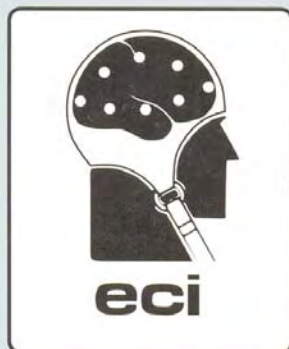


INSTRUCTION MANUAL

**for the ECI Electro-Cap
Electrode System**



ELECTRO-CAP INTERNATIONAL, INC.

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Thank You...

for choosing the Electro-Cap System for electrode placement. We feel certain that both you and your patients will appreciate the convenience and ease of use of the system. And, with proper use, this system will assure recordings equal to or better than with any other method of electrode application available today.

As with any new technique, we encourage you to familiarize yourself with the contents of this manual. If possible, practice with a friend or co-worker before actually recording your first patient or subject with the Electro-Cap.

If you encounter any difficulties, or have any questions, please contact Electro-Cap. One of our Customer Service Representatives will be happy to assist you.

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1. ELECTRODE RECORDING PRINCIPLE

Recessed electrodes were chosen for the ECI Electro-Cap Electrode System™ because of their superior recording ability. According to Cooper¹... "The most serious consequence of the steady potentials between electrodes is movement artifact. Differences of potential cause currents to flow between electrodes and any change of electrode resistance (by movement and so on) can cause potential differences to appear in the EEG. Disturbance of the ions of the electrical double layer by scalp movement alters the electrode potential and causes artifacts in the EEG. This difficulty can be overcome by having the metallic surface of the electrode remote from the scalp and the connection made with a saline bridge." Geddes² states... "Much of the movement artifact encountered when a metallic electrode is in direct contact with tissue is reduced by moving the metal a short distance from the tissue and bridging the intervening gap with an electrolytic jelly or paste... From all the evidence it is clear that the recessed electrode is the electrode of choice for recording bioelectric events on moving subjects. Almost artifact-free records can be obtained under extremely adverse conditions if the electrodes are low in mass, the electrode-electrolyte junction is stable electrochemically and mechanically, and a low electrical impedance communication is established with the subject."

NOTES

¹ R. Cooper, J.W. Osselson and J.C. Shaw, "EEG Technology," Chapter 2 Electrodes, Page 22, Butterworths, 1980.

² L.A. Geddes, "Electrodes and the Measurement of Bioelectric Events," Chapter 2 Surface Electrodes, pages 78,92, Wiley Interspace, 1972.

2. EQUIPMENT AND SUPPLIES

The ECI Electro-Cap Electrode System may be used with any brand and model EEG instrument and all EEG telephone transmission equipment.

All items listed are required to perform EEGs and must be available.

- ECI[™] Electro-Caps (7 sizes available)
- Electrode Board Adapter
- Body Harness (4 sizes available)
- Disposable Sponge Disks
- ECI Electro-Gel[™]
- Blunted Needle/Syringe Kit
- Ear Electrodes
- Color-Coded Head Measuring Tape (2 sizes available)
- Quick Insert Electrode[™]

Recommended optional items

- Metric tape measure
- Wax china marker
- 1" Micropore[®] Tape
- ECI EKG Electrodes[™] with adjustable strap
- ECI EMG Electrodes[™] with adjustable strap
- ECI Bio-Potential Electrode[™]

Additional accessories may be found in the Electro-Cap Product Catalog. If the catalog has been removed from this Instruction Manual, please call Electro-Cap for a replacement.

*An instructional video is available as a complement to this manual. Please contact Electro-Cap for further information.

**Some electrode wires now terminate in female sockets instead of connector pins. If necessary, "pins" may be read as "sockets" throughout this manual.

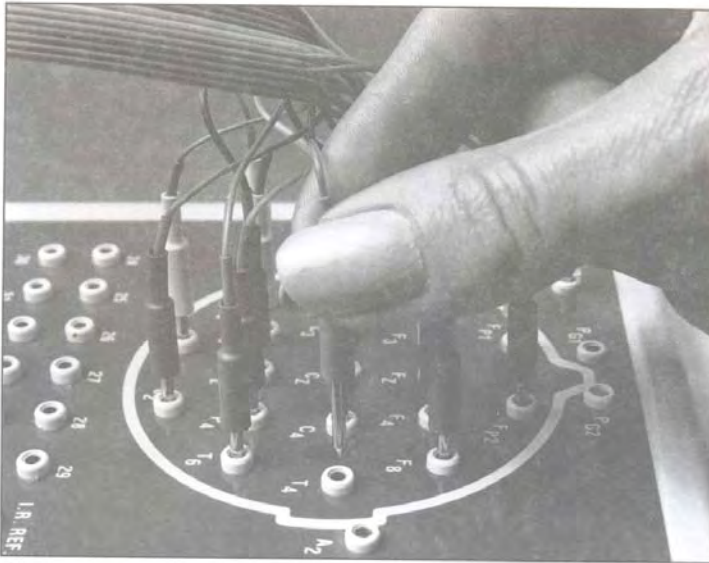


Figure 1

3. INSTALLING THE ELECTRODE BOARD ADAPTER

The Electrode Board Adapter is used to connect the Electro-Cap to most brands and models of EEG instruments.

Each wire/connector pin [socket] on the Electrode Board Adapter is color-coded for easy identification. The wire color/connector pin [socket] color combination determines the electrode placement of each wire.

If you are working with an Electro-Cap with International 10/20 placements, plug the connector pins [sockets] into the EEG instrument's electrode board (Figure 1) according to the chart below.* If you are working with an Electro-Cap with custom placements, refer to the wiring diagram included with the special Electro-Cap. If you are working with an Electro-Cap that has been wired to connect directly into the EEG instrument, please **skip to Step 4. The Electrode Board Adapter is not used.**

| WHITE TIP | WIRE COLOR | RED TIP |
|----------------------|-----------------------|--------------------|
| Fp1 | BROWN | Fp2 |
| F3 | RED | F4 |
| C3 | ORANGE . . . | C4 |
| P3 | YELLOW . . . | P4 |
| O1 | GREEN | O2 |
| F7 | BLUE | F8 |
| T3 | VIOLET | T4 |
| T5 | GRAY | T6 |
| Gnd | WHITE | Cz |
| Fz | BLACK | Pz |

NOTES

NOTES

The individual wires of the Electrode Board Adapter are separated sufficiently to fit the electrode board of essentially all commercial EEG instruments. An unusually large electrode board might require further separation of the wires. If so, separate the wires evenly and only as far as is necessary to prevent tension on any individual wire. **THE WIRES SHOULD NEVER, UNDER ANY CIRCUMSTANCES, BE SEPARATED BACK TO THE BLUE CONNECTOR.**

* The Grass Model 6 and Model 8 electroencephalographs have connectors on, or associated with, the electrode board and impedance meter which will accept the blue Electro-Cap connector. If the connector on the EEG instrument and impedance meter are used instead of the Electrode Board Adapter, false and misleading EEG results will occur. The Electrode Board Adapter **must** be installed and used.

4. PREPARING THE PATIENT

GENERAL INFORMATION

The patient's hair should be dry and all bobby pins, barrettes and earrings must be removed. While desirable, it is not necessary to wash the hair before applying the ECI Electro-Cap.

On cooperative patients, apply the cap while the patient sits up in a straight back chair. After the cap is in place, the electrodes filled and the impedances checked, move the patient to the bed or reclining chair for recording.

The application technique for infants is slightly different. Please see notes on page 19.



Figure 2



Figure 3

APPLICATION TECHNIQUE

Instruct the patient to hold his or her arms out straight. **SLIP THE BODY HARNESS UNDER THE ARMPITS AND AROUND THE CHEST** with the Velcro® strips to the patient's right side (Figure 2). Pull the elastic taut and press the Velcro® strips together. Center the snaps on the chest (Figure 3). The fit should be snug but not uncomfortable.

The body harness is available in 4 sizes: large, medium, small, and infant.

If the patient is comatose or otherwise unable to move, it will be more convenient to use the chin straps in place of the body harness.

If chin straps are being used, the body harness is not necessary. Simply connect the chin straps under the patient's chin with the Velcro®. The patient may be more comfortable if a chin strap pad is placed between the chin and the chin straps.

NOTES

NOTES

MEASURE THE CIRCUMFERENCE OF THE HEAD with the special Color-Coded Head Measuring Tape (Figures 4, 5, 6). Wrap the tape measure around the head on an imaginary line approximately one inch above the nasion (the most indented point on the bridge of the nose) and one inch above the inion (the bony protuberance at the base of the skull). When measuring children, place the tape about 1/2 inch lower. The cap to be used is the size indicated by where the end of the tape settles on the measuring tape. For example, if the end of the tape is in the red color zone, the patient will require the red (medium) cap.



Figure 4



Figure 5



Figure 6

If the end of the Color-Coded Head Measuring Tape lands on the border of two colors, it is generally advisable to use the larger of the two cap sizes.

The head circumference must be measured. An ordinary metric tape measure may be used if the Color-Coded Head Measuring Tape is not available. The various caps fit the following head sizes:

- Blue (large) fits 58-62cm head circumference
- Red (medium) fits 54-58cm head circumference
- Yellow (small) fits 50-54cm head circumference
- Green (extra small) fits 46-50cm head circumference
- Light Blue (Infa-Cap I) . . fits 42-46cm head circumference
- Pink (Infa-Cap II) fits 38-42cm head circumference
- Brown (Infa-Cap III) . . . fits 34-38cm head circumference

The above size information is also printed on the label at the back of each cap.



Figure 7

ATTACH, FILL, AND ABRADE THE EAR ELECTRODES.

Open the clip and close it onto the ear lobe (Figure 7). Using the left hand, grip the ear lobe with your index finger and thumb. Insert the blunted needle into the hole and inject a small amount of Electro-Gel into the disk cavity (Figure 8). Hold the syringe plunger with only the index finger; rock the syringe rapidly back and forth using a moderate amount of downward pressure to abrade the skin.

The best electrode stability is achieved by seating the ear clip loop in the indentation where the ear joins the head.

The ear clips may need to be adjusted. If they are too loose, gently press the loops together. If they appear too tight, pull them slightly open.

** If Adhesive Electrode Pads are being used with the Disk Electrodes instead of the ear clip electrodes, please refer to the instructions included in the Adhesive Electrode Pads Package.



Figure 8

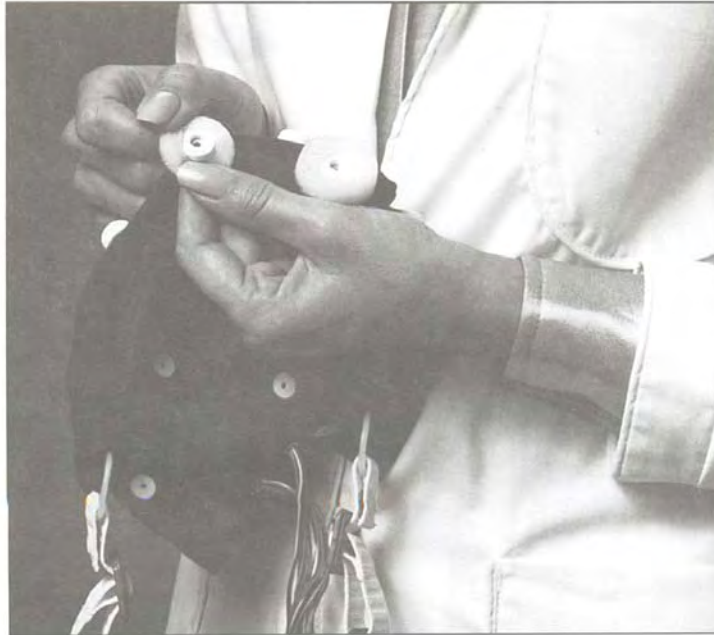


Figure 9

PLACE DISPOSABLE SPONGE DISKS AROUND THE Fp1 AND Fp2 ELECTRODE MOUNTS. Peel the paper off the back of the sponge. Work the sponge disk, sticky side toward the skin, onto each of the frontal electrode mounts (Figure 9).

(An alternative method is to determine the location of Fp1 and Fp2, and place the two sponge disks in the appropriate location on the forehead prior to cap application.)

The sponge disks absorb perspiration and prevent the spread of electrode gel onto the forehead.

NOTE: A sponge disk should also be used on electrode mounts which fall within any other area of the person's head which does not contain enough hair to hold the gel in place. However, if there is **any** hair in the area, place the adhesive toward the cap fabric.

MEASURE AND MARK THE Fp LINE. Before applying the cap, measure the nasion to inion distance with a centimeter tape. Note the result and move the decimal point one place to the left. (For example, 38 cm = 3.8 cm.) Measure this distance up from the nasion. Make a horizontal mark on the forehead at the derived distance with a china marker.

NOTES



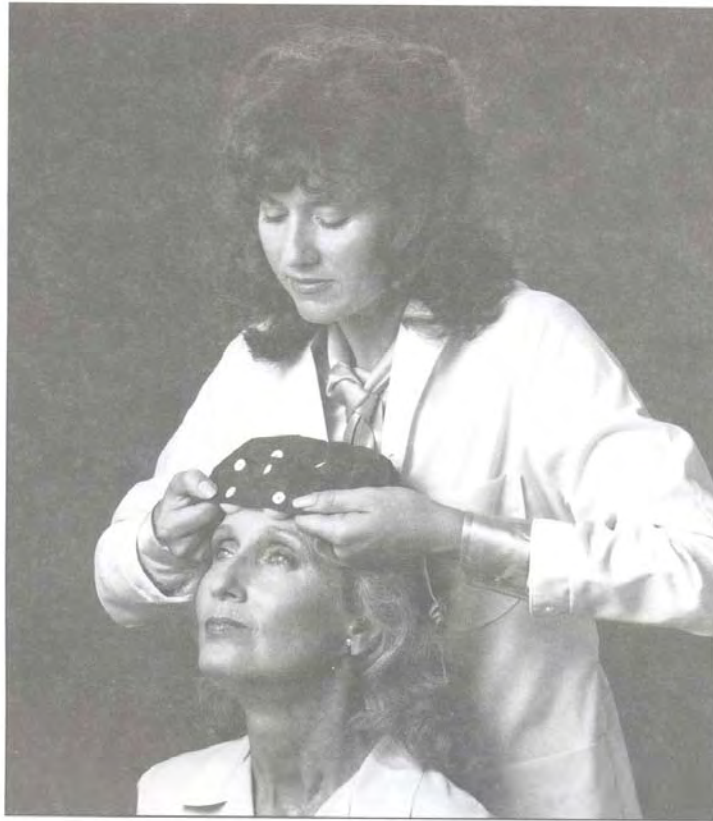


Figure 10

SLIP THE PROPER SIZE CAP ONTO THE PATIENT'S HEAD WITH THE SIZE LABEL TO THE BACK OF THE PATIENT'S HEAD. Align the holes in the Fp1 and Fp2 mounts on the forehead mark. Pull the cap onto the head using both hands in unison. With the fingers on the inside of the cap and the thumbs on the outside, "anchor" Fp1 and Fp2 on the forehead (Figure 10). Slip the cap onto the head by working the hands from the front to the back of the cap in a smooth motion (Figures 11, 12, 13). Continue without stopping to the next step.



Figure 11



Figure 12



Figure 13

NOTES



Figure 14



Figure 15



Figure 16



Figure 17

ATTACH THE CAP TO THE BODY HARNESS by holding and pulling both straps down to the body harness simultaneously (Figure 14). Cross the right strap to the left side and snap it to the body harness (Figure 15). Similarly, cross the left strap to the right side and snap it to the body harness (Figure 16).

Adjust the buckles to tighten the straps (Figure 17). **THE STRAPS MUST BE TIGHT: THE CAP MUST BE STRETCHED OVER THE HEAD AND UNDER CONSTANT TENSION. IF THE CAP IS NOT PULLED TIGHT, NUMEROUS ARTIFACTS WILL RESULT.**

NOTES

SOME IMPORTANT APPLICATION NOTES:

When the proper size cap is used on some children and very small adults, the straps will be too long to be tightened sufficiently. If this happens on a patient who requires a medium or large cap, replace the straps with those from a small or extra-small size cap. If a small cap is required, replace the straps with those from an extra small cap. (The small cap straps are 1-in. shorter than those from a medium and large cap; the straps from an extra small cap are 2-in. shorter.) Return the straps to the original cap when you are finished.

When placing the cap on semi-comatose patients, hostile patients, or those with thick bushy hair, make sure the straps are *extremely* tight, that is, as tight as possible. The cap must be under constant tension regardless of how much the patient moves. To prevent the straps from popping off the body harness snaps, safety pin the straps to the body harness.

It is advised that some people have sensitive necks. If the patient complains of discomfort, place a roll of 4-in. x 4-in. gauze squares or one or more rolled-up wash cloths between the cap and head/neck area.

If any of the electrode mounts do not fit snugly against the scalp, place a sponge disk around each of the loose electrode mounts.

USING ELECTRO-CAPS ON INFANTS

Because of the tenderness of infants' scalps, several alternative techniques for Electro-Cap application are suggested:

1. Alcohol prep pads or pumice skin prep pads (available from ECI-part #14) can be used to prep the scalp before applying the cap. Fill the electrode mounts as usual. No abrasion should then be necessary to lower impedances.
2. Should abrasion still be required, it is suggested that the wooden end of a cotton swab, rather than the blunted needle, be used.
3. The Infant Electro-Caps, by design, have no elastic around the outside edge of the cap.
4. If the Infa-Body Harness can not be used, the cap straps may be pinned to the infant's (cloth) diaper.
5. If the Infa-Cap III is slightly too large for the infant, it may be helpful to use Sponge Disks on several of the electrode mounts. (Ensure that the adhesive side of the sponge disk is toward the cap fabric.) Please only use this method if there is a *very* slight difference in the size of the infant's head circumference and the size of the cap. Infa-Caps smaller than the ones in stock are made on special order. Please contact Electro-Cap for further details.

BEFORE PROCEEDING TO THE NEXT STEP..

Determine that the cap is centered on the head, and that the patient is comfortable.

NOTES

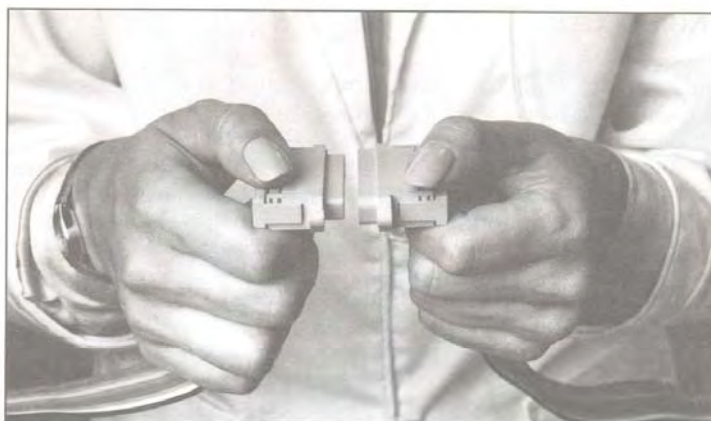


Figure 18

CONNECT THE BLUE CAP CONNECTOR TO THE BLUE ELECTRODE BOARD ADAPTER CONNECTOR (Figure 18).

FILL EACH ELECTRODE CAVITY WITH ECI ELECTRO-GEL™; REDUCE THE ELECTRODE IMPEDANCE. Press the white mount against the scalp with the first and middle fingers of the left hand. Hold the syringe with the right hand and insert the blunt needle into the hole. Lift the blunted needle off the scalp slightly. Inject Electro-Gel into the cavity until a small amount comes out the hole in the mount. Hold the syringe with only the first finger of the right hand on the syringe plunger (Figure 19). With a moderate amount of downward pressure, rock the syringe/needle rapidly back and forth (Figure 20). As each mount is filled, wipe off the excess Electro-Gel with a 4-in. x 4-in. gauze square.

The usual patient requires only 3-5 cc of gel to fill all the electrode mounts. Do *not* use an excessive amount of gel. Using too much gel is not only wasteful, it can cause electrode shunts. A flat or nearly flat channel will result.

Patients with very thick, bushy hair are the exception. Up to 10 cc of gel may be needed in these cases. The distance from the electrode disk to the scalp is much greater with thick, compacted hair; the space must be filled with gel.

Use only "ECI Electro-Gel™." Electro-Gel™ has been specially formulated for use with Electro-Cap. Other brands or types of gel will cause *high electrode impedance* and various types of *severe electrode artifacts*.

In some instances, abrasion with the blunt needle may not be desirable. This is sometimes true when testing toddlers, elderly persons, or combative patients. In these situations, it may be easier to reduce electrode impedances with the wooden end of a cotton swab. After filling each electrode mount with gel, place the wooden end of the cotton swab through the hole in the mount and twirl it between your fingers. If necessary, you may add a bit more gel to each mount.

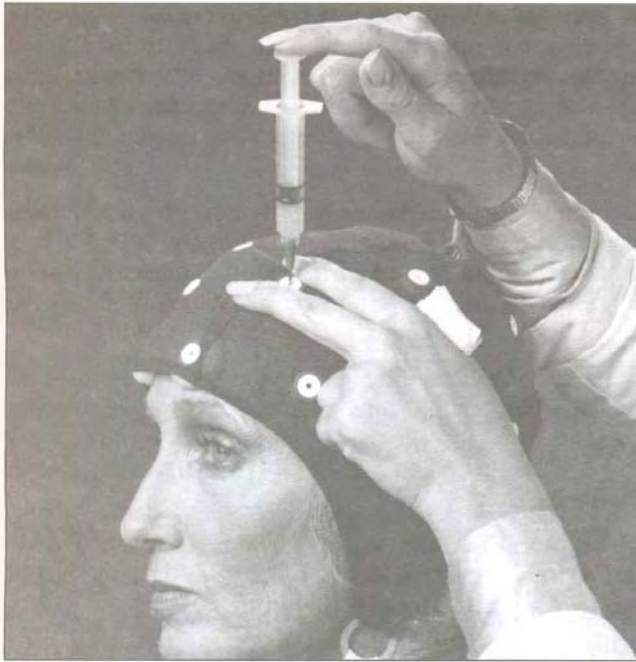


Figure 19

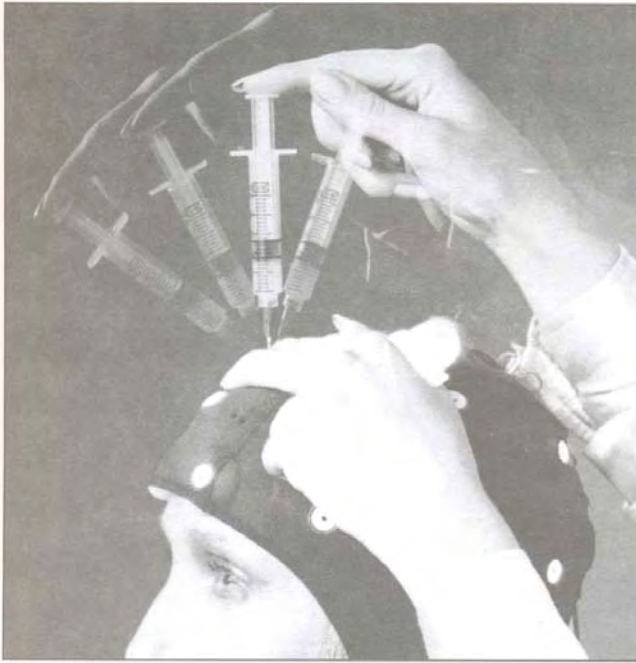


Figure 20

NOTES

NOTES

CHECK THE IMPEDANCE OF EACH ELECTRODE (Figure 21).

Checking electrode impedances with the ECI Electro-Cap™ is the same as checking the impedance on any other type of EEG electrode. If necessary, refer to the EEG instrument's instruction manual for instructions or call Electro-Cap International for guidance.

If any electrodes are found to be over 3K ohms, the skin must be reabraded. Inject a *very* small amount of Electro-Gel™ and rock the syringe rapidly back and forth again. Sufficient pressure must be placed on the syringe plunger to adequately abrade the skin.

If the impedance of a particular electrode still reads over 3K ohms after a second filling and abrading, the electrode wire may be broken. Insert a Quick Insert Electrode™ into the mount according to the instructions in Section 7, paragraph 2. Recheck the impedance.

1. If the impedance now measures below the 3K ohms limit, continue using the Quick Insert Electrode™ in that mount until the electrode wire is repaired.
2. If the electrode still measures more than 3K ohms with the Quick Insert Electrode™ in place, call Electro-Cap International for advice.

Do not start the EEG recording until all electrode impedances are below 3K ohms.

When all electrode impedances measure 3K ohms or below, **THE PATIENT IS READY FOR RECORDING** (Figure 22).

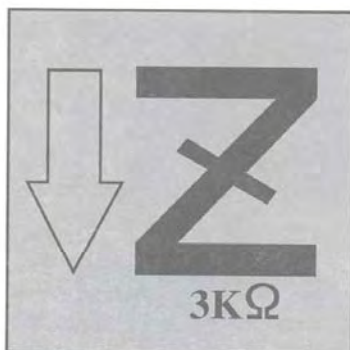


Figure 21

MOVE THE PATIENT TO THE BED OR RECLINING CHAIR.

NOTES

PLACE A TOWEL ROLL BEHIND THE PATIENT'S NECK to prevent the electrode mounts from rubbing on the bed or chair. To make a towel roll, hold two towels together so that they fall lengthwise toward the floor. Fold once vertically and roll loosely into a roll. Place the towel roll underneath the patient's neck. Ask the patient if he or she is comfortable. If not, make the roll larger or smaller by loosening or tightening the towels until the roll is a comfortable size.



Figure 22

NOTES

5. SUMMARY OF THE ELECTRO-CAP APPLICATION STEPS

1. PUT THE BODY HARNESS ON THE PATIENT (Pg. 9)
2. MEASURE THE CIRCUMFERENCE OF THE HEAD (Pg.10)
3. ATTACH THE EAR ELECTRODES: ADD GEL AND ABRASE THE SKIN (Pg. 11)
4. PLACE DISPOSABLE SPONGE DISKS AROUND Fp1 AND Fp2 (Pg. 12)
5. MEASURE AND MARK THE Fp LINE (Pg. 13)
6. SLIP THE PROPER SIZE CAP ONTO THE PATIENT'S HEAD (Pg. 14-15)
7. ATTACH THE CAP STRAPS TO THE BODY HARNESS (Pg. 16-17)
8. CONNECT THE BLUE CAP CONNECTOR TO THE ELECTRODE BOARD ADAPTER (Pg. 20)
9. FILL EACH ELECTRODE CAVITY WITH ELECTRO-GEL; ROCK THE BLUNTED NEEDLE/SYRINGE RAPIDLY BACK AND FORTH (Pg. 20-21)
10. CHECK THE ELECTRODE IMPEDANCE; LOWER IF NECESSARY (Pg. 22)
11. MOVE THE PATIENT TO THE BED OR RECLINING CHAIR FOR RECORDING (Pg. 23)
12. PLACE A TOWEL ROLL UNDER THE PATIENT'S HEAD BEFORE STARTING THE RECORDING (Pg. 23)

6. ELECTRO-CAP SYSTEM CHECK

A check of the Electro-Cap system should be made when the *first* volunteer or cooperative adult patient is prepared for recording. A system check need only be done on the first patient, or when troubleshooting a technical problem.

The system check consists of adjusting the EEG instrument and tapping each electrode mount to view how the electrode reacts on the EEG tracing. A series of rapid erratic deflections appearing on the EEG tracing in the proper channel demonstrates that the Electrode Board Adapter is installed properly.

Depending on the number of channels on the EEG instrument, choose one of the following montages. Select the montage on the EEG instrument.

8 Channel EEG

Fp1 -Al
Fp2 -Al
F3 -Al
F4 -Al
C3 -Al
C4 -Al
P3 -Al
P4 -Al

10 Channel EEG

Fp1 -Al
Fp2 -Al
F3 -Al
F4 -Al
C3 -Al
C4 -Al
P3 -Al
P4 -Al
O1 -Al
O2 -Al

16 Channel EEG

Fp1 -Al
Fp2 -Al
F3 -Al
F4 -Al
C3 -Al
C4 -Al
P3 -Al
P4 -Al
O1 -Al
O2 -Al
F7 -Al
F8 -Al
T3 -Al
T4 -Al
T5 -Al
T6 -Al

Position the patient and EEG instrument so that you can tap on the cap electrodes and simultaneously view the EEG tracing.

Turn on the EEG instrument. Tap each electrode mount in the order listed (Fp1 first, Fp2 second, F3 third, etc.). As the mount is tapped, check to see that an artifact appears in the correct channel. For example, tapping Fp1 should cause an artifact in channel 1, tapping Fp2 should cause an artifact in channel 2, tapping F3 should cause an artifact in channel 3, etc.

If an electrode mount is tapped and an artifact is not seen or is seen in the wrong channel...

6.1 Check to determine that the electrodes have been selected correctly on the EEG instrument. If not, correct it. Tap the electrode mount again. If the artifact appears in the proper channel, proceed to the next electrode in the sequence. If not, proceed to Step 6.2.

NOTES

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6.2 Check to see that the Electrode Board Adapter has been plugged in correctly. Refer to the chart in Chapter 3. If the Electrode Board Adapter is not plugged in correctly, change the connector pin [socket] and tap the electrode mount again. If an artifact appears in the proper channel, proceed to the next electrode in the sequence. If it is still incorrect, proceed to Step 6.3.

6.3 If the channel is selected correctly and the Electrode Board Adapter is plugged in properly, call Electro-Cap International for further instruction.

Select the next montage:

| 8 Channel EEG | 10 Channel EEG | 16 Channel EEG |
|----------------------|-----------------------|-----------------------|
| 01-Al | F7-Al | Fz-Al |
| 02-Al | F8-Al | Cz-Al |
| F7-Al | T3-Al | Pz-Al |
| F8-Al | T4-Al | Leave the remaining |
| T3-Al | T5-Al | channels as they |
| T4-Al | T6-Al | are; ignore these |
| T5-Al | Fz-Al | channels while |
| T6-Al | Cz-Al | you are checking |
| | Pz-Al | the remaining |
| | — | electrodes. |

Repeat the tapping procedure with the new electrodes. Check and correct as necessary.

If an 8 channel EEG instrument is being used, select the next montage:

8 Channel EEG

Fz-Al
Cz-Al
Pz-Al

Leave the remaining channels as they are; ignore these channels while you are checking the remaining electrodes.

Repeat the tapping procedure with the new electrodes. Check and correct as necessary.

7. ELECTRODE ARTIFACTS

GENERAL INFORMATION

If an electrode artifact occurs, gently reabrade the scalp, inject a small amount of Electro-Gel and blot the mount with a 4-in. x 4-in. gauze square. Most electrode artifacts will be eliminated by this simple technique.

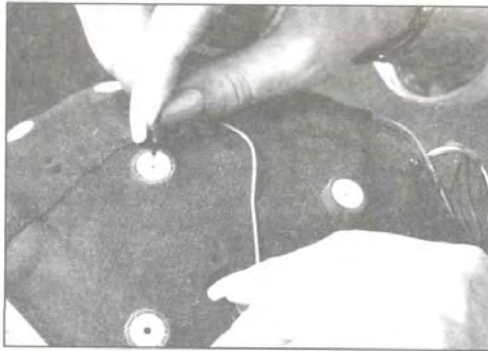


Figure 23

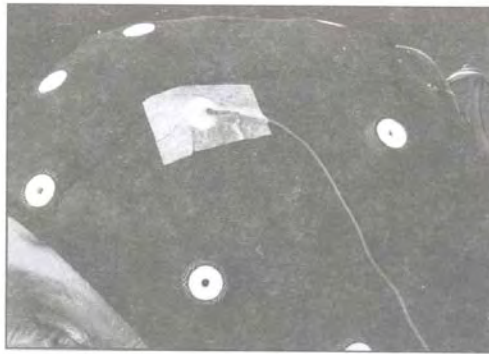


Figure 24

QUICK INSERT ELECTRODE™

If refilling does not eliminate the artifact, place a Quick Insert Electrode™ into the mount of the defective electrode (Figure 23). Put a small piece of Micropore® tape over the electrode assembly and mount so that the electrode cannot move and cause artifacts (Figure 24). Remove the proper Electrode Board Adapter connector pin [socket] from the EEG instrument's electrode board. Replace it with the Quick Insert Electrode™ connector. Make a note on the EEG tracing that a Quick Insert Electrode™ has been substituted for the artifactual electrode. Continue the EEG recording.

NOTES

NOTES

DUAL ELECTRODE RECORDING

Should "abnormal" appearing activity occur in only *one* electrode, the validity of the activity can be checked with a Quick Insert Electrode™. Place the Quick Insert Electrode™ into the mount of the questionable electrode. Put Micropore® tape over the electrode assembly. *Do not remove the Electrode Board Adapter connector pin [socket] from the electrode board.* Plug the Quick Insert Electrode™ connector into an available jack in the electrode board (for example, "X", "Y", "Pg1", #25, etc.). Select the jack chosen for the Quick Insert Electrode™ on the EEG instrument and refer it to A1 (or A2). Select the questionable electrode on an adjacent channel and also refer it to A1 (or A2). Record. The activity in the two channels should be identical; they are recording from the same electrode site.

If the activity in the two channels is identical, it can be assumed that the questionable activity is cerebral in origin. If the activity in the two channels is not identical, refer to the Trouble-Shooting Charts or call Electro-Cap International for assistance.

8. PATIENT CLEANUP

When the EEG recording is finished, remove the cap, ear electrodes and body harness. Wipe the patient's forehead and ears with a gauze square. Lightly wipe the gauze square over the hair.

Brushing or combing the hair will remove all visual evidence of the gel. The patient's next shampoo will easily and completely eliminate any residue.

9. CAP CLEANING AND PREVENTIVE MAINTENANCE

ECI Electro-Caps must be cleaned frequently for sanitary reasons. In addition, if all the gel is not washed from a cap, the material will lose its elasticity; the life of the cap will be dramatically shortened. **USE ONLY IVORY® OR PALMOLIVE® LIQUID DETERGENT FOR WASHING ECI ELECTRO-CAPS!** Other soaps and detergents, especially those common in hospitals, leave a residual film on the electrode metal. After a few washings the soap film builds up and coats the electrode. Excessively high electrode impedances and overwhelming electrode artifacts result.

The dye from the cap material may bleed during the first few washings. *Do not wash different colored caps together.* Before washing a cap, always unsnap and remove the cap straps.

The cap straps are washed separately because the strap material is thick; drying may require several hours. It is advisable, however, to wash the straps thoroughly with a brush and soapy water once a week.



Figure 25

NOTES

TO WASH CAPS (Figure 25)...

1. Unsnap and remove the straps; place to one side.
2. Fill sink with LUKEWARM tap water.
3. Add a small amount of Ivory® liquid detergent to the water.
4. Submerge *ONLY* the cap. **DO NOT** allow the blue connector to get wet. Let the cap sit in the water a few minutes.
5. Clean the gel from the electrode mounts with an "orange stick" or cotton swab. Another method is to alternate each mount, in turn, under rapidly running water. The water pressure will force most of the softened gel from the mounts.
6. Rinse the cap thoroughly.
7. Blot the cap gently in a terry cloth towel or hang it up to dry.

IMPORTANT

When drying the cap, **HANG IT SO THE CAP IS LOWER THAN THE BLUE CONNECTOR.** If the connector is lower than the cap, water will run down the multicolored cable into the blue connector. The water will quickly corrode the terminals; artifacts will result.

8. When the cap is dry, replace the straps.
9. Once a month, scrape the metal electrode disks thoroughly with an orange stick or the wooden end of a cotton swab. Oxide gradually builds up on the electrode disks and should be periodically scraped away.

In most geographic areas, an ECI Electro-Cap will air dry in about one hour. However, high humidity will extend the drying time. The straps will normally dry overnight if they are washed at the end of the work day.

If there is not enough time for the cap to air dry between patients, blot the cap with a terry cloth towel. The cap may feel damp to the touch, but will be sufficiently dry for immediate application.

A small hair dryer may also be used to quickly dry a cap. However, use only a "WARM" setting. The "HIGH" or "HOT" setting on some hair dryers is too hot and will weaken the elastic material; the cap life will be severely shortened.

ELECTRO-CAP AND COMMUNICABLE DISEASES

If an Electro-Cap is used on a patient known to have, or is suspected of having a communicable disease, it is recommended that the cap be disinfected with MetriCide®, a “cold sterilizing” solution. The following guidelines are suggested for disinfection:

1. Persons handling items likely to be contaminated with a communicable disease virus must protect themselves in accordance with their facility's policies.
2. Caps that are soiled with blood or other body fluids must be pre-cleaned using MetriZyme®. (Please refer to the MetriCide® product label, and see Note #8 below.) Otherwise, wash the cap in Ivory® liquid detergent as detailed in the Electro-Cap Instruction Manual on pages 29 and 30. Rinse well. The cap should be blotted well with a terry cloth towel to remove the excess water before proceeding to Step 3.
3. Soak for a minimum of 10 minutes in the activated MetriCide® in accordance with the product label. Do NOT allow the blue connector to get wet during the soaking process.
4. After the soaking process, rewash the cap in Ivory® liquid to remove the MetriCide® solution. Rinse until all the detergent is removed from the material. After the cap is dry it is ready to use on the next patient.
5. Dispose of contaminated liquids according to your facility's and local regulations for infectious waste disposal.

NOTES

1. Discard the used blunted needle according to your facility's infection control disposal procedures. (For your convenience, economic “bulk packs” of blunted needles [ESB-pkg. of 100] are available from Electro-Cap International.)
2. A cold gas sterilization process, properly used, may also be effective and will not damage or affect the Electro-Cap's testing performance.
3. Directions for sterilization with MetriCide® can be found on the product label.
4. **DO NOT STEAM AUTOCLAVE ELECTRO-CAPS;** the process will weaken the elastic material and significantly shorten the life of the caps.
5. Electro-Cap International assumes no responsibility for damage to its products caused by the use of products or processes not recommended in this policy.
6. MetriCide® is available from Electro-Cap International, Inc.
7. In all cases, **please refer to your facility's infection control procedures.** If questions arise, or more information is needed, please call Electro-Cap International for assistance.
8. For your convenience, MetriZyme®, an enzymatic detergent, is available from Electro-Cap International. Please contact Electro-Cap International for details.

TROUBLESHOOTING

| PROBLEM | CAUSES | CHECK | SOLUTION/REMEDY |
|--|--|---|---|
| I. HIGH IMPEDANCE ONE OR MORE ELECTRODES | 1. Insufficient scalp abrading, when filling the electrodes. | | 1. Press syringe harder during filling process. |
| | (or) | | |
| | 2. Cap washed in soap other than Ivory® | | 2. Rewash in Ivory® liquid detergent. Scrape disks with an orange stick or wooden end of cotton swab. Do not use any other soap or detergent except Ivory®. |
| | (or) | | |
| | 3. Using gel not manufactured by Electro-Cap International. | | 3. Use <i>only</i> "Electro-Gel". Other types of gel produce artifacts and high impedance electrodes. |
| | (or) | | |
| | 4. Grass Model 6 EEG | 4. Check to see if the cap connector is plugged into the top plug on electrode board. If so, disconnect. | 4. Install Electrode Board Adapter. |
| | (or) | | |
| | 5. Grass Model 8 EEG | 5. Check to see if the cap connector is plugged directly into impedance meter. If so, disconnect. | 5. Install Electrode Board Adapter into mini-electrode board. Plug cap into Electrode Board Adapter. Check impedance through mini-electrode board. |
| | 6. Nihon-Kohden EEG | 6. Check to see if ear electrodes have been applied. If not, apply gel and abrade the skin. If they have, refill and reabrade the skin with a blunted needle. | 6. Nihon-Kohden EEGs require low impedance ear electrodes to check impedance of scalp electrodes. |

NOTE: 1. Always check electrode impedances with the blunted needle out of the electrode mount.

2. Always recheck impedances if patient is moved; for example, if the patient goes to the restroom. Refill and reabrade any electrodes measuring more than 3K.

| PROBLEM | CAUSES | CHECK | SOLUTION/REMEDY |
|---|--|---|--|
| <p>II. INFINITE IMPEDANCE OF ONE ELECTRODE ON IMPEDANCE CHECK</p> <p>(or)</p> <p>ONE ELECTRODE IS "NOISY" DURING RECORDING.</p> | <p>1. Broken wire in cap or Electrode Board Adapter.</p> | <p>2. When time permits, check to see if a wire has been pulled out at the electrode mount.</p> <p>3. If wire is not visibly broken at the mount, check the continuity of the electrode disk to the connector tip with an impedance meter.</p> <p>Determine if the broken wire is in the cap or in the Electrode Board Adapter. Use another cap (with the same Electrode Board Adapter) on another patient. If it now records properly, the broken wire is in the cap. If the problem still exists, the defect is in the Electrode Board Adapter.</p> | <p>1. Short term: Use a Quick Insert Electrode™ until the cap or Electrode Board Adapter is repaired.</p> <p>2. If broken, repair electrode wire as described in section 11.</p> <p>3. Repair defective unit as described Section 11, or contact Electro-Cap International for repair information.</p> |

| PROBLEM | CAUSES | CHECK | SOLUTION/REMEDY |
|--|---|--|---|
| III. "FLAT" CHANNELS OR DECREASED AMPLITUDE ONE OR MORE CHANNELS. | 1. Gel has spread between electrodes on scalp. | | 1. Remove cap. Vigorously rub hair and scalp with terry cloth towel. Reapply cap. Use less gel when refilling mounts. |
| | (or) | | |
| | 2. Gel spread between electrodes on cap material. | | 2. Remove cap. Wash in soapy water and rinse. Towel dry. Reapply cap. |
| | (or) | | |
| | 3. Short between 01 and 02. | 3. Check to see if tab in back of cap is wet and touching 01 and 02 mounts. | 3. Carefully pull tab out of the cap. |
| | (or) | | |
| | 4. Wet cap* | | 4. Remove cap and blot dry with a terry cloth towel. |
| | (or) | | |
| | 5. Wet hair. | | 5. Remove cap and towel; blow dry hair. |

NOTE: *In some geographical locations with high humidity, it may be necessary to thoroughly dry a cap with a hair dryer or allow it to dry completely before reusing. In most geographical locations, the cap may be washed, blotted with a towel and applied to another patient. The slightly damp material will not affect the performance.

| PROBLEM | CAUSES | CHECK | SOLUTION/REMEDY |
|---------------------------------------|--|--|---|
| IV EXCESSIVE MOVEMENT ARTIFACT. | 1. Loose cap straps. | 1. Check tension of straps. Resistance should be felt when tugging straps. | 1. Tighten straps by adjusting buckles. If the cap is still not sufficiently tight, replace straps with those from the smaller cap. (The large and medium caps have the same length straps; the small and extra small cap straps are one and two inches shorter respectively.) |
| | (or) | | |
| | 2. Soap film on electrodes. | | 2. Rewash cap in Ivory® liquid detergent. Scrape disks with orange stick or wooden end of cotton swab. Use only Ivory® in future washings. |
| | (or) | | |
| | 3. High impedance on ground electrode. | 3. Check impedance of the ground electrode. | 3. Refill and reabrade the ground electrode. If the impedance is still high, put a Quick Insert Electrode™ into the mount. Place a piece of tape over the mount, and exchange the connectors in electrode boards. Repair the ground according to the Repair Section. |

NOTE: The older Grass impedance meters do not check the impedance of the ground electrode. To check the impedance of the ground electrode, move the ground electrode connector to a spare jack in the electrode board (for example, Pg1, Pg2, X or Y). If the impedance reads over 3K ohms, refill and reabrade as necessary. *Important:* Before starting to record the patient, move the ground electrode connector back to the ground electrode jack.

| PROBLEM | CAUSES | CHECK | SOLUTION/REMEDY |
|---|---|---|---|
| V. LOW FREQUENCY SWAYING OF EEG BASELINE TRACE. | <p>1. Using gel other than that manufactured by Electro-Cap International.</p> <p>(or)</p> <p>2. Dissimilar electrode metals.</p> | <p>2. Check to see that all electrodes (e.g., ear, EKG, etc.) are made of pure tin.</p> | <p>1. Use only ECI Electro-Gel.</p> <p>2. Electrodes with the Electro-Cap System are made of pure tin. <i>Only use pure tin electrodes for monitoring purposes.</i> Various monitoring electrodes are available from Electro-Cap International.</p> |

PROBLEM

VI CAP
SLIPPING
BACK ON
HEAD.

CAUSES

1. In a small percentage of patients, the cap may slip back on the head. This causes electrodes to displace posteriorly. Displacement is more apt to occur when using a reclining chair instead of a bed.
(or)

2. Wrong size cap.

(or)

3. Thick bushy hair.

CHECK

1. Check to see if the front hem is just above the eyebrows. If not, pull down and recheck impedance. Refill and reabrade any electrode as necessary.

2. Recheck head measurement to see if right size is being used.

SOLUTION/REMEDY

1. Place a piece of tape on cap between the Fp1 and Fp2 electrodes and over the bridge of the nose

2. Replace with proper size cap.

3. Use the large size cap. If necessary, use straps from a small cap. Position properly. Pin cap straps to the body harness with a safety pin to prevent the straps from snapping off the body harness.

11. REPAIRS

11.1 GENERAL INFORMATION

Electro-Cap International's limited warranty provides for repair or replacement of any item that, due to defects in material or workmanship, fails to function properly within ninety (90) days from receipt. Following the warranty period, there will be a minimal charge for repairs on broken wires in caps and Electrode Board Adapters.

The following items are considered repairable:

1. Electrode wires broken at the electrode mount or at the other points inside the cap.
2. Wires broken at the connector plug on the Electrode Board Adapter.
3. Internally broken wires at the blue connector on a cap or an Electrode Board Adapter.

Electro-Cap International, Inc., repairs broken wires in caps and Electrode Board Adapters. If needed, caps and Electrode Board Adapters are available for loan during the time required to make the repair. To arrange cap loaners and repairs call 1-800-527-2193. Broken wires on ECI Electro-Caps may also be repaired by the EEG technologist or the hospital's Bio-Medical Engineering Department. Special repair kits are available from Electro-Cap International.

ECI Electro-Caps are considered to be expendable items. Elasticity of the material dictates the life of the cap. When a cap becomes stretched and loses its elasticity, it must be discarded and replaced. The electrode placements will be inaccurate and artifacts will occur more often.

11.2 REPAIR INSTRUCTIONS

NOTES

11.2.1 BROKEN ELECTRODE WIRE

Items Needed:

1. ECI Electrode Mount Removal Tool to remove outer disk from mount.*
If not available, a small hex wrench may be used.
2. New electrode disk*
3. Soldering iron with 18 watt element and tip*
4. Paste flux (zinc chloride)*
5. 60/40 solder*
6. Wire strippers*
7. Scissors
8. Impedance meter or ohmmeter

*These items, along with some other necessary items, such as shrink tubing and mounts, are included in the Electro-Cap Repair Kit. Please call Electro-Cap for further details.

1. Remove the electrode mount assembly from the cap. From the outside, lift the plastic outer disk from the larger inner cap mount with the ECI Electrode Mount Removal Tool. After the mount is removed from the cap, turn the cap inside out.
2. Cut the white mount off of the wire at the edge of the shrink tubing. Cut shrink tubing from mount. Using soldering iron, remove wire from mount.
3. Push the electrode out of the white mount with the eraser on the end of a pencil. Inspect for cuts, nicks or deterioration. Replace if necessary. Make sure a piece of clear silicone tubing (1/16" long) is on the pin attached to the disk.
4. Strip the plastic jacket from the wire with wire strippers so that approximately 1 mm (1/16") of wire is bared. Examine the wire to see if it is shiny. If it is, proceed to Step 5. If not, cut another 1/4" off the wire. Restrip the end of the wire. Examine it to see if the wire is shiny. If it is, proceed to Step 5. If not, continue cutting and stripping until the wire is shiny. If it takes more than 1/2" to obtain a shiny wire, splice in a piece of hook-up wire. Insulate the solder joint with a short piece of shrink tubing. Shrink the tubing with a heat gun. Proceed to Step 5.
5. Dip the shiny bared wire into liquid flux.

NOTES

6. Tin the wire tip. (To tin a wire, apply a small amount of 60/40 solder to the hot soldering iron tip. Hold the tip to the exposed wire for approximately two to four seconds, or until the plastic jacket stops shrinking back.) Do not touch the soldering iron tip to the plastic jacket; the hot tip will burn the plastic.
7. Trim the tinned wire with a pair of scissors to 1mm in length.
8. On the wire place a piece of white silicone tubing 3/8" long, followed by a piece of white shrink tubing 1/16" x 1/2", followed by a piece of black shrink tubing 1/16" x 1/4".
9. Clean any old solder from the soldering iron tip with a damp sponge or wet paper towel. (Do not touch the extremely hot tip.)
10. Put the soldering iron tip in flux for one second. Solder the pre-tinned electrode wire to the center of the wire extending from the mount.
11. Center the black tubing over the solder joint. Barely touch the side of the hot soldering iron to the tubing, causing it to shrink. Do not over shrink.
12. Slide the white tubing up against the mount. Shrink the tubing, using the soldering iron.
13. Slide the silicone tubing up against the mount. Do not shrink the tubing.
14. Hold the inner mount on the cap material. Center the mount by visually lining the hole in the mount with the hole in the cap material. The electrode wire should be pointed toward the cable entry point. Snap the outer disk, FLARED EDGE DOWN, into the mount.
15. Connect the repaired cap to the Electrode Board Adapter. Check the continuity from the electrode disk (inside the mount) to the Electrode Board Adapter pin [socket] with an impedance meter or ohmmeter.

11.2.2 WIRE INTERNALLY BROKEN AT THE BLUE CONNECTOR

Items Needed:

1. Scissors
2. Small hammer
3. Paring knife or thin bladed scissors

Repair procedure:

1. Cut the ribbon cable with a pair of scissors approximately 1/4" from the blue connector. Square the end of cable with the scissors.
2. Slip a paring knife or one blade of a pair of thin bladed scissors under the edge of one end of the strain relief bar on the blue connector. Gently pull, working the bar off. Lay the strain relief bar to one side.
3. *Gently* spread one of the "wings" on the connector with your thumb nail. Simultaneously, pry up on the bar using the blade of the knife or pair of scissors. *Use extreme caution;* the wings break very easily. Release the "wing" immediately as the bar pops loose.
4. Pull the old cable off the prongs.
5. Insert the bar into the first notch in the "wings."

6a. *Electrode Board Connector*

Hold the blue connector so that the long row of pins is on top.

Insert the ribbon cable into the slot with the first brown wire of the ribbon cable on the extreme *right*. Push the cable through the slot so that no more than 1 mm of ribbon cable extends out the opposite side.

6b. *Electro-Cap Connector*

Hold the blue connector so that the long row of pins is on top. Insert the ribbon cable into the slot with the brown wire of the ribbon cable on the extreme *left*. Push the cable through the slot so that no more than one millimeter of the ribbon cable extends out the opposite side.

7. Hold the "wings" with your thumb and index finger. Tap the bar down with a small hammer or similar tool. The "wings" are very fragile; do not strike them. Even a glancing tap will break them off.
8. Fold the cable over the top of the connector. Snap the strain relief cover back into place.
9. Connect a cap and an unplugged Electrode Board Adapter together. Check the continuity of all electrodes by touching the leads from an impedance meter or ohmmeter to an electrode disk and its pin [socket]. Refer to page 7 for the chart on the electrode wire color codes.