POUL TARP A/S

Metering System

for Milk Collection

Top 20 Transformational Technologies over the ages

The wheel
Paper
Printing Press
Penicillin
Vaccination
Anaethesia
Optical Lenses
Steam Power
Electricity
Internal Combustion Engine
Pasteurization
Refrigeration
Air Conditioning
Radio
Television
Telephone
Cell Phone
Computers
Internet
GPS

Milk Metering System History

- The world dairy industry consists of 4 main players: North America, Europe, New Zealand and Australia
- Metering systems have been in commercial use in Europe, New Zealand and Australia since the late 1990's
- Delivering a competitive advantage in accuracy and data automation.

Why change from the existing system?

What is wrong with continuing to use the humble dipstick in the 21st century?

Historical Doubts - 1951

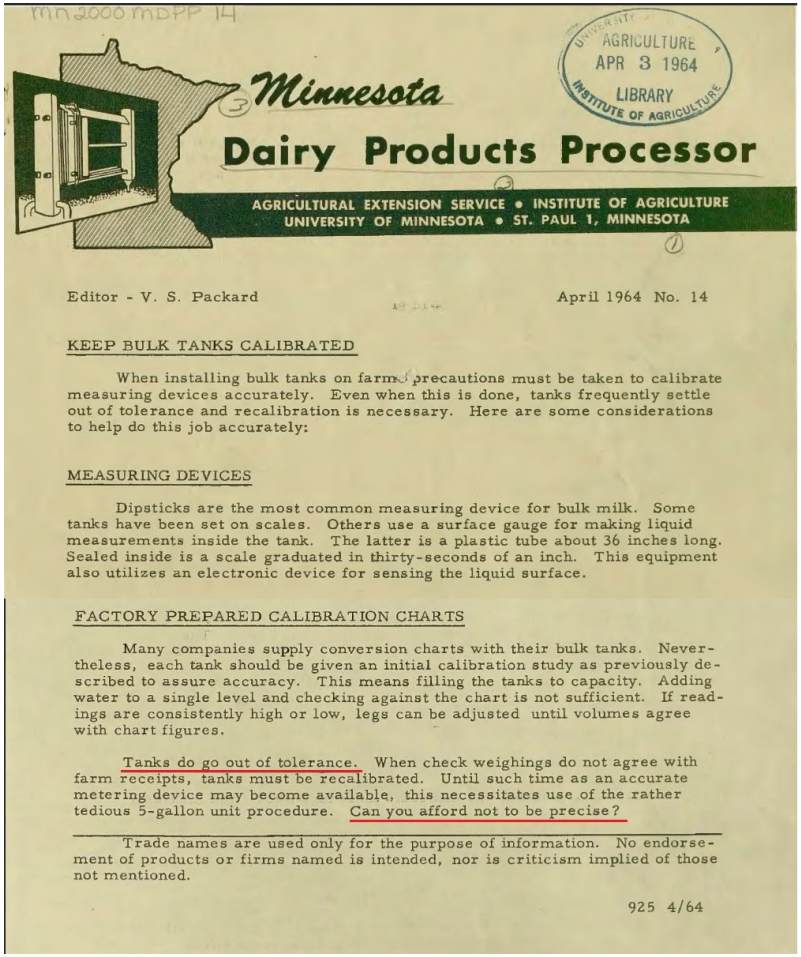
As far back as 1951, it was well known that dipsticks were an estimate of volume but not an accurate measuring device.

United States Pa 2,695,453 DIP STICK LIQUID MEASURING APPARATUS
Edward Valentine, Pico, Calif. Application November 28, 1951, Serial No. 258,697

2 Claims. (Cl. 33-12617 This invention relates to an apparatus for measuring the level of a liquid contained in a large tank, and more particularly relates to a dip stick liquid level measuring apparatus which is capable of great accuracy. The invention will be particularly illustrated as embodied in an improved dip stick liquid level measuring apparatus which is employed to measure the level of bulk milk in large dairy tanks. 1

A The method of measuring the level of a liquid in a tank by means of a dip stick has been known for a long time, and it has been widely employed, since it has several very real advantages over other methods of liquid level measurement. Thus, it is rapid, simple, and economical, very little actual apparatus being required, and the necessary operations being few and quickly carried out. However, until very recently it has never been seriously contended that the dip stick method was very accurate, and where accuracy has been a prime consideration, it has been found necessary to employ more complicated systems based on the use of floats, gauges, and other like apparatus.

Historical Doubts - 1964



MN 2000 MBPP 14

Minnesota
Dairy Products Processor
AGRICULTURAL EXTENSION SERVICE • INSTITUTE OF AGRICULTURE
UNIVERSITY OF MINNESOTA • ST. PAUL 1, MINNESOTA

Editor - V. S. Packard April 1964 No. 14

KEEP BULK TANKS CALIBRATED

When installing bulk tanks on farms precautions must be taken to calibrate measuring devices accurately. Even when this is done, tanks frequently settle out of tolerance and recalibration is necessary. Here are some considerations to help do this job accurately:

MEASURING DEVICES

Dipsticks are the most common measuring device for bulk milk. Some tanks have been set on scales. Others use a surface gauge for making liquid measurements inside the tank. The latter is a plastic tube about 36 inches long. Sealed inside is a scale graduated in thirty-seconds of an inch. This equipment also utilizes an electronic device for sensing the liquid surface.

FACTORY PREPARED CALIBRATION CHARTS

Many companies supply conversion charts with their bulk tanks. Nevertheless, each tank should be given an initial calibration study as previously described to assure accuracy. This means filling the tanks to capacity. Adding water to a single level and checking against the chart is not sufficient. If readings are consistently high or low, legs can be adjusted until volumes agree with chart figures.

Tanks do go out of tolerance. When check weighings do not agree with farm receipts, tanks must be recalibrated. Until such time as an accurate metering device may become available, this necessitates use of the rather tedious 5-gallon unit procedure. Can you afford not to be precise?

Trade names are used only for the purpose of information. No endorsement of products or firms named is intended, nor is criticism implied of those not mentioned.

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Historical Doubts - 1980

Author(s) : Burgess, J.

Author Affiliation : Milk Marketing Board Calibration Cent., Crudgington, Salop, UK.

Journal article : Nordeuropaeisk Mejeri-Tidsskrift 1980 Vol.46 No.7 pp.171-174

Abstract : For milk measurement in bulk collection the Milk Marketing Board (MMB) in England propose to replace dipsticks with flowmeters. This article describes the flow meter calibration center at the MMB creamery at Crudgington. The dairy industry set accuracy limits of plus or minus 0.35% at the farm and plus or minus 0.25% at the dairy - for dipsticks plus or minus 1% has been the norm.

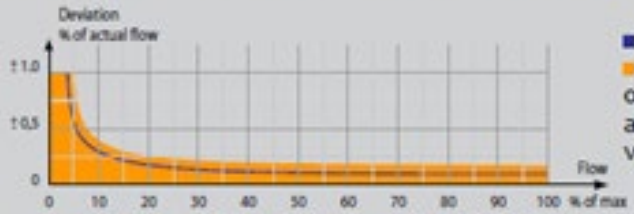
Historical Doubts – why?

- The dipstick is not calibrated correctly to the tank
- Frothing of milk in milk tank
- Tanks are damaged or not straight
- Driver's vision is poor
- Driver has to remember the dipstick measurement and then locate the weight on a wall chart. Memory issues and dyslexia can be a problem
- Driver knows the farmer personally and can skew the records in their favour
- Admin makes an error during data entry

The Current obstacle for use of Flow Meters

Magnetic flow meters have been tested to have an accuracy tolerance of + or - 0.3%. Yet the Handbook 44 requirement is a tolerance as low as + or - 0.14%

Flow Transmitter PD 340 Series



Max. error vs. actual flow rate

Flow velocity:100% of max. equals 5.4 [m/s] (C 51).

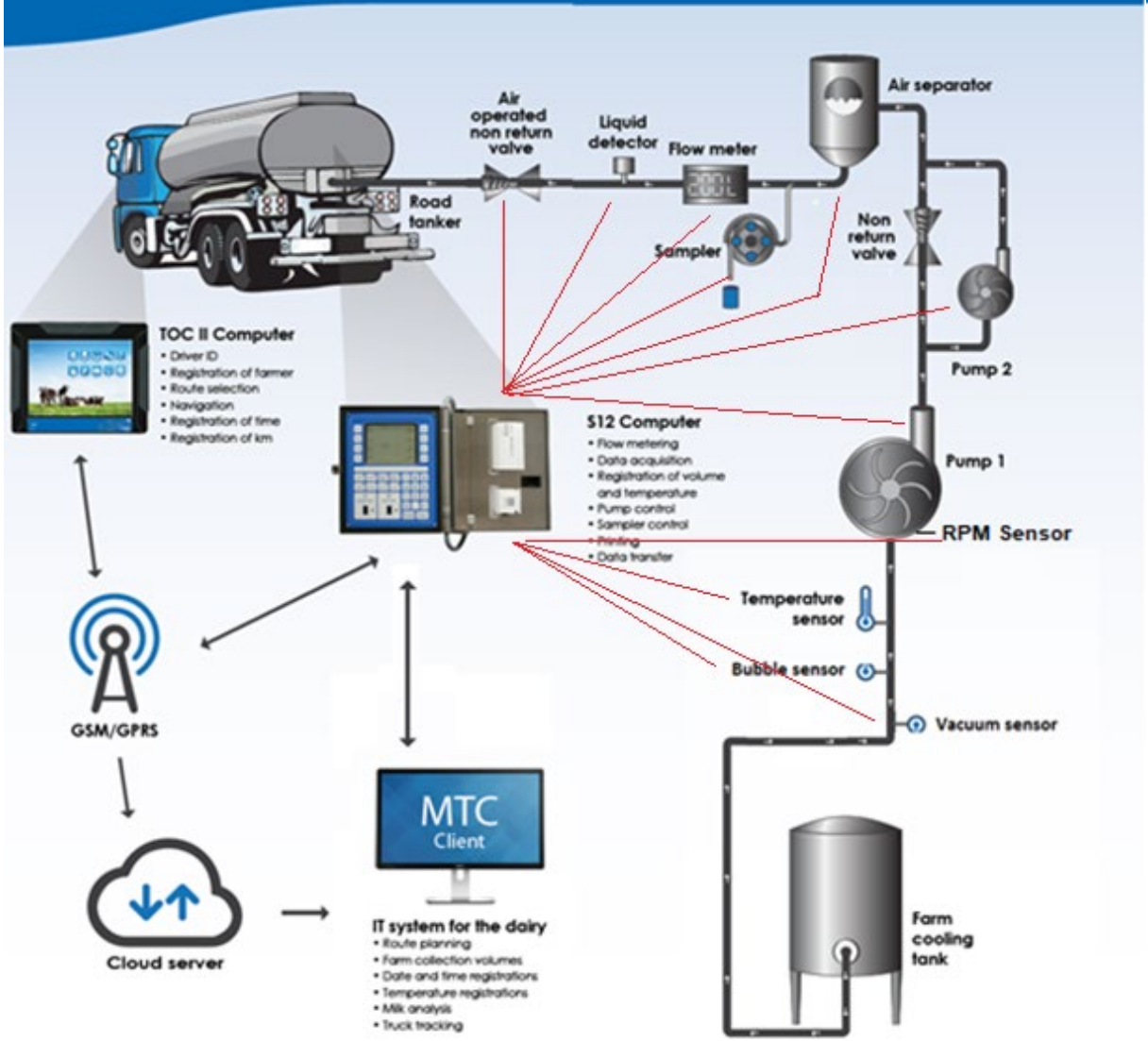
- Calibration test limits at reference conditions.
- Real life performance including the effects of variations in liquid type/temperature, ambient temperature and power supply voltage.

Flow measurement error:	See the graph above
Current output error:	As per the graph, plus ±0.3% of current output range
Linearity:	See the graph
Repeatability:	Max. 0.5 x error, (see the graph)
Liquid temperature:	-30 °C to 100 °C
Liquid pressure:	Max. 10 bar
Liquid conductivity:	Min. 5 µS/cm
Power supply:	24V AC ±15% or 24V DC ±15%
Power consumption:	Max. 6 W

Our Flow Meter System

Components:

- Computer with GPS and modem
- Barcode label printer
- Flow meter
- Sampler
- Air Eliminator Vessel
- Vent valve
- Main pump
- Priming pump
- Non return valves
- Conductivity sensors
- Vacuum sensor
- RPM sensor
- Temperature sensor


Air separator
Air operated non return valve
Liquid detector
Flow meter
Road tanker
Sampler
Non return valve
Pump 2
TOC II Computer
• Driver ID
• Registration of farmer
• Route selection
• Navigation
• Registration of time
• Registration of km
S12 Computer
• Flow metering
• Data acquisition
• Registration of volume and temperature
• Pump control
• Sampler control
• Printing
• Data transfer
Pump 1
RPM Sensor
Temperature sensor
Bubble sensor
Vacuum sensor
GSM/GPRS
MTC Client
Cloud server
IT system for the dairy
• Route planning
• Farm collection volumes
• Date and time registrations
• Temperature registrations
• Milk analysis
• Truck tracking
Farm cooling tank

Why can’t we meet the Handbook 44 tolerance?

- Milk entrains air – the cappuccino effect
- Lack of head pressure when pumping milk – some tanks are 10’ below ground
- If the flow meter by itself has a tolerance of + or – 0.3% then a complete milk metering and pumping system will have a tolerance greater than 0.3%

OIML Member Tolerances used elsewhere

Europe:

+ or – 0.5%

DANAK

FORCE Certification

DK-0200-MI005-006

Appendix to

EC-Type Examination Certificate
Measuring Instrument Directive

Number: DK-0200-MI005-006
Issued by FORCE Certification, Denmark
EC-notified body number 0200

Revision	Issue date	Changes
DK-0200-MI005-006	09-01-2015	First issue
DK-0200-MI005-006	10-08-2015	Second issue
DK-0200-MI005-006	14-04-2016	Third issue (replace of earlier issues)

The measuring system has the following characteristics

Accuracy class	0.5
Mechanical class	M3
Electromagnetic class	E3
Climatic class	Condensing/open location, H3
Ambient temperature	-25 /+55 °C
Liquid temperature	0 / +50 °C
Liquid pressure max	1 bar
Liquid types	Milk (Raw milk)
Liquid density	1.035 Kg/L at 5 °C +/- 0.02 Kg/L
Liquid conductivity	≥ 5 µS/cm

Flow characteristics for Measuring System, including Minimum Measured Quantity (MMQ), depends on actual flow sensor Proces Data 340 series in combination with Gas Elimination Device (GED) used:

MS/Meter	GED	Qmax	Qmax	Qmin	Qmin	MMQ	Inlet
Type	Type	[m³/h]	[L/min]	[m³/h]	[L/min]	[L]	[mm]
Type2/C51	PTø355	36	600	4	67	75	63.5
Type4/C51	PTø355	22.2	370	4	67	300	51
Type3/C63	PTø506	80	1334	5/(15)	84/(250)*	300/(100)*	63.5
Type5/C63	PTø406	69	1150	5	84/(250)**	300/(100/50)**	63.5/75
Type3/C76	PTø506	90	1500	12	200	300	75
Type3/C102	PTø506	90	1500	18	300	300	102

Note: The ratio between Qmax and Qmin of the measuring system, shall be at least 4 (4:1) within the flow rate range of the actual meter sensor in combination with relevant Gas elimination device.
*) MMQ 100 L only after first collection on full (primed) system.
**) MMQ 50 or 100 L only after first collection on full (primed) system.

Primary display on flow computer S12:

Indication:

Maximum capacity	99999 L	or	99999.9 L
Minimum increment of registration	1 L		0.1 L
Minimum Measured Quantity (MMQ)	300 L		≤ 300 L

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OIML Member Tolerances used elsewhere

New Zealand:

+ or – 0.5%

SCHEDULE

Pattern:	Milk Flowmetering System
Make:	DANSK MEJERI ELECTRONIK (DME) A/S
Model:	Data Collection System
Manufacturer:	Dansk Mejeri Elektronik A/S, Hinnerup, Denmark.
Submitter:	Dansk Mejeri Elektronik A/S (Denmark)
Class:	0.5
Minimum Delivery:	200 L
Maximum flowrate:	800 L/min (see description for other values)
Conditions of Approval:	**Note: This Certificate replaces the Approval Certificate 1234 and its variants, and is a new version of Certificate 1470** 1.The verification and subsequent certifications of the instrument, must be carried out by Accredited Persons who are accredited under the Weights and Measures Act 1987 Section 30A or an Inspector of Weights and Measures. 2. The instrument must be configured to prevent a vortex forming in the farm supply vat during a delivery, by reducing the flowrate for the first 50 litres and the last 400 litres of each delivery

Description:

The DME model Data Collection System is a vehicle mounted milk flowmetering system using a DME model PD340-C63 electromagnetic flowmeter approved for use as a receival system with maximum flow rates of 800 L/min and a minimum quantity of 200 L.

The PD 340 Milk Flowmetering System comprises the following main components.

1. A supply tank
2. A McEwans 2½" model centrifugal pump and either may be fitted above or below the liquid level in the supply tank.
   Note: Centrifugal type pumps shall be fitted in suction head installations.
3. A Jensen model MK2 air elimination device which eliminates any detected air and prevents it from passing through the meter.
4. A DME model 340 Cxx (with xx being the bore diameter)* electromagnetic flowmeter (see photo 2) mounted either horizontally or vertically.
5. A non-return valve
6. A DME model Lillebror digital indicator/computer
   *PD 340 C63 flow sensor is used

STAMPING (sealing): A plate providing access to calibration adjustment switches is sealed with wire terminating in a lead seal.

The following variants are approved:

VARIANT 1 (issued 16 July 1992)
Submitter: NDA Engineering Limited, Hamilton, New Zealand

The pattern remains same in all aspects except the variant covers the following:

1. Incorporating a model PD 340 flowmeter with the bore of the meter increased from 2½" to 3" diameter (also called as PD 340 C 76 flow sensor).
2. Incorporating pipework to allow for the increase to 3" diameter.

VARIANT 2 (issued 30 November 1993)
Submitter: NDA Engineering Limited, Hamilton, New Zeland

The pattern remains same in all other aspects and only the following changes are approved to authorise the use of a modified de-aerator unit.

OIML Member Tolerances used elsewhere

Australia:

+ or – 0.5%

TECHNICAL SCHEDULE No 5/6E/13A

1. Description of Pattern **approved on 24/12/04**

A vehicle-mounted milk flowmetering system using a Diessel model IZM-E DN50 G2 electromagnetic flowmeter (Table 1) approved for measuring the milk collected from a milk tank.

1.1 Field of Operation

The field of operation of the measuring system is determined by the following characteristics:

• Minimum measured quantity (V_{min})	200 L
• Maximum flow rate (Q_{max})	700 L/min
• Minimum flow rate (Q_{min})	70 L/min
• Maximum pressure of the liquid (P_{max})	800 kPa
• Ambient temperature range	-10°C to 55°C
• Accuracy class	0.5
• Vehicle-mounted operation	
• Product – milk at nominal controlled temperature	

The flowmeter is adjusted to be correct for the liquid (milk) for which it is to be verified as marked on the data plate.

1.2 The System (Figures 1a and 1b)

(i) A supply tank.

The supply tank is a milk tank or a vat to which the metering system is temporarily connected. The base of these tanks slopes towards the outlet to facilitate emptying of the contents during the measuring process.

(ii) Pump

A centrifugal type pump or a positive displacement pump of sufficient capacity may be used to draw the milk from the supply tank outlet, which may be located lower than the inlet of the pump; however for the centrifugal type pump the level of milk in the supply tank is higher than the pump inlet.

A check valve at the inlet of the pump may be required to prevent draining of liquid.

Flexible piping may be used with an appropriate adaptor/reducer to connect the pump to the outlet of the supply tank.

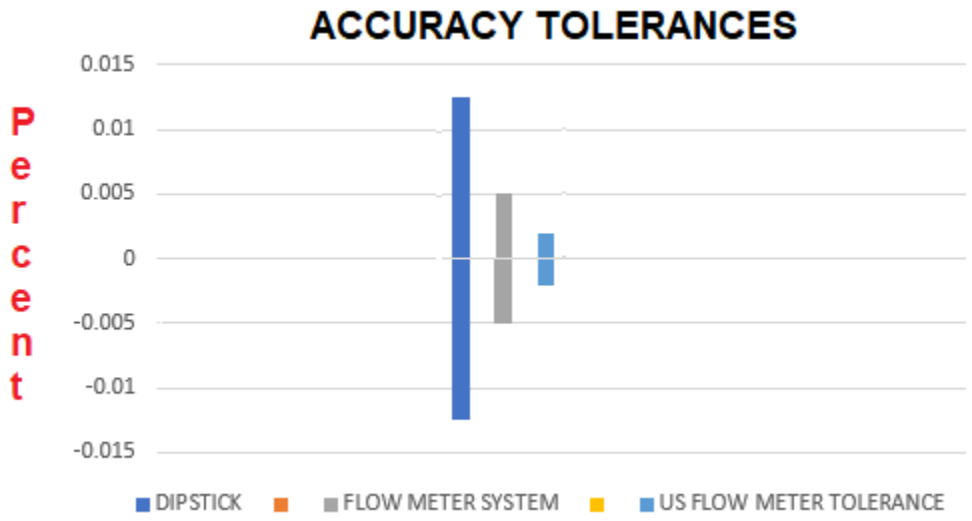
(iii) Gas Elimination Device

The gas elimination device is a Diessel/DME type E float-operated gas separator with a volume of approximately 60 litres fitted between the pump and the meter. The device incorporates a round float that has a shaft through its centre which allows the float to move in a vertical plane. At the top of this shaft is a 'needle' that operates a seat assembly designed to seal off the vent located at the top of the gas separator. As the liquid level in the gas separator rises, the float rises until the seat assembly, seals off the vent and the flow is directed to the flowmeter.

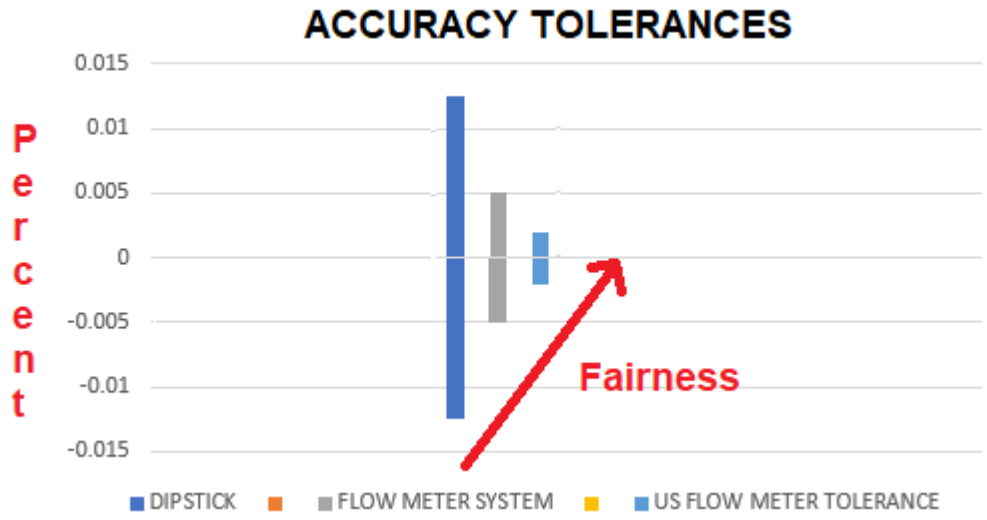
Why be satisfied with + or – 0.5%?

Because the regulators have acknowledged the benefit in moving towards a better tolerance than a dipstick is capable of

OBJECTIVE: Move to the best available tolerance



As Accuracy increases – so too Fairness



Fairness for Farmers
Fairness for Dairies

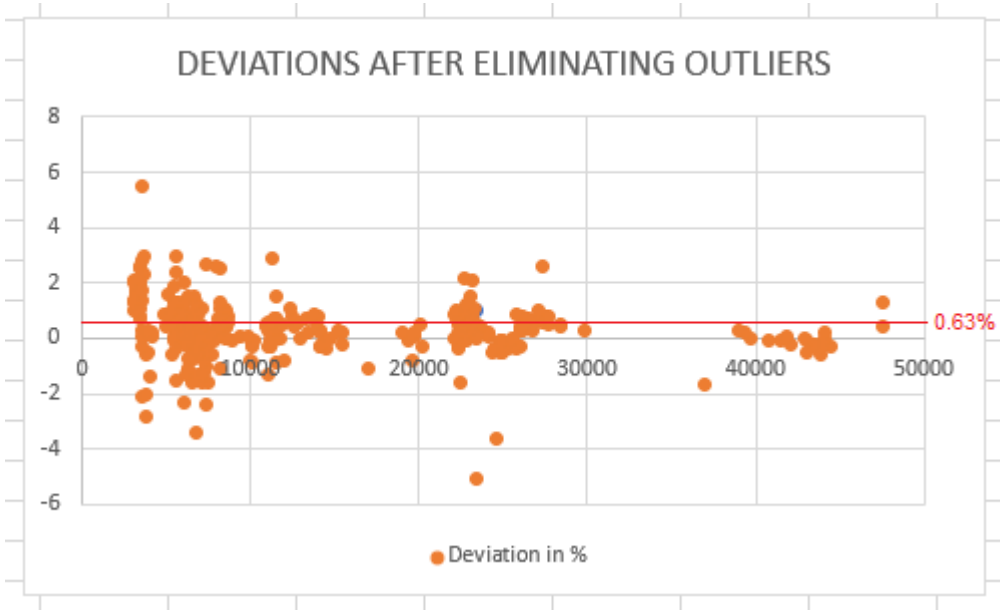
2019 Mid-west Trial findings

Results of a 3 month "blind" trial that a dairy processor in the mid-west ran from December 2018 to March 2019.

The driver was not able to see the weight of milk recorded on the computer screen so he could not be influenced by the recorded weights.

GALLONS MEASURED BY FLOW METER SYSTEM	POUNDS (lbs) ENTERED BY DRIVER	POUNDS CALCULATED BY FLOW METER (Volume x 8.6lbs)	VARIANCE BETWEEN DRIVER READINGS AND FLOWMETER	VARIANCE PERCENTAGE
495,192.00	4,285,601.00	4,258,651.20	26,949.80	0.63%

Trial Results from Blind Study



Trial Results from Blind Study

- 26 manual tasks can be reduced to 9 (eliminates human error) through data automation.
- 27% of suppliers are being systematically underpaid
- Milk collection speed can be increased from 100-200 gallons per hour to 250-400 gallons per hour
- Each driver shift can be reduced by up to 72 minutes
- Fewer trucks are required to collect the same volume of milk
- Manual data entry is eliminated entirely.
- Milk collection data is received in real time for informed management decision-making
- CIP cleaning function improved and recorded

System Benefits

Dairy Processor Benefits

- Improved Accuracy of Payments
- Automated data entry
- Interface to supplier payment app
- eliminates human errors
- Provides Real Time Knowledge
- Improved CIP process and Reports
- Representative sampling
- Traceability of loads
- Hot milk audits and control

Farmer Benefits

- More equitable payments
- Faster collection (agitation and pump speed) – lowers cost per collection
- Safer controlled loading
- Improved CIP process and Reports

Proposed New Tolerances

Collected volume	Proposed Tolerance Maintenance		Current NIST Tolerance Maintenance		Proposed Tolerance Acceptance		Current NIST Tolerance Acceptance	
	Gallon	Percent %	Gallon	Percent %	Gallon	Percent %	Gallon	Percent %
50 Gallon	0.25	0.5%			0.25	0.5%		
100 Gallon	0.5	0.5%	0.5	0.50%	0.5	0.5%	0.3	0.30%
200 Gallon	1	0.5%	0.7	0.35%	1	0.5%	0.4	0.20%
300 Gallon	1.5	0.5%	0.9	0.30%	1.5	0.5%	0.5	0.17%
400 Gallon	2	0.5%	1.1	0.275%	2	0.5%	0.6	0.15%
500 Gallon	2.5	0.5%	1.3	0.26%	2.5	0.5%	0.7	0.14%

The Proposal before you

We believe that there is a very strong case (scientifically and commercially) to ask you to move our proposal to "**Voting Status**".

There are senior representatives of the mid-west dairy here in the audience today who will support the need for this change in the Handbook tolerance.

We produce solutions
- not products!

POUL TARP A/S