Procedures for Testing Casing and Tubing Connections

API RECOMMENDED PRACTICE 5C5
FOURTH EDITION, JANUARY 2017

ADDENDUM 1, MAY 2021

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 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 utilized. 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.

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 in order to conform to the standard.

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

Informative elements: As used in a standard, "informative" denotes elements that identify the document; introduce its content and explain its background, development, and relationship with other documents; or provide additional information intended to assist the understanding or use of the document.

Normative elements: As used in a standard, "normative" denotes elements that describe the scope of the document and that set out provisions that are required to implement the standard.

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

Contents

Contents

Page

Contents

Tables

Contents

Page

Contents

Page

Introduction

This recommended practice (RP) is part of a process to provide reliable threaded tubing and casing connections fit for purpose for the oil and natural gas industry. It has been developed based on improvements to API RP 5C5, Third Edition, with input from leading users, manufacturers, and testing consultants from around the world. This RP represents the knowledge of many years of testing experience.

The validation of the connection test load envelope and failure limit loads is relevant to design of tubing and casing for the oil and natural gas industries. Tubing and casing are subject to loads that include internal pressure, external pressure, axial tension, axial compression, bending, torsion, transverse forces, and temperature changes. The magnitude and combination of these loads result in various pipe body and connection failure modes. Connection failure modes and loads are generally different and often less than that of the pipe. Consequently, experimental validation is recommended when previous testing/analytical information and sufficient field experience are not available to provide confidence in the use of the connection. The user is responsible for appropriate interpretation of the test data and determination of the user's minimum connection performance envelope.

When evaluating a connection performance envelope, it is necessary to consider the possible range of performance parameters and to apply test and limit loads under conditions targeting the extremes of those parameters. Testing at the extremes of the performance parameters assures that the production population that falls within these limits meets or exceeds the performance of the test population. Variables that contribute to threaded connection performance include dimensional tolerances, mechanical properties, surface treatment, makeup torque, and the type and amount of thread compound. For typical proprietary connections, worst-case dimensional tolerances are assumed and defined in this RP. For other connection designs, analysis may be required to define worst-case tolerance combinations.

It is necessary that users of this RP be aware that further or differing requirements might be needed for individual applications. This RP is not intended to inhibit a vendor from offering, or a purchaser from accepting, alternate equipment or engineering solutions for an individual application. This is particularly applicable when there is innovative or developing technology. Where an alternative is offered, it is the responsibility of the vendor to identify any variations from this RP and to provide details.

For specific applications that are not evaluated by the tests herein, supplementary tests may be appropriate. Annex G describes some example of special applications where supplementary testing may be considered. The user and manufacturer should discuss well applications and the potential limitations of the connection under consideration.

Representatives of users and/or other third-party personnel are encouraged to monitor the tests.

Procedures for Testing Casing and Tubing Connections

1 Scope

This Recommended Practice (RP) defines tests to determine the galling tendency, sealing performance, and structural integrity of threaded casing and tubing connections. The words “casing” and “tubing” apply to the service application and not to the diameter of the pipe. This RP addresses the primary loads to which casing and tubing strings are subjected: fluid pressure (internal and/or external), axial force (tension and/or compression), bending (buckling and/or wellbore deviation), and temperature variations.

2 Normative References

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

API Specification 5CRA, *Specification for Corrosion-resistant Alloy Seamless Tubes for Use as Casing, Tubing and Coupling Stock*

API Specification 5CT, *Specification for Casing and Tubing*

API Technical Report 5C3, *Technical Report on Equations and Calculations for Casing, Tubing, and Line Pipe Used as Casing or Tubing; and Performance Properties Tables for Casing and Tubing*

API Specification 5L, *Specification for Line Pipe*

ASTM A370 [1], *Standard Test Methods and Definitions for Mechanical Testing of Steel Products*

3 Terms, Definitions, Symbols, and Abbreviations

3.1 Terms and Definitions

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

3.1.1
actual API collapse curve at ambient temperature
Derived for the test specimen from API 5C3 using measured maximum average outside diameter (OD), measured minimum average wall, and measured minimum ambient temperature material yield strength as input parameters.

NOTE For the reference to API 5C3, the appropriate section that applies addresses the *external pressure resistance*.

3.1.2
actual VME curve at ambient temperature
Derived for the test specimen from API 5C3 using measured maximum average OD, measured minimum wall (for hoop stress only), measured minimum average wall, and measured minimum ambient temperature material yield strength as input parameters.

NOTE For the reference to API 5C3, the appropriate section that applies addresses the *triaxial yield of pipe body*.

3.1.3
ambient temperature
Actual current temperature of the test lab environment at the time of testing.

[1] ASTM International, 100 Barr Harbor Drive, West Conshohocken, Pennsylvania 19428, www.astm.org.