SLOVENSKI STANDARD
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Technical specifications for centrifugal pumps - Class II (ISO 5199:1986)

Technical specifications for centrifugal pumps - Class II (ISO 5199:1986)

Kreiselpumpen, technische Anforderungen - Klasse II (ISO 5199:1986)

Spécifications techniques pour pompes centrifuges - Classe II (ISO 5199:1986)

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English version

Technical specifications for centrifugal pumps - Class II (ISO 5199:1986)

Spécifications techniques pour pompes centrifuges - Classe II (ISO 5199:1986)

Kreiselpumpen, technische Anforderungen - Klasse II (ISO 5199:1986)

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart,36 B-1050 Brussels

Foreword

On proposal of the Technical Committee CEN/TC 197 "Pumps", the Technical Board of CEN decided to submit the International Standard :

ISO 5199:1986 "Technical specifications for centrifugal pumps - Class II"

to the formal vote.

The result of the formal vote was positive.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by april 1993, and conflicting national standards shall be withdrawn at the latest by april 1993.

In accordance with the Common CEN/CENELEC Rules, the following countries are bound to implement this European Standard :

Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

Endorsement notice

The text of the International Standard ISO 5199:1986 was approved by CEN as a European Standard without any modification.

International Standard 5199

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION•МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ•ORGANISATION INTERNATIONALE DE NORMALISATION

Technical specifications for centrifugal pumps — Class II

Spécifications techniques pour pompes centrifuges — Classe II

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work.

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. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 5199 was prepared by Technical Committee ISO/TC 115, *Pumps*.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Technical specifications for centrifugal pumps — Class II

0 Introduction

This International Standard is the first of a series dealing with technical specifications for centrifugal pumps; they correspond to three classes of technical specifications, I, II and III, of which class I has the most severe, and class III the least severe requirements.

Where a decision may be required by the purchaser, or agreement is required between purchaser and manufacturer, the relevant text is printed in bold typeface and listed in annex H.

1 Scope and field of application

1.1 This International Standard covers class II requirements for centrifugal pumps of back pull-out construction as used primarily in the chemical and petrochemical industries. However the Standard, or individual clauses of it, can be applied in other industries, for general industrial use or to pump designs other than of back pull-out construction.

1.2 Pumps as specified in ISO 2858 are typical of those conforming to this International Standard.

1.3 This International Standard includes design features concerned with installation, maintenance and safety for these pumps, including baseplate couplings and auxiliary piping but excluding the driver.

1.4 Where application of this International Standard has been called for

a) and a specific design feature is required, alternative designs which meet the intent of the Standard may be offered, provided that the alternative is described in detail;

b) pumps not complying with all requirements of the Standard may be offered for consideration provided that all deviations are stated.

1.5 Whenever the documents include contradicting technical requirements, they shall apply in the following sequence:

a) purchase order (or enquiry if no order is placed) (see annexes F and G);

b) data sheets (see annex A);

c) this International Standard;

d) other standards to which reference is made in the order or enquiry.

2 References

To the extent specified in the text, the following International Standards are used in the application of this Standard.

ISO 76, *Rolling bearings — Static load ratings.*

ISO 281/1, *Rolling bearings — Dynamic load ratings and rating life — Part 1: Calculation methods.*

ISO 1940, *Balance quality of rotating rigid bodies.*

ISO 2084, *Pipeline flanges for general use — Metric series — Mating dimensions.*

ISO 2229, *Equipment for the petroleum and natural gas industries — Steel pipe flanges, nominal sizes* 1/2 *to* 24 in *— Metric dimensions.*

ISO 2372, *Mechanical vibration of machines with operating speeds from* 10 *to* 200 rev/s *— Basis for specifying evaluation standards.*

ISO 2373, *Mechanical vibration of certain rotating electrical machinery with shaft heights between* 80 *and* 400 mm *— Measurement and evaluation of the vibration severity.*

ISO 2548, *Centrifugal, mixed flow and axial pumps — Code for acceptance tests — Class C.*

ISO 2858, *End-suction centrifugal pumps (rating* 16 bar*) — Designation, nominal duty point and dimensions.*

ISO 3069, *End-suction centrifugal pumps — Dimensions of cavities for mechanical seals and for soft packing.*

ISO 3274, *Instruments for the measurement of surface roughness by the profile method — Contact (stylus) instruments of consecutive profile transformation — Contact profile meters, system M.*

ISO 3555, *Centrifugal, mixed flow and axial pumps — Code for acceptance tests — Class B.*

ISO 3661, *End-suction centrifugal pumps — Baseplate and installation dimensions.*

ISO 3744, *Acoustics — Determination of sound power levels of noise sources — Engineering methods for free-field conditions over a reflecting plane.*

ISO 3746, *Acoustics — Determination of sound power levels of noise sources — Survey method.*

3 Definitions

Terms in this International Standard which are not self-explanatory are defined as follows.

3.1 operating conditions: All parameters (for example, operating temperature, operating pressure) determined by a given application and pumped liquid. These parameters will influence the type of construction and construction materials.

3.2 allowable operating range: The flow range at the specified operating conditions with the impeller supplied as limited by cavitation, heating, vibration, noise, shaft deflection and other similar criteria. This range shall be defined by the manufacturer.

3.3 rated conditions: Conditions (driver excluded) that define the (guarantee) point necessary to meet all defined operating conditions, taking into account any necessary margins.

3.4 rated driver output: The maximum permissible driver output under site operating conditions.

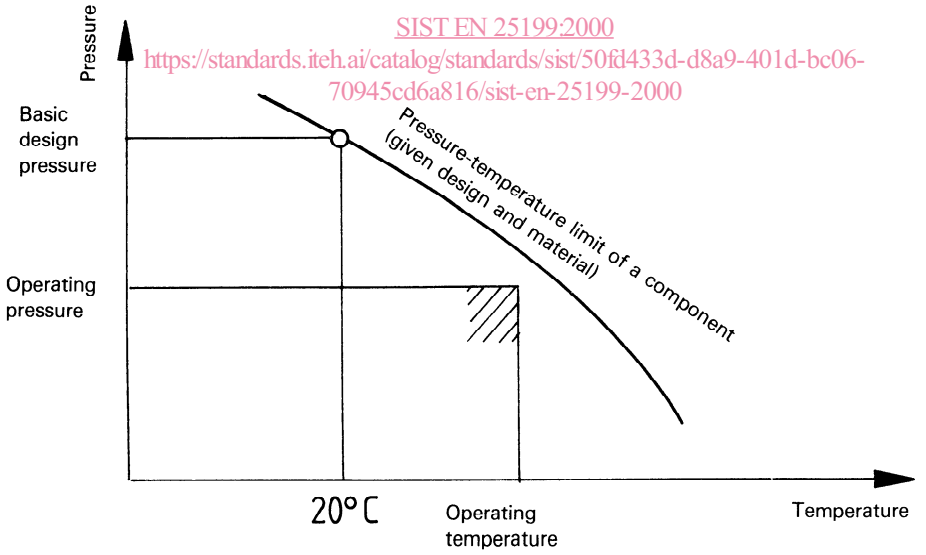
3.5 basic design pressure: This is derived from the permitted stresses at 20 °C of the material used for the pressure-containing parts.

3.6 rated pressure: The pressure limit at the most severe operating conditions in a given application.

3.7 rated inlet pressure: The inlet pressure which, with the rated head (converted to pressure) at rated flow, results in the rated outlet pressure.

3.8 rated outlet pressure: Outlet pressure of the pump at rated flow, rated head (converted to pressure) rated inlet pressure.

3.9 pressure - temperature rating: Relationship between pressure and temperature given in the form of a graph (see below).



3.10 corrosion allowance: That portion of the wall thickness of the parts wetted by the pumped liquid in excess of the theoretical thickness required to withstand the pressure limits given in 4.4.1.

3.11 maximum allowable continuous speed: The highest speed at which the manufacturer permits the pump to operate continuously.

3.12 trip speed: The speed of rotation at which the turbine emergency stop mechanism operates.

3.13 first critical speed: The speed of rotation of a machine at which the first (lowest) lateral natural frequency of vibration of the rotating parts corresponds to the frequency of rotation.

3.14 design load: The maximum hydraulic radial forces on the largest impeller (diameter and width) operating within the manufacturer's specified range on its maximum speed curve with a liquid density of 1 000 kg/m^3.

3.15 maximum load: The maximum hydraulic radial forces on the largest impeller (diameter and width) operating at any point on its maximum speed curve with a liquid density of 1 000 kg/m^3.

3.16 shaft runout: The total radial deviation indicated by a device measuring shaft position in relation to the bearing housing as the shaft is rotated manually in its bearings with the shaft in the horizontal position.

3.17 face runout: The total axial deviation indicated at the outer radial face of the stuffing box by a device attached to and rotated with the shaft when the shaft is rotated manually in its bearings in the horizontal position. The radial face is that which determines the alignment of a seal component.

3.18 shaft deflection: The term as used in this International Standard describes the displacement of a shaft from its geometric centre in response to the radial hydraulic forces acting on the impeller. It does not include shaft movement caused by tilting within the bearing clearances, bending caused by impeller imbalance or shaft runout.

3.19 circulation (flush): Return of pumped liquid from high pressure area to seal cavity can be by external piping or internal passage and is used to remove heat generated at the seal or to maintain positive pressure in the seal cavity or treated to improve the working environment for the seal. In some cases it may be desirable to circulate from the seal cavity to a lower pressure area (for example, the inlet).

3.20 injection (flush): Introduction of an appropriate (clean, compatible, etc.) liquid into the seal cavity from an external source and then into the pumped liquid. Used for the same purpose as circulation but also used to provide an improved working environment for the seal.

3.21 quenching: Continuous or intermittent introduction of an appropriate (clean, compatible, etc.) fluid on the atmospheric side of the main shaft seal. Used to exclude air or moisture, to prevent or clear deposits (including ice), lubricate an auxiliary seal, snuff out fire, dilute, heat or cool leakage.

3.22 barrier liquid (buffer): An appropriate (clean, compatible, etc.) liquid inserted between two seals (mechanical seal and/or soft packing). The barrier liquid pressure depends on the seal arrangement. The barrier liquid may be used to prevent air entering the pump. The barrier is normally easier to seal than the pumped liquid and/or creates less of a hazard on leaking.

4 Design

4.1 General

4.1.1 Characteristic curve

The characteristic curve shall indicate the permitted operating range of the pump. Pumps with a stable characteristic curve are preferred. The characteristic curves of the smallest and largest impeller diameter of the pump shall be plotted on the performance chart as a function of flow.

4.1.2 Net positive suction head (NPSH)

The NPSH required, $(NPSH)_r$, shall be based on cold water as specified in ISO 2548 or ISO 3555 unless otherwise agreed.

A $(NPSH)_r$ curve shall be provided for water as a function of flow.

Should the pump manufacturer consider that, because of the construction material and liquid pumped, more NPSH is required, this should be stated in the proposal and the appropriate curve provided.

The NPSH available $(NPSH)_a$ shall exceed $(NPSH)_r$ by a margin of at least 0,5 m. Correction factors for hydrocarbons are not allowed.

For NPSH tests, refer to 6.3.2.3.

4.1.3 Outdoor installation

The pumps shall be suitable for outdoor installation under normal ambient conditions.

Extraordinary local ambient conditions, such as high or low temperatures, corrosive environment, sand storms, etc. for which the pump must be suitable shall be specified by the purchaser.

4.2 Prime movers

The following have to be considered when determining the rated performance of the drive:

a) application and method of operation of the pump. For instance in the case of parallel operation, the possible performance range with only one pump in operation taking into account the system characteristic shall be considered;

b) position of the operating point on the pump characteristic curve;

c) shaft seal friction loss;

d) circulation flow for the mechanical seal (especially for pumps with low rate of flow);

e) properties of pumped liquid (viscosity, solids content, density);

f) power and slip loss through transmission;

g) atmospheric conditions at pump site.

Prime movers required as drivers for any pumps covered by this International Standard shall have power output ratings at least equal to the percentage of rated pump power input given in figure 1, this value being never less than 1 kW.

Where it appears that this will lead to unnecessary oversizing of the driver, an alternative proposal shall be submitted for the purchaser's approval.

4.3 Critical speed, balance and vibration

4.3.1 Critical speed

Under operating conditions, the actual first lateral critical speed of the rotor when coupled to the drive agreed upon shall be at least 10 % above the maximum permitted continuous speed including the trip speed of a turbine driven pump.

4.3.2 Balance and vibration

Balancing of the pump rotating parts shall be carried out. Vibration shall not exceed the vibration severity limits as given in table 1 when measured on the manufacturer's test facilities. These values are measured radially at the bearing housing at a single operating point at rated speed (± 5 %) and rated flow (± 5 %) when operating without cavitation.

For information, this can normally be achieved by balancing in accordance with grade G 6,3 of ISO 1940.

Table — Limits of vibration severity for horizontal pumps with multivane impellers*

Speed of rotation, n	Maximum r.m.s. values of the vibration velocity for the shaft centreline height h_1	
	$h_1 \leqslant 225$ mm	$h_1 > 225$ mm
min^{-1}	mm/s	mm/s
$n \leqslant 1800$	2,8	4,5
$1800 < n \leqslant 4500$	4,5	7,1

* The table is based on ISO 2372 and ISO 2373.

Pumps with a special impeller, for example a single channel impeller, may exceed the limits given in the table. In such a case the pump manufacturer should indicate this in his offer.

See also annex B.

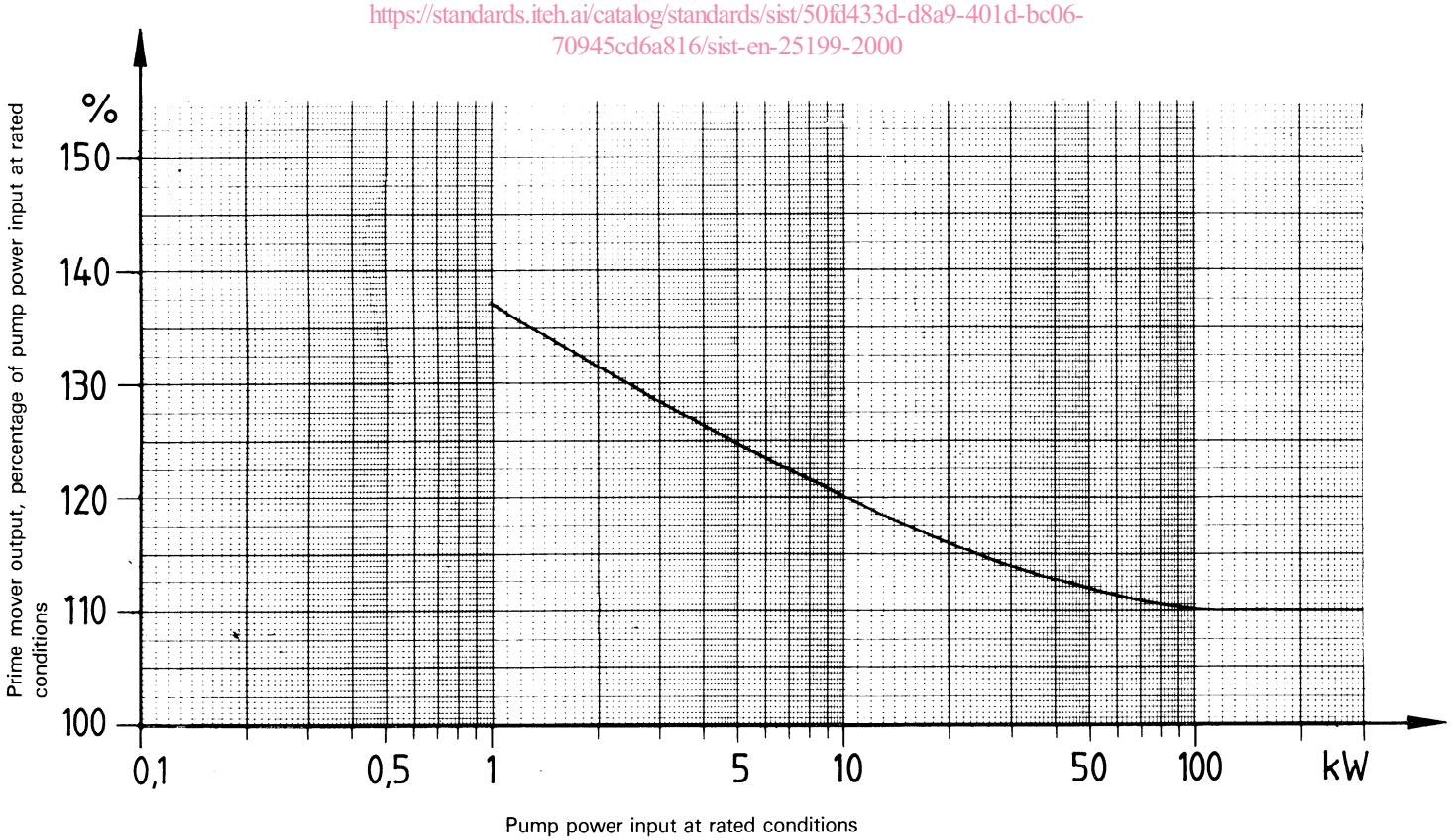


Figure 1 — Prime mover output, percentage of pump power input at rated conditions

4.4 Pressure-containing parts

4.4.1 Pressure-temperature rating

The pressure limit (rated pressure) of the pump at the most severe operating conditions shall be clearly defined by the manufacturer. In no case may the rated pressure of the pump (casing and cover including shaft seal housing and gland follower/end plate) exceed that of the pump flanges.

The basic design pressure of the pump shall be at least a gauge pressure of 16 bar[1] at 20 °C when made of cast iron, ductile iron, carbon steel or stainless steel.

For materials the tensile requirements of which do not permit the 16 bar rating, the pressure-temperature rating shall be adjusted according to the stress-temperature rating for the material and shall be clearly stated by the manufacturer.

4.4.2 Wall thickness

Pressure casings including the shaft seal housing and gland end plate shall be of such thickness as will be suitable for containing pressure and limiting distortion under the rated pressure at operating temperature.

The casing shall also be suitable for the hydrostatic test pressure (see 6.3.1) at ambient temperature.

The pressure-containing parts shall have a corrosion allowance of 3 mm unless otherwise agreed.

4.4.3 Materials

The materials used for pressure-containing parts shall depend on the liquid pumped and the application of the pump (see clause 5).

4.4.4 Mechanical features

4.4.4.1 Dismantling

The pump shall preferably be designed in back pull-out construction in order to permit removal of the impeller, shaft, shaft seal and bearing assembly without disturbing the inlet and outlet flange connections. Provision shall be made for easy separation of components, for example jackscrews.

4.4.4.2 Jackscrews

When jackscrews are supplied as a means of separating contacting faces, the mating face shall be counterbored to receive the jackscrews where marring offers a possibility of a leaky joint or poor fit. Hollow-head screws should be avoided if possible.

4.4.4.3 Jackets

Jackets for heating or cooling the casing or stuffing box, or both, are optional. Jackets shall be designed for cooling at an operating pressure of at least 6 bar at 170 °C.

4.4.4.4 Casing gaskets

Casing gaskets shall be of a design suitable for the rated operating conditions and for hydrostatic test conditions at ambient temperature. The casing-cover gaskets shall be confined on the atmospheric side to prevent blow-out.

4.4.4.5 Vapour venting

A pump handling a liquid at a pressure near its vapour pressure or with a gas content shall be designed so that the vapours can be properly vented.

4.4.4.6 External bolting

Bolts or studs that connect parts of the pressure casing, including shaft seal housing, shall be at least 12 mm diameter (ISO metric thread).

NOTE — If, due to space limitations, the use of 12 mm bolts or studs is impractical, smaller bolts or studs may be used.

The bolting selected (property class) shall be adequate for the rated pump pressure and for normal tightening procedures. If at some point it is necessary to use a fastener of special quality, interchangeable fasteners for other joints shall be of the same quality. Hollow-head screws should be avoided if possible.

4.4.4.7 Casing support for high temperature

For applications above 175 °C for example, due consideration should be given to supporting the centreline pump casing.

4.5 Branches (nozzles) and miscellaneous connections

NOTE — For the purposes of this Standard the terms branch and nozzle are synonymous.

4.5.1 Extent

This section is concerned with all fluid connections to the pump whether for operation or maintenance.

4.5.2 Inlet and outlet branches

Inlet and outlet branches shall be flanged and designed for the same pressure unless the pump manufacturer states this is not so and emphasizes the requirement for pressure relief.

4.5.3 Vent, pressure-gauge and drain

Venting of all areas of casing and seal chamber shall be provided unless the pump is made self-venting by arrangement of branches.

The connection of pressure gauges at the inlet and outlet branches shall be possible. The connections are not drilled. The enquiry and/or order should state if such connections are required to be drilled.

1) 1 bar = 0,1 MPa