



**NFPA Recommended Standard  
NFPA/T3.6.59-1993 (R2017)**

First Edition  
22 March 1993

---

**AN INDUSTRY STANDARD FOR FLUID POWER**

## **Hydraulic fluid power – Cylinders – Cushion performance**

**Descriptors:** cushion information cushion performance energy absorption guidelines hydraulic fluid power linear system

---

published by

**NATIONAL FLUID POWER ASSOCIATION, INC.**

6737 W. Washington St. Ste. 2350 / Milwaukee, WI 53214 USA  
PHONE: +1 414 778 3344 / FAX: +1 414 778 3361 / E-mail: [nfpa@nfpa.com](mailto:nfpa@nfpa.com)

Copyright 1993 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 NFPA Documents, after publication, may be revised or withdrawn at any time and current information on all NFPA Documents may be received by calling or writing NFPA.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  
Hydraulic fluid power — Cylinders — Cushion performance,  
(NFPA)T3.6.59-1993.

At the 16 March 1988 meeting of the Cylinder Section (T3.6) it was recommended that a document be initiated dealing with cushion performance. John Harding (Hydro-Line Mfg.) agreed to serve as project chairman. On 17 May 1989 a TSP was presented to the Cylinder Section for their approval. It was recommended by the section to alter the abbreviated title to "Hydraulic Cylinder Cushion Performance" and the word "performance" in the Purpose section be replaced by "suitability". The Cylinder Section approved the revised TSP and recommended that it be submitted to the NFPA Technical Board for approval. On 15 June 1989 the Technical Board concurred with the Cylinder Section and granted approval of the TSP.

At the 16 August 1989 meeting of the Cylinder Section, John Harding resigned as project chairman. Richard Schink (Hydro-Line Mfg.) agreed to serve as project chairman.

On 15 November 1989 Chairman Schink (Miller Fluid Power Corp., company affiliation has changed) reported that the project was progressing well. A working draft was prepared and discussed by the project group on 21 March 1990. It was recommended that the document be submitted to NFPA headquarters for processing. This draft will be submitted to the Cylinder Section for discussion at their 22 August 1990 meeting. If approved by the Section it will be submitted for general review.

On 22 August 1990 the Cylinder Section concurred with the project group's recommendation to submit the document for general review. NFPA's Technical Staff prepared the document for General Review on 19 October 1990.

The General Review closed with comments from two companies. These editorial changes were incorporated into the document. At the 13 November 1991 meeting, T3.6 agreed to send the document to the Technical Board for approval to ballot.

The Technical Board met on 16 January 1992 and approved T3.6.59 for ballot. NFPA Headquarters prepared the document for ballot and it was sent out 29 January 1992.

The ballot closed 10 March 1992 with two negatives. Project Chairman Schink (Vickers, Inc., company affiliation has changed) discussed the negative comments with both commentators and made minor changes to the document. Both negatives were changed to approvals by 4 June 1992.

The Technical Board granted final approval on 17 September 1992.

Project Group members who developed this standard:

**Richard Schink**  
Project Chairman  
Vickers, Inc.

**Donald Selke**  
Section Chairman  
The Sheffer Corp.

**Paul Gles**  
Section Vice Chairman  
Vickers, Inc./T-J Division

**E. Wayne Hays**  
Section Secretary  
Bimba Manufacturing Co.

**David Prevallet**  
Technical Auditor  
Dana Corp.

**Linda E. Gasso**  
Technical Coordinator  
National Fluid Power Association

**Shirley C. Seal**  
Manager of Standards Development  
Industry/National  
National Fluid Power Association

**Lido Boni**  
Parker Hannifin Corp.

**Eric Johnston\***  
S-P Manufacturing

**Gregory Pesch**  
Hanna Corp.

\*Company affiliation has changed

This is a preview of "NFPA/T3.6.59-1993 (R...)". [Click here to purchase the full version from the ANSI store.](#)



NFPA/T3.6.59-1993 (R2007)

# Hydraulic fluid power — Cylinders — Cushion performance

## 0 Introduction

In hydraulic fluid power systems, power is transmitted and controlled through a liquid under pressure within an enclosed circuit.

Standardization of presentation of cushion information will allow users to better apply cylinders and compare various company's products. This standard would be used by individual manufacturers to establish cushion capabilities if the stated assumptions are taken into account.

## 1 Scope

**1.1** This standard defines maximum energy absorption guidelines for ANSI/B93.15.

**1.2** This standard will develop a method of presenting hydraulic cushion suitability.

## 2 Normative references

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

ANSI/B93.2-1986, *Fluid power systems and products - Glossary*.

ANSI/B93.15-1981, *Fluid power systems and products - Square head industrial cylinders - Mounting dimensions*.

## 3 Terms

For definition of terms used, see ANSI/B93.2.

## 4 Key assumptions and limitations

These assumptions provide either ideal or arbitrary parameters for determining maximum cushion performance. Actual performance may be different than determined by these methods if assumptions are not maintained. The efficiency factors may also vary with application differences.

**4.1** Maximum cushion pressure is 150% of rated pressure.

**4.2** The cushion achieves constant deceleration - pressure is constant for the length of the cushion plunger.

**4.3** The upper limit of velocity is 18 in/sec.

**4.4** If velocity is below 4 in/sec the cushions become ineffective on smaller sizes.

**4.5** Friction force is zero.

**4.6** The cylinder is used in a linear system - not for rotary applications.

**4.7** Fluid viscosity is equivalent to 25 centistokes.

**4.8** Drive pressure is equal to the system relief valve setting.

**4.9** Cushion adjustment screws may be provided to tune cushion performance within limits.

**4.10** Each manufacturer is to adjust the reported energy absorbing potential of his own product with an efficiency factor to reflect characteristics of their cushion design compared to ideal cushion performance.