

# Radio frequency identification of animals, the quality of products in the field.

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## Abstract

In several parts of the world livestock animals (sheep, goats and cattle) are identified with radiofrequency identification (RFID) devices. These transponders can be read with handheld and stationary readers. The reading can be performed on the farm, during transport, in the sales yard and in the slaughterhouse. Especially when the RFID tags are read with a static reader the signal strength the transponders produce is very important (reading distance shall be sufficient if animal passes the reader). If the signal is insufficient it can result in misreads. In many countries RFID tags have to meet certain approval criteria to get allowance for use for identifying a certain species with those tags. The approval is mostly based upon tests that are performed by test agencies on new tags that the manufacturer has send to the test agency. The tags the manufacturer later on sell on the market can have a different quality as the original tested product or the quality of the RFID tags can be influenced by environmental conditions e.g. moisture. The reduced quality can increase the misread percentage. In the most RFID schemes there are no checks performed that safeguard the quality of the products sold on the market. Schemes that monitor the quality of RFID products on the market could be introduced. This monitoring could e.g. be based upon RFID sample tags that are collected during slaughter. When a certain percentages of the recovered tags are outside specification the manufacturer should improve the quality of his product. If the manufacturer e.g. within a year does not succeed to improve the quality of that product approval for that product could be withdrawn.

*Keywords: animal, identification, RFID, approval, quality, retesting*

## Introduction

All over the world animals are identified with Radio Frequency Identification (RFID) devices. Not only livestock animals but also companion animals and fish are identified with RFID. Examples of official livestock schemes currently implemented, start date in brackets, with ISO 11784 and ISO 11785 compliant equipment include:

- Australia (1998) - cattle
- Scrapie plan UK (2002) - sheep
- Cyprus (2004) - sheep
- Canada (2002) - cattle
- Botswana (1997) - cattle
- Uruguay (2005) - cattle
- Spain (2005) - sheep
- Italy regional:
  - Aosta (1998) - sheep & cattle

- Sicily (2005) - sheep & cattle
- Sardinia (2005) - sheep & cattle
- Most EU countries (2009) - sheep
- Denmark (2010) - cattle

Where official schemes are in place, farmers have learned that the technology is an excellent tool for improving their farm management and on-farm automation. Also in countries not having official schemes farmers are, for the above reasons, voluntarily using ISO 11784 and 11785 compliant RFID equipment. Millions of livestock animals have been identified with ISO 11784 and 11785 compliant RFID tags for either official or on farm use.

Also all over the world companion animals are identified with RFID injectable transponders, by far the most of these transponders are conforming to ISO 11784 & ISO 11785. In many countries regulations prescribe the use of ISO 11784 & ISO 11785 compliant technology for identifying companion animals (e.g. EU regulations for horses and dogs).

The ISO 11784 specifies the code structure of animal RFID transponders. The ISO 11784 allows two coding systems (both having the possibility of guaranteeing unique codes). The first coding system uses ISO 3166 country codes. The first three digits (000 to 899) refer to the country where the animal is born and where the birth is database registered. In this system it is a responsibility of the national competent authority to grant unique codes to every individual animal. The other system uses shared and unshared manufacturer codes. The first three digits (900 to 997) refer to the manufacturer responsibility for the granting of unique codes. ICAR is the registration authority responsible for the granting of shared and unshared manufacturer codes. Manufacturers with an unshared manufacturer code have the possibility to use all the available id codes in combination with the 3 digit manufacturer code (so far the manufacturer codes 934 to 988 have been granted). A manufacturer with a shared manufacturer code has a limited code area being granted in combination with a shared manufacturer code available (e.g. 900 has been used so far, but it is expected that before the end of 2012 also the granting of shared manufacturer codes in combination with 901 will be initiated).

The ISO 11785 air interface allows the use of full duplex (FDX) and half duplex (HDX) transponder types. The air interface is standardized in such a way that reading possibilities (change of being read by a reader) for HDX and FDX transponders are balanced with a so called dual adaptive protocol. Based upon the situation the listening (reading of the id-code) period for a certain technology (FDX or HDX) can be extended based upon what has been detected by the reader.

In the ISO 11785 standard two synchronization methods are defined. One synchronization method for handheld readers and a method for wired synchronization of static readers. For identification systems it is necessary to synchronize readers when two or more are used in physical proximity.

Quite some different RFID equipment is available on the market. It is for users of the technology difficult to understand what equipment suits their application; therefore standards have been developed for testing animal RFID equipment. Two different sets of test procedures are available for characterizing the electromagnetic characteristics of RFID equipment:

- Testing the compliance to the ISO 11784 and ISO 11785 standards of transponders (ISO 24631-1) and readers (ISO 24631-2). The granting of the manufacturer codes by a registration authority is described in the conformance test for transponders. The ID-codes of all transponders that have been conformance approved can be read with the reading equipment that has been conformance

approved. So a small injectable glass transponder (used for identifying e.g. a cat) can be read with a big static reader that has been developed for reading cattle in a slaughterhouse.

- Testing the performance of ISO 11784 and ISO 11785 conforming products. The results of the performance procedures can be used to check if a RFID product meet the requirements of a certain application (e.g. a transponder used for identifying a bull should produce a stronger signal than a transponder that is used for identifying a cat). ISO 24631-3 defines the performance test for transponders and ISO 24631-4 the performance test for readers.

Tested products are reported on the web site of the registration authority ICAR. Since 1995 the ICAR has carried out approval tests on RFID devices and is since that date the registration authority responsible for granting (shared and unshared) manufacturer codes and product codes related to animal identification. At the moment more than 50 manufacturers have received an unshared manufacturer code, more than 60 manufacturers have received a shared manufacturer code and more than 300 product codes have been granted.

The information on all approved products since 1995 is available on the ICAR webpage without knowing if the product is still manufactured or in the market/in use. On the request of user groups ICAR has decided to make an additional web page indicating only products that are still in the market. ICAR will continue to update the old 'approved products' webpage as it has been done from the start, no information will be changed or removed, unless requested by a manufacturer of a product or at withdrawal of a product code.

RFID data can be displayed by using different formats. The use of different formats might lead to misinterpretation of the information. Therefore the ISO 24631-6 standard is developed for the representation of the animal identification information. This standard mentions how the ISO 11784 information shall be displayed on a reader display and how the ISO 11784 data shall be communicated over a data link.

Wired synchronization of stationary reader equipment is broadly defined in ISO 11785 and a more detailed procedure is mentioned in ISO 24631-7. Wired synchronization is needed when two or more stationary readers are used close to each other.

The approval of RFID equipment is mostly based upon tests (that are performed by ICAR approved test agencies) on new tags that the manufacturer has send to a test agency. The tags the manufacturer later on sell on the market can have a different quality as the original tested product or the quality of the RFID tags can be influenced by environmental conditions e.g. moisture. The reduced quality can increase the misread percentage. In the most RFID schemes there are no checks performed that safeguard the quality of the products sold on the marked.

## **Quality of the Radio frequency identification equipment**

The reading success of a RFID tag is depending on RFID tag signal strength and the quality of the RFID transceiver. Also electromagnetic disturbances (e.g. of slaughterhouse equipment or farming equipment) can have an unwanted impact on the reading of tags. The person responsible for reading tags with a handheld reader or manufacturer responsible for installing stationary reading equipment shall be aware that the reading of tags can be disturbed by certain equipment.

### *Composition of the transponder*

In case a manufacturer wants to get an approval for a transponder, new products (50 or 10 depending on the type of test) have to be sent to a test agency. The test agency checks if all transponders are correctly programmed and checks the technical characteristics. The results are communicated with the registration authority and if everything is OK the registration authority grants a product code to the product (depending on the situation also a shared or unshared manufacturer code can be granted). The approval (product code) is only valid for the tested product. If the composition of a product changes it is a new product that shall have its own product code. The following changes require a new test:

- Size of the tag changes
- Moulding material of the tag changes
- A different coil is used
- Another type of integrated circuit is used (e.g. a different supplier)

A manufacturer that has several approved products can benefit from it. In the past there have been situations where there was a shortage of components; especially the waiting period for delivery of integrated circuit began to increase. Suppliers having only one type of RFID tag approved were (formally) completely dependent on one supplier of integrated circuits.

The integrated circuit is the 'engine' of a transponder and therefore the operation of a transponder can be heavily influenced by the choice of the integrated circuit. At this stage the type of integrated circuit used is not recorded in the ISO 24631 test procedures. When including this point it can be a strong motivation for manufacturers to only sell products having the same composition as the product having received a product code.

### *Choosing random products for testing*

A manufacturer has to send new products to a test agency for getting an approval. In this approach it is possible for a manufacturer to specially prepare the products intent for testing and those products do not necessary represent the quality of the products later on sold on the market. So the procedures suits for checking the capability of manufacturing transponders, but the procedure does not necessarily proof the capability of a manufacturer to produce a continuous flow of high quality of transponders.

With introducing a system where transponders are checked that are randomly picked from the market (e.g. new transponders that farmer has bought from supplier) manufacturers are motivated to safeguard the quality of the products they sell.

### *Collecting transponders at slaughter*

Products recovered at slaughter can also be used to monitor the quality of products in the field. These products have been used for mostly a longer period so also the impact of infield conditions (e.g. moisture, heat and cold) is included when using this monitoring method.

### *Reduce change on misinterpretation of information*

Since transponders have several data fields (county code or manufacturer code, id-code, retag counter and user information field) there is a change of misinterpretation.

The displaying of country code (manufacturer code) and identification code is obligatory and optionally the retagging counter value, user information (EU: species code) and the information of the additional information fields can be displayed. The format used for the optional parameters is obligatory. The obligatory format for the information communicated over a data contains the following parameters: animal bit, retagging counter, user information (EU: species code), content additional information fields, country or manufacturer code, (national) identification code. Optionally a date and time stamp can be included (format is obligatory). Both formats are defined in ISO 24631-6.

#### *Reading of RFID with portable reading equipment*

For identification systems it is necessary to synchronize readers when two or more are used in physical proximity. HDX transponders convey data using two frequencies, one of which is the same frequency as the activation signal. When two readers operate independently the respective activation signals can occur during the periods when other readers are attempting to receive HDX transponder signals. Consequently readers will mutually interfere with one another unless ON and OFF periods of the activation signals are synchronized. Synchronized readers transmit activation signals and receive HDX transponder signals in unison and will not interfere with each other.

ISO 11785 defines a wireless synchronization method (and ISO 24631-2 defines a procedure how to evaluate the possibility of a transceiver to synchronize). The synchronization mode is activated if after switching the reader on within the HDX listening period of 20 ms maximum a reader field activation is detected by the handheld transceiver. If this field is detected the portable reader shall synchronize with this field.

ISO 24631-5 also defines a procedure for testing handheld reading equipment. Reading equipment approved by this test procedure is only suitable for standalone use and this equipment shall not be used in the near other reading equipment.

#### *Using stationary reading equipment of different suppliers*

When using reading equipment of different manufacturers e.g. in farm situations the synchronization can be important aspect especially if equipment is installed close to each other. The successful reading of transponders in e.g. a calf milk dispenser can become an issue when the reader of this device is not synchronized with the cow identification system used in the milking parlour. The in ISO 24631-7 formulated procedures allows the possibility of synchronizing equipment with a wired connection.

## **Discussion and conclusion**

The animal identification ISO 11784 and ISO 11785 standards make worldwide trade of animals and the exchange of animal identification related information possible.

The ISO 24631-1..5 test procedures help users select the right products for their applications by making well-defined test results available to all interested parties. This will speed up further introduction, encourage producers to improve on performance, and reduce the costs for separate tests in multiple countries.

The ISO 24631-6 safeguards the risk of misinterpretation of animal identification information.

The ISO 24631-7 informs manufacturers how wired synchronization shall be installed for static readers, making the undisturbed use of several readers on one location possible.

Procedures that monitor the quality of products on the market and in the field can be a useful tool to help and motivate manufacturers to safeguard the composition and the quality of their products and to protect users of the technology against products with low or inconsistent quality. Withdrawal of product approval can be considered if a manufacturer incessantly is marketing inferior products

## **List of references**

ISO 11784 Radio frequency identification of animals. Code structure

ISO 11784 / AMD 1 Retag counter and user information field

ISO 11784 / AMD 2 Indication of an advanced transponder

ISO 11785 Radio frequency identification of animals. Technical concept

ISO 24631-1 Radiofrequency identification of animals. Part 1: Evaluation of conformance of RFID transponders with ISO 11784 and ISO 11785 (including granting and use of a manufacturer code).

ISO 24631-2 Radiofrequency identification of animals. Part 2: Evaluation of conformance of RFID transceivers with ISO 11784 and ISO 11785.

ISO 24631-3 Radiofrequency identification of animals. Part 3: Evaluation of performance of RFID transponders conforming with ISO 11784 and ISO 11785

ISO 24631-4 Radiofrequency identification of animals. Part 4: Evaluation of performance of RFID transceivers conforming with ISO 11784 and ISO 11785.

ISO 24631-5 Radio frequency identification of animals. RFID transceivers. Part 5: Procedure for testing the capability of reading ISO 11784 and ISO 11785 transponders.

ISO 24631-6 Radiofrequency identification of animals. Part 6: Representation of animal identification information (visual display/data transfer).

ISO 24631-7 Radiofrequency identification of animals. Part 7: Synchronization of ISO 11785 identification systems.