United States Department of Agriculture

Animal and Plant Health Inspection Service

NATIONAL ANIMAL IDENTIFICATION SYSTEM

Program Standards and Technical Reference

Version 2.2
February 2008

The NAIS is a voluntary program. This document provides the key data standards that have been established for the program, and as a reference, list other standards and technical references used in the program.

The NAIS User Guide, available at: www.usda.gov/nais, provides information on how producers and animal owners may participate in the NAIS.

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PREFACE

The National Animal Identification System (NAIS), which is a voluntary program, will enhance our ability to trace an animal disease to its source. This ability is critical to the health and economic well being of commercial livestock and poultry operations in the United States. The Animal Health Protection Act (7 U.S.C. 8301 et seq.) provides the legal authority for this program.

This Program Standards and Technical Reference document, which supplements the User Guide, provides the data element standards and other standards relative to the NAIS. Use of these standards by States, Tribes, and industry organizations involved in the administration of the system, manufacturers of identification devices, and other entities that are part of, or that support the NAIS, will ensure that the system is effective. The majority of these standards were published in the Draft Program Standards, April 2005. Several updates have been made in January and October 2007 and January 2008 (summarized below).

Section I lists the data element formats to ensure compatibility across information systems. Not all data defined in the data elements are collected for each record in the information systems that support the NAIS. Rather, the system administrators establish the databases in accordance with the data elements standards to ensure, the data elements are standardized across systems when users provide data.

Section II provides standards established for official identification devices that utilize the Animal Identification Number (AIN). Although not selecting or requiring the use of specific technology, USDA recognizes the importance of having a basic level of standardization to ensure, among other things, compatibility across vendors in the national program, adaptability/compatibility of technologies with devices produced by different manufacturers, and international recognition of identification technologies and/or devices used with the NAIS. USDA has reviewed NAIS Subcommittee recommendations, resulting from species working groups' consensus, and endorses use of technology standards published by the International Organization for Standardization (ISO). Specifically, USDA endorses use of ISO 11784 and 11785, as a radio frequency identification (RFID) technology standard for producers or service providers electing to use RF technology in the NAIS. USDA has also established standards for microchip implants.

Section III provides information on ISO standards used in the NAIS. Additional international and/or national standards will be incorporated as the appropriate standards organizations publish them.

Program Standards and Technical Reference Updates

January 2007 - Updates to the data element standards published in the 2005 Program Standards include:

- Group/Lot Identification Number: Two numeric characters were added to the format to support situations when more than one group is assembled at the same premises on the same day.
- Species Codes: Subgroups were added to some species:
  - Bovine; Beef, Bison, and Dairy
  - Avian (changed from Poultry); Ratites
- Operation Type: Boarding Facility was added.
- AIN/Animal Event Codes: Event codes have been added to support distribution of AIN Devices

October 2007 - Updates to the January 2007 version of this document include:

- Performance standards for identification eartags adjusted to include swine, sheep, and goats.
- Printing standards for individual animal ID eartags adjusted for swine, sheep, and goats.
- Printing standards added for Slaughter Swine Premises ID Eartags.

Species at the premises is an optional data element maintained in the premises registration systems at the State or Tribal level with acknowledgement that providing such information is of significant merit.

February 2008 – Updates to the October 2007 version of this document include:

- Printing standards for U.S. Shield, "Unlawful to Remove," and AIN on eartags clarified.

I. DATA STANDARDS

A. NUMBERING SYSTEMS

Key data elements needed to support the objectives of the NAIS have been defined and standardized to ensure that a nationally uniform NAIS is implemented. Imperative to the NAIS are numbering systems to identify (1) locations where livestock and poultry are managed or held (premises) and (2) animals. On November 8, 2004, USDA published in the *Federal Register* (69 FR 64644-64651, Docket No. 04-052-1) an interim rule recognizing the numbering format for use for officially identifying premises, individual animals, and groups of animals. The final rule was published in the *Federal Register* (72 FR 39301-39307, Docket No. 04-052-2) on July 18, 2007.

Another important data element of the NAIS is the non-producer participant number. This number is an identification code assigned to individuals or entities that are not associated with a livestock or poultry premises but perform certain functions or roles in the NAIS.

Table I. 1

Identification Numbers				
Data Element	**Length**	**Format**	**Example**	**Comments**
Premises ID Number (PIN)	7	Alphanumeric	A123R69	Right most character is a check digit[1]. To avoid confusion with the numbers 0 and 1, the PIN will not contain the letters O or I.
Animal ID Number (AIN)	15	Numeric	840234567890123	
	[3]		840	First 3 digits are the country code (840 = USA)
	[12]		234567890123	Last 12 digits are animal number. Start number > 2,000,000,000
Group/Lot ID Number (GIN)	15	Alphanumeric		
	[7]		A234567	First 7 characters are the Premises ID Number.
	[6]		112205	Last 6 characters are the date the lot was established – MMDDYY.
	[2][2]		05	The number (count 01 -99) of the group assembled at a premises on the same day (01 is the default when one group is assembled).
Nonproducer Partici-pant ID Number (NPN)	7	Alphanumeric	H892345	Right most character is a check digit[1]. To avoid confusion with the numbers 0 and 1, the NPN will not contain the letters O or I.

[1] *The check digit calculation algorithm is listed in Section III.*

[2] *Revised from the 2005 Program Standards.*

B. DATA ELEMENTS FOR PREMISES DATABASES

STATE/TRIBE PREMISES REGISTRATION SYSTEM DATA STANDARDS

Table I. 2

Data Elements – State/Tribe Premises Registration Database				
No.	**Field Name**	**Format**	**Length**	**Example/Comments**
Data elements 1- 12 are uploaded to the National Premises Information Repository				
1	Premises ID Number	Alphanumeric	7	025B7HK
2	Name of Entity	Alphanumeric	30	
3	Owner or Appropriate Contact Person [1]	Alphanumeric	30	
4	Street Address	Alphanumeric	30	
5	City	Alphanumeric	20	
6	State	Alphanumeric	2	
7	ZIP/Postal Code	Numeric	9	
8	Contact Phone Number	Alphanumeric	15	
9	Operation Type	Alphanumeric	1	*(See Codes – Operation Type Codes)*
10	Date Activated	Date	8	YYYYMMDD
11	Date Retired	Date	8	YYYYMMDD
12	Reason Retired	Alphanumeric	1	*(See Codes – Premises Retired – Reason Retired Codes)*
13	Species at Premises [2]	Alphanumeric	3	BOV, EQU *(See Species Code)*
	Historic Data [3]			
14	Previous Contact Person	Alphanumeric	30	
15	Previous Contact Person Phone	Alphanumeric	15	
16	Previous Contact Person – Start Date	Date	8	YYYYMMDD
17	Previous Contact Person – End Date	Date	8	YYYYMMDD
	GPS			
18	Latitude	Numeric	2.6 [4]	
19	Longitude	Numeric	3.6 [4]	
20	Alternate Phone Number	Alphanumeric	15	

[1] The contact person should be the person with whom the Animal Health Official is to communicate when performing a traceback (as determined by the entity).

[2] While species is an optional field, most premises registration systems provide the opportunity for the contact person at the premises to list species at the premises. It is suggested to report all species at the premises, but, as a minimum, listing the major species is highly recommended.

[3] Requires facility to store multiple records for data elements 14 -17.

[4] GPS coordinates contain 2 (latitude) or 3 (longitude) digits to the left of the decimal point, and 6 digits to the right of the decimal point. They contain an optional sign character: - indicates south latitudes or west longitudes.

NATIONAL PREMISES INFORMATION REPOSITORY DATA STANDARDS

The following data elements are provided to the National Premises Information Repository from the State and Tribe Premises Registration Systems.

Table I. 3

Data Elements – National Premises Information Repository				
No.	**Field Name**	**Format**	**Length**	**Example/Comments**
1	Premises ID Number	Alphanumeric	7	025B7HK
2	Name of Entity	Alphanumeric	30	
3	Owner or Appropriate Contact Person [1]	Alphanumeric	30	
4	Street Address	Alphanumeric	30	
5	City	Alphanumeric	20	
6	State	Alphanumeric	2	
7	ZIP/Postal Code	Numeric	9	
8	Contact Phone Number	Alphanumeric	15	
9	Operation Type	Alphanumeric	1	*(See Codes – Operation Type Codes)*
10	Date Activated	Date	8	YYYYMMDD
11	Date Retired	Date	8	YYYYMMDD
12	Reason Retired	Alphanumeric	1	*(See Codes – Premises Retired – Reason Retired Codes)*

[1] *The contact person should be the person the Animal Health Official is to communicate with when performing a traceback (as determined by the entity).*

C. CODES

OPERATION TYPE CODES

Premises are categorized by the type of operation with one of the following codes.

Table I. 4

Operation Type	
Code	**Description**
B	Port of Entry
C	Clinic
E	Exhibition
L	Laboratory
M	Market/Collection Point
N	Nonproducer Participant
O	Boarding Facility
P	Production Unit [1]
Q	Quarantine Facility
R	Rendering
S	Abattoir
T	Tagging Site

[1] *Includes Hunt Ranches, hobby farms, etc.*

PREMISES RETIRED – REASON RETIRED CODES

When a premises discontinues operation, the premises is designated as retired on the premises registration systems with one of the following codes.

Table I. 5

Reason Premises Retired	
Code	**Description**
D	Developed (Operation terminated resulting from commercial development)
E	Error (Reported in error)
M	Merged
O	Sold
S	Split

SPECIES CODES

Table I. 6

Species and Subgroup Codes			
Code	**Description**	**Code**	**Description**
AQU	**Aquaculture**	**BOV**	**Bovine** (Bison and Cattle)
CLM	Clams	BIS	Bison
CRA	Crawfish	BEF	Beef
CTF	Catfish	DAI	Dairy
MSL	Mussels		
OYS	Oysters	**CAM**	**Camelid** (Alpacas, Llamas, etc.)
SAL	Salmon	**CAP**	**Caprine** (Goats)
SBA	Striped Bass	**CER**	**Cervids**
SHR	Shrimp	DEE	Deer
SLP	Scallops	ELK	Elk
TIL	Tilapia	**EQU**	**Equine** (Horses[1], Mules, Donkeys, Burros)
TRO	Trout	**OVI**	**Ovine** (Sheep)
AVI [2]	**Avian**	**POR**	**Porcine** (Swine)
CHI	Chickens		
DUC	Ducks		
GEE	Geese		
GUI	Guineas		
QUA	Quail		
RTT	Ratites (Emus, Ostriches, etc.)		
TUR	Turkeys		

[1] *Equine Working Group may develop subgroups.*

[2] *POU was initially used and remains a valid code.*

GENDER CODES

Table I. 7

Animal Gender and Reproductive Status Codes	
Code	**Description**
M	Male
F	Female
C	Neutered / castrated male
S	Neutered / spayed female
X	Mixed (used only in groups)

AIN DEVICE AND ANIMAL EVENT CODES

Table I. 8

AIN and Animal Event Codes	
Code	**Description**
0	AIN device distributed – AIN is distributed to a premises or Nonproducer Participant
1	AIN allocated by USDA/APHIS to an authorized manufacturer
2	Tag applied – National Animal ID tag is applied to an animal.
3	Moved in – Animal is moved into a premises.
4	Moved out – Animal is moved out of a premises.
5	Lost tag – New tag is applied to an animal that lost a tag and previous AIN is unknown.
6	Replaced tag or Re-tagged – New tag is applied to an animal that lost a tag and previous AIN is unknown.
7	Imported – Animal is imported into the U.S.
8	Exported – Animal is exported out of the U.S.
9	Animal at location – Animal was confirmed at the premises (vaccination, tested, treated, etc.); no movement has occurred.
10	Slaughtered – Animal was sent to an abattoir.
11	Died – Animal died of natural causes or euthanized at the farm/ranch.
12	Tag retired – Tag retired by producer, packing house, etc.
13	Animal missing – Lost, stolen, etc.
14	ICVI – Certificate of Veterinary Inspection
20	Invalid AIN (determined by APHIS)
21	AIN recalled from manufacturer (determined by APHIS)
22	AIN Device returned to manufacturer (reported by manufacturer).

GROUP/LOT EVENT CODES

Table I. 9

Group/Lot Event Codes	
Code	**Description**
1	Begin Group/Lot – Group/Lot of animals was established at a premises.
2	Moved Group/Lot in – Group/Lot of animals was moved into a premises.
3	Moved Group/Lot out – Group/Lot of animals was moved out of a premises.
4	Group at location – The group or lot of animals was confirmed at the premises (vaccination, tested, treated, etc.); no movement has occurred.
5	End Group-Lot – Group/Lot inventory is zero.

II. IDENTIFICATION DEVICES WITH THE ANIMAL IDENTIFICATION NUMBER (AIN) AND OTHER APPROVED NUMBERING SYSTEMS

A. VISUAL IDENTIFICATION DEVICES

EARTAGS – VISUAL ONLY

For livestock industries that generally use visual identification, such as cattle and sheep, animal identification number (AIN) tags are the accepted industry standard when unique individual animal identification is warranted. USDA, with industry input through the species working groups, has established standards for AIN tags (readability, durability, printing characteristics, etc.).

PERFORMANCE STANDARDS FOR IDENTIFICATION EARTAGS FOR ALL SPECIES THAT USE EARTAGS

Table II. 1

Performance Standards for Identification Eartags for all Species that use Eartags	
Performance Standards	**Description**
One-time use	The tag must be designed for one-time use (tamper evident), making it impossible to remove and reapply the tag without visual evidence of tampering.
Unalterable	The printing on the tag may not be readily altered.
Readability	The AIN or other numbers used on an eartag to identify an animal must be easily and reliably readable. The printing and color contrast of the U.S. Shield, lettering, and numbers are to be readable at a distance of 30 inches (0.75 m). **Note:** For swine, the PIN must also be easily and reliably readable.
Tag loss rates *	Cattle: On average, when applied in a manner approved by the manufacturer, not more than 1 percent of tags applied may be lost in the year following application or in any year thereafter under normal field conditions over the expected life of the tag. Swine: On average, when applied in a manner approved by the manufacturer, not more than 5 percent of tags applied may be lost in the year following application or in any year thereafter under normal field conditions over the expected life of the tag. When applied just prior to entering slaughter channels, not more than 1 percent of the tags may be lost while swine are in slaughter channels. Sheep and goats: On average, when applied in a manner approved by the manufacturer, not more than 5 percent of tags applied may be lost in the year following application and not more than 2 percent in any year thereafter under normal field conditions over the expected life of the tag.
Expected tag life	The minimum time that a tag shall be expected to remain on an animal in a functional state (physically) is for the expected life of the animal.
Tag toxicity and animal injury	Tags may do no harm to an animal or affect its health or well-being. Tags may not cause chemical contamination of meat or edible offal or damage the hide.
Tag deterioration	There may be no diffusion of colorant from tags. There may be no apparent physical deterioration (other than color) due to detrimental effects by UV light, rain, heat (45C), and cold (-30C) or other environmental influences such as chemicals, mud, urine, or manure for at least 5 years of wear.
Tag plasticity	Devices may not split or crack under normal use.
Tag coupling/tensile strength	Tag coupling/tensile strength: Evaluation standards must conform to ICAR testing standards and, at minimum, should comply with ISO standards 37 and 527.
Tag abrasion resistance	Tag abrasion resistance: Tags shall not exhibit damage or change due to wear, may be subjected to ICAR testing standards and, at minimum, should comply with ISO standard 9352.
* Cattle tag loss rates used unless specifically noted for another species.	

Eartags with Radio Frequency Identification (RFID) Technology

Producers and owners of animals may choose to incorporate supplemental identification methods or technologies with the animal identification number (AIN) tag or device. If they do, the AIN tag or device is the official identifier. (See "Supplemental Identification" in the NAIS User Guide).

RFID tags that meet the standards and minimum visual characteristics, when so authorized, can be used as AIN tags. In addition to the visual standards defined above, the RFID tag must meet the following criteria.

Table II. 2

RFID Identification Eartags	
Performance Requirements	**Description**
ISO Compliant	All transponders must be certified by ICAR for conformance with ISO-11784 and 11785.[1]
Electronic Read Rates and Ranges	In a laboratory with a neutral electromagnetic environment: Transponders must have a 100 percent read rate in best orientation at 24 inches (60 cm) in a stationary test and a moving test of 1 m/sec over a passage length of at least 20 inches (50 cm). Note: This test information is optional. In a field test environment: Transponders must be reliably machine read at a rate of 95 percent without regard to orientation by a standardized dual HDX/FDX reader, as cattle move by in a single file passage at 4 mph (1m/sec).
Expected tag life	The minimum time that a tag shall be expected to remain functional (electronically) is for the expected life of the animal.
Transponder security	The official number encoded within each transponder must not be able to be altered and must be contained within the tag. Tags will be tamper-evident and impossible to unseal without visible evidence of tampering.
Transponder failure rates	The transponder within the tag shall be reliable and machine-readable for the expected lifetime of the animal.

[1] ISO 11784 and 11785 are summarized in Section III. Additional ISO standards and/or nationally recognized standards for radio frequency identification of animals will be incorporated as supplemental identification for AIN devices as they are published.

Printing Standards for Eartags

These printing standards are for visual identification, and the visual eartag is the animal's official identifier. RFID technology may be incorporated in the visual tag when the printing criteria in the table below are met. Such technology is considered supplemental identification. Both visual only and RFID eartags must meet the standards for printing as shown in Table II.3.

Table II. 3

Printing Standards for Individual Animal ID Eartags
Description
• The tag must have the U.S. Shield imprinted on its surface.[1] Print size on eartags for the U.S. Shield must be a minimum height of 0.2 inches (5 mm) and minimum width of 0.2 inches (5 mm). Smaller print sizes that meet the readability requirements may be approved for sheep and goats.
• The tag must bear: o The entire 15-digit AIN.[2] A space must be inserted between each 3rd digit of the AIN imprinted on the AIN tag, e.g., 840 003 123 456 789, **or** o The eight[3]- or nine[4]- character alphanumeric number uniquely assigned to a manufacturer under the National Uniform Eartagging System (NUES), **or** o The entire 7-digit PIN plus an individual animal number that is unique to the premises.[5] The PIN and animal number must be printed on separate lines on the eartag, **or** o For sheep or goats, a number issued by the scrapie program consisting of the flock ID plus an individual animal number that is unique to the flock.
• The font for all characters imprinted on the eartag must be Arial or, if different, approved by APHIS.
• Print size for eartags must be a minimum height of 0.2 inches (5 mm) for numbers. Smaller print sizes that meet the readability requirement may be approved for sheep and goats.
• An indentation of the manufacturer's unique, copyrighted logo or trademark must be easily observed on the tag**.** Having such information permanently imprinted on the tag is also acceptable.
• The text "UNLAWFUL TO REMOVE" must be imprinted on the tag with print size at a minimum height of 0.12 inches (3 mm).[1]
• Printing of other information may be authorized if it does not compromise readability of required information.

[1] For producers, market operators, and animal health officials,etc., to recognize eartags as "official," the U.S. Shield must be visible on the animal after it is tagged. Similarly, to emphasize the need to maintain this identification for the life of the animal, the text "UNLAWFUL TO REMOVE" must be clearly visible. Therefore, the U.S. Shield must be printed on both parts of a two-part tag, and "UNLAWFUL TO REMOVE" must be printed on the portion of the eartag most visible following application (e.g., on the back piece (outside of ear) for small button or panel tags). For panel tags, "UNLAWFUL TO REMOVE" may also be printed on the front piece (inside of ear).

[2] Eartags with RFID technology must have all 15 digits of the AIN printed on the portion of the tag that contains the transponder, which is coded with the identical 15-digit AIN. Imprinting the AIN on the portion of the tag that does not contain the transponder is optional, but when this is the case, the tag set should be packaged in containers or trays so that the two pieces are maintained as a pair until they are applied.

[3] Commonly used in small livestock serial eartags where a short number is needed on a small tag.

[4] VS programs will determine the format of the NUES to be used. Currently, the nine-character format is required for official cattle eartags other than reactor tags.

[5] This option is not available in the cattle industry where reliance on producer issued production numbers is not a feasible option due to the number of years in the cattle life span and the greater risk of duplication. The uniqueness of the production number in the swine industry will be the responsibility of the producer or the swine production company. For the Scrapie program, uniqueness is ensured by the issuance of production numbers by the program.

In order to meet the needs of the swine industry for identification of slaughter swine, especially cull breeding animals, the use of premises identification number (PIN) eartags is encouraged. Table II.4 lists the printing standards for such eartags.

Table II.4

Printing Standards for Premises ID Eartags for Slaughter Swine
Description
• The portion of the eartag most visible to animal handlers and used as the primary identifier of the animal must: o Be a minimum of 2 sq. inches in size o Bear the entire 7-digit PIN of the premises o Bear the U.S. Shield o Bear the PIN and corresponding barcode on the reverse side[1]
• The portion of the eartag most visible to animal handlers and used as the primary identifier of the animal may: o Include a management number. If a management number is applied by the manufacturer or at the premises, the PIN and management number must be printed on separate lines o Include a management number in the barcode provided the first 7 alpha numeric characters of the bar code correspond to the PIN
• The text "UNLAWFUL TO REMOVE" must be imprinted on the tag.[2]
• The font for all characters imprinted on the tag by the manufacturer must be Arial or, if different, approved by APHIS.
• Print size for eartags must be a minimum height of 0.25 inches (6mm) for numbers and letters.
• The U.S. Shield must be a minimum of 33 percent larger than the PIN print size. The minimum height and width is 0.33 inches (8mm).[2]
• An indentation of the manufacturer's unique, copyrighted logo or trademark must be easily observed on the tag. Having such information permanently imprinted on the tag is also acceptable, provided the print is on the back of the visual portion of the tag.
• Printing of other information may be authorized if it does not compromise readability of required information.

[1] Code 128 symbology is the preferred standard.

[2] For producers, market operators, and animal health officials,etc., to recognize eartags as "official," the U.S. Shield must be visible on the animal after it is tagged. Similarly, in order to emphasize the need to maintain this identification for the life of the animal, the text "UNLAWFUL TO REMOVE" must be clearly visible. Therefore, the U.S. Shield must be printed on both parts of a two-part tag, and "UNLAWFUL TO REMOVE" must be printed on a portion of the eartag that is clearly visible following application. For PIN eartags for slaughter swine, "UNLAWFUL TO REMOVE" must be printed on the back piece (outside of ear), but may also be printed on the front piece (inside of ear).

B. RADIO FREQUENCY IDENTIFICATION – INJECTABLE TRANSPONDERS

Table II. 5

RFID Injectable Transponders	
Standard	**Description**
ISO Compliant	All transponders must be certified by ICAR for conformance with ISO 11784 and 11785, unless other ISO or U.S.-based technology standards are applicable to livestock and approved for use by APHIS.
Read Range	The transponder must have a minimum read range of 4 inches with a handheld transceiver (reader). *Note: USDA APHIS will use a transceiver that reads ISO compliant transponders to test the read distance. Applicants submitting non-ISO transponders must also provide a reader with their application.*
Anti-migration	The transponder shall be constructed to prevent migration after implantation.
Transponder security	The AIN encoded within each transponder shall not be alterable (changed to represent a different AIN than what was initially encoded in the transponder).
Expected tag life	The minimum time that a tag shall be expected to remain functional (electronically) is for the expected life of the animal. (20 years for horses)
Transponder failure rates	The transponder shall be reliable and machine-readable for the expected lifetime of the animal with a failure rate of less than 1 percent per annum.
Breakage	The transponder, under normal animal husbandry conditions, shall not break.
Harmless to the animal	The implant, when injected and maintained as an implanted device, shall not cause harm to the animal.

III. OTHER REFERENCES

CHECK DIGIT CALCULATION ALGORITHM – ISO 7064, MOD 37, 36

This check digit algorithm is used for the allocation of Premises Identification Numbers (PINs) and Non-producer Participant Numbers (NPNs). The check digit algorithm referenced is based on ISO 7064:1983, Data Processing – Check Character Systems. It maps a string of alphanumeric characters to a single alphanumeric character.

Formula for Calculating the Check Digit for an 18-Character Identifier

Example: A1-2425G-ABC1234-002-x, where x is the check digit.

The characters of the identifier are processed character by character from left to right.

N=18 is defined as the number of characters, including the check digit in the identifier. The characters of the identifier (including the check digit) are numbered from right to left: a_1 is the check digit and a_2 to a_{18} are the characters of the identifier as follows.

A	1	2	4	2	5	G	A	B	C	1	2	3	4	0	0	2	x
a_{18}	a_{17}	a_{16}	a_{15}	a_{14}	a_{13}	a_{12}	a_{11}	a_{10}	a_9	a_8	a_7	a_6	a_5	a_4	a_3	a_2	a_1

Table A-1

The algorithm then comprises five steps:

Step 1: Set a_j for j = n…2 as follows:

a_n is the value for the first character of the identifier. *(See Table A-2)*

a_{n-1} is the value for the second character of the identifier

…

a_2 is the value for the last character of the identifier.

Char	Value	Char	Value	Char	Value	Char	Value
0	**0**	**9**	**9**	**I**	**18**	**R**	**27**
1	**1**	**A**	**10**	**J**	**19**	**S**	**28**
2	**2**	**B**	**11**	**K**	**20**	**T**	**29**
3	**3**	**C**	**12**	**L**	**21**	**U**	**30**
4	**4**	**D**	**13**	**M**	**22**	**V**	**31**
5	**5**	**E**	**14**	**N**	**23**	**W**	**32**
6	**6**	**F**	**15**	**O**	**24**	**X**	**33**
7	**7**	**G**	**16**	**P**	**25**	**Y**	**34**
8	**8**	**H**	**17**	**Q**	**26**	**Z**	**35**

Table A-2

Step 2: Set j=1 and P_1=36

Step 3: Calculate

$S_j = P_j|_{37} + a_{(n-j+1)}$

$P_{(j+1)} = S_j||_{36} \times 2$

For j=1…n, where

$||_{36}$ is the remainder after division by 36. If the remainder equals zero, then $||_{36} = 36$.

$|_{37}$ is the remainder after division by 37 (never equals to 0).

$a_{(n-j+1)}$ is value of a character in the string.

Step 4: The check digit a_1 must be computed so that $S_n||_{36} = 1$.

Step 5: Use Table A-2 to select the check character.

j	Char	a_j	$a_{(n-j+1)}$	P_j	$P_j\|_{37}$	S_j	$S_j\|\|_{36}$	P_{j+1}
1	A	10	10	36	36	46	10	20
2	1	1	1	20	20	21	21	42
3	2	2	2	42	5	7	7	14
4	4	4	4	14	14	18	18	36
5	2	2	2	36	36	38	2	4
6	5	5	5	4	4	9	9	18
7	G	16	16	18	18	34	34	68
8	A	10	10	68	31	41	5	10
9	B	11	11	10	10	21	21	42
10	C	12	12	42	5	17	17	34
11	1	1	1	34	34	35	35	70
12	2	2	2	70	33	35	35	70
13	3	3	3	70	33	36	36	72
14	4	4	4	72	35	39	3	6
15	0	0	0	6	6	6	6	12
16	0	0	0	12	12	12	12	24
17	2	2	2	24	24	26	26	52
18	M	22		52	15	37		

Table A-3

S_{18} is defined as $S_{18} = P_{18}|_{37}+a_1$ (a_1 being the check character). Hence, we must find an a_1, so that $15 + a_1-1$ is dividable by 36 without rest.

This leads to $a_1= 22$, which represents the character “M.” Hence the complete “identifier” is A1-2425G-ABC1234-002-M.

The following table illustrates the generation of a check digit for a 6-character Premises ID Number (104G7M).

j	Char	a_j	$a_{(n-j+1)}$	P_j	$P_j\|_{37}$	S_j	$S_j\|\|_{36}$	P_{j+1}
1	1	1	1	36	36	37	1	2
2	0	0	0	2	2	2	2	4
3	4	4	4	4	4	8	8	16
4	G	16	16	16	16	32	32	64
5	7	7	7	64	27	34	34	68
6	M	22	22	68	31	53	17	34
7	3	3		34	34	37		

Table A-4

The check digit for this example is 3, resulting in a complete Premises ID Number of 104G7M3.

ISO STANDARDS - RADIO FREQUENCY IDENTIFICATION OF ANIMALS

Radio Frequency Identification (RFID) is an electronic means of identification. The data-gathering device is a transceiver, which may be stationary or portable. The transceiver transmits data to and receives data from a transponder, which is a device attached to the object being identified. The main components of the transponder are the antenna and the microchip. The antenna consists of a coil of wire or a coil etched on a substrate. The antenna serves to receive data from and send data to the transceiver, and functions with the transceiver to supply power to the transponder while data is gathered. Since the transponder is passive (contains no battery or other power source) the microchip is activated by energy from the transceiver. Upon activation, it receives data from the transceiver and responds by sending data, including the ID number embedded in the microchip's memory, to the transceiver.

RFID technology is used in the identification of a wide variety of objects. Its use in the identification of animals is governed by two international standards – ISO 11784 and ISO 11785. ISO 11784 defines the code structure of the ID data, which is embedded in the memory of the transponder's microchip. ISO 11785 defines the technical specifications of how the transceiver gathers data from the transponder.

ISO 11784 Radio Frequency Identification of Animals – Code Structure

RFID of animals requires that the bits transmitted by a transponder are interpretable by a transceiver. Usually the bit stream contains data bits, defining the identification code and a number of other bits to ensure correct reception of the data bits. ISO 11784 defines the data bits; ISO 11785 defines the data integrity bits.

Definitions

The following terms relate to RFID, and refer to RFID devices and the data contained in and communicated by them.

- Animal Code – Bit pattern to identify an animal.
- Bit Pattern – Sequence of binary digits or bits [0,1].
- Code Field – Group of bits in the identification code with a specific meaning.
- Country Code – Bit pattern to define the country where the transponder was issued.
- Data Block – Additional group of bits with a specific meaning.
- Flag – Single bit with a specific meaning.
- Identification Code – Part of the code that is used for identification (control codes such as header, trailer and checksum are excluded).
- Manufacturer's Code – Bit pattern identifying the manufacturer of the transponder.
- National Identification Code – Code field with a unique number within a country.
- Transceiver – Device used to communicate with a transponder.
- Transponder – Device that transmits its stored information when activated by a transceiver and may be able to store new information.

Description of Code Structure

The code in the transponder is split up into a number of code fields, each with its own meaning. Each field is coded in natural binary with the high-order bit being leftmost. The structure of the code is specified in the table below. Bit number 1 in the code is the most significant bit (MSB), bit number 64 is the least significant bit (LSB).

The combination of country code and national identification code provides a unique worldwide identification number.

Table III. 1

Code Structure			
Bit No.	**Information**	**Combinations**	**Description**
1	Flag for animal (1) or non-animal (0) application.[1]	2	This bit signals whether the transponder is used for animal identification or not. In all animal applications this bit shall be 1.
2 - 15	Reserved field.	16 384	Fourteen bits of code are reserved for future use.
16	Flag indicating the existence of a data block (1) or no data block (0).	2	This bit signals that additional data is to be received (e.g., physiological data, measured by a device which combines identification and monitoring). This bit shall be 1 if additional information is appended to the identification code, otherwise it shall be 0.
17 - 26	ISO 3166 numeric-3 country code.	1 024	Country codes from 900 to 998 may be used to refer to individual manufacturers of transponders. Country code 999 is used to indicate that the transponder is a test transponder and need not contain a unique identification number. The country code for the United States is 840.
27 - 64	National identification code.[2]	274 877 906 944	Unique number within a country.[3]

[1] *The method to distinguish between animal and non-animal applications using bit No. 1 allows the code structure to be recognized electronically. However, this requires that future standards on RFID in other fields will adhere to this convention.*

[2] *The length of the national identification code was chosen to have enough combinations available for all animals in a large country. Moreover, the uniqueness of a code is expected to be maintained over thirty years.*

[3] *It is a national responsibility to ensure the uniqueness of the national identification code. If necessary, number series may be allocated to species and/or manufacturers, but this will not be standardized. Ideally, every country should maintain a central database in which all issued codes are stored, together with a reference to the database where the information concerning the associated animal can be retrieved.*

ISO 11785 Radio Frequency Identification of Animals – Technical Concept (summary)

ISO 11785 defines the technical aspects of how a transceiver communicates with a transponder, how a transponder is activated, and how the stored information is transferred to a transceiver. The standard allows communication to be either half-duplex (permitting communication between transceiver and transponder in one direction only at a time) or full-duplex (permitting simultaneous communication between the transceiver and the transponder), and is designed to facilitate both method to be incorporated in a single transceiver.

The following table lists the applicable technical specifications for transceivers and transponders. In addition to the 64 data bits defined in ISO 11784, headers, trailers, error detection bits, and, for full-duplex, control bits are defined.

Table III. 2

Summary of the FDX and HDX Systems		
Parameter	**FDX System**	**HDX System**
Activation frequency	134.2 kHz	134.2 kHz
Modulation	AM_PSK	FSK
Return frequencies	129.0 kHz to 133.2 kHz 135.2 kHz to 139.4 kHz	124.2 kHz 134.2 kHz (0)
Encoding	Modified DBP	NRZ
Bit rate	4 194 bit/s	7 762.5 bits/s (1) 8 387.5 bits/s (0)
Telegram structure:		
– Header	11	8
– Identification code	64	64
– Error detection code	16	16
– Trailer	24	24
– Control bits	13	–