AN AMERICAN NATIONAL STANDARD

Specification for Vertical In-Line Centrifugal Pumps for Chemical Process

ASME B73.2M-1991

(REVISION OF ANSI/ASME B73.2M-1984)

The American Society of Mechanical Engineers

345 East 47th Street, New York, N.Y. 10017

Copyright by the AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Mon Jun 12 09:03:31 1995

Date of Issuance: August 16, 1991

This Standard will be revised when the Society approves the issuance of a new edition. There will be no addenda or written interpretations of the requirements of this Standard issued to this edition.

ASME is the registered trademark of The American Society of Mechanical Engineers.

This code or standard was developed under procedures accredited as meeting the criteria for American National Standards. The Consensus Committee that approved the code or standard was balanced to assure that individuals from competent and concerned interests have had an opportunity to participate. The proposed code or standard was made available for public review and comment which provides an opportunity for additional public input from industry, academia, regulatory agencies, and the public-at-large.

ASME does not "approve," "rate," or "endorse" any item, construction, proprietary device, or activity.

ASME does not take any position with respect to the validity of any patent rights asserted in connection with any items mentioned in this document, and does not undertake to insure anyone utilizing a standard against liability for infringement of any applicable Letters Patent, nor assume any such liability. Users of a code or standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

Participation by federal agency representative(s) or person(s) affiliated with industry is not to be interpreted as government or industry endorsement of this code or standard.

ASME accepts responsibility for only those interpretations issued in accordance with governing ASME procedures and policies which preclude the issuance of interpretations by individual volunteers.

No part of this document may be reproduced in any form,
in an electronic retrieval system or otherwise,
without the prior written permission of the publisher.

Copyright © 1991 by
THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
All Rights Reserved
Printed in U.S.A.

Copyright by the AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Mon Jun 12 09:03:31 1995

FOREWORD

(This Foreword is not part of ASME B73.2M-1991.)

The vertical in-line style of centrifugal pump was introduced for chemical process use. These pumps have certain advantages, which have led to growing acceptance of this configuration for chemical process applications. In January 1969, in response to this interest, the Manufacturing Chemists Association (MCA) requested that the American National Standards Institute (ANSI) develop a standard. In 1971 the scope of B73 was expanded to include vertical in-line pumps, using the MCA draft of February 1971 as a basis.

American National Standard B73.2 was developed and was approved by the B73 Standards Committee; final approval by the American National Standards Institute was granted on April 21, 1975.

Shortly thereafter, the American National Standards Committee B73 undertook to revise the standard, and as a result new information on critical speed, bearing housing design, vibration, bearing frame adapter, and bearings was introduced. The 1984 edition included, for the first time, Appendix information that covers documentation of pump and driver outline drawing, vertical in-line pump data sheet, mechanical seal drawing, stuffing box piping plan, and cooling/heating piping plans.

That edition was approved by letter ballot of the B73 Main Committee on April 25, 1983. Following acceptance by the Sponsor, the revision was referred to the American National Standards Institute for designation as an American National Standard. This was granted on March 23, 1984.

In 1986, the Committee began to discuss revisions that resulted in changes to the section on jackets. Additionally, the information on stuffing box and seal chamber was expanded. Modifications have also been made to the Appendix information drawings and plans.

These revisions were approved by the B73 Committee. Following B73 approval, the proposal was submitted to the American National Standards Institute for recognition as an American National Standard. This approval was granted on January 22, 1991.

Suggestions for improvement in this Standard will be welcome and should be sent to the American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, NY 10017.

Copyright by the AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Mon Jun 12 09:03:31 1995

ASME STANDARDS COMMITTEE B73
Chemical Standard Pumps

(The following is the roster of the Committee at the time of approval of this Standard.)

OFFICERS

J. A. Reynolds, *Chairman*
R. McGinnis, *Secretary*

COMMITTEE PERSONNEL

W. Adams, Durametallic Corp., Kalamazoo, Michigan
A. Budris, Dresser Industries, Harrison, New Jersey
F. Buse, Ingersoll-Rand, Phillipsburg, New Jersey
R. Cerza, *Alternate,* Goulds Pumps, Inc., Seneca Falls, New York
G. Clasby, Duriron Co., Dayton, Ohio
R. Dolman, Newark, Delaware
R. Hart, E.I. DuPont de Nemours & Co., Wilmington, Delaware
P. Lahr, Goulds Pumps, Inc., Seneca Falls, New York
R. Monroe, Monsanto Co., St. Louis, Missouri
J. Raba, National Electrical Manufacturers Association, Washington, D.C.
C. Ramsey, Dow Chemical Co., Freeport, Texas
R. Renson, John Crane, Inc., Larchmont, New York
J. Reynolds, Union Carbide Corp., South Charleston, West Virginia
K. Schoenherr, Algonquin, Illinois
J. Swalley, *Alternate,* E.I. DuPont de Nemours & Co., Wilmington, Delaware

Copyright by the AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Mon Jun 12 09:03:31 1995

CONTENTS

Foreword iii
Standards Committee Roster v

1 Scope 1
2 Alternative Design 1
3 Nomenclature and Definitions 1
4 Design and Construction Features 1
5 General Information 12
6 References 12

Figures
1 Cylindrical Seal Chamber 5
2 Tapered Seal Chamber 6
3 Stuffing Box 7
4 Face Runout 8
5 Register Concentricity 8
6 Shaft Sleeve Runout 8

Tables
1 Pump Dimensions 2
2 Nominal Shaft Extension and Mounting Dimensions for Vertical Solid Shaft P-Base In-Line Pump Motors 9
3 Motor Horsepower Selection 11

Appendix
A Documentation 15

Figures
A1 Pump and Driver Outline Drawing 17
A2 Mechanical Seal Piping Plans 20
A3 Cooling and Heating Piping Plans 22
A4 Typical Seal Arrangements 23

Form
A1 Centrifugal Pump Data Sheet 18

Copyright by the AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Mon Jun 12 09:03:31 1995

SPECIFICATION FOR VERTICAL IN-LINE CENTRIFUGAL PUMPS FOR CHEMICAL PROCESS

1 SCOPE

This Standard covers motor-driven centrifugal pumps of vertical shaft, single stage design with suction and discharge nozzles in-line. It includes dimensional interchangeability requirements and certain design features to facilitate installation and maintenance. It is the intent of this Standard that pumps of the same standard dimension designation, from all sources of supply, shall be interchangeable with respect to mounting dimensions and size and location of suction and discharge nozzles (see Table 1).

2 ALTERNATIVE DESIGN

Alternate designs will be considered, provided they meet the intent of this Standard and cover construction and performance which are equivalent to and otherwise in accordance with these specifications. All deviations from these specifications shall be described in detail.

3 NOMENCLATURE AND DEFINITIONS

3.1 Source

All nomenclature and definitions of pump components shall be in accordance with the Hydraulic Institute Standards.

3.2 In-Line Pump

An in-line pump is a pump whose driving unit is supported exclusively by the pump, and whose suction and discharge connections have a common centerline that intersects the shaft axis.

4 DESIGN AND CONSTRUCTION FEATURES

4.1 Pressure and Temperature Limits

4.1.1 Pressure Limits. The design pressure of the casing, including stuffing box and gland, shall be at least as great as the pressure–temperature rating of ASME/ANSI B16.1 Class 125 or ASME/ANSI B16.5 Class 150 flanges for the material used. The pressure–temperature rating for cast ductile iron shall be the same as for cast carbon steel. Casing, covers, and jackets shall be designed to withstand a hydrostatic test at 1.5 times the maximum design pressure for the part and the material of construction used (see para. 5.2.1).

4.1.2 Temperature Limits. Pumps should be available for operating temperatures up to 260°C (500°F). Cast iron shall be limited to 150°C (300°F) maximum. Jacketing and other modifications may be required to meet the operating temperature.

4.1.3 Statement. Pressure–temperature limitations shall be stated by the pump manufacturer.

4.2 Flanges

Suction and discharge nozzles shall be flanged, with flange dimensions conforming to ASME/ANSI B16.1 Class 125 cast iron or ASME/ANSI B16.5 Class 150 steel standards as to bolt circle, and number and size of bolt holes. Flanges shall be flat-faced at the full raised-face thickness (minimum) called for in ANSI standards for the material of construction. Bolt holes shall straddle the centerline. As an option, Class 250 cast iron flanges per ASME/ANSI B16.1 or Class 300 flanges per ASME/ANSI B16.5, except flat-faced at full thickness, subject to the manufacturer's casing pressure–temperature limitations, may be offered. SD dimensions shall be the same for all class flanges (see Table 1).

4.3 Casing

4.3.1 Drain Connection Boss(es). Pump casing shall have cast boss(es) to provide for drain connection(s). Boss size shall accommodate ½ in. NPT minimum. Drilling and tapping of the boss(es) is optional.

Copyright by the AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Mon Jun 12 09:03:31 1995

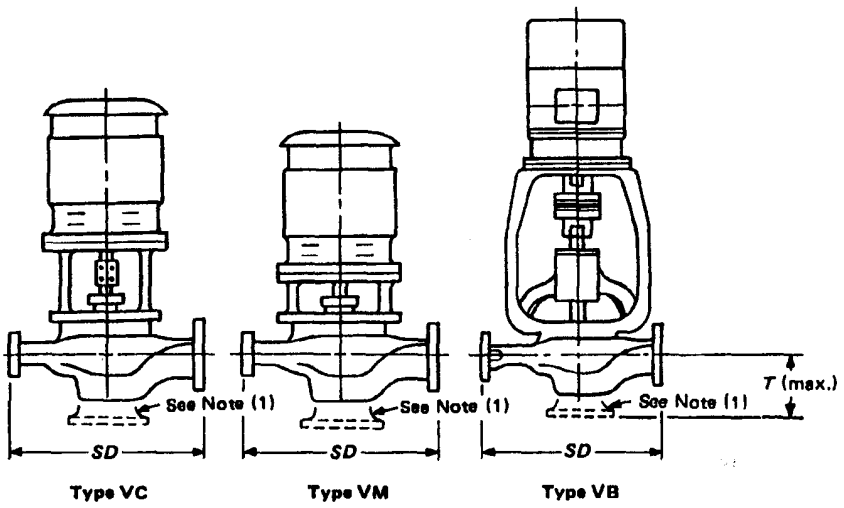


TABLE 1 PUMP DIMENSIONS

Dimensions, mm					Dimensions, in.				
Standard Pump Designation [Note (2)]	Metric Flange Sizes		*SD* +2.5 −2.0	*T* Maximum	Standard Pump Designation [Note (2)]	ANSI 125, 150, 250, or 300 Flange Sizes		*SD* +0.10 −0.08	*T* Maximum
	Suction	Discharge				Suction	Discharge		
VC, VB, VM					VC, VB, VM				
50-40-380	50	40	380	175	2015/15	2	1½	14.96	6.89
50-40-430	50	40	430	175	2015/17	2	1½	16.93	6.89
50-40-480	50	40	480	175	2015/19	2	1½	18.90	6.89
80-40-380	80	40	380	200	3015/15	3	1½	14.96	7.87
80-40-480	80	40	480	200	3015/19	3	1½	18.90	7.87
80-40-610	80	40	610	200	3015/24	3	1½	24.02	7.87
80-50-430	80	50	430	200	3020/17	3	2	16.93	7.87
80-50-510	80	50	510	200	3020/20	3	2	20.08	7.87
80-50-610	80	50	610	200	3020/24	3	2	24.02	7.87
100-80-560	100	80	560	225	4030/22	4	3	22.05	8.86
100-80-635	100	80	635	225	4030/25	4	3	25.00	8.86
100-80-710	100	80	710	225	4030/28	4	3	27.95	8.86
150-100-610	150	100	610	250	6040/24	6	4	24.02	9.84
150-100-710	150	100	710	250	6040/28	6	4	27.96	9.84
150-100-760	150	100	760	250	6040/30	6	4	29.92	9.84

NOTES:
(1) Optional separate pedestal.
(2) Pump designation defines design, flange sizes, and *SD* dimension (e.g., VC, VB 50-40-380).

Copyright by the AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Mon Jun 12 09:03:31 1995

4.3.2 Gage Connection Bosses. The suction and discharge nozzles shall have bosses for gage connections. Boss size shall accommodate ¼ in. NPT minimum, ½ in. NPT preferred. Drilling and tapping of the bosses is optional.

4.3.3 Support. The casing shall be designed to be supported by the suction and discharge flanges alone when mounted with the shaft in the vertical position; however, all casings shall be designed to accommodate an optional auxiliary support.

4.3.4 Disassembly. The complete rotating element shall be removable for inspection and maintenance without disturbing the suction or discharge pipe connections. Tapped holes for jackscrews, or equivalent means, shall be provided to facilitate disassembly of the casing and stuffing box cover and to avoid the necessity of drive wedges or prying implements.

4.3.5 Jackets. Jackets for heating or cooling the casing, stuffing box, or seal chamber are optional. Jackets shall be designed for a minimum operating pressure of 690 kPa gage (100 psig) at 170°C (340°F). Heating jackets may be required for jacket temperatures to 260°C (500°F) with a corresponding reduction in pressure. Connections shall be ½ in. NPT minimum.

Jacket inlet and outlet connections shall be identified by casting or stamped designations, J-In and J-Out, immediately adjacent to the connection.

4.3.6 Gasket(s). The casing-to-cover gasket(s) shall be confined on the atmospheric side to prevent blowout.

4.4 Impeller

4.4.1 Types. Impellers of open, semiopen, and closed designs are optional.

4.4.2 Adjustment. Means for external adjustment of the impeller axial clearance shall be provided if adjustment is required by the design.

4.4.3 Balance. All impellers shall be single plane spin balanced as a minimum. However, when the ratio of the maximum outside diameter divided by the width at the periphery including the shroud(s) is less than six, a two-plane spin balance may be required.

4.4.4 Attachment. The impeller may be keyed or threaded to the shaft with rotation to tighten. Shaft threads and keyways shall be protected so they will not be wetted by the pumped liquid.

4.5 Shaft

4.5.1 Diameter. The shaft or sleeve diameter through the stuffing box or seal chamber shall be sized in increments of 3.2 mm (⅛ in.) from 25 mm (1 in.) minimum diameter. To provide for the use of mechanical seals, the tolerance on shaft diameter through the seal chamber shall not exceed nominal to minus 0.05 mm (0.002 in.).

4.5.2 Finish. Surface finish of the shaft or sleeve through the stuffing box or seal chamber and at rubbing contact bearing housing seals shall not exceed an arithmetic roughness average of 0.8 μm (32 μin.), unless otherwise required for the mechanical seal.

4.5.3 Runout. Shaft runout shall be limited as follows:

(a) shaft rotated on centers: 0.025 mm (0.001 in.) full indicator movement (FIM) reading at any point;

(b) outside diameter of shaft or removable sleeve in pump: 0.05 mm (0.002 in.) full indicator movement at the gland end of stuffing box, or seal chamber.

4.5.4 Deflection. Dynamic shaft deflection at the impeller centerline shall not exceed 0.13 mm (0.005 in.) at maximum load.[1]

4.5.5 Running Clearances. Running clearance must be sufficient to prevent internal rubbing contact.

4.5.6 Critical Speed. The first lateral critical speed of the rotating assembly shall be at least 120% of the maximum operating speed.

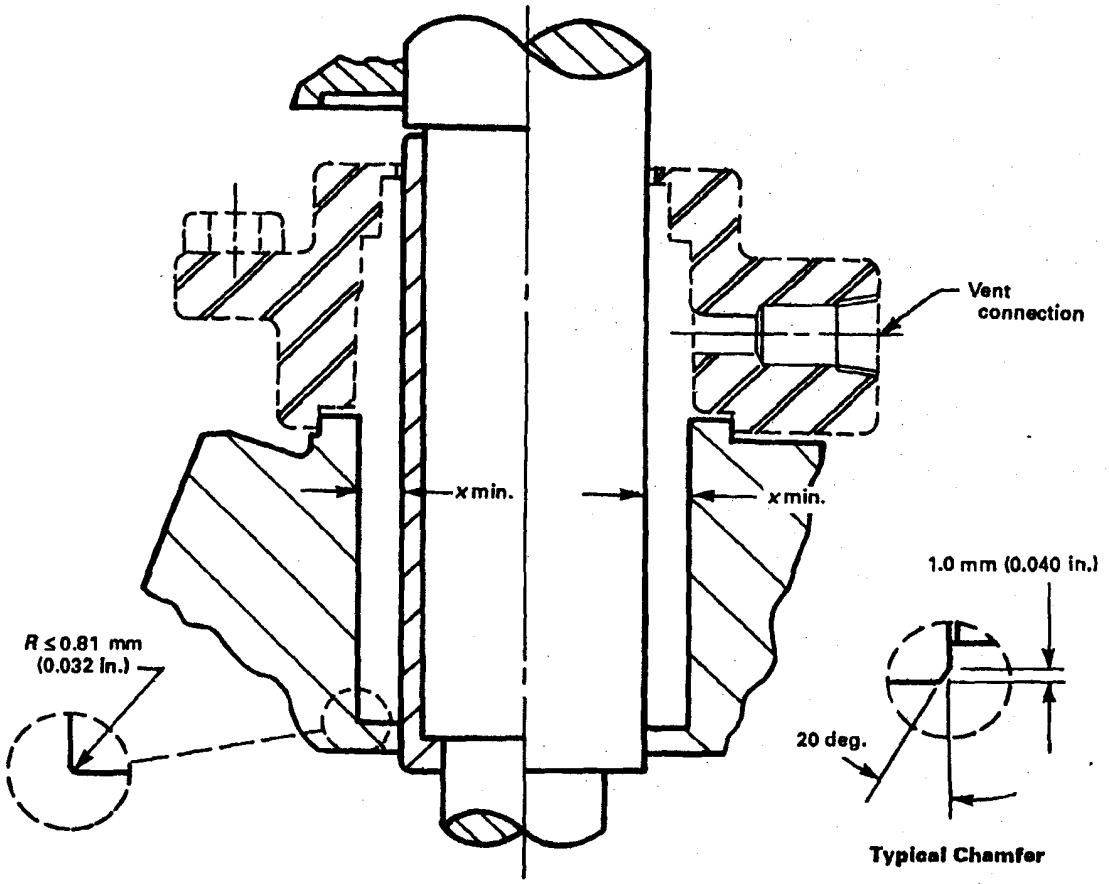
4.5.7 Fillets and Radii. All shaft shoulder fillets and radii shall be made as large as practical and finished to reduce additional stress risers.

4.6 Shaft Sealing

4.6.1 Design. Two basic types of sealing covers shall be offered, one called a seal chamber and a second called a stuffing box. The seal chamber is designed to accommodate mechanical seals only and can be of several designs for various types of seals. The design includes a separate gland plate where required. The stuffing box is intended for packing but

[1] *Maximum load* for deflection calculation is defined as the maximum radial hydraulic load on the contract impeller at any point on its curve based upon contract specific gravity or 1.0, whichever is higher. Consult manufacturer when liquid specific gravity exceeds 1.0.

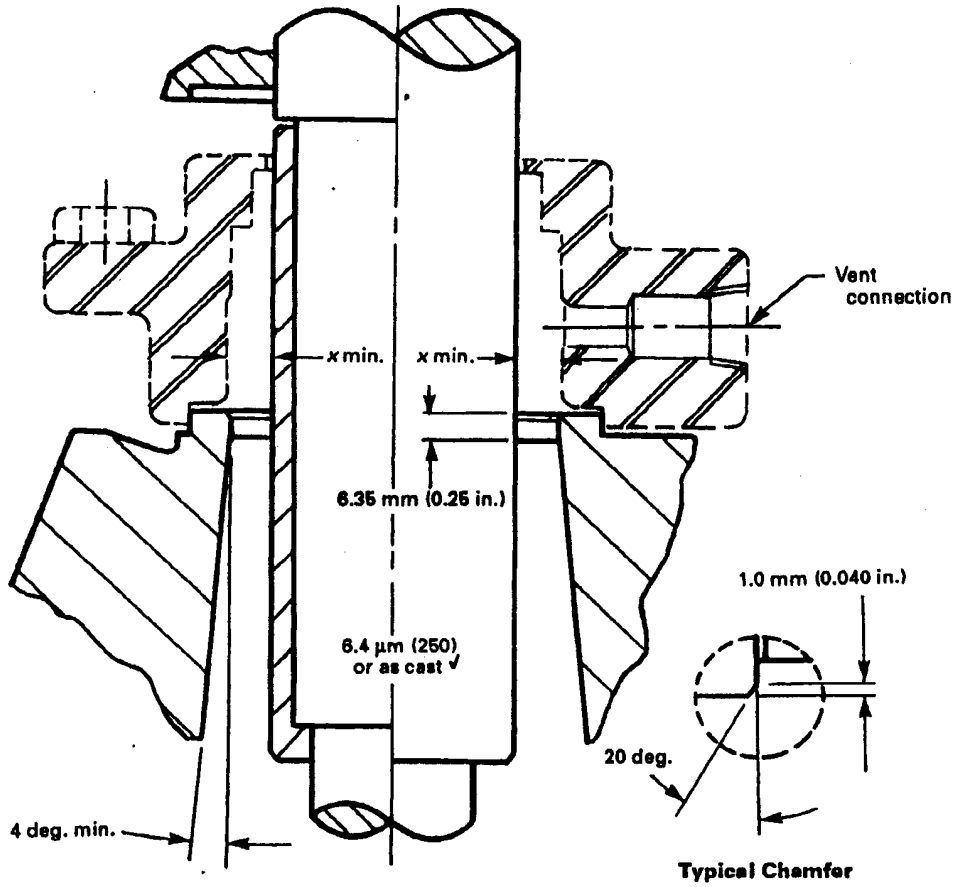
Copyright by the AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Mon Jun 12 09:03:31 1995



Shaft or Sleeve Diameter	Radial Clearance x Minimum
Up to 38 mm (1.5 in.)	x = 19 mm (0.750 in.)
More than 38 mm (1.5 in.)	x = 22.2 mm (0.875 in.)

FIG. 1 CYLINDRICAL SEAL CHAMBER

Copyright by the AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Mon Jun 12 09:03:31 1995



Shaft or Sleeve Diameter	Radial Clearance x Minimum
Up to 38 mm (1.5 in.)	x = 19 mm (0.750 in.)
More than 38 mm (1.5 in.)	x = 22.2 mm (0.875 in.)

FIG. 2 TAPERED SEAL CHAMBER

Copyright by the AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Mon Jun 12 09:03:31 1995