NNP-DVER-0005 - Design Verification Report – Network Cable Post-Test Evaluations

Contents

1.0 Document Purpose

This report documents design verification of the COSMIIC system against its reliability requirements. This verification activity was conducted in accordance with NNP-DEVP-0005 – Design Verification Protocol - Network Cable Post-Test Evaluations.

2.0 Document Scope

This report addresses verification of the COSMIIC system against the reliability requirements that are defined in NNP-REQ-0001 – Product Requirements Specification – Network Cable.

This includes the following cables:

Cable	Part Number
Cable Body, Insulated DFT Filars, Blue/Clear	NNP-DWG-140-012-001
Cable Body, Insulated SS Filars, Red/Clear	NNP-DWG-140-012-002
Cable Body, Insulated SS Filars, Green/Clear	NNP-DWG-140-012-003

3.0 Background

Initial design verification of the network cables against its reliability requirements was conducted to verify against NNP-REQ-0001 for the IDE submission of the COSMIIC device.

4.0 Definitions

Terms used in this protocol are defined in the applicable requirements specification(s) and standards, where referenced.

5.0 Requirements Addressed

This protocol addresses the requirement listed below from NNP-REQ-001 – Product Requirements Specification – Network Cable. The Requirement Text is for reference only; the listed Product Requirement Specification document is the definitive source for requirement content.

Req ID	Requirement Text
NC.7.1	The Network Cable shall remain functional during and after 1.2 x 10^6 cycles of stretching to 120% of the initial installed length of separation.
NC.7.2	The Network Cable shall remain functional during and after 1.2 x 10^6 cycles of crushing by a force of 1.2 Newtons delivered over a 1cm x 2mm bar without sharp edges.
NC.7.3	The Network Cable shall remain functional during and after 1.2 x 10^6 cycles of bending (wrapping) over a rod of 3mm radius with an angle of bend (wrap) of at least 140°.
NC.7.4	The Network Cable shall remain functional during and after 6 x 10^5 cycles of twisting at a rate of 36° of rotation per linear cm of separation about the axis of separation.

6.0 Verification by Analysis

All tests were conducted using EnduraTEC TestBench (Bose Corporation, Minnetonka, MN) equipped with two pneumatic linear actuators and one electromagnetic torsion actuator. All tests were conducted under room temperature (nominally 22°C) laboratory conditions. Before mechanical testing, each sample was prepared for testing and connected to a Fluke 8711 True RMS multimeter to measure electrical resistance with resolution of 0.1W. Impedance of the sample was measured using the Electrochemical Impedance Spectroscopy technique. A Gamry PC4/FAS1 Femtostat with current detection resolution of 1pA was utilized to detect damage to the cable insulation layer. Each sample was placed in an electrochemical cell with a test solution of physiological saline solution of 0.9wt% NaCl. An AC voltage of 1V was applied to each filar of the test sample with frequency range varying from 100kHz to 100mHz.

Impedance of the cable and phase angle between response current and applied voltage were recorded. The sample was then mounted between two pinvise grips with an exposed sample length of 45mm between the grips.

6.1 General Approach

Verification was accomplished using test methods and inspection. Testing was used to confirm the Network Cable meets the strength and durability requirements. Inspection was used to verify there was no damage or fracture to the insulating tubing of the cable after testing.

6.2 Sample Size

The sample size was four (4) Network Cable bodies. The test result was binary (pass/fail) for each test sample. A sample size of 4 was deemed sufficient primarily due to the extensive time required for each test cycle, with hundreds of thousands of cycles needed per sample, each taking a few seconds. This resulted in several days of continuous testing per sample, meaning that running four samples on a single fixture spanned a few weeks. Given the early development phase of the project, limited resources, and budget constraints, it was essential to balance thorough testing with the need to progress on multiple fronts. Contracting external experts in materials science further justified the decision to limit the sample size to four, as the associated costs and the high expense of the testing fixture necessitated a practical approach. Thus, four samples provided adequate data to inform decisions and allow the project to advance efficiently.

6.3 Test Article

The test samples were in a work in progress state; it was the finished cable body before the final assembly with the interconnect and electrodes.

6.4 Test Facility, Dates and Personnel

Verification was conducted in the Case Western Reserve University engineering laboratory under room temperature (22±2°C) conditions.

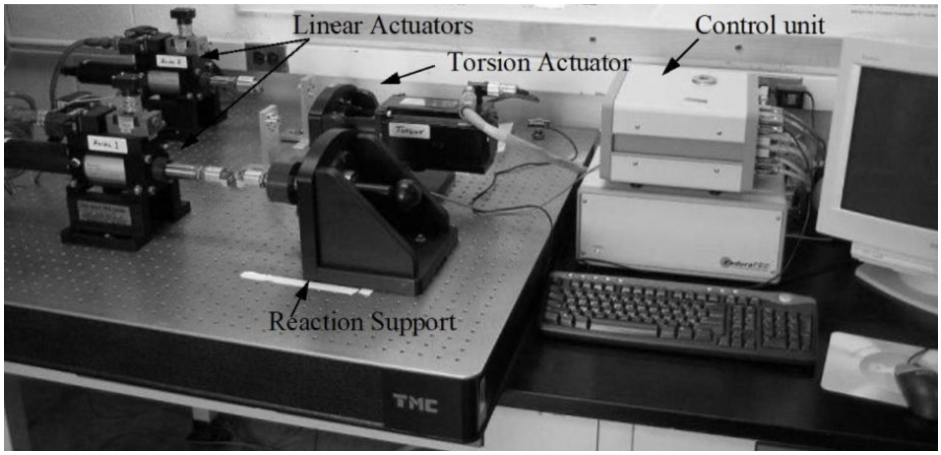


Figure 1. EnduraTEC TestBench with actuators and control unit.

6.5 Equipment and Materials

All tests were conducted using EnduraTEC TestBench (Bose Corporation, Minnetonka, MN) equipped with two pneumatic linear actuators and one electromagnetic torsion actuator. After testing, each cable was examined under an Olympus DP20 (Olympus America Inc, Center Valley, PA) optical microscope at 45x magnification.

All data for this report is recorded on the attached traveler sheets of Appendix A.

6.6 Acceptance Criteria

The acceptance criterion for the mechanical tests were:

- No visual damage or fracture of the cable can be seen through the objective lens of the microscope while moving them slowly.
- The DC resistance per unit of length of the able must not increase by more than 100% from the initial pre-test values. Any cable exceeding this threshold will be considered a failure.
- The impedance of the cable must not decrease by more than 20% between pre-test and post-test measurements. Any cable with an impedance reduction beyond this limit will be deemed to have an insulating failure.

7.0 Deviations

There were no deviations to the protocol.

8.0 Test Results

The results for measured resistance and impedance of the samples is recorded in Table 1 below. The % change in resistance and impedance values is shown in Table 2.

Table 1. Pre and post test resistance and impedance values measured for the test samples

Sample ID	Sample Type	Pre Test				Post Test				Notes
		Min Resistance (Ω)	Max Resistance (Ω)	Min Impedance (Ω)	Max Impedance (Ω)	Min Resistance (Ω)	Max Resistance (Ω)	Impedance at 10kHz (Ω)	Impedance at 100kHz (Ω)	
50-1	316LVM, 2-filar	13.6	13.7	3133640	297119					Fixture Failed
50-2		13.6	13.7	3167000	299000	8.1	8.1	2900000	280000	
50-3		13.6	13.7	3203000	302000	8.2	8.2	2870000	270000	
50-4		13.6	13.7	3002000	284000	8.2	8.3	3200000	300000	
``		14.2	14.2	3090000	290000	8.1	8.1	3220000	300000	
52-1	DFT, 2-filar	0.6	0.7	3658193	343766	0.3	0.4	3143000	297000	
52-2		0.6	0.6	3699707	346897	0.3	0.4	3120000	290000	
52-3		0.6	0.6	3540307	332882	0.3	0.4	3239000	306000	
52-4		0.6	0.7	3418140	322070	0.3	0.4	3272000	308000	
53-1	DFT, 4-filar	0.2	0.3	2900913	276523	0.1	0.2	2719000	271000	
53-2		0.2	0.3	2958667	281144	0.1	0.2	2857000	272000	
53-3		0.2	0.3	2862975	272658	0.1	0.2	2760000	270000	
53-4		0.2	0.2	2864910	273296	0.1	0.2	2810000	270000	

Table 2. % Change in the Resistance/Impedance of the Cables

Sample ID	Sample Type	% Increase in Resistance		Meets Acceptance Criteria? (% Increase <100%)	% Decrease in Impedance		Meets Acceptance Criteria? (% Decrease <20%)
		Min Resistance	Max Resistance		Impedance at 10kHz	Impedance at 100kHz	
50-1	316LVM, 2-filar	NA	NA	NA	NA	NA	NA
50-2		-40.4%	-40.9%	Yes	-8.4%	-6.4%	Yes
50-3		-39.7%	-40.1%	Yes	-10.4%	-10.6%	Yes
50-4		-39.7%	-39.4%	Yes	6.6%	5.6%	Yes
50-5		-43.0%	-43.0%	Yes	4.2%	3.4%	Yes
52-1	DFT, 2-filar	-50.0%	-42.9%	Yes	-14.1%	-13.6%	Yes
52-2		-50.0%	-33.3%	Yes	-15.7%	-16.4%	Yes
52-3		-50.0%	-33.3%	Yes	-8.5%	-8.1%	Yes
52-4		-50.0%	-42.9%	Yes	-4.3%	-4.4%	Yes
53-1	DFT, 4-filar	-50.0%	-33.3%	Yes	-6.3%	-2.0%	Yes
53-2		-50.0%	-33.3%	Yes	-3.4%	-3.3%	Yes
53-3		-50.0%	-33.3%	Yes	-3.6%	-1.0%	Yes
53-4		-50.0%	0.0%	Yes	-1.9%	-1.2%	Yes

For the 316LVM 2-filar sample type, one test iteration experienced an apparatus failure and thus an additional sample was tested. All additional 4 test samples passed testing.

For the DFT 2-filar sample type, all samples passed testing.

For the DFT 4-filar sample type, all samples passed testing.

All samples passed the visual inspection. This testing and its results are documented in the following reports:

- NNP-DVER-0001, Network Cable Stretch Test
- NNP-DVER-0002, Network Cable Crush Test
- NNP-DVER-0003, Network Cable Flex Test
- NNP-DVER-0004, Network Cable Torsion Test

9.0 Conclusion

All samples that did not experience apparatus failure passed the acceptance criteria required in this protocol.

The COSMIIC system components, part numbers NNP-DWG-140-012-001, NNP-DWG-140-012-002, and NNP-DWG-140-012-003, successfully satisfied the reliability requirements (REQ IDs NC.7.1, NC.7.2, NC.7.3, and NC.7.4) defined in NNP-REQ-0001 - Product Requirements Specification – Network Cable.

10.0 References

Document Identifier	Title
NNP-DVEP-0005	Design Verification Protocol – Network Cable Post-Test Evaluations
NNP-REQ-0001	Product Requirements Specification – Network Cable
NNP-DWG-140-012-001	Cable Body, Insulated DFT Filars, Blue/Clear
NNP-DWG-140-012-002	Cable Body, Insulated SS Filars, Red/Clear
NNP-DWG-140-012-003	Cable Body, Insulated SS Filars, Green/Clear
NNP-DVER-0001	Network Cable Stretch Test
NNP-DVER-0002	Network Cable Crush Test
NNP-DVER-0003	Network Cable Flex Test
NNP-DVER-0004	Network Cable Torsion Test

11.0 Revision History

Revision	Summary of Changes	Date	Author
v1	First version of document.	7/15/2024	J. Daghstani

Appendix A

Traveler Sheets for Network Cable Post-Test Evaluations

CASE WESTERN RESERVE UNIVERSITY EST. 1826

Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: S2-01

Cable: 31655-21/ar **Supplied by:** ~~Serial~~ Ardian Stem medical **No:** 03-30-0110 **Part No:** _____ **Rev** ____

Protocol: PRJ-NNPS-TST-PLN-01

1. Pre-Test Evaluations

Date: 8/4/08 Cable length: 71 mm, Initials: ##

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 13.6 Ω max 13.7Ω, Impedance 10kHz 313364Ω Impedance 100kHz 297119;

Data File S2-01-pretest-0.154MNaCl-080608-

Notes: Resistance value reported from 3 different measurements.

2. Stretch Test *(Test Parameters: 2% Pre stretch, 20% Stretch, 4Hz, 1.2 million cycles)*

Start Date: 09/08/08 Gage length (Start): 45 mm, End Date 09/12/08 Gage length (End): 47 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File ..../S2-01/Stretch/S2-01-Stretch.txt

Notes:

3. Crush Test *(Test Parameters: 1.2N Crush, 4Hz, 0.12 million cycles)*

Start Date: 09/13/08 Gage length (Start): 47 mm, End Date: 09/14/08 Gage length (End): 47 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 20,000 cycles;

Data File .../S2-01/Crush/S2-01-Crush.txt

Notes:

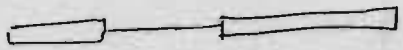
4. **Flex Test** *(Test Parameters: 140° Flex, 4Hz, 1.2 million cycles)*

Start Date: 9/29/08 Gage length (Start): 47 mm, End Date: ___/___/___ Gage length (End):_____mm,

Initials: RV Test failed – Broke at lower grip

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File _____



Notes:

N_f = 424329

10:45 AM.

5. **Torsion Test** *(Test Parameters: 2% Pre stretch, 180° Twist, 4Hz, 0.6 million cycles)*

Start Date: ___/___/___ Gage length (Start):_____mm, End Date: ___/___/___ Gage length (End):_____mm,

Initials:_____

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File _____

Notes:

6. **Post-Test Evaluations**

Date: ___/___/___ Cable length:_____mm, Initials:_____

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min_____Ω max_____Ω, Impedance 10kHz _____ Ω Impedance 100kHz _____Ω;

Data File _____

Filar:___ Resistance: min_____Ω max_____Ω, Impedance 10kHz_____, Impedance 100kHz_____;

Data File _____

Filar:___ Resistance: min_____Ω max_____Ω, Impedance 10kHz_____, Impedance 100kHz_____;

Data File _____

Filar:___ Resistance: min_____Ω max_____Ω, Impedance 10kHz_____, Impedance 100kHz_____;

Data File _____

Filar:___ Resistance: min_____Ω max_____Ω, Impedance 10kHz_____, Impedance 100kHz_____;

Data File _____

Notes: Resistance values reported from 3 different measurements.

7. **Revision History**

REV	DESCRIPTION	AUTHOR	DATE	APPROVAL
A	Initial draft	RV/HH	6/9/08	

CASE WESTERN RESERVE UNIVERSITY EST. 1826

Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: S2-02

Cable: 31655-21/1or **Supplied by:** Ardiem Medical Serial No: 03-30-0110 **Part No:** _____ **Rev** ____

Protocol: PRJ-NNPS-TR-PLN-01

1. Pre-Test Evaluations

Date: 8/4/08 Cable length: 71 mm, Initials: H

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 13.6 Ω max 13.7Ω, Impedance 10kHz 316Ω, Impedance 100kHz 299Ω

Data File S2-02-pretest-0154MNall-080608

Notes: Resistance value reported from 3 different measurements.

2. Stretch Test *(Test Parameters: 2% Pre stretch, 20% Stretch, 4Hz, 1.2 million cycles)*

Start Date: 09/30/08 Gage length (Start): 45 mm, End Date: 10/04/08 Gage length (End): 46 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File .../S2-02/stretch/S2-02-Stretch.txt

Notes:

3. Crush Test *(Test Parameters: 1.2N Crush, 4Hz, 0.12 million cycles)*

Start Date: 10/04/08 Gage length (Start): 46 mm, End Date: 10/05/08 Gage length (End): 46 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 20,000 cycles;

Data File .../Crush/S2-02-crush.txt

Notes:

4. **Flex Test** *(Test Parameters: 140° Flex, 4Hz, 1.2 million cycles)*

Start Date: 10/15/08 Gage length (Start): 46 mm, End Date: 10/16/08 Gage length (End): 46 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File .../flex/S2-02-flex.txt

Notes:

5. **Torsion Test** *(Test Parameters: 2% Pre stretch, 180° Twist, 4Hz, 0.6 million cycles)*

Start Date: 10/17/08 Gage length (Start): 46 mm, End Date: 10/18/08 Gage length (End): 46 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File .../torsion/S2-02-torsion.txt

Notes:

6. **Post-Test Evaluations**

Date: 10/22/08 Cable length: 45 mm, Initials: HH

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 8.1 Ω max 8.1 Ω, Impedance 10kHz 2.90MΩ Impedance 100kHz 0.28MΩ;

Data File S2-02-posttest-0.154MNaCl-102208

Filar: C Resistance: min 15.9 Ω max 15.9 Ω, Impedance 10kHz 2.04MΩ, Impedance 100kHz 0.20MΩ

Data File S2-02-cyan filar-0.154MNaCl-102208

Filar: G Resistance: min 15.8 Ω max 15.8 Ω, Impedance 10kHz 1.91MΩ, Impedance 100kHz 0.20MΩ

Data File S2-02-posttest-green filar-0.154MNaCl-102208

Filar:___ Resistance: min_____Ω max_____Ω, Impedance 10kHz_____, Impedance 100kHz_____;

Data File _____

Filar:___ Resistance: min_____Ω max_____Ω, Impedance 10kHz_____, Impedance 100kHz_____;

Data File _____

Notes: Resistance values reported from 3 different measurements.

7. **Revision History**

REV	DESCRIPTION	AUTHOR	DATE	APPROVAL
A	Initial draft	RV/HH	6/9/08	

8. Additional post-test evaluation with 90° bending

Date: 03/10/09 Cable length: 45 mm, Initials: HH

Filar: C Resistance: min 14.5 Ω max 14.6 Ω,

Filar: G Resistance: min 14.7 Ω max 14.9 Ω,

Filar: ___ Resistance: min _____ Ω max _____ Ω,

Filar: ___ Resistance: min _____ Ω max _____ Ω,

Notes: Resistance values reported from 3 different measurements.

CASE WESTERN RESERVE UNIVERSITY EST. 1826

Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: S2-03

Cable: 316SS - 7 filar **Supplied by:** Ardian Stem Medical Inc **Serial No:** 03-30-010 **Part No:** _____ **Rev** ____

Protocol: PRJ-NNPS-TST-PLN-01

1. Pre-Test Evaluations

Date: 8/4/08 Cable length: 71 mm, Initials: H

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 13.6 Ω max 13.7Ω, Impedance 10kHz 3203kΩ, Impedance 100kHz 302kΩ;

Data File S2-03-pretest-0.154MNaCl-080608

Notes: Resistance value reported from 3 different measurements.

2. Stretch Test *(Test Parameters: 2% Pre stretch, 20% Stretch, 4Hz, 1.2 million cycles)*

Start Date: 10/06/08 Gage length (Start): 45 mm, End Date: 10/10/08 Gage length (End): 46 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File ..../S2-03/Stretch/S2-03-Stretch.txt

Notes:

3. Crush Test *(Test Parameters: 1.2N Crush, 4Hz, 0.12 million cycles)*

Start Date: 10/13/08 Gage length (Start): 46 mm, End Date: 10/14/08 Gage length (End): 46 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 20,000 cycles;

Data File ../Crush/S2-03-crush.txt

Notes:

4. **Flex Test** *(Test Parameters: 140° Flex, 4Hz, 1.2 million cycles)*

Start Date: 10/19/08 Gage length (Start): 46 mm, End Date: 10/22/08 Gage length (End): 46 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File .../flex/S2-03-flex.txt

Notes:

5. **Torsion Test** *(Test Parameters: 2% Pre stretch, 180° Twist, 4Hz, 0.6 million cycles)*

Start Date: 10/23/08 Gage length (Start): 46 mm, End Date: 10/24/08 Gage length (End): 46 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File .../torsion/S2-03-torsion.txt

Notes:

6. **Post-Test Evaluations**

Date: 10/27/08 Cable length: 45 mm, Initials: HH

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 8.2 Ω max 8.2 Ω, Impedance 10kHz 2.87MΩ Impedance 100kHz 0.27MΩ;

Data File S2-03-posttest-0.154MNaCl-102708

Filar: C Resistance: min 16.2 Ω max 16.2 Ω, Impedance 10kHz 2.03MΩ, Impedance 100kHz 0.20MΩ

Data File S2-03-posttest-cyan filar-0.154MNaCl-102708

Filar: G Resistance: min 16.2 Ω max 16.2 Ω, Impedance 10kHz 1.98MΩ, Impedance 100kHz 0.19MΩ

Data File S2-03-posttest-green filar-0.154MNaCl-102708

Filar: ___ Resistance: min _____ Ω max _____ Ω, Impedance 10kHz _____, Impedance 100kHz _____;

Data File _____

Filar: ___ Resistance: min _____ Ω max _____ Ω, Impedance 10kHz _____, Impedance 100kHz _____;

Data File _____

Notes: Resistance values reported from 3 different measurements.

7. **Revision History**

REV	DESCRIPTION	AUTHOR	DATE	APPROVAL
A	Initial draft	RV/HH	6/9/08	

8. Additional post-test evaluation with 90° bending

Date: 03/10/09 Cable length: 45 mm, Initials: HHF

Filar: C Resistance: min 15.5 Ω max 15.7 Ω,

Filar: G Resistance: min 15.7 Ω max 15.8 Ω,

Filar: ___ Resistance: min _____ Ω max _____ Ω,

Filar: ___ Resistance: min _____ Ω max _____ Ω,

Notes: Resistance values reported from 3 different measurements.

CASE WESTERN RESERVE UNIVERSITY EST 1826

Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: S2-04

Cable: 31655 - 2 filar **Supplied by:** Ardiem Medical Inc **Serial No:** 03-20-010 **Part No:** _____ **Rev** ____

Protocol: PRJ-NNPS-TST-PLA-07

1. Pre-Test Evaluations

Date: 8/4/08 Cable length: 71 mm, Initials: H

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 13.6 Ω max 13.7 Ω, Impedance 10kHz 3.002 kΩ, Impedance 100kHz 284 kΩ

Data File S2-04-pretest-0.154MNaCl-080608

Notes: Resistance value reported from 3 different measurements.

2. Stretch Test *(Test Parameters: 2% Pre stretch, 20% Stretch, 4Hz, 1.2 million cycles)*

Start Date: 10/13/08 Gage length (Start): 45 mm, End Date: 10/16/08 Gage length (End): 46 mm, Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File ..../S2-04/stretch/S2-04-stretch.txt

Notes:

3. Crush Test *(Test Parameters: 1.2N Crush, 4Hz, 0.12 million cycles)*

Start Date: 10/17/08 Gage length (Start): 46 mm, End Date: 10/18/08 Gage length (End): 46 mm, Initials: RV

Data Acquisition: 10 cycles data for every 20,000 cycles;

Data File ---crush/S2-04-crush.txt

Notes:

4. **Flex Test** *(Test Parameters: 140° Flex, 4Hz, 1.2 million cycles)*

Start Date: 10/23/08 Gage length (Start): 46 mm, End Date: 10/29/08 Gage length (End): 46 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File flex/S2-04-flex.txt

Notes:

5. **Torsion Test** *(Test Parameters: 2% Pre stretch, 180° Twist, 4Hz, 0.6 million cycles)*

Start Date: 10/29/08 Gage length (Start): 46 mm, End Date: 10/30/08 Gage length (End): 46 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File torsion/S2-04-torsion.txt

Notes:

6. **Post-Test Evaluations**

Date: 11/13/08 Cable length: 45 mm, Initials: HH

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 8.2 Ω max 8.3 Ω, Impedance 10kHz 3.2 MΩ Impedance 100kHz 0.304 MΩ

Data File _____

Filar: C Resistance: min 16.5 Ω max 16.6 Ω, Impedance 10kHz 2.28 MΩ, Impedance 100kHz 0.22 MΩ;

Data File _____

Filar: G Resistance: min 16.5 Ω max 16.6 Ω, Impedance 10kHz 2.27 MΩ, Impedance 100kHz 0.22 MΩ

Data File _____

Filar: ___ Resistance: min _____ Ω max _____ Ω, Impedance 10kHz _____, Impedance 100kHz _____;

Data File _____

Filar: ___ Resistance: min _____ Ω max _____ Ω, Impedance 10kHz _____, Impedance 100kHz _____;

Data File _____

Notes: Resistance values reported from 3 different measurements.

7. **Revision History**

REV	DESCRIPTION	AUTHOR	DATE	APPROVAL
A	Initial draft	RV/HH	6/9/08	

8. Additional post-test evaluation with 90° bending

Date: 03/10/09 Cable length: 45 mm, Initials: HH

Filar: C Resistance: min 16.1 Ω max 16.2 Ω,

Filar: G Resistance: min 16.3 Ω max 16.4 Ω,

Filar: __ Resistance: min ____ Ω max ____ Ω,

Filar: __ Resistance: min ____ Ω max ____ Ω,

Notes: Resistance values reported from 3 different measurements.

CASE WESTERN RESERVE UNIVERSITY EST. 1826

Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: S2-05

Cable: 316L-21hr **Supplied by:** Ardiem Stem Inc. **Serial No:** 07-30-0110 **Part No:** ______ **Rev** ___

Protocol: PRJ-NNPS-TST-PLN-07

1. **Pre-Test Evaluations**

Date: 10/22/08 Cable length: 71 mm, Initials: H

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 14.2 Ω max 14.2 Ω, Impedance 10kHz 309MΩ, Impedance 100kHz 0.29MΩ

Data File S2-05-pretest-0.154MNaCl-102208

Notes: Resistance value reported from 3 different measurements.

2. **Stretch Test** *(Test Parameters: 2% Pre stretch, 20% Stretch, 4Hz, 1.2 million cycles)*

Start Date: 10/25/08 Gage length (Start): 45 mm, End Date: 10/29/08 Gage length (End): 46 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File .... /S2-05/stretch/S2-05-stretch

Notes:

3. **Crush Test** *(Test Parameters: 1.2N Crush, 4Hz, 0.12 million cycles)*

Start Date: 10/29/08 Gage length (Start): 46 mm, End Date: 10/30/08 Gage length (End): 46 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 20,000 cycles;

Data File .... /Crush/S2-05-Crush.txt

Notes:

4. **Flex Test** *(Test Parameters: 140° Flex, 4Hz, 1.2 million cycles)*

Start Date: 10/21/08 Gage length (Start): 46 mm, End Date: 11/3/08 Gage length (End): 46 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File .../flex/S2-05-flex.txt

Notes:

5. **Torsion Test** *(Test Parameters: 2% Pre stretch, 180° Twist, 4Hz, 0.6 million cycles)*

Start Date: 11/4/08 Gage length (Start): 46 mm, End Date: 11/06/08 Gage length (End): 46 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File .../torsion/S2-05-torsion.txt

Notes:

6. **Post-Test Evaluations**

Date: 11/13/08 Cable length: 45 mm, Initials: HH

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 8.1 Ω max 8.1 Ω, Impedance 10kHz 3.22M Ω Impedance 100kHz 0.305MΩ

Data File _____

Filar: C Resistance: min 16.5 Ω max 16.6 Ω, Impedance 10kHz 3.22MΩ, Impedance 100kHz 305kΩ;

Data File _____

Filar: G Resistance: min 16.5 Ω max 16.6 Ω, Impedance 10kHz 1.14MΩ, Impedance 100kHz 0.131MΩ;

Data File _____

Filar:___ Resistance: min_____Ω max_____Ω, Impedance 10kHz_____, Impedance 100kHz_____;

Data File _____

Filar:___ Resistance: min_____Ω max_____Ω, Impedance 10kHz_____, Impedance 100kHz_____;

Data File _____

Notes: Resistance values reported from 3 different measurements.

7. **Revision History**

REV	DESCRIPTION	AUTHOR	DATE	APPROVAL
A	Initial draft	RV/HH	6/9/08	

8. Additional post-test evaluation with 90° bending

Date: 03/10/09 Cable length: 45 mm, Initials: HH

Filar: C Resistance: min 15.4 Ω max 15.5 Ω,

Filar: G Resistance: min 15.1 Ω max 15.2 Ω,

Filar: ___ Resistance: min _____ Ω max _____ Ω,

Filar: ___ Resistance: min _____ Ω max _____ Ω,

Notes: Resistance values reported from 3 different measurements.

CASE WESTERN RESERVE UNIVERSITY FST. 1826

Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: D2-01 ARDIEM ITEM NO:

Cable: DFT 2-filar **Supplied by:** MEDICAL INC **Serial No:** 03-32-0210 **Part No:** _____ **Rev** ____

Protocol: PRJ-NNPS-TST-PLN-07 Rev A

1. Pre-Test Evaluations

Date: 06/13/08 Cable length: 71 mm, Initials: AR

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 0.6 Ω max 0.7Ω, Impedance 10kHz 3658193Ω Impedance 100kHz 3437665Ω

Data File D2-01-pretest-0.154M NaCl-061308

Notes: Resistance value reported from 3 different measurements.

2. Stretch Test *(Test Parameters: 2% Pre stretch, 20% Stretch, 4Hz, 1.2 million cycles)*

Start Date: 06/18/08 5:30PM Gage length (Start): 45 mm, End Date: 06/21/08 Gage length (End): 46 mm,

Initials: AR

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File C:/RAVI/Phase-I/D2-01/Stretch/D2-01-Stretch.txt

Notes: Gage length (end) measured at 11:15PM on 6/23/08

Level 1 -2.1 ; Level 2 6.9 → Required (To get)

Level 1 -2.9 ; Level 2 7.7 → Used (Use this)

3. Crush Test *(Test Parameters: 1.2N Crush, 4Hz, 0.12 million cycles)*

Start Date: 6/23/08 3PM Gage length (Start): 46 mm, End Date: 6/24/08 Gage length (End): 46 mm,

Initials: AR

Data Acquisition: 10 cycles data for every 20,000 cycles;

Data File C:/RAVI/Phase-I/D2-01/CRUSH/D2-01-Crush.txt

Notes: Gage length (end) measured at 11:AM on 6/24/08. Test Stopped much before that.

4. **Flex Test** *(Test Parameters: 140° Flex, 4Hz, 1.2 million cycles)*

Start Date: 6/24/08 Gage length (Start): 46 mm, End Date: 06/30/08 8:30PM Gage length (End): 46 mm,

Initials: VR

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File C:\Ravi\Phas-1\D2-01\~~D2-01~~ Flex \D2-01-Flex.txt

Notes: 6/25/8 - 11AM → found the actuator stopped @ ~400,000 cycles

5. **Torsion Test** *(Test Parameters: 2% Pre stretch, 180° Twist, 4Hz, 0.6 million cycles)*

Start Date: 06/30/08 Gage length (Start): 46 mm, End Date: 7/7/08 Gage length (End): 46 mm,

Initials: VR

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File \Torsion/D2-01-Torsion.txt

Notes:

6. **Post-Test Evaluations**

Date: 8/18/08 Cable length: 45 mm, Initials: HH

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 0.3 Ω max 0.4 Ω, Impedance 10kHz 3143kΩ Impedance 100kHz 297kΩ;

Data File D2-01-posttest-0.154MNaCl-081808

Filar: 1 Resistance: min 0.7 Ω max 0.7 Ω, Impedance 10kHz 188MΩ, Impedance 100kHz 0.18MΩ;

Data File D2-01-posttest-gold filar-0.154MNaCl-092408-1

Filar: 2 Resistance: min 0.7 Ω max 0.7 Ω, Impedance 10kHz 236MΩ, Impedance 100kHz 0.22MΩ

Data File D2-01-posttest-green filar-0.154MNaCl-092408-

Filar:___ Resistance: min_____Ω max_____Ω, Impedance 10kHz_____, Impedance 100kHz_____;

Data File _____

Filar:___ Resistance: min_____Ω max_____Ω, Impedance 10kHz_____, Impedance 100kHz_____;

Data File _____

Notes: Resistance values reported from 3 different measurements.

7. **Revision History**

REV	DESCRIPTION	AUTHOR	DATE	APPROVAL
A	Initial draft	RV/HH	6/9/08	

8. Additional post-test evaluation with 90° bending

Date: 03/12/09 Cable length: 45 mm, Initials: HH

Filar: 6 Resistance: min 0.7 Ω max 0.8 Ω,

Filar: 7 Resistance: min 0.7 Ω max 0.7 Ω,

Filar: ___ Resistance: min _____ Ω max _____ Ω,

Filar: ___ Resistance: min _____ Ω max _____ Ω,

Notes: Resistance values reported from 3 different measurements.

CASE WESTERN RESERVE UNIVERSITY EST. 1826

Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: D2-02

Cable: DFT-21/or **Supplied by:** ARDIEM Medical Inc **Serial No:** ITEM 03-30-0210 **Part No:** _____ **Rev** ____

Protocol: PRJ-NNPS-TST-PLN-07

1. Pre-Test Evaluations

Date: 06/13/08 Cable length: 71 mm, Initials: ~~AA~~

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 0.6 Ω max 0.6 Ω, Impedance 10kHz 3699.7075Ω Impedance 100kHz 3469.875Ω

Data File D~~X~~2-02-pretest-0.154NNaCl-061608

Notes: Resistance value reported from 3 different measurements.

2. Stretch Test *(Test Parameters: 2% Pre stretch, 20% Stretch, 4Hz, 1.2 million cycles)*

Start Date: 08/19/08 Gage length (Start): 46 mm, End Date: 08/25/08 Gage length (End): 46 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File D2-02/Stretch/D2-02-Stretch..txt

Notes:

3. Crush Test *(Test Parameters: 1.2N Crush, 4Hz, 0.12 million cycles)*

Start Date: 08/25/08 Gage length (Start): 46 mm, End Date: 08/26/08 Gage length (End): 46 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 20,000 cycles;

Data File D2-02/Crush/D2-02-Crush.txt

Notes:

4. **Flex Test** *(Test Parameters: 140° Flex, 4Hz, 1.2 million cycles)*

Start Date 09/02/08 Gage length (Start): 46 mm, End Date: 09/08/08 Gage length (End): 46 mm, Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File ---/D2-02/Flex/D2-02-flex.txt

Notes:

5. **Torsion Test** *(Test Parameters: 2% Pre stretch, 180° Twist, 4Hz, 0.6 million cycles)*

Start Date 09/06/08 Gage length (Start): 46 mm, End Date: 09/08/08 Gage length (End): 46 mm, Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File ---/D2-02/Torsion/D2-02-torsion.txt

Notes:

6. **Post-Test Evaluations**

Date: 10/01/08 Cable length: 40 mm, Initials: HH

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 0.3 Ω max 0.4 Ω, Impedance 10kHz 3.12 MΩ Impedance 100kHz 0.29 MΩ

Data File D2-02-posttest-0.154MNaCl-100108

Filar: 1 Resistance: min 0.6 Ω max 0.6 Ω, Impedance 10kHz 1.73 MΩ, Impedance 100kHz 0.185 MΩ

Data File D2-02-posttest-gold filar-0.154MNaCl-100208

Filar: 2 Resistance: min 0.6 Ω max 0.6 Ω, Impedance 10kHz 1.92 MΩ, Impedance 100kHz 0.202 MΩ

Data File D2-02-posttest-green filar-0.154MNaCl-100208

Filar: ___ Resistance: min _____ Ω max _____ Ω, Impedance 10kHz _____, Impedance 100kHz _____;

Data File _____

Filar: ___ Resistance: min _____ Ω max _____ Ω, Impedance 10kHz _____, Impedance 100kHz _____;

Data File _____

Notes: Resistance values reported from 3 different measurements.

7. **Revision History**

REV	DESCRIPTION	AUTHOR	DATE	APPROVAL
A	Initial draft	RV/HH	6/9/08	

8. Additional post-test evaluation with 90° bending

Date: 03/12/09 Cable length: 40 mm, Initials: HH

Filar: G Resistance: min 0.7 Ω max 0.8 Ω,

Filar: Y Resistance: min 0.7 Ω max 0.7 Ω,

Filar: ___ Resistance: min _____ Ω max _____ Ω,

Filar: ___ Resistance: min _____ Ω max _____ Ω,

Notes: Resistance values reported from 3 different measurements.

CASE WESTERN RESERVE UNIVERSITY EST. 1826

Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: D2-03

Cable: DFT-2 flat **Supplied by:** Ardiem Medical Inc **ITEM ~~Serial~~ No:** 03-30-0210 **Part No:** _____ **Rev** ____

Protocol: PRJ-NNPS-TST-PLN-07

1. Pre-Test Evaluations

Date: 06/13/08 Cable length: 71 mm, Initials: AL

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 0.6 Ω max 0.6 Ω, Impedance 10kHz 354-0307Ω Impedance 100kHz 332882 Ω

Data File D02-03-pretest-0.154MNaCl-062408

Notes: Resistance value reported from 3 different measurements.

2. Stretch Test *(Test Parameters: 2% Pre stretch, 20% Stretch, 4Hz, 1.2 million cycles)*

Start Date: 7/8/08 Gage length (Start): 45 mm, End Date: 7/11/08 Gage length (End): 45 mm,

Initials: LAD

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File C:/Ravi/phase-1/D2-03/stretch/D2-03-stretch.txt

Notes: to get -1.2 - 7.8

3. Crush Test *(Test Parameters: 1.2N Crush, 4Hz, 0.12 million cycles)*

Start Date: 7/12/08 Gage length (Start): 45 mm, End Date: 7/14/08 Gage length (End): 45 mm,

Initials: LAD

Data Acquisition: 10 cycles data for every 20,000 cycles;

Data File C:/Ravi/phase-1/D2-03/crush/D2-03-crush

Notes:

4. **Flex Test** *(Test Parameters: 140° Flex, 4Hz, 1.2 million cycles)*

Start Date: 7/15/08 Gage length (Start): 45 mm, End Date: 7/19/08 Gage length (End): ~~48~~ 45 mm,

Initials: LAD

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File " / Flex / D2-03-flex.txt

Notes:

5. **Torsion Test** *(Test Parameters: 2% Pre stretch, 180° Twist, 4Hz, 0.6 million cycles)*

Start Date: 7/23/08 Gage length (Start): 45 mm, End Date: 7/25/08 Gage length (End): 45 mm,

Initials: LAD

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File " / Torsion / D2-03-torsion.txt

Notes:

6. **Post-Test Evaluations**

Date: 8/18/08 Cable length: 45 mm, Initials: HH

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 0.3 Ω max 0.4 Ω, Impedance 10kHz 3239k Ω Impedance 100kHz 306kΩ;

Data File D2-03 - posttest - 0.154M NaCl - 081808

Filar: 1 Resistance: min 0.6 Ω max 0.7 Ω, Impedance 10kHz 1.73MΩ, Impedance 100kHz 0.167MΩ

Data File D2-03 - posttest - gold filar - 0.154M NaCl - 082408

Filar: 2 Resistance: min 0.6 Ω max 0.7 Ω, Impedance 10kHz 2.14MΩ Impedance 100kHz 0.233MΩ

Data File D2-03 - posttest - green filar - 0.154M NaCl - 082408

Filar: ___ Resistance: min_____Ω max_____Ω, Impedance 10kHz_____, Impedance 100kHz_____;

Data File _____

Filar: ___ Resistance: min_____Ω max_____Ω, Impedance 10kHz_____, Impedance 100kHz_____;

Data File _____

Notes: Resistance values reported from 3 different measurements.

7. **Revision History**

REV	DESCRIPTION	AUTHOR	DATE	APPROVAL
A	Initial draft	RV/HH	6/9/08	

8. Additional post-test evaluation with 90° bending

Date: 03/12/09 Cable length: 45 mm, Initials: HH

Filar: 6 Resistance: min 0.7 Ω max 0.8 Ω,

Filar: 4 Resistance: min 0.8 Ω max 0.9 Ω,

Filar:___ Resistance: min_____Ω max_____Ω,

Filar:___ Resistance: min_____Ω max_____Ω,

Notes: Resistance values reported from 3 different measurements.

CASE WESTERN RESERVE UNIVERSITY EST. 1826

Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: D2-04

Cable: DFT-2filar **Supplied by:** Ardiem Medical Inc ITEM **Serial No:** 03-30-0210 **Part No:** _____ **Rev** ____

Protocol: PRJ-NNPS-TST-PLN-07

1. Pre-Test Evaluations

Date: 06/13/08 Cable length: 71 mm, Initials: ~~AL~~

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 0.6 Ω max 0.7Ω, Impedance 10kHz 3418140Ω Impedance 100kHz 3220720Ω

Data File D2-04-pretest-0.154MNaCl-062408

Notes: Resistance value reported from 3 different measurements.

2. Stretch Test *(Test Parameters: 2% Pre stretch, 20% Stretch, 4Hz, 1.2 million cycles)*

Start Date: 7/21/08 Gage length (Start): 45 mm, End Date: 7/25/08 Gage length (End): 45 mm,

Initials: LAD

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File Phase one\D2-04\Stretch\D2-04-stretch.fdt

Notes: get -2.09 to 6.9

used -2.7 to 7.45

3. Crush Test *(Test Parameters: 1.2N Crush, 4Hz, 0.12 million cycles)*

Start Date: 7/25/08 Gage length (Start): 45 mm, End Date: 7/26/08 Gage length (End): 45 mm,

Initials: LAD

Data Acquisition: 10 cycles data for every 20,000 cycles;

Data File D2-04/Crush/D2-04-~~Stretch~~ crush

Notes:

4. **Flex Test** *(Test Parameters: 140° Flex, 4Hz, 1.2 million cycles)*

Start Date: 7/26/08 Gage length (Start): 45 mm, End Date: 7/30/08 Gage length (End): 45 mm,
Initials: LAD

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File D2-04 / ~~Torsion~~ flex / D2-04 - ~~torsion~~ flex .txt

Notes: flex

5. **Torsion Test** *(Test Parameters: 2% Pre stretch, 180° Twist, 4Hz, 0.6 million cycles)*

Start Date: 8/8/08 Gage length (Start): 45 mm, End Date: 8/10/08 Gage length (End): 45 mm,
Initials: LAD

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File D4-02 / Torsion / D4-02-torsion

Notes:

6. **Post-Test Evaluations**

Date: 8/18/08 Cable length: 44 mm, Initials: HH

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 0.3 Ω max 0.4 Ω, Impedance 10kHz 3272 kΩ Impedance 100kHz 308 Ω;

Data File D2-04-posttest-0.154MNaCl-081808

Filar: 1 Resistance: min 0.6 Ω max 0.7 Ω, Impedance 10kHz 1.56MΩ, Impedance 100kHz 0.182MΩ

Data File D2-04-posttest-gold filar-0.154MNaCl-082408

Filar: 2 Resistance: min 0.6 Ω max 0.7 Ω, Impedance 10kHz 2.26MΩ Impedance 100kHz 0.218MΩ

Data File D2-04-posttest-green filar-0.154MNaCl-082408

Filar: ___ Resistance: min _____ Ω max _____ Ω, Impedance 10kHz _____, Impedance 100kHz _____;

Data File _____

Filar: ___ Resistance: min _____ Ω max _____ Ω, Impedance 10kHz _____, Impedance 100kHz _____;

Data File _____

Notes: Resistance values reported from 3 different measurements.

7. **Revision History**

REV	DESCRIPTION	AUTHOR	DATE	APPROVAL
A	Initial draft	RV/HH	6/9/08	

8. Additional post-test evaluation with 90° bending

Date: 03/12/09 Cable length: 44 mm, Initials: HH

Filar: G Resistance: min 0.8 Ω max 0.9 Ω,

Filar: 4 Resistance: min 0.7 Ω max 0.8 Ω,

Filar: ___ Resistance: min _____ Ω max _____ Ω,

Filar: ___ Resistance: min _____ Ω max _____ Ω,

Notes: Resistance values reported from 3 different measurements.

CASE WESTERN RESERVE UNIVERSITY EST. 1826

Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: D4-01

Cable: DFT-4filar **Supplied by:** Ardiem medical inc **ITEM Serial No:** 03-30-0510 **Part No:** _____ **Rev** ____

Protocol: PRJ-NNPS-TST-PLN-07

1. Pre-Test Evaluations

Date: 06/25/08 Cable length: 71 mm, Initials: VR

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 0.2 Ω max 0.3 Ω, Impedance 10kHz 29009130 Impedance 100kHz 27652352

Data File D4-01-pretest-0.154MNaCl-062508

Notes: Resistance value reported from 3 different measurements.

2. Stretch Test *(Test Parameters: 2% Pre stretch, 20% Stretch, 4Hz, 1.2 million cycles)*

Start Date: 06/26/08 Gage length (Start): 45 mm, End Date: 06/30/08 8:30PM Gage length (End): 46 mm,

Initials: VR

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File C:/Ravi/phase-1/D4-01/stretch/D4-01-Stretch.txt

Notes:

Level 1 -2.7 ; level 2: 7.5 → used waveform.

to get -2.09, 6.9

Scan time - 2.5 • Axial 2 at count 1

Scan points - 500 • 10,000 counts between scans.

No. of Scans - 13

3. Crush Test *(Test Parameters: 1.2N Crush, 4Hz, 0.12 million cycles)*

Start Date: 06/30/08 8:30PM Gage length (Start): 46 mm, End Date: 7/9/08 Gage length (End): 46 mm,

Initials: VR

Data Acquisition: 10 cycles data for every 20,000 cycles;

Data File D4-01/Crush/D4-01-crush.txt

Notes:

4. **Flex Test** *(Test Parameters: 140° Flex, 4Hz, 1.2 million cycles)*

Start Date: 7/7/08 Gage length (Start): 46 mm, End Date: 7/11/08 Gage length (End): 46 mm,

Initials: LAD

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File D4-01/flex/D4-01-flex.fdt

Notes: Mandrel fell off sometime overnight - 3000000 cycles when it was found

5. **Torsion Test** *(Test Parameters: 2% Pre stretch, 180° Twist, 4Hz, 0.6 million cycles)*

Start Date: 7/19/08 Gage length (Start): 46 mm, End Date: 7/21/08 Gage length (End): 46 mm,

Initials: LAD

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File D4-01/torsion/D4-01-torsion.fdt

Notes:

6. **Post-Test Evaluations**

Date: 8/18/08 Cable length: 32 mm, Initials: ##

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 0.1 Ω max 0.2 Ω, Impedance 10kHz 2719k Ω Impedance 100kHz 271kΩ;

Data File D4-01-posttest-0.154MNaCl-081808

Filar: 1 Resistance: min 0.5 Ω max 0.5 Ω, Impedance 10kHz 7.68MΩ, Impedance 100kHz 0.644MΩ

Data File D4-01-posttest-gold filar-0.154MNaCl-082408-

Filar: 2 Resistance: min 0.5 Ω max 0.5 Ω, Impedance 10kHz 6.17MΩ, Impedance 100kHz 0.648MΩ

Data File D4-01-posttest-green filar-0.154MNaCl-082408

Filar: 3 Resistance: min 0.4 Ω max 0.5 Ω, Impedance 10kHz 6.69MΩ, Impedance 100kHz 0.577MΩ

Data File D4-01-posttest-blue filar-0.154MNaCl-082408

Filar: 4 Resistance: min 0.4 Ω max 0.5 Ω, Impedance 10kHz 3.03MΩ, Impedance 100kHz 0.288MΩ

Data File D4-01-posttest-white filar-0.154MNaCl-082408

Notes: Resistance values reported from 3 different measurements.

7. **Revision History**

REV	DESCRIPTION	AUTHOR	DATE	APPROVAL
A	Initial draft	RV/HH	6/9/08	

8. Additional post-test evaluation with 90° bending

Date: 03/12/09 Cable length: 30 mm, Initials: HH

Filar: G Resistance: min 0.4 Ω max 0.5 Ω,

Filar: B Resistance: min 0.3 Ω max 0.4 Ω,

Filar: W Resistance: min 0.3 Ω max 0.4 Ω,

Filar: Y Resistance: min 0.5 Ω max 0.6 Ω,

Notes: Resistance values reported from 3 different measurements.

CASE WESTERN RESERVE UNIVERSITY EST. 1826

Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: D4-02

Cable: DFT-4filar **Supplied by:** Ardiem Medical Inc. ITEM **Serial No:** 03-30-0540 **Part No:** _____ **Rev** ____

Protocol: PRJ-NNPS-TST-PLN-02

1. Pre-Test Evaluations

Date: 06/25/08 Cable length: 71 mm, Initials: ##

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 0.2 Ω max 0.3 Ω, Impedance 10kHz 29586752 Impedance 100kHz 28114452

Data File D4-02-pretest-0.154MNaCl-062508

Notes: Resistance value reported from 3 different measurements.

2. Stretch Test *(Test Parameters: 2% Pre stretch, 20% Stretch, 4Hz, 1.2 million cycles)*

Start Date: 06/30/08 8:34pm Gage length (Start): 45 mm, End Date: 7/9/08 Gage length (End): 47 mm,

Initials: VR

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File " D4-02/D4-02-Stretch.txt

Notes: Level 1 -2.7, Level 2 7.5 → used to get -2.9, 6.9

3. Crush Test *(Test Parameters: 1.2N Crush, 4Hz, 0.12 million cycles)*

Start Date: 7/5/08 Gage length (Start): 47 mm, End Date: 7/6/08 Gage length (End): 47 mm,

Initials: LAD

Data Acquisition: 10 cycles data for every 20,000 cycles;

Data File " D4-02-Crush

Notes:

4. **Flex Test** *(Test Parameters: 140° Flex, 4Hz, 1.2 million cycles)*

Start Date: 7/11/08 Gage length (Start): 47 mm, End Date: 7/15/08 Gage length (End): 47 mm, Initials: LAD

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File " D9-02-flex

Notes:

5. **Torsion Test** *(Test Parameters: 2% Pre stretch, 180° Twist, 4Hz, 0.6 million cycles)*

Start Date: 7/21/08 Gage length (Start): 47 mm, End Date: 7/23/08 Gage length (End): 47 mm, Initials: LAD

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File D9-02/torsion/D9-02-torsion

Notes:

6. **Post-Test Evaluations**

Date: 8/18/08 Cable length: 45 mm, Initials: H

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 0.1 Ω max 0.2 Ω, Impedance 10kHz 2857kΩ Impedance 100kHz 272kΩ;

Data File D4-02-posttest-0.154MNaCl-081808

Filar: 1 Resistance: min 0.5 Ω max 0.5 Ω, Impedance 10kHz 3.25MΩ, Impedance 100kHz 0.307MΩ

Data File D4-02-posttest-gold filar-0.154MNaCl-082408

Filar: 2 Resistance: min 0.4 Ω max 0.5 Ω, Impedance 10kHz 3.40MΩ, Impedance 100kHz 0.32MΩ

Data File D4-02-posttest-green filar-0.154MNaCl-082408

Filar: 3 Resistance: min 0.4 Ω max 0.5Ω, Impedance 10kHz 3.307MΩ, Impedance 100kHz 0.312MΩ

Data File D4-02-posttest-blue filar-0.154MNaCl-082408

Filar: 4 Resistance: min 0.5 Ω max 0.5 Ω, Impedance 10kHz 3.35MΩ, Impedance 100kHz 0.315MΩ

Data File D4-02-posttest-white filar-0.154MNaCl-082408

Notes: Resistance values reported from 3 different measurements.

7. **Revision History**

REV	DESCRIPTION	AUTHOR	DATE	APPROVAL
A	Initial draft	RV/HH	6/9/08	

8. Additional post-test evaluation with 90° bending

Date: 03/12/09 Cable length: 38 mm, Initials: HH

Filar: G Resistance: min 0.5 Ω max 0.5 Ω,

Filar: B Resistance: min 0.5 Ω max 0.6 Ω,

Filar: W Resistance: min 0.5 Ω max 0.6 Ω,

Filar: Y Resistance: min 0.5 Ω max 0.6 Ω,

Notes: Resistance values reported from 3 different measurements.

CASE WESTERN RESERVE UNIVERSITY EST. 1826

Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: D4-03

Cable: DFT-4filar **Supplied by:** Ardiem medical inc **ITEM Serial No:** 03-30-0510 **Part No:** _____ **Rev** ____

Protocol: PRJ-NNPS-TST-PLN-07

1. Pre-Test Evaluations

Date: 06/25/08 Cable length: 71 mm, Initials: ~~JK~~

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 0.2 Ω max 0.3 Ω, Impedance 10kHz 2862957Ω Impedance 100kHz 272658.5Ω

Data File D4-03-pretest-0.154MNaCl-062508

Notes: Resistance value reported from 3 different measurements.

2. Stretch Test *(Test Parameters: 2% Pre stretch, 20% Stretch, 4Hz, 1.2 million cycles)*

Start Date 08/30/08 Gage length (Start): 45 mm, End Date 09/03/08 Gage length (End): 47 mm, Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File .../D4-03/Stretch/D4-03-Stretch.txt

Notes:

3. Crush Test *(Test Parameters: 1.2N Crush, 4Hz, 0.12 million cycles)*

Start Date: 09/03/08 Gage length (Start): 47 mm, End Date: 09/04/08 Gage length (End): 47 mm, Initials: RV

Data Acquisition: 10 cycles data for every 20,000 cycles;

Data File: /Crush/D4-03-Crush.txt

Notes:

4. **Flex Test** *(Test Parameters: 140° Flex, 4Hz, 1.2 million cycles)*

Start Date 09/08/08 Gage length (Start): 47 mm, End Date 09/13/08 Gage length (End): 47 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File ..../Flex/D4-03-flex.txt

Notes:

5. **Torsion Test** *(Test Parameters: 2% Pre stretch, 180° Twist, 4Hz, 0.6 million cycles)*

Start Date 09/22/08 Gage length (Start): 47 mm, End Date: 9/24/08 Gage length (End): 47 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File ..../Torsion/D4-03-Torsion.txt

Notes:

6. **Post-Test Evaluations**

Date: 10/01/08 Cable length: 40 mm, Initials: ff

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 0.1 Ω max 0.2 Ω, Impedance 10kHz 2.76M Ω Impedance 100kHz 0.26MΩ;

Data File D4-03-posttest-0.154MNaCl-100108

Filar: 1 Resistance: min 0.5 Ω max 0.5 Ω, Impedance 10kHz 1.45MΩ, Impedance 100kHz 0.15MΩ

Data File D4-03-posttest-gold filar-0.154MNaCl-100208

Filar: 2 Resistance: min 0.4 Ω max 0.4 Ω, Impedance 10kHz 1.41MΩ, Impedance 100kHz 0.14MΩ

Data File D4-03-posttest-green filar-0.154MNaCl-100608

Filar: 3 Resistance: min 0.4 Ω max 0.4 Ω, Impedance 10kHz 12.3MΩ, Impedance 100kHz 0.88MΩ

Data File D4-03-posttest-blue filar-0.154MNaCl-100608

Filar: 4 Resistance: min 0.5 Ω max 0.5 Ω, Impedance 10kHz 2.37MΩ, Impedance 100kHz 0.235MΩ

Data File D4-03-posttest-white filar-0.154MNaCl-100208

Notes: Resistance values reported from 3 different measurements.

7. **Revision History**

REV	DESCRIPTION	AUTHOR	DATE	APPROVAL
A	Initial draft	RV/HH	6/9/08	

8. Additional post-test evaluation with 90° bending

Date: 03/12/09 Cable length: 34 mm, Initials: HH

Filar: 6 Resistance: min 0.5 Ω max 0.5 Ω,

Filar: 8 Resistance: min 0.6 Ω max 0.6 Ω,

Filar: 10 Resistance: min 0.5 Ω max 0.9 Ω,

Filar: 7 Resistance: min 0.3 Ω max 0.4 Ω,

Notes: Resistance values reported from 3 different measurements.

CASE WESTERN RESERVE UNIVERSITY EST 1826

Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: D4-04

Cable: DET-4 jkr **Supplied by:** Ardiem Medicalinc **ITEM Serial No:** 03-30-0510 **Part No:** _____ **Rev** ____

Protocol: PRJ-NNPS-TST-PLN-07

1. Pre-Test Evaluations

Date: 06/25/08 Cable length: 71 mm, Initials: YL

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 0.2 Ω max 0.2 Ω, Impedance 10kHz 2864910Ω Impedance 100kHz 2732965Ω

Data File D4-04-pretest-0.154M NaCl-062608

Notes: Resistance value reported from 3 different measurements.

2. Stretch Test *(Test Parameters: 2% Pre stretch, 20% Stretch, 4Hz, 1.2 million cycles)*

Start Date: 09/03/08 Gage length (Start): 45 mm, End Date: 09/08/08 Gage length (End): 48 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File ..../D4-04/Stretch/D4-04-Stretch.txt

Notes:

3. Crush Test *(Test Parameters: 1.2N Crush, 4Hz, 0.12 million cycles)*

Start Date 09/08/08 Gage length (Start): 48 mm, End Date 09/09/08 Gage length (End): 48 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 20,000 cycles;

Data File ..../crush/D4-04-crush.txt

Notes:

4. **Flex Test** *(Test Parameters: 140° Flex, 4Hz, 1.2 million cycles)*

Start Date: 09/13/08 Gage length (Start): 48 mm, End Date 9/17/08 Gage length (End): 48 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File ...../flex/D4-04-flex.txt

Notes:

5. **Torsion Test** *(Test Parameters: 2% Pre stretch, 180° Twist, 4Hz, 0.6 million cycles)*

Start Date: 09/19/08 Gage length (Start): 48 mm, End Date: 09/21/08 Gage length (End): 48 mm,

Initials: RV

Data Acquisition: 10 cycles data for every 100,000 cycles;

Data File ...../Torsion/D4-04-Torsion.txt

Notes:

6. **Post-Test Evaluations**

Date: 10/01/08 Cable length: 40 mm, Initials: HH

Data Acquisition: scan from 100kHz to 100mHz, record rate 10point/decade

Cable Resistance: min 0.1 Ω max 0.2 Ω, Impedance 10kHz 2.81M Ω Impedance 100kHz 0.27MΩ;

Data File D4-04-posttest-0.154M NaCl-100108

Filar: 1 Resistance: min 0.4 Ω max 0.4 Ω, Impedance 10kHz 1.24 MΩ, Impedance 100kHz 0.18MΩ;

Data File D4-04-posttest-gold filar-0.154MNaCl-100308

Filar: 2 Resistance: min 0.5 Ω max 0.5 Ω, Impedance 10kHz 2.48MΩ, Impedance 100kHz 0.28MΩ

Data File D4-04-posttest-green filar-0.154M NaCl-100308

Filar: 3 Resistance: min 0.5 Ω max 0.5 Ω, Impedance 10kHz 2.23MΩ, Impedance 100kHz 0.214MΩ

Data File D4-04-posttest-blue filar-0.154M NaCl-100308

Filar: 4 Resistance: min 0.4 Ω max 0.4 Ω, Impedance 10kHz 2.55MΩ, Impedance 100kHz 0.247MΩ

Data File D4-04-post-test-white filar-0.154M NaCl-100308

Notes: Resistance values reported from 3 different measurements.

7. **Revision History**

REV	DESCRIPTION	AUTHOR	DATE	APPROVAL
A	Initial draft	RV/HH	6/9/08	

8. Additional post-test evaluation with 90° bending

Date: 03/12/09 Cable length: 35 mm, Initials: HH

Filar: G Resistance: min 0.4 Ω max 0.5 Ω,

Filar: B Resistance: min 0.6 Ω max 1.0 Ω,

Filar: W Resistance: min 0.7 Ω max 0.7 Ω,

Filar: Y Resistance: min 0.5 Ω max 0.5 Ω,

Notes: Resistance values reported from 3 different measurements.