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Centrifugal, mixed flow and axial pumps — Code for acceptance tests — Class C

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FOREWORD

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Draft International Standards adopted by the Technical Committees are circulated to the Member Bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 2548 was drawn up by Technical Committee ISO/TC 115, *Pumps*, and circulated to the Member Bodies in November 1971.

It has been approved by the Member Bodies of the following countries :

Austria	Israel	South Africa, Rep. of
Belgium	Italy	Spain
Czechoslovakia	Japan	Sweden
Egypt, Arab Rep. of	Netherlands	Switzerland
France	New Zealand	Thailand
Germany	Norway	Turkey
Hungary	Poland	United Kingdom
India	Portugal	USSR
Ireland	Romania	

The Member Body of the following country expressed disapproval of the document on technical grounds :

Australia

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Centrifugal, mixed flow and axial pumps – Code for acceptance tests – Class C

WARNING – Terms used in this International Standard like "guarantee" or "acceptance" must be understood in a technical but not in a legal sense. The term "guarantee", therefore specifies values for checking purposes determined in the contract, but does not say anything about the rights or duties arising, if these values are not reached or fulfilled. The term "acceptance" does not have any legal meaning here, either. Therefore, an acceptance test carried out successfully alone does not represent an "acceptance" in the legal sense.

0 INTRODUCTION

This International Standard is the first of a set dealing with acceptance tests of centrifugal, mixed flow and axial pumps[1]; they correspond to three classes of tests A, B and C : class A is the most accurate and class C is the least accurate; the use of classes A and B is restricted to special cases when there is a need to have the pump performance more precisely defined.

Attention is drawn to the fact that class B and A tests require more accurate apparatus and methods, which increases the cost of such tests.

The standard arrangements and procedures described are those to be employed for testing a pump individually, without reference to its final installation conditions or the effect upon it of any associated fittings, these being the usual conditions in which a pump is tested at the manufacturer's works.

Pump performance may be affected by conditions of the final site installation, and procedures are described for carrying out "standard tests" on certain types of installations of which an overall performance is required.

The conditions in which pumps are finally installed, however, often do not permit reliable test measurements, and recommendations are made concerning the procedure to be adopted where the layout precludes tests in conformity with the standards, or where the tests cover the pump and the plant ancillary to the pump itself.

In this test code, all formulae are given in coherent units.

1 SCOPE AND FIELD OF APPLICATION

This International Standard constitutes a code for acceptance testing of pumps, defining the terms and quantities that are used, establishing the methods of testing and the ways of measuring the quantities involved according to class C so as to ascertain the performances of the pump and to compare them with the manufacturer's guarantee.

In general this code applies to any sizes of pumps tested with clean cold water and other liquids behaving as clean cold water such as defined in section 8.

This code is not concerned with the structural details of the pumps nor with the mechanical properties of their components.

1) In the rest of the text these three types of pumps will be simply designated as "pumps".

2 SYMBOLS

2.1 List of symbols used in the test code

TABLE 1 — **Symbols**

Reference number in ISO/R 31[1]	Reference number in ISO 2548	Quantity	Symbol	Dimensions[2]	SI units
3.1.1		Mass	m	M	kg
1.3.1		Length	l	L	m
1.6.1		Time	t	T	s
4.2.1		Temperature	θ	Θ	°C
1.4.1		Area	A	L^2	m^2
1.5.1		Volume	V	L^3	m^3
1.8.1		Angular velocity	ω	T^{-1}	rad/s
1.10.1		Velocity	v	LT^{-1}	m/s
1.11.2		Acceleration of free fall	g	LT^{-2}	m/s^2
2.3.2		Speed of rotation	n	T^{-1}	s^{-1}
3.2.1		Density	ρ	ML^{-3}	kg/m^3
3.11.1		Pressure	p	$ML^{-1}T^{-2}$	N/m^2 [6]
3.19.1		Viscosity (dynamic viscosity)	μ	$ML^{-1}T^{-1}$	$N{\cdot}s/m^2$
3.20.1		Kinematic viscosity	ν	L^2T^{-1}	m^2/s
3.22.2		Energy	E	ML^2T^{-2}	J
3.23.1		Power (general term)	P	ML^2T^{-3}	W
12.1		Reynolds number	Re	pure number	
		Diameter	D	L	m
	3.2.1.1	Mass rate of flow	q [3]	MT^{-1}	kg/s
	3.2.1.2	Volume rate of flow	Q [4]	L^3T^{-1}	m^3/s
	3.2.3.2	Distance to reference plane	z	L	m
	3.2.3.8	Pump total head	H	L	m
	3.2.3.6	Inlet total head	H_1	L	m
	3.2.3.7	Outlet total head	H_2	L	m
	3.2.3.9	Specific energy	Y	L^2T^{-2}	J/kg
	3.2.3.10	Loss of head at inlet	H_{J1}	L	m
	3.2.3.11	Loss of head at inlet	H_{J2}	L	m
	3.2.3.12	Net positive suction head	(NPSH) [5]	L	m
		Atmospheric pressure (absolute)	p_b	$ML^{-1}T^{-2}$	N/m^2 [6]
		Vapour pressure (absolute)	p_v	$ML^{-1}T^{-2}$	N/m^2 [6]
	3.2.4.2	Pump power input	P	ML^2T^{-3}	W
	3.2.4.1	Pump power output	P_u	ML^2T^{-3}	W
	3.2.4.3	Motor power input	P_{gr}	ML^2T^{-3}	W
	3.2.5.1	Pump efficiency	η	pure number	
	3.2.5.2	Transmission efficiency	η_{int}	pure number	
	3.5.2.3	Motor efficiency	η_{mot}	pure number	
	3.2.5.4	Overall efficiency	η_{gr}	pure number	
	3.2.6	Type number	K	pure number	
	5.7.6	Friction factor	λ	pure number	

1) ISO/R 31 (See Appendix W.)

2) M = Mass   L = Length   T = Time   Θ = Temperature.

3) An optional symbol for mass rate of flow is q_m.

4) An optional symbol for volume rate of flow is q_v.

5) An optional symbol for net positive suction head is H_H.

6) Also called pascal (symbol Pa).

2.2 Alphabetical lists of basic letters and subscripts

TABLE 2 — **Letters used as symbols**

Symbol	Quantity	SI units
A	Area	m^2
D	Diameter	m
E	Energy	J
g	Acceleration of free fall	m/s^2
H	Head	m
H_J	Losses in terms of head of liquid	m
K	Type number	pure number
l	Length	m
m	Mass	kg
n	Speed of rotation	s^{-1}
(NPSH)	Net positive suction head	m
p	Pressure	N/m^2
P	Power	W
q	Mass rate of flow	kg/s
Q	Volume rate of flow	m^3/s
Re	Reynolds number	pure number
t	Time	s
v	Velocity	m/s
V	Volume	m^3
Y	Specific energy	J/kg
z	Distance to reference plane	m
η	Efficiency	pure number
θ	Temperature	°C
μ	Dynamic viscosity	$N{\cdot}s/m^2$
ν	Kinematic viscosity	m^2/s
ρ	Density	kg/m^3
ω	Angular velocity	rad/s
λ	Friction factor	pure number

TABLE 3 — **Letters and figures used as subscripts**

Subscript	Meaning
1	inlet
2	outlet
a	available
b	atmospheric
G	guaranteed
gr	unit (overall)
int	intermediate
M	manometric
mot	motor
P	pump
r	required
S	eye
sp	specified[1]
t	total
u	useful
v	vapour (pressure)

3 DEFINITIONS

3.1 GENERAL DEFINITIONS

In order to avoid any error of interpretation it has seemed preferable to reproduce here the definitions of quantities and units as given in ISO/R 31 and to supplement these definitions by some specific information on their use in this test code.

g — **acceleration of free fall**[2]

n — **speed of rotation :** The quotient of the number of rotations by the time.

ρ — **density :** The quotient of mass by volume.

p — **pressure :** The quotient of force by area. Unless otherwise specified, all pressures are gauge pressures, i.e. measured with respect to the atmospheric pressure.

μ — **viscosity** (dynamic viscosity, sometimes called absolute viscosity) is defined by the expression :

$$\tau = \mu \frac{u_o}{h}$$

where

u_o is the velocity of a flat plate moving in its own plane while keeping parallel to a fixed flat wall;

h is the distance from the flat plate to the fixed flat wall;

τ is the friction force of the fluid on the area unit of the flat plate during its motion.

NOTE — h should be small enough to obtain laminar flow of the fluid between the flat plate and the fixed flat wall.

ν — **kinematic viscosity :** The quotient of the viscosity (dynamic viscosity) by the density :

$$\nu = \frac{\mu}{\rho}$$

P — **power :** The quotient of the energy transferred during a time interval by the duration of this interval.

Re — **Reynolds number** is defined by the expression :

$$Re = \frac{vD}{\nu}$$

3.2 DEFINITIONS PECULIAR TO THE TEST CODE

This clause gives the definitions of concepts used in this test code, together with the associated symbols, if any have been allocated.

Concepts, even though in current use, which are not strictly necessary to the application of this code are not here defined.

1) This indication applies to the values of quantities relating to the guarantee point.

2) For Class C test the value of g is assumed to be $9{,}81\ m/s^2$.

3.2.1 Flow rates

3.2.1.1 q – In this test code, the **mass rate of flow** designates the external mass rate of flow of the pump, i.e. the rate of flow discharged into the pipe from the outlet branch of the pump.

NOTE – Losses or abstractions inherent to the pump i.e. :

a) discharge necessary for hydraulic balancing of axial thrust,

b) cooling of bearings of the pump itself,

c) water seal to the packing,

d) leakage from the fittings, internal leakage, etc.,

are not to be reckoned in the quantity delivered. On the contrary, if they are taken at a point before the flow measuring section, all derived quantities used for other purposes, such as :

e) cooling of the motor bearings,

f) cooling of a gear box (bearings, oil cooler), etc.,

should be added to the measured rate of flow.

3.2.1.2 Q – The **outlet volume rate of flow** has the following value :

$$Q = \frac{q}{\rho_2}$$

In this test code, this symbol may also designate the **volume rate of flow in a given section**[1]; it is the quotient of the mass rate of flow in this section by the density. (The section may be designated by the proposed subscripts.)

3.2.2 v – **velocity of flow** : The mean velocity of flow equal to the volume rate of flow divided by the pipe cross-section[1] :

$$v = \frac{Q}{A}$$

3.2.3 head : The energy per unit weight of fluid.

3.2.3.1 reference plane : The horizontal plane through the centre of the circle described by the external point of the entrance edges of the impeller blades; in the case of double inlet pumps the plane should be taken through the higher centre.

The manufacturer should indicate the position of this plane with respect to precise reference points on the pump.

3.2.3.2 z designates the difference between the level of the horizontal plane under consideration and the level of the reference plane. Its value is

– positive, if the plane in question is above the reference plane;

– negative, if the plane in question is below the reference plane.

3.2.3.3 p – **gauge pressure** : The effective pressure, relative to atmospheric pressure. The head corresponding to this pressure is

$$\frac{p}{\rho g}$$

Its value is

– positive if this pressure is greater than the atmospheric pressure;

– negative if this pressure is less than the atmospheric pressure.

3.2.3.4 dynamic head : The kinetic energy per unit weight of the liquid in movement. It is expressed by :

$$\frac{v^2}{2g}$$

where v is the mean velocity of the liquid in the section considered.

3.2.3.5 total head : In any section, the total head is given by :

$$z + \frac{p}{\rho g} + \frac{v^2}{2g}$$

This is related to atmosphere. The absolute total head in any section is given by :

$$z + \frac{p}{\rho g} + \frac{p_b}{\rho g} + \frac{v^2}{2g}$$

3.2.3.6 H_1 – **inlet total head** : The total head in the inlet section of the pump :

$$H_1 = z_1 + \frac{p_1}{\rho g} + \frac{v_1^2}{2g}$$

3.2.3.7 H_2 – **outlet total head** : The total head in the outlet section of the pump :

$$H_2 = z_2 + \frac{p_2}{\rho g} + \frac{v_2^2}{2g}$$

3.2.3.8 H – **pump total head** : The algebraic difference between the outlet total head, and the inlet total head.

$$H = H_2 - H_1$$

$$= z_2 - z_1 + \frac{p_2 - p_1}{\rho g} + \frac{v_2^2 - v_1^2}{2g}$$

If the compressibility of the pumped liquid is significant, ρ may be replaced by the mean value

$$\rho_m = \frac{\rho_1 + \rho_2}{2}$$

1) Attention is drawn to the fact that in this case Q may vary for different reasons across the circuit.

3.2.3.9 Y – **specific energy** : The energy per unit mass of liquid. It is given by the equation

$$Y = gH$$

3.2.3.10 H_{J1} – **loss of total head at inlet** : The difference between the total head of the liquid at the measuring point, or possibly of the liquid without velocity in the suction chamber, and the total head of the liquid in the inlet section of the pump.

3.2.3.11 H_{J2} – **loss of total head on delivery** : The 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.

3.2.3.12 (NPSH) – **net positive suction head** : The total inlet head, plus the head corresponding to the atmospheric pressure, minus the head corresponding to the vapour pressure :

$$(\text{NPSH}) = H_1 + \frac{p_b}{\rho g} - \frac{p_v}{\rho g}$$

Thus (NPSH), as well as inlet total head, is referred to the reference plane.

It is necessary to make a distinction between

– the (NPSH) *required* at given flow and speed of rotation for a given pump; it is specified by the manufacturer;

– the (NPSH) *available* for the same flow which is inferred from the installation;

– the *test* (NPSH) – see 7.1.1.

Subscripts may be used to differentiate these quantities (for example $(\text{NPSH})_r$ when the required value is concerned and $(\text{NPSH})_a$ when the available value is concerned).

3.2.4 Power

3.2.4.1 P_u – **pump power output** : The power transferred to the liquid at its passage through the pump :

$$P_u = qgH = qY$$

3.2.4.2 P – **pump power input** : The power measured at the pump coupling.

3.2.4.3 P_{gr} – **motor power input** : The power absorbed by the pump driver.

3.2.5 Efficiency

3.2.5.1 η – **pump efficiency** :

$$\eta = \frac{P_u}{P} = \frac{\text{Pump power output}}{\text{Pump power input}}$$

3.2.5.2 η_{int} – **transmission efficiency** (shafting, coupling, gears, etc.) :

$$\eta_{int} = \frac{\text{Pump power input}}{\text{Power at motor shaft}}$$

3.2.5.3 η_{mot} – **motor efficiency** :

$$\eta_{mot} = \frac{\text{Power at motor shaft}}{\text{Motor power input}}$$

3.2.5.4 η_{gr} – **overall efficiency** :

$$\eta_{gr} = \eta\, \eta_{int}\, \eta_{mot}$$

$$= \frac{\text{Pump power output}}{\text{Motor power input}}$$

3.2.6 Type number K

The type number, a dimensionless quantity, is defined by the following formula[1] :

$$K = \frac{2\pi n Q^{1/2}}{(gH)^{3/4}}$$

NOTE – Attention is drawn to the fact that in this International Standard, the type number is based on the total head of a multistage pump, and not on the head per stage, and that it applies to the guaranteed flow rate, which is not in conformity with the common practice where K is calculated for the flow rate corresponding to the maximum efficiency.

4 GUARANTEES AND PURPOSE OF THE TESTS

4.1 Guarantees

4.1.1 *Subjects of guarantees*

It shall be agreed in the contract which values are guaranteed by the manufacturer and under what conditions.

One or more of the following quantities are usually guaranteed :

– outlet rate of flow of pump

– total head of pump

– power input or efficiency of pump or combined motor-pump unit (for example submersible pump or monobloc pump; or separate pump and motor with overall efficiency guaranteed)

– (NPSH).

Whichever of these quantities is guaranteed, it is necessary to specify the speed of rotation (or in some cases the electrical supply frequency and voltage for the motor-pump unit) and the chemical and physical properties of the liquid to be pumped (if other than clean cold water).

1) This formula is the same as the basic formula $K = \frac{\omega Q^{1/2}}{Y^{3/4}}$

It is recommended that in national standards based on this International Standard practical equations for the commonly used units should be given in addition to the homogeneous equations given above.

In this test code the guarantees only refer to the pump including the test arrangements as given in 5.7. In particular, the guarantees do not apply to

- the test of the pipe and its fittings, such as valves, etc.,
- the general installation *in situ*,

if these parts do not belong to the test arrangements according to 5.7.

The pump manufacturer is responsible neither for the determination of the pump guarantee point, nor for the arrangement of the pump, nor for the installation *in situ*, the sole exception being when he has undertaken these tasks as part of the order.

4.1.2 *Extent of guarantees*

The guarantee of the flow rate covers the flow rate at the agreed total head and speed of rotation, within the permissible tolerances above and below as given by 9.4.1.

The guarantee of the head covers the pump total head (H) at the agreed flow rate and speed of rotation, within the permissible tolerances above and below as given by 9.4.1.

The guarantee of the efficiency covers the minimum value of efficiency at the guaranteed point QH within the permissible tolerances as given by 9.4.2.

If the flow rate values and the efficiency stated are not guaranteed but are indicated on the basis of prior tests or are given in printed curves (for mass produced pumps) see Annex B.

For a combined motor-pump unit (for example submersible pump or monobloc pump; or separate pump and motor with overall efficiency guaranteed) the guarantee covers the efficiency of the entire unit.

4.1.3 *Implementation of guarantees*

4.1.3.1 FLOW RATE AND TOTAL HEAD VALUES

The guarantee for flow rate and total head is fulfilled if, at the agreed speed of rotation, the value of the equation given in 9.4.1 is greater than or equal to 1.

4.1.3.2 EFFICIENCY

The efficiency guarantee is fulfilled if, at the agreed speed of rotation, the conditions given in 9.4.2 have been achieved or exceeded.

4.1.3.3 NET POSITIVE SUCTION HEAD (NPSH)

When a test of (NPSH) is specified in the contract, the guarantees as defined in 4.1.3.1 and 4.1.3.2 shall be achieved under those conditions of (NPSH) that are specified. This does not necessarily ensure absence of cavitation (see section 7).

4.1.3.4 MOTOR SPEED OF ROTATION

If the driving motor is being supplied by the pump manufacturer, the speed of rotation named in 4.1.2 and 4.1.3 can be replaced by the frequency and the voltage.

4.2 Purpose of the tests

4.2.1 *Contractual object of the tests*

The tests are intended to ascertain the performance of the pump and to compare this with the manufacturer's guarantee. When (NPSH) also is to be guaranteed, it shall be specified in the contract whether (NPSH) is to be tested or not. Attention is drawn to the fact that a test of (NPSH) increases the costs of the tests. (See also Appendix V.)

Where a number of identical pumps are to be purchased, the number of pumps to be tested shall be agreed between the purchaser and manufacturer.

4.2.2 *Range of performance test*

The performance test of the pump shall be carried out to determine the performance of the pump with respect of the discharged rate of flow, total head, power absorbed, etc.

A check of the satisfactory running of the pump may be made from the point of view of cavitation, temperature of glands and bearings, axial thrust, and possible air or water leakage, provided the hydraulic test is carried out at the specified speed of rotation.

NOTE — It is also possible to observe the amount of noise and vibration and if necessary to examine this in the light of ISO publications.

4.2.3 *Liquid used in testing*

The liquid used in testing shall be clean cold water in accordance with the recommendations of section 8, unless otherwise specified in the contract.

5 ORGANIZATION OF TESTS

5.1 Place of testing

Acceptance tests shall be carried out either at the manufacturer's works, or alternatively at a place to be mutually agreed between the manufacturer and the purchaser.

5.2 Time of testing

The time of testing shall be mutually agreed by the manufacturer and the purchaser.

When tests are not carried out in the manufacturer's works, time should be allowed for preliminary adjustments by both the manufacturer and the installer.

5.3 Test validity

It should be ascertained that conditions permit tests to be made in accordance with the provisions of this code.

5.4 Staff

Accurate measurements depend not only on the quality of the measuring instruments used but also on the ability and skill of the persons operating and reading the measuring devices during the tests. The staff entrusted with effecting the measurements must be selected just as carefully as the instruments to be used in the test.

Specialists with adequate experience in measuring operations in general shall be charged with operating and reading complicated measuring apparatus. Reading simple measuring devices may be entrusted to such helpers who – upon short prior instruction – can be assumed to effect the readings with proper care and the accuracy required.

A chief of tests shall be appointed, possessing adequate experience in measuring operations. Normally, when the test is carried out at the manufacturer's works, the chief of tests is a staff member of the manufacturing firm.

All persons charged with effecting the measurements are subordinated during the tests to the chief of tests, who conducts and supervises the measurements, reports on test conditions and the results of the tests and then drafts the test report. All questions arising in connection with the measurements and their execution are subject to his decision.

The parties concerned shall provide all assistance that the chief of tests considers necessary.

5.5 Test programme

Only the guaranteed operational data shall form the basis of the test; other data determined by measurement during the tests shall have merely an indicative (informative) function and it shall be so stated if they are included in the programme.

5.6 Testing apparatus

When the measuring procedure is being decided on, the measuring and recording apparatus required shall be specified at the same time.

The chief of tests shall be responsible for checking the correct installation of these apparatuses and their perfect functioning.

All of the measuring apparatus shall be covered by reports showing by calibration or by comparison with other ISO documents that it complies with the requirements of 5.12. These reports shall be presented if required.

5.7 Test arrangements

5.7.1 *Standard test arrangements*

Ideally, the flow through the inlet head measuring section should be such that

a) the velocity is uniform, and axial, across the section;

b) the static pressure across the section is uniform.

These are the conditions for the standard test arrangement, but they are impossible to achieve completely, and it is impracticable to check them for the class of test covered by this International Standard.

However, significant maldistribution and swirl can be avoided by keeping bends and combinations of bends, and divergences and discontinuities of cross-sectional area, from the proximity of the measuring section. In general, the importance of inlet flow conditions increases with the pump type number, and for type numbers greater than 1,5 it is more meaningful to reproduce site conditions than it is to use a standard test arrangement. For such non-standard conditions an agreement shall be reached in the contract.

5.7.1.1 Inlet pressure tappings

In general, the pressure tapping shall be placed in a section of equal diameter to, and concentric with, the inlet branch of the pump. It should under normal conditions be located two diameters upstream from the pump inlet flange. Moreover it shall never be placed

a) in a diverging section, or within four diameters of straight pipe downstream from the divergence;

b) within the plane of a bend, either in the bend itself or within four diameters of straight pipe downstream from the bend. It may, however, be agreed to site a pressure tapping in this region at right angles to the plane of the bend;

c) within four diameters of straight pipe following a sudden contraction, or other discontinuity of cross-sectional area.

When interpretation of readings in non-standard conditions is being negotiated, consideration shall be given to

a) whether the value of inlet head itself is important (for example for NPSH tests);

b) the ratio of inlet velocity head to the pump total head.

If this ratio is very small (less than 0,5 %) and the value of inlet head itself is not important, readings from a tapping in the pump inlet flange may be used in the inlet total head equation given in 3.2.3.6 (for ratio $> 0,5\,\%$: $2\,D$ upstream).

5.7.1.2 Outlet pressure tappings

Under normal conditions the outlet pressure tapping should be located two diameters downstream from the pump outlet flange.

For the pumps of type number equal to or less than 0,5, the outlet pressure tapping may be located directly at the pump outlet, provided it is at right angles to the plane of the volute or any other bend formed by the pump casing.

For the pumps of type number greater than 0,5, the straight parallel pipe shall be coaxial with the outlet pipe of the pump and have the same bore. The tapping shall be located in the pipe wall in a plane through the pipe axis at right angles to the plane of the volute or other bend formed by the pump casing.

5.7.2 *Pumps tested with fittings*

If specified in the contract, standard tests shall be carried out on a combination of a pump and

1) associated fittings at the final site installation; or

2) an exact reproduction thereof; or

3) fittings introduced for testing purposes and taken as forming part of the pump itself. (See for examples 5.7.3, 5.7.4, etc.)

Connections on the inlet and outlet sides of the whole combination shall be made in accordance with 5.7.1.

Measurements shall then be taken in accordance with 5.11.2 and 5.11.3.

5.7.3 *Pumping installation under submerged conditions*

Where a pump, or a combination of a pump and its fittings, is tested or installed in conditions where the standard pipe connection, on either inlet or outlet as described in 5.7.1, cannot be made owing to inaccessibility or submergence, measurements shall be taken in accordance with 6.2.2.3 and 6.2.3.3.

5.7.4 *Borehole and deep-well pumps*

Borehole and deep-well pumps cannot usually be tested with their complete lengths of delivery main and, consequently, the loss of head in the portions omitted, and the power absorbed by any shafting therein, cannot be measured. Any thrust bearing would also be more lightly loaded during the test than it would be in the final installation. (See 6.2.4.4.)

5.7.5 *Self-priming pumps*

In principle the priming ability of self-priming pumps shall always be verified at the contractual static suction head with the attached inlet piping equivalent to that in the final installation. When the test cannot be carried out in the described manner, the test arrangement to be used shall be specified in the contract.