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ASME B73.3M-1997

SPECIFICATION FOR SEALLESS HORIZONTAL END SUCTION CENTRIFUGAL PUMPS FOR CHEMICAL PROCESS

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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FOREWORD

(This Foreword is not part of ASME B73.3M-1997.)

In 1991 the ASME Standards Committee B73, Chemical Standard Pumps, formed a sealless pump working group to develop a standard for sealless pumps that would correspond to ASME B73.1M, Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process.

Though these pumps are sealless (i.e., they do not use a dynamic seal to prevent leakage around the drive shaft), leakage can occur as a result of certain types of wear or misoperation. The user must take appropriate supplemental safety precautions when operating these pumps.

Suggestions for improvement of this Standard will be welcome. They should be sent to The American Society of Mechanical Engineers, Secretary, B73 Committee, 345 East 47th Street, New York, NY 10017.

This Standard was approved as an American National Standard on August 7, 1997.

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Chemical Standard Pumps

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SPECIFICATION FOR SEALLESS HORIZONTAL END SUCTION CENTRIFUGAL PUMPS FOR CHEMICAL PROCESS

1 SCOPE

This Standard covers sealless centrifugal pumps of horizontal end suction single stage and centerline discharge design, including dimensional interchangeability and features to facilitate installation and maintenance. It is the intent of this Standard that pumps of the same standard dimensional designation from all sources of supply shall be interchangeable with respect to mounting dimensions, size, and location of suction and discharge nozzles, input shafts, baseplates, and foundation bolt holes (see Tables 1, 2, 3, and 4).

2 ALTERNATIVE DESIGN

2.1 Extended Design[1]

The extended length alternative shall conform to the basic design features of this Standard including those providing interchangeability with respect to mounting dimensions at the casing, size, and location of the suction and discharge nozzles (see column heads with *e* suffix in Tables 1 through 4 for dimensional limits). Manufacturers, when offering extended length pumps, shall state this fact in their proposal.

NOTE: For Tables 1 and 2 the extended length dimension is a maximum value. Any dimension between the standard and maximum extended length is acceptable.

2.2 Alternative Design

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

[1] The purpose of the maximum extension is to enhance bearing reliability, lubrication containment systems, secondary containment sealing, increased power capability, and other features.

3 NOMENCLATURE AND DEFINITIONS

All nomenclature and definitions of pump components shall be in accordance with ANSI/HI 5.1 through 5.6.

canned motor pump (CMP): a type of sealless pump which has a common shaft to link the pump and motor in a single sealed unit. The pumped liquid is circulated through the motor, but is isolated from the motor components by a corrosion-resistant containment liner.

magnetic drive pump (MDP): a type of sealless pump which utilizes an outer ring of permanent magnets or electromagnets to drive an internal rotating assembly consisting of an impeller, shaft, and inner drive member (torque ring or inner magnet ring) through a corrosion-resistant containment shell.

4 DESIGN AND CONSTRUCTION FEATURES

4.1 Pressure and Temperature Limits

4.1.1 Pressure Limits. The design pressure of the pump shall be at least as great as the pressure–temperature rating of ASME B16.5 or ANSI/ASME B16.42 Class 150 flanges of the material used. Primary pressure-containing boundary (and secondary pressure-containing boundary if required) shall be designed to withstand a hydrostatic test at 1.5 times the maximum design pressure for the particular material of construction used (see para. 5.2.1).

All primary pressure-containing parts shall be capable of resisting a pressure differential of 760 mmHG (14.7 psi) between the wetted and atmospheric side of the component. The higher pressure shall be on the atmospheric side of the component.

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

4.1.3 Statement. Temperature limitations of the liquid at the suction flange shall be stated by the pump manufacturer.

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TABLE 1 PUMP DIMENSIONS FOR MAGENTIC DRIVE PUMPS

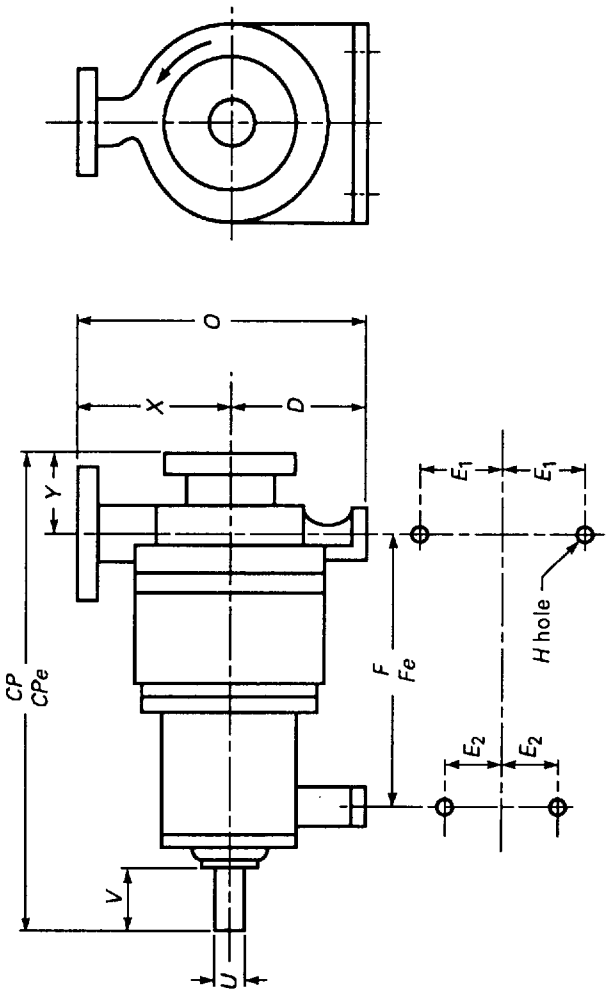

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TABLE 1 PUMP DIMENSIONS FOR MAGNETIC DRIVE PUMPS (CONT'D)

Dimension Designation	Suction Size x Discharge x Nominal Impeller Dia	Dimension in.														
											U [Note (2)]					
		CP	CPe [Note (1)]	D	$2E_1$	$2E_2$	F	Fe [Note (1)]	H	O	Dia	Keyway	V, Min.	X	Y
AA	1.5 x 1 x 6	17.5	21.5	5.25	6	0	7.25	11.25	0.625	11.75	0.875	0.188 x 0.094	2	6.50	4
AB	3 x 1.5 x 6	17.5	21.5	5.25	6	0	7.25	11.25	0.625	11.75	0.875	0.188 x 0.094	2	6.50	4
A10	3 x 2 x 6	23.5	28.5	8.25	9.75	7.25	12.5	17.5	0.625	16.5	1.13	0.25 x 0.125	2.63	8.25	4
AA	1.5 x 1 x 8	17.5	21.5	5.25	6	0	7.25	11.25	0.625	11.75	0.875	0.188 x 0.094	2	6.50	4
A50	3 x 1.5 x 8	23.5	28.5	8.25	9.75	7.25	12.5	17.5	0.625	16.75	1.13	0.25 x 0.125	2.63	8.50	4
A60	3 x 2 x 8	23.5	28.5	8.25	9.75	7.25	12.5	17.5	0.625	17.75	1.13	0.25 x 0.125	2.63	9.50	4
A70	4 x 3 x 8	23.5	28.5	8.25	9.75	7.25	12.5	17.5	0.625	19.25	1.13	0.25 x 0.125	2.63	11	4
A05	2 x 1 x 10	23.5	28.5	8.25	9.75	7.25	12.5	17.5	0.625	16.75	1.13	0.25 x 0.125	2.63	8.50	4
A50	3 x 1.5 x 10	23.5	28.5	8.25	9.75	7.25	12.5	17.5	0.625	16.75	1.13	0.25 x 0.125	2.63	8.50	4
A60	3 x 2 x 10	23.5	28.5	8.25	9.75	7.25	12.5	17.5	0.625	17.75	1.13	0.25 x 0.125	2.63	9.50	4
A70	4 x 3 x 10	23.5	28.5	8.25	9.75	7.25	12.5	17.5	0.625	19.25	1.13	0.25 x 0.125	2.63	11	4
A80	6 x 4 x 10	23.5	28.5	10	9.75	7.25	12.5	17.5	0.625	23.5	1.13	0.25 x 0.125	2.63	13.50	4
A20	3 x 1.5 x 13	23.5	28.5	10	9.75	7.25	12.5	17.5	0.625	20.5	1.13	0.25 x 0.125	2.63	10.50	4
A30	3 x 2 x 13	23.5	28.5	10	9.75	7.25	12.5	17.5	0.625	21.5	1.13	0.25 x 0.125	2.63	11.50	4
A40	4 x 3 x 13	23.5	28.5	10	9.75	7.25	12.5	17.5	0.625	22.5	1.13	0.25 x 0.125	2.63	12.50	4
A80 [Note (3)]	6 x 4 x 13	23.5	28.5	10	9.75	7.25	12.5	17.5	0.625	23.5	1.13	0.25 x 0.125	2.63	13.50	4
A90 [Note (3)]	8 x 6 x 13	33.88	39.88	14.5	16	9	18.75	24.75	0.875	30.5	2.38	0.625 x 0.313	4	16	6
A100 [Note (3)]	10 x 8 x 13	33.88	39.88	14.5	16	9	18.75	24.75	0.875	32.5	2.38	0.625 x 0.313	4	18	6
A110 [Note (3)]	8 x 6 x 15	33.88	39.88	14.5	16	9	18.75	24.75	0.875	32.5	2.38	0.625 x 0.313	4	18	6
A120 [Note (3)]	10 x 8 x 15	33.88	39.88	14.5	16	9	18.75	24.75	0.875	33.5	2.38	0.625 x 0.313	4	19	6

NOTES:
(1) See para. 2.1. This extended length dimension *CPe* is a maximum value. Any dimension between the standard and maximum extended length is acceptable.
(2) *U* may be $1\frac{5}{8}$ in. diameter in A05 through A80 sizes to accommodate high torque values.
(3) Suction connection may have tapped bolt holes.

(Table 1 continues on next page)

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TABLE 1 PUMP DIMENSIONS FOR MAGNETIC DRIVE PUMPS (CONT'D)

Dimension Designation	Suction Size × Discharge × Nominal Impeller Dia	Approximate Equivalent Dimension in mm													
											U [Note (2)]				
		CP	*CPe* [Note (1)]	*D*	$2E_1$	$2E_2$	*F*	*Fe* [Note (1)]	*H*	*O*	Dia	Keyway	*V*, Min.	*X*	*Y*
AA	40 × 25 × 150	445	547	133	152	0	184	286	16	298	22.23	4.76 × 2.38	51	165	102
AB	80 × 40 × 150	445	547	133	152	0	184	286	16	298	22.23	4.76 × 2.38	51	165	102
A10	80 × 50 × 150	597	724	210	248	184	318	445	16	420	28.58	6.35 × 3.18	67	210	102
AA	40 × 25 × 200	445	547	133	152	0	184	286	16	298	22.23	4.76 × 2.38	51	165	102
A50	80 × 40 × 200	597	724	210	248	184	318	445	16	425	28.58	6.35 × 3.18	67	216	102
A60	80 × 50 × 200	597	724	210	248	184	318	445	16	450	28.58	6.35 × 3.18	67	242	102
A70	100 × 80 × 200	597	724	210	248	184	318	445	16	490	28.58	6.35 × 3.18	67	280	102
A05	50 × 25 × 250	597	724	210	248	184	318	445	16	425	28.58	6.35 × 3.18	67	216	102
A50	80 × 40 × 250	597	724	210	248	184	318	445	16	425	28.58	6.35 × 3.18	67	216	102
A60	80 × 50 × 250	597	724	210	248	184	318	445	16	450	28.58	6.35 × 3.18	67	242	102
A70	100 × 80 × 250	597	724	210	248	184	318	445	16	490	28.58	6.35 × 3.18	67	280	102
A80	150 × 100 × 250	597	724	254	248	184	318	445	16	597	28.58	6.35 × 3.18	67	343	102
A20	80 × 40 × 330	597	724	254	248	184	318	445	16	520	28.58	6.35 × 3.18	67	266	102
A30	80 × 50 × 330	597	724	254	248	184	318	445	16	546	28.58	6.35 × 3.18	67	292	102
A40	100 × 80 × 330	597	724	254	248	184	318	445	16	572	28.58	6.35 × 3.18	67	318	102
A80 [Note (3)]	150 × 100 × 330	597	724	254	248	184	318	445	16	597	28.58	6.35 × 3.18	67	343	102
A90 [Note (3)]	200 × 150 × 330	860	1,013	368	406	229	476	629	22	775	60.33	15.88 × 7.94	102	406	152
A100 [Note (3)]	250 × 200 × 330	860	1,013	368	406	229	476	629	22	826	60.33	15.88 × 7.94	102	457	152
A110 [Note (3)]	200 × 150 × 380	860	1,013	368	406	229	476	629	22	826	60.33	15.88 × 7.94	102	457	152
A120 [Note (3)]	250 × 200 × 380	860	1,013	368	406	229	476	629	22	851	60.33	15.88 × 7.94	102	483	152

NOTES:
(1) See para. 2.1. This extended length dimension *CPe* is a maximum value. Any dimension between the standard and maximum extended length is acceptable.
(2) *U* may be 41.28 mm diameter in A05 through A80 sizes to accommodate high torque values.
(3) Suction connection may have tapped bolt holes.

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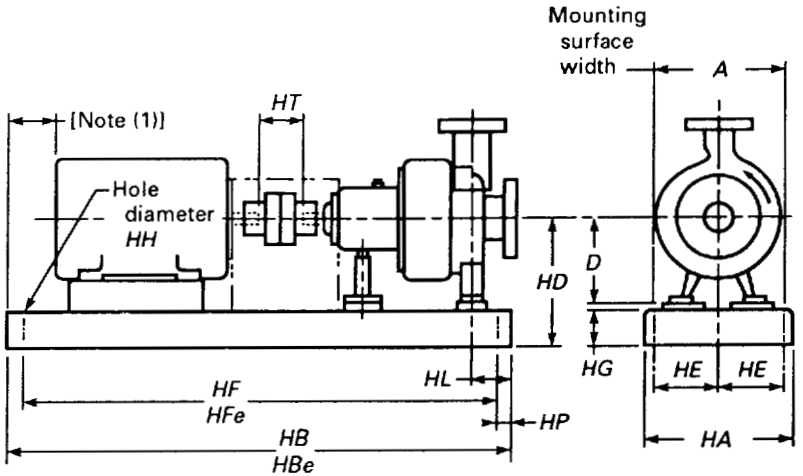

TABLE 2 BASEPLATE DIMENSIONS FOR MAGNETIC DRIVE PUMPS

Max NEMA Frame	Baseplate No. [Notes (2), (3)] For *HB*	Baseplate No. [Notes (2), (3)] For *HBe*	Dimension in. *A*, Min.	*HA*, Max	*HB*	*HBe* [Note (3)]	*HT*, Min.	*HD*, Max [Note (4)] *D* = 5.25	*D* = 8.25	*D* = 10	*D* = 14.50	*HE*	*HF*	*HFe* [Note (3)]	*HG*, Max	*HH*	*HL*	*HP*
184T	139	143	12	15	39	43	3.5	9	...	...	...	4.5	36.5	40.5	3.75	0.75	4.5	1.25
256T	148	152	15	18	48	52	3.5	10.50	...	...	...	6	45.5	49.5	4.13	0.75	4.5	1.25
326TS	153	157	18	21	53	57	3.5	12.88	...	...	...	7.5	50.5	54.5	4.75	0.75	4.5	1.25
184T	245	250	12	15	45	50	3.5	...	12	13.75	...	4.5	42.5	47.5	3.75	0.75	4.5	1.25
215T	252	257	15	18	52	57	3.5	...	12.38	14.13	...	6	49.5	54.5	4.13	0.75	4.5	1.25
286T	258	263	18	21	58	63	3.5	...	13	14.75	...	7.5	55.5	60.5	4.75	1	4.5	1.25
365T	264	269	18	21	64	69	3.5	...	13.88	14.75	...	7.5	61.5	66.5	4.75	1	4.5	1.25
405TS	268	273	22	26	68	73	3.5	...	14.88	14.88	...	9.5	65.5	70.5	4.75	1	4.5	1.25
449TS	280	285	22	26	80	85	3.5	...	15.88	15.88	...	9.5	77.5	82.5	4.75	1	4.5	1.25
286T	368	374	22	26	68	74	5	...	...	...	19.25	9.5	65.5	71.5	4.75	1	6.5	1.25
405T	380	386	22	26	80	86	5	...	...	...	19.25	9.5	77.5	83.5	4.75	1	6.5	1.25
449T	398	3,104	22	26	98	104	5	...	...	...	19.25	9.5	95.5	101.5	4.75	1	6.5	1.25

NOTES:
(1) Motor should not extend beyond the end of the baseplate.
(2) Baseplate number denotes pump frame 1, 2, or 3 and baseplate *HB* or *HBe* in inches.
(3) See para. 2.1. This extended length dimension *HBe* is a fixed value. Whenever the pump to be mounted has *CPe* greater than *CP*, the baseplate for *HBe* must be used.
(4) Includes 0.13 in. shimming allowance where motor height controls.

(Table 2 continues on next page)

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TABLE 2 BASEPLATE DIMENSIONS FOR MAGNETIC DRIVE PUMPS (CONT'D)

Max NEMA Frame	Baseplate No. [Notes (2), (3)]		Approximate Equivalent Dimension in mm														
								HD, Max [Note (4)]									
	For *HB*	For *HBe*	*A*, Min.	*HA*, Max	*HB*	*HBe* [Note (3)]	*HT*, Min.	*D* = 133	*D* = 210	*D* = 254	*D* = 368	*HE*	*HF*	*HFe* [Note (2)]	*HG*, Max	*HH*	*HL*	*HP*
184T	139	143	305	381	991	1,993	89	229	...	...	...	114	927	1,029	95	19	114	32
256T	148	152	381	457	1,219	1,321	89	267	...	...	...	152	1,156	1,258	105	19	114	32
326TS	153	157	457	533	1,346	1,448	89	327	...	...	...	191	1,283	1,385	121	19	114	32
184T	245	250	305	381	1,143	1,270	89	...	305	349	...	114	1,080	1,207	95	19	114	32
215T	252	257	381	457	1,321	1,448	89	...	314	359	...	152	1,257	1,385	105	19	114	32
286T	258	263	457	533	1,473	1,600	89	...	330	375	...	191	1,410	1,537	121	25	114	32
365T	264	269	457	533	1,626	1,753	89	...	353	375	...	191	1,562	1,690	121	25	114	32
405TS	268	273	559	660	1,727	1,855	89	...	378	378	...	241	1,664	1,791	121	25	114	32
449TS	280	285	559	660	2,032	2,159	89	...	403	403	...	241	1,969	2,096	121	25	114	32
286T	368	374	559	660	1,727	1,880	127	...	...	...	489	241	1,664	1,817	121	25	165	32
405T	380	386	559	660	2,032	2,185	127	...	...	...	489	241	1,969	2,121	121	25	165	32
449T	398	3,104	559	660	2,489	2,642	127	...	...	...	489	241	2,426	2,579	121	25	165	32

NOTES:
(1) Motor should not extend beyond the end of the baseplate.
(2) Baseplate number denotes pump frame 1, 2, or 3 and baseplate *HB* or *HBe* in inches.
(3) See para. 2.1. This extended length dimension *HBe* is a fixed value. Whenever the pump to be mounted has *CPe* greater than *CP*, the baseplate for *HBe* must be used.
(4) Includes 3 mm shimming allowance where motor height controls.

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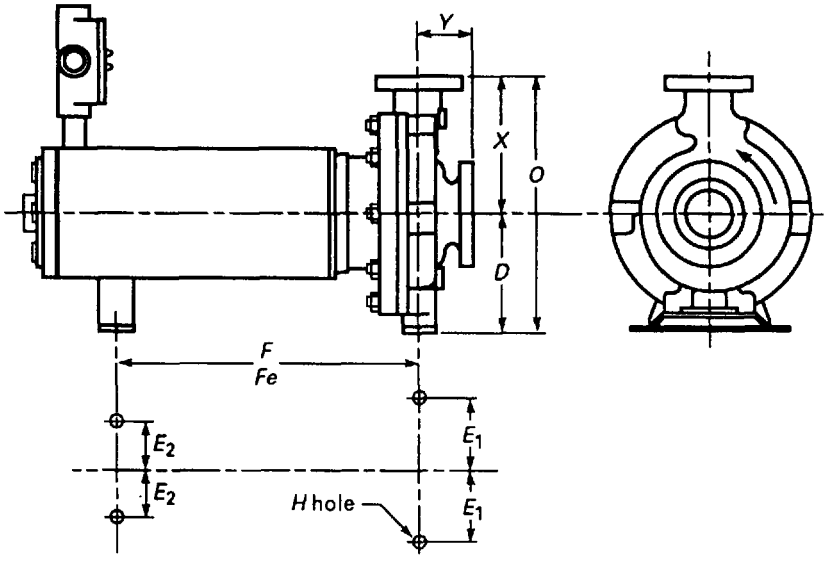

TABLE 3 PUMP DIMENSIONS FOR CANNED MOTOR PUMPS

Dimension Designation	Suction Size × Discharge × Nominal Impeller Dia	Dimension in in.								
		D	$2E_1$	$2E_2$	*F*	*Fe* [Note (1)]	*H*	*O*	*X*	*Y*
AA	1.5 × 1 × 6	5.25	6	0	7.25	11.25	0.625	11.75	6.50	4
AB	3 × 1.5 × 6	5.25	6	0	7.25	11.25	0.625	11.75	6.50	4
A10	3 × 2 × 6	8.25	9.75	7.25	12.5	17.5	0.625	16.5	8.25	4
AA	1.5 × 1 × 8	5.25	6	0	7.25	11.25	0.625	11.75	6.50	4
A50	3 × 1.5 × 8	8.25	9.75	7.25	12.5	17.5	0.625	16.75	8.50	4
A60	3 × 2 × 8	8.25	9.75	7.25	12.5	17.5	0.625	17.75	9.50	4
A70	4 × 3 × 8	8.25	9.75	7.25	12.5	17.5	0.625	19.25	11	4
A05	2 × 1 × 10	8.25	9.75	7.25	12.5	17.5	0.625	16.75	8.50	4
A50	3 × 1.5 × 10	8.25	9.75	7.25	12.5	17.5	0.625	16.75	8.50	4
A60	3 × 2 × 10	8.25	9.75	7.25	12.5	17.5	0.625	17.75	9.50	4
A70	4 × 3 × 10	8.25	9.75	7.25	12.5	17.5	0.625	19.25	11	4
A80	6 × 4 × 10	10	9.75	7.25	12.5	17.5	0.625	23.5	13.50	4
A20	3 × 1.5 × 13	10	9.75	7.25	12.5	17.5	0.625	20.5	10.50	4
A30	3 × 2 × 13	10	9.75	7.25	12.5	17.5	0.625	21.5	11.50	4
A40	4 × 3 × 13	10	9.75	7.25	12.5	17.5	0.625	22.5	12.50	4
A80 [Note (2)]	6 × 4 × 13	10	9.75	7.25	12.5	17.5	0.625	23.5	13.50	4
A90 [Note (2)]	8 × 6 × 13	14.5	16	9	18.75	24.75	0.875	30.5	16	6
A100 [Note (2)]	10 × 8 × 13	14.5	16	9	18.75	24.75	0.875	32.5	18	6
A110 [Note (2)]	8 × 6 × 15	14.5	16	9	18.75	24.75	0.875	32.5	18	6
A120 [Note (2)]	10 × 8 × 15	14.5	16	9	18.75	24.75	0.875	33.5	19	6

NOTES:
(1) See para. 2.1. This extended length dimension *Fe* is a maximum value. Any dimension between the standard and maximum extended length is acceptable.
(2) Suction connection may have tapped bolt holes.

(Table 3 continues on next page)

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TABLE 3 PUMP DIMENSIONS FOR CANNED MOTOR PUMPS (CONT'D)

Dimension Designation	Suction Size x Discharge x Nominal Impeller Dia	Approximate Equivalent Dimension in mm								
		D	$2E_1$	$2E_2$	*F*	*Fe* [Note (1)]	*H*	*O*	*X*	*Y*
AA	40 × 25 × 150	133	152	0	184	286	16	298	165	102
AB	80 × 40 × 150	133	152	0	184	286	16	298	165	102
A10	80 × 50 × 150	210	248	184	318	445	16	420	210	102
AA	40 × 25 × 200	133	152	0	184	286	16	298	165	102
A50	80 × 40 × 200	210	248	184	318	445	16	425	216	102
A60	80 × 50 × 200	210	248	184	318	445	16	450	242	102
A70	100 × 80 × 200	210	248	184	318	445	16	490	280	102
A05	50 × 25 × 250	210	248	184	318	445	16	425	216	102
A50	80 × 40 × 250	210	248	184	318	445	16	425	216	102
A60	80 × 50 × 250	210	248	184	318	445	16	450	242	102
A70	100 × 80 × 250	210	248	184	318	445	16	490	280	102
A80	150 × 100 × 250	254	248	184	318	445	16	597	343	102
A20	80 × 40 × 330	254	248	184	318	445	16	520	266	102
A30	80 × 50 × 330	254	248	184	318	445	16	546	292	102
A40	100 × 80 × 330	254	248	184	318	445	16	572	318	102
A80 [Note (2)]	150 × 100 × 330	254	248	184	318	445	16	597	343	102
A90 [Note (2)]	200 × 150 × 330	368	406	229	476	629	22	775	406	152
A100 [Note (2)]	250 × 200 × 330	368	406	229	476	629	22	826	457	152
A110 [Note (2)]	200 × 150 × 380	368	406	229	476	629	22	826	457	152
A120 [Note (2)]	250 × 200 × 380	368	406	229	476	629	22	851	483	152

NOTES:
(1) See para. 2.1. This extended length dimension *Fe* is a maximum value. Any dimension between the standard and maximum extended length is acceptable.
(2) Suction connection may have tapped bolt holes.

NOTE: The application of the pump shall take into consideration the fluid characteristics as supplied by the user. This will require consideration of such characteristics as specific heat and vapor pressure of the liquid which establishes these limits.

4.2 Flanges

Suction and discharge nozzles shall be flanged with flange dimensions conforming to ASME B16.5 Class 150 steel standards as to bolt circle, number, and size of bolt holes. Flanges shall be flat-faced at the full raised-face thickness (minimum) called for in ANSI standards for the material of construction. Bolt holes shall straddle the horizontal and vertical centerline. As an option, Class 300 flanges in accordance with ASME B16.5, except flat-faced at full raised-face thickness subject to manufacturers' casing pressure–temperature limitations, may be offered. Such pumps shall conform to the *X* and *Y* dimensions as shown in Tables 1 and 3. Flange finish shall be concentric or spiral grooving in accordance with ASME B16.5. Milled finishes are unacceptable.

4.3 Casing

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

4.3.2 Gage Connection Boss(es). The suction and discharge nozzles shall have boss(es) for gage connections. Boss size shall accommodate ¼ in. NPT minimum. Drilling and tapping of the boss(es) is optional.

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

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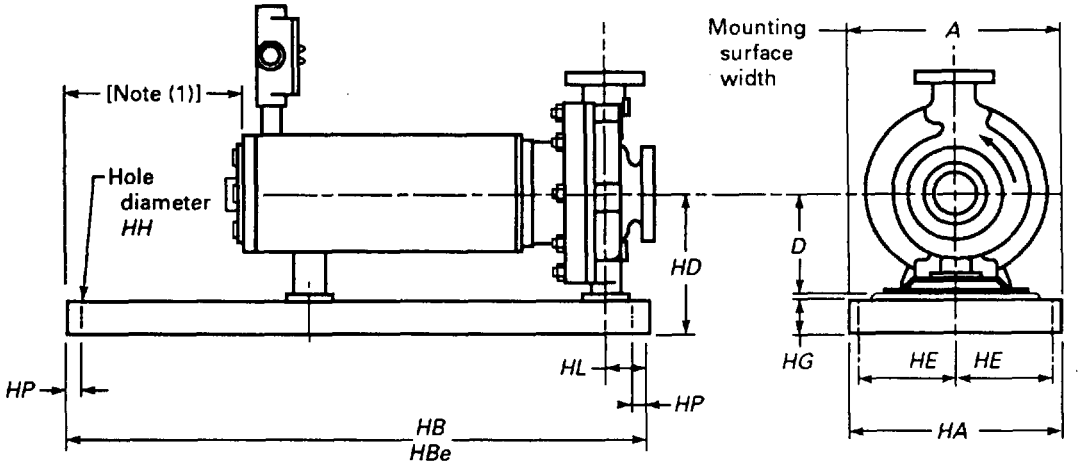

TABLE 4 BASEPLATE DIMENSIONS FOR CANNED MOTOR PUMPS

Dimension Designation	Suction Size x Discharge x Nominal Impeller Dia	Dimension in.									
		A, Min.	*HA*, Max	*HB*, Max	*HBe*, Max [Note (2)]	*HD*, Max	*HE*	*HG*, Max	*HH*	*HL*	*HP*
AA	1.5 x 1 x 6	12	15	39	43	9	4.5	3.75	0.75	4.5	1.25
AB	3 x 1.5 x 6	15	18	48	52	9	6	4.13	0.75	4.5	1.25
A10	3 x 2 x 6	18	21	58	63	12	7.5	4.75	1	4.5	1.25
AA	1.5 x 1 x 8	18	21	58	63	9	7.5	4.75	1	4.5	1.25
A50	3 x 1.5 x 8	18	21	58	63	12	7.5	4.75	1	4.5	1.25
A60	3 x 2 x 8	18	21	64	69	13.88	7.5	4.75	1	4.5	1.25
A70	4 x 3 x 8	18	21	64	69	13.88	7.5	4.75	1	4.5	1.25
A05	2 x 1 x 10	18	21	58	63	13.88	7.5	4.75	1	4.5	1.25
A50	3 x 1.5 x 10	18	21	64	69	13.88	7.5	4.75	1	4.5	1.25
A60	3 x 2 x 10	18	21	64	69	13.88	7.5	4.75	1	4.5	1.25
A70	4 x 3 x 10	22	26	68	73	14.88	9.5	4.75	1	4.5	1.25
A80	6 x 4 x 10	22	26	80	85	15.88	9.5	4.75	1	4.5	1.25
A20	3 x 1.5 x 13	22	26	80	85	15.88	9.5	4.75	1	4.5	1.25
A30	3 x 2 x 13	22	26	80	85	15.88	9.5	4.75	1	4.5	1.25
A40	4 x 3 x 13	22	26	80	85	15.88	9.5	4.75	1	4.5	1.25
A80	6 x 4 x 13	22	26	80	85	15.88	9.5	4.75	1	4.5	1.25
A90	8 x 6 x 13	22	26	80	85	19.5	9.5	4.75	1	4.5	1.25
A100	10 x 8 x 13	22	26	80	85	19.5	9.5	4.75	1	4.5	1.25
A110	8 x 6 x 15	22	26	80	85	19.5	9.5	4.75	1	4.5	1.25
A120	10 x 8 x 15	22	26	80	85	19.5	9.5	4.75	1	4.5	1.25

NOTES:
(1) Pump assembly shall not extend beyond the end of the baseplate.
(2) See para. 2.1. This extended length dimension *HBe* is a maximum value. Whenever the pump to be mounted has *Fe* greater than *F*, the baseplate for *HBe* must be used.

(Table 4 continues on next page)

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TABLE 4 BASEPLATE DIMENSIONS FOR CANNED MOTOR PUMPS (CONT'D)

Dimension Designation	Suction Size x Discharge x Nominal Impeller Dia	Approximate Equivalent Dimension in mm									
		A, Min.	*HA*, Max	*HB*, Max	*HBe*, Max [Note (2)]	*HD*, Max	*HE*	*HG*, Max	*HH*	*HL*	*HP*
AA	1.5 x 1 x 6	12	15	39	43	9	4.5	3.75	0.75	4.5	1.25
AB	3 x 1.5 x 6	15	18	48	52	9	6	4.13	0.75	4.5	1.25
A10	3 x 2 x 6	18	21	58	63	12	7.5	4.75	1	4.5	1.25
AA	1.5 x 1 x 8	18	21	58	63	9	7.5	4.75	1	4.5	1.25
A50	3 x 1.5 x 8	18	21	58	63	12	7.5	4.75	1	4.5	1.25
A60	3 x 2 x 8	18	21	64	69	13.88	7.5	4.75	1	4.5	1.25
A70	4 x 3 x 8	18	21	64	69	13.88	7.5	4.75	1	4.5	1.25
A05	2 x 1 x 10	18	21	58	63	13.88	7.5	4.75	1	4.5	1.25
A50	3 x 1.5 x 10	18	21	64	69	13.88	7.5	4.75	1	4.5	1.25
A60	3 x 2 x 10	18	21	64	69	13.88	7.5	4.75	1	4.5	1.25
A70	4 x 3 x 10	22	26	68	73	14.88	9.5	4.75	1	4.5	1.25
A80	6 x 4 x 10	22	26	80	85	15.88	9.5	4.75	1	4.5	1.25
A20	3 x 1.5 x 13	22	26	80	85	15.88	9.5	4.75	1	4.5	1.25
A30	3 x 2 x 13	22	26	80	85	15.88	9.5	4.75	1	4.5	1.25
A40	4 x 3 x 13	22	26	80	85	15.88	9.5	4.75	1	4.5	1.25
A80	6 x 4 x 13	22	26	80	85	15.88	9.5	4.75	1	4.5	1.25
A90	8 x 6 x 13	22	26	80	85	19.5	9.5	4.75	1	4.5	1.25
A100	10 x 8 x 13	22	26	80	85	19.5	9.5	4.75	1	4.5	1.25
A110	8 x 6 x 15	22	26	80	85	19.5	9.5	4.75	1	4.5	1.25
A120	10 x 8 x 15	22	26	80	85	19.5	9.5	4.75	1	4.5	1.25

NOTES:
(1) Pump assembly shall not extend beyond the end of the baseplate.
(2) See para. 2.1. This extended length dimension *HBe* is a maximum value. Whenever the pump to be mounted has *Fe* greater than *F*, the baseplate for *HBe* must be used.

4.3.4 Disassembly. The design shall permit back removal of the rotating element(s) from the casing without disturbing the suction and discharge connections or the driver for the magnetic drive pumps. Tapped holes for jackscrews or equivalent means shall be provided to facilitate the safe disassembly and reassembly of the rotating element(s) from the casing and to avoid the necessity of drive wedges or prying implements.

4.3.5 Jackets. Jackets for heating or cooling the casing and/or rotating element are optional. Jackets shall be designed for a minimum operating pressure of 690 kPa gage (100 psig) at 170°C (340°F). Heating jackets may be required for jacket temperatures to 260°C (500°F) with a corresponding reduction in pressure. Sealed jackets for motor cooling shall have a minimum pressure rating of 345 kPa gage (50 psig).

Connections shall be $\frac{3}{8}$ in. NPT minimum, with $\frac{1}{2}$ in. NPT preferred.

When a jacket is to be used for heating by steam, the inlet connection shall be located at the top quadrant of 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.

4.3.6 Gaskets. All assembly gaskets shall be confined on the atmospheric side to prevent blowout. Design shall consider thermal cycling which may occur as a condition of service.

4.3.7 Bolting. The pressure-containing fastener load shall not exceed bolt proof load at 1.5 times the rated working pressure, considering all loading conditions.

Proof load is an axial tensile load which the product must withstand without evidence of permanent set. When testing for proof load, the original length is measured, the specified proof load applied, the load released, and the length remeasured. To be acceptable,

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the after-loading length must be within +0.013 mm (+0.0005 in.) (allowance for measurement error) of the before-loading length. Proof loads are set approximately 5% less than the expected minimum yield strength.

4.4 Impeller

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

4.4.2 Balance. All impellers shall be balanced to a minimum ISO 1940, Grade G 6.3.

4.4.3 Mounting. The impeller assembly shall be attached to the shaft by being keyed or threaded. Other attachment designs may be used with the approval of the purchaser. Threads shall be designed to tighten by correct rotation.

4.5 Internal Drive Assembly

4.5.1 Mounting. The inner magnet assembly shall be positively attached to the impeller drive shaft.

4.5.2 Balance. The rotor assembly or inner magnetic assembly shall be balanced in accordance with ISO 1940, Grade G 6.3.

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

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

4.5.5 Internal Drive Assembly Bearings

4.5.5.1 Bearing Design. The bearing system shall be capable of absorbing forward and reverse thrust as well as radial thrust. Bearings shall be designed and applied considering fluid characteristics, unit loading, corrosion, erosion, wear, heat transfer, fits, and friction characteristics.

4.5.5.2 Bearing Loading. Bearing loading, alignment, shaft deflection, surface finish, and wear-in characteristics of bearing materials shall be taken into account to prevent local surface failure.

4.5.5.3 Journals. The journals may be separate sleeves, finished shaft surface, or hard faced/coated shaft areas.

4.5.5.4 Clearance. Materials used for journal sleeves, thrust collars, and bearings often have significantly different thermal expansion characteristics compared to shaft and other mating parts. Application guidelines and limits shall be established by the manufacturers for specific designs to avoid breakage or looseness under specified operating temperatures.

4.5.5.5 Lubrication. Lubrication and/or cooling of the bearings shall be by the liquid pumped or by a clean, compatible, external fluid injection.

4.5.5.6 Heat Input. The bearings shall be provided with adequate fluid circulation and pressure that considers the maximum heat input of the drive assembly (including bearing friction) in relation to the fluid-specific heat, viscosity, and vapor pressure. When requested, the manufacturers shall provide the temperature rise, and minimum pressure at that temperature, of the internal circulated fluid at operating points specified by the purchaser.

4.5.5.7 Bearing Environment. The design shall provide for removal of air or other noncondensables. The purchaser shall advise manufacturers of all changes in phase, solid content, or viscosity that may occur to the process fluid due to a change in temperature and/or pressure.

4.5.5.8 Filtration. When conditions of service require filtration of bearing lubricating fluid, a self-cleaning internal design may be used. If external filtration is required, the filter system should allow for indicating when filter change is required. Loss of flow to drive section shall be avoided.

4.6 Containment Design

4.6.1 Primary Pressure Containment. The containment shell and liner shall be the primary means of sealing and as a minimum shall be manufactured of a material equal to or higher in corrosion resistance than the pump casing.

4.6.1.1 Magnetic Drive Pump. The magnetic drive pump metallic primary and/or secondary containment shell(s) shall be designed in accordance with the table of allowable stress levels for the selected materials and the equations for the minimum required thickness as outlined in Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code. The shell may be thinner than the absolute minimum thickness stated in para. UG-16(b) of the Code.

Section VIII, Division 2, of the Code may be utilized in lieu of Division 1 for design. The manufacturer shall indicate whether Division 1 or Division 2 was used.

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Alternative containment shell materials (including nonmetallic) and/or designs, may be considered to obtain benefits such as reduction of eddy current heating and losses. However, because some nonmetallic shells may have temperature and/or pressure limits below that of the casing, alternate materials and designs are subject to approval by the purchaser.

4.6.2 Secondary Containment. In the event of leakage through the primary pressure containment, operation of the pump shall be immediately discontinued.

The purchaser shall be responsible for providing shutdown devices and procedures required for safety.

When specified, the following designs to contain any leakage shall be provided by the manufacturer.

(a) The leakage through the primary containment shall be contained by secondary containment at the maximum allowable working pressure for a minimum of 48 hr.

(b) The secondary containment shall be drainable to a residual of a maximum of 30 ml (2 cu. in.) or to a value agreed upon by the user and manufacturer.

(c) The secondary containment shall be provided with flush and drain connections.

4.6.2.1 Secondary Containment Verification. When specified, a means for checking secondary containment periodically shall be provided by the manufacturer.

4.6.3 Draining. All pumped fluid-containing areas, including vendor-supplied piping, shall be drainable to a residual of a maximum of 30 ml (2 cu. in.), or to a value agreed upon by the manufacturer and purchaser, and shall be suitable for flushing before disassembly.

4.6.4 Monitoring. Provision shall be available to allow for instrumentation to monitor containment shell temperature of magnetic drive pumps.

4.7 External Bearings (MDP)

4.7.1 Bearing Design. Bearing(s) shall be arranged to carry both the radial and axial thrust loads.

4.7.2 Bearing Life. Bearings shall be selected in accordance with ANSI/ABMA-9 and ANSI/ABMA-1. All pumps shall have a minimum L_{10} bearing life of 17,500 hr at any allowable load.

4.7.3 Sealing. The frame shall be constructed to protect the bearings from water, dust, and other contaminants.

4.7.4 Lubrication. Lubrication may be oil or grease. When oil lubrication is supplied, the frame shall be tapped for constant level oil feed regulator, level indicator, or oil mist system. Other methods of lubrication may be specified.

4.7.5 Drain. The frame shall be provided with a tapped and plugged drain hole in the lowest point of the oil cavity when oil lubrication is supplied.

4.8 Stator Assembly (CMP)

4.8.1 Stator Windings. The stator windings shall be protected by corrosion-resistant liner suitable for the specified conditions.

4.8.2 Oil Filled Stators. Oil filled stators shall have a provision for safe containment of any leakage past the primary containment liner. When expansion tanks are used, they shall be designed to contain the maximum allowable working pressure for a minimum of 48 hr unless longer containment times are specified.

The manufacturer must notify the user of any possible leak paths in the event of a primary containment liner failure.

4.8.3 Temperature Rating. Motor stator winding temperatures must be maintained at or below the values established for the grade of insulation in accordance with IEEE 117.

4.8.4 Motor Design Life. Motor sizing, stator insulation rating, cooling fluid temperature and flow, thermal isolation, and use of jackets or heat exchangers are to be designed and selected to provide a minimum of 40,000 hr design life at specified operating conditions.

4.8.5 Thermal Protection. Thermal protection is to be provided and the manufacturer shall advise the temperature setting and supply the applicable wiring diagrams.

4.8.6 Hazardous Locations. Motors, electrical components, and electrical installations shall be suitable for the area electrical classification (Class, Group, and Division), as well as national and local codes as specified by the purchaser.

4.9 Outer Magnet Assembly (MDP)

4.9.1 Mounting. The outer magnet assembly shall be positively driven by the pump drive shaft and shall have sufficient shaft engagement to insure that the axis

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of the magnet assembly is the same as the axis of the shaft.

4.9.2 Corrosion Resistance. The surfaces of ferrous materials of the outer carrier, frame, and magnets shall be sealed or coated to protect these surfaces from corrosion.

4.9.3 Balance. The outer magnet assembly shall be balanced to a minimum ISO 1940, Grade G 6.3.

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

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

4.10 Materials of Construction

The identifying material of a pump shall be that of which the pressure-containing parts are constructed. Pumps shall be available in the following materials of construction.

Material	Material Specification
Cast ductile iron	ASTM A 395
Cast carbon steel	ASTM A 216 Grade WCB
Cast high alloy steel	
(similar to 316 stainless steel)	ASTM A 744 Grade CF8M
(similar to 316L stainless steel)	ASTM A 744 Grade CF3M
(similar to Alloy 20)	ASTM A 744 CN7M
Cast Cr, Mo, Ni stainless steel	ASTM A 494
Wrought Cr, Mo, Ni stainless steel	ASTM B 575
Hastelloy C	
Cast	ASTM A 494 Grade CW12MW
Wrought	ASTM B 334 or B 575
Other	Optional

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

4.11 Corrosion Allowance

The corrosion allowance for all wetted primary pressure-containing parts shall be agreed upon between purchaser and manufacturer by consideration of corrosion rates for fluids and materials involved.

4.12 Direction of Rotation

Direction of rotation shall be clockwise when viewed from the driver 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.

4.13 Dimensions

Pump dimensions shall conform to Table 1 or 3. Baseplate dimensions shall conform to Table 2 or 4.

4.14 Miscellaneous Design Features

4.14.1 Safety Guards. A coupling guard in accordance with ASME B15.1 shall be furnished on all units that include a pump and driver mounted on a common baseplate.

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

4.14.3 Lifting Rings. A lifting ring or other equivalent device shall be provided to facilitate handling the frame and associated assembly if its mass exceeds 27 kg (60 lb). For magnetic drive pumps on bedplates, eyebolts on motors and/or pumps are not suitable for lifting the entire pump and motor assembly. See the pump manufacturers' manual for proper lifting instructions.

4.14.4 Tapped Openings. All tapped openings 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 case, except that carbon steel plugs may be used on ductile iron pumps. Threaded plugs shall not be used in the heating or cooling jackets; instead, snap-in plugs or waterproof tape shall be used to relieve possible pressure accumulation until piping is installed.

4.14.5 Venting. The entire unit including casing, drive section, and piping supplied by the manufacturer shall be self-venting or furnished with vent connections.

4.14.6 Identification. The manufacturers' part identification number and material designation shall be cast, clearly die stamped, or etched on the casing, cover, impeller, and containment shell. The manufacturers shall provide identification on the product lubricated bearings (tagging is acceptable) to assist in parts identification prior to assembly.

4.14.7 Installation. All equipment provided shall be designed for unsheltered outdoor installation and operation at specified ambient temperatures.

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4.14.8 Frame (MDP). The frame shall be designed to resist a torque at least as high as the decoupling torque strength of the largest drive magnets available for that frame.

The frame, when it clamps the rear cover plate to the pump casing, shall be made of a suitable ductile material such as cast ductile iron or cast carbon steel.

4.14.9 Baseplate Rigidity (MDP). Baseplates which are to be freestanding (foot or spring supported rather than held by anchor bolts and grouted) shall be so structurally rigid as to limit movement of the driver shaft relative to the pump drive shaft to 0.05 mm (0.002 in.) parallel offset when the driver torque of nameplate horsepower is applied.

When specified, baseplates shall have natural frequencies sufficiently removed from operating speed so as to avoid resonance of the system during operation.

4.15 Monitoring Devices

4.15.1 Description. Devices or instruments which indicate or control the condition of the sealless pump to preclude misoperation or damage to the unit should be available when specified.

4.15.2 Temperature Probe. Sensing of temperature of the recirculation fluid and/or the containment shell should be available when specified.

4.15.3 Bearing Wear Detector. A device to detect axial and radial wear for a minimum of one bearing should be available when specified.

4.15.4 Vibration. Receptacles, such as a machined conical recess for handheld vibration probes or tapped bosses for permanently installed probes, should be available when specified. The location on magnetic drive pumps shall be by the ball bearings on the frame in the horizontal position. For canned motor pumps, the location shall be on the stator band in the horizontal and vertical positions.

4.15.5 Motor. A device that monitors the motor should be available when specified. This device may detect one or more of the following:

(a) power;
(b) phase imbalance;
(c) rotation;
(d) under current;
(e) over current;
(f) single phasing; and
(g) short circuit or internal malfunction.

4.15.6 Circulation Fluid. A device to monitor the flow rate of the circulation fluid should be available when specified. This requirement will only apply to pumps with external circulation and does not apply to internal circulated pumps.

4.15.7 Direction of Rotation Indicator (CMP). A direction of rotation indicator should be available when specified.

4.15.8 Leak Detection. A device to detect leakage from the primary containment shell or liner should be available when specified.

5 GENERAL INFORMATION

5.1 Application

Application of sealless pumps requires more consideration than that for conventional centrifugal pumps. It is recommended that anyone applying this type of equipment read para. 5.3 of ANSI/HI 5.1 through 5.6.

5.1.1 Terminology. Pump application and application terminology shall be in accordance with ANSI/HI 5.1 through 5.6.

5.1.2 Flange Loading. Allowable flange loading imposed by the piping shall be in accordance with para. 1.3.3.11 of ANSI/HI 1.1 through 1.5.

5.1.3 Noise. The maximum sound pressure level produced by the pump shall comply with the limit specified. Tests, if specified, shall be conducted in accordance with the standards of the Hydraulic Institute. For magnetic drive pumps, driver and pump noise data must be determined separately.

5.1.4 Vibration. The unfiltered vibration level measured on the stator/rear bearing housing (CMP) or the frame (MDP) at the manufacturer's test facility at the rated speed ±5% and rated flow ±5% shall not exceed 6.35 mm/sec (0.25 in./sec) peak velocity or 0.064 mm (2.5 mils) peak-to-peak displacement.

5.1.5 Hydraulic Coverage. Tables 5 and 6 show the approximate hydraulic coverage for 50 and 60 Hz.

5.2 Tests

5.2.1 Hydrostatic

5.2.1.1 Standard Hydrostatic. After machining, all pressure-containing parts shall be hydrostatically tested for 10 min. minimum with water at 1.5 times

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TABLE 5 APPROXIMATE PERFORMANCE OF STANDARD PUMPS (50 Hz)

Dimension Designation	Suction Size x Discharge x Nominal Impeller Dia	1,450				2,900			
		Capacity		Total Head		Capacity		Total Head	
		gpm	m^3/h	ft	m	gpm	m^3/h	ft	m
AA	1.5 x 1 x 6	31	7.0	22	6.7	62	14.2	86	26.5
AB	3 x 1.5 x 6	62	14.2	22	6.7	125	28.3	86	26.5
A10	3 x 2 x 6	104	23.7	22	6.7	208	47.2	86	26.5
AA	1.5 x 1 x 8	42	9.4	44	13.3	83	18.9	174	52.9
A50	3 x 1.5 x 8	83	18.9	44	13.3	167	37.8	174	52.9
A60	3 x 2 x 8	125	28.3	44	13.3	250	56.7	174	52.9
A70	4 x 3 x 8	208	47.2	44	13.3	417	94.6	174	52.9
A05	2 x 1 x 10	42	9.4	61	18.6	83	18.9	243	74.1
A50	3 x 1.5 x 10	83	18.9	61	18.6	167	37.8	243	74.1
A60	3 x 2 x 10	125	28.3	61	18.6	250	56.7	243	74.1
A70	4 x 3 x 10	250	56.7	61	18.6	500	113.4	243	74.1
A80	6 x 4 x 10	830	188.6	61	18.6	1,077	244.8	243	74.1
A20 [Note (1)]	3 x 1.5 x 13	166	37.7	104	31.7	331	73.2	412	123.6
A30 [Note (1)]	3 x 2 x 13	250	56.7	104	31.7	456	103.6	378	115.2
A40 [Note (1)]	4 x 3 x 13	500	113.6	104	31.7	704	160.0	275	83.3
A80	6 x 4 x 13	911	207.0	104	31.7	...	...	...	...
A20	3 x 1.5 x 13	125	28.3	104	31.7	...	...	...	...
A30	3 x 2 x 13	250	56.7	104	31.7	...	...	...	...
A40	4 x 3 x 13	417	94.6	104	31.7	...	...	...	...
A80	6 x 4 x 13	833	189.2	104	31.7	...	...	...	...
A90	8 x 6 x 13	1,666	378.2	94	28.7	...	...	...	...
A100	10 x 8 x 13	2,917	662.2	94	28.7	...	...	...	...
A110	8 x 6 x 15	1,666	378.2	139	42.4	...	...	...	...
A120	10 x 8 x 15	2,917	662.2	139	42.4	...	...	...	...

GENERAL NOTE:
This Standard does not cover exact hydraulic performance of pumps. Information on approximate head and capacity at the best efficiency point for standard pumps is for general information only. Consult manufacturers regarding hydraulic performance data for specific applications.

NOTE:
(1) Maximum impeller diameter may be limited due to limitations of pump's rotor system.

the maximum design pressure corresponding to 38°C (100°F) for the material of construction used.

NOTE: The pressure rating of jackets may not be the same as required for pumpage-containing parts.

When secondary containment is specified, hydrostatic testing of the secondary containment components shall be in accordance with para. 1.6.4 of ANSI/HI 1.6 or pneumatic testing in accordance with ND-6112 of the ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsection ND.

5.2.1.2 Assembled Pump Hydrostatic Test. When specified, the assembled pump test shall be in accordance with para. 1.6.4 of ANSI/HI 1.6.

5.2.2 Hermetic Integrity Test. When specified, a hermetic integrity test shall be performed on the pump unit after final assembly. Prior to testing, all liquid shall be removed from all internal cavities.

CAUTION: Wetted material moisture retention characteristics should be reviewed against the application prior to testing. No disassembly is permitted after this test. This test shall be performed in accordance with para. 5.6.3 of ANSI/HI 5.1 through 5.6.

5.2.3 Performance Test. When specified, a performance test shall be performed on the pump in accordance with para. 1.6.5 of ANSI/HI 1.6. If a performance test is specified without stating the accept-

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TABLE 6 APPROXIMATE PERFORMANCE OF STANDARD PUMPS (60 Hz)

Dimension Designation	Suction Size x Discharge x Nominal Impeller Dia	1,750 Capacity gpm	1,750 Capacity m^3/h	1,750 Total Head ft	1,750 Total Head m	3,500 Capacity gpm	3,500 Capacity m^3/h	3,500 Total Head ft	3,500 Total Head m
AA	1.5 x 1 x 6	37	8.4	32	9.7	75	17.0	125	38.1
AB	3 x 1.5 x 6	75	17.0	32	9.7	150	34.0	125	38.1
A10	3 x 2 x 6	125	28.4	32	9.7	250	56.7	125	38.1
AA	1.5 x 1 x 8	50	11.3	63	19.2	100	22.7	250	76.2
A50	3 x 1.5 x 8	100	22.7	63	19.2	200	45.4	250	76.2
A60	3 x 2 x 8	150	34.0	63	19.2	300	68.1	250	76.2
A70	4 x 3 x 8	250	56.7	63	19.2	500	113.5	250	76.2
A05	2 x 1 x 10	50	11.3	88	26.8	100	22.7	350	106.7
A50	3 x 1.5 x 10	100	22.7	88	26.8	200	45.2	350	106.7
A60	3 x 2 x 10	150	34.0	88	26.8	300	68.1	350	106.7
A70	4 x 3 x 10	300	68.1	88	26.8	600	136.2	350	106.7
A80	6 x 4 x 10	1,000	227.0	88	26.8	1,300 [Note (1)]	227.0	350	106.7
A20 [Note (2)]	3 x 1.5 x 13	200	43.4	150	45.7	400	90.8	600	182.6
A30 [Note (2)]	3 x 2 x 13	300	68.1	150	45.7	500	125.0	550	167.6
A40 [Note (2)]	4 x 3 x 13	600	136.4	150	45.7	850	193.2	400	121.9
A80	6 x 4 x 13	1,100	250.0	150	45.7	...	...	...	...
A90	9 x 6 x 13	2,000	454.0	135	41.1	...	...	...	...
A100	10 x 8 x 13	3,500	794.5	135	41.1	...	...	...	...
A110	8 x 6 x 15	2,000	454.0	200	61.0	...	...	...	...
A120	10 x 8 x 15	3,500	794.5	200	61.0	...	...	...	...

GENERAL NOTE:
This Standard does not cover exact hydraulic performance of pumps. Information on approximate head and capacity at the best efficiency point for standard pumps is for general information only. Consult manufacturers regarding hydraulic performance data for specific applications.

NOTES:
(1) Liquid end may be modified for this condition.
(2) Maximum impeller diameter may be limited due to limitations of pump's rotor system.

ance level required, the test shall be performed in accordance with Acceptance Level A.

5.2.3.1 Mechanical Integrity Test. When specified, a mechanical integrity test shall be performed on the pump to demonstrate that it will operate mechanically as designed. This test is intended to detect mechanical interferences, ball bearing defects, and bushing bearing(s) defects. This test shall be performed in accordance with para. 5.6.4 of ANSI/HI 5.1 through 5.6. This test is included in the optional performance test.

5.2.3.2 Net Positive Suction Head Required (NPSHR) Test. When specified, an NPSHR test shall be performed in accordance with para. 1.6.6 of ANSI/HI 1.6. When this test is specified, the performance test must also be specified.

5.2.3.3 Winding Integrity Test for Canned Motor Pumps. The motor test shall be conducted in accordance with para. 5.6.5 of ANSI/HI 5.1 through 5.6.

5.2.4 Performance Curves. Published performance curves shall be based on tests conducted in accordance with para. 1.6.5 of ANSI/HI 1.6.

5.3 Nameplates

The nameplate(s) is to be of 24 US Standard Gauge (minimum) AISI 300 series stainless steel and shall be securely attached to the pump. It shall include pump model, ANSI standard dimension designation, serial number, size, impeller diameter installed, material of construction, maximum design pressure for 38°C

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(100°F), maximum allowable horsepower, and rated speed. Canned motor pump nameplates shall also include full load motor data.

6 REFERENCES

6.1 American National Standards

The following are available from the American National Standards Institute, 11 West 42nd Street, 13th fl, New York, NY 10036. ASME standards are also available from The American Society of Mechanical Engineers, 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300. ABMA standards are also available from the Anti-Friction Bearing Manufacturers Association, Inc., 1101 Connecticut Avenue, N.W., Suite 700, Washington, DC 20036. When the following American National Standards referred to in this document are superseded by a revision approved by the American National Standards Institute, the revision shall apply.

ANSI/ABMA 9, Load Ratings and Fatigue Life for Ball Bearings.
ANSI/ABMA 11, Load Ratings and Fatigue Life for Roller Bearings.
ASME B1.1, Unified Inch Screw Threads (UN and UNR Thread Form).
ANSI/ASME B1.20.1, Pipe Threads, General Purpose (Inch).
ASME B15.1, Safety Standard for Mechanical Power Transmission Apparatus.
ANSI/ASME B16.42, Ductile Iron Pipe Flanges and Flanged Fittings.
ASME B16.5, Pipe Flanges and Flanged Fittings.

6.2 Other Publications

6.2.1 ASTM Publications. The following are published by the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM A 216/A 216M, Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service.
ASTM A 395, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
ASTM A 494, Nickel and Nickel Alloy Castings.
ASTM A 536, Standard Specification for Ductile Iron Castings.
ASTM A 744/A 744M, Standard Specification for Castings, Iron-Chromium-Nickel, Corrosion Resistant, for Severe Service.
ASTM B 575, Low Carbon Nickel-Mo-Cr and Low C Ni-Cr-Mo Alloy Plate, Sheet, and Strip.

6.2.2 HI Publications. The following are published by the Hydraulic Institute, 9 Sylvan Way, Suite 180, Parsippany, NJ 07054-3802.

ANSI/HI 1.1 through 1.5, Centrifugal Pumps for Nomenclature, Definitions, Application, and Operation.
ANSI/HI 1.6, Centrifugal Pump Tests.
ANSI/HI 5.1 through 5.6, Sealless Pumps for Nomenclature, Definitions, Applications, Operation, and Test.

6.2.3 IEEE Publications. The following is published by the Institute of Electrical and Electronics Engineers, 345 East 47th Street, New York, NY 10017.

IEEE 117, Standard Test Procedure for Evaluation of Systems of Insulating Materials for Random-Wound AC Electric Machinery.

6.2.4 ASME Publications. The following is published by The American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, NY 10017.

1992 ASME Boiler and Pressure Vessel Code, including addenda through December 31, 1994, Section III, Division 1, Subsection ND.

7 DOCUMENTATION

7.1 Requirements

The following documents shall be supplied for each pump item furnished:

(a) pump and driver outline drawing;
(b) centrifugal pump data sheet;
(c) manufacturers cooling/heating piping drawing (if applicable);
(d) pump fluid circulation plan;
(e) performance curve with rating point;
(f) cross-sectional drawing with parts list;
(g) instruction manual;
(h) motor wiring diagram (CMP); and
(i) coupling outline drawing, parts list, and alignment tolerance limits.

7.1.1 Size. Each document shall be of a size that is a multiple of $8\frac{1}{2}$ in. x 11 in.

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7.1.2 Information. A description for each document is as follows.

7.1.2.1 Pump and Driver Outline Drawing

(a) The pump and driver outline drawing shall contain all information shown on, and should be arranged as, the sample outline drawing included herein and identified as Figs. 1 and 2.

(b) All tapped openings shall be uniformly identified on the drawing with the Roman numerals as shown in Figs. 1 and 2.

7.1.2.2 Centrifugal Pump Data Sheet

(a) The centrifugal pump data sheet may contain all information shown on and may be arranged as the sample data sheet included herein and identified as Form 1.

(b) This document may be used for inquiry, proposal, and as-built.

7.1.2.3 Circulation Piping Drawing

(a) The circulation piping drawing shall be included if the pump is fitted with a circulation piping system supplied by the pump manufacturer.

(b) The circulation 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.

7.1.2.4 Manufacturer Cooling/Heating Piping Drawing

(a) A cooling/heating piping drawing shall be included if the pump assembly 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. 4.

7.1.2.5 Performance Curve(s)

(a) Generalized published performance curves may be published at the discretion of the manufacturer. This type of curve may not be practical for specific pump design configurations due to the complexity of the variables which make up the data. When such curves are published, they shall be a composite (family) of curves for the full range of impeller diameters plotting (at constant speed) head, power consumption, efficiency, and NPSH-required versus capacity (see Figs. 5 and 6). If such information is published for magnetic drive pumps, it is to be indicated if the efficiency and power curve values contain the magnetic coupling and bearing frame losses. Such curves are not to be used by the purchaser for design and construction decisions unless the curves are certified. The delivered pumps will achieve the published results at the designated design point within the tolerances specified by the Hydraulic Institute for the site-specified condition.

(b) For specific applications the manufacturer shall provide a certified performance curve indicating the impeller diameter, the head and flow rating point, NPSH-required, and the motor brake horsepower to achieve the design conditions specified by the purchaser. The brake horsepower and the recommended motor size to meet the design conditions specified by the purchaser shall be included. This curve is to provide head, power consumption, pump efficiency, and NPSH-required versus capacity for the flow range of the selected impeller. If the specified fluid viscosity or specific gravity affects the pump performance, it shall be so noted on the performance curve in accordance with ANSI/HI 1.1 through 1.5. This information may be used by the purchaser to implement design decisions.

(c) Hydraulic tests shall be conducted in accordance with ANSI/HI 1.6.

7.1.2.6 Cross-sectional Drawing. The cross-sectional drawing shall show all assembled parts of the pump. It shall be complete with a parts list referenced to the drawing.

7.1.2.7 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 model pump assembly furnished.

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

(c) The instruction manual shall be an $8\frac{1}{2}$ in. x 11 in. size booklet or electronic format.

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

(e) Recommended tolerances for critical parts would be beneficial to users.

(f) Instruction manuals for auxiliary equipment shall be supplied by the pump manufacturer if included as part of their supply.

7.2 Specially Requested Documentation

Documentation in addition to that listed under para. 7.1 is sometimes required by users. This additional documentation shall be made available to such users upon specific request.

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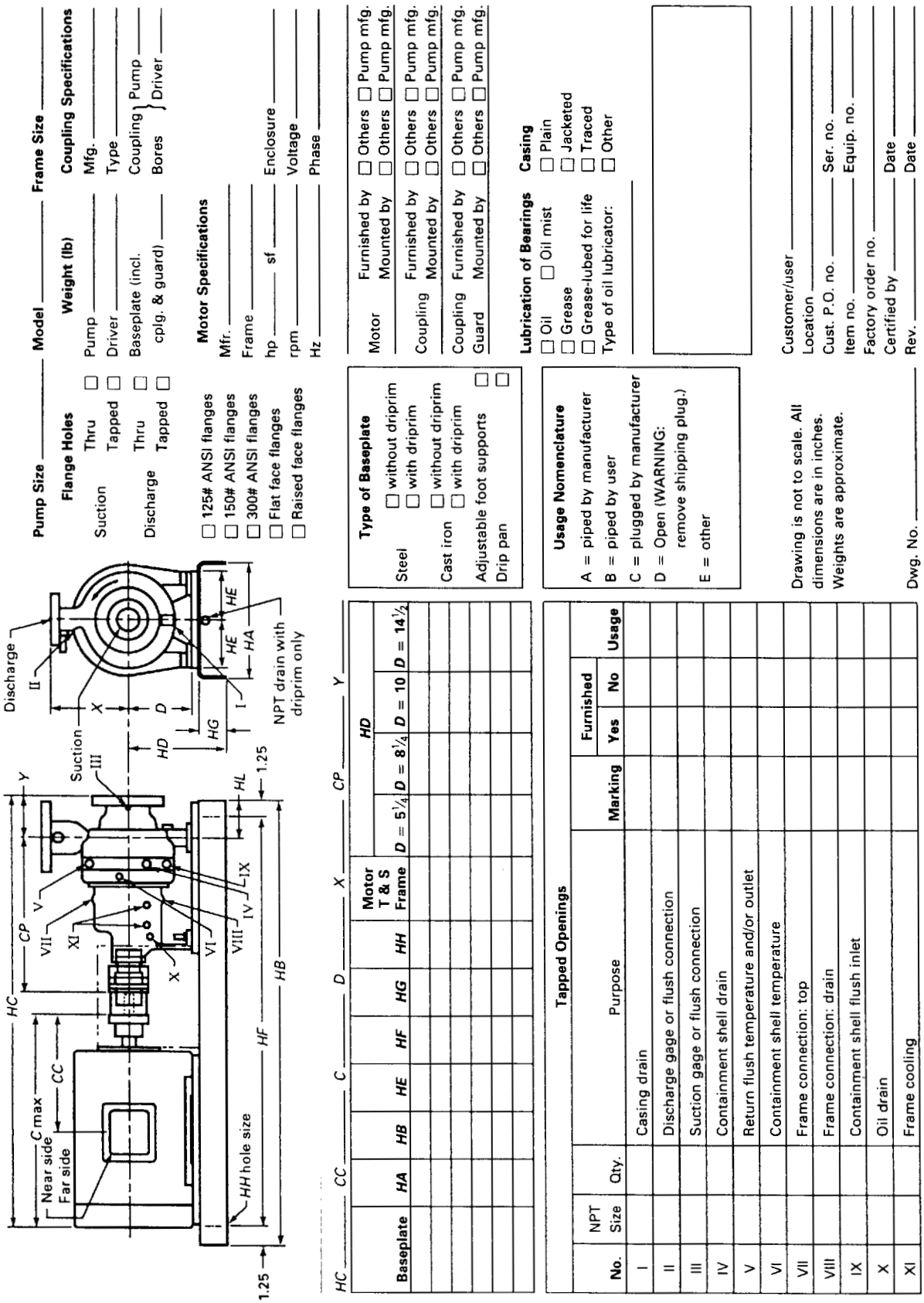

FIG. 1 PUMP AND DRIVER OUTLINE DRAWING FOR MAGNETIC DRIVE PUMPS

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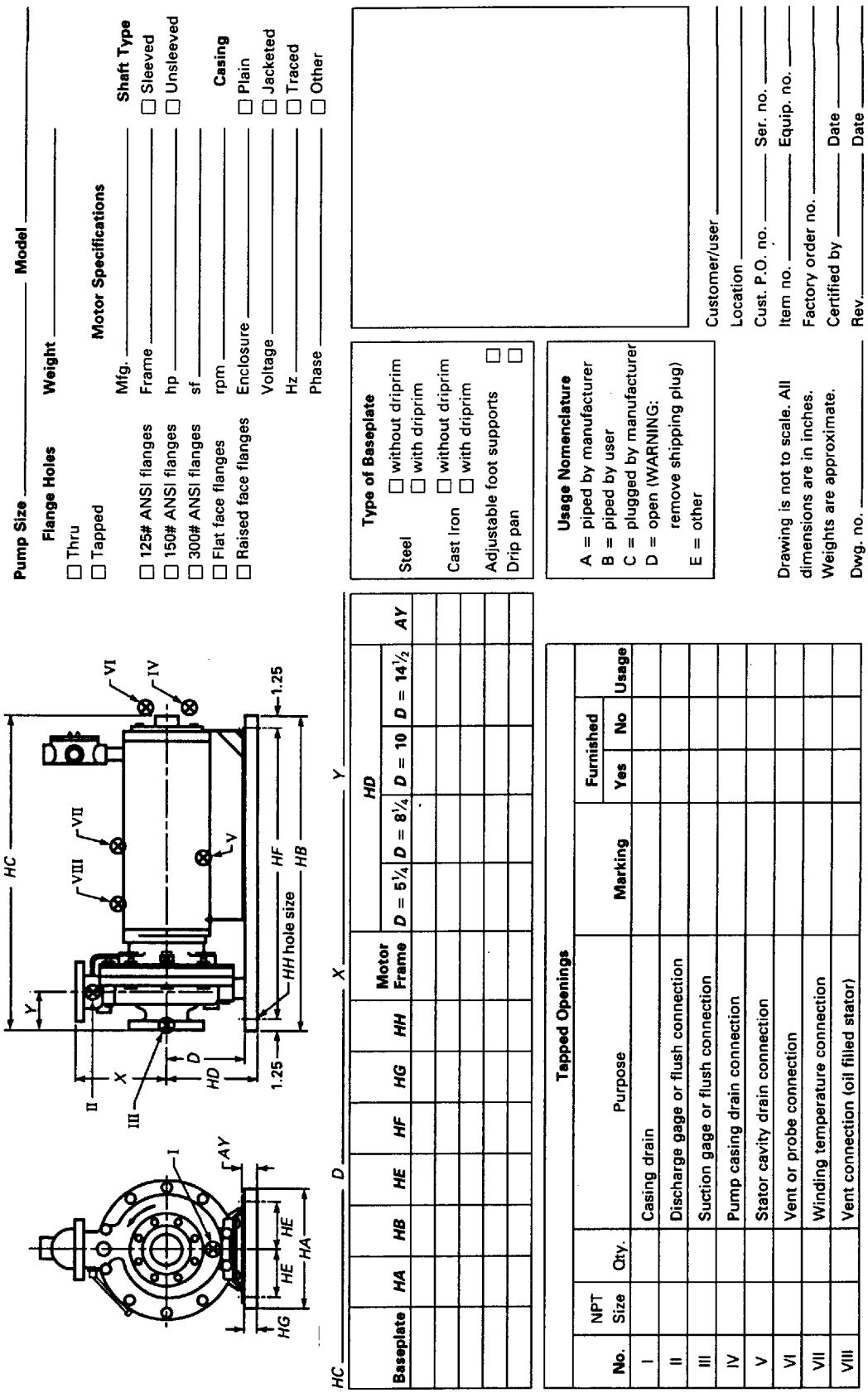

FIG. 2 PUMP AND DRIVER OUTLINE DRAWING FOR CANNED MOTOR PUMPS

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FORM 1 SEALLESS CENTRIFUGAL PUMP DATA SHEET

Applicable To _____ Proposal _____ Purchase _____ As Built _____ Request For Quote No. _____
Pump Type _____ Canned Motor _____ Magnetic Drive _____
Customer _____
Service _____ Number Required _____
Pump Mfg _____ Pump Model _____ Proposal No. _____

OPERATING CONDITIONS

Liquid _____ Capacity, Normal _____ gpm _____ Rated _____ gpm
Specific Gravity at P.T. _____ Disch. Pres. (psig) Norm _____ Max _____ Rated _____
Temperature Min. _____ Max _____ Suct. Pres. (psig) Norm _____ Max _____ Rated _____
Vapor Press at P. T. (psia) _____ Diff. Press. (psi) _____ Diff. Head (TDH) _____
Visc. at P.T. (cps) _____ at Max P.T. _____ NPSH Available (ft) _____ Specific Heat at P.T. _____
Max System Pressure (psi) _____ MAWP (psi) _____ Specific Heat at Max P.T. _____
Surrounding Ambient Temp. (°F) _____ Erosion caused by _____
Cooling Water Available: Yes _____ No _____ % Solids _____ Hardness _____ Size _____
Secondary Containment Required: Yes _____ No _____ Corrosion caused by _____

CONSTRUCTION

Main Connections

	Size	ANSI Rating	Facing	Position
Suction				
Discharge				

Impeller Closed _____ Open _____ Semi-open _____

Other Connections

Drain Size _____ Drain No. _____
Vent Size _____ Vent No. _____
Gauge Size _____ Gauge No. _____
Recirculation/Flush Plan _____

MATERIALS

Casing _____ Impeller _____
Containment Shell _____ Casing Gasket _____
Shaft _____ Thrust Washer(s) _____
Shaft Sleeve/Journal _____ Wear Ring _____
Bearing(s) _____ Bearing Housing(s) _____
Magnets _____ Baseplate _____
Magnet Coupling Type _____ Eddy Current _____ Synchronous _____
Drive Magnet Bearing Type _____ Lubrication _____

MOTOR DATA

CMP MDP

Manufacturer _____ Frame Size _____
Enclosure _____ Area Classification _____
Rated Speed _____ Rated Horsepower _____
Voltage _____ Phase _____ Hz _____
Insulation Class _____ Temperature Rise _____

Full Load Current at Rated Voltage (amp) _____
Bearings _____ Lube _____

	Full Load	3/4 Load	1/2 Load
Efficiency			
Power Factor			

Coupling Manufacturer _____ Model _____ Type _____

PERFORMANCE

Pump Curve No. _____
Impeller Dia (in.) Rated _____
Max _____ Min. _____
Max Head Rated Impeller _____
BHP Rated _____ Max HP _____
Min. Continuous Flow (gpm) _____
Efficiency at Rated Point Hydraulic _____
Hydraulic _____ Shaft Input _____

NPSH Required at Rated Point (ft) _____
Max Sound Pressure (dBA) _____
Outline Drawing No. _____
Cross-Sectional Drawing No. _____
Pump Weight (lb) _____ Baseplate weight _____
Motor Weight (lb) _____ (lb) _____

TESTS

Shop Tests	Nonwitnessed	Witnessed
Hydrostatic		
Hermaticity		
Performance		
NPSH		
Vibration		
Other		

PROTECTIVE INSTRUMENTATION

Leak Detection _____ Yes _____ No _____ Mfg. & Model _____
Motor Load _____ Yes _____ No _____ Mfg. & Model _____
Bearing(s) _____ Yes _____ No _____ Mfg. & Model _____
Temperature _____ Yes _____ No _____ Mfg. & Model _____
Other _____

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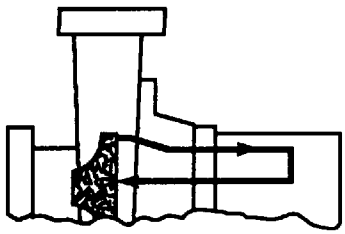
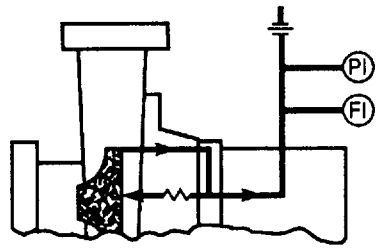


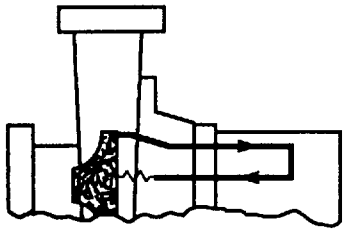
Internal Circulation
(From behind the impeller through the drive section back to suction.)

Plan 7301S



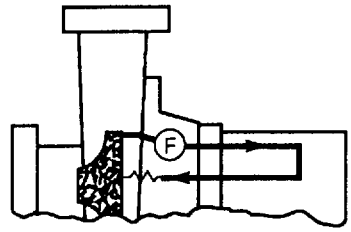
Reverse Circulation
(From behind the impeller through the drive section and return to suction vessel.)

Plan 7313S



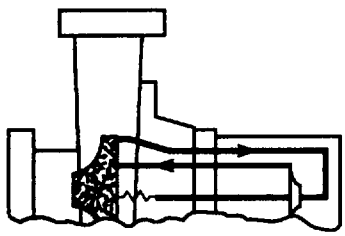
Controlled Internal Circulation
(From behind the impeller through the drive section to an internal restriction to suction.)

Plan 7314S



Filtered Internal Circulation
(From behind the impeller through a centrifugal or mechanical filter through the drive section to suction.)

Plan 7315S



Internal Circulation With Auxiliary Impeller
(From behind the impeller to an auxiliary impeller to increase pressure before passing through the drive section. Restriction to suction and return to intermediate pressure region.)

Plan 7325S

LEGEND

- (F) Filter
- Internal flow restriction
- Y-type strainer
- Heat exchanger
- (FI) Flow indicator, only when specified
- Flow regulating valve
- Cyclone separator
- (PI) Pressure gage with block valve
- Orifice (removable orifice or an integral pressure breakdown arrangement)

FIG. 3 PUMP FLUID CIRCULATION PLANS

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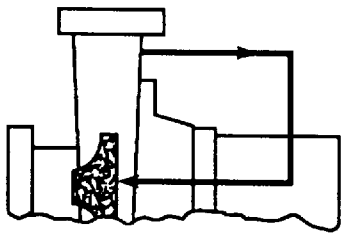
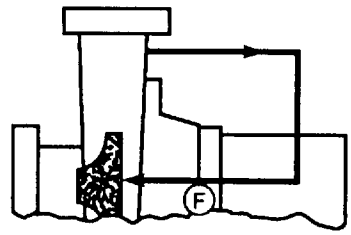


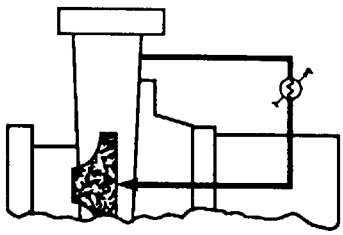
External Circulation
(From discharge through drive section to suction.)

Plan 7311S



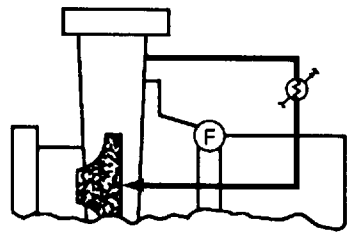
Filtered Circulation
(From discharge through filter through drive section to suction.)

Plan 7312S



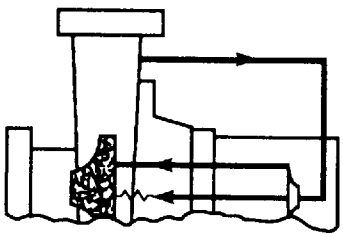
Temperature Controlled Circulation
[From discharge through heat exchanger (heat or cool) through drive section to suction.]

Plan 7321S



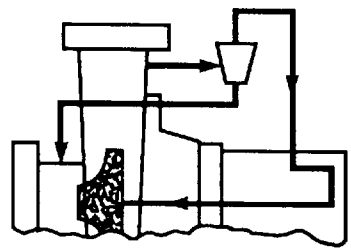
Circulation With Filter and Temperature Control
(From discharge through heat exchanger and filter through drive section to suction.)

Plan 7322S



Circulation With Pressure Increase From Auxiliary Impeller
(From discharge to an auxiliary impeller through drive section and flow restriction to suction and intermediate pressure area.)

Plan 7326S



Circulation With Centrifugal Separator
(From discharge through a centrifugal separator through drive section to suction. Waste particles to suction or drain.)

Plan 7331S

FIG. 3 PUMP FLUID CIRCULATION PLANS (CONT'D)

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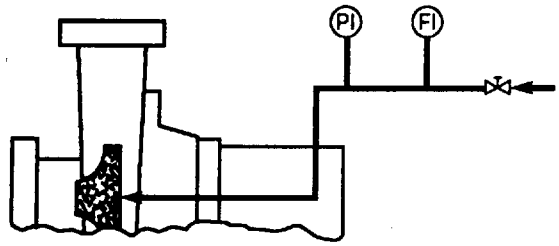
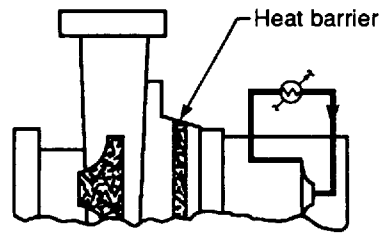


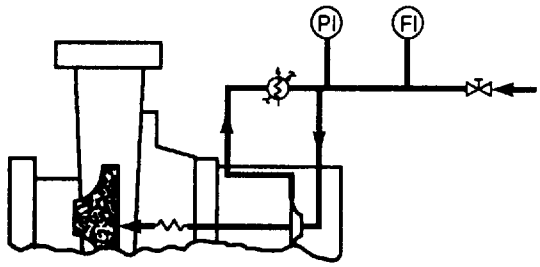
Backflushing of Drive
(Flush with compatible fluid from an external source through drive section to suction.)

Plan 7332S



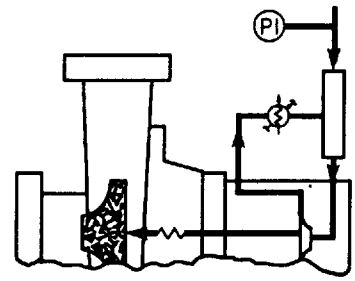
Separate Circulation System
(Circulation through drive section by an auxiliary impeller through a heat exchanger for heat removal.)

Plan 7323S



Reduced Flow Backflush
Using Separate Circulation System
(To minimize dilution, separate circulation (Plan 7323S) is used with controlled backflush rate and flow restriction seal.)

Plan 7333S



Reduced Flow Backflush Using Separate Circulation System and Fluid Reservoir
(Same as plan 7333S except controlled backflush is from a pressurized reservoir.)

Plan 7353S

FIG. 3 PUMP FLUID CIRCULATION PLANS (CONT'D)

7.2.1 Master Document List

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

(a) This list shall be submitted along with the first document in order for the user to be aware of the documents which will follow.

(b) Revisions to this document list should be made as required.

7.2.2 External Forces and Moments on Nozzles. The allowable external forces and moments on pump suction and discharge nozzles shall be in accordance with para. 1.3.3.11 of ANSI/HI 1.1 through 1.5.

7.2.3 Parts List

(a) A list of all pump parts with manufacturers' 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 one year's operation.

(c) The pump/motor manufacturer should also furnish a spare parts list for equipment supplied with the pump, but not of his manufacture, as recommended by the manufacturer of that particular equipment.

(d) These lists shall be presented to the user before the equipment is shipped in order to permit obtaining the necessary parts prior to equipment start-up.

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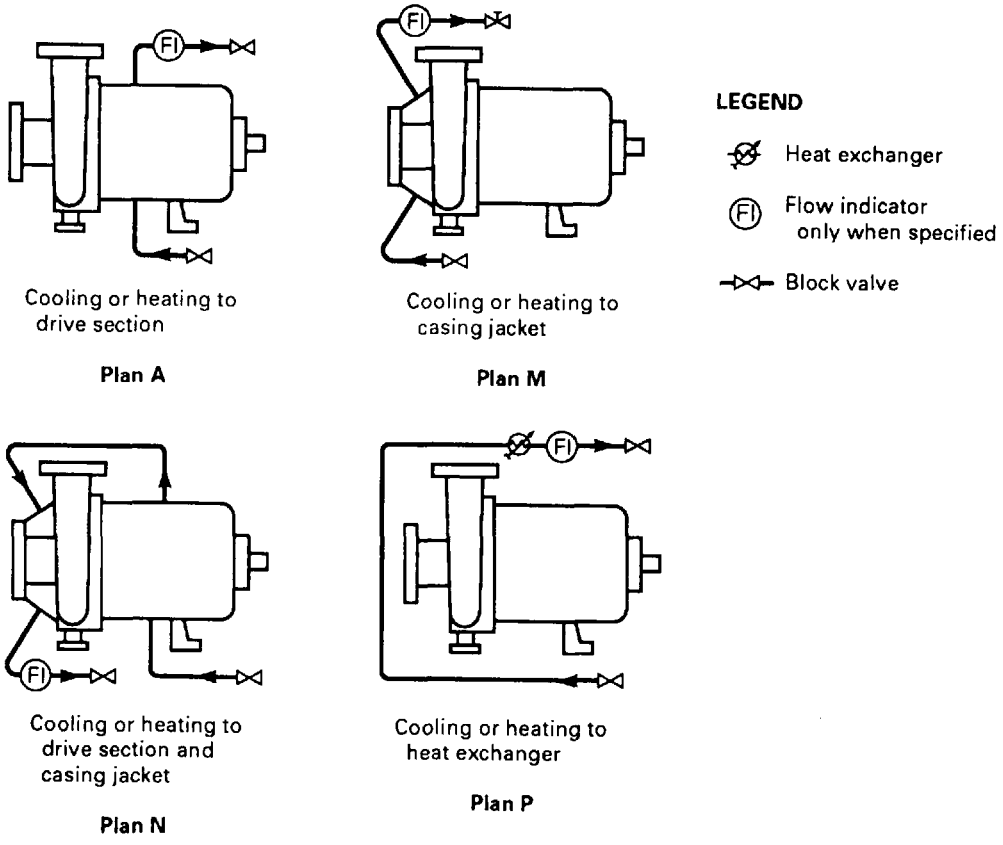

FIG. 4 COOLING AND HEATING PIPING PLANS

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

(a) minimum pump flow rate;

(b) maximum allowable casing pressure and temperature;

(c) maximum allowable jacket pressure and temperature; and

(d) external flush flow rate and pressure for sealless pump drive section.

7.2.5 Special Testing, Painting, and Preparation. Any special testing, painting, and preparation required shall be specified on the centrifugal pump data sheet.

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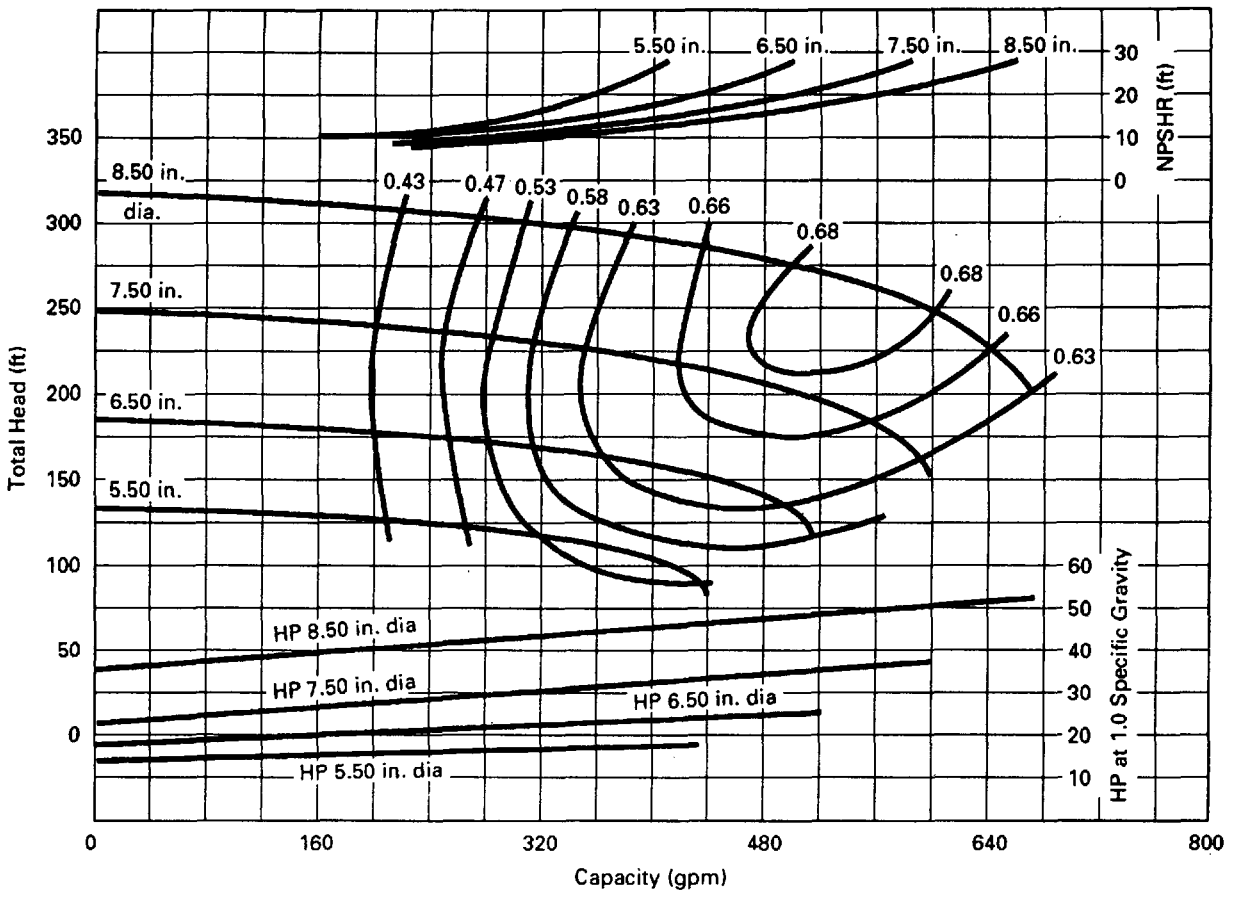

GENERAL NOTES:

(a) This curve is to be used for approximate selection only. Final selection must be made by the pump manufacturer's application engineers.

(b) The publication of a family of generalized curves as illustrated may not be practical for specific pump design configurations and the publication of such curves is at the discretion of the manufacturer. If such information is published, it is to be indicated if the efficiency and power curve values contain the magnetic coupling and bearing frame losses.

FIG. 5 TYPICAL MAGNETIC DRIVE PUMP PERFORMANCE CURVE

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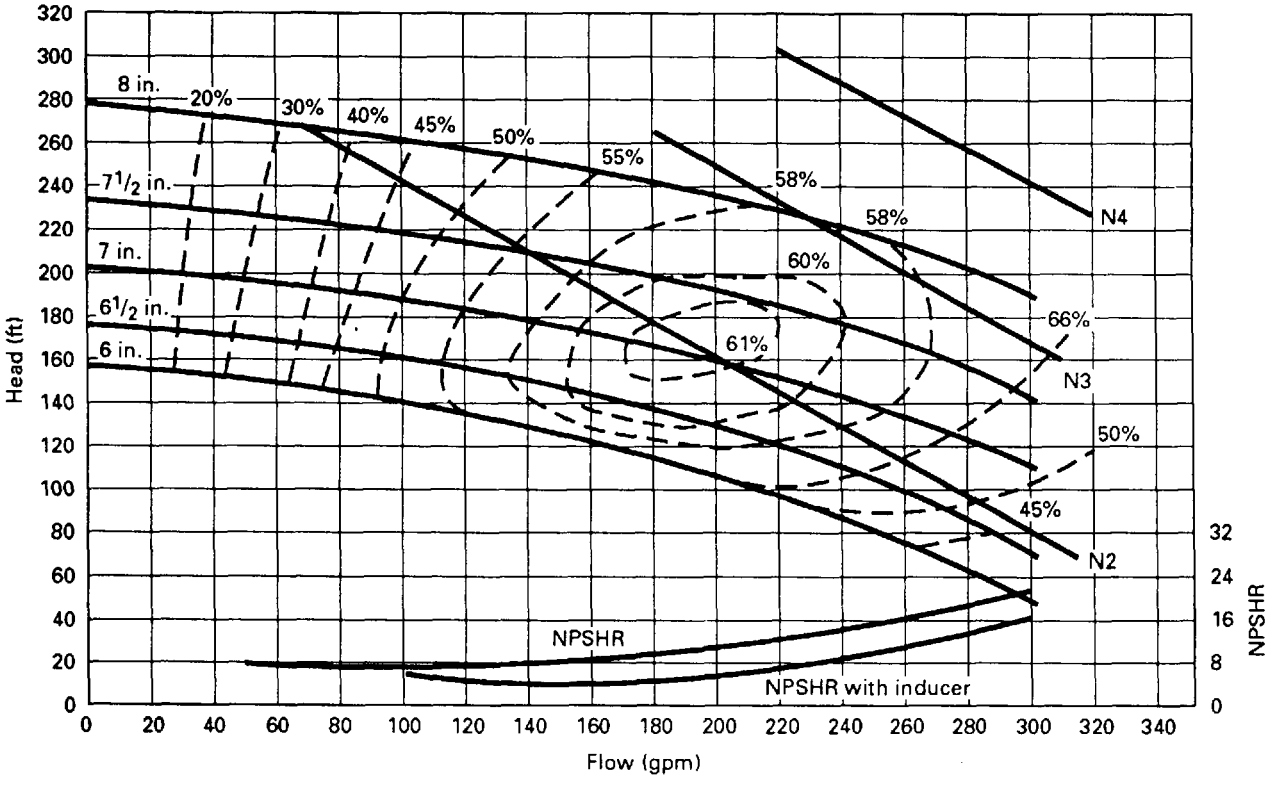

Motor Size	Full Load BHP	Full Load Efficiency
N1	6.8	72.5
N2	13.5	75
N3	23	79
N4	34	82
N5	50.8	79

GENERAL NOTES:

(a) This chart is to be used for approximate selection only. Final selection must be made by the pump manufacturer's application engineers. Viscosity, specific heat, specific gravity, vapor pressure change with temperature, operating temperature, and other factors must be considered in the sizing of canned motor pumps. System conditions such as startup, shutdown, or off-design operation should also be considered in sizing canned motor pumps.

(b) Power and efficiency:

(1) Pump input horsepower is:

$$\text{Hydraulic BHP} = \text{Capacity} \times \text{Head} \times \text{Specific Gravity} / (3960)$$

$$\text{Pump BHP} = \text{Hydraulic BHP} / \text{Efficiency}^*$$

*Efficiency is chart efficiency corrected for viscosity (see ANSI/HI 1.1 through 1.5, Figs. 1.52 and 1.53).

(2) Motor should be sized for the maximum capacity delivered by the pump with the specified impeller.

(3) Electrical input to the motor is calculated:

$$\text{Input kW} = \text{Pump Input HP} \times 0.7457 / \text{Motor Efficiency}$$

Motor efficiency at other than full load conditions should be obtained from the manufacturer.

(4) Overall (Wire to Water) efficiency is calculated:

$$\text{Overall Efficiency} = \text{Hydraulic BHP} \times 0.7457 / \text{Input kW}$$

FIG. 6 TYPICAL CANNED MOTOR PUMP PERFORMANCE CURVE

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