



National Measurement & Regulation Office

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National Project: Milk Measurement Processes from Farm to Dairy

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1. Executive Summary

- 1.1. The metrology expert panel raised the issue of milk measurement from farms to the dairies with the National Measurement and Regulation Office (NMRO) and requested NMRO take a look at the area as there had been a number of complaints from farmers. Dairy farming is an important agricultural sector for UK plc as well as for many rural communities. It is the single largest agricultural sector in the UK accounting for around 17% of agricultural production by value. For dairy farmers, the measurement of the milk they sell has become increasingly important as the margins on milk production have narrowed as a result of falling prices and oversupply in global markets.
- 1.2. NMRO therefore initiated a project to take a look at the area and invited Local Authorities to participate in a project to look at measurement systems and practice, for the collection of milk from farms. This project was completed in July 2015 and results from the exercise collated.
- 1.3. The purpose of the review was to establish if there was a problem sufficient to warrant government intervention, new regulation or further testing work to be carried out in the milk measurement process. As milk measuring instruments are not currently prescribed in the UK neither Trading Standards nor NMRO have the capability to test milk measuring systems at present. Part of this review was intended to establish if such measurement capability needed to be developed by government or could the industry effectively regulate itself. The outcome is that the dairy industry can effectively regulate itself and NMRO and Trading Standards is now working with them to ensure this.
- 1.4. This project was a fact finding exercise, with the intention of gaining information about the way in which milk is measured in the collection chain from farm to dairy, and to consider levels of accuracy of the metrology on which milk collection, and subsequent payment, is based.
- 1.5. The engagement of Local Authorities and business was such that the time frame of the project was extended beyond the normal running time of 1 year to enable all authorities who wished to, to take part and the project to be brought to a satisfactory conclusion with agreed ways forward with the industry.
- 1.6. In the United Kingdom, flow meter systems for the measurement of milk are not prescribed by regulation. There are therefore no prescribed error limits, no specific technical requirements governing their design and construction, and they do not require testing nor stamping before being legally used for trade.
- 1.7. However, if in use for trade, they are still covered by the Weights and Measures Act 1985, and Section 17 of this Act would apply in respect of false or unjust equipment, or fraud.
- 1.8. Concerns had previously been raised with some Local Authorities by a number of farmers in respect of the perceived accuracy of lorry mounted metering systems

used to measure the volume of milk collected from farms. During the course of the project, a number of farmers raised such concerns too. In almost every instance raised, following a query from a farmer, the organisation receiving the milk agreed to pay the farmer on a quantity averaged from a number of days' previous collections.

- 1.9. Seventeen Local Weights and Measures Authorities from all across the UK took part in the project and seventy seven farms, twelve dairies and six tanker depots were visited and nine tanker meter measuring systems were examined for evidence of measurement traceability.
- 1.10. Very few farms that were visited had measurement systems installed that were capable of objectively recording the volume of milk in a tank prior to collection.
- 1.11. Some had systems which noted the amount of milk recorded as having been taken from each cow in the milking parlour and then aggregated these amounts. However, they were not reliable as overall quantity indicators since discarded contaminated milk (for example containing antibiotics) could be included in such aggregated totals.
- 1.12. Bulk Milk Tankers were sometimes weighed at the off-loading dairy, but if any comparison was made with the loaded volumes, they would not relate to a specific farm – unless the whole load was from that single farm, which did not appear to be a frequent occurrence. Such weight checks did, however, enable a comparison to be made between the weight of the load, and the total volume of milk loaded, and therefore gave a degree of opportunity to check the accuracy of the tanker meter.
- 1.13. Tanker meters generally appeared to be either calibrated, or systematically replaced, annually. In some instances, they were sealed with calibrators' seals. These seals are not legally required, since the equipment is not prescribed by regulations, but they bring demonstrable security. Some calibrations were audited by Trading Standards Officers (TSOs) and these calibrations were conducted using traceable proving tanks which had themselves been calibrated by a Trading Standards Service.
- 1.14. The main conclusion of the Project is that what appears to be lacking from the milk collection process is confidence and objectivity.
- 1.15. The project did not discover any overall problem with the measurement of milk when collected from farms but there certainly were occasions when some farmers were not happy with the perceived accuracy of some measurements, based on previous collections and trends.
- 1.16. Whilst there is a degree of reassurance there were instances recorded where concerns about meter accuracy had been raised. Although these concerns had subsequently been addressed by reference to the averaging of previous collections to show the results were within reasonable and expected parameters, farmers do still have concerns about metering accuracy.

- 1.17. There is clearly a need for establishing and demonstrating increased objectivity across the whole measurement process in order to raise confidence levels for the benefit of all involved parties.
- 1.18. Based on the evidence generated we do not believe prescription of tankers for milk collection is necessary, however we believe better confidence in the measurement chain could be achieved by various other ways including:-
- Effective, obvious sealing of tanker components that could have an effect on accuracy of measurement
 - Obvious Calibration Stickers on the metering system
 - Trading Standards Officer witnessed calibrations of meters
 - Trading Standards Officers calibrating farm tanks – but this would need a specialist ‘food compatible’ form of measurement system for conducting the testing, and scrupulous hygiene procedures would need to be followed
 - A Code of Practice for the calibration of tanker metering systems
- 1.19. In order to further this, NMRO has been in discussion with regard to the Dairy Transport Assurance Scheme (DTAS). The scheme is administered by Dairy UK and is overseen by a Management Committee drawn from major milk purchasers in the UK. The DTAS scheme is intended to provide assurance to milk purchasers that the transport of raw milk and milk fractions meets food safety requirements, recognised industry good practice and specific customer needs. Membership of the scheme covers an estimated 80 to 90% of milk haulage capacity in the UK.
- 1.20. Following discussions with NMRO the DTAS Management Committee has set up a Calibration Group that will be working to produce a Code of Practice, and will be examining the DTAS Standards. An experienced Trading Standards Officer will be a member of this Calibration Group.
- 1.21. It is hoped that the code will provide the framework for objective metrological standards and tolerances, and that these will be adopted across the industry.

2. Introduction & Background

- 2.1. For a number of years, Trading Standards Services, as Local Weights and Measures Authorities, have taken part in National Metrology Projects. These have been organised to add value to enforcement work which has been done by individual Trading Standards Services as part of their local responsibility. Such work, which has been undertaken across the United Kingdom has been focussed on a particular subject, decided upon in consultation with the Trading Standards community on a risk based approach, and has been nationally collated. This has enabled an overview to be taken of a particular business sector and of the status and condition of associated weighing and measuring instruments. It has provided specific results, so that advice can be directed, and follow up work has demonstrated the successful impact and outcome of this approach. The inspection and testing of weighbridges, and of Medical Weighing Equipment are examples of this.

- 2.2. The Local Government Metrology Expert Panel, the Chartered Trading Standards Institute (CTSI) and NMRO chose the bulk measurement of milk from farms as the subject of the National Metrology Project for 2013 – 2014. The participation and subsequent information flow generated was so successful, that the proposed end date of the project was extended to summer 2015.
- 2.3. NMRO co-ordinated and collated the results of the work undertaken by Trading Standards Authorities. This report is based upon the project and its findings.

Collection of Milk from Farms

- 2.4. For many years, farmers supplied milk in churns which were collected from farms by wagon and, in later years flat-bed lorries, which carried the full churns to the dairy.
- 2.5. The churns themselves were the measures, and were calibrated and stamped as a capacity measure under Weights and Measures legislation. This system required a lot of handling and in more recent years, with larger volumes of milk and to improve logistics, farmers installed bulk refrigerated tanks and milk was collected from these by bulk tanker lorry.
- 2.6. The bulk farm tanks were not prescribed by regulation and so were not formally calibrated and stamped. They were still calibrated however, and measurement of the volume of milk collected was made by means of a dipstick and a calibration chart for each individually identified tank.
- 2.7. Subsequently, milk collection tankers were fitted with measuring systems to measure the quantity of milk collected from each individual farm tank. The farmer is normally paid by reference to this measurement, and other quality parameters.
- 2.8. The measuring instruments fitted to the milk collection tankers were not prescribed by regulation and so were not formally calibrated and stamped.
- 2.9. When the Milk Marketing Board was in existence, a Code of Practice was agreed for the calibration and use of such meter measuring systems.
- 2.10. Following the abolition of the Milk Marketing Board, milk is now collected from farms by individual dairies / carriers, and the measurement made by the tanker mounted measuring systems remains as a major input into the price paid to the farmer.
- 2.11. Whilst the Milk Marketing Board Code of Practice is no longer in place, the Dairy Transport Assurance Scheme (DTAS) is in place for much of the milk haulage sector.
- 2.12. The scheme is administered by Dairy UK and is overseen by a Management Committee drawn from major milk purchasers in the UK.
- 2.13. Whilst the DTAS is not as comprehensive in some metrological aspects as the former Milk Marketing Board Code of Practice, it is intended to provide assurance to milk purchasers that the transport of raw milk and milk fractions meets food safety

requirements, recognising industry good practice and specific customer needs. It is based on annual inspections of the milk haulage depots operated by scheme members. The assessment is conducted against 56 standards covering haulage operations, vehicle hygiene, site and statutory requirements, hazard analysis and critical control points (HACCP), personnel and training, subcontractors and contingency procedures.

- 2.14. Membership of the scheme covers an estimated 80 to 90% of milk haulage capacity in the UK.

Purpose of the Project

- 2.15. NMRO invited Local Authorities to participate in the project to look at measurement systems and practice, for the collection of milk from farms.
- 2.16. This project was designed to gain information about the way in which milk is measured in the collection chain from farm to dairy, and to consider levels of accuracy of the metrology on which milk collection, and subsequent payment, is based. The project looked solely at the metrology measurement aspects of this process. Storage of milk and food hygiene aspects were not considered as they are outside the scope of this project.
- 2.17. The project looked at the 3 stages of the milk collection process for which metrology is central, and also at the calibration status of measuring systems used at those stages:-
- 2.18. How the milk is stored at the farm, prior to collection, and any measurement that is made there on behalf of the farmer.
- 2.19. The collection and measurement of milk from the farm, and the systems used to make such measurement, including the design and construction of lorry mounted meter measuring systems and their calibration status.
- 2.20. The arrival of the milk at the dairy, and any quantity measurement that is made there, such as a weighbridge check on the vehicle, to determine the total delivery carried to the dairy.

3. Methodology

- 3.1. Some of this project work was done at the farm milk collection point, some at dairies and some at tanker depots.
- 3.2. The principles and points for consideration were as follows:-
- 3.2.1. *We wanted to determine information on the way in which milk is stored at the farm, prior to collection, and any measurement that is made there on behalf of the farmer.*
- If any measurement is made by, or on behalf of, the farmer, how is it done?
 - Farmers may have measuring devices fitted to 'on farm' milk storage tanks, and make comparisons between this and uplift measurements using the tanker mounted meters.
 - What is the accuracy and traceability of the measurement?

- How is the record of it kept?
- Does it play any part in the transaction with the carrier or the purchasing dairy?

3.2.2. We wanted to understand the processes and methods of collection and measurement of milk from the farm, and the systems used to make such measurement

- How is the quantity of collected milk measured?
- If the collection *is not* made by measuring the collected milk with a lorry mounted measuring system, how is it done?
- If the collection *is* made by measuring the collected milk with a lorry mounted measuring system, how is it done?
- How is the quantity of milk collected confirmed with the farmer?
- What is the calibration status of the measuring system used?
- Does its use require any manual intervention in order to ensure that entrapped air is not measured, or is the operation of the uplift and measuring system fully automatic?
- Has the farmer any concerns or experienced problems concerning measurements made of milk collections?
- If the measurement by the lorry mounted meter was discounted due to doubts over the accuracy of a reading, how was the quantity of milk determined for payment?

3.2.3. We wanted to understand measurement systems relating to the arrival of the milk tanker at the dairy

- When the milk tanker arrives at the dairy, is the weight of the load of the delivered milk determined or is the volume of the total load determined as the tanker is offloaded?
- What weighing or measuring instruments are used to do this and what is their legal status in the measurement of the milk in connection with its purchase?
- What is their calibration status?
- What comparisons are made and what actions are taken when the check weighing / measurement at the dairy differs from the measurement that was made when the milk was collected from the farm? – What degree of difference would trigger action in this instance?

3.2.4. We wanted to learn about the design and construction of lorry mounted measuring systems and their calibration status

- This area of work would best be done at a Milk Tanker Depot
- What type of measuring instrument is used?
- Is the milk measuring system in conformity with any MID Type Examination Certificate, from another EU Member State?
- How is it calibrated and sealed?
- How regularly is it calibrated?

4. Metrological Processes Involved

- 4.1. In the United Kingdom, flow meter systems for the measurement of milk are not prescribed. There are therefore no specific regulations which govern their design and construction. Consequently, such systems do not require stamping before they may legally be used for trade, and there are no prescribed error limits.
- 4.2. If in use for trade, they are still covered however by the Weights and Measures Act 1985, and Section 17 of this Act would apply in respect of false or unjust equipment, or fraud:-

17 Offences relating to false or unjust equipment or fraud.

(1) If any person uses for trade, or has in his possession for use for trade, any weighing or measuring equipment which is false or unjust, he shall be guilty of an offence and the equipment shall be liable to be forfeited.

- 4.3. It is unlikely that any measurement involving a farm bulk milk tank itself would fall within the 'use for trade' definition, since the final determination of the quantity of milk is generally made by the tanker meter measuring system.
- 4.4. It is possible that in some circumstances a weighbridge could be the method of determining quantity for the milk purchasing transaction. If this were the case, the weighbridge would be required to comply with the appropriate Regulations.

5. Results and Findings

- 5.1. Seventeen Local Weights and Measures Authorities took part in the project
- 5.2. Three enquiries were received from organisations involved in the Dairy Industry, asking about the purpose and intent of the Project.
- 5.3. Two Local Authorities provided background information following previous queries from farms
- 5.4. Seventy seven farms were visited
- 5.5. Twelve Dairies were visited
- 5.6. Six Tanker Depots were visited
- 5.7. Nine tanker meter measuring systems were checked for objective measurement traceability
- 5.8. The primary measurement of the milk which is collected from farms is almost always the quantity determined by the tanker meter measuring system. Farmers, and purchasers, rely on this being correct.

Farmers' Perspective

- 5.9. In a number of instances, there was a lack of confidence in the objectivity of the measurement process, in terms of accuracy, security and traceability of measurement. Concerns were expressed about the difference between the quantity

recorded by the tanker meter when compared with what the farmer thought was in the tank.

- 5.10. Farmers' estimations of quantity included tank gauges, calibrated dipsticks, reference to a datum point or even a dipstick without a calibration chart, but which could be used as a reference point.
- 5.11. Methods of measurement on farms included:-
- Dipstick and calibrated chart
 - Dipstick and no chart
 - Dipstick and chart, but tank has been moved – or even tilted to get more milk in
 - Contents gauging system
 - Yield monitors and systems which aggregated yields in the Milking Parlour – but the potential discarding of some milk needed to be taken into consideration
- 5.12. Feedback from the farming community included concerns that when a measurement or estimation of quantity of milk for collection was made on the farm and subsequently compared with the tanker meter reading, it was not possible to determine which measurement was correct - farm or tanker.
- 5.13. Instances were reported where a measurement had been challenged and a different tanker had then been used for a subsequent collection and the measure quoted from this tanker was then felt to be acceptable.
- 5.14. One farmer said that there were occasional collections using a bulk tanker, with no meter fitted.
- 5.15. Some farmers expressed anxieties about making any complaint about quantity, or challenging a measurement.
- 5.16. A view was expressed that dipstick measurements were not reliable due to frothing of milk in the bulk farm tank.
- 5.17. It is worth noting that when apparent differences in measurement accuracy between two different tankers are noted, it would be technically possible for both to have been calibrated to be within a specified set tolerance, but the error on one tanker could have been positive and the other negative. However, no such circumstances were identified.
- 5.18. Many farmers assumed that TSOs calibrated the meters. Some farmers believed they were paid according to the quantity of milk determined by the weighbridge at the dairy, and not by the tanker meter reading.

Specific Questions Raised by Farmers

- 5.19. How is the first 50 litres taken from a bulk farm tank measured by the tanker metering system when it initially will be drawing air, then a mixture of air and milk?

5.20. Can a tank calibration service be offered?

Tanker Metering Systems

5.21. Tankers appeared to have either a yearly meter calibration, against a proving vessel or a master meter, or were replaced annually.

5.22. It was understood that milk scale could potentially cause metrological problems and so regular cleaning was essential for both metrological and hygiene reasons.

5.23. In many instances, there were no visible seals on components that could affect accuracy of measurement.

5.24. Most tankers did not bear calibration stickers or show traceability of measurement.

5.25. When calibration records were checked, some meters showed calibration traceability to National Standards by use of an identified master meter, or proving vessel.

5.26. One Meter System Company has some of their tanker meter calibrations witnessed by TSOs.

Dairies

5.27. In some instances, 'mother tankers' take on board at collection points the aggregated loads of a number of smaller tankers. They then deliver this bulk load to the dairy.

5.28. One instance was determined where when a tanker was weighed at the dairy, if there was an apparent difference greater than 200 litres between the weighbridge and aggregated tanker meter readings, the meter was checked and the farmers were given an average of the last 4 collections.

5.29. When weight was converted into volume for payment, it was not always clear where the density or specific gravity determinants came from, and whether they were an industry standard, or were calculations in respect of the specific load of milk in question.

Discrepancies in Quantity

5.30. Where discrepancies in quantity were alleged and raised with a tanker company, in all but a very few instances, average values of other collections were used to determine a quantity for the queried collection. In these situations, there appeared to be a genuine sense of goodwill towards the farmers' queries. However, in the instances where this was not done, the farmers' query appeared to be unaddressed.

5.31. In one instance, a farmer said he had been credited when he said a short measurement had occurred, and he had also received credits when he had not

requested them. He believed this was due to weighing of loads, and comparison of the weight of milk with meter readings.

6. Summary and Implications

- 6.1. Milk may be collected from farms by bulk milk collection tankers operated either by independent hauliers or by the purchasing dairy enterprise.
- 6.2. Farmers have raised concerns about alleged understating of collected milk quantities, either before or during the Project.
- 6.3. Farmers' concerns are often based on experience or a reference or datum point in farm bulk tank. However, Very few farms have a means of accurately determining the quantity of milk in the farm tank before it is collected. Very few farms have a reliable or calibrated measurement system for determining the content of the farm tank. If they do, the calibration is generally not traceable.
- 6.4. Parlour milking output aggregated figures are a guide to quantity, but it has to be remembered that some produced milk could be discarded, and not go into the bulk tank.
- 6.5. Where farmers have alleged that the quantity of milk collected was less than they believed it actually was, and raised it with the tanker company, in all but a very few instances, average values of other collections have been used to determine a quantity for the queried collection.
- 6.6. When milk is received at the dairy, there is generally no reliable method of tracing deliveries from a particular farm – the load is a bulk aggregation from all collections made on a particular tanker run.
- 6.7. Weighing of bulk tanker loads at the dairy, and the comparison of the weight of milk with aggregated meter readings for the milk collected would appear to be a good practice and encourage confidence in meter accuracy.
- 6.8. There is a need for greater confidence for the farmer. This primarily requires objectivity in respect of measurement and measurement systems, and also an understanding of how the collection process works. This would, for example, explain why air is not measured by the tanker meter when the collection process starts.

7. Recommendations

- 7.1. Many tanker metering systems do not appear to be sealed when they have been calibrated. A visible seal applied by the calibrator, that would prevent further 'unauthorised' adjustment, would bring confidence.
- 7.2. Some tanker metering systems are calibrated annually and some have the meter replaced annually with a newly calibrated instrument, as a matter of course. This could be made more obvious by visible calibration stickers on the tanker. It would

bring confidence and it should also encourage any business that did not calibrate annually to do so.

- 7.3. Trading Standards calibrated proving tanks are used in some instances for tanker meter calibration, thereby providing traceability of measurement. This could be publicised more.
- 7.4. There were some examples quoted of Trading Standards Officers witnessing tanker meter calibrations. Witnessed calibrations to a stated tolerance would bring confidence, along with sealing of adjustment mechanisms. It is recommended that the DTAS Calibration Group consider tolerances and sealing when working on a Code of Practice.
- 7.5. Whilst the intended accuracy of calibration of the tanker meters is not publicised, if meters are calibrated to any set tolerance, this could be + on one tanker and – on another, and this in itself could give rise to an apparent discrepancy in measurement that would still be within recommended tolerances. The forthcoming Code of Practice should explain this.
- 7.6. A calibration service for farm tanks might bring confidence. This could be provided by either Trading Standards or private calibration companies. This should be considered, but any cost and hygiene implications would need to be considered.
- 7.7. In summary, what is needed are means of establishing and demonstrating objectivity in the measurement process, and raising confidence levels for the benefit of all involved parties.
- 7.8. In order to further this, NMRO has been in discussion with the Dairy Transport Assurance Scheme (DTAS). DTAS is administered by Dairy UK and is overseen by a Management Committee drawn from major milk purchasers in the UK. Membership of the scheme covers an estimated 80 to 90% of milk haulage capacity in the UK.
- 7.9. The DTAS is intended to provide assurance to milk purchasers that the transport of raw milk and milk fractions meets food safety requirements, recognised industry good practice and specific customer needs. It is based on annual inspections of the milk haulage depots operated by scheme members. The assessment is conducted against 56 standards covering haulage operations, vehicle hygiene, site and statutory requirements, hazard analysis and critical control points (HACCP), personnel and training, subcontractors and contingency procedures.
- 7.10. DTAS publishes a number of 'best practice' standards, protocols and codes of practice.
- 7.11. Following a joint meeting with NMRO, the DTAS Management Committee has set up a Calibration Group that will be working on a Code of Practice, and will be examining the DTAS Standards. NMRO has arranged and agreed for an experienced Trading Standards Officer will be a member of this Calibration Group. The expected outcome of this is that a new Code that sets clear criteria for metrological security and confidence which will be used by the whole business sector.