HI 20.3-2020

Hydraulic Institute Guideline for

Rotodynamic Pump Efficiency Prediction

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Hydraulic Institute Guideline

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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

a) 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.

b) Use of Hydraulic Institute Standards and Guidelines is completely voluntary. The 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

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.

Disclaimer

This document was prepared by a committee of the Hydraulic Institute and approved by following Hydraulic Institute procedures. Neither the Hydraulic Institute, Hydraulic Institute committees, nor any person acting on behalf of the Hydraulic Institute: 1) 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; 2) 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 document, 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 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.

Committee list

A working committee met many times to facilitate this documents development. At the time it was developed, the committee had the following members:

Chair – James Roberts, Xylem Inc. - Applied Water Systems
Chair – Arnie Sdano, Pentair - Fairbanks Nijhuis (Retired)
Vice-chair – Craig Redmond, Gorman-Rupp, Mansfield Division

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20.3 Rotodynamic pump efficiency prediction

20.3.1 Introduction

20.3.1.1 Purpose

The purpose of this guideline is to support the aims of the Hydraulic Institute by educating the pump user community regarding the impact on rotodynamic pump predicted efficiency from:

- Selection of a pump type or design
- Pump size and rate of flow
- Specific speed
- Wear-induced increased running clearances (leakage losses)
- Surface finish of the hydraulic passages

20.3.1.2 Scope

The scope of this guideline includes the rotodynamic pump types listed in Table 20.3.4.2.1. The efficiency values determined by this guideline only apply at the best efficiency rate of flow.

The efficiencies shown in this guideline are those generally obtained using common manufacturing practices and are based on actual data supplied by pump manufacturers. This guideline is provided for informational purposes only and should not be used to determine compliance with any existing or future regulations that set pump efficiency requirements. It is the responsibility of the pump manufacturers to ensure proper understanding and compliance with any regulations that set efficiency requirements applicable to their products.

The efficiency prediction charts (see Figures 20.3.4.2.1a and b) relate to pumps designed, manufactured, and tested in accordance with recognized industry standards (ANSI/HI 14.6 *Rotodynamic Pumps for Hydraulic Performance Acceptance Tests*, ANSI/HI 11.6 *Rotodynamic Submersible Pumps: for Hydraulic Performance, Hydrostatic Pressure, Mechanical and Electrical Acceptance Tests*, and ISO 9906 *Rotodynamic pumps - Hydraulic performance acceptance tests - Grades 1, 2 and 3*).

20.3.1.3 Preferred terms, units, and symbols

This nomenclature and definitions for this guideline are outlined in ANSI/HI 14.1-14.2 *Rotodynamic Pumps for Nomenclature and Definitions*. Specific to the procedures in this guideline, note that an alternate definition of specific speed n_s (N_s), which uses flow per impeller eye (Q'), is used. The definition for n_s (N_s) is outlined in Section 20.3.2.2.

20.3.2 Major factors which influence pump efficiency

Major factors that influence rotodynamic pump efficiency are the types of pump selected to meet the service conditions, the specific speed n_s (N_s) of the pump, surface conditions, and internal clearances. These factors are all considered in the procedure to determine predicted efficiency as laid out in Section 20.3.4.2.

20.3.2.1 Types of pumps

There are many different types of rotodynamic pumps with unique configurations and features to meet specific service conditions, e.g., paper stock, sewage, slurries, etc. By virtue of the compromises in design needed to address special applications, they may have less than the maximum attainable efficiency. Table 20.3.4.2.1 provides details on how pump features influence efficiency. Refer to ANSI/HI 14.1-14.2 *Rotodynamic Pumps for Nomenclature and Definitions* to find pump type.