HT4209 Issue 1

Qualification testing of D-150-Z393 impedance matching splice to D-6204

February 2016

TE connectivity AEROSPACE, DEFENSE & MARINE

Report Number:	**HT 4209**
Issue Number:	**Issue 1**

Qualification testing of D-150-Z393 impedance matching splice to D-6204

Author:	Nina Przybylska, Development Engineer, TE Connectivity
Signed:	*Signed electronically*
Approved by:	Sal Abughalya, Project Manager TE Connectivity
Signed:	*Approved electronically*
Date:	February 2016

Summary

This report details the qualification testing of D-150-Z393 splice to D-6204

Table of Contents

1 INTRODUCTION

This report details the qualification testing of D-150-Z393 impedance matching splice. The Splice consists of a crimp ferrule, two-part dielectric insert and a Solder Sleeve. The Splice was installed in the middle of 10ft RG393 cables and tested as per Qualification Test Program (QTP) specified in paragraph 4. Tests in each group A to E were sequential. Unless otherwise stated in this report, all tests were made at ambient temperature, pressure and humidity as specified in MIL-STD-202. The testing was performed in Menlo Park test laboratory. The test results are documented in Request Tracking System number 906510 and 1170339.

2 CONCLUSION

All samples pass the requirement of D-6204 specification.

3 SAMPLE

Description	Batch numbers
D-150-Z393	*5783083*
Cable RG393	

4 QUALIFICATION TEST PROGRAM TO D-6204 ISSUE I

Group	Sample Size	Test sequence	Requirement paragraph	Method paragraph
A	**13**	Visual examination	3.3.1, 3.3.2	4.6.1
		Workmanship	3.5	
B	**1** uninstalled sealing sleeve	Copper Mirror Corrosion	3.6.15	4.6.17
C	**4** splice assemblies 1/, 2/ (10 feet min. length)	Characteristic impedance	3.6.1	4.6.2
		Insertion loss	3.6.2	4.6.3
		Return loss	3.6.3	4.6.4
		Altitude immersion (3 cycles)	3.6.4	4.6.5
		Insulation resistance	3.6.5	4.6.6
		Immersion		4.6.7
		Altitude immersion (1 cycle)	3.6.4	4.6.5
		Insulation resistance	3.6.5	4.6.6
		Thermal shock	3.6.6	4.6.8
		Altitude immersion (1 cycle)	3.6.4	4.6.5
		Insulation resistance	3.6.5	4.6.6
		Moisture resistance	3.6.7	4.6.9
		Vibration	3.6.8	4.6.10
		Altitude immersion (1 cycle)	3.6.4	4.6.5
		Insulation resistance	3.6.5	4.6.6
		Heat aging	3.6.9	4.6.11
		Altitude immersion (1 cycle)	3.6.4	4.6.5
		Insulation resistance	3.6.5	4.6.6
		Insertion loss	3.6.2	4.6.3
		Return loss	3.6.3	4.6.4
		Dielectric withstanding voltage (wet)	3.6.10	4.6.12
		Voltage drop (after test)	3.6.11	4.6.13
		Tensile strength	3.6.12	4.6.14
D	**6** splice assemblies	Fluid Immersion	3.6.13	4.6.15
		Insulation Resistance	3.6.5	4.6.6
		Dielectric Withstanding Voltage (wet)	3.6.10	4.6.12
E	**2** splice assemblies	Flammability	3.6.14	4.6.16

5 GROUP A

5.1 Visual and dimensional check

Requirement: D-6204, SCD

Result:

All samples pass dimensional and visual inspection. Dimensions after installations are included in paragraph 7 of this report.

Summary Result: Pass

6 GROUP B

6.1 Copper Mirror Corrosion

Test Method. para. 4.6.17 of D-6204

Requirement: para. 3.6.15 of D-6204

Procedure:

The copper mirror corrosion was tested to SAE-AS83519 test method. The lower 2 inches of the test tube was immersed in an oil bath at 121°C for 16 ± .5 hours.
Evidence of corrosion shall be the removal of copper from the mirror, leaving an area of transparency greater than 8% of its total area. The copper mirror corrosion was tested on D-150-Z393 cable splice (results in the table below).

Result:

Copper Mirror Corrosion RG393 splice		
	Requirement	**Result**
Sample F1	Not exceed 10%	0%
Sample F2	Not exceed 10%	0%
Control	Not exceed 10%	0%

Summary Result: Pass

7 GROUP C

7.1 Results

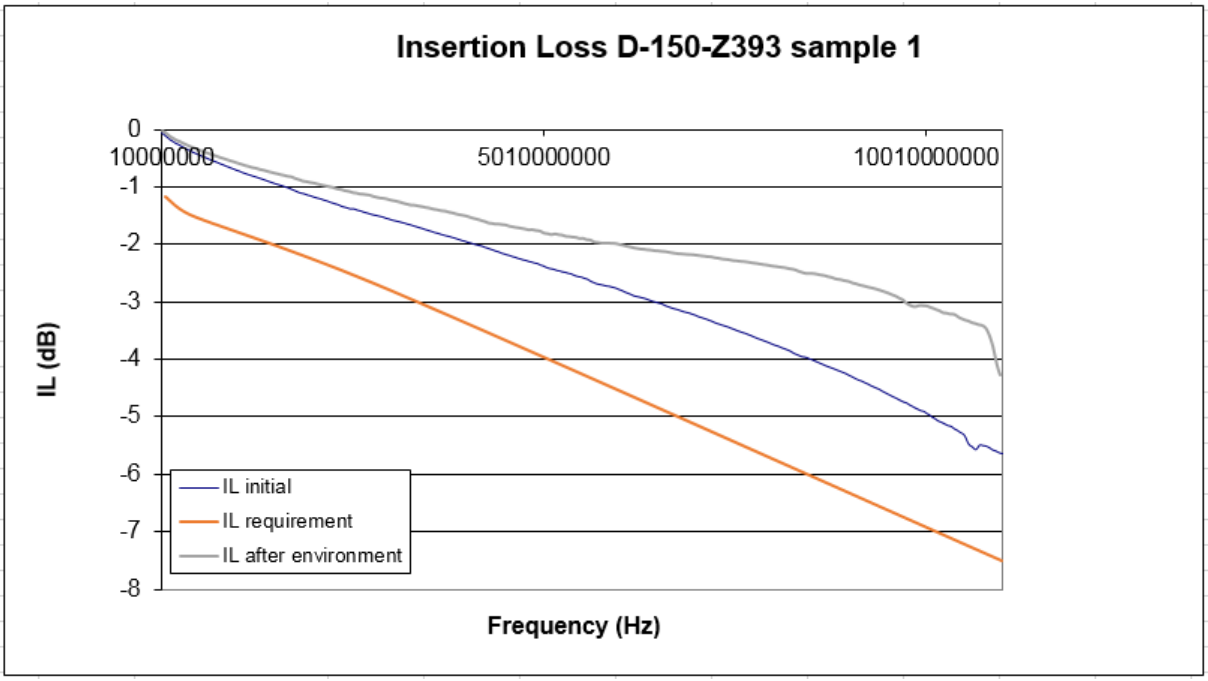
Environmental conditioning	Requirement para.	Test method	Requirement	Sample1	Sample 2	Sample 3	Sample 4	Summary
Dimension D	Table II MIL-PRF-32517	4.6.1	.630 (16 mm) max	13.05 mm	13.02 mm	13.47 mm	13.70mm	pass
Dimension L			2.56 (65 mm) max	57.25 mm	56.03 mm	55.07 mm	55.94mm	pass
Characteristic impedance	3.6.1	4.6.2	46-57.5	50.46-56.22	50.02-55.71	50.38-55.55	49.70-56.34	pass
Insertion loss	3.6.2	4.6.3	graphs from Dao	pass	pass	pass	pass	pass
Return loss	3.6.3	4.6.4	graphs from Dao	pass	pass	pass	pass	pass
Altitude immersion (3 cycles)	3.6.4	4.6.5		pass	pass	pass	pass	pass
Insulation resistance(Water-Shield)	3.6.5	4.6.6	5000 Mega Ohm min.	70G	100G	150G	150G	pass
Insulation resistance(Conductor-Shield)	3.6.5	4.6.6	5000 Mega Ohm min.	1T	1T	1T	800G	pass
Immersion	---	4.6.7		pass	pass	pass	pass	pass
Altitude immersion (1 cycle)	3.6.4	4.6.5		pass	pass	pass	pass	pass
Insulation resistance(Water-Shield)	3.6.5	4.6.7	5000 Mega Ohm min.	100G	100G	100G	100G	pass
Insulation resistance(Conductor-Shield)	3.6.5	4.6.7	5000 Mega Ohm min.	1T	5T	200G	5T	pass
Thermal shock	3.6.6	4.6.8		pass	pass	pass	pass	pass
Altitude immersion (1 cycle)	3.6.4	4.6.5		pass	pass	pass	pass	pass
Insulation resistance(Water-Shield)	3.6.5	4.6.6	5000 Mega Ohm min.	5T	5T	5T	5T	pass
Insulation resistance(Conductor-Shield)	3.6.5	4.6.6	5000 Mega Ohm min.	1T	1T	5T	1T	pass

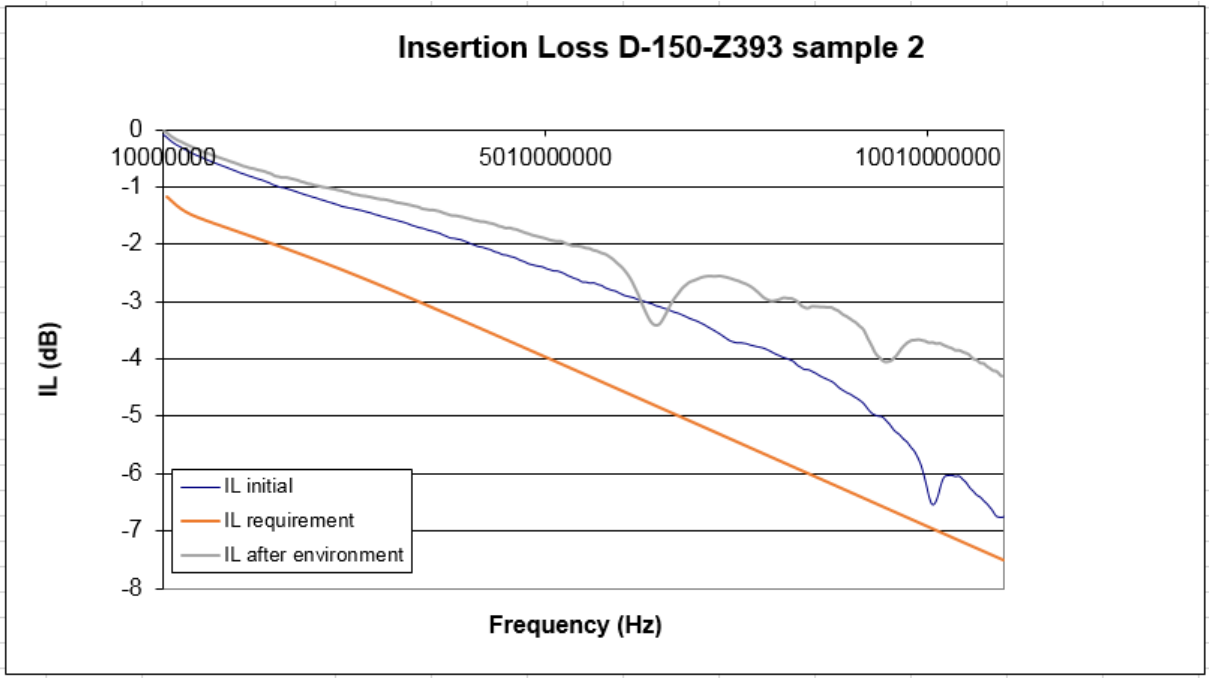
Moisture resistance	3.6.7	4.6.9	no evidence of water intrusion	pass	pass	pass	pass	pass
Vibration	3.6.8	4.6.10	no evidence of cracking, breaking or loosening of the splice assembly	pass	pass	pass	pass	pass
Altitude immersion (1 cycle)	3.6.4	4.6.5		pass	pass	pass	pass	pass
Insulation resistance(Water-Shield)	3.6.5	4.6.6	5000 Mega Ohm min.	5T	4T	5T	5T	pass
Insulation resistance(Conductor-Shield)	3.6.5	4.6.6	5000 Mega Ohm min.	2T	1T	1T	1T	pass
Heat aging	3.6.9	4.6.11		pass	pass	pass	pass	pass
Altitude immersion (1 cycle)	3.6.4	4.6.5		pass	pass	pass	pass	pass
Insulation Resistance(Water-Shield)	3.6.5	4.6.6	5000 Mega Ohm min.	1.5T	1T	3T	2T	pass
Insulation Resistance(Conductor-Shield)	3.6.5	4.6.6	5000 Mega Ohm min.	5T	4T	5T	4T	pass
Characteristic impedance	3.6.1	4.6.2	46-57.5	49.53-54.30	48.89-55.74	49.40-54.30	49.40-56.04	pass
Insertion loss	3.6.2	4.6.3	graphs from Dao	pass	pass	pass	pass	pass
Return loss	3.6.3	4.6.4	graphs from Dao	pass	pass	pass	pass	pass
Dielectric withstanding voltage (wet)	3.6.10	4.6.12	no breakdown, flashover, or spark-over	128.0 µA	142.0 µA	129.0 µA	113.0 µA	pass
	3.6.10	4.6.12	Leakage current shall be less than 2.5 milliamperes	142.0 µA	146.0 µA	148.0 µA	142.0 µA	pass

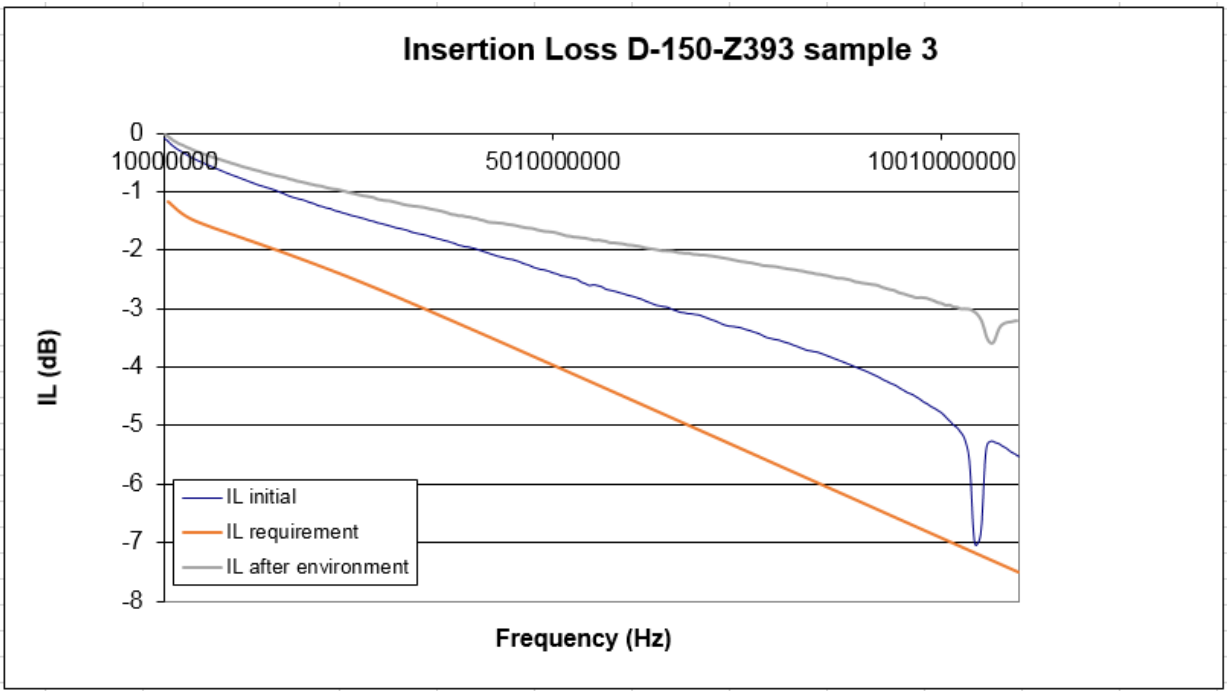
			maximum.					
Voltage drop across the shield (after test)	3.6.11	4.6.13	shall not exceed that of an equivalent length of the cable by more than 2.0 millivolts	0.330	0.300	0.293	0.295	pass
Voltage drop across the inner conductor (after test)	3.6.11	4.6.13	shall not exceed that of an equivalent length of the wire by more than 2.5 millivolts	15.88	17.0	16.83	16.09	pass
Unspliced cable shield Voltage drop	3.6.11	4.6.13	0.310-Average	0.298	0.313	0.319	0.308	pass
Unspliced wire Voltage drop	3.6.11	4.6.13	15.41-Average	15	15.01	15.63	16.01	pass
Tensile strength	3.6.12	4.6.14	125 pounds Min.	142.68	131.04	136.29	145.91	pass

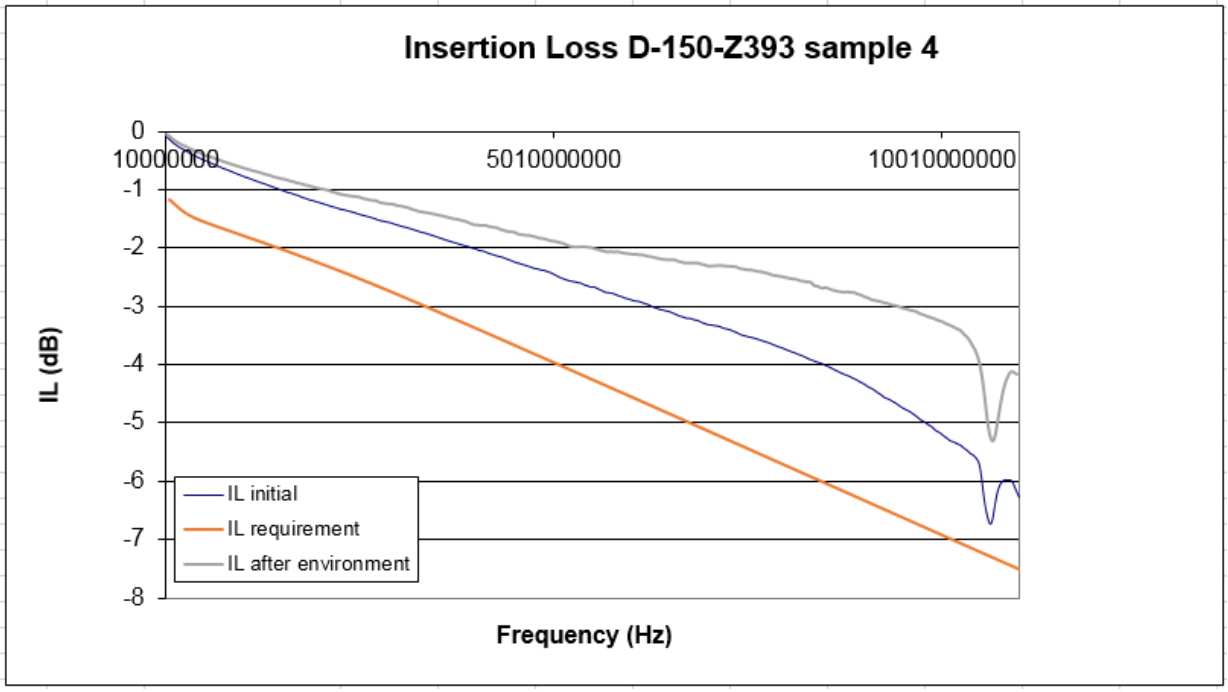
T- tera Ohm
G- giga Ohm

7.2 Insertion Loss graphs

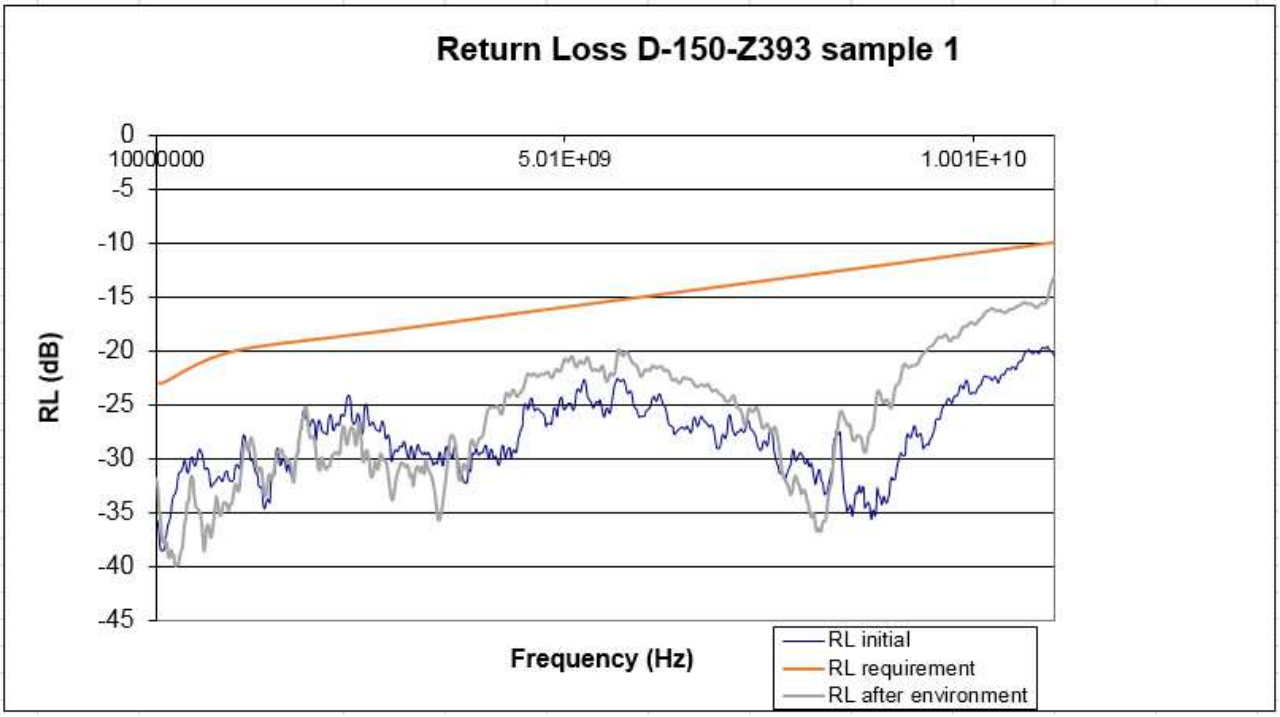


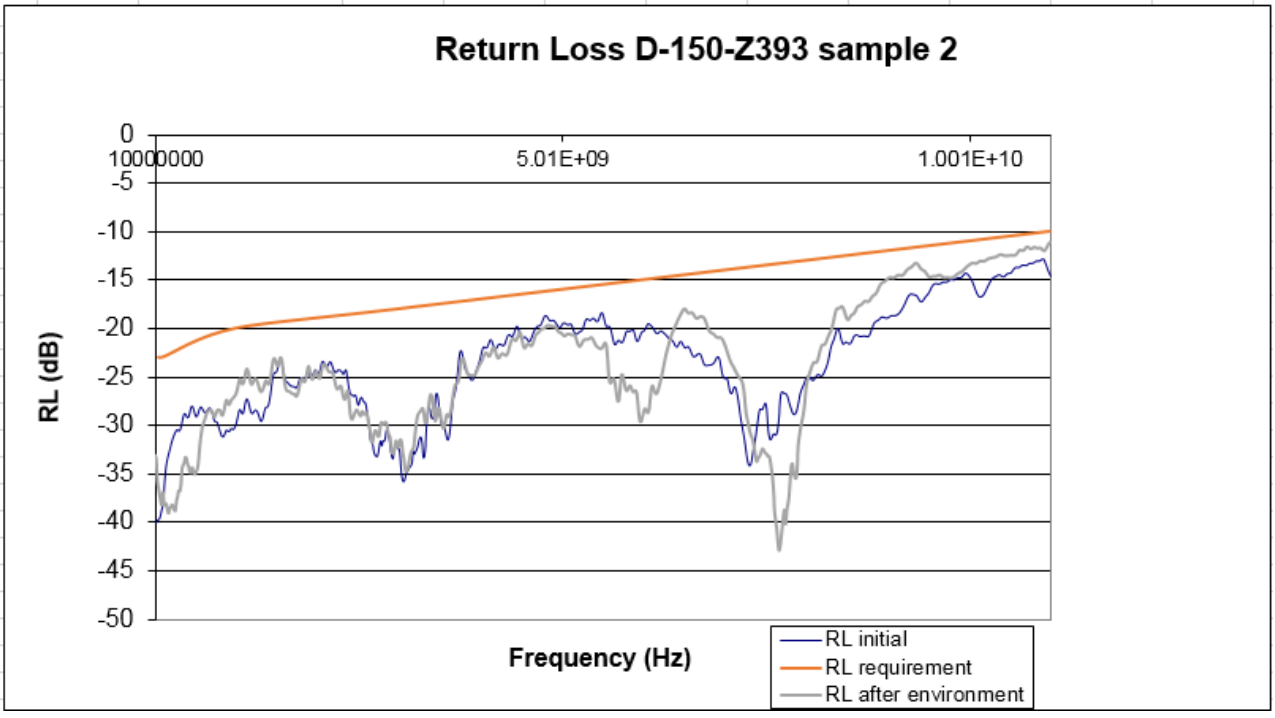


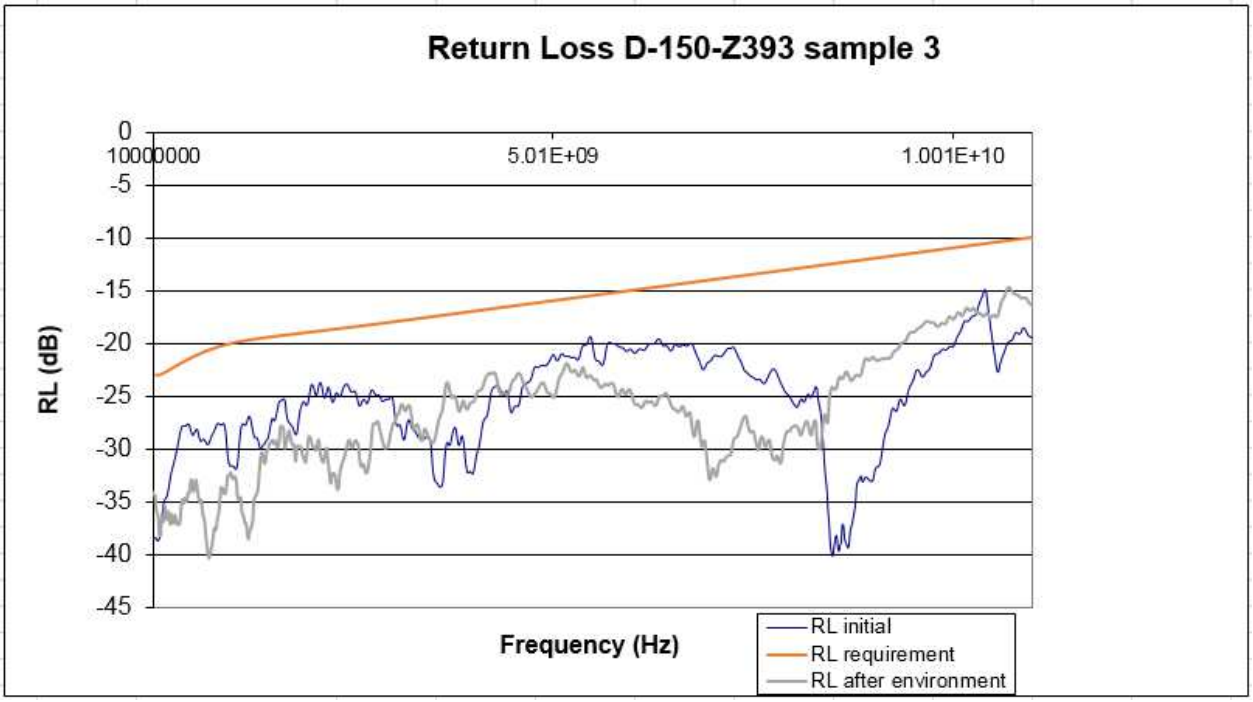


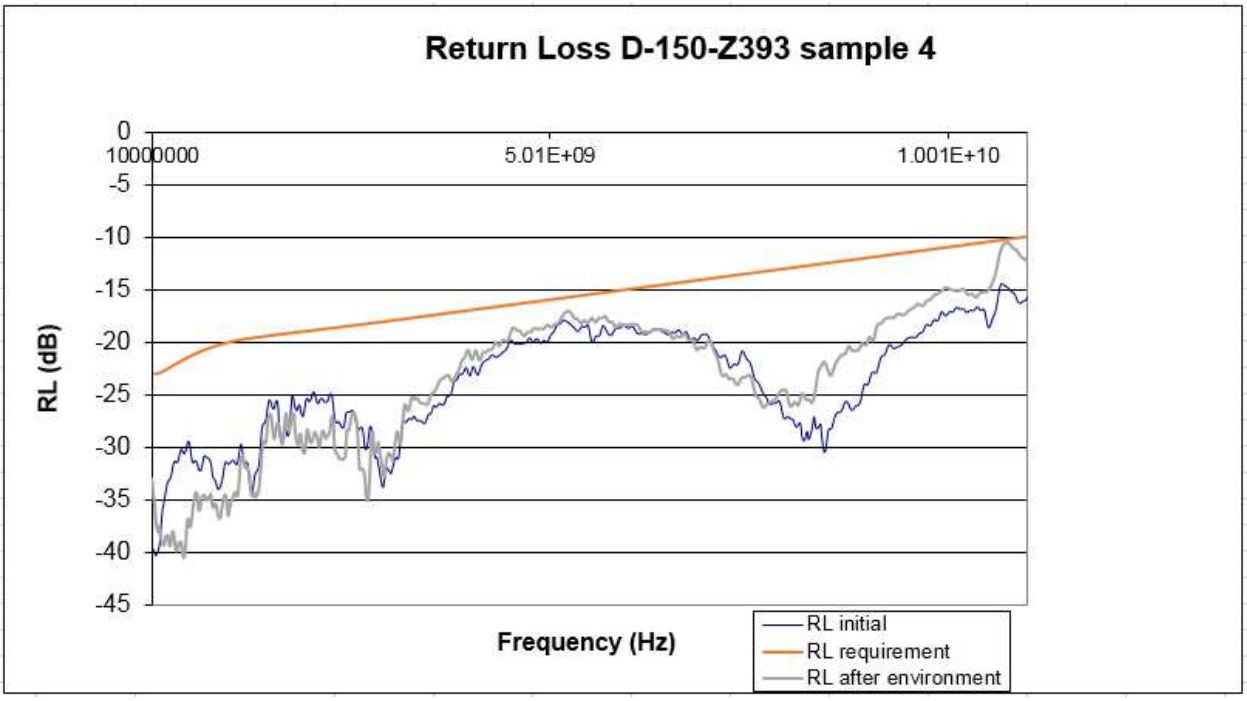


7.3 Return Loss graphs


Return Loss D-150-Z393 sample 1
0
10000000
5.01E+09
1.001E+10
-5
-10
-15
-20
-25
-30
-35
-40
-45
RL (dB)
Frequency (Hz)
RL initial
RL requirement
RL after environment


Return Loss D-150-Z393 sample 2
0
10000000
5.01E+09
1.001E+10
-5
-10
-15
-20
-25
-30
-35
-40
-45
-50
RL (dB)
Frequency (Hz)
RL initial
RL requirement
RL after environment


Return Loss D-150-Z393 sample 3
0
10000000
5.01E+09
1.001E+10
-5
-10
-15
-20
-25
-30
-35
-40
-45
RL (dB)
Frequency (Hz)
RL initial
RL requirement
RL after environment


Return Loss D-150-Z393 sample 4
0
10000000
5.01E+09
1.001E+10
-5
-10
-15
-20
-25
-30
-35
-40
-45
RL (dB)
Frequency (Hz)
RL initial
RL requirement
RL after environment

8 GROUP D

8.1 Fluid Immersion

Test Method. Para. 4.6.15 of D-6204

Requirement. Para 3.6.13 of D-6204

Procedure:

6 assembled samples were immersed in fluids as per table 1 and tested for Dielectric Withstanding voltage and Insulation resistance and the results are captured in paragraph 8.2 and 8.3 of this report.

Sample	Fluid specification	Test condition
1 2	MIL-PRF-7808 MIL-PRF-23699	a) Immerse installed splice for 5 minutes at 120 ± 3°C or at the maximum operating temperature of the splice device or wire, whichever is lower. (b) Remove and allow to drain for 1 hour at 23 ± 5°C. (c) Place in the oven at 150°C temperature or at the maximum operating temperature of the splice device or wire, whichever is lower for 22 hours. (d) Repeat a, b, and c for 7 cycles
3	MIL-PRF-5606	Same as MIL-PRF-7808, except 85 ± 3°C for step (a) and 104 ± 3°C for step (c).
4 5	SAE-AMS1424 MIL-PRF-87937 pH 10-12	Same as MIL-L-7808, except 65 ± 3°C for step (a).
6	MIL-DTL-5624 JP5 or MIL-DTL-83133 JP8	(a) Immerse at 23 ± 5°C for 20 hours. (b) Remove and allow to drain for 4 hours at 23 ± 5°C

8.2 Dielectric Withstanding Voltage (DWV)

Test Method. Para. 4.6.12 of D-6204

Requirement: Para. 3.6.10 of D-6204

Procedure:

Six samples after fluid immersions were tested for DVW (1,000V RMS, 60 Hz potential for 60 s).

Result:

DWV			
	Requirement	**Shield**	**Conductor to shield**
Sample D1	No arcing, no breakdown, Leakage current 2.5mA maximum	0.22 mA	0.23 mA
Sample D2		0.26 mA	0.26 mA
Sample D3		0.26 mA	0.25 mA
Sample D4		0.25 mA	0.26 mA
Sample D5		0.25 mA	0.26 mA
Sample D6		0.23 mA	0.23 mA

Summary Result: All samples pass the requirement

8.3 Insulation Resistance

Test Method. Para. 4.6.6 of D-6204

Requirement. Para 3.6.5 of D-6204

Procedure:

Six assembled MI splices after fluid immersion and DW test were immersed in a water bath for 30 minutes and then Insulation Resistance was tested as per Method 302 of MIL-STD-202.

Result:

Insulation Resistance		
	Requirement	**Result**
Sample D1	5000 mega-Ohms minimum	>50 GΩ
Sample D2		>50 GΩ
Sample D3		>50 GΩ
Sample D4		>50 GΩ
Sample D5		>50 GΩ
Sample D6		>50 GΩ

Summary Result: All samples pass the test requirement.

9 GROUP E

9.1 Flammability

Test Method. 4.6.16 of D-6204

Requirement: 3.6.14 of D-6204

Procedure:

The Flammability test as per D-6204 test method was performed on two assembled D-150-Z393 splices.

Result:

Flammability		
	Requirement	**Result**
Sample E1	Self-extinguishing within 5sec	0 sec
Sample E2	Self-extinguishing within 5sec	1 sec

Summary Result: Both samples pass the test requirement

10 TEST EQUIPMENT

No.	Equipment name	Equipment ID
	Group A	
1	Mitutoyo Caliper	PMC 2561
	Group B	
2	Oil Bath	PMI 2464
	Group C	
3	1864 Mega-ohmmeter	PMC 0117
4	Altitude Chamber	PMC 0189
5	Blue M Oven #2	PMC 0010
6	Instron 5967	5967R5262
7	DC Power Supply 6012B	N/A, location: Menlo Park Laboratory
8	Endevco Model 41A13 Accelerometer	N/A, location: Menlo Park Laboratory
9	Endevco Model 41A13 Accelerometer	N/A, location: Menlo Park Laboratory
10	Data Physics Abacus Lite Controller / Interface	N/A, location: Menlo Park Laboratory
11	Data Physics Scaler Vibration Software	N/A, location: Menlo Park Laboratory
12	Ling Shaker	0336655 000
13	Fluke 45 multimeter	PMC 0015
14	Fluke 45 multimeter	PMC 0125
	Group D	
13	W&C High Voltage Cage	HV1
14	Multimeter	SW29
15	Maga Ohmmeter	WCM94

11 KEYWORDS

1	D-150-Z393	4	D-6204
2	Impedance Matching Splice	5	
3	RG393	6	

12 REFERENCES

1	TE Specification D-6204
2	MIL-PRF-32715
3	SAE-AS83519
4	MIL-STD-202

13 DISTRIBUTION

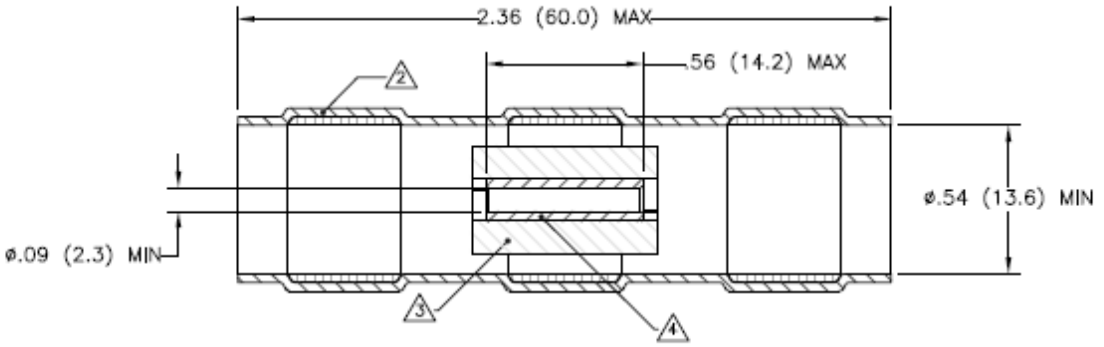
Name	Location	Title

14 APPENDIX I – D-150-Z393 CUSTOMER DRAWING

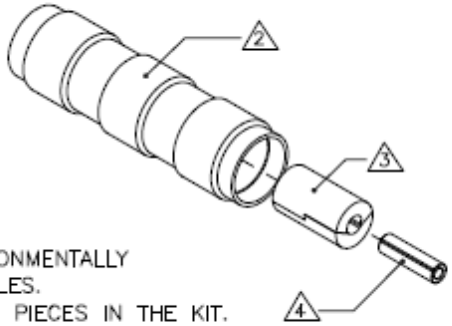
TE CONNECTIVITY (TE) RESERVES THE RIGHT TO CHANGE THIS DRAWING AT ANYTIME. USERS SHOULD EVALUATE THE SUITABILITY OF THE PRODUCT FOR THEIR APPLICATION.

REVISION

LTR	DESCRIPTION	DATE	APPROVED
A	REVISED PER ECO-15-013263	09/09/2015	N. PRZYBYLSKA



MATCHED IMPEDANCE SPLICE
FOR RG393 COAXIAL CABLE REPAIR



NOTES:

1. THIS PRODUCT IS DESIGNED FOR USE IN MAKING ENVIRONMENTALLY PROTECTED PERMANENT JOINTS ON RG393 COAXIAL CABLES. COMPONENTS 2, 3, 4, WILL BE SUPPLIED AS LOOSE PIECES IN THE KIT.
2. SOLDERSLEEVE MATERIALS:
   INSULATION SLEEVE: HEAT-SHRINKABLE, TRANSPARENT BLUE, RADIATION CROSS-LINK MODIFIED POLYVINYLIDENE FLUORIDE.
   MELTABLE RINGS: THERMALLY STABILIZED THERMOPLASTIC – COLOR: BLUE.
   SOLDER: TYPE Sn63 PER ANSI-J-STD-006.
3. DIELECTRIC INSERT MATERIAL: FLUORINATED ETHYLENE PROPYLENE.
4. CRIMP BARREL MATERIAL: ANNEALED COPPER PER ASTM B-152.
   FINISHES: TIN PLATED PER MIL-T-10727.
5. INSTALLATION REQUIREMENTS TOOL: CV1981 HEAT GUN WITH PR13C REFLECTOR.
6. FOR INSTALLATION PROCEDURE AND APPLICATION EQUIPMENT, REFER TO RPIP-1108.
7. FOR PERFORMANCE AND TEST SPECIFICATIONS, REFER TO SPECIFICATION D-6204.
8. FOR ADDITIONAL ORDERING INFORMATION, CONTACT TE TECHNICAL SUPPORT.

If this document is printed it becomes uncontrolled. Check for the latest revision.

Raychem Devices
CUSTOMER DRAWING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES. REFERENCE METRIC DIMENSIONS ARE IN BRACKETS [mm].

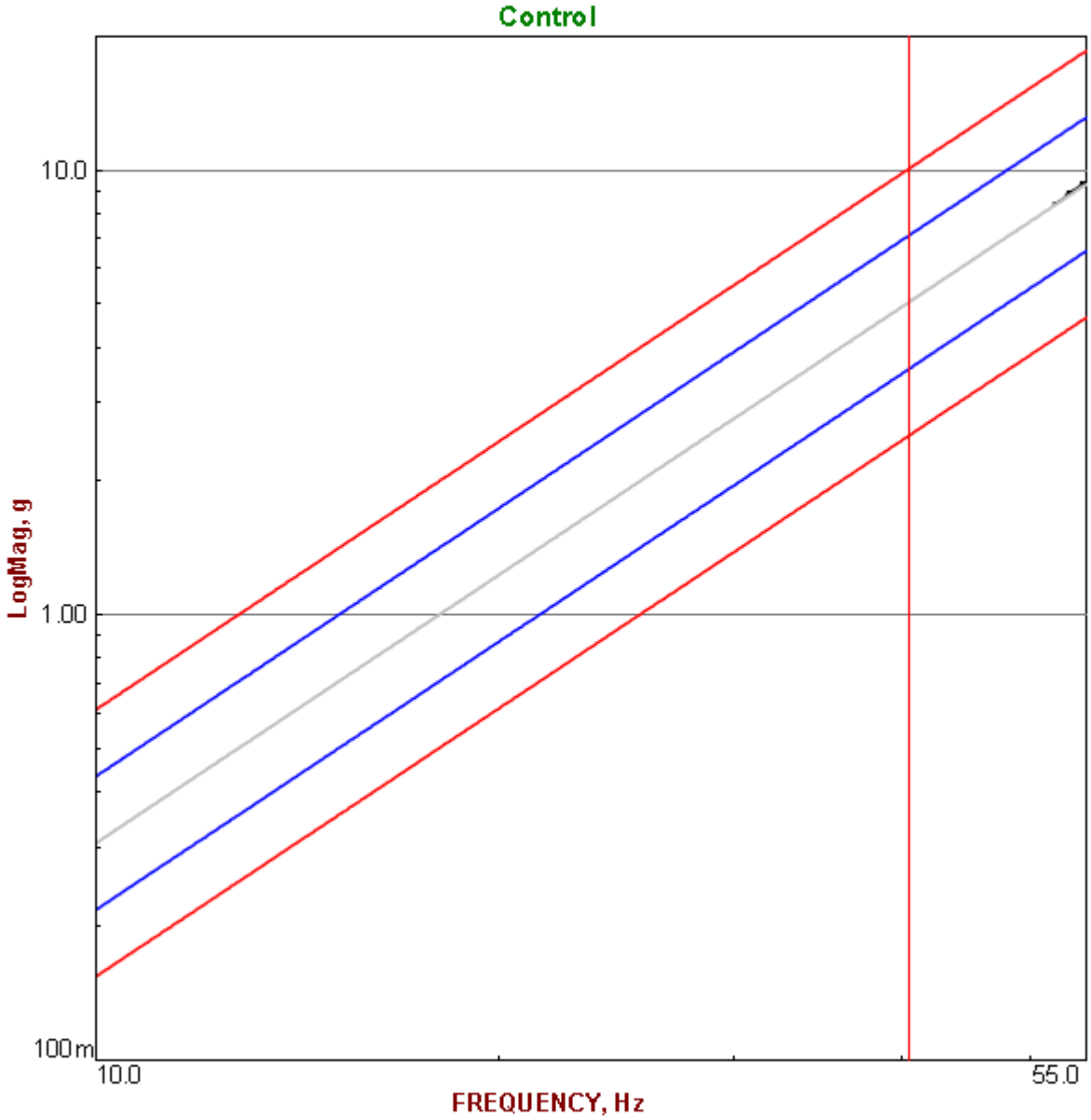
DECIMALS TOLERANCES:
XXX ± .005 [0.13mm]
XX ± .01 [0.25mm]
X ± .1 [2.50mm]
ANGLES TOLERANCE: ± 1°

DRAWN: T. NGUYEN	DATE: 03/23/2015	TE Connectivity	
CHECKED: N. PRZYBYLSKA	DATE: 03/25/2015		
APPROVED: N. PRZYBYLSKA	DATE: 04/10/2015	TITLE: D-150-Z393 – SOLDERSLEEVE	
MATERIAL: SEE NOTES	FINISH: SEE NOTES		
SCALE: DO NOT SCALE THIS DRAWING	CAD FILE: D-150-Z393.dwg	THIRD ANGLE PROJECTION	SIZE: A / SHEET: 1 OF 1 / CAGE CODE: 06090 / DRAWING NO: D-150-Z393 / REV: A

15 APPENDIX II – VIBRATION GRAPHS

MIL-STD-202F, 201A (18hrs).svc
Test Number: 005/2016
Test Item: Matched-Z 4EA RG-393 RTS#: 1170339
Axis: X

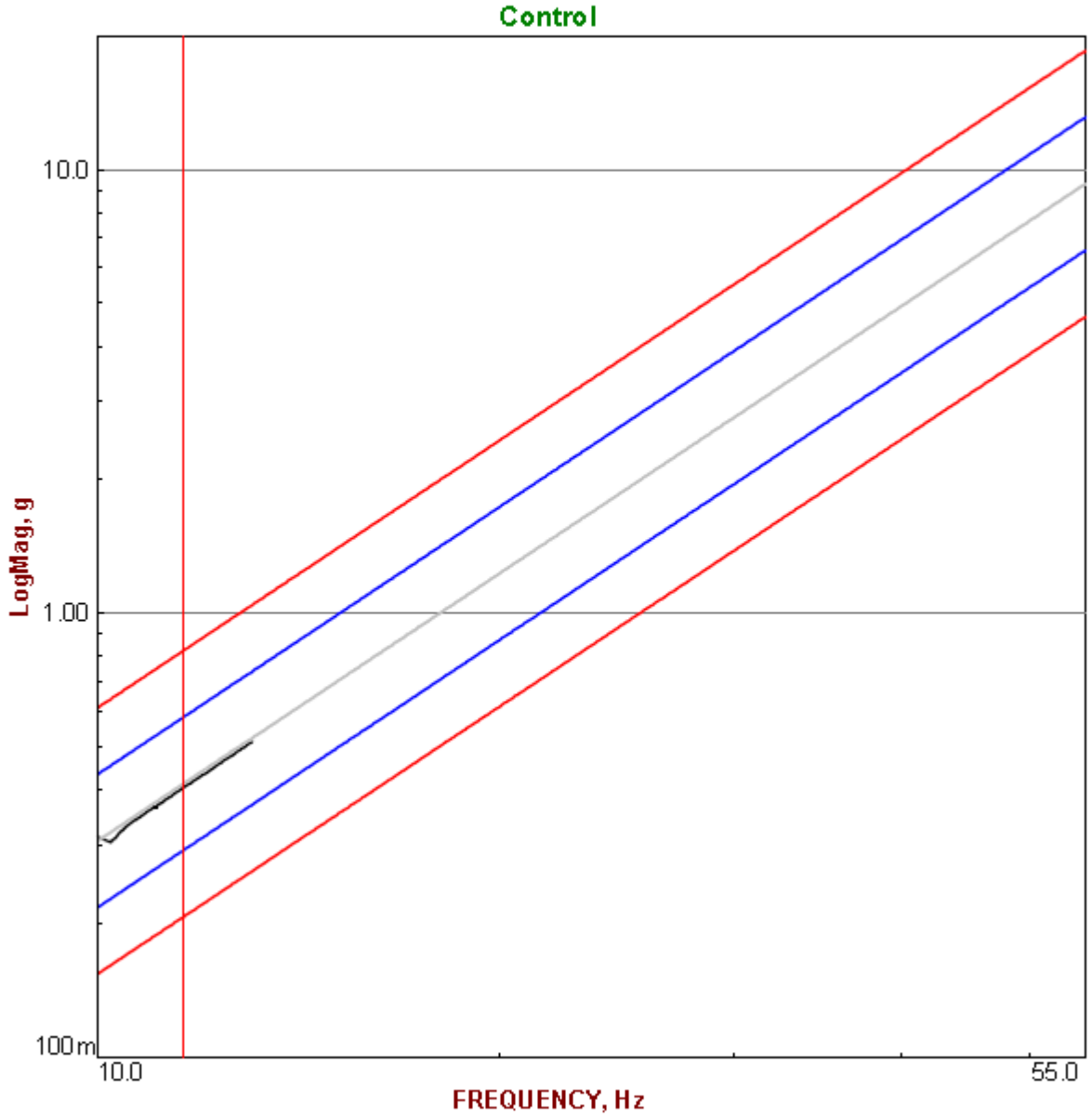
Accel: 0.0352 g Displ: in p-p Frequency: 51.950 Hz
Total Time: 18:00:10 Sweep Direction: - Remaining: 0:00:00



Operator: Keith Kanaya
START TIME: 10:39:32 AM
END TIME: 4:39:42 AM
Date: 1/6/2016

MIL-STD-202F, 201A (18hrs).svc
Test Number: 004/2016
Test Item: Matched-Z 4EA RG-393 RTS#: 1170339
Axis: Y

Accel: 0.0008 g Displ: in p-p Frequency: 13.062 Hz
Total Time: 18:00:10 Sweep Direction: + Remaining: 0:00:00



Operator: Keith Kanaya
START TIME: 7:57:35 AM
END TIME: 1:57:45 AM
Date: 1/5/2016

LAB DATA SHEET							
			RTS1170339				
TEST :	**RANDOM VIBRATION**					**DATE STARTED:**	**12/31/2015**
						DATE COMPLETED:	**01/06/2016**
		TEST EQUIPMENT			**CALIBRATION :**		
DESCRIPTION :					**CURRENT :**		**DUE :**
	1. Endevco Model 41A13 Accelerometer				**29/04/2015**		**29/04/2016**
	2. Endevco Model 41A13 Accelerometer				**29/04/2015**		**29/04/2016**
	5. Data Physics Abacus Lite Controller / Interface				**07/01/2015**		**22/01/2016**
	7. Data Physics Scaler Vibration Software				**07/01/2015**		**22/01/2016**
	5. Ling Shaker				**0336655 000**		**NA**
Lot Number: NA							
					Operator		**Keith Kanaya**