Selection Guidebook

for Portable Dewatering Pumps

CONTRACTORS cpb PUMP BUREAU

AEM

Association of Equipment Manufacturers

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Introduction

This manual contains a description of the major types of portable pumps used by contractors and explains the particular advantages of each. Utilizing this manual will help you determine the type and size of pump that is best suited for a specific job or a range of applications.

A list of Advantages and Limitations for each type of pump, a list of Do's and Don'ts, Safety Precautions, and a section on General Engineering and Application Data are included as useful references.

The **CONTRACTORS PUMP BUREAU (CPB)** was formed in 1938 for the primary purpose of providing recommended performance standards for pumps used by contractors. Look for the CPB seal on manufacturers literature and pumps and you will know that the pumps are manufactured in conformance with standards developed by the Contractors Pump Bureau. The Bureau itself does not test, inspect, or certify pumps. Conformance with CPB standards is the responsibility of the individual manufacturer.

Certain pumps will also have an M, MT or MTC rating. These ratings provide additional standards pertaining to pump capacity, ability to pass solids, and minimum engine performance. Contractors Pump Bureau Standards cover self-priming centrifugal, trash-type centrifugal and diaphragm pumps driven by air-cooled or water-cooled gasoline or diesel engines and hydraulic or electric submersible pumps.

Contractors Pump Standards

These Standards cover the following types of contractors pumps:

- Self-priming centrifugal pumps driven by either air-cooled or water-cooled gasoline or diesel engines in specified sizes including both general dewatering and trash-type self-priming centrifugal pumps.
- Diaphragm pumps with the same drive options, in specified sizes.
- Hydraulic or electric submersible pumps in specified sizes.

The performance of all pumps of these types manufactured by members of the Contractors Pump Bureau is certified by each individual manufacturer to be in accordance with these Standards, and each bears the CPB Seal:

CERTIFIED PERFORMANCE

CONTRACTORS cpb PUMP BUREAU®

The manufacturer of this pump certifies that it was manufactured in accordance with the standards of the Contractors Pump Bureau.

Self-Priming Centrifugul Pump Standards

Self-priming centrifugal dewatering pumps include both general purpose, sometimes referred to as “clear water” pumps, and solids handling “trash” pumps. Standard centrifugal units carry an “M” rating, trash pumps carry an “MT” rating if cast iron and an “MTC” rating if made of other materials.

1. Classification in these Standards covers self-priming centrifugal pumps of the following sizes: 1-1/2 in.; 2 in.; 3 in.; 4 in.; 6 in.; 8 in.; and 10 in.
2. All self-priming centrifugal pumps shall be guaranteed to prime at a 25 ft. static suction lift with nominal size hose or pipe, based on standard atmospheric conditions at sea level. All shall be guaranteed to pass spherical solids which can pass through the strainer furnished with the pump.
3. All self-priming centrifugal pumps shall perform under continuous duty as represented by the manufacturer without exceeding limitations imposed by the engine manufacturer for such service.
4. All multi-cylinder air-cooled engines shall be equipped with Stellite, or equal, exhaust valve facings and seats, and positive type exhaust valve rotators.
5. With each self-priming centrifugal pump, each manufacturer shall furnish the following as standard equipment: suction strainer; pump instruction sheet; lifting device; and engine instruction sheet.
6. Any manufacturer's published head and capacity curve or chart based upon tests of an engine driven self-priming centrifugal pump conducted at full throttle load shall be marked “Intermittent Duty.” Such data must be accompanied by a head and capacity curve or chart marked “Continuous Duty” obtained by computation using the engine manufacturer's continuous horsepower and a certified test curve of the pump using either a dynamometer or a calibrated electric motor.
7. All tests shall be made with standard production pumps driven by stock engines of the make and model regularly furnished complete with all engine accessories regularly furnished.
8. All testing conducted shall meet the applicable requirements of the Hydraulic Institute Standards pertaining to centrifugal pumps, Test Code.
9. The rate of flow shall be expressed in U.S. gallons per minute. The specific weight of water at a temperature of 68°F shall be taken as 62.3 pounds per cubic foot at 29.92 inches Hg barometric pressure. All phases of testing must be corrected to these standard conditions.
10. Pumps 1-1/2 in. through 3 in. size shall be tested with standard contractor's type suction hose 5 ft. longer than the suction lift shown.
11. All 4 in. and larger sized pumps may be tested in accordance with paragraph 10, or with a regular 90 degree elbow and pipe 5 ft. longer than lift shown.
12. A discharge valve may be used to set the discharge pressures as needed for obtaining the data.
13. Each manufacturer shall maintain a tolerance within 5% with respect to capacity and total head or discharge pressure of each pump mode.
14. Hose, or pipe and elbow, used in tests must be of the same nominal size as the pump.

M Rating Requirements

1. Certain engine driven pumps which meet all of the CPB standards for self-priming centrifugal pumps as outlined above, and, in addition, meet minimum head and capacity performances at continuous duty horsepower requirements, and also have certain other abilities as outlined below, carry an additional M rating inscription to identify the classification.
2. The M rating seal on self-priming centrifugal pumps constitutes a certification by the manufacturer that the pumps are manufactured in one of the CPB standard sizes with suction and discharge openings being of identical dimensions on each size. Materials of manufacture may vary.
3. The following M ratings, by size, will apply:

6M (1-1/2 in.)	18M (3 in.)	90M (6 in.)
8M (2 in.)	20M (3 in.)	125M (8 in.)
12M (2 in.)	40M (4 in.)	200M (10 in.)

4. Tables of minimum capacities in gallons per minute under varying suction lifts and discharge head for each pump rating are a part of these standards.
5. All M rated self-priming centrifugal pumps shall be designed to pass solids of 10% by volume and to pass spherical solids equal to 25% of the nominal inlet diameter of the pump.

Minimum Engine Specifications for M Rated Pumps

M Rating	Suction and Discharge	Minimum Continuous Duty Hp at Engine Manufacturer's Recommended Speed
6M	1-1/2 in.	2.4Hp
8M	2 in.	2.4Hp
12M	2 in.	5.6Hp
18M	3 in.	5.6Hp
20M	3 in.	7.2Hp
40M	4 in.	24.0Hp
90M	6 in.	35.0Hp
125M	8 in.	60.0Hp
200M	10 in.	64.0Hp

Minimum Capacity Tables for M Rated Self-Priming Centrifugal Pumps

Manufactured in accordance with standards of the Contractors Pump Bureau (Meters and Litres shown below in parentheses.)

MODEL 6M (1-1/2 in.)					
The following table gives capacity in gallons (litres) per min.					
TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER				
	5 ft. (1.5)	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
5 ft. (1.5)	100 (379)	—	—	—	—
10 ft. (3.0)	96 (363)	—	—	—	—
15 ft. (4.6)	93 (352)	85 (322)	—	—	—
20 ft. (6.1)	89 (337)	84 (318)	68 (257)	—	—
25 ft. (7.6)	85 (322)	82 (310)	67 (254)	—	—
30 ft. (9.1)	80 (303)	79 (299)	66 (250)	49 (186)	35 (133)
40 ft. (12.2)	71 (269)	71 (269)	60 (227)	46 (174)	33 (125)
50 ft. (15.2)	59 (223)	59 (223)	52 (197)	41 (155)	28 (106)
60 ft. (18.3)	42 (159)	42 (159)	40 (151)	32 (121)	22 (83)
70 ft. (21.3)	22 (83)	22 (83)	22 (83)	20 (75)	12 (45)

MODEL 8M (2 in.)					
The following table gives capacity in gallons (litres) per min.					
TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER				
	5 ft. (1.5)	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
5 ft. (1.5)	140 (530)	—	—	—	—
10 ft. (3.0)	137 (519)	—	—	—	—
20 ft. (6.1)	135 (511)	117 (443)	—	—	—
25 ft. (7.6)	133 (503)	116 (439)	—	—	—
30 ft. (9.1)	132 (500)	116 (439)	102 (386)	82 (310)	—
40 ft. (12.2)	123 (466)	105 (397)	100 (379)	80 (303)	58 (220)
50 ft. (15.2)	109 (413)	92 (348)	90 (341)	76 (288)	55 (208)
60 ft. (18.3)	90 (341)	70 (265)	70 (265)	70 (265)	55 (208)
70 ft. (21.3)	66 (250)	40 (151)	40 (151)	40 (151)	40 (151)
80 ft. (24.4)	40 (151)	40 (151)	40 (151)	40 (151)	40 (151)

MODEL 12M (2 in.)					
The following table gives capacity in gallons (litres) per min.					
TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER				
	5 ft. (1.5)	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
5 ft. (1.5)	200 (757)	—	—	—	—
10 ft. (3.0)	196 (742)	—	—	—	—
20 ft. (6.1)	190 (719)	167 (632)	—	—	—
25 ft. (7.6)	185 (700)	166 (628)	—	—	—
30 ft. (9.1)	174 (659)	165 (625)	140 (530)	110 (416)	—
40 ft. (12.2)	158 (598)	158 (598)	140 (530)	110 (416)	75 (284)
50 ft. (15.2)	145 (549)	145 (549)	130 (492)	106 (401)	70 (265)
60 ft. (18.3)	126 (477)	126 (477)	117 (443)	97 (367)	68 (257)
70 ft. (21.3)	102 (386)	102 (386)	100 (379)	85 (322)	60 (227)
80 ft. (24.4)	74 (280)	74 (280)	74 (280)	68 (257)	48 (181)
90 ft. (27.4)	40 (151)	40 (151)	40 (151)	40 (151)	32 (121)

MODEL 18M (3 in.)

The following table gives capacity in gallons (litres) per min.

TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER				
	5 ft. (1.5)	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
5 ft. (1.5)	300 (1136)	—	—	—	—
10 ft. (3.0)	295 (1117)	—	—	—	—
20 ft. (6.1)	277 (1048)	259 (980)	—	—	—
30 ft. (9.1)	260 (984)	250 (946)	210 (795)	200 (757)	—
40 ft. (12.2)	241 (912)	241 (912)	207 (784)	177 (670)	160 (606)
50 ft. (15.2)	225 (852)	225 (852)	202 (765)	172 (651)	140 (530)
60 ft. (18.3)	197 (746)	197 (746)	197 (746)	169 (640)	140 (530)
70 ft. (21.3)	160 (606)	160 (606)	160 (606)	160 (606)	138 (522)
80 ft. (24.4)	125 (473)	125 (473)	125 (473)	125 (473)	125 (473)
90 ft. (27.4)	96 (363)	96 (363)	96 (363)	96 (363)	96 (363)

MODEL 20M (3 in.)

The following table gives capacity in gallons (litres) per min.

TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER			
	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
30 ft. (9.1)	333 (1260)	280 (1060)	235 (890)	165 (625)
40 ft. (12.2)	315 (1192)	270 (1022)	230 (871)	162 (613)
50 ft. (15.2)	290 (1098)	255 (965)	220 (833)	154 (583)
60 ft. (18.3)	255 (965)	235 (890)	205 (776)	143 (541)
70 ft. (21.3)	212 (802)	209 (791)	184 (696)	130 (492)
80 ft. (24.4)	165 (625)	165 (625)	157 (594)	114 (432)
90 ft. (27.4)	116 (439)	116 (439)	116 (439)	94 (356)
100 ft. (30.5)	60 (227)	60 (227)	60 (227)	60 (227)

MODEL 40M (4 in.)

The following table gives capacity in gallons (litres) per min.

TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER			
	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
25 ft. (7.6)	667 (2525)	—	—	—
30 ft. (9.1)	660 (2498)	575 (2176)	475 (1798)	355 (1344)
40 ft. (12.2)	645 (2441)	565 (2139)	465 (1760)	350 (1325)
50 ft. (15.2)	620 (2347)	545 (2063)	455 (1722)	345 (1306)
60 ft. (18.3)	585 (2214)	510 (1930)	435 (1647)	335 (1268)
70 ft. (21.3)	535 (2025)	475 (1798)	410 (1552)	315 (1192)
80 ft. (24.4)	465 (1760)	410 (1551)	365 (1382)	280 (976)
90 ft. (27.4)	375 (1419)	325 (1230)	300 (1136)	220 (833)
100 ft. (30.5)	250 (946)	215 (814)	195 (738)	145 (549)
110 ft. (33.5)	65 (246)	60 (227)	50 (189)	40 (151)

MODEL 90M (6 in.)

The following table gives capacity in gallons (litres) per min.

TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER			
	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
25 ft. (7.6)	1500 (5678)	—	—	—
30 ft. (9.1)	1480 (5602)	1280 (4845)	1050 (3974)	790 (2990)
40 ft. (12.2)	1430 (5413)	1230 (4656)	1020 (3861)	780 (2952)
50 ft. (15.2)	1350 (5110)	1160 (4391)	970 (3672)	735 (2782)
60 ft. (18.3)	1225 (4637)	1050 (3974)	900 (3407)	690 (2612)
70 ft. (21.3)	1050 (3974)	900 (3407)	775 (2933)	610 (2309)
80 ft. (24.4)	800 (3028)	680 (2574)	600 (2271)	490 (1855)
90 ft. (27.4)	450 (1703)	400 (1514)	365 (1382)	300 (1136)
100 ft. (30.5)	100 (379)	100 (379)	100 (379)	100 (379)

MODEL 125M (8 in.)

The following table gives capacity in gallons (litres) per min.

TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER			
	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
25 ft. (7.6)	2100 (7949)	1850 (7002)	1570 (5943)	—
30 ft. (9.1)	2060 (7797)	1820 (6889)	1560 (5905)	1200 (4542)
40 ft. (12.2)	1960 (7419)	1740 (6586)	1520 (5753)	1170 (4429)
50 ft. (15.2)	1800 (6813)	1620 (6132)	1450 (5488)	1140 (4315)
60 ft. (18.3)	1640 (6207)	1500 (5678)	1360 (5148)	1090 (4126)
70 ft. (21.3)	1460 (5526)	1340 (5072)	1250 (4731)	1015 (3841)
80 ft. (24.4)	1250 (4731)	1170 (4429)	1110 (4201)	950 (3596)
90 ft. (27.4)	1020 (3861)	980 (3709)	940 (3558)	840 (3179)
100 ft. (30.5)	800 (3028)	760 (2877)	710 (2687)	680 (2574)
110 ft. (33.5)	570 (2158)	540 (2044)	500 (1893)	470 (1779)
120 ft. (36.6)	275 (1041)	245 (927)	240 (908)	240 (908)

MODEL 200M (10 in.)

The following table gives capacity in gallons (litres) per min.

TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER			
	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
20 ft. (6.1)	3350 (12680)	3000 (11355)	—	—
30 ft. (9.1)	3000 (11355)	2800 (10598)	2500 (9463)	1550 (5867)
40 ft. (12.2)	2500 (9463)	2500 (9463)	2250 (8516)	1500 (5678)
50 ft. (15.2)	2000 (7570)	2000 (7570)	2000 (7570)	1350 (5110)
60 ft. (18.3)	1300 (4921)	1300 (4921)	1300 (4921)	1150 (4353)
70 ft. (21.3)	500 (1893)	500 (1893)	500 (1893)	500 (1893)

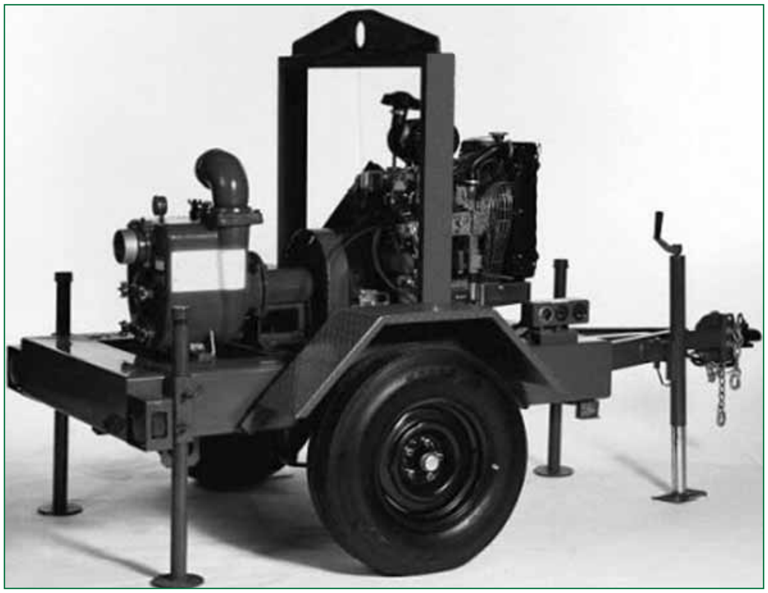
MT Trash Pump Standards

1. MT rated pumps shall be of cast iron construction for heavy duty use.
2. All pumps carrying MT ratings shall be so designed as to incorporate a removable end plate which will provide ready and easy access to the interior as well as to the impeller for clean out purposes.
3. MT rated pumps will have the ability to pass spherical solids in sizes as follows:

Rating	Pump Size	Solid Size
6MT	1-1/2 in.	1 in.
11MT	2 in.	1-1/4 in.
18MT	3 in.	1-1/2 in.
33 & 35MT	4 in.	2 in.
70MT	6 in.	2-1/2 in.

4. The MT rating seal on a trash pump constitutes a certification by the manufacturer that such pumps will meet minimum capacities in gallons per minute under varying suction lifts and discharge heads as shown on MT rating tables which are a part of this standard.
5. The MT rating seal on a trash pump also constitutes the manufacturer's certification that such pumps will meet all other CPB standards for M rated pumps.

Minimum Engine Specifications for MT Rated Pumps			
MT Rating	Spherical Solids Pumping Capability (In.)	Suction and Discharge	Minimum Continuous Duty Hp at Engine Manufacturer's Recommended Speed
6MT	1 in.	1-1/2 in.	2.4Hp
11MT	1-1/4 in.	2 in.	5.6Hp
20MT	1-1/2 in.	3 in.	7.2Hp
33MT	2 in.	4 in.	17.0Hp
35MT	2 in.	4 in.	24.0Hp
70MT	2-1/2 in.	6 in.	35.0Hp



A 6 in. heavy duty self-priming pump with diesel power on a trailer.

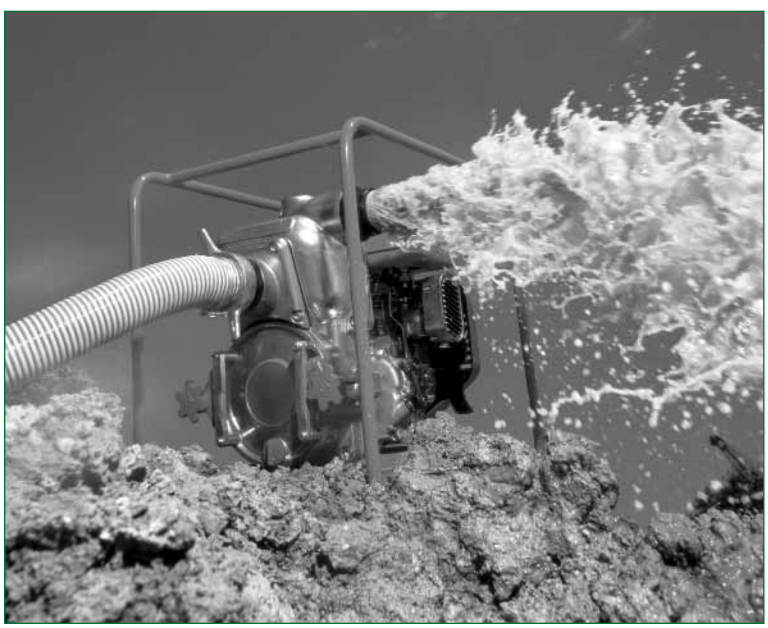
MTC Compact Trash Pump Standards

1. MTC rated pumps may be of lightweight, compact construction for easy portability.
2. All pumps carrying MTC ratings shall be so designed as to incorporate easy access to the impeller for quick clean out purposes.
3. MTC rated pumps will have the ability to pass spherical solids in sizes as follows:

Rating	Pump Size	Solid Size
6MTC	1-1/2 in.	3/4 in.
10MTC	2 in.	1 in.
18MTC	3 in.	1-1/2 in.
22MTC	4 in.	2 in.

4. The MTC rating seal on a compact trash pump constitutes a certification by the manufacturer that such pumps will meet minimum capacities in gallons per minute under varying suction lifts and discharge heads as shown on MTC rating tables which are a part of this standard.
5. The MTC rating seal on a compact trash pump also constitutes the manufacturer's certification that such pumps will meet all other CPB standards for M rated pumps.

Minimum Engine Specifications for MTC Rated Pumps			
MTC Rating	Spherical Solids Pumping Capability (In.)	Suction and Discharge	Minimum Continuous Duty Hp at Engine Manufacturer's Recommended Speed
6MT	3/4 in.	1-1/2 in.	1.7Hp
11MT	1 in.	2 in.	4.0Hp
20M	1-1/2 in.	3 in.	5.6Hp
335MT	2 in.	4 in.	9.6Hp



A 3 in. cage mounted trash pump.

Minimum Capacity Tables for MT Rated Solids Handling, Self-Priming Centrifugal Pumps

Manufactured in accordance with standards of the Contractors Pump Bureau (Meters and Litres shown below in parentheses.)

MODEL 6MT (1-1/2 in.)

The following table gives capacity in gallons (litres) per min.

TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER				
	5 ft. (1.5)	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
5 ft. (1.5)	100 (379)	—	—	—	—
10 ft. (3.0)	96 (363)	—	—	—	—
20 ft. (6.1)	89 (337)	84 (318)	68 (257)	—	—
30 ft. (9.1)	80 (303)	79 (299)	66 (250)	49 (186)	35 (133)
40 ft. (12.2)	71 (269)	71 (269)	60 (227)	46 (174)	33 (125)
50 ft. (15.2)	59 (223)	59 (223)	52 (197)	41 (155)	28 (106)
60 ft. (18.3)	42 (159)	42 (159)	40 (151)	32 (121)	22 (83)
70 ft. (21.3)	22 (83)	22 (83)	22 (83)	20 (75)	12 (45)

MODEL 11MT (2 in.)

The following table gives capacity in gallons (litres) per min.

TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER				
	5 ft. (1.5)	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
5 ft. (1.5)	185 (700)	—	—	—	—
10 ft. (3.0)	183 (693)	—	—	—	—
20 ft. (6.1)	178 (674)	164 (621)	132 (500)	—	—
30 ft. (9.1)	169 (640)	164 (621)	132 (500)	105 (397)	75 (284)
40 ft. (12.2)	164 (621)	164 (621)	132 (500)	105 (397)	75 (284)
50 ft. (15.2)	150 (568)	150 (568)	132 (500)	105 (397)	75 (284)
60 ft. (18.3)	135 (511)	135 (511)	132 (500)	105 (397)	75 (284)
70 ft. (21.3)	88 (333)	88 (333)	88 (333)	88 (333)	68 (257)
80 ft. (24.4)	40 (151)	40 (151)	40 (151)	40 (151)	40 (151)

MODEL 18MT (3 in.)

The following table gives capacity in gallons (litres) per min.

TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER			
	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
20 ft. (6.1)	310 (1173)	265 (1003)	—	—
30 ft. (9.1)	305 (1154)	265 (1003)	200 (757)	115 (435)
40 ft. (12.2)	300 (1136)	265 (1003)	200 (757)	110 (416)
50 ft. (15.2)	275 (1041)	260 (984)	200 (757)	105 (397)
60 ft. (18.3)	215 (814)	215 (814)	200 (757)	100 (379)
70 ft. (21.3)	170 (644)	170 (644)	170 (644)	100 (379)
80 ft. (24.4)	87 (329)	87 (329)	87 (329)	87 (329)
90 ft. (27.4)	25 (95)	25 (95)	25 (95)	25 (95)

MODEL 33MT (4 in.)

The following table gives capacity in gallons (litres) per min.

TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER			
	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
30 ft. (9.1)	550 (2082)	460 (1741)	350 (1325)	240 (908)
40 ft. (12.2)	540 (2044)	455 (1722)	350 (1325)	240 (908)
50 ft. (15.2)	500 (1893)	430 (1628)	340 (1287)	230 (871)
60 ft. (18.3)	450 (1703)	395 (1495)	320 (1211)	220 (833)
70 ft. (21.3)	370 (1401)	360 (1363)	300 (1136)	210 (795)
80 ft. (24.4)	275 (1041)	275 (1041)	260 (984)	180 (681)
90 ft. (27.4)	190 (719)	190 (719)	190 (719)	150 (568)
100 ft. (30.5)	100 (379)	100 (379)	100 (379)	100 (379)

MODEL 35MT (4 in.)

The following table gives capacity in gallons (litres) per min.

TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER			
	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
30 ft. (9.1)	585 (2214)	500 (1893)	350 (1325)	240 (908)
40 ft. (12.2)	585 (2214)	500 (1893)	350 (1325)	240 (908)
50 ft. (15.2)	585 (2214)	500 (1893)	350 (1325)	240 (908)
60 ft. (18.3)	545 (2063)	500 (1893)	350 (1325)	240 (908)
70 ft. (21.3)	495 (1874)	480 (1817)	350 (1325)	240 (908)
80 ft. (24.4)	430 (1628)	420 (1590)	340 (1287)	240 (908)
90 ft. (27.4)	320 (1211)	320 (1211)	260 (984)	220 (833)
100 ft. (30.5)	100 (379)	100 (379)	100 (379)	100 (379)

MODEL 70MT (6 in.)

The following table gives capacity in gallons (litres) per min.

TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER			
	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
30 ft. (9.1)	1180 (4466)	975 (3690)	715 (2706)	350 (1325)
40 ft. (12.2)	1175 (4447)	950 (3596)	715 (2706)	350 (1325)
50 ft. (15.2)	1160 (4391)	935 (3539)	715 (2706)	350 (1325)
60 ft. (18.3)	1150 (4353)	925 (3501)	715 (2706)	350 (1325)
70 ft. (21.3)	1120 (4239)	900 (3407)	715 (2706)	350 (1325)
80 ft. (24.4)	950 (3596)	875 (3312)	700 (2650)	350 (1325)
90 ft. (27.4)	700 (2650)	700 (2650)	600 (2271)	350 (1325)
100 ft. (30.5)	450 (1703)	450 (1703)	450 (1703)	300 (1136)
110 ft. (33.5)	200 (757)	200 (757)	200 (757)	200 (757)

Minimum Capacity Tables for MTC Rated Compact Trash Pumps

Manufactured in accordance with standards of the Contractors Pump Bureau (Meters and Litres shown below in parentheses.)

MODEL 6MTC (1-1/2 in.)					
The following table gives capacity in gallons (litres) per min.					
TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER				
	5 ft. (1.5)	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
5 ft. (1.5)	100 (379)	—	—	—	—
10 ft. (3.0)	96 (363)	—	—	—	—
20 ft. (6.1)	89 (337)	84 (318)	68 (257)	—	—
30 ft. (9.1)	80 (303)	79 (299)	66 (250)	49 (186)	35 (133)
40 ft. (12.2)	71 (269)	71 (269)	60 (227)	46 (174)	33 (125)
50 ft. (15.2)	59 (223)	59 (223)	52 (197)	41 (155)	28 (106)
60 ft. (18.3)	42 (159)	42 (159)	40 (151)	32 (121)	22 (83)
70 ft. (21.3)	22 (83)	22 (83)	22 (83)	20 (75)	12 (45)

MODEL 10MTC (2 in.)					
The following table gives capacity in gallons (litres) per min.					
TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER				
	5 ft. (1.5)	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
5 ft. (1.5)	168 (636)	—	—	—	—
10 ft. (3.0)	166 (628)	—	—	—	—
20 ft. (6.1)	162 (572)	151 (572)	120 (454)	95 (360)	—
30 ft. (9.1)	150 (568)	150 (568)	120 (454)	95 (360)	67 (254)
40 ft. (12.2)	130 (492)	130 (492)	112 (424)	90 (341)	67 (254)
50 ft. (15.2)	110 (416)	110 (416)	98 (371)	82 (310)	65 (246)
60 ft. (18.3)	82 (310)	82 (310)	79 (299)	70 (265)	55 (208)
70 ft. (21.3)	54 (204)	54 (204)	54 (204)	48 (182)	40 (151)

MODEL 18MTC (3 in.)					
The following table gives capacity in gallons (litres) per min.					
TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER				
	5 ft. (1.5)	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
5 ft. (1.5)	300 (1136)	—	—	—	—
10 ft. (3.0)	294 (1113)	—	—	—	—
20 ft. (6.1)	275 (1041)	275 (1041)	—	—	—
30 ft. (9.1)	274 (1037)	274 (1037)	240 (908)	212 (802)	140 (530)
40 ft. (12.2)	240 (908)	240 (908)	212 (802)	156 (591)	101 (382)
50 ft. (15.2)	180 (681)	180 (681)	180 (681)	152 (575)	100 (379)
60 ft. (18.3)	130 (492)	130 (492)	130 (492)	125 (473)	96 (371)
70 ft. (21.3)	75 (284)	75 (284)	75 (284)	75 (284)	72 (273)

MODEL 22MTC (4 in.)				
The following table gives capacity in gallons (litres) per min.				
TOTAL HEAD INCLUDING FRICTION	HEIGHT OF PUMP ABOVE WATER			
	10 ft. (3.0)	15 ft. (4.6)	20 ft. (6.1)	25 ft. (7.6)
20 ft. (6.1)	440 (1665)	378 (1431)	—	—
30 ft. (9.1)	430 (1628)	378 (1431)	312 (1181)	205 (776)
40 ft. (12.2)	350 (1325)	350 (1325)	310 (1173)	205 (776)
50 ft. (15.2)	250 (946)	250 (946)	250 (946)	203 (768)
60 ft. (18.3)	125 (473)	125 (473)	125 (473)	125 (473)

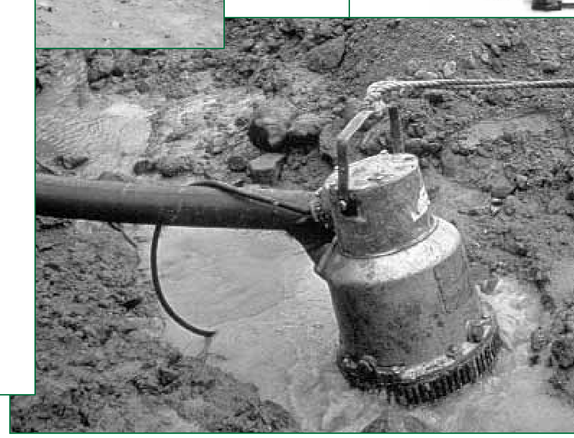
NOTE: Members of the Contractors Pump Bureau publishing any of the above tables will accompany such tables with the following statement above each table: “The following table has been adopted as a minimum capacity standard by the Contractors Pump Bureau and sets forth the performance requirements under average job conditions for this size pump. We guarantee this pump to meet the CPB Standards in every respect.”

Diaphragm Pump Standards

1. Diaphragm pumps certified by the manufacturer in accordance with CPB standards shall be manufactured in the following sizes (suction & discharge same size) and types (materials of manufacture may vary): 2 in. single; 3 in. single; 4 in. single; and 4 in. double.
2. Each manufacturer's published head and capacity chart shall be based upon continuous duty without exceeding limitations imposed by the engine manufacturer for such service. All performance points must be non-stalling, continuous points of operation. The number of strokes per minute upon which performance is based must be consistent throughout each chart, and stated on the chart.
3. With the body filled with water, all diaphragm pumps shall be guaranteed to prime at a 25 foot static suction lift with nominal size hose.
4. With each diaphragm pump, the manufacturer shall furnish the following as standard equipment: lifting device; pump instruction sheet; and engine instruction sheet.
5. All testing shall meet the applicable sections of the Hydraulic Institute Standards for Reciprocating Pumps, Power, Test Code.
6. In manufacturer's printed literature, no reference shall be made to any performance other than minimums outlined below unless actual test programs have been conducted.
7. Diaphragm pumps shall be tested with standard contractor's type suction hose five ft. longer than the suction lift shown.
8. Minimum capacity for various size diaphragm pumps at a 10 foot suction lift:

Pump Size	Minimum Capacity
2 in.	2000 gph
3 in.	3000 gph
4 in. single	6000 gph
4 in. double	9000 gph



Electric Driven Submersible Pump Standards

Definition

Electric driven submersible pumps are usually a bottom suction, single stage centrifugal pump directly mounted on the shaft of a submersible motor. Some models have two or more impellers or stages.

These pumps are designed to operate partly or completely submerged in the liquid that is being pumped. Different pump materials, impeller designs, and motor variations are available for a variety of pumping requirements.

Applications

Electric driven submersible pumps are widely used in construction for the removal of unwanted water. They are used for dewatering foundations, sumps, coffer dams, caissons, tunnels, and well-type pre-dewatering of building sites. Submersible trash-type pumps are also available from most manufacturers. These pumps are specifically designed to pump solids. Solid sizes may vary depending on the design of the thrulet.

Sizes

Standard pump discharge sizes are: 1-1/2 in.; 2 in.; 3 in.; 4 in.; 6 in.; 8 in.; 10 in.; 12 in.; and 14 in.

Specifications

Electrical driven submersible pumps certified by the manufacturer shall meet the following suggested Contractors Pump Bureau requirements:

- **Nameplates** - Each pump will have a nameplate permanently affixed to the pump housing or marked directly on the pump and contain the following data:
  1. Manufacturer's name;
  2. Model or catalog number;
  3. Serial number;
  4. Rated voltage and full load amperage (In the case of dual voltage motors, both voltages and amperage ratings must be shown);
  5. Rated frequency and number of phases;
  6. Rated horsepower or kW;
  7. Direction of correct impeller rotation or direction of start kick.
- **Power Cables** - The ampacity of all power cables shall conform to current NEC Standards and be of a type approved for underwater use on submersible pumps.
- **Overload Protection** - Each pump or the control shall be equipped with an overload protection device.
- **Control** - Each pump will be supplied with a motor starter designed to meet NEC Standards and be of sufficient electrical characteristic to provide motor protection based on the amperage and voltage rating of the pump.

- **Motor** - The pump motor shall be: induction type with a squirrel cage rotor; shell type design; housed in an air or oil filled; watertight chamber; and NEMA B type. The stator windings and stator leads shall be insulated with moisture resistant insulation. The motor shall be designed for continuous duty handling pumped media and capable of evenly spaced starts per hour.

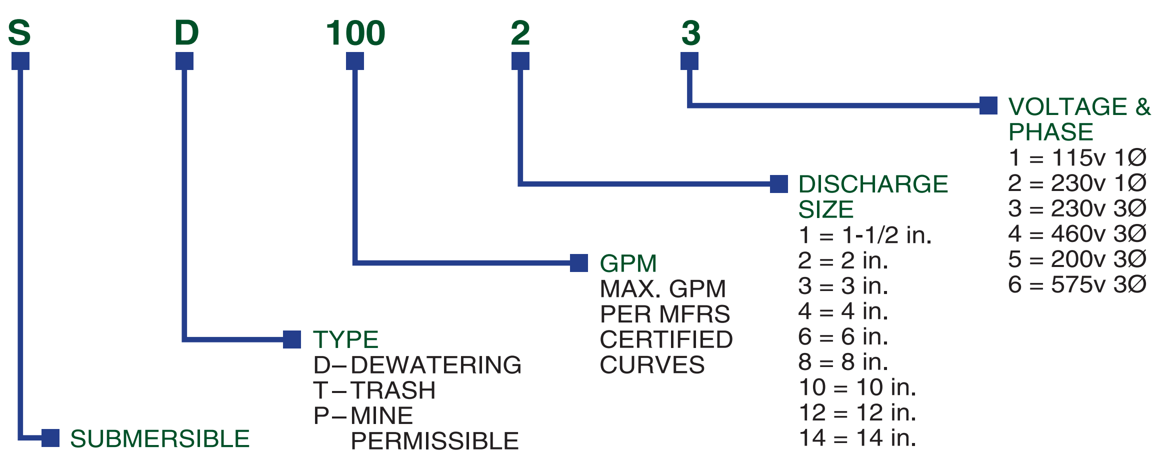
  A performance chart shall be provided showing curves for torque, current, power factor, input/output kW and efficiency.

  This chart shall also include data on starting and no-load characteristics.

  The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.
- **Liquid Temperature** - Each pump manufacturer shall provide the range of liquid pumping temperatures in their operating instructions.
- **Lifting Device** - The pump shall be furnished with a lifting device that allows the pump to lift vertically with a minimum of five times safety factor.
- **Instructions** - Each pump shall be supplied with installation and operating instructions indicating the proper procedure to follow for electrical hook-up safety and operating procedures.
- **Testing** - Each manufacturer's performance chart or curve shall be derived from test data with pumps submerged in water (SpGr= 1.0) to a depth adequate to satisfy the particular pump design. The chart or curve should show the pump's output at specific dynamic heads and shall be expressed in U.S. gallons per minute and total dynamic head in ft.
- **Optimum Efficiency** - The optimum efficiency of the pump should be clearly stated.
- **Strainers** - To protect the pump from being clogged with foreign matter, a strainer should be installed with a net area of at least three times the area of the suction inlet.

CPB SUBMERSIBLE PUMP CLASSIFICATIONS

EXAMPLE:



(Example is 2 in. dewatering submersible pump operating on 230 volts, 3 phase with 100 gpm maximum capacity)

Pump Selection Table

Type of Dewatering	Self-Priming Centifugal Pumps	Diaphragm	Trash	Submersible	Vacuum Assisted
Clear Water	X	X	X	X	X
Slimy Water	X	X	X	X	X
Muck Water	X	X	X		X
Mud Water	X	X	X	X	X
Silt Water	X	X	X	X	X
Abrasive Water	X	X	X	X	X
Hi-Solid Content Water		X	X	X	X
Slow Seepage Ditch Water	X	X	X	X	X
Fast Seepage Ditch Water	X		X	X	X
Septic Tanks		X	X		X
Manholes	X	X	X	X	X
Well Points	X	X		X	X
Coffer Dams	X			X	X
Quarries	X			X	X
Deep Piling Dewatering				X	
Supply					
To Mixer or Paver	X			X	
Concrete Curing	X			X	
Water Wagons	X			X	

SELF-PRIMING CENTRIFUGAL PUMPS

Advantages

Light weight for large capacity

Large capacity for small investment

High suction lifts; guaranteed up to 25 ft. at sea level

Relatively high discharge heads

Handle reasonable amount of trash and similar material, provided sufficient water is being pumped

Simplicity of design; few parts, and therefore not expensive or difficult to operate or repair

Suitable for limited well point service

Limitations

Require ample liquid to carry solids, otherwise excessive wear will take place

Time required for repriming may be too long when there is only a small quantity of water to be pumped, or when suction lift is high

Not adapted to pumping thick mud

DIAPHRAGM PUMPS

Advantages

Will handle slow seepage or full capacity with each stroke

Where there is a small inflow, it will keep excavations drier than most other types

Will pump thick mud and large amounts of solids without serious damage to pump itself

Diaphragm and valves are easily replaced

Suitable for well point service

Limitations

Smaller capacity for the same investment, compared with self-priming centrifugal pumps

Limited to low discharge pressure

SUBMERSIBLE PUMPS

Advantages

High discharge heads

Handles large volumes

Instant priming

Can run dry; good for mopping up

Does not require constant attention

No suction hose

No danger of being flooded out or frozen

Trash-type submersible will handle solids

Limitations

Must be pulled up out of liquid for inspection

Not adapted to pumping thick mud

How to Select the Correct Size Contractor Pump

There is a wide difference in pumping problems, and each application requires special consideration. Consequently, this section is written to help the pump user determine the model best fitted to their particular needs.

To figure any pumping job, it is necessary to know the following:

1. Desired capacity in U.S. gallons per minute.
2. Static suction lift (vertical height from water to pump).
3. Static discharge head (vertical height of discharge hose/pipe).
4. Size, type and length of any pipe or hose and fittings.
5. Pressure desired at discharge point, if any.

From these facts, it is possible to compute the total dynamic head of the application. Total Dynamic Head (TDH) is equal to static suction lift plus static discharge head plus friction loss plus velocity head.

The contractors' pumping problem is usually dewatering, and therefore generally does not include the need for discharge pressure at the end of the line. The velocity head is usually so small that generally it can be disregarded. Following is a typical pumping problem and solution. This is a fair example of a job that might confront a contractor:

A contractor is laying a sewer line in a ditch 13 ft. deep. Conditions require that the water be discharged 10 ft. above and 50 ft. away from the top of the cut.

The estimated inflow of water to be removed amounts to about 200 gallons per minute (gpm).

The contractor looks at the hose friction and velocity tables and notes that a 3-inch hose will carry this capacity at a velocity of less than 14 ft. per second. (Velocities over 14 ft. per second mean excessive power losses due to hose friction.)

The pump is placed on top of the cut and connected by 20 ft. of suction hose with strainer and 50 ft. of discharge hose. The pump has to “lift” the water 15 ft. by suction (13 ft. ditch + 2 ft. to pump suction) and discharge it 10 ft. above the pump.

The contractor must now calculate the “total dynamic head.” This is computed by adding together the static suction lift, the static discharge head and the friction loss.

Consulting the tables, the contractor notes that the friction of 3-inch smooth-bore hose when passing 200 gpm is 9.6 ft. per 100 ft. The friction of the strainer is equal to 5 ft. of hose.

Using this data, the contractor computes the dynamic suction and discharge heads separately:

Dynamic Suction Head

Static suction lift . . . . 15 ft.
Suction hose length . . . . 20 ft.
Equivalent hose length to allow for strainer . . . . 5 ft.
Total equivalent hose length . . . . 25 ft.
Friction $\frac{25 \times 9.6}{100}$ . . . . 2.4 ft.
Dynamic suction head . . . . 17.4 ft.

Dynamic Discharge Head

Static discharge head 10 ft.
Discharge hose length . . . . 50 ft.
Friction $\frac{50 \times 9.6}{100}$ . . . . 4.8 ft.
Dynamic discharge head . . . . 14.8 ft.

Adding both yields

Total Dynamic Head . . . . 32.2 ft. TDH

The next step would be to refer to the “Minuimum Capacity” tables. Under “Height of Pump Above Water” heading, find the 15 ft. column. Locate 200 gpm where the “Total Head Including Friction” value is between 30 ft. and 40 ft.

The smallest rated pump to meet these conditions would be the 18M size.

However, it usually is a wise policy to have a slightly larger pump than is absolutely necessary, and the next larger unit, the 20M pump, would be a better solution for this particular problem than the 18M.

The size of pump to be recommended depends ultimately on the type of construction and whether the user is a large or small contractor and whether he has more use for large or small pumps in his overall operations.

However, in the above example, if the conditions made it necessary to discharge the water 60 ft. horizontally and 25 ft. vertically above the pump, using pipe instead of hose, the dynamic discharge head would change, while the dynamic suction head remained the same. The dynamic discharge head would be calculated as follows:

Static discharge head . . . . .25 ft.

Horizontal discharge pipe . . . . 60 ft.
Vertical discharge pipe . . . . 25 ft.
2 elbows . . . . 16 ft.
Equivalent pipe length . . . . .101 ft.

Friction $\frac{101 \times 11.6}{100}$ . . . . .12 ft.

Dynamic discharge head . . . . .37 ft.
Dynamic suction head . . . . .17.4 ft.

Adding the two totals . . . . .54.4 ft. TDH

The Model 20M (20,000 gallons per hour) will meet these requirements.

Selecting a Contractor Pump Engine

The most common types of internal combustion engines used in pumping applications are piston driven, using either gasoline or diesel fuels. The Original Manufacturer of the pumping unit has very carefully selected the engines they use. In conjunction with the engine manufacturer, they have designed a package that operates within the capabilities of the engine and consistent with CPB standards, if so indicated. Thus, it is not our intention to instruct end users on engine application. However, we feel that if certain basic practices are followed, engine life will be optimized and full pump performance will be realized.

Selection of Gasoline or Diesel Engines

Usually the selection of gasoline or diesel fueled engines depends on the final application of the pump package. Gasoline engines are typically of lighter weight construction and are used on pumps requiring a high degree of portability, such as units to be hand carried by one person. Diesel engines are of heavier duty construction, and are more suited to extended periods of unattended operation.

Fuel consumption may also play an important part in engine selection. As a rule of thumb gasoline engines will consume between 40% and 60% more fuel than a comparable size of diesel engine.

Effect of Operating Environment

Certain outside forces can greatly affect engine performance. Two major considerations are ambient temperature and site altitude. As both of these conditions increase, the power available from engines operated on a continuous basis will be reduced.

While the exact power reduction is dependent on the method chosen by the engine manufacturer to rate engine output, the following is generally true.

Altitude: Power will decrease at the rate of 1% per each 325 ft. of altitude (1% for each 100 meters).

Temperature: Power will decrease at the rate of 2% for each 9°F above 68°F (2% for each 5°C above 20°C).

It is good practice for the specifier to determine if either of these conditions will be encountered by the pump unit, and to alert the pump manufacturer at the time of inquiry.

While on the subject of ambient conditions it should be noted that atmospheres other than normal breathable air can also adversely effect engine operation. Explosive environments, such as sometimes encountered in refineries, can result in engines operating on vapors present in the air, causing engine overspeed and failure. Also atmospheres containing very high levels of dust can cause engine damage if precautions are not taken to protect the air intakes by properly sized and maintained air filtration.

A 3 in. self-priming trash pump with air-cooled gas power on site cart.

Pump Performance in Relation to Engine Speed

It is sometimes assumed by pump operators that to increase the performance of an engine driven pump package all that is required is an increase in engine speed. However, centrifugal pumps absorb power by a cube relationship to speed. See example below.

For example, if a pump is designed by the manufacturer to operate at 10Hp @ 3000 rpm, the following will occur if the engine speed is increased to 3600 rpm.

Power required =10 x (3600/3000 x 3600/3000 x 3600/3000) = 17.3Hp @ 3600 rpm

This type of power increase between 3000 rpm and 3600 rpm is probably not feasible. If this speed increase is attempted, an engine overload condition and failure is likely to occur.

Types of Engine Cooling Systems

Both gasoline and diesel engines are available in air cooled and liquid cooled versions. The air cooled engine relies on either a flywheel fan or an axial belt driven cooling fan to supply volumes of cooling air directly across the engine cylinders and cylinder heads. Liquid cooled engines utilize a fluid (either anti-freeze coolant or in some cases, engine oil) that is pumped around the engine, and cooled in a radiator or heat exchanger, dissipating engine heat. Both types of cooling systems have advantages and disadvantages. Air cooling provides the most simple cooling solution with lower maintenance and fewer potential failure points. Liquid cooled engines, in some cases, exhibit lower noise emissions, but the pump package is encumbered with a cooling radiator which is more vulnerable to damage in construction site environments. Liquid cooled engines require a higher level of maintenance (coolant level checks, hose inspections, etc.). Internal liquid coolant leaks, if undetected, can cause major damage to internal engine components.

Noise Emission and Control

On today's construction site, the pressure is increasing on contractors to reduce noise emissions from equipment that operates for 24-hour periods. However, it is not advisable for the pump operator to modify an engine installation by covering the engine in any manner not approved by the pump and engine manufacturers. Covering the engine can often result in severe overheating problems. Recirculation of cooling air on both air cooled and liquid cooled engines will result in engine damage. If a maximum equipment noise level has been established, it is the equipment specifier's responsibility to alert the pump manufacturer prior to pump purchase. This prior warning will allow the pump manufacturer to fully assess all options regarding engine selection and overall package design.

Maintenance and Safety

You will receive a manual with each engine driven pump that outlines routine maintenance and safe operation procedures. It is your responsibility to review this information completely and keep it on file for future reference. Engine manufacturer's recommendations should always be followed when selecting oil and fuels or when performing routine maintenance.

A 6 in. compressor-assisted open trash/sewage pump with a sound attenuated canopy on a site trailer.

SPECIALIZED CONTRACTOR'S PUMPS & DEWATERING TECHNIQUES

There are methods of dewatering which can be employed when open pumping is not practical. One of the most common methods is the use of a wellpoint system. A **wellpoint system** consists of a series of shallow wells (filters) installed vertically in the ground around an area to be excavated or along a trench line to be dewatered. These wellpoints are attached to the end of riser pipes which will convey the water to the header pipes resting on the surface. The water flows through these header pipes to the pump. Because the wellpoint system must have a capacity greater than the recharge capacity of the area being dewatered (in other words, be able to pump out the ground water faster than it can flow back into the area), the pumps used on a wellpoint system must also be able to handle a large percentage of air.

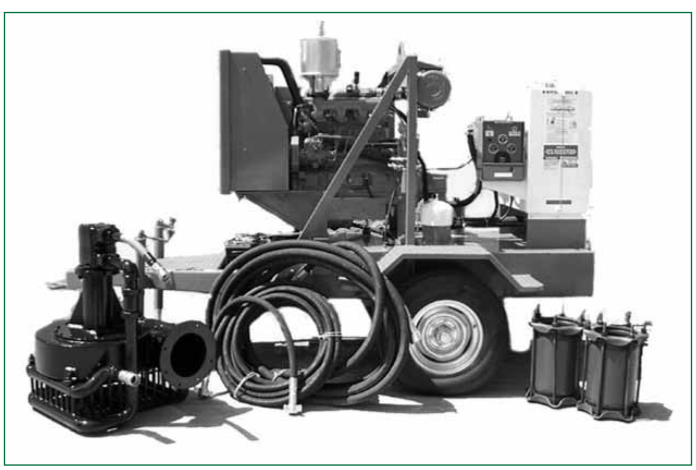
A conventional wellpoint system consists of one or more stages of wellpoints having 2 in. or smaller riser pipes which are installed near the excavation in lines or rings. These wellpoints are usually installed at varying spacings, generally less than 12 ft. apart, and are connected to a common header pumped by one or more wellpoint pumps. Conventional wellpoint systems are most suitable in shallow excavations where the required drawdown with a single stage is less than 20 ft. For greater drawdowns, additional stages are required. The water flow from each stage is determined by the permeability of the soil and the depth of the excavation in relation to the water table.

An underdrain system, installed horizontally below the water table, a shallow vacuum well system, or a jet eductor system are other methods which may be employed to affect temporary dewatering. Another method of dewatering involves the use of electric or hydraulically driven submersible pumps installed inside perforated casings.

In order to handle the large volumes of air which are associated with dewatering with a wellpoint system, a vacuum-assisted pump or a rotary pump is usually required. A vacuum-assisted pump is typically a centrifugal pump with an air separator assembly attached. While the centrifugal pump will pump the water, the vacuum pump or compressor will handle the air and enable the unit to operate at high vacuum without losing its prime.

Diaphragm pumps and self-priming centrifugal pumps also have air handling capability and can be used on some small wellpoint systems in certain soil conditions.

There are other methods of “dewatering” such as electro-osmosis and ground freezing but since they don't usually involve contractor's pumps, they will not be considered herein.



An 8 in. hydraulic submersible pump and power unit.

A 12 in. mixed flow hydraulic submersible pump.

SAFE OPERATION DO'S AND DON'TS for Self-Priming Centrifugal Pumps

DO. . .

- check manufacturer's manual for proper operation.
- check oil level in engine.
- use only good hose washers.
- fill pump with water before starting.
- drain pump when it is to be idle for a long time, especially in cold weather.
- run pump for 3 to 4 minutes after draining in cold weather.
- keep suction hose connection on tight. Use only the suction strainer recommended by the manufacturer.
- keep suction strainer clean.
- follow manufacturer's lubrication instructions on engine and pump.
- change oil in engine per engine manufacturer's recommendations.

A 6 in. vac assisted centrifugal trash pump.

- keep spare hose washers on pump.
- keep suction lifts to a minimum.
- put engine against compression when storing.
- follow engine manufacturer's recommendations for long term storage.
- store pump in a dry place. Place one-half pint of lubricating oil through discharge opening in pump and turn engine over several times to prevent excessive corrosion.
- tighten packing glands, if any, gently and evenly on both sides.
- keep oil cup filled on pumps fitted with shaft oil seals.
- keep grease cup filled on grease lubricated shaft seals.
- give grease cup a turn every six hours of operation, unless it is spring actuated.

DON'T. . .

- add oil to gasoline on 4-cycle engines.
- run the pump dry.
- run engine wide open. A reasonable engine speed saves engine and pump.
- attempt suction lifts over 25 ft.
- overtighten packing glands, if any, as they run hot.

A 3 in. centrifugal dewatering pump with air-cooled gas power.

ENGINEERING DATA

DEFINITIONS

Static suction lift is the vertical distance from the center of the pump suction connection to the surface of the liquid.

Dynamic suction head is the same as total suction head, and is the static suction lift plus suction line friction.

Static discharge head is the vertical distance from the suction connection on the pump to the point of discharge or liquid level when discharging into a tank where the pipe is immersed in the liquid.

Dynamic discharge head is the same as total discharge head, and is the static discharge head, plus the friction in the discharge line.

Total dynamic head is the same as total head and is the dynamic suction head plus the dynamic discharge head. (If this head is measured by gauges, it is necessary either to add or subtract the vertical distance between the suction and discharge gauge to the dynamic suction head and dynamic discharge head indicated by the gauges.)

STANDARDS FOR MEASURING HEAD AND CAPACITY

1. Units of measuring head can be expressed in either ft., pounds per square inch, or in inches of mercury. However, so that a common means of head measurement is understood, it is recommended that all heads be expressed in ft. of water.
2. Means of measuring heads can be done most easily with direct reading gauges which are graduated in ft. of water. Readings in pounds per square inch can be converted to ft. of water by multiplying the reading x 2.31. Readings in inches of mercury can be converted to ft. of water by multiplying the reading x 1.13.
3. Location of Gauges - The vacuum gauge should be located in the suction line close to the pump, not to exceed six inches away from the pump or the suction flange. The tap drilling should be such that the liquid velocity will not add to or detract from the actual conditions. This is accomplished by drilling at right angles to the axis of the line. The discharge gauge should be located in the discharge line not less than one and a half times the pipe diameter away from the pump. It should not be located in the pump casing or in a fitting, so that the liquid velocity head is added to the pressure head. This is accomplished by tap drilling at right angles to the axis of the line.
4. Measurement of liquid should be expressed in U.S. gallons. Any accurate means of measuring may be used.

Conversion Factors for Pressure and Vacuum
Ft. head (water) x .433 = pounds pressure
Pounds pressure (water) x 2.31 = ft. head
Ft. head (brine, sp. gr. = 1.2) x .52 = pounds pressure
Pounds pressure (brine) x 1.92 = ft. head
Ft. head (gasoline, sp. gr. = .75) x .325 = pounds pressure
Pounds pressure (gasoline) x 3.08 = ft. head
Inches of mercury x 1.13 = ft. head of water
Ft. suction lift of water x .882 = inches of mercury

WATER MEASUREMENTS

A miner's inch is the quantity that will pass through an orifice 1 sq. in. in cross section under a head of from 4 to 6-1/2 in., as fixed by statutes, and varies from 1/40 cu. ft. to 1/50 cu. ft. per second. A miner's inch is approximately 12 gpm.

One acre inch (quantity of water required to cover one acre to a depth of one inch) = 27,152 gallons.

One acre foot = 325,850 gallons.

MISCELLANEOUS

Volume of sphere = diameter^3 x .5236

Capacity of cylinder in gallons = cross-sectional area of cylinder in inches^2 x length of cylinder in inches divided by 231

Circumference of circle = diameter x 3.14

Area of circle = diameter^2 x .7854

Surface of sphere = diameter^2 x 3.14

Weight and Volume Equivalents of Water

Measures and Weights for Comparison	U.S. Gallon	Imperial Gallon	Cubic Inch	Cubic Foot	Cubic Meter	Liter	Pound
U.S. Gallon	1.00	0.833	231.00	0.1337	0.00378	3.785	8.33
Imperial Gallon	1.20	1.0	277.41	0.1605	0.00455	4.546	10.00
Cubic Inch	0.004329	0.003607	1.00	0.00057	0.000016	—	0.0361
Cubic Foot	7.48	6.232	1728.00	1.00	0.0283	28.317	62.425
Cubic Meter	284.17	220.05	—	35.314	1.00	1000.00	2204.50
Liter	0.26417	0.2200	61.023	0.0353	0.001	1.00	2.205
Pound*	0.12	0.10	27.68	0.016	—	0.454	1.00

*Volume – weight relationships taken for water at greatest density (39.2°F.)

USEFUL INFORMATION

An ordinary three-quarter inch garden hose nozzle, under 40 to 50 pounds pressure, requires six gallons per minute when throwing a solid stream, or about four gallons per minute when spraying.

1 bbl. beer = 31 U.S. gallons

1 bbl. whiskey = 45 U.S. gallons

1 bbl. oil = 42 U.S. gallons

Barrels per day x 0.02917 = gallons per minute (if barrel has 42 gallons)

1 Acre = 4,840 square yards = 43,560 sq. ft.

EFFECT ON CENTRIFUGAL PUMPS BY CHANGING SPEED OR CHANGING IMPELLER DIAMETER

Within certain limitations, there are three rules governing the operation of centrifugal pumps.

1. Capacity varies directly as the speed or the impeller diameter.
2. Head varies as the square of the speed or as the square of the impeller diameter.
3. Power varies as the cube of the speed or the cube of the impeller diameter.

ATMOSPHERIC PRESSURE

Atmospheric pressure at sea level is approximately 14.7 pounds per square inch. This pressure with a perfect vacuum will maintain a column of mercury 29.9 inches or a column of water 33.9 ft. high. Neglecting vapor pressure of the water (see section on Pumping Warm Water), this is the theoretical height to which water may be drawn by suction. The practical limit to which cold water (60°F) can be drawn by suction at sea level is 25 ft., and common sense dictates that the suction line should be kept just as short as the circumstances will permit. It should be understood that it is the pressure or weight of the air that pushes the water up the suction line. In addition, this air pressure must impart velocity to the water to get it into the pump, and must overcome the friction resulting from the flow of water in the suction line. Thus, the lower the suction lift, the greater will be the percentage of the air pressure that is available for imparting velocity to the water and overcoming the suction line friction. For this reason, the lower the suction lift, the more water the pump will get.

FLOW OF LIQUID IN PIPE OR HOSE

To determine the area of a required pipe to discharge a given volume (gallons) in a fixed time (minutes) at a given velocity.

$$\text{Velocity (ft. per sec.)} = \frac{\text{gpm} \times .408}{(\text{dia. in in.})^2} = \frac{.321 \times \text{gpm}}{\text{Area (sq. in.)}}$$

$$\text{Pipe Area (sq. in.)} = \frac{.321 \times \text{gallons}}{\text{T} \times \text{Vel. (ft./sec.)}}$$

Doubling the diameter of a pipe or cylinder increases its capacity four times. For the same diameter, friction of liquids in pipe or hose increases approximately as the square of the velocity.

Horsepower Formula

One horsepower = 33,000 ft. pounds per minute

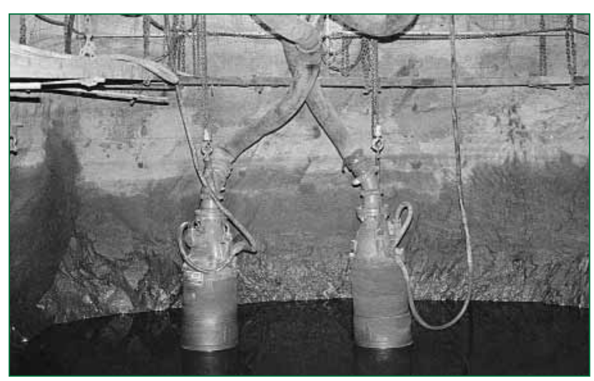
$$\text{Theoretical liquid horsepower} = \frac{\text{gpm} \times \text{total head (ft.)} \times \text{Sp. Gr.}}{3960}$$

$$\text{Theoretical water horsepower} = \frac{\text{gpm} \times \text{total head (ft.)}}{3960}$$

$$\frac{\text{gpm} \times \text{lbs. per sq. in.}}{1715}$$

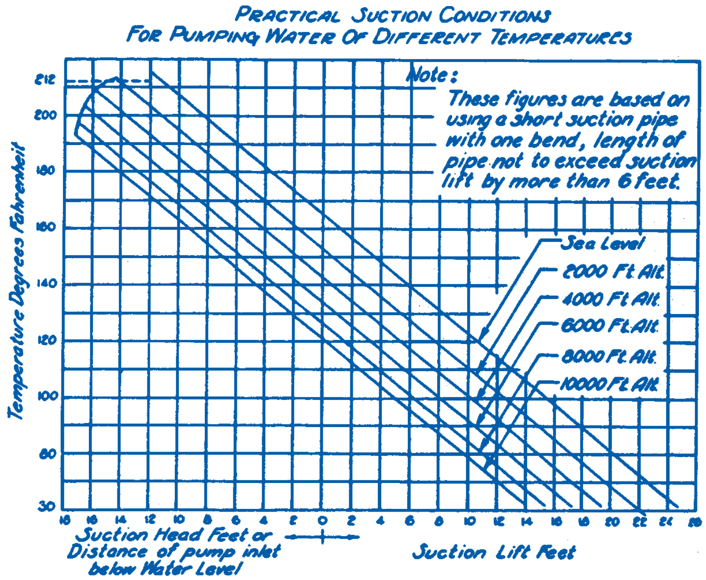
$$\text{Brake Horsepower} = \frac{\text{Theoretical water horsepower}}{\text{Pump Efficiency}}$$

A self-priming 12 in. trash pump with air-cooled diesel power on skid.



Two 6 in. electric submersible pumps.

PUMPING WARM WATER



For a particular temperature, the actual theoretical height that water can be drawn by suction by a perfect vacuum at sea level is obtained by subtracting the vapor pressure (in ft.) of water at that temperature from 33.9 ft. For example, at room temperature (72°F) this theoretical limit becomes 33 ft., and at 160°F this limit is 22.9 ft. Since proper allowance must be made for water velocity and friction, the practical limits are less than the theoretical. If the water is hot enough, it is necessary to place the pump below the level of the water so that there is an actual head on the suction. The following chart gives practical suction lifts and suction heads for pumping water of different temperatures and at different elevations.

EFFECT OF ALTITUDE ON PUMPS

When a pump is operated at elevations above sea level, the lower atmospheric pressures encountered have a double effect on the pump performance.

1. The lower atmospheric pressure cannot support as high a column of water so that the maximum practical suction lift decreases.
2. The lower atmospheric pressure reduces the horsepower output of the gas engine, thus causing it to lose speed which results in a loss of capacity and discharge head of the pump.

At elevations above sea level, the suction lift on the pump should be reduced accordingly to insure that the same amount of water can get into the pump as would get in at the equivalent sea level lift. The following table (lower left) gives equivalent suction lifts for various elevations.

When a gas engine driven pump is operated at elevations of 4,000 ft. or over, the engine should be equipped with a high altitute head. However, even with a special cylinder head, there is still a power loss of approximately 3 percent for every 1,000 ft. of elevation. This will result in a loss of speed, and a loss of pump performance. A table (lower right) gives the loss in performance that can be expected at various elevations.

Equivalent suction lifts for various elevations

Altitudes	Suction Lifts in Ft.			
Sea Level	10.0	15.0	20.0	25.0
2,000 ft.	8.8	13.2	17.6	22.0
4,000 ft.	7.8	11.7	15.6	19.5
6,000 ft.	6.9	10.4	13.8	17.3
8,000 ft.	6.2	9.3	12.4	15.5
10,000 ft.	5.7	8.6	11.4	14.3

Loss of performance at various elevations

Altitudes	Discharge	Head
Sea Level	100%	100%
2,000 ft.	97%	95%
4,000 ft.	95%	91%
6,000 ft.	93%	87%
8,000 ft.	91%	83%
10,000 ft.	88%	78%

Water Friction in 100 Ft. of Pipe

For various flows and pipe sizes, table gives velocity of water and ft. of head lost in friction in 100 ft. of *clean* iron or steel pipe.

Note: For old or rough pipes, add 50% to friction value in table.

Flow in U.S. Gals. Per Min.	Velocity in Ft. Per Sec.	Friction Head in Ft.	Velocity in Ft. Per Sec.	Friction Head in Ft.	Velocity in Ft. Per Sec.	Friction Head in Ft.	Velocity in Ft. Per Sec.	Friction Head in Ft.	Velocity in Ft. Per Sec.	Friction Head in Ft.	Velocity in Ft. Per Sec.	Friction Head in Ft.	Velocity in Ft. Per Sec.	Friction Head in Ft.
	1/2 in.		3/4 in.		1 in.		1-1/4 in.		1-1/2 in.		2 in.		2-1/2 in.	
2	2.10	4.8	1.20	1.2										
3	3.16	10.2	1.80	2.7	1.12	.82								
4	4.21	17.4	2.41	4.5	1.49	1.39	.86	.37						
5	5.26	26.5	3.01	6.8	1.86	2.11	1.07	.55						
10	10.5	95.0	6.02	24.7	3.72	7.61	2.14	1.98	1.57	.93	.96	.31	.67	.11
15			9.02	52.0	5.60	16.3	3.21	4.22	2.36	1.95	1.43	.70	1.00	.23
20	3 in.		12.0	88.0	7.44	27.3	4.29	7.21	3.15	3.38	1.91	1.18	1.34	.40
25	1.08	.25			9.30	41.6	5.36	10.8	3.94	5.07	2.39	1.75	1.68	.60
30	1.30	.35			11.2	57.8	6.43	15.3	4.72	7.15	2.87	2.45	2.01	.84
35	1.52	.46	4 in.		13.0	77.4	7.51	20.3	5.51	9.55	3.35	3.31	2.35	1.1
40	1.74	.59	1.01	.14			8.58	26.0	6.30	12.2	3.82	4.29	2.68	1.4
45	1.95	.75	1.13	.18			9.65	32.5	7.08	15.1	4.30	5.33	3.00	1.8
50	2.17	.90	1.26	.22			10.7	39.0	7.87	18.5	4.78	6.43	3.35	2.2
60	2.60	1.3	1.51	.32	5 in.		12.9	56.8	9.44	26.6	5.74	9.05	4.02	3.0
70	3.04	1.7	1.76	.41	1.12	.14	15.0	73.5	11.0	35.1	6.69	11.9	4.69	4.0
75	3.26	2.0	1.90	.48	1.20	.16			11.8	39.0	7.20	13.6	5.01	4.6
80	3.48	2.3	2.01	.58	1.28	.18			12.6	44.8	7.65	15.4	5.37	5.0
90	3.91	2.7	2.26	.68	1.44	.22	6 in.		14.2	55.5	8.60	18.9	6.04	6.3
100	4.34	3.2	2.52	.79	1.60	.27	1.11	.09	15.7	66.3	9.56	23.3	6.71	7.8
125	5.42	4.9	3.15	1.2	2.00	.42	1.39	.18			12.0	35.1	8.38	11.8
150	6.51	6.8	3.78	1.7	2.41	.57	1.67	.21			14.4	49.4	10.1	16.6
175	7.59	9.1	4.41	2.2	2.81	.77	1.94	.31			16.8	66.3	11.7	22.0
200	8.68	11.6	5.04	2.9	3.21	.96	2.22	.40					13.4	28.0
225	9.77	14.5	5.67	3.5	3.61	1.2	2.50	.48	8 in.				15.1	35.3
250	10.9	17.7	6.30	4.4	4.01	1.5	2.78	.60	1.60	.15			16.8	43.0
275	11.9	21.2	6.93	5.2	4.41	1.8	3.06	.75	1.76	.18				
300	13.0	24.7	7.56	6.1	4.81	2.0	3.33	.84	1.92	.21				
325	14.1	29.1	8.18	7.0	5.21	2.3	3.61	.92	2.08	.24				
350	15.2	33.8	8.82	8.0	5.61	2.7	3.89	.91	2.24	.27				
375			9.45	9.2	6.01	3.1	4.16	1.2	2.40	.31				
400			10.1	10.4	6.41	3.5	4.44	1.4	2.56	.35	10 in.			
450			11.3	12.9	7.22	4.4	5.00	1.7	2.88	.45	1.83	.14	12 in.	
500			12.6	15.6	8.02	5.3	5.55	2.2	3.20	.53	2.04	.18	1.42	.08
600			15.1	22.4	9.62	6.2	6.66	3.1	3.85	.74	2.44	.25	1.71	.10
700			17.6	30.4	11.2	9.9	7.77	4.1	4.49	1.0	2.85	.34	1.99	.14
800							8.88	5.2	5.13	1.3	3.26	.44	2.27	.18
900							10.0	6.6	5.77	1.6	3.66	.54	2.55	.22
1000							11.1	7.8	6.41	2.0	4.07	.65	2.84	.27
1100							12.2	9.3	7.05	2.3	4.48	.78	3.12	.32
1200							13.3	10.8	7.69	2.7	4.88	.95	3.41	.37
1300							14.4	12.7	8.33	3.1	5.29	1.1	3.69	.42
1400							15.5	14.7	8.97	3.6	5.70	1.2	3.97	.48
1500							16.6	16.8	9.62	4.1	6.10	1.4	4.20	.55
1600									10.3	4.7	6.51	1.6	4.54	.65
1800									11.5	5.6	7.32	2.0	5.11	.78
2000									12.8	7.0	8.13	2.4	5.67	.93
2500											10.2	3.5	7.09	1.5
3000											12.2	5.1	8.51	2.1
3500											14.3	6.5	9.93	2.7
4000													11.4	3.5
4500													12.8	4.5
5000													14.2	5.5

Water Friction in 100 Ft. of Smooth Bore Hose

For various flows and hose sizes, table gives velocity of water and ft. of head lost in friction in 100 ft. of smooth bore hose.

Sizes of hose shown are actual inside diameters.

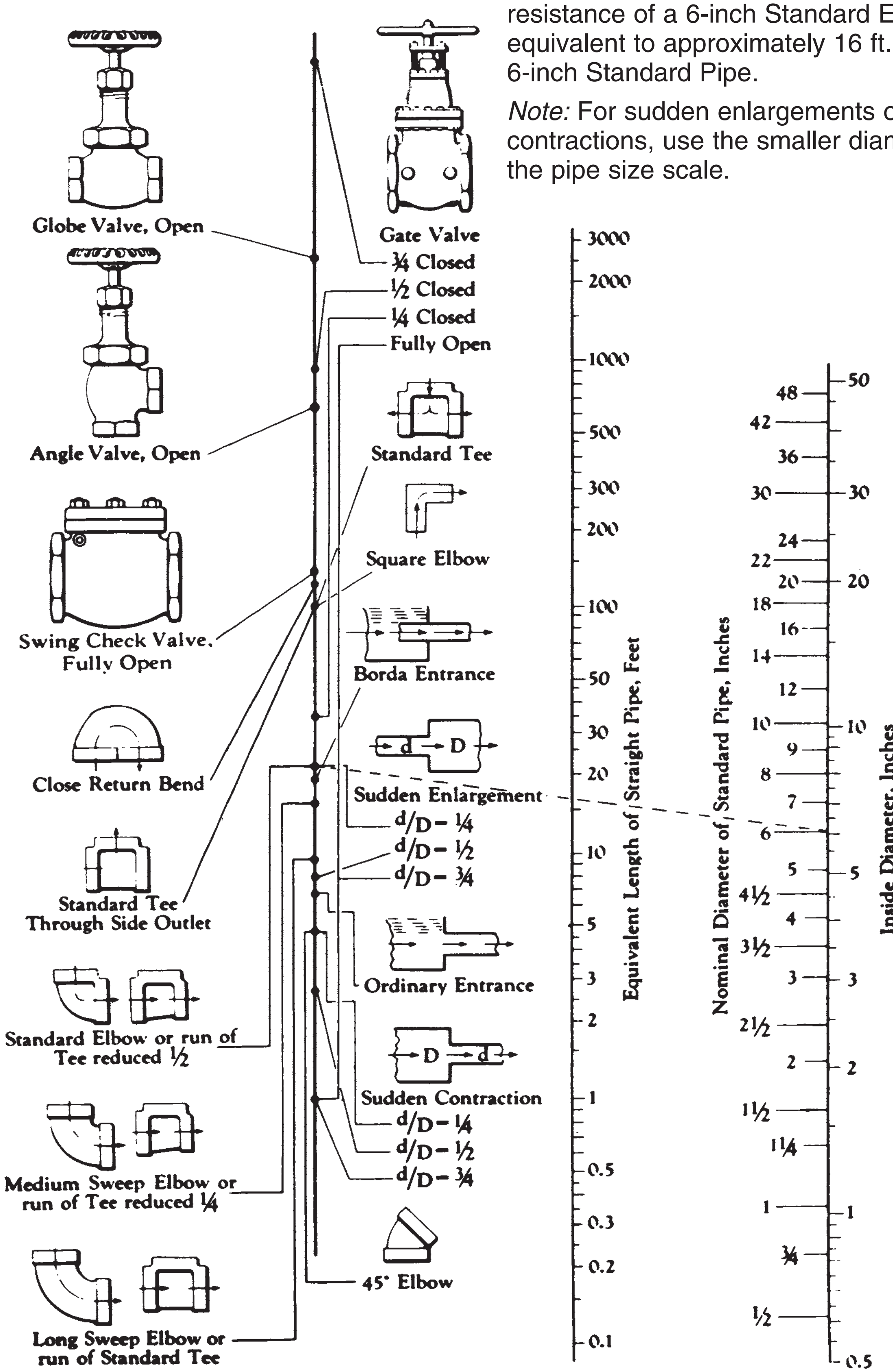
Flow in U.S. Gals. Per Min.	Velocity in Ft. Per Sec.	Friction Head in Ft.	Velocity in Ft. Per Sec.	Friction Head in Ft.	Velocity in Ft. Per Sec.	Friction Head in Ft.	Velocity in Ft. Per Sec.	Friction Head in Ft.	Velocity in Ft. Per Sec.	Friction Head in Ft.	Velocity in Ft. Per Sec.	Friction Head in Ft.
	5/8 in.		3/4 in.		1 in.		1-1/4 in.		1-1/2 in.		2 in.	
1.5	1.6	2.3	1.1	.97								
2.5	2.6	6.0	1.8	2.5								
5	5.2	21.4	3.6	8.9	2.0	2.2	1.3	.74	.9	.3		
10	10.5	76.8	7.3	31.8	4.1	7.8	2.6	2.64	1.8	1.0	1.0	.2
15	2-1/2 in.		10.9	68.5	6.1	16.8	3.9	5.7	2.7	2.3	1.5	.5
20	1.3	.32			8.2	28.7	5.2	9.6	3.6	3.9	2.0	.9
25	1.6	.51	3 in.		10.2	43.2	6.5	14.7	4.5	6.0	2.5	1.4
30	2.0	.70	1.4	.3	12.2	61.2	7.8	20.7	5.4	8.5	3.1	2.0
35	2.3	.93	1.6	.4	14.3	80.5	9.1	27.6	6.4	11.2	3.6	2.7
40	2.6	1.2	1.8	.5			10.4	35.0	7.3	14.3	4.1	3.5
45	2.9	1.5	2.0	.6			11.7	43.0	8.2	17.7	4.6	4.3
50	3.3	1.8	2.3	.7			13.1	52.7	9.1	21.8	5.1	5.2
60	3.9	2.5	2.7	1.0			15.7	73.5	10.9	30.2	6.1	7.3
70	4.6	3.3	3.2	1.3					12.7	40.4	7.1	9.8
80	5.2	4.3	3.6	1.7	4 in.				14.5	52.0	8.2	12.6
90	5.9	5.3	4.1	2.1	2.3	.5			16.3	64.2	9.2	15.7
100	6.5	6.5	4.5	2.6	2.5	.6			18.1	77.4	10.2	18.9
125	8.2	9.8	5.7	4.0	3.2	.9					12.8	28.6
150	9.8	13.8	6.8	5.6	3.8	1.3					15.3	40.7
175	11.4	18.1	7.9	7.4	4.5	1.8	5 in.		6 in.		17.9	53.4
200	13.1	23.4	9.1	9.6	5.1	2.3	3.3	.8	2.3	.32	20.4	68.5
225	14.7	29.0	10.2	11.9	5.7	2.9	3.7	1.0	2.6	.40		
250	16.3	35.0	11.3	14.8	6.4	3.5	4.1	1.2	2.8	.49		
275	18.0	42.0	12.5	17.2	7.0	4.2	4.5	1.4	3.1	.58		
300	19.6	49.0	13.6	20.3	7.7	4.9	4.9	1.7	3.3	.69		
325			14.7	23.5	8.3	5.7	5.3	2.0	3.7	.80		
350			15.9	27.0	8.9	6.6	5.7	2.3	4.0	.90		
375			17.0	30.7	9.6	7.4	6.1	2.6	4.3	1.0	8 in.	
400					10.2	8.4	6.5	2.9	4.5	1.1	2.6	.28
450					11.5	10.5	7.4	3.6	5.1	1.4	2.9	.35
500					12.8	12.7	8.2	4.3	5.7	1.7	3.2	.43
600					15.3	17.8	9.8	6.1	6.8	2.4	3.8	.60
700					17.9	23.7	11.4	8.1	7.9	3.3	4.5	.80
800							13.1	10.3	9.1	4.2	5.1	1.1
900							14.7	12.8	10.2	5.2	5.8	1.3
1000							16.3	15.6	11.4	6.4	6.4	1.6
1100							17.9	18.5	12.5	7.6	7.0	1.9
1200									13.6	9.2	7.7	2.3
1300									14.7	10.0	8.3	2.6
1400									15.9	11.9	8.9	3.0
1500									17.0	13.6	9.6	3.3
1600											10.2	3.7
1800											11.5	4.7
2000											12.8	5.7
2500											16.0	8.6
3000											19.1	12.2

Resistance of Valves and Fittings to Flow of Fluids

A simple way to account for the resistance offered to flow by valves and fittings is to add to the length of pipe in the line a length which will give a pressure drop equal to that which occurs in the valves and fittings in the line. The chart on this page can be used to find the additional length which must be added for each resistance.

Example: The dotted line shows that the resistance of a 6-inch Standard Elbow is equivalent to approximately 16 ft. of 6-inch Standard Pipe.

Note: For sudden enlargements or sudden contractions, use the smaller diameter *d* on the pipe size scale.



Capacity and Flow Chart

Table One

Amount of water per foot in excavations

Diameter of pool of water in feet	U.S. Gallons per foot of depth
1	6
2	24
3	53
4	94
5	147
6	212
7	288
8	376
9	476
10	587
15	1320
20	2350
25	3672
30	5275
35	7200
40	9400
45	11900
50	14700

Table Two

Approximate flow of streams in U.S. gallons per minute
(Stream flow rate: 1 ft. per second)

Depth of stream at midpoint in inches	Width of stream in feet			
	1	3	5	10
1	14	43	72	144
2	39	121	202	404
3	71	221	370	740
4	108	338	569	1139
5	148	470	794	1588
6	190	614	1040	2080
7	244	771	1304	2608
8		935	1582	3164
9		1106	1879	3759
10		1286	2196	4392
11		1486	2542	5084
12		1674	2866	5732
13		1864	3204	6408
14		2086	3592	7184
15		2296	3968	7936
16		2516	4360	8720
17		2770	4788	9576
18		2964	5160	10320
19		3192	5576	11152

Contractors Pump Bureau

Sound Level Measurement Standard for Pump Units

1.0 Scope

The purpose of the Standard is to provide a uniform test procedure to measure and report the A-weighted sound pressure level for portable dewatering pumps.

2.0 Test Environment

2.1 Criterion for adequacy of the test environment

The test environment shall be an outdoor site which consists of a hard, flat ground surface (such as asphalt or concrete) with no sound reflecting objects to be within a distance of 21 meters from the outermost major surface of the source. An object closer than 21 meters is considered a reflecting object if its width exceeds one-tenth of its distance from the outermost major surface of the source.

2.2 Precautions for outdoor measurements

Take care to minimize the effects of adverse meteorological conditions (for example, wind, temperature, humidity, precipitation) on the sound propagation and on the background noise during the course of the measurements. Verify that meteorological conditions are within the acceptable limits published by the instrumentation manufacturers.

2.3 Criterion for background noise

The level of background noise shall be at least 10 dB below the sound pressure level to be measured.

3.0 Instrumentation

3.1 General

The instrumentation system, including the microphones and cables, shall meet the requirements for a Type 1 instrument specified in IEC 60651, or in the case of integrating-averaging sound level meters, the requirements for a Type 1 instrument specified in the IEC 60804. The filters used shall meet the requirements of IEC 60225. Sound pressure level measurements shall be performed with A-weighting.

3.2 Calibration

Direct calibration of the measurement system shall be performed before each testing session using a Type I sound level calibrator. All instrumentation shall be calibrated on a yearly basis according to the latest and pertinent ISO and ANSI standards and traceable to NIST.

3.3 Microphone Windscreen

If measurements are to be made outdoors, a windscreen is recommended. It shall be verified by either the windscreen manufacturer, or by the user, that the windscreen does not cause attenuation of the measurement.

4.0 Installation of Pump Unit Under Test

4.1 General

The manner in which the pump unit under test is installed may have a significant influence on the sound pressure level of the pump unit. This clause specifies conditions that minimize variations in the sound pressure level due to the installation conditions of the pump unit under test.

4.2 Pump Unit Location

See Paragraph 2.1.

4.3 Pump Unit Mounting

The pump unit shall be mounted in such a way as to simulate manufacturer's recommended usage.

4.4 Pump Unit Configuration

4.4.1 Standard Configuration

The pump unit to be tested shall be a standard production unit configured as it will be when placed on the market.

4.4.2 Fuel Tanks

On-board fuel tanks shall be no more than 1/2 full.

4.4.3 Auxiliary Equipment

All auxiliary equipment, such as vacuum pumps, compressors, non-return valves, etc., shall be installed and operating during the test.

5.0 Microphone/Sound Reading Locations

5.1 Microphone Position

All microphone positions/sound level readings shall be taken at a height of 1.55 +/- .075 meters above the reflecting plane.

5.2 Distance from the Pump Unit

Sound level readings shall be taken at a distance of 7 meters from the outermost major surface of the pump unit.

5.3 Number of Sound Level Readings

Eight sound level readings shall be taken around the unit. Measurement points shall be equally spaced around the circumference of the measurement circle in accordance with Paragraph 5.2.

5.4 Period of Observation

The period of observation of each reading should be at least 15 seconds.

6.0 Operation of Pump Unit Under Test

Speed and Load

The pump unit to be tested shall be tested while operating at maximum continuous pump speed under full load maximum water horsepower condition.

7.0 Test Data to be Recorded

7.1 Background Noise

With the equipment under test shut down, the overall sound level shall be recorded to determine the background noise.

7.2 Ambient Temperature

The ambient temperature shall be recorded.

7.3 Wind Speed

The wind speed shall be recorded.

7.4 Atmospheric Pressure

The barometric pressure shall be recorded.

7.5 Sound Level

With the equipment under test running, eight sound level measurements shall be recorded around the pump as described in Section 5.0.

8.0 Presentation of Data

8.1 Test Form

A form such as illustrated in Annex A should be used for reporting the data.

8.2 Calculating Average Noise Level

The published CPB sound pressure level shall be the average of the eight sound pressure level readings, calculated to the following rules:

8.2.1 Maximum variation 5 dB or less: average the sound pressure levels arithmetically;

8.2.2 Maximum variation 5 dB to 10dB: average the sound pressure levels arithmetically and add one dB;

8.2.3 Maximum variation over 10 dB: average according to the following equation:

$$L = 10 \log_{10} \ 1/n \ [\text{antilog } L_1/10 + \text{antilog } L_2/10 + \ldots\text{antilog } L_n/10]$$

Where:

L = Average sound level dB(A), or band average sound pressure level, in decibels;

L_1 = Sound level dB(A), or band sound pressure level, in decibels at location No. 1;

L_n = Sound level dB(A), or band sound pressure level, in decibels at location No. n;

n = Number of measurement locations.

9.0 References

ISO 3744: 1995

ANSI/HI 9.4: 1994

Annex A

Sample CPB Sound Level Measurement Test Form

Test Date: ___________ Test Time: ______________

Test Location: ___________ Tested By: ______________

Witnessed By: ______________

PUMP TO BE TESTED

Pump Unit Model: ___________ Pump Unit S/N: ______________

Pump Speed: ___________ Pump Duty Conditions: ______________

TEST CONDITIONS

Background Noise: ___________ Wind Speed: ______________

Ambient Temperature: ___________ Barometer Reading: ______________

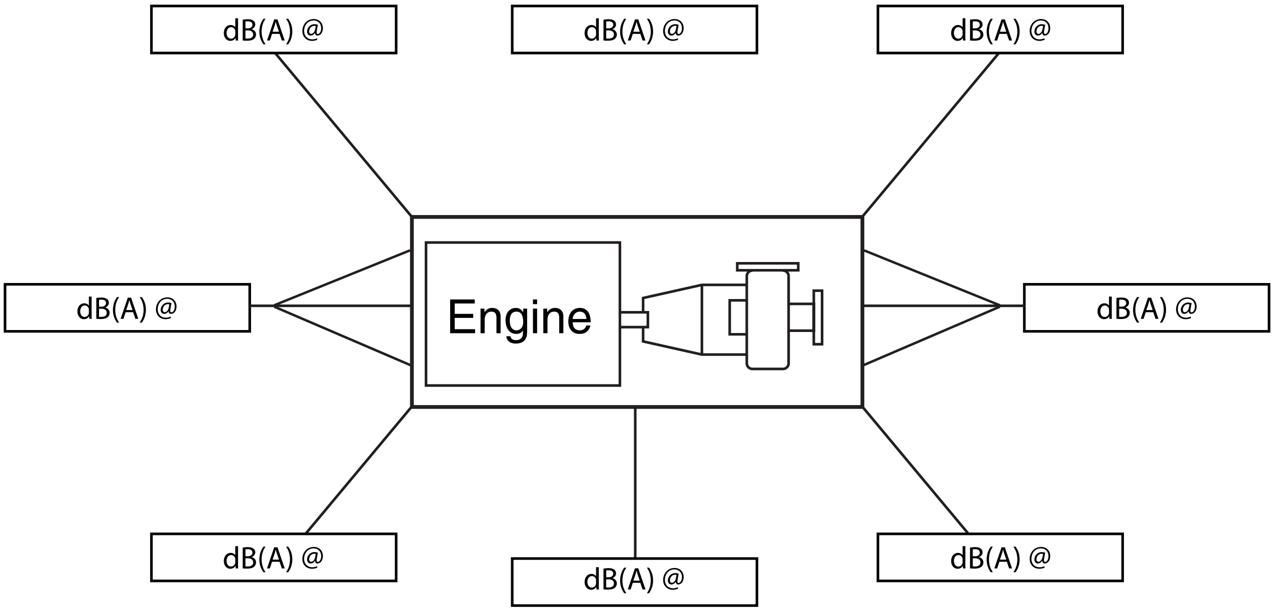
TEST EQUIPMENT

Sound Meter Mfr: ___________ Sound Meter Type: ______________

Sound Meter Serial #: ___________ Sound Meter Calibration Date: ________

Wind Screen Used (Yes/No): ___________

TEST DATA



Average Noise Level:	______________**dB(A) @ 7 meters** (Calculate in accordance with Paragraph 8.2)

NOTES: ____

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