

Linings of Aboveground Petroleum Storage Tank Bottoms

API RECOMMENDED PRACTICE 652
FIFTH EDITION, MAY 2020



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.

Neither API nor any of API'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 nor any of API's employees, subcontractors, consultants, or other assignees represent that use of this publication would not infringe upon privately owned rights.

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 authorities having jurisdiction with which this publication may conflict.

API 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 used. The formulation and publication of API publications 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.

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

Users of this recommended practice 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.

Where applicable, authorities having jurisdiction should be consulted.

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 to comply with authorities having jurisdiction.

All rights reserved. No part of this work may be reproduced, translated, stored in a retrieval system, or transmitted by any means, electronic, mechanical, photocopying, recording, or otherwise, without prior written permission from the publisher. Contact the Publisher, API Publishing Services, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001-5571.

Foreword

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.

The verbal forms used to express the provisions in this document are as follows.

Shall: As used in a standard, “shall” denotes a minimum requirement to conform to the standard.

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

May: As used in a standard, “may” denotes a course of action permissible within the limits of a standard.

Can: As used in a standard, “can” denotes a statement of possibility or capability.

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 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, 200 Massachusetts Avenue, NW, Suite 1100, 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 director.

Generally, API 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, telephone (202) 682-8000. A catalog of API publications and materials is published annually by API, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001.

Suggested revisions are invited and should be submitted to the Standards Department, API, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001, standards@api.org.

Contents

	Page
1 Scope	1
2 Normative References	1
3 Terms and Definitions	2
4 Corrosion Mechanisms	6
4.1 General	6
4.2 Chemical Corrosion	6
4.3 Concentration Cell Corrosion	6
4.4 Oxygen Cell Corrosion	7
4.5 Galvanic Cell Corrosion	7
4.6 Microbiologically Influenced Corrosion (MIC)	7
4.7 Erosion-corrosion	7
4.8 Fretting-related Corrosion	8
4.9 Generalized vs Localized (Pitting) Corrosion	8
4.10 Stress Corrosion Cracking	8
4.11 Internal Corrosion Mechanisms	8
5 Determination of the Need for Tank Bottom Lining	9
5.1 General	9
5.2 Linings for Corrosion Protection	9
5.3 Tank Corrosion History	9
5.4 Tank Foundation	10
6 Tank Bottom Lining Selection	10
6.1 General	10
6.2 Inorganic Zinc/Zinc Silicate (IOZ)	11
6.3 Thin-film Tank Bottom Linings	12
6.4 Thick-film Unreinforced Tank Bottom Linings	13
6.5 Reinforced Thick-film Tank Bottom Linings	14
6.6 Circumstances Affecting Lining Selection	16
6.7 Selecting Internal Linings for Tanks Storing Alternate Fuels	18
7 Surface Preparation	20
7.1 General	20
7.2 Pre-cleaning	21
7.3 Bottom Repair and Subsequent Weld and Component Preparation	21
7.4 Surface Cleanliness	21
7.5 Surface Profile or Anchor Pattern	22
7.6 Air and Abrasive Cleanliness	22
7.7 Removal of Salts	22
7.8 Removal of Dust	22
8 Lining Application	22
8.1 General	22
8.2 Guidelines for Lining Application	23
8.3 Temperature and Humidity Control	23
8.4 Lining Thickness	23
8.5 Lining Curing	23

Contents

	Page
9 Inspection	24
9.1 General.....	24
9.2 Qualification of Inspection Personnel.....	24
9.3 Recommended Inspection Parameters	24
10 Evaluation, Repair, and Replacement of Existing Linings	25
10.1 General.....	25
10.2 Evaluation Methods.....	25
10.3 Evaluation Criteria for Linings	25
10.4 Evaluating Serviceability of Existing Linings	26
10.5 Determining the Cause of Lining Degradation/Failure	26
10.6 Lining Repair and Replacement	26
11 Maximizing Lining Service Life by Proper Material Selection and Specification	27
11.1 General.....	27
11.2 Lining Material Selection	28
11.3 Written Specification.....	28
12 Health, Safety, and Environmental	28
12.1 General.....	28
12.2 Tank Entry	29
12.3 Surface Preparation and Lining Application	29
12.4 Manufacturer’s Safety Data Sheets.....	29
Bibliography.....	30

Linings of Aboveground Petroleum Storage Tank Bottoms

1 Scope

This recommended practice (RP) provides guidance on achieving effective corrosion control in aboveground storage tanks by application of tank bottom linings. It contains information pertinent to the selection of lining materials, surface preparation, lining application, cure, and inspection of tank bottom linings for existing and new storage tanks. In many cases, tank bottom linings have proven to be an effective method of preventing internal corrosion of steel tank bottoms.

The intent of this RP is to provide information and guidance specific to aboveground steel storage tanks in hydrocarbon service. Certain practices recommended herein may also be applicable to tanks in other services. This RP is intended to serve only as a guide. Detailed tank bottom lining specifications are not included.

Because of the wide variety of service environments, this RP does not designate specific tank bottom linings for every situation.

NACE No.10/SSPC-PA 6 and NACE No. 11/SSPC-PA 8 are industry consensus standards for installation of linings on tank bottoms and vessels. They are written in compulsory language and contain specific criteria intended for use by persons who provide written specifications for tank and vessel linings. These documents should be given consideration when designing and installing a lining system for steel bottom tanks.

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any addenda) applies.

API Bulletin 939-E, *Identification, Repair, and Mitigation of Cracking of Steel Equipment in Petroleum Refineries and Petrochemical Plants*

API Recommended Practice 651, *Cathodic Protection of Aboveground Petroleum Storage Tanks*

API Standard 653, *Tank Inspection, Repair, Alteration, and Reconstruction*

API Standard 2015, *Requirements for Safe Entry and Cleaning of Petroleum Storage Tanks*

ASTM D4285,¹ *Standard Test Method for Indicating Oil or Water in Compressed Air*

ASTM D4414, *Standard Practice for Measurement of Wet Film Thickness by Notch Gages*

ASTM D4940, *Standard Test Method for Conductimetric Analysis of Water Soluble Ionic Contamination of Blasting Abrasives*

ASTM E96, *Standard Test Methods for Water Vapor Transmission of Materials*

ASTM G9, *Standard Test Method for Water Penetration into Pipeline Coatings*

NACE 37519,² *Corrosion Data Survey—Metals Section*

¹ ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, Pennsylvania 19428-2959, www.astm.org.

² NACE International (formerly the National Association of Corrosion Engineers), 15835 Park Ten Place, Houston, Texas 77084, www.nace.org.