



API Manual of Petroleum Measurement Standards  
Chapter 17.12

El Hydrocarbon Management  
HM 51

Procedures for bulk liquid chemical cargo inspections

2nd edition, August 2015

Currently in preview, click buy full version

API MPMS CHAPTER 17.12/EI HM 51  
PROCEDURES FOR BULK LIQUID CHEMICAL CARGO INSPECTIONS

2nd edition

August 2015

Published by

**ENERGY INSTITUTE, LONDON**

The Energy Institute is a professional membership body incorporated by Royal Charter 2003

Registered charity number 1097899

Currently in preview, click buy full version

ISBN 978 0 85293 737 2

## CONTENTS

		Page
	<b>Special notes and disclaimers</b> .....	<b>6</b>
	<b>Foreword</b> .....	<b>8</b>
<b>1</b>	<b>Scope</b> .....	<b>9</b>
	1.1 General .....	9
	1.2 Measurement stages .....	9
	1.3 Quality control .....	10
	1.4 Summary of data to be reported .....	10
<b>2</b>	<b>Normative references</b> .....	<b>11</b>
	2.1 General .....	11
	2.2 API/EI documents .....	11
	2.3 EI documents .....	11
	2.4 API documents .....	11
	2.5 API/ASTM documents .....	12
	2.6 American Society for Testing and Materials (ASTM) .....	12
	2.7 Other documents .....	12
<b>3</b>	<b>Terms and definitions</b> .....	<b>13</b>
	3.1 Accuracy .....	13
	3.2 Ballast .....	13
	3.3 Capacity table, tank .....	13
	3.4 Critical zone .....	13
	3.5 Density .....	13
	3.6 Density, relative .....	13
	3.7 Dip .....	14
	3.8 Displacer (tank gauging) .....	14
	3.9 Floating cover .....	14
	3.10 Floating roof tank .....	14
	3.11 Gauging .....	14
	3.12 Inert gas .....	14
	3.13 Inhibitors .....	14
	3.14 List .....	14
	3.15 Mass .....	15
	3.16 Measurement .....	15
	3.17 Meter factor .....	15
	3.18 On-board quantity (OBQ) .....	15
	3.19 Outurn .....	15
	3.20 Reference gauge height .....	15
	3.21 Representative sample .....	15
	3.22 Restricted gauging .....	15
	3.23 Sampling .....	16
	3.24 Slops .....	16
	3.25 Spot sample .....	16
	3.26 Stripping .....	16
	3.27 Tape .....	16
	3.28 Trim .....	16
	3.29 Trim correction .....	16

<b>Contents continued</b>	<b>Page</b>
3.30 Ullage . . . . .	16
3.31 Ullage gauge . . . . .	17
3.32 Vapour . . . . .	17
3.33 Vessel experience factor (VEF, VEFL, VEFD) . . . . .	17
3.34 Volume correction factor (VCF) . . . . .	17
3.35 Volume, gross observed (GOV) . . . . .	17
3.36 Volume, gross standard (GSV) . . . . .	17
3.37 Volume, net standard (NSV) . . . . .	17
3.38 Volume, total calculated (TCV) . . . . .	17
3.39 Water, free . . . . .	18
3.40 Water cut (static measurement) . . . . .	18
3.41 Wedge formula . . . . .	18
<b>4 General principles . . . . .</b>	<b>19</b>
4.1 The purpose of a cargo inspection . . . . .	19
4.2 General responsibilities . . . . .	19
4.2.1 Communications, capabilities and performance . . . . .	19
4.2.2 Equipment . . . . .	20
4.2.3 Letters of protest/notices of apparent discrepancy . . . . .	20
4.2.4 Reporting . . . . .	21
4.3 Potential measurement error . . . . .	21
<b>5 Safety recommendations . . . . .</b>	<b>22</b>
5.1 General . . . . .	22
5.2 Safety aspects of equipment . . . . .	22
5.3 Safety at sampling points . . . . .	23
5.4 Static electricity . . . . .	23
5.5 Health hazards . . . . .	24
5.6 Entry into confined spaces . . . . .	24
5.7 Personnel transfer offshore . . . . .	25
<b>6 Operation planning (loading and discharge) . . . . .</b>	<b>27</b>
6.1 Key meeting . . . . .	27
6.2 Information to be determined before an operation commences . . . . .	27
<b>7 Inspection, sampling and quality control procedures . . . . .</b>	<b>30</b>
7.1 Loading procedures . . . . .	30
7.1.1 Shore tanks . . . . .	30
7.1.2 Dynamic measurement (metering) – See Annex B . . . . .	32
7.1.3 Sampling . . . . .	33
7.1.4 Manual sampling of shore tanks . . . . .	34
7.1.5 Automatic sampling . . . . .	34
7.1.6 Pipelines . . . . .	35
7.1.7 Vessel procedures before loading . . . . .	36
7.1.8 Vessel procedures at start of loading . . . . .	40
7.1.9 Vessel procedures after loading . . . . .	41
7.1.10 Calculations . . . . .	42
7.1.11 Vessel experience factor . . . . .	42
7.1.12 Reconciliation of measured qualities . . . . .	42

<b>Contents continued</b>	<b>Page</b>
7.2 Discharge procedures .....	42
7.2.1 Vessel measurements before discharge .....	42
7.2.2 In-transit difference .....	43
7.2.3 Sampling .....	43
7.2.4 Tank stripping operations/ROB .....	43
7.2.5 Shore tank gauging and sampling .....	44
7.2.6 Reconciliation of measured quantities .....	44
<b>8 Calculation of quantities .....</b>	<b>45</b>
8.1 General .....	45
8.2 Calculation methods .....	45
8.3 Examples of shore tank and marine tank calculations .....	46
8.3.1 Weight calculations .....	46
<b>9 Final report .....</b>	<b>47</b>
9.1 Inspection data .....	47
<b>Annexes</b>	
<b>Annex A Guidelines for verifying the accuracy of manual gauging equipment .....</b>	<b>49</b>
A.1 Introduction .....	49
A.2 Liquid-in-glass thermometers .....	49
A.2.1 Laboratory inspection .....	49
A.2.2 Field inspection .....	49
A.3 Portable electronic gauging devices (PEGDs) .....	49
A.4 Manual gauging tapes .....	49
A.5 Density determination .....	50
A.5.1 Hydrometers .....	50
A.5.2 Densitometers .....	50
<b>Annex B Monitoring metering system performance at loading .....</b>	<b>51</b>
B.1 Introduction .....	51
B.2 Description of meter loading measurement systems .....	51
B.2.1 Meter factor .....	51
B.3 Monitoring procedures .....	53
<b>Annex C Wedge formula calculation .....</b>	<b>55</b>
C.1 Calculation of the trim factor .....	55
C.2 Calculation of the length of the wedge .....	55
C.3 Calculation of $D_A$ .....	56
C.4 Wedge formula based on the tank width .....	57
C.5 Wedge formula based on theoretical tank width .....	58
<b>Annex D Offshore operations .....</b>	<b>58</b>
D.1 General .....	60
D.2 Safety – Personnel transfers .....	60
D.3 Inspection .....	60
D.4 Reconciliation of figures .....	60
D.5 Reporting and final report .....	61
<b>Annex E Wall wash guidelines .....</b>	<b>62</b>

## SPECIAL NOTES AND DISCLAIMERS

**API and EI publications are recommended for general adoption but should be read and interpreted in conjunction with Weights and Measures, Safety, Customs and Excise and other regulations in force in the country in which they are to be applied. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed. Such regulatory requirements have precedence over corresponding clauses in API/EI publications. However, where requirements of API/EI publications are more rigorous, then their use is recommended. Where applicable, authorities having jurisdiction should be consulted.** The information contained in this publication is provided as guidance only. Neither API and EI nor any of API/EI's employees, subcontractors, consultants, committees, or other assignees make any warranty or representation, either express or implied, with respect to the accuracy, completeness, or usefulness of the information contained herein, or assume any liability or responsibility for any use, or the results of such use, of any information or process disclosed in this publication. Neither API and EI nor any of API/EI's employees, subcontractors, consultants, or other assignees represent that use of this publication would not infringe upon privately owned rights.

Users of this publication should not rely exclusively on the information contained in this document. Sound business, scientific, engineering, and safety judgment should be used in employing the information contained herein. Work sites and equipment operations may differ. Users are solely responsible for assessing their specific situation in determining the appropriateness of applying the information.

Information concerning safety and health risks and proper precautions with respect to particular materials and conditions should be obtained from the employer, the manufacturer or supplier of that material, or the applicable safety data sheet.

Classified areas may vary depending on the location, conditions, equipment, and substances involved in any given situation. Users of this Standard should consult with the appropriate authorities having jurisdiction.

API/EI joint publications may be used by anyone desiring to do so. Every effort has been made by the Institutes to assure the accuracy and reliability of the data contained in them; however, the Institutes make no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaim any liability or responsibility for loss or damage resulting from its use or for the violation of any authorities having jurisdiction with which this publication may conflict.

API/EI joint publications are published to facilitate the broad availability of proven, sound engineering and operating practices. These publications are not intended to obviate the need for applying sound engineering judgment regarding when and where these publications should be utilized. The development and publication of API/EI joint publications is not intended in any way to inhibit anyone from using any other practices.

Nothing contained in any API/EI joint publication is to be construed as granting any right, by implication or otherwise, for the manufacture, sale, or use of any method, apparatus, or product covered by letters patent. Neither should anything contained in the publication be construed as insuring anyone against liability for infringement of letters patent.

API/EI are not undertaking to meet the duties of employers, manufacturers, or suppliers to warn and properly train and equip their employees, and others exposed, concerning health and safety risks and precautions, nor undertaking their obligations to comply with authorities having jurisdiction.

---

The above disclaimer is not intended to restrict or exclude liability for death or personal injury caused by own negligence.

The Energy Institute is a professional membership body incorporated by Royal Charter 2003.

Registered charity number 1097899, England

Copyright © 2015 by API, Washington DC and Energy Institute, London:

All rights reserved.

No part of this work may be reproduced, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher.

## FOREWORD

This publication was prepared jointly by the American Petroleum Institute Committee on Petroleum Measurement and the Energy Institute Hydrocarbon Management Committee.

The American Petroleum Institute Committee on Petroleum Measurement (COPM) and the Energy Institute's Hydrocarbon Management Committee (HMC) are responsible for the production and maintenance of standards and guides covering various aspects of static and dynamic measurement of petroleum. API COPM and EI HMC, their subcommittees and work groups consist of technical specialists representing oil companies, equipment manufacturers, service companies, terminal and ship owners and operators. API COPM and EI HMC encourage international participation and when producing publications their aim is to represent the best consensus of international technical expertise and good practice. This is the main reason behind the production of joint publications involving cooperation with experts from both the API and EI.

API/EI standards are published as an aid to procurement of standardized equipment and materials and/or as good practice procedures. These standards are not intended to inhibit purchasers or producers from purchasing or producing products made to specifications other than those of API or EI.

Shall: As used in a standard, "shall" denotes a minimum requirement in order to conform to the specification.

Should: As used in a standard, "should" denotes a recommendation or that which is advised but not required in order to conform to the specification.

This publication was produced following API/EI standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API/EI standard. Questions concerning the interpretation of the content of this publication or comments and questions concerning the procedures under which this publication was developed should be directed in writing to the Director of Standards, American Petroleum Institute, 1220 L Street, NW, Washington, DC 20005, USA, or the Technical Department, Energy Institute, 61 New Cavendish Street, London, W1G 7AR, UK.

Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the Director of Standards (API) or the Technical Department (EI). Generally, API/EI standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. A one-time extension of up to two years may be added to this review cycle. Status of the publication can be ascertained from the API Standards Department, 1220 L Street, NW, Washington, DC 20005, USA, or the EI Technical Department, Energy Institute, 61 New Cavendish Street, London, W1G 7AR, UK.

A catalogue of API publications can be found at [www.api.org/publications](http://www.api.org/publications).

A catalogue of EI publications can be found at <https://publishing.energyinst.org>.

Suggested revisions are invited and should be submitted to the Standards Department, API, 1220 L Street, NW, Washington, DC 20005, USA, [standards@api.org](mailto:standards@api.org) or to the Technical Department, Energy Institute, 61 New Cavendish Street, London, W1G 7AR, UK.

# 1 SCOPE

## 1.1 GENERAL

This document provides cargo measurement procedures for use primarily by inspectors and specifies procedures directed at minimising cargo contamination and losses. In the absence of, or in conjunction with, specific instructions from principal(s), this document should be considered a summary of good practice used within the industry.

Where the term 'measurement' is used in a general sense, it should be taken to include all aspects of cargo inspection including (but not limited to) tank inspection, sampling, laboratory analysis and testing and other superintending activities, as required by the inspector's principals.

The points at which inspectors are required to make their measurements are described and definitions of the terms used throughout this document are provided in section 3. Where possible terms approved by API, EI and ISO/TC28 have been adopted.

The document also considers the purpose of a cargo survey and summarises the responsibilities of those involved. These procedures may become contractual if reference to them is made in either a nomination or acknowledgement.

Safety matters and related responsibilities are defined and emphasis is placed on the need for inspectors to be continually conscious that safety requirements take precedence over all other considerations.

The document describes the procedures which inspectors should follow and provides references to analytical test methods and calculations. Reference is made to alternative methods since it is recognised that opinions may vary regarding the use of test methods, and that different methods may be specified by the parties involved.

## 1.2 MEASUREMENT STAGES

When a cargo is transported by vessel from one shore terminal to another, measurements are normally made at four locations, as shown in Figure 1 for the purpose of establishing:

- (a) the quantity of cargo delivered (i.e. to confirm the quantity of cargo shown on the Bill of Lading);
- (b) the quantity of cargo loaded by the vessel;
- (c) the quantity of cargo discharged by the vessel;
- (d) the quantity of cargo received by the receiving terminal, and
- (e) the difference between the quantities established under (a) to (d) above.

Note: for a particular voyage involving more than one loading port or discharge port, measurements should be made at all such additional ports in order that a reliable comparison can be made between the quantities shown on the Bill of Lading, the cumulative outturn and ship's figures.

Note 2: For ship to ship (STS) transfer operations please refer to Annex D.

