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भारतीय मानक मसौदा

**औद्योगिक अनुप्रयोग के लिए पम्पों के चयन, संस्थापना,
प्रचालन, और अनुरक्षण हेतु रीति सहिता —
भाग 1 चयन**

[आई एस 10596 (भाग — 1) का प्रथम पुनरीक्षण]

DRAFT Indian Standard

**CODE OF PRACTICE FOR SELECTION, INSTALLATION, OPERATION,
AND MAINTENANCE OF PUMPS FOR INDUSTRIAL APPLICATIONS —**

PART 1 SELECTION

[First Revision of IS 10596 (Part 1)]

ICS 23.080

Pumps Sectional Committee,
MED 20

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07 June 2024

FOREWORD

(Formal clause to be added later on)

This Indian standard (Part 1) was first published in 1983 and it includes modern age pumps which have a very wide field of applications, such as domestic water lifting, irrigation, firefighting, hydraulic presses, hydraulic servo systems, mining, chemical and petroleum industries. For proper functioning and having optimum life of the pumps, two requirements should be met with, namely:

- a) Proper selection of the pump type suitable to the working conditions; and
- b) Proper installation, operation and maintenance.

To deal with this situation effectively we will have to recognize the various factors responsible for the smooth and efficient working. This knowledge can be acquired only through long experience in the field and through investigations where required.

Experienced users can have the knowledge based on 'their long experience in the field while coming across various problems varying in nature. On the other hand new users without any guidelines find themselves helpless in making use of optimum life with smooth functioning. Here point of paramount importance is the proper installation and maintenance of genuine pump selected for the purpose.

This code of practice has been prepared only with an intension to provide guidelines for the proper selection, installation, operation and maintenance of pumps excluding residential and agricultural pumps.

This revision has been taken up to keep pace with the latest technological developments and practices followed in the pump industry. This revision incorporates:

- a) Figures added for better understanding; and
- b) Clause **3.7.3** has been modified.

The code of practice for selection, installation, operation, and maintenance of pumps for industrial applications is in four parts. This standard covers the guidelines for selection of pump. Other parts in this series under the general title are as follows:

- Part 2 Installation
- Part 3 Operation
- Part 4 Maintenance

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

DRAFT *Indian Standard*

CODE OF PRACTICE FOR SELECTION, INSTALLATION, OPERATION, AND
MAINTENANCE OF PUMPS FOR INDUSTRIAL APPLICATIONS

— **PART 1 SELECTION**

(*First Revision*)

1 SCOPE

This Indian Standard intends to provide general guidelines for the selection of pumps for industrial applications. This standard is not applicable to pumps for residential and agricultural applications.

2 REFERENCES

The Indian Standards listed in Annex A contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 SELECTIONS

In the process of ordering a pumping unit the user concerned is required to identify system requirements, select the pump type, lay down the pump specification and develop all information necessary for the supplier.

3.1 Liquid Characteristics

Physical and chemical properties of the liquid to be handled, such as its viscosity, density, corrosiveness, lubricating properties, chemical stability, volatility, amount of suspended particles, etc, are of paramount importance in the process of selection of a pump. Depending upon the process and the system, some or all of these properties may have an important influence on pump and system design, for example, the degree of corrosiveness of the liquid will influence the material of construction, while if the liquid contains suspended solid particles, suitable type of pump seal designs, abrasion resistant pump construction material and type of impeller may have to be considered. The effect of change of temperature, pressure, time, etc upon the liquid properties are also worth considering with regard to its possible effects on pump operation.

3.1.1 Generally, the selection of a centrifugal pump is based on the water equivalent duties that is total head/effective head and volume rate of flow. Liquid characteristics should be considered while calculating water equivalent duties, for example, in case of viscous liquids head, capacity

and efficiency is greatly affected and correction factors for these need to be considered. Reference should be made to IS : 5120 for such corrections. Similarly, for liquids with consistencies more than 3 percent correction for head capacity should be applied. Similar considerations need to be applied for liquids with solids. Proper correction should be applied for volume rate of flow depending upon solid percentage, nature and size of solids.

3.2 Total Head

A clear picture of the system, wherein the pumping system is expected to operate, should be kept in mind while calculating total head requirements. Since hydraulic losses are invariably present in the system due to pipe friction posed by pipes, bends and other fittings, due weightage should be given to these.

NOTE — Based on the layout of the system and head losses, total head should be determined.

3.2.1 The NPSH requirement in case of centrifugal pump shall be based on water performance without hydrocarbon correction factor. The NPSH required shall be based on 3 percent head drop.

3.3 Volume Rate of Flow

A pump is designed mainly on the basis of head requirements and required volume rate of flow. Hence, exact requirements of volume rate of flow should be calculated.

3.4 Alternate Mode of Operation

The various modes of operation of the system are important considerations when specifying pumping unit. The following parameter may be determined:

- a) Operation of pump - continuous or intermittent;
- b) Rate of flow or head - constant or variable; and
- c) Difference in flow and head requirements for different flow path.

3.4.1 These and many other questions arising from different modes of operation influence decisions regarding number of pumps and their volume rate of flow and need of booster pumps, to a great extent. To meet variable requirements of flow and head, number of pumps may have to be operated in series or parallel as described in Figure 1(a) and 1 (b). In such cases the effect of failure of one of the pumps shall also have to be considered as rated conditions for individual pumps shall abruptly change because of this and pumps may run on full' open side beyond operating range of pump. The failure of pumping system may occur due to motor failure, power supply failure, and loss of control in electrical power, namely, frequency, voltage, etc. Hence, proper importance should be given to these factors and occurrence of these causes should be evaluated beforehand as a part of selection of pump unit, especially the prime mover. The use of I.C. engines shall have to be considered as a prime mover to handle such exigencies.

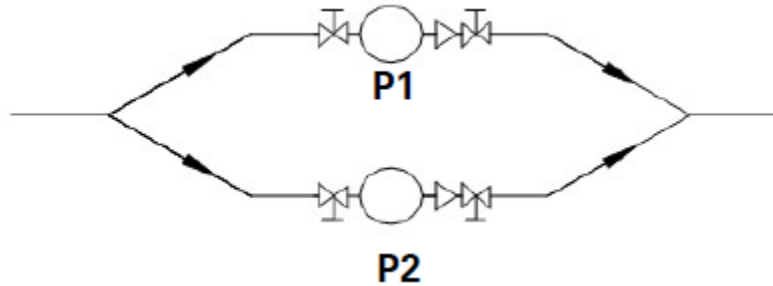


FIG 1 (a) PARALLEL OPERATION (FOR CONSTANT HIGH FLOW OR VARIABLE FLOW)

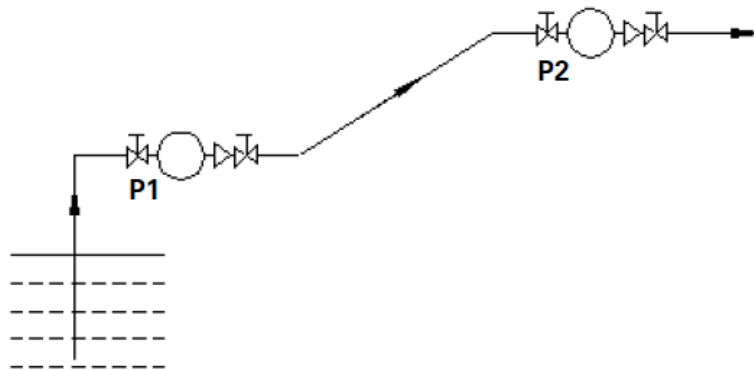


FIG 2 (b) SERIES OPERATION (FOR CONSTANT HIGH HEAD OR VARIABLE HEAD)

Note - P1 and P2 are pump 1 and pump 2

3.5 Wear

Wear occurs in the system with a lapse of time causing operating characteristics to change. The extent of such wear over the lifetime of the equipment should be properly assessed and adequate margin provided in the system parameters so that the pump can render satisfactory service even up to the end of the use of the equipment. Where abrasive or suspended material particles are to be handled, pump with replaceable liners should be specified. These liners may be of resilient material, such as rubber compound or extremely hard alloys of cast iron. Plastic linings including those on impeller are also suitable for such services.

3.6 Expected Future System Changes

The requirements of future system changes should be incorporated taking into consideration the effect on performance of a pump due to its wear and tear if they can be predicted with any degree of certainty.

3.6.1 In any event, it should be kept in mind that the equipment must operate satisfactorily in the present system for which the pumping unit is being specified and this should be a factor in every evaluation being made.

3.7 Selection of Pump

The selection of the pump class and type for a particular application is influenced by such factors as site location system requirements, system layout, liquid characteristics, intended life, energy consumption, material of construction, code requirements, etc. The behavior of the system greatly influences the choice of the basic type of pumps, such as:

- a) The required volume rate of flow and heads at different loads;
- b) The effect of changes in volume rate of flow on system head, Depending on whether flow required is constant or variable will put pump in operating at constant head or variable head;
- c) The required head remain steady or changes due to phenomena like scaling, rusting;
- d) Available NPSH; and
- e) System details, such as:
 - 1) Relief value;
 - 2) Surge chambers; and
 - 3) Expansion joints.

These-are some of the parameters for which answers are to be found out.

3.7.1 *Pump Characteristics*

3.7.1.1 Centrifugal pumps are considered suitable for variable-head, variable volume rate of flow applications.

3.7.1.2 Constant-speed reciprocating pumps find wide application in situations where the required volume rate of flow is expected to be constant over a wide range of system — head variations. This type of pumps is available in a wide range of design pressures. However the volume rate of flow is relatively small for the size of the equipment required.

3.7.1.3 While selecting a reciprocating pump, it should be kept in mind that the output from a reciprocating pump will be pulsating. Where this is objectionable, the use of rotary pumps may be made. However, the application of rotary pumps is limited to low-to-medium pressure ranges only, and are mostly recommended for handling oil and other viscous liquids.

3.7.1.4 It is to be noted that while rotary and reciprocating positive displacement pumps are self-priming, centrifugal pumps are not, unless designed specifically. As reciprocating and rotary pumps are positive displacement type units, they will continue to build up excessive pressures on the delivery side if the discharge of liquid from them, while they are in operation, is restricted or stopped either by throttling or completely closing the gate valve in the delivery pipe line or if any other obstruction is produced in the pipe for restricting or stopping the flow of the liquid. It is, therefore, always necessary to provide either an inbuilt type or a separate pressure-relieving or

relief valve on discharge side of these pumps with arrangements to set them for opening at the desired pressures and by passing the flow back to suction.

3.7.1.5 In certain cases the system layout may have a very important bearing on the choice of pump type. Normally, centrifugal pumps require less floor space for installation than reciprocating pumps and vertical pumps less floor space than horizontal pumps. However, vertical pumps may require more head room for maintenance and installation purposes. For the pressure boosting pumps to be installed in pipeline, inline circulation pumps are preferred to use them as piping accessory.

3.7.1.6 Where the available NPSH is limited, such as when handling a saturated liquid, and the application calls for the use of centrifugal pump, the engineer may have to investigate the use of providing an inducer in place of the impeller nut in the case of end-suction pumps or a vertical canned suction-type centrifugal pump to gain adequate NPSH. In certain other cases the design may call for the installation of a pump immersed in the liquid to be handled and hence, the use of a vertical submerged type pump may be advantageous.

3.7.2 *Code Requirements*

The statutory codes of the regulatory bodies may impose certain additional requirements, which can affect both pump rating and construction. Such additional requirements may affect the selection.

3.7.3 *Liquid Characteristics*

Sometimes exceptionally severe service conditions based on liquid characteristics may rule out some classes of pumps at once. For example, the handling of liquids having high solid content will exclude the use of reciprocating pumps or pumps with close clearances. On the other hand, rotary-type pumps are suitable for viscous liquids and centrifugal pumps for both clean and clear liquids or liquids with high solid content. If it is undesirable for the process liquid to come in contact with the moving parts, diaphragm type pumps may have to be used. Centrifugal pumps are also suitable for handling viscous fluids and also handle liquids with solid contents. The corrosive liquids call for special material of construction for wetted parts of the liquids. For liquids to be handled in food industry needs material of construction having RoHS compliance for wetted parts.

3.7.4 Material

Materials of construction should be selected on the basis of service conditions. Indian Standards on various types of pumps, a list of which is given in Appendix A, give recommendations on suitable materials of construction.

- a) Following main aspects should be considered while selecting the material of construction;
- b) Liquid handled and its corrosion properties;
- c) Solids present in the liquid and their abrasiveness and wear and tear due to that;
- d) Temperature of liquid and effect of the same on corrosion rate of material and mechanical properties;
- e) Maximum discharge pressure of the liquid in the casing, thickness of the casing and feasibility of casting the same;
- f) Peripheral speed of the rotating parts: and
- g) For liquids to be handled in food industry needs special material of construction having RoHS compliance for wetted parts.

3.8 Selection of Prime Mover

3.8.1 Selection of prime mover is as important as selection of the pump. Depending on the available energy sources, pumps may be driven by electric motor, I.C. engines, steam engines, gas turbines, steam turbines, etc. In addition, they may be driven at constant speed or at variable speed.

3.8.2 Generally electric motors are used in constant speed service unless a hydraulic coupling gear box or other speed varying device like variable frequency drive is introduced in the system for varying the speed. I.C. engines are chosen because of non-availability of power, portability or loss of power backup requirements. Moreover, they can operate as constant speed prime mover as well as variable speed prime mover. For variable speed applications, steam turbines, eddy-current couplings, adjustable speed motors, fluid couplings, gears, and belts are frequently used.

3.8.3 In large complex installations where the equipment is to be operated continuously, the decision on the choice of the type of prime mover and variability of the pump speed should be based on the comparison of the total operating and capital costs for the pump system over the intended plant life for the several alternatives available. Variable speed operation would usually result in lower operating costs; however, the total capital cost of the driving equipment to accomplish this would frequently be higher than for constant speed pump.

3.9 Specifying the Pump

Reference may be made to the Indian Standards, a list of which is given in Appendix A.

ANNEX A

(Clause 2 and 3.9)

LIST OF REFERRED INDIAN STANDARDS

<i>IS No.</i>	<i>Title</i>
1520 : 1980	Horizontal centrifugal pumps for clear, cold, fresh water
1710 : 1989	Vertical Turbine Pumps - Specification (<i>third revision</i>)
5120 : 1970	Technical requirements for rotodynamic special purpose pumps (<i>first revision</i>)
5600 : 2002	Pumps - Sewage and drainage - Specification Pumps - Sewage and drainage - Specification (<i>first revision</i>)
5639 : 1970	Specification for pumps handling chemicals and corrosive liquids
5659 : 1970	Specification for pumps for process water
6536 : 1972	Specification for pumps for handling volatile liquids
6596 : 1972	Specification for pumps for handling paper stock
8034 : 1976	Submersible Pumpsets - Specification
8418 : 1999	Pumps - Centrifugal self priming - Specification (<i>first revision</i>)
8472 : 2019	Centrifugal regenerative pumps for clear, cold water - Specification (<i>second revision</i>)
9137 : 2019	Code for hydraulic performance acceptance tests for centrifugal, mixed and axial flow pumps — Class C (<i>first revision</i>)
9201 : 1987	Specification for pumps for handling slurry (<i>first revision</i>)