

# Hearing Aid Redesign: Test Plans

## MECHANICAL TESTING

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### Specification Summary:

Spec	Specification	Dir.	Units	Marginal	Ideal	Measured Value	Pass/Fail
S8	Maximum temperature at outside surface of device	min	oF	98	110	Not Tested	Not Tested
S9	Range of adult ear size accommodated	max	percentile	25 <sup>th</sup> -75 <sup>th</sup>	10 <sup>th</sup> -90 <sup>th</sup>	15 <sup>th</sup> -90 <sup>th</sup>	Pass
S10	Weight of earpiece	min	g	<15	<12	15	Pass
S14	Percent of surveyed people who identify a picture of the device as something other than a hearing aid.	max	%	>60	>80	92.06	Pass
S15	Percent of surveyed hard of hearing people who prefer the form of the new device to standard behind the ear hearing aids	max	%	>50	>75	33	Fail
S16	Percent of surveyed hearing people who would use the device for Bluetooth or music listening	max	%	>50	>70	91.8	Pass
S17	Percent of surveyed people who feel the device is comfortable to wear	max	%	>50	>80	33	Fail
S18	Attaches to a standard ear tube and ear mold	yes/no	yes/no	yes	yes	yes	Pass
S19	Manufactured cost (estimated)	min	\$	<2000	<1000	\$415	Pass

# Hearing Aid Redesign: Test Plans

## ME 1: Device Surface Temperature Test

\*NOTE: Test could not be completed. Electronic printed circuit boards were not completed within the time allotted for MSD 2. As a result, the surface temperature test could not be performed.

Date Completed \_\_\_\_\_ N/A \_\_\_\_\_

Performed By \_\_\_\_\_ Alissa Anderson \_\_\_\_\_

### Specifications Tested

Spec / Customer Need	Description	Ideal	Marginal	Measured	Pass/Fail
S8 / CN11 CN12	Maximum temperature at outside surface of device	98F?	110F	N/A	N/A

### Revision History

Revision	Description	Date
1	Document Created	03/25/13

### Equipment

\_\_\_ Thermocouple

### Sections

- Part 1: Surface Temperature Test Outline
- Part 2: Figure 1: Thermocouple placement locations
- Part 3: Table 1: Temperature Results
- Part 4: Summary of Data

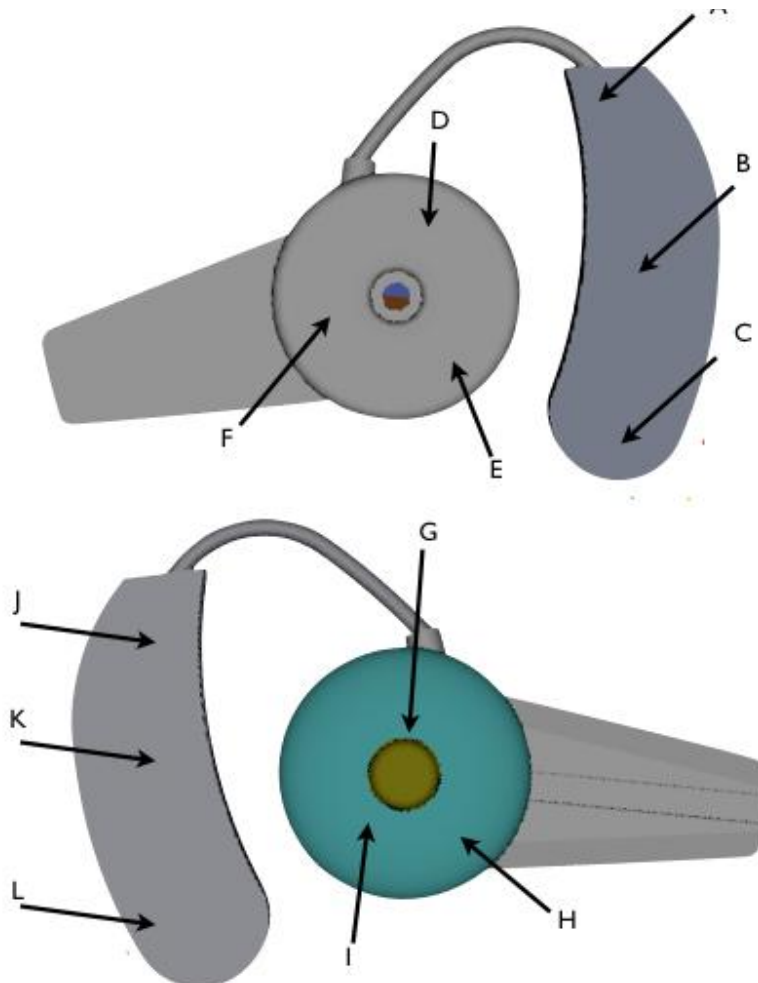
# Hearing Aid Redesign: Test Plans

## ME 1: Device Surface Temperature Test

### Part 1 – Surface Temperature Test Outline

- \_\_\_ 1. Attach a thermocouple to locations A – L (Figure 1)
- \_\_\_ 2. Record temperatures at location A-L in the “initial temperature” column of Table 1
- \_\_\_ 2. Turn device on and run at maximum power for 30 minutes
- \_\_\_ 3. Record temperatures at locations A-L in the “maximum temperature” column of Table 1
- \_\_\_ 4. Turn device off and allow to device to cool to room temperature

### Part 2 - Figure 1: Thermocouple placement locations



# Hearing Aid Redesign: Test Plans

## ME 1: Device Surface Temperature Test

### Part 3 - Table 1: Temperatures Results

Location	Initial Temperature (deg. F)	Maximum Temperature (deg. F)	Is the maximum temperature < 100F? (Y/N)
A			
B			
C			
D			
E			
F			
G			
H			
I			
J			
K			
L			

### Part 4 - Summary of Data

Are all temperature readings <110F ? Yes \_\_\_\_\_ No \_\_\_\_\_

If no, list what locations are out of spec: \_\_\_\_\_

Testing Part 1 Sign Off \_\_\_\_\_ N/A \_\_\_\_\_ Date \_\_\_\_\_ 5/7/13 \_\_\_\_\_

# Hearing Aid Redesign: Test Plans

## ME 2: Ergonomic Compatibility Test

Date Completed \_\_\_\_\_ March 15, 2003 \_\_\_\_\_

Performed By \_Paula Garcia and Marbella Vidals\_\_\_\_

### Specifications Tested

Spec / Customer Need	Description	Direction	Marginal	Ideal
S7	Connects to standard USB 2.0 computer port	Binary	Yes	Yes
S9	Range of adult ear size accommodated	Max	25 <sup>th</sup> to 75 <sup>th</sup> percentile	5 <sup>th</sup> to 95 <sup>th</sup> percentile
S15	Percent of hard of hearing people who preferred the form of new device compared to the standard hearing aids.	max	>50%	>75%
S17	Percent of surveyed people who feel the device is comfortable to wear		> 50 %	> 80 %
S18	Attaches to standard ear tube and ear mold	binary	yes	yes

### Revision History

Revision	Description	Date
1	Document Created	03/25/13

### Equipment

- |  |   |
|--|---|
| <input checked="" type="checkbox"/> Human Subjects (potential users) | <input type="checkbox"/> Prototype            |
| <input type="checkbox"/> Disinfectant wipes                          | <input type="checkbox"/> Calipers             |
| <input type="checkbox"/> Questionnaire                               | <input type="checkbox"/> Disposable ear domes |
| <input type="checkbox"/> Camera and Tripod                           |   |

**Purpose:** The intent of this test is to evaluate the design of the beta prototype in order to make any necessary changes and updates to the final prototype design. This test is to be conducted week 2 of MSD2.

# Hearing Aid Redesign: Test Plans

## ME 2: Ergonomic Compatibility Test

### Sections

- Part 1: Ergonomic Compatibility Test Outline
- Part 2: Questionnaire
- Part 3: Summary of Data

### Part 1 – Ergonomic Compatibility Test

1. Sit user in testing location
2. Present the device to the user without explaining the design intent or features (the purpose of this test is to gauge how intuitive the design is to a new user)
3. Each subject will have their ear dimensions recorded to track ear sizes
4. Data collected from each subject will be kept confidential
5. Conduct one on one interview with each participant for a maximum of 15 minutes
6. Each participant will be asked to wear a prototype and perform a set of tasks such as walking with device, adjusting volume etc.
7. The use of a Likert system will be used to answer each question.
8. Each question will reference a function on the device to evaluate basic usability standards:
  - a. Flexibility and efficiency of use
  - b. Aesthetic and minimalist design
  - c. User Control and freedom
  - d. Recognition rather than recall
9. Follow the instructions on the attached questionnaire and record answers
10. Wipe down device with disinfecting wipes
11. Dismiss user and repeat steps 1-3 for the remaining users

# Hearing Aid Redesign: Test Plans

## ME 2: Ergonomic Compatibility Test

### Part 2 – Questionnaire

#### Hearing Aid Design Survey:

Date:

Age:

Time:

Gender:

Please mark how satisfied you are with the hearing aid device for each situation:

#	Question	Very Satisfied	Satisfied	Neutral	Dissatisfied,	Very Dissatisfied	NA
1	Aesthetics/Visibility of device						
2	Overall comfort/fit-Stationary State						
3	Overall comfort/fit-Active State						
4	Weight of Device:						
5	Ease of Adjusting Volume:						
6	Ease of Adjusting Programs:						
7	Ease of changing/accessing batteries:						
8	Ease of recharging device (connection)						
9	Overall Quality of device:						

#### 10. Color Preference:

#### 11. Price range:

\$0-\$20

\$20-\$50

\$50-\$100

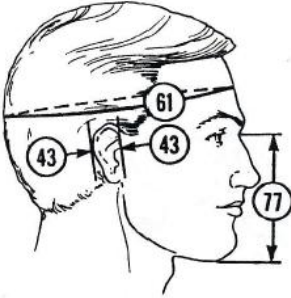
\$100-\$200

Greater than \$200

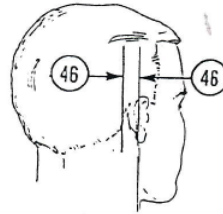
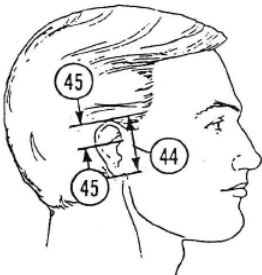
# Hearing Aid Redesign: Test Plans

## ME 2: Ergonomic Compatibility Test

Subject's Ear Dimensions:



Area	Measurements
43	
44	
45	
46	



### Part 3 – Summary of Results

Major Observations:

Description	Comments
<b>Aesthetics/Visibility</b>	Mixed reviews among participants
<b>Overall Comfort</b>	3 out of 6 people were dissatisfied with overall comfort due to long/big ear tube and round module hitting cartilage
<b>Overall Comfort (active)</b>	4 out of 6 people were not able to keep device secured on ear due to long ear tube.
<b>Weight of Device</b>	Mixed reviews among participants, Generally didn't feel uncomfortable due to weight
<b>Ease of Changing Volume</b>	3 out 6 people generally neutral on volume adjustment
<b>Ease of Changing Programs</b>	Generally satisfied/neutral on adjusting program-Some expressed good feedback on multi-function button
<b>Ease of changing/access batteries</b>	Mainly satisfied because of battery
<b>Ease of Recharging</b>	Complete Satisfaction with ability to recharge
<b>Overall Quality</b>	Mixed reviews on overall quality



# Hearing Aid Redesign: Test Plans

## ME 2: Ergonomic Compatibility Test

Specific Results:

sample size: 6

Question	Description	Results			
		Satisfied	Neutral	Dissatisfied	NA
1	Aesthetics/Visibility	33%	33%	33%	
2	Overall Comfort	17%	33%	50%	
3	Overall Comfort (active)	17%	17%		67%
4	Weight of Device	33%	17%	50%	
5	Ease of Changing Vol	17%	50%	33%	
6	Ease of Changing Prog.	33%	50%	33%	
7	Ease of changing/access batteries	50%	17%	33%	
8	Ease of Recharging	100%			
9	Overall Quality	33%	33%	33%	

Color Preference				
Blue	Black	Purple	red	silver
3	3	2	2	1
Gender	Female	4		
	Male	2		
Ages	19-25			

Performed by: \_\_\_\_\_Paula Garcia and Marbella Vidals\_\_\_\_\_

Date Complete: \_\_\_\_\_March 15, 2013\_\_\_\_\_

# Hearing Aid Redesign: Test Plans

## ME 3: Weight Test

Date Completed \_\_\_\_\_5/3/2013\_\_\_\_\_

Performed By \_Kelly Murosky\_\_\_\_\_

### Specifications Tested

Spec / Customer Need	Description	Marginal	Ideal
S10 / CN 4, 6, 10, 11	Weight of device	<15 grams	< 12 grams

### Revision History

Revision	Description	Date
1	Document Created	04/08/13
2	Results added	5/3/13

### Equipment

Assembled Device

Scale

**Purpose:** The intent of this test is to measure the mass of the assembled device (enclosure and electronics).

### Sections

- Part 1: Weight Test Outline
- Part 2: Diagram
- Part 3: Summary of Data

Date Completed \_\_\_\_\_5/3/13\_\_\_\_\_

Performed By \_\_\_\_\_Kelly Murosky\_\_\_\_\_

# Hearing Aid Redesign: Test Plans

## ME 3: Weight Test

### Part 1 – Weight Test

- 1. Zero scale
- 2. Place device on scale (Diagram 1)
- 3. Read and record weight in Part 3

### Part 2 – Diagram 1



place device on scale and record value

### Part 3 – Summary of Results

Was the device within the specified weight requirement?  Yes  No

Comments?



Testing Part 1 Sign Off  Kelly Murosky  Date  5/3/13

# Hearing Aid Redesign: Test Plans

## ME4/ISE: Aesthetics Compatibility Test

Date Completed \_\_\_\_5/5/13\_\_\_\_\_

Performed By \_Paula Garcia and Marbella Vidals\_\_\_

### Specifications Tested

Spec / Customer Need	Description	Direction	Marginal	Ideal
S14	Percent of surveyed people who Identify a picture of the device as something other than a hearing aid.	max	>60	>80
S15	Percent of hard of hearing people who preferred the form of new device compared to the standard hearing aids.	max	>50%	>75%
S16	Percent of surveyed hearing people who would use the device for Bluetooth or music listening	max	>50	>70
S17	Percent of surveyed people who feel the device is comfortable to wear	max	> 50 %	> 80 %

### Revision History

Revision	Description	Date
1	Document Created	03/25/13
2	Addition to results	5/5-6/13?

### Equipment

Human Subjects (potential users)                       Prototype(s)

Questionnaire

**Purpose:** The intent of this test is to evaluate the final design of the MSD-II prototype in order to make any document any necessary changes and updates for the next iteration of MSD team's prototype design. This test is to be conducted week 9 of MSD II during the Imagine-RIT festival.

### Sections

- Part 1: Aesthetics Compatibility Test Outline
- Part 2: Questionnaire
- Part 3: Summary of Data

# Hearing Aid Redesign: Test Plans

## ME4/ISE: Aesthetics Compatibility Test

### Part 1 – Ergonomic Compatibility Test

1. Present the device to the user without explaining the design intent or features (the purpose of this test is to gauge how intuitive the design is to a new user)
2. Each subject will be given a survey to evaluate the aesthetic design
3. Each question will reference a function on the device to evaluate basic usability standards:
  - a. Flexibility and efficiency of use
  - b. Aesthetic and minimalist design
  - c. User Control and freedom
4. Data collected from each subject will be kept confidential
5. Dismiss user and repeat steps 1-4 for the remaining users

### Part 2 – Questionnaire

<https://clipboard.rit.edu/take.cfm?sid=182c28a3>

# Hearing Aid Redesign: Test Plans

## ME4/ISE: Aesthetics Compatibility Test

### Part 3 – Summary of Results

Major Observations:

Description	Comments
Percent of surveyed people who Identify a picture of the device as something other than a hearing aid.	61.83 % Bluetooth device 30.23% Headphones
Percent of hard of hearing people who preferred the form of new device compared to the standard hearing aids.	---- Survey did not capture this spec
Percent of surveyed hearing people who would use the device for Bluetooth or music listening	91.8 % would recommend this device to a friend

Performed By: \_\_\_Paula Garcia and Marbella Vidals\_\_\_\_\_

Date Completed: \_\_\_5/5/13\_\_\_\_\_

# Hearing Aid Redesign: Test Plans

## ME 5: Ear Mold / Dome Compatibility Test

Date Completed \_\_\_\_5/3/13\_\_\_\_

Performed By \_\_Marbella Vidals and Kelly Murosky\_\_\_\_

### Specifications Tested

Spec / Customer Need	Description	Yes / No	
S18/ CN9	Attaches to a standard ear mold	yes	

### Revision History

Revision	Description	Date
1	Document Created	04/08/13
2	Test Results added	5/3/13

### Equipment

Assembled Device

Ear molds and domes

**Purpose:** The purpose of this test is to verify that the device will interface with standard ear molds and domes.

### Sections

- Part 1: Ear Mold / Dome Test Outline
- Part 2: Diagram
- Part 3: Summary of Data

Date Completed \_\_5/3/13\_\_\_\_

Performed By \_\_Marbella Vidals and Kelly Murosky\_\_\_\_

# Hearing Aid Redesign: Test Plans

## ME 5: Ear Mold / Dome Compatibility Test

### Part 1 – Ear Mold Dome Test Outline

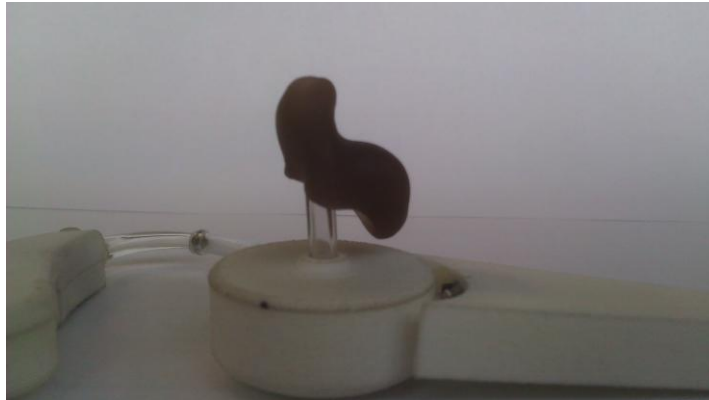
- 1. Attach ear mold / dome to device ear tube
- 2. Visually inspect connection
- 3. Record quantitative analysis of connection

### Part 2 – Diagram 1





# Hearing Aid Redesign: Test Plans



Ear Mold Compatibility



Ear Dome Compatibility

## Part 3 – Summary of Results

Mold or Dome?	Manufacturer ID	Did the part attach?	Comments / Observations
13mm	Oticon	Yes	Used Standard size tube #13 fits perfect
8 mm	Oticon	Yes	Used Standard size tube #13 fits perfect

Testing Part 1 Sign Off \_\_Kelly Murosky\_\_\_\_\_ Date\_\_5/7/13\_\_\_\_\_

# Hearing Aid Redesign: Test Plans

## ME 6: USB Feasibility Test

Date Completed 3/29/13

Performed By Kelly Murosky

### Specifications Tested

Spec / Customer Need	Description	Marginal	Ideal
None	None	None	None

### Revision History

Revision	Description	Date
1	Document Created	03/25/13
2	Document Populated	04/07/13

### Equipment

- 2 C-Clamps (1 large, 1 small)
- Mass Hanger and Weight Set
- Wooden Block
- USB (male)
- USB (female)

**Purpose:** The intent of this test is to evaluate the feasibility of using a micro USB as the main connection between the transfer module and round enclosure. This test will verify that the micro USB can structurally support the transfer module without harming the round enclosure. This test will also determine if the connection is user friendly – if it will be easy for a user to plug / unplug the micro UCB connector. A mass hanger and weight set is used to determine the maximum force micro USB can support.

### Sections

- Part 1: Micro USB Test Outline
- Part 2: Figure
- Part 3: Summary of Data

Date Completed 3/29/13

Performed By Kelly Murosky

# Hearing Aid Redesign: Test Plans

## ME 6: USB Feasibility Test

### Part 1 – Micro USB Feasibility Test

- 1. Solder the micro USB receptacle to the PCB as seen in Figure 1
- 2. Secure the male USB plug in the C-clamp as seen in Figure 2
- 3. Secure the small C-clamp by use of the wooden block then use the larger C-clamp to attach the wooden block to the table as seen in Figure 3
- 4. Plug micro USB receptacle into male USB plug and attach the mass hanger, as seen in Figure 3
- 5. Place a mass disc onto the mass hanger one disc at a time until the micro USB receptacle separates from the micro USB plug.
- 6. Record the maximum mass before separation in Table 1
- 7. Repeat steps 1-6 for a total of ten trials

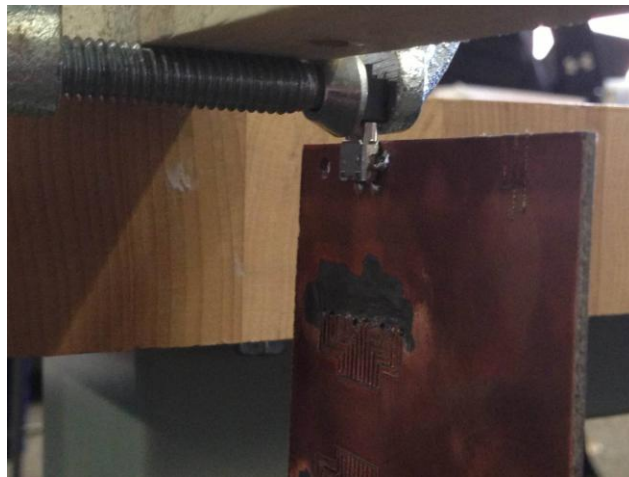
### Part 2 – Test Set Up



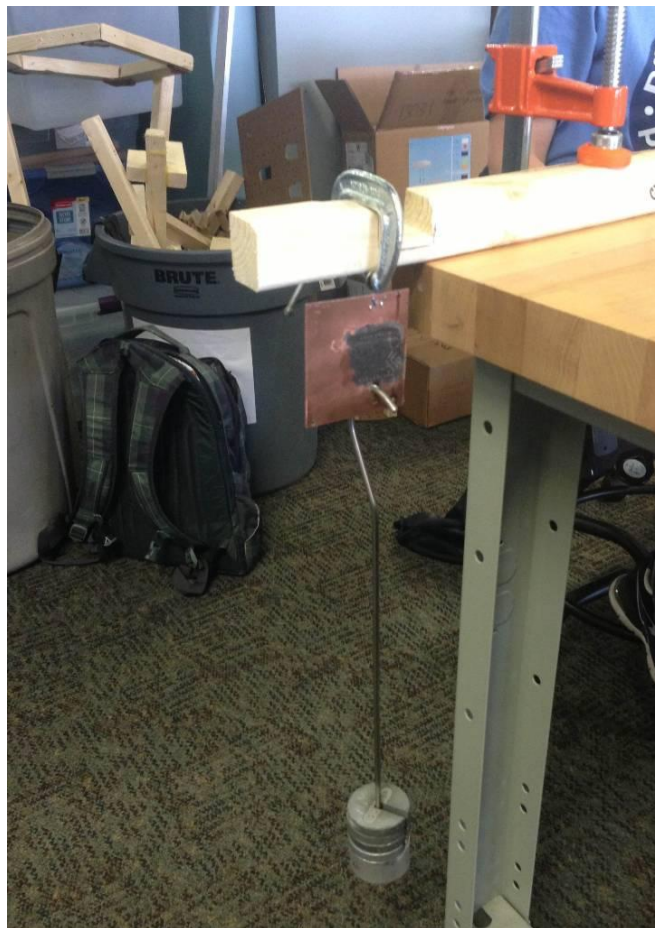
*Figure 1*

# Hearing Aid Redesign: Test Plans

## ME 6: USB Feasibility Test



*Figure 2*



*Figure 3*

# Hearing Aid Redesign: Test Plans

## ME 6: USB Feasibility Test

### Part 3 – Test Results

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Trial 9	Trial 10	Average
Weight Before Failure	1996 g	1796 g	1846 g	1896 g	1896 g	1796 g	1996 g	1896 g	1896 g	1846 g	1886 g or 4.158 lb

### Part 4 – Summary of Results

The major take away from this test is that 4.158 lb of force is required to remove the USB plug from the USB receptacle. Also, the transfer module weighs less than this 4 lb pull out force meaning that the own weight of the transfer module will not cause it to dislodge from the main enclosure. The USB connection is strong enough to be the main source of transfer module connection.

Testing Part 1 Sign Off Kelly Murosky Date 3/29/13

# Hearing Aid Redesign: Test Plans