Joint Research Centre
EUROPEAN COMMISSION
Institute for the Protection and the Security of the Citizen
Traceability and Vulnerability Assessment Unit

Technical Guidelines
For
Council Regulation No. 21/2004 of 17/12/2003

Part 1

In-field aspects: application of identifiers, their reading and recovery

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Technical Guidelines for Council Regulation No. 21/2004 of 17/12/2003

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Introduction

Part 1 of the technical guidelines describes recommended practices for the application, reading and recovery of electronic identifiers.

1. Description of the Type and Technical Characteristics of Electronic Identifiers and Readers

1.1 Electronic identification by radio frequency

Electronic animal identification is based on the use of inductively coupled radio frequency techniques operating at low frequencies. Living tissues are transparent to these frequencies, so that exposure to the radio frequency signals has no harmful side-effects for the animals.

The electronic identifier is called a "transponder" (from the words transmitter and responder) and is a passive, read-only device which contains no internal source of electrical power (e.g. battery). The identification code must not be modifiable.
The passive transponder is a miniaturized electronic radio frequency device consisting of an integrated circuit (microchip) and an antenna, all enclosed in a waterproof envelope. The transponder is energised by the signal transmitted from a "transceiver" (from the words transmitter and receiver). The transponder reacts to this signal by emitting an "information telegram", which includes the animal identification code recorded in the integrated circuit memory.
The ISO 11784 standard defines the structure of the identification code, and the ISO 11785 standard defines the technical characteristics of the transponders and transceivers to assure compatibility. The frequency of 134.2 kHz is reserved for inductively coupled animal identification applications.
Communications between transponders and transceivers are effected by two, alternative, data transmission protocols (half-duplex, HDX; and full-duplex, FDX-B). After transmission of the information telegram the transponder reverts to a completely passive state until the next activation.

1.2 Electronic identifiers

Three types of passive electronic identifiers for livestock are presently available: injectable transponders, electronic ear-tags, and ruminal boluses.
According to ICAR (2003) guidelines, the three types of electronic identifiers are defined as follows:

- injectable transponder: small size transponder able to be implanted into an animal's body by injection, and encapsulated in a biocompatible and non porous material, i.e. glass;
- electronic ear-tag: plastic-encapsulated transponders designed to be fixed to the animal's ear using a locking mechanism or to be attached in a non reversible way to an ear-tag;
- ruminal bolus: a transponder housed in a high specific gravity container (e.g. ceramic) which is orally administered to a ruminant and that remains (due to its weight, shape and size) in the reticulo-rumen permanently.

Ruminal boluses and electronic ear-tags have been extensively tested and have proven to be reliable and acceptable for the electronic identification of ovine and caprine species.
Until sufficient scientific evidence supports the routine use of injectable transponders in sheep and goats they are not accepted for official identification of sheep and goats. Problems to

resolve, reported in the literature, include high losses; breakages; and migration of the implants out of the injection area, impeding their recovery in the slaughterhouse and introducing food safety hazards for the consumer[1].

1.2.1 Ruminal boluses

A ruminal bolus is usually composed of a cylindrical capsule of ceramics or other material. In the central part of the capsule a passive transponder is located. A typical example of ruminal bolus is given by the available EU patent for ceramic bolus (The European Union et al., 1998; PTC Pub Nb. WO98/1025. Jan 15) previously tested and utilized in the IDEA project (**Figure 1**). Each ruminal bolus should visibly show the code of the transponder.

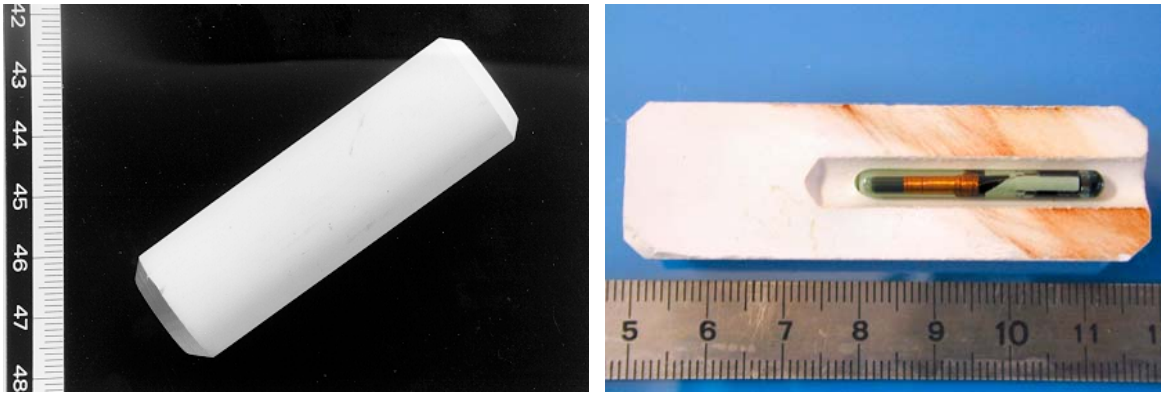

Figure 1: Example of a ceramic bolus showing the inside encased transponder

This capsule is orally administered using a mechanical applicator (similar to the ones used for medical or nutritive boluses, for details see chapter 2.2) and involuntarily swallowed by the animal (Figure 2). The bolus goes into the ruminant's fore-stomachs, where it is normally located inside the reticulum (honeycomb or 2nd fore-stomach) and permanently retained for the entire life of the animal.

Figure 2: Oral administration of a ruminal bolus to a lamb

[1] Jouveau and Potafeux (1993), Kimberling et al. (1993), Hunt (1994), Webber (1996) and FEOGA project (Caja et al., 1994; Fonseca et al., 1994; Caja et al., 1998) and AIR3-2304 Project (Caja et al., 1997; Conill et al., 2001, 2005)

1.2.2 Electronic ear-tags

A second type of electronic identifier consists of an electronic ear-tag, which is applied to the ear of the animal by using specially designed pliers with the same principle of application as for conventional plastic ear-tag. Different shaped ear-tags are available (Figure 3). In button-shaped ear-tags, the passive transponder is usually embedded in plastic as the female part of the ear-tag and it should be placed in the proximal half part of the internal face of the ear.

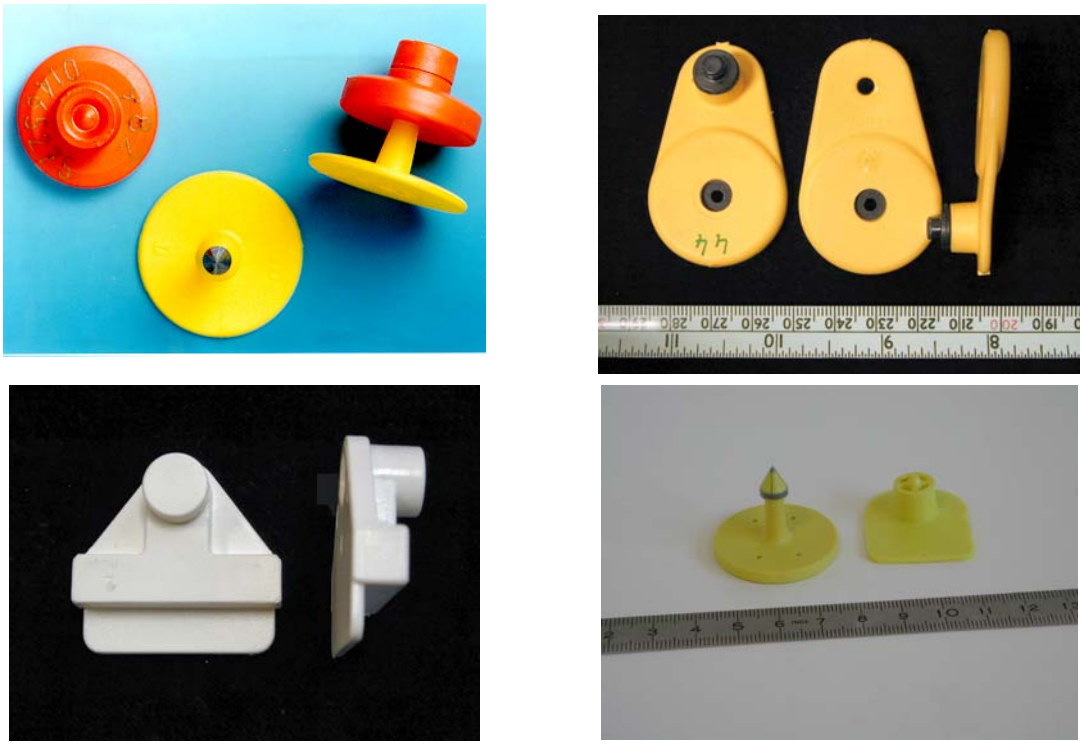

Figure 3: Examples of electronidc ear-tags

To read both types of identifiers (ruminal boluses and electronic ear-tags) with the same efficiency, it is recommended to apply the electronic ear-tags in the left ear of sheep and goats because this is also the side of the body where the reticulum is located.

1.3 Reading devices

The passive transponder contained inside the identification devices is read using readers (transceivers[2]) which shall display at least the identification code required by Regulation 21/2004 (comprising country code and individual code). In addition, readers should also display the user information field with the species code and the re-tagging counter (for details of the code structure see Part 2, chapter 2). Readers are grouped in two types regarding their use:

1.3.1 Hand-held or portable readers

The hand-held or portable readers (Figure 4 - Figure 7), run on batteries and are mainly used for the initial identification of the animal. They are used for quiet or restrained animals (e.g. tied in stalls or in head lockers) and are also appropriate for reading small flocks. These

[2] According to ISO 11785: Device used to communicate with a transponder

readers may contain an integrated antenna and / or an external antenna (for example an extensible stick antenna, useful if difficult to get close to the animal).
Various low-cost models of hand-held readers, intended for identification of pet animals (e.g. dogs, cats) only display the identification code of the animal. As a consequence, the identification code has to be manually transcribed. To avoid this inconvenience, readers which can interface with a personal computer (via wireless or cable connection) to download the code, are recommended for livestock identification.
More elaborate readers include a keyboard, an internal memory and a data link (cable or wireless) to a personal computer for the download and/or automatic transfer of data to a computer. This type of reader can permit uploading, and hence association, of data related to the animal with the electronic identifier (i.e. date of birth, performance data).

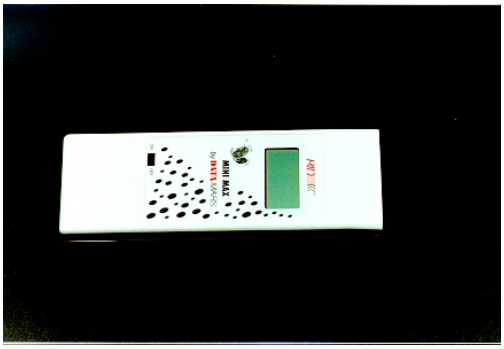

Figure 4: Example of read-only compact hand-held reader

Figure 5: Example of a two piece hand-held programmable reader

Figure 6: Example of programmable hand-held reader with internal antenna

Figure 7: Example of programmable hand-held reader with an external antenna

1.3.2 Stationary readers

Stationary readers are recommended for the unattended (dynamic) reading of animals. The stationary reading unit needs to be connected to a frame antenna and to a data recording system (e.g. personal computer) for storage and management of the acquired identification codes. Most readers also record the individual time at reading (timestamp), which is useful in control and recording processes. The frame antennas may have different shapes according to the operational conditions of the reader and the specific practical requirements (Figure 8 - Figure 12). Stationary readers and frame antenna can be either temporarily or permanently installed at a point which animals pass.

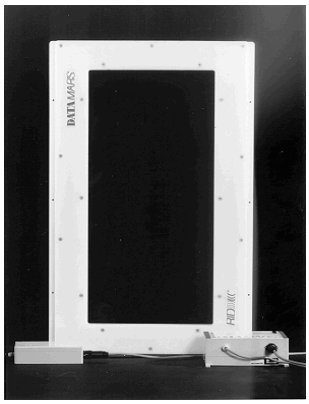

Figure 8: Example of a stationary reader and an antenna

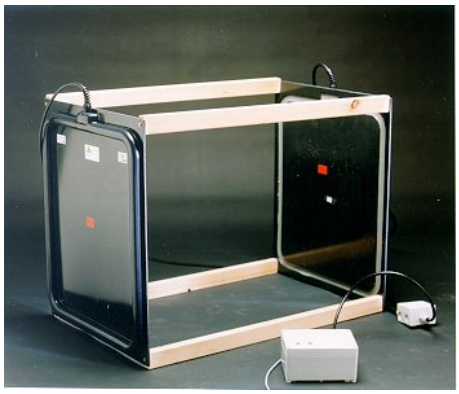

Figure 9: Stationary reader with two synchronized antennas

Figure 10: Stationary reader and transportable antenna

Figure 11: Dynamic reading of goats with the antenna placed on the left side of the race way

Figure 12: Dynamic reading of sheep with antennas placed on the left side of the race way

For efficient reading the antenna should be installed in a race way (around 40 cm width for sheep and goats) on the left side of the animal (location of the reticulum) as shown in Figure 10. Sheep and goats should preferably be handled by the habitual farm workers and passed in front of the antenna at a normal walking speed (less than 10 km/h). In these conditions it should be possible to read satisfactorily 1-2 animals/s (>3.600 animals/h).

2. Application of Electronic Identifiers

2.1 Age of tagging

Depending on national practices, the type and size of electronic identifers have to be chosen in relation to the age and live weight of the animals to be identified. The electronic identifiers must be applied to the animals without harming them.
For example, some types of electronic ear-tags can be placed very early after birth, but age of the animals at tagging, size and weight of the ear-tags have to be taken into account when selecting the appropriate type of tag.
Published scientific studies indicate that the dimensions of the bolus (length and diameter) should consider the age/live weight of the animals to be identified by ruminal bolus. Results of the IDEA project[3] conclude that the standard size ruminal bolus (around 75 grams) can safely be applied in lambs and kids of 25 kg live weight. Trials in one Member State indicate that standard size boluses should be applied not before 35kg of live weight. The correlation between the live weight and the age of the animal mainly depends on breed and feeding conditions. Very young animals (lighter than 25kg) can be safely tagged with small size ruminal bolus[4]. According to recent scientific studies, 7 day old lambs can successfully be identified with small boluses of 20 grams.

2.2 Devices for the application of electronic identifiers

For the application of electronic ear-tags similar pliers are used (Figure 13) as for conventional plastic ear-tags, which are supplied by the manufacturer. The use of different pliers than those supplied for the electronic ear-tags as well as tagging in an inappropriate location in the ear can result in an incorrect application and, as a consequence, a higher loss rate.

Figure 13: Example of pliers for the application of electronic ear-tags

The application of the ruminal bolus is performed using a device very similar to those used for the administration of vitamins and veterinary drugs. The equipment consists of a tube made of steel or other suitable material (bolus applicator or bolus gun) slightly curved with a handle, able to release the bolus by action of a sliding mandrel running in the tube (Figure 14). In the case of the ruminal bolus applicator, the main precaution to be considered is the length and tip of the applicator. On the market, one can currently find different bolus

[3] Large Scale Project on Livestock Electronic Identification, IDEA Project Final Report, http://idea.jrc.it
[4] D. Garin et al., Performance and effects of small ruminal boluses for the electronic identification of fattening lambs; Livestock Production Science 92(2005) 47-58

applicators for cattle and for sheep/goats which differ only in length. Even with experienced people it is strongly recommended not to use cattle bolus applicators in the identification of sheep/goats.
The second precaution is that the tip of the applicator has to be as smooth as possible to avoid any injury in the mouth, in particular to the palate,or oropharynx of the animal to be identified.

Figure 14: Examples of bolus applicators

2.3 Tagging procedure

The application of an electronic identifier does not result in any difficulty and/or problem when the identifier applied has the correct size in relation to the age and weight of the animal and when it is well restrained. Tagging activities should only be carried out by trained people to avoid mistakes, injuries and/or death of animals. Personnel training should cover the tagging procedure specific for the type of identifiers used.
It is recommended to follow the routines as described in Annex I and II to this part of the guidelines.

2.3.1 Application of electronic ear-tags

For a harmonised approach, it is recommended to apply electronic ear-tags normally in the left ear following the producer's instructions which are in principle the same as for conventional plastic ear-tags. Button-shaped electronic ear-tag should be applied in the proximal half part of the left ear with the female (electronic) part on the internal face of the ear.

Figure 15 shows the application of an electronic ear-tag and its final positioning on the ear.

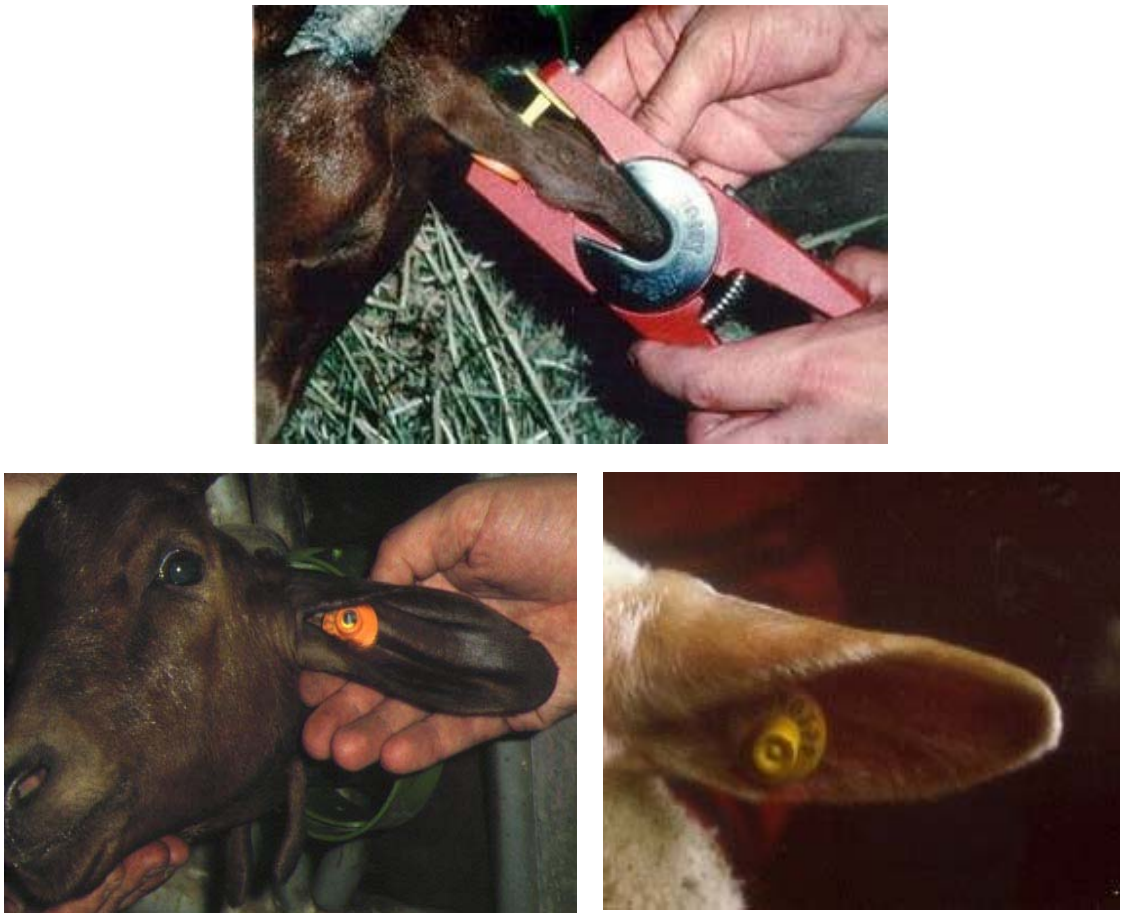

Figure 15: Application and final location of an electronic ear-tag, the electronic part in the internal face of the ear

2.3.2 Bolus application

Proper restraint of the animal is required for application of a ruminal bolus. Depending on the sex, age and size of the animal assistance may be required to assure the welfare of the animal as well as of the operator. Only properly trained operators should apply ruminal boluses and sufficient time should be allowed for tagging a group of animals. Examples how to apply a ruminal bolus are shown in Figure 2 and Figure 16 and described in detail in Annex I.

2.3.3. Re-tagging of an animal

Article 4, point 6 of Regulation 21/2004 stipulates that where an identifier has become illegible or has been lost, a replacement bearing the same code shall be applied. In addition to the code it may bear a mark with the version number of the replacement. However, the Competent Authority may allow the replacement identifier to bear a different code, provided that the objective of traceability is not compromised.

In re-tagging it is highly recommended to add a replacement number (re-tagging counter) to the electronic identification code, as defined in ISO 11784 Amd.1:2004 (for details see Part 2, chapter 2). If the number of replacements exceeds 7, an authorization has to be granted by the Competent Authority to retag the animal with a new code.

Although it is not explicitly mentioned in the Regulation, it could be practical that the type of electronic identifier used for the re-tagging be of the same type (electronic ear-tag or ruminal bolus).

In any circumstances, before applying a replacement bolus, all necessary measures should be taken to ensure that there is no functioning bolus in the animal. Before deciding to re-tag an animal, non-readability of the animal should be verified as follows:

1) Try to read at least three times by changing the direction of the portable reader antenna because the orientation of the bolus inside the animal is random.
2) Check the correct functioning of the reader using a reference transponder and/or by trying to read another animal known to be electronically tagged.
3) If the reader is able to read the reference transponder and another tagged animal, proceed with the re-tagging.
4) If the reader cannot read both transponders, re-start the procedure (point 1) with a second reader.

Figure 16: Different examples for the fixation of an animal for the application of a ruminal bolus

3. Reading of Electronic Identifiers

Reading activities are best carried out by trained operators to avoid mistakes arising from inappropriate use of the technology Operator training should cover the reading procedure specific for the type of reader used, and explain reader performance in special or difficult conditions (simultaneous use of more than one reader, synchronisation, electromagnetic interference, wet, muddy conditions, etc.). When two or more readers (portable or static) are used in close proximity operators should be aware that reading performance may be impaired unless the readers are synchronised.
After the application of an electronic identifier the link between the identifier and some data related to the animal and/or the holding can be established, e.g. if the conventional animal identification code is different to the electronic code, as in re-tagging. The specific procedures vary according to the type of reader:

Portable reader "read only" :

- Once the identifier has been read, data are downloaded into a computer (if an electronic connection is available). Other relevant data can be added.

Programmable "Intelligent" portable readers:

- Once the identifier has been read, animal related data can be added on the spot.
- In the case of a computerised holding register, selected data can be uploaded (e.g. identification codes of all animals present in the farm) to the programmable portable reader. After that, identifiers can be read to update the herd register (e.g. first-time reading of animals not previously listed in the herd register, etc.)

3.1. Pre- and post-application reading

It is recommended that the electronic ear-tags and ruminal bolus are read before tagging the animal to prevent the use of a defective identifier.
The animal should also be read prior to tagging to prevent unintentional re-tagging of animals already identified with a ruminal bolus. Readers cannot read two electronic identifiers simultaneously – this condition is known as a *collision* – due to the physics underlying the technology.
If an electronic identifier exhibits signs of physical damage (i.e. cracks in plastic or ceramic), even if operational, it should not be used for tagging, as the long-term operation of the transponder cannot be guaranteed.
After tagging the animal with a ruminal bolus, a control reading provides a check of the final location of the bolus in the reticulum. The ruminal bolus cannot be read immediately after tagging, due to the time required for the bolus to travel from the oesophagus to the reticulum. This time interval can vary according to the animal species (*up to* 20 seconds in small ruminants) and the presence and type of feed in the digestive system.
Identifier readings are performed for different purposes. In the case of a control reading to determine the number of animals in the holding or in a group of animals, the preparation of the so-called "Previous list" (i.e. the list of tagged animals expected to be read during the control reading) is recommended. A comparison between this expected data and the results of the reading operations will reveal the current status of the animals in terms of animals read, not read and not present.
Static or dynamic readings can be performed according to the different needs and according to the size of the animals to be read or controlled.

3.2 Static reading

Static reading (animals stationary) with a portable reader is recommended for reading of restrained animals (e.g. tethered, feeding grill), or of small numbers of animals.
The reading efficiency is influenced by the physical characteristics (e.g. size, shape) of the antenna and the state of charge of the battery supply (some readers decrease the reading distance at a low battery level). Proper use of the reader will greatly improve the reading efficiency.
The static reading procedure is determined by the specific functionalities of the reader. However, after switching on the reader, it is usually possible to gain access to a functional menu where the "Reading" operation can be selected. The reading of a ruminal bolus will be performed on the left side of the animal (just behind the armpit), where the reader can be brought close to the bolus in the reticulum. In case of a negative result, the reader will not display any code or, if it is equipped to do so, will emit an acoustic warning. In this case, further reading attempts should be performed, involving larger areas of the left side.

3.3 Dynamic reading

Dynamic reading systems (animals moving) are recommended in extensive farming conditions (i.e. pasture, loose housing), for large flocks, markets and in abattoirs. In these cases the animals are guided through a corridor, which is set up at the establishment or in field. An appropriate fixed reading system is installed in the corridor, which reads the passing animals and allows automated comparisons of the expected data with the readings obtained.
The correct installation of the antenna and reading unit, the proper design of the corridor and some precautions taken before and during the reading are necessary. The following list summarizes the main issues to be considered in dynamic reading:

- the width of the corridor must prevent the passage of more than one animal at a time. The suggested width is around 40 cm, depending on the breed and size of animals.
- the centre of the antenna must be located at the height at which the transponder will pass.
- avoid placing the reading antenna in contact with any electrical conductors (e.g. metal fencing)
- always check the reading distance before passing the animals, preferably by using a "test" electronic identifier of the same type used in the animals to be controlled. Never attempt dynamic readings if the reading distance thus determined is less than 50 cm.
- other readers, older PC Monitors, Portable computers and energy saving lamps can produce interference reducing reading speed and distance.

3.4. Reading points at live animal markets

In sheep and goat markets and collection points animals should be read. The number of readings required depends on the layout and flow of animals in the market. One or more reading points could be set up to ensure traceability in the market. Readings can either be performed by static or dynamic readers.

3.5. Reading points at slaughterhouse

Electronic identification is beneficial for the following processes:

1) veterinary arrival checks at the lairage,
2) meat traceability at the slaughter line,
3) collection of identifiers at the recovery point(s). Ear-tags or boluses are recovered in different sections of the slaughterhouse and therefore two reading locations should be installed if slaughtering animals with both types of electronic identifiers.

Depending on the authority's requirements and the numbers of animals, readings should be performed at least at one of these points.

4. Recovery of Electronic Identifiers and Last Reading

4.1 Recovery of electronic identifiers in animals dead in field

When an animal dies on a holding or in field, the effort required to recover the electronic identifier depends on its location in the animal. In the case of ruminal bolus, the feasibility of the recovery will depend on the cause of death, the elapsed time since death, and the requirements of the national regulations on animal and public health.
The last reading of the transponder should be performed in any case, even if recovery will not be performed, to assure correct updating of the holding register.

4.2 Recovery of electronic identifiers at slaughterhouse

Slaughterhouse staff should be properly trained on identifier recovery procedures according to the type(s) of electronic identifiers used and in respect of national health regulations.
Electronic ear-tags will be recovered following the same procedures used for conventional ear-tags. In the case of the ruminal bolus, it could be recovered in the slaughterhouse section where fore-stomachs are cleaned. The recovery should also be ensured if fore-stomachs are disposed of.

5. Disposal of Electronic Identifiers

The basic principle to be followed is that the EID -as the conventional identification of animals- must be unique. In other words, it must uniquely identify one animal only. The Competent Authorities have to ensure that recovered identifiers are not re-used. Physical destruction of recovered identifiers is recommended.

Annex I - Procedure for Ruminal Bolus Application

1) **Choose the animal** to identify and ensure that it has the adequate frame, age and weight, according to the bolus size:
2) Catch and restrain the animal as for drenching. Do not pull up the head or block the neck when restraining. The head and neck of the animal will be in natural position (angle of 90°)
3) Check the **length of the applicator in relation to the size of the head of the animal.** The part of the applicator introduced in the mouth should have the same length as the distance between lips and jaw.
4) Ensure that the animal was **not previously identified** with a bolus by using a hand-held reader. Scan the animal in the left side and in different directions to ensure the absence of a previously applied bolus.
5) **Check the bolus** to be applied and read it to ensure its functioning by using the hand-held reader. **At this moment, do not link the identifier code with any** conventional identification code, if different.
6) Put the bolus to be applied in the applicator and open the animal's mouth gently.
7) Introduce the applicator into the oral cavity of the animal to reach the **end of the tongue** (*torus linguae*). Do not push against the palate or oropharynx and **never force** to pass into the oesophagus. For the application of a bolus read also the instructions below.
8) Release the bolus by **moving back and pressing the handle of the applicator** and wait for a involuntary swallowing. Observe the bolus passage through the oesophagus, when possible. If the bolus remains between the teeth, wait until it is rejected. Do not try to remove the bolus manually.
9) Re-apply if necessary, if there is no sign of injuries.
10) **Read the applied bolus** by using the hand-held reader and if applicable, **establish the link with the conventional ear-tag number** or CIC (conventional identification code) or other individual data (i.e. age, sex, colour, body condition score,…). For scanning the animal, proceed in the left side and from caudal to cranial (from the back of the rumen to the reticulum).
11) **Mark the identified animal** with a non permanent paint (i.e. by using a wax pen) and release it back to its group.

Instructions for bolus application

The head should be restrained so as to maintain its natural position without flexion up, down or sideways. The animal should stand in a normal position, and lateral restraint of the animal, which allows better immobilization of the head and neck, contributing to more efficient and safe work, is recommended.

The most important factor during application is to avoid any movement (vertically or laterally) of the head during introduction of the applicator into the mouth. The application must never be performed on animals lying down (ventral or lateral side) or when the neck is extended, to avoid diversion in the natural swallowing reflex.

Once the animal is properly restrained, the mouth is slightly opened by introducing one or two fingers between the lower and upper jaw at the soft palate (avoid contact with the front and mandibular teeth as this may result in finger injuries!). Then, with the other hand, the applicator is introduced laterally between the lips in the inferior maxillary region – where the animal has no teeth, making the operation easier.

The application should be performed in a calm and orderly manner to minimise stress to the animal and to the operator. The bolus is deposited in the oropharynx and involuntary swallowed. Care has to be taken by holding the head firmly involuntary swallowing is not hindered or blocked. Provocation of involuntary swallowing could cause the bolus to follow the trachea, which could impair respiration. In this case, to provoke rejection of the bolus the operator can slap the occipital region, allowing simultaneous extension of the neck. It is strongly recommended that all material be cleaned and disinfected before use in another holding.

`The following figures illustrate the operations described above, as well as the physiology of the respiratory and digestive tracts.

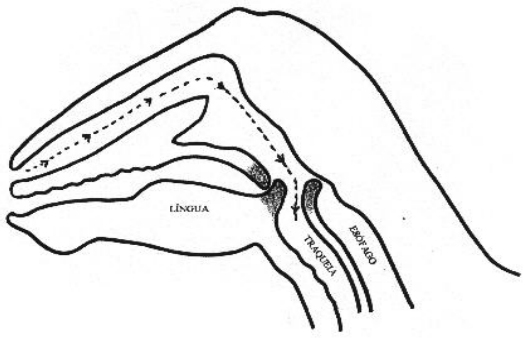

Figure 15a: Normally the respiratory tract is always open, while the digestive tract is closed. The air aspired by the nose and driven through the trachea to the lung

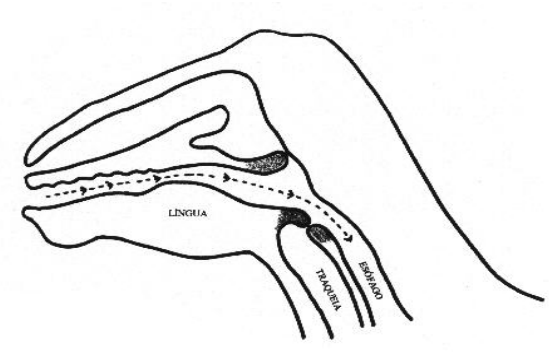

Figure 15b: Deglutition situation (swallowing) where the "velum palatinum" goes up and the epiglottis closes the larynx. The animal is momentarily without breathing. Solid or liquid elements placed in the oral cavity are driven through the oesophagus to the reticulum.

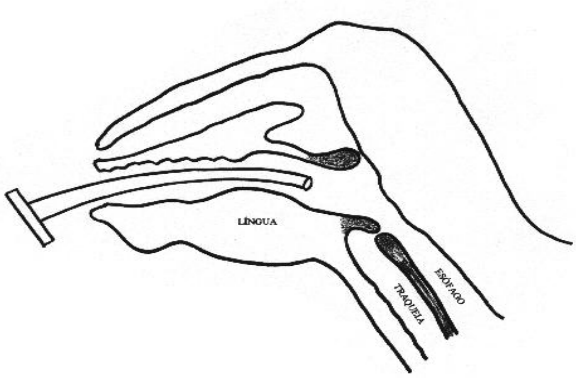

Figure 15c: Head of the animal in natural position with the applicator introduced inside the oral cavity. The extremity of the applicator is located in the posterior third of the tongue (oropharynx).

Annex II – Procedure for Electronic Ear-tag Application

1) Ensure that the type of **electronic ear-tags is appropriate for the animals** to be tagged and that the pliers used are recommended by the ear-tag manufacturer.
2) Ensure that the animal was **not previously identified** with a ruminal bolus. Use a hand-held reader and scan the animal's left side behind the armpit in different directions for a previously applied ruminal bolus.
3) **Read the electronic ear-tag** with a hand-held reader **before it is applied** to ensure its functioning. Do not yet link the identifier code with any other individual data of the animal, such as conventional identification code, if different.
4) **Properly restrain the animal** to be electronically tagged. Apply the electronic ear-tag normally in the left ear following the producer's instructions. Button-shaped electronic ear-tag should be placed in the proximal half part of the left ear with the female (electronic) part on the internal face of the ear.
5) **Read the applied ear-tag** with the hand-held reader and if applicable, **establish the link with the conventional ear-tag number** or other individual data (i.e. age, sex, colour, body condition score,…).