ANSI/HI 9.6.3-2017

American National Standard for

Rotodynamic Pumps

— Guideline for Operating Regions

HYDRAULIC INSTITUTE

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Approved January 6, 2017
American National Standards Institute, Inc.

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Published By

Hydraulic Institute
6 Campus Drive, First Floor North
Parsippany, NJ 07054-4406

www.Pumps.org

Printed in the United States of America

ISBN 978-1-935762-58-4

Recycled paper

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Foreword (Not part of Standard)

Purpose and aims of the Hydraulic Institute

The purpose and aims of the Hydraulic Institute are to promote the advancement of the pump manufacturing industry and further the interests of the public, and to this end, among other things:

a) Develop and publish standards;

b) Address pump systems;

c) Expand knowledge and resources;

d) Educate the marketplace;

e) Advocate for the industry.

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 Standard of the Hydraulic Institute

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 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 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. If no revisions are made for five years, the standards are reaffirmed using the ANSI canvass procedure.

Disclaimer

This document was prepared by a committee of the Hydraulic Institute and approved by following ANSI essential requirements. Neither the Hydraulic Institute, Hydraulic Institute committees, nor any person acting on behalf of the Hydraulic Institute: a) makes any warranty, expressed or implied, with respect to the use of any information, apparatus, method, or process disclosed in this document or guarantees that such may not infringe privately owned rights; b) assumes any liabilities with respect to the use of, or for damages resulting from the use of, any information, apparatus, method, or process disclosed in this guideline. The Hydraulic Institute is in no way responsible for any consequences to an owner, operator, user, or anyone else resulting from reference to the content of this guideline, its application, or use.

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 his designated representative.

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. 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.

Allaben Consulting
Bechtel Corporation
Black & Veatch
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Chevron U.S.A. Inc.
DuPont Company
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Fluid Sealing Association
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Syncrude Canada Limited
Weir Floway, Inc.
Weir Minerals North America
Whitley Burchett and Associates, Inc.
Xylem Inc. - Applied Water Systems

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 – Arnold Sdano, Pentair - Fairbanks Nijhuis
Vice-Chair – Ernest Sturtz, CDM Smith

Committee members	Company
Jack Bagain	John Crane Inc.
Ravindra Birajdar	Kirloskar Brothers Ltd.
Michael Coussens	Peerless Pump Company
Michael Cugal	Weir Minerals North America
Sunil Deshpande	SPP Pumps, Inc.
Lucian Dobrot	ITT - Industrial Process
Al Iseppon	Pentair - Berkeley
Paul Ruzicka	Xylem Inc. - Applied Water Systems
Jan Schyberg	Xylem Inc. - Water Solutions
Constantino Senon	MWH Americas, Inc.
Albert Ticknor, III, P.E.	National Pump Company
Robert Visintainer	GIW Industries, Inc. (A KSB Company)
James Volk	Franklin Electric Company, Inc.

Alternates	Company
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Steven Fehniger	CDM Smith
Christopher Felix	Xylem Inc. - Applied Water Systems
Carl Frizzell	CDM Smith
Mark Heiser	Xylem Inc. - Applied Water Systems
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Patricia McCarthy	Xylem Inc. - Water Solutions
Ed Pascua	MWH Americas, Inc.
James Roberts	Xylem Inc. - Applied Water Systems
Aleksander Roudnev	Weir Minerals North America
George Tey	MWH Americas, Inc.
Kristel Zaman	Xylem Inc. - Water Solutions

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9.6.3 Operating regions

This guideline discusses the effects of operating a rotodynamic pump continuously or for a long duration at rates of flow greater than or less than the pump's best efficiency point (BEP) rate of flow. These effects influence the power consumption and life of pump components and, therefore, determining the preferred/allowable operating range of flows is essential to reliable, efficient pump operation.

Design characteristics for both performance and service life are optimized near a rate of flow designated as the BEP. At BEP, the pump operates with maximum hydraulic efficiency. At BEP flow, the pumped liquid passes through the impeller vanes, casing diffuser (discharge nozzle), or vaned diffuser with minimal losses. In addition, the flow through the impeller and diffuser vanes (if so equipped) is relatively uniform and matched to the pump hydraulic geometry.

When the operating rate of flow moves away from BEP, the flow through the pump is no longer uniform. Areas of flow recirculation and separation develop increasing hydraulic losses. Nonuniform flow and uneven pressure distribution in the pump result in increased hydraulic loads and vibration.

9.6.3.1 Preferred operating region

The preferred operating region (POR) is a range of rates of flow to either side of predicted BEP within which the hydraulic efficiency and the operational reliability of the pump are not substantially degraded. Within this region, the design service life of the pump will not be affected by the internal hydraulic loads or flow-induced vibration. Operating a pump within the POR ensures higher reliability and lower energy consumption.

A range of PORs for different pump specific speeds are shown in Table 9.6.3.1. Well-matched flow in higher specific speed pumps occurs in a narrower flow range. The manufacturer may recommend an alternate POR that could be more expansive or more restrictive.

Table 9.6.3.1 — Preferred operating region related to specific speed

Specific Speed		Preferred Operating Region (POR)
Metric	US Customary	
≤90	≤4500	Between 70% and 120% of BEP
>90	>4500	Between 80% and 120% of BEP
≤140	≤7000	
>140	>7000	Between 85% and 115% of BEP
≤200	≤10,000	
>200	>10,000	Between 90% and 110% of BEP

Notes:

- Unless otherwise recommended by the manufacturer, these suggested preferred regions are applicable for the pump design speed only.
- These suggested preferred regions should be further limited and to be away from the unstable region in case of unstable head curve for the subject pump.
- These limits are recommended for the pump to be operated continuously or for long duration.
- These limits may be further limited by any influence by the system accessories and operating conditions in the site installed condition.

For slurry pumps handling high concentrations of abrasive solids, the generally acceptable POR is primarily determined by wear considerations of the wear components. Refer to ANSI/HI 12.1-12.6 *Rotodynamic Centrifugal Slurry Pumps for Nomenclature, Definitions, Applications, and Operation* for information.