

Reduce uncertainty with reliable custody transfer measurements

In this article the Emerson experts are discussing the importance of performing periodic calibration of marine custody transfer measurement systems, but also what calibration really means and what the consequences could be if international calibration standards are not followed.



The Importance of Calibration to a Traceable Standard in Custody Transfer Measurement Systems onboard LNG Carriers

It is critically important that custody transfer should be measured with absolute precision on-board LNG carriers. A lack of measurement accuracy can lead to uncertainty in terms of product value, which then causes error in the financial transaction between buyer and seller. Global LNG trade reached over 372 million tons in 2022, and even the slightest error in all these transactions has a considerable impact. Conversely, accurate and reliable measurement ensures LNG

will be billed correctly and thus avoids disputes and creates trust between stakeholders in the supply chain.

Radar technology provides highly accurate level measurements in compliance with marine regulations as part of a CTMS on-board gas carriers. However, the measurement accuracy of instrumentation can drift over time because of environmental influences such as extreme temperatures or humidity, as well as accidental damage. To counteract

any deviations that might occur, it is essential to calibrate instruments periodically to see if they have drifted. Based on the calibration result the instruments can then be adjusted as necessary to return them to the required accuracy.

A convenient method of performing such calibration is by using a reference standard which in some cases is referred to as a test cable instrument. When using this method, the calibration of the instrument

must be traceable to a higher measurement standard and have the appropriate calibration certification.

Calibration

The Bureau des Poids et Mesures/International Bureau of Weights and Measures (BIPM)

is the coordinator of the worldwide measurement systems. They define calibration as an operation that “under specified conditions, in a first step, establishes a relation between the quantity values with measurement uncertainties provided by measurement standards and corresponding indications with associated measurement uncertainties and, in a second step, uses this information to establish a relation for obtaining a measurement result from an indication.”

In other words, calibration is the act of comparing a device under test of an unknown value with a reference standard of a known value (a measurement standard).

The BIPM also states that “calibration should not be confused with adjustment of a measuring system, often mistakenly called self-calibration, nor with verification of calibration”. This point is significant, as calibration is sometimes mistakenly considered to also involve making corrective adjustments to the device under test. However, any necessary corrective adjustments are in fact made following calibration. Following corrective adjustments, the measuring system must usually be recalibrated.

The International Safety Management (ISM) Code

The International Convention for the Safety of Life at Sea (SOLAS) recommends that each ship carries a calibration procedure and that confirmation of compliance with that procedure is available on-board.

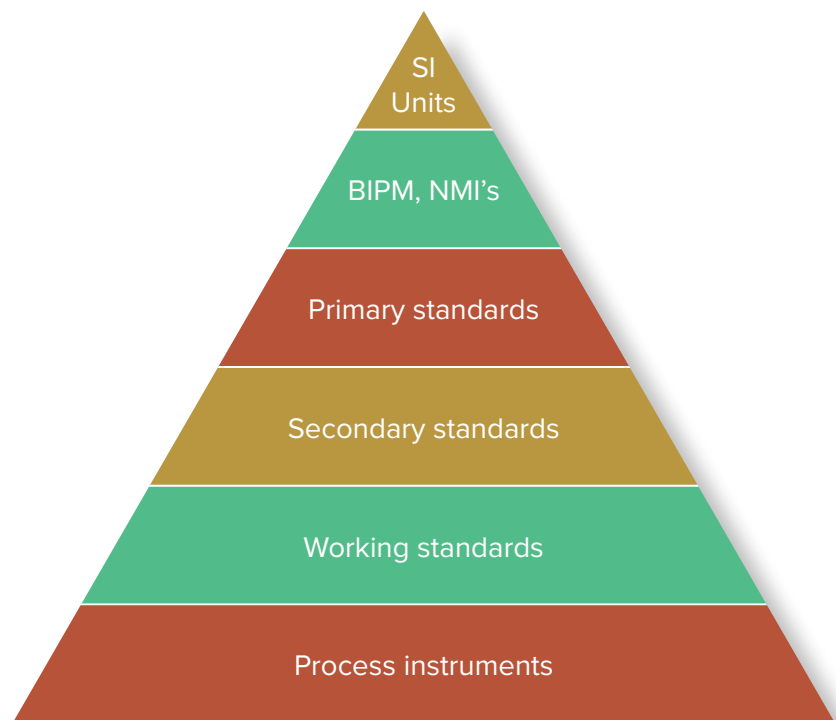
Reference instruments must themselves be calibrated at regular intervals at specialized facilities and carry a calibration certificate.

Traceability

Calibration results must be traceable to the internationally defined measurement units. Metrological traceability refers to an unbroken chain of comparisons relating an instrument’s measurements to a known standard that is directly or indirectly related to National Metrological Institute’s (NMIs), international standards or certified reference materials. Such traceability is important since it provides confidence in the accuracy of the reference instruments and gives assurance that the measurement results are correct.

Traceability is typically visualized as a calibration traceability pyramid, for which the International

System of Units (SI) are found on the top. Figure 1 is a graphical representation to demonstrate measurement traceability and the calibration hierarchy from the realization of the SI units down to the measurements performed by process instruments. Just below the SI level of the pyramid, the BIPM works directly with the NMIs of member countries to facilitate the promotion of the SI units within those countries. However, it is not always affordable or efficient for organizations to work directly with an NMI. The NMI-level standards are used to calibrate primary standards or instruments; primary standards are in turn used to calibrate secondary standards; secondary standards are used to calibrate working standards and working standards are used to calibrate process instruments. In this way, references to the SI standards can be efficiently passed down the calibration pyramid through the NMI.



By this explanation it should be clear that traceability, or traceable calibration, means that a calibration is performed with calibrated reference standards that are traceable through an unbroken chain back to the pertinent SI unit, through NMI and BIPM.

Calibration intervals

ISO 10976 is the international standard that provides accepted methods for measuring quantities onboard LNG carriers. The standard states that “all specified measurement equipment used on-board an LNG carrier shall be certified prior to initial use. Subsequently, measurement equipment and systems shall be re-calibrated and re-certified on a periodic basis, subject to sales and purchase agreements or national requirements. Measurement equipment shall be re-certified where modification or repairs are carried out and which affect the accuracy of the measurement data.”

The International Group of Liquefied Natural Gas Importers (GIIGNL) and the Society of International Gas Tanker and Terminal Operators (SIGTTO) are two organizations involved in the specification of a CTMS for gas carriers. The LNG Custody Transfer Handbook, issued by GIIGNL, states that it is recommended to perform periodic instrument calibration at intervals agreed by the buyer and seller (typically five years, during dry-docking). In the corresponding document issued by SIGTTO it is stated that instrumentation is only accurate if properly calibrated. Furthermore, the document clarifies that reference instruments must be calibrated at regular intervals in specialized facilities and carry a calibration certificate.

When calibration is neglected

Performing and documenting calibrations for CTMS instruments involves lots of resources and can require significant investment. It is relatively easy to calculate the annual cost of the calibration process, including the cost of reference instruments and recalibrating them. However, organizations should also consider the possible cost of not investing in such resources, and the risks if calibrations are overlooked. The consequences of poor calibration or neglecting to maintain the calibration process can include contractual disputes and failure in meeting regulations. Therefore, it can be less costly to make the necessary investment and ensure calibrations are performed as required.

Calibration laboratories

A calibration and the associated traceability for a tool used as part of a calibration process can be assured by using a calibration laboratory that is accredited to the international standard ISO 17025. The standard requires laboratories to demonstrate competence in both the technical aspects of the measurements and quality assurance. This ensures calibrations are performed correctly and organizations will receive a useful set of results and a valid certificate. By using a laboratory that is accredited to ISO 17025 for the calibration of reference instruments, organizations can ensure that

the calibration of a CTMS is metrologically traceable and have confidence that the system is performing accurate measurements.

Summary

Ensuring accuracy in custody transfer measurements is vital, and to be certain that measurement instruments are performing correctly, they must be periodically calibrated. This involves comparing a device's measurement against a more accurate reference standard and then documenting the comparison. A convenient way to perform such calibration is by using a calibration test cable instrument as the reference standard. In measurement systems that use this method of calibration – such as the Rosemount™ Custody Transfer Measurement System from Emerson – the calibration of the test cable instrument must be traceable to a higher measurement standard to ensure it complies with the necessary requirements in terms of accuracy.

Although performing and documenting calibrations may be time consuming, it might prove costly to neglect it as this can potentially result in dubitable financial transactions, and non-compliance with regulations. Instrument calibrations must be traceable to a nationally or internationally recognized standard, to ensure the accuracy of the CTMS and ensure that all parties involved in the transaction can trust the measurements.

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