EQUINE MICROCHIPPING 101

Marta LaColla, DVM

Equine Forum
Advancing ID, Technology & Electronic Health Records
The microchips most commonly used in the market present following dimensions:
Length -13 mm to 8 mm; Width - 2.1 mm to 1.4 mm
**HOW IT WORKS**

Microchips are RFID (Radio Frequency Identification Devices) which remain passive until stimulated by a reader.
RFID FREQUENCIES

Low Frequency

High Frequency

Ultra High Frequency

120 kHz – 140 kHz

13 MHz

1 GHz

2.4 GHz

Microchips commonly used in animals
COMMUNICATION PROTOCOL

- **Full Duplex** – communication occurs simultaneously (phone).

- **Half Duplex** - communication occurs only one way at a time (walkie-talkie).
Compliant with ISO Standards 11784 and 11785 and will be:

- 134.2 kHz
- Always 15 digits only numeric (FDX-A - alpha-numeric 9 or 10 digits)

ISO in 2007 appointed ICAR as the Registration Authority competent to register manufacturer codes used in RFID of animals in accordance to ISO 11784 and 11785.
ISO STANDARDS 11784 & 11785

<table>
<thead>
<tr>
<th>ISO STANDARD</th>
<th>RADIO FREQUENCY IDENTIFICATION OF ANIMALS</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="standard.png" alt="ISO 11784" /></td>
<td>Specifies the Code Structure</td>
</tr>
</tbody>
</table>
| ![ISO 11785](standard.png) | Technical Concept  
Specifies how a transponder is activated and how the stored information is transferred to a transceiver (applicable in connection with ISO 11784). |
ISO 11784

**Header**
- 11 bits

**Identification Code**
- 64 + 8 bits

**CRC**
- 16+2 bits

**Extension**
- 24 + 3 bits

<table>
<thead>
<tr>
<th>ID CODE</th>
<th>DESTINATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIT 1</td>
<td>(1) – Animal Transponder</td>
</tr>
<tr>
<td>BIT 2 - 15</td>
<td>Reserved part (not to be used)</td>
</tr>
<tr>
<td>BIT 16</td>
<td>Data block</td>
</tr>
<tr>
<td>BIT 17 - 26</td>
<td>Manufacturer/Country Code</td>
</tr>
<tr>
<td>BIT 27 - 64</td>
<td>Unique Identification Code</td>
</tr>
</tbody>
</table>
## ID CODE STRUCTURE

### CODE STRUCTURE – ISO 11784

<table>
<thead>
<tr>
<th>Country Code – X X X (ISO 3166)</th>
<th>Animal ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>US Country Code – 8 4 0</td>
<td>4 5 6 7 8 9 10 11 12 13 14 15</td>
</tr>
<tr>
<td>Manufacturing Code – 9 X X (900 – 998) + 999</td>
<td></td>
</tr>
<tr>
<td>Shared Code – 9 0 0</td>
<td></td>
</tr>
</tbody>
</table>
The International Committee for Animal Recording (ICAR) is an international non-profit and non-Governmental organization formed in 1951.

ICAR now strives to be the leading global provider of Guidelines, Standards and Certification for animal identification, animal recording and animal evaluation.

ICAR supports:
- **Compatibility between manufacturers by:**
  - Ensuring that devices can be read by any ISO reader and return to that reader specific standardized data.
- **Uniqueness of the ID number** embedded in the microchip.
ICAR CERTIFICATION OF CONFORMANCE

- ICAR Certification of Conformance:
  - Testing at ICAR approved and accredited test centers, according to ISO Standard 24631-1.
  - Manufacturer signs Code of Conduct, respecting ISO rules.

- If the transponder passes the Conformance Test and the manufacturer signs the ISO Code of Conduct, then the transponder receives a perpetual ICAR registration and is certified for five years.

- The manufacturer receives a Certificate of Conformance for that device along with a registration code from ICAR.

- ICAR Website displays devices that have received Certificate of Conformance.

- ICAR website displays manufacturers that have signed Code of Conduct and date of signature.
<table>
<thead>
<tr>
<th>Name of the Manufacturer</th>
<th>Manufacturer code</th>
<th>Product code</th>
<th>Technology</th>
<th>Type</th>
<th>Description</th>
<th>Latest ICAR certification date</th>
<th>Performance test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depron Fearing / Digital Angel Corporation</td>
<td>985</td>
<td>985024</td>
<td>FDX-B</td>
<td>Injectable transponder</td>
<td>Diameter 1.4 mm, length 10.4 mm, weight 0.03 g</td>
<td>09/09/2014</td>
<td></td>
</tr>
<tr>
<td>Depron Fearing / Digital Angel Corporation</td>
<td>985</td>
<td>985022</td>
<td>FDX-B</td>
<td>Injectable transponder</td>
<td>Diameter 2.1 mm, length 13.0 mm, weight 0.11 g</td>
<td>05/12/2013</td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td>ID</td>
<td>Type</td>
<td>Description</td>
<td>Date</td>
<td>Price</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-------</td>
<td>---------</td>
<td>----------</td>
<td>------------------------------------</td>
<td>------------</td>
<td>--------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>900</td>
<td>900198</td>
<td>FDX-B</td>
<td>Injectable transponder 2.14 mm, 12.08 mm, 0.098 g, transparent</td>
<td>29/06/2015</td>
<td>900 / 115000000000 115000000000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>900</td>
<td>900197</td>
<td>FDX-B</td>
<td>Injectable transponder 2.14 mm, 12.04 mm, 0.10 g, transparent</td>
<td>14/04/2015</td>
<td>900 / 113000000000 113000000000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>900</td>
<td>900193</td>
<td>FDX-B</td>
<td>Injectable transponder 2.09 mm, 12.05 mm, 0.097 g, transparent</td>
<td>13/01/2015</td>
<td>900 / 105000000000 105000000000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>900</td>
<td>900190</td>
<td>FDX-B</td>
<td>Injectable transponder 2.12 mm, 12.32 mm, 0.10 g, transparent</td>
<td>30/09/2014</td>
<td>900 / 099000000000 099000000000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ICAR WEBSITE: www.icar.org

The Global Standard for Livestock Data

Certificate of Quality

This page provides more details about the Certificate of Quality and the various certifications available:

- Conditions, Questionnaire and Application forms
- Team of Auditors
- List of Organisations granted with the CoQ
- Template for Auditors' Report for a Visited audit or for a Consultative review

- Animal identification
- Certified RFID
- Injectable transponders
- Ear tags, Tag attachments, Boluses
- ICAR Registry of ISO RFID devices

Microchips
– Official identification methods for equine include:
  – A description sufficient to identify the individual equine including but not limited to, name, age, breed, color, gender, distinctive markings, and unique and permanent forms of identification when present (e.g., brands, tattoos, scars, cowlicks, blemishes or biometric measurements).
  – Electronic identification that complies with ISO 11784/11785.
  – Non-ISO electronic identification injected to the equine on or before February 26, 2014.
  – Digital photographs sufficient to identify the individual equine.

– USDA Equine 2015 – Baseline Reference of Equine Health and Management in the US:
  – Conducted in 28 States – 3,997 operations were selected to participate in sample.
  – Data collected represented 71.6% of equids and 70.9% of operations with five or more equids.
  – Horses residing at racetracks were not eligible to be included in the sample.
<table>
<thead>
<tr>
<th>ID Method</th>
<th>Percent operations</th>
<th>Percent resident equids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot-iron brand</td>
<td>18.3</td>
<td>7.9</td>
</tr>
<tr>
<td>Freeze brand</td>
<td>20.3</td>
<td>7.9</td>
</tr>
<tr>
<td>Microchip</td>
<td>3.4</td>
<td>1.6</td>
</tr>
<tr>
<td>Tattoo</td>
<td>12.8</td>
<td>6.3</td>
</tr>
<tr>
<td>Official brand inspection</td>
<td>9.6</td>
<td>6.2</td>
</tr>
<tr>
<td>Registration papers</td>
<td>57.5</td>
<td>44.1</td>
</tr>
<tr>
<td>DNA</td>
<td>17.8</td>
<td>16.8</td>
</tr>
<tr>
<td>Coggins</td>
<td>42.2</td>
<td>32.7</td>
</tr>
<tr>
<td>Halters or collars</td>
<td>6.5</td>
<td>7.3</td>
</tr>
<tr>
<td>Passport</td>
<td>2.3</td>
<td>0.8</td>
</tr>
<tr>
<td>Other</td>
<td>3.3</td>
<td>2.0</td>
</tr>
<tr>
<td>Any</td>
<td>80.8</td>
<td></td>
</tr>
</tbody>
</table>

840 x Manufacturing Code x 900 Shared Code

- **840 Code:**
  - Limit implantation to approved USDA devices (limit to devices with ICAR Certificate of Conformance) with ID ranges supplied by USDA.
  - Traceability in disease outbreaks.
  - Definition of Country of Origin.
  - Data permanence – maintenance of historical data.
  - Data Security – could multiple data points present a higher risk of data being compromised?
  - Premise ID – could there be a different model for equine, e.g., California Horse Racing Board project?

- **Manufacturing Code:**
  - Does not require Premise ID.
  - Would rely on private industry to hold data on equine.

- **900 Code:**
  - Does not present an identifying prefix, making it more difficult to determine associated brand and registry.
  - ICAR displays manufacturer; however, does not display distributors in their respective countries.
IMPLANTATION TECHNIQUE

- These guidelines are intended for administration by or under the supervision of an accredited veterinarian or according to state laws.
- Sedation is generally not required with exception of nervous horses. Gerber et al. (2012) and Swinker et al. (2009) observed an increase in local inflammatory reaction on nervous horses.
- It is best to spend a few minutes with the horse to ensure that the animal is ready to be handled.
- If the horse needs restraint, further action should be discussed with owner.
IMPLANTATION TECHNIQUE

1. Identify if microchip reader is universal reader and that it is able to detect various frequencies.

2. Identify reading zone of microchip reader.

3. Scan the horse thoroughly all over the neck, from the poll up to the withers, moving the scanner slowly while touching the horse, in patterns parallel and perpendicular to mane, to be sure the horse has not been previously microchipped.
4. If no microchip is detected in the horse, scan the microchip product in the sealed pouch to verify the code matches the bar code label.

5. Check if the sterile protective package containing microchip has not been torn or punctured, compromising sterility.

6. Identify recommended implantation site: in the nuchal ligament, on the left side of neck, halfway between the poll and withers, approximately 1.5 to 2 inches below the mane line.

7. Area of implantation can be shaved before aseptically preparing site for implantation and use of sterile gloves is recommended.
8. Without touching the needle, remove cap, ensuring that the bevel is facing up.

9. The needle should be inserted perpendicularly to the horse’s neck, as an intramuscular injection.

10. Once the needle is completed inserted up to the hub, depress plunger and then remove the needle, while applying light pressure to the administration site.

11. Properly dispose of needle.
8. Rescan the implantation site to ensure proper insertion of microchip and record number in horse’s records

9. Horse might present a slight discomfort on implantation site similar to a routine intramuscular injection or present soreness for a couple of days. Please plan accordingly.
ISO STANDARD 15639-1: Radio frequency identification of animals:
  Standardization of injection sites for different animal species.

- Part 1: Companion animals (cat and dogs):
  - Detailed description of two standard microchipping sites.
  - Procedures in case microchip is not detected in expected location.
• ISO STANDARD 14223: Radio frequency identification of animals – Advanced Transponders
  ➢ Part 1: Air interface – published and in use.
  ➢ Part 2: Code and command structure – published and in use.
  ➢ Part 3: Applications – Memory Organization Map

[Diagram showing data microchips structure with sections for Header, Identification Code, CRC, and Extension, and notes on ISO 11784 ID locked and data located in Extension portion.]
American Veterinary Medical Association (AVMA) position:

• “RFID technology will eventually include the market availability of advanced transponders having enhanced data storage and read-write capabilities.”

• “Data security issues exist and are being addressed by the ISO, such as through the development of ISO 14233.”

• “The AVMA would support the use of advanced transponders when an open-standard solution for advanced transponders exists.”
Health Concerns

- Pain on Implantation
- Inflammatory Responses at Implantation Site
- Migration
HEALTH FACTORS ASSOCIATED WITH MICROCHIP INSERTION IN HORSES

– Objectives:
  – Characterize inflammatory response after microchip insertion.
  – Evaluate pain response and swelling at the microchip insertion site.
  – Measure migration of the microchips.

– Materials and Methods:
  – 18 Quarter Horse Mares with ages between 4 – 15 years.
    • Group 1: Microchip Group (7)
    • Group 2: Sham Group (7)
    • Group 3: Control Group (4)

INFLAMMATORY RESPONSE AFTER MICROCHIP INSERTION

– Materials and Methods:
  – Skin temperature, swelling area, and pressure threshold response were measured on the implantation and control sites before implantation, at 40, 120, 260, 380, 560, 720 and 1,440 minutes after implantation, and then daily for 2 weeks.
    – Skin temperature – measured with a dermal thermometer.
    – Swelling area – length and width were measured of any swollen area.
    – Pressure threshold – measured with an algometer to quantify pressure necessary to induce a pain threshold response.

  – Blood samples for Serum Amyloid A (SAA) were collected on days 0, 2, 7, and 14 days relative to microchip insertion

INFLAMMATORY RESPONSE AFTER MICROCHIP INSERTION

– **Results:**

  – **Skin temperature** – there were no detectable differences in skin temperature between microchip, sham and control groups.

  – **Pain threshold** – horses that were implanted with microchips exhibited more sensitivity compared with horses in sham and control groups.

  – **Swelling** – began 2 hours post-procedure on both microchip and sham group, whereas no swelling occurred in control group.

  – **SAA** – two horses exhibited elevated concentrations of SAA that could be linked to other inflammatory conditions. Overall, there was no correlation between local inflammatory reactions due to microchip insertion and plasma SAA concentrations.

Discussion:

- Insertion of microchips in horses evoked a local inflammatory response. Swelling and increased sensitivity to pressure resolved within 3 days.
- Increased inflammatory reaction of nervous horses corresponded to observations of Swinker et al. (2009):
  - Six horses were reported to have a reaction among the 307 horses implanted with a microchip. Within twenty-four hours all six horses reactions had dissipated.
  - None of the horses implanted with a microchip during the project has abscesses or any other visible reaction after twenty-four hours.
  - Four horses exhibited a slight bump at the implantation site. Within three days the bump had dissipated.

Materials and Methods:
- Radiographs were taken immediately after implantation and at 1, 2, 4 and 6 months after implantation.
- Distance between the most cranial point of 4th cervical vertebrae and microchip was measured.

Results:
- The linear regression of distance values between microchip and selected point did not present a slope significantly different from zero (P>0.05) indicating that the microchips did not migrate.

**Objectives**

To determine whether microchips used for identification migrate after implantation in horses, donkeys, and mules

**Materials and Methods**

<table>
<thead>
<tr>
<th>Group</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>20 horses previously implanted with a microchip between 1996 through 2000.</td>
</tr>
<tr>
<td>Group 2</td>
<td>16 horses, 12 donkeys and 5 mules were implanted with a microchip.</td>
</tr>
</tbody>
</table>

**Methodology**

Measurements were made by using microchip reader at 42 to 67 days after implantation of Group 2.

**Conclusions**

Microchips implanted in nuchal ligament equal or less to four years earlier did not migrate.

Reference:
Temperature Sensing Microchip
Temperature Sensing Microchip

- Microchip remains an identification device with additional sensing temperature technology, built into the integrated circuit.
- Compliant with ISO 11784 & ISO 11785.
- Biothermo microchip enables to monitor the individual Microchip Temperature in horses (temperatures ranging between from 91.4°F and 109.4°F (33°C to 43°C).

Total space of 128 bits (ISO 11784 standard)

- Header 11 bits
- Identification code 64 + 8 bits
- CRC 16 + 2 bits
- Extension or trailer 24 + 3 bits

Unique Identification Number

T-Sensing Technology

Temperatures can be read, displayed and stored when Biothermo is scanned with Destron Fearing, Allflex’s and HomeAgain microchip readers.
Biothermo Accuracy

  - Biothermo accuracy was of 0.07± 0.12°C.

- Independent lab (Terana, France):
  - **Objective** - evaluate the reliability of the Biothermo in detecting the microchip temperature compared to a reference thermometer.

- **Material and Methods**:
  - Reference Thermometer - Platinum resistance thermometer 100.
  - Microchips - 10 Biothermo microchips placed in immersion at 5cm-depth in a calibration bath.
  - Temperature measurements were performed at 33°C, 38°C and 43°C.
  - Once the nominal temperature and the thermal balance were reached, a set of measures was performed, during 10 minutes, alternately on the reference thermometer and the microchip reader.
  - The measurement frequency was every 30s.
### Table 1. Results - difference in temperature measured by the 10 Biothermo microchips and the reference thermometer.

<table>
<thead>
<tr>
<th></th>
<th>33°C</th>
<th>38°C</th>
<th>42°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.14</td>
<td>-0.03</td>
<td>0.08</td>
<td></td>
</tr>
<tr>
<td>-0.22</td>
<td>-0.13</td>
<td>-0.02</td>
<td></td>
</tr>
<tr>
<td>-0.24</td>
<td>-0.03</td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td>-0.14</td>
<td>-0.03</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>-0.24</td>
<td>-0.12</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>0.02</td>
<td>-0.03</td>
<td>-0.02</td>
<td></td>
</tr>
<tr>
<td>0.16</td>
<td>0.04</td>
<td>0.06</td>
<td></td>
</tr>
<tr>
<td>-0.16</td>
<td>0.13</td>
<td>-0.02</td>
<td></td>
</tr>
<tr>
<td>-0.24</td>
<td>0.13</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>-0.24</td>
<td>0.13</td>
<td>-0.02</td>
<td></td>
</tr>
</tbody>
</table>

**ABS 0.18**  **ABS 0.08**  **ABS 0.04**
ACCURACY INCLUDING COMMONLY USED THERMOMETERS

Graphic comparison of temperatures collected from following devices:

- Blue Device: Biothermo microchip
- Green Device: Reference thermometer (Platinum resistance thermometer 100)
- Yellow Device: Welch Allyn SureTemp 690 Digital Thermometer
- Red Device: Walgreens MT18T1
- Pink Device: Ad temp 422 Digital Thermometer
- Study involved 15 foals, with ages between 6 and 8 months old.
- Microchip Temperatures and Rectal Temperatures were measured twice a day, with same thermometer, with same operator (vet student), during 11 days.
- Environmental temperatures during the period of this study were between 55°F and 75°F.
Results

- 660 temperatures collected: 330 microchip temperatures and 330 rectal temperatures.

- Microchip Temperatures:
  - Mean: 99.46°F
  - Standard Deviation: 0.529°F

- Rectal Temperatures:
  - Mean: 100.25°F
  - Standard Deviation: 0.759°F

- AVERAGE DIFFERENCE: 0.79°F

Graph 01. Mean microchip (blue) and rectal (orange) temperatures measured from 15 foals during 11 days.
Results

Graph 03. Microchip (blue) and rectal (orange) temperatures of foal 031 during 11 days.

Mean Microchip Temperature: 99.2°F.
Mean Rectal Temperature: 100.6°F.

Graph 04. Microchip (blue) and rectal (orange) temperatures of foal 116 during 11 days.

Mean Microchip Temperature: 100.1°F.
Mean Rectal Temperature: 100.6°F.
Data collected from foals in Lexington, KY between 08/09 and 08/16/16.

- 442 Temperatures collected:
  - Microchip Temperatures:
    - Mean Temperature: 101.01°F
    - Standard Deviation: 0.77°F
  - Rectal Temperatures:
    - Mean Temperature: 101.04°F
    - Standard Deviation: 0.68°F

Courtesy of Lynn Ennis.
Materials and Methods:

- 4 healthy horses had rectal and microchip temperatures measured every 30 minutes from 8:00 am to 6:00 pm at the Equ’Institut - Clinique du Plessis, France.
- Rectal temperature was measured with Digital thermometer (®Pelime sa f67)
- Microchip temperature was measured with the Allflex Universal Microchip Scanner.
Results

Graph. Comparison between rectal and microchip temperature collected on Horse U.

Graph. Comparison between rectal and microchip temperature collected on Horse U.
Microchip Temperature was collected in 4 trotters from 05/02/16 to 06/24/16 during 4 phases of day:
- First measurements – early in the morning.
- Training period (before the exercise and right after).
- The rest phase.
- The end of the day.
3 year old Trotter
3-years old trotter
Healthy athlete
Average MT = 37.2°C
SD = 0.450
N = 150

28-years old female
Suffering from COPD
Average MT = 37.1°C
SD = 0.111
N = 129
– The Biothermo is a practical and safe method to collect temperatures frequently and from several animals, acting as a monitoring tool for health conditions.

– Evaluation of Microchip Temperatures should take into consideration rate of change in temperature for each individual.

– Collection of temperatures eliminates human errors, since data is stored in reader associated to ID, date and time.
Thank you!

Contact:
e-mail: mlacolla@allflexusa.com