American National Standard for

Rotodynamic Pumps

— for Installation, Operation, and Maintenance
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CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time.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.
# Contents

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreword</td>
<td>ix</td>
</tr>
<tr>
<td>14.4 Manuals describing installation, operation, and maintenance</td>
<td>1</td>
</tr>
<tr>
<td>14.4.1 Introduction</td>
<td>1</td>
</tr>
<tr>
<td>14.4.1.1 Purpose</td>
<td>1</td>
</tr>
<tr>
<td>14.4.1.2 Scope</td>
<td>1</td>
</tr>
<tr>
<td>14.4.1.3 Units, Symbols, and Subscripts</td>
<td>1</td>
</tr>
<tr>
<td>14.4.2 Standard outline for IOM manuals</td>
<td>1</td>
</tr>
<tr>
<td>Appendix A Installation, Operation, and Maintenance Manual Reference Information</td>
<td>4</td>
</tr>
<tr>
<td>A.1 Introduction and safety</td>
<td>4</td>
</tr>
<tr>
<td>A.1.1 Marking and approvals (UL, CSA, NSF, CE, ATEX, etc.)</td>
<td>4</td>
</tr>
<tr>
<td>A.1.2 Safety</td>
<td>4</td>
</tr>
<tr>
<td>A.1.2.1 Personal protective equipment</td>
<td>4</td>
</tr>
<tr>
<td>A.1.2.2 Manufacturer’s responsibility</td>
<td>4</td>
</tr>
<tr>
<td>A.1.2.3 Explanation of designations (safety terminology and symbols)</td>
<td>5</td>
</tr>
<tr>
<td>A.1.2.4 Rigging and lifting</td>
<td>5</td>
</tr>
<tr>
<td>A.1.2.5 General guidelines</td>
<td>5</td>
</tr>
<tr>
<td>A.1.2.5.1 Safety training</td>
<td>6</td>
</tr>
<tr>
<td>A.1.2.5.2 Safety data sheet (SDS)</td>
<td>6</td>
</tr>
<tr>
<td>A.1.2.5.3 Personnel qualification and training</td>
<td>6</td>
</tr>
<tr>
<td>A.1.2.5.4 Personnel safety actions</td>
<td>6</td>
</tr>
<tr>
<td>A.1.2.5.5 Products used in potentially explosive atmospheres</td>
<td>9</td>
</tr>
<tr>
<td>A.1.2.5.5.1 Scope of compliance</td>
<td>9</td>
</tr>
<tr>
<td>A.1.2.5.5.2 ATEX marking example</td>
<td>9</td>
</tr>
<tr>
<td>A.1.2.5.5.3 Avoiding excessive surface temperatures</td>
<td>10</td>
</tr>
<tr>
<td>A.1.2.5.5.4 Preventing the buildup of explosive mixtures</td>
<td>11</td>
</tr>
<tr>
<td>A.1.2.5.5.5 Preventing sparks</td>
<td>11</td>
</tr>
<tr>
<td>A.1.2.5.5.6 Preventing leakage</td>
<td>12</td>
</tr>
<tr>
<td>A.1.2.5.5.7 Maintenance to avoid hazards with a potential of explosion</td>
<td>12</td>
</tr>
</tbody>
</table>

This is a preview of "ANSI/HI 14.4-2018". Click here to purchase the full version from the ANSI store.
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.1.2.6</td>
<td>Noise level data</td>
</tr>
<tr>
<td>A.1.2.7</td>
<td>Rigging and lifting</td>
</tr>
<tr>
<td>A.2</td>
<td>Transport and storage</td>
</tr>
<tr>
<td>A.2.1</td>
<td>Transport and handling requirements</td>
</tr>
<tr>
<td>A.2.2</td>
<td>Rigging and lifting</td>
</tr>
<tr>
<td>A.2.3</td>
<td>Receipt, inspection, and damage reporting</td>
</tr>
<tr>
<td>A.2.4</td>
<td>Unpacking</td>
</tr>
<tr>
<td>A.2.5</td>
<td>Storage</td>
</tr>
<tr>
<td>A.2.5.1</td>
<td>Recommended storage environment</td>
</tr>
<tr>
<td>A.2.5.2</td>
<td>Uncontrolled storage moisture protection</td>
</tr>
<tr>
<td>A.2.5.3</td>
<td>Precautions when stored in potential freezing temperatures</td>
</tr>
<tr>
<td>A.2.5.4</td>
<td>Short-term storage</td>
</tr>
<tr>
<td>A.2.6</td>
<td>Long-term storage</td>
</tr>
<tr>
<td>A.2.7</td>
<td>Disposal of packaging materials</td>
</tr>
<tr>
<td>A.3</td>
<td>Product description</td>
</tr>
<tr>
<td>A.3.1</td>
<td>Configuration</td>
</tr>
<tr>
<td>A.3.2</td>
<td>Nomenclature</td>
</tr>
<tr>
<td>A.3.2.1</td>
<td>Nameplate information</td>
</tr>
<tr>
<td>A.3.2.2</td>
<td>Parts</td>
</tr>
<tr>
<td>A.3.3</td>
<td>Auxiliaries</td>
</tr>
<tr>
<td>A.3.4</td>
<td>Support systems</td>
</tr>
<tr>
<td>A.4</td>
<td>Installation</td>
</tr>
<tr>
<td>A.4.1</td>
<td>Factory support requirements</td>
</tr>
<tr>
<td>A.4.2</td>
<td>Location</td>
</tr>
<tr>
<td>A.4.2.1</td>
<td>Checking wells</td>
</tr>
<tr>
<td>A.4.2.2</td>
<td>Checking wet pits</td>
</tr>
<tr>
<td>A.4.3</td>
<td>Foundation</td>
</tr>
<tr>
<td>A.4.3.1</td>
<td>Seismic analysis</td>
</tr>
<tr>
<td>A.4.4</td>
<td>Rigging and lifting for installation</td>
</tr>
<tr>
<td>A.4.5</td>
<td>Baseplate / Sole Plate</td>
</tr>
</tbody>
</table>
A.4.5 Leveling ................................................. 20
A.4.6 Grouting ................................................. 21
A.4.6.1 Pump systems ........................................ 22
A.4.6.1.1 Piping, general guidelines ..................... 22
A.4.6.1.2 Pipe supports/anchors/joints ................... 22
A.4.6.1.3 Inlet piping requirements ....................... 23
A.4.6.1.4 Pipe reducers .................................... 24
A.4.6.1.5 Inlet valves and manifolds ...................... 24
A.4.6.1.6 Elbow at pump inlet .............................. 24
A.4.6.1.7 Inlet supply tanks ................................. 25
A.4.6.1.8 Submersible motor cooling ...................... 25
A.4.6.1.9 Outlet valves ..................................... 25
A.4.6.1.10 Air release for self-priming pumps .......... 26
A.4.6.1.11 Siphons .......................................... 26
A.4.6.1.12 Check valves .................................... 26
A.4.6.2 Strainers ............................................. 27
A.4.4 Vertical pump, lift (clearance) setting .......... 27
A.4.8 Alignment .............................................. 28
A.4.8.1 Alignment general, horizontal pumps ......... 28
A.4.8.1.1 Shaft/coupling alignment ....................... 28
A.4.8.1.2 Straightedge method of alignment .......... 28
A.4.8.1.3 Dial indicator method of alignment ......... 30
A.4.8.1.4 Alignment of shafts with spacer couplings .. 31
A.4.8.1.5 Laser method of alignment ..................... 31
A.4.8.1.6 Special couplings ............................... 32
A.4.8.1.7 V-belt drive .................................... 32
A.4.8.1.8 Protective guarding ............................. 32
A.4.8.1.9 Hot alignment considerations ................. 32
A.4.8.2 Alignment, vertically suspended pumps ...... 32
A.4.8.2.1 Vertical solid shaft drivers .................... 33
A.4.8.2.2 Vertical hollow shaft drivers ................. 33
A.6.9 Assembly ................................................................. 50
A.6.9.1 Adjustments, clearance and final settings .................... 50
A.6.10 Auxiliary equipment .................................................. 50
A.7 Trouble shooting guide .................................................. 50
A.7.1 Mechanical verification ............................................... 55
A.7.1.1 Allowable vibration ................................................. 55
A.7.1.2 Bearing operating temperature .................................. 55
A.7.1.3 Noise or sound in rotodynamic pumps ....................... 55
A.7.2 Electrical ............................................................... 55
A.8 Parts listing and cross-sectional drawings .......................... 56
A.9 Other relevant documentation and certification .................... 56
A.9.1 Why product certification matters ................................ 56
Index ................................................................................. 57

Figures
A.3 — Identification plate ..................................................... 17
A.4.5 — Typical foundation bolt, leveling screw and grout details . 21
A.4.6.1 — Typical expansion joint with tie rods ........................ 22
A.4.6.1.2 — Typical deep-well type installation ....................... 23
A.4.6.2 — Pump system with eccentric reducer in inlet pipe ........ 24
A.4.6.1.8 — Outlet valves ..................................................... 26
A.4.8.1.2a — Checking angular alignment ............................... 29
A.4.8.1.2b — Checking parallel alignment ................................ 29
A.4.8.1.3 — Dial Indicator method of alignment ................. 30
A.4.8.1.4 — Alignment of spacer-type couplings .................... 31
A.4.8.1.5 — Laser method of alignment ................................ 32
A.5.4.4.1 — Packed-type stuffing box .................................... 41
A.7.1.2 — Locations for the measurement of bearing temperature ... 55
Foreword (Not part of Standard)

Purpose and aims of the Hydraulic Institute

The purpose and aims of the Hydraulic Institute (HI) 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) HI 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 HI Standards and Guidelines is completely voluntary. Existence of HI 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

An HI 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 HI prepare even more useful future editions. Questions arising from the content of this standard may be directed to the HI Technical Director. 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 (ANSI/HI) 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.

Disclaimer

This document was prepared by an HI committee and approved by following ANSI essential requirements. Neither HI, HI committees, nor any person acting on behalf of HI: 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
This 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.

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/PVGS
Brown and Caldwell
Carollo Engineers Inc.
David McKinstry, Retired
GM BluePlan Engineering
JK Muir LLC
Kemet Inc.
Mechanical Solutions, Inc.
Outotec Canada Ltd.
Swiss Flow Solutions

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 – Paul Ruzicka, Xylem – Applied Water Systems
Vice Chair – Ernest Sturtz, CDM Smith – Water Services Group

Committee Members
Lloyd Aanonsen
Jack Bagain
Michael Coussens
Ryan Grimm (Alternate)
Patrick Hogg
Lane Larsen
Patricia McCarthy
Michael Mueller (Alternate)
Maya Place (Alternate)
Craig Redmond
Jan Schyberg (Alternate)
George Tey
Albert Ticknor, III, P.E.
Kees van der Sluijs
Jared Wageman
Clint Zentic

Company
General Rubber Corporation
John Crane Inc.
Peerless Pump Company
Sundyne LLC
Nidec Motor Corporation
Weir Specialty Pumps
Xylem Inc. - Water Solutions
Flowserve Corporation
SULZER
Gorman-Rupp, Mansfield Division
Xylem Inc. - Water Solutions
MWH Americas, Inc.
National Pump Company
Flowserve Corporation
Sundyne LLC
SULZER
14.4 Manuals describing installation, operation, and maintenance

14.4.1 Introduction

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 outline with similar content that is better addressed collectively rather than separately. Every effort has been made to include and expand 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.

The normative portion of this standard is prescriptive in nature and thereby mandatory for compliance to this standard; it provides a standard outline for manufacturer's IOM manuals.

Appendix A, a collection of IOM reference information arranged per the new standard outline, is informative and not mandatory for compliance to this standard. Pump users should refer to the manufacturer's IOM manuals for IOM information specific to their equipment.

14.4.1.1 Purpose

The purpose of this standard is provide a normative outline for pump manufacturer's IOM manuals and reference materials to serve as a manufacturer's guideline for the development of an IOM manual that complies with the requirements of the standard.

14.4.1.2 Scope

This standard applies to IOM manuals for all rotodynamic pumps. For additional instructions on sealless rotodynamic pumps, see ANSI/HI 5.1-5.6 Sealless Rotodynamic Pumps for Nomenclature, Definitions, Application, Operation, and Test. For additional information on rotodynamic pumps types, see ANSI/HI 14.1-14.2 Rotodynamic Pump for Nomenclature and Definitions.

14.4.1.3 Units, Symbols, and Subscripts

The normative portion of this standard is related to the outline of the IOM only; therefore, this section is left blank.

14.4.2 Standard outline for IOM manuals

The standard outline shall be used when writing IOM manuals. The subtopics that appear under each section may be combined and/or arranged to meet the specific needs of the product being addressed. Not all of the subtopics listed need to be included in the IOM manual for all products; the manufacturer will be given the latitude to decide if a particular subtopic is applicable. If the manufacturer has elected not to include a specific section they should include the section in their document and table of contents but identify it as not applicable. Additional content may be added after Section A.9.

For example, in Section A.1, the explanation of safety designations should precede specific safety warnings for a product.

A.1 Introduction and Safety

- Marking and approvals (UL, CSA, NSF, CE, ATEX, etc.)
- Safety