



**NFPA Recommended Standard  
NFPA/T3.6.29 R2-2000 (R2019)**

Third edition  
15 March 2000

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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**

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**Reaffirmed 2019**

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

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## 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.

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## 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, *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, *SI units and recommendations for the use of their multiples and of certain other units.*

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

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