# MACRODUCT
# SWEAT COLLECTION
# SYSTEM

Model 3700 SYS

# Applications Manual

57-2008-01L
(Last updated 06 January 2020)

REF

Manufactured in the United States of America by:
**ELITechGroup Inc.**
370 West 1700 South
Logan, Utah 84321-8212 USA

CE
2797

The Notified Body number 2797 above signifies that British Standards Institute BSi has certified the Production Quality Assurance System of ELITechGroup Inc., according to Annex V of the Medical Device Directive 93/42/EEC (MDD). The scope of that certificate, CE 59518, is

**The manufacture of sweat analysis systems for cystic fibrosis; and sweat inducers (to obtain samples for use in the subsequent laboratory diagnosis of cystic fibrosis)**

This covers the Class IIa devices Macroduct Model 3700 and Nanoduct (Model 1030) Together with the Declaration of Conformance issued by the manufacturer according to Annex VII, this allows the CE marking of these devices. There are no accessories to which the CE certificate or the BSi Notified Body Number 2797 applies.

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INTRODUCTION

## *1.1 Instrument Overview*

### Using this Manual

This manual provides instructions to install, operate, and maintain the Macroduct® Sweat Collection System. The manual is an important part of the product. Read it carefully and completely before setup and first use of the instrument.

If additional accident prevention and environmental protection requirements exist in the country of operation, this manual must be supplemented by appropriate instructions to ensure compliance.

The Pilogel Discs for Macroduct are designed to be used with this instrument, and should be used wherever they are legally available. In areas where they are not available, users should check with ELITechGroup for the availability of fiber pilocarpine reservoirs of the same size as Pilogel discs, for use with pilocarpine solutions supplied by the user. Unless otherwise indicated, any mention of Pilogel discs in this manual applies equally to the fiber pilocarpine discs.

**Safety Regulations (Webster Sweat Inducer)**

***Classification***

This equipment is classified as Type BF Medical Equipment, Internally Powered.

This instrument has been built and tested in accordance with safety regulations under EN 60601-1. In order to maintain this condition and ensure safe operation, the operator must observe all the instructions and warnings contained in this manual. For current information about applicable standards, please refer to the CE Declaration of Conformity included with the documents shipped with this device.

***NOTE:*** *This equipment complies with the following emission and immunity requirements: EN 60601-1-2 and EN 55022.*

**Specification of Safe Use:**
Using this device in a manner not specified by ELITechGroup Inc may impair the safety protection designed into the equipment and may lead to injury. Do not use where flammable anesthetic is present or in any oxygen-enriched environment.

**WARNING!**
**Do not use this equipment if it is not functioning properly.**

**Statement of Environmental Limits:**
This equipment is designed to be safely operated at 15° to 35 °C, maximum relative humidity 80%.

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## *1.1 Instrument Overview*

**Understanding Warnings**
This manual uses three warning levels to alert you to important information as shown in the following examples.

**WARNING!**
**A Warning alerts to the possibility of personal injury, death, or other serious adverse reactions stemming from the use or misuse of this device or its components.**

**CAUTION:**
**A Caution alerts to possible problems with the device associated with its use or misuse. Such problems include device malfunction, failure, damage, damage to the sample, or damage to other property. Where applicable, a Caution may include precautions to be taken to avoid the hazard.**

***NOTE:*** *A Note reinforces or supplies additional information about a topic.*

**Specific Warnings**
Pay particular attention to the following safety precautions. If these safety precautions are ignored, personal injury or damage to the instrument may occur. Each individual precaution is important.

**WARNING!**
**Due to the possibility of an explosion, never attempt iontophoresis on a patient receiving oxygen-enriched respiratory therapy in an enclosed space. With medical approval, remove the patient from that environment during iontophoresis.**

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## *1.1 Instrument Overview*

**WARNING!**
**Pilogel discs should be refrigerated at 2 to 10 °C. DO NOT FREEZE. Never use discs that have been frozen or that are cracked.**

**WARNING!**
**Never attach an electrode to the skin without Pilogel or a fiber pilocarpine reservoir. Direct skin-to-metal contact will burn the patient. Refer to Section 1.4 for additional information.**

**CAUTION:**
**This equipment has been designed and tested to CISPR 11 Class A and FCC Part 15 Class A. In a domestic environment it may cause radio interference, in which case, you may need to take measures to mitigate the interference.**

**CAUTION:**
**Only spare parts supplied or specified by Elitech Group should be used in this device. Using non-approved parts may affect the performance and safety features of the instrument. If the equipment is used in a manner not specified by Elitech Group, the protection provided by the equipment may be impaired. If in doubt, contact your Elitech Group representative.**

### Functional Description

The Macroduct Sweat Collection System is used to stimulate and collect human sweat specimens for laboratory confirmation of a physician's diagnosis of Cystic Fibrosis. This system should only be used by trained and qualified laboratorians in a clinical laboratory setting.

The system safely and efficiently accomplishes the stimulation of human sweat through pilocarpine iontophoresis using the Webster Sweat Stimulator. The Macroduct Sweat Collector collects a pristine and error free sample of the stimulated sweat that automatically indicates collected sample volume. The sample can then be analyzed for indications of Cystic Fibrosis with the Sweat-Chek™ Sweat Conductivity Analyzer using the principle of total electrolyte concentration in the sweat sample; or with the Chloro-Chek® Chloridometer using the principle of coulometric titration.

The Macroduct Sweat Collection system consists of the Webster Sweat Inducer, which is a microprocessor controlled Direct Current power supply, electrodes to connect a patient's arm to the inducer, and a kit of single-use supplies. The sweat inducer automates and controls the standard sweat test process used to detect cystic fibrosis. In that sweat test process, pilocarpine ions are 'pushed' into the sweat glands of the skin by a small electric current (1.5 milliamperes Direct Current) where they stimulate sweat in the same way as the chemicals released by the brain to control body heat through sweating on a hot day. After sweating has been stimulated in a particular area, the electrodes are removed and the skin is cleaned. A plastic Macroduct collector is strapped to the stimulated area so that the emerging sweat is directed into plastic tubing coiled on the surface of the collector. The pure sweat collected in this tubing may be analyzed by any method that is compatible with the sample volume.

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## *1.1 Instrument Overview*

### Key Features

- Air-free collector prevents condensate error
- Negligible (≤ 0.1 microliters per hour) sweat evaporation rate
- Sweat yield can be gauged by the operator
- Patient comfort and safety assured during sweat stimulation and collection
- Complete patient mobility during sweat collection
- Integrity of sweat specimen uncompromised by human error
- Profiled electrical current prevents patient discomfort during sweat stimulation
- To maximize patient safety, the inducer continuously monitors current
- Convenient and easy to attach electrodes
- Pilogel® discs provide for efficient sweat stimulation, operator convenience and above all patient safety

### Intended Use

The Macroduct System is intended for clinical laboratory use by qualified personnel for stimulation and collection of sweat from humans for analysis for the diagnosis of cystic fibrosis.

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INTRODUCTION

## *1.1 Instrument Overview*

***Table 1: General Specifications, Model 3700 Webster Sweat Inducer***

| **Category** | **Characteristics** |
|---|---|
| Power Supply | 2 x 9 V alkaline batteries, EDA/ANSI 1604A |
| Iontophoresis Current | 1.5 mA (automatic) |
| Iontophoresis Time | 5 minutes 30 seconds maximum (automatic), at operating current |
| Current Control | (a) Current profile-controlled, approximately 20 second rise time, 5 second fall time.<br>(b) Provides full current at resistance up to 20,000 ohms.<br>(c) Fail-safe limited by circuit design. |
| Fault Indication | Audible tone |
| Current Flow Indicator | Green LED, series-connected with the electrodes |
| Low Battery Indicator | Amber LED |
| Electrode Set | Jacketed stainless steel, premium-quality instrumentation lead wires, polarized locking connector |
| Dimensions<br>Width<br>Height<br>Depth | <br>9.3 cm (3.7 in.)<br>4.5 cm (1.77 in.)<br>15.5 cm (6.10 in.) |
| Weight | 454 grams (0.96 lb.) |

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INTRODUCTION

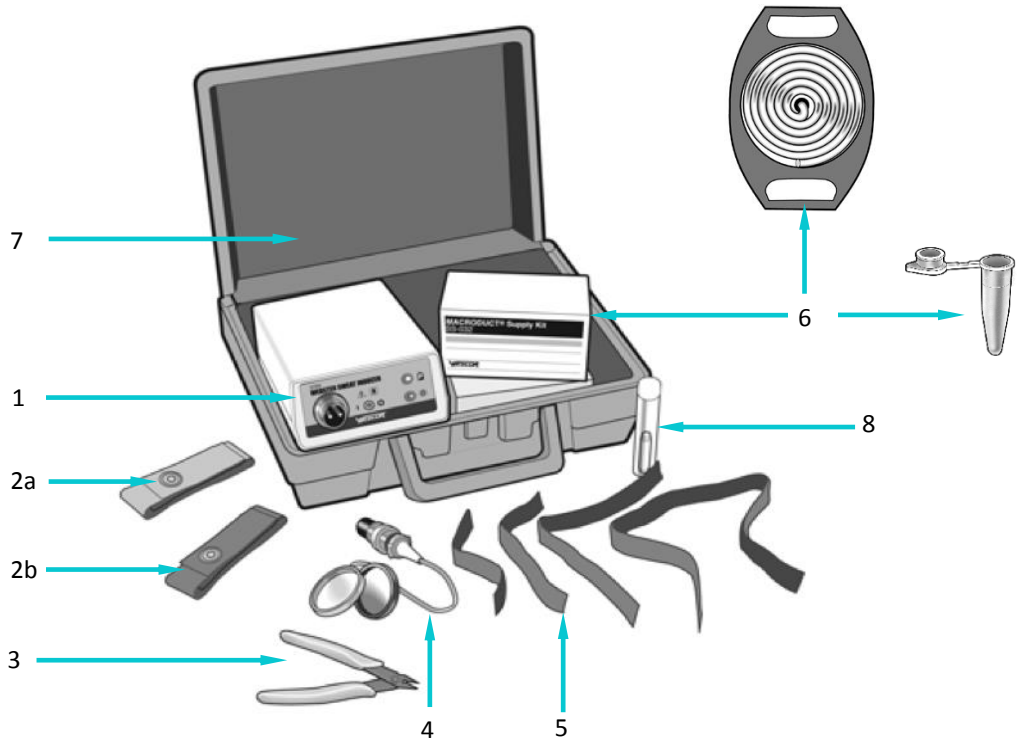
## *1.1 Instrument Overview*

### *Table 2: Explanation of Symbols*

| | |
|---|---|
|  | Classification of degree of protection against electric shock (BF) |
|   | Authorized Representative in the European Community |
|   | Batch Code |
|   | Catalog Number (Model Number) |
|  | Caution, Consult Accompanying Documents (Attention, see instructions for use) |
|  | General Warning, Risk of Danger |
| CE | CE Mark, product meets the essential requirements designated in Annex V of the Medical Device Directive 93/42/EC (MDD). |
|  | Consult Instructions For Use |
|  | Do Not Reuse |
|  | Harmful/Irritant |
|  | Use By |
| I | “On” (Power) |
| O | “Off” (Power) |
|  | Low Battery Symbol |
|  | Current Indicator |
|   | RoHS Directive 2011/65/EU |
|  | Manufacturer |
|  | Waste Electrical and Electronic Equipment |

## *1.2 Instrument Description*

***Figure 1: System Components***




1 – Webster Sweat Inducer
2a – Velcro Electrode Attachment Strap (Red)
2a – Velcro Electrode Attachment Strap (black)
3 – Nippers
4 – Electrode Set (1.2 m long)
5 – Macroduct Straps:
    Extra Large (diameter up to 13 cm)
    Large (diameter up to 9 cm)
    Medium (diameter up to 6 cm)
    Small (diameter up to 3 cm)
6 – Supply Kit for 6 Sweat Tests
    12 Pilogel Discs
    6 Macroduct Sweat Collectors
    6 small Sealable Containers
7 – Plastic Carrying Case
8 – Sweat Dispenser

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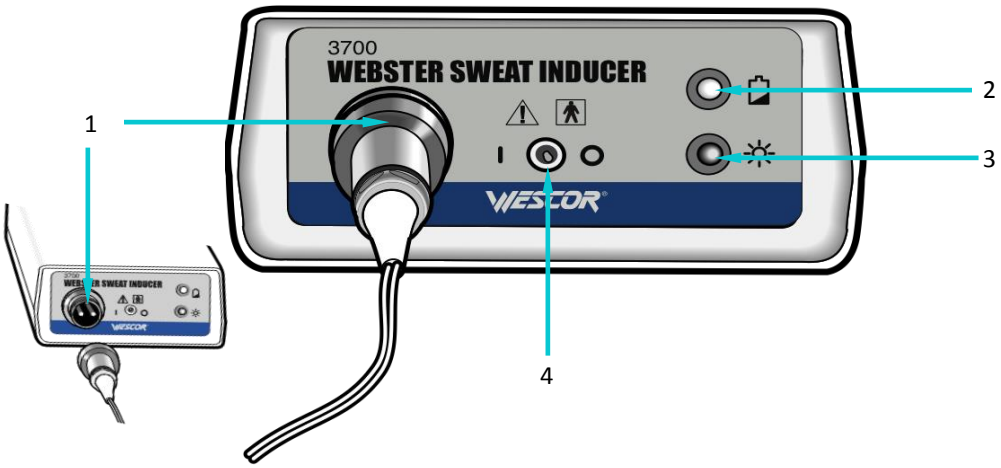
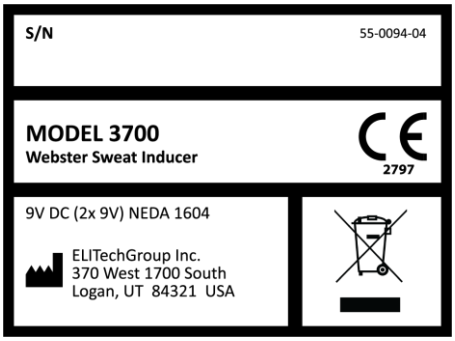
## *1.2 Instrument Description*

***Figure 2: Front Panel***




1 – Electrode Connector
2 – Low Battery Indicator
3 – Current Flow Indicator
4 – ON/OFF Switch

***Figure 3: Model/Serial Number Identification Label***



## *1.2 Instrument Description*

***Figure 4: Electrode Set***

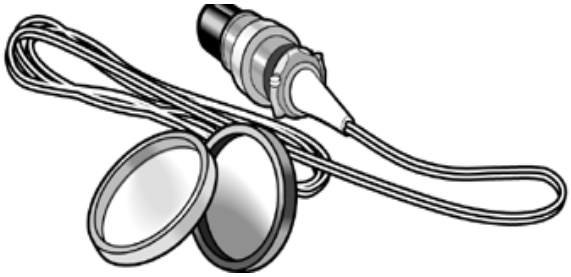


***Figure 5: Pilogel Iontophoretic Discs***


***Figure 6: Macroduct Sweat Collector***

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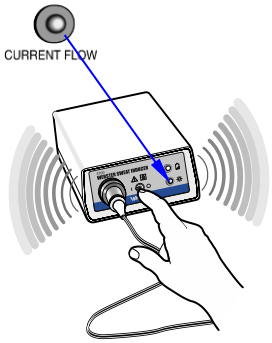
## *1.2 Instrument Description*

***Table 3: Front Panel Controls and Indicators***

| Button | Name | Description |
|---|---|---|
|  | Run/Stop Control Switch | I = RUN<br>O =STOP |
|  | Current Flow indicator | During a normal iontophoresis cycle, the current indicator increases in brightness until maximum current is reached, then diminishes in brightness at the end of the cycle. |
|  | Low battery Indicator | Indicator is lit when batteries are low. Indicator flashes when batteries are too low to complete a cycle. |

## *1.3 Webster Sweat Inducer*

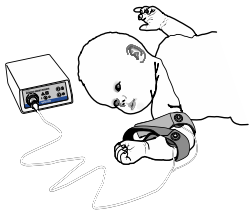
The Webster Sweat Inducer is an integral part of the Macroduct Sweat Collection System. Its design is based on years of clinical experience, research, and product development, with patient safety and comfort given paramount importance. It is a fully automatic unit featuring advanced electronic circuitry and many fail-safe and operator convenience features.




### How It Works

When the RUN/STOP switch is moved to the “I” position, a brief tone signals that external electrode circuit resistance is acceptable and that the instrument has begun to deliver iontophoretic current. A green CURRENT FLOW INDICATOR confirms current delivery. The tone sounds again briefly at the completion of iontophoresis.

Iontophoretic current rises to 1.5 mA during an approximately 20 second interval, remains at 1.5 mA for 5 minutes, then decreases in the final 5 seconds to zero, at which time the instrument switches off. This "profiling" of iontophoretic current prevents the sensation of electrical shock that results when current changes abruptly. The CURRENT FLOW indicator is wired in series with the electrodes.



During the complete iontophoretic sequence, the total electrical charge delivered to the positive electrode is approximately 450 millicoulombs or 78 millicoulombs/cm$^2$. Due to impurities in the agar, Pilogel discs contain sodium and other cations in total molar concentrations approximately equal to that of the pilocarpinium ion. These therefore compete with each other for transport of electrical charge which produces an approximately 50% reduction in the amount of pilocarpine that would have been delivered to the glands in the absence of such salts. However, sufficient drug is transported to produce maximal sweat stimulation.

### Fault Conditions

To maximize safety, the inducer continuously monitors the current. If an unexpected condition is detected the current turns off and an alarm sounds. This alarm continues until you move the switch to STOP (0).

A fault condition can occur if one of the electrodes becomes detached. An alarm may also be due to low batteries, (see next page). See Section 4 for more details about fault conditions and alarms.

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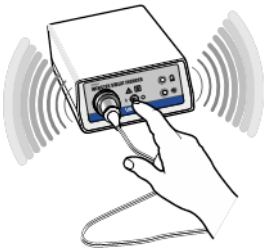
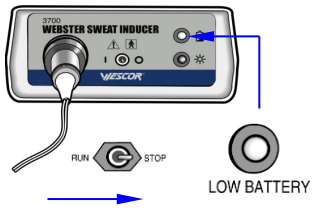
## *1.3 Webster Sweat Inducer*



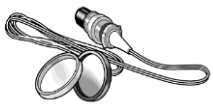



### Low Batteries

The alarm sounds if the batteries are low when the switch is moved to RUN (I). In this case, the amber LOW BATTERY indicator will also be illuminated, and the inducer will not start. The alarm continues until the control switch is moved to the STOP (0) position.

If batteries get low during iontophoresis, the instrument completes the cycle using remaining power in the batteries, but at the end of the cycle, the tone sounds and the LOW BATTERY indicator flashes. To disable the LOW BATTERY alert, push the switch to the STOP (0) position.

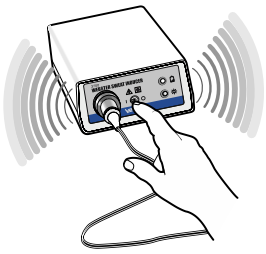
Replace batteries before attempting another iontophoresis cycle. See Section 4.4.



**Check for cracks in lead**

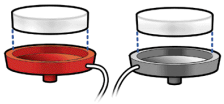
### Electrodes

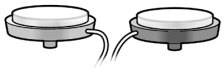
The high-grade stainless steel electrodes require only minimal maintenance. This consists of cleaning them with purified water after each use so they will be ready for the next procedure (See Section 4.2). Lead wires should be periodically inspected for breaks or cracks in the insulation. If electrode wires, insulation, or the plastic electrode-housing exhibit cracks or breaks the entire electrode set should be replaced.



***NOTE:*** *If you activate the run switch while the electrodes are not attached to the patient's limb, an "open circuit" alarm will sound. To disable the open circuit alarm, push the switch to the STOP position.*

## *1.4 Pilogel® Iontophoretic Discs*



The traditional reagent solutions for pilocarpine iontophoresis are pilocarpine nitrate and sodium nitrate. These have been applied either to absorbent fabric (such as gauze) or to discs of thick paper that are then interposed between the electrode surfaces and the skin. Such reagent reservoirs have always presented problems to both operators and patients.

Pilogel iontophoretic discs were developed specifically to overcome these and other problems. They consist of a solid agar gel that is 96% water, into which is dissolved 0.5% pilocarpine nitrate and a trace of antifungal compounds.

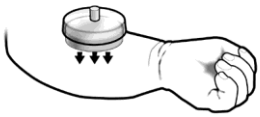
The discs are approximately 6 mm thick and sized to fit snugly into the standard recessed electrodes. Pilogel is supplied in a resealable vial containing 12 discs intended for one-time use (sufficient for 6 iontophoretic sweat stimulations). Discs are used in both positive and negative electrodes. Sweat stimulation occurs under the positive electrode, while the disc under the negative electrode completes the electrical circuit.

The Pilogel system provides monumental improvements in patient safety, efficiency of sweat stimulation, and convenience to the operator.

***NOTE:*** *In areas where Pilogel discs are not available, users should check with ELITechGroup for the availability of fiber pilocarpine reservoirs of the same size as Pilogel discs, for use with pilocarpine solutions supplied by the user.*

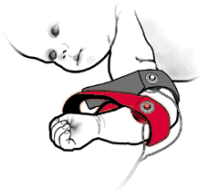
**WARNING!**
**Pilogel is considered harmful. Do not ingest. Consult the SDS sheet for more information.**

### Efficient Sweat Production



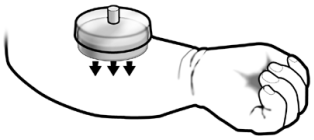
Reliable, uniform, gel-to-skin contact ensures delivery of pilocarpine over the whole skin area, thus providing total gland stimulation and maximal sweat yield.

Despite being mostly water and presenting a "wet" surface to the skin, Pilogel discs do not exude fluid even under the pressure applied during limb attachment. This eliminates any possibility of "bridging". Gel-fitted electrodes may be placed in close proximity without risking a short circuit, a great advantage when dealing with neonates.



Pilogel eliminates the need to apply gauze or paper pads. The discs are immediately ready for use. There is no need to prepare or store reagent solutions. With Pilogel, the electrodes, once fitted, require no further attention during iontophoresis. In areas where Pilogel is not available, fiber pilocarpine reservoirs must be saturated with pilocarpine nitrate solution according to accompanying instructions.

## *1.4 Pilogel® Iontophoretic Discs*



### Ensuring Patient Safety

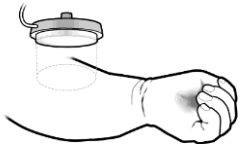
The Macroduct system represents a dramatic improvement in patient safety over previous sweat induction and collection methods.

Pilogel discs provide an air-free continuous conduction medium and even distribution of current over the stimulated skin area, reducing the possibility of electrical burns to the skin.

The Pilogel disc fits snugly into the recess of the electrode, preventing disc separation from the electrode. This virtually eliminates any possibility of a burn from direct metal-to-skin contact.

### Burns During Iontophoresis

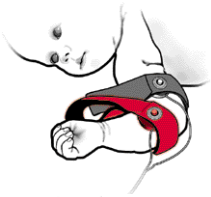
The Macroduct Sweat Collection System has become perhaps the most frequently used system in hospitals and clinics worldwide.



While the Macroduct system is clearly superior to previous methods, burns during iontophoresis have not been totally eliminated. Based on reports from practitioners, we estimate a frequency of 1 burn in 50,000 iontophoretic procedures.

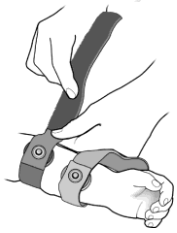
Burn descriptions vary from “tiny black pinholes in the skin” to “crater-like, third degree burns two to three millimeters in diameter.” In most of the reported cases the children have exhibited no sign of pain or discomfort during iontophoresis, and the burn was not discovered until the electrodes were removed.

Parents must be informed and allowed to read the “Information for Parents” included with the Macroduct supply kit (see also Section 2.4). You should also have them sign an appropriate release form before performing this procedure.



If the procedures outlined in the manual are followed correctly, burns should be extremely rare.

We strongly recommend the following burn prevention procedures:



- Do not use Pilogel discs that have an unusual appearance (fractures etc.). (Not applicable to fiber pilocarpine reservoirs.)
- Electrode strap pressure should promote firm contact between the skin and the gel disc. Straps should not be tight enough to crush the disc between skin and electrode. (Not applicable to fiber pilocarpine reservoirs.)
- Leave skin slightly wet after washing the area where the electrode will be attached

**(OR)**

- Add a drop of water to either the skin or the pilogel surface (after installation in the electrode).

## *1.4 Pilogel® Iontophoretic Discs*

**WARNING!**
**Although these recommendations are designed to prevent burns during iontophoresis, there is no guarantee they will not occur. Any institution providing sweat tests should thoroughly explain this possibility to parents and obtain a written waiver from them prior to iontophoresis. Besides limiting liability from an unfortunate incident, parents thus warned can make an informed decision about testing their child and are less likely to be upset if a burn occurs.**

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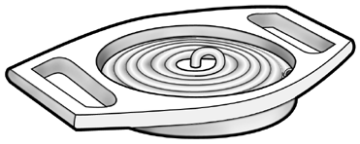
## *1.5 Macroduct Sweat Collector*



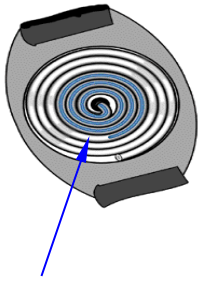
The Macroduct Sweat Collector is a **disposable** plastic device with a shallow concave undersurface that covers the skin area previously stimulated by pilocarpine iontophoresis. The collection surface is contoured such that when firmly applied to the stimulated area, the skin bulges into the concavity, leaving no air space. At the apex of the conical surface, a tiny orifice leads to a small-bore plastic tube or duct, having an inside diameter of approximately 0.64 mm, and coiled into a spiral.

The base of the sweat gland is 2 to 3 mm beneath the surface of the skin. Fluid secreted by the gland creates hydraulic pressure that moves the fluid upward through the sweat duct to emerge from the skin as sweat. When sweat surfaces beneath a Macroduct collector, this same hydraulic pressure forces it into the air-free interface between the skin and the concave surface of the collector. Since the pressure of the skin against the collector surface is greatest at the rim and decreases inwardly toward the center, the secreted sweat is directed to the orifice and into the plastic "macroduct."

After attachment, sweat becomes visible in the spiral tube of Macroduct within one to four minutes, depending upon the relative elasticity of the skin and the subject's sweating rate.

***NOTE:*** *Due to possible biological contamination, the Macroduct Sweat Collector is a single use device.*

***NOTE:*** *For best results, the stimulated skin area should cover deep flesh such as reasonably thick musculature. Thin skin sections overlaying palpable tendons or bony structures are not suitable as collection sites.*



**Blue Colored Sweat**

The emergent sweat is turned blue by contact with a small amount (≤ 10 nanomoles) of blue water-soluble dye (FDC certified food color) applied to the Macroduct collection surface. This allows easy assessment of the volume produced at any time during collection.

This dye does not interfere with sweat chloride assay by colorimetry. The dye contributes slightly to the osmolality and sodium content of the sweat sample. Even with a low sweat yield of only 20 mL, this contribution will not exceed 1.5 mmol/kg or 1.0 mmol/L, respectively, and is negligible.

The spiral collection tube capacity is approximately 85 microliters. This is adequate for average sweat production levels (50 to 60 microliters) in 30 minutes of collection. This volume is sufficient for all current methods of sweat analysis (see Notes Regarding Sweat Yield on the following page).

At the end of the collection period, the collector must remain on the limb until the pristine sweat specimen is removed by severing the plastic tube at its attachment point. See complete instructions in Section 2 before attempting this procedure.

## *1.5 Macroduct Sweat Collector*

### Advantages of Macroduct

- By preventing any exposure to an air space the collected sweat is not subject to condensate error.
- Evaporation of sweat can only occur at the advancing meniscus in the plastic collecting duct. This has been found by measurement to produce a negligible loss of 0.1 microliters per hour.
- The operator can gauge the amount of sweat produced at any time, a unique and unprecedented feature that eliminates guesswork in deciding the duration of the collection period.
- The patient has complete mobility during the collection period. (The collector can be over-wrapped with an elastic bandage to keep curious young fingers from causing mischief.)
- Macroduct collects sweat passively and automatically, driven by the same hydraulic pressure that causes sweat to move from the base of the sweat gland to the skin surface.
- There is no "harvesting" procedure during which the integrity of the sweat specimen is liable to be compromised by human error or other factors.

### Notes Regarding Sweat Yield

Technologists experienced with the Gibson and Cooke pad absorption method of sweat collection often raise the question of the "100 mg Rule," or some variation, which requires a minimum sweat volume for the analytical result to be valid. To the extent that such requirements were imposed to mitigate the error possibilities of the pad absorption method, they may be disregarded, since Macroduct collection is free of such errors.

On the other hand, some authorities have suggested that the minimum yield rules were promulgated because low sweating rates are associated with anomalous electrolyte concentrations, and therefore may give rise to a misleading diagnostic result. In order to establish an equivalent minimum yield threshold for Macroduct, one must take into account the differences in electrode size (area) and the recommended collection times for the two methods.

Applying these ratios shows that an average collection of 50 µL in 15 minutes using Macroduct is equivalent to a yield, in terms of sweating rate, of approximately 350 mg by the pad absorption method. Conversely, the sweat yield with Macroduct corresponding to the "100 mg Rule" is approximately 15 µL.

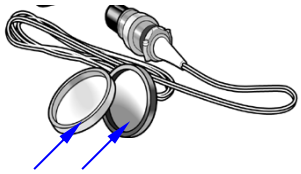
SECTION 2
SWEAT INDUCTION AND COLLECTION

## *2.1 Inducing Sweat*

**WARNING!**
**Due to the possibility of an explosion, never attempt iontophoresis on a patient receiving oxygen-enriched respiratory therapy in an enclosed space. With medical approval, remove the patient from that environment during iontophoresis.**

**1 ASSEMBLE EQUIPMENT AND SUPPLIES**

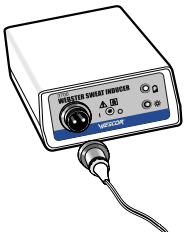
Make certain everything is on hand for the complete procedure. In addition to the complete Macroduct Sweat Collection System you will need a supply of pure water, alcohol, and cotton balls or gauze pads.



**Electrodes**

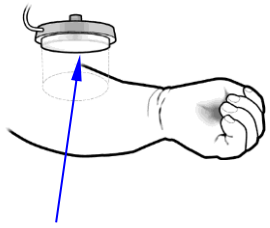
**2 INSPECT ELECTRODES AND CONNECT TO INDUCER**

Clean the electrodes if necessary (see Section 4.2). Check wires and insulation for cracks or fraying. Replace electrodes if wires, insulation, or plastic housing are cracked or frayed.

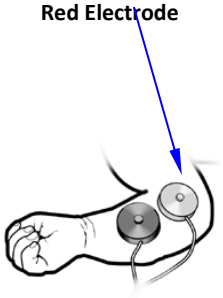


Press the electrode plug into the jack on the sweat inducer panel. You must engage the positive/negative alignment pins correctly to do so. Tighten the locking ring to secure the connection.

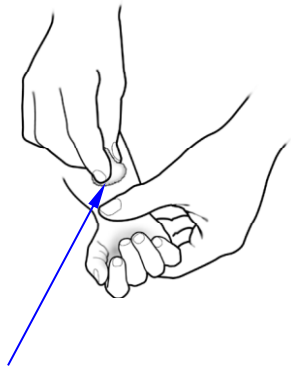
# *2.1 Inducing Sweat*



**Red Electrode**



**Tiny Infant Placement**



**Swab with alcohol and then purified water**

**3 CLEAN THE SELECTED SKIN AREAS**

The positive (RED) electrode must be placed correctly for successful sweat collection. Locate it on an area of skin with a high density of sweat glands for optimum sweat yield. The preferred site is the lower portion of the flexor aspect of the forearm. This generally has a very high density of sweat glands, provided the limb is not so small as to prevent proper attachment of the Macroduct collector.

***NOTE:*** *Do not place the electrode so close to the wrist that tendons or bone are palpable just beneath the skin. Reasonably thick musculature is necessary for a proper interface with the Macroduct collector.*

If the limb is tiny, place the red electrode on the upper portion of the flexor aspect of the forearm (nearer the elbow) or even the upper arm. If the entire arm is too small to attach the collector (such as a premature infant), use the inner thigh. In this case, constrain the infant from flexing the knee during collection to avoid a loss of interface between the skin and the collector.

Attach the negative (BLACK) electrode at any other convenient position on the arm, or to the leg (**on the same side of the body**).

The selected site must be free of breaks, fissures, or observable abnormality in the skin. There should be no sign of inflammation. Apart from exacerbating the complaint, there is the possibility of contamination of the sweat by serous exudates. The area must be as wrinkle-free and hairless as possible.

Clean the skin at the selected sites to remove dirt, fatty material, and loose dead cells, to minimize the electrical impedance of the skin. To do this:

A Swab the area vigorously with alcohol, then with plenty of purified water.

B Leave the skin wet where the Pilogel disc is to be attached

**(OR):**

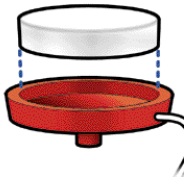
Place a drop of water on the skin or on the surface of the Pilogel disc just before attachment.

This will ensure uniform contact over the area and reduce the possibility of a burn.

***NOTE:*** *Be sure that you are familiar with the precautions found in Section 1.4.*

SECTION 2
SWEAT INDUCTION AND COLLECTION

## *2.1 Inducing Sweat*



**4 INSTALL PILOGEL DISCS ON BOTH ELECTRODES**

Pilogel discs have a diameter slightly larger than the inside diameter of the electrode skirt to provide a tight fit. Be sure to press firmly all around the outer perimeter of the disc to achieve uniform, air-free contact with the electrode. This may shave small slivers of gel from the outside of the disc as it is seated against the electrode. This is normal.

Do not be concerned if the Pilogel disc has a tendency to bulge away from the stainless steel electrode at the center. Attachment to the limb will flatten it against the electrode.

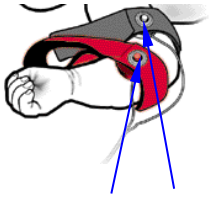
**WARNING!**
**Pilogel discs should be refrigerated at 2 to 10 °C. DO NOT FREEZE. Never use discs that have been frozen or that are cracked. (Not applicable to fiber pilocarpine reservoirs.)**

**WARNING!**
**Never attach an electrode to the skin without Pilogel. Direct skin-to-metal contact will burn the patient. Refer to Section 1.4 for additional information.**

**5 ATTACH THE ELECTRODES TO LIMB**

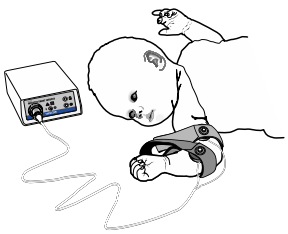
Place each strap so that the stud of the electrode protrudes through the rivet of the strap, with the “hook” portion of the short tab facing upward, away from the skin. Secure the electrode firmly so that the gel surface is pressed flat against the skin. There should be moderate pressure to minimize discomfort, but do not tighten enough to crush the gel disc.

**WARNING!**
**Watch for any signs of interference with blood circulation in the limb, such as cyanosis, swelling, or unusual pallor, and discontinue the test on that limb if any of those conditions should occur.**

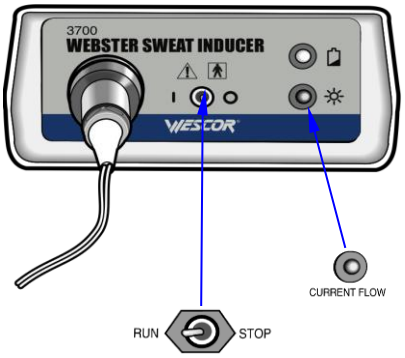


***NOTE:*** *Individuals vary in their sensitivity to iontophoretic current. Most subjects feel nothing more than a slight prickling sensation during iontophoresis. If a child complains or if an infant shows signs of distress, check to ensure that gel disc is pressed tightly against skin.*

**Electrode Studs**



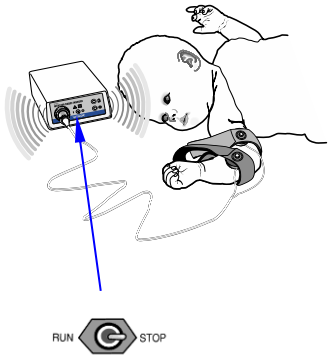
## *2.1 Inducing Sweat*




**6 ACTIVATE IONTOPHORESIS**

Push the control switch to the RUN (I) position and hold momentarily until you hear a short “beep.” A steady tone indicates excessive external circuit resistance, a break in the line, or weak batteries. If this occurs, move the control switch to STOP (0) and correct the fault condition before proceeding (Section 4).

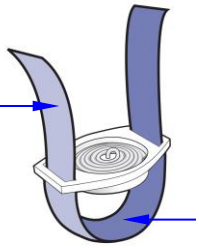
If everything is normal, the CURRENT FLOW indicator reaches full brightness in approximately 20 seconds, and diminishes in brightness during the last 5 seconds of iontophoresis as the current is reduced to zero.




If the circuit is broken even briefly during iontophoresis, current flow ceases and the alarm sounds. If this occurs, switch the inducer to STOP (0). Check leads and electrodes for fissures, breaks, etc. See Section 4 for complete information.

SECTION 2
SWEAT INDUCTION AND COLLECTION

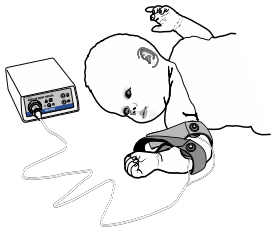
## *2.2 Collecting Sweat*




**Firmer textured, lighter blue "hook" side should face out. The soft textured "loop" surface should be inside the loop formed by the strap and the collector.**

**1 PREPARE MACRODUCT SWEAT COLLECTOR DURING IONTOPHORESIS**

Using gloves to prevent contamination of the collector, open one end of the plastic wrapper and slide the Macroduct sweat collector slightly out of the package. Thread a strap of suitable size through one slot so that the firmer textured "hook" side (lighter blue) of the strap faces away from the collection surface. The softer textured "loop" (darker blue) side of the strap should be on the inside of the loop formed by the strap. DO NOT TOUCH THE COLLECTION SURFACE.



**Remove the black electrode first**

**2 REMOVE ELECTRODES AT COMPLETION OF IONTOPHORESIS**

Iontophoresis proceeds automatically for approximately 5-1/2 minutes after RUN is activated. At completion, an audible tone sounds briefly and the instrument turns itself off.

Remove the negative (black) electrode first and then clean the exposed area of skin. Before removing the positive (red) electrode, mark around the stimulated area with an alcohol-based felt marker to ensure proper placement of the Macroduct sweat collector.

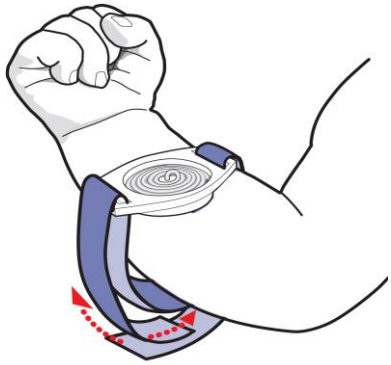
Remove the positive (red) electrode.

## *2.2 Collecting Sweat*

**3 CLEAN THE SKIN UNDER THE POSITIVE (RED) ELECTRODE**

Clean the stimulated skin and the surrounding area thoroughly with purified water to remove salt, then blot dry. There should be a distinct redness under the red electrode. Proceed to Step 4 immediately.

**4 ATTACH MACRODUCT SWEAT COLLECTOR FIRMLY TO LIMB**



**The softer textured "loop" side of the strap should be on the inside of the loop against the patient's skin and also form the outside overlapping layer on each end of the strap as it is attached. The ends of each side of the strap must overlap to engage the hook and loop mechanism.**

Thread the limb through the opening in the strap. Apply the concave surface of the Macroduct collector precisely over the area of skin contacted by the Pilogel disc. (The reddened area of skin will generally be larger than the sweat-stimulated area.)

While applying slight pressure to the collector, fold one end of the strap over and hold in place. While holding the collector in place, fold the other end back around so that it overlaps and attaches over the previously folded end. The overlap should be at least 3 to 4 cm. Verify that the collector is firmly attached.

Check for collector displacement during attachment, and adjust if necessary.

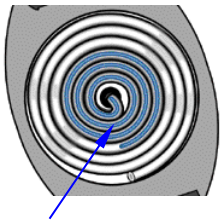
If the child attempts to disturb the collector, overwrap the device with an elastic bandage.

For neonate sweat collections, where the limbs are extremely small, overwrap the collector firmly with a 2 or 3 inch-wide elastic bandage. This ensures continuous and firm contact between the collector and the skin, and greatly improves the probability of successful collection.

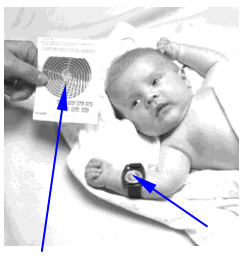
Macroduct allows visual assessment of sweat production at any time by referring to the spiral tube calibration diagram included in the Pilogel packaging.

When the blue colored sweat begins to appear in the collection tube at the center of the collector, start the sweat collection timing period. Collect the sweat for 30 minutes.

A 30-minute collection time usually yields 50-60 microliters of sweat, although variance among individuals is extremely wide.



**Blue Colored Sweat**

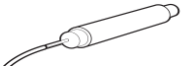


**Spiral Tube Calibration Diagram**

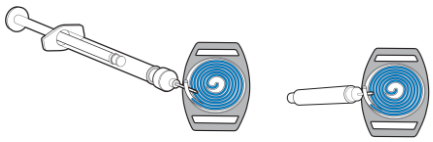
SECTION 2
SWEAT INDUCTION AND COLLECTION

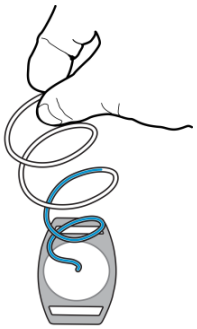
## *2.2 Collecting Sweat*

**Syringe (REF: SS-045)**



**Sweat Dispenser (REF: RP-065)**





***NOTE:*** *Inadequately tightened collector straps can be detected simply by pressing the collector very firmly against the skin. If the advancing meniscus of sweat in the spiral tube moves by more than 2-3 millimeters, attach the strap more firmly.*

**5 HARVEST AND STORE THE SWEAT SAMPLE**

**CAUTION!**
**The following procedure must be performed in its entirety while the Macroduct collector is still firmly strapped to the limb. Removing the complete device before detaching the tubing may create a vacuum that will draw the collected sweat from the tubing and seriously reduce sample volume.**

***NOTE:*** *There are two tools available for harvesting and storing a sweat sample the Sweat Dispenser (REF: RP-065, which is part of the Macroduct Sweat Collection System and is NOT used with the Sweat-Chek Analyzer),.or the syringe (REF: SS-045, which is included with the Sweat-Chek Analyzer). If using the Sweat Chek analyzer only the syringe can be used. Either the syringe or the sweat dispenser can be used to remove sweat sample for storage or analysis by any other method than the Sweat-Chek analyzer. Do not attempt to use the sweat dispenser with the Sweat-Chek analyzer.*

**WARNING!**
**If any sweat from the patient is drawn into the syringe or the dispenser, or if any sweat contaminates the needle of either tool, they must be discarded to prevent cross contamination of any following sample.**

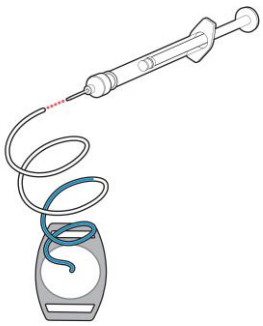
**FOLLOW THESE INSTRUCTIONS CLOSELY:**

a Remove the protective transparent cover by inserting a pointed tool into one of the cut-out sections and prying upward. (The nippers supplied with the Macroduct system will work well.)

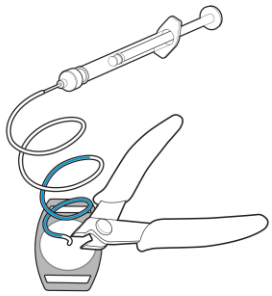
b For easier and safer insertion, lift the open outer end of the micro-bore tubing and pull one or two inches (3 to 5 centimeters) of the tube free from the adhesive base before attaching the tube to the blunt needle of the syringe or dispenser.

**CAUTION!**
**Although some illustrations, for the sake of clarity, show the Macroduct collector in isolation, these collection procedures must take place while the collector is firmly attached to the patient's limb.**

## *2.2 Collecting Sweat*



**Use a twisting motion while inserting the blunt needle into the end of the microbore tubing.**



**Grasp tubing where it is attached to the needle and pull tubing away from collector body to sever the tubing from the collector.**

**Harvesting Sweat Sample Using the Syringe**

- Position the syringe plunger at mid-point before inserting it into the tubing.
- Holding the open end of the tubing in one hand, carefully insert the blunt needle approximately 1/4 inch (5 mm) into the microbore tubing using a twisting motion.
- Be careful not to squeeze the syringe body or move the syringe plunger at any time while inserting the needle into the tubing or during the following procedure.
- Grasp the tubing where it is attached to the needle and pull the tubing away from the collector body until the tubing is completely uncoiled and extending outward from the point of attachment.
- Use the provided nippers to sever the tube as close as possible to the collector surface.
- Immediately after severing the tubing, use the plunger to carefully draw the column of sample sweat further into the tube (towards but not into the syringe) one or two inches (3 to 5 centimeters). This is to prevent any loss of sweat from the cut end due to expansion of air in the syringe body. It also allows you to squarely cut-off the tightly coiled end of the microbore tubing for easier handling.
- If using the Sweat-Chek™ Analyzer, attach the end of the tube to the Sweat-Chek intake for analysis. Refer to instructions in the Sweat-Chek instruction manual.

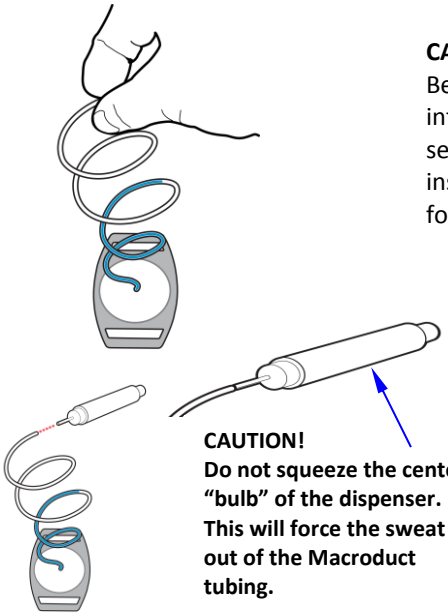
  OR

- Expel the sweat specimen into the small sealable container by placing the open end of the Macroduct tubing in a small sealable container such as the one provided with the Macroduct Supply Kit (REF: SS-032). Hold the tubing securely in the container while the sweat is expelled and immediately close the cover to protect the specimen.
- Sweat is expelled by slowly moving the syringe plunger down. The sweat should move smoothly down and out of the tubing.

SECTION 2
SWEAT INDUCTION AND COLLECTION

## *2.2 Collecting Sweat*

**Harvesting Sweat Sample Using the Sweat Dispenser**



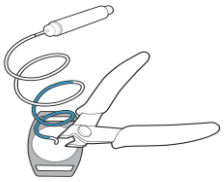
**CAUTION!**
**Do not squeeze the center "bulb" of the dispenser. This will force the sweat out of the Macroduct tubing.**

**CAUTION!**
Be careful not to squeeze the dispenser at any time while inserting the needle into the tubing or during the following procedure. The dispenser is particularly sensitive to possible squeezing while manipulating the tool during needle insertion. We recommend that the user grasp the dispenser over the black forward end rather than on the flexible middle section.

- Holding the open end of the tubing in one hand, carefully insert the blunt needle approximately 1/4 inch (5 mm) into the microbore tubing using a twisting motion

**Use a twisting motion while inserting the blunt needle into the end of the microbore tubing.**

- Grasp the tubing where it is attached to the needle and pull the tubing away from the collector body until the tubing is completely uncoiled and extending outward from the point of attachment. Use the provided nippers to sever the tube as close as possible to the collector surface.

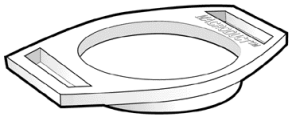


**Grasp tubing where it is attached to the needle and pull tubing away from collector body. Squarely sever the tubing where it is attached to the collectors.**

- Expel the sweat specimen into the small sealable container by placing the open end of the Macroduct tubing in a small sealable container such as the one provided with the Macroduct Supply Kit (REF: SS-032). Hold the tubing securely in the container while the sweat is expelled and immediately close the cover to protect the specimen.

- Lightly squeeze the center "bulb" are of the dispenser to expel the sweat sample down and out of the tubing.

## *2.2 Collecting Sweat*



**6 REMOVE AND DISCARD THE COLLECTOR BODY**

Detach the collector body from the patient's limb. Retain the strap, and discard the collector body.

**WARNING!**
**Due to possible biological contamination, Macroduct collectors are single use only and must be discarded after use.**

**7 CLEAN THE ELECTRODES**

Remove and discard the Pilogel discs. Clean the electrodes with purified water and wipe dry. See Section 4.2.

SECTION 2
SWEAT INDUCTION AND COLLECTION

## *2.3 Abbreviated Instructions*

**CAUTION!**
**These instructions are intended for reference only. Never attempt sweat induction and collection until you have read and thoroughly understand the complete procedures detailed in the instruction manual.**

1 ASSEMBLE EQUIPMENT AND SUPPLIES
2 INSPECT ELECTRODES AND CONNECT TO INDUCER
3 CLEAN THE SELECTED SKIN AREAS
4 INSTALL PILOGEL DISCS IN BOTH ELECTRODES
5 ATTACH THE ELECTRODES TO LIMB
6 ACTIVATE IONTOPHORESIS
7 PREPARE MACRODUCT SWEAT COLLECTOR DURING IONTOPHORESIS
8 REMOVE ELECTRODES AT COMPLETION OF IONTOPHORESIS
9 CLEAN THE SKIN UNDER THE POSITIVE (RED) ELECTRODE
10 ATTACH MACRODUCT SWEAT COLLECTOR FIRMLY TO STIMULATED SKIN SITE
11 HARVEST AND STORE SWEAT SAMPLE
12 REMOVE AND DISCARD THE COLLECTOR BODY
13 CLEAN THE ELECTRODES

## *2.4 Information for Parents*

**SWEAT TESTING POSES A REMOTE RISK OF MINOR SKIN BURNS**

There is an element of risk inherent in all medical procedures, no matter how simple. The sweat test has been an important laboratory tool since the 1950s. It provides a quantitative test result to confirm or exclude a clinical diagnosis of cystic fibrosis. Unfortunately, the test has been accompanied by occasional minor burns.

The sweat test consists of three sequential procedures: (1) sweat stimulation, (2) sweat collection, and (3) sweat analysis. The first procedure is known as pilocarpine iontophoresis. It is universally accepted by medical authorities as a safe and effective method of stimulating sweat glands. A sweat-inducing drug, pilocarpine, is delivered from the surface of the skin through the watery pathways of the sweat ducts into the sweat glands by a small electric current that is made to flow through the dermal layers. The electric current is supplied by a battery-powered device through a pair of electrodes fitted to the limb of the patient.

Minor skin burns have been an unwelcome, adverse side-effect of pilocarpine iontophoresis from the beginning. Some types of iontophoretic apparatus are prone to cause burns, particularly if there is procedural error. Fortunately, such burns are extremely rare with the Elitech iontophoretic system. It uses a sophisticated microprocessor current controller and a very low delivery current of only 1.5 milliamperes. Pilocarpine is contained in unique Pilogel gel drug reservoirs that are 96% water. These features substantially reduce, but do not totally eliminate, the possibility of skin burns.

Burn descriptions vary from “tiny black pinholes in the skin” to “crater-like, third-degree burns two to three millimeters in diameter.” In most of the incidents reported, the children have exhibited no sign of pain or discomfort during iontophoresis, and the burn was not discovered until the electrodes were removed.

Most individuals exhibit a sensitivity to pilocarpine that is typically manifested as mild erythema (redness) of the skin at the electrode locations. In some cases, one or more blister-like welts may also form. These are often mistaken as burns, but they are simply the reaction of the skin to pilocarpine. Such “blisters” invariably disappear within 2 to 3 hours, leaving no after-effects.

Based on current data and reported events, the apparent burn rate is less than 1 in 50,000. Elitech prescribes proper test procedures which minimize the risk of burns from its equipment. It is highly unlikely that your child will suffer a burn during the sweat stimulation phase of the sweat test.

We realize these statistics will be of scant comfort to the parents of a child who has the misfortune of suffering the “one burn in 50,000.”However, experience has shown that when burns do occur, the injuries are minor and there are no lasting effects. The burns usually heal completely within one to two weeks with little or no scarring.

SECTION 3
SWEAT ANALYSIS

## *3.1 An Overview to Sweat Analysis*

The procedures described up to this point in the manual provide the laboratorian with an undiluted sweat sample. By virtue of the specific safeguards against condensation and evaporation error, the sample is fully representative of the patient's secretion and is therefore a valid specimen for analysis.

### Sodium and/or Chloride Analysis

These are the traditional sweat test analytes. Sodium may be measured on Macroduct samples by adding an aliquot of the sweat sample (5 or 10 µL) to an appropriate volume of lithium sulphate diluent and directly aspirating this solution into a flame photometer that does not automatically predilute. Sodium assay in itself is not a reliable method in CF diagnosis, because there is some overlap between normal and abnormal groups. It is usually performed together with chloride, which has in the past been determined using micro-titration with mercuric nitrate, an old method that requires prohibitively large sample volumes for acceptable accuracy. In recent times coulometric titration requiring as little as 10 µL is often used. Ion-specific electrodes can be employed but these usually require sample dilution to a point where sensitivity is compromised. A simple colorimetric method is available that requires only 5 µL of undiluted sweat, and is not affected by the minute amount of dye that is present in Macroduct specimens.

### Osmolality

A modern approach to diagnostic sweat analysis that is more rapid, and more sensitive is the measurement of osmolality using the Vapro® Vapor Pressure Osmometer. This instrument can provide an osmolality value on a little as 5 µL of undiluted sweat within 1.5 minutes. Since osmolality indicates total solute concentration, which in sweat is made up almost completely of electrolytes, it provides a convenient single-measurement assessment of sweat electrolyte level. Extensive trials with hospital patients have shown that the normal range in children is approximately 50 to 150 mmol/kg and the CF patients show values in excess of 200 mmol/kg with an average of 270 mmol/kg.

### Electrical Conductivity

Elitech's Sweat-Chek™ Sweat Conductivity Analyzer was designed to measure conductivity of Macroduct collected samples. Field testing in clinics in the U.S. and in the United Kingdom, testify to its simplicity, economy, and accuracy in the diagnosis of cystic fibrosis. The results show clearly that conductivity, osmolality, and chloride have equal capacity to distinguish between normal and CF subject groups, and are therefore equivalent as diagnostic indicators.

A detailed account of the nature of sweat conductivity, the clinical trial results, and its status in the international clinical laboratory scene is presented in the Sweat-Chek User's Manual.

SECTION 4
MAINTENANCE AND TROUBLESHOOTING

## *4.1 Troubleshooting*

Aside from electrode cleaning, there is no regular periodic maintenance required in the Model 3700 Webster Sweat Inducer. If the system appears to malfunction, use the following information to identify and remedy the problem.

***Table 4: General Troubleshooting and Diagnosis***

| SYMPTOM | PROBABLE CAUSE/SOLUTION |
|---|---|
| Nothing happens when switch is pushed to RUN (I). | High circuit resistance (will be accompanied by an audible alarm). Completely dead batteries. Check and replace if necessary. |
| Low battery light comes on and alarm sounds when switch is pushed to RUN. | Low batteries. Replace batteries. See Section 4.4. |
| Alarm alternates from high to low pitch. | Open Circuit. Make sure the electrodes are clean and unmarked. If necessary, clean or replace electrodes. See Section 4.2.<br><br>Make sure electrodes are strapped securely to the patient's limb. If alarm continues, arrange a short circuit at the inducer connector by holding the two electrodes (with Pilogel disks installed) against each other. The Pilogel disks should be facing each other and touching. If the unit still does not operate, check electrodes and wires for open connections. If the inducer will not function with the connector shorted, call Elitech Service. |
| Alarm with steady tone. | High skin resistance. Since the inducer has a fixed limit for acceptable resistance, try using another area of skin that may offer lower resistance, or scrub the skin vigorously to remove as much dead epithelial cell material as possible. See Appendix D. |
| Alarm has multiple alternating pitches, much like a siren | Overcurrent indication. Do not use inducer until it has been checked. Return to Elitech for service if needed. |
| LOW BATTERY light flashes after iontophoresis and audio warning signal sounds. | Low batteries. Replace batteries. See Section 4.4. |

If the malfunction has been traced to a faulty electrode, replacement parts can be ordered from Elitech (APPENDIX B).

If the malfunction has been traced to the electronics or cannot be isolated following the above procedures, the inducer and electrodes should be returned to Elitech for inspection and repair.

**CAUTION**
**DO NOT OPEN the case and attempt repairs during the one-year warranty period except when authorized and instructed by Elitech service personnel. To do otherwise will void the inducer warranty. We strongly recommend that you return any malfunctioning unit to Elitech for service even after the warranty has expired. Repairs made by electronic technicians who are not completely familiar with the fail-safe features of this device may render such features inoperable. Since the instrument is small enough to be shipped by airmail or UPS, factory repair service will inevitably be the fastest and least expensive method of repair.**

## *4.2 Cleaning the Electrodes*

Electrodes must be cleaned following each iontophoresis procedure.

1 Remove any remaining Pilogel disc material from the electrodes.

2 Use a cotton ball or swab with purified water to thoroughly clean each electrode.

3 If the electrode appears dirty after an extended idle period or will not clean with steps 1 and 2, try using a small round piece of light duty cleaning pad (such as 3M Scotch Bright™ #7445) to buff the electrode surface.

**CAUTION!**
**Never use harsh abrasives such as steel wool, sandpaper or emery cloth to clean electrodes. Never scrape electrodes with metal tools.**

***NOTE:*** *When needed, the instrument case and electrode cable can be cleaned using a damp cloth soaked in a 10% household bleach or mild soap solution. Avoid excessive moisture to the instrument.*

## *4.3 Cleaning/Disinfecting the Macroduct Straps*

Use the following options to clean Macroduct straps, or any other parts that come into contact with a patient:

**Option A:**

1 Soak the straps for 30 minutes in a freshly prepared 10% dilution of household bleach.

2 Rinse soaked straps thoroughly in tap water.

3 Allow to air-dry (high heat may damage strap hook surfaces).

**Option B.**

1 Soak straps in 70% Isopropyl alcohol for 1 to 5 minutes.

2 Rinse straps thoroughly 2 to 3 times in water.

3 Allow to air-dry (high heat may damage strap hook surfaces).

**Option C: Treat Straps as disposables**

1 Discard straps after each use.

2 Purchase new straps from Elitech (See Appendix B for complete information).

Contact Elitech for current prices and ordering information.

SECTION 4
MAINTENANCE AND TROUBLESHOOTING

## *4.4 Replacing the Inducer Batteries*

The battery compartment for the Webster Sweat Inducer is on the bottom of the unit. To access and replace the batteries:

1 Slide the battery access panel out and away from the case.

2 Remove the foam spacer from the end of the batteries.

3 Carefully remove each battery from its connectors. Dispose of batteries properly, (see below).

***NOTE:*** *Always replace both batteries at the same time.*

4 Insert two new 9-volt batteries (type EDA/ANSI 1604A). Be sure the batteries are correctly aligned and seated in the connectors.

5 Replace the foam spacer at the end of the batteries.

6 Replace the battery compartment lid.

**BATTERY CARE AND DISPOSAL**

**WARNING!**
**Do not connect improperly, charge, or dispose of batteries in fire. Batteries can explode or leak. Do not carry batteries loose in your pocket or elsewhere as burn injury may result.**

**Dispose of spent batteries in accordance with applicable laws and ordinances.**

## *4.5 Disposal of the Instrument*

This device should be completely decontaminated and disposed of as follows:

Under Directive 2002/96/EC (WEEE), this equipment cannot be disposed of in a normal landfill. Instead, the equipment must be disposed of either by:

1 Routing to an authorized local facility approved for handling hazardous materials.

OR

2 Returning the equipment to Elitech.

## *4.6 Customer Service Information*

Elitech Group's Service Department will help you resolve any questions about the operation or performance of your Macroduct system.

Customers in the United States should contact us by telephone. Outside the U.S., our authorized dealers offer full local service and support.

**ELITechGroup Inc.**
370 West 1700 South
Logan, Utah 84321-8212 USA

**Telephone:**
800 453 2725 *(United States & Canada)*
(+1) 435 752 6011 *(International calls)*

**Fax:**
(+1) 435 752 4127

**Email:**
Service_EBS@elitechgroup.com *(Service)*
Sales_EBS@elitechgroup.com *(Sales)*

**Web Page:**
www.elitechgroup.com

**European Authorized Representative:**
MT Promedt Consulting GmbH
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Telephone: +49(0)68 94-58 10 20
Fax: +49(0)68 94-58 10 21
Email: info@mt-procons.com

# APPENDIX A
# *Pilogel Information*

⚠ The following information identifies the critical chemicals of each reagent used in this instrument.

**PILOGEL® DISCS (Contained in SS-032 Macroduct Supply Kit)**
**Proprietary Name:**
Pilogel® Discs

**Single Use Only: possible biological contamination; pilocarpine exhaustion.**
For areas in which Pilogel discs are not available, users should check with ELITechGroup for the availability of fiber pilocarpine reservoirs of the same size as Pilogel discs, for use with pilocarpine solutions supplied by the user. Unless otherwise indicated, any mention of Pilogel discs in this manual applies equally to the fiber pilocarpine discs.

**Indications:**
Pilogel/pilocarpine is used under iontophoresis to induce sweating for sweat analysis for the laboratory confirmation of a clinical diagnosis of cystic fibrosis.

**Contraindications:**
- It is important for the clinician to assess the area for suitability for treatment before application.
- Check condition of skin. Do not apply to broken or damaged skin surface.
- Dermal sensitivity.
- Known sensitivity or allergy to any ingredient.
- Not for consumption; do not eat.
- Single use only.

**Identification:**
A translucent off-white gel disc. (Fiber pilocarpine reservoirs are not translucent.)

**Side Effects and Special Precautions:**
The typical and well known side effects associated with pilocarpine use during iontophoresis onto the skin are adverse skin reactions. Based on current data and reported events, the incidence of such skin reactions is very rare (<1 in 50,000 tested patients). Most individuals exhibit a sensitivity to pilocarpine that is typically manifested as mild erythema (redness) of the skin at the electrode locations. In some cases, one or more blister-like welts may also form. Such "blisters" invariably disappear within 2 to 3 hours, leaving no after effects. But some patients may also experience skin burns in various degrees.

Burn descriptions vary from "tiny black pinholes in the skin" to "crater-like, third degree burns two to three millimeters in diameter." In most of the incidents reported, the children have exhibited no sign of pain or discomfort during iontophoresis, and the burn was not discovered until the electrodes were removed.

Elitech carefully records any side effects reported with its pilocarpine iontophoresis systems. According to an analysis of the complaints since 2005, the apparent burn rate is far less than 1 in 50,000.

**Storage Instructions:**
Refrigerate at 2 to 10 °C. Do not Freeze. Keep locked up and out of reach of children. (Not applicable to fiber pilocarpine reservoirs.)

APPENDIX A
## *Pilogel Information*

**Registration Numbers:**
SS-023 and SS-032

**Name and Business Address of Manufacturer:**
ELITechGroup Inc.
Biomedical Systems Division
370 West 1700 South
Logan, Utah 84321-8212
USA

### *Table 5: Critical Components of Pilogel*

| Product(s) | Critical Components |
|---|---|
| SS-023 and SS-032 Pilogel Iontorphorectic Discs contains: | Pilocarpine Nitrate = 0.5 % (USP grade)<br>Methyl Paraben (Methyl p-Hydroxybenzoate) [preservative] = 0.06%<br>Propyl Paraben (Propyl p-Hydroxybenzoate) [preservative] = 0.03% |

### *Table 6: Hazard and Precautionary Statements*

Reagent SS-023 Pilogel Iontophoretic Discs – are associated with the following Hazard and Precautionary statements. The associated signal word is: Warning.

| | |
|---|---|
| H302 | Harmful if swallowed |
| P102 | Keep out of reach of children |
| P264 | Wash hands, forearms and face thoroughly after handling |
| P270 | Do not eat, drink or smoke when using this product |
| P301+P312 | If swallowed: Call a POISON CENTER, a doctor if you feel unwell |
| P330 | Rinse mouth |
| P501 | Dispose of contents/container to an authorized waste collection point |

# APPENDIX B
## *Replacement Parts and Supplies*

**Only replacement parts supplied by Elitech Group should be used in this instrument. Use of non-approved parts may affect the performance and safety features of this product.**

| **REPLACEMENT PARTS** | **REFERENCE NUMBER** |
|---|---|
| Electrode Set (red, black) | RP-383 |
| Red Electrode Attachment Strap | RP-382 |
| Black Electrode Attachment Strap | RP-381 |
| Sweat Dispenser | RP-065 |
| Nippers | RP-066 |

**SUPPLIES**

| | |
|---|---|
| Supply Kit (enough for 6 sweat tests) | SS-032 |
| Containing: | |
| 12 ea. Pilogel Discs | |
| 6 ea. Macroduct Sweat Collectors | |
| 6 ea. Small Sealable Containers | |
| Macroduct Strap, Small (diameter up to 3 cm) | SS-255 |
| Macroduct Strap, Medium (diameter up to 6 cm) | SS-256 |
| Macroduct Strap, Large (diameter up to 9 cm) | SS-257 |
| Macroduct Strap, Extra Large (diameter up to 13 cm) | SS-258 |
| Macroduct Strap Set, 1 ea (Small, Medium, Large, Extra Large) | SS-259 |
| Macroduct Sweat Collector | SS-142 |
| Pilogel Discs (Set of 12) | SS-023 |

# APPENDIX C
## *A Perspective on the Sweat Test*

The "sweat test" provides laboratory confirmation of the clinical diagnosis of cystic fibrosis. It originated in the early 1950's following the discovery that children afflicted by the disease are prone to acute hyponatremia during hot weather. This occurs because of an abnormally high salt concentration in their eccrine sweat, ranging from three to five times higher than that of normal children.

The prospect of obtaining a sweat specimen for analysis of its salt (or electrolyte) content is conceptually simple, but practical obstacles to accomplishment of the diagnostic objective have made sweat testing one of the most controversial and criticized of all laboratory procedures. This stems mainly from the fact that the test has traditionally been associated with a large number of false results, most of which fall into the equivocal (borderline) or positive range. Complications connected to sweat testing resulted in some fatalities[1] (in the early days), and include numerous incidences of skin burns to patients and minor allergic reactions.

Vociferous debate has raged among clinicians and researchers as to the efficacy of various sweat testing methods, often with little apparent regard for the concerns of the beleaguered individual who must actually conduct the test. As a result, the sweat test generally ranks as one of the least popular laboratory procedures that a medical technologist must administer.

The sweat test is actually a composite of three separate, sequential procedures that must be accomplished without interventional error. In order, they are (1) Sweat Stimulation, (2) Sweat Collection, and (3) Sweat Analysis. The 1959 pad absorption method of Gibson and Cooke[2] introduced pilocarpine iontophoresis as a preferential method of sweat stimulation, replacing the dangerous practice of sweat stimulation by induced hyperpyrexia. The method is also known as the "Quantitative Pilocarpine Iontophoresis Test," or QPIT.

Because the pad absorption method has withstood the test of time, it is considered by many to be the reference method for sweat testing. Unfortunately, the method is long and tedious, requiring many steps where human error can intervene. Laboratorians in C.F. centers who specialize in this method of sweat testing develop the requisite skills to maintain consistently accurate results; but in outlying clinics and hospitals where the test is requested only on an occasional basis, the chances of obtaining a false result have proven to be unacceptably high.

The need for a simpler method spawned the development of alternative procedures during the late 60's and early 70's. Principally among these were the cup-collection systems which used electrical conductivity as the analytical procedure, and the direct-skin chloride electrode system. These methods were highly innovative, were procedurally simpler than the Gibson and Cooke method and were commercially successful. They nevertheless failed in their objective to eliminate false diagnostic results. Wide adoption of the new sweat testing methods exacerbated the problem, evoking a storm of criticism in the professional literature with calls for a return to the pad absorption "reference" method.[3,4]

# APPENDIX C
## *A Perspective on the Sweat Test*

In the United States, C.F. referral centers operating under accreditation of the Cystic Fibrosis Foundation were forbidden to use any sweat testing method other than the QPIT.

These early attempts to produce a simplified sweat testing system failed for two principal reasons: (1) error intrinsic to the method of collection and beyond the control of the operator, or (2) extreme susceptibility to variations in operator technique. Further progress was stymied until these factors had been fully investigated and identified through research findings published in the late 70's.[5,6]

In 1978, Wescor (now ELITechGroup) introduced the Model 3500 Webster Sweat Collection System.[7] Its unique, heated collection cup operated at a temperature slightly warmer than the skin. This prevented the condensate error that was intrinsic to all previous cup collection systems. It was the first "simplified" sweat collection method worthy of comparison to the Gibson and Cooke method, and it enjoyed considerable commercial success.

The Webster system was a significant breakthrough in the effort to develop a modern sweat collection system worthy of displacing the venerated method of Gibson and Cooke. Despite the fact that the heated cup solved the most significant problem connected to cup collection of sweat, it was nevertheless burdened by a problem common to all cup collection systems, i.e., the need to "harvest" sweat accumulated under the cup during the collection period. Wescor's commitment to resolve this problem eventually led to a significant breakthrough in the collection phase of the sweat test–the invention of the Macroduct® Sweat Collector.

Vested in Elitech's scientific and engineering staff is a combination of many years experience in laboratory sweat testing and in the development of modern electronic laboratory instrumentation. These professional talents were marshaled in support of the company's commitment to achieve objectives that it believed were essential to advancing laboratory sweat testing from the era of the 1950's to the present day:

- Eliminate all intrinsic sources of error concomitant to previous collection methods.
- Ensure impeccable accuracy in the diagnostic result by reducing human error potential to the lowest possible level.
- Maximize patient safety and comfort.
- Maximize operator convenience within the strictures imposed by objectives 1, 2, and 3.

# APPENDIX C
## *A Perspective on the Sweat Test*

During the development of the Macroduct system, Wescor's research team conducted a comprehensive and detailed review of every aspect of the sweat test, with the object of simplifying the procedure to the greatest degree possible. Laboratory research and experimentation led to a better understanding of the parameters governing stimulation by pilocarpine iontophoresis, and ultimately, to the development of a fully automatic electronic sweat inducer that requires no judgmental decisions or adjustments by the operator. A review of all currently available methods for sweat analysis was made in order to identify the procedure(s) most suitable for use with the unique new method of collection.

With the introduction of the Model 3600 Macroduct Sweat Collection System in 1983, all of the comprehensive objectives had been successfully accomplished. Paramount among the system's several unique and novel features was the innovative Macroduct disposable sweat collector.[8, 9, 10, 11]

The Macroduct sweat collector preserves absolute integrity in the collected sweat specimen and gives the unprecedented advantage of visual quantitation of the volume of sweat collected at any time during the collection period. Other unique features of the system include the unique Pilogel®[12] pilocarpine reagent reservoirs that provide maximum protection from burns, eliminate the problem of 'bridging," and are extremely simple and easy to use.

Macroduct sweat collection, combined with a modern, single-step, micro-analytical procedure, provides a diagnostic result having the highest confidence level in the history of laboratory sweat testing.

The Macroduct Sweat Collection System has been unequivocally approved by the U.S. Cystic Fibrosis Foundation for sweat stimulation and collection.

In keeping with Elitech's commitment of excellence, still further improvements have now been made in the Macroduct system. The new Model 3700 Webster Sweat Inducer has all of the fail-safe and convenience features of its predecessor, the Model 3600, but does not require a separate charging unit or access to AC power for recharging. It is powered by a pair of ordinary 9 volt alkaline batteries that have sufficient capacity for up to 400 separate iontophoretic procedures.

Additional descriptive details and information covering each of the Macroduct Sweat Collection System components are found throughout this manual.

1. Gibson, L.E., The sweat abnormality in cystic fibrosis, Textbook of Cystic Fibrosis, (J.D. LLoyd-Still, ed., John Wright, pub.) , PSG Inc., Littleton, Mass., 3-7, 1983.
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6. Webster, H.L. and Lochlin, H., Cystic fibrosis screening by sweat analysis. A critical review of techniques, Med. J. Aust., 1, 923, 1977.
7. Webster, H.L. and Barlow, W.K., New approach to cystic fibrosis diagnosis by use of an improved sweat-induction/ collection system and osmometry, Clin. Chem., 27, 385, 1981.
8. Webster, H.L., Laboratory diagnosis of cystic fibrosis, CRC Critical Reviews in Clinical Laboratory Sciences, CRC Press, Florida, 18, 313, 1983
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11. Sens, D.A., Simmons, M.A., and Spicer, S.S., The analysis of human sweat proteins by isoelectric focusing. I. Sweat Collection utilizing the macroduct system demonstrates the presence of previously unrecognized sex-related proteins, Pediatr. Res., 19, 8, 873-878, 1985.
12. Webster, H.L., Improved pilocarpine reservoir for use in sweat testing, Clin. Chem., 28, 2182, 1982.

# APPENDIX D
## *Procedure for High Skin Resistance*

Almost all of the electrical resistance in an iontophoretic circuit is provided by the two skin areas involved, and is due to the relatively dry dead cell layer of the epidermis, which varies in thickness according to location and also between individuals. When iontophoresis begins, the resistance is high, but rapidly reduces as the ducts begin to carry salt containing sweat to the skin surface. In the great majority of cases, the standard pre-cleaning procedure of a brisk rub with alcohol and water to remove excess skin oils, a vigorous wash to remove as much dead cell material as possible, and a final wetting of the involved areas just before applying Pilogel will lower resistance to satisfactory levels.

**Special Procedure for Exceptional Resistance**

Iontophoretic shut down by the 3700 Sweat Inducer due to very high resistance is quite rare. However, the physiological literature contains many references to high resistance in certain racial types where the skin is highly pigmented. In field sweat testing, such problems could arise where children of these racial types are involved. In such cases the unusually thick stratum corneum and dryness of the skin often confers electrical resistance sufficient to shut down the circuit. In the past, with simple battery and rheostat devices, the operator could increase the applied voltage to dangerously high levels in order to overcome this resistance and reach the desired current level, thus greatly increasing the possibility of a serious burn. This is not possible with the 3700 Sweat Inducer.

Laboratories that frequently experience these high skin resistance characteristics should purchase a new Model 3700 Sweat Inducer, which allows for higher skin resistance.

Alternatively, contact Elitech to have a newer loan instrument sent to perform the sweat test.

APPENDIX E

## *Electromagnetic Compatibility (EMC)*

Medical Electrical Equipment, in general, needs special precautions regarding EMC and needs to be used according to the EMC information provided in the accompanying documents. Portable and mobile RF communications equipment can affect Medical Electrical Equipment.

The Model 3700 Webster Sweat Inducer is not susceptible to some types of electrical interference, because it is battery-powered and doesn't connect to power lines that might conduct high frequency noise along with the power. However, it could be affected by radio emissions from other devices. Like all digital electronic equipment it also emits some radio frequency energy when it operates. Use of accessories or cables other than those supplied with the Sweat Inducer or supplied by the manufacturer as replacement parts could result in increased emissions or decreased immunity of the Sweat Inducer.

The tables below show the test results for both EMC emissions and immunity.

**Guidance and manufacturer's declaration – electromagnetic emissions**

The Macroduct system (specifically the Webster Sweat Inducer Model 3700) is intended for use in the electromagnetic environment specified below. The customer or the user of the Macroduct system should assure that it is used in such an environment.

| Emissions Test | Compliance | Electromagnetic Environment - guidance |
|---|---|---|
| RF Emissions<br>CISPR 11 | Group 1 | The Macroduct system uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment. |
| RF Emissions<br>CISPR 11 | Class A | The Macroduct system is suitable for use in all establishments other than domestic. It is battery-powered and does not connect to the public power supply network. |

The Macroduct system should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the Macroduct system should be observed to verify normal operation in the configuration in which it will be used.

**Guidance and manufacturer's declaration – electromagnetic immunity**

The Macroduct system is intended for use in the electromagnetic environment specified below. The customer or the user of the Macroduct system should assure that it is used in such an environment.

| IMMUNITY test | IEC 60601 test level | Compliance level | Electromagnetic environment - guidance |
|---|---|---|---|
| Electrostatic discharge (ESD)<br>IEC 61000-4-3 | +/- 6 kV contact<br>+/- 8 kV air | +/- 6 kV contact<br>+/- 8 kV air | The Macroduct system is isolated from ground. Any typical flooring may be used. |

APPENDIX E

## *Electromagnetic Compatibility (EMC)*

**Guidance and manufacturer's declaration – electromagnetic immunity**

The Macroduct system is intended for use in the electromagnetic environment specified below. The customer or the user of the Macroduct system should assure that it is used in such an environment.

| IMMUNITY test | IEC 60601 test level | Compliance level | Electromagnetic environment - guidance |
|---|---|---|---|
| Electrostatic discharge (ESD) IEC 61000-4-3 | @ 3V/m, 80MHz-2.0GHz, 3V/m 2.0-2.5 GHz 80% AM modulation | @ 3V/m, 80MHz-2.0GHz, 3V/m 2.0-2.5 GHz 80% AM modulation | Recommended minimum separation distance (m)<br>1.17 x sqrt(RF Watts) (80 – 800 MHz)<br>2.33 x sqrt(RF Watts) (800 MHz – 2.5 GHz)<br><br>Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[a], should be less than the compliance level in each frequency range. [b]<br><br>Interference may occur in the vicinity of equipment marked with  the following symbol: |

NOTE 1 At 80 MHz and 800 MHz, the higher frequency range applies.
NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

[a]Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the Macroduct system is used exceeds the applicable RF compliance level above, the Macroduct system should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the Macroduct system

[b]Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

**Recommended separation distances between portable and mobile RF communications equipment and the Macroduct system**

The [ME EQUIPMENT or ME SYSTEM] is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the [ME EQUIPMENT or ME SYSTEM] can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the [ME EQUIPMENT or ME SYSTEM] as recommended below, according to the maximum output power of the communications equipment.

| Rated maximum output power of transmitter (Watts) | Minimum separation distance (m) between portable and mobile RF communications equipment and the Macroduct system | | |
|---|---|---|---|
| | **150 kHz to 80 MHz**<br>d(m)=(3.5/3)x√Watts | **80 MHz to 800 MHz**<br>d(m)=(3.5/3)x√Watts | **800 MHz to 2.5 GHz**<br>d(m)=(7/3)x√Watts |
| .01 Watts Maximum | .1 m | .1 m | .2 m |
| .1 Watts Maximum | .4 m | .4 m | .7 m |
| .5 W Maximum<br>(typical mobile phone) | .8 m | .8 m | 1.6 m (mobile phone) |
| 1 Watts Maximum | 1.2 m | 1.2 m | 2.3 m |
| 10 Watts Maximum | 3.7 m | 3.7 m | 7.4 m |
| 100 Watts Maximum | 11.7 m | 11.7 m | 23.3 m |

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.
NOTE 1 At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.
NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.