SLOVENSKI STANDARD
SIST EN 12723:2000

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Črpalke za tekočine - Splošni izrazi za črpalke in inštalacije - Definicije, količine, črkovni simboli in enote

Liquid pumps - General terms for pumps and installations - Definitions, quantities, letter symbols and units

Flüssigkeitspumpen - Allgemeine Begriffe für Pumpen und Pumpenanlagen - Definitionen, Größen, Formelzeichen und Einheiten

Pompes pour liquides - Termes généraux pour les pompes et installations - Définitions, grandeurs, symboles et unités

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23.080	Črpalke	Pumps

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EUROPEAN STANDARD

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English version

Liquid pumps - General terms for pumps and installations - Definitions, quantities, letter symbols and units

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This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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

Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 197 "Pumps", the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by November 2000, and conflicting national standards shall be withdrawn at the latest by November 2000.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard deals with terms, letter symbols and units related to the flow of liquids through rotodynamic and positive displacement liquid pumps and associated installations. It serves as a means of clarifying communications between the installation designer, manufacturer, operator and plant constructor.

The standard identifies the units in common usage but all further legal units may be used.

A definition of a liquid pump is included.

This standard deals solely with conditions described by positive values for the rate of flow and pump head. The definitions are set out showing firstly the most common form of a quantity followed by some frequently used variants. Other variants can be constructed and appropriate symbols evolved using the symbols and subscripts shown. Prefixes such as working ..., design ..., can be also applied to the defined quantities.

This standard is not concerned with terms, letter symbols and units referring to the component parts of rotodynamic and positive displacement pumps and installations.

Whenever possible symbols and definitions conform to those used in ISO 31 and ISO 1000, with further explanations where these are deemed appropriate. Some deviations have been incorporated for reasons of consistency.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ISO 31, *Quantities, units and symbols*

ISO 1000, *SI units and recommendations for the use of their multiples and of certain other units*

3 General terms and definitions for pumps and installations

3.1 List of symbols and quantities

Where units in formulars are given, these units shall be used. For all other units care shall be taken to use consistant units.

3.1.1 Alphabetical list of symbols

Symbol	Quantity	Units
A	Area	m^2
E	Energy	J
e	Overall uncertainty, relative value	[%]
F	Force	N
f	Frequency	s^{-1}, Hz
g	Acceleration due to gravity	m/s^2
H	Head	m
K	Type number	1/s
k	Equivalent uniform roughness	m
l	Length	m
m	Mass	kg
M	Moment	Nm
n	Speed of rotation, stroke frequency	s^{-1}, min^{-1}, r/s, r/min, stroke/s
$(NPSH)$	Net positive suction head	m
p	Pressure	bar
P	Power	W, kW
q	Mass rate of flow	kg/h
Q	Volume rate of flow	m^3/h
Re	Reynolds number	pure number
tol	Tolerance, relative value	[%]
t	Time	s, h
T	Temperature thermodynamic	K
ϑ	Temperature Celsius	°C
U	Mean velocity	m/s
v	Local velocity	m/s
V	Volume	m^3
y	Specific energy	J/kg
z	Height above reference plane	m
η	Efficiency	–
λ	Pipe friction loss coefficient	pure number
ρ	Density	kg/m^3
υ	Kinematic viscosity	m^2/s
μ	Dynamic viscosity	$N{\cdot}s/m^2$
ω	Angular velocity	rad/s
Additional symbols used for positive displacement pumps		
K	Bulk modulus	m^3/kg
(Mi)	Miller number	–
$(NPIP)$	Net positive inlet pressure	bar
w	Number of pistons or other displacement elements	–
RL	Rod load	N, MN
β	Compressibility	–
s	Length of stroke	m

3.1.2 Alphabetical list of quantities

Quantity	Symbol	Units
Acceleration due to gravity	g	m/s^2
Angular velocity	ω	rad/s
Area	A	m^2
Density	ρ	kg/m^3
Dynamic viscosity	μ	$N \cdot s/m^2$
Efficiency	η	–
Energy	E	J
Equivalent uniform roughness	k	m
Force	F	N
Frequency	f	s^{-1}, Hz
Head	H	m
Height above reference plane	z	m
Kinematic viscosity	υ	m^2/s
Length	l	m
Local velocity	v	m/s
Mass	m	kg
Mass rate of flow	q	kg/h
Mean velocity	U	m/s
Moment	M	Nm
Net positive suction head	$(NPSH)$	m
Overall uncertainty, relative value	e	[%]
Pipe friction loss coefficient	λ	pure number
Power	P	W, kW
Pressure	p	bar
Reynolds number	Re	pure number
Specific energy	y	J/kg
Speed of rotation, stroke frequency	n	s^{-1}, min^{-1}, r/s, r/min, stroke/s
Temperature Celsius	ϑ	°C
Temperature thermodynamic	T	K
Time	t	s, h
Tolerance, relative value	tol	[%]
Type number	K	1/s
Volume	V	m^3
Volume rate of flow	Q	m^3/h
Additional quantities used for positive displacement pumps		
Bulk modulus	K	m^3/kg
Compressibility	β	–
Length of stroke	s	m
Miller number	(Mi)	–
Net positive inlet pressure	$(NPIP)$	bar
Number of pistons or other displacement elements	w	–
Rod load	RL	N, MN

NOTE 1: Acceleration due to gravity can be taken usually to be 9,81 m/s^2, but for particularly exact investigations a local variant may need to be considered.

NOTE 2: All pressures as shown are gauge pressures except atmospheric and vapour pressures which are taken as absolute pressures: $p_{abs} = p_x + p_{amb}$

Where: p_{abs} = absolute pressure; p_x = gauge pressure; p_{amb} = atmospheric pressure

3.2 List of letters, figures and symbols used as subscripts

The subscript can be used to denote the quantity value at a particular place i.e. the observed point, and/or a particular set of conditions.

NOTE: Observed point is the position indicated by a subscript at which the particular value of a quantity is referred to in a definition.

Subscript	Designation	Example	
0	At zero rate of flow	H_0	Shut-off head
1	Inlet side (suction)	p_1	Pressure at pump inlet
1'	Inlet side measuring point	$p_{1'}$	Pressure at measuring point on pump inlet
2	Outlet side (discharge)	p_2	Pressure at pump outlet
2'	Outlet side measuring point	$p_{2'}$	Pressure at measuring point on pump outlet
3, 4, ...	Intermediate take-off points	p_3	Pressure at intermediate take-off point
3', 4', ...	Intermediate measuring point	$p_{3'}$	Pressure at intermediate measuring point
A	Relating to the installation	p_{A1}	Pressure at measuring point on installation inlet
abs	Absolute	p_{abs}	Absolute pressure
amb	Ambient	t_{amb}	Ambient temperature
all	Allowable	n_{all}	Rotating speed allowed
ax	axial	F_{ax}	Axial load of pump rotor
B	Balancing	Q_B	Balancing rate of flow
C	Relating to pump casing	$p_{all\,w\,c}$	Maximum allowable casing working pressure
c	Critical	n_c	Critical speed
D	*(NPSH)* datum plane	z_D	Height of datum plane above reference plane
d	Design	Q_d	Design flow
dry	Dry	$n_{c\,dry}$	Dry critical speed
G	Guaranteed	Q_G	Guarantered rate of flow
gr	Relating to pump unit	η_{gr}	Overall efficiency
h	Hydraulic	η_h	Hydraulic efficiency
int	Internal	η_{int}	Internal efficiency
J	Losses	H_J	Loss in head
L	Leak	Q_L	Leakage rate of flow
m	Relating to mechanical	P_{Jm}	Pump mechanical power losses
max	Maximum	n_{max}	Maximum speed of rotation
min	Minimum	n_{min}	Minimum speed of rotation
mot	Relating to motor	P_{mot}	Motor power input
M	Manometric	H_M	Head shown on gauge
n	Normal	Q_n	Normal flow
N	Nominal	p_N	Basic design pressure

3.2 List of letters, figures and symbols used as subscripts (Continued)

Subscript	Designation	Example	
op	Operating	Q_{op}	Operating flow
opt	At best efficiency duty point	H_{opt}	Optimum head
r	Rated	Q_r	Rated flow
sch	Peak point of a performance curve	H_{sch}	Head at peak point
s	Specific	n_s	Specific speed
sp	Specified	n_{sp}	Specified speed
ss	Suction specific	n_{ss}	Suction specific speed
stable	Stable	$Q_{min\ stable}$	Minimum continous stable flow
stat	Static	H_{stat}	Static head
S	Relating to shaft seal	$p_{S\ op}$	Maximum dynamic sealing pressure
T	Transmitted, Torque	M_T	Transmitted moment = Torque
t	Total	H_t	Total head at point x
test	Test	p_{test}	Hydrostatic test pressure
thermal	Thermal	$Q_{min\ thermal}$	Minimum continuous thermal flow
thr	Throat	U_{thr}	Mean velocity at throat
u	Useful	P_u	Useful power output
v	Vapour	p_v	Vapour pressure
w	Working	p_w	Working pressure
x	Observed point to be identified	H_x	Head at observed point to be identified by replacing x with subscript
X	Horizontal direction	F_X	Force in horizontal direction such as along the line of shaft of a horizontal pump
Y	Vertical direction at right angle to X	M_Y	Moment of force in vertical direction at right angle to X such as along the line of shaft of a vertical pump
Z	Perpendicular direction to X and Y	F_Z	Force perpendicular to X and Y

3.2 List of letters, figures and symbols used as subscripts (Concluded)

Additional subscripts used for positive displacement pumps			
Subscript	**Designation**	**Example**	
a	Accumulation	$p_{RV\,a}$	Relief valve accumulation pressure
b	Back	$p_{RV\,b}$	Relief valve back pressure
DR	Relating to dampener	$p_{1\,DR}$	Inlet dampener pre-charge pressure
F	Relating to foundation	z_F	Height of foundation above reference plane
FE	Related to the pumping element	A_{FE}	Pumping chamber area(s)
g	Geometrical	Q_g	Geometrical flow rate
PI	Relating to piston	U_{PI}	Mean velocity of piston
PL	Relating to plunger	U_{PL}	Plunger mean velocity
PR	Relating to piston rod	F_{PR}	Force in piston rod
pul	Pulsating	$p_{2\,pul}$	Outlet pressure pulsations
rs	Reseat	$p_{2\,RV\,rs}$	Relief valve reseat pressure
RV	Relating to relief valve	z_{RV}	Height of relief valve
sl	Slip	Q_{sl}	Slip flow
st	Set	$p_{RV\,st}$	Relief valve set pressure
sw	Swept	V_{sw}	Swept volume
VST	Relating to valve seat	A_{VST}	Valve seat area
VSP	Relating to valve spill	A_{VSP}	Valve spill area

NOTE 1: A hyphen (-) between two subscripts indicates the difference between the values at the points identified by the subscripts but does not imply which is the greater:

e.g. $z_{1\text{-}2} = z_2 - z_1$ or $= z_1 - z_2$

NOTE 2: Throughout this standard the subscript, x, is used to indicate where a subscript should be selected and substituted for x in order to fully identify the observed point to which the value of the quantity refers, e.g the total head at pump inlet = H_{tx} at pump inlet = H_{t1}

3.3 General definitions

3.3.1 General terms

	Term	Definition
3.3.1.1	Pump	In general pumps are defined as being terminated by their inlet and outlet connections as well as in general their shaft ends.
3.3.1.2	Pump unit	A pump unit comprises the pump above, the driver including transmission elements, baseplate and any auxiliary equipment.
3.3.1.3	Installation	The arrangement of pipes, supports, foundations, controls, drives, etc., into which the pump or pump unit is connected in order to achieve the service for which it was acquired.
3.3.1.4	System	Those parts of an installation which together with the pump determine the functional performance of the installation.
3.3.1.5	Conditions	All parameters (for example temperatures, pressures) determined by the application and the pumped liquid which affect the function and performance of the system.

3.3.2 Prefixes usable with some terms in this standard

	Term	Definition
3.3.2.1	Design	Values used in the design of a pump for the purpose of determining the performance, the minimum permissible wall thickness and physical characteristics of the different parts of the pump. NOTE: Use of the word design in any term (such as design pressure, design power, design temperature or design speed) should be avoided in the purchaser's specifications. This terminology should be used only by the equipment designer and manufacturer.
3.3.2.2	Rated	A specified performance selected to ensure that the operating performance will be achieved by the pump or pump unit when installed.
3.3.2.2.1	Rated conditions	Conditions (driver excluded) that define the guarantee values necessary to meet all defined operating conditions, taking into account any necessary margins.
3.3.2.3	Operating	One or several operating settings for which the pump is intended to be used. NOTE: The operating values should be equal or lower than maximum allowable working values.
3.3.2.3.1	Operating conditions	All parameters (for example, operating temperature, operating pressure) determined by a given application and pumped liquid. NOTE: These parameters will influence the type and materials of construction.
3.3.2.4	Pressure-temperature rating	Pressure-temperature limit of a component at given design and material (see figure A.2).
3.3.2.5	Normal	The conditions at which usual operation is expected.
3.3.2.6	Allowable	The limiting values and/or ranges of conditions for a pump as built, owing to the material, and the design and execution.
3.3.2.7	Working	Conditions existing at the moment that an event is noted or a quantity is measured.
3.3.2.7 (altern.)	Allowable working	The limiting values and/or ranges of conditions at which the pump unit can be operated, owing to the material, and the design and execution.
3.3.2.8	Test	Terms which describe the characteristics of the pump, or the fluid or the conditions which exist during an examination.
3.3.2.9	Nominal	An appropriate rounded value of a magnitude to designate a component, a unit or a device.

3.4 Rates of flow

Concerning quantities of liquid pumped.

	Term	Symbol	Unit	Definition
3.4.1	Mass rate of flow	q	kg/s kg/h t/h	The mass of liquid discharged from the outlet area of the pump in a given time. NOTE: Losses inherent to the pump i.e. discharge necessary for a) the hydraulic balancing of axial thrust; b) cooling of bearings of the pump; c) liquid seal to the packing; d) leakage from fittings, internal leakage, etc. should not to be reckoned in the mass rate of flow. Quantities used for other purposes, such as: e) cooling of motor bearings; f) cooling of gearbox (bearings, oil cooler), etc. should be reckoned in the mass rate of flow, if they are taken from a point before the flow measuring section. Whether and how these flows should be taken into account depends upon the location of their source and relationship to the flow-measuring section.
3.4.2	Rate of flow	Q	m^3/s m^3/h l/s l/h	The volume rate of flow corresponding to the mass rate of flow given by the equation: $Q = \frac{q}{\rho}$ NOTE: This symbol, Q, may be used also to designate the volume rate of flow occurring at any other observed point indicated by a subscript.
3.4.2.1	Optimum rate of flow	Q_{opt}		Rate of flow at the point of best efficiency.
3.4.2.2	Rated flow	Q_r		Rate of flow at the guarantee point taking into account any necessary margin.
3.4.2.3	Normal flow	Q_n		Rate of flow at which usual operation is expected.
3.4.2.4	Maximum flow	Q_{max}		Greatest rate of flow which is expected at operating conditions.
3.4.2.5	Minimum flow	Q_{min}		Smallest rate of flow which is expected at operating conditions.