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Bovine EID numbering **16/03/2015**

Retention of the current numbering system for GB cattle is feasible under bovine EID if the existing species code (introduced for sheep EID) is used in conjunction with the country code and the individual animal ID (minus the check-digit) on a transponder. Importantly, use of the species code is also logically consistent with the ambition to create multi-species databases. If the species code is not accepted as part of the unique identifier, less elegant solutions are available but may incur additional costs and cause confusion likely to dampen farmers' enthusiasm for adopting bovine EID. However, the species code is not currently fully prescribed internationally within ISO11784 – meaning that either the prevailing standard needs to be updated or further EU regulation is required.

Introduction

1. All sheep and cattle IDs in GB[1] are currently constructed in the same way, a two-letter (UK) country code + a six-digit herd/flock number + a five-digit animal number. For sheep, an additional leading zero (0) is inserted ahead of the flock number. For cattle, an additional check-digit (C) is calculated from the other digits and inserted between the herd number (HHHHHH) and the animal number (AAAAA). These give the IDs written externally on ear tags. For example: UK**0**HHHHHHAAAAA for sheep, UKHHHHHH**C**AAAAA for cattle; two letters + 12 decimal digits.

2. For a given farm, the herd and flock numbers are identical. For each herd and flock number, the Ear Tag Allocation System (ETAS) issues animal numbers sequentially, but separately for cattle and sheep.[2] For example, UK**0**55555500001 for the first lamb born and UK555555**2**00001 for the first calf born on a farm with herd/flock number 555555; UK**0**55555500002 for the second lamb and UK555555**3**00002 for the second calf, and so on.

3. This means that cattle and sheep born on the same farm can share 11 decimal digits in common, with only placement of the leading zero and check-digits distinguishing them. That is, since herd and flock numbers are the same for a given farm and animal numbers are issued in parallel sequences (1,2,3 etc), duplication of these elements between sheep and cattle is inevitable.

4. This paper summarises how the current cattle numbering system poses a problem in moving towards bovine EID and identifies solutions that would enable efficient implementation of bovine EID alongside that of sheep. Some solutions would also facilitate the development of multi-species databases.

[1] Arrangements in Northern Ireland differ to those in England, Scotland and Wales.
[2] Moreover, ETAS holds separate databases for cattle and sheep numbers issued – the two are not linked.

EID numbering

5. The prevailing international standard prescribing how animal IDs are stored on an electronic transponder is ISO11784. This specifies precisely which “binary digits” or "bits" of a transponder can be used to hold the decimal ID in binary form (zeroes and ones).[3] Regardless of the actual physical storage capacity of a transponder, ISO11784 confines attention to only 64-bits. Moreover, although 64-bits are extracted from the (longer) data telegram, only some of these are interpreted by ISO11784 as the unique animal ID (see Annex A). As such, it is the prevailing standard (rather than the technology) that constrains how animal IDs are represented on transponders.

6. For example, 10 bits (bits 17 to 26 on the transponder) are allocated for the country code (a three-digit[4] decimal number rather than two-letter code; “826” for the UK) and 38 bits (bits 27 to 64 on the transponder) for the individual decimal animal ID. In addition, one bit (bit 1) is used to indicate whether the transponder is being used for an animal ID and three bits (bits 2 to 4) are used as a retag counter, to indicate if the animal has had any replacement tags. This gives a format of 1 0 826 NNNNNNNNNNN within which to represent an existing visual ID.

7. A 12-digit decimal number starting with a zero can be fitted into 38 bits, as evidenced by implementation of sheep EID. However, the highest 12-digit decimal number that can be stored in 38 bits is 274877906943 and many existing visual cattle IDs legitimately exceed this. For example, all 12-digit Scottish cattle IDs start with a "5", all Welsh IDs with a “7”, and many English IDs with a “3”. Consequently, although a derogation within the EU bovine EID regulations will allow a transition period before all visual and transponder numbers have to bear the same identification code, a move to EID under ISO11784 is incompatible with the established GB cattle numbering system.

A partial solution: dropping the check-digit

8. Dropping the check-digit (and inserting a leading zero to left-pad to 12 digits) would reduce the numerical value of an existing cattle ID sufficiently for it to then fit into the available 38 bits of storage on the transponder. As the name implies, the check-digit was originally used as a convenient means of checking for manual transcription errors in reporting IDs - a need that diminishes with a move to electronic reading. Moreover, the check-digit can be calculated by software interfaces to reading equipment and reinserted for display purposes and/or inclusion in a database - meaning that most existing GB cattle IDs could perhaps be retained under EID despite the ISO11784 constraint on transponder storage (some older ID numbers in the historic herd may still be problematic, see Annex C). As an example precedent, the check-letter printed on sheep tags in Eire is not present on the transponder.

9. However, because cattle and sheep born on the same holding can share the same 11 decimal digits representing herd/flock and animal numbers, the uniqueness of a cattle ID without its check-digit is not guaranteed. For example, in Scotland, over 10,000 holdings currently have identical herd and

[3] Binary expresses values in base 2, decimal in base 10. For example, 11 in binary is equivalent to 3 in decimal.
[4] Strictly, a four-digit number up to 1023 – but no country codes of this length have been issued.

flock numbers and over 600,000 existing cattle IDs will duplicate those of existing electronically identified sheep if the check digit is dropped (see Annex C).[5]

10. Since duplicate transponder IDs are not acceptable, dropping the check-digit is not, on its own, a solution to the problem of cattle EID numbering. However, it is a partial solution that should be viewed in the context of complementary options for addressing the problem whilst also seeking to meet the cattle sector's preference for (as near as possible) What-You-See-Is-What-You-Get (WYSIWYG) matching between existing visual and new electronic numbers. WYSIWYG offers the benefits of transparency to users and, moreover, simplifies database design and operation. Possible options considered below include amendment of ISO11784, various forms of transponder numbering and a new international standard for animal identification. The Scottish Governments preferred option is presented first.

Option 1: use of the species code

11. Although not fully prescribed by ISO11784, bits 5 to 9 on a transponder (defined as "user data") are permitted to hold an internationally-recognised species code (see Annex B) for livestock in the EU. The use of "04" as the species code for sheep is mandatory under Commission Decision 2006/968 implementing Council Regulation (EC) 21/2004.

12. If this existing information was recognised officially as part of the transponder ID it would ensure unique numbering even without the check-digit. The full format would be: one-digit animal flag + one-digit retag counter + two-digit species code + three-digit country code + a zero + six-digit herd/flock number + five-digit animal number. For example, 1 0 02 826 055555500001 for a cow, 1 0 04 826 055555500001 for a sheep. Databases and software interfaces to reading equipment could be programmed to either display the species code as part of the ID, or more simply to use the species code as a flag to re-insert a check-digit to recreate the current visual two letter +12 decimal digit cattle ID (i.e. for UK country codes, insert check-digit if species code is 02, otherwise not).

13. Bits 5 to 9 are currently defined as "user information" under ISO11784, and are only used in conjunction with the country code. Official international adoption of them as species code information would thus require formal revision of ISO11784, which may or may not be feasible depending on how countries beyond the EU currently use those bits on their transponders: previous approaches to ISO on this topic were unsuccessful. Nevertheless, ISO11784 is currently undergoing its latest quinquennial review and a previous review cycle did convert bits 2 to 4 from "reserved" to a prescribed retag counter accepted as part of the unique transponder numbering – so there is a precedent for change. Equally, the principle of using bits outwith those specified for the ID itself to determine how the ID should be interpreted is already accepted since the first bit on a transponder indicates whether the ID relates to an animal or not (see Annex A). Similarly, the actual data telegram emanating from a transponder indicates to reading equipment whether a low-frequency (LF) transponder is HDX of FDX.

[5] England and Wales will face a similar situation, although the numbers involved have yet to be estimated. Due to their using different numbering systems, including unified sequencing for different species, it does not appear that other MS across the EU face the same problem, although this has yet to be confirmed and several do have 12-digit cattle IDs and others may face different format compatibility issues.

14. The use of bits 5 to 9 for species codes under EC21/2004 is compatible with ISO11784 since the "user information" is specified by the EU and used (or not) by the relevant Competent Authorities across EU Member States. Moreover, once written-to during the manufacturing process, bits 5 to 9 are equally secure against alteration as the country code and animal number bits.[6] Hence the species code can safely be used **within the EU** in conjunction with the country code and formal animal ID to achieve unique cattle numbering. Consequently, at least in principle, even if ISO11784 is not revised to specify bits 5 to 9 for use as species codes internationally, trade within the EU would still be feasible using species codes to ensure unique IDs. There could be an impact on live animals exported outwith the EU in terms of these animals needing to be renumbered (this is the case for cattle imported into the EU from Third Countries), but live cattle exports from GB are many times less than the number of cattle potentially requiring renumbering.

15. This option offers a practical GB-wide solution to the problem of fitting existing GB cattle IDs into the bit space allowed under ISO11784. It uses information already mandated by EC21/2004 to be on EID transponders and would require no adjustment to visual IDs or reading equipment to implement as-and-when bovine EID is actually introduced. **Importantly, irrespective of offering a solution to the immediate problem of GB cattle IDs, use of the species code is logically consistent with the ambition to create multi-species databases**. Specifically, not only does a species code dramatically increase the availability of unique animal IDs, but its adoption also enhances the ability to structure databases in an efficient manner without recourse to cross-referencing to specify animals' species. This will influence the costs, robustness, accuracy and speed of databases and their usefulness for tracing contemporaneous movements of different species.

16. Hence, for multiple reasons, adoption of the species code is the solution preferred by Scottish Government. Ideally, ISO11784 would be revised to prescribe bits 5 to 9 for species codes internationally but, failing that, agreement at an EU level to formalise their use within the EU as a means of using current flexibility within ISO11784 could have significant benefits for standardisation for intra-community trade. Alternatively, actual use of the species code could remain optional (i.e. bits 5 to 9 set to zero if species code not used) for individual countries since the species code is only used in conjunction with the country code.

<u>Option 2: insertion of a leading "2"</u>

17. If use of the species code is not feasible but the check-digit is dropped, duplication of sheep IDs could still be avoided by adding a leading digit other than "0" (but smaller than "3"). Ideally, this would be a "1" since all resulting numbers would fit into 38 bits. However, "1" was previously allocated for sheep in Northern Ireland plus Guernsey, Jersey and the Isle of Man. A leading "2" would work for most IDs, yielding 12-digit numbers starting with "21", "22" or "23" in England and "25" in Scotland. However, not all Welsh cattle numbers currently commencing with a "7" would fit when starting as "27" and many (or, for consistency, all) would have to be adjusted to start "26" instead. Software interfaces to readers and/or databases could be used to either drop the leading "2" (or convert a Welsh "26" to "7") and reinsert the check-digit or simply report the new number. Recourse to cross-referencing ("tag buckets") could be avoided through using the leading "2" and

[6] "user information" is thus available to end-users (e.g. farmers, marts) but is determined by the Competent Authority responsible for issuing IDs.

"826" country code to guide interpretation. Although the transponder number would not be exactly the same as the original visual number, it would still retain recognisable elements of the original number in a near-WYSIWYG manner and would be acceptable under the transition derogation if not more generally.

18. Although each cattle transponder would have a unique number, some transponder numbers would, by chance, duplicate existing 12-digit visual numbers. In principle, this should not matter since the scope for confusion between the two should be limited since few numbers will be being transcribed manually from reader displays. Nevertheless, this may be a sufficient concern to render this option undesirable – further checking (via ETAS) of the extent of possible duplication would be sensible.

Option 3: animal renumbering

19. Another way of avoiding duplication arising from dropping the check-digit would be for ETAS to simply issue completely new visual IDs to affected cattle. Specifically, since the current problem arises from issuing cattle and sheep numbers separately, ETAS could allocate replacement animal numbers for affected cattle by using the next number(s) available in the numbering sequence used for **sheep** on a given farm –unifying the numbering sequence by interweaving sheep and cattle.

20. For example, if 05555550002 is the highest current sheep number in use for the farm with the herd/flock number 555555, 055555500003 would be used as a replacement cattle number. This would break the continuity of numbering for each species, with sheep and cattle numbers being drawn from the same sequence. For example, whereas currently the next sheep born after 05555550002 would be numbered 055555500003, with this taken by a calf, the next available number would skip to 05555550004.

21. Renumbering of cattle can only occur with the permission and control of the Competent Authority, and the practical impact would have to be considered in consultation with officials and with industry. For example, with respect to the additional costs of retagging, the potential for cross-compliance confusion and the effort required to update central (e.g. CETAS, CTS) and on-farm database records. Views of farmers (particularly, but not only, pedigree breeders) accustomed to using separate sequential numbering for cattle and sheep would also need to be gauged.

Option 4: herd renumbering

22. As an alternative, to avoid the need for unified sequencing between cattle and sheep, herd and flock numbers could be distinguished. For example, this could be achieved by using different two-digit codes for APHA offices at the start of herd numbers and flock numbers. For example, in Scotland, "50" is currently used by Inverness to start all flock and herd numbers, but 51 could be used for herd numbers of affected cattle. This would differentiate sheep and cattle even once a check digit was dropped. Equally, cutting herd numbering from six to five decimal digits or more radically revising herd numbers would allow retention of the check digit to differentiate between sheep and cattle.

23. However, such approaches would again necessitate wide-spread renumbering of any (potentially hundreds of thousands of) cattle switching to EID – with the same additional cost and disruption implications. In addition, it would lead to a mix of herd numbers (e.g. 50HHHH and 51HHHH) on

affected farms. Furthermore, although offering a solution for Scotland, for the specific case of adding "one" to APHA office codes, there are not enough spare office codes available to cover all of GB. This approach would also require an upgrade to the current APHA Sam database system allocating herd/flock marks, which could be expensive and take some time to implement.

Option 5: adopting a new standard

24. Although adherence to ISO11784 is often presented as a necessary requirement for bovine EID[7], a broader perspective suggests that – given its origins in the 1990s - it unnecessarily constrains abilities to utilise current technological possibilities (e.g. of transponders but also databases) to better satisfy users' preferences.

25. In particular, whereas ISO11784 is problematic for current GB cattle IDs **and** is incapable of handling IDs containing spaces or letters (e.g. as found in the UK historic herd and indeed elsewhere in the EU), it is perfectly possible to place such information onto a transponder by utilising more of the available storage space and a different encoding system. For example, six-bit coding could handle all existing cattle IDs as true-WYSIWYG.[8] As such, adopting a different standard has some merit. A new standard could build on the existing ISO11784, for example by retaining the current 64-bit definitions but extending consideration to additional bits, or could start again from scratch.

26. It is unclear exactly how quickly a new standard could be implemented if it was based on common coding schemes (e.g. six-bit ASCII) and received wide-spread support. Nevertheless, it is presumed that drafting and getting a new standard accepted will be challenging and not necessarily easier than seeking revision to ISO11784 or agreement across the EU and may not be achievable within the timescale for the introduction of bovine EID. Hence it is less immediately practical than option 1 but may merit further consideration – especially if option 1 is not pursued or is unsuccessful and all renumbering options are deemed too disruptive.

Discussion

27. Cattle already have unique identifiers, most easily seen printed on ear tags and on paper passports. However, these IDs are also held in central databases (e.g. ETAS, CTS) and in local management databases (e.g. on-farm registers). Any renumbering exercise will impose costs if changes have to be made to existing visual IDs (e.g. retagging, updating paper records) and/or to database records.

28. A distinction needs to be made here between an existing visual ID and its (new) electronic representation on a transponder. Visual IDs are already installed and the aim should be to retain these in order to minimise disruption and confusion such that voluntary adoption of bovine EID is not discouraged. This entails working within both technical and regulatory constraints to find numbering systems that can be adopted at minimal cost.

29. Option 5 (new standard) would allow all existing visual IDs, including older formats found amongst the historic herd, to be retained. Option 1 (species code) would allow all current visual IDs to be

[7] Although, interestingly, barcode representations of cattle IDs seem to have been accepted without recourse to any specific standards.

[8] See https://www.scoteid.com/Public/Documents/WYSIWYG%20EID%20for%20cattle%20v1.5.pdf

retained, but older formats would have to be accommodated through the derogation (existing EU regulations may also need amendment to extend the permitted length of IDs). Retention of existing visual IDs would avoid any additional retagging and paper-revision costs. Similarly, existing central and local databases could continue to be structured around the existing visual IDs. Moreover, preservation of existing visual IDs and reasonably close correspondence between the visual and electronic IDs should help to avoid confusion amongst users.

30. Options 3 and 4 would, however, require immediate changes to visual IDs, with implications for additional costs arising from re-tagging and revisions to existing records (paper and database) but also the potential for causing confusion amongst farmers. The costs of replacement tags (allowing for the fact that one new EID tag would be required anyway) might be relatively modest, but the need for any renumbering would inevitably impose regulatory costs and cross-compliance risks even before the effort required to amend existing paper and database records is considered. Recourse to the derogation would allow retention of all existing visual IDs under option 2.

31. Preferences between options may also be guided by the likely speed with which they could be implemented. Options 1 and 5 require the support of other countries, and hence their progress would be dependent on international consultation and decision-making processes. Given that ISO11784 is currently undergoing a review, it is assumed that option 1 should fit with the likely timetable for introduction of bovine EID. Although GS1 (a not-for-profit, international organisation) is known to be working on a UHF standard for animal IDs, the speed with which option 5 could progress is essentially unknown. By contrast, options 2 to 4 require only domestic agreement and could be progressed more rapidly – subject to consultation and resourcing across the constituent parts of the UK. Table 1 below summarises the pros and cons of each of the options.

Conclusion

32. The introduction of bovine EID is to be welcomed. However a move to EID under the current version of ISO11784 is fundamentally incompatible with the existing GB cattle numbering system – despite the existing numbers being compliant with previous ID regulations. Hence the challenge is to find a cost-effective means of achieving compatibility that will not discourage voluntary uptake of bovine EID. Dropping the check-digit helps, but needs to be used in conjunction with other changes.

33. Although various solutions can be envisaged, the options presented above essentially comprise either revision of ISO11784, some form of renumbering, or adoption of a new animal EID standard. Of these, although only subject to domestic decision-making processes, renumbering is undesirable as it is potentially expensive and disruptive. By contrast, adopting a new standard or revising ISO11784 are less costly and disruptive, but are dependent on international processes.

34. The Scottish Government's preference is to seek inclusion of species code information as part of the unique transponder ID under ISO11784 or, if this cannot be achieved, agreement on its use across the EU.

Table 1: summary of options for bovine EID numbering

Option Number	Pros	Cons
1: Use of Species code. Amend ISO 11784 so that the species code outlined in 21/2004 becomes part of the unique EID.	WYSIWYG & GB-wide solution. Simple and logical. Zero additional cost [9] to and impact on the industry and Competent Authority. Fits well with the development of multi-species databases.	Securing international agreement for amending ISO 11784 is not guaranteed. Cannot accommodate older format IDs amongst the historic herd. Existing EU regulation may need amendment to extend maximum permitted ID length.
2: Insert a leading 2. Use a leading 2 in the EID ID to indicate cattle.	Almost WYSIWYG solution. Little additional cost to or impact on the industry and Competent Authority. Not dependent on international agreement.	Would require further adjustment for Welsh cattle IDs. Duplication between some transponder numbers and some existing visual IDs. Would require modification of existing EID software. Possibly only a transitional solution.
3: Animal renumbering. ETAS to issue new visual IDs to affected cattle	WYSIWYG & GB-wide solution. Not dependent on international agreement.	Large number of animals will need to be renumbered, with confusion likely and possibility of cross-compliance errors for keepers in revising on-farm records. Changes likely to be required for CETAS, AHPA & BCMS databases. Likely to cause significant negative publicity.
4: Herd renumbering. Different herd numbers would be issued for cattle, to separate herd and flock numbers	WYSIWYG solution. Not dependent on international agreement.	Not necessarily a GB-wide solution. Large number of animals will need to be renumbered, with confusion likely and possibility of cross-compliance errors for keepers in revising on-farm records Changes likely to be required for CETAS, AHPA & BCMS databases. Likely to cause significant negative publicity
5: Adopting a new animal ID standard. Avoiding reliance on ISO11784	WYSIWYG & GB-wide solution. Zero additional cost to or impact on the industry and Competent Authority. Only solution which would cope with all historic cattle IDs. Responds to changing technical possibilities and user preferences	Gaining approval of a new standard could prove challenging and may not meet the EU timetable for the introduction of bovine EID.

[9] Adopting EID will require replacing one conventional ear tag with an electronic tag. Any changes to visual IDs will impose additional costs in the form of having to replace the other conventional ear tag as well as updating paper and database records. Hence option costs are presented here relative to the minimum cost baseline.

Annex A: transponder code structure (i.e. bit allocation) under ISO11784

Bit positions	No. of bits	Decimal digits	Max decimal value	Description
1	1	1	1	Indicates if transponder is used for animal ID (1 for yes)
2 to 4	3	1	7	Retagging code (0 to 7)
5 to 9	5	2	31	User information (species code in EU)
10 to 14	5	2	31	Reserved for future uses (all set to 0)
15	1	1	1	User data in memory (1 for advanced transponder type)
16	1	1	1	Presence/absence of a data block (0 for animals)
17 to 26	10	4	1023	ISO3166 3-digit country code (826 for UK)
27 -64	38	12	274877906943	National Identification Code

Note: it is not clear what future uses are envisaged for bits 10 to 14.

Annex B: species codes

CN code	Species code	Description
0101	01	Live horses, asses, mules and hinnies
0102	02	Live bovine animals
0103	03	Live swine
0104	04	Live sheep and goats
0105	05	Live poultry
0106	06	Other live animals

Note: Combined Nomenclature (CN) code for Common Custom Tariff, EEC No 2658/87 consistent with the internationally recognised Harmonised System (HS) of the World Customs Organisation (WCO)

Annex C: summary of bovine EID renumbering implications for the Scottish herd if species code information not used

The following ScotEID estimates are based on data from BCMS/CTS for live cattle in Scotland on 19/12/2014.

Out of a total herd of 1,705,632, 1,616,495 (94.77%) have UK IDs commencing with a 5 which are thus not storable in the prescribed space on a transponder. This confirms the widespread need to drop the check digit in order to adopt bovine EID under ISO11784.

Combined sheep and cattle farming is very common in Scotland: 6,356 of the 10,515 Scottish birth-holdings for cattle are also birth-holdings for sheep. Consequently, of the 1,616,495 cattle noted above, 628,334 (38.9% of national herd) have herd numbers and animal numbers already issued as unique ISO11784 identifiers for sheep. As a result, if the species code information is not used, if they switch to EID, all of these cattle will need to be renumbered to ensure unique 11 digit IDs. In addition, at least some of a further 59,950 cattle born elsewhere in the UK will also share 11 digits with existing sheep EIDs. The proportion is unknown (but could be calculated by using regional data in the same way as for cattle born in Scotland), but if it were around 25%, this would represent a further 15,000 cattle requiring renumbering.

Separately, a smaller number of cattle with other (mostly older) ID formats are problematic for other reasons, mainly the presence of letters or spaces in the ID. However, most of these will disappear over time (although they are prevalent in other MS). Conversely, given the longevity of breeding cattle and the number of lambs born each year, overlaps between 11-digit numbering for cattle and sheep will increase over time.

Unique Identifier Type as recorded by BCMS/CTS	No. of Scottish Herd in this category	No. potentially requiring new ID	Problem	Comment and what will happen in the future regarding incompatibility with current ISO11784
SC_UK_12_Numeric	1616495	628,334	38.87% already issued to sheep	Scottish born: Likely to increase over time
NS_UK_12 Numeric	59950	14987	Assume 25% already issued to sheep	Other UK born: Likely to increase over time
UK_Space_Alpha	5335	5335	Contains Letters	Will disappear in time
UK_Alpha_Alpha	5284	5284	Contains Letters	Will disappear in time
UK not 14 digits	215	215	Structurally difficult/impossible	Will disappear in time
Non UK	17813	17813	Very old Numbers and Foreign Cattle	Some will disappear. Imports will not
Total Scottish Cattle	1705092	**671968**		
Percentage		**39.41%**		

Note: SC = born in Scotland, NS = born elsewhere in UK