

When is it Necessary to Use Two Patient Return Electrodes?

The Clinical Information HOTLINE is seeing a dramatic increase in the number of calls inquiring about the need for two patient return electrodes (PRE's). Some common questions are:

- **When should two PRE's be applied to the patient?**
- **Should two PRE's always be used for obese patients?**
- **Should two PRE's be used for patients weighing over 300 pounds?**

To effectively answer these questions, a complete understanding of Valleylab patient return electrode technology must be reviewed.

During monopolar electrosurgery the electrosurgical unit (ESU) produces the current that travels through the active electrode and into the target tissue to produce a therapeutic (cut and/or coagulation) tissue effect. The current then passes through the patient's body to the PRE where it is collected and carried back to the generator. The PRE is a critical element in the electrosurgical circuit and a potential source of patient injury.

Since the inception of electrosurgery, the PRE has taken many forms. Some examples are the metal plate, the cardboard plate, cardboard plate with conductive gel, flexible pre-gelled, dry conductive adhesive and hydrophilic conductive adhesive patient return electrodes. Although these developments enhanced patient safety, pad site burns continued to occur.

PRE-site burns are the result of current concentration and

excessive temperature. If the surface area contact between the patient and the PRE is reduced, or if the **impedance** of that contact is increased, a dangerous condition can develop. In the case of reduced contact area, the current flow is concentrated in a smaller area. As the current concentration increases, the temperature at the PRE site increases. If the temperature at the PRE site exceeds 112° F (44.4° C), a patient burn may result. Surface area impedance can be increased by excessive hair, adipose tissue, bony prominences, fluid invasion, adhesive failure, scar tissue, and other variables such as emaciation and obesity. To help eliminate the risk of current concentration, the PRE should present a large **low impedance** contact area to the patient. Placement should be on conductive tissue, preferably a large muscle mass that is close to the surgical site.

In 1981 Valleylab introduced the first return electrode contact quality monitoring (RECQM) system to dramatically reduce electrosurgical burns under the patient return electrode. This system is comprised of **two** key elements: the Valleylab REM™ split patient return electrode and the Valleylab REM™ equipped electrosurgical generator.

A key objective in return electrode design was to develop a product that minimizes the heat produced in and under the return electrode while maximizing current distribution. Less heat produced under the pad indicates better thermal performance, resulting in a safer procedure for the patient. The objective was met with the development of PolyHesive™ hydrogel. The



Jan Fickling RN, CNOR
Clinical Product Specialist

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Cherie Ryan Loeffler RN, BSN, CNOR
Clinical Product Specialist

excellent conductive properties and adhesive characteristics of this patented material enable it to lower skin resistance, reduce heat buildup, and conform evenly to skin surface irregularities.

The REQM equipped generator constantly passes and monitors an interrogation current from the generator through the pad-to-patient interface via the split plates of the REM™ PolyHesive™ PRE and then back to the generator. This circuit monitors the electrical impedance of the pad-to-patient interface. If the impedance level of the interface should deviate from a preset safety range built into the generator, the REM™ system disables the ESU and alerts the surgical staff with an audible and visual alarm. **Using a conventional, single-section PRE or capacitive PRE does not enable the REQM system.**

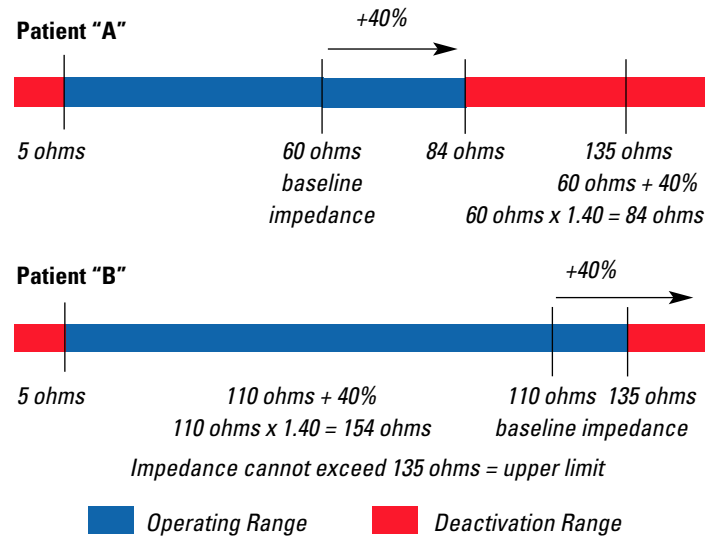
The first generation contact quality monitoring system, referred to as **non-adaptive REM™**, checked the quality of the pad-to-patient interface thousands of times per second through an integrated feedback circuit. Under non-adaptive monitoring, Valleylab generators have fixed impedance limits (generally between 5 and 135 ohms). When contact conditions fall outside these parameters, an audible and visual alarm is issued and the generator is deactivated (Fig. 1). Non-adaptive monitoring systems treat every skin type in a similar manner and do not account for differences in patient skin conditions.



Under Valleylab's hardware monitoring system, return electrode impedances were allowed to fluctuate between 5 and 135 ohms. Outside this range, the generator was deactivated.

(Fig.1)

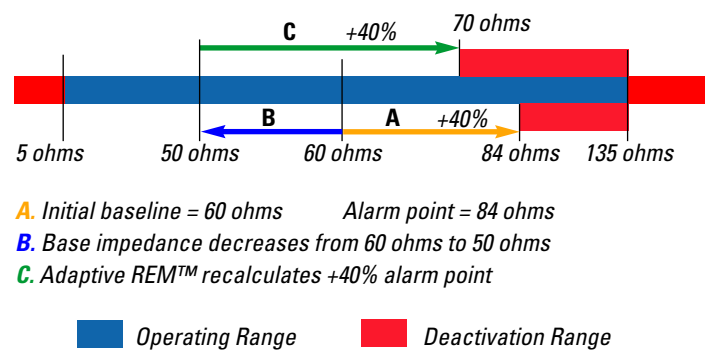
The Valleylab line of generators with Instant Response™ technology and certain other Force series generators incorporates a further advance in return electrode monitoring. **Adaptive REM™** combines the feedback circuitry of hardware monitoring with an advanced software-controlled adaptation feature. The adaptive system still maintains the 5-135 ohms limit; however, because every patient is different adaptive REM™ measures the initial contact impedance level of the patient's skin and will alarm when an increase in contact resistance is greater than 40% from the original measurement. (Fig. 2a).



As these figures illustrate, the adaptive REM™ system calculates a window of acceptable impedance based on the initial measured value. Impedance levels cannot exceed the baseline value +40%.

(Fig. 2a)

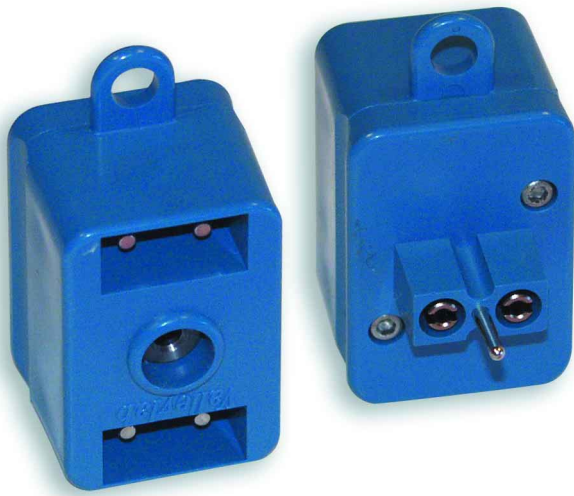
Adaptive REM™ is important because skin impedance changes throughout surgery. There are a number of factors that determine the impedance level of skin. These factors include surface temperature and contouring, vascular conditions, body mass (emaciation, obesity), pharmaceuticals being administered, the introduction of fluids, age of the patient, and surface elements like hair, oil or skin diseases. During a typical electrosurgical procedure, skin resistance can rise or fall depending on intraoperative conditions. For example, sweat can quickly lower the impedance of the pad-to-patient interface. Unlike other contact quality monitoring systems, adaptive REM™ has the ability to modify its operating range if the patient's skin impedance decreases during surgery. This means that when a patient's skin impedance decreases, that new value is used to recalculate the point at which a REM™ alarm would occur. (Fig. 2b)



Impedance cannot exceed 135 ohms = upper limit

(Fig. 2b)

A patient's weight is not the best indicator in determining the need for a second PRE. Valleylab adult REM™ PRE's do not have a labeled maximum weight because a person weighing 300 pounds could have adequate musculature and require only one PRE while another individual weighing 200 pounds may have poor musculature and reduced conductivity which may trigger a REM™ alarm. Generally, if a REM™ alarm should occur and can not be satisfied by using a new PRE at the original site, or by using a new PRE at a different site, two dispersive pads can be attached to the patient and connected to the ESU using a dual patient return electrode adapter (E0507-B). Detailed guidelines for satisfying a REM™ alarm can be found in the Valleylab REM™ generator user's guide or the instructions for use for Valleylab REM™ adult patient return electrodes. Using two electrodes will double the available surface area of the return electrode and reduce the contact impedance to a point that should satisfy the alarm condition.



E0507-B Multiple Return/S Cord Adapter

Valleylab does not recommend the use of two PRE's prophylactically on obese patient's or on patient's weighing 300 pounds or more.

If a second PRE is required to satisfy a REM™ alarm condition, potential sites for placement include but are not limited to the thigh, upper biceps, calf and lower back or flank. If it is necessary to apply both PRE's to the same extremity, such as the thigh, the PRE should ideally be applied on the anterior and posterior surface or to the lateral and medial surface to maximize the distance between the dispersive electrodes. In addition, placing the PRE on the bias prevents overlapping and reduces the chance of a tourniquet effect. The PRE should not be placed circumferentially on the extremity. Site selection for placement of the second PRE should always consider the basic guidelines for PRE application.

The need for a dual patient return electrode adapter can not be anticipated. In the best interest of the patient and staff it is recommended to have a dual PRE adapter readily available for unforeseen situations. Being prepared will prevent delays in surgery as well as unexpected and costly cancellations.

Valleylab's REM™ Contact Quality Monitoring System provides technological advancement in patient safety. It is recommended to consult the PRE manufacturer for specific user guidelines related to their product.

It is important to note that the information discussed herein applies to **conventional** electrosurgery **only** and not **ablative** procedures or those using high power settings for extended periods of time in a conductive fluid medium.

References:

- The Science of PolyHesive™ Patient Return Electrodes.* Valleylab. 2000.
- Valleylab Adaptive REM™ System.* Valleylab. 2001.