

Using Farm Based Software for Monitoring of Milking System Performance and Validation of Data Acceptability in Herd Recording Programs



NATIONAL
DHIA

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Changing Dynamics of Herd Recording

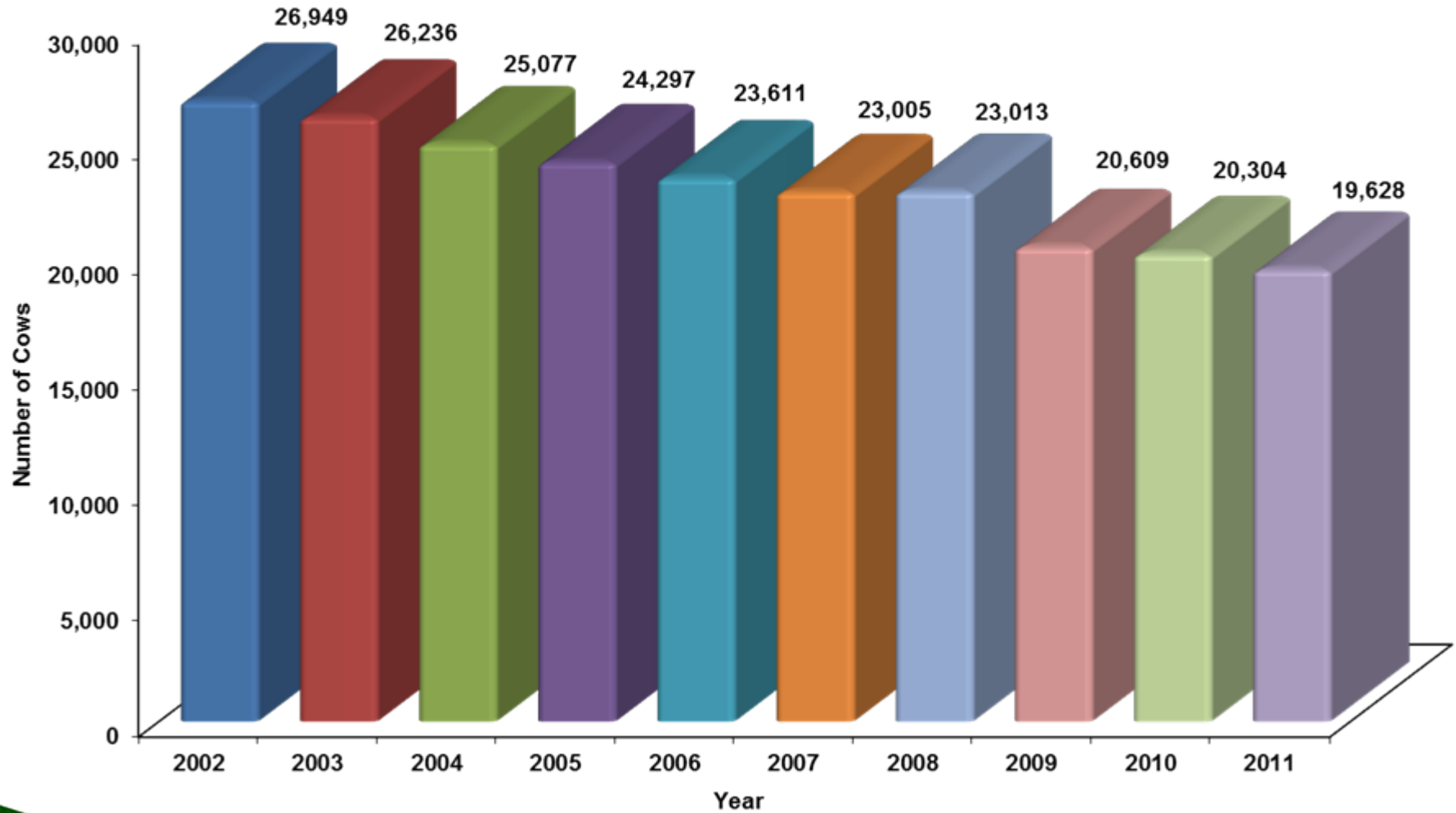
Traditional herd recording programs rely on

- Portable meters owned by herd recording organization
- Control of meter maintenance, calibration and operation
- Investment in equipment carried by recording organization

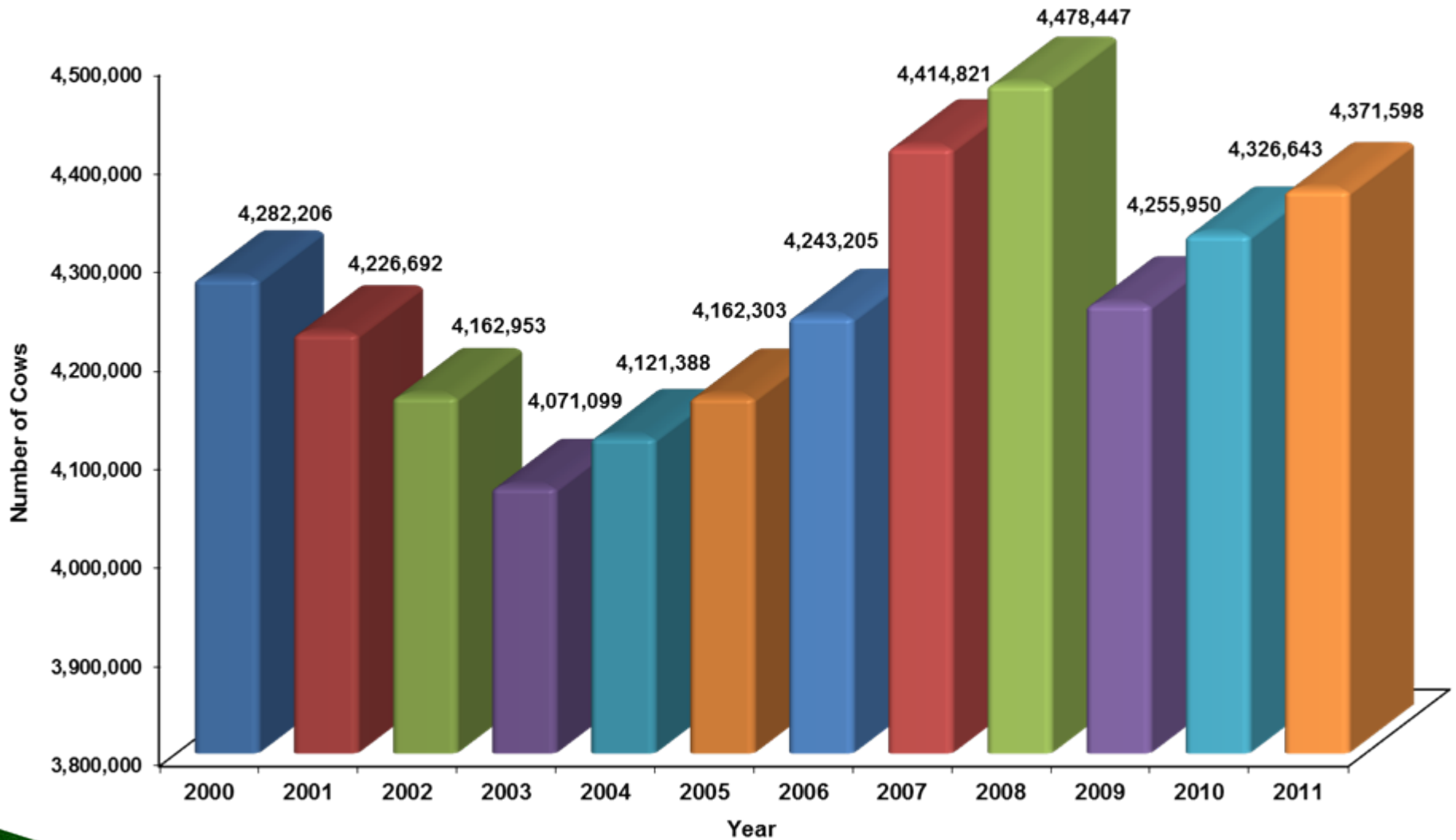
The new construct of herd testing

- Smaller number of herds coupled with increase herd size
- Desire for immediate access to data and results
- Investment in integrated milking systems/software by dairy
- Desire for increased labor and data handling efficiency
- Use of multi-day milk yield averages in recording programs

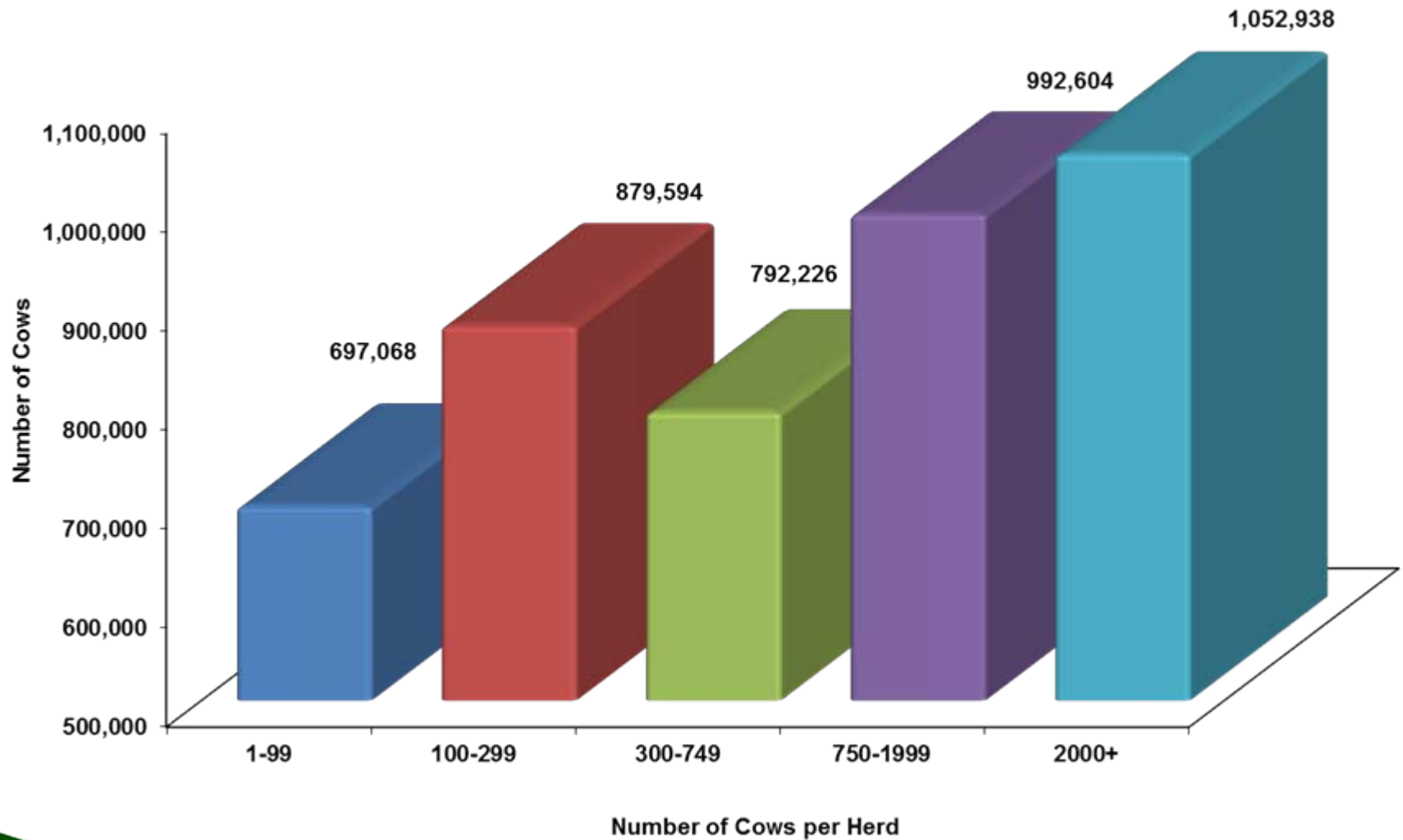
Herds on DHI Programs



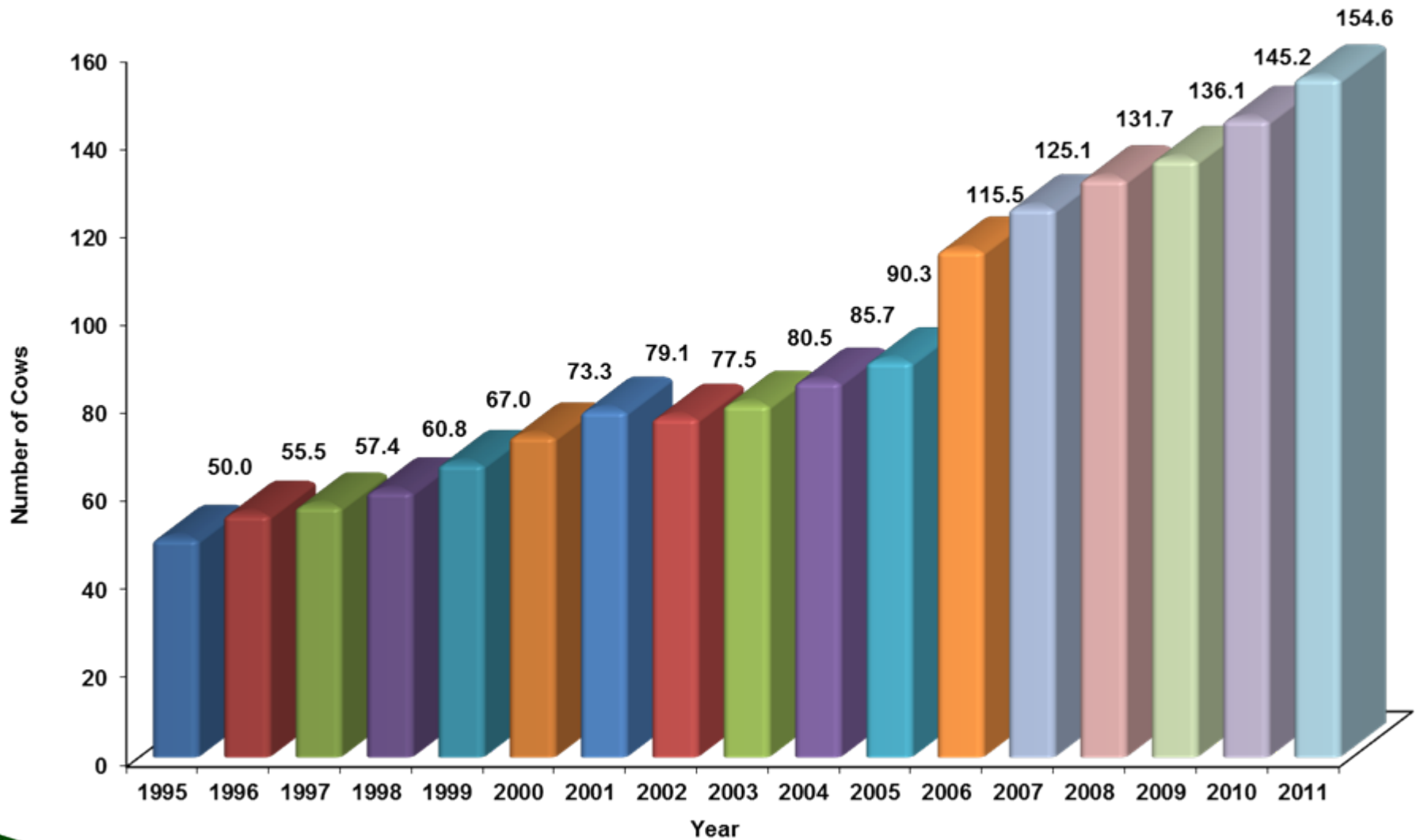
Cows on DHI Programs



DHI Cows by Herd Size During 2011



Average Size of DHI Herds



Changing Dynamics of Herd Recording in the USA

Portable Meters

2008 2009 2010 2011

Dairy Owned Meters

2008 2009 2010 2011

Total Meters	112,389	110,117	107,369	92,289	46,875	49,318	56,034	89,167
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Calibration method used

Water Test, n	112,389	110,117	107,369	92,289	32,016	27,470	27,289	36,648
Water Test, %	100	100	100	100	68	56	49	41

Statistical, n					14,859	21,848	28,745	52,519
Statistical, %					32	44	51	59

Calibration of Daily Meters

An water test at installation is a requirement

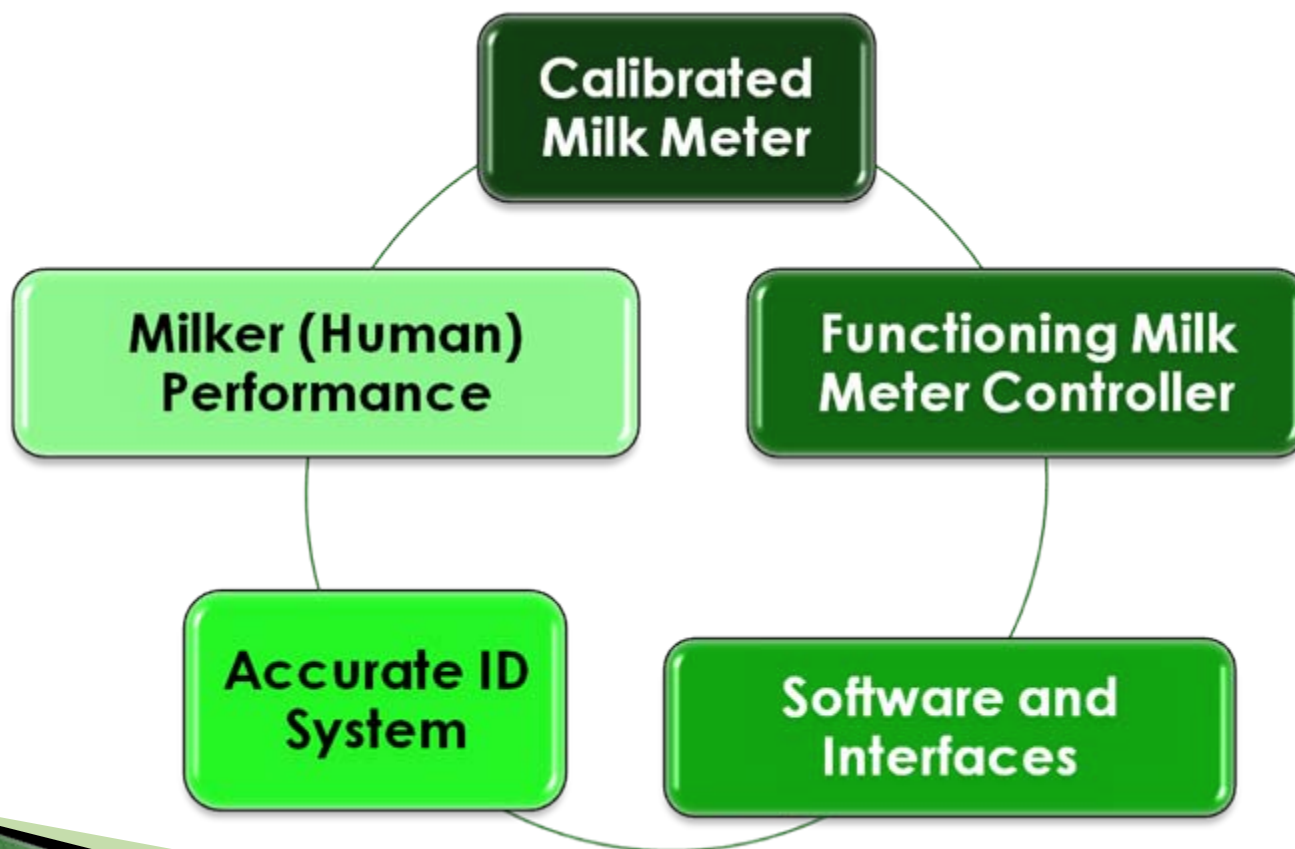
- Assure accuracy of each meter
- Assurance the entire milking system is operational

Ongoing calibration – what is needed?

- An annual water test calibration may not be enough
- Higher usage level – 24 h per day in some cases
- No oversight of meter maintenance or software by recording organization – is the data accurate for each recording day?
- Need to balance expense, labor, and time

Key Concept with Statistical Monitoring of Daily Milk Meters

The in-place milk meter is only part of a linked system that includes...



Potential Sources of Error in Data Recording

Accuracy	Excellent	Good	Fair
Milk Meter	98%	98%	98%
Controller	99%	99%	99%
Animal ID	100%	97%	95%
Milker (Human)	99%	99%	99%
Data Transfer	100%	100%	100%
Maximum Data Accuracy from On-Farm System	96%	93%	90%

- **Calibrating the milk meter alone may not be sufficient**
- **Errors also exist when using portable meters for herd recording**
- **Need to review entire system and minimize errors**

Variables Required for Meter Performance Report

- Date
- Herd name or Herd code
- Animal ID
- Stall or meter ID
- Measured milk weight
- Number of milkings represented at each stall/meter
- Deviation for each stall/meter
- Optional
 - *Defined tolerance for reference*
 - *ID errors (missing cows, duplicate reads, wrong pens)*
 - *Reattachment and manual detach incidents*
 - *Milking time deviations*
 - *Milking speed*
 - *Cross reference with milk shipped weights integrated into the report or software program*

Calculation of the Daily Milk Meter's Performance

Expected Milk Weight (MW) this milking



*Yield average on the last X milkings at M_n * "herd factor"*

$$\left(\frac{\sum_{i=1}^X y_{ni}}{X} \right) \times \frac{h_{n(\text{current milking})}}{\left(\frac{\sum_{i=1}^X h_{ni}}{X} \right)}$$

Deviation from Expected

Cow Deviation (kg) = Measured yield (kg) – Expected yield (kg)

Meter Deviation (%)

$$\frac{\text{sum of cow deviations (kg) for this milk meter}}{\text{sum of expected yields (kg) of these cows for this milk meter}} \times 100$$

Removal of Outliers from Calculation

Expected Milk Yield (2x), Adjusted for Herd Effect

	<u><65%</u>	<u><70%</u>	<u><75%</u>	<u><80%</u>	<u>>120%</u>	<u>>125%</u>	<u>>130%</u>	<u>>135%</u>
Observed,n	12	22	33	69	77	33	15	12
Observed, %	0.07	0.12	0.18	0.37	0.42	0.18	0.08	0.07
<14 DIM	8	14	20	46	84	24	11	10
14-21 DIM	3	5	5	8	10	5	2	1
22-28 DIM	1	1	4	7	7	3	2	1
29-35 DIM	0	1	2	4	5	1	0	0
>35 DIM	0	0	2	4	3	0	0	0
Total Outliers	12	21	33	69	109	33	15	12

- Exclusion of cows <30 DIM from meter performance report is justified as prediction of expected milk yield is unreliable
- May consider removal of expected milk yields deviating $\pm 30\%$

Accurate ID is Important

Cow ID and Stall ID are essential to the Meter Performance Report

- Electronic ID systems
 - Manufacturer ID – transponders
 - Third Party EID tags and readers
 - *Primary Source of Error – TECHNOLOGY*
- Manual ID entry
 - Cow ID is keyed on the controller in the milking stall
 - Usually leg bands or visual cow number
 - *Primary Source of Error - HUMAN*

Acceptable Meter Performance Report

Meter	Number Weights	No Cow#	Cow# Hand	Cow# Auto	% Auto vs. Hand	----Averages---- Milk	Time	%Dev	Total Milk
1	20	0	2	18	90	29.68	361	3	593.50
2	20	0	0	20	100	28.21	351	-2	564.10
3	20	0	0	20	100	31.02	363	-0	620.30
4	20	0	1	19	95	31.59	362	6	631.70
5	20	0	1	19	95	26.69	336	-0	533.80
6	20	0	0	20	100	26.02	339	-0	520.50
7	20	0	1	19	95	31.62	337	1	632.30
8	20	0	2	18	90	24.02	312	-1	480.40
9	20	0	1	19	95	29.77	355	5	595.50
10	18	0	1	17	94	26.05	340	1	468.90
11	22	0	6	16	73	29.14	336	5	641.10
12	22	0	4	18	82	27.17	349	-6	597.80
13	22	0	4	18	82	28.57	322	5	628.60
14	22	0	2	20	91	27.49	350	1	604.80
15	22	0	0	22	100	31.75	347	4	698.40
16	21	0	5	16	76	28.75	343	1	603.70
17	22	0	2	20	91	27.40	382	1	602.70
18	22	0	1	21	95	27.91	329	0	614.00
19	21	0	0	21	100	28.72	356	4	603.20
20	22	0	1	21	95	27.31	306	-0	600.90
21			2	19	92	28.44	344	1	591.81
416			34	382					11836.20

Acceptable Meter Performance Report

Stall No.	No. Milking	No. Obs.	% Difference From Expected
101	10	252	-1.1
102	10	246	+1.6
103	10	252	0.0
104	10	257	-0.1
105	10	258	-0.4
106	10	253	-1.9
201	10	259	-0.3
202	10	260	+3.7
203	10	254	+0.7
204	10	258	+0.2
205	10	260	-0.8
206	10	254	-2.0

Stall No.= Station (first char.), Side (next char.) and Stall (last 2 chars.)

817 - Milking Report - Electronic Milk Meter Monitoring Report - Date 02-21-2011

Electronic Milk Meter Monitoring Report (EMMMR) Detail
Percent Difference From Expected By Milking

***** Date/Milking Number *****										
Stall	02-21	02-21	02-21	02-20	02-20	02-20	02-19	02-19	02-19	02-19
No.	1	2	3	1	2	3	1	2	3	4
101	+1.1	+2.4	-3.5	-2.4	-2.1	+1.4	-7.7	+0.4	-1.2	+1.1
102	+9.2	-0.7	-2.7	+1.6	+5.8	+1.8	+3.3	+2.1	-0.5	-4.5
103	-1.4	+0.7	+1.2	+1.1	-1.0	-1.4	+2.1	+0.1	-0.6	-1.2
104	-2.4	-3.1	-0.2	+2.0	+4.1	-1.3	+1.1	-2.6	-0.3	+2.5
105	-2.2	-1.6	+1.4	+4.8	-2.5	-0.4	+1.6	-0.3	-4.2	-1.0
106	+2.3	-5.8	-2.3	-3.5	-3.7	-1.4	-0.9	+0.2	-1.4	-2.8
201	-4.6	-2.5	+2.6	+1.3	-0.3	-0.6	-3.4	+1.9	+1.1	+1.1
202	+1.9	+3.2	+5.7	+2.8	+2.4	+4.9	+5.9	+2.3	+3.7	+4.2
203	-0.4	-0.5	+2.1	+2.0	+0.8	+1.3	+0.7	+0.6	-2.0	+2.1
204	+1.4	+1.1	+0.5	-2.9	-1.2	+2.5	+0.7	-0.7	+1.8	-0.6
205	+0.0	-4.0	-1.3	+0.6	-0.1	-2.0	-2.4	0.0	+2.3	-1.9
206	-3.3	-2.5	-2.8	-5.3	+0.2	-4.1	-0.9	-1.7	+2.4	-1.2

Deviating Meters on the Report

- It does not necessarily mean the meter is out of calibration...
 - But if one meter is out of tolerance on the report, the whole report may not usable
- Time to be a detective and isolate/correct errors...
 - Primary contacts
 - *Dairy Manager*
 - *Representative(s) from Herd Recording Organization*
 - Secondary contacts
 - *Milker(s)*
 - *Representative from Equipment Manufacturer*

Meter Performance Reports cannot be used with..

- Herds with incomplete identification or EID system challenges
- Herds with one or more failing/non-communicating controllers
- Herds with one or more missing or out-of-service meters
- Herds where all strings do not have the same milking frequency (some strings 4x, some strings 2x) – may be solved with additional programming/logic

Sources of Variation – ID System

Possible cause(s)

- Inaccurate ID reads from automated system
- Incomplete herd ID
- Duplicate animal ID
- Data entry errors by milking personnel

817 - Milking Report - Electronic Milk Meter Monitoring Report - Date 07-31-2009

Electronic Milk Meter Monitoring Report (EMMMR) Detail

Percent Difference From Expected By Milking

***** Date/Milking Number *****										
Stall	07-31	07-31	07-30	07-30	07-29	07-29	07-28	07-28	07-27	07-27
No.	1	2	1	2	1	2	1	2	1	2
80	+10.1	+49.2	+14.6	-8.0	+7.9	+8.2	+11.4	+19.4	+18.7	+18.9
81	-0.1	+52.4	+10.6	+3.3	+4.7	+13.7	+9.9	+24.8	+10.0	+14.8
82	+1.1	+27.3	-0.8	+9.5	+10.0	+19.9	+16.1	+8.8	+29.2	+12.5
83	+10.3	+47.0	+5.0	+6.8	+6.8	+15.5	+13.3	+26.2	+7.3	+19.6
84	+26.9	+56.6	-2.6	+9.8	+5.7	-0.2	+13.3	+17.8	+39.0	-8.6
85	-8.9	+19.4	+5.3	+2.8	-3.5	+11.3	+21.4	+31.4	+20.9	+18.3
86	+116.5	+39.0	+0.9	-28.2	+5.7	+12.7	+15.0	+22.2	+39.3	+27.7
87	+2.0	+59.2	+2.5	+27.5	+0.6	+16.2	+2.3	-5.1	+25.8	+18.3
88	+4.9	+23.8	+22.5	-98.6	+21.8	-24.9	-9.0	+40.3	+44.9	+24.5
89	-4.9	+42.5	+42.5	+73.6	+36.3	+163.0	+30.1	+33.2	+14.9	+18.6
90	+18.6	+10.7	+19.8	+39.0	+27.3	+22.4	+22.4	+11.9	-1.9	+110.9
91	+110.9	+51.5	+12.3	+33.7	+7.9	+51.2	+8.5	+5.4	+18.5	+113.5
92	-11.8	+59.7	+64.5	+24.8	+53.8	+57.8	+57.5	+48.5	+77.9	+27.9
93	+54.8	+60.1	+74.9	+73.2	+20.8	+23.7	+39.6	+21.1	+28.3	+41.8
94	+17.4	+46.3	+48.4	+38.3	+38.4	+29.7	+8.8	+15.6	+54.6	+54.6
95	+41.9	+51.8	+43.6	+66.2	+12.1	+100.5	+39.8	+40.2	+25.9	+45.8
96	+20.5	+43.9	+35.6	+56.3	+78.5	+60.1	+19.6	+27.7	+33.5	+18.4
97	+18.4	+40.9	-13.3	+79.1	+12.3	+103.0	+13.6	+91.0	+45.6	-1.6
98	+39.6	+51.0	+23.0	+103.0	+7.4	+98.8	+28.4	+24.9	+28.9	+58.3
99	-21.5	+31.5	+7.7	+30.7	+1.8	+35.8	+26.6	+72.4	+32.9	+83.7
100	+36.5	+25.7	+70.9	+116.0	+84.3	+86.5	+31.8	+60.3	+44.6	+54.8
101	-11.8	+83.8	+132.8	+194.7	+27.3	+77.7	+22.4	+99.0	-28.5	+116.6
102	+11.6	+29.2	-5.0	+39.8	+6.1	+46.4	+4.0	+16.7	-19.2	+5.7
103	-3.6	+46.8	+89.7	+80.2	+111.3	+49.7	+61.4	+22.1	+29.4	+119.8
AV.	+13.8	+43.7	+27.6	+40.6	+24.4	+44.9	+20.2	+32.3	+25.9	+40.0

Detail information for each milking for each cow is stored in file MeterDtl.csv
File is located in C: PCDART 12184502. Open file with spreadsheet program.

Sources of Variation – Equipment

- Reattachment of milkers – Is the total milk weight computed?
- Treated cows – do they bypass the meter?
- Incomplete letdown by cows
- Meter out of calibration

817 - Milking Report - Electronic Milk Meter Monitoring Report - Date 06-25-2009

Electronic Milk Meter Monitoring Report (EMMHR) Detail Percent Difference From Expected By Milking

***** Date/Milking Number *****										
Stall No.	06-25 1	06-25 2	06-25 3	06-24 1	06-24 2	06-24 3	06-23 1	06-23 2	06-23 3	06-23 4
1	+8.1	+2.9	+6.9	+7.8	-0.4	-2.4	+1.6	+1.0	+3.0	+8.9
2	+0.8	+9.5	+4.7	-1.5	+9.6	+5.4	+6.9	+5.7	+3.8	+1.5
3	+4.6	+12.3	+8.4	+9.9	+6.9	+2.1	+6.4	+8.4	+2.9	+2.3
4	+8.0	+2.5	-4.1	+2.8	+3.4	+9.5	+7.2	+4.3	+7.5	+2.4
5	+9.4	+11.7	+3.3	-4.6	+3.7	+6.6	+5.0	-3.0	+13.5	+6.7
6	-2.3	+1.0	+0.6	-0.8	+0.3	-2.3	+4.1	+0.3	-0.9	-1.3
7	+10.4	+6.3	-2.3	+6.0	+7.6	+3.6	+4.7	+6.2	+8.0	+10.0
8	+6.4	-0.6	+0.2	+3.8	+3.3	+1.1	+2.4	+5.8	+6.6	+2.7
9	+4.1	+4.3	+3.3	-0.5	-2.1	+2.3	+1.7	+7.9	+3.8	+8.4
10	+0.3	+4.1	+12.5	+7.8	+0.2	+0.2	+7.8	+8.8	+9.5	+6.3
11	+11.4	-1.6	+9.8	+5.6	+1.9	+2.7	+4.3	+4.0	+1.3	-0.2
12	+2.4	+13.1	+2.2	+4.6	+6.2	+3.0	-5.5	+3.1	-1.6	-0.3
13	-3.3	+0.0	+3.3	-0.6	+2.1	+4.1	+7.8	+5.5	+3.4	-1.0
14	+2.4	+4.2	+13.0	+9.5	+7.1	+6.5	+11.7	+9.4	+6.1	+8.8
15	-5.9	-5.5	-6.2	-3.4	+4.0	-3.8	-5.3	-10.9	-4.9	-11.6
16	+10.3	+10.2	+6.2	+9.8	+14.7	+6.2	+6.3	+10.3	+6.3	+10.6
17	-27.0	-21.9	-22.1	-28.2	-30.1	-23.8	-23.8	-29.2	-24.0	-19.0
18	+1.8	+6.9	+8.2	+9.6	+8.1	+7.8	+13.3	+5.1	+6.2	+1.2
19	-23.3	-22.9	-25.2	-24.3	-27.3	-22.5	-26.7	-22.4	-24.9	-20.1
20	+3.3	+3.2	+10.4	+8.8	-1.2	+15.1	+9.3	+9.7	+6.0	+5.0
21	-25.7	-35.5	-27.9	-18.3	-26.2	-22.0	-26.5	-26.1	-24.4	-25.6
22	-13.1	-14.8	-15.4	-12.1	-10.8	-15.4	-18.5	-21.2	-17.4	-14.2
23	+5.3	+4.4	+6.3	+7.9	+6.2	+8.1	+1.2	+3.1	-2.6	+3.2
24	+3.2	-1.4	-5.7	-0.5	+1.7	-5.0	-1.2	-2.3	-0.6	-2.9
AV.	-0.3	-0.3	-0.4	0.0	-0.5	-0.5	-0.2	-0.7	-0.6	-0.8

Detail information for each milking for each cow is stored in file MeterDtl.csv
File is located in C: PCDART 23150461. Open file with spreadsheet program.

Sources of Variation - Equipment

- Meters installed properly?
- Meter out of calibration?
- Modifications to milking system?

Electronic Milk Meter Monitoring Report (EMMMR) Detail

Percent Difference From Expected By Milking

***** Date/Milking Number *****

Stall No.	03-18 1	03-18 2	03-18 3	03-17 1	03-17 2	03-17 3	03-16 1	03-16 2	03-16 3	03-15 1
1	+0.0	+1.7	+1.2	+5.1	+5.4	+0.2	+2.9	+2.0	+0.2	+3.7
2	+4.4	+4.5	+5.9	+9.6	+9.9	+1.5	+3.7	+10.0	+1.2	+4.7
3	+2.2	+4.8	+2.9	+3.7	+5.0	-1.2	+4.5	+8.8	+1.2	+5.5
4	-34.2	-37.1	-31.4	-30.6	-25.0	-15.5	-31.0	-30.4	-38.8	-37.4
5	+5.2	+8.2	+4.0	+3.2	+13.4	+3.6	+6.2	+2.0	+2.6	+5.6
6	+0.1	-5.1	-3.4	-5.2	-6.2	-1.2	-9.9	-6.6	-4.7	-1.3
7	+4.5	+4.2	+0.3	+0.9	+0.0	+4.7	+3.8	+7.2	+4.2	+4.6
8	+1.4	+5.1	+3.2	+2.3	-1.2	-1.3	+1.1	+5.3	+2.9	-4.1
9	+2.4	+0.4	+0.2	+1.3	-3.2	-3.3	+8.5	-2.7	-0.5	+3.8
10	+7.4	+6.7	+3.7	-1.5	+8.0	+0.0	+0.6	+1.7	+7.3	+9.8
11	-0.4	+0.0	-1.0	+5.3	-6.5	+0.5	+7.1	+4.6	+9.9	-0.2
12	+4.4	+6.1	+9.6	+7.8	+1.4	+6.6	+2.5	-3.0	+5.3	+6.9
AV.	+0.3	+0.2	+0.1	+0.0	+0.4	-0.4	+0.6	-0.2	-0.3	+0.1

Detail information for each milking for each cow stored in file METERDTL.CSV

File is located in PCDART 32200303. Open file with spreadsheet program.

Sources of Variation – Missing Milkings

Electronic Milk Meter Monitoring Report (EMMMR) Detail

Percent Difference From Expected By Milking

***** Date/Milking Number *****										
Stall	07-30	07-30	07-29	07-29	07-28	07-28	07-27	07-27	07-26	07-26
No.	1	2	1	2	1	2	1	2	1	2
80	+4.6	-4.2	+5.2	-4.2	+0.1		+22.9	-2.1	+4.5	-3.6
81	+3.6	-5.4	+4.1	-5.4	-4.1		+7.6	+0.9	-0.6	+10.1
82	-1.7	-6.2	-2.9	-6.2	+0.0		-3.8	-0.6	+4.4	-6.9
83	+15.0	+10.1	+3.2	+10.1	+11.0		+0.4	-3.4	+3.3	+2.1
84	+9.1	+14.0	+9.5	+14.0	-7.4		+1.2	+11.3	-5.1	+10.3
85	+4.8	+7.4	+5.1	+7.4	+2.3		+9.6	-4.6	+6.0	-1.5
86	-97.5	-96.4	-98.0	-96.4	+6.1		+9.9	+0.0	+4.9	-3.5
87	+1.8	-0.7	+2.4	-0.7	+4.3		-0.7	+6.1	-0.6	+5.2
88	+5.1	+14.1	+5.5	+14.1	+1.4		+0.5	-12.4	+23.6	+4.0
89	-2.0	+3.7	-1.5	+3.7	+1.2		+2.5	+1.5	+9.3	+1.3
90	-9.7	-0.3	-9.3	-0.3	+1.5		-3.2	-0.3	-2.7	+3.6
91	+8.4	-5.2	+3.8	-5.2	-6.3		-1.6	-6.3	-6.5	-6.0
92	+3.7	+3.3	+8.5	+3.3	-0.1		-3.0	+3.5	-4.3	-6.2
93	-6.9	+2.6	-6.6	+2.6	-1.3		-3.8	+8.2	+2.0	+0.4
94	+4.2	+5.0	+4.6	+5.0	-3.9		-2.5	-8.0	+8.1	-0.7
95	+5.4	+1.9	+4.1	+1.9	-11.3		-2.2	-0.8	+1.9	-0.7
96	-3.0	+0.6	-8.4	+0.6	+3.5		+3.0	+4.5	-19.7	+0.0
97	+5.3	+10.4	+5.7	+10.4	+2.5		+3.9	+8.0	+1.9	+0.0
98	+0.5	+6.0	+3.0	+6.0	+0.4		-6.4	+1.7	+4.6	+1.2
99	+0.7	+22.3	+0.8	+22.3	+1.1		+4.5	-2.1	+4.0	-1.6
100	-0.1	+3.4	+0.3	+3.4	+5.8		-14.7	-3.4	+0.1	-3.3
101	+2.0	+7.7	+2.3	+7.7	-3.4		+4.3	+8.4	-8.4	-2.1
102	-2.9	+1.2	-2.2	+1.2	-1.7		-6.4	-2.6	-0.4	-0.4

Sources of Variation – Software/Interface

- Upload/interface errors
 - ID data not transferred properly
 - Milk weights not transferred
 - Stall identification errors
- Software upgrades or modifications

Stall No.	No. Milkings	No. Obs.	% Difference From Expected
80	10	13	-4.1
81	10	12	-14.9
82	10	15	+7.7
83	10	16	+12.7
84	10	13	-5.0
85	10	9	-3.0
86	10	14	+16.5
87	10	15	-2.9
88	10	10	-9.8
89	10	7	+3.7
90	10	2	-39.3
91	10	20	-2.4
92	10	15	+16.7
93	10	8	-15.6
94	10	6	-23.2
95	10	12	-21.8
96	10	13	-2.1
97	10	9	+6.5
98	10	8	-2.1
99	10	10	-10.4
100	10	7	+1.5
101	10	13	+6.3
102	10	15	+4.8
103	10	9	+9.5

Electronic Milk Meter Monitoring Report (EMMMR) Detail
Percent Difference From Expected By Milking

Stall No.	Date/Milking Number									
	03-11 1	03-11 2	03-11 3	03-10 1	03-10 2	03-10 3	03-09 1	03-09 2	03-09 3	03-08 1
80	+3.8	-25.6	+523.8	+10.1	+9.8		+9.2	-18.3	-19.0	+7.4
81	-20.2		-93.9		+12.4	-17.9	-33.8	-0.2	+7.3	
82		+20.6		+7.3	+24.7	+1.0	+6.6	-1.1	-16.6	+9.2
83	+15.4	+21.3	-93.7	+16.2	+13.2	+23.7	+15.1	-16.4	+20.6	+16.9
84	-19.7		+171.8	-36.6	+25.6	+16.5	-36.9	-9.7		-8.3
85	+4.2	+5.0	-92.3		-2.8			+0.0		-4.6
86				+12.5	-2.6	+21.4	+11.8	+61.2	-9.2	+9.0
87	-5.6	-21.6	-94.6	-0.9	-3.3	-0.4	-1.7		+9.4	
88	+0.0	+36.0		-8.2	-34.4	-32.6	-8.9	-17.5	-22.4	-14.9
89	+0.0	+24.2			-2.7	+6.4		-5.2		+6.3
90					-47.6	-31.2				
91	+8.1	-2.1	-93.6	-3.2	-4.5	-11.6	-3.7	-10.2	+32.1	-29.4
92		+4.7	+531.3	+32.8	+33.7	-7.2	+31.9	-5.3	-9.7	-8.5
93		-16.6	-91.9	-9.5	-11.8	+10.9	-10.4			
94	-1.5	-6.7	-94.8							-26.2
95		-22.3	-33.3	-31.2		-21.0	-31.5		-11.9	
96	-10.1	-9.9	-95.1	+9.7		-18.7	+9.0	+4.6	+21.6	+2.9
97				+2.8	+0.3	+25.8	+1.9	-2.2		-2.7
98				+16.7	-18.5	+35.8	+16.0		-16.9	+2.5
99	+16.5		-90.0		-24.5			+10.8	-16.5	+0.0
100		-12.5				+8.1			-1.4	+18.4
101	+0.0	-20.3		+1.0	+43.6	-5.7	+0.2	+24.3	+22.8	+8.4
102	-3.5	+0.2	+607.3	-6.3	+12.9		-7.3	-10.7		-3.3

Considerations on Meter Performance Reports

- Low cost
- Frequency – i.e. monthly
- Ease of producer access
- Ease of recording personnel access
- Shorter turnaround and targeted repairs
- Identify weaknesses in the entire linked milk recording system
- Service opportunity for herd recording organization – build value into recording program
- Ongoing assurance of data validity for use in recording programs

Advantages

- Does not clearly indicate whether a meter is operating within tolerances
 - *Part of the process*
 - *Not the answer or result*
- There is no meter system certification or validation without...
 - *communication*
 - *interpretation*
 - *action*
 - *follow-up*
- Does not replace installation test

Disadvantages

Thank You!

