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VHF TRANSMITTING SUBSYSTEM HANDLING GUIDE

Please read this summary sheet immediately upon receipt of your transmitters and again prior to deployment of your units. Not all information concerning handling, deployment, and operation can be included in this short guide and if you have any questions or concerns that are not addressed in the guide please contact the factory before deploying units in the field. Not all the information included in this guide may be relevant to your equipment, but the majority of the information is critical to your successful use of the transmitting subsystems. Telonics Transmitting subsystems are guaranteed against defects in materials and workmanship and specific warranty information can be found on the website for specific units. Note that the transmitter frequencies, pulse widths, pulse periods, and some additional specifications are provided on the Transmitter Test Data form or contained within the .tpf programming files or printed record of the programming records of the files called .tpf records. You should have received this information in an email prior to receiving your units or alternatively with each shipment of transmitters. It is the user's responsibility to understand the programming, field operation and correct handling of the transmitters before the units are deployed.

TURNING UNITS ON/OFF

Most Telonics transmitting subsystems are provided with power supplies (batteries) and use a magnet taped to the unit as a means to keep the unit turned off during shipping and storage. The correct magnet position is often indicated by a line, blue arrow, or blue dot on the unit but on some configurations such as some implants there is no external indications of the correct position for the shutdown magnet. With transmitters designed for implantation the magnet is taped in place on the bag containing the implant, rather than on the implant itself, to avoid damaging the wax coating. In the case of implants it may be necessary to place the magnet in a few positions to find the place where the magnet will induce a shutdown.

Upon receipt, we suggest the user first verify that the unit is not transmitting due to handling by receiving personnel. We also recommend that the user verify operation of each transmitter with a receiver to confirm that they can be properly tuned to each transmitter frequency on the receiver to be used in the study. To do so, remove the magnet from one transmitter at a time, test that transmitter, and replace the magnet to assure the transmitter is off. This testing of one transmitter at a time is suggested because transmitters operating in very close proximity to the receiver (e.g. in the same room) may "bleed over" onto adjacent frequencies. Such "bleed over" resulting in what sounds like a “dull click” rather than a “clear tone” should not occur in the field because of the greater distance between the transmitters and receiver.

TRANSMITTER STORAGE:

When storing transmitters, each transmitter should be tested with a receiver to verify that the magnet is properly positioned and the unit is shut down for storage. Special care must be taken with units that have been programmed with transmission duty cycles and may have periods of time when the transmitter might not be transmitting. The “off period” could be wrongly interpreted by the user to conclude the unit is actually shut down. If long-term storage is anticipated, the magnet should be removed for one or two days each month to maintain proper battery condition. Be sure that during storage, magnets are not in close proximity (<1 inch) from each other and that the magnet is not placed on metal shelving. This is to avoid the magnetic flux field being canceled, and the transmitter unknowingly being turned on, thereby consuming battery capacity and reducing operational life. Once the transmitters are in storage, each frequency should again be checked on a receiver to be sure that the transmitters are indeed off.

INITIALIZING TRANSMITTERS FOR OPERATION:

There are several versions of transmitter electronics used in various configurations designed for different animal species. To assure you are using the correct initialization procedure for your device the user must first determine which transmitter electronics are used in their configuration. The ordering process with Telonics’ staff involves selecting the configuration model number and transmitter electronics that will be used. It is also possible to go to the website and determine which transmitter electronics are in each VHF transmitter configuration. If you are still uncertain please contact the factory.

1. UNITS THAT ARE NOT MICROPROCESSOR CONTROLLED

CHP units are the only transmitter electronics that are not microprocessor controlled. These units are designed to shut down when the magnet is present and transmit when the magnet is removed. These units do not have duty cycling capabilities.

2. MICROPROCESSOR CONTROLLED UNITS

There are now several versions of microprocessor controlled VHF configurations each with different transmitter electronics inside. Generally speaking all these units simply shut down when the magnet is applied for a few seconds. However, the start-up sequence can be slightly different depending on the microprocessor and software contained in the unit you purchased. If you are uncertain about the type of transmitter electronics used in your configuration please contact the factory for clarification and to assure the proper start up and operation of your units.

INITIALIZING MK-8 AND MK-9 ELECTRONICS

When the magnet is removed from MK-8 or MK-9 microprocessor-controlled transmitters there should be an initial rapid series of 4-5 pulses which indicates proper start-up. These pulses should be monitored on your telemetry receiver when tuned to the correct transmission frequency. If this rapid series of pulses is not heard, replace the magnet and leave it in place at least two seconds before attempting to restart the transmitter. If for any reason the unit does not transmit the 4-5 pulses at start up the unit should not be deployed.

Special considerations when starting units with duty cycles:

Transmitting Subsystems built with MK8 electronics - if the VHF microprocessor-controlled transmitting subsystems have a programmed duty cycle, special steps are required when starting the transmitters. These microprocessor-controlled transmitting subsystems do contain a clock, but not a “real time clock” or “RTC”. The clock is calibrated to time zero based on removal of the magnet. Because the clock is not a RTC and is not synchronized to calendar date and time of day, the magnets must be removed from the transmitters at the right time to assure proper duty cycling. ***If the goal of your study is for all of the units to turn on and off at specific times and dates, the magnets should all be removed at the same time.*** If the magnets are reattached after being pulled, the duty cycle will reset to the beginning and the unit will need to be reinitialized to start at the correct time.

Transmitting Subsystems built with MK9 electronics - The microprocessor-controlled transmitting subsystems contain a real time clock or RTC and are synchronized to calendar date and time of day. The removal and replacement of the magnet is for turning the units on and off and does not affect the duty cycle start times if you happen to pull the magnet during a time period when the unit is scheduled to be in an off period

INITIALIZING MK-11 AND MK-12 TRANSMITTERS

As with Telonics' other VHF transmitters, the MK-11/12 devices are shut down and started up using a magnet. MK-11/12 devices contain an internal Real Time Clock (RTC) which allows them to properly duty-cycle On and Off at specific times of day that you specify when you order the transmitters, and are programmed into the units at the Telonics factory. The programming must be specified by the user and is always input in

UTC time to avoid confusion with regard to local time and such local time issues as Standard time versus Daylight Saving Time. This means that the time at which the magnet is removed does not affect the times at which On or Off periods begin or end. As the end user, you can also modify the operational parameters including duty cycle timing yourself by utilizing Telonics' Product Programmer software (TPP) and program them into the transmitters by connecting the transmitters to your PC with an appropriate Telonics' Smart Cables (TSC-XX). If you have any questions about programming your MK-11/12 transmitters, please contact the factory for more information.

You should always test each of your transmitters one at a time or by moving away from other operating transmitters to avoid any possible confusion over receiving signals from more than one transmitter at a time. Tune your telemetry receiver to the correct frequency of the transmitter being tested as indicated on the transmitter final test data sheet or .tpf record you received with your units. Remove the magnet from that unit. Approximately 5 seconds later, the unit will transmit a single burst of 2 rapid pulses to indicate that it is 'starting' operation. This will then be followed by 'normal' single pulses at the pulse period defined by the unit's operational parameters as described in the .tpf programming record that you received by email or with the transmitters.

'Normal' single pulses may be -- a fixed pulse period, a pulse period that defines the current temperature, or a pulse period that defines the current activity level. Based upon when you removed the magnet, it is also possible that the Duty Cycle parameters programmed into the unit could place the unit in an 'Off' period at this exact point in time. Some units are programmed to transmit at a 'very slow' pulse period (1 pulse every 5 seconds) during this 'Off' time, allowing you to still hear them transmit. However, some units are programmed to be completely 'Off' during these periods, transmitting NO pulses. Check your .tpf record to see how your units are programmed during the “Off” periods.

To make testing easier, units are typically programmed with a Predeployment Season Duration of 1 hour, which is utilized to guarantee that from the time that the magnet is removed, the unit will be 'On the air' transmitting its 'Normal' pulses for a period of 1 hour, allowing ample time for testing. After the 1 hour period completes, the unit will resume its 'Normal' programmed behavior, to include 'Off' periods, if so programmed.

After proper operation of the unit is verified, continue listening to the transmissions with your receiver and replace the magnet. After approximately 5 seconds, the unit will transmit a single burst of 3 rapid pulses, and then go off the air completely, showing that it is successfully shut down.

NOTE: Cold Temperature Operation: The VHF microprocessor-controlled transmitting subsystems have a normal operating temperature range of -40°C to +65°C. As a customer, you may have requested that your units be cold temperature tested to -40°C to ensure proper operation. At temperatures less than -40°C, the units could be affected. Several components in the transmitting electronics are not rated below -40°C. The batteries used to power the units are not rated for operations below -40°C.

Conventional VHF telemetry units are subject to similar limitations. However, when the units are warmed to higher temperatures, they will resume normal operation. In the case of the microprocessor-controlled VHF transmitting subsystems, there is a possibility of the microprocessors resetting at extremely low temperatures, in which the duty cycling could be interrupted and reset to the beginning of the cycle or even lose the RTC time.

TRANSMITTER ELECTRONICS: SUPPLIED WITHOUT BATTERIES:

If the user is supplying their own power supply, the transmitter electronics provided by Telonics still includes a reed switch or a magnetically sensitive electronic switch to allow on/off switching via a magnet. After connection of the power supply, shut the transmitter off with a magnet and then restart it by removing the magnet. This assures proper start-up, which is not always accomplished by simply connecting power. Be sure not to apply excessive voltage or reverse-voltage to the transmitter!

Remove the magnet and verify transmitter operation before deploying the transmitter.

COLLAR MOUNTED TRANSMITTERS:

Overall performance of your telemetry system depends on many factors, including the characteristics of both the receiving and transmitting subsystems, the environment in which tracking is conducted, and the specific characteristics and behavior of the animal which is being tracked. The manner in which the transmitting antenna is deployed on collar mounted transmitters is also an important consideration, and a few important technical realities must be carefully considered in such deployments. All materials, even multi-stranded stainless steel cables, fatigue. Any exposed portion of the antenna will eventually break as a result of this metal fatigue. The time frame may vary from weeks, to months, to years, depending on the species, the antenna gauge or thickness, the antenna material, and percentage of antenna exposed. If the antenna breaks before the battery capacity is fully utilized, the result will be a reduction in range performance. The shorter the remaining antenna, the more limited the range. In addition, the antenna does not perform very well when it is wrapped back on itself, or brought in close proximity to the metal canister housing the transmitter due to proximity effects. Therefore, in many cases a compromise must be achieved, protecting as much antenna as possible without exposing the remainder of the antenna to the negative effects of proximity to itself or other metal objects. We hope an acceptable compromise has already been established in discussions between you as the principal investigator and our technical staff. The instructions below should aid you in making last minute adjustments to the antenna structure when deploying your transmitter collars on animals.

ANTENNA ISSUES FOR COLLAR MOUNTED TRANSMITTERS:

MONOPOLE WHIP ANTENNAS:

The large majority of Telonics transmitters are supplied with a monopole, whip antenna. When mounted on a collar for attachment to an animal, one of two basic designs is typically used. In the first design, the antenna is completely internal, or at least as much of the antenna as possible is internal. When the antenna cable is longer than the collar, an exposed portion extends out the end of the collar material. With the second design, the antenna is exited from the collar material somewhere along the length of the collar. For reference sake, we call the first type of antennas "Internal", and the second type "External". During the process of ordering your transmitters and collars, you were probably asked whether you preferred an Internal or External antenna, and the collars where built accordingly.

When specified as External, antennas are typically exited from the collar prior to the first adjustment hole. This allows for protection of the maximum amount of antenna possible, given the range of neck circumferences and preference for an external antenna as you specified at the time of order. In general we recommend no more than 6 inches of external antenna. External Antennas generally require no special modification prior to deployment; however, the researcher should realize that external portion of the antenna is subject to eventual breakage as indicated above. On animals with relatively small necks, or on collars designed for a wide range of neck circumferences, the exposed section of antenna can be quite long. The longer the exposed portion of antenna the more likely it will be that the antenna will break in a shorter period of time after deployment. We typically recommend that no more than 6 inches of antenna is external to the collar. Loss of the exposed portion of the antenna can result in significant reduction in system range performance.

Internal Antennas (i.e. those with the antenna cable enclosed completely within the collar or exiting out the end of collars when collar length is shorter than antenna length) are utilized for many animals, especially those which are predictably likely to break off any external portion of an antenna. With most carnivores, and in a number of other applications, Internal Antennas are left completely enclosed within the collar when the collar is deployed on the animal. This affords maximum protection to the antenna. In some other applications, the researcher may elect to order collars with Internal Antennas, but then exit the antenna from the collar themselves when collaring each animal. Diagram 1 illustrates exiting of the antenna 75-80% of the distance around the circumference of the neck. Deployment of the antenna in this manner provides the improved power radiation of an External Antenna, while allowing most of the antenna to be kept internal (and protected from breakage) as opposed to the External Antenna design described above. When exiting the antenna, the biologist should cut a small hole in the outer collar material and carefully withdraw the antenna from the collar. Care should be taken to be sure not to damage the antenna or its plastic coating when exiting the antenna from the collar.

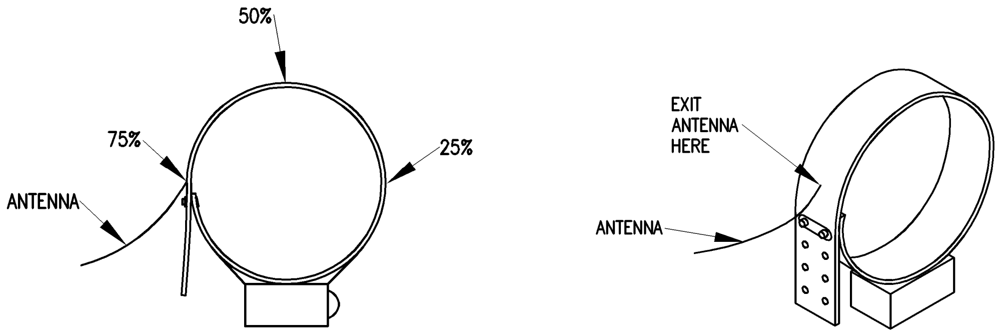

DIAGRAM 1

DIPOLE WHIP ANTENNAS:

On large species of animals it is sometimes possible to use a dipole antenna, in which case the transmitter appears to have two antennas. One antenna is called the "hot antenna" and the other the "cold antenna" as shown in Diagram 2. The most important antenna is the hot antenna, and it is the one most protected by the collar. The second antenna is usually only partially protected in the collar. The exposed portion of the cold antenna will break after a time. The additional range provided by the dipole may be enjoyed until the antenna breaks. In order to gain the benefits of the dipole the two antennas must remain as far apart as possible. The ideal case is shown in Diagram 3 to be 180° apart. Little benefit is realized if the tips of the two antennas are brought within 8"-12". If, as in Diagram 4, the tips of the two antennas are brought closer together than 8"-12", the range of the transmitting subsystem is actually degraded.

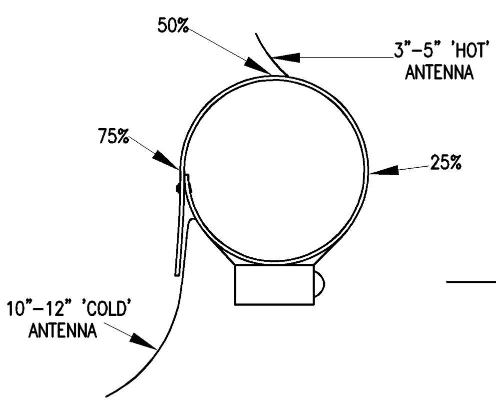

DIAGRAM 2

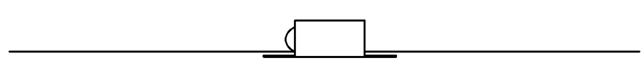

DIAGRAM 3

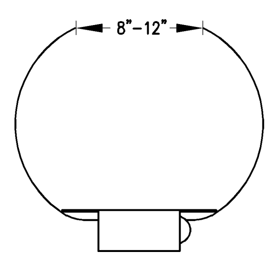

DIAGRAM 4

BREAKAWAY/EXPANSION COLLARS:

Breakaway and expansion collars present special collar design challenges. The time frame for breakaway to occur can vary dramatically, depending upon environmental conditions for a given study site, and behavior of individual animals. Actual breakaway times, or performance of an expandable collar can only be determined empirically for a given species in a given environment. Telonics is quite willing to offer available technical information or to aid the researcher in establishing estimates of breakaway and expansion times prior to the initiation of a large scale instrumentation effort. However, stated breakaway times or expansion performance varying with conditions in the field and therefore the estimates are gross approximations only, and are not subject to warranty.

IMPLANTABLE TRANSMITTERS:

As previously mentioned, the magnets used to turn implantable transmitters off are attached to a plastic bag enclosing the implant, rather than to the implant itself, so as to avoid damage to the wax coating. Care must also be taken not to expose implants to extreme temperatures. The wax coating is designed for use at physiological temperatures. Excessive heat will melt the wax, and excessive cold can cause the wax to crack. Both should be avoided.

Implants should be "sterilized" prior to use. For example, soaking the implants in a dilute solution of Zephiran Chloride for approximately 24 hours has proved successful. Use of alcohol is not recommended because there has been some evidence of alcohol adversely reacting with the polymers used in sealing some implants.

Sterilization of Implantable Transmitters:

Telonics transmitters designed for implantations are coated in a physiologically compatible wax which also acts as an important part of the moisture barrier. The wax is heated to approximately 100°C for its application and, after cooling, the implants are placed in plastic bags to keep them clean (but they are not sterilized) prior to use. ***Implant transmitters coated in physiological wax should never be exposed to temperatures exceeding 45°C.***

Previously, we have recommended the implants be “cold sterilized” prior to implantation, for example, by soaking in zephiran chloride for 24 hours. Review of articles published in wildlife journals regarding use of implantable transmitters revealed a number of chemicals which have been recently used for “sterilization” of implants. These have included ethylene oxide (gas), chlorhexidine diacetate (Nolvasan), povidone-iodine, zephiran and benzalkonium chorides, ethyl and isopropyl alcohols, glutaraldehydes (Cidex), and Hibitane. According to the articles on sterilization techniques, length of submergence of the implantable transmitters in the chemicals ranged from a dip or rinse to soaking for 24 hours. Several of the articles mentioned a rinse in sterile saline prior to implantation, and one mentioned warming the “sterilant” and rinse to near body temperature. The following information is provided as a starting point for those desiring additional information on this topic, but this information should not be regarded as a complete review of the topic.

Most of the implant preparation procedures mentioned above from the wildlife literature is more accurately referred to as disinfection rather than sterilization. Exact definitions of these terms vary somewhat between sources, as does the categorization of specific techniques or chemical compounds. Sterilization is generally defined as the complete elimination of destruction of microbial life, including all bacteria, mycobacteria, fungi, viruses, and spores. Spores are the most difficult to kill of the life forms just mentioned, thus, methods or substances which killed spores, termed sporicides, were often considered synonymous with sterilants. Some protozoan cysts and metazoan (e.g. pinworm) eggs have now been shown to be more difficult to kill at room temperature than spores. Chemical “cold-sterilants” are ineffective against these materials, thus they should perhaps not be classified as sterilants. This is an area currently under debate.

Disinfection is a somewhat looser term, generally describing a process which eliminates many or all pathogenic microorganisms, excepting spores (and now also cysts and metazoan eggs). High-, intermediate-, and low- levels of disinfection are sometimes referenced. Not all disinfectants are effective against all types of microorganisms, and manufacturers labels should be checked to verify whether a specific substance has been tested and proved effective against a wide range of microorganisms.

In hospital settings, sterilization is recommended for items which will enter tissue, the vascular system or blood. High-level disinfection is recommended for items which contact mucous membrane or non-intact skin. Intermediate- and low-level disinfection are typically used for items which only contact intact skin, such as linens, furniture, walls, crutches, etc.

Methods of actual sterilization include wet heat (≈121°C), dry heat (≈160°C), ethylene oxide gas, chemical soaks, and radiation. Disinfection is typically accomplished by an appropriate chemical disinfectant. Wet and dry heat sterilization techniques are not applicable for use with implantable transmitters as used in wildlife because the temperatures required would melt the outer wax coating. Whichever methodology is selected, ***Implant transmitters coated in physiological wax should never be exposed to temperatures exceeding 45°C.*** Radiation sterilization is effective and operates at room temperatures, but it is expensive and not widely available. Gas sterilization is a recommended technique if implantation is being conducted in a controlled hospital setting. With gas sterilization it is also possible to sterilize implants within special packaging, which can then be used to maintain sterility during storage and transport to field sites. Doubly wrapped packages can remain sterile for six months. Care must be taken during storage and transport of the implants to the field because extreme heat, cold, or moisture can be detrimental to the sterile wrapping, and extreme temperatures can also damage the wax coating on the implants.

Gas sterilization with ethylene oxide has proven to be effective against all pathogens when properly carried out. Gas concentrations, temperature, relative humidity, and exposure time interact to determine effectiveness. Although the general ranges used for sterilization of surgical devices and instruments include concentrations between 450-1200 mg/liter, temperatures between 29-77°C, humidites between 30-85%, and exposure times between 2-12 hours care should be taken to avoid melting the wax on implantable transmitters. ***Implant transmitters coated in physiological wax should never be exposed to temperatures exceeding 45°C.***

Ethylene oxide sterilization leaves toxic residues; therefore, sterilized objects must be aerated prior to use or implantation. Aeration chambers are typically a component of the overall sterilizing equipment. Metal or glass objects should be aerated at 50°C (too high a temperature for wax coated implants) for 2 hours, while more absorbent materials such as PVC have recommended aeration times of 12 hours. The wax coated implants should be aerated in the chamber for 12-24 hours. Storage in a sterile pack on a shelf at room temperate for a week or more is probably also beneficial in providing additional aeration. Ethylene oxide is also considered a carcinogen, and in the U.S. there are regulations regarding its use. In summary, ethylene oxide is a favored sterilant but it does require specialized equipment and care must be taken to use it properly.

To date, chemical soaks have been the technique most frequently used in a preparation of transmitters for implantation in wildlife. As previously mentioned, whether chemical soaks at room temperature should technically be considered sterilization or disinfection is in debate. There is general consensus, however, that some chemicals are better than others for such disinfection or sterilization, and that it is important to follow manufacturers' guidelines when using chemical disinfectants or sterilants. Objects to be disinfected or sterilized should first be cleaned and rinsed because excessive organic matter can reduce the effectiveness of many chemical sterilants and disinfectants. Dilutions, if required, should be made in accordance with manufactures' instructions because effectiveness of the chemicals can be reduced at either too high or too low concentrations (hard water may also reduce the effectiveness of some chemicals, so deionized water should be used if recommended). Chemicals should be freshly mixed prior to use as a sterilant or disinfectant for implants because their effectiveness can decrease over time. The pH of solutions is also important in their effectiveness. Buffers within many solutions will maintain the pH over a range of dilutions, but again this is reason for closely following manufacturers' recommendations. Temperature and contact time of the implant (or other object to be sterilized) with the chemical solution are also important, with a minimum of 6-10 hours soaking at room temperature recommended for many solutions. A rinse in sterile, physiological saline after soaking in the disinfectant or sterilant is recommended since some of the chemicals used can be irritating to tissues.

Although specific recommendations and classifications (i.e. sterilant or disinfectant) vary between spores, three groups of chemical compounds are generally recommended as sterilants. These are glutaraldehyde-based formulations (2%) demand-release chlorine dioxide, and stabilized hydrogen peroxide (6%). Other chemicals including most of those referenced above from the wildlife literature are typically classified as disinfectants of various levels. Table 1 briefly summarizes information on a number of chemicals as compiled primarily from Boatfield & Clifford 1984, Harrison & Malinke 1991, Rutala 1987, and Ratala 1990. Block 1983, Block 1991, and Gardner & Peel 1986 provide more in-depth information (e.g. modes of action, details of use, tests of efficiency, etc.) on chemical sterilants and disinfectants, ethylene oxide gas sterilization and other sterilization techniques.

Note: Information taken from a Telonics Quarterly Article written by Bill Burger, Telonics Don DeYoung, DVM, University of Arizona and Dave Hunter, DVM, Idaho Fish & Game

Table 1 Chemical compounds commonly used as sterilants or disinfectants

COMPOUND	EFFECTIVE AGAINST	COMMENTS
glutaraldehyde-based, 2% (e.g. cidex)	bacteria, fungi, viruses, spores	Must be activated to alkaline state (pH 7.5 – 8.5) to be sporicidal, generally non-corrosive, can irritate skin & mucous membranes
demand-release chloride dioxide	bacteria, fungi, viruses, spores	Can corrode aluminum, copper, brass, series 400 stainless steel, & chrome w/ prolonged exposure; inactivated by organic matter
hydrogen peroxide, 6%	bacteria, fungi, viruses, spores	Can corrode copper, zinc, & brass
ethyl & isopropyl alcohols, 70-90%	bacteria, fungi, some viruses	Flammable, volatile
iodine (as an iodophor, e.g. povidone iodine)	bacteria, fungi, viruses	Proper dilution critical, may irritate mucous membranes and stain; inactivated by UV light, heat, organic load
quatemary ammonium compounds (e.g. benzalkonium and zephiran chlorides)	most bacteria, fungi, some viruses	Not completely effective against gram negative bacteria; hard water, soap, soil, anionic residues decrease effectiveness
chlorhexidine (e.g. nolvasan)	some bacteria, fungi	Inactivated by soaps and some detergents; non-toxic, non-irritant generally used as skin and mucous membrane disinfectant and antiseptic

Sources:
Block, S.S. (ed). 1983. Disinfection, Sterilization, and Preservation, 3rd ed. Lea & Febiger, Philadelphia. 1053pp.
Block, S.S. (ed). 1991. Disinfection, Sterilization, and Preservation, 4th ed. Lea & Febiger, Philadelphia. 1162pp.
Boatfield, M.P. & D.H. Clifford. 1984. Disinfection in Veterinary Medicine. Veterinary Technician 5(1):31-38.
Gardner, J.F. & M.M. Peel. 1986. Introduction to Sterilization and Disinfection. Churchill Livingstone, Melbourne. 183pp.
Harrision, S.K. & C. Malinke. 1991. Selection and Use of Disinfectants and Sterilants. American Assoc. For Laboratory Animal Science 30(2):10-14.
Rutala, W.A. 1987. Disinfection, Sterilization and Waste Disposal, in Prevention and Control of Nosocomial Infections, R.P. Wenzel (ed). Williams & Wilkins, Baltimore. 641pp.
Rutala, W.A. 1990. APIC Guidelines for Selection and Use of Disinfectants. American J. of Infection Control 18(2):99-117.

CALIBRATING TEMPERATURE SENSITIVE IMPLANTS

If transmitters include temperature sensors, a calibration curve of pulse period relative to temperature should be established prior to use. A circulating water bath should be utilized, and the transmitters should be allowed to stabilize at each calibration temperature. The relationship between pulse period and temperature is not linear, so a sufficient number of calibration points should be utilized to achieve a proper curve over the range of temperatures of interest.

IMPLANTS WITH EXTERNAL ANTENNAS

Most implantable transmitters utilize internal antennas. There are, however, some implants which utilize flexible whip antennas. The ends of these whips have been sealed to prevent fraying. The length of the whips is as decided at the time of order. If, for some reason, the whips need to be shortened please contact our laboratory.

AVIAN ATTACHMENTS:

A wide range of attachment methods have been utilized on birds, and a discussion of all these is well beyond the scope of this paper. Even within a generalized attachment method; for example, backpacks, a number of different materials, harness designs, and fitting techniques have been utilized. Your transmitters have been designed for the type of attachment specified at the time of order.

TRANSMITTER MODULES SUPPLIED WITHOUT POWER SUPPLIES

Telonics offers many customized collar and attachment designs to meet the needs of individual research objectives. However, we also provide the transmitter, battery and all interconnects sealed in a metal canister ready to be mounted on a collar, harness etc. as supplied by the researcher. For users who prefer to provide their own power supply, packaging and attachment, we also supply transmitter electronics alone. Under such circumstances, the researcher assumes all responsibility for proper completion of the transmitting subsystem. We will be happy to provide technical advice or review a design upon the request of the researcher. We assume no responsibility for problems resulting from designs which have not received prior approval from Telonics.

CONCLUSION:

It is a generally accepted fact in the wildlife field that Telonics stands behind our products. You will find our staff eager to assist you in achieving your goals at any time during the course of your study. Those researchers who have been most successful have not hesitated to seek information prior to procuring equipment and beginning their work, and have maintained active avenues of communication throughout their projects. Please call prior to the deployment of the transmitters if you have any questions, or if we can be of additional assistance. We want to help you be successful.

GOOD LUCK IN YOUR WORK!