



American National Standard for

# Rotodynamic (Centrifugal and Vertical) Pumps

– Guideline for Condition Monitoring

ANSI/HI 9.6.5-2009



6 Campus Drive  
First Floor North  
Parsippany, New Jersey  
07054-4406  
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**Rotodynamic (Centrifugal and  
Vertical) Pumps —**  
Guideline for Condition Monitoring

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## Foreword (Not part of Standard)

### Purpose and aims of the Hydraulic Institute

The purpose and aims of the Institute are to promote the continued growth and well-being of pump manufacturers and further the interests of the public in such matters as are involved in manufacturing, engineering, distribution, safety, transportation and other problems of the industry, and to this end, among other things:

- a) To develop and publish standards and guidelines for pumps;
- b) To collect and disseminate information of value to its members and to the public;
- c) To appear for its members before governmental departments and agencies and other bodies in regard to matters affecting the industry;
- d) To increase the amount and to improve the quality of pump service to the public;
- e) To support educational and research activities;
- f) To promote the business interests of its members but not to engage in business of the kind ordinarily carried on for profit or to perform particular services for its members or individual persons as distinguished from activities to improve the business conditions and lawful interests of all of its members.

### Purpose of Standards and Guidelines

- 1) Hydraulic Institute Standards and Guidelines are adopted in the public interest and are designed to help eliminate misunderstandings between the manufacturer, the purchaser and/or the user and to assist the purchaser in selecting and obtaining the proper product for a particular need.
- 2) Use of Hydraulic Institute Standards and Guidelines is completely voluntary. Existence of Hydraulic Institute Standards does not in any respect preclude a member from manufacturing or selling products not conforming to the Standards.

### Definition of a Hydraulic Institute Guideline

A Hydraulic Institute Guideline is not normative. The guideline is tutorial in nature, to help the reader better understand the subject matter.

### Comments from users

Comments from users of this guideline will be appreciated, to help the Hydraulic Institute prepare even more useful future editions. Questions arising from the content of this guideline may be directed to the Hydraulic Institute. It will direct all such questions to the appropriate technical committee for provision of a suitable answer.

If a dispute arises regarding contents of an Institute publication or an answer provided by the Institute to a question such as indicated above, the point in question shall be sent in writing to the Technical Director of the Hydraulic Institute, who shall initiate the Appeals Process.

### Revisions

The Standards and Guidelines of the Hydraulic Institute are subject to constant review, and revisions are undertaken whenever it is found necessary because of new developments and progress in the art. If no revisions are made for five years, the standards and guidelines are reaffirmed using the ANSI canvass procedure.

### Units of measurement

Metric units of measurement are used and corresponding US customary units appear in brackets. Charts, graphs, and sample calculations are also shown in both metric and US customary units. Since values given in metric units are not exact equivalents to values given in US customary units, it is important that the selected units of measure to be applied be stated in reference to this guideline. If no such statement is provided, metric units shall govern.

## Consensus

Consensus for this guideline was achieved by use of the Canvass Method. The following organizations, recognized as having an interest in the standardization of rotodynamic pumps, were contacted prior to the approval of this revision of the guideline. Inclusion in this list does not necessarily imply that the organization concurred with the submittal of the proposed guideline to ANSI.

## Committee list

Although this guideline was processed and approved for submittal to ANSI by the Canvass Method, a working committee met many times to facilitate its development. At the time it was developed, the committee had the following members:

Chairman: E. W. Allis, Peerless Pump Company

### Committee Members

R. B. Erickson  
J. Anspach  
D. Rusnak  
A. Hobrastch

### Company

Flowserve Pump Division  
John Anspach Consulting  
Flowserve Pump Division  
National Pump

## 9.6.5 Rotodynamic (Centrifugal and Vertical) Pumps for Condition Monitoring

### 9.6.5.0 Scope

This guideline is for rotodynamic (centrifugal and vertical) pumps, including both sealed and sealless pump designs as stated in each section.

#### 9.6.5.0.1 Purpose

This document is intended to give the pump user a tool for condition monitoring of the pumps in their systems, but does not directly address process management systems.

#### 9.6.5.0.2 Use of this document

It is the user's responsibility to identify the need for implementing pump condition monitoring practices. The user is also responsible for identifying those parameters they wish to monitor. *This document does not require any monitoring be done*, but will provide information relevant to making such decisions, and provides suggestions for carrying out the monitoring process.

This guideline discusses the indicators that can be monitored or reviewed on rotodynamic pumps to identify pump failure modes. Common means of measuring those indicators have been defined. Control limits have been recommended, where appropriate, for those indicators whose limits are not defined in other Hydraulic Institute Standards. ANSI/HI 9.6.4 contains default initial field alarm and trip vibration measurement setting recommendations that may be used until a baseline can be established and the recommendations contained herein may be applied.

There are a number of potential failure modes for rotodynamic pumps. For each failure mode there can be several possible causes. To anticipate the occurrence of each cause, one or more of the following 14 indicators may be monitored or reviewed. The failure modes, causes, and indicators are listed in Appendix A. The inverse, namely indicators, causes, and failure modes, are listed in Appendix B.

There are definitions included in Appendix C to clarify terms used in this standard.

In addition to those indicators listed below, changes in pump sound can sometimes be used to indicate some changes in pump performance. However, interpretation of change in sound is usually subjective in nature.

Various failure modes can be characterized by the following observations and processes.

- Power absorbed
- Temperature rise
- Corrosion/Erosion
- Leakage
- Pressure (suction, discharge, differential)
- Vibration
- Periodic lubricant analysis
- Shaft position
- Rate of flow