THE GLOBAL STANDARD
FOR LIVESTOCK DATA

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ICAR Testing & Validation of Sensor Systems

KdK1

Measuring, Recording, and Sampling Devices Subcommittee

23 September 2025

Diapositiva 1

KdK1 There is no such a stamp for certified devices
Koning, Kees de; 2025-09-22T13:36:49.957

SS1 0 The ICAR Brand policy has a stamp

Steven Sievert; 2025-09-22T14:41:13.815

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Certification vs. Validation

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Traditional Recording Systems

Device Certification and Use

- Recording device is tested and certified to perform at certain level of accuracy and precision with listing of devices on ICAR website
- The ICAR Guidelines provide these standards to minimize errors or define the parameters of the recording scheme when using a certified device
- Recording Organisation controls animal ID, sample ID, data handling, human components, calibration and other quality assurance aspects of the system to minimize components of error.

Diapositiva 2

KdK1 certified devices are mentioned at the ICAR web site
Koning, Kees de; 2025-09-22T13:31:39.859

SS1 0 Added
Added
Steven Sievert; 2025-09-22T14:42:33.131

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Certification vs. Validation

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Sensor System Challenges

Sensor Systems

- The system is more than a sensor recording observations
- Simultaneous & automatic ID and measurement recording
- Linkage to sensor ID to official ID is critical for data moving off the farm
- Data transformation, handling, editing – what is measured is rarely what is reported

Used as Part of a Recording System or Scheme

- The traditional practices from the recording organisation to reduce errors are removed
- A new, system-based approach is needed for an assurance of continuous data quality

Diapositiva 3

KdK1 Clear: so we talk about certification of a device (as we always did) vs Validation of the Sensor System
Koning, Kees de; 2025-09-22T13:24:08.007

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ICAR Validation Services

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Validation of Systems vs. Certification of Devices

ICAR Validation of Systems

New service from ICAR, providing validation testing of sensor systems

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- Manufacturer uses a certified device and validation of the system using that device
- Manufacturer comes with 'performance claim' for validation of the system
- Manufacturer comes with a system but no claim or characteristics and ICAR uses scientific approach to review/test

ICAR Certification of Devices

No change to traditional ICAR verification testing and certification of devices to specific ICAR guidelines

Diapositiva 4

KdK1 Sensor systems?
Koning, Kees de; 2025-09-22T13:33:05.505

SS1 0 Changed
changed
Steven Sievert; 2025-09-22T14:43:15.529

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The System Approach

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Data Quality

vs.

Data Accuracy

Data Quality – The System Approach

Data that has these five elements of quality:

- accuracy
- completeness
- consistency
- credibility
- custody

Data Accuracy – A Device Approach

an element of quality that deals with the data meeting bias & precision standards when using a single or series of certified device measurements

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Simultaneous Animal ID & Sensor Measures

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Errors Associated with ID

ID Association

- Wrong live animal with ID in data file
- Direct affect on management decisions on farm using the data

ID Linkage or Cross-Reference

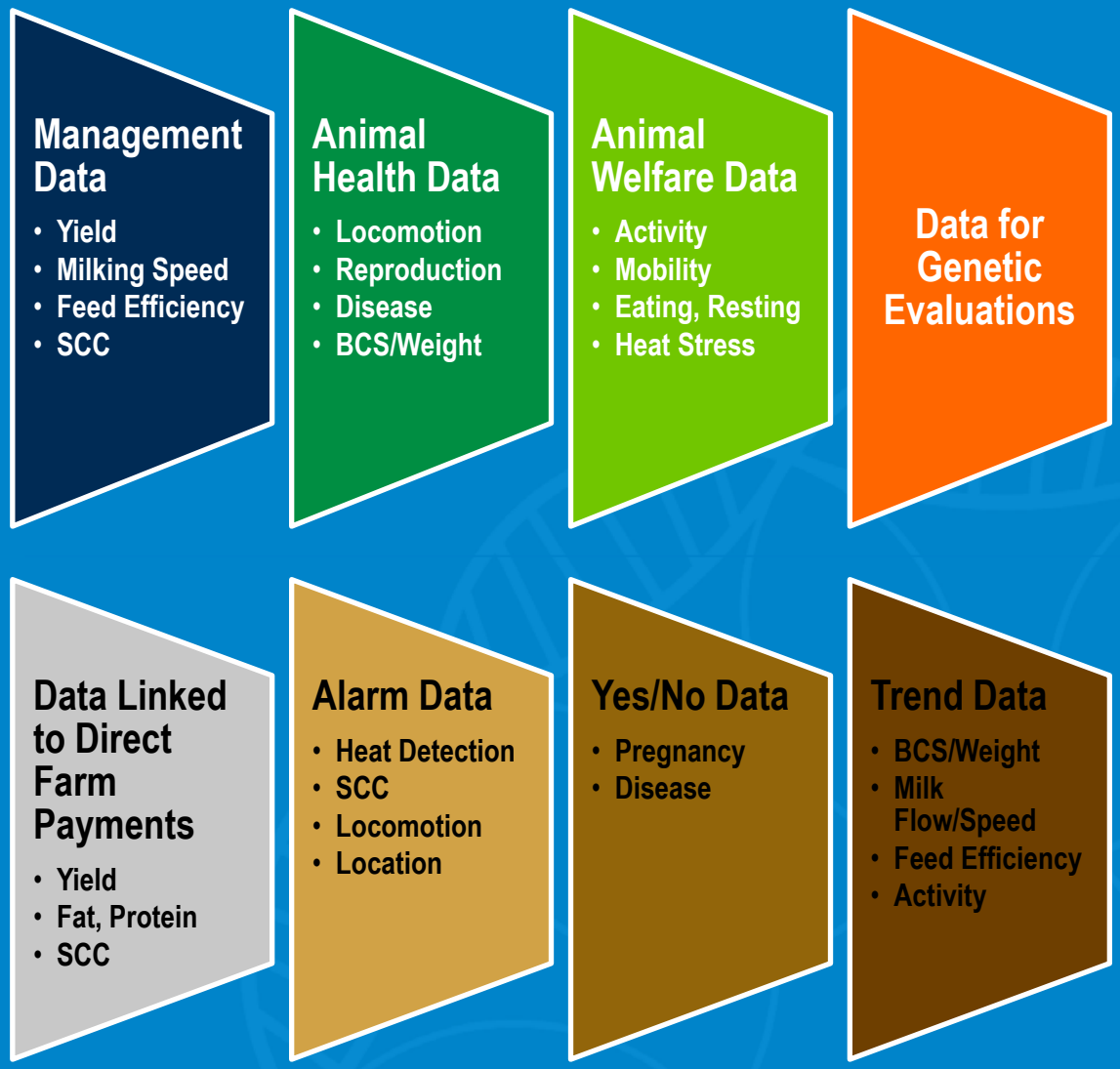
- Wrong sensor ID with official ID
- May not management decisions on farm but issues with data after leaving the farm

ID Positional Errors

- Missing data points (unreadable ID)
- Cows out of order (reading errors)
- Measurements not associated with correct animal

Uses of Data from Sensor Systems

Manufacturer Defines Use(s) of Data from the System in the Application for Validation Testing



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Testing & Validation Procedure

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Online Application

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Secure Online Application for Sensor System Testing

ICAR Staff Manages Submission & Test Contracts

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Online Application

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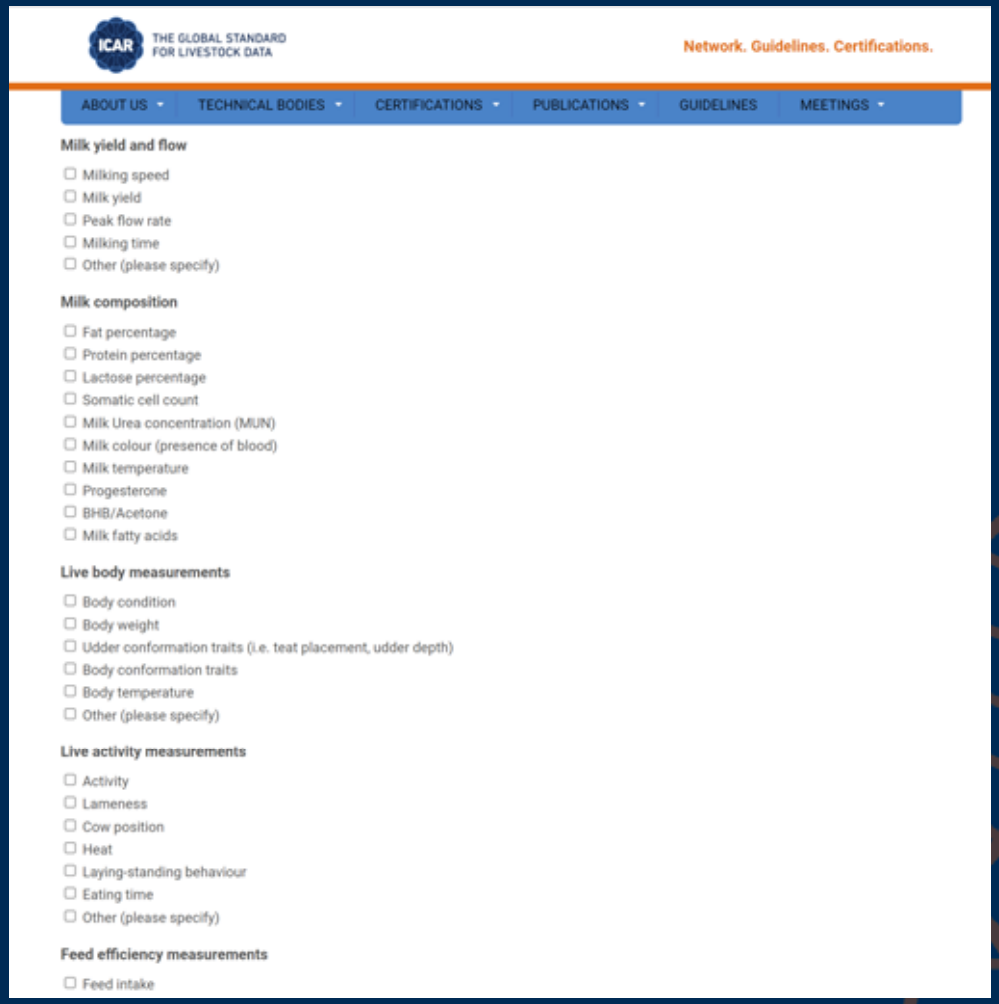

Six Major Categories as Outlined by SD-TF

Milk Yield & Flow
Milk Composition
Live Body Measurements
Live Activity Measurements
Feed Efficiency Measurements
Greenhouse Gas Measurements

Manufacturer Selects Specific Traits or Measurements to be Included in the Test

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Online Application

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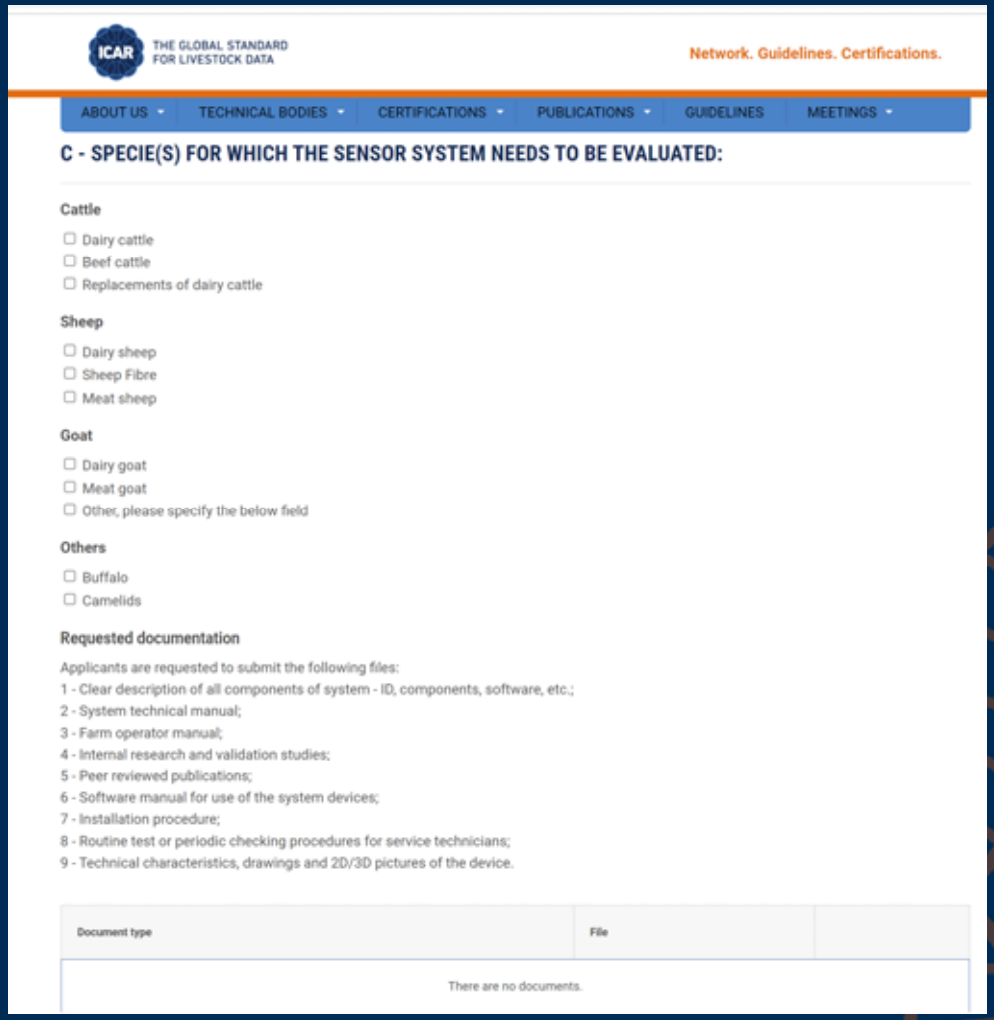

Use & purpose defined in the test

Species to be included in the test is based on Manufacturer Request

Direct & Secure Upload of Documentation of the System to ICAR Server

Protect IP, Avoid Email & File Transfer/Sharing Services

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Components of the ICAR Validation Test

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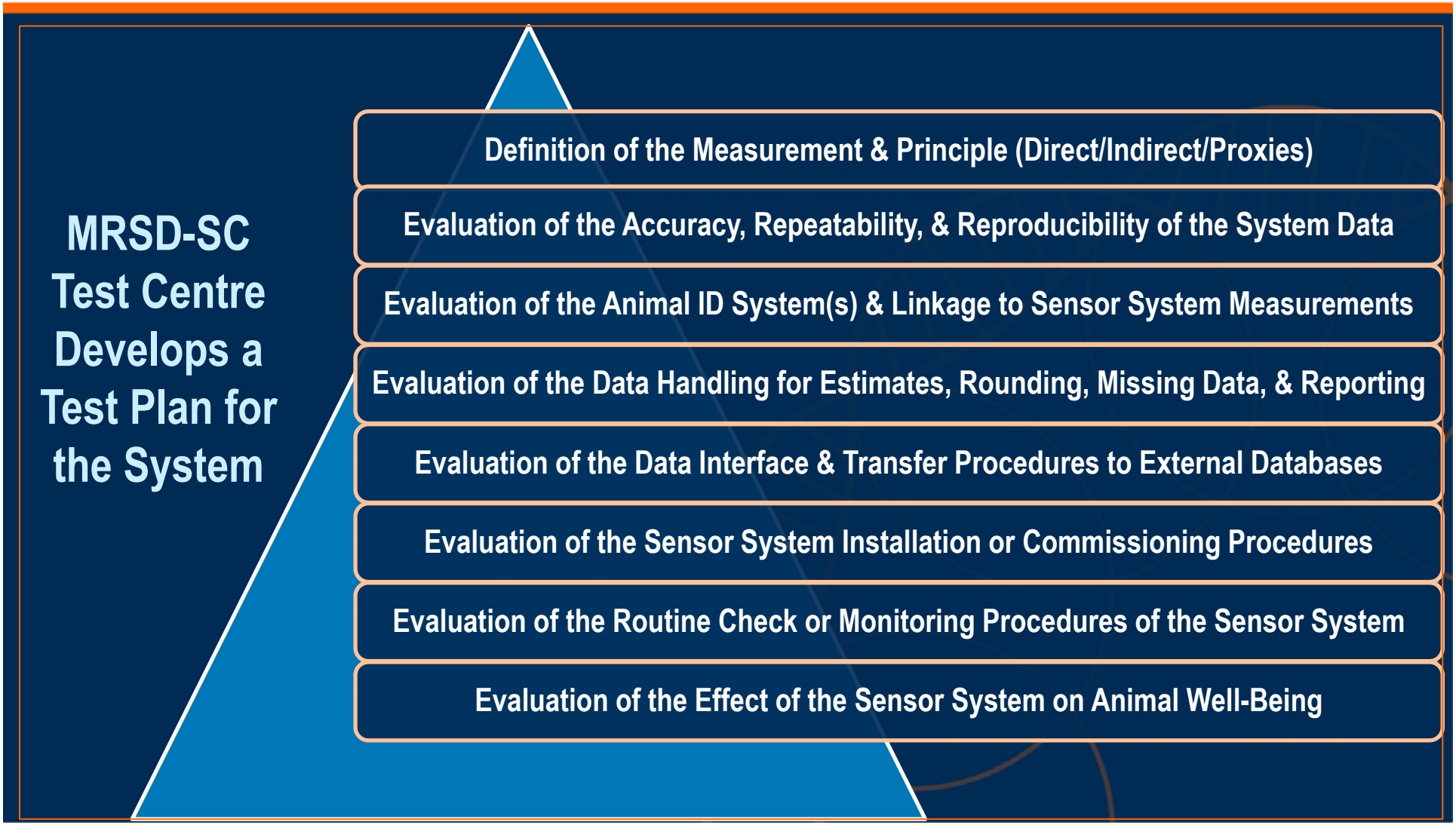

Diapositiva 12

KdK1 In fact this is the Validation process
Koning, Kees de; 2025-09-22T13:19:07.776

KdK1 0 In the next slides Sensor System Test, System approach are used, perhaps better to use Validation in the title as the overarching keyword?
Koning, Kees de; 2025-09-22T13:29:27.529

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Conducting the Sensor System Test

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MRSD-SC Test Centre Conducts the Test Plan for the System

- The Test Centre Coordinates the System Test – One Contact, One Contract, One Report for the System Manufacturer
- The Test Plan May Reference Other Sections of ICAR Guidelines (ADE, Milk Analysis, Feed Efficiency, Conformation, Etc.)
- The Test Plan May Reference other Standards when no ICAR Guideline Exists or when no "Golden Standard" is Available (IDF, ISO, AOAC, Etc.)
- External Parties or Resources Involved as Needed – Data Modeling, Expertise (Consultation, Review, Labour)
- Review of Internal Manufacturer Data, Peer-Reviewed Publications, Field Testing, and/or Data Modeling
- Confidential Test Report to MRSD-SC for Review and Recommendation
- Test Report Provides Public Comments to MRO/HRO on Quality Assurance – Installation, Routine Checking, Use Considerations, and Limitations of System

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The System Approach

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System Validation provides…

- Review of sensor system with respect to purpose and use of data
- Separation of devices used in traditional recording systems vs. simultaneous ID & recording systems

What is provided?

- Clear communications – fact sheet & summary
- Value for data users – help with usability decision
- Value for system manufacturers – internal & external
- Ensure the continued value of device certification

Information so the user(s) of data can make decision on acceptability and use of data within their organisation

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Example Fact Sheet

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Brolis BHL01 – Validation of Principle for an Inline Analyser for Milk Fat and Protein

Fact Sheet and Summary of ICAR Validation Test Findings
Measuring, Recording & Sampling Devices Sub-Committee
4 February 2025

Overview of Test Purpose and Scope

Category of Measurement(s)	Milk Composition
Species	Dairy Cattle
Life Stage	Lactating Cows
Level of Reporting	Individual Cow Measurements at Each Milking
Parameters Included in the Validation Test	Milk Fat, Milk Protein
Use and Usability of Data	Data Use & Usability Was Not Evaluated in this Test.

Definition of the measurement principle

- The Brolis BHL01 in-line analyser is designed to measure in-line fat and protein content of individual cows milked by an automatic milking system.
- The device has a spectroscopic unit (NCN) generating a tuneable emission spectrum for milk spectroscopy.
- The device is mounted in the milk transfer line of an automatic milking system and has a control unit and interfaces with AMS and the Brolis cloud.

Evaluation of the accuracy/repeatability/reproducibility of measuring component(s) of the system

- Overview of results of two selected (at random) devices on bias, regression, R^2, homoscedasticity and standard deviation. Due to the setup with farm testing with cows calculations for repeatability are not available.

Parameter	MLK0502 (fat)	MLK0502 (protein)	MLK0514 (fat)	MLK0514 (protein)
Farm AMS	BouMatic Gemini	BouMatic Gemini	DeLaval VMS300	DeLaval VMS300
Claim Brolis - Range	2.0% - 10.0%	2.0% - 7.0%	2.0% - 10.0%	2.0% - 7.0%
Claim Brolis - Bias g/100g	< 0.13	< 0.13	< 0.13	< 0.13
Claim Brolis - Accuracy g/100g	< 0.25	< 0.25	< 0.25	< 0.25
# measurements	105	105	105	105
Range min-max	2.68% - 6.22%	2.48% - 4.59%	2.56% - 6.10%	2.61% - 4.18%
Average	4.08%	3.43%	4.20%	3.24%
Bias w/ reference (%)	-0.002	-0.006	-0.08	-0.02
Standard deviation %	0.67	0.45	0.74	0.27
Significance	NS	Sig	Sig	Sig
Regression line	0.0118x – 0.0502	-0.0994x +0.3352	0.0522x -0.3012	-0.1073x +0.3318
R^2	0.0052	0.2073	0.2144	0.1496
Homoscedasticity	yes	yes	yes	yes
Standard deviation %	0.099	0.098	0.084	0.075

Evaluation of the animal ID system and linkage to measurement

- Animal ID used by the Brolis BHL01 in-line analyser and application is delivered by the interface with the automatic milking system.
- The Test Centre did not face challenges with correct ID values during the ICAR validation test.

Evaluation of the data handling – estimates, rounding, missing data points, and outliers

- The Brolis BLH01 in-line analysers produces accurate data for fat and protein when compared with reference samples analysed in the laboratory.
- Missing values are reported as no value.
- The Brolis HerdLine application can present data in several reports and graphs for farmer support.

Evaluation of the data interface & transfer procedures to MRO and databases

- The data interface of the Brolis BLH01 in-line analyser is operated through the Brolis HerdLine cloud and offers several possibilities for data exchange using ISO formats or existing formats (ADE) within ICAR.

Evaluation of the system installation parameters and procedures

- The Brolis BLH01 in-line analyser has to be installed by the manufacturer of the automatic milking system.
- The device is mounted in the milk transfer line of the automatic milking system directly after the milk pump.
- The software of the sensor is connected to the software of the AMS and the Brolis HerdLine cloud.

Evaluation of the routine or periodic checking procedures

- BHL sensors do not have calibration procedures as mentioned in the ICAR Guidelines.
- BHL sensors are not field-serviceable and do not have a field calibration option.
- Malfunctioning sensors have to be changed to new ones and inspected/refurbished in factory.
- A procedure to compare results of the Brolis BHL01 in-line analyser with bulk tank data and/or MRO data is run in the Brolis Cloud service; however, no description of this process was available for review during the test.

Evaluation of the effect of the system on animal well-being

- There is no direct effect of the system on animal well-being is expected for this device.
- In general, the device and application is expected to positively support farm management.

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L01 – Validation of Principle for an Inline Analyser for Milk Fat and Protein

r Claim(s) and Technical Characteristics

Table 2.1 Technical characteristics of the BHL01 analyser

Spectroscopic measurement			
Technology		Short Wavelength Infrared Absorption	
Wavelength Range		2000 nm – 2400 nm	
Optical Safety		Class 1	
Single Measurement Time		1 s [Note: software adjustable]	
Sample Size [irradiated volume]		> 10 µl	
Measurement parameters			
	Range	Bias (g/100 g)	Accuracy (g/100 g)
Fat	2.0 % - 10.0 %	< 0.13	< 0.25
Protein	2.0 % - 7.0 %	< 0.13	< 0.25
Lactose	3.0 % - 6.0 %	[pending]	[pending]
Conductivity	[-]		
Color	[-]		
Temperature	20 °C – 70 °C		
Environmental			
IP Rating		IP66	
Operational Temperature		5 °C – 35 °C	
Storage Temperature		-10 °C – 60 °C	
Ambient Humidity		up to 100 %	
Mechanical			
Length x Width x Height		150 mm x 100 mm x 70 mm not including pipe/hose connectors	
Weight		1.5 kg	
Build Materials		Aluminium, PVC, parts in contact with milk are food-contact-safe	
Mechanical Connection		16 mm inner diameter milking hose or DIN 32676 couplings for installations on stainless steel pipe	
Electrical			
Power supply		IEEE 802.3at compliant power over ethernet (PoE+)	
Maximal Power Consumption		25 W	
Data interface		1000BASE-TX Fast Ethernet	
Network		IPv4 with dynamic IP addressing (DHCP) support	
Cable type		Cat5e (or higher), gel filled, outdoor grade, tinned unshielded twisted pair (F/UTP)	
Data and Power Connector		RJ45	
Auto Crossover (Auto-MDIX) Support		Yes	

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Example Fact Sheet

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Species	Dairy Cattle
Life Stage	Lactating Cows
Level of Reporting	Individual Cow Measurements at Each Milking
Parameters Included in the Validation Test	Milk Fat, Milk Protein
Use and Usability of Data	Validation of the Principle of Measurement(s) Rather Than Assessment of Data Use or Usability

Definition of the measurement principle

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- The device has a spectroscopic unit (NQN) generating a tuneable emission spectrum for milk spectroscopy.
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Key Points…

- Additional plots available to ICAR member on request
- Reminder – validation criteria is manufacturer's claim and not to be measured against other manufacturers

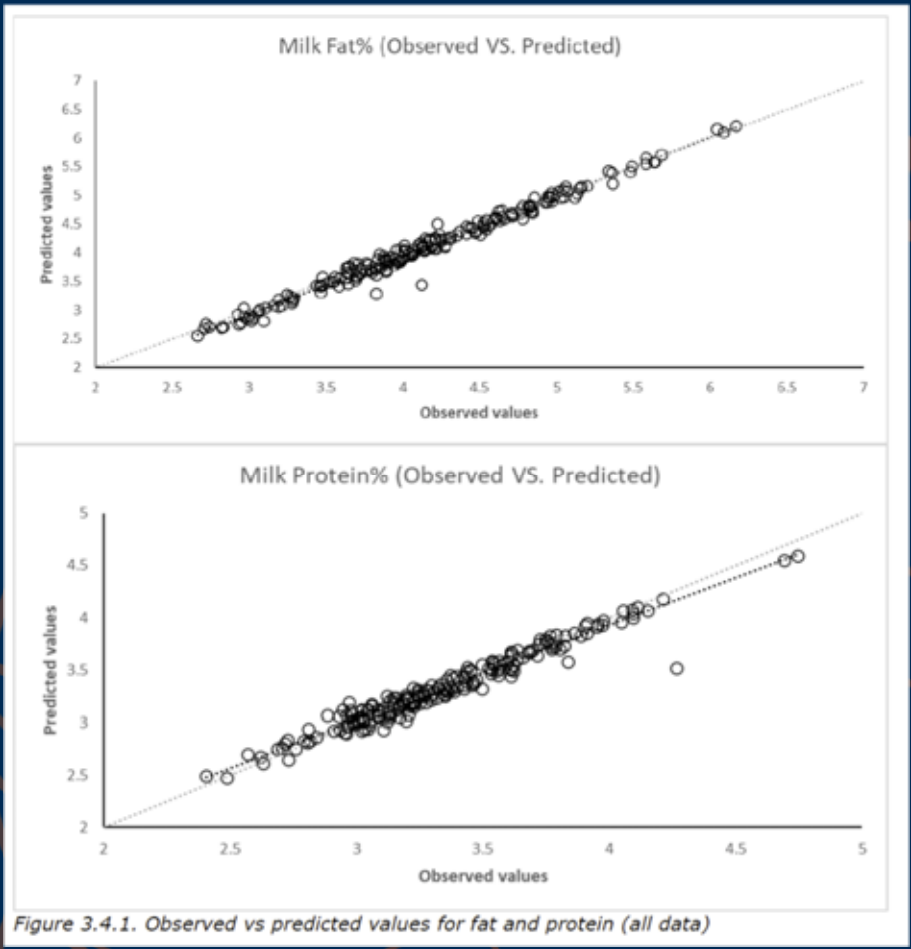

Figure 3.4.1. Observed vs predicted values for fat and protein (all data)

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Questions & Discussion

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