MICROCHIP ID

Critical factors in selecting RFID transponders and delivery systems for use in animal studies

Introduction

One of the most fundamental risks adversely impacting animal research programs is unreliable or inadequate animal traceability. As the market moves towards digital solutions using RFID technology, and away from manual ones, such as tattooing or ear tagging, it is clear that without an extremely reliable and consistently performing tracking system the integrity of the overall program could be compromised. Clearly, the use of any approach, especially involving implanted devices, must also consider the impact on the animal's welfare and care must be taken to avoid imparting any unnecessary stress on individuals during implantation.

In view of the above it is important to note that there is a tendency to assume that all RFID transponders provide a similar level of quality, durability and ultimately, reliability, irrespective of type and mode of manufacture. This is in fact not the case and in order to guarantee both performance and dependability over an extended period, it is important that the transponder meet certain minimum requirements.

Similarly, with respect to implanting the device, the level of stress and overall discomfort experienced by the animal can vary significantly when comparing different transponders and/or the injection devices/techniques used to deliver them.

Mechanical Properties to be considered

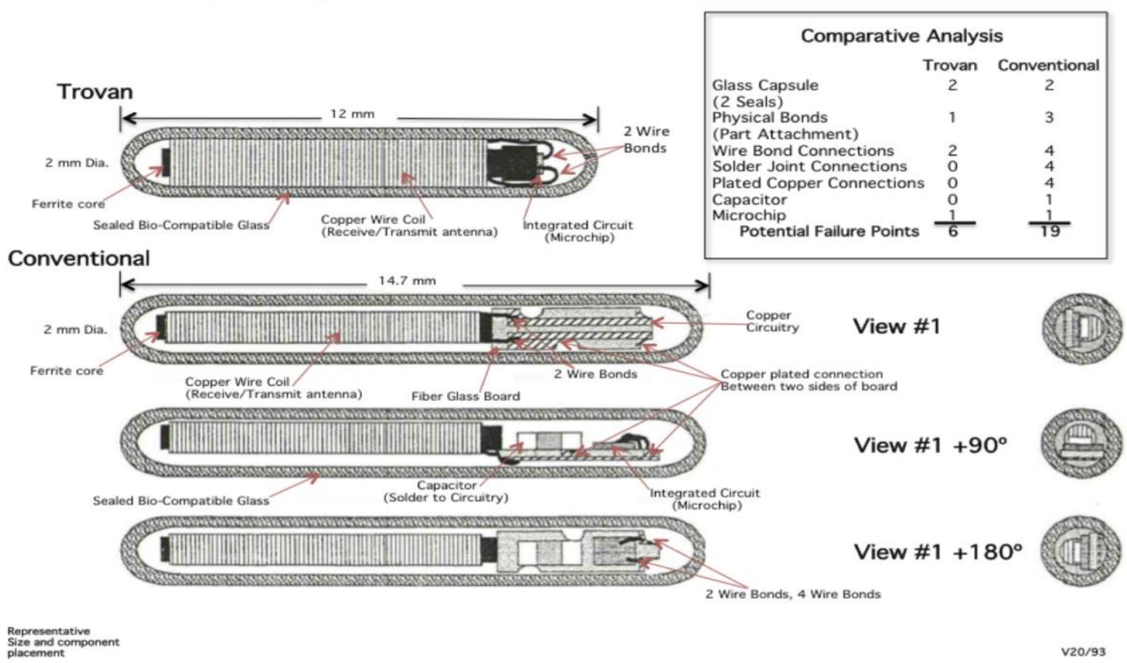
The following points are not exhaustive but are generally intended to provide guidance on the desired characteristics of transponders and their associated implanting devices to both improve the long term durability and reliability of the transponders as well as reducing the stress associated with implantation of the chip.

a) **Use of ROM memory.** Transponders nowadays typically contain EEPROMs (electronically programmed integrated circuits) because these are stock products and can easily be programmed during microchip production. The main advantage of using EEPROMs is facilitation of small batch production. However, manufacturers of EEPROM (electronically programmed) ICs typically guarantee them for 10 years or 100,000 cycles, whichever comes first. Each time the IC is queried, which will happen numerous times during even a short read, counts as a cycle. The number of cycles depends on the system and the length of time the operator pushes the button and may range from a couple dozen to over 100 times in one read. Also, exposure to strong electromagnetic fields can result in the IDs of EEPROMs spontaneously being altered. Trovan transponders are laser-programmed ROMs, mechanically encoded during manufacture and as such are not subject to these same limitations.

trovan

b) **Reduced component count.** The medium to longer term integrity of the transponder can be impacted significantly by the transponder's design (see schematic below) and mode of manufacture. Transponders consist of a copper wire coil wrapped around a ferrite core, which acts as an antenna. In conventionally designed transponders, the ferrite core is attached to a small substrate (or PC board), on which the IC and possibly a capacitor are mounted (so-called "flip chip" construction). In this type of construction, there are numerous solder joint connections and plated copper connections. In simple terms the conventional transponders have up to 19 potential failure points (connections or components) whereas the Trovan chip has only 6 potential failure points (connections or components). The reduced component count is achieved by eliminating the substrate, and capacitor. Additionally, Trovan's production process makes use of a patented direct bonding technique using thermocompression bonding, improving firstly the integrity of the joint and secondly reducing the number of potential failure points. If the user is looking for guaranteed longevity, well into post mortem periods, then the Trovan chip is unrivalled.

Microchip Transponder Construction in Relationship to Reliability



c) **No solder joints.** The thermocompression bonding approach eliminates the use of solder joints, which use lead (a toxic metal) and are generally considered to be less reliable and chemically stable. The thermocompression bonding approach uses gold, which is a highly stable compound, instead of lead..

d) **Biocompatible glass.** Microchips are normally encapsulated in a glass vial with the glass shielding the electronics from body fluids and corrosion. Glass is the preferred material in medical applications where permeation is to be avoided and is used in preference to polymers. Not all glass capsules are created equally however with conventional glass incorporating heavy metals. The Trovan microchips are encapsulated using a specially made bio-glass designed to ensure biocompatibility and reduce exposure to heavy metals.

e) **Laser sealing of the glass vial and annealing.** The encapsulation process is completed by final sealing. This is achieved by the application of heat to metal the glass. The Trovan transponder encapsulation process utilizes a special laser sealing method which ensures heat application with pin point precision, so that the electronics are not exposed to any form of thermal stress. The more conventional method of sealing uses an open flame with less control of the thermal impact. As thermal application can lead to additional stresses in the glass, leading to brittleness of the vial, Trovan transponders are subsequently thermally destressed by a specialized annealing process designed to improve the capsule integrity. This cannot be said of some of the conventional chips.

f) **Fully automated production process.** The overall consistency of the production process is important when considering the dependability and overall integrity of the chip. It is important that the variability of performance and reliability of the component does not vary significantly from chip to chip. The Trovan chips are manufactured by precision instrumentation robotics, eliminating human error and inaccuracy during assembly which in turn creates an improved product consistency.

g) **Stabilization of components.** Finally, from a construction standpoint the ferrite antenna and IC are normally partly incased in a special resin which must be subsequently cured. This process is called potting and it is important to achieve full curing of the resin during manufacture otherwise the desired stabilization is not achieved, and lead to premature failure of the chip.

Animal Welfare Considerations

h) From an animal welfare standpoint it is obviously important that the chip implantation is accomplished in as humanely as possible, with the design of the delivery device optimized to achieve the lowest impact and in turn impart the lowest stress (and pain) on the animal. With proper design, the delivery of the transponder should take minimal force and ensure accurate placement in the animal. Recent developments of injection devices now provide options with tactile feedback as the chip is primed for insertion in the eye of the needle and a further tactile click after the microchip placement has taken place correctly. When the plunger is pushed into its final, fully extruded position it also prevents the chip being sucked back into the needle when the needle is withdrawn.

Finally greater visibility can be achieved by utilizing a lancet-type insertion device that provides for visual feedback during the insertion process. The hub of the lancet does not have a luer lock, allowing the operator to optimize the orientation of the needle on the implanter and expediting throughput by minimizing the number of movements required.

Operators may take advantage of the above innovations to reduce stress/pain on the animal at each stage in the process.

It can take some time for the body tissues to grow around the microchip and keep it in place. Studies done as well as empirical reports from the field show a direct correlation between chip size and propensity to migrate, but for the so-called "micro-transponders" (those 12 mm in length or less) incidence is low and doesn't generally impact the well-being of the animal.

The above photograph shows some suppliers attempts that have been claimed as anti-migration features: a polypropylene cap on the left,, and an anti-migration coating shown in the center. Trovan's normal chip is shown on the right. Claims of "anti-migratory" properties of caps and coatings applied to transponders have not been substantiated, and in fact studies carried out have shown that these caps and coatings were no more effective than the conventional transponders at reducing the degree of migration http://www.ncbi.nlm.nih.gov/pubmed/10530881

Conclusion

It is generally recognized that using RFID transponders in lieu of conventional identification methods enhances animal welfare. When selecting an RFID transponder, product reliability and longevity, as well as animal welfare are critical considerations. Method of manufacture and RFID transponder design directly impact product integrity and operational longevity. Awareness and consideration of these factors enables researchers to select a system that ensures best results and return on investment.

Notes