

# Thread Compounds for Casing, Tubing Line Pipe, and Drill Stem Elements

API RECOMMENDED PRACTICE 5A3  
FOURTH EDITION, FEBRUARY 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. The use of API publications is voluntary. In some cases, third parties or authorities having jurisdiction may choose to incorporate API standards by reference and may mandate compliance.

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 ensure 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.

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](mailto:standards@api.org).

Currently in preview, click buy full version

## Contents

	Page
<b>1</b> Scope.....	1
<b>2</b> Normative References .....	1
<b>3</b> Terms and Definitions .....	1
<b>4</b> Thread Compound Characteristics .....	3
<b>4.1</b> Product Characteristics.....	3
<b>4.2</b> Physical and Chemical Characteristics.....	4
<b>5</b> Thread Compound Performance Properties .....	8
<b>5.1</b> Frictional Property Test (Annex I).....	8
<b>5.2</b> Galling Resistance Properties (Annex J).....	9
<b>5.3</b> Fluid Sealing Properties for Casing, Tubing, and Line Pipe (Annex K) .....	9
<b>6</b> Quality Assurance and Control .....	10
<b>7</b> Marking Requirements.....	10
<b>7.1</b> Marking .....	10
<b>7.2</b> Labeling .....	11
Annex A (informative) API Modified Thread Compound .....	12
Annex B (informative) Casing, Tubing, and Line Pipe API Modified Reference Standard Formulation .....	15
Annex C (normative) Penetration Test.....	17
Annex D (normative) Evaporation Test.....	18
Annex E (normative) Oil Separation Test .....	19
Annex F (normative) Application/Adherence Test.....	21
Annex G (normative) Gas Evolution Test .....	23
Annex H (normative) Water Leaching Test.....	27
Annex I (normative) Frictional Properties Test for Thread Compounds.....	30
Annex J (normative) Extreme Surface-Contact Pressure (Galling) Properties Test.....	45
Annex K (informative) Fluid Sealing Test for Casing, Tubing, and Line Pipe .....	53
Annex L (informative) Corrosion Inhibition Tests .....	63
Annex M (informative) Compound High-temperature Stability Test.....	68
Bibliography.....	69

# Contents

	Page
<b>Figures</b>	
E.1 Oil Separation Test Apparatus .....	19
G.1 Gas Evolution Test Apparatus (Example 1) .....	25
G.2 Gas Evolution Test Apparatus (Example 2) .....	26
H.1 Example 1: Water Leaching Test Apparatus .....	28
H.2 Example 2: Water Leaching Test Apparatus .....	29
I.1 Contact Pressure (psi) vs Coefficient of Friction versus Degrees of Rotation (Turns).....	32
I.2 4140 Static Specimens (inches) .....	35
I.3 P550 Dynamic Specimens (inches).....	36
I.4 Mechanical System (Torque Machine) Example.....	38
I.5 Coefficient of Friction (Sample)/Coefficient of Friction (Reference).....	42
I.6 Example Torque and Coefficient of Friction vs. Turn Data.....	43
J.1 Contact Pressure (psi) vs Coefficient of Friction vs. Turns Data.....	46
J.2 Inconel Static Galling Specimen (inches) .....	48
J.3 Inconel Dynamic Galling Specimen (inches) .....	49
K.1 Example Plot—Typical Thread Compound Sealability Test.....	54
K.2 Example Log—Thread Compound Sealability Test .....	55
K.3 Example Plot: Typical Passing Lead-Based Thread Compound Sealability Test .....	58
K.4 Example Plot: Typical Failing Thread Compound Sealability Test .....	59
K.5 Example Plot: Typical Passing Non-Lead Thread Compound Sealability Test .....	59
K.6 Example Drawing: Benchtop Revision A Pin Connection .....	60
K.7 Example Drawing: Benchtop Revision A Box Connection .....	61
K.8 Required Thread Form.....	62
<b>Tables</b>	
1 Thread Compound Qualification, Physical and Chemical Characteristic Tests (Required) .....	5
2 Compound Qualification, Physical and Chemical Characteristic Tests (Suggested) .....	5
A.1 Proportions of Solids and Grease Base.....	12
A.2 Proportions of Solids.....	12
A.3 Modified Thread Compound Control and Performance Tests.....	13
A.4 Modified Thread Compound Component Requirements (Graphite) .....	13
A.5 Modified Thread Compound Component Requirements (Lead Powders).....	14
A.6 Modified Thread Compound Component Requirements (Zinc Dust).....	14
A.7 Modified Thread Compound Component Requirements (Copper Flake) .....	14
B.1 Reference Standard Composition and Tolerances .....	15
B.2 Grease Base Requirements .....	16
B.3 Reference Standard Constituent Limitations, Percent Mass Fraction .....	16
G.1 Sample Test Data.....	24
I.1 Bolt Reference Compound Formulation .....	33
I.2 Bolt Reference Compound Requirements .....	33
I.3 Bolt Reference Compound Component Requirements (Grease Base) .....	33
I.4 Bolt Reference Compound Component Requirements (Calcium Fluoride).....	33
I.5 Bolt Reference Compound Component Requirements (Calcium Sulfate).....	34
I.6 Surface Finish Conversion Chart.....	34
J.1 Surface Finish Conversion Chart.....	47
J.2 Galling Level Description .....	52

**Contents**

	Page
J.3 Example Test Report Key .....	52
L.1 Test Environment .....	65

Currently in preview, click buy full versi

Currently in preview, click buy full version

# Thread Compounds for Casing, Tubing, Line Pipe, and Drill Stem Elements

## 1 Scope

This standard provides requirements, recommendations, and methods for the testing of thread compounds intended for use on threaded casing, tubing, and line pipe connections; and for thread compounds intended for use on rotary shouldered connections. The tests outlined are used to evaluate the critical performance properties and physical and chemical characteristics of thread compounds under laboratory conditions.

These test methods are primarily intended for thread compounds formulated with a lubricating base grease and are not applicable to some materials used for lubricating and/or sealing thread connections. It is recognized that many areas can have environmental requirements for products of this type. This standard does not include requirements for environmental compliance. It is the responsibility of the end-user to investigate these requirements and to select, use and dispose of the thread compounds and related waste material accordingly.

## 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 errata or addenda) applies.

ASTM D217, *Standard Test Methods for Cone Penetration of Lubricating Greases*

ASTM D2265, *Standard Test Method for Dropping Point of Lubricating Grease over Wide Temperature Range*

ASTM D4048, *Standard Test Method for Detection of Copper Corrosion from Lubricating Grease*

ASTM E11, *Standard Specification for Wire Cloth and Sieves for Testing Purposes*

ISO 2137, *Petroleum products and lubricants—Determination of cone penetration of lubricating greases and petrolatum*

ISO 2176, *Petroleum products—Lubricating grease—Determination of dropping point*

## 3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

### 3.1

#### **API connection**

A threaded assembly of tubular components manufactured in accordance with API 5B.

### 3.2

#### **API modified reference standard formulation**

A casing, tubing, and line pipe (CT and LP) thread compound that is formulated in accordance with the requirements of [Annex B](#), to include the limitations and tolerances in [Tables B.1](#), [B.2](#), and [B.3](#).

NOTE—The reference standard formulations are not intended for general field service.

### 3.3

#### **API modified thread compound**

A compound designated as modified thread compound is a compound that meets the material constituents and performance tests as stipulated in [Annex A](#).