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American Water Works Association

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AWWA Standard

Horizontal and Vertical Line-Shaft Pumps

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AWWA Standard

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Contents

All AWWA standards follow the general format indicated subsequently. Some variations from this format may be found in a particular standard.

Foreword

This foreword is for information only and is not a part of ANSI/AWWA E103.*

I. Introduction.

I.A. *Background.* This standard describes the minimum requirements for horizontal centrifugal pumps and for vertical line-shaft pumps for installation in wells, water treatment plants, water transmission systems, and water distribution systems. Pumps described in this standard are intended for pumping freshwater at flow rates (at best efficiency point) ranging from 100 gpm to 40,000 gpm (23 m^3/hr to 9,100 m^3/hr) at discharge pressures dictated by pump type and discharge conditions. This standard is applicable for driver power range from 10 hp to 1,500 hp (7 kW to 1,100 kW); however, this standard does not include requirements for drivers.

I.B. *History.* The original standard for vertical line-shaft turbine pumps presented the composite findings from studies conducted from 1949 to 1986 by committees consisting of manufacturers, consumers, and engineers. The first standard was published in 1955. In 1961, the standard was revised to include standards for submersible vertical turbine pumps. Additional technical changes were added in the 1971 revision. Solid shaft motors were added in the 1977 revision, together with numerous editorial changes and conversions to the international system of units. The 1977 standard was reaffirmed in 1982 without revision. Additional revisions were made in 1988.

In 1994, AWWA's Standards Council approved development of a new standard for horizontal centrifugal pumps. The new standard was assigned to AWWA Standards Committee 276 for Horizontal Centrifugal Pumps. Upon review of pump standards development in 1996, AWWA's Standards Council modified the development process to include two new pump standards to replace ANSI/AWWA E101-88, Vertical Turbine Pumps—Line Shaft and Submersible Types. As part of this action, two committees were renamed. AWWA Standards Committee 276 for Horizontal Centrifugal Pumps was changed to AWWA Standards Committee 276 for Horizontal and Vertical Line-Shaft Pumps. Committee 276 was charged with development of ANSI/AWWA E103, Horizontal and Vertical Line-Shaft Pumps. AWWA Standards Committee 375 for Vertical Turbine Pumps was changed to AWWA Standards Committee 375 for Submersible Vertical Turbine Pumps. Committee 375 was charged with development

* American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.

of ANSI/AWWA E102, Submersible Vertical Turbine Pumps. During development of these two replacement standards, ANSI/AWWA E101-88 was withdrawn effective June 2000. The first edition of ANSI/AWWA E103 was approved by the AWWA Board of Directors on June 24, 2007. This edition was approved on June 7, 2015.

I.C. *Acceptance.* In May 1985, the US Environmental Protection Agency (USEPA) entered into a cooperative agreement with a consortium led by NSF International (NSF) to develop voluntary third-party consensus standards and a certification program for direct and indirect drinking water additives. Other members of the original consortium included the Water Research Foundation* (formerly AwwaRF) and the Conference of State Health and Environmental Managers (COSHEM). The American Water Works Association (AWWA) and the Association of State Drinking Water Administrators (ASDWA) joined later.

In the United States, authority to regulate products for use in, or in contact with, drinking water rests with individual states.† Local agencies may choose to impose requirements more stringent than those required by the state. To evaluate the health effects of products and drinking water additives from such products, state and local agencies may use various references, including

1. An advisory program formerly administered by USEPA, Office of Drinking Water, discontinued on Apr. 7, 1990.
2. Specific policies of the state or local agency.
3. Two standards developed under the direction of NSF‡: NSF/ANSI 60, Drinking Water Treatment Chemicals—Health Effects, and NSF/ANSI 61, Drinking Water System Components—Health Effects, and NSF/ANSI 372 Drinking Water System Components—Lead Content.
4. Other references, including AWWA standards, *Food Chemicals Codex*, *Water Chemicals Codex*,§ and other standards considered appropriate by the state or local agency.

Various certification organizations may be involved in certifying products in accordance with NSF/ANSI 61. Individual states or local agencies have authority to accept or accredit certification organizations within their jurisdictions. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

* Water Research Foundation, 6666 West Quincy Avenue, Denver, CO 80235.
† Persons outside the United States should contact the appropriate authority having jurisdiction.
‡ NSF International, 789 North Dixboro Road, Ann Arbor, MI 48105.
§ Both publications available from National Academy of Sciences, 500 Fifth Street, NW, Washington, DC 20001.

Annex A, "Toxicology Review and Evaluation Procedures," to NSF/ANSI 61 does not stipulate a maximum allowable level (MAL) of a contaminant for substances not regulated by a USEPA final maximum contaminant level (MCL). The MALs of an unspecified list of "unregulated contaminants" are based on toxicity testing guidelines (noncarcinogens) and risk characterization methodology (carcinogens). Use of Annex A procedures may not always be identical, depending on the certifier.

ANSI/AWWA E103 does not address additives requirements. Users of this standard should consult the appropriate state or local agency having jurisdiction in order to

1. Determine additives requirements, including applicable standards.
2. Determine the status of certifications by parties offering to certify products for contact with, or treatment of, drinking water.
3. Determine current information on product certification.

NSF/ANSI 372, Drinking Water System Components—Lead Content, specifies restrictions for maximum lead content of materials in contact with drinking water. The user shall specify NSF/ANSI 372 when applicable in the purchase documents. Currently compliance with NSF/ANSI 372 is mandatory in some states and meets the new low lead requirements of the U.S. Safe Drinking Water Act, which went into effect January 2014.

II. Special Issues.

II.A. *General.* A pumping system consists of several components: the pump, the driver, the controls, the baseplate or mounting plate, the foundation, suction and discharge piping, and in many cases auxiliary equipment such as cooling water and lubrication systems. This AWWA E 103 standard discusses only the pump unit. Users of this standard should review other publications such as the American Petroleum Institute (API) Recommended Practice 686, Recommended Practices for Machinery Installation and Installation Design; Hydraulic Institute (HI) Standard 1.3, Standard for Centrifugal Pumps for Design and Application; and HI 2.3, Standard for Vertical Pumps for Design and Application. Users should especially review these and other publications for information on baseplates, mounting plates, foundation design, connection into suction, discharge piping systems, and component alignment recommendations. Conditions under which a pump will operate must be carefully evaluated by the purchaser and described by the purchase documents.

II.A.1 Operating range. Evaluations should include the determination of the hydraulic characteristics of the pumping system and the extremes (maximum and minimum) of heads and flows under which the pump will be required to operate.

II.A.2 Inlet conditions. Pump field performance and service life can be significantly reduced if pump inlet conditions, including net pump suction head (NPSH), are not appropriate. Anticipated pump performance curves, including net pump suction head required (NPSHR) curves provided by manufacturers, are based on a flow pattern at the pump inlet being uniform, steady, and free from swirls and vortices. Inadequate pump inlet conditions can result in damaging vibrations, excessive component stresses, and reduced performance. Hydraulic Institute (HI) Standard ANSI/HI 9.8, Rotodynamic Pumps for Pump Intake Design, provides recommendations for both suction pipe arrangements and wet pits (sumps).

II.A.3 Operating region. This standard does not require pumps to be furnished that will operate within a preferred operating region (POR) or within an allowable operating region (AOR) as defined by ANSI/HI 9.6.3, Rotodynamic (Centrifugal and Vertical) Pumps—Guidelines for Allowable Operating Region. Operation outside these regions will have an adverse effect on the life of the pump. Purchasers should be aware of the operating limits when specifying pumps and should, as a minimum, define the maximum and minimum anticipated operating heads and flow rates. Purchasers may require submittal of data by manufacturers defining the operating regions and advising anticipated bearing life and vibrations when operating within these regions. Refer to Section III of this foreword.

II.A.4 Drivers. This standard does not include requirements for drivers (motors, engines, gear drives, etc.). Driver torque characteristics must be suitable for the pump torque requirements and the pump starting and stopping method. Driver requirements should be provided by the purchase documents. Refer to NEMA (National Electrical Manufacturers Association) MG 1, Motors and Generators, for guidance in the proper selection and application of motors and generators.

II.A.5 Driver mounting and compatibility. Drivers are an integral part of a pumping unit. Drivers affect pump-to-driver coupling requirements, motor stands (vertical turbine pumps), base plates (horizontal pumps), shaft seals, and vibration levels. Bearings in drivers that support rotating elements of the pump must be designed for static and dynamic thrust loads. This standard does not require the pump manufacturer to furnish the driver nor to mount the driver to the pump. If this is a concern, requirements for furnishing or mounting the driver should be provided by the purchaser.

II.A.6 Can pumps. Pump barrels or cans, while not an integral part of a vertical pumping unit, can significantly affect pump performance, as can any sump arrangement that affects the flow pattern at the pump inlet. Pump barrels may be fabricated

from many materials, including concrete and steel pipe. Barrel inlet piping inlet velocity and barrel dimensions will affect pump performance. Barrel inlets located too close to the pump suction inlet may produce turbulence affecting performance or causing vibration. Flow vanes and/or suction inlet devices may be required. This standard does not include pump barrel requirements. Requirements for pump cans, including installation, can be found in ANSI/HI 9.8, Rotodynamic Pumps for Pump Intake Design. This standard does not require the pump manufacturer to furnish the barrel nor to mount the barrel to the pump. If there is a requirement for furnishing the barrel or mounting the pump in the barrel, this should be noted by the purchase documents.

II.B. *Advisory Information on Product Application.* This standard does not cover applications or manufacturing technologies. Some waters may have high conductivity levels well in excess of 200 μhm/cm, where it may be advisable to consult with a metallurgist or corrosion expert to determine whether special materials or techniques to deal with galvanic corrosion are required. The purchaser should identify special requirements and deviations from this standard and include appropriate language in the purchase documents. (For example, Sec. 4.4.3.2.3 of this standard requires vertical pump suction cases and bells to have grease-packed CA [bronze] bearings. If other types of bearings are required, this should be stated in the purchase documents.)

II.B.1 Materials. Materials required by this standard are selected based on suitability for operation with water as described in the scope. Selection is based on successful experience in the waterworks industry and local code and regulation requirements for suitable materials.

II.B.1.1 Treatment chemicals. The potential for corrosion because of chemicals added to the water should be considered. Materials, including some bronzes and rubber compounds exposed to water containing chlorine, chloramines, or other chemicals, may not be suitable. If such problems are anticipated, the purchase documents should identify the maximum expected concentrations of these chemicals and other factors, such as pH and temperature ranges, that may affect the corrosivity of these chemicals. The purchaser and manufacturer should be aware that at times the pump may be used to disperse chemicals into the system, which may result in local concentrations much higher than normal concentration intended for the system. The purchaser should consult with the manufacturer and, if appropriate, specify special requirements for these materials in the purchase documents.

II.B.1.2 Disinfection chemicals. Pumps are often disinfected prior to being placed in service initially or after a repair. During the disinfection process, wetted surfaces are exposed to liquids far more corrosive than that allowed by the scope of

this standard. Materials required by this standard may not be suitable for prolonged exposure to corrosive chemicals, including chlorine and sodium hypochlorite. Therefore, these chemicals should be removed and surfaces flushed with water meeting scope requirements immediately after disinfection.

II.B.1.3 Dealloying. Some waters promote dealloying corrosion of some copper alloys in the form of dezincification or dealuminization, particularly when the material is exposed to water at high velocity. If this is a concern, the purchaser should consult with the manufacturer and, if appropriate, require alternate materials in the purchase documents.

II.B.2 Coatings. This standard requires that ferrous (except for stainless) surfaces of pumps exposed to water be coated. The purchase documents should delete this requirement if coatings are not required.

II.C. *Pump Tests.*

II.C.1 Factory tests.

II.C.1.1 Procedures. This standard requires factory tests to be performed in accordance with the current version of ANSI/HI 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.

II.C.1.2 Extent. This standard requires nonwitnessed hydrostatic testing only.

1. For horizontal pumps: the assembled pump.
2. For vertical pumps: the bowl assembly and discharge head.

II.C.1.3 Additional factory tests. Additional factory tests, including hydrostatic tests of an assembled vertical pump, vertical pump column section, performance, NPSHR, mechanical, and witnessed tests, may be included by the purchase documents.

II.C.2 Field tests. This standard does not include field performance testing requirements. The following can be used to define field-test requirements.

1. ANSI/HI 1.6 and 2.6 test standards, as described above for factory tests, may be used for field testing at the discretion of the purchaser. ANSI/HI test standards require minimum pipe lengths, internal straightening vanes, and other criteria that, while practical in a controlled test loop, may not be available in the field. Application of these standards for field testing requires parties to agree on the scope and protocol of the test prior to the test.

2. ASME-PTC 8.2, Centrifugal Pumps, relies on the parties' agreement beforehand on the scope and protocol of the test. The code does not include acceptable performance tolerances and does not address how test results shall be used to compare with guarantees.

3. Appendix B included with this standard.

II.D *Vibration Limits.* The vibration characteristics of a pumping system depend on a combination of pump and driver design and construction, baseplate or mounting plate design and construction, support foundation design and construction, balancing requirements, the pump installation, component alignment requirements, and the operating flow rate relative to the pump's operating best efficiency point. Users of this standard should review various HI standards and other standards regarding these subjects and provide requirements within the purchase documents regarding vibration limits and vibration limit verification.

III. Use of This Standard. It is the responsibility of the user of an AWWA standard to determine that the products described in that standard are suitable for use in the particular application being considered. Users of horizontal centrifugal and vertical line-shaft pumps should not expect long-lasting or reliable service unless all aspects of the pump application are defined: operating conditions, environmental conditions, and local ambient conditions. Additionally, the pump and driver unit, baseplate or mounting plate, foundation system, and connecting suction and discharge piping must be designed, installed, and aligned as an integrated system.

III.A. *Information for Manufacturers.* When placing orders for pumps, purchasers should provide basic data to manufacturers so that pumps will meet purchase document's requirements. Suggested forms that can be used to order pumps are located in appendixes C and D. Users of this standard should review HI standards Rotodynamic Centrifugal Pumps for Design and Application (ANSI/HI 1.3), and Rotodynamic Vertical Pumps of Radial, Mixed, and Axial Flow Types for Design and Application (ANSI/HI 2.3), which provide requirements for proper pump applications, principal pump features, and recommended precautions for pumps.

III.A.1 Basic data for vertical and horizontal pumps.

III.A.1.1 Standard used—that is, ANSI/AWWA E103, Horizontal and Vertical Line-Shaft Pumps, of latest revision.

III.A.1.2 Installation location (country, state, or province).

III.A.1.3 Water data.

III.A.1.3.a Temperature range.

III.A.1.3.b pH range.

III.A.1.3.c Vapor pressure range (function of altitude and temperature).

III.A.1.3.d Maximum concentration of corrosive chemicals, including but not limited to

1. Free chlorine.
2. Chloramine.

3. Chlorides.

4. Ozone.

5. Other (include other oxidants and corrosive chemicals).

III.A.1.3.e Solids.

1. Maximum sand concentration after a 15-minute pumping interval.

2. Maximum size of solids allowed to pass through the pump.

III.A.1.4 Operating conditions.

III.A.1.4.a Altitude at impeller shaft (for vertical pumps, use the eye of the lowest impeller).

III.A.1.4.b Maximum suction pressure or maximum static suction lift.

III.A.1.4.c Pump startup and shutdown conditions:

1. Describe in detail if discharge valve is other than a mechanical gravity-actuated type of check valve.

2. If the driver is variable speed and the discharge valve is other than a mechanical nonactuated type of check valve, describe the timing and coordination of valve opening and closure with pump speed ramp-up and ramp-down times.

III.A.1.4.d Reverse rotation.

1. Indicate if the pump system will or will not be equipped with means to prevent reverse shaft rotation. Nonreverse ratchets are required for motors that drive open line-shaft vertical turbine pumps having a minimum water level that is 50 ft (15 m) or more below the elevation of the shaft seal in the discharge head.

2. For pump systems without means to prevent reverse rotation, indicate the maximum differential pressure across the pump during flow reversal.

III.A.1.4.e Speed. Specify speed for constant-speed pumps (usually maximum speed based on a review of pump curves and discussions with manufacturers). If variable-speed pumps are required, specify an operating speed range.

III.A.1.4.f Sanitary codes. Provide information necessary for the pump to be constructed to meet applicable code requirements.

III.A.1.5 Performance requirements. Refer to Section 3 of this standard for definition of terms.

III.A.1.5.a At rated condition point.

1. Rate of flow.

2. Total head or bowl assembly total head.

NOTE: Total head must be used for horizontal pumps. Either total head or bowl assembly total head can be used for vertical pumps. The latter is used when the purchaser

accounts for and is responsible for head losses in the strainer, suction pipe (if used), suction vessel (can pumps), column, and discharge head.

3. Minimum efficiency:

a. Pump efficiency, or

b. Bowl assembly efficiency, if bowl assembly total head is specified, or

c. Overall (wire-to-water) efficiency. NOTE: This can be specified only if the drive is supplied by the pump manufacturer.

4. Net positive suction head available (NPSHA) range.

III.A.1.5.b At other condition points. Pumps are usually required to provide a minimum rate of flow under high head conditions, which may exist when multiple pumps operate, when the discharge gradient is at a maximum, or when the suction gradient is at a minimum. Pumps are also required to operate under minimum head conditions, which may exist when only one pump operates in a station that has multiple pumps, when the discharge gradient is at a minimum, or when the suction gradient is at a maximum. Including a system head curve, especially on multiple-pump installations and variable-speed systems, will allow the pump supplier to select the most suitable pump curve shape for the application.

1. Maximum head condition. Include data listed above for the rated condition point except:

a. Instead of rate of flow, specify minimum rate of flow.

b. Instead of total head or bowl assembly total head, specify maximum total head or maximum bowl assembly total head.

2. Minimum head condition. Include data listed above for the rated condition point except:

a. Instead of rate of flow, specify maximum rate of flow.

b. Instead of total head or bowl assembly total head, specify minimum total head or minimum bowl assembly total head.

c. Instead of NPSHA, specify a maximum NPSHR.

III.A.1.5.c Allowable suction specific speed (maximum or range).

III.A.1.5.d Pump input power (brake horsepower). Specify the maximum input power required for the pump assembly over the required pump operating range.

NOTE 1: Thrust-bearing power requirements must be considered by the purchaser and added to the pump input horsepower when pump thrust bearings are provided in the driver and the driver is not part of the pump assembly. Gear drive power requirements must also be considered if the gear drive is not part of the pump assembly.

NOTE 2: Vertical turbine pump line-shaft bearing losses must also be considered by the purchaser and added to pump input horsepower when bowl assembly performance has been specified.

III.A.1.5.e Best efficiency point (BEP).

1. Specify the minimum efficiency required at the BEP.
2. Flow at BEP. Pumps should be selected for maximum efficiency at the normal condition point. Constant-speed pumps in a multiple-pump system normally operate at a higher flow rate when not operating in parallel with other pumps. Variable-speed pumps normally operate at a lower flow rate than the flow at the rated condition point, when the rated condition point is based on the maximum speed. Specify a range of flows or heads that the BEP must fall within.

III.A.1.6 Construction requirements.

III.A.1.6.a Impeller type: open, semi-open, or enclosed.

III.A.1.6.b Impeller wear rings. Wear rings can be specified for enclosed impellers. Thrust-balance–type rings can be specified for both semi-open, and enclosed impellers.

III.A.1.7 Stuffing box arrangement. Specify the type of sealing required. Select packing, single mechanical seal, or double mechanical seal.

III.A.1.8 Packing or mechanical seal cooling and lubricating water requirements.

III.A.1.8.a Water must be supplied to the packing or seal when the shaft is rotating. Water suitable for this purpose may be available from the fluid being pumped.

It may also be desirable to provide water to packing when the shaft is not rotating, to prevent loss of prime (pumps with suction lifts) or prevent packing from drying out.

III.A.1.8.b If the water contains materials that can cause rapid packing wear or seal wear, suitable clean water at the appropriate pressure from an external source should be applied to the lantern ring of the packing. If a mechanical seal is used, it should be a double seal with clean water applied between the seal elements.

III.A.1.8.c If the pressure of the pumped fluid at the upstream face of the packing or seal is less than 10 psig (69 kPa), which may be the case with horizontal double-suction and end-suction pumps, clean water should be supplied from a connection to the pump volute.

III.A.1.8.d If water at a pressure of 10 psig (69 kPa) or greater is not available for a period exceeding the pump manufacturer's recommendations during startup (as may be the case with vertical pumps having deep settings or slowly rising water columns), clean water should be supplied from an external source during the startup period.

III.A.1.8.e Specify cooling and lubricating water arrangement and requirements.

III.A.1.9 Column piping for vertical turbine pumps. Sizing of the column pipe and minimum column pipe wall thickness shall be the responsibility of the pump manufacturer. The column pipe serves as a pressurized discharge pipe between the pump bowl assembly and the discharge head and is subject to the effects of internal pressure, combined weight of the bowl assembly and column piping including the pumped liquid, hydraulic thrust loads developed during pump operation, and vibration. When required by the purchaser, the pump manufacturer should provide information on the flow velocity and friction loss in the column pipe.

III.A.1.10 Shaft critical speed. This standard provides requirements for operating speed locations of the shaft lateral and shaft torsional critical speeds for horizontal centrifugal and vertical line-shaft pumps. The shaft critical speeds have a significant relationship to potential vibration and shaft stress issues with a pump, especially with pumps having adjustable speed drives. It is recommended that users of this standard review the operating speed range of the pump and identify additional critical speed criteria in the purchase documents.

III.A.2 Materials.

III.A.2.1 Drinking water requirements. Refer to Sec. 4.1. The purchaser should state whether compliance with NSF/ANSI 61, Drinking Water System Components—Health Effects, and/or NSF/ANSI 372, Drinking Water System Components—Lead Content, is required. If compliance is required, the purchase documents should note, "This product shall be certified as suitable for contact with drinking water by an accredited certification organization in accordance with NSF/ANSI 61, Drinking Water System Components—Health Effects, and/or NSF/ANSI 372, Drinking Water System Components—Lead Content."

Purchasers should be aware that the availability of NSF/ANSI 61–certified pumps may be very limited, and this requirement may limit competition and add to the cost and delivery time of the pumps. Purchasers should also be aware that some states may allow installation of noncertified pumps, based on submittal and acceptance of materials used to construct the pump, especially if suitable certified pumps are not available.

Compliance with NSF/ANSI 372 meets the new low lead requirements of the US Safe Drinking Water Act, which went into effect January 2014. Most pump manufacturers are able to certify compliance with NSF/ANSI 372.

III.A.2.2 Alternative materials. Purchase documents may require alternative materials or limit manufacturer's choices of materials listed in this standard. For example, this standard lists silicon bronze, aluminum bronze, and stainless steel as impeller materials. Silicon bronze may not be suitable if the water contains a significant concentration of

chlorine or chloramine. Aluminum bronze and stainless-steel components may be more costly and difficult to fabricate than silicon bronze components. Purchasers should be aware that alternatives to or limitations on manufacturer's selections may increase costs and delivery time.

III.A.3 Flanges. This standard requires flat-faced flanges. If other facing is required, it must be specified by the purchaser.

III.A.4 Factory tests.

III.A.4.1 Tests other than the hydrostatic tests described in Section 5 may be desired. Purchasers can specify the following additional tests in accordance with current ANSI/HI standards:

1. Performance.
2. NPSHR.
3. Mechanical.
4. Prime time for self-priming pumps.
5. Airborne sound.

III.A.4.2 Witnessed testing. Purchase documents may specify optional witnessed testing for all or some of the factory tests.

III.A.4.3 Special testing. Purchase documents may specify variations from the ANSI/HI standard tests. These variations may include duplication of field conditions.

III.A.4.4 Other testing. Purchase documents may specify testing a sample pump selected at random for any test other than the prescribed hydrostatic tests.

III.A.5 Submittals. This standard includes minimum requirements for submittals. If additional submittals (including affidavits of compliance) are required, they should be provided by the purchase documents. Additional submittal data that may be required include: welding procedures and welder qualification requirements associated with column piping and discharge head assemblies, repair procedures for castings, torsional shaft stress analysis, lateral and torsional shaft vibration analysis, and structural dynamic analysis. The purchase documents should describe the desired submittals and analyses including the acceptance criteria.

III.A.6 Shop inspections. This standard does not provide for inspections at the manufacturer's facility either during or after the pumps are constructed. If inspections are required, the extent should be defined by the purchase documents.

III.A.7 Installation and alignment. This standard does not contain requirements or recommendations regarding pump and driver installation or alignment of components and piping. Further, this standard does not contain requirements or recommendations regarding suction and discharge piping stiffness requirements for maintaining pump and

driver alignment. It is not possible for pump manufacturers to make more than general recommendations regarding installation and alignment. This is due to many factors that can affect installation, some of which are beyond the control of the pump manufacturer. Additionally, the degree of installation and alignment precision desired on the part of purchasers may vary significantly. Users of this standard should review the various Hydraulic Institute standards and other standards regarding these subjects and provide additional requirements in the purchase documents regarding installation and alignment of the pump and driver system.

III.B. *Basic Data for Vertical Pumps.*

III.B.1 Construction requirements.

III.B.1.1 Specify type. Refer to ANSI/HI 2.1-2.2, Rotodynamic Vertical Pumps or Radial, Mixed, and Axial Flow Types for Nomenclature and Definitions, for a description of types. Select:

1. Barrel (can) pump with suction nozzle in discharge head or in barrel.
2. Deep well.
3. Wet pit with above-floor or below-floor discharge.

III.B.1.2 Specify line-shaft details and bearing details.

1. Open or enclosed line shaft.
2. For open line shaft specify bearing material (bronze or rubber).
3. For enclosed line shaft specify lubrication (water or oil).

III.B.1.3 Specify column pipe details.

1. Refer to appendix E for recommendations.
2. Specify nominal size, wall thickness, and material.

III.B.2 Driver details. Although drivers are not included in this standard, they are an important component of a vertical pump. Refer to appendix E for recommendations.

III.C. *Basic Data for Horizontal Pumps.*

III.C.1 Construction requirements.

III.C.1.1 Specify type. Refer to ANSI/HI 1.1-1.2, Rotodynamic Centrifugal Pumps for Nomenclature and Definitions, for a description of types. Select:

1. Separately coupled, single-stage, inline, flexible coupling.
2. Separately coupled, single-stage, inline, rigid coupling.
3. Separately coupled, single-stage, end suction.
4. Separately coupled, single-stage, horizontal, axial, or mixed flow.
5. Single-stage, horizontal, double- or single-suction split case.
6. Vertically mounted, horizontal, double- or single-suction split case.

IV. Modification to Standard. Any modification of the provisions, definitions, or terminology in this standard must be provided by the purchaser.

V. Major Revisions. Major changes made to the standard in this revision include the following:

1. Most sections of the standard underwent extensive revision.
2. Purchaser defined options are to be called out in the purchase documents.
3. A flow range requirement was added (Sec. 4.2.2).
4. New requirements were added for: castings (Sec. 4.2.1.6), impellers (Sec. 4.2.1.8), shafts (Sec. 4.2.3), vibration limits (Sec. 4.6 and Sec. II.D), casings and wear rings (Sec. 4.3.1.7), bowls (Sec. 4.4.3.1), and coatings (Sec. 4.5.5).

VI. Comments. If you have any comments or questions about this standard, please contact Engineering and Technical Services at 303.794.7711, FAX at 303.795.7603; write to the department at 6666 West Quincy Avenue, Denver, CO 80235-3098; or email at standards@awwa.org.

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American Water Works Association
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AWWA Standard

Horizontal and Vertical Line-Shaft Pumps

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard provides minimum requirements for horizontal centrifugal pumps and for vertical line-shaft pumps for installation in wells, water treatment plants, water transmission systems, and water distribution systems.

1.1.1 *Service.* Pumps described in this standard are intended for pumping freshwater having a pH range between 5.5 and 10.0, a temperature range from 33°F to 125°F (14°C to 37°C), a maximum chloride content of 250 mg/L, and a maximum suspended solids content of 1,000 mg/L, and that is either potable or will be treated to become potable.

1.1.2 *Pumps covered by this standard.*

1.1.2.1 Driver power range: 10 hp to 1,500 hp (7 kW to 1,100 kW).

1.1.2.2 Rate of flow (at BEP): 100 gpm to 40,000 gpm (23 m^3/hr to 9,100 m^3/hr).

1.1.2.3 Maximum discharge pressure ratings. The maximum steady-state pressure at the pump discharge (which considers the suction pressure, possible operation for short periods at shutoff head, and the elevation of the discharge) is limited to the pressure rating for the ANSI/AWWA C207 class of flange shown for the pump types described below.