



**NFPA Recommended Standard  
NFPA/T3.9.22 R2-2000 (R2014)**

Third edition  
15 March 2000

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AN INDUSTRY STANDARD FOR FLUID POWER

**Pump/motor – 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 metal fluid power pump and motor**

**(Revision of NFPA/T3.9.22 R1-1995)**

**Descriptors:** pump/motor hydraulic fluid power fluid power pressure cyclic test pressure rated fatigue pressure rated burst pressure burst test pressure rating by similarity pressure rating by test pressure rating.

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## Foreword

This Foreword is not part of NFPA Recommended Standard *Pump/Motor - 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 metal fluid power pump and motor, NFPA/T3.9.22 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 1999. Comments were reviewed at the T2.6 committee meeting of 9 February 1998, and proposed changes were reviewed by the T3.21 committee at its meeting of 18 May 1999. NFPA headquarters prepared the ballot draft on 2 August 1999. There were no negative ballots and the Technical Board granted final approval on 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, pump/motor(s) in a system may be loaded from internal pressure, gravity, inertia, thermal variation 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 pump/motor(s) 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 pump/motor(s). 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 pump/motor(s) 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 pump/motor(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 pump/motor(s) 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/T2.6.1 R2. Nevertheless, design knowledge of the pump/motor(s) population and its representative samples, including consistency in materials, shapes, fabrication techniques, etc. is necessary to maximize accuracy in the verification method.

This standard describes specific methods for testing pump/motor(s) for verifying their fatigue pressure ratings and establishing burst pressure ratings. It also provides specific means to determine some of the optional parameters.

This standard is a supplement to the basic pressure rating standard, NFPA/T2.6.1 R2. It follows the provisions of that document but is more specific to pump/motor(s). Application of this pressure rating method will require use of both documents.

This version of NFPA/T3.9.22 R2 replaces the 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 clause 12 for the differences in rating identification.

# **Pump/motor – 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 metal fluid power pump and motor**

## **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 of the pressure containing envelope on positive displacement fluid power pump/ motor(s);
- common requirements and an industry-wide philosophy in judging one type of pressure capability for fluid power pump/motor(s);
- uniform methods of product comparison.

**1.2** This standard limits conditions as follows:

- constant amplitude, pressure induced loading of the elements that constitute or maintain the pressure containing envelope;
- pump/motor(s) that are used on systems that use a liquid, rather than a gas to transmit power;
- product life of at least 100,000 cycles;
- defined conditions for pressure levels and pulse durations;
- temperatures from the charpy impact transition temperature to the threshold of creep sensitivity;
- environments which are chemically compatible with the materials of the pressure containing envelope;
- materials that are aluminum, magnesium, steel, iron, copper based alloys, cobalt, titanium, stainless steels, nickel steels and monel. Specifically excluded are creep sensitive materials such as: zinc, plastic, rubber and sealing devices;
- cavity failures that will cause fluid to leak to the environment are covered by this standard.

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