing was performed in accordance with EIA-364-18B. Specimens were visually examined and no evidence of physical damage detrimental to product performance was observed.

3.2. Termination Resistance (Low Level)

Testing was performed in accordance with EIA 364-23C using a test current of 100 mA and a test voltage limited to 20mV.

3.3. Dielectric Withstanding Voltage

Refer to Qualification Test Report 501-106094 Rev C for results of dielectric withstanding voltage test.

3.4. Insulation Resistance

Refer to Qualification Test Report 501-106094 Rev C for results of insulation resistance test.

3.5. Temperature Rising

Testing was performed in accordance with EIA-364-70C. Thermocouples were soldered to each test specimen. Test specimens were connected in series in a draft free chamber. Each test current was applied until specimen temperatures were stable, then recorded. Stability occurred when 3 consecutive temperature measurements taken at 5 minutes intervals did not differ by more than 1°C.

3.6. Vibration (Low Frequency)

The test specimens were subjected to a sinusoidal vibration test in accordance with specification EIA-364-28F, Condition I. The parameters consist of simple harmonic motion having an amplitude of 1.52 mm. The vibration frequency was varied logarithmically between the approximate limits of 10 to 55 Hertz (Hz). The entire frequency range of 10 to 55 Hz and return to 10 Hz was traversed in approximately 1 minute. This cycle was performed in all three mutually perpendicular axes for a total period of approximately 2 hours in each plane.

3.7. Physical Shock

Testing was performed in accordance with EIA-364-27C, Condition V, Level A. Mated specimens were subjected to a physical shock test having a half-sine waveform of 50 gravity units (g peak) and a duration of 11 milliseconds. Three shocks in each direction were applied along the 3 mutually perpendicular planes for a total of 18 shocks. Specimens were monitored for discontinued of 1 µs or greater using a current of 100 mA.

3.8. Connector Mating Force

Testing was performed in accordance with EIA-364-13E. Mating force was measured with a tensile/compression machine. The cap housing was held in a vice mounted to an X-Y table rigidly clamped to the base of the tensile/compression testing machine. The plug housing was placed onto the cap housing with the latching feature disabled. Wire leads were supported to prevent unnecessary stress while mating force was measured. The moveable crosshead was lowered at a rate of 100 mm/min until the specimen was fully mated. The peak force required to mate the connector was recorded.

3.9. Connector Unmating Force

Testing was performed in accordance with EIA-364-13E. Unmating force was measured with a tensile/compression machine. The cap housing was held in a vice mounted to an X-Y table rigidly clamped to the base of the tensile/compression testing machine with the latch disengaged. Wire leads were supported to prevent unnecessary stress while mating force was measured. The moveable crosshead was raised at a rate of 100 mm/min until the specimen was fully unmated. The peak force required to unmate the connector was recorded.

3.10. Receptacle Contact Insertion Force

Testing was performed in accordance with 108-106094, Rev D. Contact insertion force was measured by applying an increasing force to each contact using a tensile/compression device with a rate of travel at 25.4 mm per minute until the contact was properly seated in the housing.

3.11. Receptacle Contact Retention Force

Testing was performed in accordance with 108-106094, Rev D. Contact retention force was measured by applying an increasing force to each contact using a tensile/compression device with a rate of travel at 100 mm per minute until the contact was dislodged from the housing.

3.12. Contact Mating Force

Testing was performed in accordance with 108-106094, Rev D.

3.13. Contact Unmating Force

Testing was performed in accordance with 108-106094, Rev D.

3.14. Crimping Tensile Strength

Testing was performed in accordance with EN 60352-2-2006. The force load was applied to each specimen was applied to each specimen using a tensile/compression device with the rate of travel at 100 mm per minute.

3.15. Durability (Repeated Mating/Unmating)

Testing was performed by mating and unmating test specimens for 30 cycles.

3.16. Housing Locking Strength

Refer to Qualification Test Report 501-106094 Rev C for results of housing locking strength test.

3.17. NH_3

Testing was performed in accordance with 108-106094, Rev. D. Mated specimens were subjected to a 3% NH_3 solution environment for 7 hours.

3.18. Humidity-Temperature Cycling

Refer to Qualification Test Report 501-106094 Rev C for results of humidity-temperature cycling test.

3.19. H_2S

Testing was performed in accordance with 108-106094, Rev. D. Mated specimens were subjected to a 3±1 ppm H_2S environment for 96 hours at a temperature of 40±2°C.

3.20. Thermal Shock

Testing was performed in accordance with EIA-364-32G. Mated specimens were subjected to 25 cycles of thermal shock with each cycle consisting of 30 minutes dwells at –55°C and 85°C. The transition between temperature was less than 5 minutes.

3.21. Salt Spray

Testing was performed in accordance with EIA-364-26C. Mated specimens were subjected to a 5% salt spray environment for 48 hours. The temperature of the box was maintained at 35°C while the pH of the salt solution was between 6.5 and 7.2.

3.22. Resistance to Cold

Testing was performed in accordance with IEC 60512-11-10-2002. Mated specimens were placed in a cold storage unit at a temperature of –30°C for 96 hours.

3.23. Heat Aging

Testing was performed in accordance with IEC 60512-11-9-2002. Mated specimens were placed in an air-circulating oven at a temperature of 105°C for 96 hours.

3.24. Post Retention Force

Refer to Qualification Test Report 501-106094 Rev C for results of post retention force test.

3.25. Solderability

Refer to Qualification Test Report 501-106094 Rev C for results of solderability test.

3.26. Resistance to Soldering Heat

Refer to Qualification Test Report 501-106094 Rev C for results of resistance to soldering heat test.

3.27. Hammering Shocks

Refer to Qualification Test Report 501-106094 Rev C for results of hammering shocks test.