MACAN Manufacturing

Vet * Star

general purpose isolated output veterinary electrosurgical generator

OWNER'S MANUAL

Please read and comprehend the manual before using the generator clinically

For sale to or on the order of a licensed veterinary physician for veterinary use only

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Appendix

The key to understanding electrosurgery lies in thinking of it as a means of inducing histological change in soft tissue. Although electrosurgery uses high frequency electrical energy to induce histological changes rather than chemical reaction, electrosurgery may still be thought of as sharing certain characteristics with pharmacological therapy, a concept that simplifies explanation: histological effect depends on a dosage, in terms of quality and quantity.

- Dosage quality is established by the function selection (CUT, BLEND, COAG)
- Dosage quantity is established by the RF Power setting

In terms of therapeutic current dosage quality:

- Tissue is incised or excised as with scalpel via the CUT function.
- Tissue is coagulated for haemostasis as with cautery via the COAG function.
- Tissue is incised or excised with concurrent haemostasis via the BLEND function, so called because it blends cutting and coagulating functions together simultaneously.

In terms of therapeutic dosage quantity:

Since electrosurgery induces histological effects thermo-dynamically by the introduction of energy into tissue where it reacts with intra-cellular water, then it follows mathematically that the gross quantity of energy required to achieve an intervention is the integral of the energy required to treat a single cell taken over the entire surface of the electrode in contact with tissue. In other words, the proper dosage quantity (RF power knob setting) is a function of the size and shape of the electrode. Charts have been prepared for your guidance, not unlike PDR dosage data.

Also like pharmacological therapy, electrosurgery has potential side effects that must be considered for successful clinical application. Primary potential side effect is related to the capacity of physio-anatomy to safely withstand the electrical therapeutic currents introduced to it and is managed by approach (technique set up). Secondary potential side effect is related to the ability of tissue to absorb and dissipate heat and is managed by surgical technique (speed). The nature of the indicated surgical intervention and the physio-anatomy being treated suggest the preferred approach, that is, monopolar, bipolar, or “two-point” technique, since their respective therapeutic current distribution characteristics which represent limits in one circumstance represent advantages in another, therefore, conceptually are like selecting one medication over another for a given patient depending on the particular aspects of their case.

Finally, electrosurgery has another aspect analogous to pharmacological therapy: dosage requires some titration for optimal histological effect.

Healing by surgery combines aspects of art and science, however, medical science. It is felt that the approach to explaining the use of the Vet * Star taken here will assure successful integration into clinical practice in contrast to using a strong emphasis on electro-technical theory which has a far more nebulous relationship. On the other hand, this manual is limited to controlling the histological effects obtained with the Vet * Star, the preferred approaches according to clinical circumstances, avoiding pitfalls, but does not presume to teach medicine.

GENERATOR SET UP

Insert the medical grade IEC 320 style power cord and seat it firmly.

Plug in the foot pedal cord. Note that the widest key on the plug faces up and that the plug goes in easily. Any need to force indicates that the plug is not aligned correctly. Once the plug is in, rotate the locking ring clockwise about 1 turn to secure the plug.

Place the foot pedal where it will be convenient but as far out of the way of accidental activation as possible.

CAUTION! **Do not obstruct the cooling vents on the Vet * Star since it relies on convection for cooling. Serious damage to the unit is probable if the vents are obstructed.**

BASIC OPERATION

1 Switch on the unit.

Be sure to allow at least 20 seconds to elapse after first switching on the unit before attempting operation.

If Edison power to the OR suite is lost, the unit will not operate until after 15 to 20 seconds have elapsed when power is restored to the suite. This feature is intended to prevent accidental operation at an abnormally high setting.

2 Dispersive pad:

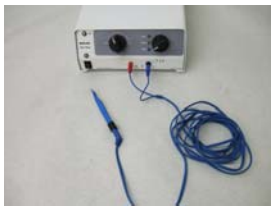
Place the dispersive pad *unless you are <u>absolutely</u> sure you will not need it,* since placing the pad after sterile draping is extremely difficult and disruptive. See page 20 for information on placing the dispersive pad. **Be sure to attach the red cable at the dispersive pad.**

3 Choose the technique set up clinically appropriate to the intended surgical procedure:

Monopolar. This is the most commonly used technique set up, but has some significant limitations.

See page 4

Requires the dispersive pad to function.



Bipolar. This is the method of choice for vessel or tubal electro-ligation, and is effective in wet or bloody fields on all soft tissue.

See page 5

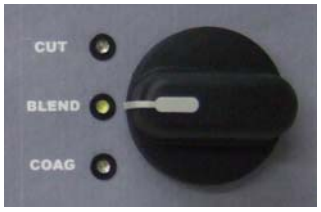
Does not rely on the dispersive pad for operation.

"Two-point". This excision method is appropriate for treating pedicularly attached organs or structures, amputation, and in abdominal and thoracic surgery for added safety since dispersive current is constrained.

See page 4

Does not rely on the dispersive pad for operation.

4 Select the histological effect appropriate to the intended surgical procedure:



CUT incises and excises like scalpel

BLEND incises and excises with concurrent haemostasis

COAG induces haemostasis via coagulation like cautery

5 Set the initial energy (therapeutic current) dose :

The correct setting depends on the electrode size and shape.

See pages 9 and 11.

See pages 12 and 13 for titration.

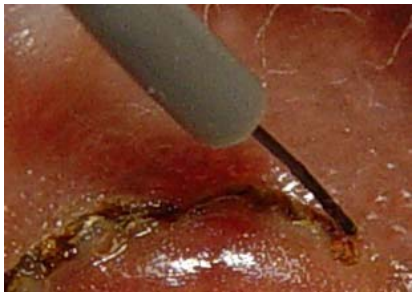
The setting shown is only an example!

6 Activate the unit by stepping on the foot pedal.

The yellow indicator shows that therapeutic energy is available at the electrode tip.

NOTE! **Step on the pedal squarely**. If the pedal is caught on the corners only, it may not work properly.

7 Perform the surgical intervention and release the pedal.

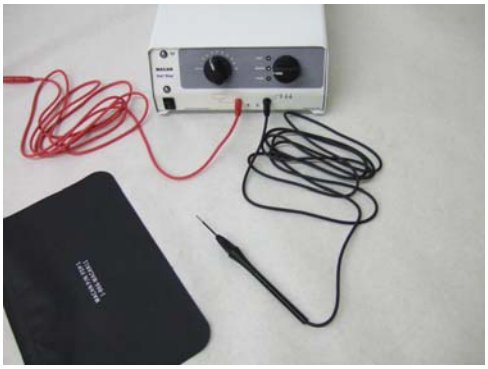


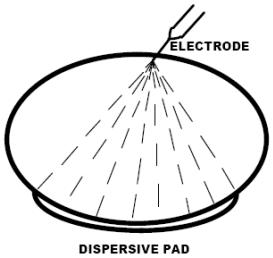
NOTE! Activate the unit for a maximum of 10 seconds at a time and then allow 20 seconds before the next activation. When activation is less than 10 seconds, cooling time is also proportionally less, in a 1:2 ratio. When activations are a series of short 2 or 3 second bursts, then cooling time may be ignored.

SUMMARY OF BASIC OPERATION:

1) Turn on the unit, allow 20 sec for stabilization after initial turn on before activating it
2) Place the dispersive pad (unless *you are* **absolutely** *sure you will not need it*)
3) Set up monopolar, bipolar, or “two-point” technique according to the intended procedure
4) Select the intended histological effect (CUT, BLEND, COAG knob)
5) Establish the initial power setting according to electrode size (RF Power knob)
6) Step on the foot pedal to activate the unit (produce therapeutic energy)
7) Perform the surgical step and release the pedal

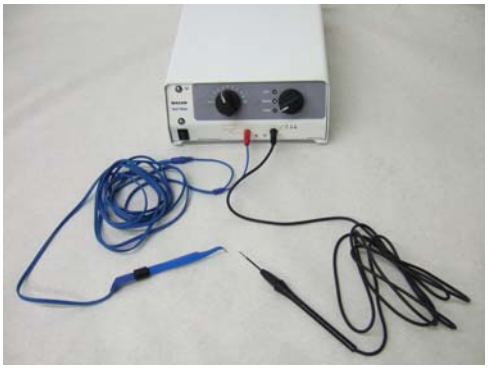
Monopolar Technique

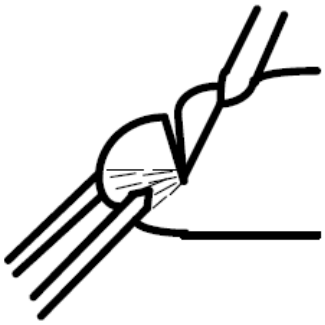




The illustration shows the diffusion of therapeutic current through the body from the electrode to the dispersive plate. The advantage to this principle is the constraint of heat to the electrode site since current density over the dispersive pad is too low to generate any significant heat. Surgical control is easy and accurate. The disadvantage is a need to avoid current concentration within a narrow pedicular anatomic structure connecting the treatment site to the body, such as a testicle, kidney, or ovary, for example. **This technique is not recommended for treating such anatomic structures.** Caution is required approaching the eyelid, gingiva, and extremities.

"Two-Point" Technique



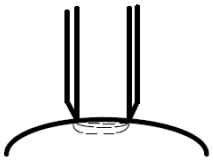


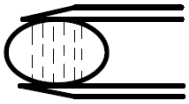
Note the insulator on the unused bipolar plug

The illustration shows a forceps acting as the dispersive electrode in the "two-point" excision set up. Therapeutic current passes distally to the forceps rather than proximally through the body as in the normal monopolar setup. This setup allows safe approach to the anatomic structures for which the monopolar setup is problematic. This technique is limited to excision since the very small contact area afforded by the forceps will induce thermal artifact at the contact point, however, for tissue that is to be sacrificed anyway, this is irrelevant. (not appropriate for biopsy though). This technique is especially effective for male neutering, as well as for avians, exotic pets, and laboratory animals since their small body mass does not support much electrosurgical current in the first place. Adds very significant safety in abdominal and thoracic surgery.

The power setting for this technique is significantly lower than for monopolar application since the electrical losses incurred by energy passing proximally through the body are absent.

Bipolar Coagulation Technique





The above figures show how coagulating therapeutic current introduced by a bipolar forceps is constrained to the immediate volume of tissue being treated. The figure on the left shows a bipolar forceps inducing superficial coagulation on the surface of an anatomic structure, and the one on the right shows vessel or tubal coagulation (also called electro-ligation). The advantages of this application are controllability, freedom from charring or burning, and it avoids involving the surrounding tissue, which makes it effective on anatomic structures such as testes, ovaries, or kidneys and in the mesentery or thorax where monopolar application is problematic. The disadvantage is time: monopolar "soft" coagulation is much faster. Note also that this technique is effective in wet fields whereas monopolar coagulation is marginal at best.

The preceding techniques illustrated represent the approaches possible with the Vet * Star to address the potential side effects arising from ability of physio-anatomy to withstand therapeutic current. The following chart illustrates the principle but should not be considered exhaustive:

anatomic structure	incision, excision	haemostasis, coagulation
initial incision	monopolar	monopolar, bipolar forceps
large organs, open surgery	monopolar, two-point	monopolar, bipolar forceps
oral, dental	monopolar	monopolar * bipolar forceps @
pedicularly attached #	two-point	bipolar forceps
thoracic	two-point preferred	bipolar forceps preferred
abdominal	two-point preferred	bipolar forceps preferred
dermal lesions	monopolar, two-point	monopolar, bipolar forceps
eye lid, aesthetically significant	monopolar	monopolar ("soft" pin point)
laparoscopy (with instrument)	_ _ _ _ _ _ _ _ _ _ _ _ _	bipolar (with instrument)
amputation (also de-claw)	two-point preferred	bipolar forceps
male neutering	two-point	bipolar forceps
female neutering	two-point	bipolar (instrument or forceps)

* NEVER on exposed bone @ safe on exposed bone
# Kidney, testes, ovaries, gall bladder, penis, extremity (the smaller the patient the more critical)

The Vet * Star provides three choices of therapeutic energy quality which correlates to histological effect as follows:

Incision and excision with minimal collateral tissue denaturing
Typical collateral denaturing width is 350 to 500 microns. *

Has some, but minimal, concurrent haemostasis.

Fastest healing time, on par with scalpel and laser, negligible cicatrix formation expected.

Incision and excision with pronounced concurrent haemostasis.
Typical collateral denaturing width is 500 to 750 microns. *

Used the most often by far due to haemostatic control.

Slightly longer healing time than pure CUT, some minor cicatrix expected.

Induces coagulation in tissue.

Not intended for incision or excision.

Healing time and cicatrix formation depend on the size of the area treated and the depth to which coagulation penetrates.

Histological effects are modified by surgical technique. This is why a **consistent technique** is essential for predicable results. The above collateral denaturing widths assume adequate surgical technique and proper therapeutic energy dose titration.

* Using R-10 or similar .010” diameter wire electrode. Thicker electrodes increase denaturing width, allowing adaptation to specific clinical circumstances. See page 8.

While the **quality of therapeutic current is the primary factor** in establishing the degree of concurrent haemostasis accompanying an incision or excision, **electrode geometry also has a significant effect.** There are 6 degrees of concurrent haemostasis possible with Vet * Star:

CUT therapeutic current

ELECTRODE	HAEMOSTASIS	COLLATERAL DENATURING	
R-10 thin wire	minimal	minimal	see note 1
R-53 thick wire	significant	moderate	see note 2
R-72 lancet	strong	significant	see note 3

BLEND therapeutic current

ELECTRODE	HAEMOSTASIS	COLLATERAL DENATURING	
R-10 thin wire	significant	moderate	see note 4
R-53 thick wire	strong	significant	see note 5
R-72 lancet	very strong	profound	see note 6

The above presumes proper dose titration and adequate surgical technique.

Choice is a matter of clinical judgment taking into account the nature of the procedure, the physio-anatomy being treated, and hemolytic health, including the effects of disease or ongoing treatment. Obviously, bleeding control during surgery to reduce blood loss is one of the major factors for employing electrosurgery in the first place, however, **adding concurrent haemostasis is easy, but applying too much initially will only increase healing time and add scarring. Use a conservative choice since touching up minor hemorrhagic response is relatively easy but excess collateral tissue denaturing cannot be undone.**

1 thin delicate tissue (eyelid, gingiva), epilation, biopsy, infants, laboratory animals, avians

2 thin dermis (infants, laboratory animals, avians), small animal vascular organ (hepatic, renal)

3 initial incision adult canine, vascular organs (hepatic, renal, spleen)

4 gingiva, oral mucosa, thin dermis (infants, laboratory animals, avians) infant vascular organs

5 canine, feline initial incision; feline, canine vascular organ; extreme haemostasis in infants

6 adult canine extreme concurrent haemostasis in vascular organs, large animals

The above list is illustrative of principle, and should not be considered exhaustive

R-10 R-53 R-72 R-12 R-34 R-45 R-31 R-51 R-52

incision

	CUT	BLEND
R-10 thin wire	2 ½ - 3	3 - 3 ½
R-53 thick wire	6 - 6 ½	6 ½ - 7
R-72 lancet	7 ½ - 8	8 - 8 ½

plane

	CUT	BLEND
R-12 thin wire, bent	6 - 6 ½	6 - 6 ½
R-31 triangle loop	6 - 6 ½	6 ½ - 7
R-34 9,5mm loop	5 - 5 ½	5 - 5 ½
R-45 12,5mm loop	6 - 6 ½	6 ½ - 7

deep excision

	CUT	BLEND
R-34 9,5mm loop	8 - 8 ½	8 ½ - 9
R-45 12.5mm loop	9 ½ - 10	9 ½ - 10

biopsy

	CUT	BLEND
R-34 9,5mm loop	7 ½ - 8	not recommended
R-45 12,5mm loop	9 ½ - 10	not recommended

coagulation

	"hard"	"soft"
R-51 small ball	4 ½ - 5 COAG current	4 - 4 ½ COAG current
R-52 large ball	6 ½ - 7 BLEND current	4 - 4 ½ BLEND current

ablation

	CUT	BLEND
R-51 small ball	3 ½ - 4	4 - 4 ½

R-10 R-53 R-72 R-12 R-34 R-45 R-31

incision

	CUT	BLEND
R-10 thin wire	1 ½ - 2	2 - 2 ½
R-53 thick wire	2 - 2 ½	3 - 3 ½
R-72 lancet	3 - 3 ½	4 - 4 ½

excision

	CUT	BLEND
R-34 9,5mm loop	3 - 3 ½	4 - 4 ½
R-45 12,5mm loop	3 - 3 ½	4 - 4 ½

BIPOLAR COAG INITIAL SETTINGS

	RF power (COAG)	approximate time
small vessel 1 – 2mm	2 - 2 ½	1 - 1 ½ seconds
larger vessel, tube	2 - 2 ½	2 - 3 seconds
large area (surface)	4	varies *

* coagulum should begin to appear in about 1 ½ - 2 seconds. If not, increasing RF power to 4 ½ is suggested.

NOTE: wet fields may require initial bipolar COAG settings about ½ to 1 number higher.

Pharmacologic therapy offers a fair analogy here : pharmacological dosage is titrated in practice to maintain a therapeutic blood serum level in compensation for an individual patient's body mass and rates of absorption and excretion. In the case of electrosurgery, the electrosurgical electrical energy actually expended in inducing the intended histological changes in tissue may be thought of as analogous to therapeutic blood serum level in pharmacological treatment. Electrical losses incurring as electrosurgical electrical energy diffuses proximally through the body toward the dispersive pad may be thought of as analogous to absorption loss in pharmacological therapy. It should be clear that insofar as individual patients differ, that some titration to the initial electrosurgical energy dose is to be expected.

The assessment of titration from proper initial setting is a matter of clinical judgment:

Way to low a setting will not incise, it will only induce coagulation burn

Too low a setting will cause the electrode to "drag" and tissue detritus will adhere to the electrode

A slightly low setting will allow protein deposits to form on the electrode with slight adhesions

A proper titration allows free electrode motion without sparking, adhesion, or deposits

A slightly high setting shows some sparking

Too high a setting sparks noticeably and induces unnecessary extra collateral coagulum

Way too high a setting sparks, induces significant collateral desiccation, and carbonizes electrode

It should be noted that titrations normally do not vary from initial setting by more than one number on the power dial, perhaps 1 1/2 at most. An abnormally high titration requirement strongly suggests an electrical compromise and should be investigated before proceeding or turning up the power setting to a dangerous level. *Insure that the dispersive pad is plugged in at both ends and properly positioned, insure that the cables are not damaged, insure that the cables are plugged into the proper jacks, and insure that the COAG therapeutic current has not been selected inadvertently for incision or excision.*

Compensation for body mass and the coupling efficiency of the dispersive pad are the primary factors requiring titration in monopolar electrosurgery. Given that, it should be clear why the bipolar and "two-point" techniques require less titration since these factors are largely avoided by the latter methods. Never the less, tissue character itself is a factor since electrosurgery reacts with intra-cellular fluid to induce histological change : the lower water content of fatty, fibrotic, or cartilaginous tissue may require a somewhat higher energy dose for equal histological effect in comparison to normal muscle tissue.

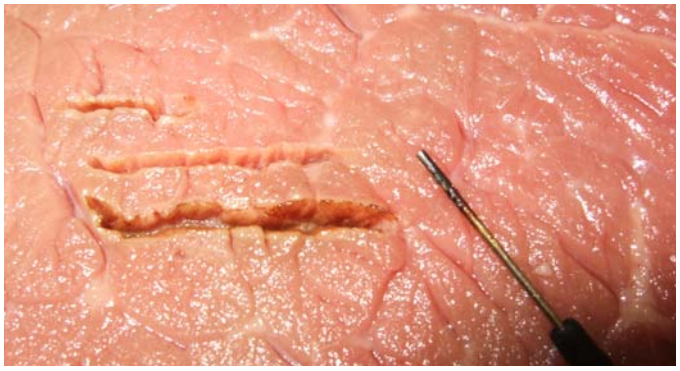
NOTE! Vet * Star is a relatively low voltage low impedance generator, therefore is sensitive to electrode hygiene. **Significant accretions of proteinaceous material will require excessive dose titration to compensate or may not work at all. It is imperative that electrodes are kept clean with bare metal showing clearly in the tissue contact area.**

A secondary factor affecting dose titration is surgical technique itself, which is unique to each surgeon. Simply put, the reaction of therapeutic current and tissue depends on the electrical properties of the tissue. Tissue electrical properties are in turn altered by electrosurgery, in significant part as a function of surgical technique. In other words, **consistent** surgical technique is an important aspect of obtaining consistent surgical results and minimizing the need to titrate, since a dramatic change in surgical technique may invalidate a given titration.

The discussion takes us back to **initial settings according to electrode size**: these **are not carved in stone.** You are highly encouraged to **take notes as you gain experience** with the Vet * Star **and amend the figures given accordingly.** Since this approach takes into account your own personal surgical technique, **the end result will be a reduced need to titrate when similar surgical conditions are encountered.**

Too low a setting. The electrode “drags” or resists motion through tissue. Note the detritus adhering to the electrode. Significant unwanted collateral denaturing occurs which unnecessarily delays healing and adds scarring.

Good titration. The electrode moves freely without sparking and stays clean. The expected collateral coagulum obtains and fast healing with minimal cicatrix is expected.



Too high a setting. Sparking is evident, excessive tissue collateral denaturing with the beginnings of char formation is seen. Note the carbon deposits on electrode. This quality of incision unnecessarily delays healing as the denatured tissue is reabsorbed and unnecessary scarring forms.

Consider this example: when moving one's hand briskly over a lit candle, hardly any sensation is noticed. However, as movement is slowed down, the sensation of heat becomes increasingly more painful until one slows down to the point that a burn is induced. This is a fair analogy for electrosurgical incision and excision. Several significant points follow for incision and excision:

Keep the electrode moving. Do not stop.

Do not repeat a stroke in the same area until 5 seconds have elapsed in order to allow the capillary bed to dissipate the heat before adding more.

Maintain a minimum stroke speed of 5 to 7mm per second. (more is better)

Maintain as consistent a stroke speed as humanly possible.

Speed is the variable by which gross tissue heat is controlled in incision and excision. However, speed and accuracy are generally mutually exclusive in terms of human endeavor. Therefore, when doing longer incisions it is advised that these be divided up into as many shorter sections as necessary in order to achieve adequate accuracy while maintaining sufficient minimum stroke speed.

Remember, a high stroke speed is harmless thermo-dynamically (actually, it is desirable) since electrosurgical incision can easily proceed at speeds in excess of 50mm per second. **It is excessively slow motion that induces excess heat into tissue, and this error is one of the leading causes of poor electrosurgical clinical results.** Collateral tissue denaturing width during incision and excision increases non-linearly as incision speed decreases below 5 to 7mm per second. The threshold between mediocre result and injury is rather abrupt, and the only way to avoid it is to maintain a steady adequate surgical technique at all times. Clearly, for those not experienced with electrosurgery, some practice before clinical use is very strongly advised.

Please note that a finite minimum amount of heat must be introduced into tissue in order to achieve volatization, otherwise, incision or excision cannot occur. In other words, tissue heat cannot be controlled by "dialing down" the electrosurgical generator power setting. This leaves surgical technique as the primary means of heat control.

It cannot be overemphasized that the key to predictable clinical results is consistent surgical technique.

Too slow. Excess collateral coagulum is evident, which only delays healing and adds scarring.

7mm/sec speed. This incision quality promises fast scar free healing.

The bottom incision was made at a power setting of 8 which should have caused havoc, however, it was done at 50mm/sec.

The last example is a curious feature of electrosurgery: a fast technique can compensate for a somewhat high dose titration, but nothing can compensate for too low a titration or too slow a technique.

Deep excision and biopsy are accomplished by moving the electrode through tissue as rapidly as possible using a steady motion. If one has not done this, practice is very strongly advised before clinical use. A slight, but distinct, tactile resistance to electrode motion through tissue is normal for large loop electrodes.

The use of loop electrodes is more demanding of adequate surgical technique than linear incision with wire straight electrodes or the lancet. **It is imperative that deft, steady, motion be employed with loop electrodes for deep excision. The larger the loop, the more demanding.**

Biopsy in particular leaves no room for technique error, and no room for too low a power setting error. Always use the pure CUT therapeutic current for biopsy to avoid thermal artifact in the sample.

It is also vital to establish an adequate initial power setting for deep excision with loop electrodes when using the BLEND therapeutic current.

NOTE! *Experience suggests that* **unsatisfactory clinical results** using loop electrodes for biopsy and deep incision **arise primarily from inadequate power setting,** and secondarily from too slow a motion or unsteady motion.

Planing with a loop electrode is an alternative for reducing lesions that has several advantages over a single deep pass:

- lower power setting, less demand on technique
- smaller volumes of tissue allow better surgical control
- smaller volumes of tissue allow better thermal control

By reducing a lesion in small volumes, the surgeon has better visualization so as to avoid unnecessarily removing healthy tissue while still assured that abnormal tissue is fully addressed.

Along the same line of thought, using the CUT therapeutic current for the majority of the reduction induces less gross heat into tissue and helps with visualization. Using BLEND current for the last one or two thin slices provides haemostatic control.

The planing method is especially appropriate for dermal lesions owing to the limited dermal thickness, however, is not limited to skin. The planing method is perfectly appropriate for internal lesions as well and shares the same advantages, although the use of CUT therapeutic current on vascular organs may not prove adequate for bleeding control in turn requiring the use of BLEND therapeutic current.

The best surgical and thermal control of a loop electrode for planing is obtained when the slice taken is 1/3 to ½ the width of the electrode, and the electrode is held at an angle of from 5^0 to 15^0 from the surface of the tissue being treated.

The “two-point” technique is clinically classed as “excision” since tissue is removed. However, this technique behaves like monopolar incision from the perspective of the electrosurgical generator in an electrical sense. In other words, the advice given for “ INCISION SURGICAL TECHNIQUE” and “LOOP EXCISION SURGICAL TECHNIQUE” applies equally to the “two-point” technique, with the notable exception of biopsy, for which the “two-point” technique is not suited.

Straight wire electrodes, lancet, or loop electrodes are all appropriate for this technique.

However, an inherent potential problem one should be aware of exists due to the proximity of the dispersive electrode (forceps) and the active electrode in actual use: **the surgeon must avoid contacting the forceps with the electrode**. Harm to the patient is astronomically unlikely, and harm to the electrosurgical generator highly unlikely, however, the electrode may be damaged. A loop electrode is fairly susceptible to damage. The significance is that the loss of a needed tool during a procedure is not something a surgeon wishes for. It is suggested that an extra sterilized loop electrode be kept on hand when using the “two-point” technique for loop excisions as back up insurance in the event that a loop is damaged, however unlikely that may be.

Remember, the initial power settings for “two-point” are significantly lower than for monopolar.

An injury to a pedicularly attached organ during monopolar electrosurgery is illustrated here. A relatively high energy setting appropriate to the lancet electrode and BLEND current were used. The incision proceeded normally until it seemed that the illustration would fail and then the entire cross section of the pedicle was coagulated abruptly in a fraction of a second. In actual practice, the organ would be lost with possible fatal outcome.

An excessive setting of BLEND current was used along with the “two-point” technique to reinforce the illustration. Note the complete freedom from injury to the pedicle, however, the same cannot be said for the distal tissue due to the excessive power used and the deliberately slow surgical technique employed to reinforce the illustration.

Time is the variable in controlling bipolar forceps coagulation. Assessing histological effect is a matter of clinical judgment: the unit is activated until the target tissue grasped with the forceps visibly blanches. It is essential that a low power setting be employed for bipolar coagulation, otherwise, the tissue will blanch before the surgeon can release the foot pedal. One should definitely avoid applying current until a vessel "pops" like meat in a sauté pan, since this will result in weakness presenting a risk of subsequent hemorrhage.

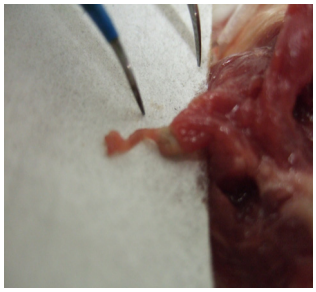
Electro-ligation (another term for "bipolar forceps coagulation ") is practical on vessels up to 3mm in diameter directly, without sutures. Vessels or tubes larger than this will require suture in addition to electro-ligation.

Experts are divided over whether pure CUT (unmodulated) therapeutic current or COAG (modulated) therapeutic current is preferable for bipolar forceps coagulation. In any case, pure CUT current works faster making the low initial setting more critical. COAG current tends toward more coagulum spread lateral to the forceps in a given time to blanching than CUT current. It is suggested that CUT is more appropriate to larger vessels and COAG to smaller ones.

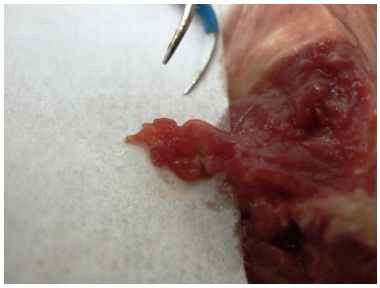
NOTE! An excessively high initial power setting represents a risk of burning off a vessel rather than sealing it, particularly with CUT current. A low initial setting can be easily increased when necessary, but a burned off vessel may be a seriously problematic complication.

Large areas of soft tissue may be superficially coagulated with bipolar forceps coagulation in lieu of monopolar "spray" coagulation or laser "carmelization" by placing a curved forceps upside down on the tissue surface, activating the unit in COAG, and then moving the forceps around. Penetration is a matter of the rate of motion and the distance between the forceps tips. Holding the tips closer together will increase penetration depth. Note that large area superficial coagulation with bipolar forceps is appropriate for haemostatic control but not to be relied on for addressing remnant metastatic cells in tumor excision sites due to relatively superficial penetration. This method of haemostatic control is excellent for treating the face of resected vascular organs, and in dermatologic treatment to address large open wounds.

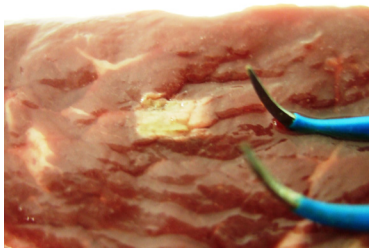
Although safe on exposed bone, bipolar coagulation there is considered a palliative convenience for the surgeon. It does not substitute for the use of bone wax where clinically applicable.



small section electro-ligation achieved with COAG current



larger section electro-ligation achieved with CUT current



broad areacoagulation achieved with COAG current and back of forceps

NOTE! Do not allow the forceps tips to touch during bipolar coagulation in any case since therapeutic current will then circumvent the tissue precluding histological effect from occurring.

The R-51 small ball electrode along with COAG therapeutic current and R-52 large ball electrode along with BLEND current are used in monopolar mode to induce coagulation in soft tissue. The ball shape distributes therapeutic current over a relatively large area compared to the surface of a wire electrode to insure that cutting does not occur.

Vet * Star performs two types forms of monopolar coagulation: “hard” and “soft”.

“Hard” coagulation has deeper penetration into tissue and **is achieved by bringing the electrode into contact with tissue and then activating the unit to apply therapeutic current.** Effect is judged by observing tissue blanching.

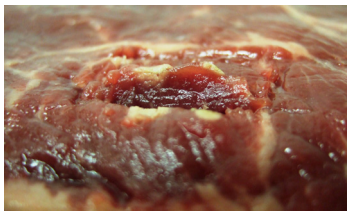
“Soft” coagulation has shallower penetration into tissue and **is achieved by first activating the unit and then bringing the electrode toward the tissue** to allow some sparking to occur as the electrode approaches the tissue. The sparking is actually ionized atmospheric gas along with gasses released due to cellular volatization. The ionized gasses provide a high impedance conduction medium that affects the flow and quality of therapeutic current and helps distribute it across the face of the electrode. A notable surface coagulum results and effect is judged by observing between applications.

There is a time honored **variation of “hard” coagulation** which has been a mainstay of surgical practice for many decades: **“buzzing the hemostat”.** In this technique, a vessel which is grasped by a hemostat may be readily coagulated by **touching the hemostat with an active electrosurgical electrode and applying COAG** therapeutic current.

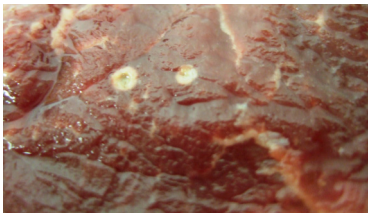
Note also that the broad side of a lancet electrode is eminently well suited to “hard” coagulation or “soft” coagulation because the geometry of the electrode is such that cutting only occurs along the narrow leading edge while coagulation is simultaneously occurring along the broad sides. This is the main reason that this particular electrode is so popular in general surgery since it may be used to incise with strong concurrent haemostasis and may also be used to coagulate only, thus avoiding the need to change electrodes during a procedure.

Remember that monopolar coagulation is marginally effective at best in wet or bloody fields.

“hard” coagulation with large ball using BLEND current



relative depth “hard” vs. “soft” with large ball and BLEND current



“hard” vs. “soft” with small ball using COAG current

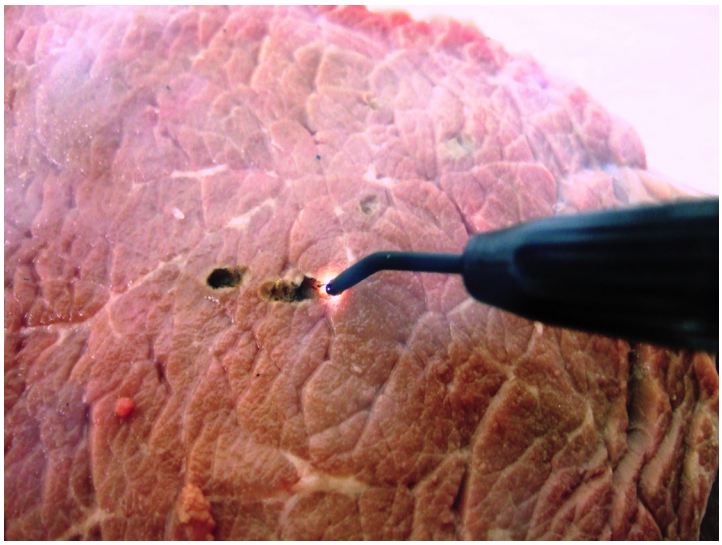
Fulguration (whose name derives from the Latin word for “lightning”) is a monopolar application where COAG therapeutic current is applied via an arc (spark) and is used primarily for tissue desiccation when treating skin lesions. However, the application is also effective for treating tumor excision beds to address metastatic remnants as well as addressing remnant bacteria in enucleated cysts or fistulous tracts. The electrode does not intentionally touch tissue during fulguration. The spark is a column of ionized gas, which has significant effects on the flow of therapeutic current resulting in distributing the current over the surface of the tissue, enhancing desiccation, and limiting the depth of penetration. Keep the electrode moving during fulguration and at a constant distance above the tissue.

- **The Vet * Star is an inherently low voltage unit, therefore, to do fulguration with it, an optional adaptor is required.**
- The ME6000 adaptor allows about 1mm arc length at most. While this is quite modest for human use, it is not inappropriate for smaller animals. The use of an optical loupe is helpful during fulguration with the ME6000 adaptor.
- **Use a maximum power setting of “6” and COAG when using the fulguration adaptor.**

Although the histological effect of fulguration is primarily desiccation, never the less some coagulum accompanies it along with some volatization of the tissue surface. High heat is associated with fulguration and this should be borne in mind to avoid overheating tissue. This will become evident when cleaning the ball electrode afterwards due to the heavy accretion of carbon and protein on it.

When fulguration is used for addressing potentially metastatic cells in tumor excision beds, either the R-51 or R-52 ball electrodes are recommended. The smaller R-51 affords better access into enucleated cysts or smaller excision sites at the expense of somewhat more aggressive action in comparison to the larger R-52.

Treating dermal lesions is better served by the larger R-52. Note also that fulguration of open dermal wounds will result in an overlying coagulum which simultaneously helps sterilize the wound and provides a covering for healing by second intent. Some serous fluid seepage is expected from the desiccation of underlying tissue. Appropriate dressing and subsequent care will be required.



Note the charring associated with fulguration which is reminiscent of laser.

The copious smoke production is testimony to the high heat associated with this technique.

The R-51 ball electrode is seen in action here and some degree of tissue ablation is occurring due to the small area of the ball.

A modest volume of tissue was ablated using the R-51 electrode and CUT therapeutic current in monopolar mode. **This method induces significant heat and appropriate precaution must be exercised to allow adequate cooling time between passes.**

This technique is rarely used due to the associated heat, however, it is valuable in tumor reduction along the edges:

- it provides a means of working near veins and arteries where a loop or wire electrode represent a risk of nicking the vessel
- it allows good visualization assuring adequate reduction of abnormal tissue without reducing healthy tissue unnecessarily
- adequate energy penetration occurs to address remnant metastatic cells

Since this technique does induce high heat, reduction of the bulk of a tumor by means of a loop is preferred with ablation reserved for the edges.

For added haemostatic control and deeper penetration to address metastatic cells, the BLEND current may be used.

For very fine ablation the R-62 electrode is recommended.

The “two-point” technique provides marginal effectiveness when combined with ablation since the effective conduction cross section of tissue narrows as the lesion is removed, and the latter stages become increasingly difficult and inefficient which tempts one to overheat the tissue.

The Vet * Star “Flexi-plate” dispersive pad works by means of capacitive coupling where the pad acts as one half of a capacitor and the patient acts as the other half. This allows the dispersive pad to work without direct skin contact, unlike human general surgery machines that use lower frequencies and require an adhesive disposable pad that must be placed over bare skin, shaved when necessary (a very cumbersome prospect for veterinary medicine).

Never the less, **the Vet * Star, like all isolated monopolar electrosurgery units, is quite sensitive to dispersive pad placement and coverage. It is imperative that as much as possible of the dispersive pad is covered by the patient.** The flexible design of the dispersive pad allows it to be wrapped around smaller patients to insure maximum coupling.

In human surgery the dispersive pad is never placed under the patient since capillary flow compromise reduces heat dissipation in the pad area and human surgeries can last for many hours. In veterinary medicine, the smaller patients, shorter surgeries, and the lower energies used combine to permit safe dispersive pad placement under the patient for supine or prone positioned surgery. For smaller patients, such as felines or small dogs, placing sand bags laterally under the dispersive pad to form it up around the patient is suggested.

The “Flexi-plate” dispersive pad is not autoclavable. It should not therefore touch bare skin due to the risk of cross infection. Placing the dispersive pad in a thin plastic bag will satisfy this requirement.

There are two leads on the “Flexi-plate”: one has a plug to attach it to the red dispersive cable and the other is a dummy with no connector. The dummy lead is a convenience to allow the two leads to be drawn around like the strings on an apron so as to provide more placement options.

When the surgical site is an extremity or on the head or neck (dental or oral surgery also) then the dispersive pad may be draped over the patient to excellent effect. The two leads may provide a convenient method of securing it.

For bovines and equines the haunches are recommended. Once again, the two leads may be used to secure the dispersive pad. An “Ace” bandage or gauze may be used to help secure the dispersive plate, however, be sure to wrap as loosely as possible.

For large dogs, the inside of the thigh, which has the least fur, is the preferred dispersive site, wrapping the dispersive pad around the leg as much as possible. Again, a loose wrapping of gauze or an “Ace” bandage are suitable means of securing the dispersive pad in place.

Note that heavy fur may adversely affect dispersive pad coupling. When this requires an abnormally high therapeutic energy dose titration, reposition the pad to the inside of the thigh.

The pad need not be physically removed for “two-point” or bipolar use, since that function is accomplished electrically by the cables.

There are no negative implications for cardioversion and the pad may be left in place, connected to the unit.

The dispersive pad is thin enough to be placed under the patient on top of a hypo/hyper-thermia pad without significantly reducing thermal efficiency.

NOTE! The isolated output of the Vet * Star and the type BF applied part rating do permit safe use of human disposable dispersive pads when clinically appropriate.

ELECTRODE HYGIENE

The Vet * Star is a relatively low voltage, low impedance type of generator which makes it sensitive to accretions of protein or detritus on the electrode that impede the flow of therapeutic current. Conventional high voltage generators will “blast” through such deposits, but the relatively low voltage Vet * Star cannot. It is imperative that electrodes have clean bare metal showing in the tissue contact area.

The use of “scratch pads”, available sterile and disposable from medical suppliers are recommended for dealing with accretions occurring during surgery. However, “scratch pads” are aggressive and leave a somewhat rough surface afterwards which encourages rapid accretion. To overcome this it is recommended that electrodes treated with a “scratch pad” be addressed with very fine emery cloth or pumice during routine cleaning to polish the surface back to smoothness which in turn retards the protein accretion process.

Carbon deposit which can prevent the electrode from working with Vet * Star

DENTAL AND ORAL SURGERY

Vet * Star is eminently well suited to dental and oral surgery for those who wish to integrate this into their veterinary practice. It is suggested that one request the MACAN Radiosurge MC6A Owner’s Manual for advice on how to use electrosurgery in oral and dental care. Most indications can be addressed with the electrodes supplied with the Vet * Star, and the Radiosurge Owner’s Manual will suggest which others are appropriate for additional clinical indications.

SPARKING AND NEURO-MUSCULAR STIMULATION

The orders of magnitude disparity in the rate of reversal (frequency) of the applied therapeutic current with respect to the absolute refractory period of molecular exchange across cellular permeable membranes precludes neuro-muscular stimulation. However, significant sparking distorts the therapeutic current by displacing some of the energy into “side bands” (harmonics of the frequency) according to Fourier’s Theorem. The lower “side bands” can, and readily do, induce stimulation under adverse conditions. Some recommendations and suggestions follow:

- always try to use proper therapeutic energy dose titration to minimize sparking
- muscles may have to be held firmly during electrosurgical intervention on them
- heavy irrigation to electrically dampen sparking may be required for approach to the bladder, uterus, or urethra
- use “two-point” and bipolar techniques wherever practical
- larger surface area electrodes tend to spark less than smaller ones (lancet vs. wire, thick wire vs. thin wire), therefore, use the largest practical when sparking is an issue
- avoid “soft” coagulation and fulguration on muscular structures (use bipolar instead)

Beware of a spark jumping to a nerve when working in fatty structures! Permanent injury with resultant distal paralysis is possible. **To avoid this possibility, use “two-point” and bipolar techniques when working in such areas.**

IRRIGATION

Irrigation is used to dampen sparking, add thermal injury protection, and to reduce the production of smoke in addition to the clinical function of keeping tissues moist during surgery.

- **saline solution** is electrically conductive and **must not be used with monopolar electrosurgery due to collateral burn risk**
- If saline is used, flush with sterile water prior to monopolar electrosurgery
- **use only sterile water for irrigation in conjunction with monopolar electrosurgery**
- “two-point” electrosurgery is “monopolar” from an irrigation perspective
- saline solution and bipolar electrosurgery are fully compatible

Keep irrigation flowing during electrosurgery and avoid pooling. Stagnant pools of fluid trap heat and become conductive over time due to contamination from volatized cellular contents which reduces electrosurgical efficiency and may represent a risk of collateral burn (see saline).

IS ELECTROSURGERY “SELF STERILIZING”?

Bacteria and fungus on the target tissue are volatized or coagulated along with the target tissue. This is helpful in reducing post-operative infection especially in dental and oral surgery or in emergency care where preparation time is necessarily limited.

On the other hand, any biological contamination on the electrode *outside* the tissue is unaffected, therefore, to avoid cross infection, electrodes and hand pieces must be sterilized between uses. Note that viruses may survive electrosurgery. See Basic Safety Precautions regarding smoke for additional advice.

OPHTHALMIC AND CORNEAL SURGERY

The Vet * Star is simply too powerful for this application. *Do not attempt it.* Corneal and ophthalmic surgery remains the unchallenged bailiwick of laser and scalpel.

EYE ENUCLEATION

Monopolar electrosurgical dispersive current will follow the optic nerve back to the brain and induce grand mal seizure. Eye enucleation is contra-indicated for monopolar electrosurgery.

Bipolar and "two-point" techniques show promise for accomplishing this surgery, however, their use in this procedure have not been clinically investigated, therefore, they cannot be recommended at this time.

The practical consequence is that electrosurgery should not be used for eye enucleation.

PACEMAKERS, IMPLANTED ELECTRONIC DEVICES, ID CHIPS

The use of electrosurgery in the presence of a pacemaker (patient or staff) requires that the primary physician be consulted prior to electrosurgery. Modern shielded types are safe with electrosurgery, whereas **electrosurgery in the immediate presence of an unshielded type is contra-indicated.** Only consultation with the primary physician can verify. Note that defibrillating type pacemakers may require additional precautions, reinforcing the need for consultation.

Indwelling devices such as neuro-stimulators, infusion pumps, cochlear implants, and electronic bone growth generators are contra-indications for monopolar electrosurgery. *Although not an issue in veterinary medicine per se this may be of significance for animal research laboratories working with medical electronic implants.* **Only bipolar and "two-point" techniques should be used on patients with these devices. Take extra precaution during surgery to avoid accidentally contacting a pacing lead.**

The effect of monopolar electrosurgery on implanted ID chips has not been investigated and reported. One may reasonably speculate that if the chip were in the dispersive path it may be at risk. It is suggested that ID chips be checked for proper function after electrosurgery.

PHYSIO-MONITORS, CARDIO-VERSION

The Vet * Star is rated safe for concurrent use with physio-monitors. Needle type monitoring electrodes are not recommended. Monitoring electrode pads (or clips, the larger the better) should be placed anatomically opposite to the dispersive pad whenever possible, or as far away as possible otherwise. It is also preferable to place monitoring electrodes distal to the dispersive pad whenever possible. ***Avoid placing the dispersive cable or hand piece cable along side a monitoring cable.*** Maintain the maximum distance practical between monitoring cables and electrosurgical cables.

There are no dispersive implications for cardio-version. The dispersive pad may be left in place and connected to the generator, even if a human direct contact pad type is used. The surgical electrode should not be in contact with tissue during cardio-version however.

As muscle tissue, steak provides a viable test medium for practice before clinical use. Steak also provides a reasonably sensitive indicator of histological effect, whereas pork and chicken are much less sensitive indicators. Beef liver is an especially sensitive indicator of histological effect.

A steak (or roast) of 2# (0,9kg) is an ideal size. Some marbling as on a cheaper cut provides variation in tissue quality to work with.

To simulate the effects on dispersive plate coupling with an average veterinary patient, place 8 kitchen type paper towels folded in half in a plastic bag and place this on the dispersive pad. Place the steak on top of the plastic bag. The bag facilitates clean up and prevents desiccation of the steak from the paper towels during practice. Avoid using the Styrofoam container or blotters the steak comes in.

Since the Vet * Star is an isolated output type of generator, the steak may become elevated at RF, and contact with bare hands may induce an unpleasant tingle or “shocking” sensation. The use of surgical gloves is highly recommended. This advice is applicable to monopolar and bipolar forceps as well.

Figures shown on pages 4 (gingiva), 12, 13, 15, 16, 17, 18, 19, and 21 (all steak) illustrate what may be expected.

The objective of practice is to become familiar with:

- controlling the histological effects possible with the Vet * Star
- the relationship between electrode size and initial power setting dosage
- assessing and performing dose titration
- the effect of electrode size on collateral denaturing
- the relationship between electrode size and surgical technique tolerance
- practice with all three technique setups : monopolar, bipolar, and “two-point”
- controlling bipolar coagulation

Some hints for facilitating practice are:

- vary the number of paper towels for practicing dose titration due to patient mass
- mechanically pull off thin strings of meat to simulate small blood vessels
- try a dozen or more towels to see the effect of poor dispersive pad positioning
- disconnect the dispersive pad to see the effect
- directly compare the performance of a clean electrode to a badly contaminated one
- fill an indentation in the steak with water and try bipolar coagulation (effect on titration)
- fill an indentation in the steak with water and try monopolar incision (effect on titration)

FIRE HAZARDS:

EXPLOSION HAZARD: ***Do not use in the presence of flammable anesthetics.***

Do not use in the presence of flammable astringents or surgical cements. Allow fumes to evaporate before applying electrosurgery. Maintain adequate ventilation.

Do not allow concentrations of oxygen or nitrous oxide to pool in a cavity. This situation is especially exacerbated when gauze or cotton are present. NOTE PARTICULARLY THAT THE SPACE UNDER A SURGICAL DRAPE QUALIFIES AS A "CAVITY" IN TERMS OF FIRE HAZARD since it provides a space for gas pooling *and* provides combustible material.

Colon polypectomy is an especially serious situation due to the methane content of endogenous gasses. Fatal explosions have been reported. PROPER PREPARATION IS AN ABSOLUTE ESSENTIAL and so is constant monitoring for the presence of methane gas.

ELECTROSURGICAL SMOKE:

The smoke is generally considered a mild carcinogen and adequate ventilation should be maintained. The use of a smoke evacuator is recommended.

Electrosurgery volatizes bacteria and fungus, however, viruses can survive and may be present in smoke. If it is known that the tissue being treated has viral infection, the use of appropriate filtered masks is recommended in addition to smoke evacuation.

Studies have shown that metastatic cells released during electrosurgery do not result in tumor spread and do not represent a hazard to patient or staff.

Smoke is not unique to electrosurgery since laser surgery and thermal cautery incision share this.

NEVER COAGULATE DIRECTLY WITHIN A TOOTH EXTRACTION SOCKET.

Monopolar current will enter the nutrient foramen of the surrounding bone and necrotize the contents, resulting in osseous fissures and subsequent vascularization compromise. Bone sequestration is certain and a matter of degree. The efficacy of bipolar application in this case has not been clinically investigated and therefore cannot be recommended as an alternative.

NEVER APPLY MONOPOLAR COAGULATING CURRENT TO BONE.

See the precaution regarding extraction sockets. When bleeding control on exposed bone is required, bipolar coagulation where the tips of the forceps are placed on the surface of the bone astride the bleed is the safe, effective alternative method of choice.

DO NOT TURN UP THE POWER SETTING TO A HIGH LEVEL WHEN AN ELECTROSURGERY UNIT SUDDENLY APPEARS TO LACK POWER until the dispersive pad connection and placement have been checked as well as the cables. *If power needs to be increased to compensate for tissue conditions as it sometimes is, do so a little at a time.*

NEVER USE NEEDLE TYPE MONITORING ELECTRODES.

DO NOT DEFEAT THE GROUND CONNECTION OR USE THE UNIT WITH ANY TYPE OF TWO-PIN EXTENSION CORD OR ADAPTER.

DO NOT USE IN THE PRESENCE OF A PACEMAKER (patient or staff) UNTIL THE REFERRING CARDIOLOGIST HAS BEEN CONSULTED.

Electrosurgery is contra-indicated in the immediate presence of an unshielded pacemaker.

AVOID TOUCHING ANY METALLIC OR CONDUCTIVE OBJECT IN THE FIELD.

Any metallic object in contact with a monopolar electrode becomes an extension of the electrode and can induce serious injury as a result. **Insure adequate clearance so that a spark cannot possibly jump to the metallic object.** **DOUBLE THIS PRECAUTION WHEN BIO-ELECTRIC LEADS ARE PRESENT OR INDWELLING CATHETERS.**

ELECTROSURGERY MAY CAUSE INTERFERENCE WITH OTHER EQUIPMENT, ADVERSELY AFFECTING THE FUNCTION OF THAT EQUIPMENT.

Although the Vet * Star incorporates a medical grade EMI/RFI filter, surge suppression, and first order RF band pass filtration, never the less, electrosurgery emits powerful radio waves which can adversely affect sensitive unshielded devices

ALWAYS BE VERY CAREFUL OF HAND PIECE OR FORCEPS PLACEMENT, AND NEVER LEAVE A HAND PIECE OR FORCEPS LYING ON THE PATIENT.

Inadvertent activation of the foot pedal will produce electrosurgical energy at the electrode tip: whether or not this represents an electrosurgical burn risk to the patient, surgeon, or assistant depends entirely on where the hand piece is stowed between uses. **The use of non-conductive holsters or stowage clips is highly recommended.**

HAVE DIRECT VIEW ENDOSCOPES, URETHROSCOPES, AND ARTHROSCOPES USED WITH ELECTROSURGERY CHECKED REGULARLY BY QUALIFIED PERSONNEL FOR INSULATION INTEGRITY.

Serious permanent injury to a surgeon's eye has been reported due to sparks from failed insulation in a urethroscope. In that case, the urethroscope was modified in house at the hospital where it was used. **Do not modify accessories or cables from their factory configuration.**

AN INTERNAL FAILURE WITHIN THE ELECTROSURGICAL GENERATOR MAY RESULT IN AN UNEXPECTED INCREASE IN OUTPUT ENERGY.

Unit fails to turn on. (No green light)

- *Verify that the electrical outlet is functional by plugging in another appliance known good.*
- *Verify that power cord is firmly seated in the appliance entry.* page 2

Unit turns on OK, but unit will not activate. (no yellow light)

- *Verify that the foot pedal connector is attached and seated properly.* page 2
- *Verify that the foot pedal cord is not damaged.*
- *Check foot pedal for obvious faults: does it "click" when pressed?*

Sometimes depressing the foot pedal activates the unit, sometimes not.

- *If the foot pedal is depressed on the extreme corners it may not "click". Be sure to step on it squarely and as fully as practical to avoid this annoyance.*

The yellow "active" indicator comes on OK, but I get no cutting.

- *Verify that the "Flexi-plate" dispersive plate is plugged in at the patient and at the unit.* page 2
- *Verify that the electrode is clean (bare metal showing in the tissue contact area)* page 21
- *Verify that the electrode is fully seated and insulation is not caught in the chuck.* page 28
- *Verify that the dispersive cable is undamaged and functional.* page 29
- *Verify that the hand piece cable is undamaged and functional.* page 29

Poor operation (weak or erratic)

- *Verify that proper initial power setting for the electrode selected is established.* page 8-9
- *Verify that COAG has not been inadvertently selected for an incision or excision.* page 7
- *Verify that heavy, thick fur is not adversely affecting dispersive efficiency* page 20
- *Verify dispersive pad positioning* page 20
- ***Keep electrodes clean*** page 21

Checking operation

The beef steak recommended in the practice section is not the only potential test medium: hot dogs, citrus fruits, apples, cooked chicken, lunch meats, and even bar soap will demonstrate basic operation when placed on the dispersive plate and cut with an incision electrode. Soap should be moistened for this test. Paper, plastic, or metal cannot be cut with electrosurgery. Sparking to ground or the dispersive plate is not a valid test for the Vet * Star. The electrode tip will not get hot outside tissue or a suitable test medium.

Note: when monopolar operation fails to work, try bipolar operation on a test medium. If bipolar operation works, then either the hand piece or the dispersive cable is faulty. If "two point" technique works when monopolar operation does not, then the dispersive cable is faulty.

Checking cables

There are several methods to test cable integrity:

Palpation. Drape the cable over the forefinger and press the insulation firmly with the thumbnail. A soft spot in the insulation reveals an occult fracture in the conductor. A gentle pull on the cable where it enters the hand piece likewise reveals an occult fracture in the conductor hidden within the hand piece when the insulation stretches. Faults typically occur within 3" of the ends, however, running over a cable with a chair or heavy cart can also cause a conductor fracture. Obvious damage or visible scuffing of the insulation usually accompanies the latter condition.

Electrical continuity test. Any electrician, clinical engineer, electronic repair shop, most hardware stores, or most automotive repair shops can do this. It is advisable to flex the suspect cable, particularly near the ends to reveal occult or intermittent conditions.

Radiography. X-ray will reveal occult fractures readily. Fluoroscopy is also very effective.

CAUTION! **Repairs to damaged or faulty cables are not permissible. Replace them if faulty.** *Although the Vet * Star is low voltage compared to conventional electrosurgical generators, the voltage available makes tape or shrink tubing repairs unsafe never the less.*

Hint: Stepping on the dispersive cable during surgery or in working around the OR is the leading cause of dispersive cable failure. The plug is pulled down and bent, typically. When this occurs it often damages the jack as well or else the pin is broken off in the jack. Please consider this when setting up for surgery so as to avoid unnecessary inconvenience.

THE ELECTRODE **must be steam autoclave sterilized before clinical use.** FDA regulations do not recognize chemical sterilization as effective for electrosurgery. Dry heat WILL damage the item. Steam autoclave at 275^{0}F and 15PSI for 30 minutes, or at 275^{0}F and 30PSI for 15 minutes.

The electrode must be visually inspected for insulation damage prior to use. If any insulation fault is evident, DO NOT use the item. Failure to observe this precaution represents significant risk of coagulation burn injury to the patient.

To remove detritus on the wire portion place the electrode on a flat surface to avoid breakage and use fine emery cloth. Do not scrape the electrode since nicks may cause failure in service. Soaking *only* the wire portion of the electrode (not *the insulation*) in hydrogen peroxide will help with removal of stubborn detritus. Brief ultrasound cleaning is acceptable. To maintain optimal efficiency, rub with an aluminum oxide paste (or pumice paste) between the fingers or use very fine emery cloth. Rinse thoroughly in clean water after pre-cleaning.

NOTE! The R-72 lancet electrode is an exception to the cleaning rules. Any tendency to stick is greatly reduced if carbon deposits are left on the sides of the electrode. The recommendation for the lancet electrode is to mechanically clean just the leading and trailing edges. Of course, protienaceous detritus should be removed from the flanks, but the thin carbon deposit left intact.

THE HAND PIECE **must be steam autoclave sterilized before clinical use.** FDA regulations do not recognize chemical sterilization as effective for electrosurgery. Dry heat WILL damage the item. Steam autoclave at 275^{0}F and 15PSI for 30 minutes or at 275^{0}F and 30PSI for 15 minutes. The nose cap should be removed prior to autoclave and placed in bag. Coil the cord loosely when placing in an autoclave bag. **The use of sterile covers is not an alternative to autoclaving.**

The hand piece must be visually inspected for cracks or insulation damage prior to use. If any bare metal shows, a crack is evident, or an insulation fault is evident, DO NOT use the item. Failure to observe this precaution represents significant risk of coagulation burn injury to the patient or clinician.

The hand piece must be dry prior to and during use. Copious frank fluid entering the nose cap represents a burn or shock hazard to the patient or clinician. Splashing is not hazardous.

To insert an electrode, loosen the cap counter-clockwise one or two turns. It is not necessary to remove the cap. Do be sure that the electrode fully seats **and no part of the metal shaft shows**. Tighten the cap by clockwise rotation to secure the electrode in place. If electrode fit is a little tight, remove the nose cap and insert an electrode several times to “break in” the combination. **Do not operate without the nose cap.** Be sure insulation is not caught in the chuck.

Chemical cleaning to remove detritus and fluid stains in preparation for autoclave may be done with mild detergents, 70% ethyl alcohol, hydrogen peroxide solution, or an EPA hard surface rated disinfectant. The hand piece should not be soaked. Rinse thoroughly in clean water after pre-cleaning.

CAUTION! **The hand piece has a finite life in clinical service. It should be routinely replaced after two years of use or 800 autoclave cycles to avoid failure during a procedure.**

DISPERSIVE CABLE

Treat like the hand piece. The dispersive cable is fully autoclavable.

GENERATOR

Disconnect the unit from the electrical supply outlet prior to cleaning. The unit may be cleaned with mild detergent applied with a clean moistened towel. Do not saturate the towel. *Avoid spray disinfectants since frank fluid entering the unit represents a significant electrical shock hazard.* Spraying onto a clean towel and then wiping the unit with the moist towel is the alternative when the contents of a spray can disinfectant are clinically indicated. Disinfectants applied by means of a moistened clean towel are also permissible. Disinfectant residue or cleaner removal from the unit is not necessary. Allow to air dry.

POWER CORD

Treat the same way as the unit itself. **Be sure to disconnect from the electrical outlet first!** Allow to air dry and do not allow fluid to enter the female portion of the cord set.

"Flexi-plate" DISPERSIVE PAD

Clean with soap and water, an EPA hard surface rated germicide, or disinfectant applied with a cloth or spray. Rinse with clean water (or with a dampened cloth) and allow to air dry. Avoid soaking. The "Flexi-plate" is NOT autoclavable and will be damaged if autoclave is attempted.

NOTE! The "Flexi-plate" is made of polyurethane and should not be exposed to acetone, methylethylketone, or hydrocarbon solvents. Although very durable for years of service, if the inner conductive metallic fabric shows then the "Flexi-plate" should be replaced. **DO NOT use the "Flexi-plate" if the inner conductor shows** due to a possible risk of "Bovie" burn at that site.

FOOT PEDAL

The foot pedal may be cleaned with mild detergent, 70% isopropyl alcohol, hydrogen peroxide, or an EPA hard surface rated disinfectant. Allowing frank fluid to enter the foot pedal should be avoided since the foot pedal is rated IP20 "splash-proof". Inundation of the "splash-proof" foot pedal may enter the mechanism causing continuous activation. **If the "splash-proof" foot pedal is inundated the electrosurgical unit should be PROMPTLY switched off and the foot pedal should be replaced or referred for service prior to subsequent use.**

WARNING! Frank fluid entering the Vet * Star generator represents a significant risk of serious electrical shock. If frank fluid enters the unit, **disconnect from the electrical outlet** *(do not touch the unit itself)* **and refer the unit to qualified service personnel.** *Do not attempt reuse until the unit has been thoroughly inspected and tested.*

WARNING! Lethal electrical voltages exist within the generator when energized. **Do not open the cabinet of the unit or attempt repairs due to the risk of serious injury or death.** *Refer all servicing to qualified service personnel.*

HPAC-1

NCS-1

DPC-2

FDP-1

Foot Switch 61.102

Hospital Grade Power Cord 01.096

R-10 R-53 R-72 R-12 R-34 R-45 R-31 R-51 R-52

Bipolar Forceps and Cable

BPF-C2
Angled style, serrated
100mm, .75mm tips

BPF-S1
Jeweler's style, smooth
114mm, micro tip

BPF-S2
Straight iris style, serrated
100mm, .75mm tip

BPF-C1
Curved Jeweler's style, smooth
114mm, micro tip

Forceps are normally supplied with a "MACAN bipolar" cable. For the "MACAN bipolar" cable alone, please contact Customer Service directly.

NOTE: colors may vary from the illustrations

WARNING! **Do not use MACAN supplied bipolar accessories with a ground referenced electrosurgical instrument due to risk of injury to the patient or failure to perform the intended bipolar function under adverse conditions.**

Fulguration adaptor

Shown here in use with the MV-7A small animal precision veterinary electrosurgical generator.

ME6000

Waterproof foot pedal

Rated IP68 for especially harsh environments. Will tolerate full inundation. Like the standard IP20 pedal, it is rustproof.

IP68 foot pedal

Bipolar neuro-surgery adaptor This accessory reduces RF leakage to **full bipolar specifications** allowing neuro-surgery to be performed safely and reliably using industry standard sterile disposable bipolar incision and excision pens (available from leading medical distributors). This feature may be of special interest to animal laboratories working with bio-electric implants since electrosurgical incision with its concurrent haemostatic capability may be safely applied.

The adaptor also allows switching between monopolar floating jacks and bipolar jacks so that monopolar (or "two-point") and bipolar accessories may be safely plugged in simultaneously. Alternately, both monopolar and "two-point" may be plugged in simultaneously. Note that the standard HPAC-1 hand piece is also available in white (CHPAC-1) to allow ready differentiation when two hand pieces are used that way. The bipolar neuro-surgery adaptor comes with its own manual to fully explain its uses. **Order the "standard American pattern" bipolar cable for use with this adaptor** (the regular MACAN bipolar cable has the wrong plug for this adaptor).

Medical (2,65mm) .093" shaft hand pieces and electrodes

These hand pieces allow industry standard medical electrodes to be used with the Vet * Star allowing the surgeon access to the wide array of specialty electrodes available from leading medical suppliers (for example, long de-barking electrodes or ablation electrodes). Like the standard size hand pieces, the medical size hand pieces are also available in black or white to allow ready differentiation in the OR.

MACAN manufactures an extensive line of medical size electrodes. Please visit us on the web.

www.MacanManufacturing.com

The MACAN Vet * Star veterinary electrosurgery is warranted for 5 years from date of purchase, *exclusive of accessories*.

The warranty does not cover accidental damage. Damage arising from dropping, falling, or inundation will be assessed at normal repair rates. Damage from shipping must be reported to the common carrier and will be assessed at normal repair rates. Damage arising from improper packing will be assessed at repair rates. If the correct carton and packing materials are required to safely return a unit, please request them when the warranty claim is made.

All domestic warranty claims must be made through the MACAN business office to obtain a Return Authorization number for prompt service, proper credit, and accurate tracking. Warranty claims made through domestic dealers will be honored, but do please be aware that this will take a little more time. Customers outside the USA should submit warranty claims to their dealer.

The warranty is void if the unit cover is opened. Hospital clinical engineering departments, military medical equipment maintenance departments, and dealer repair departments should make special arrangements with the MACAN Customer Service Department before attempting repairs to a unit under warranty.

The warranty and all liability to MACAN is void if the unit or accessories are modified or tampered with. For special requirements, such as requests for schematic diagrams, contact the MACAN Customer Service Department.

Units returned for credit are subject to a restocking charge. Units returned for credit must be complete with all accessories since charges will be assessed for missing items.

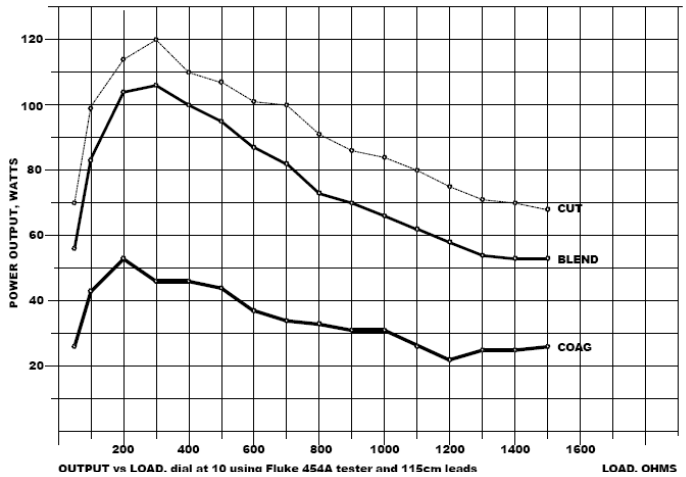
USED ELECTRODES CANNOT BE RESTOCKED

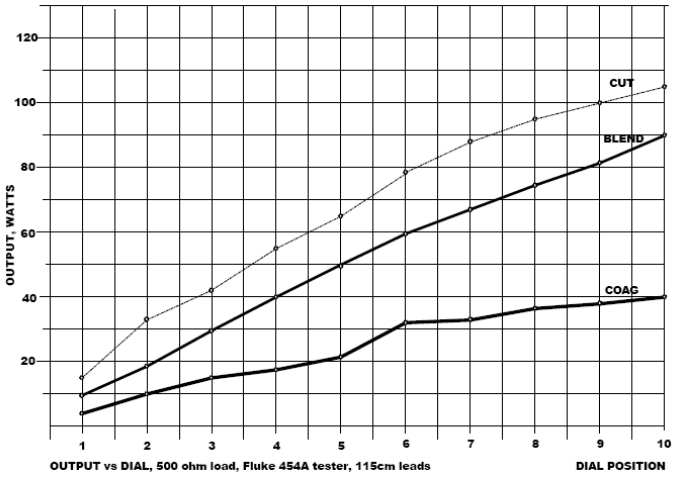
NOTICE! **Do not return a unit under warranty or for service that is biologically contaminated. Please clean a contaminated unit or accessory or else pack it in an appropriate biohazard bag and label it accordingly.**

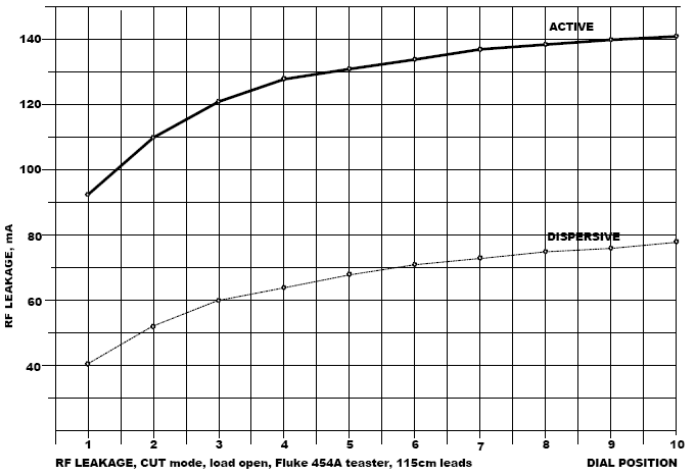
DISCLAIMER: **MACAN does not accept responsibility for the use of accessories other than those supplied by MACAN or those authorized in writing for use with the MACAN Vet * Star. Failure to function, damage to the unit, and injury to the patient or operator arising from the use of non-approved accessories are hereby disclaimed.**

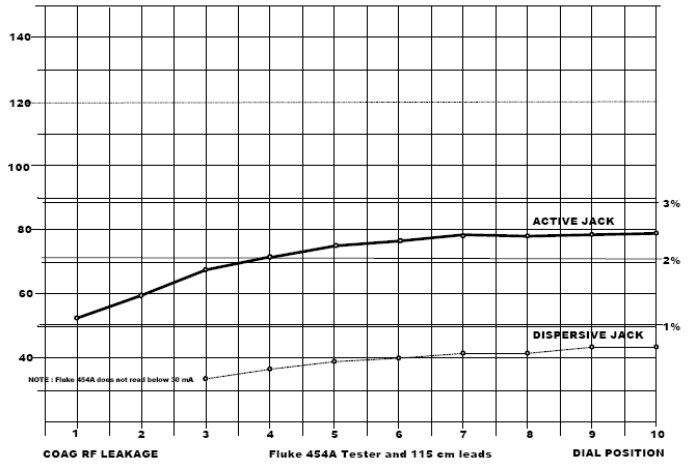
Technical Support:
Monday through Friday
9:00am—5:00pm Eastern Time
Telephone: 302-645-8068
Fax: 302-645-7049
Email: info@macanmanufacturing.com
Address: 21 Shay Lane, Milton, DE 19968

A Vet*Star Service Manual is available to qualified services organizations (see warranty)









Output: CUT 120watts (+/- 10%) into 300ohms, crest factor 1.4, unmodulated
BLEND 105watts (+/- 20%) into 300ohms, crest factor 1.9, 2x line modulation (sine)
COAG 55watts (+/- 25%) into 300ohms, crest factor 2.6, 1x line modulation, (½ sine)
Frequency: 3.0mHz, +/- 5%
Voltage: 1kVp-p (est.) CUT mode, open load, "10" setting
Source Impedance: 300ohms, nominal

Operation: 0^0 C to 35^0 C, 80% R.H., non-condensing (00 C to 85^0 C storage)
duty cycle: 10sec ON, 20sec OFF (non-enforced)
manual analog power control, no units specified
single foot pedal activation control
convection cooling
splash rating: IP0

Dimensions: 9" wide, 3 ¾" high, 12 ½"deep (exclusive of knobs and jacks)
228,6mm w, 92,25mm h, 317,5mm d (exclusive of knobs and jacks)
8# net, 11# shipping 3,64kg net, 5kg shipping

Power requirement: 120V 60Hz (+/- 10%), max consumption 360watts
230V 50Hz (+/- 10%), max consumption 360VA (optional, to order)

Refer to international standards IEC 60601-1-1 Medical Safety and IEC 60601-2-2 Special High Frequency Surgical

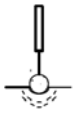
Non-ionizing radiation symbol This symbol represents electromagnetic energy, specifically radio frequency electrical energy.

Type BF applied part symbol This symbol represents the degree of protection against mains power electrical shock hazard provided by the port (jack) to which it refers. For the Vet * Star this degree of protection applies to both the hand piece jack and the dispersive jack.

Floating symbol This symbol refers to isolation from the electrical distribution grid earth ground. This applies to both the hand piece and dispersive jacks. Radio frequency energy is significantly restrained from going into earth ground. In turn this implies that the Vet * Star cannot perform monopolar electrosurgery without the dispersive plate, also that Vet * Star is safe for concurrent use with physio-monitors.

Monopolar pure CUT incision symbol This symbol indicates incision without significant concurrent haemostasis.

Monopolar BLEND cut incision symbol The dashed lines adjacent to the incision indicate coagulation which induces significant concurrent haemostasis during the incision.



Monopolar COAG symbol The dashed lines indicate coagulation.

Dispersive electrode symbol For Vet * Star this is the “Flexi-plate” dispersive pad. The port (jack) to which this symbol refers is also used for the monopolar forceps used in “two-point” technique, made possible by the isolated output.

NOTE! The Vet * Star is rated as “isolated”. Although “isolated” and “bipolar” generators share similar RF isolation output circuitry, and both types significantly constrain therapeutic current from flowing into earth ground, “bipolar” is a significantly greater degree of isolation than “isolated”. “Bipolar” is suitable for neuro-surgery whereas “isolated” is not.

WARRANTY INFORMATION AND NOTES

Date of Purchase _____ **Serial Number** _____

Dealer _____

NOTES

Thank You

MACAN Manufacturing

Notes:

Notes: