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American National Standard for

Rotodynamic Centrifugal Pumps

for Design and Application

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Hydraulic INSTITUTE

6 Campus Drive
First Floor North
Parsippany, New Jersey
07054-4406
www.Pumps.org

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Foreword (Not part of Standard)

Scope

The purpose and aims of the Institute are to promote the continued growth of pump knowledge for the interest of pump users and manufacturers and to 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 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

1) Hydraulic Institute Standards 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 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.”

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 sent to the Technical Director of the Hydraulic Institute. The inquiry will then be directed to the appropriate technical committee for provision of a suitable answer.

If a dispute arises regarding the content of an Institute Standard 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 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.

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 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 standard was achieved by use of the canvass method. The following organizations recognized as having interest in rotodynamic centrifugal pumps for design and application 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 and Consulting, LLC
Bechtel Power Corporation
Black & Veatch Corp.
ekwestrel Corp.
J.A.S. Solutions Ltd.
KCWTD
Kemet Inc.
Patterson Pump Company
Pentair Water
Pump Design, Development & Diagnostics
Sulzer Pumps (US) Inc.
TACO, Inc.
The Gorman-Rupp Company
Weir Floway, Inc.
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 approved, the committee had the following members:

Chair – Al Iseppon, Pentair Water
Vice-chair – Joseph Salah, Sulzer Process Pumps (US) Inc.

Committee members	**Company**
Greg Case	Pump Design, Development & Diagnostics
Michael Cropper	Sulzer Pumps (US) Inc.
Michael Cugal	Weir Hazleton, Inc.
Lucian Dobrot	TACO, Inc.
Mike Noble	Lewis Pumps
Aleksander Roudnev	Weir Minerals North America
Gary Saylor (Alternate)	Weir Hazleton, Inc.
LeRoy Sell	PumpWorks 610

1.3 Design and application

The purpose of this standard is to provide a guide for the design and application of rotodynamic centrifugal pumps for various services. This is not an attempt to cover all phases of rotodynamic pump design and application but an endeavor has been made to recognize and identify the application requirements of the most common industry segments. Principal features of pumps and the necessary precautions for proper use are pointed out.

Rotodynamic pumps are kinetic machines in which energy is continuously imparted to the pumped fluid by means of a rotating impeller, propeller, or rotor. The most common types of rotodynamic pumps are centrifugal (radial), mixed flow, and axial flow pumps.

Centrifugal pumps use bladed impellers with essentially radial outlet to transfer rotational mechanical energy to the fluid primarily by increasing the fluid kinetic energy (angular momentum) and also increasing potential energy (static pressure). Kinetic energy is then converted into usable pressure energy in the discharge collector.

It can be considered that a rotodynamic pump (centrifugal pump) thereby converts liquid that is at a low pressure to a higher pressure by the use of a rotating shaft that spins a specially designed disk(s) within the boundaries of an enclosed vessel. This transaction converts rotating mechanical energy into hydraulic energy by increasing the fluid kinetic energy (angular momentum).

In the pump industry, the vessel described above is referred to as the *casing*. It has an inlet or suction port for the low-pressure liquid to enter the vessel and a discharge port for the high-pressure liquid to exit. There is a seal (or seals) to control the leakage of liquid where the shaft penetrates the casing. A motor, turbine, or engine is used to drive the rotating shaft. The special disk attached to the shaft is called the *impeller*. There are semiradial integral passageways enclosed within or exposed on the impeller. The liquid enters at the lower diameter of these passageways. The mechanical energy of the rotating shaft is transferred to the impeller. The impeller then increases the liquid kinetic energy as it moves through the impeller passageway to the outer diameter. As the liquid exits the outer diameter of the impeller it enters a discharge collector within the stationary casing. The collector converts kinetic energy into pressure energy through a diffusion process.

Both the impeller vane passage area and the discharge collector inlet area (cutwater or throat area) are controlled in size to regulate the rate of fluid pumped (capacity) and to define a certain rate of flow typically known as the *pump best efficiency point* (BEP). The pumped fluid exits the casing via the pump discharge port or outlet.

1.3.1 Scope

This standard is for rotodynamic centrifugal, regenerative turbine, and Pitot tube pumps of all industrial/commercial types except vertical single and multistage diffuser pump types. It includes design and application.

Included rotodynamic centrifugal pump types are as shown in Figure 1.3.1.

1.3.2 Introduction to pump classifications

Rotodynamic pumps may be classified by such methods as impeller or casing configuration, end application, specific speed, or mechanical configuration. The method used within this standard (as indicated in Appendix A, Figures A.1, A.2, and A.3) is based primarily on commonly distinctive mechanical configurations. Commonly used pump types are classified as overhung (type OH), between-bearings (type BB), or vertically suspended (type VS).

ANSI/HI Standards (for Design and Application) have historically been subdivided into *rotodynamic centrifugal pumps (ANSI/HI 1.3)* and *rotodynamic vertical pumps (ANSI/HI 2.3)*, with a demarcation between the two categories being determined by the arrangement of the hydraulic configuration (impeller, casing, bowl, or diffuser). Within these lines of demarcation there are pump types that can be clearly identified to fit into each of the defined categories.

There are, however, several pump types or arrangements that are not so clearly defined.