Manual of Petroleum Measurement Standards Chapter 19.3—Evaporative Loss Measurement

Part D—Fugitive Emission Test Method for the Measurement of Deck-Seam Loss Factors for Internal Floating-Roof Tanks

FIRST EDITION, JUNE 2001

REAFFIRMED, JULY 2023

American Petroleum Institute

SPECIAL NOTES

API publications necessarily address problems of a general nature. With respect to particular circumstances, local, state, and federal laws and regulations should be reviewed.

API is 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 under local, state, or federal laws.

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 material safety data sheet.

Nothing contained in any API 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.

Generally, API standards are reviewed and revised, reaffirmed, or withdrawn at least every five years. Sometimes a one-time extension of up to two years will be added to this review cycle. This publication will no longer be in effect five years after its publication date as an operative API standard or, where an extension has been granted, upon republication. Status of the publication can be ascertained from API [telephone (202) 682-8000]. A catalog of API publications and materials is published annually and updated quarterly by API, 200 Massachusetts Avenue, NW, Washington, DC 20001.

This document was produced under API standardization procedures that ensure appropriate notification and participation in the developmental process and is designated as an API standard. Questions concerning the interpretation of the content of this standard or comments and questions concerning the procedures under which this standard was developed should be directed in writing to the standardization manager, American Petroleum Institute, 200 Massachusetts Avenue, NW, Washington, DC 20001. Requests for permission to reproduce or translate all or any part of the material published herein should also be addressed to the gen-eral manager.

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

Any manufacturer marking equipment or materials in conformance with the marking requirements of an API standard is solely responsible for complying with all the applicable requirements of that standard. API does not represent, warrant, or guarantee that such products do in fact conform to the applicable API standard.

FOREWORD

This standard provides rules for testing the deck seams or deck joints of internal floating roofs under laboratory conditions to provide evaporative deck-seam loss factors or deck-joint loss factors. It was prepared by Task Group II of the API Committee on Evaporative Loss Estimation (CELE).

A testing program was conducted in 1982 that used the pilot tank test method for measuring the deck-seam loss factors of mechanically-joined, contact and non-contact internal floating roofs. The deck-seam loss factor that is published in API Publication 2519, *Evaporative Loss From Internal Floating-Roof Tanks*, and in API *Manual of Petroleum Measurement Standards*, Chapter 19.2, "Evaporative Loss From Floating-Roof Tanks," is based on these tests. This deck-seam loss factor and the test method that was used to develop it have been widely accepted by oil companies, manufacturers, industry groups, regulatory agencies, and general interest groups. API has not, however, tested or developed deck-seam loss factors for proprietary designs of individual manufacturers.

A second testing program was conducted in the period from 1994 through 1996 that used the weight loss test method for measuring deck-seam loss factors. These tests were directed at developing a test protocol that would eventually be published in the API *Manual of Petroleum Measurement Standards*, Chapter 19.3, Part C, "Weight Loss Test Method for the Measurement of Deck-Seam Loss Factors for Internal Floating-Roof Tanks." The first edition of this publication is still under development.

A third testing program was conducted in 1999 that used the fugitive emission test method for measuring deck-seam loss factors. These tests were directed at developing the test protocol that is described in this publication.

By publishing this fugitive emission test method, the API is making this test method available to interested parties who wish to test particular deck seams or deck joints under the auspices of the API.

API certification of an evaporative loss factor developed through this program is subject to the following three-step process:

a. The testing shall be performed in laboratories licensed by the API. The requirements to qualify for licensure are presented in the API Manual of Petroleum Measurement Standards, Chapter 19.3, Part G, "Certified Loss Factor Testing Laboratory Registration;"

b. Testing and determination of test results shall be performed as specified herein; and

c. The evaluation of the test results and the certification of an evaporative loss factor for the item tested shall be conducted in accordance with the API *Manual of Petroleum Measurement Standards*, Chapter 19.3, Part F, "Evaporative Loss Factor for Storage Tanks Certification Program."

API publications may be used by anyone desiring to do so. Every effort has been made by the Institute to assure the accuracy and reliability of the data contained in them; however, the Institute makes no representation, warranty, or guarantee in connection with this publication and hereby expressly disclaims any liability or responsibility for loss or damage resulting from its use or for the violation of any federal, state, or municipal regulation with which this publication may conflict.

Suggested revisions are invited and should be submitted to the standardization manager, American Petroleum Institute, 200 Massachusetts Avenue, NW, Washington, DC 20001.

CONTENTS

Page

0 INTRODUCTION 1

1 SCOPE 1

2 REFERENCES 1
2.1 API References 1
2.2 ASTM References 1

3 TERMINOLOGY 2
3.1 Definitions 2
3.2 Units of Measurement 3
3.3 Nomenclature 4

4 SUMMARY OF TEST METHOD 5

5 SIGNIFICANCE AND USE 5

6 LIMITATIONS TO TEST METHOD 5
6.1 Evaluation of Results 5
6.2 Low Loss Rates 5

7 TEST APPARATUS 5
7.1 Test Apparatus Illustrations 5
7.2 Test Room 5
7.3 Test Assembly 6
7.4 Test Liquid 7
7.5 Test Apparatus Air Flow 7

8 TEST ITEM 9
8.1 Test Item Construction 9
8.2 Test Item Attachment 9
8.3 Test Item End Connections 9

9 PREPARATION OF APPARATUS 9
9.1 Test Item Placement 9
9.2 Test Liquid Filling 9
9.3 Instrumentation Attachment 9
9.4 Test Room Air Temperature Control 9
9.5 Sample Pump Startup 9
9.6 Steady-State Operation 9

10 INSTRUMENTATION AND CALIBRATION 9
10.1 Accuracy 9
10.2 Data Acquisition System 10
10.3 Temperature Measurements 10
10.4 Pressure Measurements 11
10.5 Atmospheric Pressure Measurement 11
10.6 Pressure Difference Measurement 11
10.7 Flow Rate Measurements 14
10.8 Total Hydrocarbon Concentration Measurements 14

Page

11 TEST PROCEDURE 14
11.1 Levels of Pressure Difference 14
11.2 Data to be Recorded 14
11.3 Duration of Test 15

12 CALCULATION OF TEST RESULTS 15
12.1 Calibration Corrections 15
12.2 Vapor Pressure 15
12.3 Vapor Pressure Function 16
12.4 Vapor Density 16
12.5 Test Enclosure Loss Rate 16
12.6 Test Enclosure Loss Factor 16
12.7 Deck-Seam Loss Factor 17
12.8 Deck-Joint Loss Factor 17
12.9 Uncertainty Analysis 17

13 REPORT OF TEST RESULTS 17
13.1 Report 17
13.2 Data Curves 17
13.3 Loss Factor Graph 17

14 PRECISION AND BIAS 18

APPENDIX A UNCERTAINTY ANALYSIS 21
APPENDIX B METRIC UNITS 29
APPENDIX C BIBLIOGRAPHY 31

Figures
1 Flow Diagram of the Test Apparatus 8
2 Plan View of the Fugitive Emission Test Facility 12
3 Test Assembly 13
4 Typical Test Enclosure Loss Rate Curve 19
5 Typical Deck-Seam Loss Factor Graph 20

Tables
1 Instrument Requirements 10
A.1 Summary of Example Uncertainty Analysis Results 24

Chapter 19.3—Evaporative Loss Measurement

Part D—Fugitive Emission Test Method for the Measurement of Deck-Seam Loss Factors for Internal Floating-Roof Tanks

0 Introduction

The purpose of this standard is to establish a uniform method for measuring evaporative deck-seam loss factors and deck-joint loss factors of mechanically-joined deck seams that are used on internal floating-roof tanks. These deck-seam loss factors and deck-joint loss factors are to be determined in terms of their loss rate at specified pressure differences across the deck seam or deck joint for certification purposes.

It is not the purpose of this standard to specify procedures to be used in the design, manufacture, or field installation of deck seams or deck joints. Furthermore, equipment should not be selected for use solely on the basis of evaporative-loss considerations. Many other factors, such as tank operation, maintenance, and safety, are important in designing and selecting tank equipment for a given application.

1 Scope

This test method may be used to establish evaporative deck-seam loss factors and deck-joint loss factors for mechanically-joined deck seams that are used on internal floating-roof tanks. The test method involves passing a controlled flow rate of air through a test enclosure that is sealed to the top deck of a test pan. The test pan incorporates the test deck seam or test deck joint and contains a test liquid. The total hydrocarbon concentration in the air streams entering and leaving the test enclosure are measured over a range of pressure differences across the test deck seam.

This standard specifies the test apparatus, the instruments, the test procedure, and the calculation procedures to be used. The variables that are to be measured are defined, and quality provisions are stipulated. The format for reporting the values of both the test results and their associated uncertainty are also specified.

This standard may involve the use of 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 to determine the applicability of regulatory limitations prior to use.

2 References

The following standards contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below.

2.1 API REFERENCES

Manual of Petroleum Measurement Standards:

Chapter 15	"Guidelines for the Use of the International System of Units (SI) in the Petroleum and Allied Industries," Second Edition, December 1980.
Chapter 19.2	"Evaporative Loss From Floating Roof Tanks," First Edition, April 1997.
Chapter 19.3, Part F	"Evaporative Loss Factor for Storage Tanks Certification Program," First Edition, May 1997.
Chapter 19.3, Part G	"Certified Loss Factor Testing Laboratory Registration," First Edition, March 1997.
Chapter 19.3, Part H	"Tank Seals and Fittings Certification Administration," First Edition, March 1998.

Standards and Publications:

Standard 650	*Welded Steel Tanks for Oil Storage*, Tenth Edition, November 1998.

2.2 ASTM[1] REFERENCES

Standards:

D323	*Test Method for Vapor Pressure of Petroleum Products (Reid Method).*
D3195	*Standard Practice for Rotameter Calibration.*
E220	*Method for Calibration of Thermocouples by Comparison Techniques.*
E230	*Temperature—Electromotive Force (EMF) Tables for Standardized Thermocouples.*

[1]ASTM International, 100 Bar Harbor Drive, West Conshohocken, Pennsylvania 19428.