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Centrifugalne ļ rpalke - Priporoļ ila za pritrjevanje dotoļ nih in odtoļ nih cevi

Rotodynamic pumps - Recommendations for fitting of inlet and outlet on piping

Kreiselpumpen - Empfehlungen für Rohrleitungsanschlüsse an Ein-und Autrittstutzen

Pompes rotodynamiques - Recommandations pour les raccordements des tuyauteries d'aspiration et de refoulement

Ta slovenski standard je istoveten z: CEN/TR 13932:2009

ICS:

23.080	Ļ rpalke	Pumps

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Rotodynamic pumps - Recommendations for fitting of inlet and outlet on piping

Pompes rotodynamiques - Recommandations pour les raccordements des tuyauteries d'aspiration et de refoulement

Kreiselpumpen - Empfehlungen für Rohrleitungsanschlüsse an Ein-und Autrittstutzen

This Technical Report was approved by CEN on 13 October 2008. It has been drawn up by the Technical Committee CEN/TC 197.

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COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This document (CEN/TR 13932:2009) has been prepared by Technical Committee CEN/TC 197 “Pumps”, the secretariat of which is held by AFNOR.

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This document supersedes CR 13932:2000.

Introduction

The inlet and outlet piping of a pump almost always includes peculiarities or accessories (changes of cross-sectional area, elbows, connections, valves, filters, check valves, etc.). Particularly in the case of inlet piping, flow disturbances such as swirl, unbalance in the distribution of velocities and pressures and sudden variations in velocity are harmful to the hydraulic performance of the pump, its mechanical behaviour and its reliability.

This document cannot attempt to cover the almost infinite range of disturbances that may be encountered as well as all their types, geometries and possible combinations. In cases that are not dealt with below, the layout of the piping should be determined by mutual agreement between the parties in keeping with the spirit or a certain number of principles:

— straight lengths indicated in this document are adequate values in most cases but it is always beneficial, from a purely hydraulic point of view, to increase them. The optimum length is usually the result of a cost-benefit trade-off.

— the most hazardous disturbances are those which create a swirling flow as a result of several changes of direction in various planes, this swirl always takes a very long time to settle down, or disturbances which create a very marked unbalanced flow due to a sudden change in cross-sectional area.

— generally speaking, the higher the specific speed of a pump, the more sensitive it is to feed conditions. For this reason, especially strict requirements should be imposed in the case of an axial-flow pump.

In fact, the correct operation of a rotodynamic pump is closely linked to the features of the piping system in which it is fitted. The noise level of this system as well as any vibrations originating from turbulence or hydraulic shocks also depend on its layout as well as the choice and arrangement of components such as valves, filters, convergent pipes, divergent pipes, etc.

The following recommendations are intended to reduce the risk of incorrect operation of the pump and the system as far as possible. Under no circumstances can they guarantee perfect operation for several reasons:

— the need to make allowance for economic considerations which very often imposes deviation from the ideal arrangement and the risk of incorrect operation which this involves increases the greater such deviation becomes.

— the extremely complex influence on the recommended values of several factors which cannot be described in detail without complicating the implementation of these recommendations excessively. This is the reason why somewhat wide "average" values have been adopted even though they may sometimes lead to excessive precautions which may still sometimes nevertheless be inadequate.

The main factors in question are as follows:

— the type of pump (centrifugal, mixed flow, axial flow);

— the size and speed of the pump;

— the margin between the available "NPSHA" and the "NPSHR" required by the pump;

— the characteristics of the liquid (nature, viscosity, presence of dissolved gas or solids in suspension, etc.);

— the flow rate of the liquid.

The last two factors have a very marked effect on the behaviour of the system and on the measures to be taken in order to limit unwanted conditions.

1 Scope

This CEN Technical Report lays down stipulations relating to installation conditions for sudden change in section or direction (elbows, tee fittings, junctions) and the most widely used accessories at the inlet and outlet of pumps (valves and fittings) in order to minimise the effect of disturbances in the flow of liquid thereby created upstream and downstream from the pump and on the operation of the pump.

NOTE 1 The recommendations given in this document permit to solve a majority of the most current cases.

These recommendations relate to three aspects of installation:

- the fitting of the pump to pipework by convergent and divergent pipes;
- in the case of elbows, tees and branching, their direction with respect to the axis of the pump;
- the minimum clearances to be adhered to between a disturbing (elbow, valve, etc.) and the mounting flange of the pump.

This document applies to the installation of rot dynamic pumps (centrifugal, mixed flow and axial flow) fitted in piping. It applies to pumps having intake diameters equal to or less than 500 mm. The recommendations may be adapted in agreement with the pump manufacturer for intakes having dimensions exceeding 500 mm or for special applications. This document is not applicable to pumps of which the inlet is located in reservoirs, sumps or tanks and which will be dealt with in a subsequent standard.

The recommendations in this document are only valid under the following conditions:

- Newtonian fluids having a maximum viscosity of 2.10^{-4} m^2/s;
- occluded gas content at pumping temperature and inlet pressure not exceeding 2 % by volume for water and 4 % for other fluids;
- solids content (small particle size, such as sand) not exceeding 1 % by volume, nor 1 % by weight;
- in piping with diameters D_1 and D_2 (see Figure 11), flow rate velocity, should be in the following ranges:
  - 3 m/s to 5 m/s at inlet;
  - 4 m/s to 10 m/s at outlet.

NOTE 2 These flow rate velocity values are not optimal; they are limits which are not to be exceeded unless special precautions are taken.

NOTE 3 In all cases where these limits are exceeded, it is essential that the pipework design engineer consults the pump manufacturer before finalizing the installation drawings.

Even if conditions are well within the stated limits, it is highly advisable to adopt this approach sufficiently early to allow any modifications requested by the manufacturer to be made.

Many difficulties experienced in a pumping system actually originate from errors in the design and/or production of piping.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 593, *Industrial valves — Metallic butterfly valves*

EN 736-1:1995, *Valves — Terminology — Part 1: Definitions of types of valves*

EN 736-3:2008, *Valves — Terminology — Part 3: Definition of terms*

EN 1171, *Industrial valves — Cast iron gate valves*

EN 1983, *Industrial valves — Steel ball valves*

EN 1984, *Industrial valves — Steel gate valves*

EN 12334, *Industrial valves — Cast iron check valves*

EN 13397, *Industrial valves — Diaphragm valves made of metallic materials*

EN 13709, *Industrial valves — Steel globe and globe stop and check valves*

EN 13789, *Industrial valves — Cast iron globe valves*

EN 14341, *Industrial valves — Steel check valves*

EN ISO 9906, *Rotodynamic pumps — Hydraulic performance acceptance tests — Grades 1 and 2 (ISO 9906:1999)*

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*

3 Definitions

For the purposes of this document, the definitions of EN 736-1:1995 apply, and also the following which are in accordance with EN 736-3:2008.

3.1
full bore valves
valve with a flow section equal to or greater than 80 % of the section corresponding to the nominal inside diameter of the body end port

NOTE The nominal inside diameter of the body end for the particular valve type is specified in the corresponding product or fitness for purpose standard.

3.2
clearway valve
valve designed to have an unobstructed flow way to pass a theoretical sphere having a diameter not less than the body end port nominal inside diameter

NOTE The nominal inside diameter of the body end for the particular valve type is specified in the corresponding product or fitness for purpose standard.

3.3 reduced bore valve
valve with a flow section equal to or greater than 36 % of the section corresponding to the port nominal inside diameter of the body end port and which does not correspond to the full bore valve

NOTE The nominal inside diameter of the body end for the particular valve type is specified in the corresponding product or fitness for purpose standard.

4 Minimum installation precautions

4.1 Pipework components

4.1.1 Convergent - divergent pipes

4.1.1.1 Convergent transition section

4.1.1.1.1 Horizontal installation

For a horizontal installation, the configuration of the convergent transition section is usually non-symmetrical. Its top generating line should then be horizontal, so as to avoid the formation of pockets of air or gas. The angle (α) should not exceed 20° (see Figure 1).

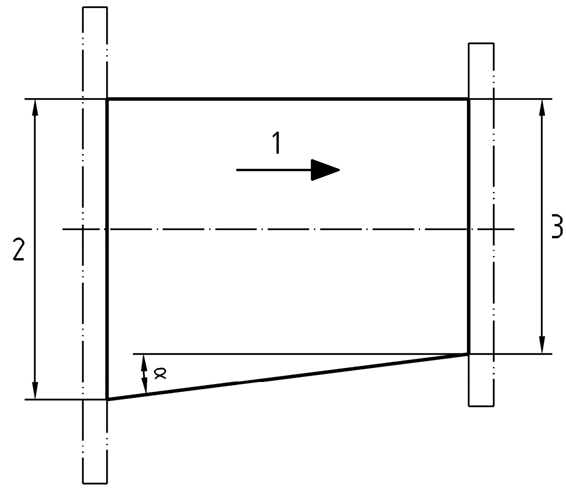
When the angle exceeds 20°, the fitting of the convergent to the pump intake should be made by means of a transition zone with a radius of at least ¼ of the pump inlet diameter.

However, when the degassing is carried out on the upstream side of the convergent transition section continuously:

— either naturally; or

— by means of a suitable device.

It will be possible to use a symmetrical convergent transition section as described in Clause 4.1.1.1.2.



Key

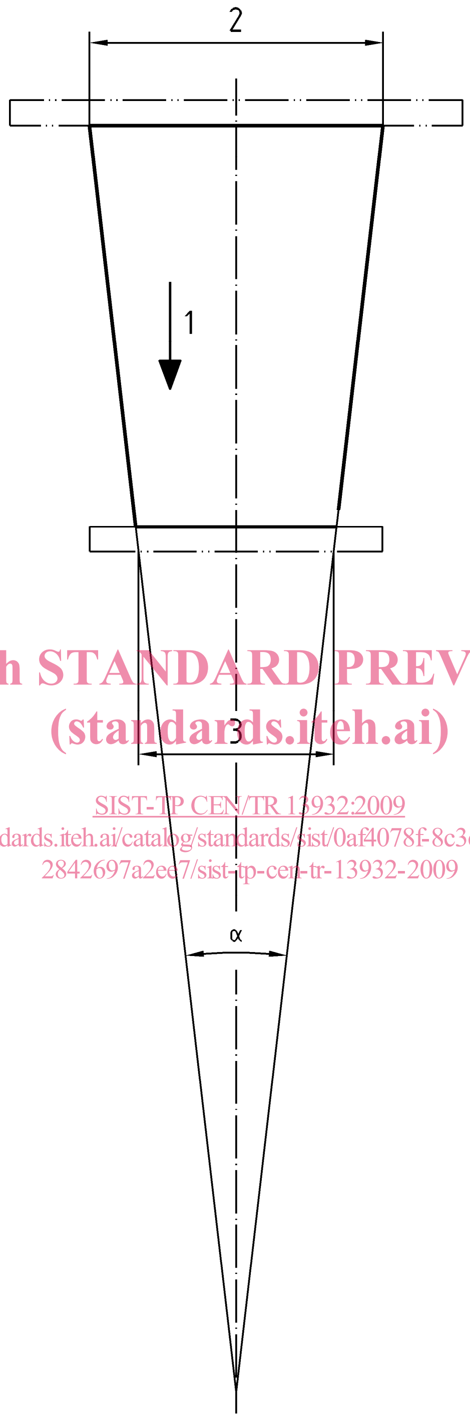
1 Direction of fluid flow
2 Diameter of the pipework inlet
3 Diameter of the pump inlet

Figure 1 — Non-symmetrical convergent transition section

NOTE In some cases, particularly when the pump incorporates an inducer, it is not recommended fitting a convergent transition section to the pump inlet. In this case, the inlet pipeline near the pump should be studied jointly between the pump manufacturer and those responsible for the installation.

4.1.1.1.2 Vertical installation

The configuration of the convergent transition section is symmetrical for a vertical installation (see Figure 2). The included angle (α) should not exceed 25°.



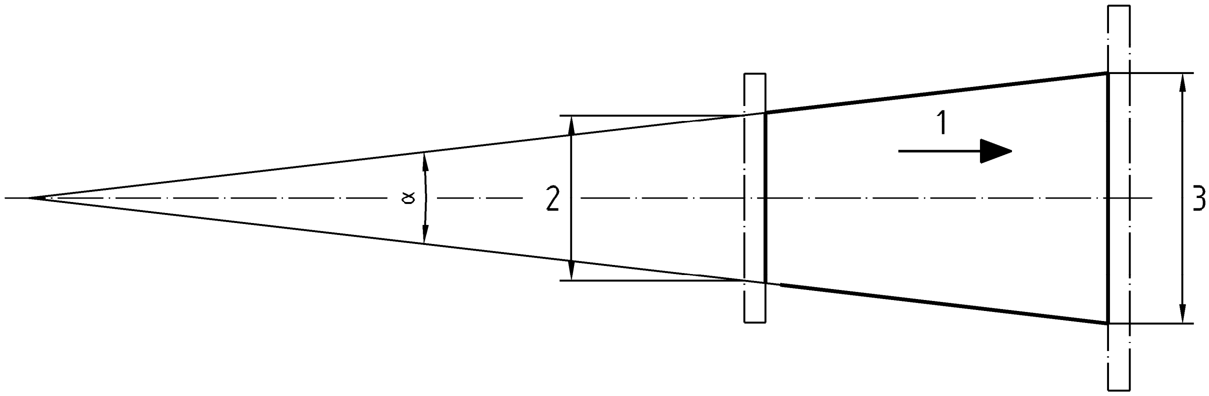
Key

1 Direction of fluid flow
2 Diameter of the pipework inlet
3 Diameter of the pump inlet

Figure 2 —Symmetrical convergent transition section

4.1.1.2 Divergent transition section

The configuration of the divergent transition section is usually symmetrical, irrespective of the installation (see Figure 3).



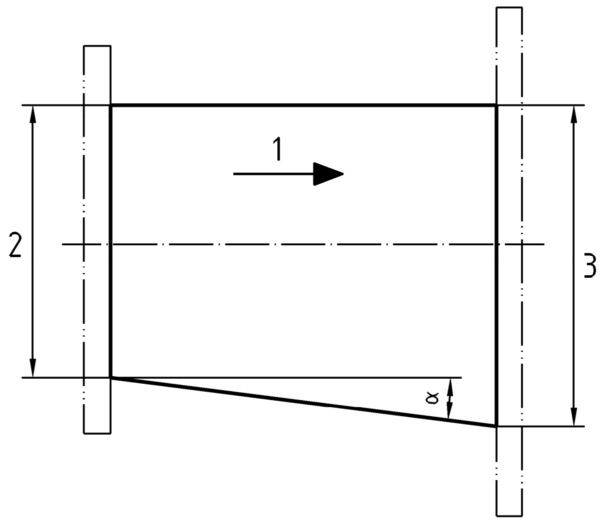
Key

1 Direction of fluid flow
2 Diameter of the pump outlet
3 Diameter of the pipework outlet

Figure 3 — Symmetrical divergent transition section

The include angle (α) for a divergent transition sections is recommended to be between 7° and 12° to avoid excessive energy losses.

In some special cases, "on-line" pumps for example, the non-symmetrical configuration of the divergent may be permitted with a maximum angle of 8° (see Figure 4).



Key

1 Direction of fluid flow
2 Diameter of pump
3 Diameter of pipework

Figure 4 — Non-symetrical divergent transition section