Manual of Petroleum Measurement Standards Chapter 3—Tank Gauging

Section 5—Standard Practice for Level Measurement of Light Hydrocarbon Liquids Onboard Marine Vessels by Automatic Tank Gauging

FIRST EDITION, MARCH 1997

REAFFIRMED, FEBRUARY 2013

AMERICAN PETROLEUM INSTITUTE

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FOREWORD

This publication covers standard practice for level measurement of light hydrocarbon liquids onboard marine vessels by automatic tank gauging. The light hydrocarbon liquids covered in this standard may be pressurized or refrigerated, or both. The light hydrocarbon liquids covered include: liquefied petroleum gas (LPG), natural gas liquid (NGL) and other petrochemical liquids where the storage and transportation requirements and the methods of measurement are similar to that for LPG and NGL gauging.

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Suggested revisions are invited and should be submitted to the Measurement Coordinator, Exploration and Production Department, American Petroleum Institute, 1220 L Street, N.W., Washington, D.C. 20005.

CONTENTS

Standard Practice for Level Measurement of Light Hydrocarbon Liquids Onboard Marine Vessels by Automatic Tank Gauging

1 Scope

This standard covers accuracy, installation, calibration and verification of automatic tank gauges (ATGs) in custody transfer application in which the ATG is used for measuring the level of light hydrocarbon liquids, such as liquefied petroleum gas (LPG) transported aboard marine vessels (i.e., tankers and barges). The light hydrocarbon liquids covered in this standard may be pressurized or refrigerated, or both.

This standard is applicable to natural gas liquid (NGL) and other petrochemical liquids where the storage and transportation requirements and the methods of measurement are similar to those for LPG gauging.

This standard is not applicable to cryogenic liquids (below –100 °F) such as liquefied natural gas (LNG).

Although the accuracy of marine automatic tank gauging is affected by some of the limitations described in *Manual of Petroleum Measurement Standards (MPMS)*, Chapters 3.3 and 3.4, ATGs onboard LPG marine carriers can be used in custody transfer when no better, alternative measurement is available.

The standard also covers the requirements for data collection, transmission, and receiving.

This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2 References

API

Manual of Petroleum Measurement Standards (MPMS):
- Chapter 1, "Vocabulary"
- Chapter 2, "Tank Calibration"
- Chapter 3, "Tank Gauging"
- Chapter 7, "Temperature Determination"
- Chapter 12, "Calculation of Petroleum Quantities"
- Chapter 17, "Marine Measurement"

GPA[1]
- Standard 8195, *Standard for Converting Net Vapor Space Volumes to Equivalent Liquid Volumes*

3 General

This section is applicable to all types of ATGs used in marine vessels carrying light hydrocarbon liquids. Safety precautions are listed separately from general precautions that affect accuracy or performance.

3.1 SAFETY PRECAUTIONS

The following recommended practices and guidelines on safety should be followed:

a. API Recommended Practice 500, *Classification of Locations for Electrical Installations at Petroleum Facilities.*
b. API Recommended Practice 2003, *Protection Against Ignition Arising Out of Static, Lightning and Stray Currents.*
c. ISGOTT—*International Safety Guide for Oil Tankers and Terminals.*
d. IMO—*International Code for Construction and Equipment of Ships Carrying Liquefied Gases in Bulk* (IGC Code), Chapter 13.1, Instrumentation (Gauging, Gas Detection).
e. US Coast Guard (USCG) regulation—33 CFR, Part 153.
f. USCG regulation—46 CFR, Part 39.20.
g. USCG Marine Safety Center NVIC 2-89, "Basic Guidance for Electrical Installations on Merchant Vessels."

Other applicable safety codes and regulations should be complied with.

3.1.1 Electrical Safety

All electric components of a marine ATG for use in electrically classified areas should be appropriate to the classification of the area and should conform to appropriate national (UL, FM, FCC, NEC, etc.) electrical safety standards, and/or international (IMO, IEC, CENELEC, ISO, and so forth) marine electrical safety standards.

3.1.2 Equipment Precautions

3.1.2.1 All marine ATG equipment should be capable of withstanding the pressure, temperature, operating, and environmental conditions likely to be encountered in the service.

3.1.2.2 Measures should be taken to guarantee that all exposed metal parts of the ATG and its associated equipment should have the same electrical potential as the tank.

3.1.2.3 All marine ATG equipment should be maintained in safe operating condition, and manufacturers' maintenance instructions should be complied with. As an alternate, the sensors should be intrinsically safe.

Note 1: The design and installation of ATGs may be subject to the approval of a national measurement organization, which will normally have issued a type approval for the design of the ATG for the particular service for which it is to be employed. Type approval is normally issued after an ATG has been subjected to a specific series of tests. Type approval is also based on installation in a preapproved manner. Type approval tests may include the following:

[1]Gas Processor Association, 6526 East 60th Street, Tulsa, Oklahoma 74145

visual inspection, performance, vibration, humidity, dry heat, inclination, fluctuations in power supplies, insulation, resistance, electromagnetic compatibility, high voltage, pressure compatibility, and material certificates. Further fireproof certificates may be required.

Note 2: The design and installation may be subject to the approval of national safety organizations dealing with pressure vessels and the application of measuring instruments.

3.1.3 General Precautions

The following general precautions apply to all types of marine ATGs and should be observed where they are applicable.

3.1.3.1 The measurement of pressure and temperature of the vapor in the tank, liquid temperature, or any other relevant parameter should be time correlated with the tank level measurement. The tank liquid temperature should be representative of the liquid contents. The cargo tank should be isolated from other tanks and lines when taking ATG readings.

3.1.3.2 All information obtained from the measurement in a bulk transfer should be recorded promptly as it is taken.

3.1.3.3 Whenever a determination of the contents of a tank is made before the movement of a bulk quantity of liquid (opening gauge) and after the movement of a bulk quantity of liquid (closing gauge), the same general procedures should be used to measure the tank level.

3.1.3.4 All parts of the ATG in contact with the product or its vapor should be chemically compatible with the product, to avoid both product contamination and corrosion of the ATG.

3.1.3.5 ATGs should have sufficient dynamic response to track the liquid level during maximum tank filling or emptying rates.

3.1.3.6 Marine ATGs should be designed to withstand damage caused by waves in the tanks due to ship movement.

Note 1: This protection may require mounting the ATGs in perforated or slotted still pipes.

Note 2: Alternately, this protection may require that the mechanical float type be raised to a "store" position when it is not being used.

3.1.3.7 Following the transfer of product, the tank should be allowed to settle so that the liquid surface is sufficiently quiescent before the tank level is measured.

3.1.3.8 Following a rapid change in the ambient conditions, or operation of the liquefaction plant onboard the vessel, the liquid surface may show temporary instability (such as boiling). The level measuring equipment should be capable of detecting the liquid surface even when it is unstable, and it should be capable of providing a reading corresponding to the liquid level.

3.1.3.9 The ATG should be able to measure levels as near to the bottom of the tank as possible. This may require provision of a sump in the tank bottom.

Note: The minimum measurable level of certain types of ATGs may limit their ability to measure small volumes of remaining on board/on board quantity (ROB/OBQ).

3.1.3.10 If practical, an ATG is checked or calibrated by manual gauging. The manual gauging should be performed in accordance with applicable procedures in API MPMS Chapter 3.1A and Chapter 17.2A. At least three consecutive manual gauge readings should be taken and the readings should be averaged. If the vessel is in heavy motion due to swells or waves, at least five manual gauge readings should be taken. Due to the difficulty of restrictive or closed manual gauging and the boiling effect of the cargo, the range of the consecutive manual gauge readings, however, can be relaxed to ± ½ inch (12 millimeters).

3.1.3.11 To achieve better accuracy of verification, the vessel should be on an even keel and upright. In situations where both trim and list exist, every effort should be made to eliminate at least one condition, preferably list.

Trim and list corrections are not required on vessel tanks of cuboid (i.e., rectangular prism) or prismatic shape, provided the ATG is located at the geometric center of the deck area for the tank. Where the ATG is not so located, correction will be required. On vessel tanks that have curvature(s), such as the aft and forward wing tanks, trim and list, corrections are recommended. Correction for trim, list, and wedge is permissible by table or calculation, using applicable procedures described in API MPMS Chapter 17.

3.1.3.12 The ATG reading should be the average reading. Some ATGs or the microprocessor-based tank monitoring system provide internal filtering algorithms as part of the readout to average the level readings over a time interval. A stable average reading may not be available due to the vessel motion and the boiling effect of the cargo, and/or due to the lack of an automatic averaging feature of the ATG system. In this situation, at least three consecutive ATG readings (corresponding to the high and low level of the wave of the cargo liquid surface) should be taken and the readings should be averaged.

3.1.3.13 ATGs should provide facilities to prevent unauthorized adjustment or tampering. ATGs used in custody transfer service should provide security to allow sealing of the calibration adjustment.

4 Accuracy Requirement

The accuracy of automatic level measurement is affected by the inherent (intrinsic) error of the marine ATG, the effect of installation, the effect of changes in operating conditions, and vessel motion. Some of the factors described below also

affect manual measurement that may be used as part of the ATG setting and calibration.

4.1 INHERENT ERROR OF ATGs

4.1.1 The level measurement accuracy of all ATGs is affected by the inherent error of the ATG, i.e., the error of the ATGs when tested under defined referenced conditions as specified by the manufacturers.

4.1.2 For ATGs that compute level from pressure sensors, such as hydrostatic tank gauges (HTGs), if the HTG-computed level is used to determine cargo volume and/or mass, the repeatability of the pressure sensor should meet manufacturer's performance specifications. The full scale of the pressure sensor should be selected so that the accuracy of the pressure sensor, which is usually measured as percent of the full scale, can be optimized for the intended application.

The intended range of the pressure sensor should be less than the full-scale or upper-range value of sensor. The intended operating range should include zero and the maximum level conditions.

4.2 CALIBRATION PRIOR TO INSTALLATION

4.2.1 Readings of marine ATG in custody transfer service should be calibrated prior to installation (such as in the factory or testing laboratory under controlled conditions) to agree with a certified reference (such as a certified gauge tape) to ± ¼ inch (6 millimeters) over the entire operating range of the ATG. The certified reference should be traceable to the National Institute of Standards and Technology (NIST). The uncertainty of the certified reference should not exceed ⅛ inch (3 millimeters) with the calibration correction applied.

Note: ATGs used in internal inventory control or operational applications (such as, tank filling and emptying and level control) should be calibrated to ensure safe operation. The accuracy on level is determined by the owner of the marine vessel.

4.2.2 For an ATG that computes level from pressure sensors, for example, a pressure-based system such as a hydrostatic tank gauge (HTG) and the level derived is used to determine cargo volume and/or mass, each pressure sensor used in the HTG should be calibrated against a certified pressure reference.

Note: An HTG does not measure level directly. The level derived by an HTG can be affected by stratification of cargo density and temperature.

4.2.2.1 The difference between the pressure measured by each pressure sensor (used in the HTG to compute level) and by the certified pressure reference should not exceed 0.25 inch H_2O, or 60 Pa (pressure). The calibration should cover the entire operating range of the pressure sensors. The intended operating range should include zero and the maximum level conditions.

4.2.2.2 The uncertainty of the level should also be calculated. The calculation should be based on the uncertainty of all sensors of the gauging system used in determining the level and on the level equation used in the HTG system. The uncertainty of level thus calculated should be within ± ½ inch (12 millimeters) over the intended operating range of the HTG.

4.3 SHIPYARD ADJUSTMENT

Shipyard adjustment (setting) procedures should be in accordance with the ATG manufacturer's instructions. The shipyard adjustment should confirm that the remote readout and the local readout, if provided, read the same level.

4.4 ERROR CAUSED BY INSTALLATION AND CHANGE OF OPERATING CONDITIONS

The error caused by installation and change of vessel operating conditions on an ATG in custody transfer application should not exceed ± ½ inch (12 millimeters), provided the operating conditions are within the limits specified by the ATG manufacturer. The error of installation includes the uncertainty of draft gauges, the inclinometer, and the uncertainty of measurement of the locations of the ATG and the tank reference.

Note 1: The accuracy of measurements using ullage-type ATGs is affected by vertical movement of the upper reference point used to calibrate the ATG or vertical movement of the ATG top mounting point during tank transfers. Accuracy may also be affected by tank tilt, hydrostatic pressure, and vapor pressure.

Note 2: The accuracy of measurements by innage ATGs may be affected by vertical movement of the ATG bottom mounting point during tank transfers and/or pressure variations.

Note 3: Volume measurements using tanks are limited by the following installed accuracy limitations, regardless of the ATGs used. These limitations may have a significant effect on the overall accuracy of both manual level gauging and of all types of automatic tank gauges, and/or on the accuracy of the quantity of the content in the tank.

a. Tank capacity table accuracy (including the effect of tank tilt and hydrostatic pressure).
b. Changes of tank geometry due to temperature.
c. Random errors in level, liquid, vapor density, pressure, and temperature measurement.
d. Operational procedures used in the transfer.
e. Difference between opening and closing levels (i.e., minimum parcel size).

Note 4: Special consideration should be given to volume and/or mass measurements in pressurized tanks with respect to the amount of product present in the vapor space of the tank.

4.5 USE OF ATGs IN CUSTODY TRANSFER SERVICE

The total accuracy of level measurement by ATGs, as installed, is affected by the inherent error of the ATG, the effect of installation, and the effect of changes in operating conditions. Depending on the total (overall) accuracy of the ATG as installed (installed accuracy), ATGs may be used in

custody transfer service per mutual contractual agreement between the buyer and the seller.

4.5.1 Accuracy Requirements of ATGs in Custody Transfer Service

4.5.1.1 The ATG should meet the preinstallation calibration tolerance (see Section 4.3).

4.5.1.2 The ATG should meet the tolerance for ATG setting at the shipyard (see Section 6).

4.5.1.3 Including the effects of the installation and changes in operating conditions (see Section 4.4), the ATG should meet the onboard verification tolerance (see Section 7).

4.5.1.4 The remote readout, if used, should meet the requirements of this standard (see to Section 10).

4.5.2 ATGs Not Described in This Standard

Marine ATGs that use technology other than those described in this standard can be used in custody transfer if they provide the required accuracy for the intended application.

5 Installation Requirements

5.1 GENERAL

The following sections outline recommendations and precautions for the installation of ATGs.

5.2 MOUNTING LOCATION

5.2.1 The mounting location of an ATG may affect the installed accuracy. For custody transfer accuracy, the ATG mounting location should have minimal movement with respect to the tank reference, due to changes in temperature, liquid head, and/or vapor pressure.

5.2.2 The ATG should preferably be mounted as close as practical to the vertical centerline axis of the tank.

5.2.3 The level sensing element should be protected against excessive turbulence caused by the product inlet or outlet. If such an operating condition is expected, an installation with a still pipe should be considered.

5.3 MANUFACTURER'S REQUIREMENTS

The ATG and level transmitter should be installed and wired in accordance with the manufacturer's instructions.

5.4 INSTALLATION OF ATGs

5.4.1 The level sensor(s) of an ATG should be located such that the measurement of level is not affected by excessive turbulence caused by the product inlet or outlet, by vapor flow, or by condensing liquid from the liquefaction plant.

5.4.2 Some ATGs are mounted on properly suspended still pipes. The still pipe protects the ATG level sensing element from liquid turbulence, and may provide the fixing point for the datum plate. The slots, holes and their spacing, and the diameter of the still pipe should conform to ATG manufacturer's recommendations. Use of still pipes without slots or holes can lead to serious level measurement errors.

5.4.3 For ease of maintenance and verification, the level sensor(s) of the ATG should preferably be installed such that the sensor(s) can be retrieved from the cargo tanks with the tank in service.

5.4.4 Mechanical, float-and-tape type ATGs using guide wires should be mounted on a properly installed flange (such as a nozzle). The level sensing element should be protected against excessive turbulence.

5.4.5 Microwave ATGs mounted on still pipes should be designed to ensure that sufficient signal strength is obtained and interference is minimized under the following conditions:

a. Boiling conditions, which can occur during emptying a high pressure tank.
b. Condensing conditions due to refrigeration and/or re-liquification process on the vessel.

The construction of the ATG may not require installation of an isolation valve for maintenance purposes when a permanent pressure seal that is transparent to the ATG is applied. Adequate means should be provided (for example, verification pins or calibration devices positioned on various heights in the still pipe) for maintenance and verification purposes. To allow adjustment when the tank is full, the highest pin should be positioned above the maximum filling height.

5.4.6 Installation of ATGs other than those described in this standard should be consistent with the requirements set forth in this standard.

6 Setting of ATG at Shipyard

6.1 PREPARATION

6.1.1 Check for critical reference distances.

Before filling the tank with product, the following critical reference distances, if applicable to the ATG installed, should be measured. The maximum uncertainty of these measurements should not exceed ⅛ inch (3 millimeters). Depending on the ATG type, these distances can include, the following examples:

a. The distance between the position of the datum plate and the tank bottom.
b. The distance between the datum plate and the reference flange on the deck on which the ATG assembly is mounted.
c. The distances between the reference flange (on which the ATG assembly is mounted) and the individual verifica-

tion pins, or similar methods. The pins should be located to cover the entire intended operating range of the ATG.
d. The distances between the reference flange (on which the ATG assembly is mounted) and the stopper located at the lower end of the support pipe of electronic float gauges.
e. The vertical distance between the pressure sensors of the HTG to the reference point of the tank.

6.1.2 Check for free movement of the level sensing element of intrusive ATGs.

The travel of the level sensing element through the normal range from top to bottom of the tank should be smooth and free, with no binding or friction. After mounting a new or repaired ATG and prior to adjusting (or setting) the sensing element (e.g., sensor float) and guiding mechanism (such as the tape, cable, and the connecting element), the ATG should be checked to ensure that the level sensing element can operate freely and smoothly over the entire operating range. This check should be performed slowly to simulate actual operation and to avoid damaging the ATG sensing element mechanism.

6.1.3 Check for the influence of changes in physical and electrical properties of the product (vapor/liquid).

Most ATG technologies are affected, in one way or another, by changes in the physical and/or electrical properties of the liquid and vapor in the tank. The manufacturer should quantify these influences.

6.2 SETTING ATGs

6.2.1 General

6.2.1.1 Shipyard ATG setting or adjustment procedures should be in accordance with the ATG manufacturer's instructions. Setting or adjustment of an ATG usually consists of setting a single point on the calibrated span to match the height of a reference point. In general, such a point can be one or more of the following:

a. The reference point in a calibration chamber.
b. The top of the isolation valve, or the point where a verification pin is located.
c. The tank datum plate.

The value of this point should be recorded (see note).

Note: When more than one point may be accessed, these points should be measured and recorded for later verification purposes.

The shipyard adjustment should confirm that the level displayed by the remote readout and the level transmitter (if the ATG is provided with a local deck readout) is the same.

6.2.1.2 Adjustment and verification of ATGs other than those described in this standard should be consistent with the accuracy verification criteria described in this standard.

Note: Many ATGs are calibrated prior to installation and the span may not be adjusted with cargo in the tank. Therefore, the ATGs are verified rather than calibrated onboard.

6.2.2 Setting of Electrical Capacitance Type ATGs

Mount the capacitance sensor tape in a nonmetallic container tank. Fill the tank with test liquid. Compare with level measured by the sensor and the liquid depth in the tank measured by a certified reference. Record the temperature of the liquid at the same time. The comparison should be made at various levels as recommended by the ATG manufacturer covering the intended operating range of the gauge. The test data is then used to generate a linearity curve to reflect the unique characteristics of the sensor tape being tested.

Then, use a reference capacitance calibrator (such as capacitance bridge) to simulate change of level, calculate the difference between the reference and the ATG measured capacitance. Calculate the corresponding difference and convert it to liquid level (such as in inches or millimeters). The comparison should be made at least every 18 inches (500 millimeters). The ATG readings and the reference readings, converted to level, should be within ½ inch (12 millimeters) over the entire intended operating range.

Note: This calibration may be performed at the ATG manufacturer's facilities or where the calibration equipment is available. If this is the case, the calibration is usually witnessed by the owner of the ATG and/or the representative of the shipyard.

6.2.3 Setting of Mechanical Float-and-Tape ATGs

After mounting an ATG that uses a float, the tape, cable, and connecting elements should be centered. Float travel through the normal range from top to bottom of the tank should be smooth and free with no binding or friction.

The tape, cable, gauge head, and all components of a float-operated ATG should be checked by manually moving the tape or cable through the entire range to assure free operation. This check should be done slowly to simulate actual operation and to avoid damaging the ATG.

Setting mechanical float-and-tape ATGs is accomplished as follows:

a. Lower the level sensing element to the datum plate or stopper (or the lower reference point).
b. Set the ATG reading to agree with the predetermined reference point.
c. Raise the level sensing element back to the upper reference point (see 6.2.1). Then lower the level sensing element to the datum plate (or the lower reference point) and record the reading.
d. Repeat the step in Item c, to obtain a total of three consecutive readings which should not exceed a range of ½ inch (12 millimeters) for both reference points. Reset the ATG if necessary to agree with the predetermined reference point or points.

6.2.4 Setting of Electronic (e.g., Magnetic) Float ATGs

a. Lower the level sensing element to the lowest point of the support/guide pole or stopper (or the lower reference point).
b. Set the ATG reading to agree with the predetermined reference point.
c. Raise the level sensing element back to the upper reference point (see 6.2.1) and compare the ATG readings at least every 6 feet (2 meters) against a reference tape or other calibration reference. Record the readings. The difference between the ATG readings and the reference readings should be within ½ inch (12 millimeters) over the entire range.
d. Lower the level sensing element to the datum plate (or the lower reference point) and follow the procedure in Item c above.

6.2.5 Setting of Microwave ATGs

a. Set the ATG measurement to the locations of the verification pins (or similar verification devices).
b. Take an ATG reading at each of all verification pins from top to bottom. Repeat this step three times. The maximum spread of the three ATG readings at each pin should not exceed ¼ inch (6 millimeters).
c. Use a target to simulate liquid level and operate the ATG to measure the level. The maximum error of the ATG level should not exceed ¼ inch (6 millimeters) when tested in air.

Note: The accuracy of a microwave ATG measurement is affected by the variation of composition of the vapor and variation of vapor density. The tolerance described above, which is in air, does not include these effects on the accuracy of the ATG when in actual operations.

6.2.6 Setting of HTGs—When Used As Level Gauges

a. Connect the pressure sensors with the reference pressure source to simulate operating conditions.
b. Vary the pressure output signal of the reference to cover the minimum pressure and maximum pressure of the intended application. The maximum pressure should be the full scale of the pressure transmitter as specified.
c. Compare the level derived by the reference and the level computed using the same algorithm of the HTG using the pressure transmitters. The difference of the levels should be within ½ inch (12 millimeters) over the entire operating range of the HTG.

Note: The level computed by an HTG can be affected by density stratification and temperature stratification of the cargo (liquid) in the tank. The tolerance stated above does not include these effects, which vary depending upon the operating conditions.

6.2.7 Other ATGs Not Described in This Standard

Marine ATGs other than those described in this standard should be set so that the ATG reading agrees with predetermined and stable verification points. The procedure, which may vary depending on the ATG technology and/or design, should be consistent with the criteria described above to meet the intent of the ATG setting.

7 Onboard Verification of ATGs

7.1 INTRODUCTION

The purpose of the onboard verification is to ensure that the ATG, as installed, can sense and indicate level (i.e., liquid/vapor interface) over its entire measuring range as accurately as properly performed manual level gauging if manual gauging (for level) were possible. Verification is a process that confirms that the installed accuracy of the ATG is appropriate for the intended service.

Note: ATGs are designed to measure the distance from the ATG reference to the liquid surface. They cannot compensate for all limitations of the accuracy of tank level measurement described in the standard. The following fundamental influences, which may affect the accuracy of the level measurement, should be considered:

a. Tank installation errors.
b. Changes in operating conditions.
c. Errors inherent to the principle of operation of the ATG.
d. Following the adjustment of the ATG, the overall accuracy of the ATG is verified by:
   1. Comparing the ATG readings against the recorded levels used during the calibration procedure.
   2. Measuring the reference height, if the ATG permits such a measurement.

7.2 VERIFICATION PROCEDURE

The maximum resolution of the ATG should be used. The readings should not be rounded off.

To minimize the effect of vessel motion and adverse external conditions, verification should be performed with a stable liquid level. The liquid level at which the ATG is verified should be within the intended operating range of the ATG. The average of ATG readings should be used in most circumstances as the ATG reading. Automatic filtering and averaging by the ATG is recommended to reduce error due to manually guessing the ATG reading on a rolling sea.

7.3 PROCEDURE FOR APPLICATIONS WHERE MANUAL GAUGING IS PRACTICAL

7.3.1 If the reading by ATG and the reading by manual gauging agree within ½ inch (12 millimeters), no further action should be required.

Note: Where the reference gauge point for manual gauging is different from the ATG, apply the appropriate correction.

7.3.2 If the reading by ATG and the reading by manual gauging differ by more than ½ inch (12 millimeters), the ATG reading and the manual gauging should be repeated three times (or five times if there are waves in the tank). The average manual gauge reading and the average ATG reading should be compared.

7.3.3 If the difference between the average ATG reading and the average of the manual gauge reading exceeds ½ inch (12 millimeters), and it is determined that the difference is not caused by sea conditions or by change of operating conditions during the manual gauging, the ATG should be adjusted to agree with the manual gauging. These adjustments and the reasons for them should be recorded in the vessel's equipment maintenance log.

7.3.4 After adjustment, the ATG reading should be compared with the manual gauge reading in accordance with procedure described above. If the difference between the average ATG reading and the average manual gauge reading is less than ½ inch (12 millimeters), no further action should be required.

7.3.5 If the ATG cannot be adjusted to agree with the average manual gauge reading, a correction may be used. This correction should be documented by the vessel.

7.4 PROCEDURE FOR APPLICATIONS WHERE MANUAL GAUGING IS NOT PRACTICAL

For ocean-going marine vessels carrying light hydrocarbon liquids, manual gauging is usually not practical to verify the ATGs. The ATGs should be checked in accordance with manufacturer's recommendations and procedures.

7.4.1 Verifying an ATG Against a Reference Point

As an alternate method for some ATGs, the ATG can be verified against a reference measurement value(s) or a reference point(s) at the cargo tank. The ATG measurement and the reference measurement should be corrected to reflect the actual operating conditions (for example, shrinkage due to low temperature).

7.4.1.1 Depending upon the ATG type, some ATGs can be verified against a reference point (such as upper reference point) or against a verification device (for example, a pin, a stopper). If this method is available, the difference between the ATG and the reference should be within ¼ inch (6 millimeters).

7.4.1.2 If the readings by the ATG and the reference differ by more than ¼ inch (6 millimeters), and if the ATG or the tank monitoring computer system does not have a filtering or averaging function, take three spot ATG readings (or five spot readings if necessary). The average of the ATG readings should be used as the ATG reading. During verification, the vessel should be on an even keel and upright. In situations where both trim and list exist, every effort should be made to eliminate at least one condition, preferably list.

7.4.1.3 If the difference between the average ATG reading and the reference exceeds ¼ inch (6 millimeters), the ATG should be adjusted to agree with the reference. These adjustments and the reasons for them should be recorded in the vessel's equipment maintenance log.

7.4.1.4 After adjustment, the ATG reading should be compared with the reference in accordance with procedure described above. If the difference between the average ATG reading and the reference reading is less than ¼ inch (6 millimeters), no further action should be required.

7.4.1.5 If the ATG cannot be adjusted to agree with the reference, a correction may be used. The correction value should be posted near the ATG readout and used to correct the ATG reading. This correction should be documented by the vessel.

7.4.2 Cross-Checking of ATGs

For ocean-going tankers in which each prismatic cargo tank is divided into two wing compartments, there may be two ATGs in each compartments. If this is the case, the two ATGs in the same compartment can be cross-checked against each other.

In addition, by opening the equalization valve (on the bulkhead) connecting two adjacent compartments, the ATGs in two adjacent compartments can be checked against each other—provided the product density and temperature of the cargo in the two compartments are nearly the same.

It is recognized that these procedures cannot verify the accuracy of an ATG to ensure it meets the tolerance set forth in this standard. However, they provide an indication of the performance of the ATGs on the vessel.

8 Subsequent ATG Verification

A verification program should be established for ATGs used in custody transfer. The ATG installation should be verified as recommended by the manufacturer's instructions.

The ATG should be verified at least once per quarter. If operating experience confirms stable performance within the verification tolerance, the verification schedule can be extended to once a year. The frequency of subsequent verification may also be established by use of a verification tolerance control chart based on statistical quality control.

9 ATG Verification Records

ATG verification records should be documented and the record should be available for inspection by involved parties. The records should be kept for at least three years.

A maintenance schedule based on the manufacturer's recommendations should be put into force for each ATG installation. The schedule should ensure that each ATG is inspected at regular intervals. Remote indication equipment should be included in the schedule. Records of maintenance work should be kept.

10 Data Communication and Receiving

This section provides recommendations for the specification of the communication between level transmitter(s) and receiver(s) and vice versa. The measurement data by an ATG may include other information.

The ATG system should be designed and installed such that the data transmission and receiving unit should:

a. Not compromise the accuracy of the measurement. This criterion is defined as follows:

1. For digital signal transmission, the difference between the level readings displayed by the remote receiving unit and the level readings displayed (or measured) by the ATG at the tank should agree to each to within 1⁄16 inch (1 millimeter).
2. For electronic analog signal transmission, the difference between the level readings displayed by the remote receiving unit and the level readings displayed (or measured) by the ATG at the tank should agree to within 1⁄8 inch (3 millimeters) if the resolution of the readouts permits. The readout that provides the best resolution should be used.

Note: The local, deck-mounted readout of some ATGs cannot calculate and display average level. In this situation, do not compare an instantaneous, spot ATG reading by the local readout against the average level calculated and displayed by the remote readout equipment.

b. Not compromise the resolution of the measurement output signal.

c. Provide proper security and protection of the measured data to ensure its integrity.

d. Provide adequate speed to meet the update time required for the receiving unit.

e. Not be susceptible to electromagnetic interference.

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