ASME B73.2-2003
(Revision of ASME B73.2M-1991)

Specification for Vertical In-Line Centrifugal Pumps for Chemical Process

AN AMERICAN NATIONAL STANDARD



The American Society of Mechanical Engineers

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FOREWORD

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

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

Shortly thereafter, the American National Standards Committee B73 revised the standard, introducing new information on critical speed, bearing housing design, vibration, bearing frame adapter, and bearings. The 1984 edition included, for the first time, an appendix that covered documentation of pump and driver outline drawing, vertical in-line pump data sheet, mechanical seal drawing, stuffing box piping plan, and cooling/heating piping plans.

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

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

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

With the expanding utilization of the ASME B73 pumps in the chemical process industry and its growing acceptance in hydrocarbons processing industry, the B73 committee has continued to improve the B73.2 standard. This revision of the Standard incorporates the addition of the technical documentation of the pump as a mandatory portion of the Standard, which previously appeared as a nonmandatroy appendix. The incorporation is partly in response to the needs of the user community for compliance to U.S. Government regulation covering chemical process equipment and pumps, specifically OSHA Process Safety Management, 29 CFR 1910.119. Recent publications by the Hydraulic Insititute in areas such as preferred operating region and NPSH margin have been incorporated into this revision. Additionally, the material of construction section was expanded to include readily available corrosion-resistant alloy. In total, these revisions to the Standard are intended to better serve process industries and expand the use of ASME B73 pumps worldwide.

Suggestions for improvement in this Standard are welcome and should be sent to the Secretary, B73 Main Committee, American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

This revision was approved as an American National Standard on September 10, 2003.

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Chemical Standard Pumps

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

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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 the Standard may interact with the Committee by proposing revisions and attending Committee meetings. Correspondence should be addressed to:

Secretary, B73 Standards Committee
The American Society of Mechanical Engineers
Three Park Avenue
New York, NY 10016-5990

Proposing Revisions. Revisions are made periodically to the Standard to incorporate changes which 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.

Attending Committee Meetings. The B73 Standards Committee regularly holds meetings or telephone conferences, which are open to the public. Persons wishing to attend any meeting or telephone conference should contact the Secretary of the B73 Standards Committee or check our Web site: http://www.asme.org/codes/.

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SPECIFICATION FOR VERTICAL IN-LINE CENTRIFUGAL PUMPS FOR CHEMICAL PROCESS

1 SCOPE

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

2 ALTERNATIVE DESIGN

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

3 NOMENCLATURE AND DEFINITIONS

3.1 Source

All nomenclature and definitions of pump components shall be in accordance with the Hydraulic Institute, ANSI/HI 1.1-1.2.

3.2 In-Line Pump

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

4 DESIGN AND CONSTRUCTION FEATURES

4.1 Pressure and Temperature Limits

4.1.1 Pressure Limits. Pressure limitations shall be stated by the pump manufacturer.

4.1.1.1 The design pressure of the casing, including seal chamber or stuffing box and gland, shall be at least as great as the pressure-temperature rating of ASME B16.5 Class 150 flanges or B16.42 Class 150 flanges for the material used.

4.1.1.2 The design pressure of jackets shall be at least 100 psig (690 kPa gage) at 340°F (170°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.

4.1.1.3 Casing, stuffing box cover or seal chamber, 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. 5.2.1).

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

4.2 Flanges

Suction and discharge nozzles shall be flanged. Flanges shall conform to ASME B16.5 Class 150 or 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. As an option, Class 300 flanges per ASME B16.5 or B16.42 may be offered subject to the manufacturer's casing pressure-temperature limitations. All pumps regardless of flange rating shall conform to the SD dimension shown in Table 1. SD dimensions shall be the same for all class flanges (see Table 1).

4.3 Casing

4.3.1 Drain Connection Boss(es). Pump casing shall have cast boss(es) to provide for drain connection(s). Boss size shall accommodate ½ in. NPT min. Boss(es) shall be drilled and tapped when specified by customer.

4.3.2 Gage Connection Bosses. The suction and discharge nozzles shall have bosses for gage connections. Boss size shall accommodate ¼ in. NPT min., ½ in. NPT preferred. Boss(es) shall be drilled and tapped when specified by customer.

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

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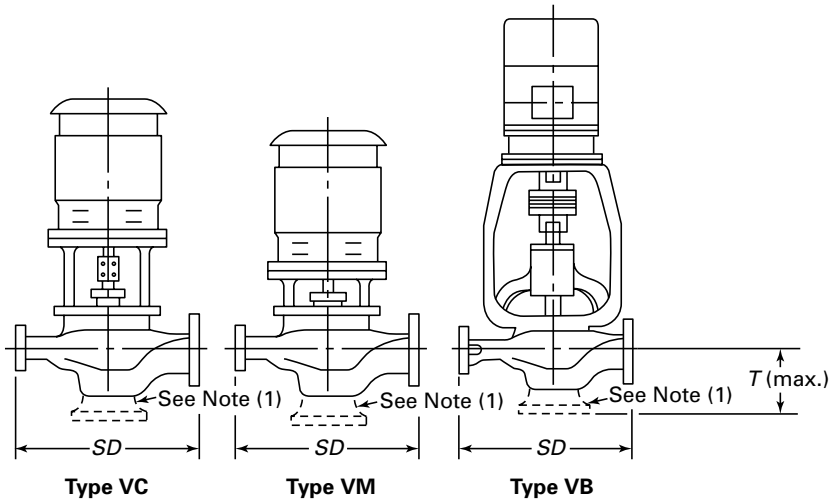

Table 1 Pump Dimensions

Dimensions, mm					Dimensions, in.				
Standard Pump Designation [Note (2)]	Metric Flange Sizes		SD 2.5 −2.0	*T*, Max.	Standard Pump Designation [Note (2)]	ANSI 125, 150, 250, or 300 Flange Sizes		SD +0.10 −0.08	*T*, Max.
	Suction	Discharge				Suction	Discharge		
50-40-380	50	40	380	175	2015/15	2	1.5	14.96	6.89
50-40-430	50	40	430	175	2015/17	2	1.5	16.93	6.89
50-40-480	50	40	480	175	2015/19	2	1.5	18.90	6.89
80-40-380	80	40	380	200	3015/15	3	1.5	14.96	7.87
80-40-480	80	40	480	200	3015/19	3	1.5	18.90	7.87
80-40-610	80	40	610	200	3015/24	3	1.5	24.02	7.87
80-50-430	80	50	430	200	3020/17	3	2	16.93	7.87
80-40-510	80	50	510	200	3020/20	3	2	20.08	7.87
80-50-610	80	50	610	200	3020/24	3	2	24.02	7.87
100-80-560	100	80	560	225	4030/22	4	3	22.05	8.86
100-80-635	100	80	635	225	4030/25	4	3	25.00	8.86
100-80-710	100	80	710	225	4030/28	4	3	27.95	8.86
150-100-610	150	100	610	250	6040/24	6	4	24.02	9.84
150-100-710	150	100	710	250	6040/28	6	4	27.95	9.84
150-100-760	150	100	760	250	6040/30	6	4	29.92	9.84

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

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

4.3.5 Jackets

4.3.5.1 Jackets for heating or cooling the casing, seal chamber, or stuffing box are optional. Connection shall be $\frac{3}{8}$ in. NPT min., with $\frac{1}{2}$ in. NPT preferred.

When a jacket is to be used for steam heating, the inlet connection shall be located at the highest point on the jacket and the drain connection shall be located at the bottom portion of the jacket to prevent the formation of water pockets. Jackets for water cooling shall have a drain for freeze protection.

4.3.5.2 There are several available methods of cooling or heating specific areas of most ASME pumps.

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The following are examples of acceptable methods and should be available as optional features:

(a) stuffing box jacket
(b) seal chamber jacket
(c) pump casing jacket
(d) bolt on external heating and cooling jacket
(e) bearing housing cooling

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

4.4 Impeller

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

4.4.2 Adjustment. Means for external adjustment (without disassembly of the pump except for the coupling guard) of the impeller axial clearance shall be provided if adjustment is required by the design.

4.4.3 Balance. Impellers shall meet ISO 1940/1 Grade 6.3 after final machining.

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

4.5 Shaft

4.5.1 Diameter. The seal mounting surface includes the shaft or shaft sleeve outside diameter within the seal chamber or stuffing box and enough length beyond to accommodate outside seals. The diameter of the seal mounting surface shall be sized in increments of $\frac{1}{8}$ in. (3.2 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).

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

4.5.3 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; and

(b) outside diameter of shaft or removable sleeve in pump: 0.002 in. (0.05 mm) full indicator movement at the gland end of seal chamber or stuffing box (see Fig. 1).

4.5.4 Deflection. Dynamic shaft deflection at the impeller centerline shall not exceed 0.005 in. (0.13 mm) anywhere within the operating region as specified in para. 5.1.6. Hydraulic loads and shaft deflection shall be calculated in accordance with ANSI/HI 1.3.

4.5.5 Running Clearances. Running clearance must be sufficient to prevent internal rubbing contact within the operating region (para. 5.1.6) and with the pump subjected to the maximum allowable flange loads as specified in para. 5.1.2.

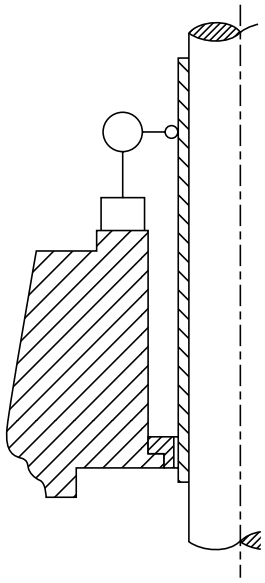

Fig. 1 Shaft Sleeve Runout

4.5.6 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 (see ANSI/HI 9.6.4) is adequate to verify compliance. ANSI/HI 1.3 shall be used to calculate static deflections used for the critical speed calculation.

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

4.6 Shaft Sealing

4.6.1 Design. Two basic types of sealing covers shall be offered, one called a seal chamber and a second called a stuffing box. The seal chamber is designed to accommodate mechanical seals only and can be of several designs for various types of seals. The design includes a separate gland plate where required. The stuffing box is designed for packing, but may be able to accommodate mechanical seals as an alternative. Figures 2 and 3 show some of the piping systems that can be used with the various seals shown in Fig. 4. A separate universal cover adapter to accommodate either a seal chamber or stuffing box is optional.

4.6.2 Seal Chamber. The seal chamber can be a cylindrical or a tapered design. The tapered bore seal chamber shall have a minimum of a 4 deg taper open toward the pump impeller.

The seal chamber shall be designed to incorporate the details quantified on Figs. 5 and 6.

The secondary seal contact surface(s) shall not exceed a roughness of 63 μin. (1.6 μm).

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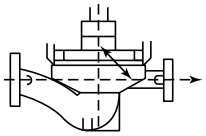
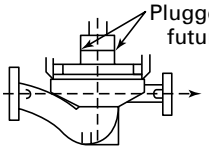
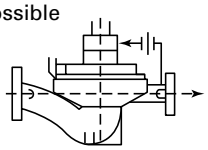
RECIRCULATION OF PUMP FLUID



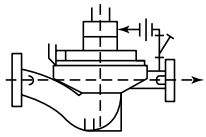
Plan No. 7301
Internal recirculation from pump discharge to seal.



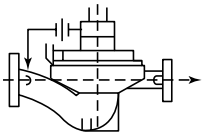
Plan No. 7302
Dead-ended seal chamber with no circulation of flush fluid.
Water cooled chamber jacket and throat bushing required unless otherwise specified.



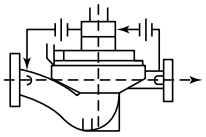
Plan No. 7311
Recirculation from pump case through orifice to seal.



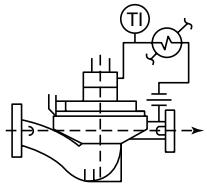
Plan No. 7312
Recirculation from pump case through strainer and orifice to seal.



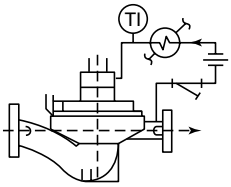
Plan No. 7313
Recirculation from seal chamber through orifice to seal.



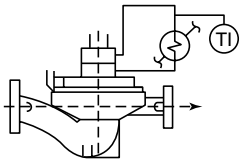
Plan No. 7314
Recirculation from pump case through orifice to seal and simultaneously from the seal chamber through a control orifice (if required) to pump suction. Plan 14 is a combination of Plan 11 and Plan 13.



Plan No. 7321
Recirculation from pump case through orifice and cooler to seal.

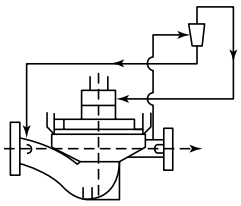


Plan No. 7322
Recirculation from pump case through strainer, orifice, and cooler to seal.

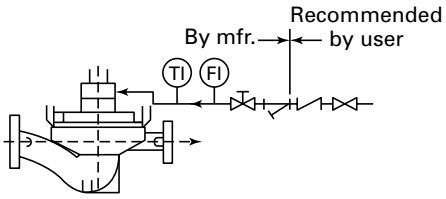


Plan No. 7323
Recirculation from seal with pumping ring through cooler and back to seal.

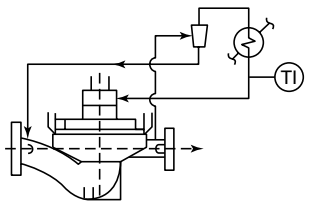
EXTERNAL FLUSHING



Plan No. 7331
Recirculation from pump case through cyclone separator delivering clean fluid to seal and fluid with solids back to pump suction.



Plan No. 7332
Injection to seal from external source of clean, cool fluid.
[See Note (1).]



Plan No. 7341
Recirculation from pump case through cyclone separator delivering clean fluid through cooler to seal and fluid with solids back to pump suction.

LEGEND

- (FI) flow indicator
- (FS) flow switch
- (LS) level switch
- (PI) pressure gage with block valve
- (PS) pressure switch, including block valve, only when specified
- (TI) dial thermometer, only when specified



back pressure regulator



block valve



check valve

flow regulating valve

cyclone separator



filter



heat exchanger



orifice (removable orifice or an integral pressure breakdown arrangement)



trap

Y-type strainer

Fig. 2 Mechanical Seal Piping Plans

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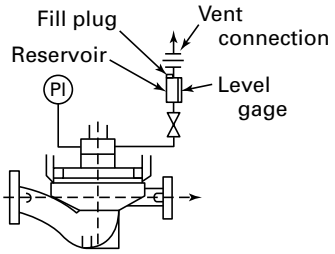
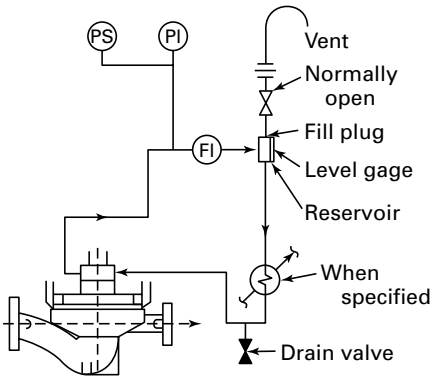
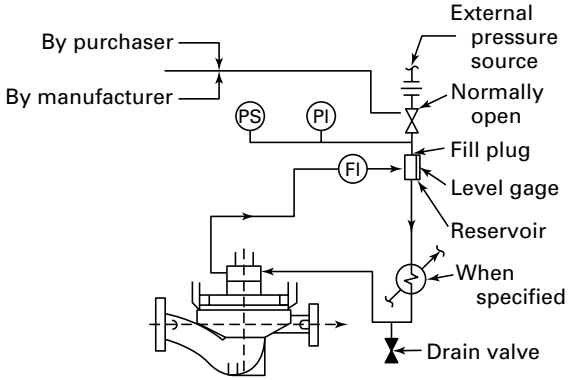


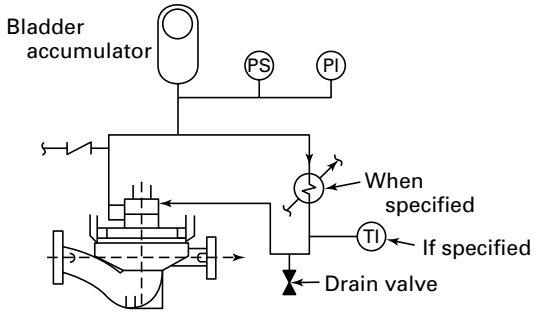
Plan No. 7351
Dead-ended blanket.



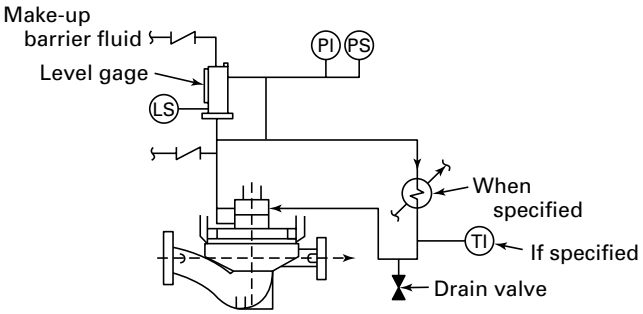
Plan No. 7352
External fluid reservoir for unpressurized dual seals. Thermosyphon or forced circulation, as required. [See Note (1).]



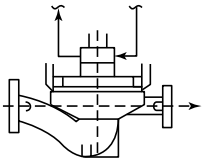
Plan No. 7353A
Pressurized external barrier fluid reservoir supplying clean fluid to the seal chamber. Circulation is by an internal pumping ring. Reservoir pressure is greater than the process pressure being sealed.



Plan No. 7353B
External piping provides fluid for the outer seal of a pressurized dual seal arrangement. Prepressurized bladder accumulator provides pressure to the circulation system. Flow is maintained by an internal pumping ring. Heat is removed from the circulation system by an air-cooled or water-cooled heat exchanger.



Plan No. 7353C
External piping provides fluid for the outer seal of a pressurized dual seal arrangement. Reference line from the seal chamber to a piston accumulator provides pressure to the circulation system. Flow is maintained by an internal pumping ring. Heat is removed from the circulation system by an air-cooled or water-cooled heat exchanger.



Plan No. 7354
Circulation of clean buffer fluid from an external source. [See Note (1).]

Fig. 2 Mechanical Seal Piping Plans (Cont'd)

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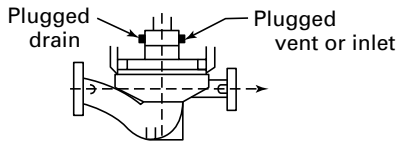
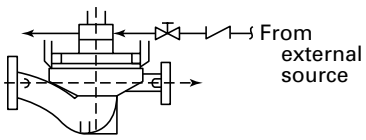


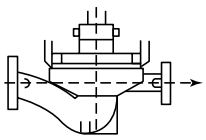
Plan No. 7361

Tapped connections for user's use. Note (1) shall apply when user is to supply fluid (steam, gas, water, other) to auxiliary sealing device.



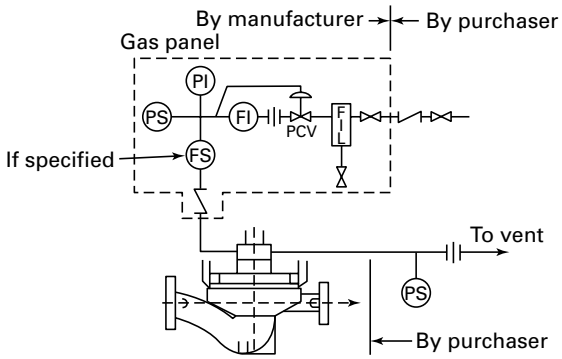
Plan No. 7362

External fluid quench (steam, gas, water, other). [See Note (1).]



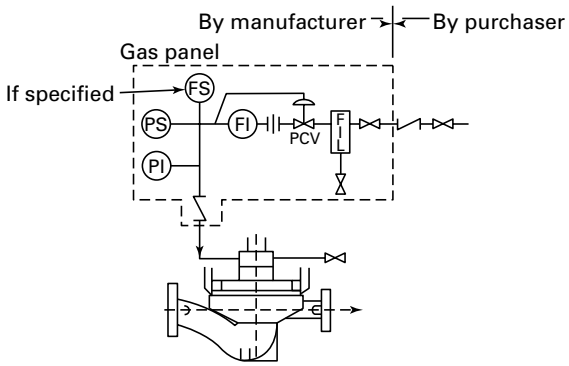
Plan No. 7371

Tapped connections for purchaser's use. Typically this plan is used when purchaser may use buffer gas in the future.



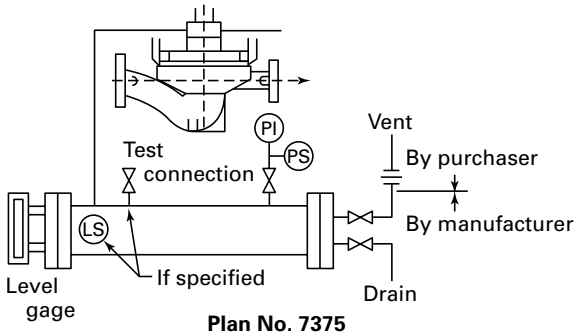
Plan No. 7372

Externally supplied gas buffer used alone to dilute seal leakage or in conjunction with Plan 7375 or 7376 to help sweep leakage into a closed collection system. Pressure of buffer gas is lower than process side pressure of inner seal.



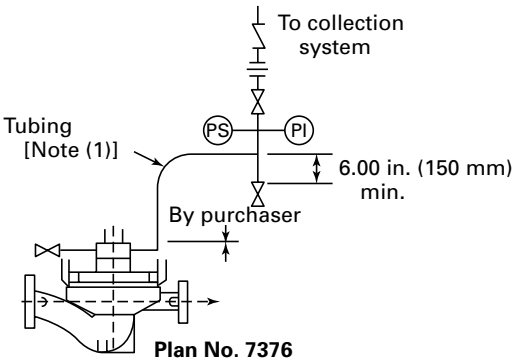
Plan No. 7374

Externally supplied gas barrier gas used to positively prevent process fluid from leaking to atmosphere. Pressure of barrier gas is higher than process side of inner seal. When specified, orifice in barrier gas supply line to be 0.062 in. (1.5 mm).



Plan No. 7375

Containment seal chamber drain for condensing leakage. This plan is used when pumped fluid condenses at ambient temperatures. System is supplied by manufacturer.



Plan No. 7376

Containment seal chamber drain for noncondensing leakage. This plan is used when pumped fluid does not condense at ambient temperatures. System is supplied by purchaser. Tubing shall rise continuously from the CSV connection to the piping/instrument harness.

MATERIALS OF CONSTRUCTION

Code A (a) Tubing: carbon steel, $^3/_8$ in. O.D. min. × 0.035 in. wall, ASTM A 519 or ASTM A 179
(b) Tube Fittings; carbon steel, bite type.
Code B (a) Tubing: 316 stainless steel, $^3/_8$ in. O.D. min. × 0.035 in. wall ASTM A 269 or ASTM A 213
(b) Tube Fittings; 316 stainless steel, bite type.
Code C (a) Pipe: carbon steel, $^3/_8$ in. nominal min. Schedule 40 min., ASTM A 106 Grade B or ASTM A 53 Grade B (screwed piping shall be schedule 80 min.)
(b) Pipe Fittings: carbon steel, 150 , ASTM A 105
Code D (a) Pipe: 316 stainless steel, $^3/_8$ in. nominal min. Schedule 40 S min., ASTM A 312 (screwed piping shall be schedule 80S min.)
(b) Pipe Fittings: 316 stainless steel, 150 , ASTM A 182.
Code E Tubing: armored TFE resin with suitable alloy fittings, design pressure of 350 psi at 500 .
Code F Other (specify).

GENERAL NOTE: These plans represent commonly used systems. Other variations are available and should be specified in detail.

NOTE:

(1) User shall specify fluid characteristics when supplemental seal fluid is provided. Manufacturer shall specify the required flow rate and pressure where these are factors.

Fig. 2 Mechanical Seal Piping Plans (Cont'd)

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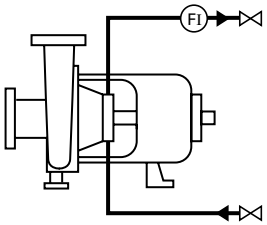
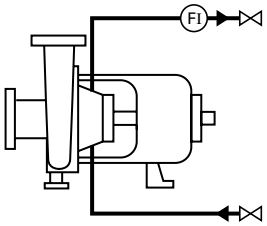
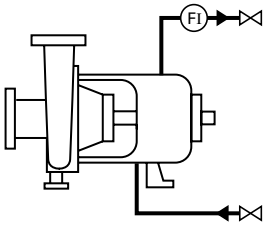


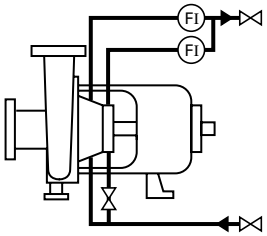
Plan N
Cooling or heating to seal gland



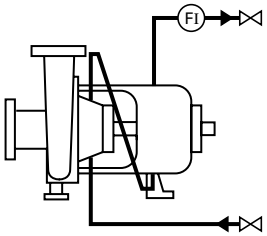
Plan C
Cooling or heating to seal chamber jacket



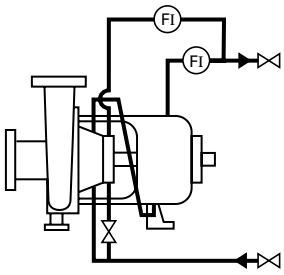
Plan A
Cooling or bearing housing



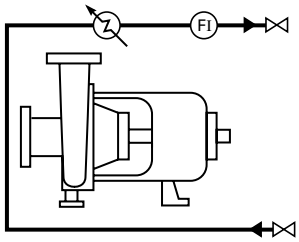
Plan D
Cooling or heating to seal chamber jacket with parallel flow to seal gland



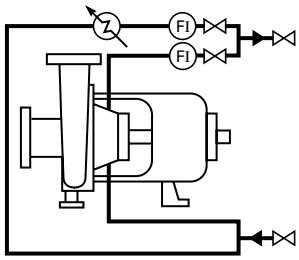
Plan E
Cooling to seal chamber jacket and bearing housing in series



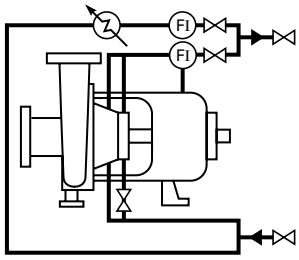
Plan F
Cooling to seal chamber jacket and bearing housing in series with parallel flow to seal gland



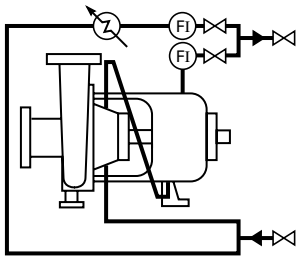
Plan P
Cooling or cooler



Plan J
Cooling to seal chamber jacket with parallel flow to cooler



Plan M
Cooling to seal chamber jacket. Seal gland and cooler in parallel.



Plan K
Cooling to seal chamber jacket and bearing housing in series with parallel flow to cooler

GENERAL NOTE: Flow indications are optional, furnished only when specified.

Fig. 3 Cooling and Heating Piping Plans

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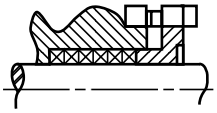
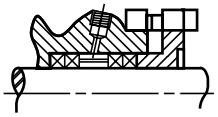
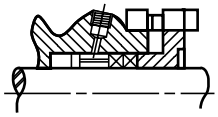
Soft Packing – P



P1: Soft packing without lantern ring



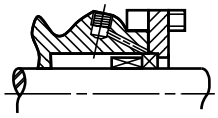
P2: Soft packing with lantern ring. Used for injection or circulation of liquid for sealing, buffering, cooling, etc.



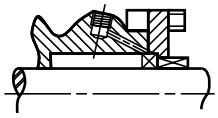
P3: Soft packing with extended flushing throat bushing used for injection or circulation of liquid for cooling, to clear deposits, etc.

Single Mechanical Seal – S

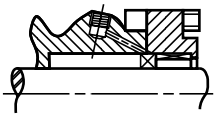
Unbalanced (as in sketches) or balanced. With or without circulation or injection to the sealed faces. With or without throat bushing. See Note (1).



S1: Inside arrangement



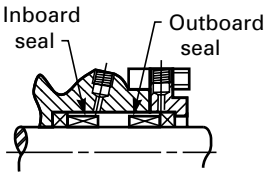
S2: Outside arrangement



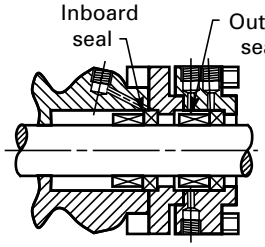
S3: Inside arrangement with rotating seal seat

Multiple Mechanical Seal – D

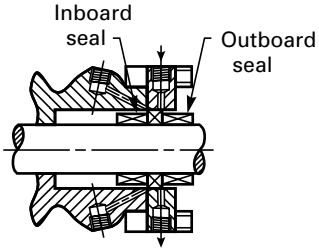
Either or both may be unbalanced or balanced. See Note (1).



D1: Double arrangement



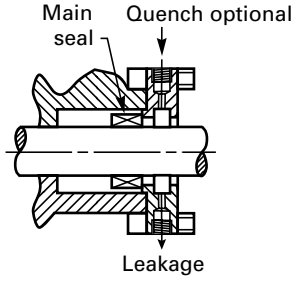
D2: Tandem arrangement



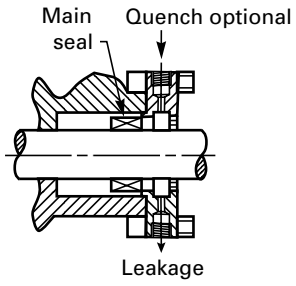
D3: Double arrangement

Quench Arrangement – Q

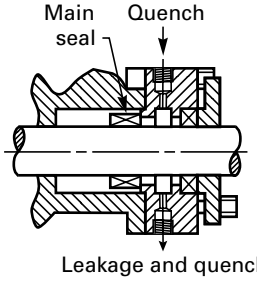
For soft packing, single and double mechanical seal.



Q1: Main seal without throttle bushing or auxiliary seal



Q2: Main seal with throttle bushing



Q3: Main seal with auxiliary seal or packing

GENERAL NOTES:

(a) Liquid quench — in at bottom, out at top

(b) Steam or gas quench — in at top, out at bottom

NOTE:

(1) Add “C” to “S” or “D” for cartridge arrangement.

Fig. 4 Typical Seal Arrangements

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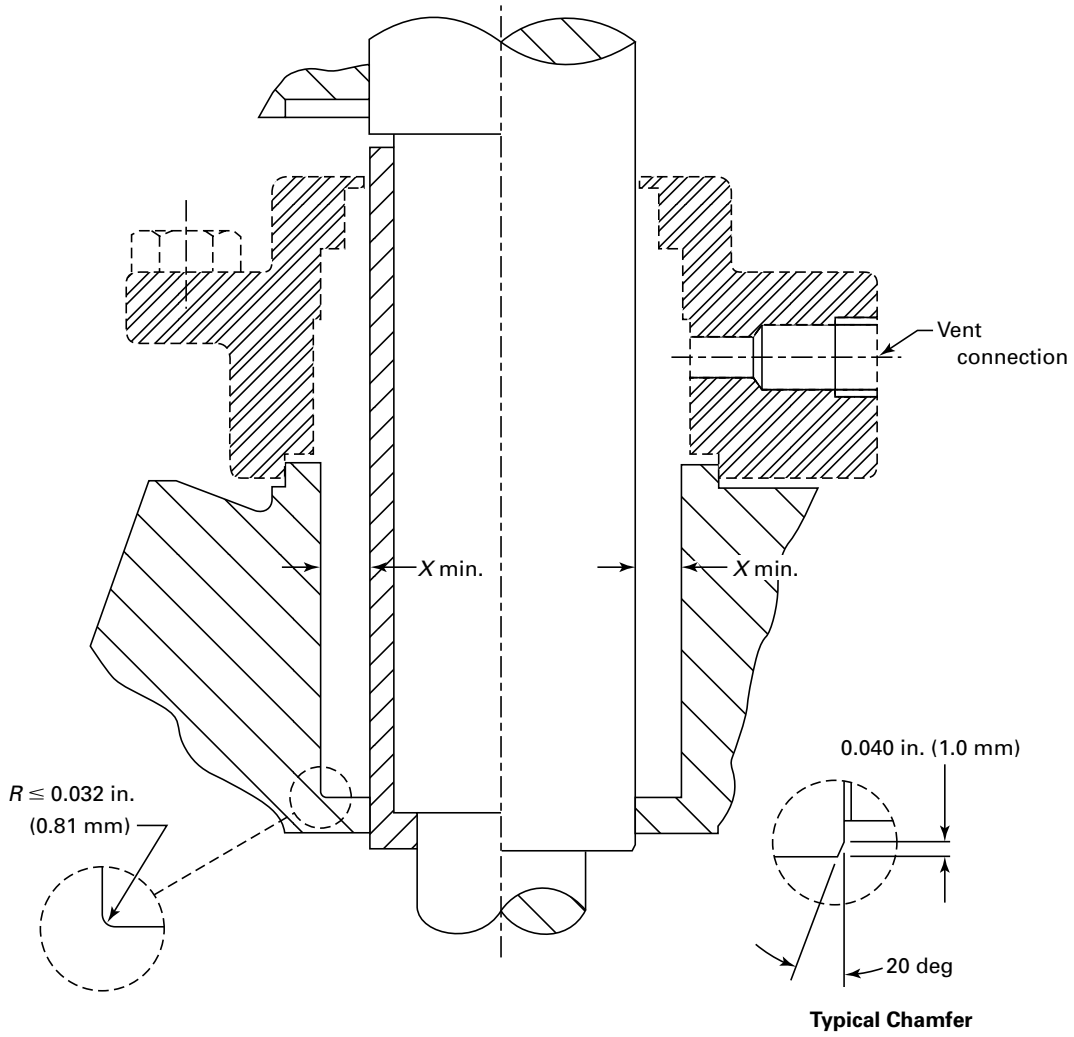

Shaft or Sleeve Diameter	Radial Clearance X Min.
up to 1.5 in. (38 mm)	X = 0.750 in. (19 mm)
more than 1.5 in. (38 mm)	X = 0.875 in. (22.2 mm)

Fig. 5 Cylindrical Seal Chamber

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.

Cartridge seals may center on the shaft and not pilot on the seal chamber.

Pumps equipped with seal chambers experience increased process fluid velocity in the seal chamber and mechanical seal gland area. Any particles in the process fluid, including fluids described as clear that have incidental particles, can collect in this area and cause erosion. Contact the pump manufacturer for solutions that extend the life of the seal chamber and mechanical seal gland.

The size of all piping connections to the seal and seal gland shall be $\frac{1}{4}$ in. NPT min., with $\frac{1}{2}$ in. NPT preferred.

4.6.3 Stuffing Box. The stuffing box packing bore surface shall not exceed a roughness of 63 μin (1.6 μm). One lantern ring connection shall be provided. A second connection and the location of piping connections to the stuffing box and gland is optional. The size shall be

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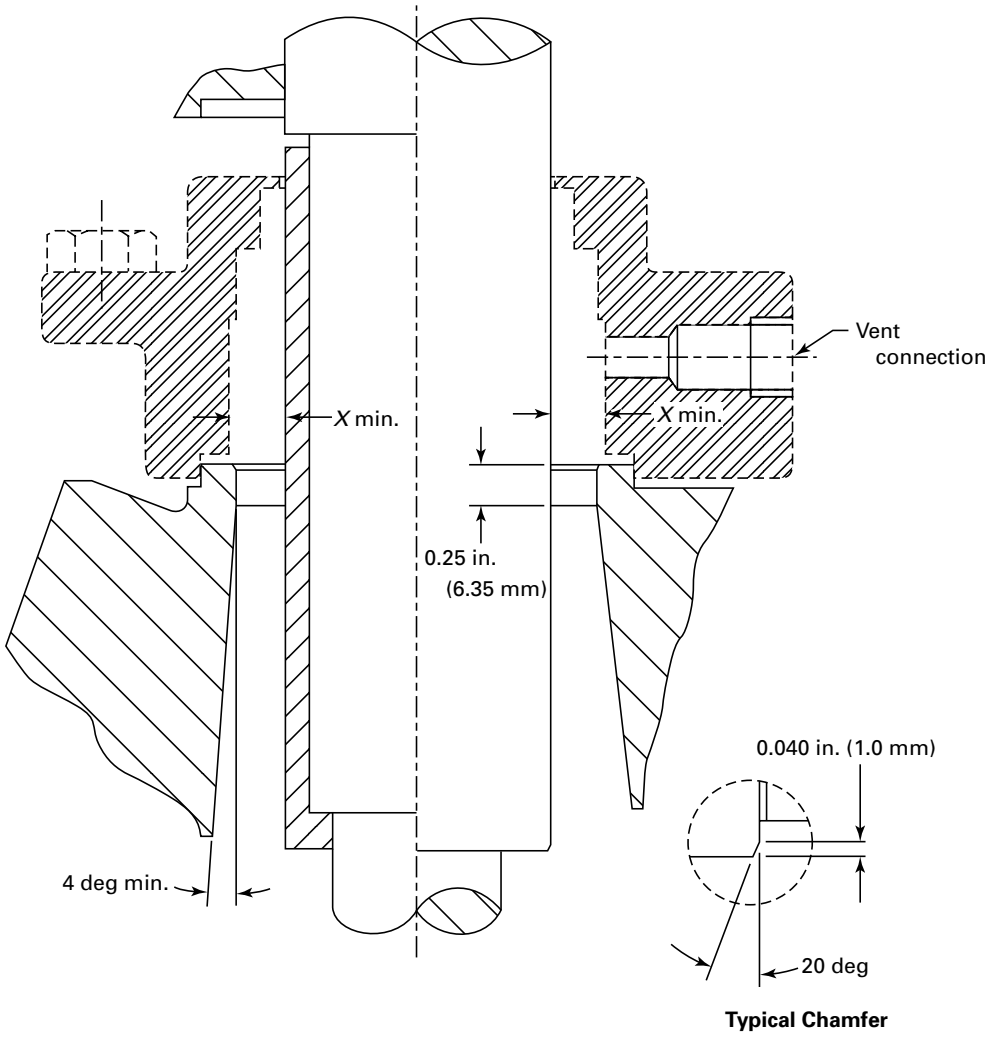

Shaft or Sleeve Diameter	Radial Clearance X Min.
up to 1.5 in. (38 mm)	X = 0.750 in. (19 mm)
more than 1.5 in. (38 mm)	X = 0.875 in. (22.2 mm)

Fig. 6 Tapered Seal Chamber

¼ in. NPT min., ½ in. NPT preferred. Registers shall maintain the stuffing box bore concentric with the axis of the pump shaft within 0.005 in. (0.13 mm) FIM and the stuffing box face perpendicular to the axis of the assembled pump shaft within 0.003 in. (0.08 mm) FIM. Figure 7 shows the recommended stuffing box dimensions.

The stuffing box also shall be suitable for proper installation and operation of mechanical seals, including means of eliminating trapped air or gas at the highest practical point.

4.6.4 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 given in 4.6.4(a) and (b). On smaller 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

(a) Seal Chamber Face Runout. This is a measure of the squareness 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 the total indicator runout at the face of the seal chamber. The maximum allowable runout is 0.003 in. (0.08 mm) FIM (see Fig. 8).

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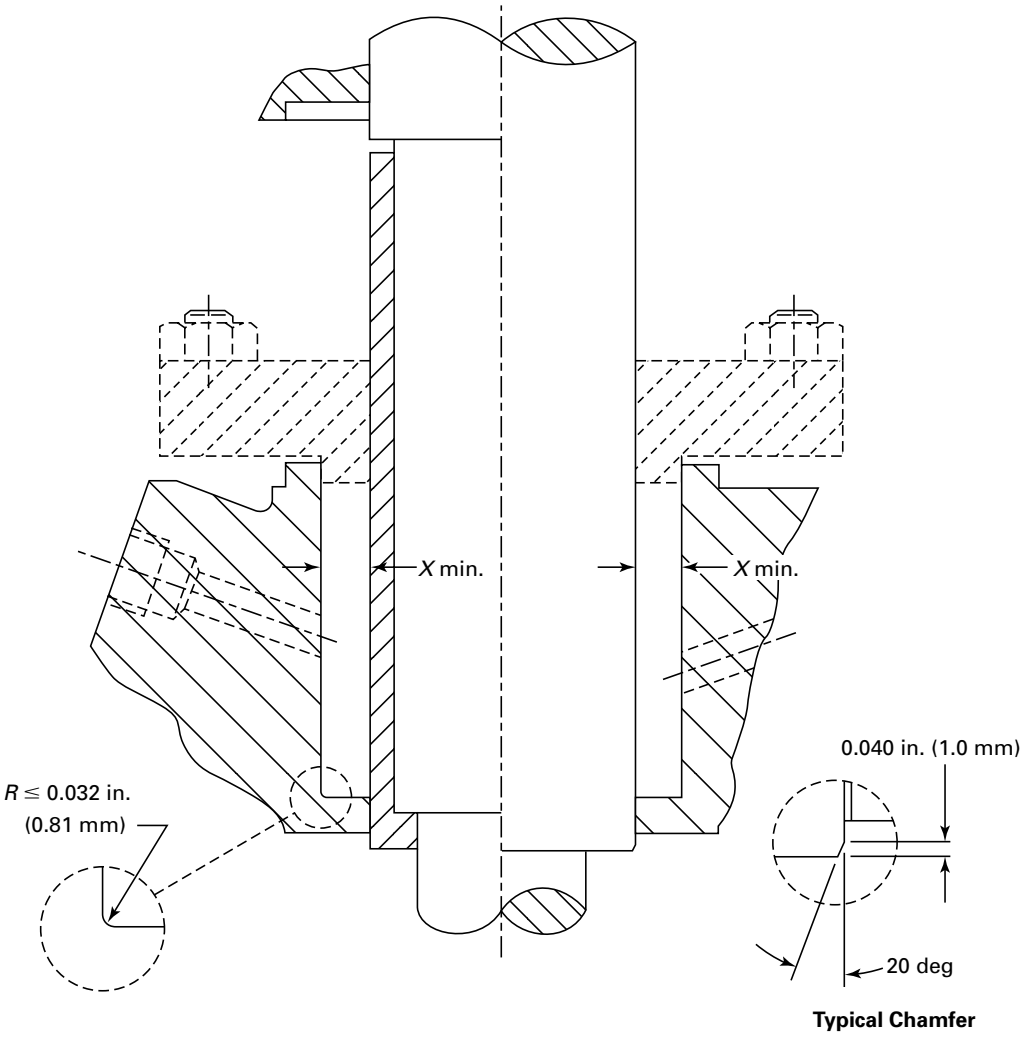

Shaft or Sleeve Diameter	Radial Clearance X Min.
up to 1.5 in. (38 mm)	X = .312 in. (7.94 mm)
more than 1.5 in. (38 mm)	X = .375 in. (9.52 mm)

Fig. 7 Stuffing Box

(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 with the shaft and shall have a total indicator runout reading no greater than 0.005 in. (0.13 mm) FIM (see Fig. 9).

4.6.5 Space Requirements

4.6.5.1 Space in the various seal chamber designs shall provide for one or more of the following configurations of cartridge or noncartridge seals:

(a) single inside mechanical seal, balanced or unbalanced, with or without a throat bushing, and with or without a throttle bushing

(b) double seal, balanced or unbalanced inboard and outboard

(c) outside mechanical seal, balanced or unbalanced, with or without a throat bushing

(d) tandem seals, either balanced or unbalanced

(e) gas seals

4.6.5.2 Space in the stuffing box and exterior clearance area shall provide for

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

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

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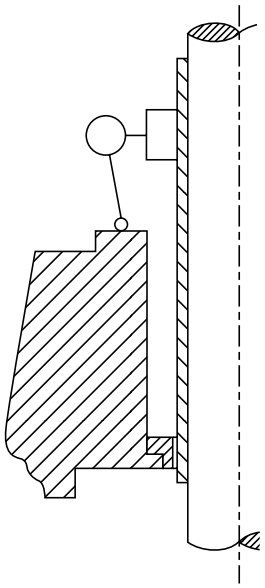

Fig. 8 Face Runout

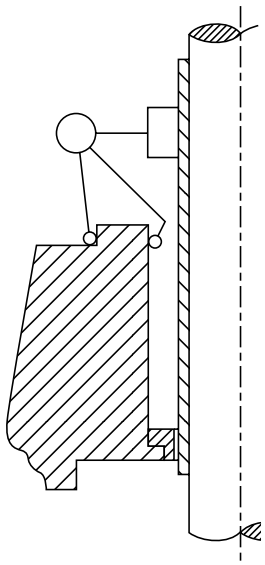

Fig. 9 Register Concentricity

4.6.6 Gland

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

(a) two-bolt or four-bolt for packing; and

(b) four-bolt for mechanical seals.

Minimum gland bolt size shall be $\frac{3}{8}$ in.

4.6.6.2 Gasket. The gland-to-seal chamber gasket or O-ring used for mechanical seals shall be confined on the atmospheric side to prevent blowout. It is acceptable for cartridge seals to pilot off of the shaft and not require a register fit to the seal chamber.

4.6.6.3 Materials of Construction. The mechanical seal gland shall be 316 SS min. Reference ASTM A276 for glands made from wrought bar and ASTM A744 (CF8M) for glands made from castings. Other materials shall be the purchaser's option.

4.7 Driver and Coupling Design

4.7.1 Coupled Design VC (Vertical Coupled). The pump shaft is attached to the motor shaft by a rigid spacer coupling, permitting removal of the pump shaft, shaft seal, and impeller without disturbing the motor (see Table 1).

(a) Drive motor for VC pumps shall be NEMA P-base In-Line Pump Motor, available in all standard enclosures. These P-base motors shall have mounting and shaft extension dimensions per NEMA Standard MG 1-18.620 (see Table 2).

(b) Tolerance for mounting and shaft dimensions for P-base motors shall also be per NEMA Standard MG 1-18.620.

4.7.2 Motorshaft Design VM (Vertical Motor Shaft). Pumps that have the impeller mounted on an extended motor shaft (see Table 1).

(a) Motors for VM pumps shall be NEMA JM or JP solid shaft, designed for vertical operation (JMV, JPV), with mounting and shaft dimensions per NEMA MG 1-18.614. Alternative shaft extension dimensions may be offered.

(b) Tolerances for mounting and shaft dimensions for the JMV/JPV motors shall be per NEMA MG 1-18.614.

4.7.3 Bearing Housing Design VB (Vertical Bearing Housing). Pumps that have their own bearing housings and bearings designed to handle the pump loads (see Table 1).

(a) Motors for VB pumps shall be NEMA C-face motors, available in all standard enclosures.

(b) Tolerance for mounting and shaft dimensions shall be per NEMA MG 1-11.35.

(c) The pump shaft is attached to the motor shaft by a flexible spacer coupling, permitting removal of the pump shaft, seal, and impeller without disturbing the motor.

4.7.4 Motor Horsepower Selection. Motors shall be selected having nameplate horsepower ratings at least as high as in Table 3, based on the pump rated bhp in the Table. Where it appears that using this Table leads to unnecessary oversizing of the motor, an alternative size may be offered in addition to the Table selection.

4.7.5 Bearings — VC and VM Pumps

(a) Duty. The motor bearings shall carry the hydraulic radial and thrust loads imposed by the pump, in addition to the weight of all rotating parts.

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Table 2 Nominal Shaft Extension and Mounting Dimensions for Vertical Solid Shaft P-Base In-Line Pump Motors

NEMA Frames	Shaft Diameter, *U*	Length of Shaft with *U* Diameter, *V*	Shaft Protrusion Below Base, *AH*	Rabbet Diameter, *AK*	Bolt Circle, *AJ*	Base Diameter, *BD*
143 & 145-LP	1 1/8	2 3/4	2 3/4	8 1/4	9 1/8	10
182 & 184-LP	1 1/8	2 3/4	2 3/4	8 1/4	9 1/8	10
213 & 215-LP	1 5/8	2 3/4	2 3/4	8 1/4	9 1/8	10
254 & 256-LP	1 5/8	2 3/4	2 3/4	8 1/4	9 1/8	10
284 & 286-LP	2 1/8	4	4 1/2	13 1/2	14 3/4	16 1/2
324 & 326-LP	2 1/8	4	4 1/2	13 1/2	14 3/4	16 1/2
364 & 365-LP	2 1/8	4	4 1/2	13 1/2	14 3/4	16 1/2
404 & 405-LP	2 1/8	4	4 1/2	13 1/2	14 3/4	16 1/2
444 & 445-LP	2 1/8	4	4 1/2	13 1/2	14 3/4	16 1/2

GENERAL NOTE: All dimensions in inches (1 in. = 25.4 mm). See NEMA MG 1-18.620 for complete dimensions.

Table 3 Motor Horsepower Selection

For Pump Rated bhp up to [Note (1)]	Select Motor With Nameplate, hp Rating		Maximum Allowable Motor Load, (hp) [Note (2)]	Percent of Margin, Motor hp	For Pump Rated bhp up to [Note (1)]	Select Motor With Nameplate, hp Rating		Maximum Allowable Motor Load, (hp) [Note (2)]	Percent of Margin, Motor hp
	SF 1.0	SF 1.15				SF 1.0	SF 1.15		
0.70	1	...	1.00	43	21.00	25	...	25.00	19
0.82	...	1	1.15	41	24.40	...	25	28.75	18
1.08	1.5	...	1.50	39	25.50	30	...	30.00	17.5
1.25	...	1.5	1.72	38	29.50	...	30	34.50	17
1.46	2	...	2.00	37	34.50	40	...	40.00	16
1.70	...	2	2.30	35	40.00	...	40	46.00	15
2.25	3	...	3.00	33.5	43.80	50	...	50.00	14
2.62	...	3	3.45	31.5	50.90	...	50	57.50	13
3.85	5	...	5.00	29.5	53.30	60	...	60.00	12.5
4.49	...	5	5.75	28	62.00	...	60	69.00	11.5
5.93	7.5	...	7.50	26.5	67.50	75	...	75.00	11
6.90	...	7.5	8.62	25	78.00	...	75	86.25	10.5
8.10	10	...	10.00	23.5	91.00	100	...	100.00	10
9.36	...	10	11.50	23	104.50	...	100	115.00	10
12.30	15	...	15.00	22	113.50	125	...	125.00	10
14.25	...	15	17.25	21	131.00	...	125	144.00	10
16.60	20	...	20.00	20.5	136.50	150	...	150.00	10
19.20	...	20	23.00	20	156.50	...	150	172.50	10

GENERAL NOTE: 1 hp = 0.746 kW.

NOTES:

(1) bhp at the specified operating condition.

(2) Motor nameplate hp times service factor.

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(b) Life. After tentative selection of the motor size and manufacturer, the pump manufacturer shall be responsible for assuring the bearing life when calculated in accordance with ANSI/ABMA 9, ANSI/ABMA 11, and ISO 281. The minimum L10h bearing life is 17,500 hr in the operating region as defined in para. 5.1.6.1 and for all standard and optional arrangements of bearings, lubrication, shafts, covers, sealing, and impellers.

If the calculated bearing life fails to meet this specification, the pump manufacturer shall determine whether to use a larger or different motor whose bearings will meet the specification, or to reduce the loads sufficiently in order to comply.

(c) End Play. End play in the shaft from the motor thrust bearing and its assembly due to internal bearing clearances and tolerances shall be a minimum to maximize seal and bearing life.

4.7.6 Bearings — VB Pumps

(a) Duty. Pump bearing housing and bearings shall be designed specifically to handle radial and thrust loads imposed by the pump, in addition to the weight of all rotating parts. Motor bearings are not subjected to the additional pump loads.

(b) Life. Bearings shall be selected in accordance with ANSI/ABMA-9, ANSI/ABMA-11, and ISO 281. The minimum L10h bearing life shall be 17,500 hr in the operating region as defined in para. 5.1.6 and for all standard and optional arrangements of bearings, lubrication, shafts, covers, sealing and impellers.

(c) End Play. End play in the shaft from the pump thrust bearing and its assembly due to internal bearing clearances and tolerances shall be a minimum to maximize seal and bearing life.

4.8 Materials of Construction

The identifying material of a pump shall be that of which the major pumpage-wetted parts are constructed. Pumps should be available with the following materials of construction.

Material	Material Specification
Cast ductile iron	ASTM A 395 (for pressure containing parts); ASTM A 395 or A 536 for nonpressure containing parts
Cast carbon steel	ASTM A 216 – Grade WCB
Cast high alloy steel (similar to 316 stainless steel)	ASTM A 744 – Grade CF8M
Cast Alloy 20	ASTM A744 – Grade CN7M
Other	Optional

No repair by plugging, peening, or impregnation is allowed on any pressure- containing, wetted metal parts.

4.9 Corrosion Allowance

The casing, cover, and gland shall have a corrosion allowance of at least 0.12 in. (3.2 mm).

4.10 Direction of Rotation

Direction of rotation shall be clockwise viewed from the motor end of the pump. 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.

4.11 Dimensions

Pump dimensions shall conform to Table 1.

4.12 Miscellaneous Design Features

4.12.1 Safety Guards. As a minimum a coupling guard in accordance with ASME B15.1 shall be furnished on all Type VB and Type VC pumps that include a pump and driver. An auxiliary device to control spray from seal chamber / stuffing box leakage shall be provided when specified. Local regulation may require additional guards.

4.12.2 Threads. All threaded parts, such as bolts, nuts, and plugs, shall conform to ANSI standards.

4.12.3 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). Eyebolts on motors are not suitable for lifting the entire pump and motor assembly. The pump manufacturer's manual shall provide lifting instructions.

4.12.4 Tapped Openings. All tapped openings, including those in the mechanical seal gland which 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 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 should be cast or stamped immediately adjacent to the opening. The markings shall be in accordance with para. 7.3.1. When a steam quench is specified, the inlet connection shall be located at the highest point on the gland, and the drain connection shall be located at the lowest point of the gland to prevent the formation of water pockets.

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

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4.12.6 Driver Pedestal and Adapter. The driver pedestal on Type VB and Type VC pumps and adapter on Type VM pumps shall be designed to resist a torque at least as high as the ultimate torque strength of the pump shaft at the coupling end. When the driver pedestal or adapter is used to clamp the rear cover to the casing, the material properties of the driver pedestal and adapter shall meet the requirement of para. 4.12.7.

4.12.7 Nonwetted Pressure Resisting Components. Nonwetted pressure resisting components shall be made of a material which is classified as ductile throughout the full range of operating temperatures, such as cast ductile iron or cast carbon steel.

4.12.8 Drainage. A threaded drain connection(s) ($\frac{1}{2}$ in. NPT preferred) shall be provided so that liquid will drain from the motor adapter and cover.

5 GENERAL INFORMATION

5.1 Application

5.1.1 Terminology. Pump application and application terminology shall be in accordance with ANSI/HI 1.1-1.2.

5.1.2 Flange Loading. Allowable flange loading imposed by the piping shall be in accordance with ANSI/HI-9.6.2.

5.1.3 Sound. The maximum sound pressure level produced by the pump and driver shall comply with the limit specified by the customer. Tests, if specified, shall be conducted in accordance with ANSI/HI 9.1-9.5. Driver noise data must be determined separately.

5.1.4 Vibration. The vibration level measured on the motor upper bearing housing on VC and VM pumps and on the pump's upper bearing housing on VB pumps at the manufacturer's test facility at rated condition point (speed ±5%, flow ±5%) shall not exceed twice the limits shown in Fig. 9.6.4.5 of ANSI/HI 9.6.4.

5.1.5 Operating Region. Pumps shall be designed to operate continuously between 110% of the flow at the Best Efficiency Point and the minimum flows shown on Table 4, unless specifically noted otherwise by the manufacturer, and meet the requirements of paras. 4.5.4 (shaft deflection), 4.7.5, 4.7.6 (bearing life), and 5.1.4 (vibration) when pumping water at ambient conditions.

CAUTION: The values in Table 4 do not consider minimum thermal flow for a specific installation, therefore, the practical minimum operating flow may be higher than shown. Pumpage is heated as it goes through a pump and the minimum thermal flow is that where the temperature rises enough through the pump that recirculation of some of the flow reduces the available net positive suction head below that required by the pump, resulting in cavitation. Refer to ANSI/HI 1.3, for detailed application information.

5.1.6 NPSH Margin. An operating NPSH margin is necessary to ensure satisfactory operation. A margin of 3 ft or a margin ratio of 1.2 (whichever yields a higher NPSH requirement) is often adequate. Refer to ANSI/HI 9.6.1, Centrifugal and Vertical Pumps, NPSH Margin for additional application information.

5.1.7 Performance Curves. Published performance curves in written or electronic format shall be based on tests conducted in accordance with ANSI/HI 1.6, so the performance shall meet acceptance level "A."

5.2 Tests

5.2.1 Hydrostatic. After machining, casings, covers, and jackets shall be hydrostatically tested for 10 min minimum with water at 1.5 times the maximum design pressure corresponding to 100°F (38°C) for the material of construction used. No leakage through the part shall be permitted.

5.2.2 Performance. When performance tests are required, they shall be conducted in accordance with ANSI/HI 1.6, level "A." 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.

5.2.3 Mechanical. When mechanical tests are required, they shall be conducted in accordance with ANSI/HI 1.6, Section 1.6.7.

5.3 Nameplates

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

6 REFERENCES

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

ANSI/ABMA-9, Loaded Rating and Fatigue Life for Ball Bearings

ANSI/ABMA-11, Loaded Ratings and Fatigue Life for Roller Bearings

Publisher: American Bearing Manufacturers Association, Inc.(ABMA), 2025 M Street, NW, Suite 800, Washington, DC 20036.

API 610, Eighth Edition, Centrifugal Pumps for Heavy-Duty Chemical and Gas Industry Services

American Petroleum Institute (API), 1220 L Street, NW, Washington, DC 20005-4070

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Table 4 Minimum Continuous Flow

Dimension Designation	Suction	Discharge	Flange to Flange, in., *SD*	Minimum Continuous Flow, % BEP [Note (1)] 3500/2900 rpm 60/50 Hz	Minimum Continuous Flow, % BEP [Note (1)] 1750/1450 rpm 60/50 Hz
2015/15	2	1½	14.96	15	10
3015/15	3	1½	14.96	15	10
3020/17	3	2	16.93	20	10
2015/17	2	1½	16.93	20	10
3015/19	3	1½	18.90	20	10
4030/22	4	2	22.05	20	10
2015/19	2	1½	18.90	25	10
3020/20	3	2	20.08	30	15
4030/25	4	3	25.00	30	15
4030/28	4	3	27.95	30	15
6040/24	6	4	24.02	40	20
3015/24	3	1½	24.02	30	15
3020/24	3	2	24.02	40	15
6040/28	6	4	27.95	. . .	40
6040/30	6	4	29.92	. . .	40

GENERAL NOTE: See para. 5.1.6 for cautions using values in this Table.

NOTE:

(1) Limits refer to actual hydraulic performance, not the approximate values in Table 3. Consult manufacturers regarding hydraulic performance data for specific applications.

ANSI/ASTM A105/A105M, Standard Specification for Carbon Steel Forgings for Piping Applications

ANSI/ASTM A106, Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service

ANSI/ASTM A216/A216M, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Services

ANSI/ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

ANSI/ASTM A276, Standard Specification for Stainless Steel Bar and Shapes

ANSI/ASTM A312/A312M, Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes

ANSI/ASTM A519, Standard Specification for Seemless Carbon and Alloy Steel Mechanical Tubing

ANSI/ASTM A744/A744M, Standard Specification for Casting, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service

ASTM A312/A312M, Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes

ASTM A 395, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures

ASTM A 536, Standard Specification for Ductile Iron Castings

Publisher: American Society for Testing and Materials (ASTM International), 100 Barr Harbor Drive, W. Conshohocken, PA 19428-2959.

ANSI/HI 1.1-1.2, Centrifugal Pumps — Nomenclature nad Definitions

ANSI/HI 1.3, Centrifugal Pumps — Design and Applications

ANSI/HI 1.6, Centrifugal Pump Tests

ANSI/HI 9.1-9.5, Pumps — General Guidelines

ANSI/HI 9.6.1, Centrifugal and Vertical Pumps — NPSH Margin

ANSI/HI 9.6.4, Centrifugal and Vertical Pumps — Vibration Measurement and Allowable Values

ANSI/HI 9.6.2, Centrifugal and Vertical Pumps — Allowable Nozzle Loads

Publisher: Hydraulic Institute (HI), 9 Sylvan Way, Parsippany, NJ 07054-3802.

ISO 1940, Balance Quality Requirements of Ridged Rotors

Publisher: International Organization for Standardization (ISO), 1 rue de Varembé, Case Postale 56, CH-1211, Genève 20, Switzerland/Suisse

ASME B15.1, Safety Standard for Mechanical Power Transmission Apparatus

ASME B16.5, Pipe Flanges and Flanged Fittings

ASME B16.42, Ductile Iron Pipe Flanges and Flanged Fittings, Class 150 and 300

Publisher: The American Society of Mechanical Engineers (ASME International), Three Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, Box 2300, Fairfield, NJ 09007-2300

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ANSI/NEMA MG 1, Motors and Generators

Publisher: National Electrical Manufacturers Association (NEMA), 1300 North 17th Street, Suite 1847, Rosslyn, VA 22209

7 DOCUMENTATION

7.1 General

The documentation specified covers the minimum required to provide clear communication between the pump user and pump manufacturer, and to facilitate the safe design, installation, and operation 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 utilization of the documentation.

7.2 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) vendor's cooling/heating piping drawing (if applicable)

(f) performance curve with rated point

(g) cross-section drawing with parts list

(h) instruction manual

(i) coupling data

(j) if specified, certificate of compliance of ASME B73.2 with purchaser's specification

7.3 Information

A description for each document follows.

7.3.1 Pump and Driver Outline Drawing

(a) The pump and driver outline drawing shall contain all information shown on, and may be arranged as, the sample outline drawing included herein and identified as Fig. 10.

(b) Tapped openings, when supplied, shall be identified on the drawing with the following markings.

Marking	Purpose
I	Casing design
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
BI	Barrier/buffer fluid inlet
BO	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

7.3.2 Centrifugal Pump Data Sheet

(a) Data Sheet. Process Industry Practices (PIP) Form 1 or Form 2 in Mandatory Appendix I, shall be used as the data sheet for all pumps covered by this Standard. Copies of the data sheet may be obtained from PIP and/or ASME as indicated in Mandatory Appendix I.

(b) Electronic Data. The B73 Standardized Electronic Data Exchange File Specification may be used for the electronic transfer of centrifugal pump data (see Table 5).

(c) The data sheet and/or electronic file shall be used for inquiry, proposal, and as-built.

7.3.3 Mechanical Seal Drawing

(a) A mechanical seal drawing shall be included if the pump is fitted with a mechanical shaft 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 dimensions referred to on the seal chamber face.

(e) The drawings shall have a title block including the information on the title block on the pump data sheet, Form 1 or 2, and have a blank space for the user's identification stamp $1\frac{1}{2}$ in. – 3 in. (38 mm – 76 mm) minimum.

7.3.4 Mechanical Seal Piping Drawing

(a) A mechanical seal piping drawing or schematic shall be included if the pump is fitted with a mechanical seal piping system supplied by the pump manufacturer.

(b) The mechanical seal piping drawing or schematic may contain all information and uniform nomenclature shown in, and may be arranged as, the sample drawings included herein and identified as Fig. 2.

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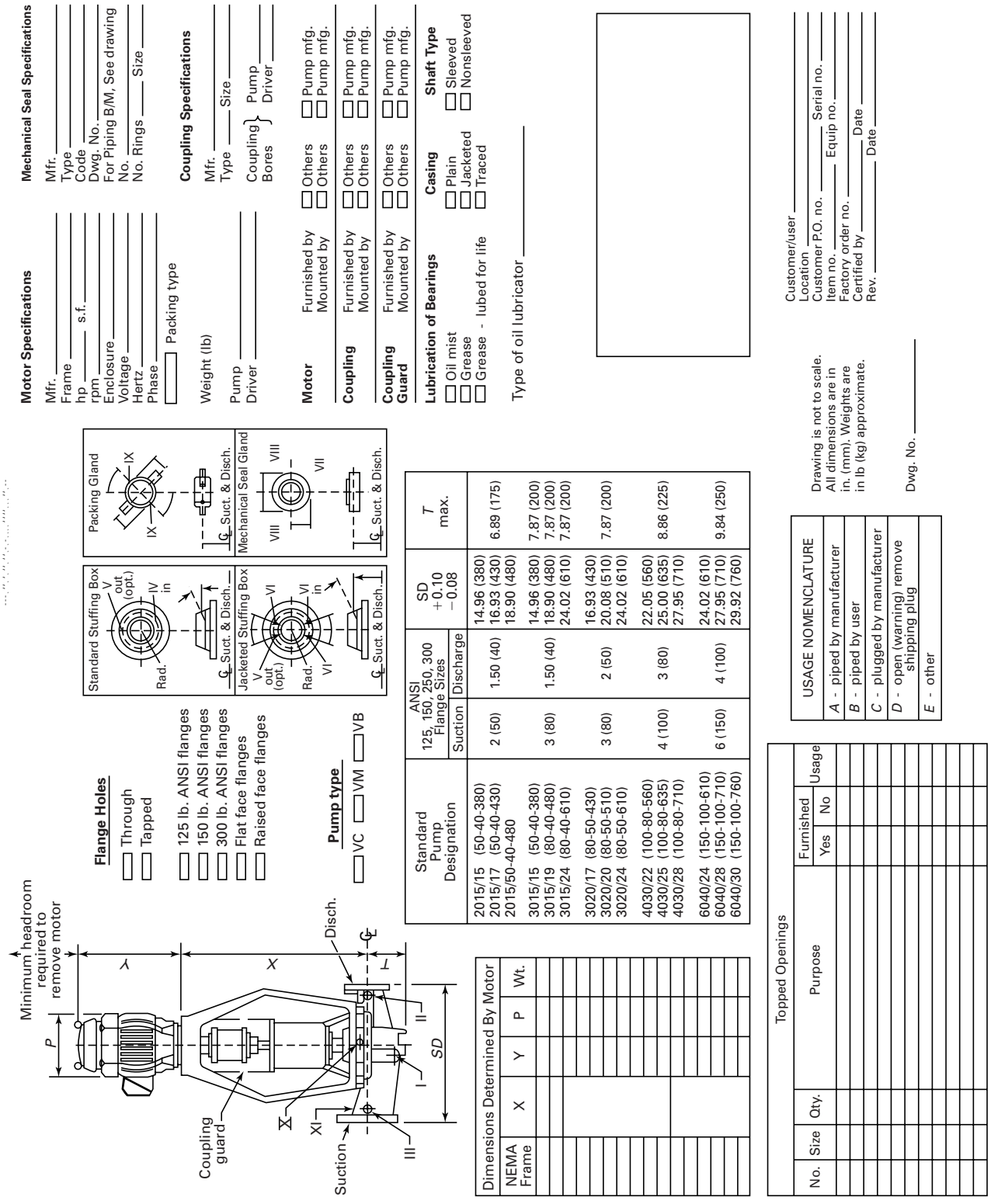

Fig. 10 Sample Outline Drawing

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Table 5 B73 Standardized Electronic Data Exchange File Specification

No.	Name	Field	Type	Length	Contents/Unit
Pump Data					
Headings					
A001	Job No.	JOB_NO	C	10	
A002	Item No.	JOB_NO	C	25	
A003	Requisition No.	REQ_N	C	25	
A004	Specification No.	SPEC_N	C	25	
A005	Purchase Order No.	PO_NO	C	25	
A006	Purchase Order Date	DATE	D	8	YYYYMMDD
A007	Inquiry No.	INQ_NO	C	25	
A008	Inquiry By	INQ_BY	C	15	
A011	For	FOR	C	59	
A013	Unit	UNIT	C	20	
A014	Site	SITE	C	59	
A015	Number Required	NO_REQD	I	5	
A016	Service	SERVICE	C	30	
A017	Pump Size	PUMP_SIZE	C	30	
A018	Pump Type	PUMP_TYPE	C	20	
A020	Manufacturer	MFGR	C	25	
A021	Model	MODEL	C	20	
A022	Serial No.	SERIAL	C	20	
General					
A023	Operation	OPERATE	C	1	A: parallel; B: series; C: both, series and parallel; Z: other
A027	Number Motor Driven	NO_PMPS_M	I	5	
A028	Number Turbine Driven	NO_PMPS_T	I	5	
A029	With	PUMP_WITH	C	20	
A031	Pump Item No. Turbine Drive	ITEM_NO_T	C	24	
A032	Gear Item No.	G_ITEM_NO	C	24	
A033	Motor Item No.	M_ITEM_NO	C	24	
A034	Turbine Item No.	T_ITEM_NO	C	24	
A035	Gear Provided By	G_BY	C	20	
A036	Motor Provided By	M_BY	C	20	
A037	Turbine Provided By	T_BY	C	20	
A038	Gear Mounted By	G_MTD_BY	C	20	
A039	Motor Mounted By	M_MTD_BY	C	20	
A040	Turbine Mounted By	T_MTD_BY	C	20	
Operating Conditions					
A044	Normal Capacity	NORM_CAP	N	13	m^3/h
A045	Rated Capacity	RATED_CAP	N	13	m^3/h
A047	Suction Pressure Max.	SUCT_PRESM	N	13	kPa
A048	Suction Pressure Rated	SUCT_PRES	N	13	kPa
A049	Discharge Pressure	DISCH_PRES	N	13	kPa
A050	Differential Pressure	DIFF_PRES	N	13	kPa
A051	Differential Head	HEAD	N	13	m
A052	NPSH Available	NPSHA	N	13	m
A053	Hydraulic Power	HYD_POWER	N	13	kW
A056	Service	OPER_SERV	C	1	A: continuous; B: intermittent; Z: other
A057	Starts Per Day	STRTS_PER	I	5	
Site and Utility Data					
A059	Indoor	INDOOR	C	1	1: yes (true); 0: no (false)
A060	Outdoor	OUTDOOR	C	1	1: yes (true); 0: no (false)
A067	Electric Area Classification CL	ELECT_CL	C	6	
A068	Electric Area Classification GR	ELECT_GR	C	6	
A069	Electric Area Classification DIV	ELECT_DIV	C	1	
A072	Altitude	ELEV	N	13	m

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Table 5 B73 Standardized Electronic Data Exchange File Specification (Cont'd)

No.	Name	Field	Type	Length	Contents/Unit
Site and Utility Data (Cont'd)					
A074	Ambient Temperature: Min.	SITE_TM_MIN	N	13	°C
A075	Ambient Temperature: Max.	SITE_TM_MX	N	13	°C
A103	Cooling Water Temperature Inlet	C_WTR_TMIN	N	13	°C
A104	Cooling Water Max. Return	C_WTR_TMOU	N	13	°C
A108	Cooling Water Max. Delta P	C_WTR_PRDI	N	13	kPa
Liquid					
A113	Name of Liquid	LIQ_NAME	C	40	
A114	Pumping Temperature Normal	TEMP_NORM	N	13	°C
A115	Pumping Temperature Max.	TEMP_MAX	N	13	°C
A116	Pumping Temperature Min.	TEMP_MIN	N	13	°C
A117	Specific Gravity at Normal Temperature	SG_NORM	C	13	
A118	Specific Gravity at Max. Temperature	SG_MAX	C	13	
A119	Specific Gravity at Min. Temperature	SG_MIN	C	13	
A126	Corrosive/Erosive Agent	CORROSIVE	C	15	
A129	Hazardous (Toxic)	TOXIC	C	1	1: yes (true); 0: no (false)
A130	Flammable	FLAMMABLE	C	1	1: yes (true); 0: no (false)
A131	Other Liquid Hazard	OTHER_HZRD	C	1	1: yes (true); 0: no (false)
Performance					
A132	Rated Pump Speed	PMP_RPM	N	13	rpm
A133	Proposal Curve No.	PROP_CRV_N	C	15	
A134	Impeller Diameter Rated	IMP_DIA_RA	N	13	mm
A135	Impeller Diameter Max.	IMP_DI_MAX	N	13	mm
A137	Rated Power	BHP	N	13	kW
A138	Efficiency	EFF	N	13	% (0 to 100)
A139	Minimum Flow: Thermal	MN_FL_THER	N	13	m^3/h
A140	Minimum Flow Stable	MN_FL_STAB	N	13	m^3/h
A141	Maximum Head Rated Impeller	MAX_HEAD	N	13	m
A144	Allowable Operating Region (Min.)	ALWB_OPER1	N	13	m^3/h
A145	Allowable Operating Region (Max.)	ALWB_OPER2	N	13	m^3/h
A146	Maximum Power Rated Impeller	MAX_PWR	N	13	kW
A148	Suction Specific Speed	SP_SPEED	N	13	Metric units (see para. 1.4.42)
A149	Maximum Sound Pressure Level Required	DBA	N	13	DBA
A151	Performance Remark	PERF_REMK	C	140	
Construction					
A152	Pump Classification ID	PUMP_CLASS	C	3	Overhung type: OH1: foot mounted/horizontal/flexibly coupled OH2: center line mounted/horizontal/flexibly coupled OH3: in-line bearing frame/vertical/flexibly coupled OH4: in-line/vertical/rigidly coupled
A156	Suction Size	SUCT_SIZE	C	10	The decimal numeric value is followed by "mm" or "in." (e.g., 1.5 in. or 38 mm)
A157	Suction Rating	SUCT_RATE	C	10	
A158	Suction Facing	SUCT_FACE	C	1	A: flat face; B: rated flange; C: ring type joint; D: threaded
A160	Discharge Size	DISCH_SIZE	C	10	The decimal numeric value is followed by "mm" or "in." (e.g., 1.5 in. or 38 mm)

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Table 5 B73 Standardized Electronic Data Exchange File Specification (Cont'd)

No.	Name	Field	Type	Length	Contents/Unit
Construction (Cont'd)					
A161	Discharge Rating	DISCH_RATE	C	10	
A162	Discharge Facing	DISCH_FACE	C	1	A: flat face; B: rated flange; C: ring type joint; D: threaded
A173	Drain Size	DRN_SIZE	C	10	The decimal numeric value is followed by "mm" or "in." (e.g., 1.5 in. or 38 mm)
A197	Maximum Allowable Working Pressure	MAWP	N	13	kPa
A198	Reference Temperature for MAWP	T_MAWP	N	13	°C
A199	Casing Hydrotest Pressure	CASE_HYD	N	13	kPa
A200	Rotation	ROTATION	C	1	A: CW; B: CCW per Hydraulic Institute; Z: other
A209	Coupling Make	CPLG_MFG	C	15	
A210	Coupling Model	CPLG_MODEL	C	10	
A214	Coupling Spacer Length	CPLG_SPCR	N	13	mm
A221	Nongrout Construction	NON_GROUT	C	1	1: yes (true); 0: no (false)
A224	Coupling Remark	CPLG_REMK	C	140	
Materials					
A225	Table H1 Material Class	MATL_CLASS	C	5	
A227	Barrel/Case Material	MATL_CASE	C	20	
A228	Impeller Material	MATL_IMP	C	20	
A231	Shaft Material	MATL_SHAFT	C	20	
A232	Sleeve Material	MATL_SLEEV	C	20	
A237	Baseplate Material	MATL_BASEPL	C	20	
Bearings and Lubrication					
A239	Radial Bearing Type	RAD_BRG_TY	C	10	
A240	Radial Bearing No.	RAD_BRG_NO	C	10	
A241	Thrust Bearing Type	THR_BRG_TY	C	10	
A242	Thrust Bearing No.	THR_BRG_NO	C	10	
A246	Constant Lever Offer	CONST_LVL	C	1	1: yes (true); 0: no (false)
A250	Oil Viscosity ISO Grade	ISO_VIS	C	15	
A253	Lubrication Remark	LUBE_RMK	C	140	
Mechanical Seal or Packing					
A265	Seal Manufacturing	SEAL_MFG	C	15	
A268	Manufacturer Code	SEAL_MFG_C	C	15	
A272	Circulating Device	CIRC_DEV	C	1	1: yes (true); 0: no (false)
A273	Sleeve Material	SLEEVE_MAT	C	10	
A274	Gland Material	GLAND_MATL	C	1	1: yes (true); 0: no (false)
A277	Flush Gland Taps	F_GLAND_TA	C	1	1: yes (true); 0: no (false)
A278	Drain Gland Taps	D_GLAND_TA	C	1	1: yes (true); 0: no (false)
A282	Quench Gland Taps	Q_GLAND_TA	C	1	1: yes (true); 0: no (false)
A290	Flush Min. Temperature	FLUSH_T_MI	N	13	°C
A291	Flush Max. Temperature	FLUSH_T_MA	N	13	°C
A292	Specific Gravity	FLUSH_SG	C	13	
A294	Flush Fluid Name	FLUSH_FLUI	C	20	
A295	Flush Specific Heat	FLUSH_SP_H	N	13	KJ/Kg°C
A296	Flush Vapor Pressure	FLUSH_VP	N	13	kPa abs
A297	Flush Vapor Pressure Temperature	FLUSH_VP_T	N	13	°C
A300	Flush Other	FLUSH_OTHE	C	15	
A301	Flush Max. Flowrate	FLUSH_MAX	N	13	m^3/h
A302	Flush Min. Flowrate	FLUSH_MIN	N	13	m^3/h
A303	Flush Max. Pressure	FLUSH_P_MX	N	13	kPa
A304	Flush Min. Pressure	FLUSH_P_MIN	N	13	kPa
A305	Flush Max. Temperature	FLUSH_T_MX	N	13	°C

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Table 5 B73 Standardized Electronic Data Exchange File Specification (Cont'd)

No.	Name	Field	Type	Length	Contents/Unit
Mechanical Seal or Packing (Cont'd)					
A306	Flush Min. Temperature	FLUSH_T_MIN	N	13	°C
A307	Barrier Min. Temperature	BARR_TM_MN	N	13	°C
A308	Barrier Max. Temperature	BARR_TM_MX	N	13	°C
A309	Barrier SG	BARR_SG	C	13	
A311	Barrier Liquid Name	BARR_FLUID	C	20	
A312	Barrier Vapor Pressure	BARR_VP	N	13	kPa abs
A313	Barrier Vapor Pressure Temperature	BARR_VP_TM	B	13	° C
A319	Barrier Max. Pressure	BARR_PR_MX	N	13	kPa
A320	Barrier Min. Pressure	BARR_PR_MN	N	13	kPa
A321	Barrier Temperature Max.	BARR_T_MAX	N	13	°C
A322	Barrier Temperature Min.	BARR_T_MIN	N	13	°C
A326	Seal Piping Construction	SEAL_PIPE	C	1	A:tubing; B:piping; C:other; Z:other
A327	Piping Material	PIPE_MAT	C	1	A: carbon steel; B: stainless steel; C: other; Z: other
A328	Other Material Description	O_MTL_DESC	C	20	
A330	Aux. Piping Plan Construction	AUX_PLAN_T	C	1	A: tubing; B: pipe; Z: other
A331	Aux. Piping Plan Material	AUX_PLAN_M	C	1	A: carbon steel; B: stainless steel; C: other; Z: other
A332	Other Aux. Material Description	O_AUX_M_D	C	20	
A337	Seal Flow Indicator	SEAL_FL	C	1	1: yes (true); 0: no (false)
A342	Seal Level Switch Type	SEAL_LS_TY	C	15	
A343	Seal Level Gauge	SEAL_LG	C	1	1: yes (true); 0: no (false)
A346	Mechanical Seal Remarks	SEAL_RMK	C	140	
Cooling Water Piping					
A356	Cooling Water Sight Flow Indicator	SIGHT_FLOW	C	1	1: yes (true); 0: no (false)
A357	Cooling Water Manifold Outlet Valve	MANIFOLD_V	C	1	1: yes (true); 0: no (false)
A358	Cooling Water Piping Material	CW_PIP_MAT	C	1	A: galvanized pipe; B: copper tube; C: stainless tubing; Z: other
A367	Total Cooling Water Flow	TOTAL_FLOW	N	13	m^3/h
A369	Cooling Water Remark	CW_RMK	C	140	
Instrumentation					
A381	Temperature Gauges	TEMP_GAGES	C	1	1: yes (true); 0: no (false)
A388	Instrument Remark	INST_RMK	C	140	
Motor Drive					
A395	Motor Power	MTR_POWER	N	13	kW
A396	Motor Speed	MTR_SPEED	C	13	RPM
A423	Motor Remark	MTR_RMK	C	140	
Surface Preparation and Painting					
A474	Manufacturer Preparation Standard	PREP_MFR_S	C	1	1: yes (true); 0: no (false)
A475	Prep Other	PREP_OTHER	C	20	
A486	Shipment Type	SHP_DEST	C	1	A: domestic; B: export; Z: other
A487	Export Boxing Required	SHP_EXP_BO	C	1	1: yes (true); 0: no (false)
QA Inspection and Test					
A525	Shop Inspection	SHOP_INSP	C	1	1: yes (true); 0: no (false)
A527	Hydrostatic Test	HYD	C	1	1: yes (true); 0: no (false)
A528	Performance Test	PERF	C	1	A: nonwitnessed; B: witnessed; C: observed; D: none; Z: other
A529	NPSH Test	NPSH	C	1	A: nonwitnessed; B: witnessed; C: observed; D: none; Z: other

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Table 5 B73 Standardized Electronic Data Exchange File Specification (Cont'd)

No.	Name	Field	Type	Length	Contents/Unit
QA Inspection and Test (Cont'd)					
A532	Dismantle After Test	DISM	C	1	A: nonwitnessed; B: witnessed; C: observed; D: none; Z: other
A538	Other Test Description 1	DESC_OTH_1	C	20	
A539	Other Test 1	TEST_OTH_1	C	1	A: nonwitnessed; B: witnessed; C: observed; D: none; Z: other
A546	Material Certificate for Casing	MAT_CER_CA	C	1	1: yes (true); 0: no (false)
A547	Material Certificate for Impeller	MAT_CER_IM	C	1	1: yes (true); 0: no (false)
A548	Material Certificate for Shaft	MAT_CER_SH	C	1	1: yes (true); 0: no (false)
A549	Material Certificate for Other	MAT_CER_OT	C	20	
A550	Casting Repair Procedure Approval	CAS_REP_PR	C	1	1: yes (true); 0: no (false)
General Remarks					
A573	General Remark 1	GEN_RMK1	C	254	
A574	General Remark 2	GEN_RMK2	C	254	
A575	General Remark 3	GEN_RMK3	C	254	
A576	General Remark 4	GEN_RMK4	C	254	
A577	General Remark 5	GEN_RMK5	C	254	
A578	General Remark 6	GEN_RMK6	C	254	
Additional Data					
Construction					
B009	Coupling Guard Nonspark	CP_G_N_SP	C	1	1: yes (true); 0: no (false)
Liquid					
B026	Solid Dia.	SOLID_DIA	N	13	
Materials					
B032	Guard Material	MTR_MATL	C	20	
PIP Data					
P001	Maximum Capacity	MAX_CAP	N	13	
P002	Minimum Capacity	MIN_CAP	N	13	m^3/h
P003	Suction Pressure Min.	SUCTPR_MIN	N	13	kPa
P004	Operating Time at Rated Capacity	OPT_RATED	N	5	hr/y
P005	Operating Time at Max. Capacity	OPT_MAX	N	5	hr/y
P006	Operating Time at Normal Capacity	OPT_NORM	N	5	hr/y
P007	Operating Time at Min. Capacity	OPT_MIN	N	5	hr/y
P008	NPSH Available at Rated Capacity	RATED_NPSH	N	13	m
P009	NPSH Available at Max. Capacity	MAX_NPSH	N	13	m
P010	NPSH Available at Normal Capacity	NORM_NPSH	N	13	m
P011	NPSH Available at Min. Capacity	MIN_NPSH	N	13	m
P012	System Design	SYS_DESIGN	C	1	A: stand alone; B: parallel; C: series
P013	System Control Method	SYS_CONTRL	C	1	A: speed; B: flow; D: temperature; E: pressure; F: pi
P014	Pumping Temperature Rated	TEMP_RATED	N	13	°C
P015	Specific Gravity at Rated Temperature	SG_RATED	N	13	
P016	Vapor Pressure at Rated Temperature	VP_RATED	N	13	kPa abs
P017	Vapor Pressure at Max. Temperature	VP_MAX	N	13	kPa abs

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Table 5 B73 Standardized Electronic Data Exchange File Specification (Cont'd)

No.	Name	Field	Type	Length	Contents/Unit
PIP Data (Cont'd)					
P018	Vapor Pressure at Normal Temperature	VP_NORM	N	13	kPa abs
P019	Vapor Pressure at Min. Temperature	VP_MIN	N	13	kPa abs
P020	Viscocity at Rated Temperature	VISC_RATED	N	13	cP
P021	Viscocity at Max. Temperature	VISC_MAX	N	13	cP
P022	Viscocity at Normal Temperature	VISC_NORM	N	13	cP
P023	Viscocity at Min. Temperature	VISC_MIN	N	13	cP
P024	Specific Heat at Rated Temperature	SPHT_RATED	N	13	kJ/kg°C
P025	Specific Heat at Max. Temperature	SPHT_MAX	N	13	kJ/kg°C
P026	Specific Heat at Normal Temperature	SPHT_NORM	N	13	kJ/kg°C
P027	Specific Heat at Min. Temperature	SPHT_MIN	N	13	kJ/kg°C
P028	Initial Boiling Point Temperature	BP_TEMP	N	13	°C
P029	Initial Boiling Point Pressure	BP_PRESS	N	13	kPa abs
P030	NPSH Required at Rated Capacity	NPSHR_RATE	N	13	m
P031	NPSH Required at Max. Capacity	NPSHR_MAX	N	13	m
P032	NPSH Required at Normal Capacity	NPSHR_NORM	N	13	m
P033	NPSH Required at Min. Capacity	NPSHR_MIN	N	13	m
P034	Total Differential Head at Rated Impeller	RATED_HEAD	N	13	m
P035	Best Efficiency Point for Rated Impeller	BEP	N	13	m^3/h
P036	Nonhazardous Electrical Classification	ELEC_HAZRD	C	1	1: yes (true); 0: no (false)
P037	Impeller Type	IMPLR_TYPE	C	1	A: closed; B: semi-opened; C: opened; D: other
P038	Other Impeller Type	OTHER_IMP	C	15	
P039	Bearing Manufacturer	BRG_MANUF	C	20	
P040	Bearing Isolators	BRG_ISOL	C	25	
P041	Shaft Stiffness Ratio (L3/D4)	SS_RATIO	N	13	1/mm
P042	Lubrication	LUBE_TYPE	C	1	A: food; B: grease; C: purge mist; E: shielded; B: seal
P043	Housing Vent Required	HSG_VENT	C	1	1: yes (true); 0: no (false)
P044	Magnetic Drain Plug In Housing Required	MAG_PLUG	C	1	1: yes (true); 0: no (false)
P045	Oil Cooler Required	OIL_COOLER	C	1	1: yes (true); 0: no (false)
P046	Seal Spray Guard Required	SPRAY_GRD	C	1	1: yes (true); 0: no (false)
P047	Drain Required	DRAIN	C	1	1: yes (true); 0: no (false)
P048	Drain Connection Type	DRAIN_CONN	C	1	A: threaded; B: welded and flanged; Z: other
P049	Cover Material	MATL_COVER	C	25	
P050	Casing Gasket Material	ML_CSG_GSK	C	25	
P051	Impeller Gasket Material	ML_IMP_GSK	C	25	
P052	Casing Fastener Material	ML_CSG_FST	C	25	
P053	Gland Fastener Material	ML_GLD_FST	C	25	
P054	Bearing Housing Material	ML_BRG_HSG	C	25	
P055	Bearing Housing Adapter Material	ML_BRG_HA	C	25	

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Table 5 B73 Standardized Electronic Data Exchange File Specification (Cont'd)

No.	Name	Field	Type	Length	Contents/Unit
PIP Data (Cont'd)					
P056	Bearing Housing End Seals	ML_BRG_ESL	C	25	
P057	Driver Selected for Max. Specific Gravity	DR_MAX_SG	N	13	
P058	Driver Selected for Max. Viscosity	DR_MAX_VSC	N	13	
P059	Coupling Type	CPLING_TYPE	C	20	
P060	Coupling Size	CPLING_SIZE	C	20	
P061	Coupling Guard Manufacturer's Standard	CG_MFG_STD	C	1	1: yes (true); 0: no (false)
P062	Coupling Guard Baseplate Mounted	CG_BP_MNT	C	1	1: yes (true); 0: no (false)
P063	Baseplate Type	BP_TYPE	C	1	A: grouted; B: freestanding; Z: other
P064	Centerline of Pump to Stilt Bottom	CTR_P_TO_S	N	13	mm
P065	Vertical Pump Case Support Bracket	VPC_SUP_BR	C	1	1: yes (true); 0: no (false)
P066	Baseplate Design	BP_DESIGN	C	1	A: PIP standard RESP002; B: manufacturer's standard; Z: other
P067	Baseplate Remarks	BP_REMARKS	C	50	
P068	Baseplate Paint	BP_PAINT	C	1	A: manufacturer's standard; B: other
P069	Other Baseplate Paint	BP_OTH_PNT	C	20	
P070	Number of Months of Storage	MTH_STRO	N	3	Month
P071	Days Notification Required Final Shop Inspection	DAYS_FI	N	3	Day
P072	Hydrostatic Certificate Required	HYDRO_CRT	C	1	1: yes (true); 0: no (false)
P073	Performance Certificate Required	PERF_CRT	C	1	1: yes (true); 0: no (false)
P074	NPSHR Certificate Required	NPSH_CRT	C	1	1: yes (true); 0: no (false)
P075	Vibration Test	VIBRATION	C	1	A: nonwitnessed; B: witnessed; C: none; Z: other
P076	Vibration Certificate Required	VIBE_CRT	C	1	1: yes (true); 0: no (false)
P077	Other Test Certificate Required	TST_OT_CRT	C	1	1: yes (true); 0: no (false)
P078	Material Certificate for Cover	MAT_CER_CV	C	1	1: yes (true); 0: no (false)
P079	Inspection for Connection Welds	CONN_INSP	C	1	A: manufacturer's standard; B: visual inspection; C: none; Z: other
P080	Inspections for Castings	CAST_INSP	C	1	A: manufacturer's standard; B: visual inspection; C: none; Z: other
P081	Other Inspection Required for Castings	OTH_CINSP	C	25	
P082	For Vendor Data Requirements Refer To:	VNDR_DATA	C	15	
P083	Manufacturer Documentation Remarks	MD_REMARKS	C	00	
P084	Mechanical Seal Supplied By	MS_SUPP_BY	C	1	A: pump manufacturer; B: purchaser; Z: other
P085	Mechanical Seal Mounted By	MS_MNT_BY	C	1	A: pump manufacturer; B: purchaser; Z: other
P086	Seal Classification Code	MS_CODE	C	5	
P087	Seal Model	SEAL_MODEL	C	25	
P088	Cartidge or Component Seal Type	MS_TYPE_CC	C	1	A: cartridge; B: component; Z: other
P089	Seal Design Type	SEAL_DSGN	C	1	A: single; B: dual; C: dry gas; D: liquid dual; Z: other
P090	Seal Pressurized or Unpressurized Type	SEAL_PRTYP	C	1	A: pressurized; B: unpressurized
P091	Seal Chamber	SEAL_CHAM	C	1	A: taper bore; B: cylindrical bore; Z: other
P092	Seal Chamber Size	SEAL_CHSIZ	C	1	A: oversized; B: standard; Z: other
P093	Throat Bushing Required	THRO_B	C	1	1: yes (true); 0: no (false)

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Table 5 B73 Standardized Electronic Data Exchange File Specification (Cont'd)

No.	Name	Field	Type	Length	Contents/Unit
PIP Data (Cont'd)					
P094	Throat Bushing Material	THRO_B_MAT	C	20	
P095	Other Taps Required	OT_TAP	C	1	1: yes (true); 0: no (false)
P096	Other Taps Required Description	OSC_OT_TAP	C	20	
P097	Throttle Bushing Required	THRT_B	C	1	1: yes (true); 0: no (false)
P098	Throttle Bushing Material	THRT_B_MAT	C	20	
P099	Primary Flush Plan No.	PR_PI_PL	C	1	A: none; B: ASME Plan 7301; C: ASME Plan 7302; D: ASME Plan 7311
P100	Primary Flush Piping/Tubing Size	PR_PL_SIZE	N	5	mm
P101	Primary Flush Piping Assembly	PR_FL_ASM	C	1	A: threaded; B: unions; C: flanges; D: tube type fittings; E: socket welded
P102	Barrier Flush Plan	BR_PI_PL	C	1	A: none; B: ASME Plan 7351; C: ASME Plan 7352; D: ASME Plan 7353
P103	Barrier Fluid Specific Heat	BR_FL_SH	N	13	kJ/kg°C
P104	MAWP of Secondary Seal System	BR_MAWP	N	13	kPa
P105	Barrier Flush Piping/Tubing Size	BR_FL_SIZE	N	13	mm
P106	Barrier Flush Piping Assembly	BR_FL_ASM	C	1	A: threaded; B: unions; C: flanges; D: tube-type fittings; E: socket welded
P107	Primary Seal Flow Gauge Required	SEAL_PFG	C	1	1: yes (true); 0: no (false)
P108	Primary Seal Flow Switch Required	SEAL_PFS	C	1	1: yes (true); 0: no (false)
P109	Primary Seal Temperature Switch Required	SEAL_PTS	C	1	1: yes (true); 0: no (false)
P110	Primary Seal Pressure Gauge Required	SEAL_PPG	C	1	1: yes (true); 0: no (false)
P111	Primary Seal Pressure Switch Required	SEAL_PPS	C	1	1: yes (true); 0: no (false)
P112	Primary Seal Flow Switch Required	SEAL_PSS	C	1	1: yes (true); 0: no (false)
P113	Secondary Seal Pressure Gauge	SEAL_SPG	C	1	1: yes (true); 0: no (false)

GENERAL NOTE: This Table is composed of the applicable fields from Appendix Q, ANSI/API 610, Centrifugal Pumps for Petroleum, Heavy-Duty Chemical and Gas Industry Services, with the addition of data fields from the Process Industry Practices (PIP) specification that completely define necessary data for the electronic exchange of ASME B73 pump data. See Appendix Q, API 610 for complete information on the neutral data exchange file format.

7.3.5 Manufacturer's Cooling/Heating Piping Drawing

(a) A cooling/heating piping drawing shall be included if the pump is fitted with a heating/cooling piping system supplied by the pump manufacturer.

(b) The cooling/heating piping drawing may contain all information and uniform nomenclature shown in, and may be arranged as, the sample drawings included herein and identified as Fig. 3.

7.3.6 Performance Curve

(a) The performance curve shall be the composite (family) type curve for full impeller diameter range, plotting head against capacity and including efficiency, minimum flow, NPSH, power consumption, and speed. Power consumption shall be provided at all flows, including shutoff. The design impeller diameter shall be stated with the rated point identified for proposal and as-built curves.

(b) If the pump fluid viscosity or specific gravity affects the pump performance, it shall be so noted on the proposal performance curve.

7.3.7 Cross-Section Drawing. The cross-section drawing shall show all assembled parts of the pump. It shall be complete with a parts list referenced to the drawing and shall include material descriptions.

7.3.8 Instruction Manual

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

(b) Any limitations or warnings on the installation, operation, etc., of the unit should be clearly defined.

(c) The instruction manual shall be in booklet form.

(d) The use of a single manual to describe many similar models of pumps should be minimized to reduce

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user confusion on the exact model furnished.

(e) Recommended tolerances for coupling alignment shall be supplied to the user.

(f) Instruction manuals for the pump driver, mechanical seal, coupling, etc., shall be furnished by the pump vendor if included as part of their supply.

7.4 Specially Requested Documentation

Documentation in addition to that listed in 7.2 and 7.3 is sometimes required by some users. This additional documentation shall be made available to those users upon specific request.

7.4.1 Master Document List

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

(b) This list shall be submitted along with the first document so that the user is aware of which documents will follow.

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

7.4.2 External Forces and Moments on Nozzles. The allowable external forces and moments on pump suction and discharge nozzles shall be in accordance with para. 5.1.2.

7.4.3 Parts List

(a) A list of all pump parts with pump identification number(s) shall be supplied by the manufacturer.

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

(1) for start-up; and

(2) for 3 year's operation.

(c) The pump manufacturer should also furnish a spare parts list for equipment supplied with the pump, but not of their manufacture, as recommended by the manufacturer of that particular equipment. This would include, as applicable, mechanical seal, coupling, driver, gear boxes, etc.

(d) These lists shall be presented to the user before the equipment is shipped, allowing the user to obtain the necessary parts prior to equipment start-up.

7.4.4 Special Operating or Design Data. Special operating and design data required by the user shall be supplied. This may include the following:

(a) minimum mechanical seal flush flow

(b) stuffing box or seal chamber pressure

(c) maximum allowable casing pressure and temperature

(d) maximum allowable jacket pressure and temperature

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

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MANDATORY APPENDIX I
ASME CENTRIFUGAL PUMP DATA SHEET

This data sheet was provided by the Process Industry Practices Initiative (PIP). Copies of this data sheet may be obtained from PIP through their website at http://www.pip.org and/or the ASME B73 Committee through their website at http://cstools.asme.org/wbpms/CommitteePages.cfm?Committee=C34000000.

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PIP

FORM 1 ASME CENTRIFUGAL PUMP
Data Sheet (U.S. Customary Units)

RESP73
PAGE 1 of 3
November 2000

Job Number _____ Item Number _____ Purchase Order Number _____ Date _____
Req./Spec. Number _____ / _____ Inquiry Number _____ By _____

Note: ○ Indicates Information Completed by Purchaser ☐ by Manufacturer ☒ by Purchaser or Manufacturer

○ For _____ ○ Unit _____
○ Site _____ ○ Service _____
○ No. Req. _____ ☒ Pump Size _____ ☒ Type _____
☒ Manufacturer _____ ☒ Model _____ ☐ Serial Number _____

○ GENERAL

○ Number Motor Driven _____ ○ Number Turbine Driven _____ ○ Gearbox Item Number _____
○ Motor Item Number _____ ○ Turbine Item Number _____ ○ Gearbox Provided By _____
○ Motor Provided By _____ ○ Turbine Provided By _____ ○ Gearbox Mounted By _____
○ Motor Mounted By _____ ○ Turbine Mounted By _____

○ OPERATING CONDITIONS

	Rated	Max.	Normal	Min.
Capacity (gpm)				
Suction Pressure (psig)				
Discharge Pressure (psig)				
Differential Pressure (psi)				
Differential Head (ft)		@ Minimum S.G.		
Hydraulic Power (hp)				
At Designated Capacity	Rated	Max.	Normal	Min.
Operating Time (hr/yr)				
NPSH Available (ft)				

System Design
○ Stand Alone Operation ○ Parallel Operation
○ Series Operation with Item Number _____
Suction Pressure Min./Max. _____ / _____ (psig)

Service
○ Continuous ○ Intermittent (Starts/Day) _____

System Control Method
○ Speed ○ Flow ○ Level ○ Temperature
○ Pressure ○ Pipe Friction Resistance Only

○ PUMPED FLUID

Pumped Fluid _____

	Rated	Max.	Normal	Min.
Pumping Temperature (°F)				
At Designated Temperature	Rated	Max.	Normal	Min.
Specific Gravity				
Vapor Pressure (psia)				
Viscosity (cp)				
Specific Heat (BTU/lb°F)				

Initial Boiling Point _____ (°F) @ _____ (psia)
Liquid ○ Hazardous ○ Flammable
○ Other _____

Corrosion/Erosion Caused By _____
% Solid _____ Max. Particle Size _____ (in.)

○ PERFORMANCE

☐ Performance Curve No. _____ ☒ Speed (rpm) _____

Measured at Capacity	Rated	Max.	Normal	Min.
☐ NPSH Req'd (ft.)				

☐ Total Differential Head @ Rated Impeller _____ (ft)
☐ Max. Differential Head @ Rated Impeller _____ (ft)
☐ Minimum Continuous Flow
Thermal (gpm) _____ Stable (gpm) _____
☐ Allowable Operating Region _____ To _____ (gpm)
☐ Best Efficiency Point for Rated Impeller _____ (gpm)
☐ Suction Specific Speed _____
☐ Impeller Diameter Rated _____ Max. _____ Min. _____ (in.)
☐ Pump Rated Power _____ (bhp) ☐ Efficiency _____ (%)
☐ Maximum Power @ Rated Impeller _____ (bhp)
Rotation (Viewed from Coupling End) ☐ CW ☐ CCW

Case Pressure Rating
☐ Max. Allowable Working Pressure _____ (psig)
@ _____ (°F)
☐ Hydrostatic Test Pressure _____ (psig)

○ SITE CONDITIONS

Location ○ Indoor ○ Outdoor
Altitude _____ (ft)
Range of Ambient Temperatures Min./Max. _____ / _____ (°F)
Electrical Classification CL. _____ Gr. _____ Div. _____
○ Nonhazardous

○ GENERAL REMARKS

REV	DATE	REASON FOR REVISION	BY	CHECK	APPROVED
4					
3					
2					
1					
0					

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PIP

FORM 1 ASME CENTRIFUGAL PUMP
Data Sheet (U.S. Customary Units)

RESP73
PAGE 2 of 3
November 2000

Job Number _____ Item Number _____ Purchase Order Number _____ Date _____
Req./Spec. Number _____/ _____ Inquiry Number _____ By _____

☒ MECHANICAL DATA

Impeller Type
☒ Closed ☒ Open
☒ Semi-open ☒ Other _____
Casing Mounting
☒ Foot ☒ Centerline
☒ Vertical Inline ☒ Close-coupled
Bearings
☒ Bearings Manufacturer _____
☐ Radial Bearing Type _____ No. _____
☐ Thrust Bearing Type _____ No. _____
☒ Bearing Isolators _____
☐ Shaft Stiffness Ratio (L^3/D^4) _____
Lubrication
○ Flood ○ Pure Mist ○ Shielded (Grease)
○ Grease ○ Purge Mist ○ Sealed (Grease)
○ Constant Level Oiler Required
☐ Housing Vent Required
○ Magnetic Drain Plug in Housing Required
☒ Oil Cooler Required
○ Seal Spray Guard Required
☒ Oil Viscosity ISO Grade _____
☒ Other _____

Nozzle Connections

	☐ Size	☒ Rating	☒ Facing
Suction			
Discharge			

Aux. Case Connection ○ Drain Required
☒ Size _____ (in.)
○ Threaded ○ Welded and Flanged

☒ MATERIALS

Material Class Code _____
Casing _____
Impeller _____
Cover _____
Shaft _____
Shaft Sleeve _____
Baseplate _____
Casing Gasket _____
Impeller Gasket _____
Casing Fasteners _____
Bearing Housing _____
Bearing Housing Adapter _____
Bearing Housing End Seals _____
Coupling Guard _____
Mechanical Seal Gland _____
Mechanical Seal Gland Fasteners _____

☒ DRIVER

Horsepower Rating _____ (hp) Speed _____ (rpm)
Drive HP Selected or Max. S.G. _____ & Max. Visc. _____ (cp)
Remarks _____

☒ COUPLING BETWEEN PUMP AND DRIVER

Manufacturer _____
Type _____
Size _____
Model _____
Spacer Length (in.) _____
Coupling Guard Type
☒ Manufacturer's Standard
☒ Baseplate Mounted
☒ Nonspark Coupling Guard Required
Remarks _____

☒ BASEPLATE

Remarks ○ Grouted ○ Free Standing
☐ Centerline of Pump to Stilt Bottom _____ (in.)
○ Vertical Pump Case Support Bracket
Design ○ PIP Standard RESP002 (Data Sheet Attached)
○ Manufacturer's Standard
Remarks _____

PAINT AND SHIPMENT PREPARATION

Pump
○ Manufacturer's Standard
○ Other _____

Baseplate
○ Manufacturer's Standard
○ Other _____

Shipment
○ Domestic ○ Export ○ Export Boxing Required
○ Number of Months of Storage _____
Total Weight _____ (lb)

INSPECTION AND TESTING

○ Final Inspection Required ○ Days Notification Required ____

Test	Nonwitnessed	Witnessed	Certificate
Hydrostatic	○	○	○
Performance	○	○	○
NPSHR	○	○	○
Vibration	○	○	○
Other	○	○	○

○ Dismantle and Inspect After Test
○ Casting Repair Procedure Approval Required
Material Certification Required
○ Casing ○ Cover ○ Impeller ○ Shaft
○ Other _____
Inspection Required for Connection Welds
○ Manufacturer's Standard ○ Visual Inspection
Inspection Required for Castings
○ Manufacturer's Standard ○ Visual Inspection
○ Other _____

MANUFACTURER DOCUMENTATION REQUIREMENTS

○ For Vendor Data Requirements Refer to: _____
Remarks _____

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PIP

FORM 1 ASME CENTRIFUGAL PUMP
Data Sheet (U.S. Customary Units)

RESP73
PAGE 3 of 3
November 2000

Job Number _____ Item Number _____ Purchase Order Number _____ Date _____
Req./Spec. Number _____ / _____ Inquiry Number _____ By _____

☐ MECHANICAL SEAL

Supplied By ○ Pump Manufacturer ○ Purchaser
Mounted By ○ Pump Manufacturer ○ Purchaser
Seal Classification Code _____
☐ Manufacturer _____
☐ Model _____
☐ Manufacturer Code _____
Seal Type ○ Cartridge ○ Component
Seal Design ○ Single ○ Dual ○ Dry Gas
○ Pressurized ○ Unpressurized
Seal Chamber ○ Taper Bore ○ Cylindrical Bore
Seal Chamber Size ○ Oversized ○ Standard
_____
☐ Pumping Ring Required
☐ Throat Bushing Required ☐ Materials _____
Remarks _____

☐ SEAL GLAND

Taps Required ○ Quench ○ Flush ○ Drain
○ Other _____
☐ Throttle Bushing ☐ Materials

☐ SEAL FLUSHING

Primary Flush Plan No. _____
○ External Flush Liquid _____
○ Supply Temperature Min./Max. _____ / _____ (°F)
○ Specific Gravity _____
○ Specific Heat _____ (BTU/lb °F)
○ Vapor Pressure _____ (psia) @ _____ (°F)
☐ Flow Rate Required Min./Max. _____ / _____ (gpm)
☐ Pressure Required Min./Max. _____ / _____ (psig)
☐ Temperature Required Min./Max. _____ / _____ (°F)
Primary Seal Flush Piping
○ Tubing ○ Pipe ○ Other _____
Material ○ 316SS ○ Carbon Steel
○ Other _____
○ Piping/Tubing Size _____ (in.)
Piping Assembly ○ Threaded ○ Unions ○ Flanged
○ Tube Type Fittings ○ Socket Welded
Remarks _____

☐ BARRIER/BUFFER FLUSH SYSTEM

Barrier Flush Plan _____
○ Barrier Flush Liquid _____
○ Temperature Min./Max. _____ / _____ (°F)
○ Specific Gravity _____
○ Specific Heat _____ (BTU/lb °F)
○ Vapor Pressure _____ (psia) @ _____ (°F)
☐ Pressure Required Min./Max. _____ / _____ (psig)
☐ MAWP of Secondary Seal System _____ (psig)
○ Temperature Required Min./Max. _____ / _____ (°F)
Secondary Seal Flush Piping ○ Tubing ○ Pipe
Material ○ 316SS ○ Carbon Steel
○ Other _____
○ Piping/Tubing Size _____ (in.)
Piping Assembly ○ Threaded ○ Unions ○ Flanged
○ Tube Type Fittings ○ Socket Welded
Remarks _____

SEAL SYSTEM INSTRUMENTATION

	Gauges	Switches
Primary Seals		
Flow	○	○
Temperature	○	○
Pressure	○	○
Secondary Seals		
Flow	○	○
Pressure	○	○
Level	○	○

Remarks _____

☐ COOLING OR HEATING PIPING PLANS

○ Piping Plan No. _____
○ Name of Fluid _____
○ Inlet Temperature _____ (°F)
○ Outlet Temperature _____ (°F)
☐ Rated Flow _____ (gpm)
☐ Supply Pressure _____ (psig)
☐ Max. Allowable ΔP _____ (psi)

○ Galvanized Pipe ○ SS Tubing
○ Sight Flow Indicator
○ Outlet Shut-Off Valve
Remarks _____

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PIP

FORM 2 ASME CENTRIFUGAL PUMP
Data Sheet (SI Units)

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PAGE 1 of 3
November 2000

Job Number _____ Item Number _____ Purchase Order Number _____ Date _____
Req./Spec. Number _____ / _____ Inquiry Number _____ By _____

Note: ○ Indicates Information Completed by Purchaser ☐ by Manufacturer ☒ by Purchaser or Manufacturer

○ For _____ ○ Unit _____
○ Site _____ ○ Service _____
○ No. Req. _____ ☒ Pump Size _____ ☒ Type _____
☒ Manufacturer _____ ☒ Model _____ ☒ Serial Number _____

○ GENERAL

○ Number Motor Driven _____ ○ Number Turbine Driven _____ ○ Gearbox Item Number _____
○ Motor Item Number _____ ○ Turbine Item Number _____ ○ Gearbox Provided By _____
○ Motor Provided By _____ ○ Turbine Provided By _____ ○ Gearbox Mounted By _____
○ Motor Mounted By _____ ○ Turbine Mounted By _____

○ OPERATING CONDITIONS

	Rated	Max.	Normal	Min.
Capacity (m^3/h)				
Suction Pressure (kPa)				
Discharge Pressure (kPa)				
Differential Pressure (kPa)				
Differential Head (m)		@ Minimum S.G.		
Hydraulic Power (kW)				
At Designated Capacity	Rated	Max.	Normal	Min.
Operating Time (hr/yr)				
NPSH Available (m)				

System Design
○ Stand Alone Operation ○ Parallel Operation
○ Series Operation with Item Number _____
Suction Pressure Min./Max. _____ / _____ (kPa)

Service
○ Continuous ○ Intermittent (Starts/Day) _____

System Control Method
○ Speed ○ Flow ○ Level ○ Temperature
○ Pressure ○ Pipe Friction Resistance Only

○ PUMPED FLUID

Pumped Fluid _____

	Rated	Max.	Normal	Min.
Pumping Temperature (°C)				
At Designated Temperature	Rated	Max.	Normal	Min.
Specific Gravity				
Vapor Pressure (kPa abs)				
Viscosity (cp)				
Specific Heat (kJ/kg °C)				

Initial Boiling Point _____ (°C) @ _____ (kPa abs)
Liquid ○ Hazardous ○ Flammable
○ Other _____
Corrosion/Erosion Caused By _____
% Solid _____ Max. Particle Size _____ (mm)

○ PERFORMANCE

☐ Performance Curve No. _____ ☒ Speed (rpm) _____

Measured at Capacity	Rated	Max.	Normal	Min.
☐ NPSH Req'd (m)				

☐ Total Differential Head @ Rated Impeller _____ (m)
☐ Max. Differential Head @ Rated Impeller _____ (m)
☐ Minimum Continuous Flow
Thermal (m^3/h) _____ Stable (m^3/h) _____
☐ Allowable Operating Region _____ To _____ (m^3/h)
☐ Best Efficiency Point for Rated Impeller _____ (m^3/h)
☐ Suction Specific Speed _____
☐ Impeller Diameter Rated _____ Max. _____ Min. _____ (mm)
☐ Pump Rated Power _____ (bhp) ☐ Efficiency _____ (%)
☐ Maximum Power @ Rated Impeller _____ (kW)
Rotation (Viewed from Coupling End) ☐ CW ☐ CCW

Case Pressure Rating
☐ Max. Allowable Working Pressure _____ (kPa)
@ _____ (°C)
☐ Hydrostatic Test Pressure _____ (kPa)

○ SITE CONDITIONS

Location ○ Indoor ○ Outdoor
Altitude _____ (m)
Range of Ambient Temperatures Min./Max. _____ / _____ (°C)
Electrical Classification CL. _____ Gr. _____ Div. _____
○ Nonhazardous

○ GENERAL REMARKS

REV	DATE	REASON FOR REVISION	BY	CHECK	APPROVED
4					
3					
2					
1					
0					

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FORM 2 ASME CENTRIFUGAL PUMP
Data Sheet (SI Units)

RESP73
PAGE 2 of 3
November 2000

Job Number _____ Item Number _____ Purchase Order Number _____ Date _____
Req./Spec. Number _____ / _____ Inquiry Number _____ By _____

☐ MECHANICAL DATA

Impeller Type
☐ Closed ☐ Open
☐ Semi-open ☐ Other _____

Casing Mounting
☐ Foot ☐ Centerline
☐ Vertical Inline ☐ Close-coupled

Bearings
☐ Bearings Manufacturer _____
☐ Radial Bearing Type _____ No. _____
☐ Thrust Bearing Type _____ No. _____
☐ Bearing Isolators _____
☐ Shaft Stiffness Ratio (L^3/D^4) _____

Lubrication
○ Flood ○ Pure Mist ○ Shielded (Grease)
○ Grease ○ Purge Mist ○ Sealed (Grease)
○ Constant Level Oiler Required
☐ Housing Vent Required
○ Magnetic Drain Plug in Housing Required
☐ Oil Cooler Required
○ Seal Spray Guard Required
☐ Oil Viscosity ISO Grade _____
☐ Other _____

Nozzle Connections

	☐ Size	☐ Rating	☐ Facing
Suction			
Discharge			

Aux. Case Connection ○ Drain Required
☐ Size _____ (mm)
○ Threaded ○ Welded and Flanged

☐ MATERIALS

Material Class Code _____
Casing _____
Impeller _____
Cover _____
Shaft _____
Shaft Sleeve _____
Baseplate _____
Casing Gasket _____
Impeller Gasket _____
Casing Fasteners _____
Bearing Housing _____
Bearing Housing Adapter _____
Bearing Housing End Seals _____
Coupling Guard _____
Mechanical Seal Gland _____
Mechanical Seal Gland Fasteners _____

☐ DRIVER

Horsepower Rating _____ (kW) Speed _____ (rpm)
Drive HP Selected or Max. S.G. _____ & Max. Visc. _____ (cp)
Remarks _____

☐ COUPLING BETWEEN PUMP AND DRIVER

Manufacturer _____
Type _____
Size _____
Model _____
Spacer Length (mm) _____
Coupling Guard Type
☐ Manufacturer's Standard
☐ Baseplate Mounted
☐ Nonspark Coupling Guard Required
Remarks _____

☐ BASEPLATE

Remarks ○ Grouted ○ Free Standing
☐ Centerline of Pump to Stilt Bottom _____ (mm)
○ Vertical Pump Case Support Bracket
Design ○ PIP Standard RESP002 (Data Sheet Attached)
○ Manufacturer's Standard
Remarks _____

PAINT AND SHIPMENT PREPARATION

Pump
○ Manufacturer's Standard
○ Other _____

Baseplate
○ Manufacturer's Standard
○ Other _____

Shipment
○ Domestic ○ Export ○ Export Boxing Required
○ Number of Months of Storage _____
Total Weight _____ (kg)

INSPECTION AND TESTING

○ Final Inspection Required ○ Days Notification Required _____

Test	Nonwitnessed	Witnessed	Certificate
Hydrostatic	○	○	○
Performance	○	○	○
NPSHR	○	○	○
Vibration	○	○	○
Other	○	○	○

○ Dismantle and Inspect After Test
○ Casting Repair Procedure Approval Required
Material Certification Required
○ Casing ○ Cover ○ Impeller ○ Shaft
○ Other _____
Inspection Required for Connection Welds
○ Manufacturer's Standard ○ Visual Inspection
Inspection Required for Castings
○ Manufacturer's Standard ○ Visual Inspection
○ Other _____

MANUFACTURER DOCUMENTATION REQUIREMENTS

○ For Vendor Data Requirements Refer to: _____
Remarks _____

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PIP

FORM 2 ASME CENTRIFUGAL PUMP
Data Sheet (SI Units)

RESP73
PAGE 3 of 3
November 2000

Job Number _____ Item Number _____ Purchase Order Number _____ Date _____
Req./Spec. Number _____ / _____ Inquiry Number _____ By _____

☐ MECHANICAL SEAL

Supplied By ○ Pump Manufacturer ○ Purchaser
Mounted By ○ Pump Manufacturer ○ Purchaser
Seal Classification Code _____
☐ Manufacturer _____
☐ Model _____
☐ Manufacturer Code _____
Seal Type ○ Cartridge ○ Component
Seal Design ○ Single ○ Dual ○ Dry Gas
○ Pressurized ○ Unpressurized
Seal Chamber ○ Taper Bore ○ Cylindrical Bore
Seal Chamber Size ○ Oversized ○ Standard
☐ Sleeve Material _____
☐ Pumping Ring Required _____
☐ Throat Bushing Required ☐ Materials _____
Remarks _____

☐ SEAL GLAND

Taps Required ○ Quench ○ Flush ○ Drain
○ Other _____
☐ Throttle Bushing ☐ Materials

☐ SEAL FLUSHING

Primary Flush Plan No. _____
○ External Flush Liquid _____
○ Supply Temperature Min./Max. _____ / _____ (°C)
○ Specific Gravity _____
○ Specific Heat _____ (kJ/kg °C)
○ Vapor Pressure _____ (kPa abs) @ _____ (°C)
☐ Flow Rate Required Min./Max. _____ / _____ (m^3/h)
☐ Pressure Required Min./Max. _____ / _____ (kPa)
☐ Temperature Required Min./Max. _____ / _____ (°C)
Primary Seal Flush Piping
○ Tubing ○ Pipe ○ Other _____
Material ○ 316SS ○ Carbon Steel
○ Other _____
○ Piping/Tubing Size _____ (mm)
Piping Assembly ○ Threaded ○ Unions ○ Flanged
○ Tube Type Fittings ○ Socket Welded
Remarks _____

☐ BARRIER/BUFFER FLUSH SYSTEM

Barrier Flush Plan _____
○ Barrier Flush Liquid _____
○ Temperature Min./Max. _____ / _____ (°C)
○ Specific Gravity _____
○ Specific Heat _____ (kJ/kg °C)
○ Vapor Pressure _____ (kPa abs) @ _____ (°C)
☐ Pressure Required Min./Max. _____ / _____ (kPa)
☐ MAWP of Secondary Seal System _____ (kPa)
○ Temperature Required Min./Max. _____ / _____ (°C)
Secondary Seal Flush Piping ○ Tubing ○ Pipe
Material ○ 316SS ○ Carbon Steel
○ Other _____
○ Piping/Tubing Size _____ (mm)
Piping Assembly ○ Threaded ○ Unions ○ Flanged
○ Tube Type Fittings ○ Socket Welded
Remarks _____

SEAL SYSTEM INSTRUMENTATION

	Gauges	Switches
Primary Seals		
Flow	○	○
Temperature	○	○
Pressure	○	○
Secondary Seals		
Flow	○	○
Pressure	○	○
Level	○	○

Remarks _____

☐ COOLING OR HEATING PIPING PLANS

○ Piping Plan No. _____
○ Name of Fluid _____
○ Inlet Temperature _____ (°C)
○ Outlet Temperature _____ (°C)
☐ Rated Flow _____ (m^3/h)
☐ Supply Pressure _____ (kPa)
☐ Max. Allowable ΔP _____ (kPa)

○ Galvanized Pipe ○ SS Tubing
○ Sight Flow Indicator
○ Outlet Shut-Off Valve
Remarks _____

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