

## Guidelines for Determining the Fullness of Pipelines between Vessels and Shore Tanks

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#### 1 Scope

This document describes procedures for determining or confirming the fill condition of pipeline systems used for the transfer of liquid cargoes ~~before and/or after the liquid is loaded onto or discharged from marine vessels.~~ It includes descriptions of methods and procedures that apply to crude oil and petroleum products.

While this document includes descriptions of common line fill verification methods, it does not recommend any particular method. The responsibility for selecting a method appropriate for a given terminal, and documenting its effectiveness, rests with those responsible for operating the terminal where it is applied.

#### 2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

~~API Chapter 1/HM 0, Vocabulary.~~

API MPMS Chapter 3.1A, *Standard Practice for Manual Gauging of Petroleum and Petroleum Products*

API MPMS Chapter 3.1B, *Standard Practice for Level Measurement of Liquid Hydrocarbons in Stationary Tanks by Automatic Tank Gauging*

API MPMS Chapter 7.3, ~~Fixed Automatic Tank Temperature Systems~~*Temperature Determination.*

~~API MPMS Chapter 17.1 Guidelines for Marine Inspection.~~

~~API MPMS Chapter 17.2, Measurement of Cargoes On Board Tank Vessels.~~

~~API MPMS Chapter 17.4, Method for Quantification of Small Volumes on Marine Vessels (OBQ/ROB)~~

~~API MPMS Chapter 17.11/HM 52, M, Measurement and Sampling of Cargoes On Board Tank Vessels Using Closed/Restricted Equipment.~~

EI HM 4 Manual Level Measurement for Hydrocarbon Liquids.

~~OCIMF/ISGOTT: International Safety Guide for Oil Tankers and Terminals.~~

#### 3 Terms and Definitions

For the purposes of this document, the following definitions apply. Terms of more general use may be found in the API MPMS Chapter 1 Online Terms and Definitions Database.

##### 3.1

##### Agreed tolerance

Before executing the line displacement method, all authorized parties should agree on the amount of difference that will be accepted when comparing measurements taken before and after the procedure. This agreement may be in terms of volume, percentage or ~~rather than~~ level measurement. ~~The term agreed tolerance refers to this agreed-upon span of acceptable difference.~~

### **3.2**

#### **high-point bleed-valve method**

~~Sight-glass/mechanical sight verification method~~

~~Checking for the presence of liquid at high-point valves or sight glasses in the designated pipeline system between the shore tank and the vessel berth.~~

### **3.3**

#### **internal circulation method**

~~Transferring a measured volume of liquid from one shore tank into the same or another shore tank through the pipeline system designated for the transfer of cargo to or from a marine vessel.~~

### 3.4

#### **line displacement method**

Measuring the amount of liquid pumped from a shore tank to a vessel (or from a vessel to a shore tank) through the pipeline system designated for cargo transfer and comparing the measured volume delivered to the measured volume received. TOV is the normal method used.

### 3.5

#### **line press method**

#### **line pack method**

Pressurizing the contents of the designated pipeline system with a liquid to determine if gases are present.

### 3.6

#### **pigging method**

Displacement of the contents of a pipeline system by a tight fitting wiping device propelled through the line by gas or liquid, leaving the line full of the propellant.

## **4 Health and Safety Precautions**

### **4.1 General**

Due consideration shall be given to applicable safety and health procedures. Considerations shall include—but are not limited to—potential electrostatic and other fire and explosion hazards; considerations regarding potential personnel exposure (such as exposure limits, hazard communication, training, and associated protective clothing and equipment requirements, and work practices); and potential explosive and toxic hazards associated with a cargo tank's atmosphere. The physical characteristics of the cargo and existing operational conditions shall be evaluated, and applicable international, federal, state, and local regulations shall be observed. Safety procedures designated by the employer, the vessel operator, and other concerned parties shall also be observed. The International Safety Guide for Oil Tankers and Terminals and appropriate Oil Companies International Marine Forum (OCIMF) and API publications shall be consulted for additional safety information.

**Caution—**Petroleum vapors and associated substances, including hydrogen sulfide vapors may also involve potential toxicity. Petroleum vapors with high concentrations of hydrogen sulfide may cause unconsciousness or death. During and after the opening of the gauge hatch, stand so that vapor inhalation is minimized.

**Caution—**Harmful vapors or oxygen deficiency cannot be detected safely by smell, visual inspection, or judgment. ~~Take Appropriate precautions shall be used~~ for protection against toxic vapors or oxygen deficiency. ~~Develop Procedures shall be developed~~ to provide for appropriate exposure monitoring, personal protective equipment, and emergency rescue precautions. When it is necessary, ~~utilize personnel shall have~~ suitable respiratory protection before entering the gauge site and during the gauging procedure.

### **4.2 Physical Characteristics and Fire Considerations**

**Warning—**Personnel who handle petroleum-related substances (as well as other chemical materials) shall be familiar with their physical and chemical characteristics—including potential for fire, explosion, and reactivity—and with potential toxicity and health hazards and emergency procedures. They shall comply with individual company safe operating practices and local, state, and federal regulations. Personnel shall be alert to avoid potential sources of ignition and shall keep containers of materials closed when not in use. Refer to the substance's Safety Data Sheet and other documents relevant to the cargo's quality.

## 4.15 Significance and Use

### 4.15.1 General

When ~~custody of~~ petroleum liquids ~~are~~ transferred, ~~the to or from marine vessels,~~ accuracy ~~in the measurement of the measurement~~ quantities transferred is affected by the ~~condition~~ contents and integrity of the ~~connecting shore and vessel~~ pipelines. This requires ~~and by shore and vessel tank measurements.~~ Pipelines that contain air or vapor, when assumed to be filled with liquid, require procedures be adopted that either eliminate or determine the volume of air/vapor or liquid ~~or vapor~~ contained in the pipeline. The minimum requirement to conform to this standard is to perform a line verification at the start of custody transfer. This can be accomplished by either filling or emptying the line by one of the following means in no preference.

1) ~~Displacing the air or vapor with liquid.~~

2) ~~Displacing the entire line contents.~~

The following methods, listed alphabetically, are recommended for line fill determination. Local limitations, product characteristics, and specific designs may restrict the best selection and use of a procedure and may affect the accuracy of the procedure selected.

a) High-point bleed-valve method (or sight-glass/mechanical sight verification method).

b) Internal circulation method.

Line clearing method (Pigging/Blowing/Stripping).

Line displacement involving marine vessels.

c) ~~.~~

NOTE ~~This method can directly affect custody transfer volumes.~~

d) Line press method (or line pack method).

e) Pigging method.

NOTE While it is recommended that a line verification be performed after custody transfer, operational constraints may prevent line fullness from being determined. If line fullness is not able to be determined at the end of the transfer it can have an effect on the overall custody transfer volume. In theory this could be up to the capacity of the line.

NOTE The high point bleed valve method (or sight glass method), the internal circulation method, and the line displacement method are all intended to fill the designated pipeline system with liquid. The pigging method is intended to entirely displace the contents of the designated pipeline system. The line press method (or line pack method) is intended to assess the fill condition of the designated pipeline system.

### 4.25.2 Considerations for Selecting a Method

~~The following should be taken into consideration when selecting a method for line verification. Local limitations, product characteristics, and specific designs may restrict the selection and use of a procedure and may affect the accuracy of the procedure selected. The following should be taken into consideration when selecting a method for line verification before the transfer.~~

~~The design, equipment, and operational capabilities of the vessel and/or terminal.~~

~~a) The "High-point bleed-valve method (or sight-glass/mechanical sight verification method), Internal circulation method and Line press method (or line pack method)" Methods in 4.1, Items a), b), d), and e) may be performed prior to the start of the custody transfer vessel arrival. These methods also provide an opportunity to confirm integrity of pipeline condition (e.g. leaking misaligned valves) and to take corrective action as necessary without becoming a portion of the custody transfer volumes determination. TOV is the normal method used.~~

~~The design, equipment, and operational capabilities of the vessel and/or terminal. Terminals that pig, blow or strip their lines before and after transfers, may result in their lines being in an unknown condition, as none of these methods can fully evacuate the line. When this situation occurs, it is necessary to quantify the volume of product in the line. The line can either be filled prior to the custody transfer by circulating the line, or a line displacement can be performed to determine the amount of the void in the line.~~

~~The high-point bleed-valve method (or sight-glass/mechanical sight verification method), and the internal circulation method, are intended to fill the line prior to custody transfer.~~

~~The line displacement method can either be used to prove the line is full, or can be used to quantify the void in the line.~~

~~The line press method (or line pack method) pressurizes the contents of the designated pipeline system with a liquid to minimize any void spaces that may be present.~~

~~b)~~

~~After transfer all of the above methods except for line displacement can be used.~~

## **5—Health and Safety Precautions**

### **5.1—General**

~~Due consideration should be given to applicable safety and health procedures. Considerations should include—but are not limited to—potential electrostatic and other fire and explosion hazards; considerations regarding potential personnel exposure (such as exposure limits, hazard communication, training, and associated protective clothing and equipment requirements, and work practices); and potential explosive and toxic hazards associated with a cargo tank's atmosphere. The physical characteristics of the cargo and existing operational conditions should be evaluated, and applicable international, federal, state, and local regulations should be observed. Safety procedures designated by the employer, the vessel operator, and other concerned parties should also be observed. The International Safety Guide for Oil Tankers and Terminals and appropriate Oil Companies International Marine Forum (OCIMF) and API publications should be consulted for additional safety information.~~

~~**Caution—Petroleum vapors and associated substances, including hydrogen sulfide vapors from "sour" crude, also may involve potential toxicity. Petroleum vapors with high concentrations of hydrogen sulfide may cause unconsciousness or death. During and after the opening of the gauge hatch, stand so that vapor inhalation is minimized.**~~

~~**Caution—Harmful vapors or oxygen deficiency cannot be detected safely by smell, visual inspection, or judgment. Appropriate precautions should be used for protection against toxic vapors or oxygen deficiency. Procedures should be developed to provide for appropriate exposure monitoring, personal protective**~~

~~equipment, and emergency rescue precautions. When it is necessary, personnel should have suitable respiratory protection before entering the gauge site and during the gauging procedure.~~

## ~~5.2 Physical Characteristics and Fire Considerations~~

~~Warning—Personnel who handle petroleum-related substances (as well as other chemical materials) should be familiar with their physical and chemical characteristics—including potential for fire, explosion, and reactivity—and with potential toxicity and health hazards and emergency procedures. They should comply with individual company safe operating practices and local, state, and federal regulations. Personnel should be alert to avoid potential sources of ignition and should keep containers of materials closed when not in use.~~

## ~~6 Terminal Requirements~~

### ~~6.1 General~~

~~Nothing in this document should be construed as overriding safe operating procedures or applicable environmental regulations.~~

## 6.2 Requirements

~~The following terminal requirements should be taken into consideration.~~

- ~~a) Terminal personnel should designate a tank, a pipeline system (including meters, if used), and the method that will allow the most accurate determination of the quantity received or delivered. If automatic tank gauges are used, terminal personnel should provide evidence that they are custody transfer qualified in accordance with the provisions of API MPMS Ch. 3.1B.~~
- ~~b) The selected line fill verification procedure should be performed immediately before and/or after custody transfer.~~
- ~~c) Empty shore tanks should not be designated to receive line displacement or internal circulation volumes.~~
- ~~d) A floating roof should not be in the critical zone.~~
- ~~e) If the high point bleed valve method (or sight glass method) is selected to determine if a designated pipeline system is full, the valve or sight glass locations designated for this purpose should be identified.~~
- ~~f) Data showing the results of the method selected should be available.~~

## 7 Vessel Requirements

~~The vessel's line condition can affect the accuracy of the line displacement volumes between vessel and shore. Vessel personnel shall provide the capacity of the designated lines, indicate their fullness condition, and offer every assistance to accurately verify this condition.~~

## 8 Procedures

### 6.1 General Procedures

Terminal personnel shall designate a tank(s), a pipeline system (including meters, if used), and the method(s) that are available to determine line fullness. If automatic tank gauges are used, terminal personnel shall provide evidence that they are custody transfer qualified in accordance with the provisions of API MPMS Ch. 3.1B and API MPMS Ch. 7.3

#### 8.1

##### 8.1.1 General

~~In the cases where operational constraints exist such as: different grades in line, different custody of existing cargo in line, line capacity requires multiple shore tanks, or 120 % line capacity exceeds the custody transfer volume, then 100 % of the combined capacity, in lieu of 120 %, of all designated vessel and shore transfer lines may be used.~~

##### 8.1.2.2 Loading or and Discharging

Before loading or discharging marine cargoes, the following information should be obtained, recorded, and agreed upon to ensure that procedures to determine the fullness condition are as thorough as possible.

- a) The capacity of all designated pipelines. ship and shore.

b) The stated condition of the designated pipelines (full, slack, or empty).

~~c) The date and time of last cargo movement through the designated pipeline(s).~~

c) The last (or current) product in the designated pipeline(s).

d) The temperature of cargo to be transferred.

~~d)~~

~~e) The temperature of cargo to be loaded or discharged.~~

~~The sources of all the above information.~~



### **8.1.3 Pipeline Fullness**

~~Agree on the method of pipeline fullness verification to be used and on the extent—if any—of corrective actions that may be required.~~

### **8.1.4 Automatic Equipment**

~~If automatic equipment is used to record measurements, it shall meet the precision requirements described in API MPMS Ch. 3.1B and API MPMS Ch. 7.~~

### **8.1.5 Accuracy**

~~6.2.1 Review measurement accuracy limits outlined in API MPMS Ch. 3.1A, and agree on the tolerance to be met for the method selected (see Section 9).~~ **Measurement Tolerance Agreement**

For line displacement and line circulation methods, a measurement tolerance shall be established between the commercial parties.

However, in the absence of such, the tolerance shall be the volume represented by twice the measurement accuracy, as stated in API MPMS Ch 3.1A/HM 4 and API MPMS Ch. 3.1B, of the sending and receiving tanks.

**Note 1** Currently, the measurement accuracy stated in in API MPMS Ch. 3.1A /HM 4 is 1/8" or 3mm.

**Note 2** Currently, the measurement accuracy stated in in API MPMS Ch. 3.1B is 3/16" or 4 mm.

In the case of meters the manufacturers stated precision statement shall be used.

In the event that TCV volumes are used then temperature tolerance may also be taken into account.

**Note 3** Currently, the temperature resolution stated in API MPMS Ch. 7.2<sup>[1]</sup> and API MPMS Ch. 7.3 is 0.1 °F or 0.1 °C

## **7 Procedures and Application**

### **7.1 Procedures for High-point Bleed-valve Method (or Sight-glass/Mechanical Sight Verification Method)**

#### **7.1.1 General**

This method can be used both before and after transfer, and will not affect custody transfer volumes.

### **8.1.6 Measuring Equipment**

~~The procedures described in API MPMS Ch. 3.1A, API MPMS Ch. 17.2, and API MPMS Ch. 17.11 for selecting, calibrating, and using measurement equipment should be strictly followed.~~

#### **7.1.2 Requirements**

High-point valves shall be located at those points along the pipeline where the line's elevation is the highest, such as road crossings or other elevated sections. High-point valves shall be installed into the pipe at the highest point on

the pipe's circumference; otherwise this procedure shall not be used.

Sight-glass connections shall be at the top and bottom of the pipeline circumference and permit convenient visual observation. If sight-glass systems do not enable bleeding to evacuate gases seen in the sight glass, one of the alternate verification methods shall be selected.

All appropriate valves between the designated shore tank and the vessel berth shall be open and under sufficient positive pressure to permit the line to be filled with liquid.

Appropriate action shall be taken to ensure that any venting of vapors or release of liquids during bleeding operations is controlled and contained in accordance with applicable safety and environmental regulations.

The operation of high-point valves or sight glasses shall be performed by terminal personnel and shall be witnessed by authorized parties interested in the custody-transfer measurement.

### **7.1.3 High-point Bleed-valve Method Procedure**

To apply the high-point bleed-valve method (or the sight-glass method), perform the following steps consecutively.

STEP 1 — Before opening high-point bleed valves; ensure that lines are under positive pressure at bleed positions.

STEP 2 — Place an appropriate container under each valve opening to receive liquid.

STEP 3 — Slowly open the valve and allow it to remain open until liquid appears in a steady stream. Allow adequate time between the bleedings of any two valves for gas to collect at the bleed points.

STEP 4 — Close the valve and proceed to the next bleed valve.

STEP 5 — Bleed each valve in the same manner until all valves are bled.

## **8.07.2 Procedure for Internal Circulation Method**

### **8.0.47.2.1 General**

This method can be used both before and after transfer, and will not affect custody transfer volumes when performed before transfer, however, has potential to affect custody transfer volumes when performed after transfer.

### **7.2.2 Requirements**

Terminal personnel shall ~~allow~~ circulate product through the designated pipeline system ~~after the system has been isolated. Circulation should pass through the designated via the~~ dock manifold ~~and be performed immediately before and/or after custody transfer~~. If circulation cannot pass through the designated dock manifold, then an evaluation shall ~~allow~~ be made of the validity and accuracy of using this method.

Shore tanks designated to receive internal circulation volumes shall not be in the bottom (nonlinear) or critical zones as indicated on the strapping chart.

The circulation method is generally used on pipelines already considered to be full. This method can also be used after custody transfer.

### **8.0.47.2.3 Internal Circulation Method Steps**

To apply the internal circulation method, perform the following steps consecutively.

STEP 1 Gauge the delivering and receiving tanks before line circulation, using either ~~Measurements should be taken using reliable automatic gauging equipment~~ or manual measurement equipment. ~~If automatic tank gauges will be used, terminal personnel should provide evidence that they are custody-transfer qualified in accordance with the provisions of API MPMS Ch. 3.1B.~~

STEP 2 Circulate product to displace the volume of the pipeline. ~~agreed volume.~~

STEP 3 Close tank valves and re-gauge tank(s) using the same method as that used for opening gauges.

~~STEP 3 Using the tank calibration table; convert the measurements taken before and after internal circulation to volumes.~~

~~STEP 4 Compare measured volume delivered to measured volume received to determine whether their difference exceeds the agreed tolerance. If the difference exceeds agreed tolerance, repeat line circulation and the measurements. If the excessive difference persists, the integrity of the system should be investigated.~~

~~STEP 5 For purposes of line fill determination, the designated pipeline system may be considered full if the difference between measured volume delivered and measured volume received is within the agreed tolerance.~~

### **7.3 Procedure for Line Displacement Method**

#### **7.3.1 General**

This method is only practical at the beginning of the transfer and an alternative method would have to be used after the transfer. This method can have an effect on custody transfer volumes when line voids are detected.

#### **7.3.2 Requirements**

Where possible the vessel shall be on an even keel with no list. Otherwise, a trim or list correction shall be applied and noted on the report. If a wedge calculation is necessary, refer to API MPMS Ch. 17.4<sup>[4]</sup>.

The vessel's line condition can affect the accuracy of the line displacement volumes between vessel and shore. Vessel personnel shall provide the capacity of the designated lines, indicate their fullness condition, and offer every assistance to accurately verify this condition.

The number of vessel tanks used for line displacement shall be minimized, and their location should be selected to minimize changes in trim or list.

The shore lines and the vessel lines including deck lines and bottom lines should remain in the same fullness condition, prior to and after the line displacement. However, if vessel line conditions change, corrections to volumes shall be applied.

Agree on the quantity to be displaced, which shall be a minimum of 100 % of the combined capacity of all designated vessel and shore transfer lines.

Shore tanks designated to receive or deliver line displacement volumes shall not be in the bottom (nonlinear) or critical zones as indicated on the strapping chart.

#### **7.3.3 Procedure**

To apply the line displacement method, perform the following steps consecutively.

STEP 1 Measure the liquid level and temperature of delivering and receiving tanks. Measurements may be taken using either automatic measurement equipment or manual measurement equipment. If meters are utilized then record meter reading.

STEP 2 Transfer the agreed volume for displacement between vessel and shore. Immediately after the transfer is complete, close the vessel manifold valve and the shore tank valve to prevent continued product flow between the vessel and the shore tank.

STEP 3 Repeat Step 1 using the same types of equipment and technique that were used for the opening measurements.

STEP 4 Using tank calibration tables or meters, as appropriate, convert the measurements taken before and after line displacement to volumes. Normally, TOV is used to quantify volumes transferred; -however,

~~NOTE~~ TCV can be used ~~may should~~ if it has been historically demonstrated to be appropriate for the pipeline size, distance between— vessel and shore, and/or temperature difference between vessel, pipelines and tanks, or by commercial agreement.

STEP 5 Compare delivered and received volumes. The designated pipeline system may be considered full if the difference between measured volume delivered and received is within the agreed tolerance. No further line fullness determination is required and cargo transfer may proceed.

If vessel and shore volumes differ by more than the agreed tolerance, the following steps to be performed.

- a) Check all calculations for accuracy.
- b) Verify all measurements are accurate and confirm vessel lines are in same fullness condition as before the transfer.
- c) If difference still exceeds tolerance, refer to customer instructions on line displacement difference exceeding agreed tolerance. In the event no instructions have been given then contact all parties involved to establish agreement on how to proceed further.
- If customers cannot be contacted for further instructions it is recommended to perform a second line displacement if the terminal will allow it.

d) ~~NOTE—This does not necessarily ensure that voids do not exist in the line.~~

## **8.1 — Procedure for Line Displacement Method**

### **8.1.1 — General**

The vessel should be on an even keel with no list. Otherwise, a trim or list correction should be applied and noted on the report. If a wedge calculation is necessary, refer to API MPMS Ch. 17.4.

**NOTE** — Even keel measurements are preferred because of the precision limitations involved in trim, list, and wedge calculations.

### **8.1.2 — Requirements**

The vessel quantity survey should be conducted prior to line displacement.

The number of vessel tanks used for line displacement should be minimized, and their location should be selected to minimize changes in trim or list.

The shore lines and the vessel lines including deck lines and bottom lines should remain in the same fullness condition, prior to and after the line displacement. However, if vessel line conditions change, corrections to volumes shall be applied.

Agree on the quantity to be displaced. Product displaced should be at least 120 % of the combined capacity of all designated vessel and shore transfer lines unless the conditions referred to in 8.1. apply, then 100 % of line capacity will suffice.

Agree on the cargo flow rate.

### **8.1.3 — Line Displacement Method Procedure**

To apply the line displacement method, perform the following steps consecutively.

**STEP 1** Measure the liquid level and temperature of delivering and receiving tanks before line displacement. Measurements may be taken using either automatic measurement equipment or manual measurement equipment.

**STEP 2** Transfer the agreed volume for displacement between vessel and shore. Immediately after the transfer is complete, close the vessel manifold valve and the shore tank valve to prevent continued product flow between the vessel and the shore tank and vice versa.

**STEP 3** Re-gauge the vessel's tanks utilized and re-gauge shore tanks using the same types of equipment and technique that were used for the opening measurements.

**STEP 4** Using shore and vessel tank calibration tables, convert the measurements taken before and after line displacement to volumes. TOV should be used to quantify volumes transferred.

**NOTE** TCV may be considered if it has been historically demonstrated to be appropriate for the pipeline size, distance between vessel and shore, and/or temperature difference between vessel, pipelines and tanks, or by commercial agreement.

**STEP 5** Compare measured volumes of delivering and receiving tank(s) to determine whether their difference exceeds the agreed tolerance. If vessel and shore volumes differ by more than the agreed tolerance, any or all of the following options may be exercised until all parties agree that line fullness has been determined to their satisfaction.

a) ~~Check all calculations for accuracy.~~

a) ~~Re-gauge shore tank and re-gauge designated vessel tank(s).~~

b) ~~Re-gauge all vessel tanks and reconfirm vessel lines are in same fullness condition as before the transfer.~~

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~~c) Repeat the line displacement procedure.~~

~~d) Proceed with cargo transfer and determine after transfer whether the line fill difference has had any unacceptable effect on the cargo transfer volume.~~

~~STEP 6 For purposes of line fill determination, the designated pipeline system may be considered full if the difference between measured volume delivered and measured volume received is within the agreed tolerance.~~

~~NOTE Measurements obtained from vessels and /or shore tanks with non slotted standpipes shall not be used for the line displacement method (refer to API MPMS Ch. 3.1A). Another line fullness verification method is required.~~

## ~~8.2 Procedures for High-point Bleed-valve Method (or Sight-glass/Mechanical Sight Verification Method)~~

### ~~8.2.1 General~~

~~High-point bleed valves should be installed for the purpose of line fill verification only. Other valves on a pipeline should not be used for this purpose. High-point valves or sight glasses should be located beginning at a point near the vessel and at those points along the pipeline where the line's elevation is the highest, such as road crossings or other elevated sections. High-point valves should be tapped into the pipe at the highest point on the pipe's circumference; otherwise this procedure should not be used.~~

~~NOTE 1 This method may not be applicable to pipeline systems with horizontal sections since gases may remain in these sections.~~

~~NOTE 2 Should the high-point bleed valve method be selected, valves designated for this operation should be identified.~~

~~NOTE 3 Product flowing through a pipeline system while valves are being bled may cause existing air pockets to move past the bleed point.~~

### ~~8.2.2 Requirements~~

~~Sight-glass connections should be at the top and bottom of the pipeline circumference and should permit convenient visual observation. If sight-glass systems do not enable bleeding to evacuate gases seen in the sight glass, one of the alternate verification methods should be selected.~~

~~All appropriate valves between the designated shore tank and the vessel berth should be open and under sufficient positive pressure to permit the line to be filled with liquid.~~

~~Appropriate action should be taken to ensure that any venting of vapors or release of liquids during bleeding operations is controlled and contained in accordance with applicable safety and environmental regulations.~~

~~The operation of high-point valves or sight glasses should be performed by terminal personnel and should be witnessed by authorized parties interested in custody-transfer measurements.~~

### ~~8.2.3 High-point Bleed-valve Method Procedure~~

~~To apply the high-point bleed-valve method (or the sight-glass method), perform the following steps consecutively. STEP 1 Before opening high-point bleed valves; ensure that lines are under positive pressure at bleed positions. STEP 2 Place an appropriate container under each valve opening to receive liquid. STEP 3 Slowly open the valve and allow it to remain open until liquid appears in a steady stream. Allow adequate time between the bleedings of any two valves for gas to collect at the bleed points.~~



~~STEP 4—Close the valve and proceed to the next bleed valve.~~

~~STEP 5—Bleed each valve in the same manner until all valves are bled.~~

## **8.5.7.4 Procedures for Line Pigging Clearing Methods**

### **8.5.17.4.1 General**

The three common methods for line clearing are pigging, blowing and stripping. All three have the objective of evacuating the line; however, the receiving tank shall be measured before and after to determine the amount of product displaced from the line. These methods can be used both before and after transfer, and corrections shall be applied to any volumetric differences in line condition, and will therefore affect custody transfer volumes.

~~4—The pigging method is an acceptable method only when the terminal is fitted with the launching and retrieving systems designed for this purpose.~~

### **7.4.2 Pigging Method**

~~**Requirements** This pigging method is an acceptable method only when the terminal is fitted with the launching and retrieving systems designed for this purpose.~~

### **8.5.2**

In the pigging method, a ~~tight-fitting~~ wiping device (or “pig”) is placed in a launching system and then pushed through the designated pipeline system with liquid, gas, or air. The original contents of the pipeline system are therefore ~~completely~~ displaced by the ~~air, gas, or liquid, gas, or air~~ used to propel the pig through the line.

All pigs ~~shall~~ be accounted for after use. The operation ~~shall~~ be repeated when pigs are lost or damaged in pipelines.

~~**7.4.3 Line Blowing Method** The pigging method may be executed before, after, or both before and after a cargo transfer. If the pigging method is selected, appropriate corrections for full and empty line conditions shall be applied.~~

This method entails blowing the line with either compressed air, nitrogen, or other gas.

### **7.4.4 Line Stripping Method**

This method involves using stripping pumps to remove product from the pipelines involved.

## **8.6.7.5 Procedure for Line Press Method (or Line Pack Method)**

### **8.6.17.5.1 General**

This procedure assumes that the designated pipeline system is tight and able to withstand pressures applied during line press operations without loss of line pressure as determined by pressure readings from a ~~calibrated~~ pressure gauge. This procedure is invalid with any pipeline system that does not meet this tightness recommendation.



This method will not have an effect on custody transfer volumes.

#### **8-6-27.5.2 Line Pack Method Procedure**

To apply the line press method (or the line pack method), perform the following steps consecutively.

STEP 1 Close the valve at the dock manifold. Open the shore tank and pump valves, and gauge the tank before line press. Measurements may be taken using either ~~reliable~~ automatic gauging equipment or manual measurement equipment. If automatic tank gauges will be used, terminal personnel ~~shall~~ provide evidence that they are custody-transfer qualified in accordance with the provisions of API MPMS Ch. 3.1B.

STEP 2 Start the pump and run it until the discharge pressure stabilizes and/or reaches a predetermined pressure. The predetermined pressure ~~shall~~ be higher than the maximum static pressure available on the system.

STEP 3 Isolate the pipeline to prevent backflow and stop the pump.

STEP 4 Once the pump has been shut down, record the pressure and re-gauge the tank using the same gauging method as that used for the opening measurements. Record the tank product level.

STEP 5 If the tank product levels before and after the line press are within 1/8 in. (3 mm) of one another for manual measurement, or 3/16" (4mm) for automatic tank gauges, pipelines may be considered liquid-full and no correction is necessary.

STEP 6 If the tank liquid levels before and after the line press differ from one another by more than the above tolerance 1/8 in. (3 mm), relieve the line pressure into the tank ~~until the pressure at the highest elevation is slightly above product vapor pressure~~ and then repeat the test. If the tank product levels before and after the second line press differ from one another by less than the tolerance above an 1/8 in. (3 mm), pipelines are now full of liquid because condensable vapors have been re-liquefied and no further correction is necessary.

STEP 7 If the tank liquid levels before and after the second line press differ from one another by more than the tolerance 1/8 in. (3 mm), the line fill condition may be corrected by one of the alternate methods listed under 54.1.

### **8 Procedure for partially empty/full line condition**

Some facilities blow or strip their lines, leaving them partially empty. These can lead to differences in fill condition between the start and completion of custody transfer that will need to be taken into account.

If the line is unable to be filled prior to transfer, then it is recommended to perform a line displacement and correct for the void detected in the line. After transfer is complete, the shore tanks shall be gauged off while the line is still full and before any line stripping or blowing commences. This will complete the custody transfer.

Any stripping or blowing of lines after this point has no effect on custody volumes and will only affect inventory volumes between the terminal and its customer. ~~when either and/or after will influence, if outside the agreed tolerance~~

All details of the displacement should be recorded and reported as appropriate; however, any adjustment to transferred quantities shall be at the agreement of the commercial parties.

~~(pigging, blowing and stripping) influence~~

~~These methods can be used both before and after transfer, and corrections shall be applied to any volumetric differences in line condition; however, any adjustment to transferred quantities shall be at the agreement of the commercial parties.~~

~~NOTE For discharge operations in the event of an unexplained out turn gain the line condition upon completion of discharge should be verified when possible. As the line could potentially be only partially full resulting in an overstated out turn figure.~~

~~STEP 8 For purposes of line fill verification, the designated pipeline system may be considered full if the difference between the volume gauged before line press and the volume gauged after line press is within measurement precision.~~

~~NOTE This does not ensure that voids equal to compressed gas volumes less than measurement precision do not exist in the line.~~

### **~~8.7—Line Verification After Cargo Transfer~~**

~~After cargo has been transferred, the fullness condition of shore pipelines can be determined by the application of any method outlined in 8.2 to 8.6.~~

## **~~9—Establishing Agreed Tolerance~~**

~~The precision of the liquid level measurement for each tank—regardless of whether it's a vessel tank or a shore tank—is stated in API MPMS Ch. 3.1A and Ch. 3.1B depending on whether it is manual or automatic gauging.~~

~~To agree on tolerances when comparing volumes using line displacement, both the measurement precision limits above and historical experiences should be considered. The factors listed under “General Procedures” (8.1) should also be considered as possible influences on measurement~~

~~tolerances. Special situations such as those involving temperature variations between line contents and tanks, the effect of volumetric shrinkage, and product quality differences should also be considered.~~

~~It should also be recognized that all measurements shall be recorded to API MPMS standards. Rounding of gauges is not a recommended practice.~~

## Bibliography

- ~~[1] API MPMS Chapter 12.3, Calculation of Volumetric Shrinkage Resulting from Blending Volatile Hydrocarbons with Crude Oils~~
- ~~[2] API MPMS Chapter 17.1, Guidelines for Marine Cargo Inspection~~
- ~~[3] API MPMS Chapter 17.4, Method for Quantification of Small Volumes on Marine Vessels (OBQ/ROB)~~
- ~~[4] API MPMS Chapter 17.12, Procedure for Bulk Liquid Chemical Cargo Inspection by Cargo Inspectors~~
- ~~[5] OCIMF<sup>4</sup>, ISGOTT: International Safety Guide for Oil Tankers and Terminals~~

### Annex A (Informative)

## Procedure for Line Displacement Method – not involving marine vessels

### A1.0 Requirements

Shore tanks should all be static and not in the bottom (nonlinear) critical zone or floating roof critical zone.

Terminal personnel should all provide the capacity of the designated lines, indicate their fullness condition, and offer every assistance to accurately verify this condition.

Agree on the quantity to be displaced, which should all be a minimum of 100 % of the combined capacity of all designated transfer lines.

NOTE — This method can have an effect on custody transfer volumes when line voids are detected.

### A1.1 Procedure

To apply the line displacement method, perform the following steps consecutively.

STEP 1 Measure the liquid level and temperature of delivering and receiving tanks. Measurements may be taken using either automatic measurement equipment or manual measurement equipment. If meters are utilized then record meter reading.

STEP 2 Transfer the agreed volume for displacement between tanks. Immediately after the transfer is complete, close the shore tank valves to prevent continued product flow between the tanks.

STEP 3 Repeat Step 1 using the same types of equipment and technique that were used for the opening measurements.

STEP 4 Using tank calibration tables or meters, as appropriate, convert the measurements taken before and after line displacement to volumes. Normally, TOV is used to quantify volumes transferred; however, TCV can be used if it has been historically demonstrated to be appropriate for the pipeline size, distance between shore facilities, and/or temperature difference between shore pipelines and tanks, or by commercial agreement.

STEP 5 Compare delivered and received volumes. The designated pipeline system may be considered full if the difference between measured volume delivered and measured volume received is within the agreed tolerance. No further line fullness determination is required and transfer may proceed.

If volumes differ by more than the agreed tolerance, the following steps to be performed.

- a) Check all calculations for accuracy.
- b) Verify all measurements are accurate and confirm all lines are in same fullness condition as before the transfer.
- c) If difference still exceeds tolerance, refer to customer instructions on line displacement difference exceeding agreed tolerance. In the event no instructions have been given then contact all parties involved to establish agreement on how to proceed further.
- d) If customers cannot be contacted for further instructions it is recommended to perform a second line displacement if the terminal will allow it.

## **Annex B** **(Informative)**

### Example of procedure to pig lines

1. Reference to the product Safety Data Sheet ~~should~~**must** be made before pigging any product, and safety precautions including Personal Protective Equipment (PPE) ~~should~~**must** be observed.
2. The correct propellant for the pigging operation ~~should~~**must** be selected, appropriate to the product
3. Before opening the pig launcher the Operator will ensure the main line isolation valve is closed and the launcher's vent/drain valve is open.
4. While standing to one side of the line to be pigged, open end closure.

5. Insert the suitably sized pig and position it in the pig trap/launcher (utilizing the metal launcher cage if necessary)
6. Check the gasket is in good condition, (new gasket should be used every time) and correctly aligned. Close the end closure and seal using a "full head of bolts".
7. Ensure all vent and drain lines are closed.
8. Connect air/nitrogen hose (as appropriate for product to be pigged) to the launcher.
9. All pigging operations ~~should~~must be undertaken with both ends of the pipeline to be pigged attended by Operators liaising directly by phone or radio.
10. Only one pigging operation should be completed at once, this helps to confirm the routing of the pipeline.
11. The Duty Operator at the launching end ~~should~~must ensure the receiving end is ready to receive the pig and get the Receivers authority to launch prior to firing the pig.
12. The Operator launching the pig should announce which line the pig is being sent down, the receiving Operator should also state which line he is expecting to receive the pig into and his location on the site.
13. The Duty Operator at the receipt end of the line will, before giving permission for the pig to be launched, confirm that all valves are correctly set. In particular he will check and confirm the following:
  - (a) The drain valve is closed
  - (b) The main line valve is open (inlet)
  - (c) The tank side valve is open (outlet)
  - (d) The end closure is tight and secure (full head of bolts)
14. After receiving clearance, the Duty Operator at the launching end of the pipework will now proceed as follows: -
  - (a) Slowly open the air/nitrogen supply to the launcher.
  - (b) Check the pipework for leaks.
  - (c) If there are no leaks vent pressure from the launcher via the vent/drain valve.
  - (d) Close the vent/drain valve and slowly open the main pipework line valve.
  - (e) Slowly open the air/nitrogen supply to the launcher.
  - (f) Advise the receiving Operator "pig launched".
15. The receiving Operator will confirm that this message has been received. If confirmation is not forthcoming the operation will be shut down immediately.
16. Control of the pig's speed will be the responsibility of the receiving Operator. He should monitor the pressure on the pipeline by listening to the speed of the liquid being released through the gagged valve on the outlet of the pig receiver. Adjustments should be made if required by opening or closing the outlet valve on the pig receiver.
17. When the pig is received the receiving Operator will advise the launching Operator to close the air/nitrogen supply.

18. On receipt of advice that the pig has been received the launching Operator will close the air/nitrogen valve and the main line isolation valve. He will then inform the receiver that this action has been carried out.
19. On confirmation that the air/nitrogen supply has been isolated and the main line valve is closed, the receiving Operator will allow as much pressure through the line into the receiving tank as possible (when pigging liquid into the tank) and then close the pig receiver valve.
20. The receiving operator shall isolate all valves to the pig receiver and check the pressure gauge within the pig receiver. All pressure should be released to a safe area before attempting to remove the pig receiver door.
21. Once the pig is removed it should be washed out and squeezed dry before being placed in the appropriate pig skip.
22. The Duty Operators will then agree who will be releasing the remaining pressure in the line. The line will still contain residues of the product so an assessment ~~should~~ must be made to ensure the pressure is released into a safe area away from the Operators place of work.
23. Having decided how the excess line pressure will be handled, it will be done so in a controlled manner. Any drain points or vent lines used will be closed and capped after use.

NOTE The attending Inspector ~~should~~ must rely on the information provided by the terminal in relation to prior cargo(es) and any washing/cleaning performed on the shore line prior to pigging.

## **Bibliography**

- [1] API MPMS Chapter 7.2, Portable Electronic Thermometers
- [2] API MPMS Chapter 17.1, Guidelines for Marine Inspection
- [3] API MPMS Chapter 17.2, Measurement of Cargoes On Board Tank Vessels
- [4] API MPMS Chapter 17.4, Method for Quantification of Small Volumes on Marine Vessels (OBQ/ROB)
- [5] API MPMS Chapter 17.11/HM 52, Measurement and Sampling of Cargoes On Board Tank Vessels Using Closed and Restricted Equipment
- [6] EI HM 69, Procedures for determining H<sub>2</sub>S concentration in cargo tank head spaces.
- [7] OCIMF<sup>1</sup>, ISGOTT: International Safety Guide for Oil Tankers and Terminals.

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<sup>1</sup> Oil Companies International Marine Forum, 27 Queen Anne's Gate, London SW1H 9BU, United Kingdom, [www.ocimf.com](http://www.ocimf.com)