



**NFPA Recommended Standard
NFPA/T3.6.29 R2-2000 (R2009)**

Third edition
15 March 2000

AN INDUSTRY STANDARD FOR FLUID POWER

**Tie rod or bolted cylinder – Pressure rating supplement to
NFPA/T2.6.1 R2-2000, Fluid power components – Method for
verifying the fatigue and establishing the burst pressure ratings of
the metal pressure containing envelope of a tie rod or bolted
cylinder**

(Revision of NFPA/T3.6.29 R1-1996)

Descriptors: cylinder bolted end head tie rod element fluid power pressure cyclic test rated fatigue burst analytical methods.

published by

NATIONAL FLUID POWER ASSOCIATION, INC.

3333 N. Mayfair Road / Milwaukee, WI 53222-3219 USA

PHONE: +1 414 778 3344 / FAX: +1 414 778 3361 / E-mail: nfpa@nfpa.com

Copyright 2000 by the
NATIONAL FLUID POWER ASSOCIATION
Printed in the USA

All standards, recommended practices, information reports, and bibliographies (collectively, "NFPA Documents") are advisory only. Use thereof by anyone for any purpose is entirely voluntary and in any event without risk of any nature to the National Fluid Power Association (NFPA), its officers, directors or authors of such work. There is no agreement by or between anyone to adhere to any NFPA Document. In formulating and approving NFPA Documents, NFPA and/or its councils and committees will not investigate or consider citations, references or patents which may or may not apply to such subject matter since prospective users of such NFPA Documents alone are responsible for establishing necessary safeguards in connection with utilization of such matters, including technical data, proprietary rights or patentable materials.

The information and data contained in NFPA Documents has been obtained from sources believed to be reliable. However, it should not be assumed that all acceptable or applicable sources of information, procedures, methods or techniques are contained in NFPA Documents, or that additional measures may not be required under certain circumstances or conditions.

NFPA Documents and/or policies and procedures are subject to periodic review and may be changed without notice. NFPA Documents are only current as of their publication date. NFPA Documents, after publication, may be revised or withdrawn at any time and current information on all NFPA Documents may be received by calling or writing NFPA. Additionally, the various codes and regulations referenced in NFPA Documents may be amended from time to time and it should not be assumed that the versions referenced therein are the most current versions of such codes and regulations. Please consult the appropriate regulatory authorities for the most up-to-date versions.

NFPA Documents imply a consensus of those substantially concerned with their scope and provisions and are intended as a guide to aid the manufacturer, the consumer and the general public. The publication of NFPA Documents does not in any respect preclude anyone, whether they have participated in the development of or approved such NFPA Documents or not, from manufacturing, marketing, purchasing, or using of products, processes or procedures not conforming to the NFPA Documents. NFPA Documents do not constitute or indicate a warranty of any sort, express or implied, including but not limited to a warranty or representation as to quality, merchantability or fitness for a particular use or purpose.

Participation by federal agency representative(s) or person(s) affiliated with the industry is not to be interpreted as government or industry endorsement of an NFPA Document(s).

NOTICE

NFPA Documents do not express or imply any judgment, certification or endorsement of or with respect to, the safety, design or performance of any product, component, or its use.

NFPA does not examine, investigate, test, recommend, or certify the design, use or safety of any product or component, even those which may incorporate one or more NFPA Documents. NFPA Documents therefore have no application to and do not express or imply any recommendation, representation or warranty, with respect to the safety, design, use, performance, or functional interchangeability of components or products which incorporate NFPA Documents.

This publication may not, in whole or in part, be reproduced, copied or disseminated, entered into or stored in a computer database or retrieval system, or otherwise utilized without the prior written permission of NFPA.

Foreword

This Foreword is not part of NFPA Recommended Standard *Tie rod or bolted cylinder – Pressure Rating Supplement to NFPA/T2.6.1 R2-2000, Fluid power components – Method for verifying the fatigue and establishing the burst pressure ratings of the pressure containing envelope of a tie rod or bolted cylinder, NFPA/T3.6.29 R2-2000.*

The project was initiated on 11 February 1997. The Technical Board approved the TSP on 10 April 1997. The first draft was an update to coordinate the document with the updated NFPA/T2.6.1 R2. Both were issued for general review on 30 December 1998. Comments were reviewed at the T2.6 committee meeting of 9 February 1999, and proposed changes were reviewed by the T3.21 committee at its meeting of 18 May 1999. NFPA headquarters the ballot draft on 2 August 1999. One negative ballot was reviewed by the T2.6 committee at its meeting on 22 September 1999 but not resolved. The negative ballot was overridden by the Technical Board, and the document given final approval, at their meeting of 18 November 1999.

Project Group Members who developed this standard:

John Berninger

Project Chairman and T2.6 Chairman
Parker Hannifin Corp.

June VanPinsker

Technical Coordinator
National Fluid Power Association

Donald Blackman

Section Chairman
Miller Fluid Power Corporation.

Shirley Seal*

Manager of Standards Development -
Industry/National
National Fluid Power Association

Thomas Hurley

Section Secretary
The Rexroth Corp.

Matt Boswell

Bosch Automation Technology

Paul Schacht

Technical Auditor
Bosch Automation Technology

*Retired

/jmv

Introduction

In fluid power systems, power is transmitted and controlled through a fluid (liquid or gas) under pressure within an enclosed circuit. During operation, tie rod or bolted fluid power cylinders in a system may be loaded from internal pressure, gravity, inertia, thermal variations and external forces. The nature of these loads can vary from a single static application, to continuously varying amplitudes, repetitive loadings and even shock.

It is important to know how well a tie rod or bolted fluid power cylinder can withstand these loads but this standard addresses only the loading due to internal pressure.

There are many ways in which internal pressure loads are imposed upon a tie rod or bolted fluid power cylinder. This standard considers a broad range of waveforms but within prescribed time limits, temperatures, environmental conditions and only upon certain metals. It is anticipated that these limitations could still provide sufficient common ground for comparing products. This rating method, therefore, provides the system designer with certain information to assist in a selection of tie rod or bolted fluid power cylinders for an application. The designer still has the responsibility to consider the other loading characteristics described above and to determine how they might affect the cylinder's ultimate pressure retaining capability.

This standard serves as a universal "verification test" to give credibility to the many in-house and other methods of determining tie rod or bolted fluid power cylinders pressure ratings. The credibility is based upon the fundamental nature of fatigue of metals with its statistical treatment and use of the pressure rating verification theory developed in NFPA standard NFPA/T2.6.1 R2-2000. Nevertheless, design knowledge of the component population and its representative samples, including consistency in materials, shapes, fabrication techniques, etc. is necessary to maximize accuracy in the verification method.

The basic pressure rating document, NFPA/T2.6.1 R2, established a group of common requirements intended to provide an industry-wide philosophy and basic standard, providing a rationale for judging a component's ability as a pressure containing envelope. Although the specific applicability of NFPA/T2.6.1 R2 is limited, it immediately established a uniform base for subsequent, more specific proposed NFPA recommended standards for individual fluid power components. This standard implements NFPA/T2.6.1 R2 and specifically applies to tie rod or bolted cylinders.

The method for verifying the fatigue and establishing the burst pressure ratings of the pressure containing envelope of metal fluid power telescopic cylinders and cylinders of nonbolted end construction is covered in a separate document, NFPA/T3.6.31 R2.

This version of NFPA/T3.6.29 R2 replaces earlier editions and utilizes the same basic theory. Products rated under the first (1976) edition may not be rated to the same values under this edition. See 13.1 for the differences in rating identification.

Tie rod or bolted cylinder – Pressure rating supplement to NFPA/T2.6.1 R2-2000, Fluid power components – Method for verifying the fatigue and establishing the burst pressure ratings of the metal pressure containing envelope of a tie rod or bolted cylinder

1 Scope

1.1 This standard provides:

- test and statistical methods for generating fatigue distribution data;
- test and statistical methods for conducting a verification of the pressure ratings on tie rod or bolted cylinder;
- common requirements and an industry-wide philosophy in judging one type of pressure capability for fluid power tie rod or bolted cylinders;
- uniform methods of product comparison.

1.2 Follow NFPA/T2.6.1 R2.

1.3 This standard encourages manufacturers to use this common method to enhance the credibility of their pressure ratings.

2 Normative references

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

NFPA/T2.6.1 R2-2000, *Fluid power components – Method for verifying the fatigue and establishing the burst pressure ratings of the pressure containing envelope of a metal fluid power component.*

ISO 1000-1992, *SI units and recommendations for the use of their multiples and of certain other units.*

ISO 5598:1985, *Fluid power systems and components – Vocabulary.*

ASTM E466-1996, *Standard Practice for Conducting Force Controlled Constant Amplitude Axial Fatigue Tests of Metallic Materials.*