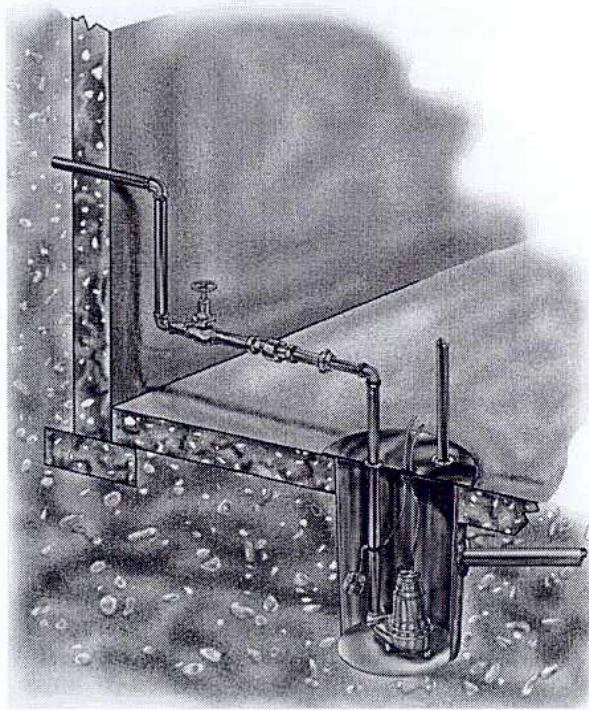


Little **GIANT** Pump Company

GUIDELINES FOR SIZING SEWAGE PUMPS & SYSTEMS



These guidelines cover the steps that need to be taken to accurately select the correct sewage pump and applicable systems to use in sewage ejectors.

The system is selected first and in sizing a system you need to work through five steps to determine:

- System Capacity (GPM required)
- Total Head
- Pump Selection
 - a. Solids Handling
- Basin Size
- Simplex/Duplex System

GUIDELINES FOR SIZING

SYSTEM CAPACITY refers to the rate of flow in gallons per minute (GPM) necessary to efficiently maintain the system. The "Fixture Unit" method is suggested for determining this figure. This approach assigns a relative value to each fixture or group of fixtures normally encountered. Determination of the required **SYSTEM CAPACITY** is as follows:

- List all fixtures involved in the installation and using Figure 1 assign a Fixture Unit value to each. Add to obtain total.
- Referring to figure 2 locate the total Fixture Unit amount along the horizontal axis of the graph and follow vertically until intersecting the plotted line. Read the **SYSTEM CAPACITY** in GPM along the vertical axis.

Fig. 2

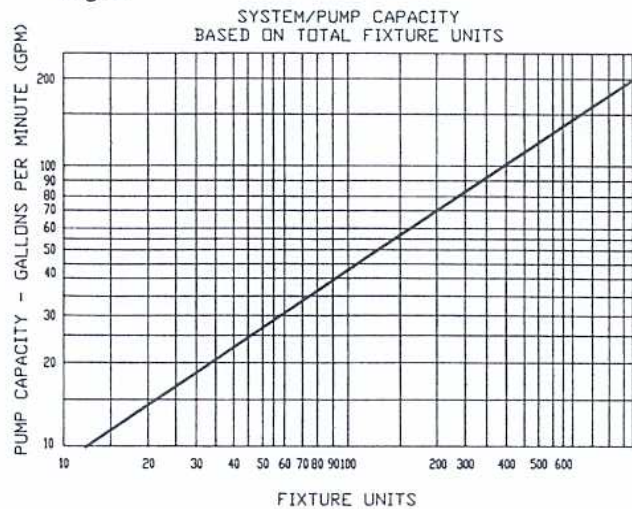


Fig. 1	FIXTURE DESCRIPTION	UNIT VALUE	TOTAL USED
	BATHROOM GROUP, CONSISTING OF LAVATORY, BATHTUB OR SHOWER AND (DIRECT FLUSH) WATER CLOSET	10	
	BATHROOM GROUP, CONSISTING OF LAVATORY, BATHTUB OR SHOWER AND (FLUSH TANK) WATER CLOSET	6	
	BATHTUB WITH 1-1/2" TRAP	2	
	BATHTUB WITH 2" TRAP	3	
	BIDET WITH 1-1/2" TRAP	3	
	DENTAL UNIT OR CUSPIDOR	1	
	DRINKING FOUNTAIN	1	
	DISHWASHER DOMESTIC TYPE	2	
	KITCHEN SINK DOMESTIC	2	
	KITCHEN SINK DOMESTIC WITH WASTE GRINDER	3	
	LAVATORY WITH 1-1/2" TRAP SIZE	1	
	LAVATORY BARBER OR BEAUTY SHOP	2	
	LAUNDRY TRAY 2-COMPARTMENT	2	
	SHOWER STALL	2	
	SHOWER (GROUP) PER HEAD	3	
	SINK (DIRECT FLUSH VALVE)	7	
	SINK (SERVICE TYPE WITH FLOOR DRAIN)	3	
	SINK (SCULLERY)	4	
	SINK (SURGEONS)	3	
	URINAL (WITH FLUSH VALVE)	8	
	URINAL (WITH FLUSH TANK)	4	
	WATER CLOSET (FLUSH VALVE)	7	
	WATER CLOSET (FLUSH TANK)	3	
	SWIMMING POOLS (PER 1000 GAL. CAPACITY)	1	
	UNLISTED FIXTURE WITH 1-1/4" TRAP SIZE	2	
	UNLISTED FIXTURE WITH 1-1/2" TRAP SIZE	3	
	UNLISTED FIXTURE WITH 2" TRAP SIZE	4	
	UNLISTED FIXTURE WITH 2-1/2" TRAP SIZE	5	
	UNLISTED FIXTURE WITH 3" TRAP SIZE	6	
	UNLISTED FIXTURE WITH 4" TRAP SIZE	7	
	WATER SOFTENER (DOMESTIC)	4	
	WASHING MACHINE	2	
	TOTAL		

2. TOTAL HEAD

TOTAL HEAD is a combination of two components — Static Head and Friction Head — and is expressed in feet. (Refer to Typical Installation Illustration, Figure 4).

A. Static Head is the actual vertical distance measured from the minimum water level in the BASIN to the highest point in the discharge piping.

B. Friction Head is the additional head created in the discharge system due to resistance to flow within its components. All straight pipe, fittings, valves, etc. have a friction factor which must be considered. These friction factors are converted to, and expressed as, equivalent feet of straight pipe, which can then be totaled and translated to Friction Head depending on the flow and pipe size. Basically this is reduced to four steps.

1. It will be necessary to determine the discharge pipe size. In order to ensure sufficient fluid velocity to carry solids, (generally accepted to be 2 feet per second), flows should be at least:

9 GPM through 1-1/4" pipe
 13 GPM through 1-1/2" pipe
 21 GPM through 2" pipe
 30 GPM through 2-1/2" pipe
 46 GPM through 3" pipe

2. The length of the discharge piping is measured from the discharge opening of the pump to the point of final discharge, following all contours and bends.
3. To determine the equivalent length of discharge piping represented by the various fittings and valves, refer to Figure 6 and total all values. Add this to the measured length of discharge pipe and divide by 100 to determine the number of 100 ft. increments.
4. Refer to Figure 5 and find the required **PUMP CAPACITY**. (determined from figure 2). Follow gallon per minute to pipe size being used. Multiply this number by the number of 100 foot increments.
- C. Add the Static Head and Friction Head to determine **TOTAL HEAD**.

GUIDELINES FOR SIZING

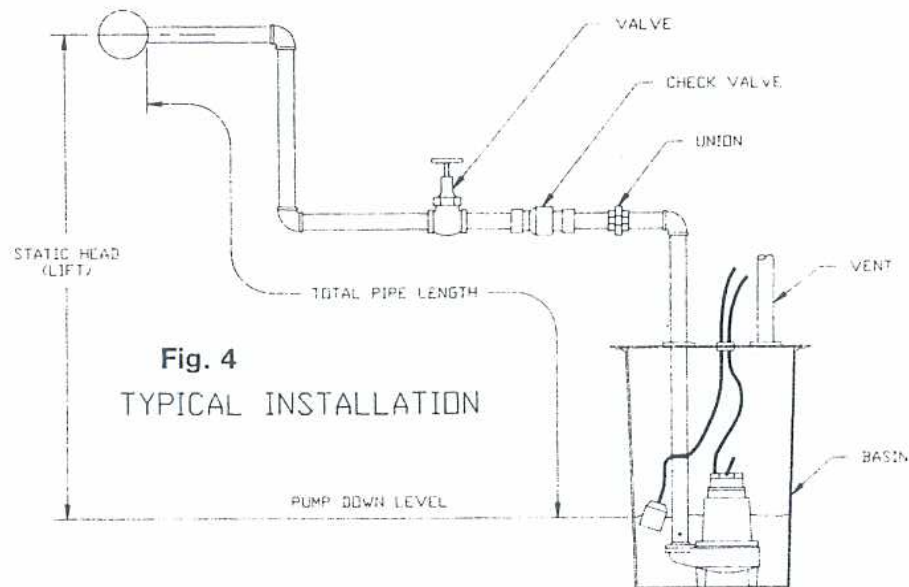


Fig. 5

PLASTIC PIPE: FRICTION LOSS (IN FEET OF HEAD) PER 100 FT.						
REQ'D PUMP CAPACITY GPM	1-1/4" ft.	1-1/2" ft.	2" ft.	2-1/2" ft.	3" ft.	4" ft.
1						
2	.10					
3	.21	.10				
4	.35	.16				
5	.51	.24				
6	.71	.33	.10			
8	1.19	.55	.17			
10	1.78	.83	.25	.11		
15	3.75	1.74	.52	.22		
20	6.39	2.94	.86	.36	.13	
25	9.71	4.44	1.29	.54	.19	
30	13.62	6.26	1.81	.75	.26	
35	18.17	8.37	2.42	1.00	.35	.09
40	23.55	10.70	3.11	1.28	.44	.12
45	29.44	13.46	3.84	1.54	.55	.15
50		16.45	4.67	1.93	.66	.17
60		23.48	6.60	2.71	.93	.25
70			8.83	3.66	1.24	.33
80			11.43	4.67	1.58	.41
90			14.26	5.82	1.98	.52
100				7.11	2.42	.63
125				10.83	3.80	.95
150					5.15	1.33
175					6.90	1.78
200					8.90	2.27
250						3.36
300						4.85
350						6.53

GUIDELINES FOR SIZING

Fig. 6

**FRICTION FACTORS FOR PIPE FITTINGS
IN TERMS OF EQUIVALENT FEET OF STRAIGHT PIPE**

NOMINAL PIPE SIZE	90° ELBOW	45° ELBOW	TEE (THROUGH FLOW)	TEE (BRANCH FLOW)	SWING CHECK VALVE	GATE VALVE
1-1/4	3.5	1.8	2.3	6.9	11.5	0.9
1-1/2	4.0	2.2	2.7	8.1	13.4	1.1
2	5.2	2.8	3.5	10.3	17.2	1.4
2-1/2	6.2	3.3	4.1	12.3	20.3	1.7
3	7.7	4.1	5.1	15.3	25.5	2.0

TOTAL HEAD REQUIRED		
(A) STATIC HEAD		
(B) TOTAL LENGTH OF PIPING		
(C) TOTAL FRICTION FACTORS OF FITTINGS		
(D) TOTAL (B+C)		
(E) DIVIDED (D) BY 100		
(F) HEAD LOSS PER 100 FT. OF PIPE (FROM FIG 5)		
(G) FRICTION HEAD (E x F)		
(H) TOTAL HEAD (A+G)		

3. PUMP SELECTION

Every centrifugal pump has a unique performance curve. This curve illustrates the relationship of flow (GPM) to pressure (TOTAL HEAD) at any point. The pump will operate at any point along this performance curve.

Pump capacity is therefore the flow the pump will generate at any specific pressure. The object is to select a pump whose performance curve passes either through or close to the design-condition, preferably above.

Step 1:

Start with the smallest pump horsepower size that will pass the required solid size. If the solid size is not required or mentioned, go to Step 2 and check performance.

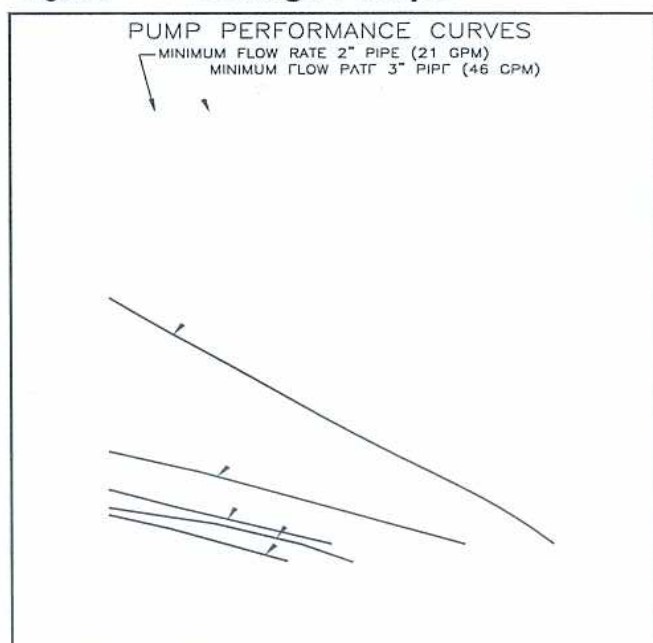
Step 2:

With the pump selected in Step 1, check performance curve(s) to see that it passes above or through the design condition.

SOLID HANDLINGS

SOLID HANDLINGS requirements may be determined by local codes and/or by the type of application and types of solids anticipated. Unless otherwise stated by codes, a sewage pump should have the capability of handling spherical solids of at least 2" in diameter in installations involving water closet.

Figure 3 **Sewage Pumps**



GUIDELINES FOR SIZING

4. BASIN SIZE

BASIN selection is best accomplished by relating to required SYSTEM CAPACITY as determined by the FIXTURE UNIT method.

Figure 7 shows recommended basin diameters, assuming the normal pump differential (distance in inches between turn-on and turn-off), and running time ranges from 15 seconds to 4 minutes. BASIN depth, however, should be at least 24" below basin inlet for most pumps and deeper where greater pumping differentials are anticipated.

NOTE:

Since basin size is directly related to frequency of pump operation, it is important to select a basin of sufficient size to insure that the pump does not short cycle.

The question of whether to use a SIMPLEX or DUPLEX system depends on the type of installation and/or local codes. Generally, a determination can be made using the following guidelines.

A. Domestic — SIMPLEX System is usually adequate.

B. Commercial — OPTIONAL — Depending on the type of business and the need for uninterrupted sanitary drainage facilities.

C. Public or Industrial — DUPLEX System is essential.

While you are sizing the system and before you select the pump, you will need to know — and consider — or make allowances for the following:

- Volts/Phase/Hertz—What is available?
- Will the pump share a circuit?
- Does the home, business, etc. have circuit breakers or fuses?
- What is the breaker or fuse amp rating? Make sure it is enough.
- Check local or state codes for (1) Solid size requirements (2) Amp ratings/circuit cord size/ratings or type (3) Pipe material/size/depth to bury (4) Tank size/location.
- Are there plans for future expansion? As in, adding upstairs bath, basement plumbing, washing machine, etc.

BASIN SIZING

Fig. 7 BASIN DIAMETER (INCHES)

	18"	24"	30"	36"	42"	48"
20						
25						
30						
35						
40						
45						
50						
60						
70						
80						
90						
100						
125						
150						
175						
200						
225						
GALLONS/FOOT OF BASIN DEPTH	13.2	23.9	36.7	52.9	72.0	94.0
GALLONS IN 2-1/2' OF BASIN DEPTH	33.0	59.7	91.7	132.2	180.0	235.0

SELECT MINIMUM BASIN DEPTH SO THAT 2-1/2' OF BASIN DEPTH IN GALLONS = PUMP CAPACITY IN G.P.M.

■ = ACCEPTABLE BASIN SIZE

GUIDELINES FOR SIZING

6. EXAMPLE SIZING PROBLEM

A. What PUMP CAPACITY would be required to handle the drainage from a 4 bathroom home, also including a dishwasher, a washer, a laundry tray, a kitchen sink, water softener, basement shower, a 13,000 gallon pool and a bar sink (1-1/2" trap)?

1. From Figure 1:

Description	Fixture Units
Four bathroom groups	24
Water Softner	4
Dishwasher	2
Washing Machine	2
Laundry Tray	2
Kitchen Sink with Disposal	3
Basement Shower	2
Swimming Pool	13
Bar Sink (unlisted 1-1/2")	3
FIXTURE UNITS TOTAL	55

2. Refer to Figure 2:

Find 55 Fixture Units on the horizontal axis. Follow vertically until intersecting the line then horizontally to the left. The PUMP CAPACITY on the vertical axis is 30 GPM.

B. Determine the TOTAL HEAD of the installation illustrated in figure 4, The Typical Installation Illustration:

1. That Static Head in this instance is 7 feet.

2. Friction Head:

a. Since the required PUMP CAPACITY in this illustration of 30 GPM is less than the 46 GPM necessary to carry solids through 3" pipe, 2" or 2-1/2" pipe should be used. If 3" pipe is preferred or required, a PUMP CAPACITY of at least 46 GPM is required.

b. Measurement of the length of the discharge pipe totals 200'.

c. Refer to Figure 6 and note the friction factor in equivalent feet for each fitting:

3-90 degree elbows, 2" 16 equivalent feet

1-gate valve, 2" 1

1-swing check valve, 2" 17

34 equivalent feet

Adding 34 feet to the measured pipe length, the total effective pipe length becomes 234 feet or 2.34 100-foot increments.

d. Refer to Figure 5. Find the 30 GPM required PUMP CAPACITY on the left scale and follow over to the 2" PVC pipe size column. Friction Head is $1.8 \times 2.34 = 4.2$ feet.

3. Total Head Required:

Total Head = Static Head + Friction Head

Example:

Total Head = $7 + 4.2$

Total Head = 11.2

C. Due to the existence of water closets in this installation, a pump with 2" SOLIDS HANDLING capacity should be used unless otherwise specifically stated by applicable codes. Use Figure 3 to select pump.

D. To determine the BASIN size, find the PUMP CAPACITY (30GPM) in the column on the left of figure 7. Any BASIN diameter of 18" or greater is acceptable.

E. Since this application is domestic, a SIMPLEX System is sufficient.

F. Summary: Recommended selections for this installation would be a SIMPLEX System utilizing an 18" or greater diameter BASIN and a 2" SOLIDS HANDLING pump capable of delivering at least 30 GPM at 11".

GUIDELINES FOR SIZING

SUMMARY WORKSHEET

NUMBER OF FIXTURE UNITS _____

FLOW RATE - GALLONS PER MINUTE _____

TOTAL HEAD REQUIRED _____

PUMP SELECTION _____

TYPICAL SINGLE FAMILY DWELLING SEWAGE PUMP CHART

Note: The data contained herein is for reference only. Proper sizing and selection of sewage pumps requires consideration of many factors. Always consult applicable local codes before installing any equipment. This chart is based on a residential application with not more than 34 fixture units (values assigned to each plumbing fixture). The TDH (Total Dynamic Head) of the system is calculated based on Total Vertical Lift, Horizontal Length of discharge piping, and the friction losses for 2" diameter plastic pipe (3" diameter plastic pipe where the 16S pump is shown).

TOTAL LENGTH OF DISCHARGE PIPE IN FEET

TOTAL VERT. LIFT	100'	150'	200'	250'	300'	350'	400'	450'	500'	550'	600'	650'	700'	750'	800'
	TDH PUMP GPM	TDH PUMP GPM	TDH PUMP GPM	TDH PUMP GPM	TDH PUMP GPM	TDH PUMP GPM	TDH PUMP GPM	TDH PUMP GPM	TDH PUMP GPM	TDH PUMP GPM	TDH PUMP GPM	TDH PUMP GPM	TDH PUMP GPM	TDH PUMP GPM	TDH PUMP GPM
5'	6.9' 9S 69 GPM	7.5' 9S 64 GPM	8.2' 9S 60 GPM	8.8' 9S 57 GPM	9.5' 9S 52 GPM	10.1' 9S 49 GPM	10.8' 9S 44 GPM	11.4' 9S 40 GPM	12.1' 9S 37 GPM	12.7' 9S 33 GPM	13.4' 9S 29 GPM	14.0' 9S 25 GPM	14.7' 10S 51 GPM	15.3' 10S 46 GPM	16.0' 10S 40 GPM
6'	7.9' 9S 61 GPM	8.5' 9S 58 GPM	9.2' 9S 55 GPM	9.8' 9S 51 GPM	10.5' 9S 46 GPM	11.1' 9S 43 GPM	11.8' 9S 38 GPM	12.4' 9S 34 GPM	13.1' 9S 31 GPM	13.7' 9S 27 GPM	14.4' 10S 54 GPM	15.0' 10S 48 GPM	15.7' 10S 42 GPM	16.3' 10S 38 GPM	17.0' 10S 31 GPM
7'	8.9' 9S 55 GPM	9.5' 9S 52 GPM	10.2' 9S 48 GPM	10.8' 9S 44 GPM	11.5' 9S 39 GPM	12.1' 9S 37 GPM	12.8' 9S 32 GPM	13.4' 9S 29 GPM	14.1' 9S 24 GPM	14.7' 10S 51 GPM	15.4' 10S 44 GPM	16.0' 10S 40 GPM	16.7' 10S 33 GPM	17.3' 10S 27 GPM	18.0' 14S 52 GPM
8'	9.9' 9S 50 GPM	10.5' 9S 46 GPM	11.2' 9S 42 GPM	11.8' 9S 38 GPM	12.5' 9S 33 GPM	13.1' 9S 31 GPM	13.8' 9S 26 GPM	14.4' 10S 54 GPM	15.1' 10S 47 GPM	15.7' 10S 42 GPM	16.4' 10S 36 GPM	17.0' 10S 31 GPM	17.7' 14S 55 GPM	18.3' 14S 50 GPM	19.0' 14S 45 GPM
9'	10.9' 9S 44 GPM	11.5' 9S 39 GPM	12.2' 9S 36 GPM	12.8' 9S 32 GPM	13.5' 9S 28 GPM	14.1' 9S 24 GPM	14.8' 10S 50 GPM	15.4' 10S 44 GPM	16.1' 10S 39 GPM	16.7' 10S 33 GPM	17.4' 14S 56 GPM	18.0' 14S 52 GPM	18.7' 14S 48 GPM	19.3' 14S 42 GPM	20.0' 14S 40 GPM
10'	11.9' 9S 38 GPM	12.5' 9S 33 GPM	13.2' 9S 30 GPM	13.8' 9S 26 GPM	14.5' 10S 53 GPM	15.1' 10S 47 GPM	15.8' 10S 41 GPM	16.4' 10S 36 GPM	17.1' 10S 30 GPM	17.7' 14S 55 GPM	18.4' 14S 49 GPM	19.0' 14S 45 GPM	19.7' 14S 39 GPM	20.3' 14S 35 GPM	21.0' 14S 31 GPM
11'	12.9' 9S 32 GPM	13.5' 9S 28 GPM	14.2' 9S 23 GPM	14.8' 10S 50 GPM	15.5' 10S 43 GPM	16.1' 10S 39 GPM	16.8' 10S 32 GPM	17.4' 14S 56 GPM	18.1' 14S 51 GPM	18.7' 14S 46 GPM	19.4' 14S 41 GPM	20.0' 14S 40 GPM	20.7' 14S 33 GPM	21.3' 14S 28 GPM	22.0' 14S 25 GPM
12'	13.9' 9S 26 GPM	14.5' 10S 53 GPM	15.2' 10S 46 GPM	15.8' 10S 41 GPM	16.5' 10S 35 GPM	17.1' 10S 30 GPM	17.8' 14S 54 GPM	18.4' 14S 49 GPM	19.1' 14S 44 GPM	19.7' 14S 39 GPM	20.4' 14S 34 GPM	21.0' 14S 31 GPM	21.7' 14S 25 GPM	16.9' 16S 117 GPM	17.2' 16S 115 GPM
13'	14.9' 10S 49 GPM	15.5' 10S 43 GPM	16.2' 10S 38 GPM	16.8' 10S 32 GPM	17.5' 14S 55 GPM	18.1' 14S 51 GPM	18.8' 14S 47 GPM	19.4' 14S 41 GPM	20.1' 14S 38 GPM	20.7' 14S 33 GPM	21.4' 14S 27 GPM	22.0' 14S 25 GPM	17.6' 16S 113 GPM	17.9' 16S 112 GPM	18.2' 16S 111 GPM
14'	15.9' 10S 40 GPM	16.5' 10S 35 GPM	17.2' 10S 29 GPM	17.8' 14S 54 GPM	18.5' 14S 48 GPM	19.1' 14S 44 GPM	19.8' 14S 38 GPM	20.4' 14S 34 GPM	21.1' 14S 30 GPM	21.7' 14S 25 GPM	18.0' 16S 112 GPM	18.3' 16S 111 GPM	18.6' 16S 109 GPM	18.9' 16S 108 GPM	19.2' 16S 107 GPM
15'	16.9' 10S 31 GPM	17.5' 14S 55 GPM	18.2' 14S 50 GPM	18.8' 14S 47 GPM	19.5' 14S 40 GPM	20.1' 14S 38 GPM	20.8' 14S 32 GPM	21.4' 16S 27 GPM	18.4' 16S 110 GPM	18.7' 16S 109 GPM	19.0' 16S 108 GPM	19.3' 16S 107 GPM	19.6' 16S 105 GPM	19.9' 16S 103 GPM	20.2' 16S 99 GPM
16'	17.9' 14S 53 GPM	18.5' 14S 48 GPM	19.2' 14S 43 GPM	19.8' 14S 38 GPM	20.5' 14S 33 GPM	21.1' 14S 30 GPM	21.8' 14S 24 GPM	19.1' 16S 107 GPM	19.4' 16S 107 GPM	19.7' 16S 105 GPM	20.0' 16S 103 GPM	20.3' 16S 99 GPM	20.6' 16S 98 GPM	20.9' 16S 95 GPM	21.2' 16S 95 GPM
17'	18.9' 14S 46 GPM	19.5' 14S 40 GPM	20.2' 14S 37 GPM	20.8' 14S 32 GPM	21.5' 14S 26 GPM	19.5' 16S 107 GPM	19.8' 16S 104 GPM	20.1' 16S 102 GPM	20.4' 16S 99 GPM	20.7' 16S 98 GPM	21.0' 16S 96 GPM	21.3' 16S 95 GPM	21.6' 16S 94 GPM	21.9' 16S 92 GPM	22.2' 16S 90 GPM
18'	19.9' 14S 37 GPM	20.5' 14S 33 GPM	21.2' 14S 29 GPM	21.8' 14S 24 GPM	20.2' 16S 100 GPM	20.5' 16S 99 GPM	20.8' 16S 97 GPM	21.1' 16S 96 GPM	21.4' 16S 95 GPM	21.7' 16S 93 GPM	22.0' 16S 91 GPM	22.3' 16S 90 GPM	22.6' 16S 86 GPM	22.9' 16S 84 GPM	23.2' 16S 82 GPM
19'	20.9' 14S 30 GPM	21.5' 14S 26 GPM	20.6' 16S 98 GPM	20.9' 16S 97 GPM	21.2' 16S 95 GPM	21.5' 16S 94 GPM	21.8' 16S 92 GPM	22.1' 16S 91 GPM	22.4' 16S 89 GPM	22.7' 16S 85 GPM	23.0' 16S 83 GPM	23.3' 16S 82 GPM	23.6' 16S 81 GPM	23.9' 16S 79 GPM	24.2' 16S 78 GPM
20'	21.9' 14S 23 GPM	21.2' 16S 95 GPM	21.6' 16S 93 GPM	21.9' 16S 91 GPM	22.2' 16S 90 GPM	22.5' 16S 88 GPM	22.8' 16S 84 GPM	23.1' 16S 82 GPM	23.4' 16S 81 GPM	23.7' 16S 80 GPM	24.0' 16S 79 GPM	24.3' 16S 78 GPM	24.6' 16S 77 GPM	24.9' 16S 76 GPM	25.2' 16S 75 GPM