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Rotodynamic pumps—Hydraulic performance acceptance tests—Grades 1, 2 and 3

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In the event of any doubts arising as to the contents, the original JIS is to be the final authority.

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by The Japan Society of Industrial Machinery Manufacturers (JSIM)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14. Consequently **JIS B 8301**:2000 is replaced with this Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with patent rights, applications for a patent after opening to the public or utility model rights. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying any of such patent rights, applications for a patent after opening to the public or utility model rights.

Rotodynamic pumps—Hydraulic performance acceptance tests—Grades 1, 2 and 3

Introduction

This Japanese Industrial Standard has been prepared based on **ISO 9906**:2012, Edition 2, with some additions and modifications made to reflect the conventions of business transactions conducted in Japan.

The vertical lines on both sides and dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JH. Annexes JA to JG provide unique contents to **JIS** that are not given in the corresponding International Standard.

1 Scope

This Standard specifies performance acceptance tests for centrifugal, mixed flow and axial pumps (hereafter all referred to as pumps) that are conducted for delivery inspection. It can be applied to any size and to any pumped liquids which behave as clean, cold water (see **5.7.1A**). It does not cover structural requirements or requirements regarding mechanical characteristics of the pump.

This Standard specifies three levels of acceptance, grade 1, grade 2, and grade 3, which are further classified into the following: grades 1B, 1E and 1U with tighter tolerance; grades 2B and 2U with broader tolerance; and grade 3B with even broader tolerance.

Apart from above, there are acceptance grades with other sets of tolerances intended for pumps with a power input of below 10 kW, and acceptance grade 3J (see Annex JA), which is applicable to pumps without reduction of impeller diameter.

This Standard applies either to a pump itself without any fittings or to a combination of a pump associated with all or part of its upstream and/or downstream fittings.

NOTE The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 9906:2012 *Rotodynamic pumps—Hydraulic performance acceptance tests—Grades 1, 2 and 3* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS B 0131 *Glossary of terms for turbopumps*

NOTE Related International Standards: **ISO 17769-1** and **ISO 17769-2**.

JIS B 8327 *Testing methods for performance of pump using model pump*

JIS Z 8000-1 *Quantities and units—Part 1: General*

ISO 2186 *Fluid flow in closed conduits—Connections for pressure signal transmissions between primary and secondary elements*

ISO 7194 *Measurement of fluid flow in closed conduits—Velocity-area methods of flow measurement in swirling or asymmetric flow conditions in circular ducts by means of current-meters or Pitot static tubes*

ISO 13709 *Centrifugal pumps for petroleum, petrochemical and natural gas industries*

3 Terms, quantities, definitions, symbols and units

For the purposes of this document, the following terms, quantities, definitions, symbols and units apply. In **3.1** below, definitions of general terms used in this Standard are given. For other terms than given in **3.1**, definitions in **JIS B 0131** apply. Table 1 gives a list of definitions, symbols and units of quantities used for this Standard. The definitions, symbols and units in the said table are in accordance with **JIS Z 8000-1**. Table 2 gives an alphabetical list of the symbols used and Table 3 gives a list of subscripts. All formulae are given in coherent SI units. For conversion of other units to SI units, see Annex I.

3.1 General terms and definitions

Definitions of general terms are given in the following.

3.1.1

guarantee point

flow/head (Q/H) point, which a tested pump shall meet, within the tolerances of the agreed[1] acceptance class

See Figure 2 or Figure 3 given in **4.4.3**.

Note [1] Agreed between the purchaser and the manufacturer or supplier.

3.1.1A

acceptance grade

pump performance grade defined by the guarantee point and permissible range of deviation from the guarantee point, assigned to each pump application

These acceptance grades are classified according to whether the specified tolerances are unilateral or bilateral, and according to the degree of tolerance assigned to pump efficiency.

3.1.2

factory performance test

pump test performed to verify the initial performance of new pumps as well as checking for repeatability of production units, accuracy of impeller trim calculations, performance with special materials, etc.

NOTE A typical performance test consists of the measurement of flow, head and power input to the pump or pump test motor. Additional measurements, such as NPSH, may be included as agreed upon. A factory test is understood to mean testing at a dedicated test facility, often at a pump manufacturer's plant or at an independent pump test facility.

3.1.3 non-witnessed pump test

3.1.3.1

factory test

test performed without the presence of a purchaser's representative, in which the pump manufacturer is responsible for the data collection and judgement of pump acceptance

NOTE The advantage of this test is cost savings and accelerated pump delivery to the pump user. In many cases, if the purchaser is familiar with the performance of the pump (e.g. identical pump model order), a factory non-witnessed test may be acceptable.

3.1.3.2

signed factory test

test performed without the presence of a purchaser's representative, in which the pump manufacturer is responsible for compliance with the parameters of the agreed acceptance class

NOTE The pump manufacturer conducts the test, passes judgement of pump acceptance and produces a signed pump test document. The advantage of this test is the same as seen on the non-witnessed test in **3.1.3.1**. Compared to a witnessed test, this test is substantially less expensive and often leads to accelerated pump delivery to the end user.

3.1.4 witnessed pump test

test performed in the presence of a purchaser's representative

The witnessing of a pump test by a representative of the pump purchaser can serve many useful functions. There are various ways of witnessing a test.

3.1.4.1

witnessing by the purchaser's representative

testing physically attended by the purchaser, who signs off on the raw test data to certify that the test is performed satisfactorily

NOTE See **H.1**.

3.1.4.2

remote witnessing by the purchaser's representative

pump performance testing which is witnessed from a distance by the purchaser, and of which the raw test data obtained by the measuring system is checked by the purchaser

NOTE See **H.2**.

3.2 Quantities, definitions, symbols and units

Table 1 gives a list of quantities, definitions, symbols and units.

Table 1 Quantities, definitions, symbols and units

No.	Quantity	Definition	Symbol	Dimen-sion	Unit
3.2.1	angular velocity	number of radians of a shaft per unit time, expressed as follows $\omega = 2\pi n$ .... (1) where, n is in s^{-1}.	ω	T^{-1}	rad/s
3.2.2	speed of rotation	number of rotations per unit time	n	T^{-1}	s^{-1}, min^{-1}
3.2.3	mass flow rate	mass of flow discharged, per unit time, into the pipe from the outlet connection of the pipe	q [a)]	MT^{-1}	kg/s
3.2.4	volume rate of flow (flow)	volume of flow discharged, per unit time, at the outlet of the pump, given by $Q = \frac{q}{\rho}$ .... (2) NOTE 1 In this Standard, this symbol may also designate the volume rate of flow in any given section. It is the quotient of the mass rate of flow in this section by the density. (The section may be designated by subscripts.) If the compression of pumped liquid is such that density change is significant, average density $\rho_m = \frac{\rho_1 + \rho_2}{2}$ shall be applied to density ρ. The volume rate of flow [c)] at a designated section is expressed with a subscript representing the position of that section. The volume rate of flow in this case is the quotient of the mass rate of flow in the designated section by the density in that section. NOTE 2 The following losses or extraction flowrate that are intrinsic to pumps should not be considered: a) extraction flowrate required for balancing the axial thrusts; b) cooling of pump bearings; c) seal water for shaft seal. NOTE 3 Leakage through the pipe joint or inner leakage of the pipe should not be considered. NOTE 4 The volume of flow extracted upstream of the measured section for the following purposes may be included in the volume rate of flow: a) cooling of motor bearing; b) cooling of gear box (bearing, oil cooler).	Q [b)]	L^3T^{-1}	m^3/s, m^3/min, L/min

Table 1 (continued)

No.	Quantity	Definition	Symbol	Dimension	Unit
3.2.5	mean velocity	mean value of the axial speed of flow, expressed as a quotient of the flow by pipe cross-section The mean velocity is given by: $U = \frac{Q}{A}$ .... (3) where, Q is in m^3/s.	U	LT^{-1}	m/s
3.2.6	local velocity	speed of flow at any given point	v	LT^{-1}	m/s
3.2.7	head	energy of mass of liquid per unit mass, divided by g The head is given by: $H = \frac{y}{g}$ .... (4) NOTE For g, see **3.2.30A**, for y, see **3.2.16**.	H	L	m
3.2.8	reference plane	any horizontal plane used as a datum for height measurement NOTE For practical reasons, it is preferable not to specify an imaginary reference plane.	—	—	—
3.2.9	height above reference plane	height of the considered point above the reference plane (see Figure A.1 and Figure A.2.) NOTE Its value is: — positive, if the considered point is above the reference plane; — negative, if the considered point is below the reference plane.	z	L	m
3.2.10	gauge pressure	pressure relative to atmospheric pressure, and a force per unit area applied in a direction perpendicular to a measured section of the liquid NOTE 1 All pressures in this Standard are gauge pressures read from a manometer or similar pressure sensing instrument, except atmospheric pressure and the vapour pressure of the liquid, which are expressed as absolute pressures. NOTE 2 Its value is: — positive, if this pressure is greater than the atmospheric pressure; — negative, if this pressure is less than the atmospheric pressure.	p	$ML^{-1}T^{-2}$	Pa
3.2.11	velocity head	kinetic energy of the liquid in movement, divided by g The velocity head is given by: $\frac{U^2}{2g}$ .... (5)	—	L	m

Table 1 (continued)

No.	Quantity	Definition	Symbol	Dimension	Unit
3.2.12	total head	overall energy in any cross section, divided by g The total head is given by: $$H_x = z_x + \frac{p_x}{\rho g} + \frac{U_x^2}{2g} \quad \text{(6)}$$ The absolute total head in any section is given by: $$H_{x(abs)} = z_x + \frac{p_x}{\rho g} + \frac{p_{amb}}{\rho g} + \frac{U_x^2}{2g} \quad \text{(7)}$$	H_x	L	m
3.2.13	inlet total head	overall energy at the inlet section of the pump The inlet total head is given by: $$H_1 = z_1 + \frac{p_1}{\rho g} + \frac{U_1^2}{2g} \quad \text{(8)}$$	H_1	L	m
3.2.14	outlet total head	overall energy at the outlet section of the pump The outlet total head is given by: $$H_2 = z_2 + \frac{p_2}{\rho g} + \frac{U_2^2}{2g} \quad \text{(9)}$$	H_2	L	m
3.2.15	pump total head	algebraic difference between the outlet total head, H_2, and the inlet total head, H_1 The pump total head is given by: $$H = z_2 - z_1 + \frac{p_2 - p_1}{\rho g} + \frac{U_2^2 - U_1^2}{2g} \quad \text{(10)}$$ NOTE 1 If compressibility is negligible, $H = H_2 - H_1$. If the compressibility of the pumped liquid is significant, the density, ρ, should be replaced by the mean value: The density is given by: $$\rho_m = \frac{\rho_1 + \rho_2}{2} \quad \text{(11)}$$ NOTE 2 The correct mathematical symbol is $H_{1\text{-}2}$.	$H_{1\text{-}2}$	L	m
3.2.16	specific energy	energy of liquid per unit mass, given by: $$y = gH \quad \text{(12)}$$	y	L^2T^{-2}	J/kg
3.2.17	loss of head at inlet	difference between the total head of the liquid at the measuring point and the total head of the liquid in the inlet section of the pump	H_{J1}	L	m
3.2.18	loss of head at outlet	difference between the total head of the liquid in the outlet section of the pump and the total head of the liquid at the measuring point	H_{J2}	L	m
3.2.19	pipe friction loss coefficient	coefficient for the head loss by friction in the pipe	λ	None	—