
	Design Verification Report - Electrode Cable Post-Test Evaluations	Doc. Number	Rev.
		NNP-DVER-0010	v1

NNP-DVER-0010 - Design Verification Report – Electrode Cable Post-Test Evaluations

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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-0010 – Design Verification Protocol - Electrode 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-0002 – Product Requirements Specification – Electrodes.

This includes the following cables:


Cable	Part Number
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 electrode cables against its reliability requirements was conducted to verify against NNP-REQ-0002 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.

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5.0 Requirements Addressed


This protocol addresses the requirement listed below from NNP-REQ-0002 – Product Requirements Specification – Electrodes. The Requirement Text is for reference only; the listed Product Requirement Specification document is the definitive source for requirement content.

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

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6.1 General Approach

Verification was accomplished using test methods and inspection. Testing was used to confirm the Electrode 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) Electrode 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 ($22\pm 2^{\circ}\text{C}$) conditions.

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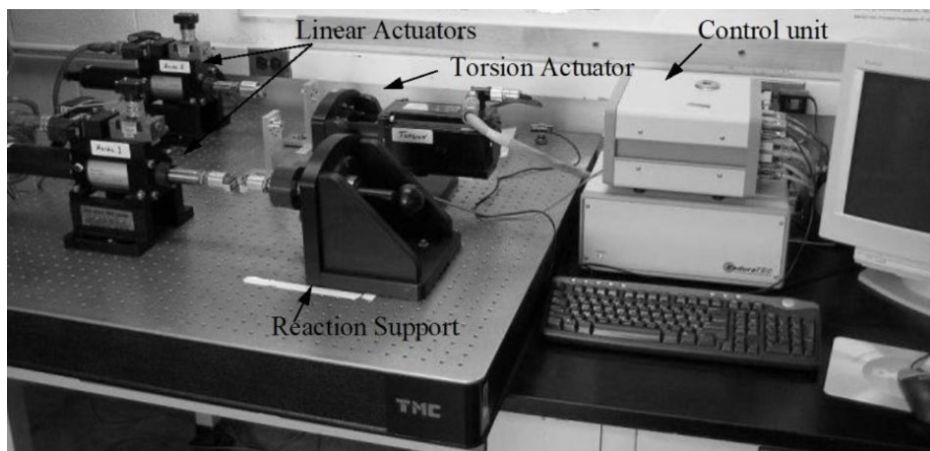


Figure 1. EnduraTEC TestBench with actuators and control unit.

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 cable 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.

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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	
50-5		14.2	14.2	3090000	290000	8.1	8.1	3220000	300000	


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

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.

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

- NNP-DVER-0006, Electrode Cable Stretch Test
- NNP-DVER-0007, Electrode Cable Crush Test
- NNP-DVER-0008, Electrode Cable Flex Test
- NNP-DVER-0009, Electrode Cable Torsion Test

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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-140-012-002 and NNP-DWG-140-012-003, successfully satisfied the reliability requirements (REQ IDs EL.7.1, EL.7.2, EL.7.3, and EL.7.4) defined in NNP-REQ-0002 - Product Requirements Specification – Electrodes.

10.0 References

Document Identifier	Title
NNP-DVEP-0010	Design Verification Protocol – Electrode Cable Post-Test Evaluations
NNP-REQ-0002	Product Requirements Specification – Electrodes
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-0006	Electrode Cable Stretch Test
NNP-DVER-0007	Electrode Cable Crush Test
NNP-DVER-0008	Electrode Cable Flex Test
NNP-DVER-0009	Electrode Cable Torsion Test

11.0 Revision History

Revision	Summary of Changes	Date	Author
v1	First version of document.	7/19/2024	J. Daghestani



Appendix A

Traveler Sheets for Network Cable Post-Test Evaluations



Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: S2-01

Cable: 316SS-24hr Supplied by: Ardian Stem Serial No: 03-30-0110 Part No: _____ Rev _____

Protocol: PRJ-NNPS-TST-PLN-07

1. Pre-Test Evaluations

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

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

Cable Resistance: min 13.6 Ω max 13.7 Ω , Impedance 10kHz 3133640 Ω , Impedance 100kHz 297119;

Data File S2-01-pretest-0154MNaCl-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: 9/24/08 Gage length (Start): 47 mm, End Date: / / Gage length (End): mm,

Initials: *RV*

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	



Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: S2-02

Cable: 316SS-24hr Supplied by: Ardeum from Medical Serial 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: HT

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

Cable Resistance: min 13.6 Ω max 13.75 Ω , Impedance 10kHz 3167 Ω , Impedance 100kHz 299 Ω

Data File S2-02-pretest-0154MNaCl-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: 10/16/08 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 2.90M Ω Impedance 100kHz 0.28M Ω ;

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

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

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

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

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.



Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: S2-03

Cable: 316SS - 241ar Supplied by: Ardisium Stem Medical Serial No: 03-31-010 Part No: _____ Rev _____

Protocol: PRJ-NNPS-TST-PLAN-17

1. Pre-Test Evaluations

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

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

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

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: ++

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

Cable Resistance: min 8.2 Ω max 8.2 Ω , Impedance 10kHz 287M Ω Impedance 100kHz 0.27M Ω ;

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

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

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

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

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: HH

Filar: G 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.



Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: S2-04

Cable: 316SS - 2 filar Supplied by: Ardisys gram Medical Serial No: 03-70-0110 Part No: _____ Rev _____

Protocol: PRJ-NNPS-TST-PLN-07

1. Pre-Test Evaluations

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

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

Cable Resistance: min 13.6 Ω max 13.7 Ω , Impedance 10kHz 3002k Ω , Impedance 100kHz 284k Ω

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 0.2 M Ω Impedance 100kHz 0.304 M Ω

Data File _____

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

Data File _____

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

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: A Resistance: min Ω max Ω ,

Filar: Resistance: min Ω max Ω ,

Notes: Resistance values reported from 3 different measurements.



Development of Networked Implantable Neuroprostheses (NNPS)

Traveler sheet for Cable Endurance Tests

SPECIMEN ID: S2-05

Cable: 316L-26hr Supplied by: Archiev Stem Serial No: 07-30-0110 Part No: _____ Rev _____

Protocol: P2T-NNPS-TST-PLN-07

1. Pre-Test Evaluations

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

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

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

Data File S2-05-preTest-0.154MNAck-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: 10/27/08 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/52-05-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/52-05-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 0.305M Ω

Data File _____

Filar: C Resistance: min 16.5 Ω max 16.6 Ω , Impedance 10kHz 3.22M Ω , Impedance 100kHz 3.05k Ω ;

Data File _____

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

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: 03/10/04 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.