# CASCADE NOISE REDUCTION CHECKLIST
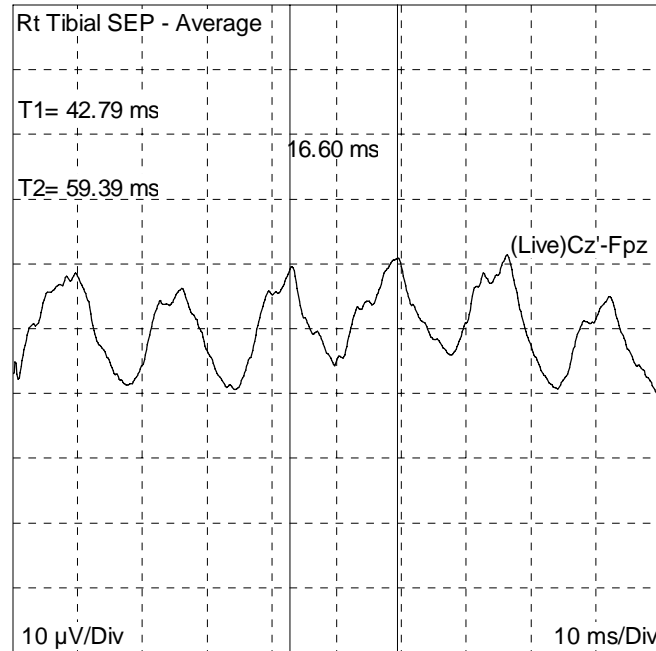
❑ **Check all cable connections.**
- Make sure there are no bent pins in the amplifier cable and the input extender cables.
- Make sure all cables are securely connected.

❑ **Verify that the Procedure Setup is correct.**
- Make sure that the appropriate amplifier inputs are assigned to the channels in the test montage.
- Make sure that the channels from the test montage have been assigned to the acquisition modes correctly.
- Verify that the appropriate gain and filter settings are being utilized.
- Verify that the appropriate sweep speed is being utilized for each acquisition mode.
- Delete unused channels from the test montage.

❑ **Check Electrode Impedances.**
- Make sure all electrode impedances are below 5k Ohms and are well balanced.

❑ **Location of Ground Electrode.**
- Place the ground electrode on the patient's head near the evoked potential recording electrodes.

❑ **Twist Lead Wires together and bundle.**
- Try to twist the electrode lead wires together and bundle all of them together if possible. For example, twist and bundle the SEP electrode leads together, and do the same for the EMG leads from the Left leg and Right leg.
- Try to use short electrode lead wires in combination with the input extender cables.

❑ **Position of main Amplifier.**
- Move the amplifier away from potential noise sources. Moving it 1-2 feet from its current location can sometimes make a difference.
- Moving the electrode lead wires a few inches can also make a difference.

❑ **Check grounding of Laptop or desktop PC and Cart.**
- Make sure that the Laptop or desktop PC is grounded. A wire should be attached from the Laptop or PC to the ground connector on the back of the Cascade base unit.
- If the Cascade is sitting on a metal cart, use a second wire to ground the cart to the same ground connector on the back of the Cascade base unit.

❑ **Connect power directly to wall outlet, bypass power strips or isolation transformers.**
- If the Cascade's power cord is plugged into a power strip or isolation transformer with other devices, try plugging the Cascade directly into the wall outlet.

❑ **Determine the Frequency of the Noise and,**
- **A)** If the noise is 60 Hz, try using the Notch Filter.
- **B)** Change the Repetition Rate to an integer multiple of the noise source plus an additional ½ period. *See explanation that follows.*
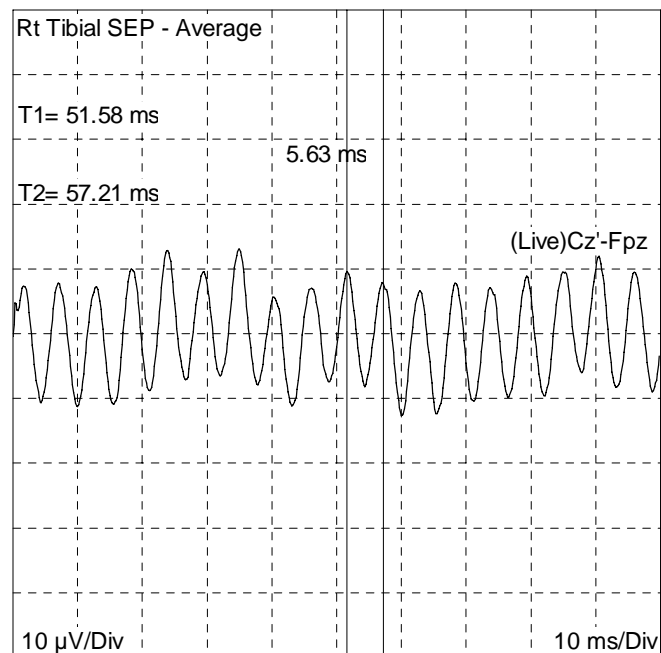
   **To Determine the Frequency of the Noise:**
   1. Right click on one of the EP Average windows.
   2. Select the LIVE option from the pop-up menu.

3. Stop the mode so that the LIVE trace will be frozen within the window.
4. Right click on the window again and use the Time Marker option to place two vertical time markers on the window.
5. Place the markers so that you can measure the Peak to Peak interval of the noise.
6. Divide the resulting Peak to Peak interval (in milliseconds) into 1000. The result is the frequency of the noise. The following two examples illustrate this for 60 and 180 Hz noise.

Rt Tibial SEP - Average

T1= 42.79 ms

16.60 ms

T2= 59.39 ms

(Live)Cz'-Fpz

10 µV/Div                          10 ms/Div

60 Hz Noise.  (1000 / 16.6 = 60)

Rt Tibial SEP - Average

T1= 51.58 ms

5.63 ms

T2= 57.21 ms

(Live)Cz'-Fpz

10 µV/Div                          10 ms/Div

180 Hz Noise.  (1000 / 5.6 = 180)

**Table:** Common Noise Frequencies and their
corresponding Peak To Peak Interval

| Peak To Peak Interval (msec) | Frequency Of Noise (Hz) |
|---|---|
| 16.66 | 60 |
| 8.33 | 120 |
| 6.66 | 150 |
| 5.55 | 180 |
| 4.16 | 240 |
| 3.33 | 300 |
| 3.03 | 330 |
| 2.77 | 360 |
| 2.38 | 420 |
| 2.08 | 480 |
| 0.4 | 2500 |
| 0.35 | 2800 |
| 0.33 | 3000 |

**To Determine the Optimal Repetition Rate to Use:**

Mathematical modeling shows that the best repetition rate to use for steady state noise is one that when divided into the noise frequency results in an integer multiple of the noise source plus an additional ½ period (i.e., 0.5).

For example, if you use a repetition rate of 2.72 with 60 Hz noise:

$$60 / 2.72 = 22.059$$

This would <u>not be a good</u> repetition rate to use.

But, if you use a repetition rate of 2.79 with 60 Hz noise:

$$60 / 2.79 = 22.505$$

This <u>would be a good</u> choice to use since the result is almost exactly an integer plus 0.5.

When using the wrong repetition rate the noise will wax and wane during averaging.  That is, it will start to average out and then will appear to grow back into the response.

When using the correct repetition rate the noise should progressively be reduced during averaging and should not return.

The tables on the next page list some suggested repetition rates to use with varying frequencies of noise.  You can obtain a complete Excel spreadsheet of repetition rate vs. noise frequency by contacting Cadwell Laboratories.

### SEP Repetition Rates

| Rep Rate | 60 Hz | 120 Hz | 180 Hz | 240 Hz | 300 Hz |
|---|---|---|---|---|---|
| | | **Use With This Noise** | | | |
| **2.18** | Yes | No | Yes | No | No |
| **2.20** | No | Yes | No | No | No |
| **2.35** | Yes | No | Yes | No | No |
| **2.41** | No | No | No | Yes | Yes |
| **2.55** | Yes | No | Yes | No | No |
| **3.07** | Yes | No | No | No | No |
| **3.63** | Yes | No | Yes | No | No |
| **4.13** | Yes | No | Yes | No | No |
| **4.44** | Yes | No | Yes | No | Yes |

### ABR Repetition Rates

| Rep Rate | 180 Hz | 2500 Hz | 2800 Hz | 3000 Hz |
|---|---|---|---|---|
| | | **Use With This Noise** | | |
| **11.34** | No | Yes | No | Yes |
| **11.45** | No | No | Yes | No |
| **11.61** | Yes | No | No | No |
| **16.81** | No | No | Yes | Yes |
| **16.92** | No | No | Yes | No |
| **21.14** | No | No | Yes | No |
| **21.46** | No | Yes | Yes | No |
| **33.11** | No | Yes | No | No |
| **33.14** | No | No | Yes | Yes |

❑ **Try using the Digital Smoothing Filters**
- **Right click** on the **EP Average window** and select **Mode Setup**. Try applying the Digital Smoothing filters in the order that they are listed. The SF filters remove high frequency noise from the traces, SF1 the least amount, SF5 the most. The ABR1 and ABR2 filters are designed to specifically enhance the peaks of the ABR response.

❑ **Change the system to the "Optimize For Synchronous Noise Reduction" stimulus triggering mode.**
- From the **Edit** menu select **System Setup**. On the **General** tab select the option **Optimize For Synchronous Noise Reduction**. Click **OK**. You will need to stop and restart all data acquisition after making this change.
- Again, determine the frequency of the noise source and choose an appropriate repetition rate.
  **Note:** There are more restrictions on the attainable repetition rates when using the Optimize For Synchronous Noise Reduction triggering mode.
- Try to start and stop all running modes synchronously, it may help to use the **Synch Start 1** setting in the **Run Mode** field.