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American National Standard for

Rotodynamic Pumps

— Guideline for NPSH Margin

HYDRAULIC INSTITUTE

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American National Standard

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Contents

Figures

Tables

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.

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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.

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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 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.

Arizona Public Service Electric Company
Bechtel Corporation
Black & Veatch
Brown and Caldwell
CH2M Hill
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The Conservation Fund
WEG Electric Corp.
Weir Minerals North America
Whitley Burchett and Associates, Inc.
WorleyParsons
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 – Constantino Senon, MWH Americas, Inc.

Committee members	Company
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
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Paul Moulton	AECOM
Rodney Mrkvicka	Smith & Loveless, Inc.
Paul Ruzicka	Xylem Inc. - Applied Water Systems
Jan Schyberg	Xylem Inc. - Water Solutions
Ernest Sturtz	CDM Smith
Albert Ticknor, III, P.E.	National Pump Company
Robert Visintainer	GIW Industries, Inc. (A KSB Company)

Alternates	Company
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Steven Fehniger	CDM Smith
Carl Frizzell	CDM Smith
Patricia McCarthy	Xylem Inc. - Water Solutions
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James Roberts	Xylem Inc. - Applied Water Systems
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George Tey	MWH Americas, Inc.
Kristel Zaman	Xylem Inc. - Water Solutions

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9.6.1 Pump NPSH margin

9.6.1.1 Introduction

The purpose of this guideline is to establish recommended net positive suction head available (NPSHA) above the published NPSH required (NPSHR) that will lead to acceptable pump performance and service life. It describes the benefits to pump longevity when the NPSHA is greater than the NPSHR by a margin defined in Section 9.6.1.4, and recommends NPSH margins for specific applications. See Section 9.6.1.2 for terms and definitions.

An NPSH margin may also be needed to cover the uncertainties of what level the NPSHA will be, over the range of operation.

Noise, vibration, and overall reliability of a rotodynamic pump may be affected if an appropriate NPSH margin is not provided by the system above the published NPSHR for the pump.

The scope of this guideline applies to rotodynamic pumps with absorbed power levels up to 4 megawatts (MW) (5300 horsepower [hp]) and impeller inlet tip speeds less than 40 meters per second (m/s) (130 feet per second [ft/s]).

9.6.1.2 Terms and definitions

NPSH: For the purpose of this document, net positive suction head (NPSH) is considered equivalent to the net positive suction head available (NPSHA).

NPSHA: The NPSHA is the total suction head absolute, over the vapor pressure of the liquid pumped at its operating conditions in the NPSH datum plane defined as follows:

$$\text{NPSH}A = h_{atm} + h_s - h_{vp}$$

Where:

h_{atm} = atmospheric pressure head, in m (ft)

h_s = total suction head = $h_{gs} + h_{vs} + z_s$, in m (ft)

h_{gs} = suction gauge head, in m (ft)

h_{vs} = suction velocity head, in m (ft)

z_s = elevation from the suction gauge centerline to datum (see Figure 9.6.1.2a), in m (ft)

h_{vp} = liquid vapor pressure head (taken at the highest sustained operating temperature), in m (ft)

NPSH datum plane: The horizontal plane through the center of the circle described by the external points of the entrance edges of the impeller blades; in the first stage in the case of multistage pumps. In the case of double inlet pumps with vertical or inclined axis, it is the plane through the higher center. The manufacturer should indicate the position of this plane with respect to precise reference points on the pump (see Figure 9.6.1.2a).