ANSI/HI 14.6-2011

American National Standard for

Rotodynamic Pumps

for Hydraulic Performance Acceptance Tests

ANSI/HI 14.6-2011

Hydraulic INSTITUTE

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

ANSI/HI 14.6-2011

American National Standard for

Rotodynamic Pumps

for Hydraulic Performance Acceptance Tests

Sponsor
Hydraulic Institute
www.Pumps.org

Approved August 9, 2011
American National Standards Institute, Inc.

American National Standard

Approval of an American National Standard requires verification by ANSI that the requirements for due process, consensus and other criteria for approval have been met by the standards developer.

Consensus is established when, in the judgement of the ANSI Board of Standards Review, substantial agreement has been reached by directly and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made toward their resolution.

The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether he has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation of any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on the title page of this standard.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute require that action be taken periodically to reaffirm, revise, or withdraw this standard. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

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 978-1-935762-01-0

Recycled paper

Contents

Figures

Tables

Foreword (Not part of Standard)

This new ANSI/HI 14.6 pump test standard is a substantially revised and updated standard replacing ANSI/HI 1.6 *Centrifugal Pump Tests* and ANSI/HI 2.6 *Vertical Pump Tests*. It is in harmony with the revised ISO 9906 *Rotodynamic pumps - Hydraulic performance acceptance test* standard and ANSI/HI 11.6 *Submersible Pump Tests*. These three standards now have identical pump acceptance test criteria with worldwide acceptance. This means that users in all parts of the world, whether they are using this standard, ANSI/HI 11.6, or ISO 9906, when specifying a pump hydraulic performance acceptance test, will be working with identical technical requirements and acceptance grades.

Although quite different in both format and layout, the changes in this standard from ANSI/HI 1.6 and 2.6 are mostly in the area of acceptance requirements and informational details rather than in pure technical issues and test procedures. Test methods and procedures are similar in both the new and old ANSI/HI standards.

This standard is normative, meaning that what is written in the standard must be adhered to in order to comply with the standard. 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.

Differences between the old (ANSI/HI 1.6 and ANSI/HI 2.6) and new (ANSI/HI 14.6) standards include:

- Old: Has two test acceptance levels, A and B. New: Has three levels of acceptance: Grade 1 with tighter tolerance band that can be applied in three acceptance grades (1U, 1E, 1B); Grade 2 with a broader tolerance band can be applied in two acceptance grades (2B, 2U); and Grade 3 with even broader tolerance band. Acceptance grades 1U and 2U have no negative tolerance.

- The new standard spells out measurement uncertainty and allowable measurement fluctuations in greater detail than the old standard.

- The new standard goes into a more detailed discussion of the tolerance band and what constitutes acceptance.

- The new standard allows a wider efficiency tolerance for pumps with an input power below 10 kW.

- The new standard defines industry-specific default test acceptance grades for cases where the user has not defined an acceptance grade.

- The new standard has an informative appendix that provides information about various types of measurement equipment.

- The new standard has an informative appendix that provides information about performing string tests.

- The new standard has an informative appendix that provides educational information about testing parameters and variations.

Purpose and aims of the Hydraulic Institute

The purpose and aims of the Institute are to promote the continued growth and well-being of pump users and pump manufacturers and 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 contents 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

In this standard all principal quantities and formulae, as well as charts and graphs, are given in coherent metric units. Corresponding US customary units appear in brackets. Example calculations are given in metric and US customary units, as appropriate.

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 be stated in reference to this standard. If no such statement is provided, metric units shall govern.

Consensus for this standard was achieved by use of the Canvass Method

The following organizations, recognized as having an interest in the standardization of rotodynamic (centrifugal) 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.

2guysfromTU
A.R. Wilfley & Sons, Inc.
A.W. Chesterton Company
Brown and Caldwell
E.I. DuPont Company
ekwestrel corp
Fluid Sealing Association
GIW Industries, Inc.
Healy Engineering, Inc.
ITT - Industrial Process
ITT - Water & Wastewater
J.A.S. Solutions Ltd.
John Crane Inc.
Kemet Inc.
LVVWD - Las Vegas Valley Water District
National Pump Company
Peerless Pump Company
Pentair Water - Engineered Flow GBU
Powell Kugler, Inc.
Pump Design, Development & Diagnostics, LLC
Sulzer Pumps (US) Inc.
TACO, Inc.
Wasserman, Horton - Consultant
Weir Floway, Inc.
Weir Minerals North America
Weir Specialty Pumps

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 (2000 - 2011) - Stefan Abelin, ITT - Water & Wastewater
Chair (2011) - Al Iseppon, Pentair Water
Vice-chair (2000 - 2011) - Roger Turley, formerly of Flowserve
Vice-chair (2011) - Michael Coussens, Peerless Pump Company

Committee Members	Company
Graeme Addie	GIW Industries, Inc.
John Anspach	John Anspach Consulting
Charles Cappellino	ITT - Industrial Process
Jack Claxton	Patterson Pump Company
Michael Cropper	Sulzer Pumps (US) Inc.
James Healy	Healy Engineering, Inc.
Greg Highfill	A.R. Wilfley & Sons, Inc.
Allen Hobratschk	National Pump Company
David McKinstry	IMO Colfax
Rodney Mrkvicka	Smith & Loveless, Inc.
Michael Mueller	Flowserve Corporation
James Roberts	ITT - Residential & Commercial Water
Mark Rosebraugh	Yeomans Chicago Corporation
Aleksander Roudnev	Weir Minerals North America
Paul Ruzicka	ITT Residential and Commercial Water
Joseph Salah	Sulzer Process Pumps (US) Inc.
Arnold Sdano	Pentair Water
Ernest Sturtz	CDM
Greg Towsley	Grundfos North America
Fred Walker	Weir Floway, Inc.

Alternates	Company
Lech Bobowski	Peerless Pump Company
Dimitar Kalchev	Peerless Pump Company
Gary Leander	Weir Minerals North America
Patrick Moyer	ITT - Residential & Commercial Water
Bruce Ticknor	National Pump Company
Robert Visintainer	GIW Industries, Inc.

Other Contributors	Company
Charlie Allaben	Formerly of CDM
Ed Allis	Formerly of Peerless Pump Company
Tom Angle	Formerly of Weir Specialty Pumps
Thomas Hendrey	Whitley Burchett & Associates
Michael Hiscock	South Florida Water Management District
Garr Jones	Brown and Caldwell
Mika Kaplan	King County Wastewater Treatment Division
Yuri Khazanov	InCheck Technologies Inc
Zan Kugler	Powell Kugler, Inc.
Bill Livoti	Baldor
Rolf Lund	
Richard O'Donnell	ITT - Industrial Process
Sami Sarrough	Brown and Caldwell

Special thanks to:

Bill Beekman, formerly of Weir Floway
Fred Buse, formerly of Flowserve

IPSC:

Rene Barbarulo, CLYDEUNION
Frank Ennenbach, ABS Group
Norbert Kastrup, KSB
Friedrich Kluetsch, Fachverband Pumpen Im VDMA

14.6 Hydraulic performance acceptance tests

14.6.1 Scope

This standard covers hydraulic performance tests for acceptance of rotodynamic pumps (centrifugal, mixed flow, and axial flow pumps), in this document referred to as *pumps*.

ANSI/HI Standard 14.6 is intended to be used for pump acceptance testing at pump test facilities, such as manufacturers' pump test facilities or laboratories only. Industry experience shows that it is very difficult to perform measurements accurate enough to satisfy the acceptance requirements in this standard when testing is performed in the field.

Information in the standard may be applied to pumps of any size and to any pumped liquids behaving as clear water.

The standard includes three grades of accuracy of measurement: grade 1 for higher accuracy, and grades 2 and 3 for lower accuracy. These grades include different values for tolerance factors for allowable fluctuations and uncertainties of measurement.

This standard applies to a pump by itself without any fittings. The pump may also be tested with a combination of upstream and/or downstream fittings by prior agreement and agreed on contractually.

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.

There are other pump acceptance test standards for submersible and sealless pumps, as defined in their respective documents, that take into account the unique features that those products exhibit. The Hydraulic Institute recommends that the user of this standard consult those respective standards (ANSI/HI 11.6 *Submersible Pump Tests* and ANSI/HI 4.1-4.6 *Sealless, Magnetically Driven Rotary Pumps for Nomenclature, Definitions, Application, Operation, and Test*) to determine if they are more appropriate for the products being considered for testing.

14.6.2 Terms and definitions

14.6.2.1 Introduction

For the purposes of this standard, the quantities, definitions, symbols, and units given here apply.

Pump performance acceptance grades for flow, head, efficiency, or power are used in this standard when evaluating acceptance of a pump for a guarantee point. A guarantee point, as defined in Section 14.6.3.1, is a flow/head (*Q/H*) point that a tested pump shall meet, within the tolerances of the agreed acceptance class, to be accepted according to this standard.

Table 14.6.2.1 gives definitions of quantities used in this standard. The definitions, particularly those given for head and net positive suction head (NPSH), may not be appropriate for general use in hydrodynamics, and are for the purpose of this standard only.

Table 14.6.2.2a gives an alphabetical list of symbols used, and Table 14.6.2.2b gives a list of subscripts.

In this standard all formulae are given in coherent metric units. For conversion of other units to metric units see Appendix L.