ANSI/HI 9.6.4-2022

American National Standard for

Rotodynamic Pumps

for Vibration Measurements and Allowable Values

HYDRAULIC INSTITUTE™

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Rotodynamic Pumps

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American National Standard

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Foreword [Not part of American National Standard (ANSI)]

Purpose and aims of the Hydraulic Institute

The purpose and aims of the Hydraulic Institute are to drive all Pump System stakeholders towards a sustainable future by:

a) Advancing Solutions for Pump System Performance and Efficiency

b) Developing Standards and Technical Resources

c) Educating the Global Marketplace

d) Advocating for the Industry

Purpose of Document:

Hydraulic Institute Standards and Guidelines may be published as American National Standards, and are adopted in the public interest 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. Use is completely voluntary and does not in any respect preclude a member from manufacturing or selling products which are not conforming.

Definition of Hydraulic Institute Standard

Quoting from Article XV, Standards, of the By-Laws of the Institute, Section B:

> "An Institute Standard defines the product, material, process or procedure with reference to one or more of the following: nomenclature, composition, construction, dimensions, tolerances, safety, operating characteristics, performance, quality, rating, testing and service for which designed."

Definition of 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 standard will be appreciated, to help the Hydraulic Institute prepare even more useful future editions. Questions arising from the content of this standard may be directed to the Technical Director of the Hydraulic Institute. If appropriate, the inquiry will then be directed to the appropriate technical committee for provision of a suitable answer.

Revisions

American National Standards 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. Errata or addenda may be issued to address limited changes. If no revisions are made for five years, the standards are reaffirmed using the ANSI canvass procedure.

Disclaimer

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This document does not contain a complete statement of all requirements, analyses, and procedures necessary to ensure safe or appropriate selection, installation, testing, inspection, and operation of any pump or associated products. Each application, service, and selection is unique with process requirements that shall be determined by the owner, operator, or its designated representative.

Units of measurement

Metric units of measurement are used, and corresponding US customary units appear in parentheses. Charts, graphs, and sample calculations are also shown in both metric and US customary units. Because 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 standard. If no such statement is provided, metric units shall govern.

Consensus

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

4B Engineering & Consulting, LLC
AECOM
Brown and Caldwell
CDM Smith - Water Services Group
DynaTech Engineering, Inc.
Ekwestrel Engineering LLC
Exponent
Flowserve Corporation
Irving Oil
Las Vegas Valley Water District
Mechanical Solutions, Inc.
MEIER Consulting
MWI Pumps
OTP Industrial Solutions
Parametrix
Patterson Pump Company
Peerless Pump Company
Pentair
Industry Partner
Plymon Vibration Consultants
WC Livoti Consulting
Sulzer
Summit Pump Inc.
Suncor
Swiss Flow Solutions GmbH
TACO, Inc.
Industry Partner
Tarrant Regional Water District
U.S. Bureau of Reclamation
UPB
Westinghouse Electric Co.
Xylem, Inc.

Committee list

Although this standard 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:

Chair – Paul Behnke, ITT - Industrial Process (Retired)
Chair – David Skinner, ITT - Industrial Process
Vice-chair – Paul Boyadjis, Mechanical Solutions, Inc.

Committee members	Company
Aleks Roudnev	Weir Minerals North America
Barry Jongsma	Pentair - Fairbanks Nijhuis
Bryce Wells	Flowserve Corporation
Charlie Allaben	HDR, Inc.
Clint Zentic	Sulzer
Daniel Boldt	Trillium Pumps USA
George Tey	Stantec
Jan Schyberg	Xylem Inc. - Water Solutions
Jerry Szofer	Grundfos Water Utility

Jim Wall	Sulzer Pumps Solutions Inc.
John Kelly	Smith & Loveless, Inc.
Jorge Cortes	Patterson Pump Company
Mantosh Bhattacharya	Industry Partner
Maria Elena Rodriguez Hernandez	Ingeteam Indar Machines
Mark Supplee	Hazen and Sawyer, P.C.
Michael Coussens	Peerless Pump Company
Patrick Hogg	Nidec Motor Corporation
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Paul Ruzicka	Xylem Inc. - Applied Water Systems
Raghu Kadava	Black & Veatch
Ravindra Birajdar	Kirloskar Brothers Ltd.
Rex Beach	PSG, a Dover Company
Robert Sayer	Industry Partner
Steven Fehniger	CDM Smith - Water Services Group
Sunil Deshpande	SPP Pumps, Inc.

Alternates	**Company**
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Bryce Neilson	Patterson Pump Company
Doug Lawrence	Weir Minerals North America
Jack Claxton	Patterson Pump Company
James Roberts	Xylem Inc. - Applied Water Systems
Jason Kerns	HDR, Inc.
Joseph Orlins	AECOM
Karen Bettencourt	AECOM
Maki Onari	Mechanical Solutions, Inc.
Mark Allen	CDM Smith - Water Services Group
Michael Cugal	Weir Minerals North America
Robert McCann	Stantec

9.6.4 Rotodynamic pumps for vibration measurements and allowable values

9.6.4.1 Introduction and scope

9.6.4.1.1 Introduction

This standard pertains to evaluation of vibration when the vibration measurements are made on stationary parts associated with bearings (bearing housings) of rotodynamic pumps. It provides specific maximum allowable vibration values measured on bearing housings of rotodynamic pumps in field and factory test environments.

Vibration measurements can be useful for many purposes, such as acceptance tests, diagnostic or analytical investigations, and operational monitoring. The principal purpose of this standard is to establish vibration measurement methodology and maximum allowable vibration values for acceptance testing of new equipment. A general description of the principles to be applied for the measurement and assessment of vibration on rotodynamic pumps is given for vibration on stationary parts associated with bearings.

This standard is based on experiences from pump users and manufacturers as well as vibration measurements by many companies. Vibration data from both factory test and field test environments have been incorporated into the maximum allowable vibration values. Values are applicable when the pump is installed per Hydraulic Institute Standards or the manufacturer's specifications.

For certain vertical pump types, the vibration transducers shall be located near the top of the motor support (refer to Figure 9.6.4.2.3.1, Measurement locations and directions). For vertical pump types, the reference to "bearing housing" refers to this location.

Since the last revision of this standard the recommended guidance for below-ground vibration for vertically suspended (VS) pumps has been added in Appendix D. In addition, Appendix C has been revised to include guidance for vibration criteria for horizontal motors. The vibration test requirements for submersible pumps previously located in the ANSI/HI 11.6 standard are now presented in Section 9.6.4.3 of this standard. New guidance for vibration collection during pump acceptance testing is also included in Appendix E.

9.6.4.1.2 Scope

This standard applies to the evaluation of vibration on rotodynamic pump applications absorbing more than 2 kilowatts (kW) (3 horsepower [hp]) and of the types as indicated in Figure 9.6.4.2.3.1. It pertains to evaluation of vibration when the vibration measurements are made on stationary parts associated with bearings (bearing housing vibration).

The general evaluation criteria are included for acceptance tests in field environments or at the manufacturer's test facility, as appropriate and as defined in the standard. The vibration amplitude limits provided in this standard assume that the machinery is not in a resonant condition. Refer to ANSI/HI 9.6.8 *Rotodynamic Pumps – Guideline for Dynamics of Pumping Machinery* for more information.

This standard applies to tests conducted within the rated speed ±10%. Tests conducted at speeds exceeding these limitations (such as variable-speed pumps or 50-cycle pumps tested with 60-cycle power for factory tests) shall be mutually agreed upon by the manufacturer and user due to the possibility of objectionable resonance effects.

This standard is also applicable to solids-handling pump types. A *solids-handling pump* is defined as a pump designed to ensure maximum freedom from clogging when handling liquids containing organic solids or stringy materials.

This standard is also applicable to slurry pump types. A *slurry pump* is defined as a pump suitable for pumping a mixture of abrasive solids with specific gravity greater than 1 and concentration by volume greater than 2% in a liquid carrier, usually water. For more information on slurry pump types, refer to the latest edition of ANSI/HI 12.1–12.6 *Rotodynamic Centrifugal Slurry Pumps for Nomenclature, Definitions, Applications, and Operation*. If an