ASME B73.1-2020

(Revision of ASME B73.1-2012)

# Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process



AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

Two Park Avenue • New York, NY • 10016 USA

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The American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990

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# FOREWORD

In 1955, the Standards Committee on Centrifugal Pumps for Chemical Industry Use, B73, undertook the development of centrifugal pump standards to meet the needs of the chemical industry. Although the Standards Committee had not completed its assignment, the work of one of its task forces resulted in the development of a de facto standard that was published by the Manufacturing Chemists Association in 1962 as an American Voluntary Standard (AVS). More than a dozen manufacturers of chemical process pumps marketed pumps conforming with the AVS.

In 1965, the Hydraulic Institute published a tentative standard similar in content to the AVS, but updated certain portions. Although the Hydraulic Institute Tentative Standard reflected more nearly the current practice of manufacturers and users, it was believed necessary to publish a new document that would supersede both the original AVS and the tentative standard, and that could incorporate the technical content of both documents and dimensional criteria and features generally accepted by manufacturers and users. The January 1968 revision of the AVS was therefore approved as an American National Standard under the existing standards method and published as ANSI B123.1-1971.

ANSI B73.1 superseded ANSI B123.1-1971 and was first published in 1974. The 1974 edition brought to 15 the number of pump sizes covered by the standard. The committee continued to be active, adding 5 more sizes for a total of 20, and making a number of revisions in the text of the standard.

Shortly thereafter, the American National Standards Committee B73 undertook to revise the standard, and, as a result, new information on baseplate rigidity, bearing frame adapter, and bearing housing drain was introduced. The 1984 edition included, for the first time, information that covered documentation of the pump and driver outline drawing of the centrifugal pump, data sheet, mechanical seal drawing, packing box piping plans, and cooling/heating piping plans.

The 1991 revision included larger and self-venting tapered seal chambers, as well as conventional packing boxes; revised baseplate dimensions, with a new identification numbering system; and a ductile material requirement for the bearing frame adapter if it clamps the rear cover plate to the casing.

With the expanding utilization of the ASME B73.1 pumps in the chemical process industry and its growing acceptance in the hydrocarbons processing industry, the B73 committee continued to improve the B73.1 standard. The 2001 revision of the standard incorporated 7 new sizes of pumps, bringing the total number to 27. Many of the new additions were at the request of the user population. Inclusion of ISO standard size pumps was considered by the committee. It was consensus that the ISO inclusion would have made the B73.1 standard overly complex and weakened its mechanical fortitude. Thus, this action was rejected by the committee. The "Materials of Construction" section of the standard was expanded to include readily available corrosion-resistant alloys. Recent publications by the Hydraulic Institute in areas such as baseplate tolerance, acceptable nozzle loads, preferred operating region, and NPSH margin were incorporated into this revision. A standardized electronic data exchange file specification was established as an integral portion of the standard. This was, in part, in response to the needs of the user community for compliance to U.S. government regulations covering chemical process equipment and pumps, specifically OSHA Process Safety Management, 29 CFR 1910.119. In total, these revisions to the standard were intended to better serve process industries and expand the use of ASME B73 pumps worldwide.

The 2012 revision of the standard includes several changes to reduce redundancy in the B73 set of standards and to better align with the Hydraulic Institute (HI) and American Petroleum Institute (API) pump standards. Revisions have also been made to further improve the reliability of the B73.1 pumps. ASME standard B73.5 on solid polymer pumps has been merged into B73.1 due to the many similarities of the two standards. B73.5 will be withdrawn. Reference is now made to API practices for mechanical seal configurations and cooling and heating plans. A mechanical seal configuration code and a material classification code have been added to B73.1. A universal cover has been added to the standard as an alternate sealing cover. Requirements for the bearing frame have been revised to assure more robust pumps. C-face motor adapters are now an option. The default performance test acceptance grade has been revised to reflect the new HI/ISO performance test standard. More detail has been added to the required drawings, curve, and documentation that should be included with the pump. A new data sheet has been developed and added to the standard. The standard endorses the electronic data exchange standard that was developed by the Hydraulic Institute and Fiatech Automating Equipment Information Exchange (AEX) project.

This revision was approved as an American National Standard on March 19, 2020.

# ASME B73 COMMITTEE
# Chemical Standard Pumps

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

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**J. S. Simmons III**, *Contributing Member*, Occidental Petroleum Corp.

# CORRESPONDENCE WITH THE B73 COMMITTEE

**General.** ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions or a case, and attending Committee meetings. Correspondence should be addressed to:

Secretary, B73 Standards Committee
The American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990
http://go.asme.org/Inquiry

**Proposing Revisions.** Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

**Proposing a Case.** Cases may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Standard and the paragraph, figure, or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Standard to which the proposed Case applies.

**Attending Committee Meetings.** The B73 Standards Committee regularly holds meetings and/or telephone conferences that are open to the public. Persons wishing to attend any meeting and/or telephone conference should contact the Secretary of the B73 Standards Committee. Future Committee meeting dates and locations can be found on the Committee Page at http://go.asme.org/B73committee.

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# SPECIFICATION FOR HORIZONTAL END SUCTION CENTRIFUGAL PUMPS FOR CHEMICAL PROCESS

## 1 SCOPE

*(a)* This Standard is a design and specification standard that covers metallic and solid polymer centrifugal pumps of horizontal, end suction single stage, centerline discharge design. This Standard includes dimensional interchangeability requirements and certain design features to facilitate installation and maintenance and to enhance reliability and safety of B73.1 pumps. 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, size, and location of suction and discharge nozzles, input shafts, baseplates, and foundation bolt holes (see Tables 1-1 and 1-2). Maintenance and operation requirements are not included in this Standard.

*(b)* This Standard has been revised to include solid polymer pumps formerly covered under ASME B73.5. The design and construction features for metallic pumps are covered in section 5. The design and construction features for solid polymer pumps are covered in section 6. This Standard must be read in its entirety for proper application.

*(c)* This Standard has been revised to broaden the scope to include specialty designs developed on ASME B73.1 product line platforms. These specialty designs have many common components with the B73.1 models and meet the intent of the standard except for most notably the standard's dimensional and hydraulic coverage requirements. These specialty designs include pump models referred to as self-primer, recessed impeller, low flow, and repeller pumps.

*(d)* Sealless Pumps (Magnetic Drive and Canned Motor) are covered in ASME B73.3.

## 2 REFERENCES

The following documents form a part of this Standard to the extent specified herein. The latest edition shall apply.

ANSI B11.19, Performance Criteria for Safeguarding
Publisher: Association for Manufacturing Technology (AMT), 7901 Jones Branch Drive, Suite 900, McLean, VA 22102-3316 (www.amtonline.org)

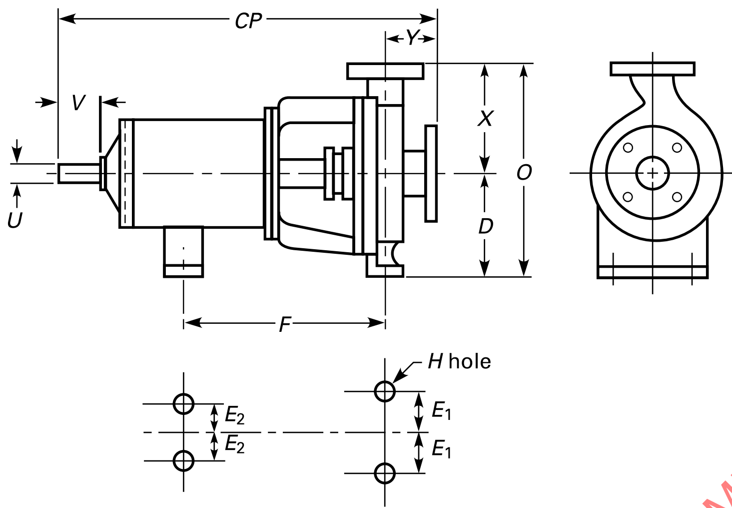
ANSI/ABMA-9, Load Ratings and Fatigue Life for Ball Bearings
ANSI/ABMA-11, Load Ratings and Fatigue Life for Roller Bearings
Publisher: American Bearing Manufacturers Association (ABMA), 1001 N. Fairfax Street, Suite 500, Alexandria, VA 22314 (www.americanbearings.org)

ANSI/AGMA 9000, Flexible Couplings — Potential Unbalance Classification
ANSI/AGMA 9002, Bores and Keyways for Flexible Couplings (Inch Series)
Publisher: American Gear Manufacturers Association (AGMA) 1001 North Fairfax Street, Suite 500, Alexandria, VA 22314 (www.agma.org)

ANSI/HI 1.4, Rotodynamic (Centrifugal) Pumps for Manuals Describing Installation, Operation and Maintenance
ANSI/HI 9.1-9.5, Pumps — General Guidelines for Types, Definitions, Application, Sound Measurement and Decontamination
ANSI/HI 9.6.1, Rotodynamic Pumps — Guideline for NPSH Margin
ANSI/HI 9.6.2, Rotodynamic Pumps for Assessment of Applied Nozzle Loads
ANSI/HI 9.6.3, Rotodynamic (Centrifugal and Vertical) Pumps — Guideline for Allowable Operating Region
ANSI/HI 9.6.4, Rotodynamic Pumps Vibration Measurements and Allowable Values
ANSI/HI 9.6.8, Dynamics of Pumping Machinery
ANSI/HI 14.1-14.2, Rotodynamic Pumps for Nomenclature and Definitions
ANSI/HI 14.3, Rotodynamic Pumps for Design and Application
ANSI/HI 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests
Publisher: Hydraulic Institute (HI), 6 Campus Drive, Parsippany, NJ 07054-4406 (www.pumps.org)

API Std 610, Centrifugal Pumps for Petroleum, Petrochemical and Natural Gas Industries
API Std 682, Pumps — Shaft Sealing Systems for Centrifugal and Rotary Pumps
Publisher: American Petroleum Institute (API), 200 Massachusetts Avenue NW, Suite 1100, Washington, DC 20001–5571 (www.api.org)

## Table 1-1 Pump Dimensions




| Dimension Designation | Size; Suction × Discharge × Nominal Impeller Diameter | *CP* | *D* | $2E_1$ | $2E_2$ | *F* |
|---|---|---|---|---|---|---|
| AA | 1.5 × 1 × 6 (40 × 25 × 150) | 17.5 (445) | 5.25 (133) | 6 (152) | 0 | 7.25 (184) |
| AB | 3 × 1.5 × 6 (80 × 40 × 150) | 17.5 (445) | 5.25 (133) | 6 (152) | 0 | 7.25 (184) |
| AC [Note (1)] | 3 × 2 × 6 (80 × 50 × 150) | 17.5 (445) | 5.25 (133) | 6 (152) | 0 | 7.25 (184) |
| AA [Note (1)] | 1.5 × 1 × 8 (40 × 25 × 200) | 17.5 (445) | 5.25 (133) | 6 (152) | 0 | 7.25 (184) |
| AB [Note (1)] | 3 × 1.5 × 8 (80 × 40 × 200) | 17.5 (445) | 5.25 (133) | 6 (152) | 0 | 7.25 (184) |
| A10 | 3 × 2 × 6 (80 × 50 × 150) | 23.5 (597) | 8.25 (210) | 9.75 (248) | 7.25 (184) | 12.5 (318) |
| A50 | 3 × 1.5 × 8 (80 × 40 × 200) | 23.5 (597) | 8.25 (210) | 9.75 (248) | 7.25 (184) | 12.5 (318) |
| A60 | 3 × 2 × 8 (80 × 50 × 200) | 23.5 (597) | 8.25 (210) | 9.75 (248) | 7.25 (184) | 12.5 (318) |
| A70 | 4 × 3 × 8 (100 × 80 × 200) | 23.5 (597) | 8.25 (210) | 9.75 (248) | 7.25 (184) | 12.5 (318) |
| A05 [Note (1)] | 2 × 1 × 10 (50 × 25 × 250) | 23.5 (597) | 8.25 (210) | 9.75 (248) | 7.25 (184) | 12.5 (318) |
| A50 | 3 × 1.5 × 10 (80 × 40 × 250) | 23.5 (597) | 8.25 (210) | 9.75 (248) | 7.25 (184) | 12.5 (318) |
| A60 | 3 × 2 × 10 (80 × 50 × 250) | 23.5 (597) | 8.25 (210) | 9.75 (248) | 7.25 (184) | 12.5 (318) |
| A70 | 4 × 3 × 10 (100 × 80 × 250) | 23.5 (597) | 8.25 (210) | 9.75 (248) | 7.25 (184) | 12.5 (318) |
| A40 | 4 × 3 × 10 (100 × 80 × 250) | 23.5 (597) | 10 (254) | 9.75 (248) | 7.25 (184) | 12.5 (318) |
| A80 [Note (2)] | 6 × 4 × 10 (150 × 100 × 250) | 23.5 (597) | 10 (254) | 9.75 (248) | 7.25 (184) | 12.5 (318) |
| A20 [Note (1)] | 3 × 1.5 × 13 (80 × 40 × 330) | 23.5 (597) | 10 (254) | 9.75 (248) | 7.25 (184) | 12.5 (318) |
| A30 | 3 × 2 × 13 (80 × 50 × 330) | 23.5 (597) | 10 (254) | 9.75 (248) | 7.25 (184) | 12.5 (318) |
| A40 | 4 × 3 × 13 (100 × 80 × 330) | 23.5 (597) | 10 (254) | 9.75 (248) | 7.25 (184) | 12.5 (318) |
| A80 [Note (2)] | 6 × 4 × 13 (150 × 100 × 330) | 23.5 (597) | 10 (254) | 9.75 (248) | 7.25 (184) | 12.5 (318) |
| A90 [Note (2)] | 8 × 6 × 13 (200 × 150 × 330) | 33.875 (860) | 14.5 (368) | 16 (406) | 9 (229) | 18.75 (476) |
| A100 [Note (2)] | 10 × 8 × 13 (250 × 200 × 330) | 33.875 (860) | 14.5 (368) | 16 (406) | 9 (229) | 18.75 (476) |
| A105 [Note (2)] | 6 × 4 × 15 (150 × 100 × 380) | 33.875 (860) | 14.5 (368) | 16 (406) | 9 (229) | 18.75 (476) |
| A110 [Note (2)] | 8 × 6 × 15 (200 × 150 × 80) | 33.875 (860) | 14.5 (368) | 16 (406) | 9 (229) | 18.75 (476) |
| A120 [Note (2)] | 10 × 8 × 15 (250 × 200 × 380) | 33.875 (860) | 14.5 (368) | 16 (406) | 9 (229) | 18.75 (476) |
| A105 [Note (2)] | 6 × 4 × 17 (150 × 100 × 430) | 33.875 (860) | 14.5 (368) | 16 (406) | 9 (229) | 18.75 (476) |
| A110 [Note (2)] | 8 × 6 × 17 (200 × 150 × 430) | 33.875 (860) | 14.5 (368) | 16 (406) | 9 (229) | 18.75 (476) |
| A120 [Note (2)] | 10 × 8 × 17 (250 × 200 × 430) | 33.875 (860) | 14.5 (368) | 16 (406) | 9 (229) | 18.75 (476) |

**Table 1-1 Pump Dimensions**

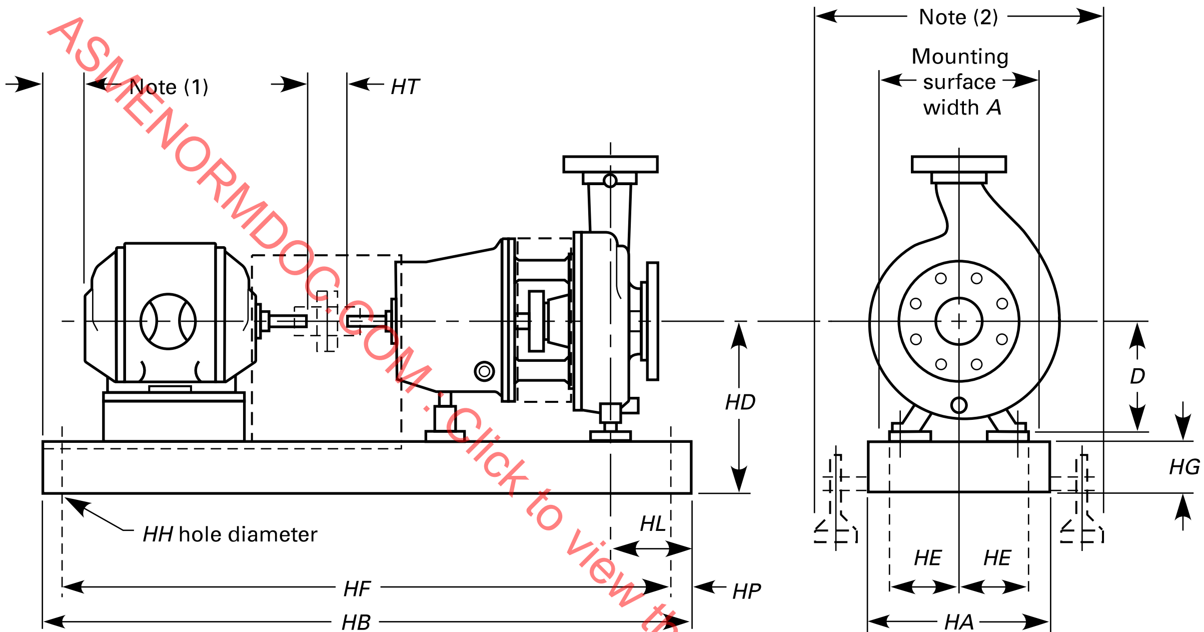
| *H* | *O* | *U* [Note (3)] | | *V* Min. | *X* | *Y* | Dimension Designation |
|---|---|---|---|---|---|---|---|
| | | Diameter | Keyway | | | | |
| 0.625 (16) | 11.75 (298) | 0.875 (22.23) | 0.188 × 0.094 (4.76 × 2.38) | 2 (51) | 6.5 (165) | 4 (102) | AA |
| 0.625 (16) | 11.75 (298) | 0.875 (22.23) | 0.188 × 0.094 (4.76 × 2.38) | 2 (51) | 6.5 (165) | 4 (102) | AB |
| 0.625 (16) | 11.75 (298) | 0.875 (22.23) | 0.188 × 0.094 (4.76 × 2.38) | 2 (51) | 6.5 (165) | 4 (102) | AC [Note (1)] |
| 0.625 (16) | 11.75 (298) | 0.875 (22.23) | 0.188 × 0.094 (4.76 × 2.38) | 2 (51) | 6.5 (165) | 4 (102) | AA [Note (1)] |
| 0.625 (16) | 11.75 (298) | 0.875 (22.23) | 0.188 × 0.094 (4.76 × 2.38) | 2 (51) | 6.5 (165) | 4 (102) | AB [Note (1)] |
| 0.625 (16) | 16.5 (420) | 1.125 (28.58) | 0.25 × 0.125 (6.35 × 3.18) | 2.625 (67) | 8.25 (210) | 4 (102) | A10 |
| 0.625 (16) | 16.75 (425) | 1.125 (28.58) | 0.25 × 0.125 (6.35 × 3.18) | 2.625 (67) | 8.5 (216) | 4 (102) | A50 |
| 0.625 (16) | 17.75 (450) | 1.125 (28.58) | 0.25 × 0.125 (6.35 × 3.18) | 2.625 (67) | 9.5 (242) | 4 (102) | A60 |
| 0.625 (16) | 19.25 (490) | 1.125 (28.58) | 0.25 × 0.125 (6.35 × 3.18) | 2.625 (67) | 11 (280) | 4 (102) | A70 |
| 0.625 (16) | 16.75 (425) | 1.125 (28.58) | 0.25 × 0.125 (6.35 × 3.18) | 2.625 (67) | 8.5 (216) | 4 (102) | A05 [Note (1)] |
| 0.625 (16) | 16.75 (425) | 1.125 (28.58) | 0.25 × 0.125 (6.35 × 3.18) | 2.625 (67) | 8.5 (216) | 4 (102) | A50 |
| 0.625 (16) | 17.75 (450) | 1.125 (28.58) | 0.25 × 0.125 (6.35 × 3.18) | 2.625 (67) | 9.5 (242) | 4 (102) | A60 |
| 0.625 (16) | 19.25 (490) | 1.125 (28.58) | 0.25 × 0.125 (6.35 × 3.18) | 2.625 (67) | 11 (280) | 4 (102) | A70 |
| 0.625 (16) | 22.5 (572) | 1.125 (28.58) | 0.25 × 0.125 (6.35 × 3.18) | 2.625 (67) | 13.5 (343) | 4 (102) | A40 |
| 0.625 (16) | 23.5 (597) | 1.125 (28.58) | 0.25 × 0.125 (6.35 × 3.18) | 2.625 (67) | 13.5 (343) | 4 (102) | A80 [Note (2)] |
| 0.625 (16) | 20.5 (520) | 1.125 (28.58) | 0.25 × 0.125 (6.35 × 3.18) | 2.625 (67) | 10.5 (266) | 4 (102) | A20 [Note (1)] |
| 0.625 (16) | 21.5 (546) | 1.125 (28.58) | 0.25 × 0.125 (6.35 × 3.18) | 2.625 (67) | 11.5 (292) | 4 (102) | A30 |
| 0.625 (16) | 22.5 (572) | 1.125 (28.58) | 0.25 × 0.125 (6.35 × 3.18) | 2.625 (67) | 12.5 (318) | 4 (102) | A40 |
| 0.625 (16) | 23.5 (597) | 1.125 (28.58) | 0.25 × 0.125 (6.35 × 3.18) | 2.625 (67) | 13.5 (343) | 4 (102) | A80 [Note (2)] |
| 0.875 (22) | 30.5 (775) | 2.375 (60.33) | 0.625 × 0.313 (15.88 × 7.94) | 4 (102) | 16 (406) | 6 (152) | A90 [Note (2)] |
| 0.875 (22) | 32.5 (826) | 2.375 (60.33) | 0.625 × 0.313 (15.88 × 7.94) | 4 (102) | 18 (457) | 6 (152) | A100 [Note (2)] |
| 0.875 (22) | 30.5 (775) | 2.375 (60.33) | 0.625 × 0.313 (15.88 × 7.94) | 4 (102) | 16 (406) | 6 (152) | A105 [Note (2)] |
| 0.875 (22) | 32.5 (826) | 2.375 (60.33) | 0.625 × 0.313 (15.88 × 7.94) | 4 (102) | 18 (457) | 6 (152) | A110 [Note (2)] |
| 0.875 (22) | 33.5 (851) | 2.375 (60.33) | 0.625 × 0.313 (15.88 × 7.94) | 4 (102) | 19 (483) | 6 (152) | A120 [Note (2)] |
| 0.875 (22) | 30.5 (775) | 2.375 (60.33) | 0.625 × 0.313 (15.88 × 7.94) | 4 (102) | 16 (406) | 6 (152) | A105 [Note (2)] |
| 0.875 (22) | 32.5 (826) | 2.375 (60.33) | 0.625 × 0.313 (15.88 × 7.94) | 4 (102) | 18 (457) | 6 (152) | A110 [Note (2)] |
| 0.875 (22) | 33.5 (851) | 2.375 (60.33) | 0.625 × 0.313 (15.88 × 7.94) | 4 (102) | 19 (483) | 6 (152) | A120 [Note (2)] |

**Table 1-1 Pump Dimensions (Cont'd)**

GENERAL NOTES:
(a) Dimensions in parentheses are approximate equivalents in millimeters.
(b) All other dimensions are in inches.
(c) Due to the inherently different casing design described in para. 5.3.5 of the self-priming pumps and para. 5.3.7 of the recessed impeller pumps, these pump types are not required to comply with these dimensions. For the same reason, the size designations of these pump types do not apply.
(d) Due to the inherently different casing design of centerline mounted pumps, mounting and centerline height dimensions may differ from those in this table.

NOTES:
(1) Discharge flange may have tapped bolt holes.
(2) Suction flange may have tapped bolt holes.
(3) *U* diameter may be 1.625 in. (41.28 mm) in A05 through A80 sizes to accommodate high torque values.

## Table 1-2 Baseplate Dimensions




| Max. NEMA Frame | Base-plate No. [Note(3)] | A Min. | HA Max. [Note(2)] | HB | HT Min. | HD Max. [Note (4)] D = 5.25 (133) | HD Max. D = 8.25 (210) | HD Max. D = 10 (254) | HD Max. D = 14.5 (368) | HE | HF | HG Max. | HH | HL | HP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 184T | 139 | 12 (305) | 15 (381) | 39 (991) | 3.5 (89) | 9 (229) | ... | ... | ... | 4.5 (114) | 36.5 (927) | 3.75 (95) | 0.75 (19) | 4.5 (114) | 1.25 (32) |
| 256T | 148 | 15 (381) | 18 (457) | 48 (1 219) | 3.5 (89) | 10.5 (267) | ... | ... | ... | 6 (152) | 45.5 (1 156) | 4.13 (105) | 0.75 (19) | 4.5 (114) | 1.25 (32) |
| 326TS | 153 | 18 (457) | 21 (533) | 53 (1 346) | 3.5 (89) | 12.88 (327) | ... | ... | ... | 7.5 (191) | 50.5 (1 283) | 4.75 (121) | 0.75 (19) | 4.5 (114) | 1.25 (32) |
| 184T | 245 | 12 (305) | 15 (381) | 45 (1 143) | 3.5 (89) | ... | 12 (305) | 13.75 (349) | ... | 4.5 (114) | 42.5 (1 080) | 3.75 (95) | 0.75 (19) | 4.5 (114) | 1.25 (32) |
| 215T | 252 | 15 (381) | 18 (457) | 52 (1 321) | 3.5 (89) | ... | 12.38 (314) | 14.13 (359) | ... | 6 (152) | 49.5 (1 257) | 4.13 (105) | 0.75 (19) | 4.5 (114) | 1.25 (32) |
| 286T | 258 | 18 (457) | 21 (533) | 58 (1 473) | 3.5 (89) | ... | 13 (330) | 14.75 (375) | ... | 7.5 (191) | 55.5 (1 410) | 4.75 (121) | 1 (25) | 4.5 (114) | 1.25 (32) |
| 365T | 264 | 18 (457) | 21 (533) | 64 (1 626) | 3.5 (89) | ... | 13.88 (353) | 14.75 (375) | ... | 7.5 (191) | 61.5 (1 562) | 4.75 (121) | 1 (25) | 4.5 (114) | 1.25 (32) |
| 405TS | 268 | 22 (559) | 26 (660) | 68 (1 727) | 3.5 (89) | ... | 14.88 (378) | 14.88 (378) | ... | 9.5 (241) | 65.5 (1 664) | 4.75 (121) | 1 (25) | 4.5 (114) | 1.25 (32) |
| 449TS | 280 | 22 (559) | 26 (660) | 80 (2 032) | 3.5 (89) | ... | 15.88 (403) | 15.88 (403) | ... | 9.5 (241) | 77.5 (1 969) | 4.75 (121) | 1 (25) | 4.5 (114) | 1.25 (32) |
| 286T | 368 | 22 (559) | 26 (660) | 68 (1 727) | 5 (127) | ... | ... | ... | 19.25 (489) | 9.5 (241) | 65.5 (1 664) | 4.75 (121) | 1 (25) | 6.5 (165) | 1.25 (32) |
| 405T | 380 | 22 (559) | 26 (660) | 80 (2 032) | 5 (127) | ... | ... | ... | 19.25 (489) | 9.5 (241) | 77.5 (1 969) | 4.75 (121) | 1 (25) | 6.5 (165) | 1.25 (32) |
| 449T | 398 | 22 (559) | 26 (660) | 98 (2 489) | 5 (127) | ... | ... | ... | 19.25 (489) | 9.5 (241) | 95.5 (2 426) | 4.75 (121) | 1 (25) | 6.5 (165) | 1.25 (32) |

GENERAL NOTES:
(a) Dimensions in parentheses are approximate equivalents in millimeters.
(b) All other dimensions are in inches.

## Table 1-2 Baseplate Dimensions (Cont'd)

GENERAL NOTES: (Cont'd)

(c) Due to the inherently different casing design described in para. 5.3.5 of the self-priming pumps and para. 5.3.7 of the recessed impeller pumps , these pump types are not required to comply with these dimensions.

(d) Due to the inherently different casing design of centerline mounted pumps, some dimensions may differ from those in this table.

NOTES:

(1) Motor should not extend beyond end of baseplate.

(2) Contact manufacturer for additional space required for free-standing baseplates.

(3) Baseplate number denotes pump frame 1, 2, or 3 and baseplate *HB* in inches.

(4) Includes 0.13-in. (3-mm) shimming allowance where motor height controls.

ASME B16.5, Pipe Flanges and Flanged Fittings
ASME B16.11, Forged Steel Fittings, Socket-Welding and Threaded
ASME B16.42, Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300
ASME B31.3, Process Piping
Publisher: The American Society of Mechanical Engineers (ASME), Two Park Avenue, New York, NY 10016-5990 (www.asme.org)

ASTM A48/A48M, Standard Specification for Gray Iron Castings
ASTM A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A106/A106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A194/A194M, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both
ASTM A216/A216M, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A276, Standard Specification for Stainless Steel Bars and Shapes
ASTM A312/A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A395/A395M, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
ASTM A479/A479M, Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels
ASTM A494/A494M, Standard Specification for Castings, Nickel and Nickel Alloy
ASTM A519, Standard Specification for Seamless Carbon and Alloy Steel Mechanical Tubing
ASTM A536, Standard Specification for Ductile Iron Castings
ASTM A743/A743M, Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
ASTM A744/A744M, Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service
ASTM A890/A890M, Standard Specification for Castings, Iron-Chromium-Nickel-Molybdenum Corrosion-Resistant, Duplex (Austenitic/Ferritic) for General Application
ASTM A995/A995M, Standard Specification for Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts
ASTM B160, Standard Specification for Nickel Rod and Bar
ASTM B164, Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM B335, Standard Specification for Nickel-Molybdenum Alloy Rod
ASTM B348, Standard Specification for Titanium and Titanium Alloy Bars and Billets
ASTM B367, Standard Specification for Titanium and Titanium Alloy Castings
ASTM B473, Standard Specification for UNS N08020, UNS N08024, and UNS N08026 Nickel Alloy Bar and Wire
ASTM B574, Standard Specification for Low-Carbon Nickel-Chromium-Molybdenum, Low-Carbon Nickel-Molybdenum-Chromium, Low-Carbon Nickel-Molybdenum-Chromium-Tantalum, Low-Carbon Nickel-Chromium-Molybdenum-Copper, and Low-Carbon Nickel-Chromium-Molybdenum-Tungsten Alloy Rod
ASTM B575, Standard Specification for Low-Carbon Nickel-Chromium-Molybdenum, Low-Carbon Nickel-Chromium-Molybdenum-Copper, Low-Carbon Nickel-Chromium-Molybdenum-Tantalum, Low-Carbon Nickel-Chromium-Molybdenum-Tungsten, and Low-Carbon Nickel-Molybdenum-Chromium Alloy Plate, Sheet, and Strip
Publisher: American Society for Testing and Materials (ASTM International), 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959 (www.astm.org)

AWS B1.11, Guide for the Visual Examination of Welds
AWSD1.1, Structural Welding — Steel
Publisher: American Welding Society (AWS), 8669 NW 36 Street, No. 130, Miami, FL 33166 (www.aws.org)

HI50.7, Electronic Data Exchange for Pumping Equipment
Publisher: Hydraulic Institute (HI), 6 Campus Drive, Parsippany, NJ 07054-4406 (www.pumps.org)

ISO 281, Rolling bearings — Dynamic load ratings and rating life
ISO 9606, Qualification Testing of Welders (all parts)
ISO 21940-11, Mechanical Vibration — Rotor Balancing — Part 11: Procedures and Tolerances for Rotors With Rigid Behavior

Publisher: International Organization for Standardization (ISO) Central Secretariat, Chemin de Blandonnet 8, Case Postale 401, 1214 Vernier, Geneva, Switzerland (www.iso.org)

MSS SP-55, Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components — Visual Method for Evaluation of Surface Irregularities
MSS SP-93, Quality Standard for Steel Castings and Forgings for Valves, Flanges, Fittings, and Other Piping Components — Liquid Penetrant Examination Method
Publisher: Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS), 127 Park Street, NE, Vienna, VA 22180 (www.msshq.org)

NFPA 704, Standard System for the Identification of the Hazards of Materials for Emergency Response
Publisher: National Fire Protection Association (NFPA), 1 Batterymarch Park, Quincy, MA 02169-7471 (www.nfpa.org)

## 3 ALTERNATIVE DESIGNS

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

## 4 NOMENCLATURE AND DEFINITIONS

### 4.1 Definitions of Terms

The nomenclature and definitions of pump components shall be in accordance with ANSI/HI 14.1-14.2, except as noted below.

### 4.2 Additional Definitions

*auxiliary piping:* includes all piping connected to the pump, seal chamber, packing box, or seal piping plan, excluding the main piping connected at the pump suction and discharge flanges. Auxiliary piping includes piping, tubing, and all attached components, such as valves, instrumentation, coolers, and seal reservoirs.

*non-pressure-containing nonwetted parts:* pump parts that do not contain or retain pressure and are not wetted by the pumped fluid (e.g, baseplate, coupling, bearing carrier frame).

*non-pressure-containing wetted parts:* pump parts that do not contain or retain pressure but are wetted by the pumped fluid (e.g., wear ring).

*pressure-containing wetted parts:* pump parts that contain pressure and are wetted by the pumped fluid (e.g., casing, sealing cover).

*pressure-retaining nonwetted parts:* pump parts that retain pressure but are not wetted by the pumped fluid (e.g., adapter, fasteners).

*sealing cover:* refers to seal chamber, universal cover, or packing box.

*supplier:* manufacturer or manufacturer's representative that supplies the equipment.

## 5 DESIGN AND CONSTRUCTION FEATURES FOR METALLIC PUMPS

Section 6 contains the design and construction features that are unique for thermoplastic and thermoset polymer pumps.

### 5.1 Pressure and Temperature Limits

**5.1.1 Pressure Limits.** Pressure limitations shall be stated by the pump manufacturer. See para. 5.8.3 for auxiliary piping.

**5.1.1.1** The design pressure of the casing, sealing cover, and gland shall be at least as great as the pressure–temperature rating of ASME B16.5 Class 150 or ASME B16.42 Class 150 flanges for the material used.

**5.1.1.2** The design pressure of any optional jackets shall be at least 100 psig (689 kPa gage) at 340°F (171°C). Heating jackets may be required for jacket temperatures to 500°F (260°C) with a reduction in pressure corresponding to the reduction in yield strength of the jacket material.

**5.1.1.3** The design pressure of any optional oil cooler shall be at least 100 psig (689 kPa gage) at 250°F (121°C).

**5.1.1.4** Casing, sealing cover, gland, and jackets shall be designed to withstand a hydrostatic test at 1.5 times the maximum design pressure for the particular component and material of construction used (see para. 7.2.1.1).

**5.1.2 Temperature Limits.** Temperature limitations shall be stated by the pump manufacturer. Pumps should be available for temperatures up to 500°F (260°C). Jacketing and other modifications may be required to meet the operating temperature. For services above 350°F (170°C), centerline mounting and oil sump cooling options should be made available. See para. 5.8.3 for auxiliary piping.

### 5.2 Flanges

**5.2.1 General.** Suction and discharge nozzles shall be flanged. Flange drilling, facing, and minimum thickness shall conform to ASME B16.5 Class 150 or ASME B16.42 Class 150 standards, except that marking requirements are not applicable and the maximum acceptable tolerance on parallelism of the back of the flange shall be 3 deg. Flanges shall be flat-faced at the full-raised-face thickness (minimum) specified in the ASME standards for the material of construction. Raised-face flanges may be offered as an option. Bolt holes shall straddle the horizontal and vertical centerlines. Bolt holes may be tapped when adequate space for nuts is not available behind flanges, as noted in Table 1-1. Through bolt holes are preferred. When tapped holes are supplied, they shall be noted on the outline drawing.

**5.2.2 Class 300 Option.** As an option, Class 300 flanges in accordance with ASME B16.5 or ASME B16.42 may be offered with pressure ratings subject to the manufacturer's casing pressure–temperature limitations. Class 300 flanges shall be flat-faced at full raised-face thickness (minimum), or raised-face flanges may be offered as an option.

**5.2.3 *X* and *Y* Dimensions.** All pumps, regardless of flange rating, shall conform to the *X* and *Y* dimensions shown in Table 1-1.

**5.2.4 Drilling.** Where heavy hex nuts cannot be used, or if through or blind tapped holes are supplied, the location shall be noted on the outline drawing.

NOTE: ASME B16.5 and ASME B16.42 indicate the use of heavy hex nuts for certain flange connections. On many B73 pumps, heavy hex nuts cannot be used due to available space. Standard hex nuts are often substituted. The use of standard hex nuts may not allow the achievement of full bolt stress, which may impact proper gasket compression. With most gasket materials, this does not reduce the gasket's ability to properly seal. However, this is a consideration for metallic and semimetallic (i.e., spiral wound) gaskets where significant preload may be required to achieve sufficient tightness.

## 5.3 Casing

**5.3.1 Drain Connection Boss(es).** Pump casing shall have boss(es) to provide for drain connection(s) in the lowest part of the casing. Boss size shall accommodate $\frac{1}{2}$-in. NPT min. Boss(es) shall be drilled and tapped when specified by the purchaser.

**5.3.2 Auxiliary Connection Bosses.** The suction and discharge nozzles shall have bosses for gage connections. Boss size shall accommodate $\frac{1}{4}$-in. NPT min., $\frac{1}{2}$-in. NPT preferred. Bosses shall not be drilled and tapped unless specified by the purchaser.

**5.3.3 Support.** The casing shall be supported by feet beneath the casing or a suitable support between the casing and baseplate.

**5.3.4 Disassembly.** The design shall permit removal of the back pullout assembly from the casing without disturbing the suction and discharge connections. The design shall also avoid disturbing the motor except for assemblies using the C-face motor adapters (see para. 5.13.8). Tapped holes for jackscrews, slots for wedges, or equivalent means shall be provided to facilitate removal of the back pullout assembly. Jackscrews shall not cause damage to parts that will interfere with reassembly and sealing when the parts are reused.

**5.3.5 Self Priming Pumps.** Self-priming designs should be available for applications where the pump must be able to evacuate gas from the suction line when the liquid level is below the pump when started. These designs incorporate integral chambers that, once initially filled, keep liquid in the casing for use during the priming cycle and expel gas out the discharge. This design does not require a check valve or any other equipment to maintain liquid in the casing after initial filling.

**5.3.6 Low Flow Pumps.** The following should be available: concentric volute designs that allow for reliable operation at best efficiency point (BEP) and minimum flows below that available with normal expanding volute designs.

**5.3.7 Recessed Impeller Pumps.** Vortex pumps with recessed impeller casing designs should be available. These designs incorporate tangential discharge and concentric volutes.

### 5.3.8 Heating or Cooling

**5.3.8.1** There are several methods of cooling or heating areas of most ASME B73 pumps. The sealing cover, pump casing, and bearing housing are areas of the pump that may have design features available for heating or cooling.

**5.3.8.2** Jackets for heating or cooling the casing and/or sealing cover are optional. Connections shall be $\frac{3}{8}$-in. NPT min., with $\frac{1}{2}$-in. NPT preferred. When a jacket is to be used for heating by steam, the inlet connection shall be located at the top of the jacket, and the drain connection shall be located at the bottom of the jacket to prevent the formation of water pockets. Jackets for liquid cooling shall have the inlet in the bottom half, the outlet at the top to support thermal convection and prevent the formation of vapor pockets, and a drain at the bottom for freeze protection.

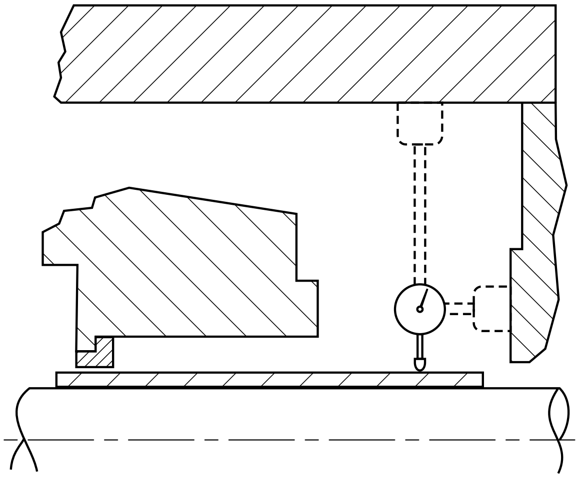
**5.3.9 Gasket(s).** The casing-to-sealing cover gasket shall be confined on the atmospheric side to prevent blowout.

## 5.4 Impeller

**5.4.1 Types.** Impellers may be of the open, semi-open, or closed design.

**5.4.2 Adjustment.** If axial adjustment is required by the design, the pump shall be provided with a means for external adjustment of the impeller clearance without disassembly of the pump except for the coupling guard.

**Figure 5.5.3-1 Shaft Sleeve Runout**



**5.4.3 Balance.** Impellers shall be balanced in accordance with ISO 21940-11 and meet Grade 6.3 after final machining. Impellers shall be single-plane balanced if the ratio of impeller diameter to impeller peripheral width is 6 or greater. For ratios less than 6, impellers shall be two-plane balanced.

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

## 5.5 Shaft

**5.5.1 Diameter.** The seal mounting surface includes the shaft or shaft sleeve outside diameter within the packing box or seal chamber and enough length beyond to accommodate outside seals. The diameter of the seal mounting surface shall be sized in increments of 0.125 in. (3.18 mm). To provide for the use of mechanical seals, the tolerance on that diameter shall not exceed nominal to minus 0.002 in. (0.05 mm).

**5.5.2 Finish.** Surface finish of the shaft or sleeve through the sealing cover and at bearing housing seals shall not exceed a roughness of 32 μin. (0.8 μm) AA unless otherwise required.

**5.5.3 Runout.** Shaft runout shall be limited as follows:

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

*(b)* outside diameter of shaft or removable sleeve when installed in pump: 0.002 in. (0.05 mm) FIM at the gland end of sealing cover (see Figure 5.5.3-1).

**5.5.4 Deflection.** Dynamic shaft deflection at the impeller centerline shall not exceed 0.005 in. (0.13 mm) anywhere within the allowable operating region as specified in para. 7.1.5. Hydraulic loads and shaft deflection shall be calculated in accordance with ANSI/HI 14.3.

NOTE: Shaft deflection at the impeller centerline will be significantly greater than the shaft deflection at the primary seal faces. Based on impeller centerline deflection of 0.005 in. (0.13 mm), the shaft deflection at the primary seal faces will normally be 0.003 in. (0.08 mm) or less.

**5.5.5 Running Clearances.** Clearances must be sufficient to prevent internal rubbing when the pump is subjected to the maximum allowable flange loads (para. 7.1.2) while running within the allowable operating region (para. 7.1.5).

**5.5.6 Critical Speed.** The first lateral critical speed of the rotating assembly shall be at least 120% of the maximum operating speed. A "dry critical speed" calculation is adequate to verify compliance. ANSI/HI 9.6.8 shall be used to calculate static deflections used for the critical speed calculation.

**5.5.7 Fillets and Radii.** All shaft shoulder fillets and radii shall be made as large as practical and finished to minimize stress risers.

**5.5.8 Solid Shaft/Shaft Sleeve.** Solid shaft (no sleeve) is preferred whenever mechanical seals are used and the metallurgy or seal design does not preclude their use. Shaft sleeves shall be provided whenever shaft packing is used.

## 5.6 Shaft Sealing

**5.6.1 Design.** The following are the three basic types of sealing covers:

*(a)* seal chamber

*(b)* universal cover

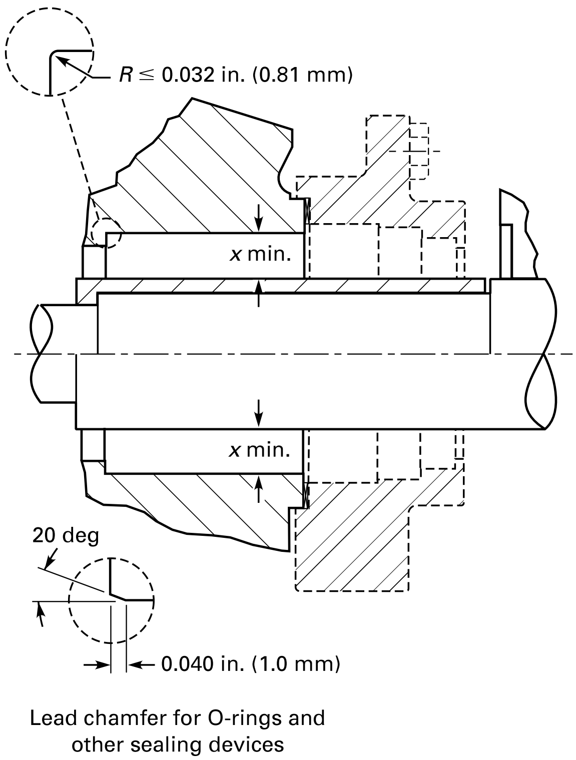
*(c)* packing box

The seal chamber and packing box are standard arrangements. The universal cover should be available as an option.

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 universal cover is designed to provide a standard dimensional platform for installation of cartridge-mounted mechanical seals. The packing box is designed for packing but may be able to accommodate some sizes and types of mechanical seals without the advantages of the seal chamber or universal cover.

Details and tutorials on piping plans for mechanical seals can be found in API 682 (ISO 21049). Piping plan designations found in API 682 (e.g., Plan 11, Plan 53A) will be applied to ASME B73 pump applications. Details and designations on piping plans involving pump heating or cooling (e.g., bearing bracket cooling, heating and cooling jackets) can be found in API 610. The piping plan references from API 682 and API 610 shall apply only to the schematic and general description

**Figure 5.6.2-1 Cylindrical Seal Chamber**




| Dimension Designation | Minimum Radial Clearance, $x$ |
|---|---|
| AA – AB | $x$ = ¾ in. (19.05 mm) |
| A05 – A80 | $x$ = ⅞ in. (22.22 mm) |
| A90 – A120 | $x$ = 1.0 in. (25.40 mm) |

of the piping plan, and not to the specific design of components and hardware that may be contained in these standards.

**5.6.2 Seal Chamber.** The seal chamber can be a cylindrical or a tapered design. The tapered bore seal chamber shall have a minimum of 4-deg taper open toward the pump impeller and shall include features that prevent the accumulation of solid particles in the chamber, unless otherwise specified. The seal chamber shall be designed to incorporate the details quantified in Figures 5.6.2-1 and 5.6.2-2.

The secondary seal contact surface(s) shall not exceed a roughness of 63 μin. (1.60 μm) AA. Seal chamber bore corners and entry holes, such as those used for flushing or venting, shall be suitably chamfered or rounded to prevent damage to secondary seals at assembly.

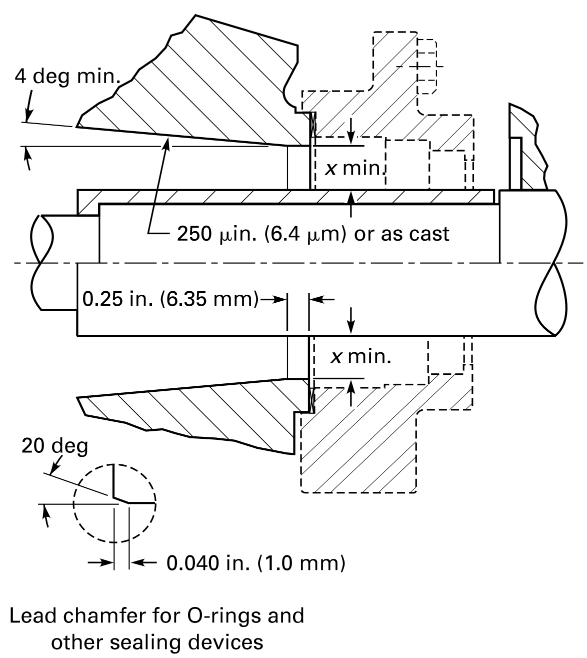
The seal chamber shall include means of eliminating trapped air or gas. Vent connections, when required for this purpose, shall be located at the highest practical point; drains, when provided, shall be located at the lowest practical point. The location of piping connections to the seal chamber for other functions is optional. A primary flush plan is not recommended for single mechanical seals with tapered bore seal chambers and may impede its operation. The size of all piping connections to the seal chamber shall be ¼-in. NPT min., with ½-in. NPT preferred.

**5.6.2.1 Seal Chamber Runout.** Mechanical seal performance is highly dependent on the runout conditions that exist at the mechanical seal chamber. Pumps shall be designed for compliance with the runout limits shown in (a) and (b). On smaller pump sizes, the actual measurement of these runout values may not be possible or practical on an assembled pump. Types of runout having significant effect on seal performance include the following:

(a) *Seal Chamber Face Runout.* This is a measure of the perpendicularity of the seal chamber face with respect to the pump shaft. It is measured by mounting a dial indicator on the pump shaft and measuring FIM at the face of the seal chamber. The maximum allowable runout is 0.003 in. (0.08 mm) FIM (see Figure 5.6.2.1-1).

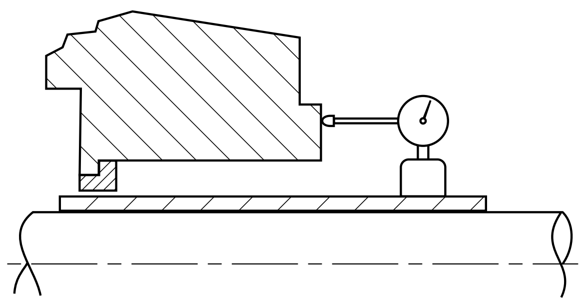
(b) *Seal Chamber Register Runout.* Provisions shall be made for centering the gland with either an inside or outside diameter register. This register shall be concentric

**Figure 5.6.2-2 Self-Venting Tapered Seal Chamber**




| Dimension Designation | Minimum Radial Clearance, $x$ |
|---|---|
| AA – AB | $x$ = ¾ in. (19.05 mm) |
| A05 – A80 | $x$ = ⅞ in. (22.22 mm) |
| A90 – A120 | $x$ = 1.0 in. (25.40 mm) |

**Figure 5.6.2.1-1 Seal Chamber Face Runout**



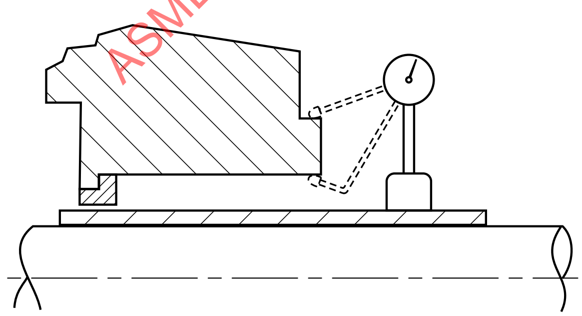
with the shaft or sleeve within 0.005 in. (0.13 mm) FIM (see Figure 5.6.2.1-2).

**5.6.3 Universal Cover.** The universal cover shall be as indicated in Figure 5.6.3-1. The runout requirements from para. 5.6.2.1 apply for face and register fits.

**5.6.4 Packing Box.** The packing box packing bore surface shall not exceed a roughness of 63 µin. (1.60 µm) AA. One flush connection shall be provided as a minimum. Additional connections to the packing box are optional. The size shall be $\frac{1}{4}$-in. NPT min., with $\frac{1}{2}$-in. NPT preferred. Registers shall maintain the packing box bore concentric with the axis of the pump shaft within 0.005 in. (0.13 mm) FIM. The packing box face shall be perpendicular to the axis of the assembled pump shaft within 0.003 in. (0.08 mm) FIM. Figure 5.6.4-1 shows the recommended packing box dimensions. The packing box also shall be suitable for proper installation and operation of some sizes and types of mechanical seals, including means of venting trapped air or gas at the highest practical point.

**5.6.5 Cover With Clamp Ring.** A cover with clamp ring is not available on metallic pumps.

**Figure 5.6.2.1-2 Seal Chamber Register Concentricity**



NOTE: The seal operating cavity is the responsibility of the mechanical seal supplier and should be incorporated into the seal gland.

### 5.6.6 Space Requirements

**5.6.6.1** Space in the various seal chamber designs shall provide for the seal configurations identified in Mandatory Appendix II.

**5.6.6.2** Space in the packing box and exterior clearance area shall provide for

*(a)* five rings of packing plus a lantern ring and repacking space

*(b)* throat bushing, a lantern ring, and three rings of packing

### 5.6.7 Gland

**5.6.7.1 Bolting.** Pumps shall be designed for four gland bolts, but glands shall be

*(a)* two-bolt or four-bolt for packing

*(b)* four-bolt for mechanical seals

The minimum bolt sizes are as follows:

| Pump Length (CP), in. (mm) | Gland Bolt Size, in. |
|---|---|
| $17\frac{1}{2}$ (445) | $\frac{3}{8}$ |
| $23\frac{1}{2}$ (597) | $\frac{3}{8}$ |
| $33\frac{7}{8}$ (860) | $\frac{1}{2}$ |

**5.6.7.2 Gasket.** The gland-to-seal-chamber gasket or O-ring used for mechanical seals shall be confined on the atmospheric side to prevent blowout.

**5.6.7.3 Cartridge Seal Glands.** Cartridge seals shall either center on the shaft or pilot on the seal chamber.

**5.6.8 Alternative Seal Specification.** As an alternative to the mechanical seal specifications found in this Standard, seals may be provided in accordance with API 682 Category 1. The requirement to apply API 682 must be designated on the Centrifugal Pump Data Sheet (Mandatory Appendix I) or on the purchasing specification. Seals provided in accordance with API 682 are intended only for ASME B73 pumps using a cylindrical seal chamber, self-venting tapered seal chamber, or universal cover. The seal chamber design and mechanical seal interface specifications shall be applied from ASME B73.1, not from API 682.

## 5.7 Bearings, Lubrication, and Bearing Frame

### 5.7.1 Bearings

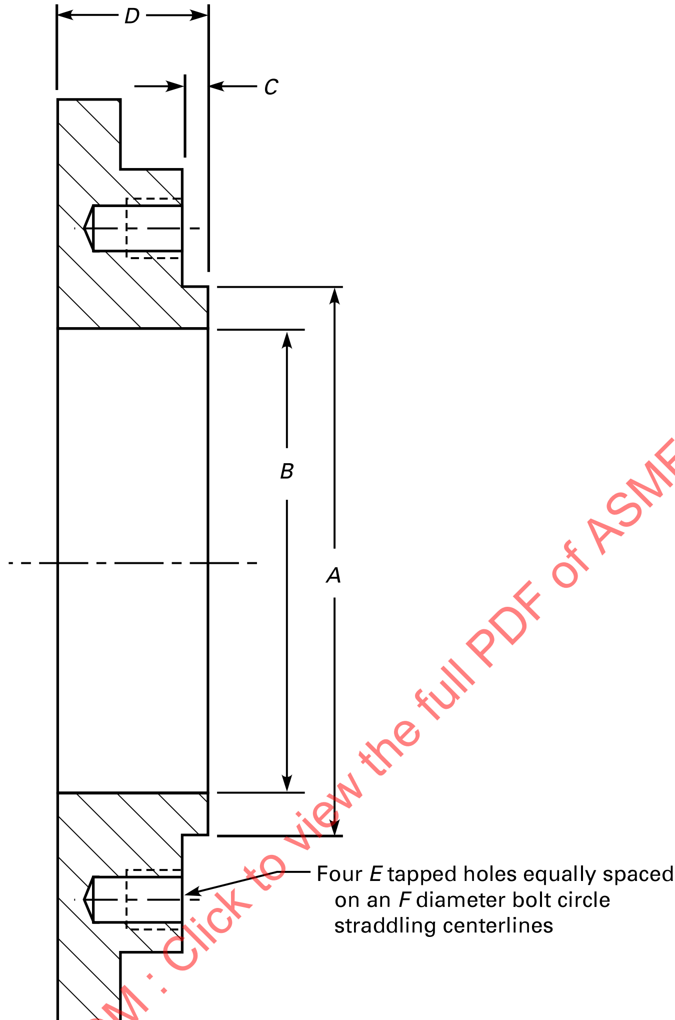
**5.7.1.1 Design.** Two rolling element bearing assemblies shall be provided as follows:

*(a)* an assembly free to float within the frame to carry radial loading only

*(b)* an assembly arranged to carry both radial loading and axial thrust

**5.7.1.1.1** The bearing provided for radial-only loading shall be a single-row deep groove ball bearing or roller bearing.

## Figure 5.6.3-1 Universal Cover



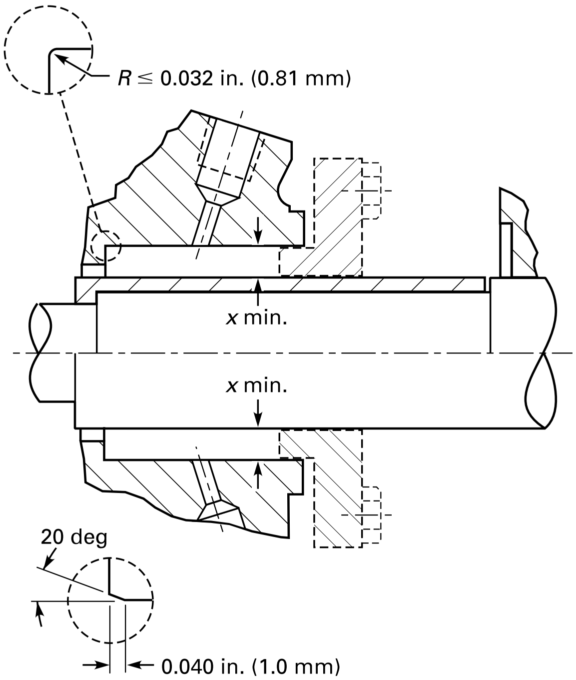



**Universal Cover Dimensions**

| Feature | Dimension Designations AA-AC | Dimension Designations A05-A80 | Dimension Designations A05-A80 Option | Dimension Designations A90-A120 |
|---|---|---|---|---|
| *A* | 3.374 ± 0.001 | 4.249 ± 0.001 | 4.624 ± 0.001 | 5.249 ± 0.001 |
| *B* | 2.876 ± 0.001 | 3.501 ± 0.001 | 3.876 ± 0.001 | 4.251 ± 0.001 |
| *C* | 0.19 | 0.25 | 0.25 | 0.25 |
| *D* | 1.55 | 1.75 | 2.12 | 2.12 |
| *E* | $^{3}/_{8}$-16 UNC | $^{5}/_{8}$-11 UNC | $^{5}/_{8}$-11 UNC | $^{3}/_{4}$-10 UNC |
| *F* | 4.25 | 5.50 | 5.875 | 6.875 |

GENERAL NOTE: All dimensions are in inches.

**Figure 5.6.4-1 Packing Box**




| Dimension Designation | Minimum Radial Clearance, $x$ |
|---|---|
| AA – AB | $x = 5/16$ in. (7.94 mm) |
| A05 – A80 | $x = 3/8$ in. (9.52 mm) |
| A90 – A120 | $x = 7/16$ in. (11.11 mm) |

**5.7.1.1.2** The bearing provided for both radial and thrust loading shall be either a double row angular contact or paired single-row angular contact mounted back-to-back.

**5.7.1.1.3** Nonmetallic cages shall not be used. Machined brass cages shall be provided for paired single-row angular contact bearings and when specified for double-row angular contact bearings.

**5.7.1.1.4** Single- or double-row bearings shall not have filling slots.

**5.7.1.2 Life.** Bearings shall be selected in accordance with ANSI/ABMA-9, ANSI/ABMA-11, and ISO 281. The minimum $L_{10}$ bearing life shall be 17,500 hr in the allowable operating region as defined in para. 7.1.5 and for all standard and optional arrangements of bearings, lubrication, shafts, covers, sealing, and impellers.

NOTE: The minimum $L_{10}$ bearing life above represents a worst-case scenario for certain sizes running at maximum rated speed with maximum impeller diameter and flows at the edge of the allowable operating region. The actual $L_{10}$ life for the typical B73.1 pump may be far in excess of 17,500 hr. Consult the pump manufacturer for the actual $L_{10}$ life of the selected pump and rated operating conditions if desired.

**5.7.1.3 End Play.** The maximum end play of the shaft assembly shall not exceed the internal axial clearance for the thrust bearing used. Minimum and maximum shaft end play values shall be published in the pump manufacturer's instruction manual.

### 5.7.2 Lubrication

**5.7.2.1** Oil bath lubrication is standard.

**5.7.2.2** Oil mist lubrication shall be optional. When oil mist lubrication is specified, the location of the inlets, drains, and the vents should be mutually agreed upon between the purchaser and the supplier.

**5.7.2.3** Greased-for-life or regreaseable lubrication shall be optional.

**5.7.2.3.1** When greased-for-life is specified, the bearings shall be double shielded and pre-filled with grease by the bearing manufacturer. A corrosion-resistant metal tag shall be affixed to the bearing housing stating that the housing is equipped with greased-for-life bearings and that further lubrication is not necessary.

NOTE: Double-shielded bearings are not available for single-row angular contact bearings.

**5.7.2.3.2** When regreaseable lubrication is specified, a means for grease relief shall be provided.

**5.7.3 Bearing Frame.** Bearing frame shall be constructed to protect the bearings from water, dust, and other contaminants and provide lubrication for the bearings. The standard design is for oil bath lubrication and shall include labyrinth-type bearing isolators, a 1-in. (25-mm) bull's eye oil sight glass, magnetic drain plug, and plugged top vent.

**5.7.3.1 Sealing.** The standard design shall include labyrinth-type bearing isolators. In addition, optional designs may be offered that allow for the use of a variety of other bearing frame seals, such as lip seals or magnetic oil seals, as may be specified by the purchaser. In those cases where the bearing frame seal does not allow the bearing frame pressure to equalize with atmospheric pressure during operation, an expansion chamber or breather is necessary.

**5.7.3.2 Bearing Frame Drain.** Bearing frame shall be provided with a tapped and plugged drain hole at its lowest point. A magnetic drain plug shall be used.

**5.7.3.3 Lubricant Level Indication.** Bearing frame for oil bath lubrication shall be provided with a 1-in. (25-mm) bull's eye level indicator that is capable of optionally being installed on either side or both sides of the bearing frame.

**Table 5.8.1.2-1 Pump Material Classification Codes**

| Base Code — Pressure Casing and Impeller | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Part Name** | **73DI-** | **73DI/SS-** | **73SS-** | **73A20-** | **73CD4-** | **73C276-** | **73X-** |
| Casing | Ductile iron | Ductile iron | 316 SS | Alloy 20 | CD4 MCu | Alloy C276 | As specified |
| Impeller | Ductile iron | 316 SS | 316 SS | Alloy 20 | CD4 MCu | Alloy C276 | As specified |
| Cover | Ductile iron | Ductile iron | 316 SS | Alloy 20 | CD4 MCu | Alloy C276 | As specified |
| Seal gland | 316 SS | 316 SS | 316 SS | Alloy 20 | Alloy 20 | Alloy C276 | As specified |

| First Suffix — Shaft | | | |
|---|---|---|---|
| **Part Name** | **A** | **B** | **X** |
| Shaft | Solid shaft | Sleeved shaft | As specified |
| Wetted area of shaft with no sleeve | 316 SS minimum, same as casing for higher alloy | NA | As specified |
| Shaft sleeve | NA | 316 SS minimum, same as casing for higher alloy | As specified |
| Shaft with sleeve | NA | Carbon steel with 316 SS sleeve, or 316 SS with higher alloy sleeve | As specified |

| Second Suffix — Fasteners | | | | |
|---|---|---|---|---|
| **Part Name** | **CS** | **SS** | **TCS** | **X** |
| Casing fasteners | Carbon steel | 304 SS or 316 SS | Carbon steel with PTFE fluoropolymer coating | As specified |
| Gland fasteners | 304 SS or 316 SS | 304 SS or 316 SS | 304 SS or 316 SS | As specified |

| Third Suffix — Casing Gasket | | | | |
|---|---|---|---|---|
| **Part Name** | **AF** | **T** | **G** | **X** |
| Casing gasket | Manufacturer standard aramid fiber | Modified PTFE | Flexible graphite | As specified |

GENERAL NOTES:
(a) As an example, the pump material classification code 73DI-A-TCS-T indicates the following:
*(1)* casing = ductile iron
*(2)* impeller = ductile iron
*(3)* cover = ductile iron
*(4)* seal gland = 316 SS
*(5)* shaft = 316 SS solid shaft
*(6)* casing fasteners = carbon steel with PTFE coating
*(7)* gland fasteners = 304 SS or 316 SS
*(8)* casing gasket = modified PTFE
(b) NA = not applicable; PTFE = polytetrafluoroethylene

The proper oil level for the nonoperating pump shall be indicated on the outside of the bearing frame.

**5.7.3.4 Constant Level Oiler.** A constant level oiler is not part of the standard design but may be included as an option when specified. If a constant level oiler is supplied, it shall be set initially by the supplier for the proper level during operation.

**5.7.3.5 Oil Cooling.** If water cooling is required to maintain oil and bearing temperatures, the oil cooler shall be constructed of plain or finned tubing/pipe of a corrosion-resistant nonferrous metal or austenitic stainless steel. There shall be no welded or mechanical pressure joints inside the housing. The oil cooler shall be located so that it is completely submerged in oil when the oil reservoir is filled to normal level.

## 5.8 Materials of Construction

### 5.8.1 General

**5.8.1.1** The identifying material of a pump shall be that of which the casing is constructed.

**5.8.1.2** The pump material classification code in Table 5.8.1.2-1 shall be used to specify the pump materials of construction.

**5.8.1.3** The pump part materials shall be in accordance with the specific ASTM material specifications in Table 5.8.1.3-1 for each of the listed material designations.

**5.8.1.4** Other materials shall be agreed upon by the purchaser and the supplier.

**5.8.1.5** No repair by plugging, peening, or impregnation is allowed on any parts wetted by the pumped fluid.

### Table 5.8.1.3-1 ASTM Material Specifications

| Material Designation | Casting Wetted by Pumped Fluid | Casting Not Wetted by Pumped Fluid | Bar Stock | Pressure-Retaining Bolts and Studs | Nuts |
|---|---|---|---|---|---|
| Cast iron | ... | A48 | ... | ... | ... |
| Ductile iron | A395 Grade 60-40-18 | A395 Grade 60-40-18 or A536 | ... | ... | ... |
| Carbon steel | A216 Grade WCB | ... | A108 Grade 1144 or A434 Grade 4140 | A193 Grade B7 | A194 Grade 2H |
| Carbon steel with PTFE coating | ... | ... | ... | A193 Grade B7 coated with PTFE flouropolymer coating | A194 Grade 2H coated with PTFE flouropolymer coating |
| 304 SS | ... | ... | ... | A193 Grade B8 Class 2 or 2B | A194 Grade 8 |
| 316 SS | A744 Grade CF8M | A744 Grade CF8M or A743 Grade CF8M | A276 Type 316 | A193 Grade B8 Class 2, B8M2, or M8M3 | A194 Grade 8M |
| Alloy 20 stainless steel | A744 Grade CN7M | A744 Grade CN7M | B473 N08020 | B473 N08020 | B473 N08020 |
| 316L SS | A744 Grade CF3M | A744 Grade CF3M or A743 Grade CF3M | ... | ... | ... |
| Duplex stainless steel | A995 Grade 1B (CD4MCuN) | A890 Grade 1B (CD4MCuN) | A276 Grade S32205 | A276 Grade S32205 | A276 Grade S32205 |
| Monel | A494 Grade M35-1 | A494 Grade M35-1 | B164 N04400 | ... | ... |
| Nickel | A494 Grade CZ100 | A494 Grade CZ100 | B160 N02200 | ... | ... |
| Alloy B2 | A494 Grade N7M | A494 Grade N7M | B335 N10665 | ... | ... |
| Alloy C4 | A494 Grade CW2M | A494 Grade CW2M | B575 N06455 | ... | ... |
| Alloy C276 | A494 Grade CW6M or A494 Grade CW2M | A494 Grade CW6M or A494 Grade CW2M | B574 N10276 | ... | ... |
| Alloy C22 | A494 Grade CX2MW | A494 Grade CX2MW | B574 N06022 | ... | ... |
| Titanium | B367 Grade C3 | B367 Grade C3 | B348 Grade 2 | ... | ... |

GENERAL NOTES:
(a) For glands and gland fastening, see para. 5.8.2.
(b) PTFE = polytetrafluoroethylene.

**Table 5.8.3.1-1 Minimum Requirements for Auxiliary Piping Materials**

| | ASTM Material Requirements by Type | | | |
|---|---|---|---|---|
| | Tubing | Tube Fittings | Pipe | Pipe Fittings |
| Material Designation | Size Range: $^3/_8$-in. O.D. to $^3/_4$-in. O.D. Minimum Wall Thickness: 0.035 in. | Compression Type | Schedule 40 Min. | ASME B16.11 Class 2000 Min. |
| Carbon steel | A519 (seamless) | A108 | A106 Grade B (seamless) | A105 |
| 316 SS | Seamless A269 Grade TP316 | Bar Stock: A479 Type 316; Forgings: A182 Grade F316 | Seamless A312 Grade TP316 | A182 Grade F316 |

### 5.8.2 Gland

**5.8.2.1** Mechanical seal gland materials shall be in accordance with the ASTM designations in Table 5.8.1.3-1 with 316 SS as a minimum. If wetted by the pumped fluid and the casing is a higher alloy than 316 SS, the gland shall be constructed of the same material specified for the casing or, with purchaser approval, a material having an equivalent or better corrosion resistance.

**5.8.2.2** Gland bolt, stud, and nut materials shall be in accordance with the ASTM designations in Table 5.8.1.3-1, with 304 SS as a minimum. Grade B7 and Grade 2H carbon steel are not allowed for gland bolt, stud, and nut materials.

### 5.8.3 Auxiliary Piping

**5.8.3.1** Auxiliary piping shall, as a minimum, be available with the materials of construction in accordance with Table 5.8.3.1-1.

**5.8.3.2** Auxiliary piping in contact with the pumped fluid shall have a pressure–temperature rating equal to, or greater than, the maximum allowable working pressure (MAWP) of the pump. Auxiliary piping that may become exposed to pumped fluid in the event of a seal failure shall meet this requirement.

**5.8.3.3** Auxiliary piping and components normally in contact with the pumped fluid shall have a corrosion resistance to the pumped fluid that is equal to, or greater than, that of the casing.

## 5.9 Corrosion Allowance

The casing, cover, and gland shall have a corrosion allowance of at least 0.12 in. (3.0 mm).

## 5.10 Direction of Rotation

Direction of rotation shall be clockwise when viewed from the coupling end. An arrow showing the direction of rotation shall be provided, either cast on the casing or stamped on a plate of durable construction affixed to the pump in a prominent location.

## 5.11 Dimensions

Pump dimensions shall conform to Table 1-1. Baseplate dimensions shall conform to Table 1-2.

## 5.12 Welding

**5.12.1** Welding and weld repairs shall be performed in accordance with procedures qualified to the requirements of Table 5.12.1-1. When specified, all post foundry casting repairs shall have the utilized welding procedures, examinations, and weld repair acceptance criteria submitted to the purchaser for information. Alternative standards may be proposed by the manufacturer for the purchaser's approval.

**5.12.2** The manufacturer shall be responsible for the review of all repairs and repair welds to ensure they are properly heat-treated and non-destructively examined for soundness and compliance with the applicable qualified procedures.

**5.12.3** Specified connections welded to pressure casings shall be installed per paras. 5.12.3.1 through 5.12.3.3.

**5.12.3.1** Auxiliary piping welded to alloy steel casings shall be of a material with the same nominal properties as the casing material. If the casing is stainless steel, auxiliary piping shall be of low-carbon austenitic stainless steel. Other materials compatible with the casing material and intended service may be used with the purchaser's approval.

**5.12.3.2** Post-weld heat-treatment, if required, shall be carried out after all welds, including piping welds, have been completed.

**5.12.3.3** If specified, proposed connection designs shall be submitted to the purchaser for approval before fabrication. The drawing shall show weld designs, size, materials, and pre-weld and post-weld heat-treatments.

## 5.13 Miscellaneous Design Features

**5.13.1 Safety Guards.** Guards shall be provided for the coupling and any exposed rotating element including the area between the bearing housing and mechanical seal to

**Table 5.12.1-1 Welding Requirements**

| Requirement | Applicable Code or Standard |
|---|---|
| Welder/operator qualification | ASME BPVC IX or ISO 9606 (all parts) |
| Welder procedure qualification | Applicable material specification or, where weld procedures are not covered by the material specification, ISO 15609 (all parts), ASME BPVC IX, or ASME B31.3 |
| Non-pressure-retaining structural welding, such as baseplates or supports | AWS D1.1 |
| Magnetic-particle or liquid-penetrant examination of the plate edges | MSS-SP-93, ASME B31.3 or ASME BPVC, Section VIII, Division 1, UG-93 (d)(3) |
| Post-weld heat-treatment | Applicable material specification, EN 13445-4, ASME Division 1, UW 40, or ANSI/ ASME B31.3 BPVC VIII |



prevent personnel from contacting rotating parts during operation.

**5.13.1.1 Performance Criteria.** All guards shall meet the performance criteria and maximum gap/opening allowances based on the distance between the guard and the rotating hazard in accordance with of ANSI B11.19.

**5.13.1.2 Accessibility.** Guards shall be securely attached and removable without disturbing the guarded rotating components.

**5.13.1.3 Material Construction.** Guards of metal construction are preferred. Alternate materials may be provided with purchaser approval. Sheet metal may be expanded metal, perforated sheet metal, or solid sheet metal depending on ventilation requirements.

**5.13.1.4 Attachment.** Guards shall be securely fastened to equipment framework to protect against unauthorized adjustment or circumvention.

**5.13.1.5 Hazard Communication.** Guards shall be ANSI Safety Yellow (RAL 1003) or ANSI Safety Orange (RAL 2004).

**5.13.1.6 Coupling Guards.** Coupling area safety guards shall be constructed of steel, brass, or aluminum unless otherwise specified by the purchaser.

**5.13.1.7 Seal Area Guards.**

**5.13.1.7.1** Safety guards used for the area between the bearing housing and mechanical seal shall be sufficiently vented to prevent the accumulation of seal emissions, liquid, or vapor.

**5.13.1.7.2** Seal area safety guards shall be constructed of stainless steel, brass, or aluminum unless otherwise specified by the purchaser.

**5.13.1.7.3** When specified, the seal area safety guard shall also serve as a seal area spray guard intended to provide protection from directional spray in the event of seal leakage that could pose a hazard to personnel located near the pump. Spray guards shall be constructed of a solid sheet material.

**5.13.2 Threads.** All threaded parts, such as bolts, nuts, and plugs, shall conform to ASME standards unless otherwise specified.

**5.13.3 Lifting Rings.** A lifting ring or other equivalent device shall be provided to facilitate handling the frame and associated assembly if its mass exceeds 60 lb (27 kg). The frame assembly lifting ring must not be used to lift the entire pump or assembly. Eyebolts on motors are not suitable for lifting the entire pump and motor assembly. The pump supplier's instructions shall provide lifting instructions.

**5.13.4 Tapped Openings.** All tapped openings, including those in the mechanical seal gland that may be exposed to the pumped fluid under pressure, shall be plugged with threaded metal plugs. Plugs normally in contact with the pumped fluid shall be of the same generic material as the casing, except that carbon steel plugs may be used in ductile iron pumps. Threaded plugs shall not be used in the heating or cooling jackets, including glands with heating or cooling passages; instead, snap-in plugs or waterproof tape shall be used to relieve possible pressure accumulation until piping is installed.

All tapped openings in the mechanical seal gland shall be identified to designate their purpose. This designation shall be cast, stamped, or engraved immediately adjacent to the opening. The markings shall be in accordance with para. 8.3.1. When a steam quench is specified, the inlet connection shall be located at the top quadrant of the mechanical seal gland, and the drain connection shall be located at the bottom position of the mechanical seal gland to prevent the formation of water pockets.

**5.13.5 Identification.** The manufacturer's part identification number and material designation shall be cast, stamped, or engraved on the casing, cover, and impeller.

**5.13.6 Adapter.** The bearing frame adapter shall be designed to resist a torque at least as high as the ultimate torque strength of the pump shaft at the coupling end. The frame adapter or adapter ring, when it clamps the rear cover plate to the casing, shall be made of a suitable ductile material, such as cast ductile iron or cast carbon steel.

**5.13.7 Baseplates.**

**5.13.7.1 General.** When provided, baseplates shall be single piece and designed in accordance with ANSI/HI 14.3, which includes grouted (fabricated steel or cast iron), nonmetallic, and freestanding baseplates. The purchaser shall specify the type and desired features.

**5.13.7.2 ASME B73 Standard Baseplate.** When an ASME B73 Standard baseplate is specified, the baseplate shall have the following options available and provided when specified:

*(a)* fabricated steel construction with continuous welding (no skip welds) on all top surface welds

*(b)* pump and motor mounting surfaces machined flat and parallel within 0.002 in./ft (0.17 mm/m)

*(c)* full drain rim with surface sloped to minimum 1-in.-NPT drain connection to allow complete drainage

*(d)* motor alignment adjusters

*(e)* devices to allow lifting of complete unit (pump, motor, baseplate, and attached auxiliaries)

NOTE: Some auxiliaries may need removal for safe handling in the field.

**5.13.7.3 Industrial Duty Grouted Fabricated Steel Baseplate.** When an industrial duty fabricated steel baseplate is specified, the baseplate shall include

*(a)* a fully decked and fabricated steel construction.

*(b)* cross member supports designed to provide stiffness and lock into grout.

*(c)* continuous welding (no skip welds) on all top surface welds.

*(d)* welded pump and motor mounting surfaces machined flat and parallel within 0.002 in./ft (0.17 mm/m). The pads shall be larger than the foot of the mounted equipment, including extra width of shims.

*(e)* driver mounting pads machined to allow for the installation of shims at least $\frac{1}{8}$-in. (3 mm) thick.

*(f)* full drain rim with surface sloped to minimum 1-in.-NPT drain connection to allow complete drainage.

*(g)* motor alignment adjusters.

*(h)* devices to allow lifting of complete unit (pump, motor, baseplate, and attached auxiliaries).

*(i)* end caps to increase stiffness and retain grout.

*(j)* at least 2 in. radii in the plan view for the outside corners of the baseplate in contact with the grout.

*(k)* the bottom surface shall be primed for epoxy grouting.

*(l)* at least one 4-in. grout hole that is centrally located in each section created by structural members. Sufficient vent holes shall be provided to allow complete venting of each section or high spot. Vent holes shall be a minimum $\frac{1}{2}$-in diameter.

**5.13.7.4 Nonmetallic Baseplate.** When a nonmetallic baseplate is specified, the baseplate shall include the following features:

*(a)* Nonmetallic baseplates shall be available for grouted, concrete filled (pedestal), or free-standing installation.

NOTE: Free-standing, nonmetallic baseplates may not be suitable for large horsepower applications due to the transferred motor torque to the baseplate. Check with the manufacturer for allowable horsepower.

*(b)* Nonmetallic materials shall be polymer composite materials (i.e. polymer concrete, filled epoxy, or other filled polymeric materials). When specified, the selection of baseplate materials shall be compatible with the pumped fluid.

*(c)* Threaded stainless steel inserts permanently fixed within the baseplate material are required for all pump and motor feet bolting. When specified, the selection of insert materials shall be compatible with the pumped fluid or the local environment.

*(d)* Individual pump and motor mounting surfaces shall be coplanar within 0.002 in./ft (0.17 mm/m). Parallel flatness between pump and motor mounting surfaces shall be within 0.005 in./ft (0.43 mm/m). The mounting surfaces shall be larger than the foot of the mounted equipment, including extra width of shims.

*(e)* Catch basin/drain pan under pump with a minimum $\frac{1}{2}$-in.-NPT drain port.

*(f)* Separate metallic or nonmetallic motor mounting blocks may be required to establish the correct motor shaft centerline.

*(g)* Supplier shall inform the purchaser when the specified nonmetallic baseplate does not conform to the dimensions shown in Table 1-2.

**5.13.7.5 Cast Iron Baseplate.** When a cast iron baseplate is specified, the baseplate shall include the following:

*(a)* single piece cast iron construction, Cast Iron Specification ASTM A48

*(b)* one in radius corners

*(c)* integral cast in cross bracing for reinforcement to maximize rigidity and torsional stiffness and lock in grout

*(d)* machined pads for pump and motor mounting that are larger than the foot of the mounted equipment, including extra width of shims

*(e)* motor and pump mounting pads machined flat and parallel within 0.005 in./ft

*(f)* 4 in. diameter grout hole and 1 in. diameter vent holes

*(g)* optional primer for epoxy grout on the underside

*(h)* optional 316SS drip pan with $\frac{1}{2}$-in.-NPT drain connection

**5.13.7.6 Free-Standing Baseplate** When a free-standing baseplate is specified, the baseplate shall include the following features:

(a) Standard designs shall be available to accommodate motor sizes up to and including those shown below:

| Motor Number of Poles | Maximum Motor Nameplate, hp (kW) |
|---|---|
| 2 | 75 (55) |
| 4 | 60 (45) |
| 6 | 40 (30) |

NOTE: Users may choose to mount B73.1 pumps and motors that are larger than those in the chart above to free-standing bases. However, this normally will require that the free-standing base incorporates cross-bracing and is outside the scope of this Standard. The user is cautioned that all free-standing base designs, including cross-braced designs, must be structurally rigid as to limit the movement of the driver shaft relative to the pump shaft to 0.002 in. (0.05 mm) parallel offset when the driver nameplate horsepower plus the maximum moment on the suction nozzle (same direction as shaft rotation) is applied.

(b) Open channel or cast iron baseplates which are intended for and rely on a grouted installation for proper stiffness are not allowed for use as a free standing baseplate. The essential design feature of freestanding baseplates is a closed cross section formed by welding a bottom plate to the channel flanges. This forms a closed cross section that is much stiffer in both bending and torsion than an open channel.

(c) Continuous welding (no skip welds) on all top surface welds.

(d) The top plate minimum thickness shall be $\frac{1}{2}$ in. (or 12 mm) for baseplate length less than 60 in. and $\frac{5}{8}$ in. (or 16 mm) when baseplate length is equal to or greater than 60 in. Minimum bottom plate thickness shall be $\frac{1}{2}$ in. (or 12 mm).

(e) Welded pump and motor mounting surfaces machined flat and parallel within 0.005 in./ft. The pads shall be larger than the foot of the mounted equipment, including the extra width of shims.

(f) Driver mounting pads machined to allow for the installation of shims at least $\frac{1}{8}$ in. thick.

(g) Freestanding baseplates shall have four stilts/feet with one pair located so that it is in a plane that passes through the pump discharge nozzle centerline and the other pair located at the approximate center of gravity of the motor.

(h) No grout holes are to be cut in baseplate.

(i) The baseplate shall be so structurally rigid as to limit the movement of the driver shaft relative to the pump shaft to 0.002-in. (0.05-mm) parallel offset when the driver nameplate horsepower plus the maximum moment on the suction nozzle (same direction as shaft rotation) is applied.

**5.13.8 C-Face Motor Adapter.** A C-face motor adapter rigidly connects a C-face motor to the pump bearing frame, to minimize or eliminate the need for alignment. See Figure 5.13.8-1. Successful installation requires control of manufacturing tolerances, proper coupling selection, and, in some cases, initial motor alignment.

Tolerance cannot always be controlled to ensure shaft alignments will meet requirements with all pump components; therefore, special consideration such as adjustment features and/or flexible couplings must be used to ensure satisfactory operation.

Larger motors that are too heavy to be cantilevered may require additional support. Refer to the specific supplier's instructions for proper installation and operation.

**5.13.9 Coupling.** When specified, the couplings between driver and pump shall be supplied by the Supplier.

**5.13.9.1** Couplings shall be spacer type with the distance between the pump and driver shaft ends which will permit removal of the back pull out assembly (bearing housing, adapter, impeller, seal, pump coupling hub) without disturbing the driver, driver coupling hub, or the pump casing.

**5.13.9.2** Unless specified otherwise, couplings should be elastomeric or metallic flexible element spacer type.

NOTE: Elastomeric-type couplings are typically supplied on drivers of 100 HP and below.

**5.13.9.3** Unless specified otherwise, couplings shall be selected for a minimum service factor based on the driver rating and the coupling supplier's recommended service factor for the driver type used. Maximum allowable service factor shall be within the coupling manufacturer's specified limits.

**5.13.9.4** If specified, couplings shall be balanced to ISO 21940-11, grade G6.3.

**5.13.9.5** Unless specified otherwise, coupling hubs shall be supplied with a clearance fit as per ANSI/AGMA 9002.

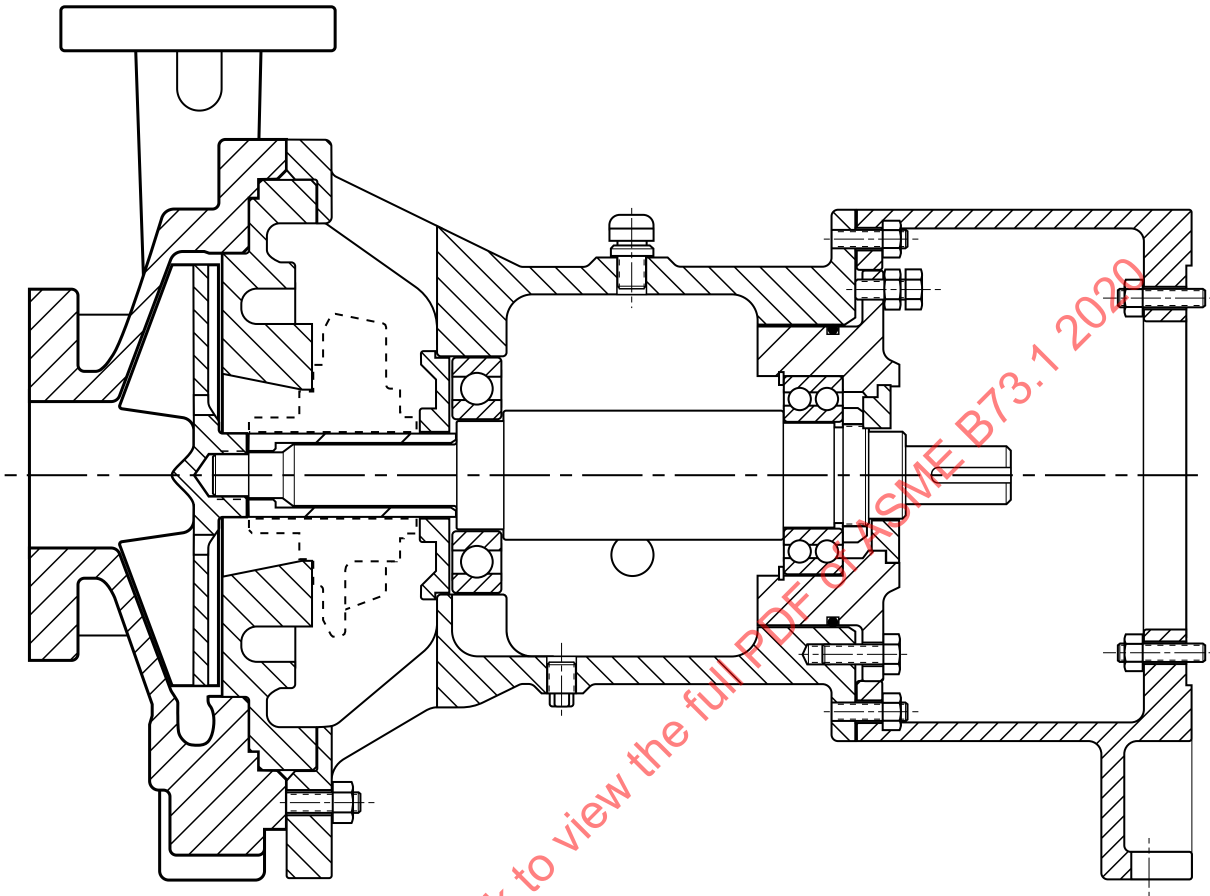
**5.13.9.5.1** When interference fit is specified, straight bore hubs shall be supplied with an interference fit as per ANSI/AGMA 9002. Hubs shall be supplied with tapped puller holes.

**5.13.9.6** Metallic flexible diaphragm or disc type couplings (when provided) shall be designed to positively retain the spacer if a flexible element fails.

## 6 DESIGN AND CONSTRUCTION FEATURES FOR THERMOPLASTIC AND THERMOSET POLYMER MATERIAL PUMPS

This section contains the design and construction features that are unique for thermoplastic and thermoset polymer pumps. Those paragraphs that appear in section 5 that also apply to thermoplastic and thermoset

**Figure 5.13.8-1 Pump With C-Face Motor Adapter, Short Coupled**





pumps have not been repeated in this section, although references to the appropriate paragraphs in section 5 have been made.

## 6.1 Pressure and Temperature Limits

**6.1.1 Pressure Limits.** Pressure limitations shall be stated by the pump manufacturer. See para. 5.8.3 for auxiliary piping.

**6.1.1.1** The pressure-containing wetted parts of thermoplastic and thermoset polymer material pumps, consisting of the casing, sealing cover, and gland, shall have a design pressure at least equal to that shown in Table 6.1.1.1-1. Pumps may be offered at higher design pressures than the minimum stated pressures.

**6.1.1.2** The design pressure of jackets shall be at least 100 psig (689 kPa gage) at the upper temperature application limit corresponding to the pump casing material.

**6.1.1.3** See para. 5.1.1.4.

**6.1.2 Temperature Limits.** Thermoplastic and thermoset polymer material pumps should be available, designed mechanically for a temperature range of −20°F (−29°C) to 248°F (120°C).

**Table 6.1.1.1-1 Thermoplastic and Thermoset Pump Minimum Design Pressures**

| | Minimum Design Pressure at 100°F (38°C) for Maximum Operating Speed | | | |
|---|---|---|---|---|
| | 3,600 rpm | | 1,800 rpm | |
| Nominal Full-Size Impeller Diameter, in. (mm) | psig | kPa gage | psig | kPa gage |
| 6 (152) | 200 | 1 380 | 100 | 690 |
| 8 (203) | 200 | 1 380 | 100 | 690 |
| 10 (254) | 240 | 1 650 | 100 | 690 |
| 13 (330) | ... | ... | 125 | 860 |
| 15 (381) | ... | ... | 160 | 1 100 |

**6.1.3 Test Data.** The pressure–temperature limits of a thermoplastic or thermoset polymer material pump will vary with the materials and the molding process. The manufacturer should have documented test data on the parts made of the composite material on which the pressure–temperature curves are based.

## 6.2 Flanges

The suction and discharge nozzles of thermoplastic and thermoset polymer material pumps shall be flanged or provided with attachments conforming to the dimensions of ASME B16.5 Class 150 for steel flanges, including bolt circle and number and size of bolt holes, except that they shall be flat-faced and be at full raised-face thickness. Threaded bolt holes shall use metallic-threaded inserts. Bolt holes, inserts, or stud locations shall straddle the horizontal or vertical centerline and be subject to the manufacturer's casing pressure–temperature limitations.

Such pumps shall conform to the *X* and *Y* dimensions shown in Table 1-1.

## 6.3 Casing

**6.3.1 Drain Connection Boss(es).** See para. 5.3.1.

**6.3.2 Auxiliary Connection Bosses.** See para. 5.3.2.

**6.3.3 Support.** See para. 5.3.3.

**6.3.4 Disassembly.** See para. 5.3.4.

**6.3.5 Heating or Cooling.** See paras. 5.3.8.1 and 5.3.8.2.

**6.3.6 Gasket(s).** See para. 5.3.9.

**6.3.7 Casing Fasteners for Thermoplastic and Thermoset Polymer Material Pumps.** Metallic materials used to fabricate casing fasteners and washers shall be a 300 series stainless steel or other specified corrosion-resistant material and shall not be in contact with the pumped fluid. Nonmetallic materials shall be compatible with the atmospheric conditions or as specified by the purchaser. Washer contact surface shall be flat and perpendicular (within 3 deg) to the bolt axis. Serrated or split washer surfaces are prohibited. Bolt heads and nuts shall be reinforced by a flat washer or metal backup ring. The metal ring may be integral with another part. When flat washers are used, they shall have a minimum outside diameter of 2 times the bolt diameter or be specified by the purchaser. The manufacturer shall state the assembly torque values in the instruction manual. To maintain even gasket loading, the fasteners shall be tightened in a sequential progression, as stated by the manufacturer.

## 6.4 Impeller

**6.4.1 Types.** See para. 5.4.1.

**6.4.2 Adjustment.** See para. 5.4.2.

**6.4.3 Balance.** For thermoplastic and thermoset polymer material impellers, balancing shall be accomplished by removal of material. A final balancing check shall be performed to assure compliance with ISO 21940-11 Grade 6.3 after final coating in accordance with para. 6.8.1.4.

**6.4.4 Attachment.** See para. 5.4.4.

## 6.5 Shaft

**6.5.1 Diameter.** See para. 5.5.1.

**6.5.2 Finish.** See para. 5.5.2.

**6.5.3 Runout.** See para. 5.5.3.

**6.5.4 Deflection.** See para. 5.5.4.

**6.5.5 Running Clearances.** See para. 5.5.5.

**6.5.6 Critical Speed.** See para. 5.5.6.

**6.5.7 Fillets and Radii.** See para. 5.5.7.

## 6.6 Shaft Sealing

**6.6.1 Design.** The following four basic types of sealing covers shall be offered:

*(a)* seal chamber
*(b)* bolt on seal chamber
*(c)* packing box
*(d)* clamp ring

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 bolt on seal chamber provides a platform for installation of cartridge-mounted mechanical seals. The packing box is designed for packing but may be able to accommodate some sizes and types of mechanical seals without the advantages of a seal chamber.

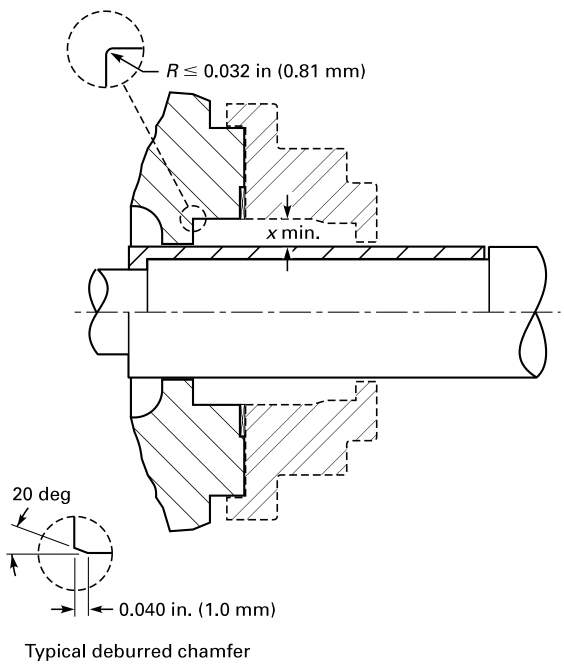
Details and tutorials on piping plans for mechanical seals can be found in API 682. Piping plan designations found in API 682 (e.g., Plan 11, Plan 53A) will be applied to ASME B73 pump applications. Details and designations on piping plans involving pump heating or cooling (e.g., bearing bracket cooling, heating and cooling jackets) can be found in API 610. The piping plan references from API 682 and API 610 shall apply only to the schematic and general description of the piping plan, and not to the specific design of components and hardware that may be contained in these standards.

**6.6.2 Seal Chamber.** See para. 5.6.2.

**6.6.2.1 Seal Chamber Runout.** See para. 5.6.2.1.

**6.6.3 Cover With Bolt on Seal Chamber.** Other types of seals (inside-mounted, Arrangement 2 or 3) may be used with this design (see Figure 6.6.3-1). Note that the universal cover requirements of para. 5.6.3 are not applicable to thermoplastic and thermoset polymer material pumps.

### Figure 6.6.3-1 Cover With Bolt on Seal Chamber




| Dimension Designation | Minimum Radial Clearance, *x* |
|---|---|
| AA – AB | *x* = 5/16 in. (7.94 mm) |
| A05 – A80 | *x* = 3/8 in. (9.52 mm) |
| A90 – A120 | *x* = 1.0 in. (25.40 mm) |

**6.6.4 Packing Box.** See para. 5.6.4.

**6.6.5 Cover With Clamp Ring.** Outside mechanical seals are often used with a cover and a clamp ring (see Figure 6.6.5-1). The bore in both these parts is sized to fit the stationary seat and is not controlled by this Standard. Note that the universal cover requirements of para. 5.6.3 are not applicable to thermoplastic and thermoset polymer material pumps.

**6.6.6 Space Requirements.** See paras. 5.6.6.1 and 5.6.6.2.

#### 6.6.7 Gland

**6.6.7.1 Bolting.** See para. 5.6.7.1.

**6.6.7.2 Gasket.** See para. 5.6.7.2.

**6.6.7.3 Cartridge Seal Glands.** See para. 5.6.7.3.

**6.6.8 Alternate Seal Specification.** See para. 5.6.8.

## 6.7 Bearings, Lubrication, and Bearing Frame

### 6.7.1 Bearings

**6.7.1.1 Design.** See para. 5.7.1.1.

**6.7.1.2 Life.** See para. 5.7.1.2.

**6.7.1.3 End Play.** See para. 5.7.1.3.

### 6.7.2 Lubrication

**6.7.2.1** See para. 5.7.2.1.

**6.7.2.2** See para. 5.7.2.2.

**6.7.2.3** See para. 5.7.2.3.

**6.7.3 Bearing Frame.** See para. 5.7.3.

**6.7.3.1 Sealing.** See para. 5.7.3.1.

**6.7.3.2 Bearing Frame Drain.** See para. 5.7.3.2.

**6.7.3.3 Lubricant Level Indication.** See para. 5.7.3.3.

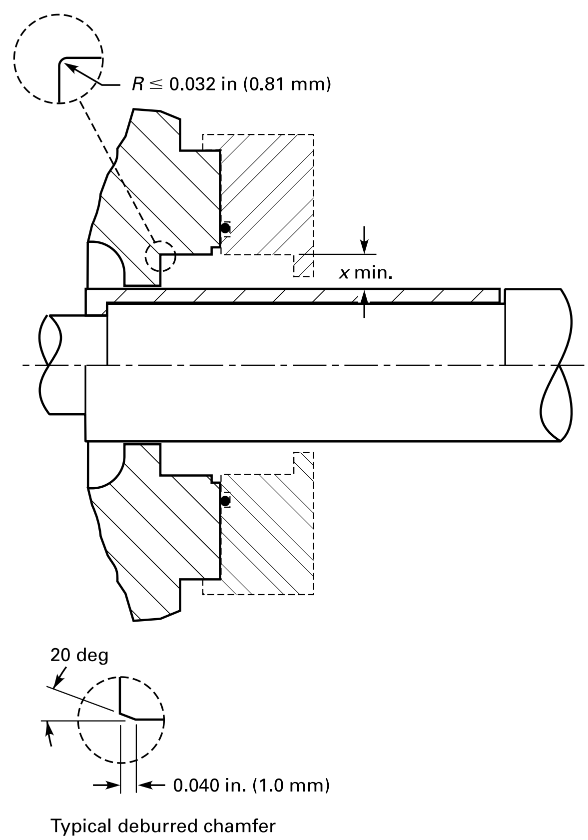
**6.7.3.4 Constant Level Oiler.** See para. 5.7.3.4.

## 6.8 Materials of Construction

### 6.8.1 General

**6.8.1.1** The identifying material of a pump shall be that of which the major pumped fluid wetted parts are constructed.

### Figure 6.6.5-1 Cover With Clamp Ring



**6.8.1.2** The pump material classification code in Table 5.8.1.2-1 shall be used to specify the pump materials of construction with base code 73X for polymer casing, impeller, and cover, and first suffix X for polymer shaft sleeve. Listed below are common materials used.

*(a)* Thermosetting composite shall be able to withstand continuous service with the liquid pumped at temperatures not exceeding 248°F (120°C), unless otherwise qualified by the manufacturer. Thermosetting materials include

*(1)* vinyl esters
*(2)* epoxies
*(3)* polyesters

*(b)* Thermoplastic composite shall be able to withstand continuous service with the liquid pumped at temperatures not exceeding 248°F (120°C), unless otherwise qualified by the manufacturer. Thermoplastic materials include

*(1)* CPVC (chlorinated polyvinyl chloride)
*(2)* PVC (polyvinyl chloride)
*(3)* polypropylene
*(4)* polyethylene
*(5)* polyester
*(6)* PVDF (polyvinylidene fluoride)
*(7)* PTFE (polytetrafluoroethylene)
*(8)* PPS (polyphenylene sulfide)
*(9)* PEEK (polyetheretherketone)

*(c)* Fluoropolymer-lined metallic wetted parts designed for temperatures not exceeding 350°F (177°C) , unless otherwise qualified by the manufacturer.

*(d)* Non-wetted non-pressure-retaining cast iron parts may be ASTM A48.

*(e)* Non-wetted pressure-retaining cast parts shall be a ductile material such as ASTM A216 Grade WCB or cast ductile iron ASTM A395 Grade 60-40-18.

**6.8.1.2.1** When supplied, the pump metallic materials shall be in accordance with the detailed requirements in Table 5.8.1.3-1.

**6.8.1.2.2** Other materials shall be agreed upon by the purchaser and supplier.

**6.8.1.3** No repair by plugging or impregnation is allowed on any parts wetted by the pumped fluid. Impregnation may be used as part of the standard manufacturing process using the equivalent base resin only if done prior to hydrotesting. Other compatible resin materials may be used for impregnation if approved by the purchaser and supplier. Fluoropolymer linings may not be repaired.

**6.8.1.4** Internal and external surfaces of thermoplastic and thermoset polymer material pumps that have been altered by manufacturing processes such as machining, grinding, or filing the as-molded condition shall be coated with the base polymer after these operations. This requirement will assure surface integrity by sealing exposed pores as well as prevent wicking into exposed reinforcement fibers. Other methods of maintaining a nonporous surface shall be agreed upon by the purchaser and supplier.

### 6.8.2 Gland

**6.8.2.1 Materials of Construction.** Mechanical seal glands shall be as a minimum 316 SS. If wetted by the pumped fluid, the gland shall be constructed of the same material specified for the casing or, with purchaser approval, a material having an equivalent or better corrosion resistance. Other materials shall be as agreed by the purchaser and supplier.

**6.8.2.2** See para. 5.8.2.2.

### 6.8.3 Auxiliary Piping

**6.8.3.1** See para. 5.8.3.1.

**6.8.3.2** As a minimum, auxiliary pumped fluid piping shall have a pressure–temperature rating not less than that of the pump discharge flange.

**6.8.3.3** See para. 5.8.3.3.

## 6.9 Corrosion Allowance

The materials of the wetted components shall be mutually selected by the purchaser and pump supplier to provide a minimum life of 2 yr (when operated in accordance with the manufacturer's instructions and pressure–temperature limits in the specified pumped fluid).

## 6.10 Direction of Rotation

See para. 5.10.

## 6.11 Dimensions

See para. 5.11.

## 6.12 Miscellaneous Design Features

**6.12.1 Safety Guards.** See para. 5.13.1.

**6.12.2 Threads.** See para. 5.13.2.

**6.12.3 Lifting Rings.** See para. 5.13.3.

**6.12.4 Tapped Openings.** All tapped openings, including those in the mechanical seal gland that may be exposed to the pumped fluid under pressure, shall be plugged. Threaded plugs shall be of the same material as the pump casing or of a material with an equal or greater corrosion resistance, and shall be capable of containing the hydrostatic test pressure of the casing. Threaded plugs shall not be used in the heating or cooling jackets, including glands with heating or cooling passages; instead, snap-in plugs or waterproof tape shall be used to relieve possible pressure accumulation until piping is installed.

All tapped openings in the mechanical seal gland shall be identified to designate their purpose. This designation shall be cast, stamped, or engraved immediately adjacent to the opening. The markings shall be in accordance with para. 8.3.1. When a quench is specified, the inlet connection shall be located at the top quadrant of the mechanical seal gland, and the drain connection shall be located at the bottom position of the mechanical seal gland.

**6.12.5 Identification.** See para. 5.13.5.

**6.12.6 Adapter.** The bearing frame adapter shall be designed to resist a torque at least as high as the ultimate torque strength of the pump shaft at the coupling end. The frame adapter or adapter ring, when it clamps the rear cover plate to the casing, shall be made of a suitable ductile material, such as cast ductile iron or cast carbon steel. Additionally, a composite adapter may be used on thermoplastic and thermoset polymer material pumps.

**6.12.7 Baseplates.** See para. 5.13.7.

**6.12.8 C-Face Motor Adapter.** See para. 5.13.8.

### 6.13 Inserts and Connecting Fasteners for Thermoplastic and Thermoset Polymer Material Pumps

Inserts shall be encapsulated except for the mating threaded surface. The insert material shall be compatible with the mating fastener. The installed insert shall be capable of being tested to 200% of the assembly values applied to the connecting fasteners or in-service values. Manufacturers shall state nominal fastener torque in the instruction manual. When specified, the manufacturer shall provide evidence that the inserts are capable of a minimum of 20 assemblies at 200% of the assembly values. Fastener tightening to the specified torque values shall be in accordance with the manufacturer's prescribed progressive sequential instructions.

## 7 GENERAL INFORMATION

### 7.1 Application

**7.1.1 Terminology.** Terminology shall be in accordance with ANSI/HI 14.1-14.2 and ANSI/HI 14.6 except as the net positive suction head required (NPSHR) is clarified in para. 7.1.7.

**7.1.2 Nozzle Loading.** Allowable nozzle loading imposed by the piping shall be in accordance with ANSI/HI 9.6.2.

**7.1.3 Sound.** The maximum sound pressure level produced by the pump and driver shall comply with the limit specified by the purchaser. A test, if specified, shall be conducted in accordance with the standards of ANSI/HI 9.1-9.5. Driver noise data must be determined separately.

**7.1.4 Vibration.** The vibration level measured on the pump bearing frame, when specified, at the supplier's test facility at rated condition point (speed ±5%, flow ±5%) shall not exceed the allowable "factory" pump bearing housing vibration limits shown in ANSI/HI 9.6.4 for type OH1 pumps (B73.1 pumps).

**7.1.5 Allowable Operating Region.** Pumps shall be designed to operate continuously between 120% of the flow at the BEP and the minimum flow specified by the manufacturer and meet the requirements of paras. 5.5.4 (shaft deflection), 5.7.1.2 (bearing life), and 7.1.4 (vibration) when pumping water at ambient conditions.

**7.1.6 Preferred Operating Region** Pumps shall be designed with a preferred operating region in accordance with ANSI/HI 9.6.3 when pumping water at ambient conditions.

**7.1.7 NPSHR.** NPSHR is defined as per ANSI/HI 14.6, except this value is equal to or greater than NPSH3. Under special circumstances, NPSHR may be less than NPSH3 if agreed upon between the supplier and the purchaser.

**7.1.8 NPSH Margin.** An operating NPSH margin is necessary to ensure satisfactory operation. A minimum margin of 3 ft (0.9 m) or a margin ratio of 1.2 (whichever yields a higher NPSH requirement) should be made available for all specified operating flows. This margin should be increased if variables exist that will increase the NPSHR of the pump. Refer to ANSI/HI 9.6.1 for additional application information.

**7.1.9 Performance Curves.** Published performance curves in printed or electronic format shall be based on tests conducted in accordance with ANSI/HI 14.6. Accuracy of the curves shall be that 90% of pumps purchased "untested," when operated between minimum allowable flow and BEP, will perform to the published curve within the following tolerances:

*(a)* head +5%, −5%
*(b)* efficiency −5%

NOTE: The published performance curves shall be used for preliminary sizing only and are based on water performance with a simple sealing device such as packing or a single mechanical seal. Other sealing configurations may add to the power requirement. Head and efficiency at flows greater than BEP may have greater variation than the tolerances stated above.

**7.1.9.1 Published Performance Curve Rated Speeds**

**7.1.9.1.1** The following table of curve speeds shall be used for rated speeds except when para. 7.2.1.2(c) is specified by purchaser.

**Table 7.1.9.1-1 Published Performance Curve Rated Speeds**

| Motor Rating Range, hp (kW) | No. of Poles | Frequency: 60 Hz Synchronous Speed | Frequency: 60 Hz Curve Speed | Frequency: 50 Hz Synchronous Speed | Frequency: 50 Hz Curve Speed |
|---|---|---|---|---|---|
| 1 to 10 (0.75 to 7.5) | 2 | 3,600 | 3,510 | 3,000 | 2,900 |
| | 4 | 1,800 | 1,750 | 1,500 | 1,450 |
| | 6 | 1,200 | 1,160 | 1,000 | 950 |
| | 8 | 900 | 870 | 750 | 725 |
| 15 to 25 (11 to 18.5) | 2 | 3,600 | 3,540 | 3,000 | 2,950 |
| | 4 | 1,800 | 1,770 | 1,500 | 1,475 |
| | 6 | 1,200 | 1,775 | 1,000 | 975 |
| | 8 | 900 | 880 | 750 | 730 |
| 30 to 125 (22 to 90) | 2 | 3,600 | 3,550 | 3,000 | 2,950 |
| | 4 | 1,800 | 1,780 | 1,500 | 1,475 |
| | 6 | 1,200 | 1,180 | 1,000 | 975 |
| | 8 | 900 | 890 | 750 | 740 |
| 150 to 500 (110 to 375) | 2 | 3,600 | 3,570 | 3,000 | 2,975 |
| | 4 | 1,800 | 1,785 | 1,500 | 1,485 |
| | 6 | 1,200 | 1,190 | 1,000 | 990 |
| | 8 | 900 | 890 | 750 | 740 |

**7.1.9.1.2** Published performance curves that illustrate multiple impeller diameters shall use the motor speed based on the maximum horsepower for the largest impeller diameter on that curve.

## 7.2 Tests and Inspections

Unless otherwise agreed, the supplier shall give at least 5 working days of advanced notification of an observed or witnessed test or inspection.

### 7.2.1 Tests

#### 7.2.1.1 Hydrostatic

(a) *Metallic Pumps.* After machining, casings, covers, and jackets shall be hydrostatically tested for a minimum of 10 min with water at 1.5 times the maximum design pressure corresponding to 100°F (38°C) for the material of construction used. No visible leakage through the part shall be permitted. Drilled and tapped connections added post-hydro require a visual inspection only, to ensure no voids exist and threads are well formed.

(b) *Thermoplastic Material Pumps.* After machining, the casing and covers shall be hydrostatically tested for a minimum of 10 min with water at 1.5 times the maximum design pressure corresponding to 100°F (38°C) for the material of construction used. No visible leakage through the part shall be permitted.

(c) *Thermoset Polymer Material Pumps.* Irreversible damage can occur to the reinforcement of thermoset reinforced parts that are put under excessive pressure. After machining, the casing and covers shall be hydrostatically tested for a minimum of 10 min with water at 1.1 times the maximum design pressure corresponding to 100°F (38°C) for the material of construction used.

No visible leakage through the part shall be permitted. It should be so noted that due to a combination of material of construction, processing techniques, and thicker wall sections, the length of time to which a part is exposed to pressure may need to be increased to ensure that the part is liquid tight. The decision to test a part longer than 10 min will be left to the manufacturer since they are ultimately responsible for providing a liquid-tight part. An increase in test time can also be requested by the purchaser, with the understanding that there may be an additional charge for this service. The manufacturer should be able to verify through test records that adequate sampling was done to prove that the parts can sustain 1.5 times the maximum design pressure. When a 1.5 hydrostatic test pressure is requested, all parties should agree to the consequences of possible irreversible damage.

#### 7.2.1.2 Performance

(a) *Procedure.* When performance tests are required, they shall be conducted in accordance with ANSI/HI 14.6.

(b) *Acceptance Criteria.* Performance acceptance grade 1B shall be used for all pump input powers. ANSI/HI 14.6 performance acceptance grade 1B includes power or efficiency as an optional guarantee requirement. When specified, the acceptance criteria shall include either power or efficiency at rated condition point. Power acceptance criteria shall include all causes (cumulative tolerances are not acceptable). Measured test data shall be corrected for speed, specific gravity of the rated condition point. The corrected values shall be within the tolerance bands of Grade 1B.

NOTE: The referenced ANSI/HI 14.6–2016 acceptance grade 1B requires that the manufacturer guarantee that the measured pump curve (corrected for speed, specific gravity) will touch or pass through a tolerance band of ±3% total head and ±5% flow surrounding the rated condition point. Due to the typical specific speed and resultant curve shape of pumps supplied in accordance with this standard, the total head tolerance is likely the controlling parameter. The optional power criteria specifies the corrected measured power not exceed 104% of the rated value and the optional efficiency criteria specifies the corrected measured efficiency be no more than 3% below the rated value.

*(c)* Performance tests results shall be corrected for the rated speeds listed in Table 7.1.9.1-1. When specified, the actual nameplate rated speed of the job driver (if provided) shall be used as the rated speed for impeller diameter selection and performance guarantee.

NOTE: If the pump driver is not in the manufacturer's scope of supply, the purchaser should provide the actual rated speed of the intended driver to the manufacturer for impeller diameter selection and performance guarantee. Manufacturers catalog pump curve speeds (Table 7.1.9.1-1) may not accurately represent actual running speed of the job driver. For variable speed applications, there is typically one guaranteed condition point; other operating points are to be used for reference only or as optional test points.

*(d)* When specified, the performance test shall include vibration measurements in accordance with para. 7.1.4.

*(e)* If the tested impeller is required to be trimmed less than 5% of trimmed diameter due to failure to meet acceptance criteria, a retest after trimming is not necessary. Trims of greater than 5% require a retest. If a new impeller is required, a retest is required.

*(f)* A complete written record of the relevant test information, including performance curves, the date of the tests, and the signature of the person(s) responsible for conducting the tests, shall be delivered as part of the pump documentation.

**7.2.1.3 Additional Data.** Additional data, when specified, may be taken during the performance test. These data may include, e.g., vibration, bearing housing temperature, and oil sump temperature. Unless otherwise specified, the additional data shall be taken at the rated duty point. When these data are specified, they shall be conducted in accordance with ANSI/HI 14.6.

**7.2.1.4 Leak.** When specified by the purchaser, the assembled pump shall be leak-tested using a procedure and acceptance criteria as agreed upon. If the assembly is to contain a mechanical seal, consult with the seal manufacturer for the seal static pressure limits before exposing it to the test pressure.

**7.2.1.5 NPSHR.** When NPSHR tests are required, they shall be conducted in accordance with ANSI/HI 14.6. Unless otherwise agreed to by the purchaser and supplier, the NPSH test shall be a Type II test, which is for determination of NPSH3 at the rated flow only.

NOTE: A NPSHR test does not necessarily include a performance test. The purchaser must specify both if desired.

### 7.2.2 Inspections

**7.2.2.1 Final Inspection.** A final inspection may be specified by the purchaser. If specified, the purchaser or purchaser's representative shall be given access to the completed pump assembly for visual inspection of the assembly prior to shipment.

**7.2.2.2 Dismantling and Inspection After Test.** If specified, the pump shall be dismantled and inspected after the test. Inspection procedure and criteria must be agreed upon by the purchaser and supplier.

**7.2.2.3 Inspection of Connection Welds and Castings.** As a minimum, the wetted pressure containing boundary including casing, sealing cover, and auxiliary piping shall be inspected by the manufacturer's standard quality control procedures. When specified by the purchaser, the inspections shall be in accordance with the Inspection Levels in Table 7.2.2.3-1. Visual Inspection (VI), Ultrasonic Inspection (UT), Liquid-penetrant Inspection (PT), Magnetic-particle Inspection (MT) and Radiography (RT) methods and acceptance criteria shall be in accordance with the sections, articles and appendices of the ASME Boiler and Pressure Vessel Code that pertain to the welding/joining and inspection technique(s) used.

**7.2.2.3.1** When a Level 1 inspection of weld connections is specified, it shall be conducted in accordance with AWS B1.11 for evaluation of size of weld, undercut, and splatter. A complete written record of welder, date of welding, method, and filler material must be retained.

**7.2.2.3.2** When a Level 1 inspection of cast parts is specified, a visual inspection shall be conducted in accordance with MSS SP-55 for evaluation of cast surfaces.

## 7.3 Nameplates

Nameplate(s) shall be of 24 U.S. standard gage (minimum) AISI 300 series stainless steel and shall be securely attached to the pump. It shall include, as a minimum, the pump model, standard dimension designation, serial number, size, impeller diameter (maximum and installed), material of construction, and maximum design pressure for 100°F (38°C).

**Table 7.2.2.3-1 Specified Nondestructive Testing Levels**

| Part Type | Level 1 | Level 2 | Level 3 |
|---|---|---|---|
| Wetted pressure-retaining parts — cast | VI | Level 1 plus 100% (MT) or 100% (PT) | Level 2 plus (RT) critical casting sections or 100% (UT) plus wall thickness verification |
| Auxiliary connection welds | VI | Level 1 plus MT or PT | Level 1 plus MT or PT |
| Process piping: butt weld | VI plus 10% RT | Level 1 plus MT or PT | Level 1 plus MT or PT |
| Process piping: socket weld | VI | Level 1 plus MT or PT | Level 1 plus MT or PT |

## 8 DOCUMENTATION

### 8.1 General

The documentation specified covers the minimum required to provide clear communication between the purchaser and supplier, and to facilitate the safe design, installation, operation, and maintenance of the pump. Additional data, as required for specific purposes, shall be available if requested. It is the intent that information be furnished in a similar form from all sources to improve clarity and foster efficient use of the documentation.

### 8.2 Requirements

The following documents shall be supplied for each pump item furnished. There can be a difference between proposal and purchase documents.

*(a)* pump and driver outline drawing
*(b)* centrifugal pump data sheet
*(c)* mechanical seal drawing (if applicable)
*(d)* mechanical seal piping drawing (if applicable)
*(e)* cooling/heating piping drawing (if applicable)
*(f)* performance curve with rated point
*(g)* cross-section drawing with parts list
*(h)* manual describing installation, operation, and maintenance
*(i)* coupling data (if applicable)
*(j)* driver data (if applicable)
*(k)* Statement of Compliance (when specified) (see para. 8.4.6)
*(l)* CMTR for wetted pump parts (when specified) (see para. 8.4.7)

### 8.3 Document Description

#### 8.3.1 Pump and Driver Outline Drawing

*(a)* The pump and driver outline drawing may contain all information shown on, and may be arranged as, the sample outline drawing included herein as Figure 8.3.1-1.

*(b)* Tapped openings, when supplied, shall be identified with the following markings:

| Marking | Purpose |
|---|---|
| I | Casing drain |
| II | Discharge gage or flush connection |
| III | Suction gage or flush connection |
| X | Oil drain |
| XI | Bearing frame cooling |
| F | Mechanical seal flush or lantern ring |
| FI | Flush inlet |
| FO | Flush outlet |
| LBI | Liquid barrier/buffer inlet |
| LBO | Liquid barrier/buffer outlet |
| V | Vent |
| D | Drain |
| Q | Quench |
| C/HI | Cooling/heating inlet |
| C/HO | Cooling/heating outlet |
| CSD | Containment seal drain |
| CSV | Containment seal vent |
| GBI | Gas barrier/buffer inlet |
| GBO | Gas barrier/buffer outlet |

#### 8.3.2 Centrifugal Pump Data

*(a) Data Sheet.* The ASME Centrifugal Pump Data Sheet in Mandatory Appendix I shall be used for all pumps covered by this Standard when the data sheet is initiated by the purchaser. The data sheet, electronic or printed copy, shall be used for inquiry, proposal, and as-built.

*(b) Electronic Data.* See Nonmandatory Appendix A.

#### 8.3.3 Mechanical Seal Drawing

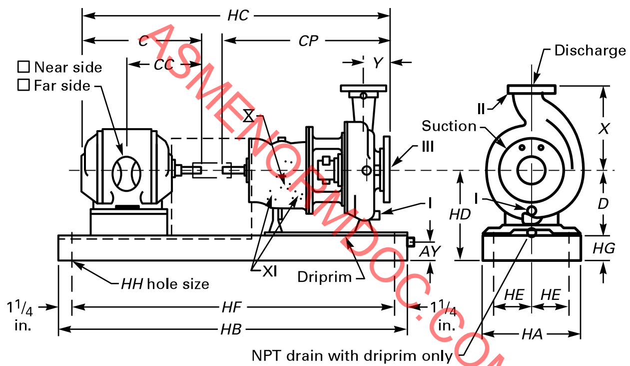
*(a)* A mechanical seal drawing shall be included if the pump is fitted with a mechanical seal.

*(b)* The drawing shall show the general arrangement of the mechanical seal, identifying all parts with name, part number, and material of construction.

*(c)* If a throat bushing is to be installed in the seal cavity, it is to be clearly indicated and identified on the seal drawing.

*(d)* Drawings for noncartridge seals shall include dimensions complete with the seal setting dimension referenced to the seal chamber face.

## Figure 8.3.1-1 Sample Outline Drawing




HC______ CC ______ C ______ D ______ X ______ CP ______ Y ______

| Baseplate | HA | HB | HE | HF | HG | HH | Motor T & TS Frame | HD D-5 1/2 | HD D-8 1/4 | HD D-10 | HD D-14 | AY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

**Pump Casing and Bearing Housing Tapped Openings**

| No. | NPT Size | Qty. | Purpose | Marking | Furnished Yes | Furnished No | Usage |
|---|---|---|---|---|---|---|---|
| I | | | Casing drain | | | | |
| II | | | Discharge gage or flush connection | | | | |
| III | | | Suction gage or flush connection | | | | |
| X | | | Oil drain | | | | |
| XI | | | Bearing frame cooling | | | | |

Pump Size ______ Model ______ Brg. Frame ______

**Flange Holes**

**Suction**: Thru ☐ Tapped ☐
**Discharge**: Thru ☐ Tapped ☐

☐ Class 150 flanges
☐ Class 300 flanges
☐ Flat face flanges
☐ Raised face flanges

**Type of Baseplate**

☐ Steel ☐ With driprim
☐ Cast Iron ☐ With driprim
☐ Adjustable foot supports
☐ Grouted

**Lubrication of Bearings**

☐ Oil
Type of oil lubricator ______
☐ Oil mist ☐ Pure mist
☐ Purge mist
☐ Grease
☐ Grease – lubed for life

**Casing**: ☐ Plain ☐ Jacketed ☐ Traced
**Shaft Type**: ☐ Sleeved ☐ Nonsleeved

**Weight (lb.)**

Pump ______
Driver ______
Baseplate (incl. Cplg. & Guard) ______
☐ Packing Type ______

**Motor Specifications**

Mfg. ______
Frame ______
hp ______ s.f. ______
rpm ______
Enclosure ______
Voltage ______
Hertz ______
Phase ______

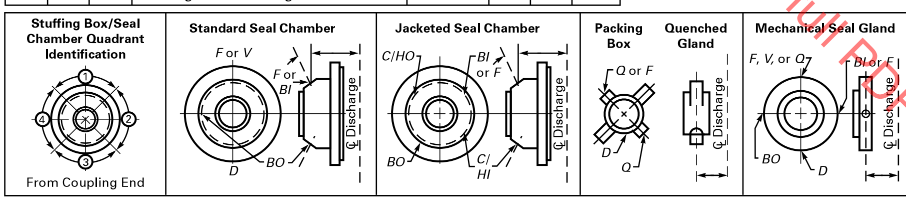
**Coupling Specifications**

Mfr. ______
Type ______ Size ______
Coupling Bores } Pump ______ Driver ______
No. rings ______ Size ______

**Mechanical Seal Specifications**

Mfr. ______
☐ Single ☐ Dual
☐ Cartridge ☐ Pressurized
☐ Bellows
Model ______
Code ______
Dwg. no. ______
For piping B/M, see drawing
No. ______

| | | | |
|---|---|---|---|
| Motor | Furnished by<br>Mounted by | ☐ Others<br>☐ Others | ☐ Pump mfg.<br>☐ Pump mfg. |
| Coupling | Furnished by<br>Mounted by | ☐ Others<br>☐ Others | ☐ Pump mfg.<br>☐ Pump mfg. |
| Coupling Guard | Furnished by<br>Mounted by | ☐ Others<br>☐ Others | ☐ Pump mfg.<br>☐ Pump mfg. |




**Stuffing Box, Seal Chamber, and Gland Connections**

| Marking | NPT Size | Qty. | Purpose | Quadrant | Furnished Yes | Furnished No | Usage |
|---|---|---|---|---|---|---|---|
| F | | | Lantern ring or mechanical seal flush | | | | |
| BI | | | Barrier / buffer fluid inlet | | | | |
| BO | | | Barrier / buffer fluid outlet | | | | |
| V | | | Vent | | | | |
| D | | | Drain | | | | |
| Q | | | Quench | | | | |
| C/HI | | | Cooling / heating inlet | | | | |
| C/HO | | | Cooling / heating outlet | | | | |

**Usage Nomenclature**

A = piped by manufacturer
B = piped by user
C = plugged by manufacturer
D = open (WARNING: Remove shipping plug.)
E = other

Customer / user ______
Location ______
Customer P.O. no. ______ Ser. no. ______
Item no. ______ Equip. no. ______
Factory order no. ______
Certified by ______ Date ______
Rev. ______ Date ______

Drawing is not to scale.
All dimensions are in inches.
Weights are approximate.

Dwg. no. ______

(e) The drawings shall have a title block including the information on the title block from the pump data sheet and have a blank space for the purchaser's identification stamp, measuring $1\frac{1}{2}$ in. × 3 in. (40 mm × 80 mm) min.

### 8.3.4 Mechanical Seal Piping Drawing

(a) A mechanical seal piping drawing or schematic shall be provided if the pump includes a mechanical seal piping system.

(b) The mechanical seal piping drawing or schematic shall contain information and uniform nomenclature consistent with the references given in para. 5.6.1.

### 8.3.5 Cooling/Heating Piping Drawing

(a) A cooling/heating piping drawing or schematic shall be provided if the pump includes a cooling/heating piping system.

(b) The cooling/heating piping drawing or schematic shall contain information and uniform nomenclature consistent with the references given in para. 5.6.1.

### 8.3.6 Performance Curve

**8.3.6.1 Single-Speed Performance.** The single-speed performance curve shall be the composite (family) type curve for full impeller diameter range, plotting head against flow and including efficiency, minimum flow, NPSHR, power consumption, and speed. Power consumption shall be provided at all flows, including shutoff. Performance curves may be categorized as published, proposal, as-built, and test.

(a) The published, or catalog, performance curve shall be as stated above and is based on water. These performance curves are normally found in the manufacturer's catalogs or electronic media and do not reflect a pump configured for a specific pumping application.

(b) The proposal performance curve shall be as stated above. The design impeller diameter shall be indicated with the rated duty point identified on the curve. It is not necessary to include the complete composite (family) curves; however, the maximum and minimum impeller diameter head-flow curves must be included. When the pumped fluid viscosity or specific gravity affects the pump performance, the proposal performance curve shall be corrected for these effects per ANSI/HI 9.6.7. Mechanical seal losses shall be reflected in the proposal performance curve. The proposal performance curves are normally supplied as part of a pump proposal and reflect a pump that has been configured for the specific pumping application.

(c) As-built, or as-configured, performance curves shall be as stated for the proposal performance curves, and they must be for the pump configuration actually supplied to the purchaser. As-built, or as-configured, performance curves are provided as part of the pump's final documentation package.

**8.3.6.2 Variable Speed Performance.** When variable speed operation is specified, variable speed performance curves shall be provided. The requirements and categories of variable speed curves are the same as for single-speed curves (see para. 8.3.6.1), except that the curve will show a composite of curves with a single impeller trim when operated over a range of speeds. The speed for each curve shall be clearly indicated.

**8.3.6.3 Performance Test Curve.** The performance test curve, if specified, shall be at rated speed and as described in para. 7.2.1.2(f), and provided as part of the pump final documentation package.

**8.3.7 Cross-Section Drawing.** The cross-section drawing shall show all components of the pump. It shall be complete with a parts list referenced to the drawing. Nomenclature and definitions should be in accordance with ANSI/HI 14.1-14.2.

### 8.3.8 Instruction Manual

(a) The instruction manual should include information on the correct installation, preparation for start-up, starting up, operation, trouble checklist, and maintenance for the pump model furnished.

(b) Any limitation or warning on the installation, operation, etc., of the unit shall be clearly defined.

(c) The instruction manual shall be in electronic or printed format.

(d) The use of a single manual to describe many similar models of pumps should be minimized to reduce purchaser confusion on the exact model furnished.

(e) The recommended tolerance for coupling alignment shall be supplied to the purchaser.

(f) An instruction manual for the pump driver, mechanical seal, coupling, etc., shall be furnished if included in the scope of supply.

(g) A guideline for developing instruction manuals may be found in ANSI/HI 14.4.

**8.3.9 Coupling Data.** The coupling data shall include the following: manufacturer, type, model, size, spacer length, materials of construction, and hub-to-shaft attachment method.

**8.3.10 Driver.** The driver data shall include manufacturer, nameplate, and dimensional data.

## 8.4 Specially Requested Documentation

Documentation in addition to that listed in para. 8.3 shall be made available when specified.

### 8.4.1 Master Document List

(a) This is a composite list of all documents submitted by the supplier, including title of document and drawing or other identification numbers, with revision dates.

(b) This list shall be submitted along with the first document to apprise the purchaser of the documents that will follow.

(c) Revisions to this document list shall be made as required.

**8.4.2 Allowable External Forces and Moments on Nozzles List.** This list summarizes the allowable external forces and moments on the pump suction and discharge nozzles (see para. 7.1.2).

**8.4.3 Parts List**

(a) A list of all pump parts with pump identification numbers, part numbers, and material descriptions shall be supplied. This list shall be as-built.

(b) A list of recommended spare parts shall be supplied and shall be subdivided into two categories:

(1) for start-up

(2) for 3 yr of operation

(c) A spare parts list for auxiliary equipment shall be supplied with the pump. This would include, as applicable, mechanical seal, coupling, driver, gear boxes, etc.

(d) These lists shall be presented to the purchaser before the equipment is shipped, and reflect the as-built equipment.

**8.4.4 Special Operating and Design Data.** Special operating and design data required by the purchaser shall be supplied. For example, these may include the following:

(a) minimum mechanical seal flush flow

(b) seal chamber/packing box pressure

(c) maximum allowable casing pressure and temperature

(d) maximum allowable jacket pressure and temperature

**8.4.5 Special Testing, Painting, and Preparation.** Any required special testing, painting, and preparation shall be specified on the centrifugal pump data sheet or the purchase order.

**8.4.6 Statement of Compliance.** A statement of compliance shall be included if specified. This statement shall include assurance that the pump is being supplied according to the requirements of the purchase specifications.

**8.4.7 Certified Mill Test Reports (CMTR).** The manufacturers physical and chemical data from mill reports (or certification) of wetted parts when specified.

# MANDATORY APPENDIX I
# ASME CENTRIFUGAL PUMP DATA SHEET (as of November 2019)

See Form I-1 and Form I-1M on the following pages.

## Form I-1 Centrifugal Pump Data Sheet (U.S. Customary)

| ASME B73 | Centrifugal Pump Data Sheet<br>Rev No.:_________ Rev Date:____________________ | Issue Date<br>November 2019 |
|---|---|---|
| | ASME Centrifugal Pumps (US Customary Units)<br>ASME B73.1, ASME B73.2 | Page 1 of 4 |

Usage key - data provided by: ● Purchaser ■ Supplier ▲ Supplier if not by purchaser

1 Issued for: ☐ Proposal ☐ Purchase ☐ As built
2 Facility name / location: ________ | P&ID number: ________
3 Item name: ________ | Purchaser / location: ________
4 Item tag number: ________ | Job number: ________
5 Service: ________ | Purchaser order number: ________
6 Unit: ________ | Supplier / location: ________
7 Number of pumps required: | Supplier order / serial numbers: /
8 ● **GENERAL**
9 ▲ Pump size: ________ | Driver item number: ________
10 ▲ Pump model: ________ | Driver provided by: ________
11 ▲ Pump type: ☐ Horizontal End Suction ☐ Vertical In-line ☐ Repeller | Driver mounted by: ________
12 ☐ Recessed Impeller ☐ Self Priming ☐ Low Flow | Variable speed operation ☐ YES ☐ NO

13 ● **Operating Conditions**

| | | Rated | Maximum | Normal | Minimum | Other | |
|---|---|---|---|---|---|---|---|
| 15 | Flow: | | | | | | (gpm) |
| 16 | | *[1]At flow designated above* | | | | | |
| 17 | Head[1]: | | | | | | (ft) |
| 18 | NPSHA[1]: | | | | | | (ft) |
| 19 | Suct pres[1]: | | | | | | (psig) |

20
21 System design:
22 Suction pressure: min. / max.: _____ / _____ (psig)
23 Suction temperature: min. / max.: _____ / _____ (°F)
24 ☐ Stand alone operation
25 ☐ Parallel operation with item no.: ________
26 ☐ Series operation with item no.: ________
27 Service:
28 ☐ Continuous ☐ Intermittent: _____ starts/day
29 System control method:
30 ☐ Speed ☐ Throttle ☐ System Resistance Only
31

13 ■ **Performance**
14 Performance curve number: ________
15 ▲ Speed: _____ (rpm) ☐ B73 curve speed ☐ Job driver nameplate
16 Maximum differential head @ rated impeller: _____ (ft)

| | *[3] at specified flow* | Rated | Maximum | Normal | Minimum | Other | |
|---|---|---|---|---|---|---|---|
| 18 | Head[3]: | | | | | | (ft) |
| 19 | NPSHR[3]: | | | | | | (ft) |
| 20 | Speed(if variable)[3]: | | | | | | (rpm) |

21 Minimum continuous stable flow: _____ (gpm)
22 Allowable operating region: _____ to: _____ (gpm)
23 Best efficiency point for rated impeller: _____ (gpm)
24 Suction specific speed: _____
25 Impeller diameter Rated: _____ Max: _____ Min: _____ (in)
26 Pump rated power: _____ (BHP) Efficiency: _____ (%)
27 Maximum power with rated impeller: _____ (BHP)
28 **Case pressure rating:**
29 Maximum allowable working pressure: _____ (psig) @ _____ (°F)
30 Hydrostatic test pressure: (psig)
31 ● **Site Conditions and Utilities**

32 ● **Pumped Fluid**
33 Pumped fluid: ________

| | | Rated | Maximum | Normal | Minimum | |
|---|---|---|---|---|---|---|
| 35 | Pumping temperature: | | | | | (°F) |
| 36 | | *[2]At pumping temperatures designated above* | | | | |
| 37 | Specific gravity[2]: | | | | | |
| 38 | Vapor pressure[2]: | | | | | (psia) |
| 39 | Viscosity[2]: | | | | | (cP) |
| 40 | Specific heat[2]: | | | | | (Btu/lb °F) |

41 Atm pressure boiling point: _____ (°F) @ _____ (psia)
42 Liquid: ☐ Hazardous ☐ Flammable pH _____
43 ☐ Other: ________
44 Fluid Rating System: ☐ NFPA 704 ☐ HMIS
45 Health: _____ Flammability: _____ Instability: _____
46 Corrosion / erosion caused by: ________
47 % solids: _____ ☐ % Volume ☐ % Weight
48 Max. particle size: _____ (in)
49 Other:

32 Location: ☐ Indoor ☐ Outdoor Altitude: _____ (ft)
33 Range of ambient temperatures: min. / max.: _____ / _____ (°F)
34 Area classification: ☐ Nonhazardous
35 Cl: _____ Div or Zone: _____ Gr: _____ T Code: _____

| | Electricity | Voltage | Phase | Hertz |
|---|---|---|---|---|
| 37 | Drivers | | | |
| 38 | Heating | | | |

39 Cooling water: Source: ________
40 Supply temp.: _____ (°F) Max. return temp.: _____ (°F)
41 Supply pressure: _____ (psig) Design press.: _____ (psig)
42 Min. return press. _____ (psig) Max. allow. D.P. _____ (psi)
43 Chloride concentration: (ppm)
44 ● **General Remarks**
45 ________
46 ________
47 ________
48 ________

| | Number | Date | Data Revision Description | By | Approved |
|---|---|---|---|---|---|
| 51 | | | | | |
| 52 | | | | | |
| 53 | | | | | |

## Form I-1 Centrifugal Pump Data Sheet (U.S. Customary) (Cont'd)

| ASME B73 | Centrifugal Pump Data Sheet<br>Rev No.:________ Rev Date:________________ | Issue Date<br>November 2019 |
|---|---|---|
| | ASME Centrifugal Pumps (US Customary Units)<br>ASME B73.1, ASME B73.2 | Page 2 of 4 |

Usage key - data provided by: ● Purchaser ■ Supplier ▲ Supplier if not by purchaser

**Mechanical Data**

▲ **Impeller Type:**
☐ Closed ☐ Open ☐ Semi-open

▲ **Casing Mounting:**
☐ Foot ☐ Centerline ☐ Vertical

■ **Bearings:**
▲ Bearing manufacturer: ________
Radial bearing type: ________ No.: ________
Thrust bearing type: ________ No.: ________
▲ Bearing isolators: ☐ Labyrinth (standard) ☐ Magnetic seal
Manufacturer: ________

▲ **Lubrication:**
☐ Oil bath ☐ Pure mist ☐ Shielded (grease)
☐ Grease ☐ Purge mist ☐ Sealed (grease)
☐ Magnetic drain plug in housing ▲ ☐ Oil cooler
■ ☐ Oil viscosity: ISO grade: ________ Other: ________

**Nozzle Connections:**

| | ▲ Size | ▲ Rating | ▲ Facing |
|---|---|---|---|
| Suction: | | | |
| Discharge: | | | |

● **Aux. case connection:** ☐ Drain
▲ Size: ________ NPT / NPS
☐ Threaded ☐ Welded and flanged

▲ **MATERIALS**
Material class code: ________
Casing: ________
Impeller: ________
Cover: ________
Shaft: ________
Shaft sleeve: ________
Baseplate: ________
Casing gasket: ________
Impeller o-ring / gasket: ________
Casing fasteners: ________
Gland fasteners: ________
Bearing housing: ________
Bearing housing adapter: ________
Bearing isolators: ________
Coupling guard: ________
Mechanical seal materials - see page 3

▲ **Coupling Between Pump and Driver**
Specification: ________
Manufacturer: ________
Type: ________
Model / Size: ________
Spacer length: ________ (in)
☐ Coupling balanced to ISO 21940-11, grade G6.3
☐ Straight bore hub with interference fit
Coupling guard type:
☐ Pump supplier's standard ASME B73 Guard
☐ Purchaser Specification: ________
☐ Non-spark coupling guard
Remarks: ________

▲ **Driver**
Power rating: ________ (HP) Speed: ________ (rpm)
Drive HP selected for max. S.G. ________ & max. visc.: ________ (cP)
Driver specification: ________
Driver manufacturer: ________
Driver enclosure: ________ Driver frame: ________
Remarks: ________

● **Baseplate**
Type: ☐ Grouted
☐ Concrete filled (non-metallic pedestal baseplate)
☐ Free standing ▲ Pump CL to foundation ________ (in)
☐ Vertical in-line pump case support bracket
Design: ☐ Purchaser specification ________
☐ ASME B73 standard
☐ Industrial duty grouted fabricated steel
☐ Non-metallic
☐ Cast iron
Remarks: ________

● **Paint, Shipment, and Storage Preparation**
Paint:
☐ Pump supplier's standard
☐ Other: ________
Shipment:
☐ Domestic ☐ Export ☐ Export boxing
Storage:
☐ Outside ☐ Under roof ☐ Environmentally controlled
☐ Short term ☐ Long term (>3 months)
Environment: ________
☐ Supplier's standard preservation specification
Purchaser storage specification: ________
■ Unit shipping weight: ________ (lbs)

● **Tests and Inspections**

| Test: | Non-witnessed | Witnessed | Certificate |
|---|---|---|---|
| Hydrostatic: | ☐ | ☐ | ☐ |
| Leak: | ☐ | ☐ | ☐ |
| NPSHR: | ☐ | ☐ | ☐ |
| Performance: | ☐ | ☐ | ☐ |

Opt perf acceptance criteria: ☐ Power ☐ Efficiency ☐ Neither
Additonal data: ☐ Vibration ☐ Brg temp
☐ Other perf. data: ________
☐ Final inspection Days notification required: ________
☐ Dismantle and inspect after test
☐ Casting repair procedure approval required
☐ Statement of Compliance
☐ Certified Mill Test Reports:
☐ Casing ☐ Cover ☐ Impeller ☐ Shaft
☐ Other: ________
Inspection required for connection welds and castings:
☐ Manufacturer's standard ☐ Level 1 ☐ Level 2 ☐ Level 3
☐ Other: ________
Remarks: ________