

Hydraulic Institute Standards for Rotodynamic Pumps Covering Definitions and Nomenclature, Design and Application, Manuals for Installation, Operation and Maintenance, and Hydraulic Performance Acceptance Testing

Centrifugal & Vertical Pump Standards Overview

Historically, Hydraulic Institute standards have been divided into “1-series” standards covering centrifugal pumps and “2-series” standards covering vertical pumps. These included the following standards:

Centrifugal Pump Standards

- ANSI/HI 1.1-1.2 Centrifugal Pumps for Nomenclature and Definitions
- ANSI/HI 1.3 Centrifugal Pumps for Design and Application
- ANSI/HI 1.4 Centrifugal Pumps For Manuals Describing Installation, Operation and Maintenance
- ANSI/HI 1.6 Centrifugal Pump Tests

Vertical Pump Standards

- ANSI/HI 2.1-2.2 Vertical Pumps For Nomenclature and Definitions
- ANSI/HI 2.3 Vertical Pumps For Design and Application
- ANSI/HI 2.4 Vertical Pumps For Manuals Describing Installation, Operation and Maintenance
- ANSI/HI 2.6 Vertical Pump Tests

The 1-series centrifugal pumps were synonymous with horizontal pumps that were primarily of radial flow impeller discharge and the 2-series vertical pumps were synonymous with vertical pumps of radial, mixed and axial flow impeller discharge. The demarcation between the two categories is also determined by the arrangement of the hydraulic configuration (impeller, casing, bowl, or diffuser). However, in each case they have shared physical features and hydraulic functions that are better addressed together rather than separately. Therefore, in the 2000’s the Institute’s technical leadership reviewed its standards and nomenclature and determined the content in the 1-series and 2-series documents had repetitive information and that the nomenclature could be more accurately described. This resulted in an effort to combine each of the 1-series and 2-series standards into a single 14-series standard. This effort proved to be a challenging and time consuming process that resulted in the publication of ANSI/HI 14.6 in 2011 and 2016 revision and is culminating in 2018 with the publication of the remaining standards. The series of standards is as follows:

- [ANSI/HI 14.1 -14.2 Rotodynamic Pumps For Nomenclature and Definitions](#)
- [ANSI/HI 14.3 Rotodynamic Pumps For Design and Application](#)
- [ANSI/HI 14.4 Rotodynamic Pumps For Installation, Operation and Maintenance](#)
- [ANSI/HI 14.6 Rotodynamic Pumps For Hydraulic Performance Acceptance Tests](#)

As noted in the names of the standards, the old centrifugal and vertical pumps are grouped under the name rotodynamic, which is an improvement in the accuracy of the nomenclature describing these types of pumps. Rotodynamic pumps are kinetic machines in which energy is continuously imparted to the pumped fluid by means of a rotating impeller, propeller, or rotor. These pumps transfer mechanical energy to the fluid primarily by increasing the fluid kinetic energy. Kinetic energy is then converted into potential energy (pressure) in the discharge collector. The most common types of rotodynamic pumps are radial flow (centrifugal), mixed flow, and axial flow (propeller) pumps, including pumps that are historically referred to as *vertical turbines*. Rotodynamic pumps can have a rotor with vertical or horizontal axis of rotation. The term centrifugal pump, frequently used in industry is synonymous with the radial flow impeller. Figure 1 shows the three flow types for impellers classified under the rotodynamic umbrella. In all three types the flow enters axially to the shaft, with radial flow turning approximately 90 degrees to discharge, mixed flow turning approximately 45 degrees to discharge, and axial flow continuing axially to discharge.

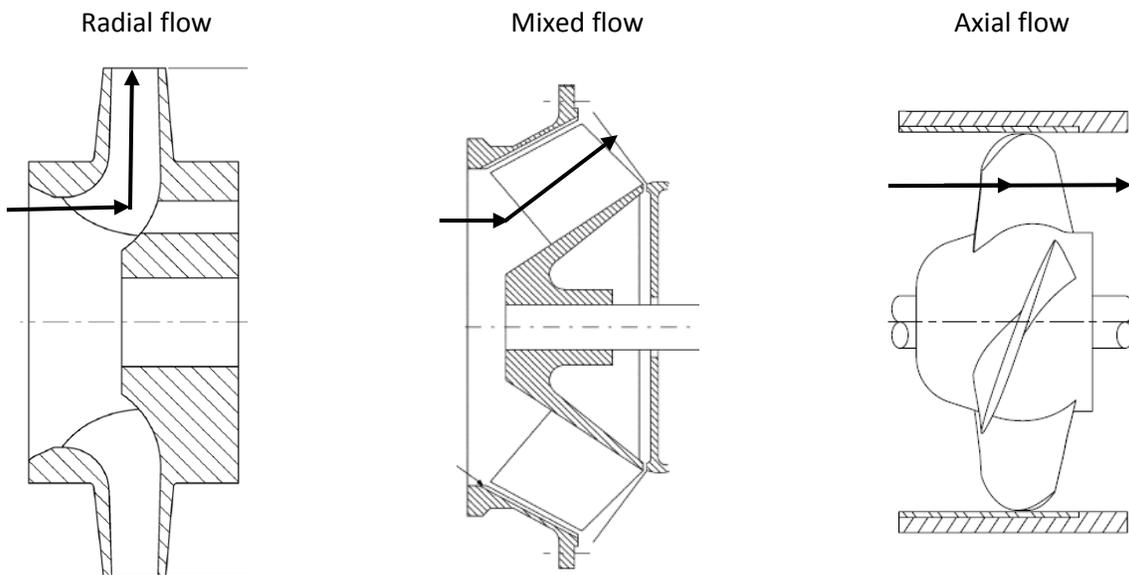


Figure 1 – Radial (centrifugal), mixed, and axial flow impellers

Additionally, rotodynamic pumps are classified as shown in Figure 2 by orientation, special designation, stage count, and coupling method.

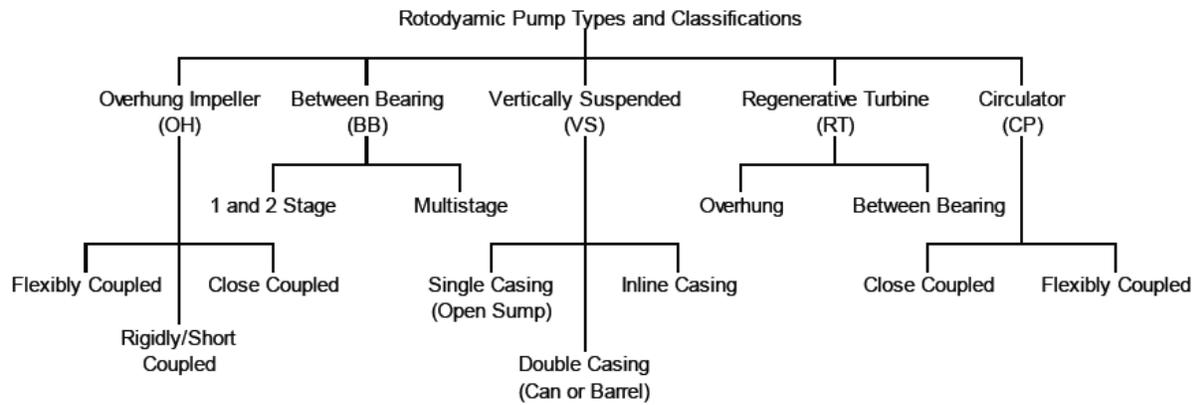


Figure 2 – Rotodynamic Pumps Types

The 14 series standards are available at <https://estore.pumps.org/Standards.aspx> and description of each of the new rotodynamic pump standards is described in the following sections.

[ANSI/HI 14.1-14.2 - Rotodynamic Pumps for Nomenclature and Definitions](#)

ANSI/HI 14.1-14.2 is a normative document for nomenclature and definitions for rotodynamic pumps of various configurations and services. This standard is for types, nomenclature, and definitions of rotodynamic pumps with radial, mixed, and axial flow impellers, as well as regenerative turbine, Pitot tube, and vertical diffuser pumps.

ANSI/HI Standards for Nomenclature and Definitions have historically been subdivided into ANSI/HI 1.1-1.2 *Rotodynamic Centrifugal Pumps for Nomenclature and Definitions* and ANSI/HI 2.1-2.2 *Rotodynamic Vertical Pumps for Radial, Mixed and Axial Flow Types for Nomenclature and Definitions*. The demarcation between the two categories is determined by the arrangement of the hydraulic configuration (impeller, casing, bowl, or diffuser). However, in each case they have shared physical features and hydraulic functions that are better addressed together. The combined standard includes and expands all the information contained in these previous standards into a single resource. The result is this single source of nomenclature and definitions information for the pump community. Additionally this standard introduces new pump type identification that more logically describes and classifies the variants of pumps available in today's markets.

[ANSI/HI 14.3 – Rotodynamic Pumps for Design & Application](#)

ANSI/HI 14.3 provides guidance and recommendations for the general application and design of rotodynamic pumps outlined in ANSI/HI 14.1-14.2. This standard includes expanded content and provides accepted methods for the evaluation of the hydraulic performance and design of all related and supporting equipment. It does not include detailed hydraulic design methods. This standard recognizes and identifies application requirements, principal features, performance considerations, and the necessary precautions for proper use of rotodynamic pumps.

ANSI/HI Standards for Design and Application have historically been subdivided into ANSI/HI 1.3 *Rotodynamic (Centrifugal) Pumps for Design and Application* and ANSI/HI 2.3 *Rotodynamic (Vertical) Pumps of Radial Flow, Mixed Flow, and Axial Flow Types for Design and Application*. The demarcation

between the two categories is determined by the arrangement of the hydraulic configuration (impeller, casing, bowl, or diffuser). However, in each case they have shared physical features and hydraulic functions that are better addressed together rather than separately. The combined standard includes and expands all the information contained in these previous standards into a single resource. The result is this single source of design and application information for the pump community.

ANSI/HI 14.4 – Rotodynamic Pumps for Manuals Describing Installation, Operation, and Maintenance

For pumps defined in ANSI/HI 14.1-14.2, this standard provides a normative outline for pump manufacturer's IOM manuals and reference materials contained within the appendix to inform the development of a manufacturer's IOM manual that complies with the requirements of the standard.

ANSI/HI Standards for Rotodynamic Installation, Operation and Maintenance (IOM) have historically been subdivided into ANSI/HI 1.4 *Rotodynamic Centrifugal Pumps for Manuals Describing Installation, Operation, and Maintenance* and ANSI/HI 2.4 for *Rotodynamic Vertical Pumps for Manuals Describing Installation, Operation, and Maintenance*. The demarcation between these two standards was determined by the arrangement of the hydraulic configuration (impeller, casing, bowl, or diffuser). However, in each case they have shared a standard IOM outline with similar content that is better addressed collectively rather than separately. The combined standard includes and expands all the information contained in these previous standards into a single resource. This document establishes a single source for a standard outline for IOM manuals for the pump community.

ANSI/HI 14.6 – Rotodynamic Pumps for Hydraulic Performance Acceptance Tests

For pumps within scope of ANSI/HI 14.1-14.2, ANSI/HI 14.6 provides acceptance criteria and uniform procedures for performance, net positive suction head, and hydrostatic pressure testing, and data recording and reporting of test results for rotodynamic pumps. It provides acceptance grades that can be specified for various types of applications. It also defines test procedures that will result in consistent and repeatable results. Final acceptance grade selections are defined in a contractual agreement between the purchaser and manufacturer.

ANSI/HI 14.6 replaced ANSI/HI 1.6 *Centrifugal Pump Tests* and ANSI/HI 2.6 *Vertical Pump Tests*. The performance acceptance criteria are in harmony with the revised ISO 9906 *Rotodynamic pumps - Hydraulic performance acceptance test* standard and ANSI/HI 11.6 *Rotodynamic Submersible Pumps for Hydraulic Performance, Hydrostatic Pressure, Mechanical, and Electrical Acceptance Tests*. These three standards now have identical pump acceptance grades. This standard is normative, meaning the standard must be adhered to in order to comply when included in specification. The appendices of this standard are either normative or informative; they are individually marked to clearly show their status. The normative appendices must be adhered to in order to comply with the standard, whereas informative appendices are written to inform and educate the user and do not require compliance.

The standard includes three grades of accuracy of measurement: grade 1 for higher accuracy, and grades 2 and 3 for lower accuracy. Each grade includes different values for tolerance bands for allowable fluctuations and uncertainties of measurement. It also defines separate tolerances for pumps below 10 kW.

It is recommended that the user specify their desired acceptance grade; however, when the user has not specified an acceptance grade, this standard defines industry-specific default test acceptance grades. These default test acceptance grades may not be fully harmonized with ISO 9906.

References to ANSI/HI 1.6 *Centrifugal Pump Tests* or ANSI/HI 2.6 *Vertical Pump Tests* in procurement documents and test specifications shall refer to ANSI/HI 14.6 for all applicable parts of the standard.