Welfare Quality
Assessment protocol for dairy cows

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Version 2.0	Date: 2016/10	Contributor of the version: E Mainau Brunso; X Manteca; M Brscic; M Kirchner	Reviewed by: Welfare Quality Network
	Modification form the previous version: Typos were corrected Calves protocol was removed. It will be added again when amended.		
Version 3.0	Date: 2023/11	Contributor of the version: R Lardy, I Veissier	Reviewed by: Welfare Quality Network
	Modification form the previous version: The protocol for cattle is now split in three protocols (fattening cattle, dairy cows, veal calves) Correction of typos (missing items in the table of content; in resources checklist, 8L/min was written instead of 20L/min) In Section 'Background to the Welfare Quality protocols': - Change of explanation Box 4, 5, and 6 In protocol for dairy cows: - Correction of the Choquet coefficients for injuries (the coefficients were inverted in the previous version); - Modification of Absence of prolonged thirst indicator (a linear version of the initial calculation is now used and the score is weighted by a cleanliness score); - Modification of the calculations for the "Absence of disease" indicator (suppression of coughing measurement, one spline is calculated per disease, and then a Choquet integration is applied on the three lowest scores).		

	The modifications on calculations of the score for absence of thirst and absence of disease were decided by the general Assembly of the Welfare Quality Network and implemented by Romain Lardy.		
Version 3.1	Date: 2024/02	Contributor of the version: R Lardy, I Veissier	Reviewed by: Welfare Quality Network
	Correction equation for the comfort around resting: I = 100 – **100** x [4 x (no. moderate problems) + 9 x (no. serious problems)]/108		

Acknowledgement

Disclaimer
Restrictions on use of the integrated Welfare Quality system

This document presents the practical assessment protocols required to carry out a Welfare Quality assessment. The practical application and integrity of this system depends upon the following;

- **Training and validation** in the methods and protocols is **essential**. It is recommended to consult the website for finding training opportunities http://www.welfarequalitynetwork.net

- Ownership or possession of these assessment documents alone does not indicate capability to carry out assessment without adequate approved training.

- No individual or organisation can be considered capable of applying these methods in a robust, repeatable, and valid way without attending harmonised training approved by the Welfare Quality Network and passing an associated examination.

- The strength of the integrated approach lies in the use of the entire assessment method. Use of isolated elements of the Welfare Quality system will not be considered as appropriate for assessing animal welfare.

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This document presents version 3 of the assessment protocol for cattle.

September, 2023

Foreword

The European Welfare Quality project developed standardized ways of assessing animal welfare and a standardized way of integrating this information to enable farms and slaughterhouses to be assigned to one of four categories (from poor to good animal welfare).

One of the innovations of the Welfare Quality animal welfare assessment system is that it focuses more on animal-based measures (e.g. directly related to animal body condition, health, injuries, behaviour, etc.). Other approaches existing at that time largely concentrated on design or management-based characteristics (e.g. size of cage or pen, flooring specifications, handling, etc.). Of course, this does not mean that resource-based or management-based factors are ignored in Welfare Quality; and many of these are important features of the system. A particular attraction of using animal-based measures is that they show the 'outcome' of the interaction between the animal and its environment (housing design and management) and this combined outcome is assessed by the Welfare Quality assessment system. This protocol describes the Welfare Quality assessment procedure for cattle.

Within the Welfare Quality project, these assessment protocols have been developed through the collaboration of a large number of research groups and institutes. A list of the contributors to Welfare Quality can be found in Annex C. Special thanks are due to Xavier Boivin, Raphaëlle Botreau, Nina Brörkens, Elisabetta Canali, Sue Haslam, Ute Knierim, Simone Laister, Katharine Anne Leach, Joop Lensink, Helene Leruste, Susanna Lolli, Finn Milard, Michela Minero, Fabio Napolitano, Regina Quast, Anna-Maria Regner, Giuseppe de Rosa, Viveca Sandström, Claudia Schmied, Heike Schulze Westerath, Susanne Waiblinger, Francoise Wemelsfelder, Rebecka Westin, Helen Rebecca Whay, Ines Windschnurer, Karin Zenger, Daniela Zucca for their work in the development of the final protocols.

This report has been initially edited by Christoph Winckler (Universität für Bodenkultur Wien), Bo Algers (Sveriges Lantbruksuniversitet), Kees van Reenen (Wageningen Universiteit) and Hélène Leruste (Groupe ISA) for the species specific parts. Furthermore Isabelle Veissier (Institut National de la Recherche Agronomique) and Linda Keeling (Sveriges Lantbruksuniversitet) edited the introductory parts of the document, and the English edit was carried out by Andy Butterworth (University of Bristol). Isabelle Veissier also contributed to the development of the calculation systems. Gwen van Overbeke and Vere Bedaux (NEN, Netherlands Standardization Institute) supported the writing and editing of the protocol. The version 2 has been edited by Marlene K. Kirchner (Copenhagen University), Eva Mainau Brunso (IRTA, Girona), Xavier Manteca (University Barcelona), Marta Brscic (University Padova). The current version (3.0) has been edited by Romain Lardy, and Isabelle Veissier for INRAE.

This version of the Welfare Quality protocols for cattle reflects the present scientific status of the Welfare Quality Network, but will be subjected to an on-going process of updating and revision since all protocols are considered 'living documents'.

Dr Antoni Dalmau (Coordinator Welfare Quality Network)
Girona, September 2023

Please use the following citation when referring to this document:
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Table of content

Version 3.0

Introduction

Animal welfare is an important attribute of an overall 'food quality concept' and consumers expect their animal-related products, especially food, to be produced with respect for the welfare of the animals. Surveys carried out by the European Commission[1] as well as studies within the Welfare Quality project[2], confirm that animal welfare is an issue of considerable significance for European consumers and that European citizens show a strong commitment to animal welfare. In order to accommodate societal concerns about the welfare quality of animal food products as well as related market demands, e.g. welfare as a constituent aspect of product quality, there is a pressing need for reliable science based systems for assessing the animals' welfare status[3].

In January 2006 the European Commission adopted a Community Action Plan on the Protection and Welfare of Animals[4]. The Action Plan outlined the Commission's planned initiatives and measures to improve the protection and welfare of animals for the period 2006-2010. The Action Plan aimed to ensure that animal welfare was addressed in the most effective manner possible, in all EU sectors and through EU relations with Third Countries. Among other things the Action Plan foresaw a classification system for animal welfare practices, to differentiate between where minimum standards are applied and cases where even higher standards are used. It also foresaw setting up standardised indicators whereby production systems which apply higher animal welfare standards than the minimum standards get due recognition. The option of an EU label for animal welfare was also put forward, to promote products obtained in line with certain animal welfare standards.

Consumers' concern and the apparent demand for information on animal welfare was the starting point of Welfare Quality, funded from the European Commission within the 6th EU programme. The project started in 2004 and became the largest piece of integrated research work yet carried out in animal welfare in Europe. The Welfare Quality project was a partnership of 40 institutions in Europe and, since 2006, four in Latin America. The partners were based in 13 European and four Latin American countries.

The Welfare Quality Network is a collaborative effort of a large group of former partners of the Welfare Quality project (see http://www.welfarequalitynetwork.net/). The Welfare Quality Network focuses on scientific exchange and activities to contribute to the further development of the Welfare Quality animal welfare assessment systems. The Welfare Quality Network also aims to provide relevant knowledge and services to support actors in animal production chains who would like to implement or use the Welfare Quality animal welfare assessment systems.
The activities focus on the following main areas:
- Management of the system and support instruments (including training in their use by Network partners)
- Maintenance of the system
- Upgrading the system
- Promoting stakeholder involvement
- Prioritizing and facilitating research

The Welfare Quality Network relies on funding from the partner institutes for its existence.

The Welfare Quality project set out to develop scientifically based tools to assess animal welfare. The acquired data provides feedback to animal unit managers about the welfare status of their animals, and was translated into accessible and understandable information on the welfare status of food producing animals for consumers and others. Welfare Quality also generated knowledge on practical strategies to improve animal welfare on farm and at slaughter.

In a truly integrated effort Welfare Quality combined analyses of consumer perceptions and attitudes with existing knowledge from animal welfare science and thereby identified 12 criteria that should be adequately covered in the assessment systems. To address these areas of concern, it was decided to concentrate on

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[1] European Commission (2005). Attitudes of consumers towards the welfare of farmed animals. Eurobarometer, Brussels. 138 pp.
European Commission (2006). Communication from the Commission to the European Parliament and the Council on a Community Action Plan on the Protection and Welfare of Animals 2006-2010, COM (2006) 13 final, Brussels.
European Commission (2007). Attitudes of EU citizens towards Animal Welfare. Eurobarometer, Brussels. 82 pp.

[2] Kjaernes, U., Roe, E. & Bock, B. (2007). Societal concerns on farm animal welfare. In: I. Veissier, B. Forkman and B. Jones (Eds), Assuring animal welfare: from societal concerns to implementation (pp. 13-18). Second Welfare Quality stakeholder conference, 3-4 May 2007, Berlin, Germany.

[3] Blokhuis, H.J., Jones, R.B., Geers, R., Miele, M. & Veissier, I. (2003). Measuring and monitoring animal welfare: transparency in the food product quality chain. Animal Welfare, 12, 445-455.

[4] European Commission. (2006). Communication from the commission to the European Parliament and the Council on a community action plan on the protection and welfare of animals 2006e2010, COM (2006) 13 final, Brussels.

so-called animal-based measures that address aspects of the actual welfare state of the animals in terms of, for instance, their behaviour, fearfulness, health or physical condition. Such animal-based measures include the effects of variations in the way the farming system is managed (role of the farmer) as well as specific system-animal interactions. However, it is clear that resource and management-based measures can also contribute to a welfare assessment if they are closely correlated to animal-based measures. Moreover, resource and management-based measures can also be used to identify risks to animal welfare and identify causes of poor welfare so that improvement strategies can be implemented.

Following a common approach across animal species an integrated, standardized and, wherever possible, animal-based methodology for assessment of animal welfare was then developed. The chosen animal species, based on their economic and numeric importance, are pigs, poultry and cattle. In addition, the focus has been on the production period of the animals´ life (i.e. on farm/transport/slaughter).

The present protocol describes the procedures and requirements for the assessment of welfare in cattle and is restricted to the key production animals, which are fattening cattle, dairy cows and veal calves.

This document presents the collection of data for fattening cattle measured on farm, followed by the procedures for calculating the scores. The collection of data at the slaughterhouse to assess welfare of fattening cattle at slaughter is presented in the following section. Subsequently, the procedure for the collection of data for dairy cows on farm and calculation of scores for the overall assessment of welfare on the farm is described. After this, the protocols for the collection of veal calves data measured on farm are provided. Additionally, the collection of data measured at the slaughterhouse but which reflect on farm welfare are also described. These two sections complement each other and are used together in the calculation of welfare scores for veal calves on farm.

Glossary

ACBSS   Australian Carcass Bruise Scoring System
cm   Centimetre(s)
$(c)m^2$ Square (centi-) metre
e.g.   exempli gratia: for example
h   Hour(s)
i.e.   id est: that is
L   Liter(s)
Min   Minute(s)
No.   Number

OLA   Outdoor loafing area
QBA   Qualitative behaviour assessment
RS   Recording sheet
s   Second(s)
VAS   Visual analogue scale

1 Scope

This cattle protocol deals with measures related to welfare assessment made during the production period on farm for the following categories: fattening cattle, dairy cows and veal calves. The descriptions were kept as short as possible, and though for training purposes more detailed descriptions of the measures will be required. In addition to the on-farm assessment, the quality of the slaughterhouse from a welfare perspective is assessed for fattening cattle at the time of slaughter.

At least three major periods can be distinguished: the rearing period, the production period (meat and milk) and the end of life of the animal, where it will be transported and slaughtered.
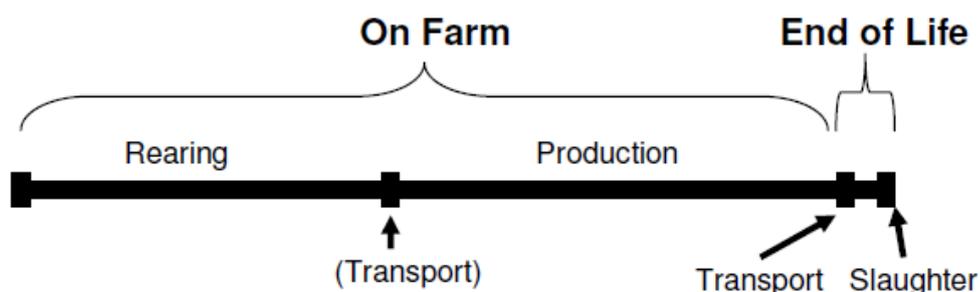

Figure 1 *Schematic reproduction of the different periods in the life of production animals. These are not necessarily all covered in the protocols.*

Some specific periods are not yet included in the protocols for some categories of animals:
- For veal calves the rearing period is essentially the production period and thus no distinction between the two is made;
- In this protocol we do not consider the rearing period for fattening cattle and dairy (cows). No data will be collected during the time the animals are transported to slaughter, although some measures taken at the slaughterhouse allow assessment of the welfare of animals during transport;
- Transport between farms, for example as sometimes occurs between rearing and production periods is not considered;
- The protocol is not applicable to other ruminant species such as sheep and goats.

Table 1 *Periods in the life of animals which are considered in the Welfare Quality Protocols.*

	Rearing	Producing	End of life
Fattening cattle		▓▓▓	▓▓▓
Dairy cows		▓▓▓	
Veal calves	▓▓▓	▓▓▓	

▓▓▓ Included in cattle protocol ☐ Not included in protocol

The protocols described in this section only apply to fattening cattle, dairy cows and veal calves. The protocols for cattle was developed for intensive housing systems. The applicability of the protocol in fully extensive systems can be limited. The protocol is not applicable to other ruminant species such as sheep, goat, or buffalo.

When visiting a farm for professional assessment purposes, it may be appropriate to collect additional information. Such information may be useful for management support or to provide advice for the farmer. This advisory support role must be separated from the inspection role as, in general, assessors must not involve themselves in giving prescriptive advice to clients. If additional information is collected, this may contribute to improved efficiency in the long term, by reducing the total number of visits to particular farms. However, since this document deals with the assessment system, only questions necessary for the assessment process are included. It is proposed that any additional questions aimed at advisory support are best developed independently by the advisory or management support services present in each country.

2 Legal aspects

The Welfare Quality protocols should only be applied to farming systems which operate within the applicable legal framework of the country. The Welfare Quality protocols do not replace or supersede any existing farm assurance or legal standards. They provide an additional tool for the assessment of animal welfare using predominantly animal-based measures and as such can add valuable additional information to existing inspection programs.

The individual animal unit manager has responsibility to operate within legal requirements. It is not considered feasible or desirable to list all legal statutes relevant to animal and farm operation in Europe within this document. For these reasons, a list of current normative legal texts is not provided within the Welfare Quality protocols.

However, the current key legislative framework can be found at the webpage of EUR-lex, where the relevant treaties, legislation, case-law and legislative proposals can be consulted[5]. If the application or interpretation of any element of this standard conflicts with legislation, current acting legislation always has priority.

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[5] http://eur-lex.europa.eu

3 Terms and definitions

Advisor
Person who uses the outcome of the Welfare Quality protocols and other information to advise the animal unit manager on how to improve welfare
NOTE This is distinct from the assessor

Animal unit
Section of a farm, a transport unit or a slaughter plant that deals with a certain type of animal
NOTE An animal unit can, for example, be the section of a farm where all adult animals are kept or the section of a slaughter plant where all animals are handled and slaughtered

Animal unit manager
Person responsible for an animal unit
NOTE This can be the farmer or the slaughter plant manager (or person responsible for animal care)

Animal-based measure
Measure that is taken directly from the animal
NOTE Animal-based measures can include, for instance, behavioural and clinical observations

Assessment protocol
An assessment protocol is a description of the procedures and requirements for the overall assessment of welfare

Assessor
Person in charge of collecting data using the Welfare Quality protocols on an animal unit in order that the welfare of animals is assessed

Dairy cows *(Bos taurus)*
Female cattle after calving, that are kept for the purpose of milk production

Fattening cattle *(Bos taurus)*
Bulls, steers or heifers above 200 kilograms live weight, which are raised with the purpose of red meat production. This does not include the cows and replacement stock in cow-calf herds. Although beef production can also be based on pasture systems, this is not covered in this protocol.

Heifer (*Bos taurus*)
Female cow that has not yet calved

Management-based measure
Measures which refer to what the animal unit manager does on the animal unit and what management processes are used
NOTE Management-based measures contain, for instance, the procedures used to protect animals from disease, including for example use of anaesthetics and the duration of fattening

Overall assessment of welfare
Synthesis of welfare information, which will then be used to allocate an animal unit to a welfare category. The overall assessment of welfare reflects the overall welfare state of the animals

Resource-based measure
Measure that is taken regarding the environment in which the animals are kept
NOTE Resource-based measures include for instance the number of drinkers

Transport unit
The transportation truck, lorry, module etc, which is considered as part of an animal unit for assessment purposes

Veal calf (*Bos taurus*)
Calf raised up to an age of 8 months with the purpose of white meat production

Welfare category
Final categorization obtained by an animal unit that indicates the overall welfare of animals
NOTE This is expressed on a 4 level scale: not classified, acceptable, enhanced, and excellent

Welfare criterion
Represents a specific area of welfare, which indicates an area of welfare concern
NOTE An example of a welfare criterion is "absence of injuries"

Welfare measure
Measure taken on an animal unit that is used to assess a welfare criterion
NOTE A measure can be animal-based, resource-based or management-based

Welfare principle
Collection of criteria associated with one of the following four areas: feeding, housing, health and behaviour

Welfare Quality protocol
Description of the measures that will be used to calculate the overall assessment of welfare
NOTE The protocols also specify how the data will be collected

Welfare score
Score that indicates how well an animal unit fulfils a criterion or principle

4 Background to the Welfare Quality protocols

This chapter outlines the principles and overall structure of the Welfare Quality protocols and how they are to be used in the overall assessment of animal welfare.

4.1 Overall structure of the project

Welfare Quality developed a system to enable overall assessment of welfare and the standardised conversion of welfare measures into summary information.

The welfare assessment related to a specific animal unit is based on the calculation of welfare scores from the information collected on that unit. An advisor can use the welfare assessment to highlight points requiring the animal unit manager's attention. The information can also be used to inform consumers and other stakeholders about the welfare status of animal products or the welfare quality of the supply chain.

The species protocols contain all the measures relevant for the species and an explanation of what data should be collected, and in what way. The species protocols address animals at different stages of their lives and/or in various housing systems. It can cover the rearing, the production, or the end of life of the animal, which includes transport and slaughter (Figure 2). At the moment there are no measures that are carried out during the actual transport process, but the effects of transport on welfare can be determined by examining the animals on arrival at the slaughterhouse. Transport measures may be added in the future.
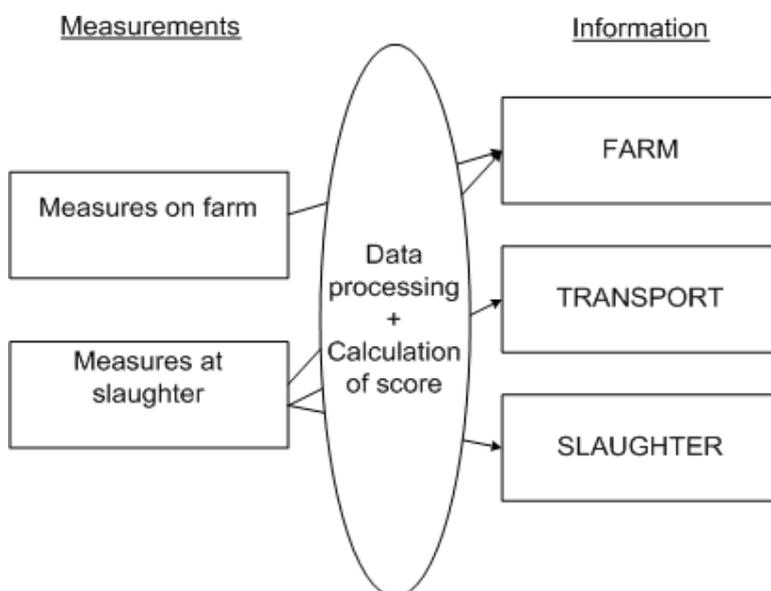

Figure 2 *The different sources of information in Welfare Quality. It is outside the scope of this document, but potential use of the output generated includes information provided to consumers, advisors and retailers.*

4.2 Basic principles

4.2.1 Introduction

Welfare is a multidimensional concept. It comprises both physical and mental health and includes several aspects such as physical comfort, absence of hunger and disease, possibilities to perform motivated behaviour, etc. The importance attributed to different aspects of animal welfare may vary between different people.

The different measurable aspects of welfare to be covered are translated into welfare criteria. The criteria reflect what is meaningful to animals as understood by animal welfare science. They also have to be agreed by stakeholders in order to ensure that wider ethical and societal issues have been dealt with, and furthermore to maximize the likelihood of successful translation into practice. In the case of Welfare Quality these have been systematically discussed with members of the general public and farmers, as well as with representatives of these and other stakeholder groups.

A top-down approach was used - four main welfare principles were identified and then split into twelve independent welfare criteria. Finally, measures were selected to assess these welfare criteria. In general, the principles and criteria which have been chosen are relevant for different species and throughout an animal's entire lifespan. A bottom-up approach, i.e. stepwise integration of measures, leads ultimately to the overall assessment of welfare (see Figure 3).

Animals differ in their genetics, early experience and temperament and therefore may experience the same environment in different ways. Even apparently similar environments may be managed differently by the stockperson, further affecting animals' experience of a particular situation. Because welfare is a characteristic of the individual animal, Welfare Quality has based its welfare assessment essentially on animal-based measures (e.g. health and behaviour). Since resource-based measures (e.g. type of housing and stocking density) or management-based measures (e.g. breeding strategies and health plans) are a poor direct guarantee of good animal welfare in a particular situation, these measures are generally avoided within the protocols. However, when no animal-based measure is available to check a criterion, or when such a measure is not sensitive or reliable enough, measures of the resources or the management are used to check as much as possible that a given welfare criterion is met.

There is no gold standard measure of overall animal welfare and no available information on the relative importance animals attribute to the various welfare aspects. Welfare Quality scientists are aware that the production of an overall assessment of animal welfare is by nature bound to ethical decisions, e.g. on whether we should consider the average state of animals vs. the worst ones, whether we should consider each welfare criterion separately vs. together in a more holistic approach, or whether a balance between societal aspirations for high welfare levels and the realistic achievements of such levels in practice should be achieved. Welfare Quality scientists did not decide upon these ethical issues themselves. They consulted experts, including animal scientists, social scientists, and stakeholders, and the methodology for overall assessment was then adjusted according to their opinions; e.g. all of the parameters used in the scoring model were optimised so as to best match expert opinions.

4.2.2 Defining welfare principles and criteria

Each welfare principle is phrased in such a way that it communicates a key welfare question. Four main principles are identified: good feeding, good housing, good health, appropriate behaviour. They correspond to the questions:
- Are the animals properly fed and supplied with water?
- Are the animals properly housed?
- Are the animals healthy?
- Does the behaviour of the animals reflect optimized emotional states?

Each principle comprises two to four criteria. Criteria are independent of each other and form an exhaustive but minimal list. Welfare principles and criteria are summarized in Table 2.

Table 2 *The principles and criteria that are the basis for the Welfare Quality assessment protocols.*

Welfare principles		Welfare criteria
Good feeding	1	Absence of prolonged hunger
	2	Absence of prolonged thirst
Good housing	3	Comfort around resting
	4	Thermal comfort
	5	Ease of movement
Good health	6	Absence of injuries
	7	Absence of disease
	8	Absence of pain induced by management procedures
Appropriate behaviour	9	Expression of social behaviours
	10	Expression of other behaviours
	11	Good human-animal relationship
	12	Positive emotional state

More detailed definitions of welfare criteria are described below.
1. Animals should not suffer from prolonged hunger, i.e. they should have a suitable and appropriate diet.
2. Animals should not suffer from prolonged thirst, i.e. they should

have a sufficient and accessible water supply.

3. Animals should have comfort when they are resting.
4. Animals should have thermal comfort, i.e. they should neither be too hot nor too cold.
5. Animals should have enough space to be able to move around freely.
6. Animals should be free of injuries, e.g. skin damage and locomotory disorders.
7. Animals should be free from disease, i.e. animal unit managers should maintain high standards of hygiene and care.
8. Animals should not suffer pain induced by inappropriate management, handling, slaughter, or surgical procedures (e.g. castration, dehorning).
9. Animals should be able to express normal, non-harmful, social behaviours (e.g. grooming).
10. Animals should be able to express other normal behaviours, i.e. it should be possible to express species-specific natural behaviours such as foraging.
11. Animals should be handled well in all situations, i.e. handlers should promote good human- animal relationships.
12. Negative emotions such as fear, distress, frustration or apathy should be avoided whereas positive emotions such as security or contentment should be promoted.

4.2.3 Measures developed to check criteria

Whenever possible, the final Welfare Quality assessment measures have been evaluated with respect to their validity (does the measure reflect some aspect of the actual welfare of animals), reliability (acceptable inter or intra observer repeatability and robustness to external factors e.g. time of day or weather conditions) and their feasibility. A further important aspect of this data collection is that value judgements are minimized, i.e. the assessor counts or classifies animals according to a simple series of categories illustrated by pictures or video clips. Hence measures in the protocols do not require veterinary diagnostic expertise or specialist animal behaviour knowledge to be accurately recorded. Some measures which were initially proposed did not meet these conditions and were dropped from the scheme early in the evaluation process, whereas other measures have been accepted in anticipation of further improvements and refinements. This latter concession was made because at least one measure per criterion is needed to assess overall animal welfare. For some criteria, it has been necessary to include resource- and/or management-based measures because no animal-based measure was sufficiently sensitive or satisfying in terms of validity, reliability, or feasibility.

NOTE It is important to remember that research is continuing to identify new and better measures and that Welfare Quality protocols will continue to be updated in the light of new knowledge.

4.2.4 Calculation of scores

Once all the measures have been performed on an animal unit, a bottom-up approach is followed to produce an overall assessment of animal welfare on that particular unit: first the data collected (i.e. values obtained for the different measures on the animal unit) are combined to calculate criterion- scores; then criterion-scores are combined to calculate principle-scores; and finally the animal unit is assigned to one welfare category according to the principle-scores it attained (Figure 3). A mathematical model has been designed to produce the overall assessment.


Measures	Step 1	Criteria	Step 2	Principles	Step 3	Overall assessment
~30		12		4		1
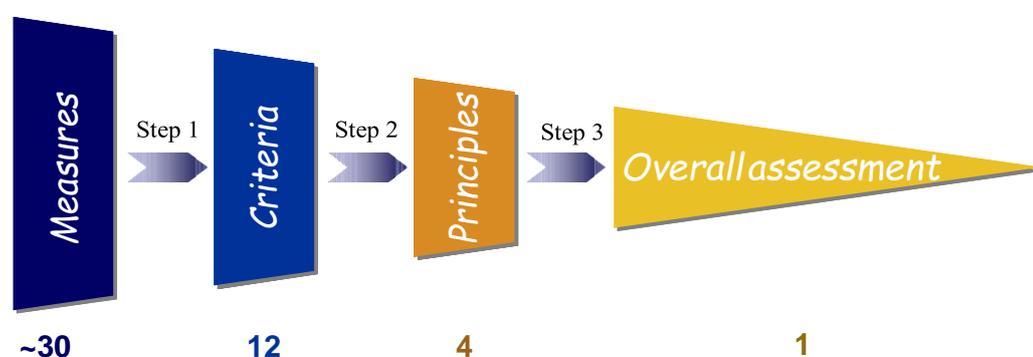
Figure 3 Bottom-up approach for integrating the data on the different measures to an overall assessment of the animal unit.

Calculation of criterion-scores

Although this is not generally the case, some measures may be related to several criteria (e.g. low body condition score can originate from hunger or disease, or both). In order to avoid double counting, measures have been allocated to only one criterion, except in very few cases where we could distinguish the way they were interpreted (e.g. access of cattle to pasture is used to check the Ease of movement criterion, especially for animals which are tethered in winter, and the expression of other behaviour).

The data produced by the measures relevant to a given criterion are interpreted and synthesized to produce a criterion-score that reflects the compliance of the animal unit to this criterion. This compliance is expressed on a 0 to 100 value scale, in which:

- '0' corresponds to the worst situation one can find on an animal unit (i.e. the situation below which it is considered there cannot be further decrements in welfare)
- '50' corresponds to a neutral situation (i.e. level of welfare is not bad but not good)
- '100' corresponds to the best situation one can find on a farm (i.e. the situation in which it is considered there cannot be further improvements in welfare).

Because the total number of measures, the scale on which they are expressed, and the relative importance of measures vary between and within criteria and also between animal types, the calculation of scores varies accordingly. In general, there are three main types of calculation:

- When all measures used to check a criterion are taken at farm level and are expressed in a limited number of categories, a decision tree is produced. An example is provided in Explanation box 1.

Explanation box 1: Decision tree as applied to absence of prolonged thirst in fattening pigs
Thirst is not assessed directly on animals because signs of dehydration can be detected only in extreme cases. Rather, the number of drinking places, their functioning and their cleanliness are assessed. The recommended number of pigs is calculated (10 pigs per functioning drinking place and 5 for a drinking place of reduced capacity). If there are more pigs in the pen than recommended then the number of drinking places is considered insufficient. Thereafter, cleanliness of drinkers and whether pigs have access to two drinkers in the same pen is considered. The following decision tree is applied:

- When a criterion is checked by only one measure taken at individual level, this scale generally represents the severity of a problem and the proportion of animals observed can be calculated (e.g. percentage animals walking normally, percentage moderately lame animals, percentage severely lame animals). In that case a weighted sum is calculated, with weights increasing with severity. An example is provided in Explanation box 2.
- When the measures used to check a criterion lead to data expressed on different scales (e.g. percentage animals lying outside the lying area, or average latency to lie down expressed in seconds), data are compared to an alarm threshold that represents the limit between what is considered abnormal and that considered to be normal. Then the number of alarms is used as the measure value. An example is provided in Explanation box 3.
- When the measures to check a criterion are taken at group level, the score attributed to the animal unit is equal to the worst score obtained at group level as long as at least 15% of the observed animals are in groups that obtain this score or a lower one.

**Explanation box 2: Weighted sum and I-spline functions as applied to lameness in dairy cows**
The % of animals moderately lame and the % of animals severely lame are combined in a weighted sum, with a weight of 2 for moderate lameness and 7 for severe lameness. This sum is then transformed into an index that varies from 0 to 100:

Index for lameness $\mathbf{I} = \left(100 - \dfrac{2(\%moderate)+7(\%severe)}{7}\right)$

This index is computed into a score using I-spline functions:

When $\mathbf{I} \leq 65$ then Score = (0.0988 x $\mathbf{I}$) - (0.000955 x $\mathbf{I}^2$)- (5.34 x 10-5 x $\mathbf{I}^3$)

When $\mathbf{I} \geq 65$ then Score = 29.9 - (0.944 x $\mathbf{I}$) - (0.0145 x $\mathbf{I}^2$) + (1.92 x 10-5 x $\mathbf{I}^3$)
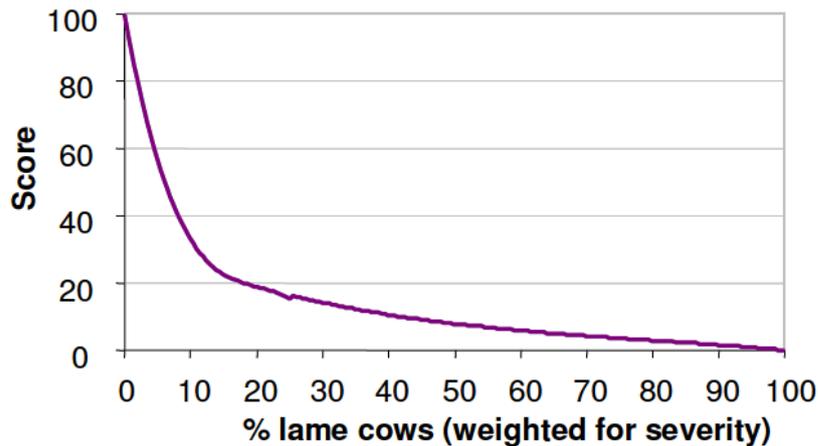
Explanation box 3: Use of alarm thresholds applied to absence of diseases in broilers
In broiler chicken the following disorders are checked on the farm or at slaughter: ascites, dehydration, septicaemia, hepatitis, pericarditis, subcutaneous abscesses. The incidence of each disorder is compared to an alarm threshold, defined as the incidence above which a health plan is required at the farm level.

Disorder	Alarm Threshold (%)
Ascites	1
Dehydration	1
Scepticaemia	1.5
Hepatitis	1.5
Pericarditis	1.5
Subcutaneous abscess	1

When the incidence observed on a farm reaches half the alarm threshold, a warning is attributed. The number of alarms and warnings detected on a farm are calculated. They are used to calculate a weighted sum finally transformed into a score using I-spline functions (as in the example shown in Explanation box 2).

Experts from animal sciences were consulted to interpret the raw data in terms of welfare. When necessary, alarm thresholds were defined by consultation with them. Then experts were asked to score virtual farms. In situations where weighted sums were to be calculated, this consultation was used to define weights that produce the same ranking of farms as the one given by experts.
This exercise showed that experts do not in general follow a linear reasoning, e.g. for a given disorder a 10 % increase does not yield the same decrement in expert scores at the bottom of the [0,100] scale (where most animals get this disorder) than at the top of the scale (when most animals are normal). It is therefore necessary to resort to non-linear functions to produce criterion-scores, in this case I-spline functions. Briefly, I-spline functions allow calculation of portions of curves so as to obtain a smooth representative curve.

They are expressed in the form of cubic functions (Explanation box 2).

When a criterion was composed of very different measures which experts found difficult to consider together, blocks of measures were aggregated using Choquet integrals (Explanation box 4).

Explanation box 4: Use of a Choquet integral to calculate the principle-scores for 'Good feeding'.
'Good feeding integrates 2 criteria; 'Absence of prolonged hunger' and 'Absence of prolonged thirst'. First the scores obtained by a farm for the 2 criteria are sorted in increasing order. The first criterion-score is considered, and then the difference between that score and the second criterion-score is multiplied by the 'capacity' of the second criterion. This can be written as follows:

$$\begin{cases} S_1 + (S_2 - S_1)\mu_2 & if \ \ S_1 \leq S_2 \\ S_2 + (S_1 - S_2)\mu_1 & if \ \ S_2 \leq S_1 \end{cases}$$

Where S_1 and S_2 are the scores obtained by a given farm for Criterion 1 (Absence of prolonged hunger) and 2 (Absence of prolonged thirst)
μ_1 μ_2 are the capacities of Criterion 1 and 2

Calculation of principle-scores from criterion-scores

Criterion-scores are synthesized to calculate principle-scores. For instance, the scores obtained by an animal unit for absence of injuries, absence of disease, and absence of pain due to management procedures are combined to reflect compliance of this unit with the principle 'good health'. Animal and social scientists were consulted, and considered some criteria to be more important than others (e.g. in most animal types, 'Absence of disease' is considered to be more important than 'Absence of injuries' which in turn is more important than 'Absence of pain induced by management procedures') in general. However, most weight for the principle-score is contributed by the lowest corresponding criterion-score. Nevertheless, synthesis does not allow full compensation between criterion-scores (e.g. absence of disease does not compensate for injuries and vice versa). A specific mathematical operator (Choquet integral) was used to take into account these two lines of reasoning. In short, the Choquet integral calculates the difference between the minimum score and the next minimum score and attributes a weight (called 'capacity') to that difference. This process is repeated until the highest score is reached. In the species-specific sections, only the 'capacities' are given (μ_x for the capacity of a criterion x, μ_{xy} for the capacity of a group made of 2 criteria x and y, etc.). An example of the calculation of principle-scores is provided in Explanation box 4, 5 and 6, for respectively 2, 3 and 4 criteria.

Explanation box 5: Use of a Choquet integral to calculate the principle-scores for 'Good health'.
'Good health' integrates 3 criteria; 'Absence of injuries', 'Absence of disease', and 'Absence of pain induced by management procedures'. First the scores obtained by a farm for the 3 criteria are sorted in increasing order. The first criterion-score is considered, and then the difference between that score and the next criterion-score is multiplied by the 'capacity' (see explanation below) of the group made of all criteria except the one that brings the lowest score. Following this, the difference between the last but one score and the next score is multiplied by the 'capacity' of the group made by the combined criteria except those that bring the two lowest scores. This can be written as follows:

$$\begin{cases} S_6 + (S_7 - S_6)\mu_{78} + (S_8 - S_7)\mu_8 & if \ \ S_6 \leq S_7 \leq S_8 \\ S_6 + (S_8 - S_6)\mu_{78} + (S_7 - S_8)\mu_7 & if \ \ S_6 \leq S_8 \leq S_7 \\ S_7 + (S_6 - S_7)\mu_{68} + (S_8 - S_6)\mu_8 & if \ \ S_7 \leq S_6 \leq S_8 \\ S_7 + (S_8 - S_7)\mu_{68} + (S_6 - S_8)\mu_6 & if \ \ S_7 \leq S_8 \leq S_6 \\ S_8 + (S_6 - S_8)\mu_{67} + (S_7 - S_6)\mu_7 & if \ \ S_8 \leq S_6 \leq S_7 \\ S_8 + (S_7 - S_8)\mu_{67} + (S_6 - S_7)\mu_6 & if \ \ S_8 \leq S_7 \leq S_6 \end{cases}$$

Where S_6, S_7, and S_8 are the scores obtained by a given farm for Criterion 6 (Absence of injuries), 7 (Absence of disease), and 8 (Absence of pain induced by management procedures)
μ_6 μ_7 μ_8 are the capacities of Criterion 6, 7 and 8
μ_{67} is the capacity of the group made of criteria 6 and 7, etc.

Explanation box 6: Use of a Choquet integral to calculate the principle-scores for 'Appropriate behaviour'.

'Appropriate behaviour' integrates 4 criteria; 'Expression of social behaviours', 'Expression of other behaviours', 'good human-animal relationship' and 'Positive emotional state'. First the scores obtained by a farm for the 4 criteria are sorted in increasing order. The first criterion-score is considered, and then the difference between that score and the next criterion-score is multiplied by the 'capacity' (see explanation below) of the group made of all criteria except the one that brings the lowest score. difference between the second and the third score is multiplied by the 'capacity' of the group made by the combined criteria except those that bring the two lowest scores. Finally the difference between the third and the last score is multiplied by the 'capacity' of last score. This can be written as follows:

$$
\begin{cases}
S_9 + (S_{10} - S_9)\mu_{10,11,12} + (S_{11} - S_{10})\mu_{11,12} + (S_{12} - S_{11})\mu_{12} & if & S_9 \leq S_{10} \leq S_{11} \leq S_{12} \\
S_9 + (S_{10} - S_9)\mu_{10,11,12} + (S_{12} - S_{10})\mu_{11,12} + (S_{11} - S_{12})\mu_{11} & if & S_9 \leq S_{10} \leq S_{12} \leq S_{11} \\
S_9 + (S_{11} - S_9)\mu_{10,11,12} + (S_{10} - S_{11})\mu_{10,12} + (S_{12} - S_{10})\mu_{12} & if & S_9 \leq S_{11} \leq S_{10} \leq S_{12} \\
S_9 + (S_{11} - S_9)\mu_{10,11,12} + (S_{12} - S_{11})\mu_{10,12} + (S_{10} - S_{12})\mu_{10} & if & S_9 \leq S_{11} \leq S_{12} \leq S_{10} \\
S_9 + (S_{12} - S_9)\mu_{10,11,12} + (S_{10} - S_{12})\mu_{10,11} + (S_{11} - S_{10})\mu_{11} & if & S_9 \leq S_{12} \leq S_{10} \leq S_{11} \\
S_9 + (S_{12} - S_9)\mu_{10,11,12} + (S_{11} - S_{12})\mu_{10,11} + (S_{10} - S_{11})\mu_{10} & if & S_9 \leq S_{12} \leq S_{11} \leq S_{10} \\
S_{10} + (S_9 - S_{10})\mu_{9,11,12} + (S_{11} - S_9)\mu_{11,12} + (S_{12} - S_{11})\mu_{12} & if & S_{10} \leq S_9 \leq S_{11} \leq S_{12} \\
S_{10} + (S_9 - S_{10})\mu_{9,11,12} + (S_{12} - S_9)\mu_{11,12} + (S_{11} - S_{12})\mu_{11} & if & S_{10} \leq S_9 \leq S_{12} \leq S_{11} \\
S_{10} + (S_{11} - S_{10})\mu_{9,11,12} + (S_9 - S_{11})\mu_{9,12} + (S_{12} - S_9)\mu_{12} & if & S_{10} \leq S_{11} \leq S_9 \leq S_{12} \\
S_{10} + (S_{11} - S_{10})\mu_{9,11,12} + (S_{12} - S_{11})\mu_{9,12} + (S_9 - S_{12})\mu_9 & if & S_{10} \leq S_{11} \leq S_{12} \leq S_9 \\
S_{10} + (S_{12} - S_{10})\mu_{9,11,12} + (S_9 - S_{12})\mu_{9,11} + (S_{11} - S_9)\mu_{11} & if & S_{10} \leq S_{12} \leq S_9 \leq S_{11} \\
S_{10} + (S_{12} - S_{10})\mu_{9,11,12} + (S_{11} - S_{12})\mu_{9,11} + (S_9 - S_{11})\mu_9 & if & S_{10} \leq S_{12} \leq S_{11} \leq S_9 \\
S_{11} + (S_{10} - S_{11})\mu_{9,10,12} + (S_9 - S_{10})\mu_{9,12} + (S_{12} - S_9)\mu_{12} & if & S_{11} \leq S_{10} \leq S_9 \leq S_{12} \\
S_{11} + (S_{10} - S_{11})\mu_{9,10,12} + (S_{12} - S_{10})\mu_{9,12} + (S_9 - S_{12})\mu_9 & if & S_{11} \leq S_{10} \leq S_{12} \leq S_9 \\
S_{11} + (S_9 - S_{11})\mu_{9,10,12} + (S_{10} - S_9)\mu_{10,12} + (S_{12} - S_{10})\mu_{12} & if & S_{11} \leq S_9 \leq S_{10} \leq S_{12} \\
S_{11} + (S_9 - S_{11})\mu_{9,10,12} + (S_{12} - S_9)\mu_{10,12} + (S_{10} - S_{12})\mu_{10} & if & S_{11} \leq S_9 \leq S_{12} \leq S_{10} \\
S_{11} + (S_{12} - S_{11})\mu_{9,10,12} + (S_{10} - S_{12})\mu_{10,9} + (S_9 - S_{10})\mu_9 & if & S_{11} \leq S_{12} \leq S_{10} \leq S_9 \\
S_{11} + (S_{12} - S_{11})\mu_{9,10,12} + (S_9 - S_{12})\mu_{10,9} + (S_{10} - S_9)\mu_{10} & if & S_{11} \leq S_{12} \leq S_9 \leq S_{10} \\
S_{12} + (S_{10} - S_{12})\mu_{9,10,11} + (S_{11} - S_{10})\mu_{11,9} + (S_9 - S_{11})\mu_9 & if & S_{12} \leq S_{10} \leq S_{11} \leq S_9 \\
S_{12} + (S_{10} - S_{12})\mu_{9,10,11} + (S_9 - S_{10})\mu_{11,9} + (S_{11} - S_9)\mu_{11} & if & S_{12} \leq S_{10} \leq S_9 \leq S_{11} \\
S_{12} + (S_{11} - S_{12})\mu_{9,10,11} + (S_{10} - S_{11})\mu_{9,10} + (S_9 - S_{10})\mu_9 & if & S_{12} \leq S_{11} \leq S_{10} \leq S_9 \\
S_{12} + (S_{11} - S_{12})\mu_{9,10,11} + (S_9 - S_{11})\mu_{9,10} + (S_{10} - S_9)\mu_{10} & if & S_{12} \leq S_{11} \leq S_9 \leq S_{10} \\
S_{12} + (S_9 - S_{12})\mu_{9,10,11} + (S_{1.} - S_9)\mu_{10,11} + (S_{11} - S_{10})\mu_{11} & if & S_{12} \leq S_9 \leq S_{10} \leq S_{11} \\
S_{12} + (S_9 - S_{12})\mu_{9,10,11} + (S_{11} - S_9)\mu_{10,11} + (S_{10} - S_{11})\mu_{10} & if & S_{12} \leq S_9 \leq S_{11} \leq S_{10}
\end{cases}
$$

Where S_9, S_{10}, S_{11} and S_{12} are the scores obtained by a given farm for Criterion 9 (Expression of social behaviours), 10 (Expression of other behaviours), 11 (good human-animal relationship) and 12 (Positive emotional state).

μ_9 μ_{10} μ_{11} μ_{12} are the capacities of Criterion 9, 10, 11 and 12

$\mu_{9,10}$ is the capacity of the group made of criteria 9 and 10, etc.

Assignment of animal units to the welfare categories

The scores obtained by an animal unit on all of the welfare principles are used to assign that farm to a welfare category. At this stage, animal scientists, social scientists and stakeholders, were consulted. The stakeholders were members of the Advisory Committee of Welfare Quality.

Four welfare categories were distinguished to meet stakeholders' requirements:

Excellent: the welfare of the animals is of the highest level.
Enhanced: the welfare of animals is good.
Acceptable: the welfare of animals is above or meets minimal requirements.
Not classified: the welfare of animals is low and considered unacceptable.

'Aspiration values' are defined for each category. They represent the goal that the farm should try to achieve to be assigned to a given category. The excellence threshold is set at 80, the one for enhanced at 55 and that for acceptability at 20. But, just as criteria do not compensate each other within a principle (see above), high scores in one principle do not offset low scores in another, so categories cannot be based on average scores. At the same time, it is important that the final classification reflects not only the theoretical acknowledgement of what can be considered excellent, enhanced etc. but also what can realistically be achieved in practice. Therefore, a farm is considered 'excellent' if it scores more than 55 on all principles and more than 80 on two of them while it is considered 'enhanced' if it scores more than 20 on all principles and more than 55 on two of them. Farms with 'acceptable' levels of animal welfare score more than 10 on all principles and more than 20 on three of them. Farms that do not reach these minimum standards are not classified (Figure 4). An indifference threshold equal to 5 is applied: For instance, 50 is not considered significantly lower than 55.
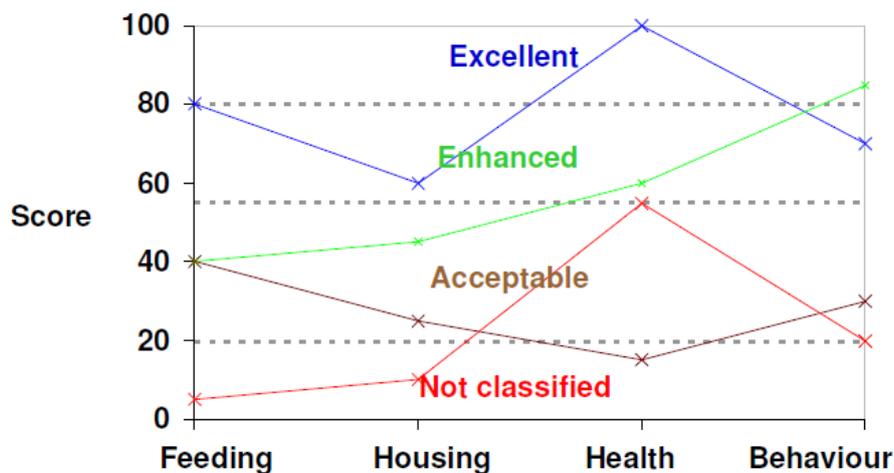
Figure 4 *Examples of farms in the four welfare categories.*

Software has been developed to calculate welfare scores and to produce the overall assessment of animal units. For more information, visit the WAFA website (https://www1.clermont.inrae.fr/wq/).

Final comments

The following sections are specific to the animal species covered in this document. They are structured to present firstly the measures collected on farms, secondly the measures collected at slaughter that apply to welfare assessment on-farm, thirdly the calculation of scores needed for overall assessment, and finally the measures collected at slaughter that apply to assessment of the welfare of the animals during transport and slaughter. For calculation of the scores, full dataset without missing values are needed.

It should be emphasised again that scientific research will continue to refine measures and that the Welfare Quality protocols will be updated in the light of new knowledge. **Training and validation** in the methods and protocols **is essential** and no individual or organisation can be considered capable of applying these methods in a robust, repeatable, and valid way without attending harmonised training approved by the Welfare Quality Network.

5 Welfare Quality applied to dairy cows

The assessment of welfare should be a multi–disciplinary process since the assessment on a variety of different parameters can provide a more comprehensive assessment of an animal's welfare in any given system. To this end, the Welfare Quality project utilizes physiological, health and behavioural characteristics to assess the welfare of dairy cows on farm.

In this chapter, a description of each measure for dairy cows is given, followed by information about the sample size and the order in which the different measures have to be carried out.

Before commencing farm visits, assessors will have been fully trained in all the measures that are to be assessed using photographs, video clips and practical 'on farm' training. For some of the health measures, this training will involve recognition of symptoms of certain conditions/diseases; however it is imperative that this document is not used as a diagnostic tool to identify individual health conditions, but rather as a tool to highlight the presence of health problems affecting the welfare of animals. The assessor should not enter into discussions with the animal unit manager on the prevalence or severity of different diseases on their farm; this is a matter for the animal unit manager and the herd veterinarian. Additionally, in general, the role of the assessor is to assess, and not to advise directly.

Trained assessors will use either animal–based, management-based, and resource–based measures to achieve a representative welfare assessment for each farm. Many different measures are assessed, and most are scored according to a three–point scale ranging from 0 – 2. The assessment scales have been selected so that a score 0 is awarded where welfare is good, a score 1 is awarded (where applicable) where there has been some compromise on welfare, and a score 2 is awarded where welfare is poor and unacceptable. In some cases a binary (0/2 or Yes/No) or a cardinal scale (e.g. m2) scale is used.

The assessor should prepare and start the visit according to the description provided for in Annex A ('guideline for visit of animal unit'). For most measures data can be recorded with aid of Annex B ('Recording Sheets').

5.1 Collection of data for dairy cows on farm

		Welfare Criteria	Measures
Good feeding	1	Absence of prolonged hunger	Body condition score
	2	Absence of prolonged thirst	Water provision, cleanliness of water points, water flow, functioning of water points
Good housing	3	Comfort around resting	Time needed to lie down, animals colliding with housing equipment during lying down, animals lying partly or completely outside the lying area, cleanliness of udders, cleanliness of flank/upper legs, cleanliness of lower legs
	4	Thermal comfort	*As yet, no measure is developed*
	5	Ease of movement	Presence of tethering, access to outdoor loafing area or pasture
Good health	6	Absence of injuries	Lameness (loose housed animals), lameness (tied animals), integument alternations
	7	Absence of disease	Nasal discharge, ocular discharge, hampered respiration, diarrhoea, vulvar discharge, milk somatic cell count, mortality, dystocia, downer cows
	8	Absence of pain induced by management procedures	Disbudding/dehorning, tail docking
Appropriate behaviour	9	Expression of social behaviours	Agonistic behaviours
	10	Expression of other behaviours	Access to pasture
	11	Good human-animal relationship	Avoidance distance
	12	Positive emotional state	Qualitative behaviour assessment

5.1.1 Good feeding

5.1.1.1 Absence of prolonged hunger

Title	**Body condition score**
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according § 6.1.5
Method description	This measure applies to all dairy cows (lactating and dry) and to pregnant heifers if they are kept together with dairy cows. View the animal from behind and from the side in the loin and tail head area and assess the animals' body condition. Animals must not be touched but only observed. Animals are scored as follows, with regard to 4 criteria and according to breed (see photographic illustration): **Descriptors for indicators in dairy breeds:**

Body Region	Very lean	Very fat
Cavity around tail	• Deep cavity around tail head	• Tail head cavity head full and folds of fatty tissue present
Loin	• Deep depression between backbone and hipbones (tuber coxae)	• Convex between backbone and hipbones (tuber coxae)
Vertebrae	• Ends of transverse processes sharp	• Transverse processes not discernible
Tail head, hipbones, spine and ribs	• Tail head, hipbones (tuber coxae), spine and ribs prominent	• Outlines of fat patches visible under skin

	Descriptors for indicators in dual purpose breeds:

	Descriptors for indicators in dual purpose breeds:		
	Body Region	*Very lean*	*Very fat*
	Cavity around tail head	• Cavity around tail head	• Tail head cavity full and folds of fatty tissue present
	Loin	• Visible depression between backbone and hipbones (tuber coxae)	• Convex between backbone and hipbones (tuber coxae)
	Vertebrae	• Ends of transverse processes distinguishable	• Transverse processes not discernible
	Tail head, hipbones, spine and ribs	• Tail head, hipbones (tuber coxae), spine and ribs visible	• Outlines of fat patches patches visible under skin
	Individual level: **0** – Regular body condition **1** – Very lean: indicators for 'very lean' present in at least three body regions **2** – Very fat: indicators for 'very fat' present in at least three body regions		
Classification	**Herd level:** **Percentage** of very lean cows (i.e. score 1)		
Optional additional information	As yet, for the calculation of scores, only very lean animals are taken into account. However, for advisory purposes information on very fat animals (risk for metabolic disorders and calving difficulties etc.) may be useful.		

Body condition – Dairy breeds

Score 1	Score 0	Score 2
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Body condition – Dual purpose breeds

Score 1	Score 0	Score 2
© BOKU	© Winckler BOKU	© Dippel BOKU

5.1.1.2 Absence of prolonged thirst

Title	**Water provision**
Scope	Resource-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5
Method description	All water points in question are assessed within the area of the animal unit where lactating animals are kept.
	Check the type of the water points per pen (see photographic illustration), and count the number of animals per pen. In the case of open troughs, measure the length of the trough. In the case of bowls with reservoirs, bowls, nipple drinkers or drinkers with balls/antifrost devices, count the number of water points.
Classification	**Group level:** **Number** of animals and **Number** of each type of water points. **Length** of troughs in **cm**.

Trough	Tip-over trough	Anti-frost with balls
© BOKU	© Brinkmann BOKU	© Brinkmann BOKU
Bowl	Bowl with reservoir	Nipple drinker
© Kirchner BOKU	© Gratzer BOKU	© Winckler BOKU

| Title	**Cleanliness of water points**
Scope	Resource-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5
Method description	All water points in question are assessed within the area of the animal unit where lactating animals are kept.
	Check the cleanliness of the water points with regard to the presence of old or fresh dirt on the inner side of the bowl or trough as well as staining of the water (see photographic illustration). Water points are considered as clean when there is no evidence of crusts of dirt (e.g. faeces, mould) and/or decayed food residues. Note that some amount of fresh food is acceptable.

Classification	**Group level:** **0** – Clean: drinkers and water clean at the moment of inspection **1** – Partly dirty: drinkers dirty, but water fresh and clean at moment of inspection or only part of several drinkers clean and containing clean water **2** – Dirty: drinkers and water dirty at moment of inspection

clean	Partly dirty	Dirty
© Gratzer BOKU	© Gratzer BOKU	© Gratzer BOKU

Dirty
© Gratzer BOKU

Title	**Water flow**
Scope	Resource-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5
Method description	All water points in question are assessed within the area of the animal unit where lactating animals are kept. Check the amount of water coming out of the drinker per minute, e.g. by filling it up to the brim and then collecting the overflow for 1 minute using a bucket. To be sufficient the water flow must be at least 10 L/min in case of a bowl and 20 L/min in case of a trough. In the case of troughs with a large reservoir, this test does not have to be carried out. Water flow is then set to 20L/min. **Point level:** Amount of water in **L/min** per water point.
Classification	**Group level:** **Number** of water bowls with sufficient water flow **Length** of trough with sufficient water flow

Title	**Functioning of water points**
Scope	Resource-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5
Method description	All water points in question are assessed within the area of the animal unit where lactating animals are kept. Check if water drinkers are working correctly, e.g. if levers are movable and that water flows if they are moved.
Classification	**Group level:** **0** – The drinkers are working correctly **2** – The drinkers are malfunctioning

5.1.2 Good housing

5.1.2.1 Comfort around resting

Title	**Time needed to lie down**
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according § 6.1.5
Method description	This measure applies to lactating cows as well as to dry cows and pregnant heifers if they are kept with lactating animals. It considers all observable lying down movements (minimum sample size of 6 is required). Time recording of a lying down sequence starts when one carpal joint of the animal is bent and lowered (before touching the ground). The whole lying down movement ends when the hind quarter of the animal has fallen down and the animal has pulled the front leg out from underneath the body. Time needed to lie down is recorded in seconds, continuously in the focus segment. The duration of a lying down movement is only taken when undisturbed by other animals or human interaction and – in case of cubicles and littered systems – if it takes place on the supposed lying area. Observations take place in segments of the barn (→ 6.1.4.1). **Individual level:** Time in **seconds**
Classification	**Herd level:** Mean time to lie down (in **seconds**)

Title	**Animals colliding with housing equipment during lying down**
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according § 6.1.5
Method description	This measure applies to lactating cows as well as to dry cows and pregnant heifers if kept with lactating animals. It considers all lying down movements for which time needed to lie down has been recorded (minimum sample size of 6 is required). A collision is defined as occurring when, during lying down, the cow collides with or contacts housing equipment with any part of the body (usually hind quarter or side). The collision is obviously seen or heard. Collisions with housing equipment are recorded continuously in the focus segment. The duration of a lying down movement is only taken when undisturbed by other animals or human interaction and – in case of cubicles and littered systems – if it takes place on the supposed lying area. Observations take place in segments of the barn (→ 6.1.4.1). **Individual level:** **0 –** No collision **2 –** Collision
Classification	**Herd level:** **Percentage** of animals colliding with housing equipment (i.e. score 2)

Title	**Animals lying partly or completely outside the lying area**
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5
Method description	This measure applies to lactating cows as well as to dry cows and pregnant heifers if they are kept with lactating animals. Assess the number of animals which are lying and how many of them are lying with their hind quarter on the edge of the cubicle or the deep littered area (edge markedly pressing into the hind leg of the animal), lying with hind quarter (both hind legs) or completely outside the supposed lying area (cubicles, deep littered area). Observations take place in segments of the barn. Animals lying partly/completely outside the lying area are recorded at the start and at the end of each segment

	observation (see 6.1.4.1).
	Group level: **Number** of animals lying **Number** of animals lying partly/completely outside lying area
Classification	**Herd level:** **Percentage** of animals lying partly/completely outside lying area out of all lying animals

Title	**Cleanliness of udder, flank/upper legs and lower legs**
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according § 6.1.5
Method description	This measure applies to lactation cows as well as to dry cows and pregnant heifers if kept with lactating animals, and groups of dry cows which are kept separately. Cleanliness of the applicable body parts is defined as the degree of dirt on the body parts considered (see photographic illustration): • splashing (e.g. faeces, mud) • plaques: three-dimensional layers of dirt amounting to the size of the palm of a hand or if more than half of the area under consideration is covered Assess one side of the body (random side selection, especially in tie stalls) and from behind. The following areas are scored: • the lower hind legs (including the hock), • hind quarters - upper hind leg, flank and rear view including tail (excluding udder) • the udder **Individual level:** *Lower hind legs:* **0** – No dirt or minor splashing **2** – Separate or continuous plaques of dirt above the coronary band *Hind quarters:* **0** – No dirt or minor splashing **2** – Separate or continuous plaques of dirt *Udder:* **0** – No dirt or minor splashing, other than on teats **2** – Distinct plaques of dirt on udder or any dirt on and around the teats
Classification	**Herd level**: *Lower hind legs:* **Percentage** of animals with clean lower hind legs (i.e. score 0) **Percentage** of animals with dirty lower hind legs (i.e. score 2) *Hind quarters:* **Percentage** of animals with clean hindquarters(i.e. score 0) **Percentage** of animals with dirty hindquarters(i.e. score 2) *Udder:* **Percentage** of animals with a clean udder (i.e. score 0) **Percentage** of animals with dirty udder (i.e. score 2)

Cleanliness of udder

Score 0	Score 2
© March BOKU	© Leach UNIVBristol

Cleanliness of hindquarter

Score 0	Score 2
© Brinkmann BOKU	© March BOKU

Cleanliness of lower hindleg

Score 0	Score 2
© Leach UNIVBristol	© UNIVBristol

5.1.2.2 Thermal comfort

As yet, no measure is developed.

5.1.2.3 Ease of movement

Title	**Presence of tethering**
Scope	Resource-based measure: Dairy cows
Sample size	Animal unit
Method description	The resources provided on the animal unit are checked with regard to lactating cows. The assessor checks whether the farm has a tie stall system or a loose housing system.
Classification	**Herd level:** **0** – Loose housing system **2** – Tie stall system

| Title	**Access to outdoor loafing area or pasture**
Scope	Management-based measure: Dairy cows
Sample size	Animal unit
Method description	This measure applies to lactating cows as well as to dry cows if kept with lactating animals. The animal unit manager is asked about the loafing area and pasture management on the farm with regard to the availability of an outdoor loafing area and/or access to pasture, and also the respective conditions in terms of days per year and average time spent in the outdoor loafing area/pasture per day.
Classification	**Herd level:** **Availability of outdoor loafing area (OLA) (herd level): 0** – Yes **2** – No and **Number** of days with access to OLA per year **Number** of hours with access to OLA per day **Availability of pasture (herd level): 0** – Yes **2** – No and **Number** of days on pasture per year **Number** of hours on pasture per day

5.1.3 Good health

5.1.3.1 Absence of injuries

Title	**Lameness (loose housed animals)**
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5
Method description	This measure applies to lactating cows, dry cows and pregnant heifers if kept with lactating animals as well as all dry cows if kept separately, able to move freely and individually controlled, i.e. loose housed animals as well as animals which are kept in tie stalls but are released at least twice a week. Lameness describes an abnormality of movement and is most evident when the legs are in motion. It is caused by reduced ability to use one or more limbs in a normal manner. Lameness can vary in severity from reduced ability to inability to bear weight. Indicators of lameness are: • irregular foot fall • uneven temporal rhythm between hoof beats • weight not borne for equal time on each of the four feet The following gait attributes are taken into account: • timing of steps • temporal rhythm • weight-bearing on feet. Assess the gait score of the animal. All animals should be walked in a straight line on a hard, level, non-slippery surface on which they would normally walk. The

	assessor should view them from the side and/or behind. Animals must not be assessed when they are turning. **Individual level:** **0** – Not lame: timing of steps and weight-bearing equal on all four feet. **1** – Lame: imperfect temporal rhythm in stride creating a limp **2** – Severely lame: strong reluctance to bear weight on one limb, or more than one limb affected
Classification	**Herd level:** **Percentage** of not lame animals (score 0) **Percentage** of moderately lame animals (score 1) **Percentage** of severely lame animals (score 2)

Title	**Lameness (tied animals)**
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5

Method description	This measure applies to all lactating cows, dry cows and pregnant heifers if kept with the lactating animals kept in tie stalls and which are not released at least twice a week.
	Lameness describes an abnormality of movement and is most evident when the legs are in motion. It is caused by reduced ability to use one or more limbs in a normal manner. However, in some tie stall systems it will not be practical to release the cows to carry out gait scoring. A method for detecting lame cows in tie stalls has been developed and validated against gait scoring. The 'stall lameness score' is based upon the following indicators:
	• Resting:
	  Resting a foot (one more than another).
	• Standing:
	  Standing on the edge of a step (to avoid bearing weight on one foot/part of foot).
	• Stepping:
	  Frequent weight shifting between feet ("stepping"), or repeated movements of the same foot (this could also be due to nervousness, flies, or anticipation of feeding.)
	• Reluctance:
	  Reluctance to bear weight on a foot when moving.
	
	Assess the score of the animal. Firstly, observe how the cow stands when undisturbed. Then move the cow to the left and to the right, observing how she shifts weight from foot to foot. Then observe the position the cow returns to after movement. If the cow has been lying down, get it up and wait 3 - 4 minutes before assessing.
	
	Individual level:
	0 – Not lame: cow showing none of the indicators listed above
	2 – Lame: cow showing at least one of the four indicators listed above

Classification	**Herd level:** **Percentage** of not lame animals (i.e. score 0) **Percentage** of severely lame animals (i.e. score 2)

Title	**Integument alterations (hairless patches and lesions/swellings)**
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5
Method description	This measure applies to all dairy cows (lactating and dry) and to pregnant heifers if kept together with dairy cows. Integument alterations are defined as hairless patches and lesions/swellings. Only skin alterations of a minimum diameter of 2 cm at the largest extent are counted. Additionally, skin alterations in terms of hairless patches and lesions/swellings are counted in accordance with criteria below: Hairless patch (see photographic illustration): • area with hair loss

- skin not damaged
- extensive thinning of the coat due to parasites
- hyperkeratosis possible

Lesion/swelling (see photographic illustration):
- damaged skin either in form of a scab or a wound
- dermatitis due to ectoparasites
- completely or partly missing teats
- ear lesions due to torn off ear tags

From a distance not exceeding 2 m, five body regions on one side of the focal animal have to be examined with regard to the criteria listed above.
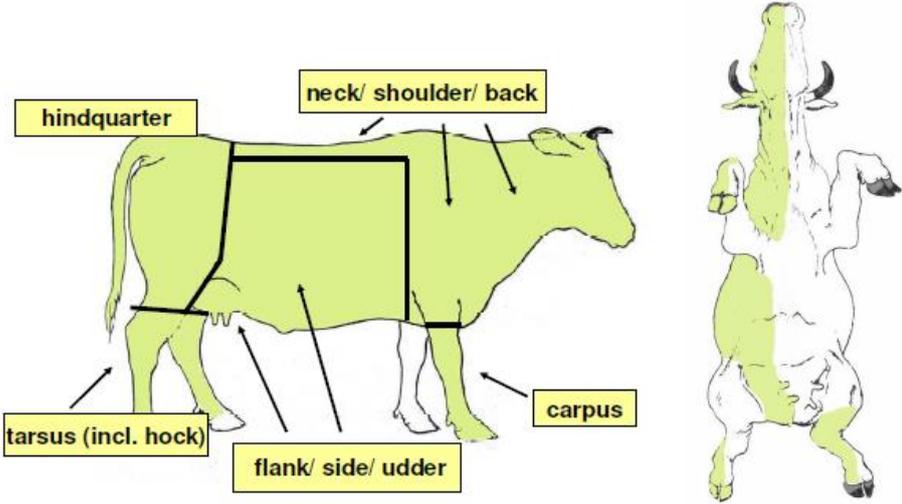
These body regions are scanned from the rear to the front, excluding the bottom side of the belly and the inner side of the legs, but including the inner side of the opposite hind leg as well as the udder with teats.

A random side selection (left or right) has to be ensured, especially in tie-stalls. To prevent biased results, the side selection should be carried out before the examination. In most cases, the side which is seen first when approaching the animal can be chosen.

In the case of more than 20 alterations per category only ">20" is noted. The maximum (">20") is also given if the area affected is at least as large as the size of a hand.

If there are different categories of alterations at the same location (e.g. swelling and lesion at one leg joint) or adjacent to each other (e.g. a round hairless patch with a lesion in its centre) all these alterations are counted.

Individual level:
Number of hairless patches Number of lesions/swellings

Classification	**Herd level:** **Percentage** of animals with no integument alteration (no hairless patch, no lesion/swelling) **Percentage** of animals with mild integument alterations (at least one hairless patch, no lesion/swelling) **Percentage** of animals with severe integument alterations (at least one lesion/swelling)
Optional additional information	For the calculation of scores, this measure is taken into account as the total count from all body regions. However, for advisory purposes more detailed information may be necessary.

a) hairless patches

No hairless patch	hairless patch (tarsal joint)	hairless patch (carpel joint)
© Wincler BOKU	© Brinkmann BOKU	© Brinkmann BOKU

b) lesions

No lesion	lesion (tarsal joint)
© Wincler BOKU	© Brinkmann BOKU

c) swellings

No swelling	Swelling (carpel joint)
© Wincler BOKU	© Brinkmann BOKU

5.1.3.2 Absence of disease

Title	**Nasal discharge**
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5
Method description	This measure applies to all dairy cows (lactating and dry) and to pregnant heifers, if kept together with dairy cows. Nasal discharge is defined as clearly visible flow/discharge from the nostrils; transparent to yellow/green and often of thick consistency. The animal is observed but must not be touched. Animals are scored with regard to the nasal discharge criteria (see photographic illustration). **Individual level:** **0** – No evidence of nasal discharge **2 –** Evidence of nasal discharge
Classification	**Herd level:** **Percentage** of animals with nasal discharge

	Score 0	Score 2
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Title	**Ocular discharge**
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5
Method description	This measure applies to all dairy cows (lactating and dry) and to pregnant heifers, if kept together with dairy cows. Ocular discharge is defined as clearly visible flow/discharge (wet or dry) from the eye, at least 3 cm long. The animal is observed but must not be touched. Animals are scored with regard to the ocular discharge criteria (see photographic illustration). **Individual level:** **0** – No evidence of ocular discharge **2 –** Evidence of ocular discharge
Classification	**Herd level:** **Percentage** of animals with ocular discharge

	Score 0	Score 2
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Title	**Hampered respiration**
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5
Method description	This measure applies to all dairy cows (lactating and dry) and to pregnant heifers, if kept together with dairy cows. Hampered respiration rate is defined as deep and laboured or overtly difficult breathing. Expiration is supported by the muscles of the trunk, mostly accompanied by pronounced sound. Breathing rate may only slightly be increased. The animal is observed but must not be touched. Animals are scored with regard to the hampered respiration criteria.

	Individual level:
	0 – No evidence of hampered respiration
	2 – Evidence of hampered respiration
Classification	**Herd level:**
	Percentage of animals with hampered respiration

Title	**Diarrhoea**
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5
Method description	This measure applies to all dairy cows (lactating and dry) and to pregnant heifers, if kept together with dairy cows. Diarrhoea is defined as loose watery manure below the tail head on both sides of the tail, area affected at least the size of a hand. The animal is observed but must not be touched. Animals are scored with regard to the diarrhoea criteria (see photographic illustration). **Individual level:** **0** – No evidence of diarrhoea **2 –** Evidence of diarrhoea
Classification	**Herd level:** **Percentage** of animals with diarrhoea

Score 0	Score 2
© Gratzer BOKU	© Gratzer BOKU

Title	**Vulvar discharge**
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5
Method description	This measure applies to all dairy cows (lactating and dry) and to pregnant heifers, if kept together with dairy cows. Vulvar discharge is defined as purulent effluent from the vulva or plaques of pus on the bottom side of the tail (CAVE: viscous mucus in animals in late pregnancy). The animal is observed but must not be touched. Animals are scored with regard to the vulvar discharge criteria (see photographic illustration). **Individual level:** **0** – No evidence of vulvar discharge **2 –** Evidence of vulvar discharge
Classification	**Herd level:** **Percentage** of animals with vulvar discharge

	Score 0	Score 2
	© Gratzer BOKU	(c) UNIVMilan

Title	**Milk somatic cell count**
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5
Method description	This measure applies to all dairy cows, and requires input from animal unit manager. Milk somatic cell count data can be obtained from milk records. They are collected at individual cow level from a period of three months prior to the farm visit. Such data can also be collected in advance of the farm visit. Somatic cell counts greater than 400,000 are considered to indicate subclinical inflammation. **Individual level:** **0 –** Somatic cell count below 400,000 within 3 months **2 –** Somatic cell count of 400,000 or above within 3 months
Classification	**Herd level:** **Percentage** cows with somatic cell count of 400,000 or above (i.e.; score 2)

Title	**Mortality**
Scope	Animal-based measure: Dairy cows
Sample size	Animal unit
Method description	Mortality is defined as the 'uncontrolled' death of animals as well as cases of euthanasia and emergency slaughter. The animal unit manager is asked about the number of dairy cows which died on the farm, were euthanized due to disease or accidents or were emergency slaughtered during the last 12 months. Additionally the average number of dairy cows in the animal unit is asked. Farm records may also be used.
Classification	**Herd level:** **Percentage** of animals dead, euthanized and emergency slaughtered on the farm during the last 12 months

Title	**Dystocia**
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5
Method description	Dystocia incidence is defined as the number of calvings where major assistance was required during the last 12 months. Data is collected from herd records, or the animal unit manager is asked about the number of dystocia cases on the farm during the last 12 months (animal unit manager estimates). The average number of calvings (on a yearly basis) is also recorded.
Classification	**Herd level:** **Percentage** of dystocia

Title	**Downer cows**
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5
Method description	Incidence of downer cows is defined as the number of cases of non-ambulatory cows during the last 12 months. Data is collected from herd records, or the animal unit manager is asked about the number of downer cows on the farm during the last 12 months (animal unit manager estimates). The average number of dairy cows (on a yearly basis) is also recorded.
Classification	**Herd level:** **Percentage** of downer cows

5.1.3.3 Absence of pain induced by management procedures

Title	**Disbudding/dehorning**
Scope	Management-based measure: Dairy cows
Sample size	Animal unit
Method description	The animal unit manager is asked about the disbudding/dehorning practices on the farm with regard to the following items: • Procedures used for disbudding of calves/dehorning of cattle • Use of anaesthetics • Use of analgesics
Classification	**Herd level:** **0** – No dehorning or disbudding **1** – Disbudding of calves using thermocautery **2** – Disbudding of calves using caustic paste **3** – Dehorning of cattle and **0** – Use of anaesthetics **3** – No use of anaesthetics and **0** – Use of analgesics **2** – No use of analgesics

Title	**Tail docking**
Scope	Management-based measure: Dairy cows
Sample size	Animal unit
Method description	This measure applies to dairy cows as well as dairy heifers The animal unit manager is asked about mutilation management on the farm with regard to the following items: • Procedures for tail docking • Use of anaesthetics • Use of analgesics
Classification	**Herd level:** **0** – No tail docking **1** – Tail docking using rubber rings **2** – Tail docking using surgery and **0** – Use of anaesthetics **3** – No use of anaesthetics and **0** – Use of analgesics **2** – No use of analgesics

5.1.4 Appropriate behaviour

5.1.4.1 Expression of social behaviours

Title	Agonistic behaviour
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5
Method description	This measure applies to lactating cows as well as to dry cows and pregnant heifers if kept with lactating animals.

This measure applies to lactating cows as well as to dry cows and pregnant heifers if kept with lactating animals.

Agonistic behaviour is defined as social behaviour related to fighting and includes aggressive as well as submissive behaviours. Here, only aggressive interactions are taken into account. Assess the occurrence of the behaviours listed below.

Observations take place in segments of the barn. Per segment not more than 25 cows should be assessed on average. Total net (overall) observation time is 120 minutes. Minimum duration of observation per segment is 10 minutes. If possible with regard to herd size and housing design, the area in question should be divided in not more than 6 segments in order to allow for a repetition of the observations in the second hour. In larger herds up to 12 segments may be observed without repetition. In very large herds (approximately > 250 cows), representative segments covering all areas of the housing system have to be chosen.

Agonistic behaviours are recorded using continuous behaviour sampling always taking the actor into account. Interactions between animals in different segments are recorded if the actor's head is located in the focus segment.

Parameter	Description
Head butt	• Interaction involving physical contact where the actor is butting, hitting, thrusting, striking or pushing the receiver with forehead, horns or horn base with a forceful movement; the receiver does not give up its present position (no displacement, see definition below).
Displacement	• Interaction involving physical contact where the actor is butting, hitting, thrusting, striking, pushing or penetrating the receiver with forehead, horns, horn base or any other part of the body with a forceful movement and as a result the receiver gives up its position (walking away for at least half an animal-length or stepping aside for at least one animal-width). Penetrating is defined as an animal shoving itself between two other animals or between an animal and barn equipment (e.g. at feeding rack, at water trough). If after a displacement neighbouring animals also leave their feeding places but physical contact as described above is not involved, this reaction is not recorded as displacement.
Chasing	• The actor makes an animal flee by following fast or running behind it, sometimes also using threats like jerky head movements. Chasing is only recorded if it follows an interaction with physical contact. If, however, chasing occurs in the context of fighting then it is not counted separately. • Chasing is not applicable in tie stalls.
Fighting	• Two contestants vigorously pushing their heads (foreheads, horn bases and/or horns) against each other while planting their feet on the ground in 'sawbuck position' and both exerting force against each other • Pushing movements from the side are not recorded as head butt as long as they are part of the fighting sequence. • A new bout starts if the same animals restart fighting after

		more than 10 seconds or if the fighting partner changes.
		• Fighting is not applied in tie stalls.
	Chasing-up	• The actor uses forceful physical contact (e.g. butting, pushing and shoving) against a lying animal which makes the receiver rise.

Before starting and after finishing the behaviour observation in a segment the number of animals present in the segment and the number of animals lying has to be counted. Animals which are found lying, standing or feeding across the boundaries of segments are counted in the section where the main part of their body is situated.

Note that agonistic and cohesive behaviours are recorded at the same time and therefore the number of animals at the start and the end of each observation period/number of animals lying is only recorded once.

Group level:
Number of animals in pen or segment
Number of head butts per observation period
Number of displacements (agonistic behaviours except head butts) per observation period
Duration of observations

Classification	**Herd level:** **Mean** number of head butts per animal and hour **Mean** number of displacements (agonistic behaviours except head butts) per animal and hour
Optional additional information	Number of observation points and duration of observations per segment:

Number of segments	Duration of observations (min)	Repeated observations	Total net duration
1	120	No	120
2	30	Yes	120
3	20	Yes	120
4	15	Yes	120
5	12	Yes	120
6	10	Yes	120
8	15	No	120
10	12	No	120
12	10	No	120

5.1.4.2 Expression of other behaviours

Title	**Access to pasture**
Scope	Resource-based measure: Dairy cows
Sample size	Animal unit
Method description	This measure applies to lactating cows, as well as dry cows and pregnant heifers if kept together with lactating animals. Check the availability of access to pasture. The animal unit manager is asked about pasture management (days per year, average time spent on pasture per day).
Classification	**Herd level:** **Number of days** with access to pasture per year and **Number of hours** per day on pasture

5.1.4.3 Good human–animal relationship

Title	**Avoidance distance**
Scope	Animal-based measure: Dairy cows
Sample size	Sample size according to § 6.1.5
Method description	This measure applies to all dairy cows (lactating and dry) and to pregnant heifers if kept with lactating animals.

	The test can start, when at least 75 % of the cows are back in the barn after milking. Place yourself on the feed bunk at a distance of 2 m (if possible) in front of the animal to be tested. The head of the animal has to be completely past the feeding rack / neck rail over the feed. Make sure that the animal is attentive or taking notice of your presence. If an animal is not obviously attentive, but also not clearly distracted, it can be tested. A way to attract the animals' attention is to make some movements in front of them (at the starting position). If you do not have 2 m in front of the animals for approaching them, then choose an angle of up to 45° with the feeding rack, and start at a distance of 2.5 m. If a distance of 2.5 meters is not possible, still carry out the assessment but note down the maximum distance possible on the recording sheet. Approach the animal at a speed of one step per second and a step length of approximately 60 cm with the arm held overhand in an angle of approximately 45° from the body. When approaching, direct the back of the hand toward the animal. Do not look into the animal's eyes but look at the muzzle. Continue to walk towards the animal until signs of withdrawal or until touching the nose/muzzle. Definition of withdrawal is when the animal moves back, turns the head to the side, or pulls back the head trying to get out of the feeding rack; head shaking can also be found. In the case of withdrawal the avoidance distance is estimated (= distance between the hand and the muzzle at the moment of withdrawal) with a resolution of 10 cm (200 cm to 10 cm possible). If withdrawal takes place at a distance lower than 10 cm, the test result is still 10 cm. If you can touch the nose muzzle, an avoidance distance of 0 cm is recorded. Make sure that the hand is always closest to the animal during the approach (not the knee of the feet). Especially when getting close to animals that are feeding or have their heads in a low position, bend a little in order to try to touch them. Neighbouring animals that react to an animal being tested should be tested later on. In order to reduce the risk of influencing the neighbour's test result, every second animal can be chosen. Retest animals at a later time if the reaction was unclear. **Individual level:** Distance in **cm** (200-0 cm, with a resolution of 10 cm)
Classification	**Herd level:** **Percentage** of animals that can be touched **Percentage** of animals that can be approached closer than 50 cm but not be touched **Percentage** of animals that can be approached as closely as 100 to 50 cm **Percentage** of animals that cannot be approached as closely as 100 cm

5.1.4.4 Positive emotional state

Title	**Qualitative behaviour assessment**							
Scope	Animal-based measure: Dairy cows							
Sample size	Animal unit (depending on number of observation points, see method description)							
Method description	Qualitative Behaviour Assessment (QBA) considers the expressive quality of how animals behave and interact with each other and the environment i.e. their 'body language'. Select between one and eight observation points (depending on the size and structure of the farm) that together cover the different areas of the farm. Decide the order to visit these observation points, wait a few minutes to allow the animals to return to undisturbed behaviour. Watch the animals that can be seen well from that point and observe the expressive quality of their activity at group level. It is likely that the animals will initially be disturbed, but their response to this can be included in the assessment. Total observation time should not exceed 20 minutes, and so the time taken at each observation point depends on the number of points selected for a farm:							

Number of observation points	1	2	3	4	5	6	7	8
Duration of observation per observation point in minutes	10	10	6.5	5	4	3.5	3	2.5

	When observation at all selected points has been completed, find a quiet spot and score the 20 descriptors using the visual analogue scale (VAS, see Annex B3). Please note that scoring is not done during observation, and that only one integrative assessment is made per farm.
	Each VAS is defined by its left 'minimum' and right 'maximum' point. 'Minimum' means that at this point, the expressive quality indicated by the term is entirely absent in any of the animals you have seen. 'Maximum' means that at this point this expressive quality is dominant across all observed animals. Note that it is possible to give more than one term a maximum score; animals could for example be both entirely calm and content.
	To score each term, draw a line across the 125 mm scale at the appropriate point. The measure for that term is the distance in millimetres from the minimum point to the point where the line crosses the scale. Do not skip any term.
	Please be aware when scoring terms that start with a negative pre-fix, such as unsure or uncomfortable. As the score gets higher, the meaning of the score gets more negative, not more positive.
	The terms used for dairy cow QBA assessment are: • Active • Frustrated • Irritable • Relaxed • Friendly • Uneasy • Fearful • Bored • Sociable • Agitated • Playful • Apathetic • Calm • Positively occupied • Happy • Content • Lively • Distressed • Indifferent • Inquisitive
Classification	**Herd level:** **Continuous scales** for all body language parameters from minimum to maximum.

5.1.5 Sampling and practical information

The assessor should first become familiar with the facilities (pens/houses, potential observation points, etc.). Any disturbance of the animals should be avoided as far as possible at this time.
There is a logical order in which the different measures should be carried out and which measures can be carried out at the same time. For some of the measures, input from the animal unit manager is required (see Table 12). An appointment with the animal unit manager should be planned taking into account the timing of the animal-based measures.

Table 12 Order in which the (groups of) measures will be assessed during the on-farm visit and approximate time needed at each step.

	Parameter	Sample size	Time needed approximately
1	Avoidance distance	Sample size depending on herd size according to Table 13	1 min/animal
2	Qualitative behaviour assessment	Up to 8 observation points (total net observation time 20 min)	25 min
3	Behavioural observations • Time needed to lie down, animals colliding with housing equipment during lying down • Animals lying partly or completely outside the lying area • Agonistic behaviours	Up to 12 segments	150 min
4	Clinical scoring • Body condition score • Cleanliness of udder, flank/upper legs and lower legs	Sample size depending on herd size according to Table 13 All measures are recorded in the same sample of animals. If	3 min/animal

	• Lameness • Integument alternations • Nasal discharge, ocular discharge, hampered respiration • Diarrhoea • Vulvar discharge	animals are kept in different groups, proportionate sampling according to group size has to be carried out.	
5	Resources checklist • Water provision • Cleanliness of water points • Water flow • Functioning of water points • Presence of tethering	All pens where lactating cows are kept	15 min
6	Management questionnaire • Access to outdoor loafing area or pasture • Disbudding/dehorning • Tail docking • Milk somatic cell count • Mortality • Dystocia • Downer cows	Animal unit (interview with animal unit manager)	15 min
		TOTAL	**25 cows: 4.4 h** **60 cows: 5.6 h** **100 cows: 6.6 h** **200 cows: 7.7 h**

Selecting dairy cows for assessment

For some of the measures, random sampling is required. This is indicated in the description of the measures. Check the current number of animals and determine the sample size according to Table 13.

Table 13 Sample size for clinical scoring depending on the herd size.

Herd size	Number of animals to score (suggestion A)	If suggestion A is not feasible
30	30	30
40	30	30
50	33	30
60	37	32
70	41	35
80	44	37
90	47	39
100	49	40
110	52	42
120	54	43
130	55	45
140	57	46
150	59	47
160	60	48
170	62	48
180	63	49
190	64	50
200	65	51
210	66	51
220	67	52
230	68	52
240	69	53
250	70	53
260	70	54
270	71	54
280	72	54
290	72	55
300	73	55

- A random sample can be obtained by selecting every nth animal in the milking parlour. These animals are marked, to enable re-identification afterwards for data-collection.
- If animals can be locked in a feeding rack, they can be selected by choosing every nth animal in the row(s). Data collection can be carried out immediately.
- In the least preferable method, animals in all areas of the pen including standing, feeding and lying animals are considered together.
- To simplify the assessment, animals can be marked with a stock marking device after assessing them.
- The same animals can be assessed for the scoring of all measures, where random sampling is required.
- If animals are kept in different groups, proportionate sampling according to group size should be carried out.
- For all the measures that assess the quality of water provision the assessed pens are those in which the lactating animals are kept.
- For the measures time needed to lie down, animals colliding with housing equipment and animals lying partly or completely outside the lying area, observations take place in segments of the barn. Per segment not more than 25 cows should be assessed on average. Total net (overall) observation time is 120 minutes. Minimum duration of observation per segment is 10 minutes. If possible with regard to herd size and housing design, the area in question should be divided in not more than 6 segments in order to allow for a repetition of the observations in the second hour.
- Cleanliness of the body and integument alterations are assessed on the same side of each animal.

5.2 Calculation of scores for dairy cows on farm

5.2.1 Criterion-scores

5.2.1.1 Absence of prolonged hunger

The score of a farm in regard to absence of hunger is calculated from the % of very lean cows (that is with a body condition score of 1). This % is turned into a score using an I-spline function (Figure 18) as follows:

Let I = 100 - % of very lean cows,

A spline function is used to compute the index into a score, with the general formula:

Score = a + b x I + c x I^2 + d x I^3
with a, b, c, d differing when I is lower or equal to a specific value (called knot) vs. equal or higher that this value.

The values for a, b, c, d and the knot are:

knot	80
a when I < knot	0
a when I > knot	-2961.3146422677
b when I < knot	0.2216596254
b when I > knot	111.2709595652
c when I < knot	-0.0027707453
c when I > knot	-1.3908870043
d when I < knot	0.0000592709
d when I > knot	0.0058430887
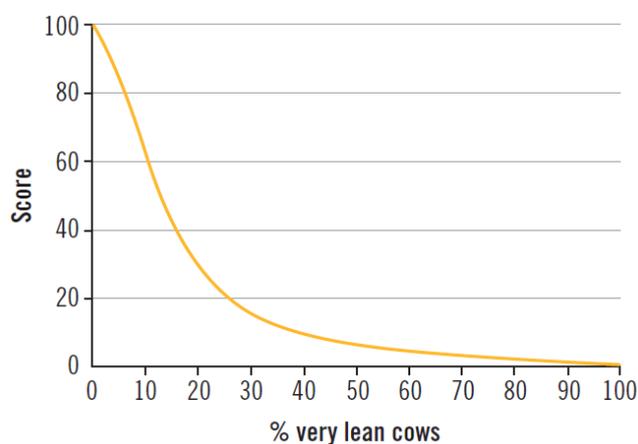
Figure 19 *Calculation of the score for absence of prolonged hunger according to the percentage of very lean cows in the herd.*

5.2.1.2 Absence of prolonged thirst

For each group of animals three aspects are considered:
- Is the number of functioning drinkers sufficient?
- Are the drinkers clean?
- Are there at least 2 drinkers available for an animal?

To be sufficient, there must be at least 1 water bowl for 10 cows and/or 6 cm of trough per cow.
If a drinker is not functioning properly or the water flow is insufficient (i.e. lower than 20L/min for a trough or lower than 10 L/min for a bowl) then it counts for half. The score is calculated as follows:
1. We calculate a cumulated number of bowl and cumulated cm of through (taking into account their functioning)
2. We "convert" the number of bowls into length of equivalent trough (i.e. 1 water bowl = 60 cm)

3. We calculate a "drinkers' availability" score based on "cm of trough" (or equivalent) per cow according to a two piecewise linear equations. The equations depend on whether cows have access to at least 2 drinkers or not. In the case of tied cows, we consider that there are at least 2 drinkers per cow if the number of bowl is at least equal to the number of cows:

$$Score = \begin{cases} \min(10 * cm_{OfThroughPerCow}; 60) & if\ less\ than\ 2\ drinkers\ per\ cow \\ 15 * cm_{OfThroughPerCow} & if\ at\ least\ 2\ drinkers\ and\ cm_{OfThroughPerCow} < 4 \\ \min(60 + (cm_{OfThroughPerCow} - 4) * 20; 100) & else \end{cases}$$

"drinkers' availability" Score

at least 2 drinkers? ——Yes ——No
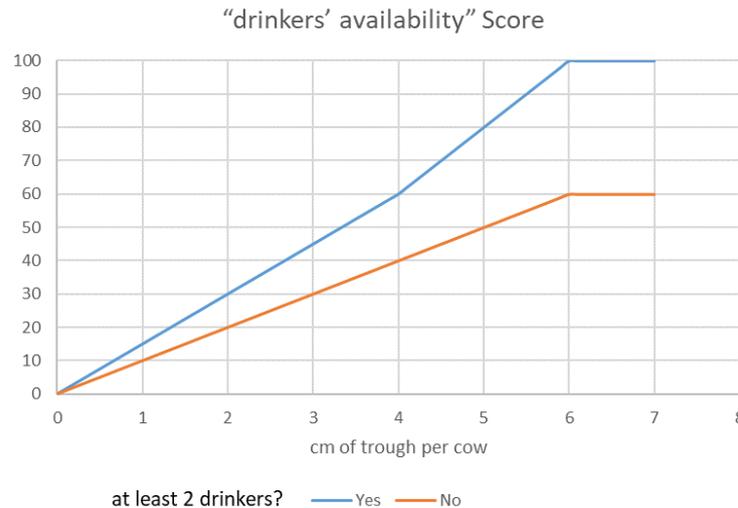
4. We calculate a "water cleanliness" score as the weighted score for cleanliness of the drinkers (a clean drinker scored 1, a partially dirty 2, and a dirty one 3)
5. The thirst score is then the "drinkers' availability" score divided by the "cleanliness" score

Then the score attributed to the whole animal unit is equal to the worst score obtained at group level as long as at least 15% of the observed animals are in groups that obtain this score of a lower one.

5.2.1.3 Comfort around resting

For each measure, we consider 3 levels from a welfare point of view: normal (no problem), moderate problem, serious problem. The limits between the categories are defined for each measure (Table 14).

Table 14 *Limits between welfare categories* on each measure.

	Normal	Moderate problem	Serious problem
Time needed to lie down	≤ 5.20 s	5.20 s < ≤ 6.30 s	> 6.30 s
Percentage of animals lying partly or completely outside the supposed lying area	≤3%	3% < ≤ 5%	> 5%
Percentage of collisions with housing equipment during lying down	≤ 20%	20% < ≤ 30%	> 30%
Cleanliness: % of animals with dirty lower	≤ 20%	20% < ≤ 50%	> 50%
Cleanliness: % of animals with dirty udder	≤ 10%	10% < ≤ 19%	> 19%
Cleanliness: % of animals with dirty hindquarters	≤ 10%	10% < ≤ 19%	> 19%

The total number of moderate problems and serious problems on a farm is calculated.

For instance, Farm A with 10% cows lying outside the resting area, 25% collisions against equipment during lying down, and 25% cows with dirty udder has 1 serious and 1 moderate behavioural problem and 1 serious problem regarding cleanliness.

Overall importance of 3 for resting behaviour and 1 for cleanliness are attributed because cleanliness is considered less important than behaviour.

Therefore, Farm A is estimated to have 3 moderate problems (1x3) and 4 serious problems (3x1 + 1).

We calculate a weighted sum of moderate and serious problems. In this sum, the weights are set at 4 for moderate problems and 9 for serious problems.

For Farm A this sum gives 3x4 + 4x9 = 48

The theoretical maximum of this sum is 9 x 12 = 108. To obtain an index between 0 and 100 (with 0- worst; 100—best), the sum is then divided by the theoretical maximum (108) and multiplied by 100 and the difference to 100 is calculated:

Let I be the index for the comfort around resting:
I = 100 – 100 x [4 x (no. moderate problems) + 9 x (no. serious problems)]/108
For farm A, this brings 100 – 100 x (48/108) = 55.6

Finally this index is computed into a score using I-spline functions (Figure 19), with the general formula:
Score = $a + b \times I + c \times I^2 + d \times I^3$
with a, b, c, d differing when I is lower or equal to a specific value (called knot) vs. equal or higher that this value.

The values for a, b, c, d and the knot are:

knot	62
a when I < knot	0
a when I > knot	-152.5694102955
b when I < knot	0.5647086656
b when I > knot	7.9470994784
c when I < knot	0.0046442175
c when I > knot	-0.1144266019
d when I < knot	-0.0000380402
d when I > knot	0.0006021255
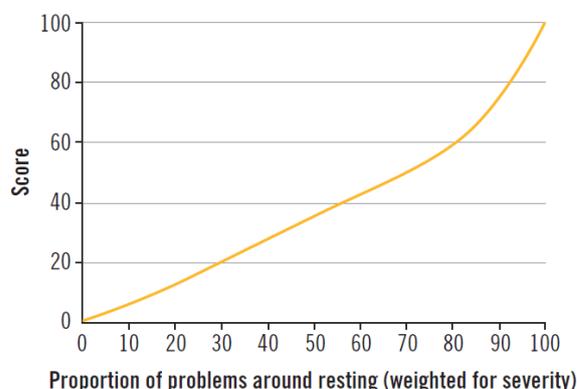
Figure 20 *Calculation of the score for comfort around resting according to the number of moderate and serious problems on behaviour around resting and cleanliness of the cows (weights: 0.44 for moderate problems and 1 for serious problems.*

5.2.1.4 Thermal comfort

As yet this criterion is not assessed for dairy cows.

5.2.1.5 Ease of movement

The score for ease of movement is attributed according to the number of days per year and hours per day cows are able to move freely (i.e. not tethered).

A cow is considered tethered on a given day if it spends at least 18 hours tethered. At year level a cow is

considered:

- tethered all year round if it is tethered (as defined above) for at least 265 days per year,
- tethered only in winter if it is tethered for at least 15 days but less than 265 days per year,
- not tethered if it is tethered for less than 15 days per year.
- when a cow is tethered, it is considered to have regular exercise when it is released for at least 1 hour per day on at least 2 days per week.

The following scores are attributed to each of these possibilities:

```
                          ┌── During all the year ──┬── With NO regular exercice* ──── 15
                   ┌── Yes ─┤                         └── With regular exercice*     ──── 32
                   │        │
Tethered ──────────┤        └── Only during winter ──┬── With NO regular exercice* ──── 34
                   │                                  └── With regular exercice*    ──── 60
                   │
                   └── No ────────────────────────────────────────────────────────────── 100
```
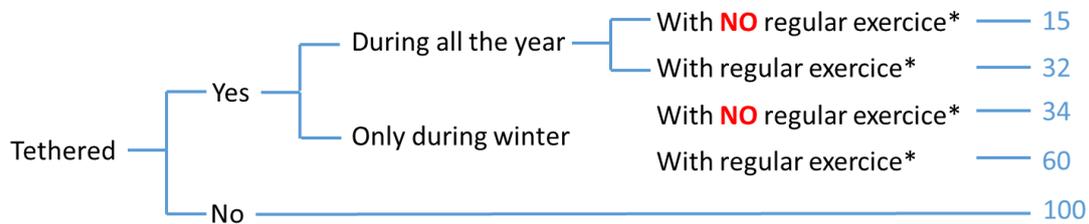
5.2.1.6 Absence of injuries

Two partial scores are calculated, one for integument alterations, and one for lameness, before being combined into a criterion score.

Partial score for integument alterations

The % of animals affected by one or several mild alterations and no severe one and the % animals affected by one or more severe alterations are combined in a weighted sum, with a weight of 1 for mild alterations and 5 for severe ones. This sum is then transformed into an index that varies from 0 to 100 as follows:

Index for integument alterations: $I_{alteration} = \left(100 - \frac{(\%mild)+5(\%severe)}{5}\right)$

A spline function is used to compute the index into a score (Figure 20), with the general formula:

Score = a + b x I + c x I^2 + d x I^3
with a, b, c, d differing when I is lower or equal to a specific value (called knot) vs. equal or higher that this value.

The values for a, b, c, d and the knot are:

knot	65
a when I < knot	0
a when I > knot	29.8965836056
b when I < knot	0.4353924567
b when I > knot	-0.9444498651
c when I < knot	-0.0066983455
c when I > knot	0.0145299979
d when I < knot	0.0001281117
d when I > knot	0.0000192484
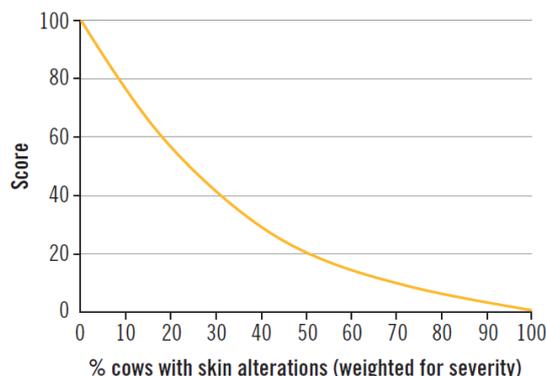
Figure 21 *Calculation of the partial score for integument alterations according to the % animals affected by mild alterations and % animals affected by severe ones (weights: 0.2 for mild and 1 for severe alterations).*

Partial score for lameness

The % of animals moderately lame and the % of animals severely lame are combined in a weighted sum, with a weight of 2 for moderate lameness and 7 for severe lameness (note that for tied cows only the proportion of severely lame animals is used). This sum is then transformed into an index that varies from 0 to 100 as follows:

Index for lameness: $I_{lameness} = \left(100 - \frac{2(\%moderate) + 7(\%severe)}{7}\right)$

A spline function is used to compute the index into a score (Figure 21), with the general formula:
Score = a + b x I + c x I² + d x I³
with a, b, c, d differing when I is lower or equal to a specific value (called knot) vs. equal or higher that this value.

The values for a, b, c, d and the knot are:

knot	78
a when I < knot	0
a when I > knot	-2129.5217776808
b when I < knot	0.0750111002
b when I > knot	81.9796965434
c when I < knot	-0.0000242066
c when I > knot	-1.0500842958
d when I < knot	0.0000449587
d when I > knot	0.0045323951
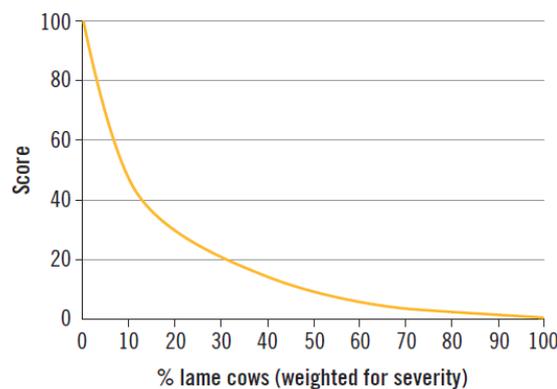
Figure 22 *Calculation of the partial score for lameness according to the % animals moderately lame and the % animals severely lame (weights: 0.29 for moderate and 1 for severe lameness).*

Score for absence of injuries

The two partial scores are combined using a Choquet integral. The parameters of the Choquet integral are:

$\mu_{lameness}=0.56$ and $\mu_{alteration}=0.31$

An example of data produced is presented in Table 15 below.

Table 15 *Example of scores for absence of injuries calculated from partial scores for integument alteration and lameness*

	Integument alteration Score	Lameness score	Score for absence of injuries
Farm 1	40	60	51
Farm 2	50	50	50
Farm 3	60	40	46

5.2.1.7 Absence of disease

The prevalence of each health problem recorded is transformed into a score thanks to Spline functions (Figure 22), with the general formula:

Score = a + b x I + c x I^2 + d x I^3

with a, b, c, d differing when I is lower or equal to a specific value (called knot) vs. equal or higher that this value.

The values for a, b, c, d and the knot are:

	Diarrhoea	Downer cow	Dystocia
knot	0.14	0.13	0.15
a when I < knot	104.73777883	104.8108292	104.5225185
a when I > knot	0.07903919	0.2281151	0.8753256
b when I < knot	-13.056372292	-18.9713108	-12.23917892
b when I > knot	-0.004449332	-0.01303954	-0.02006115
c when I < knot	0.3047166	1.0950293	0.2825625
c when I > knot	0.00007566163	0.000223492	0.0001476052
d when I < knot	0.007043499	-0.01917619	0.005019234
d when I > knot	-0.0000003978852	-0.000001180743	-0.0000003513676

	Hampered respiration	Mastitis	Mortality
knot	0.11	0.33	0.12
a when I < knot	105.65027052	102.5585011	104.76763787
a when I > knot	0.09275524	0.2430248	0.04456048
b when I < knot	-23.253076099	-5.949038272	-26.471292966
b when I > knot	-0.004256608	-0.006463557	-0.002530646
c when I < knot	1.613741	0.08272253	2.292605
c when I > knot	0.00006872319	0.00005957293	0.00004332391
d when I < knot	-0.03316278	0.0001100515	-0.06788601
d when I > knot	-0.0000003625169	-0.0000001940451	-0.0000002290172

	Nasal discharge	Ocular discharge	Vulva discharge
knot	0.26	0.17	0.12
a when I < knot	103.1028857	104.21150502	103.5389575
a when I > knot	0.05825432	0.06653079	0.3187816
b when I < knot	-7.483119455	-11.055517044	-25.6040749
b when I > knot	-0.002821373	-0.003586719	-0.0184825
c when I < knot	0.1265633	0.2450122	2.2345443304
c when I > knot	0.00004311633	0.00005924924	0.0003193296
d when I < knot	0.0003536821	0.002772511	-0.06820562
d when I > knot	-0.0000002096808	-0.0000003052889	-0.000001695598

The three lowest scores are then aggregated with a Choquet integral with the following capacities:

μ_i = 0.155

$\mu_{ij,}$ = 0.3

with j and *i* being respectively the second and the third lowest score
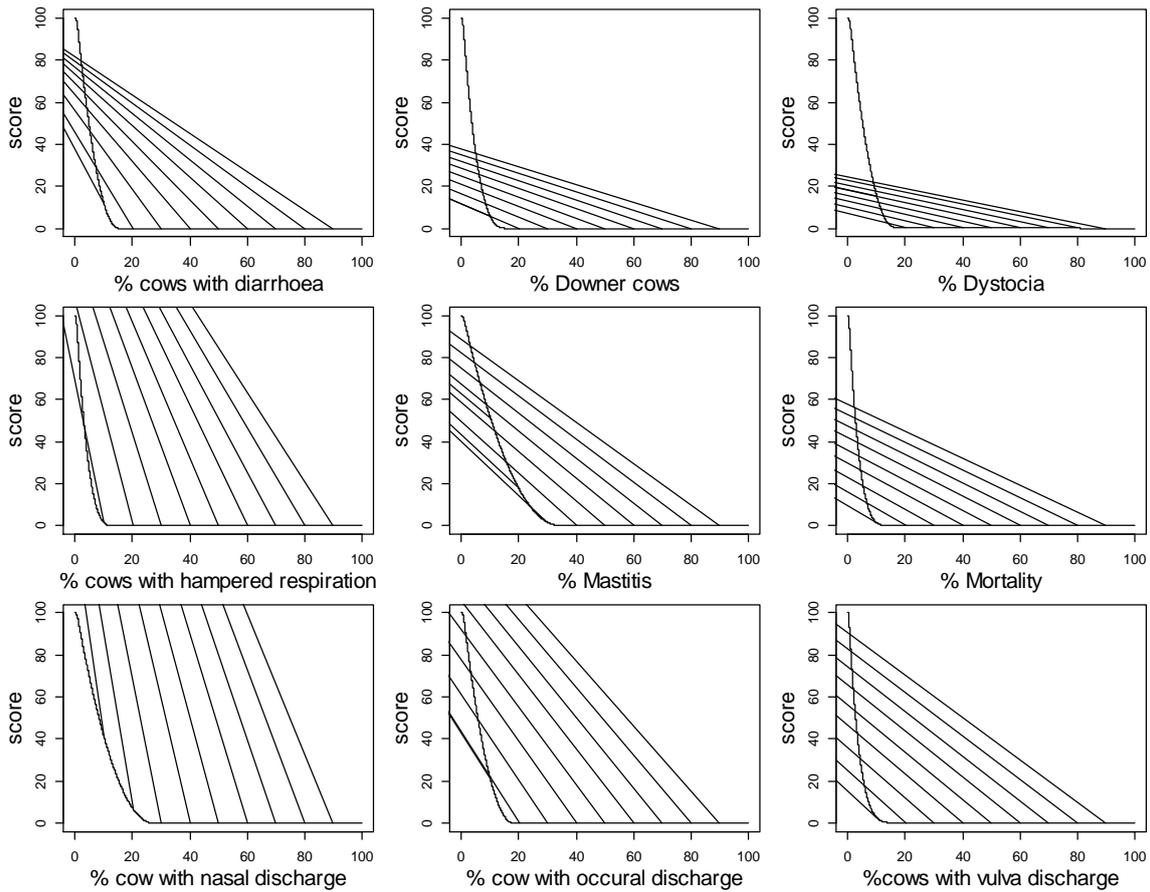
***Figure 23** Calculation of the partial score for disease according to the symptom prevalences.*

5.2.1.8 Absence of pain induced by management procedures

One score is attributed to dehorning and one to tail docking. These partial scores are attributed according to decision trees (Figure 23 and 24).

Then at criterion level, the worst score among the two partial scores (one for dehorning and one for tail docking) is retained.

A farm is considered as practicing dehorning or disbudding when at least 15% of the animals present on the farm are dehorned or disbudded. The same principle is applied to tail docking.

Age	Method	Use of medicines	Scores
Nothing (neither disbudding nor dehorning)			100
Disbudding (i.e. performed on a young animal)	Thermal	Nothing	28
		Anaesthetic	52
		Analgesic	49
		Anaesthetic + Analgesic	75
	Chemical	Nothing	20
		Anaesthetic	39
		Analgesic	41
		Anaesthetic + Analgesic	58
Dehorning (i.e. horn cut on an adult, not considering cases when dehorning is motivated by medical reasons (e.g. a cow which broke one horn itself) and then done surgically)		Nothing	2
		Anaesthetic	14
		Analgesic	13
		Anaesthetic + Analgesic	22

***Figure 24** Scores attributed to combinations of answers to questions on dehorning.*

Method	Use of medicines	Scores

Tail Docking
- Nothing → 100
- Rubber ring
  - Nothing → 3
  - Anaesthetic → 21
  - Analgesic → 19
  - Anaesthetic + Analgesic → 28
- Surgery
  - Nothing → 0
  - Anaesthetic → 19
  - Analgesic → 16
  - Anaesthetic + Analgesic → 33
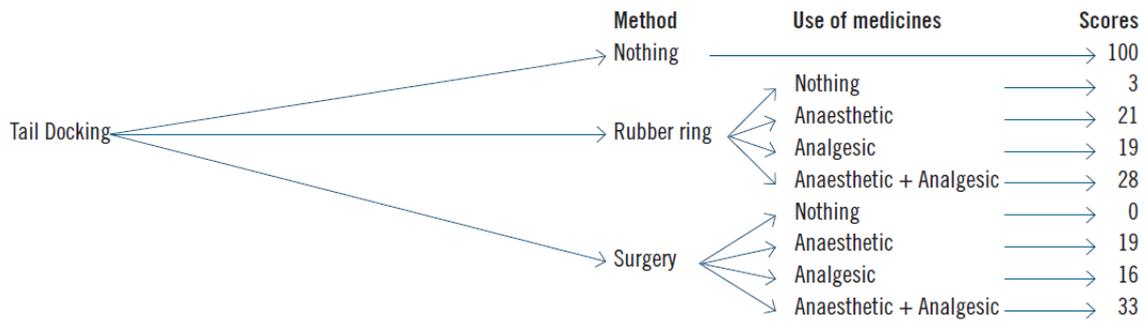
Figure 25 *Scores attributed to combinations of answers to questions on tail docking.*

5.2.1.9 Expression of social behaviours

According to experimental studies, the absolute maximum expected is an average of 5 agonistic encounters per cow per hour, including 3.4 displacements and 1.6 head butts. A weighted sum is calculated, with 4 the weight of head butts and 11 that of displacements. The theoretical maximum of this sum is 43.8 (4x1.6 head butts + 11 x 3.4 displacements). To obtain an index between 0 and 100 (with 0-worst and 100-best), the sum is transformed into an index as follows:

Index for social behaviour $I = 100 \times \dfrac{(43.8) - 4(head\ butts) - 11(displacements)}{43.8}$

A spline function is used to compute the index into a score (Figure 25), with the general formula:
Score = a + b x I + c x I^2 + d x I^3
with a, b, c, d differing when I is lower or equal to a specific value (called knot) vs. equal or higher that this value.

The values for a, b, c, d and the knot are:

knot	70
a when I < knot	0
a when I > knot	92.1225251801
b when I < knot	0.3919305016
b when I > knot	-3.5561777144
c when I < knot	-0.0055990072
c when I > knot	0.0508025387
d when I < knot	0.0001240486
d when I > knot	-0.0001445301
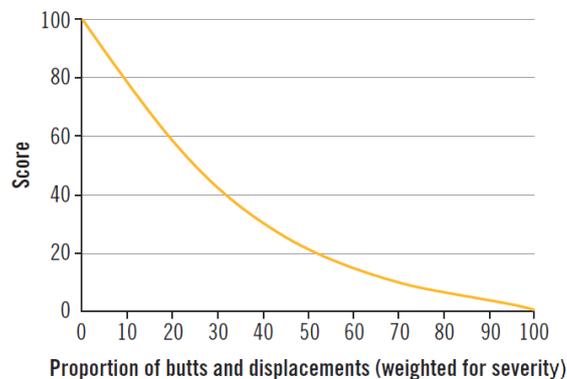
Figure 26 *Calculation of scores for the expression of social behaviour according to the frequency of head butts and displacements (weight: 0.36 for butts and 1 for displacements) and in comparison to an extreme situation with 1.6 butts and 3.4 displacements.*

5.2.1.10 Expression of other behaviours

The % days per year with at least 6 h at pasture is considered.
A spline function is used to compute the index into a score (Figure 26), with the general formula:
Score = a + b x I + c x I^2 + d x I^3
with a, b, c, d differing when I is lower or equal to a specific value (called knot) vs. equal or higher that this value.
The values for a, b, c, d and the knot are:

knot	50
a when I < knot	0
a when I > knot	-37.3194755012
b when I < knot	1.7752743048
b when I > knot	4.0144428355
c when I < knot	-0.0009243370
c when I > knot	-0.0457077076
d when I < knot	-0.0001056035
d when I > knot	0.0001929523
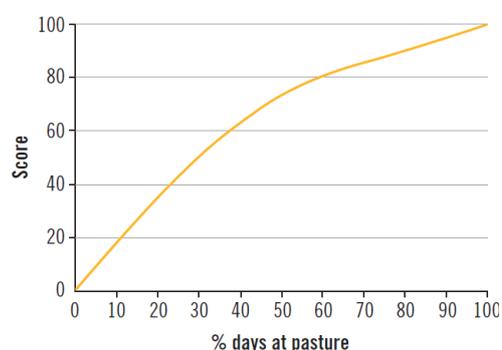
Figure 27 *Calculation of scores for the expression of other behaviours according to the proportion of days per year spent at pasture.*

5.2.1.11 Good human-animal relationship

Four categories of animals are distinguished and the % of animals in each of them are combined in a weighted sum, with the following weights:
- 0 for animals that can be touched (Avoidance Distance (AD) = 0),
- for animals that can be approached closer than 50 cm but not touched (0 < AD ≤ 50),
- 11 for animals that can be approached as closely as 100 cm to 50 cm (50 < AD ≤ 100),
- 26 for animals that cannot be approached as closely as 100 cm (AD > 100).

This sum is computed into an index that varies from 0 (worst situation) to 100 (best situation):

Index for good human-animal relationship $I = 100 - \dfrac{3(\%cat\,2) + 11(\%cat3) + 26(\%cat\,4)}{26}$

A spline function is used to compute the index into a score (Figure 27), with the general formula:
Score = a + b x I + c x I^2 + d x I^3
with a, b, c, d differing when I is lower or equal to a specific value (called knot) vs. equal or higher that this value.
The values for a, b, c, d and the knot are:

knot	70
a when I < knot	0
a when I > knot	-247.7002454443
b when I < knot	0.7221171736
b when I > knot	11.3378420026
c when I < knot	-0.0103159596
c when I > knot	-0.1619691718
d when I < knot	0.0001114496
d when I > knot	0.0008336078
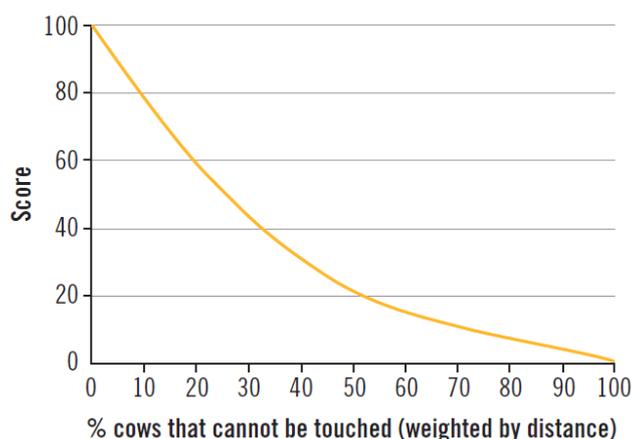
Figure 28 Calculation of scores for good human-animal relationship according to the proportion of animals that cannot be touched (weight: 0.12, 0.42 and 1 for animals with approach distances less than 50 cm, less than 100 cm, or more than 100 cm)

5.2.1.12 Positive emotional state

The values (between 0 and 125) obtained by a farm for the 20 terms of the Qualitative Behaviour Assessment are turned into an index using a weighted sum:

$$Index = \sum_{k=1}^{20} w_k N_k$$

with N_k, the value obtained by a farm for a given term k
w_k, the weight attributed to a given term k

The weights of the various terms in this sum are:

Terms	Weights
active	0.00768
relaxed	0.01004
fearful	-0.01286
agitated	-0.01620
calm	0.00881
content	0.01213
indifferent	-0.01116
frustrated	-0.01609
friendly	0.01172
bored	-0.01087
playful	0.00109
positively occupied	0.01183
lively	0.00028
inquisitive	0.00048
irritable	-0.02182
uneasy	-0.01032
sociable	0.00527
apathetic	-0.01562
happy	0.01468
distressed	-0.02027

A spline function is used to compute the index into a score (Figure 28), with the general formula:
Score = a + b x I + c x I² + d x I³
with a, b, c, d differing when I is lower or equal to a specific value (called knot) vs. equal or higher that this value.

The values for a, b, c, d and the knot are:

knot	0
a when I < knot	50
a when I > knot	50
b when I < knot	8.75
b when I > knot	11.6667
c when I < knot	0.3125
c when I > knot	-0.55556
d when I < knot	0
d when I > knot	0

In addition the score can vary only between 0 and 100. Therefore:
if a calculation brings a value below 0 then Score = 0
if a calculation brings a value above 100 then Score = 100
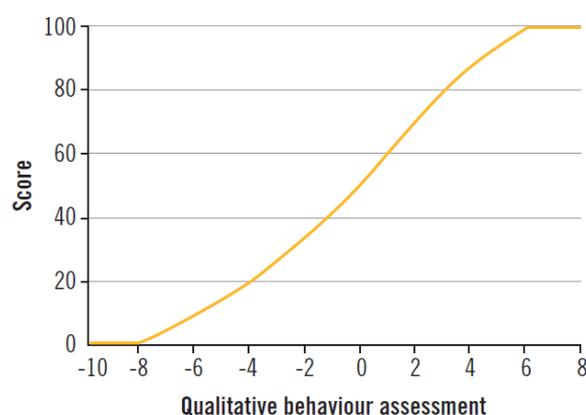
Figure 29 *Calculation of scores for positive emotional state according to the values the farm obtained for the various terms used in qualitative Behaviour Assessment (combined in a weighted sum).*

5.2.2 Principle scores

Criterion-scores are combined to form principle-scores thanks to Choquet integrals. The parameters of the integrals are given below for each principle.

Principle Good feeding

μ_1	μ_2
0.12	0.27

with 1, Absence of prolonged hunger and 2, Absence of prolonged thirst

Principle Good housing

μ_3	μ_4	μ_5
0.15	0.11	0.12

μ_{34}	μ_{35}	μ_{45}
0.34	0.43	0.37

with 3, Comfort around resting; 4, Thermal comfort; 5, Ease of movement

Thermal comfort is not assessed in dairy cows. The missing criterion-score is replaced by the best score among Comfort around resting and Ease of movement.

Principle Good health

μ_6	μ_7	μ_8
0.11	0.24	0.13

μ_{67}	μ_{68}	μ_{78}
0.42	0.24	0.24

with 6, Absence of injuries; 7, Absence of disease; 8, Absence of pain induced by management procedures

Principle Appropriate behaviour

μ_9	μ_{10}	μ_{11}	μ_{12}
0.10	0.07	0.12	0.17

μ_{910}	μ_{911}	μ_{912}
0.12	0.12	0.18

μ_{1011}	μ_{1012}	μ_{1112}
0.15	0.19	0.27

μ_{91011}	μ_{91012}	μ_{91112}	μ_{101112}
0.42	0.49	0.52	0.48

with 9, Expression of social behaviours; 10, Expression of other behaviours; 11, Good human- animal relationship; 12, Positive emotional state.

- Due to the positive values of the interactions between criterion-scores, the principle-scores are always intermediate between the lowest and the highest values obtained at criterion level, and always closer to the minimum value.
- Within each principle, some criteria are considered more important than others (and will contribute to a large extent to the principle-score):
  - Within principle "Good feeding", Criterion "Absence of prolonged thirst" is considered more important than Criterion "Absence of prolonged hunger".
  - Within principle "Good housing", Criterion "Ease of movement" and Criterion "Comfort around resting" are considered more important than Criterion "Thermal comfort".
  - Within principle "Good health", Criterion "Absence of disease" is considered more important than Criterion "Absence of injuries" which in turn is considered more important than Criterion "Absence of pain induced by management procedures".
  - Within principle "Appropriate behaviour", the order of importance of criteria is: "Positive emotional state" (most important), "Good human-animal relationship", "Expression of social behaviours", "Expression of other behaviours" (least important).

Examples of principle-scores resulting from criterion-scores are provided in Tables 16 to 19 below.

Table 16 *Examples of scores for "Good feeding" according to combinations of Criterion-scores for "Absence of prolonged hunger" and "Absence of prolonged thirst".*

Criteria		Principle
Absence of hunger	**Absence of thirst**	**Good feeding**
25	75	39
40	60	45
50	50	50
60	40	42
75	25	31

Table 17 *Examples of scores for "Good housing" according to combinations of Criterion-scores for "Comfort around resting", "Thermal comfort", and "Ease of movement".*

Criteria			Principle
Comfort around resting	**Thermal comfort**	**Ease of movement**	**Good housing**
25	50	75	37
25	75	50	37
50	25	75	39
75	25	50	40
40	50	60	45
40	60	50	45
50	40	60	46
50	50	50	50
50	75	25	36
75	50	25	37
50	60	40	45
60	40	50	46
60	50	40	45

Table 18 *Examples of scores for "Good health" according to combinations of criterion-scores for "Absence of injuries" Absence of disease", and "Absence of pain induced by management procedures".*

Criteria			Principle
Absence of injuries	**Absence of disease**	**Absence of pain induced by management procedures**	**Good health**
25	50	75	34
25	75	50	37
50	25	75	34
75	25	50	34
40	50	60	44
40	60	50	45
50	40	60	44
50	50	50	50
50	75	25	42
75	50	25	38
50	60	40	47
60	40	50	44
60	50	40	45

Table 19 *Examples of scores for "Appropriate behaviour" according to combinations of Criterion-scores for "Expression of social behaviours", "Expression of other behaviours", "Good human- animal relationship", and "Positive emotional state".*

Criteria				**Principle**
Expression of social behaviours	**Expression of other behaviours**	**Good human-animal relationship**	**Positive emotional state**	**Appropriate behaviour**
35	35	65	65	43
35	50	50	65	45
35	50	65	50	44
35	65	35	65	41
35	65	50	50	43
35	65	65	35	40
50	35	50	65	45
50	35	65	50	45
50	50	35	65	45
50	50	50	50	50
50	50	65	35	43
50	65	35	50	43
50	65	50	35	42
65	35	35	65	40
65	35	50	50	44
65	35	65	35	39
65	50	35	50	44
65	50	50	35	43
65	65	35	35	39

5.2.3 Overall assessment

The synthesis of the four principle-scores into an overall assessment is carried out in a similar way for all animal types. The overall assessment is explained in Chapter 4.

5.3 Collection of data for dairy cows at slaughterhouse

As yet, this is not included in the protocol.

5.4 Calculation of scores for dairy cows at slaughterhouse

As yet, this is not included in the protocol.

Annex A: Guidelines for visit to the animal unit

Dairy cows

Since data recording starts after the morning milking, it is important to know the farm routines and to know the timing of the farm routines. It may be necessary to choose a random sample of cows during the milking. This is further explained in paragraph 6.1.5. Some basic information is needed in advance for the planning of the farm visit:

- Number of groups of lactating cows and dry cows present at the farm and respective number of cows per group
- Presence of dry cows and pregnant heifers with lactating animals
- Presence of a bull, running with the herd and possibilities to separate it from the herd
- Routine times for feeding and milking and daily morning routines
- Presence and use of headlocks/locking feed barrier
- Access to pasture
- Date of last claw trimming. There should be a period of at least 4 weeks between the last routine claw trimming and the farm visit.
- Any possibly interfering activities planned for the day of your farm visit (e. g. regrouping of animals, visit of a breeding adviser)
- Availability of the animal unit manager during visit
- If possible, information on somatic cell count
- Layout of the barn

Annex B: Recording sheets (RS)

B1. Recording Sheets for dairy cattle on farm

Audit Protocol Instruction: Dairy cattle on farm

Name	
Date	
Farm name	
Number of dairy cows and heifers kept with dairy cows on site (at the time of the visit, including dry cows)	
Number of dry cows (at the time of the visit)	
Breed	

1) Avoidance distance at the feeding place

	group/pen	collar no.	ear tag no.	test 1	test 2 (retest)	remarks
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

2) Qualitative Behaviour Assessment

Visual Analogue Scale VAS for Qualitative Behaviour Assessment in Fattening cattle

NAME: _____

Date: _____

Time of day: _____

Farm: _____

Housing unit: _____

No. of animals in unit: _____

Breed: _____

Brief description of system and unit (e.g. indoor/outdoor areas, bedding, enrichment, lighting, feeding system, etc.). Please be sure that the lines of the QBA measures are 125 mm, if not then perform an homothetic transformation when reporting results.

Please observe the animals in the unit for 10-20 minutes, and then assess their behavioural expression ('body language') by scoring the following terms:

Active   Min. |_____| Max.

Relaxed   Min. |_____| Max.

Fearful   Min. |_____| Max.

Agitated   Min. |_____| Max.

Calm   Min. |_____| Max.

Content   Min. |_____| Max.

Indifferent   Min. |_____| Max.

Frustrated   Min. |_____| Max.

Friendly   Min. |_____| Max.

Bored   Min. |_____| Max.

Playful   Min. |_____| Max.

Positively occupied
Min.   Max.

Lively
Min.   Max.

Inquisitive
Min.   Max.

Irritable
Min.   Max.

Calmless/ Uneasy
Min.   Max.

Sociable
Min.   Max.

Apathetic
Min.   Max.

Happy
Min.   Max.

Distressed
Min.   Max.

General comments or observations:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

3) Behaviour observations

Time needed for lying down and collisions with housing equipement

	Duration sec	collision with housing equipment		
		yes	**no**	**Not observed/ heard**
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

Observation of social behaviour and coughing (loose housed dairy cattle)

Segment	Pen	START – END	Duration (min)	Segment scan						Agonistic					Health	
				STANDING	FEEDING or DRINKING	LYING	SUM	LYOUT[1]	LYOUT no statement	HEADBUTT	DISPLACEMENT	FIGHTING	CHASING	CHASING UP	COUGHING	Remarks

[1] Lying outside = lying partly or completely outside the lying area

Observation of social behaviour and coughing (dairy cattle in tie stalls)

Segment	Pen	START – END	Duration (min)	Agonistic											Health	
				NOT LYING	LYING	SUM	LYOUT[1]	LYOUT no statement	HEADBUTT	DISPLACEMENT	FIGHTING	CHASING	CHASING UP		COUGHING	Remarks

[1] Lying outside = lying partly or completely outside the lying area

4) Clinical scoring

Loose housed dairy cattle

Transponder no.			
Eartag no.			
Breed	dairy	Dual purpose	
Body condition score	0	1	2
Cleanliness			
Legs	0	2	■
Flank	0	2	■
Udder	0	1	2
Integument	**Hairless**	**Lesion**	**Swelling**
Tarsus			
Hindquarter			
Neck/shoulder/back			
Carpus			
Flank/side/udder			
Other			
Clinical signs			
Nasal discharge	0	2	■
Ocular discharge	0	2	■
Hampered respiration	0	2	■
Diarrhoea	0	2	■
Vulgar discharge	0	2	■
Lameness	**0**	**1**	**2**

Dairy cattle in tie stalls

Transponder no.			
Eartag no.			
Breed	dairy	Dual purpose	
Body condition score	0	1	2
Cleanliness			
Legs	0	2	■
Flank	0	2	■
Udder	0	1	2
Lameness	Resting a foot	**0**	**1**
0	Standing on edge	0	1
2	Stepping	0	1
■	Reluctance	1	1
Integument	**Hairless**	**Lesion**	**Swelling**
Tarsus			
Hindquarter			
Neck/shoulder/back			
Carpus			
Flank/side/udder			
Other			
Clinical signs			
Nasal discharge	0	2	■
Ocular discharge	0	2	■
Hampered respiration	0	2	■
Diarrhoea	0	2	■
Vulgar discharge	0	2	■

5) Resources checklist

Loose housed dairy cattle

Pen no.:			
Number of animals			
Number of water points per pen			
Number of animals using water points			
Water point 1 Type	☐trough ☐tip-over trough ☐bowl ☐bowl with reservoir ☐trough with balls/anti-frost ☐nipple drinkers	length ……… cm length ……… cm	
Cleanliness	☐no	☐partly	☐yes
Are water points functioning?	☐no	☐yes	
Water flow	Bowl ☐<10l/min ☐≥10l/min Trough ☐<20l/min ☐≥20l/min		
Water point 2 Type	☐trough ☐tip-over trough ☐bowl ☐bowl with reservoir ☐trough with balls/anti-frost ☐nipple drinkers	length ……… cm length ……… cm	
Cleanliness	☐no	☐partly	☐yes
Are water points functioning?	☐no	☐yes	
Water flow	Bowl ☐<10l/min ☐≥10l/min Trough ☐<20l/min ☐≥20l/min		
Water point 3 Type	☐trough ☐tip-over trough ☐bowl ☐bowl with reservoir ☐trough with balls/anti-frost ☐nipple drinkers	length ……… cm length ……… cm	
Cleanliness	☐no	☐partly	☐yes
Are water points functioning?	☐no	☐yes	
Water flow	Bowl ☐<10l/min ☐≥10l/min Trough ☐<20l/min ☐≥20l/min		
Water point 4 Type	☐trough ☐tip-over trough ☐bowl ☐bowl with reservoir ☐trough with balls/anti-frost ☐nipple drinkers	length ……… cm length ……… cm	
Cleanliness	☐no	☐partly	☐yes
Are water points functioning?	☐no	☐yes	
Water flow	Bowl ☐<10l/min ☐≥10l/min Trough ☐<20l/min ☐≥20l/min		

Water point 5 Type	☐trough length ……… cm ☐tip-over trough length ……… cm ☐bowl ☐bowl with reservoir ☐trough with balls/anti-frost ☐nipple drinkers		
Cleanliness	☐no	☐partly	☐yes
Are water points functioning?	☐no	☐yes	
Water flow	Bowl ☐<10l/min ☐≥10l/min Trough ☐<20l/min ☐≥20l/min		

Dairy cattle in tie stalls:

Number of animals			
Average number of animals using one water point			
Type of water points	☐bowl: diameter …… cm ☐bowl with reservoir: diameter …… cm		
Are water points clean?	☐ no	☐ partly	☐ yes
Are water points functioning?	☐ no	☐ yes	
Water flow	☐<20l/min	☐>20l/min	

Management questionnaire – fattening cattle

Tick NA if question not appropriate to housing system

1	**Number of animals**
	What is the annual average number of dairy cows and heifers kept with dairy cows in the animal unit?
	………… Animals

2	**Access to pasture**
	How long do the animals have access to pasture on average?
	……… days / year (0-365); …… hours / day

3	**Dystocia (if no herd records available)**
	How many dairy cows or heifers kept with dairy cows suffered from dystocia during the last 12 months? .... animals

4	**Downer cows (if no herd records available)**
	How many dairy cows or heifers kept with dairy cows have been diagnosed as downer cows during the last 12 months? .... animals

5	**Mortality rate (if no herds record available)**
	How many dairy cows or heifers kept with dairy cows died on the farm or were euthanized due to disease or accidents during the last 12 months? .... animals

6	**Disbudding/dehorning**
	How many animals are disbudded/dehorned? ……………%
	Are the animals disbudded/dehorned on the farm? ☐ yes ☐ no ☐ NA
	If yes:
	Disbudding: Age: ……………… weeks Method: ☐ thermocautery ☐ caustic paste Analgesics: ☐ yes ☐ no
	Dehorning: Age: ……………… weeks/months Analgesics: ☐ yes ☐ no

If animals are not dehorned/disbudded on farm:
Do you know how they are disbudded/dehorned? ☐ yes ☐ no

If yes:
      Disbudding:
      Age: ……………… weeks
      Method: ☐ thermocautery   ☐ caustic paste
      Analgesics: ☐ yes   ☐ no

      Dehorning:
      Age: ……………… weeks/months
      Analgesics: ☐ yes   ☐ no

7	**Tail docking**

How many animals are tail-docked?   ……………%

Are the animals tail-docked on the farm? ☐ yes   ☐ no
If yes:
      Age: …………… weeks/months

      Method: ☐ rubber ring ☐ surgery
      Analgesics: ☐ yes   ☐no

If animals are not tail-docked on farm:

Do you know how they are tail-docked? ☐ yes   ☐ no
If yes:
      Age: …………… weeks/months

      Method: ☐ rubber ring ☐ surgery
      Analgesics: ☐ yes   ☐no

B2. Recording Sheet for dairy cattle at slaughter

Not included within the protocol at the moment

Annex C: Contributors to Welfare Quality

Welfare Quality partners	Country
ID-Lelystad, Instituut voor dierhouderij en diergezondheid, Lelystad	The Netherlands
IFIP Institut du Porc, Rennes	France
Cardiff University (formerly known as UWC: University of Wales, Cardiff), Cardiff	United Kingdom
Coopérative Interdépartementale Aube, Loiret, Yvonne, Nièvre	France
Aarhus University (formerly known as DIAS: Danish Institute of Agricultural Sciences), Aarhus	Denmark
University of Natural Resources and Applied Life Sciences, Vienna	Austria
University of Kassel, Kassel	Germany
Institut national de recherche pour l'agriculture, l'alimentation et l'environnement – INRAE (formerly known as INRA Institut National de la Recherche Agronomique) , Paris	France
Institut de l'Elevage, Paris	France
Institut de Recerca i Tecnologia Agroalimentàries, Girona	Spain
Institut Supérieur d'Agriculture Lille, Lille	France
Veterinärmedizinische Universität Wien,Vienna	Austria
Katholieke Universiteit Leuven, Leuven	Belgium
University of Copenhagen (formerly known as KVL: The Royal Veterinary and Agricultural University), Copenhagen	Denmark
UPRA France Limousin Selection, Boisseuil	France
Teagasc - The National Food Centre, Carlow	Ireland
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Centro Ricerche Produzioni Animalia SpA, Reggio Emilia	Italy
Vyzkumny ustav zivocisme vyroby, Prague	Czech Republic
The University of Exeter, Exeter	United Kingdom
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Instituut voor Landbouw- en Visserijonderzoek, Merelbeke	Belgium
Universidad de la República, Montevideo	Uruguay
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Colophon