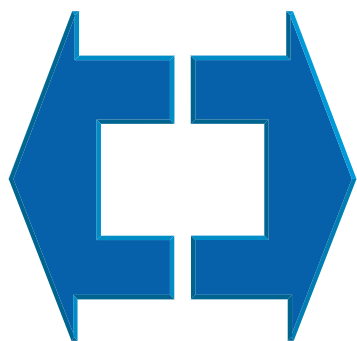




American National Standard for

Reciprocating Pump Tests

ANSI/HI 6.6-2000



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First Floor North
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Reciprocating Pump Tests

Secretariat
Hydraulic Institute
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Approved February 25, 2000
American National Standards Institute, Inc.

American National Standard

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Foreword (Not part of Standard)

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 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 directed to the Hydraulic Institute. It will direct all such questions to the appropriate technical committee for provision of a suitable answer.

If a dispute arises regarding contents of an Institute publication or an answer provided by the Institute to a question such as indicated above, the point in question shall be referred to the Executive Committee of the Hydraulic Institute, which then shall act as a Board of Appeals.

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; corresponding US units appear in brackets. Charts, graphs and sample calculations are also shown in both metric and US 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 for this standard was achieved by use of the Canvass Method

The following organizations, recognized as having an interest in the standardization of 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.

Bal Seal Engineering
Black & Veatch LLP
Bran & Luebbe
Brown & Caldwell
Camp Dresser & McKee, Inc.
Cheng Fluid Systems, Inc.
David Brown Union Pumps
DeWante & Stowell
Equistar LP
Exeter Energy Limited Partnership
Fluid Sealing Association
Illinois Department of Transportation
Ingersoll-Dresser Pump Company
Krebs Consulting Service

Malcolm Pirnie, Inc.
Marine Machinery Association
McFarland Pump Company
Pacer Pumps
Pinellas County, Gen. Serv. Dept.
The Process Group, LLC
Raytheon Engineers & Constructors
Skidmore
South Florida Water Mgmt. Dist.
Stone & Webster Eng. Corp.
Summers Engineering, Inc.
Systecon, Inc.
Tuthill Pump Group

6.6 Test

6.6.1 Scope

This Standard is for reciprocating power pumps, including controlled volume metering pumps, which are driven by power from an outside source applied to the crankshaft. It includes procedures for testing such pumps.

These standards apply to test of the pump only, unless stated otherwise.

The type of test performed and the auxiliary equipment to be used should be agreed upon by the purchaser and manufacturer prior to the test.

It is not the intent to limit or restrict tests to only those described herein. Variations in test procedures may exist without violating the intent of this standard. Exceptions may be taken if agreed upon by the parties involved without sacrificing the validity of the applicable parts of the standard.

6.6.1.1 Objective

This standard provides uniform procedures for hydrostatic, hydraulic and mechanical pump performance testing and for recording of the test results of reciprocating pumps.

Vibration and acoustical testing methods are not included in this standard. Refer to ANSI/HI 9.1–9.5-2000, Section 9.5 Sound Measurement, for acoustical testing procedures.

6.6.2 Types of tests

This standard contains procedures for the following types of tests:

- a) Performance test to demonstrate one of the following:
 - 1) Mechanical integrity at speed and pressure specified;
 - 2) Rate of flow and mechanical integrity at speed and pressure specified;
 - 3) Rate of flow, power and mechanical integrity at speed and pressure specified.

Optional tests as follows when specified:

- b) Hydrostatic testing of pressure-retaining components is described in Section 6.6.5;

- c) Net positive suction head testing is described in Section 6.6.6.

6.6.2.1 Performance test

Unless otherwise specified, the rate of flow, pressure and efficiency are based on shop tests using water corrected to 20°C (68°F).

If the facility cannot test at rated speed because of limitations in power, electrical frequency, or available speed changers, the pump may be tested at between 50% and 200% of rated speed.

6.6.3 Terminology

The following terms and symbols are used to designate test parameters used in connection with pump tests.

6.6.3.1 Symbols

See Table 6.15 on page 2.

6.6.3.2 Subscripts

See Table 6.16 on page 3.

6.6.3.3 Rated condition point

Rated condition point applies to the rate of flow, discharge pressure, suction pressure, NPSHR, speed and power of the pump as specified by the order.

6.6.3.4 Normal condition point

Normal condition point applies to the point at which the pump will normally operate. It may be the same as the rated condition point.

6.6.3.5 Volume (standard units)

The standard unit of volume shall be as follows:

- 1) Metric – cubic meter;
- 2) US units – US gallon or cubic foot.

The specific weight (γ) of water at a temperature of 20°C (68°F) shall be taken as 396 kN/m³ (62.3 lb/ft³). For other temperatures, proper specific weight corrections shall be made, using values from the ASME steam tables.

Table 6.15 — Symbols

Symbol	Term	Metric unit	Abbreviation	US Customary Unit	Abbreviation	Conversion factor ^a
A	Area	square millimeter	mm ²	square inches	in ²	645.2
a	Area of piston rod	square millimeter	mm ²	square inches	in ²	645.2
β (beta)	Meter or orifice ratio	dimensionless	—	dimensionless	—	1
C	Coefficient for acceleration head	dimensionless	—	dimensionless	—	1
D	Displacement	cubic meters per hour	m ³ /h	US gallons/minute	gpm	0.2271
d	Diameter	millimeter	mm	inches	in	25.4
Δ (delta)	Difference	dimensionless	—	dimensionless	—	1
η (eta)	Efficiency	percent	%	percent	%	1
g	Gravitational acceleration	meter/second squared	m/s ²	feet/second squared	ft/sec ²	0.3048
γ (gamma)	Specific weight			pounds/cubic foot	lb/ft ³	
h	Head	meter	m	feet	ft	0.3048
L	Stroke length	millimeter	mm	inches	in	25.4
M	Number of pistons	dimensionless	—	dimensionless	—	1
n	Speed	revolutions/minute	rpm	revolutions/minute	rpm	1
NPSHA	Net positive suction head avail.	kilopascal	kPa	pounds/square inch	psi	6.895
NPSHR	Net positive suction head required	kilopascal	kPa	pounds/square inch	psi	6.895
ν (nu)	Kinematic viscosity	millimeter squared/sec	mm ² /s	seconds Saybolt Universal	SSU	0.22
π	pi = 3.1416	dimensionless	—	dimensionless	—	1
p	Pressure	kilopascal	kPa	pounds/square inch	psi	6.895
P	Power	kilowatt	kW	horsepower	hp	0.7457
q	Rate of flow (capacity)	cubic meter/hour	m ³ /h	cubic feet/second	ft ³ /sec	101.94
Q	Rate of flow (capacity)	cubic meter/hour	m ³ /h	US gallons/minute	gpm	0.2271
ρ (rho)	Density	kilogram/cubic meter	kg/m ³	pound mass/cubic foot	lbm/ft ³	16.02
s	Specific gravity	dimensionless	—	dimensionless	—	1
S	Slip	percent	%	percent	%	1
t	Temperature	degrees Celsius	°C	degrees Fahrenheit	°F	(°F–32) × ⁵ / ₉
τ (tau)	Torque	Newton – meter	N·m	pound-feet	lb-ft	1.356
v	Velocity	meter/second	m/s	feet/second	ft/sec	0.3048
V	Specific volume	cubic meters/kiloNewton	m ³ /kN	cubic feet/pound	ft ³ /kN	6.365
x	Exponent	none	none	none	none	1
Z	Elevation gauge distance above or below datum	meter	m	feet	ft	0.3048

^a Conversion factor × US units = metric units.