

ITT

Residential Water Systems

Goulds Pumps

Technical Data

Water Products



Goulds Pumps is a brand of ITT Corporation.

www.goulds.com

Engineered for life



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GOULDS PUMPS Residential Water Systems

Index

FRICITION LOSS

| | |
|------------------------------------|---|
| Plastic..... | 1 |
| Steel | 2 |
| Copper | 3 |
| Rubber Hose..... | 3 |
| Fittings | 4 |
| Offset Jet Pump Pipe Friction..... | 4 |
| Website Addresses..... | 5 |

JET AND SUBMERSIBLE PUMP SELECTION

| | |
|--|---|
| Private Residences, Yard Fixtures, Public Buildings, Farm Use | 6 |
| Boiler Feed Requirements | 6 |

TANK SELECTION

| | |
|---|---|
| HydroPro® | 7 |
| Galvanized..... | 8 |
| Capacities of Tanks of Various Dimensions | 9 |

CENTRIFUGAL PUMP FUNDAMENTALS

| | |
|------------------------------|--------|
| NPSH and Cavitation..... | 10, 11 |
| Vapor Pressure of Water..... | 12 |

ELECTRICAL DATA

| | |
|-----------------------------|----|
| NEMA Panel Enclosures | 13 |
|-----------------------------|----|

DETERMINING WATER LEVEL

| | |
|-------------------------------|----|
| Determining Water Level | 14 |
|-------------------------------|----|

USE OF TAIL PIPE WITH JET PUMPS

| | |
|--------------------------------------|----|
| Use of Tail Pipe with Jet Pumps..... | 15 |
|--------------------------------------|----|

DETERMINING FLOW RATES

| | |
|---|----|
| Full Pipe Flow | 16 |
| Pipe Not Running Full | 16 |
| Discharge Rate in Gallons per Minute | 16 |
| Theoretical Discharge of Nozzles in U.S. Gal. per Min.. | 17 |

TERMS AND USABLE FORMULAS

| | |
|--------------------------------|----|
| Calculating Suction Lift | 19 |
| Definitions | 20 |
| Basic Formulas..... | 20 |
| Affinity Laws..... | 22 |

CONVERSION CHARTS

| | |
|------------------------|----|
| Conversion Charts..... | 23 |
|------------------------|----|

TYPICAL INSTALLATIONS

| | |
|-----------------------------------|----|
| Jet – Deep and Shallow Well | 27 |
| Submersible – 4" Well..... | 28 |
| High Capacity Submersible | 29 |
| Centrifugal Booster | 30 |
| Jet Booster..... | 31 |

PIPE VOLUME AND VELOCITY

| | |
|--|----|
| Storage of Water in Various Size Pipes | 32 |
| Minimum Flow to Maintain 2 Ft./Sec..... | 32 |
| Storage of Water in Various Sizes of Wells | 32 |

MOTOR DATA

| | |
|---|----|
| Goulds Pumps and A.O. Smith Motor Data..... | 33 |
| Electrical Components..... | 33 |
| Terminal Board and Voltage Change Plug..... | 34 |
| Capacitor Start Induction Run – Motor Wiring..... | 34 |

NOTE:

Submersible Motor Data moved to catalog "Motor Section"

EMERSON MOTOR WIRING

| | |
|----------------------|----|
| 115/230 Voltage..... | 35 |
|----------------------|----|

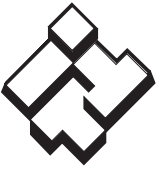
PRESSURE SWITCH WIRING AND ADJUSTMENTS

| | |
|--------------------------|----|
| Square "D" Switches..... | 36 |
| Furnas Pro Control | 36 |

WIRING DIAGRAMS

| | |
|---|----|
| AWA501, AWA502 | 37 |
| Power/Pump Connections: AWA501, AWA502..... | 38 |

| | |
|--|-------|
| Components for a Low Yield Well with a Booster System | 39 |
| Suction Vortex..... | 40 |
| Check Valves and Water Hammer – Compliments of Danfoss Flomatic | 41-42 |



ITT

GOULDS PUMPS
Residential Water Systems

Friction Loss

SCH 40 – PLASTIC PIPE: FRICTION LOSS (IN FEET OF HEAD) PER 100 FT.

| GPM | GPH | 3/8" | 1/2" | 3/4" | 1" | 1 1/4" | 1 1/2" | 2" | 2 1/2" | 3" | 4" | 6" | 8" | 10" |
|------|--------|-------|-------|-------|-------|--------|--------|-------|--------|------|------|------|------|-----|
| | | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. |
| 1 | 60 | 4.25 | 1.38 | .356 | .11 | | | | | | | | | |
| 2 | 120 | 15.13 | 4.83 | 1.21 | .38 | .10 | | | | | | | | |
| 3 | 180 | 31.97 | 9.96 | 2.51 | .77 | .21 | .10 | | | | | | | |
| 4 | 240 | 54.97 | 17.07 | 4.21 | 1.30 | .35 | .16 | | | | | | | |
| 5 | 300 | 84.41 | 25.76 | 6.33 | 1.92 | .51 | .24 | | | | | | | |
| 6 | 360 | | 36.34 | 8.83 | 2.69 | .71 | .33 | .10 | | | | | | |
| 8 | 480 | | 63.71 | 15.18 | 4.58 | 1.19 | .55 | .17 | | | | | | |
| 10 | 600 | | 97.52 | 25.98 | 6.88 | 1.78 | .83 | .25 | .11 | | | | | |
| 15 | 900 | | | 49.68 | 14.63 | 3.75 | 1.74 | .52 | .22 | | | | | |
| 20 | 1,200 | | | 86.94 | 25.07 | 6.39 | 2.94 | .86 | .36 | .13 | | | | |
| 25 | 1,500 | | | | 38.41 | 9.71 | 4.44 | 1.29 | .54 | .19 | | | | |
| 30 | 1,800 | | | | | 13.62 | 6.26 | 1.81 | .75 | .26 | | | | |
| 35 | 2,100 | | | | | 18.17 | 8.37 | 2.42 | 1.00 | .35 | .09 | | | |
| 40 | 2,400 | | | | | 23.55 | 10.70 | 3.11 | 1.28 | .44 | .12 | | | |
| 45 | 2,700 | | | | | 29.44 | 13.46 | 3.84 | 1.54 | .55 | .15 | | | |
| 50 | 3,000 | | | | | | 16.45 | 4.67 | 1.93 | .66 | .17 | | | |
| 60 | 3,600 | | | | | | 23.48 | 6.60 | 2.71 | .93 | .25 | | | |
| 70 | 4,200 | | | | | | | 8.83 | 3.66 | 1.24 | .33 | | | |
| 80 | 4,800 | | | | | | | 11.43 | 4.67 | 1.58 | .41 | | | |
| 90 | 5,400 | | | | | | | 14.26 | 5.82 | 1.98 | .52 | | | |
| 100 | 6,000 | | | | | | | | 7.11 | 2.42 | .63 | .08 | | |
| 125 | 7,500 | | | | | | | | 10.83 | 3.80 | .95 | .13 | | |
| 150 | 9,000 | | | | | | | | | 5.15 | 1.33 | .18 | | |
| 175 | 10,500 | | | | | | | | | 6.90 | 1.78 | .23 | | |
| 200 | 12,000 | | | | | | | | | 8.90 | 2.27 | .30 | | |
| 250 | 15,000 | | | | | | | | | | 3.36 | .45 | .12 | |
| 300 | 18,000 | | | | | | | | | | 4.85 | .63 | .17 | |
| 350 | 21,000 | | | | | | | | | | 6.53 | .84 | .22 | |
| 400 | 24,000 | | | | | | | | | | | 1.08 | .28 | |
| 500 | 30,000 | | | | | | | | | | | 1.66 | .42 | .14 |
| 550 | 33,000 | | | | | | | | | | | 1.98 | .50 | .16 |
| 600 | 36,000 | | | | | | | | | | | 2.35 | .59 | .19 |
| 700 | 42,000 | | | | | | | | | | | | .79 | .26 |
| 800 | 48,000 | | | | | | | | | | | | 1.02 | .33 |
| 900 | 54,000 | | | | | | | | | | | | 1.27 | .41 |
| 950 | 57,000 | | | | | | | | | | | | | .46 |
| 1000 | 60,000 | | | | | | | | | | | | | .50 |

NOTE: See page 5 for website addresses for pipe manufacturers – there are many types of new plastic pipe available now.



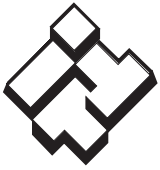
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GOULDS PUMPS
Residential Water Systems

Friction Loss

STEEL PIPE: FRICTION LOSS (IN FEET OF HEAD) PER 100 FT.

| GPM | GPH | 3/8" | 1/2" | 3/4" | 1" | 1 1/4" | 1 1/2" | 2" | 2 1/2" | 3" | 4" | 5" | 6" | 8" | 10" |
|------|--------|-------|-------|-------|-------|--------|--------|-------|--------|--------|-------|-------|------|-------|-------|
| | | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. |
| 1 | 60 | 4.30 | 1.86 | .26 | | | | | | | | | | | |
| 2 | 120 | 15.00 | 4.78 | 1.21 | .38 | | | | | | | | | | |
| 3 | 180 | 31.80 | 10.00 | 2.50 | .77 | | | | | | | | | | |
| 4 | 240 | 54.90 | 17.10 | 4.21 | 1.30 | .34 | | | | | | | | | |
| 5 | 300 | 83.50 | 25.80 | 6.32 | 1.93 | .51 | .24 | | | | | | | | |
| 6 | 360 | | 36.50 | 8.87 | 2.68 | .70 | .33 | .10 | | | | | | | |
| 7 | 420 | | 48.70 | 11.80 | 3.56 | .93 | .44 | .13 | | | | | | | |
| 8 | 480 | | 62.70 | 15.00 | 4.54 | 1.18 | .56 | .17 | | | | | | | |
| 9 | 540 | | | 18.80 | 5.65 | 1.46 | .69 | .21 | | | | | | | |
| 10 | 600 | | | 23.00 | 6.86 | 1.77 | .83 | .25 | .11 | .04 | | | | | |
| 12 | 720 | | | 32.60 | 9.62 | 2.48 | 1.16 | .34 | .15 | .05 | | | | | |
| 15 | 900 | | | 49.70 | 14.70 | 3.74 | 1.75 | .52 | .22 | .08 | | | | | |
| 20 | 1,200 | | | 86.10 | 25.10 | 6.34 | 2.94 | .87 | .36 | .13 | | | | | |
| 25 | 1,500 | | | | 38.60 | 9.65 | 4.48 | 1.30 | .54 | .19 | | | | | |
| 30 | 1,800 | | | | 54.60 | 13.60 | 6.26 | 1.82 | .75 | .26 | | | | | |
| 35 | 2,100 | | | | 73.40 | 18.20 | 8.37 | 2.42 | 1.00 | .35 | | | | | |
| 40 | 2,400 | | | | 95.00 | 23.50 | 10.79 | 3.10 | 1.28 | .44 | | | | | |
| 45 | 2,700 | | | | | 30.70 | 13.45 | 3.85 | 1.60 | .55 | | | | | |
| 70 | 4,200 | | | | | 68.80 | 31.30 | 8.86 | 3.63 | 1.22 | .35 | | | | |
| 100 | 6,000 | | | | | | 62.20 | 17.40 | 7.11 | 2.39 | .63 | | | | |
| 150 | 9,000 | | | | | | | 38.00 | 15.40 | 5.14 | 1.32 | | | | |
| 200 | 12,000 | | | | | | | 66.30 | 26.70 | 8.90 | 2.27 | .736 | .30 | .08 | |
| 250 | 15,000 | | | | | | | 90.70 | 42.80 | 14.10 | 3.60 | 1.20 | .49 | .13 | |
| 300 | 18,000 | | | | | | | | 58.50 | 19.20 | 4.89 | 1.58 | .64 | .16 | .0542 |
| 350 | 21,000 | | | | | | | | 79.20 | 26.90 | 6.72 | 2.18 | .88 | .23 | .0719 |
| 400 | 24,000 | | | | | | | | 103.00 | 33.90 | 8.47 | 2.72 | 1.09 | .279 | .0917 |
| 450 | 27,000 | | | | | | | | 130.00 | 42.75 | 10.65 | 3.47 | 1.36 | .348 | .114 |
| 500 | 30,000 | | | | | | | | 160.00 | 52.50 | 13.00 | 4.16 | 1.66 | .424 | .138 |
| 550 | 33,000 | | | | | | | | 193.00 | 63.20 | 15.70 | 4.98 | 1.99 | .507 | .164 |
| 600 | 36,000 | | | | | | | | 230.00 | 74.80 | 18.60 | 5.88 | 2.34 | .597 | .192 |
| 650 | 39,000 | | | | | | | | | 87.50 | 21.70 | 6.87 | 2.73 | .694 | .224 |
| 700 | 42,000 | | | | | | | | | 101.00 | 25.00 | 7.93 | 3.13 | .797 | .256 |
| 750 | 45,000 | | | | | | | | | 116.00 | 28.60 | 9.05 | 3.57 | .907 | .291 |
| 800 | 48,000 | | | | | | | | | 131.00 | 32.40 | 10.22 | 4.03 | 1.02 | .328 |
| 850 | 51,000 | | | | | | | | | 148.00 | 36.50 | 11.50 | 4.53 | 1.147 | .368 |
| 900 | 54,000 | | | | | | | | | 165.00 | 40.80 | 12.90 | 5.05 | 1.27 | .410 |
| 950 | 57,000 | | | | | | | | | 184.00 | 45.30 | 14.30 | 5.60 | 1.41 | .455 |
| 1000 | 60,000 | | | | | | | | | 204.00 | 50.20 | 15.80 | 6.17 | 1.56 | .500 |



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GOULDS PUMPS Residential Water Systems

Friction Loss

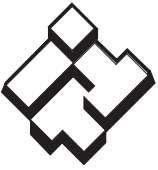
COPPER PIPE: FRICTION LOSS (IN FEET OF HEAD) PER 100 FT.

| GPM | GPH | 3/8" | 1/2" | 3/4" | 1" | 1 1/4" | 1 1/2" | 2" | 2 1/2" | 3" | 4" |
|------|--------|------|------|------|------|--------|--------|------|--------|------|------|
| | | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. | ft. |
| 1 | 60 | 6.2 | 1.8 | .39 | | | | | | | |
| 2 | 120 | 19.6 | 6.0 | 1.2 | | | | | | | |
| 5 | 300 | | 30.0 | 5.8 | 1.6 | | | | | | |
| 7 | 420 | | 53.0 | 11.0 | 3.2 | 2.2 | | | | | |
| 10 | 600 | | | 19.6 | 5.3 | 3.9 | | | | | |
| 15 | 900 | | | 37.0 | 9.9 | 6.2 | 2.1 | | | | |
| 18 | 1,080 | | | 55.4 | 16.1 | 6.9 | 3.2 | | | | |
| 20 | 1,200 | | | | 18.5 | 10.4 | 3.9 | | | | |
| 25 | 1,500 | | | | 27.7 | 14.3 | 5.3 | 1.5 | | | |
| 30 | 1,800 | | | | 39.3 | 18.7 | 7.6 | 2.1 | | | |
| 35 | 2,100 | | | | 48.5 | 25.4 | 10.2 | 2.8 | | | |
| 40 | 2,400 | | | | | 30.0 | 13.2 | 3.5 | 1.2 | | |
| 45 | 2,700 | | | | | 39.3 | 16.2 | 4.2 | 1.6 | | |
| 50 | 3,000 | | | | | | 19.4 | 5.1 | 1.8 | | |
| 60 | 3,600 | | | | | | 27.7 | 6.9 | 2.5 | 1.1 | |
| 70 | 4,200 | | | | | | 40.0 | 9.2 | 3.5 | 1.4 | |
| 75 | 4,500 | | | | | | 41.6 | 9.9 | 3.7 | 1.6 | |
| 80 | 4,800 | | | | | | 45.0 | 11.6 | 4.2 | 1.8 | |
| 90 | 5,400 | | | | | | 50.8 | 13.9 | 4.8 | 2.2 | |
| 100 | 6,000 | | | | | | | 16.9 | 6.2 | 2.8 | |
| 125 | 7,500 | | | | | | | 25.4 | 8.6 | 3.7 | |
| 150 | 9,000 | | | | | | | 32.3 | 11.6 | 4.8 | 1.2 |
| 175 | 10,500 | | | | | | | 41.6 | 16.2 | 6.9 | 1.7 |
| 200 | 12,000 | | | | | | | 57.8 | 20.8 | 9.0 | 2.2 |
| 250 | 15,000 | | | | | | | | 32.3 | 13.9 | 3.5 |
| 300 | 18,000 | | | | | | | | 41.6 | 18.5 | 4.6 |
| 350 | 21,000 | | | | | | | | | 32.3 | 5.8 |
| 400 | 24,000 | | | | | | | | | 39.3 | 7.2 |
| 450 | 27,000 | | | | | | | | | 44.0 | 9.2 |
| 500 | 30,000 | | | | | | | | | | 11.1 |
| 750 | 45,000 | | | | | | | | | | 23.1 |
| 1000 | 60,000 | | | | | | | | | | 37.0 |

RUBBER HOSE: FRICTION LOSS (IN FEET OF HEAD) PER 100 FT.

| GPM | Actual Inside Diameter in Inches | | | | | | | |
|-----|----------------------------------|-----|--------|--------|------|--------|------|-----|
| | 3/4" | 1" | 1 1/4" | 1 1/2" | 2" | 2 1/2" | 3" | 4" |
| 15 | 70 | 23 | 5.8 | 2.5 | .9 | .2 | | |
| 20 | 122 | 32 | 10 | 4.2 | 1.6 | .5 | | |
| 25 | 182 | 51 | 15 | 6.7 | 2.3 | .7 | | |
| 30 | 259 | 72 | 21.2 | 9.3 | 3.2 | .9 | .2 | |
| 40 | | 122 | 35 | 15.5 | 5.5 | 1.4 | .7 | |
| 50 | | 185 | 55 | 23 | 8.3 | 2.3 | 1.2 | |
| 60 | | 233 | 81 | 32 | 11.8 | 3.2 | 1.4 | |
| 70 | | | 104 | 44 | 15.2 | 4.2 | 1.8 | |
| 80 | | | 134 | 55 | 19.8 | 5.3 | 2.5 | |
| 90 | | | 164 | 70 | 25 | 7 | 3.5 | .7 |
| 100 | | | 203 | 85 | 29 | 8.1 | 4 | .9 |
| 125 | | | 305 | 127 | 46 | 12.2 | 5.8 | 1.4 |
| 150 | | | 422 | 180 | 62 | 17.3 | 8.1 | 1.6 |
| 175 | | | | 230 | 85 | 23.1 | 10.6 | 2.5 |
| 200 | | | | 308 | 106 | 30 | 13.6 | 3.2 |

| GPM | Actual Inside Diameter in Inches | | | | | | | |
|------|----------------------------------|----|--------|--------|-----|--------|-----|------|
| | 3/4" | 1" | 1 1/4" | 1 1/2" | 2" | 2 1/2" | 3" | 4" |
| 250 | | | | | 162 | 44 | 21 | 4.9 |
| 300 | | | | | 219 | 62 | 28 | 6.7 |
| 350 | | | | | 292 | 83 | 39 | 9.3 |
| 400 | | | | | | 106 | 49 | 11.8 |
| 500 | | | | | | 163 | 74 | 17.1 |
| 600 | | | | | | 242 | 106 | 23 |
| 700 | | | | | | 344 | 143 | 30 |
| 800 | | | | | | 440 | 182 | 40 |
| 900 | | | | | | | 224 | 51 |
| 1000 | | | | | | | 270 | 63 |
| 1250 | | | | | | | 394 | 100 |
| 1500 | | | | | | | 525 | 141 |
| 1750 | | | | | | | | 185 |
| 2000 | | | | | | | | 230 |



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GOULDS PUMPS Residential Water Systems

Friction Loss

EQUIVALENT NUMBER OF FEET STRAIGHT PIPE FOR DIFFERENT FITTINGS

| Size of fittings, Inches | ½" | ¾" | 1" | 1¼" | 1½" | 2" | 2½" | 3" | 4" | 5" | 6" | 8" | 10" |
|---|------|------|------|------|------|------|------|------|-------|-------|-------|-------|-----|
| 90° Ell | 1.5 | 2.0 | 2.7 | 3.5 | 4.3 | 5.5 | 6.5 | 8.0 | 10.0 | 14.0 | 15 | 20 | 25 |
| 45° Ell | 0.8 | 1.0 | 1.3 | 1.7 | 2.0 | 2.5 | 3.0 | 3.8 | 5.0 | 6.3 | 7.1 | 9.4 | 12 |
| Long Sweep Ell | 1.0 | 1.4 | 1.7 | 2.3 | 2.7 | 3.5 | 4.2 | 5.2 | 7.0 | 9.0 | 11.0 | 14.0 | |
| Close Return Bend | 3.6 | 5.0 | 6.0 | 8.3 | 10.0 | 13.0 | 15.0 | 18.0 | 24.0 | 31.0 | 37.0 | 39.0 | |
| Tee-Straight Run | 1 | 2 | 2 | 3 | 3 | 4 | 5 | | | | | | |
| Tee-Side Inlet or Outlet or Pitless Adapter | 3.3 | 4.5 | 5.7 | 7.6 | 9.0 | 12.0 | 14.0 | 17.0 | 22.0 | 27.0 | 31.0 | 40.0 | |
| ① Ball or Globe Valve Open | 17.0 | 22.0 | 27.0 | 36.0 | 43.0 | 55.0 | 67.0 | 82.0 | 110.0 | 140.0 | 160.0 | 220.0 | |
| ① Angle Valve Open | 8.4 | 12.0 | 15.0 | 18.0 | 22.0 | 28.0 | 33.0 | 42.0 | 58.0 | 70.0 | 83.0 | 110.0 | |
| Gate Valve-Fully Open | 0.4 | 0.5 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | 1.7 | 2.3 | 2.9 | 3.5 | 4.5 | |
| Check Valve (Swing) | 4 | 5 | 7 | 9 | 11 | 13 | 16 | 20 | 26 | 33 | 39 | 52 | 65 |
| In Line Check Valve (Spring) or Foot Valve | 4 | 6 | 8 | 12 | 14 | 19 | 23 | 32 | 43 | 58 | | | |

① There are many new, full port valve designs available today which are more efficient and create much less friction loss, consult with valve suppliers for new data.

Example:

(A) 100 ft. of 2" plastic pipe with one (1) 90° elbow and one (1) swing check valve.

90° elbow – equivalent to 5.5 ft. of straight pipe
 Swing check – equivalent to 13.0 ft. of straight pipe
 100 ft. of pipe – equivalent to 100 ft. of straight pipe
 118.5 ft. = Total equivalent pipe

Figure friction loss for 118.5 ft. of pipe.

(B) Assume flow to be 80 GPM through 2" plastic pipe.

- Friction loss table shows 11.43 ft. loss per 100 ft. of pipe.
- In step (A) above we have determined total ft. of pipe to be 118.5 ft.
- Convert 118.5 ft. to percentage $118.5 \div 100 = 1.185$
- Multiply $11.43 \times 1.185 = 13.54455$ or 13.5 ft. = Total friction loss in this system.

OFFSET JET PUMP PIPE FRICTION

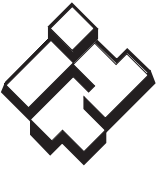
Where the jet pump is offset horizontally from the well site, add the following distances to the vertical lift to approximate capacity to be received.

PIPE FRICTION FOR OFFSET JET PUMPS

Friction Loss in Feet Per 100 Feet Offset

| JET SIZE HP | SUCTION AND PRESSURE PIPE SIZES (in inches) | | | | | | | | | |
|----------------|---|---------|---------|---------|--------|-------|--------|---------|--------|-------|
| | 1¼ x 1 | 1¼ x 1¼ | 1½ x 1¼ | 1½ x 1½ | 2 x 1½ | 2 x 2 | 2½ x 2 | 2½ x 2½ | 3 x 2½ | 3 x 3 |
| ½ | 12 | 8 | 6 | 4 | | | | | | |
| ¾ | | 22 | 16 | 11 | 6 | 4 | | | | |
| 1 | | | 25 | 16 | 9 | 6 | | | | |
| 1½ | | | | | 13 | 8 | 5 | 3 | | |
| 2 | | | | | 20 | 13 | 7 | 5 | | |
| 3 | | | | | | | 13 | 9 | 6 | 4 |

NOTE: Friction loss is to be added to vertical lift.



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GOULDS PUMPS
Residential Water Systems

WEBSITE ADDRESSES FOR PIPE MANUFACTURERS, CHECK VALVE INFORMATION AND ITT PUMP COMPANIES

Pipe and Plastic Well Casing Manufacturer's websites:

www.shur-align.com or www.modernproducts.net

- Drop pipe - many types

www.certainteed.com

- Kwik-set® threaded drop pipe in Sch 80 & 120,
- Solvent weld pressure pipe in Sch 40 & 80, class 160 (SDR26), class 200 (SDR 21) and class 315 (SDR 13.5)
- PVC sewer & drain pipe

www.pweaglepipe.com

- PW Eagle PVC Pipe - many types

Check Valve Manufacturer's websites:

www.flomatic.com

- Danfoss Flomatic Valves

www.simmonsmfg.com

- Simmons Mfg.

ITT Corporation:

www.goulds.com

- Goulds Pumps Water and Wastewater Products

www.centripro.com

- CentriPro Accessories, Motors & Control Boxes and Wastewater Panels



ITT

GOULDS PUMPS Residential Water Systems

Jet and Submersible Pump Selection

PRIVATE RESIDENCES

| Outlets | Flow Rate GPM | Total Usage Gallons | Bathrooms in Home | | | |
|---|---------------|---------------------|-------------------|------------------|------------------|-------------------|
| | | | 1 | 1½ | 2-2 ½ | 3-4 |
| Shower or Bathtub | 5 | 35 | 35 | 35 | 53 | 70 |
| Lavatory | 4 | 2 | 2 | 4 | 6 | 8 |
| Toilet | 4 | 5 | 5 | 10 | 15 | 20 |
| Kitchen Sink | 5 | 3 | 3 | 3 | 3 | 3 |
| Automatic Washer | 5 | 35 | — | 18 | 18 | 18 |
| Dishwasher | 2 | 14 | — | — | 3 | 3 |
| Normal seven minute* peak demand (gallons) | | | 45 | 70 | 98 | 122 |
| Minimum sized pump required to meet peak demand without supplemental supply | | | 7 GPM (420 GPH) | 10 GPM (600 GPH) | 14 GPM (840 GPH) | 17 GPM (1020 GPH) |

Notes:

Values given are average and do not include higher or lower extremes.

* Peak demand can occur several times during morning and evening hours.

** Count the number of fixtures in a home including outside hose bibs. Supply one gallon per minute each.

YARD FIXTURES

| | |
|------------------|---------|
| Garden Hose — ½" | 3 GPM |
| Garden Hose — ¾" | 6 GPM |
| Sprinkler— Lawn | 3-7 GPM |

FARM USE

| | |
|--------------|--------------------|
| Horse, Steer | 12 Gallons per day |
| Dry Cow | 15 Gallons per day |
| Milking Cow | 35 Gallons per day |
| Hog | 4 Gallons per day |
| Sheep | 2 Gallons per day |
| Chickens/100 | 6 Gallons per day |
| Turkeys/100 | 20 Gallons per day |
| Fire | 20-60 GPM |

PUBLIC BUILDINGS

| Pump Capacity Required in U.S. Gallons per Minute per fixture for Public Buildings | | | | | | | |
|--|--------------------------|-------|--------|---------|---------|---------|----------|
| Type of Building | Total Number of Fixtures | | | | | | |
| | 25 or Less | 26-50 | 51-100 | 101-200 | 201-400 | 401-600 | Over 600 |
| Hospitals | 1.00 | 1.00 | .80 | .60 | .50 | .45 | .40 |
| Mercantile Buildings | 1.30 | 1.00 | .80 | .71 | .60 | .54 | .48 |
| Office Buildings | 1.20 | .90 | .72 | .65 | .50 | .40 | .35 |
| Schools | 1.20 | .85 | .65 | .60 | .55 | .45 | .35 |
| Hotels, Motels | .80 | .60 | .55 | .45 | .40 | .35 | .33 |
| Apartment Buildings | .60 | .50 | .37 | .30 | .28 | .25 | .24 |

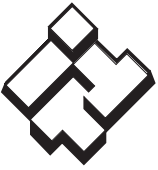
- For less than 25 fixtures, pump capacity should not be less than 75% of capacity required for 25 fixtures.
- Where additional water is required for some special process, this should be added to pump capacity.
- Where laundries or swimming pools are to be supplied, add approximately 10% to pump capacity for either.
- Where the majority of occupants are women, add approximately 20% to pump capacity.

BOILER FEED REQUIREMENTS

| Boiler | | Boiler | | Boiler | | Boiler | | Boiler | |
|--------|------|--------|------|--------|------|--------|------|--------|------|
| HP | GPM | HP | GPM | HP | GPM | HP | GPM | HP | GPM |
| 20 | 1.38 | 55 | 3.80 | 90 | 6.21 | 160 | 11.1 | 275 | 19.0 |
| 25 | 1.73 | 60 | 4.14 | 100 | 6.90 | 170 | 11.7 | 300 | 20.7 |
| 30 | 2.07 | 65 | 4.49 | 110 | 7.59 | 180 | 12.4 | 325 | 22.5 |
| 35 | 2.42 | 70 | 4.83 | 120 | 8.29 | 190 | 13.1 | 350 | 24.2 |
| 40 | 2.76 | 75 | 5.18 | 130 | 8.97 | 200 | 13.8 | 400 | 27.6 |
| 45 | 3.11 | 80 | 5.52 | 140 | 9.66 | 225 | 15.5 | 450 | 31.1 |
| 50 | 3.45 | 85 | 5.87 | 150 | 10.4 | 250 | 17.3 | 500 | 34.5 |

- Boiler Horsepower equals 34.5 lb. water evaporated at and from 212°F, and requires feed water at a rate of 0.069 gpm.

Select the boiler feed pump with a capacity of 2 to 3 times greater than the figures given above at a pressure 20 to 25% above that of boiler, because the table gives equivalents of boiler horsepower without reference to fluctuating demands.



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GOULDS PUMPS Residential Water Systems

HydroPro and CentriPro Tank Selection

TABLE 1 – TANK MODELS – See your Full Line Catalog Tank Bulletins for a listing of all available models.

| Model No. | Total Volume (Gals.) | ① Drawdown in Gals. at System Operating Pressure Range of | | | Max. Drawdown Vol. (Gals.) |
|-----------|----------------------|---|------------|------------|----------------------------|
| | | 18/40 PSIG | 28/50 PSIG | 38/60 PSIG | |
| V6P | 2.0 | 0.8 | 0.7 | 0.6 | 1.2 |
| V15P | 4.5 | 1.8 | 1.5 | 1.3 | 2.7 |
| V25P | 8.2 | 3.3 | 2.8 | 2.4 | 4.5 |
| V45P | 13.9 | 5.6 | 4.7 | 4.1 | 8.4 |
| V45B | 13.9 | 5.6 | 4.7 | 4.1 | 8.4 |
| V45 | 13.9 | 5.6 | 4.7 | 4.1 | 8.4 |
| V60B | 19.9 | 8.0 | 6.8 | 5.8 | 12.1 |
| V60 | 19.9 | 8.0 | 6.8 | 5.8 | 12.1 |
| V80 | 25.9 | 10.4 | 8.8 | 7.6 | 13.9 |
| V80EX | 25.9 | 10.4 | 8.8 | 7.6 | 13.9 |
| V100 | 31.8 | 12.8 | 10.8 | 9.4 | 13.8 |
| V100S | 31.8 | 12.8 | 10.8 | 9.4 | 13.8 |
| V140B | 45.2 | 18.2 | 15.4 | 13.3 | 27.3 |
| V140 | 45.2 | 18.2 | 15.4 | 13.3 | 27.3 |
| V200B | 65.1 | 26.2 | 22.1 | 19.2 | 39.3 |
| V200 | 65.1 | 26.2 | 22.1 | 19.2 | 39.3 |
| V250 | 83.5 | 33.6 | 28.4 | 25.6 | 50.8 |
| V260 | 84.9 | 34.1 | 28.9 | 25.0 | 44.7 |
| V350 | 115.9 | 46.6 | 39.4 | 34.1 | 70.5 |

Tank Drawdown Pressure Factors Using an "Extra" 2 PSI of Drawdown

| Pressure Differential | Factor with extra 2 psi* |
|-----------------------|--------------------------|
| 18 – 40 | .402 |
| 28 – 50 | .340 |
| 38 – 60 | .295 |
| 48 – 70 | .260 |

To Calculate drawdown capacity multiply: Factor x Tank Volume.

① Drawdown based on a 22 psi differential and Boyle's Law. Temperature, elevation and pressure can all affect drawdown volume.

TABLE 2 – PRESSURE FACTORS

| | | Pump Cut-In Pressure – PSIG | | | | | | | | | | | | | | | | | | | |
|------------------------------|-----|-----------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| | | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 100 | 105 | 110 | 115 |
| Pump Cut-Out Pressure – PSIG | 30 | .22 | | | | | | | | | | | | | | | | | | | |
| | 35 | .30 | .20 | | | | | | | | | | | | | | | | | | |
| | 40 | .37 | .27 | .18 | | | | | | | | | | | | | | | | | |
| | 45 | .42 | .34 | .25 | .17 | | | | | | | | | | | | | | | | |
| | 50 | .46 | .39 | .31 | .23 | .15 | | | | | | | | | | | | | | | |
| | 55 | .50 | .43 | .36 | .29 | .22 | .14 | | | | | | | | | | | | | | |
| | 60 | .54 | .47 | .40 | .33 | .27 | .20 | .13 | | | | | | | | | | | | | |
| | 65 | | .50 | .44 | .38 | .31 | .25 | .19 | .13 | | | | | | | | | | | | |
| | 70 | | .53 | .47 | .41 | .35 | .30 | .24 | .18 | .12 | | | | | | | | | | | |
| | 75 | | | .50 | .45 | .39 | .33 | .28 | .22 | .17 | .11 | | | | | | | | | | |
| | 80 | | | .53 | .48 | .42 | .37 | .32 | .26 | .21 | .16 | .11 | | | | | | | | | |
| | 85 | | | | .50 | .45 | .40 | .35 | .30 | .25 | .20 | .15 | .10 | | | | | | | | |
| | 90 | | | | .53 | .48 | .43 | .38 | .33 | .29 | .24 | .19 | .14 | .10 | | | | | | | |
| | 95 | | | | | .50 | .46 | .41 | .36 | .32 | .27 | .23 | .18 | .14 | .09 | | | | | | |
| | 100 | | | | | .52 | .48 | .44 | .39 | .35 | .31 | .26 | .22 | .17 | .13 | .09 | | | | | |
| | 105 | | | | | | .50 | .46 | .42 | .38 | .33 | .29 | .25 | .21 | .17 | .13 | .08 | | | | |
| 110 | | | | | | .52 | .46 | .44 | .40 | .36 | .32 | .28 | .24 | .20 | .16 | .12 | | | | | |
| 115 | | | | | | | .50 | .46 | .42 | .39 | .35 | .31 | .27 | .23 | .19 | .15 | .12 | .06 | | | |
| 120 | | | | | | | .52 | .48 | .45 | .41 | .37 | .33 | .30 | .26 | .22 | .19 | .15 | .11 | | | |
| 125 | | | | | | | | .50 | .47 | .43 | .39 | .36 | .32 | .29 | .25 | .21 | .16 | .14 | .11 | .07 | |

To determine tank drawdown of operating pressure ranges other than those listed in table, use following procedure:

Multiply total tank volume (table 1) by pressure factor (table 4).

Example: Operating range: 35/55

Tank being used: V-200

65.1 = Total volume of tank (table 1)

x .29 = Pressure factor (table 4)

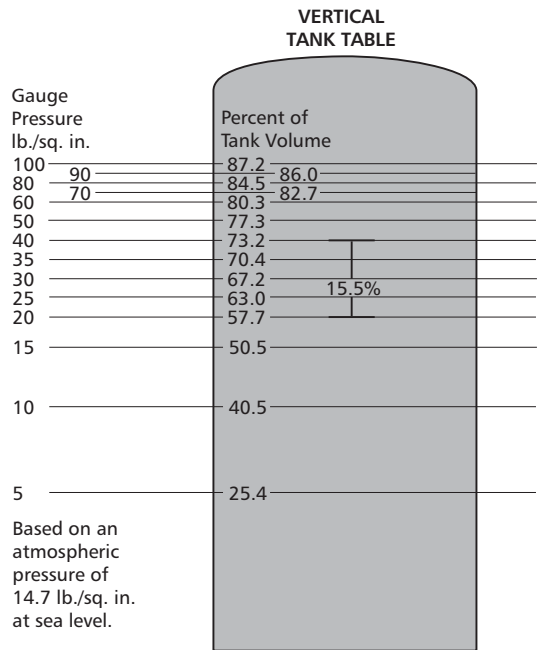
18.9 = Drawdown in gallons at 35/55 PSI operating range.



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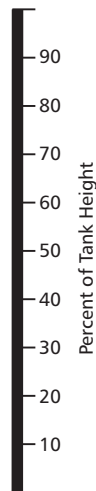
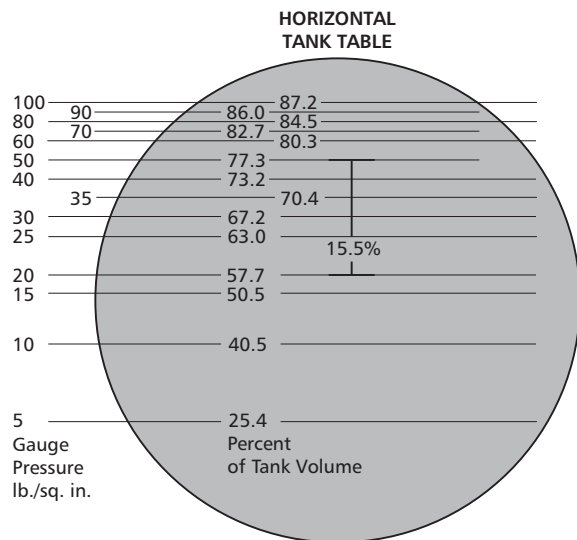
GOULDS PUMPS Residential Water Systems

Tank Selection



When using large standard galvanized tanks, a constant air cushion is required for proper operation of the water system. The illustrations show the percent of tank volume as related to the pressure gauge reading. To determine the amount of water you will receive as drawoff from the tank, you should subtract the smaller number from the larger number to get the percentage. Then multiply by the size of the tank to get the gallons drawoff.

Example:

$$\begin{aligned}
 &50 \text{ lbs.} = 77.3 \\
 &\text{minus } 30 \text{ lbs.} = 67.2 \\
 &\quad = 10.1\% \\
 &\quad \times 120 \text{ gallon size} \\
 &\quad \quad \text{(size of tank)} \\
 &\quad = 12.12 \text{ gallons} \\
 &\quad \quad \text{drawoff}
 \end{aligned}$$




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GOULDS PUMPS
Residential Water Systems

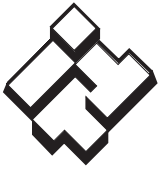
Tank Selection

CAPACITIES OF TANKS OF VARIOUS DIMENSIONS

| Dia. in inches | Length of Cylinder | | | | | | | | | | | | | | | | | | |
|-------------------|--------------------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------|--------|--------|
| | 1" | 1' | 5' | 6' | 7' | 8' | 9' | 10' | 11' | 12' | 13' | 14' | 15' | 16' | 17' | 18' | 20' | 22' | 24' |
| 1 | | 0.04 | 0.20 | 0.24 | 0.28 | 0.32 | 0.36 | 0.40 | 0.44 | 0.48 | 0.52 | 0.56 | 0.60 | 0.64 | 0.68 | 0.72 | 0.80 | 0.88 | 0.96 |
| 2 | 0.01 | 0.16 | 0.80 | 0.96 | 1.12 | 1.28 | 1.44 | 1.60 | 1.76 | 1.92 | 2.08 | 2.24 | 2.40 | 2.56 | 2.72 | 2.88 | 3.20 | 3.52 | 3.84 |
| 3 | 0.03 | 0.37 | 1.84 | 2.20 | 2.56 | 2.92 | 3.30 | 3.68 | 4.04 | 4.40 | 4.76 | 5.12 | 5.48 | 5.84 | 6.22 | 6.60 | 7.36 | 8.08 | 8.80 |
| 4 | 0.05 | 0.65 | 3.26 | 3.92 | 4.58 | 5.24 | 5.88 | 6.52 | 7.18 | 7.84 | 8.50 | 9.16 | 9.82 | 10.5 | 11.1 | 11.8 | 13.0 | 14.4 | 15.7 |
| 5 | 0.08 | 1.02 | 5.10 | 6.12 | 7.14 | 8.16 | 9.18 | 10.2 | 11.2 | 12.2 | 13.3 | 14.3 | 15.3 | 16.3 | 17.3 | 18.4 | 20.4 | 22.4 | 24.4 |
| 6 | 0.12 | 1.47 | 7.34 | 8.80 | 10.3 | 11.8 | 13.2 | 14.7 | 16.1 | 17.6 | 19.1 | 20.6 | 22.0 | 23.6 | 25.0 | 26.4 | 29.4 | 32.2 | 35.2 |
| 7 | 0.17 | 2.00 | 10.0 | 12.0 | 14.0 | 16.0 | 18.0 | 20.0 | 22.0 | 24.0 | 26.0 | 28.0 | 30.0 | 32.0 | 34.0 | 36.0 | 40.0 | 44.0 | 48.0 |
| 8 | 0.22 | 2.61 | 13.0 | 15.6 | 18.2 | 20.8 | 23.4 | 26.0 | 28.6 | 31.2 | 33.8 | 36.4 | 39.0 | 41.6 | 44.2 | 46.8 | 52.0 | 57.2 | 62.4 |
| 9 | 0.28 | 3.31 | 16.5 | 19.8 | 23.1 | 26.4 | 29.8 | 33.0 | 36.4 | 39.6 | 43.0 | 46.2 | 49.6 | 52.8 | 56.2 | 60.0 | 66.0 | 72.4 | 79.2 |
| 10 | 0.34 | 4.08 | 20.4 | 24.4 | 28.4 | 32.6 | 36.8 | 40.8 | 44.8 | 48.8 | 52.8 | 56.8 | 61.0 | 65.2 | 69.4 | 73.6 | 81.6 | 89.6 | 97.6 |
| 11 | 0.41 | 4.94 | 24.6 | 29.6 | 34.6 | 39.4 | 44.4 | 49.2 | 54.2 | 59.2 | 64.2 | 69.2 | 74.0 | 78.8 | 83.8 | 88.8 | 98.4 | 104.0 | 118.0 |
| 12 | 0.49 | 5.88 | 29.4 | 35.2 | 41.0 | 46.8 | 52.8 | 58.8 | 64.6 | 70.4 | 76.2 | 82.0 | 87.8 | 93.6 | 99.6 | 106.0 | 118.0 | 129.0 | 141.0 |
| 13 | 0.57 | 6.90 | 34.6 | 41.6 | 48.6 | 55.2 | 62.2 | 69.2 | 76.2 | 83.2 | 90.2 | 97.2 | 104.0 | 110.0 | 117.0 | 124.0 | 138.0 | 152.0 | 166.0 |
| 14 | 0.67 | 8.00 | 40.0 | 48.0 | 56.0 | 64.0 | 72.0 | 80.0 | 88.0 | 96.0 | 104.0 | 112.0 | 120.0 | 128.0 | 136.0 | 144.0 | 160.0 | 176.0 | 192.0 |
| 15 | 0.77 | 9.18 | 46.0 | 55.2 | 64.4 | 73.6 | 82.8 | 92.0 | 101.0 | 110.0 | 120.0 | 129.0 | 138.0 | 147.0 | 156.0 | 166.0 | 184.0 | 202.0 | 220.0 |
| 16 | 0.87 | 10.4 | 52.0 | 62.4 | 72.8 | 83.2 | 93.6 | 104.0 | 114.0 | 125.0 | 135.0 | 146.0 | 156.0 | 166.0 | 177.0 | 187.0 | 208.0 | 229.0 | 250.0 |
| 17 | 0.98 | 11.8 | 59.0 | 70.8 | 81.6 | 94.4 | 106.0 | 118.0 | 130.0 | 142.0 | 153.0 | 163.0 | 177.0 | 189.0 | 201.0 | 212.0 | 236.0 | 260.0 | 283.0 |
| 18 | 1.10 | 13.2 | 66.0 | 79.2 | 92.4 | 106.0 | 119.0 | 132.0 | 145.0 | 158.0 | 172.0 | 185.0 | 198.0 | 211.0 | 224.0 | 240.0 | 264.0 | 290.0 | 317.0 |
| 19 | 1.23 | 14.7 | 73.6 | 88.4 | 103.0 | 118.0 | 132.0 | 147.0 | 162.0 | 177.0 | 192.0 | 206.0 | 221.0 | 235.0 | 250.0 | 265.0 | 294.0 | 324.0 | 354.0 |
| 20 | 1.36 | 16.3 | 81.6 | 98.0 | 114.0 | 130.0 | 147.0 | 163.0 | 180.0 | 196.0 | 212.0 | 229.0 | 245.0 | 261.0 | 277.0 | 294.0 | 326.0 | 359.0 | 392.0 |
| 21 | 1.50 | 18.0 | 90.0 | 108.0 | 126.0 | 144.0 | 162.0 | 180.0 | 198.0 | 216.0 | 238.0 | 252.0 | 270.0 | 288.0 | 306.0 | 324.0 | 360.0 | 396.0 | 432.0 |
| 22 | 1.65 | 19.8 | 99.0 | 119.0 | 139.0 | 158.0 | 178.0 | 198.0 | 218.0 | 238.0 | 257.0 | 277.0 | 297.0 | 317.0 | 337.0 | 356.0 | 396.0 | 436.0 | 476.0 |
| 23 | 1.80 | 21.6 | 108.0 | 130.0 | 151.0 | 173.0 | 194.0 | 216.0 | 238.0 | 259.0 | 281.0 | 302.0 | 324.0 | 346.0 | 367.0 | 389.0 | 432.0 | 476.0 | 518.0 |
| 24 | 1.96 | 23.5 | 118.0 | 141.0 | 165.0 | 188.0 | 212.0 | 235.0 | 259.0 | 282.0 | 306.0 | 330.0 | 353.0 | 376.0 | 400.0 | 424.0 | 470.0 | 518.0 | 564.0 |
| 25 | 2.12 | 25.5 | 128.0 | 153.0 | 179.0 | 204.0 | 230.0 | 255.0 | 281.0 | 306.0 | 332.0 | 358.0 | 383.0 | 408.0 | 434.0 | 460.0 | 510.0 | 562.0 | 612.0 |
| 26 | 2.30 | 27.6 | 138.0 | 166.0 | 193.0 | 221.0 | 248.0 | 276.0 | 304.0 | 331.0 | 359.0 | 386.0 | 414.0 | 442.0 | 470.0 | 496.0 | 552.0 | 608.0 | 662.0 |
| 27 | 2.48 | 29.7 | 148.0 | 178.0 | 208.0 | 238.0 | 267.0 | 297.0 | 326.0 | 356.0 | 386.0 | 416.0 | 426.0 | 476.0 | 504.0 | 534.0 | 594.0 | 652.0 | 712.0 |
| 28 | 2.67 | 32.0 | 160.0 | 192.0 | 224.0 | 256.0 | 288.0 | 320.0 | 352.0 | 384.0 | 416.0 | 448.0 | 480.0 | 512.0 | 544.0 | 576.0 | 640.0 | 704.0 | 768.0 |
| 29 | 2.86 | 34.3 | 171.0 | 206.0 | 240.0 | 274.0 | 309.0 | 343.0 | 377.0 | 412.0 | 446.0 | 480.0 | 514.0 | 548.0 | 584.0 | 618.0 | 686.0 | 754.0 | 824.0 |
| 30 | 3.06 | 36.7 | 183.0 | 220.0 | 257.0 | 294.0 | 330.0 | 367.0 | 404.0 | 440.0 | 476.0 | 514.0 | 550.0 | 588.0 | 624.0 | 660.0 | 734.0 | 808.0 | 880.0 |
| 32 | 3.48 | 41.8 | 209.0 | 251.0 | 293.0 | 334.0 | 376.0 | 418.0 | 460.0 | 502.0 | 544.0 | 586.0 | 628.0 | 668.0 | 710.0 | 752.0 | 836.0 | 920.0 | 1004.0 |
| 34 | 3.93 | 47.2 | 236.0 | 283.0 | 330.0 | 378.0 | 424.0 | 472.0 | 520.0 | 566.0 | 614.0 | 660.0 | 708.0 | 756.0 | 802.0 | 848.0 | 944.0 | 1040.0 | 1132.0 |
| 36 | 4.41 | 52.9 | 264.0 | 317.0 | 370.0 | 422.0 | 476.0 | 528.0 | 582.0 | 634.0 | 688.0 | 740.0 | 792.0 | 844.0 | 898.0 | 952.0 | 1056.0 | 1164.0 | 1268.0 |

Capacities, in U.S. Gallons, of cylinders of various diameters and lengths.

Volume = $\frac{\pi d^2}{4} \times H$ (Cylinder), L x W x H (Cube)



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GOULDS PUMPS Residential Water Systems

Centrifugal Pump Fundamentals

NET POSITIVE SUCTION HEAD (NPSH) AND CAVITATION

The Hydraulic Institute defines NPSH as the total suction head in feet absolute, determined at the suction nozzle and corrected to datum, less the vapor pressure of the liquid in feet absolute. Simply stated, it is an analysis of energy conditions on the suction side of a pump to determine if the liquid will vaporize at the lowest pressure point in the pump.

The pressure which a liquid exerts on its surroundings is dependent upon its temperature. This pressure, called vapor pressure, is a unique characteristic of every fluid and increases with increasing temperature. When the vapor pressure within the fluid reaches the pressure of the surrounding medium, the fluid begins to vaporize or boil. The temperature at which this vaporization occurs will decrease as the pressure of the surrounding medium decreases.

A liquid increases greatly in volume when it vaporizes. One cubic foot of water at room temperature becomes 1700 cu. ft. of vapor at the same temperature.

It is obvious from the above that if we are to pump a fluid effectively, we must keep it in liquid form. NPSH is simply a measure of the amount of suction head present to prevent this vaporization at the lowest pressure point in the pump.

NPSH Required is a function of the pump design. As the liquid passes from the pump suction to the eye of the impeller, the velocity increases and the pressure decreases. There are also pressure losses due to shock and turbulence as the liquid strikes the impeller. The centrifugal force of the impeller vanes further increases the velocity and decreases the pressure of the liquid. The NPSH Required is the positive head in feet absolute required at the pump suction to overcome these pressure drops in the pump and maintain the liquid above its vapor pressure. The NPSH Required varies with speed and capacity within any particular pump. Pump manufacturer's curves normally provide this information.

NPSH Available is a function of the system in which the pump operates. It is the excess pressure of the liquid in feet absolute over its vapor pressure as it arrives at the pump suction. Fig. 4 shows four typical suction systems with the NPSH Available formulas applicable to each. It is important to correct for the specific gravity of the liquid and to convert all terms to units of "feet absolute" in using the formulas.

In an existing system, the NPSH Available can be determined by a gage reading on the pump suction. The following formula applies:

$$NPSH_A = P_B - V_p \pm Gr + h_v$$

Where Gr = Gage reading at the pump suction expressed in feet (plus if above atmospheric, minus if below atmospheric) corrected to the pump centerline.

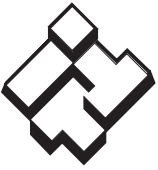
h_v = Velocity head in the suction pipe at the gage connection, expressed in feet.

Cavitation is a term used to describe the phenomenon which occurs in a pump when there is insufficient NPSH Available. The pressure of the liquid is reduced to a value equal to or below its vapor pressure and small vapor bubbles or pockets begin to form. As these vapor bubbles move along the impeller vanes to a higher pressure area, they rapidly collapse.

The collapse, or "implosion" is so rapid that it may be heard as a rumbling noise, as if you were pumping gravel. The forces during the collapse are generally high enough to cause minute pockets of fatigue failure on the impeller vane surfaces. This action may be progressive, and under severe conditions can cause serious pitting damage to the impeller.

The accompanying noise is the easiest way to recognize cavitation. Besides impeller damage, cavitation normally results in reduced capacity due to the vapor present in the pump. Also, the head may be reduced and unstable and the power consumption may be erratic. Vibration and mechanical damage such as bearing failure can also occur as a result of operating in cavitation.

The only way to prevent the undesirable effects of cavitation is to insure that the NPSH Available in the system is greater than the NPSH Required by the pump.



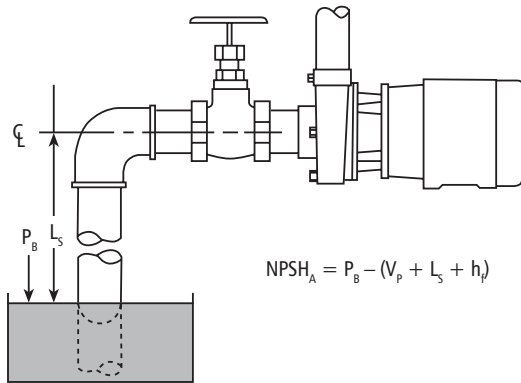
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GOULDS PUMPS Residential Water Systems

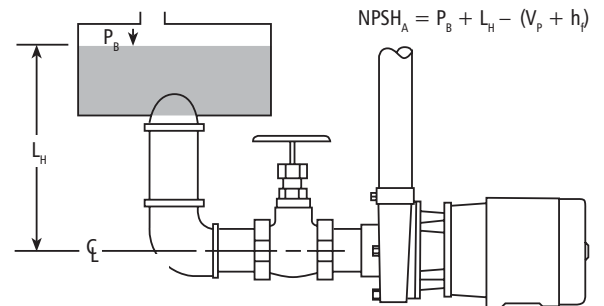
Centrifugal Pump Fundamentals

NET POSITIVE SUCTION HEAD (NPSH) AND CAVITATION

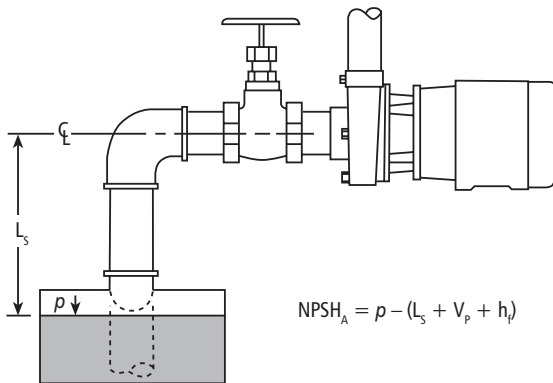
4a SUCTION SUPPLY OPEN TO ATMOSPHERE
– with Suction Lift



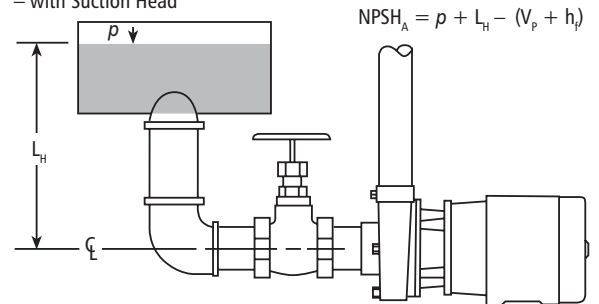
4b SUCTION SUPPLY OPEN TO ATMOSPHERE
– with Suction Head



4c CLOSED SUCTION SUPPLY
– with Suction Lift



4d CLOSED SUCTION SUPPLY
– with Suction Head



P_B = Barometric pressure, in feet absolute.

V_p = Vapor pressure of the liquid at maximum pumping temperature, in feet absolute (see next page).

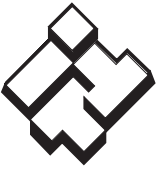
p = Pressure on surface of liquid in closed suction tank, in feet absolute.

L_s = Maximum static suction lift in feet.

L_H = Minimum static suction head in feet.

h_f = Friction loss in feet in suction pipe at required capacity.

Note: See page 23, atmospheric pressure chart.

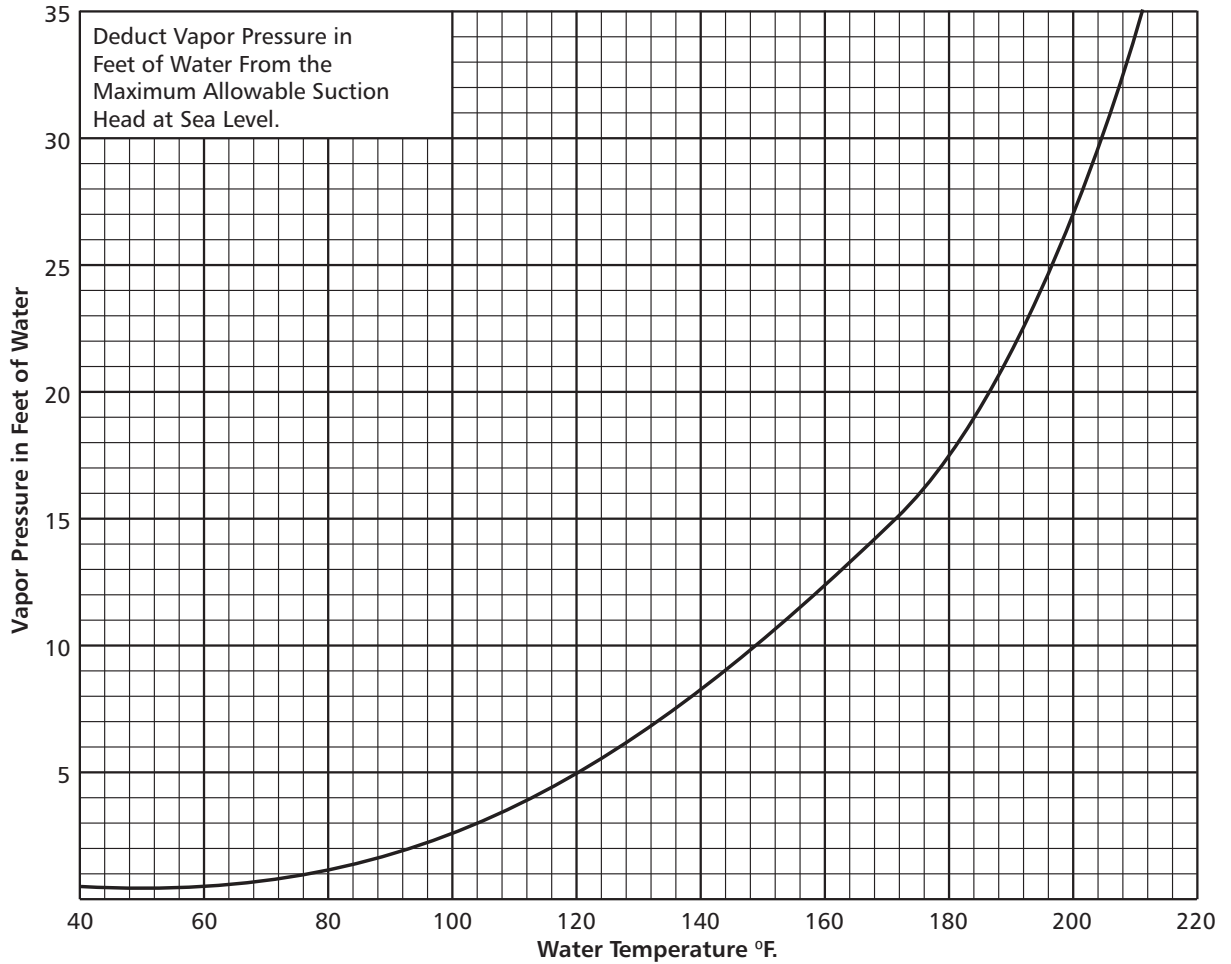


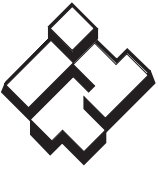
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GOULDS PUMPS
Residential Water Systems

Centrifugal Pump Fundamentals

VAPOR PRESSURE OF WATER





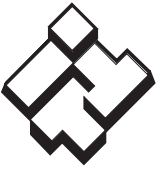
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GOULDS PUMPS Residential Water Systems

Electrical Data

NEMA CONTROL PANEL ENCLOSURES

| Enclosure Rating | Explanation |
|--|---|
| NEMA 1 General Purpose | To prevent accidental contact with enclosed apparatus. Suitable for application indoors where not exposed to unusual service conditions. |
| NEMA 2 Driptight | To prevent accidental contact, and in addition, to exclude falling moisture or dirt. |
| NEMA 3 Weatherproof (Weatherproof Resistant) | Protection against specified weather hazards. Suitable for use outdoors. |
| NEMA 3R Raintight | Protects against entrance of water from a beating rain. Suitable for general outdoor application not requiring sleetproof. |
| NEMA 4 Watertight | Designed to exclude water applied in form of hose stream. To protect against stream of water during cleaning operations, etc. |
| NEMA 4X Watertight & Corrosion Resistant | Designed to exclude water applied in form of hose stream. To protect against stream of water during cleaning operations, etc. Corrosion Resistant. |
| NEMA 5 Dusttight | Constructed so that dust will not enter enclosed case. Being replaced in some Dust Tight equipment by NEMA 12. |
| NEMA 6 Watertight, Dusttight | Intended to permit enclosed apparatus to be operated successfully when temporarily submerged in water. |
| NEMA 7 Hazardous Locations Class I | Designed to meet application requirements of National Electrical Code for Class 1, Hazardous Locations (explosive atmospheres). Circuit interruption occurs in air. |
| NEMA 8 Hazardous Locations A, B, C or D Class II – Oil Immersed | Identical to NEMA 7 above, except the apparatus is immersed in oil. |
| NEMA 9 Class II – Hazardous Locations | Designed to meet application requirements of National Electrical Code for Class II Hazardous Locations (combustible dusts, etc.). E, F and G. |
| NEMA 10 Bureau of Mines Permissible | Meets requirements of U.S. Bureau of Mines. Suitable for use in coal mines. |
| NEMA 11 Dripproof Corrosion Resistant | Provides oil immersion of apparatus such that it is suitable for application where equipment is subject to acid or other corrosive fumes. |
| NEMA 12 Driptight, Dusttight | For use in those industries where it is desired to exclude dust, lint, fibers and flyings, or oil or Industrial coolant seepage. |



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GOULDS PUMPS Residential Water Systems

Determining Water Level

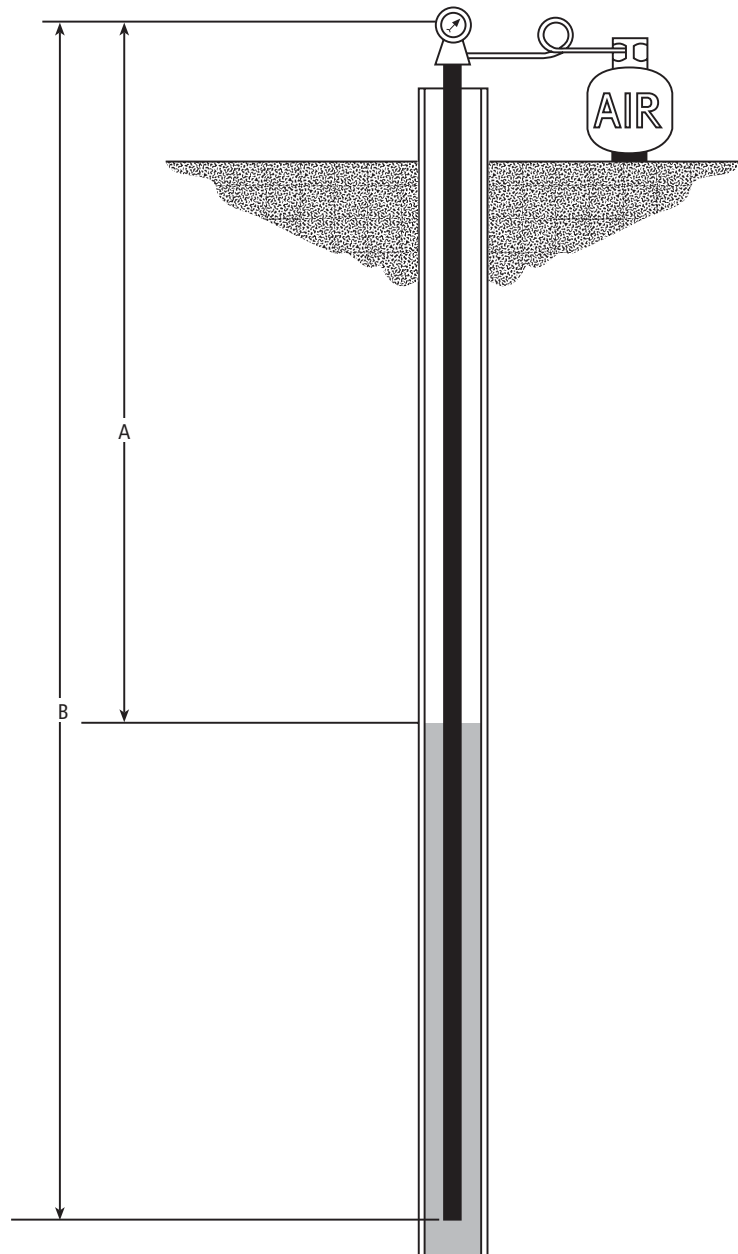
Install $\frac{1}{8}$ " or $\frac{1}{4}$ " tubing long enough to be 10' to 15' below low water level. Measure the tubing length as it is lowered into the well.

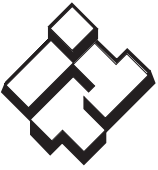
Once the tubing is fixed in a stationary position at the top, connect an air line and pressure gauge. Add air to the tubing until the pressure gauge reaches a point that it doesn't read any higher. Take a gauge reading at this point.

- A. Depth to water (to be determined).
- B. Total length of air line (in feet).
- C. Water pressure on air tubing. Gauge reads in pounds. Convert to feet by multiplying by 2.31.

Example:

If the air tube is 100' long,
and the gauge reads 20 lbs.
 $20 \text{ lbs.} \times 2.31 = 46.2 \text{ ft.}$
Length of tube = 100 ft.
minus 46.2 ft. = 53.8 ft.
Depth to water (A) would
be 53.8 ft.





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GOULDS PUMPS Residential Water Systems

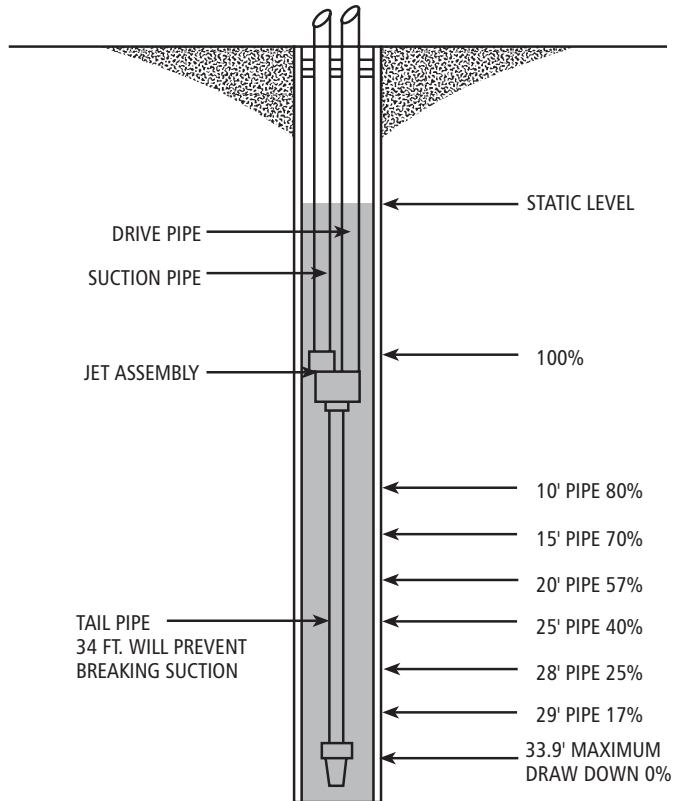
Tail Pipe

HOW TO USE TAIL PIPE ON DEEP WELL JET PUMPS

Pipe below the jet, or "tail pipe" as it is commonly known, is used when you have a weak deep well. Under normal conditions, the jet assembly with the foot valve attached is lowered into the well. You receive your rated capacity at the level you locate the jet assembly. On a weak well, as the water level lowers to the level of the foot valve (attached to the bottom of the jet assembly), air enters the system. By adding 34' of tail pipe attached to the bottom of the 34' length of pipe, it will not be possible to pull the well down and allow air to enter the system. The drawing indicates the approximate percentage of rated capacity you will receive with tail pipe.

Using a tail pipe, the pump delivery remains at 100% at sea level of the rated capacity down to the jet assembly level. If water level falls below that, flow decreases in proportion to drawdown as shown in the illustration. When pump delivery equals well inflow, the water level remains constant until the pump shuts off.

This rule can also be used when determining suction pipe length on shallow well systems.





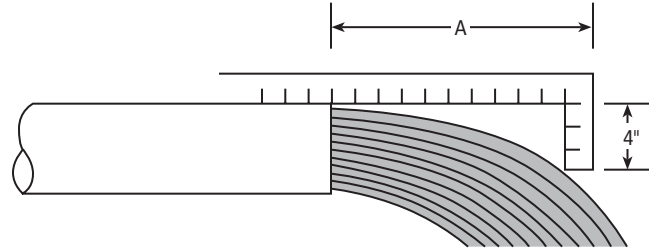
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GOULDS PUMPS Residential Water Systems

Determining Flow Rates

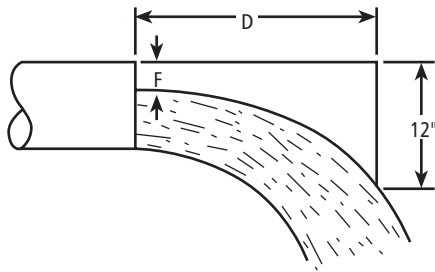
FULL PIPE FLOW – CALCULATION OF DISCHARGE RATE USING HORIZONTAL OPEN DISCHARGE FORMULA

An L-shaped measuring square can be used to estimate flow capacity, using the chart below. As shown in illustration, place 4" side of square so that it hangs down and touches the water. The horizontal distance shown "A" is located in the first column of the chart and you read across to the pipe diameter (ID) to find the gallons per minute discharge rate.



Example: A is 8" from a 4" ID pipe
= a discharge rate of 166 GPM.

PIPE NOT RUNNING FULL – CALCULATION OF DISCHARGE RATE USING AREA FACTOR METHOD



Flow From Horizontal Pipe (Not Full)

Flow (GPM) = $A \times D \times 1.093 \times F$
 A = Area of pipe in square inches
 D = Horizontal distance in inches
 F = Effective area factor from chart
 Area of pipe equals inside Dia.² x 0.7854

Example: Pipe inside diameter = 10 in.
 D = 20 in.
 F = 2½ in.
 A = 10 x 10 x 0.7854 = 78.54 square in.

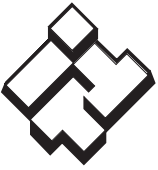
$$R\% = \frac{F}{D} = \frac{2\frac{1}{2}}{10} = 25\%$$

F = 0.805
 Flow = 78.54 x 20 x 1.039 x 0.805 = 1314 GPM

| Ratio F/D = R % | Eff. Area Factor F | Ratio F/D = R % | Eff. Area Factor F |
|--------------------|-----------------------|--------------------|-----------------------|
| 5 | 0.981 | 55 | 0.436 |
| 10 | 0.948 | 60 | 0.373 |
| 15 | 0.905 | 65 | 0.312 |
| 20 | 0.858 | 70 | 0.253 |
| 25 | 0.805 | 75 | 0.195 |
| 30 | 0.747 | 80 | 0.142 |
| 35 | 0.688 | 85 | 0.095 |
| 40 | 0.627 | 90 | 0.052 |
| 45 | 0.564 | 95 | 0.019 |
| 50 | 0.500 | 100 | 0.000 |

DISCHARGE RATE IN GALLONS PER MINUTE/NOMINAL PIPE SIZE (ID)

| Horizontal Dist. (A) Inches | Pipe Diameter | | | | | | | | | | | |
|-----------------------------------|---------------|------|------|------|------|------|------|-----|------|------|------|------|
| | 1" | 1¼" | 1½" | 2" | 2½" | 3" | 4" | 5" | 6" | 8" | 10" | 12" |
| 4 | 5.7 | 9.8 | 13.3 | 22.0 | 31.3 | 48.5 | 83.5 | | | | | |
| 5 | 7.1 | 12.2 | 16.6 | 27.5 | 39.0 | 61.0 | 104 | 163 | | | | |
| 6 | 8.5 | 14.7 | 20.0 | 33.0 | 47.0 | 73.0 | 125 | 195 | 285 | | | |
| 7 | 10.0 | 17.1 | 23.2 | 38.5 | 55.0 | 85.0 | 146 | 228 | 334 | 380 | | |
| 8 | 11.3 | 19.6 | 26.5 | 44.0 | 62.5 | 97.5 | 166 | 260 | 380 | 665 | 1060 | |
| 9 | 12.8 | 22.0 | 29.8 | 49.5 | 70.0 | 110 | 187 | 293 | 430 | 750 | 1190 | 1660 |
| 10 | 14.2 | 24.5 | 33.2 | 55.5 | 78.2 | 122 | 208 | 326 | 476 | 830 | 1330 | 1850 |
| 11 | 15.6 | 27.0 | 36.5 | 60.5 | 86.0 | 134 | 229 | 360 | 525 | 915 | 1460 | 2100 |
| 12 | 17.0 | 29.0 | 40.0 | 66.0 | 94.0 | 146 | 250 | 390 | 570 | 1000 | 1600 | 2220 |
| 13 | 18.5 | 31.5 | 43.0 | 71.5 | 102 | 158 | 270 | 425 | 620 | 1080 | 1730 | 2400 |
| 14 | 20.0 | 34.0 | 46.5 | 77.0 | 109 | 170 | 292 | 456 | 670 | 1160 | 1860 | 2590 |
| 15 | 21.3 | 36.3 | 50.0 | 82.5 | 117 | 183 | 312 | 490 | 710 | 1250 | 2000 | 2780 |
| 16 | 22.7 | 39.0 | 53.0 | 88.0 | 125 | 196 | 334 | 520 | 760 | 1330 | 2120 | 2960 |
| 17 | | 41.5 | 56.5 | 93.0 | 133 | 207 | 355 | 550 | 810 | 1410 | 2260 | 3140 |
| 18 | | | 60.0 | 99.0 | 144 | 220 | 375 | 590 | 860 | 1500 | 2390 | 3330 |
| 19 | | | | 110 | 148 | 232 | 395 | 620 | 910 | 1580 | 2520 | 3500 |
| 20 | | | | | 156 | 244 | 415 | 650 | 950 | 1660 | 2660 | 3700 |
| 21 | | | | | | 256 | 435 | 685 | 1000 | 1750 | 2800 | |
| 22 | | | | | | | 460 | 720 | 1050 | 1830 | 2920 | |
| 23 | | | | | | | | 750 | 1100 | 1910 | 3060 | |
| 24 | | | | | | | | | 1140 | 2000 | 3200 | |



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GOULDS PUMPS Residential Water Systems

Determining Flow Rates

THEORETICAL DISCHARGE OF NOZZLES IN U.S. GALLONS PER MINUTE

| Head | | Velocity of Discharge Feet Per Second | Diameter of Nozzle in Inches | | | | | | | | | |
|--------|-------|---------------------------------------|------------------------------|------|------|------|------|------|------|------|------|--|
| Pounds | Feet | | 1/16 | 1/8 | 3/16 | 1/4 | 3/8 | 1/2 | 5/8 | 3/4 | 7/8 | |
| 10 | 23.1 | 38.6 | 0.37 | 1.48 | 3.32 | 5.91 | 13.3 | 23.6 | 36.9 | 53.1 | 72.4 | |
| 15 | 34.6 | 47.25 | 0.45 | 1.81 | 4.06 | 7.24 | 16.3 | 28.9 | 45.2 | 65.0 | 88.5 | |
| 20 | 46.2 | 54.55 | 0.52 | 2.09 | 4.69 | 8.35 | 18.8 | 33.4 | 52.2 | 75.1 | 102 | |
| 25 | 57.7 | 61.0 | 0.58 | 2.34 | 5.25 | 9.34 | 21.0 | 37.3 | 58.3 | 84.0 | 114 | |
| 30 | 69.3 | 66.85 | 0.64 | 2.56 | 5.75 | 10.2 | 23.0 | 40.9 | 63.9 | 92.0 | 125 | |
| 35 | 80.8 | 72.2 | 0.69 | 2.77 | 6.21 | 11.1 | 24.8 | 44.2 | 69.0 | 99.5 | 135 | |
| 40 | 92.4 | 77.2 | 0.74 | 2.96 | 6.64 | 11.8 | 26.6 | 47.3 | 73.8 | 106 | 145 | |
| 45 | 103.9 | 81.8 | 0.78 | 3.13 | 7.03 | 12.5 | 28.2 | 50.1 | 78.2 | 113 | 153 | |
| 50 | 115.5 | 86.25 | 0.83 | 3.30 | 7.41 | 13.2 | 29.7 | 52.8 | 82.5 | 119 | 162 | |
| 55 | 127.0 | 90.4 | 0.87 | 3.46 | 7.77 | 13.8 | 31.1 | 55.3 | 86.4 | 125 | 169 | |
| 60 | 138.6 | 94.5 | 0.90 | 3.62 | 8.12 | 14.5 | 32.5 | 57.8 | 90.4 | 130 | 177 | |
| 65 | 150.1 | 98.3 | 0.94 | 3.77 | 8.45 | 15.1 | 33.8 | 60.2 | 94.0 | 136 | 184 | |
| 70 | 161.7 | 102.1 | 0.98 | 3.91 | 8.78 | 15.7 | 35.2 | 62.5 | 97.7 | 141 | 191 | |
| 75 | 173.2 | 105.7 | 1.01 | 4.05 | 9.08 | 16.2 | 36.4 | 64.7 | 101 | 146 | 198 | |
| 80 | 184.8 | 109.1 | 1.05 | 4.18 | 9.39 | 16.7 | 37.6 | 66.8 | 104 | 150 | 205 | |
| 85 | 196.3 | 112.5 | 1.08 | 4.31 | 9.67 | 17.3 | 38.8 | 68.9 | 108 | 155 | 211 | |
| 90 | 207.9 | 115.8 | 1.11 | 4.43 | 9.95 | 17.7 | 39.9 | 70.8 | 111 | 160 | 217 | |
| 95 | 219.4 | 119.0 | 1.14 | 4.56 | 10.2 | 18.2 | 41.0 | 72.8 | 114 | 164 | 223 | |
| 100 | 230.9 | 122.0 | 1.17 | 4.67 | 10.5 | 18.7 | 42.1 | 74.7 | 117 | 168 | 229 | |
| 105 | 242.4 | 125.0 | 1.20 | 4.79 | 10.8 | 19.2 | 43.1 | 76.5 | 120 | 172 | 234 | |
| 110 | 254.0 | 128.0 | 1.23 | 4.90 | 11.0 | 19.6 | 44.1 | 78.4 | 122 | 176 | 240 | |
| 115 | 265.5 | 130.9 | 1.25 | 5.01 | 11.2 | 20.0 | 45.1 | 80.1 | 125 | 180 | 245 | |
| 120 | 277.1 | 133.7 | 1.28 | 5.12 | 11.5 | 20.5 | 46.0 | 81.8 | 128 | 184 | 251 | |
| 125 | 288.6 | 136.4 | 1.31 | 5.22 | 11.7 | 20.9 | 47.0 | 83.5 | 130 | 188 | 256 | |
| 130 | 300.2 | 139.1 | 1.33 | 5.33 | 12.0 | 21.3 | 48.0 | 85.2 | 133 | 192 | 261 | |
| 135 | 311.7 | 141.8 | 1.36 | 5.43 | 12.2 | 21.7 | 48.9 | 86.7 | 136 | 195 | 266 | |
| 140 | 323.3 | 144.3 | 1.38 | 5.53 | 12.4 | 22.1 | 49.8 | 88.4 | 138 | 199 | 271 | |
| 145 | 334.8 | 146.9 | 1.41 | 5.62 | 12.6 | 22.5 | 50.6 | 89.9 | 140 | 202 | 275 | |
| 150 | 346.4 | 149.5 | 1.43 | 5.72 | 12.9 | 22.9 | 51.5 | 91.5 | 143 | 206 | 280 | |
| 175 | 404.1 | 161.4 | 1.55 | 6.18 | 13.9 | 24.7 | 55.6 | 98.8 | 154 | 222 | 302 | |
| 200 | 461.9 | 172.6 | 1.65 | 6.61 | 14.8 | 26.4 | 59.5 | 106 | 165 | 238 | 323 | |

Note:

The actual quantities will vary from these figures, the amount of variation depending upon the shape of nozzle and size of pipe at the point where the pressure is determined. With smooth taper nozzles the actual discharge is about 94 percent of the figures given in the tables.



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GOULDS PUMPS Residential Water Systems

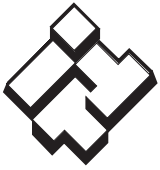
Determining Flow Rates

THEORETICAL DISCHARGE OF NOZZLES IN U.S. GALLONS PER MINUTE (continued)

| Head | | Velocity of Discharge Feet Per Second | Diameter of Nozzle in Inches | | | | | | | | |
|--------|-------|---------------------------------------|------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|-------------------------------|------|-------------------------------|-------------------------------|
| Pounds | Feet | | 1 | 1 ¹ / ₈ | 1 ¹ / ₄ | 1 ³ / ₈ | 1 ¹ / ₂ | 1 ³ / ₄ | 2 | 2 ¹ / ₄ | 2 ¹ / ₂ |
| 10 | 23.1 | 38.6 | 94.5 | 120 | 148 | 179 | 213 | 289 | 378 | 479 | 591 |
| 15 | 34.6 | 47.25 | 116 | 147 | 181 | 219 | 260 | 354 | 463 | 585 | 723 |
| 20 | 46.2 | 54.55 | 134 | 169 | 209 | 253 | 301 | 409 | 535 | 676 | 835 |
| 25 | 57.7 | 61.0 | 149 | 189 | 234 | 283 | 336 | 458 | 598 | 756 | 934 |
| 30 | 69.3 | 66.85 | 164 | 207 | 256 | 309 | 368 | 501 | 655 | 828 | 1023 |
| 35 | 80.8 | 72.2 | 177 | 224 | 277 | 334 | 398 | 541 | 708 | 895 | 1106 |
| 40 | 92.4 | 77.2 | 188 | 239 | 296 | 357 | 425 | 578 | 756 | 957 | 1182 |
| 45 | 103.9 | 81.8 | 200 | 253 | 313 | 379 | 451 | 613 | 801 | 1015 | 1252 |
| 50 | 115.5 | 86.25 | 211 | 267 | 330 | 399 | 475 | 647 | 845 | 1070 | 1320 |
| 55 | 127.0 | 90.4 | 221 | 280 | 346 | 418 | 498 | 678 | 886 | 1121 | 1385 |
| 60 | 138.6 | 94.5 | 231 | 293 | 362 | 438 | 521 | 708 | 926 | 1172 | 1447 |
| 65 | 150.1 | 98.3 | 241 | 305 | 376 | 455 | 542 | 737 | 964 | 1220 | 1506 |
| 70 | 161.7 | 102.1 | 250 | 317 | 391 | 473 | 563 | 765 | 1001 | 1267 | 1565 |
| 75 | 173.2 | 105.7 | 259 | 327 | 404 | 489 | 582 | 792 | 1037 | 1310 | 1619 |
| 80 | 184.8 | 109.1 | 267 | 338 | 418 | 505 | 602 | 818 | 1070 | 1354 | 1672 |
| 85 | 196.3 | 112.5 | 276 | 349 | 431 | 521 | 620 | 844 | 1103 | 1395 | 1723 |
| 90 | 207.9 | 115.8 | 284 | 359 | 443 | 536 | 638 | 868 | 1136 | 1436 | 1773 |
| 95 | 219.4 | 119.0 | 292 | 369 | 456 | 551 | 656 | 892 | 1168 | 1476 | 1824 |
| 100 | 230.9 | 122.0 | 299 | 378 | 467 | 565 | 672 | 915 | 1196 | 1512 | 1870 |
| 105 | 242.4 | 125.0 | 306 | 388 | 479 | 579 | 689 | 937 | 1226 | 1550 | 1916 |
| 110 | 254.0 | 128.0 | 314 | 397 | 490 | 593 | 705 | 960 | 1255 | 1588 | 1961 |
| 115 | 265.5 | 130.9 | 320 | 406 | 501 | 606 | 720 | 980 | 1282 | 1621 | 2005 |
| 120 | 277.1 | 133.7 | 327 | 414 | 512 | 619 | 736 | 1002 | 1310 | 1659 | 2050 |
| 125 | 288.6 | 136.4 | 334 | 423 | 522 | 632 | 751 | 1022 | 1338 | 1690 | 2090 |
| 130 | 300.2 | 139.1 | 341 | 432 | 533 | 645 | 767 | 1043 | 1365 | 1726 | 2132 |
| 135 | 311.7 | 141.8 | 347 | 439 | 543 | 656 | 780 | 1063 | 1390 | 1759 | 2173 |
| 140 | 323.3 | 144.3 | 354 | 448 | 553 | 668 | 795 | 1082 | 1415 | 1790 | 2212 |
| 145 | 334.8 | 146.9 | 360 | 455 | 562 | 680 | 809 | 1100 | 1440 | 1820 | 2250 |
| 150 | 346.4 | 149.5 | 366 | 463 | 572 | 692 | 824 | 1120 | 1466 | 1853 | 2290 |
| 175 | 404.1 | 161.4 | 395 | 500 | 618 | 747 | 890 | 1210 | 1582 | 2000 | 2473 |
| 200 | 461.9 | 172.6 | 423 | 535 | 660 | 790 | 950 | 1294 | 1691 | 2140 | 2645 |

Note:

The actual quantities will vary from these figures, the amount of variation depending upon the shape of nozzle and size of pipe at the point where the pressure is determined. With smooth taper nozzles the actual discharge is about 94 percent of the figures given in the tables.



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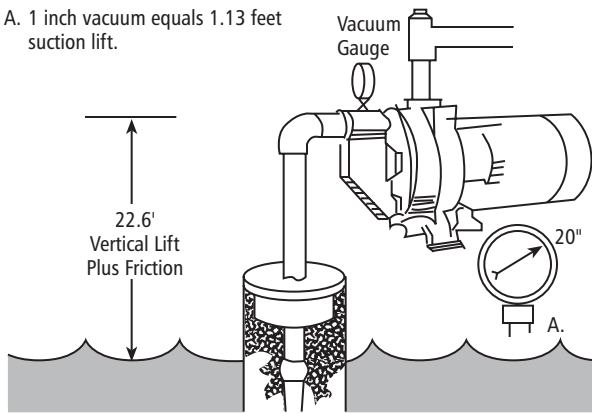
GOULDS PUMPS Residential Water Systems

Terms and Usable Formulas

CALCULATING SUCTION LIFT

Suction lift is measured with a vacuum gauge. The gauge can be calibrated in feet suction lift or inches vacuum.

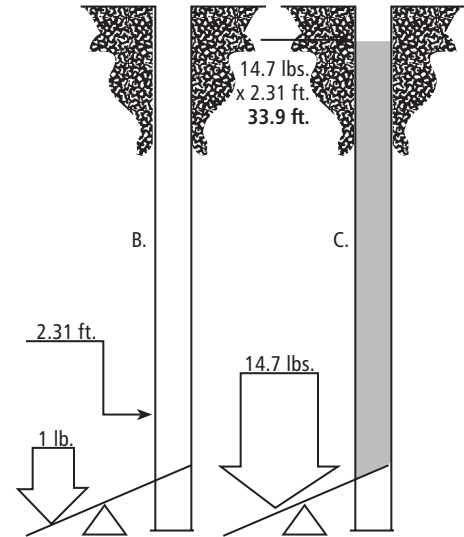
A. 1 inch vacuum equals 1.13 feet suction lift.



A reading of 20" on a vacuum gauge placed on the suction side of the pump would tell you that you had a vacuum or suction lift of 22.6 feet.

$$20" \times 1.13' = 22.6 \text{ feet}$$

C. Atmospheric pressure of $14.7 \times 2.31 = 33.9$ feet which is the maximum suction lift at sea level.



A vacuum gauge indicates total suction lift (vertical lift + friction loss = total lift) in inches of mercury. 1" on the gauge = 1.13 ft. of total suction lift (based on pump located at sea level).

RULE OF THUMB

Practical suction lift at sea level is 25 ft. Deduct 1 ft. of suction lift for each 1000 ft. of elevation above sea level.

Shallow Well System

Install vacuum gauge in shallow well adapter. When pump is running, the gauge will show no vacuum if the end of suction pipe is not submerged or there is a suction

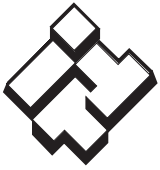
leak. If the gauge shows a very high vacuum (22 inches or more), this indicates that the end of suction pipe is buried in mud, the foot valve or check valve is stuck closed or the suction lift exceeds capability of pump.

High Vacuum (22 inches or more)

- Suction pipe end buried in mud
- Foot valve or check valve stuck closed
- Suction lift exceeds capability of the pump

Low Vacuum (or 0 vacuum)

- Suction pipe not submerged
- Suction leak



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GOULDS PUMPS Residential Water Systems

Terms and Usable Formulas

The term "head" by itself is rather misleading. It is commonly taken to mean the difference in elevation between the suction level and the discharge level of the liquid being pumped. Although this is partially correct, it does not include all of the conditions that should be included to give an accurate description.

■ **Friction Head:**

The pressure expressed in lbs./sq. in. or feet of liquid needed to overcome the resistance to the flow in the pipe and fittings.

■ **Suction Lift:** Exists when the source of supply is below the center line of the pump.

■ **Suction Head:** Exists when the source of supply is above the center line of the pump.

■ **Static Suction Lift:** The vertical distance from the center line of the pump down to the free level of the liquid source.

■ **Static Suction Head:** The vertical distance from the center line of the pump up to the free level of the liquid source.

■ **Static Discharge Head:**

The vertical elevation from the center line of the pump to the point of free discharge.

■ **Dynamic Suction Lift:**

Includes static suction lift, friction head loss and velocity head.

■ **Dynamic Suction Head:** Includes static suction head minus friction head minus velocity head.

■ **Dynamic Discharge Head:** Includes static discharge head plus friction head plus velocity head.

■ **Total Dynamic Head:**

Includes the dynamic discharge head plus dynamic suction lift or minus dynamic suction head.

■ **Velocity Head:** The head needed to accelerate the liquid. Knowing the velocity of the liquid, the velocity head loss can be calculated by a simple formula $Head = V^2/2g$ in which g is acceleration due to gravity or 32.16 ft./sec. Although the velocity head loss is a factor in figuring the dynamic heads, the value is usually small and in most cases negligible. See table.

BASIC FORMULAS AND SYMBOLS

Formulas

$$GPM = \frac{Lb./Hr.}{500 \times Sp. Gr.}$$

$$H = \frac{2.31 \times psi}{Sp. Gr.}$$

$$H = \frac{1.134 \times In. Hg.}{Sp. Gr.}$$

$$H_v = \frac{V^2}{2g} = 0.155 V^2$$

$$V = \frac{GPM \times 0.321}{A} = \frac{GPM \times 0.409}{(I.D.)^2}$$

$$BHP = \frac{GPM \times H \times Sp. Gr.}{3960 \times Eff.}$$

$$Eff. = \frac{GPM \times H \times Sp. Gr.}{3960 \times BHP}$$

$$N_s = \frac{N\sqrt{GPM}}{H^{3/4}}$$

$$H = \frac{V^2}{2g}$$

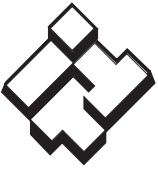
Approximate Cost of Operating Electric Motors

| Motor HP | *Average kilowatts input or cost based on 1 cent per kilowatt hour | | Motor HP | *Av. kw input or cost per hr. based on 1 cent per kw hour |
|----------|--|---------|----------|---|
| | 1 Phase | 3 Phase | | 3 Phase |
| 1/3 | .408 | | 20 | 16.9 |
| 1/2 | .535 | .520 | 25 | 20.8 |
| 3/4 | .760 | .768 | 30 | 26.0 |
| 1 | 1.00 | .960 | 40 | 33.2 |
| 1 1/2 | 1.50 | 1.41 | 50 | 41.3 |
| 2 | 2.00 | 1.82 | 60 | 49.5 |
| 3 | 2.95 | 2.70 | 75 | 61.5 |
| 5 | 4.65 | 4.50 | 100 | 81.5 |
| 7 1/2 | 6.90 | 6.75 | 125 | 102 |
| 10 | 9.30 | 9.00 | 150 | 122 |
| | | | 200 | 162 |

Symbols

- GPM = gallons per minute
- Lb. = pounds
- Hr. = hour
- Sp. Gr. = specific gravity
- H = head in feet
- psi = pounds per square inch
- In. Hg. = inches of mercury
- h_v = velocity head in feet
- V = velocity in feet per second
- g = 32.16 ft./sec.² (acceleration of gravity)

- A = area in square inches (πr²) (for a circle or pipe)
- ID = inside diameter in inches
- BHP = brake horsepower
- Eff. = pump efficiency expressed as a decimal
- N_s = specific speed
- N = speed in revolutions per minute
- D = impeller in inches



ITT

GOULDS PUMPS Residential Water Systems

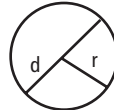
Terms and Usable Formulas

BASIC FORMULAS AND SYMBOLS

Temperature conversion

$$\text{DEG. C} = (\text{DEG. F} - 32) \times .555$$

$$\text{DEG. F} = (\text{DEG. C} \times 1.8) + 32$$



CIRCLE

Area of a Circle

A = area; C = circumference. D = diameter

$$A = \pi r^2; \pi = 3.14 \quad r = \text{radius}$$

$$C = 2\pi r$$

$$\text{Water Horsepower} = \frac{\text{GPM} \times 8.33 \times \text{Head}}{33000} = \frac{\text{GPM} \times \text{Head}}{3960}$$

Where:

GPM = Gallons per Minute
8.33 = Pounds of water per gallon
33000 = Ft. Lbs. per minute in one horsepower
Head = Difference in energy head in feet (field head).

$$\text{Laboratory BHP} = \frac{\text{Head} \times \text{GPM} \times \text{Sp. Gr.}}{3960 \times \text{Eff.}}$$

$$\text{Field BHP} = \text{Laboratory BHP} + \text{Shaft Loss}$$

$$\text{Total BHP} = \text{Field BHP} + \text{Thrust Bearing Loss}$$

Where:

GPM = Gallons per Minute
Head = Lab. Head (including column loss)
Eff. = Lab. Eff. of Pump Bowls
Shaft Loss = HP loss due to mechanical friction of lineshaft bearings
Thrust Bearing Loss = HP Loss in driver thrust bearings
 (See (1) below under Misc.)

$$\text{Input Horsepower} = \frac{\text{Total BHP}}{\text{Motor Eff.}}$$

Motor Eff. from Motor mfg. (as a decimal)

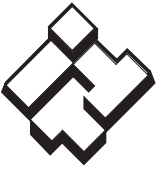
$$\text{Field Efficiency} = \frac{\text{Water Horsepower}}{\text{Total BHP}}$$

Water HP as determined above
 Total BHP as determined above

$$\text{Overall Plant Efficiency} = \frac{\text{Water Horsepower}}{\text{Input Horsepower}}$$

(See (2) below under Misc.)
 Water HP as determined above
 Input HP as determined above

| | | |
|---------------|---|--|
| Electrical | $\text{Input Horsepower} = \frac{\text{BHP}}{\text{Mot. Eff.}} = \frac{4.826 \times \text{K} \times \text{M} \times \text{R}}{\text{T}} = \frac{1.732 \times \text{E} \times \text{I} \times \text{PF}}{746}$ | |
| | <p>BHP = Brake Horsepower as determined above Mot. Eff. = Rated Motor Efficiency K = Power Company Meter Constant M = Power Company Meter Multiplier, or Ratio of Current and Potential Transformers connected with meter R = Revolutions of meter disk T = Time in Sec. for R E = Voltage per Leg applied to motor I = Amperes per Leg applied to motor PF = Power factor of motor 1.732 = Factor for 3-phase motors. This reduces to 1 for single phase motors</p> | |
| Miscellaneous | $\text{Kilowatt input to Motor} = \frac{.746 \times \text{I.H.P.}}{1000} = \frac{1.732 \times \text{E} \times \text{I} \times \text{PF}}{1000}$ | $\text{KW-Hrs. Per 1000 Gallons of Cold Water Pumped Per Hour} = \frac{\text{HD in ft.} \times 0.00315}{\text{Pump Eff.} \times \text{Mot. Eff.}}$ |
| | <p>(1) Thrust Bearing Loss = .0075 HP per 100 RPM per 1000 lbs. thrust.* (2) Overall Plant Efficiency sometimes referred to as "Wire to Water" Efficiency *Thrust (in lbs.) = (thrust constant (k) laboratory head) + (setting in feet x shaft wt. per ft.) Note: Obtain thrust constant from curve sheets</p> | |
| | $\text{Discharge Head (in feet of fluid pumped)} = \frac{\text{Discharge Pressure (psi)} \times 2.31}{\text{Sp. Gr. of Fluid Pumped}}$ | |



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GOULDS PUMPS Residential Water Systems

Affinity Laws

| | | |
|---|---|---|
| <p>The affinity laws express the mathematical relationship between several variables involved in pump performance. They apply to all types of centrifugal and axial flow pumps. They are as follows:</p> <p>Q = Capacity, GPM H = Total Head, Feet BHP = Brake Horsepower N = Pump Speed, RPM D = Impeller Diameter (in.)</p> | <p>Use equations 1 through 3 when speed changes and impeller diameter remains constant</p> <ol style="list-style-type: none"> $\frac{Q_1}{Q_2} = \frac{N_1}{N_2}$ $\frac{H_1}{H_2} = \left(\frac{N_1}{N_2}\right)^2$ $\frac{BHP_1}{BHP_2} = \left(\frac{N_1}{N_2}\right)^3$ | <p>Use equations 4 through 6 with impeller diameter changes and speed remains constant</p> <ol style="list-style-type: none"> $\frac{Q_1}{Q_2} = \frac{D_1}{D_2}$ $\frac{H_1}{H_2} = \left(\frac{D_1}{D_2}\right)^2$ $\frac{BHP_1}{BHP_2} = \left(\frac{D_1}{D_2}\right)^3$ |
|---|---|---|

To illustrate the use of these laws, let's look at a particular point (1) on a pump curve (figure 1). The diameter of the impeller for this curve is 6 inches. We will determine by the use of the Affinity Laws what happens to this point if we trim the impeller to 5 inches.

From the 6 inch diameter curve we obtain the following information:

D₁ = 6" Dia. D₂ = 5" Dia.
Q₁ = 200 GPM Q₂ = TBA
H₁ = 100 Ft. H₂ = TBA
BHP₁ = 7.5 HP BHP₂ = TBA

The equations 4 through 6 above with speed (N) held constant will be used and rearranged to solve for the following:

Equation 4 $Q_2 = \frac{D_2}{D_1} \times Q_1$

Equation 5 $H_2 = \left(\frac{D_2}{D_1}\right)^2 \times H_1$

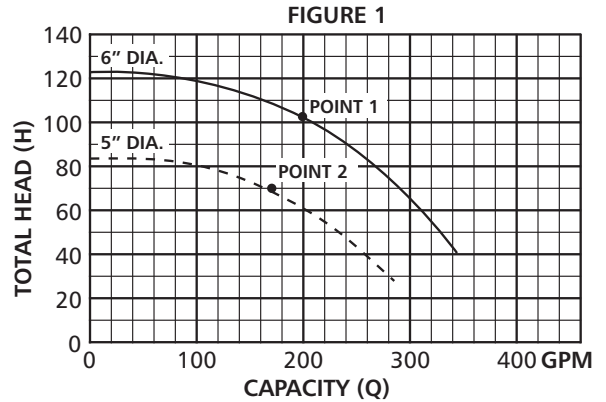
Equation 6 $BHP_2 = \left(\frac{D_2}{D_1}\right)^3 \times BHP_1$

The 6 inch information is put into the formulas and the new 5 inch diameter point is calculated:

$Q_2 = \frac{5" \text{ dia.}}{6" \text{ dia.}} \times 200 \text{ GPM} = 167 \text{ GPM}$

$H_2 = \left(\frac{5" \text{ dia.}}{6" \text{ dia.}}\right)^2 \times 100 \text{ Ft.} = 69 \text{ Ft.}$

$BHP_2 = \left(\frac{5" \text{ dia.}}{6" \text{ dia.}}\right)^3 \times 7.5 \text{ BHP} = 4.3 \text{ BHP}$



The 5 inch diameter Head/Capacity performance point can be plotted on the graph (figure 1; point 2). By taking additional Head/Capacity points on the 6" diameter curve line and using this procedure, a new Head/Capacity curve line can be produced for the 5 inch diameter impeller.

This same procedure and equations 1 through 3 can be used when pump speed changes and the impeller diameter remains constant.

Calculating impeller trim using Affinity Laws:

Example:

Assume a requirement of 225 GPM at 160' of Head (point 2, figure 2). Note this point falls between 2 existing curve lines with standard impeller diameters. To determine the trimmed impeller diameter to meet our requirement, draw a line from the required point (point 2) perpendicular to an existing curve line (point 1). Notice point 1 has an impeller diameter (D₁) of 6¾" and produces 230 GPM (Q₁) at 172' TDH (H₁).

Applying Affinity Law 5 to solve for our new impeller diameter (D₂).

Point 1 (Known)

D₁ = 6¾" Dia. Impeller
H₁ = 172' TDH
Q₁ = 230 GPM

Point 2 (Unknown)

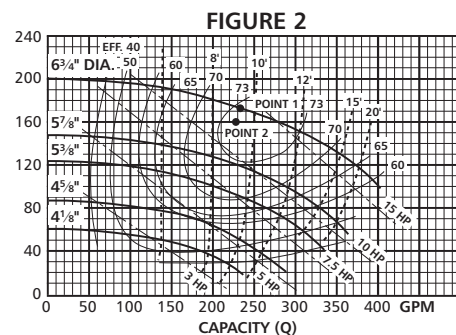
D₂ = Unknown
H₂ = 160' TDH
Q₂ = 225 GPM

Rearranging law 5 to solve for D₂:

$$D_2 = D_1 \times \sqrt{\frac{H_2}{H_1}}$$

$$D_2 = 6.75 \times \sqrt{\frac{160}{172}}$$

$$D_2 = 6.55 = 6\frac{9}{16}''$$



Determine that the new impeller will meet the required capacity:

Rearranging law 4 to solve for Q₂:

$$Q_2 = \frac{D_2}{D_1} \times Q_1 = \frac{6.55}{6.75} \times 230 = 223$$



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GOULDS PUMPS Residential Water Systems

Conversion Charts

Decimal and Millimeter Equivalents of Fraction

| Inches | | Millimeters | Inches | | Millimeters |
|-----------|----------|-------------|-----------|----------|-------------|
| Fractions | Decimals | | Fractions | Decimals | |
| 1/64 | .015625 | .397 | 33/64 | .515625 | 13.097 |
| 1/32 | .03125 | .794 | 17/32 | .53125 | 13.494 |
| 3/64 | .046875 | 1.191 | 25/64 | .546875 | 13.891 |
| 1/16 | .0625 | 1.588 | 9/16 | .5625 | 14.288 |
| 5/64 | .078125 | 1.984 | 37/64 | .578125 | 14.684 |
| 3/32 | .09375 | 2.381 | 19/32 | .59375 | 15.081 |
| 7/64 | .109375 | 2.778 | 39/64 | .609375 | 15.487 |
| 1/8 | .125 | 3.175 | 5/8 | .625 | 15.875 |
| 9/64 | .140625 | 3.572 | 41/64 | .640625 | 16.272 |
| 5/32 | .15625 | 3.969 | 21/32 | .65625 | 16.669 |
| 11/64 | .171875 | 4.366 | 43/64 | .671875 | 17.066 |
| 3/16 | .1875 | 4.763 | 11/16 | .6875 | 17.463 |
| 13/64 | .203125 | 5.159 | 45/64 | .703125 | 17.859 |
| 7/32 | .21875 | 5.556 | 23/32 | .71875 | 18.256 |
| 15/64 | .234375 | 5.953 | 47/64 | .734375 | 18.653 |
| 1/4 | .250 | 6.350 | 3/4 | .750 | 19.050 |
| 17/64 | .265625 | 6.747 | 49/64 | .765625 | 19.447 |
| 9/32 | .28125 | 7.144 | 25/32 | .78125 | 19.844 |
| 19/64 | .296875 | 7.541 | 51/64 | .796875 | 20.241 |
| 3/16 | .3125 | 7.938 | 13/16 | .8125 | 20.638 |
| 21/64 | .328125 | 8.334 | 53/64 | .828125 | 21.034 |
| 11/32 | .34375 | 8.731 | 27/32 | .84375 | 21.431 |
| 23/64 | .359375 | 9.128 | 55/64 | .859375 | 21.828 |
| 5/8 | .375 | 9.525 | 7/8 | .875 | 22.225 |
| 25/64 | .390625 | 9.922 | 57/64 | .890625 | 22.622 |
| 13/32 | .40625 | 10.319 | 29/32 | .90625 | 23.019 |
| 27/64 | .421875 | 10.716 | 59/64 | .921875 | 23.416 |
| 3/16 | .4375 | 11.113 | 15/16 | .9375 | 23.813 |
| 29/64 | .453125 | 11.509 | 61/64 | .953125 | 24.209 |
| 15/32 | .46875 | 11.906 | 31/32 | .96875 | 24.606 |
| 31/64 | .484375 | 12.303 | 63/64 | .984375 | 25.003 |
| 1/2 | .500 | 12.700 | 1 | 1.000 | 25.400 |

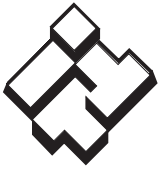
Atmospheric Pressure, Barometer Reading and Boiling Point of Water at Various Altitudes

| Altitude | | Barometer Reading | | Atmos. Press. | | Boiling Pt. of Water °F |
|----------|---------|-------------------|---------|---------------|-----------|-------------------------|
| Feet | Meters | In. Hg. | Mm. Hg. | Psia | Ft. Water | |
| - 1000 | - 304.8 | 31.0 | 788 | 15.2 | 35.2 | 213.8 |
| - 500 | - 152.4 | 30.5 | 775 | 15.0 | 34.6 | 212.9 |
| 0 | 0.0 | 29.9 | 760 | 14.7 | 33.9 | 212.0 |
| + 500 | + 152.4 | 29.4 | 747 | 14.4 | 33.3 | 211.1 |
| + 1000 | 304.8 | 28.9 | 734 | 14.2 | 32.8 | 210.2 |
| 1500 | 457.2 | 28.3 | 719 | 13.9 | 32.1 | 209.3 |
| 2000 | 609.6 | 27.8 | 706 | 13.7 | 31.5 | 208.4 |
| 2500 | 762.0 | 27.3 | 694 | 13.4 | 31.0 | 207.4 |
| 3000 | 914.4 | 26.8 | 681 | 13.2 | 30.4 | 206.5 |
| 3500 | 1066.8 | 26.3 | 668 | 12.9 | 29.8 | 205.6 |
| 4000 | 1219.2 | 25.8 | 655 | 12.7 | 29.2 | 204.7 |
| 4500 | 1371.6 | 25.4 | 645 | 12.4 | 28.8 | 203.8 |
| 5000 | 1524.0 | 24.9 | 633 | 12.2 | 28.2 | 202.9 |
| 5500 | 1676.4 | 24.4 | 620 | 12.0 | 27.6 | 201.9 |
| 6000 | 1828.8 | 24.0 | 610 | 11.8 | 27.2 | 201.0 |
| 6500 | 1981.2 | 23.5 | 597 | 11.5 | 26.7 | 200.1 |
| 7000 | 2133.6 | 23.1 | 587 | 11.3 | 26.2 | 199.2 |
| 7500 | 2286.0 | 22.7 | 577 | 11.1 | 25.7 | 198.3 |
| 8000 | 2438.4 | 22.2 | 564 | 10.9 | 25.2 | 197.4 |
| 8500 | 2590.8 | 21.8 | 554 | 10.7 | 24.7 | 196.5 |
| 9000 | 2743.2 | 21.4 | 544 | 10.5 | 24.3 | 195.5 |
| 9500 | 2895.6 | 21.0 | 533 | 10.3 | 23.8 | 194.6 |
| 10000 | 3048.0 | 20.6 | 523 | 10.1 | 23.4 | 193.7 |
| 15000 | 4572.0 | 16.9 | 429 | 8.3 | 19.2 | 184.0 |

Head and Pressure Equivalents

| 1. Feet Head of Water and Equivalent Pressures To change head in feet to pressure in pounds, multiply by .434 | | | | | | | |
|--|------|-----------|-------|-----------|--------|-----------|--------|
| Feet Head | PSI | Feet Head | PSI | Feet Head | PSI | Feet Head | PSI |
| 1 | .43 | 30 | 12.99 | 140 | 60.63 | 300 | 129.93 |
| 2 | .87 | 40 | 17.32 | 150 | 64.96 | 325 | 140.75 |
| 3 | 1.30 | 50 | 21.65 | 160 | 69.29 | 350 | 151.58 |
| 4 | 1.73 | 60 | 25.99 | 170 | 73.63 | 400 | 173.24 |
| 5 | 2.17 | 70 | 30.32 | 180 | 77.96 | 500 | 216.55 |
| 6 | 2.60 | 80 | 34.65 | 190 | 82.29 | 600 | 259.85 |
| 7 | 3.03 | 90 | 38.98 | 200 | 86.62 | 700 | 303.16 |
| 8 | 3.46 | 100 | 43.31 | 225 | 97.45 | 800 | 346.47 |
| 9 | 3.90 | 110 | 47.64 | 250 | 108.27 | 900 | 389.78 |
| 10 | 4.33 | 120 | 51.97 | 275 | 119.10 | 1000 | 433.09 |
| 20 | 8.66 | 130 | 56.30 | - | - | - | - |

| 2. Pressure and Equivalent Feet Head of Water To change pounds pressure to feet head, multiply by 2.3 | | | | | | | |
|--|-----------|-----|-----------|-----|-----------|------|-----------|
| PSI | Feet Head | PSI | Feet Head | PSI | Feet Head | PSI | Feet Head |
| 1 | 2.31 | 20 | 46.18 | 120 | 277.07 | 225 | 519.51 |
| 2 | 4.62 | 25 | 57.72 | 125 | 288.62 | 250 | 577.24 |
| 3 | 6.93 | 30 | 69.27 | 130 | 300.16 | 275 | 643.03 |
| 4 | 9.24 | 40 | 92.36 | 140 | 323.25 | 300 | 692.69 |
| 5 | 11.54 | 50 | 115.45 | 150 | 346.34 | 325 | 750.41 |
| 6 | 13.85 | 60 | 138.54 | 160 | 369.43 | 350 | 808.13 |
| 7 | 16.16 | 70 | 161.63 | 170 | 392.52 | 375 | 865.89 |
| 8 | 18.47 | 80 | 184.72 | 180 | 415.61 | 400 | 922.58 |
| 9 | 20.78 | 90 | 207.81 | 190 | 438.90 | 500 | 1154.48 |
| 10 | 23.09 | 100 | 230.90 | 200 | 461.78 | 1000 | 2309.00 |
| 15 | 34.63 | 110 | 253.98 | - | - | - | - |



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GOULDS PUMPS Residential Water Systems

Conversion Charts

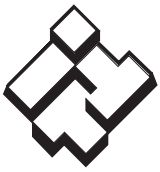
English measures – unless otherwise designated, are those used in the United States.

Gallon – designates the U.S. gallon. To convert into the Imperial gallon, multiply the U.S. gallon by 0.83267. Likewise, the word ton designates a short ton, 2,000 pounds.

Properties of water – it freezes at 32°F, and is at its maximum density at 39.2°F. In the multipliers using the properties of water, calculations are based on water at 39.2°F. in a vacuum, weighing 62.427 pounds per cubic foot, or 8.345 pounds per U.S. gallon.

| Multiply | By | To Obtain |
|----------------------|--------------------------|--------------------|
| Acres | 43,560 | Square feet |
| Acres | 4047 | Square meters |
| Acres | 1.562 x 10 ³ | Square miles |
| Acres | 4840 | Square yards |
| Atmospheres | 76.0 | Cms. of mercury |
| Atmospheres | 29.92 | Inches of mercury |
| Atmospheres | 33.90 | Feet of water |
| Atmospheres | 10,332 | Kgs./sq. meter |
| Atmospheres | 14.70 | Lbs./sq. inch |
| Atmospheres | 1.058 | Tons/sq. ft. |
| Barrels-Oil | 42 | Gallons-Oil |
| Barrels-Beer | 31 | Gallons-Beer |
| Barrels-Whiskey | 45 | Gallons-Whiskey |
| Barrels/Day-Oil | 0.02917 | Gallons/Min-Oil |
| Bags or sacks-cement | 94 | Pounds-cement |
| Board feet | 144 sq. in. x 1 in. | Cubic inches |
| B.T.U./min. | 12.96 | Foot-lbs./sec. |
| B.T.U./min. | 0.02356 | Horsepower |
| B.T.U./min. | 0.01757 | Kilowatts |
| B.T.U./min. | 17.57 | Watts |
| Centimeters | 0.3937 | Inches |
| Centimeters | 0.01 | Meters |
| Centimeters | 10 | Millimeters |
| Cubic feet | 2.832 x 10 ⁴ | Cubic cms. |
| Cubic feet | 1728 | Cubic inches |
| Cubic feet | 0.02832 | Cubic meters |
| Cubic feet | 0.03704 | Cubic yards |
| Cubic feet | 7.48052 | Gallons |
| Cubic feet | 28.32 | Liters |
| Cubic feet | 59.84 | Pints (liq.) |
| Cubic feet | 29.92 | Quarts (liq.) |
| Cubic feet/min. | 472.0 | Cubic cms./sec. |
| Cubic feet/min. | 0.1247 | Gallons/sec. |
| Cubic feet/min. | 0.4719 | Liters/sec. |
| Cubic feet/min. | 62.43 | Lbs. of water/min. |
| Cubic feet/sec. | 0.646317 | Millions gals./day |
| Cubic feet/sec. | 448.831 | Gallons/min. |
| Cubic inches | 16.39 | Cubic centimeters |
| Cubic inches | 5.787 x 10 ⁻⁴ | Cubic feet |
| Cubic inches | 1.639 x 10 ⁻⁵ | Cubic meters |
| Cubic inches | 2.143 x 10 ⁻⁵ | Cubic yards |

| Multiply | By | To Obtain |
|------------------|--------------------------|-----------------------|
| Cubic inches | 4.329 x 10 ⁻³ | Gallons |
| Cubic inches | 1.639 x 10 ⁻² | Liters |
| Cubic inches | 0.03463 | Pints (liq.) |
| Cubic inches | 0.01732 | Quarts (liq.) |
| Cubic yards | 764,544.86 | Cubic centimeters |
| Cubic yards | 27 | Cubic feet |
| Cubic yards | 46,656 | Cubic inches |
| Cubic yards | 0.7646 | Cubic meters |
| Cubic yards | 202.0 | Gallons |
| Cubic yards | 764.5 | Liters |
| Cubic yards | 1616 | Pints (liq.) |
| Cubic yards | 807.9 | Quarts (liq.) |
| Cubic yards/min. | 0.45 | Cubic feet/sec. |
| Cubic yards/min. | 3.366 | Gallons/sec. |
| Cubic yards/min. | 12.74 | Liters/sec. |
| Fathoms | 6 | Feet |
| Feet | 30.48 | Centimeters |
| Feet | 12 | Inches |
| Feet | 0.3048 | Meters |
| Feet | 1/3 | Yards |
| Feet of water | 0.0295 | Atmospheres |
| Feet of water | 0.8826 | Inches of mercury |
| Feet of water | 304.8 | Kgs./sq. meter |
| Feet of water | 62.43 | Lbs./Sq. ft. |
| Feet of water | 0.4335 | Lbs./sq. inch |
| Feet/min. | 0.5080 | Centimeters/sec. |
| Feet/min. | 0.01667 | Feet/sec. |
| Feet/min. | 0.01829 | Kilometers/hr. |
| Feet/min. | 0.3048 | Meters/min. |
| Feet/min. | 0.01136 | Miles/hr. |
| Feet/sec. | 30.48 | Centimeters/sec. |
| Feet/sec. | 1.097 | Kilometers/hr. |
| Feet/sec. | 0.5924 | Knots |
| Feet/sec. | 18.29 | Meters/min. |
| Feet/sec. | 0.6818 | Miles/hr. |
| Feet/sec. | 0.01136 | Miles/min. |
| Feet/sec./sec. | 30.48 | Cms./sec./sec. |
| Feet/sec./sec. | 0.3048 | Meters/sec./sec. |
| Foot-pounds | 1.286 x 10 ³ | British Thermal Units |
| Foot-pounds | 5.050 x 10 ⁷ | Horsepower-hrs. |
| Foot-pounds | 3.240 x 10 ⁴ | Kilogram-calories |



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GOULDS PUMPS Residential Water Systems

Conversion Charts

| Multiply | By | To Obtain |
|--------------------------|------------------------|--------------------------|
| Foot-pounds | 0.1383 | Kilogram-meters |
| Foot-pounds | 3.766×10^7 | Kilowatt-hours |
| Gallons | 3785 | Cubic centimeters |
| Gallons | 0.1337 | Cubic feet |
| Gallons | 231 | Cubic inches |
| Gallons | 3.785×10^{-3} | Cubic meters |
| Gallons | 4.951×10^{-3} | Cubic yards |
| Gallons | 3.785 | Liters |
| Gallons | 8 | Pints (liq.) |
| Gallons | 4 | Quarts (liq.) |
| Gallons-Imperial | 1.20095 | U.S. gallons |
| Gallons-U.S. | 0.83267 | Imperial gallons |
| Gallons water | 8.345 | Pounds of water |
| Gallons/min. | 2.228×10^{-3} | Cubic feet/sec. |
| Gallons/min. | 0.06308 | Liters/sec. |
| Gallons/min. | 8.0208 | Cu. ft./hr. |
| Gallons/min. | .2271 | Meters ³ /hr. |
| Grains/U.S. gal. | 17.118 | Parts/million |
| Grains/U.S. gal. | 142.86 | Lbs./million gal. |
| Grains/Imp. gal. | 14.254 | Parts/million |
| Grams | 15.43 | Grains |
| Grams | .001 | Kilograms |
| Grams | 1000 | Milligrams |
| Grams | 0.03527 | Ounces |
| Grams | 2.205×10^{-3} | Pounds |
| Horsepower | 42.44 | B.T.U./min. |
| Horsepower | 33,000 | Foot-lbs./min. |
| Horsepower | 550 | Foot-lbs./sec. |
| Horsepower | 1.014 | Horsepower (metric) |
| Horsepower | 0.7457 | Kilowatts |
| Horsepower | 745.7 | Watts |
| Horsepower (boiler) | 33,493 | B.T.U./hr. |
| Horsepower (boiler) | 9.809 | Kilowatts |
| Horsepower-hours | 2546 | B.T.U. |
| Horsepower-hours | 1.98×10^6 | Foot-lbs. |
| Horsepower-hours | 2.737×10^5 | Kilogram-meters |
| Horsepower-hours | 0.7457 | Kilowatt-hours |
| Inches | 2.540 | Centimeters |
| Inches of mercury | 0.03342 | Atmospheres |
| Inches of mercury | 1.133 | Feet of water |
| Inches of mercury | 345.3 | Kgs./sq. meter |
| Inches of mercury | 70.73 | Lbs./sq. ft. |
| Inches of mercury (32°F) | 0.491 | Lbs./sq. inch |
| Inches of water | 0.002458 | Atmospheres |
| Inches of water | 0.07355 | Inches of mercury |
| Inches of water | 25.40 | Kgs./sq. meter |
| Inches of water | 0.578 | Ounces/sq. inch |
| Inches of water | 5.202 | Lbs. sq. foot |
| Inches of water | 0.03613 | Lbs./sq. inch |
| Kilograms | 2.205 | Lbs. |

| Multiply | By | To Obtain |
|---|------------------------|-------------------|
| Kilograms | 1.102×10^{-3} | Tons (short) |
| Kilograms | 10^3 | Grams |
| Kiloliters | 10^3 | Liters |
| Kilometers | 10^5 | Centimeters |
| Kilometers | 3281 | Feet |
| Kilometers | 10^3 | Meters |
| Kilometers | 0.6214 | Miles |
| Kilometers | 1094 | Yards |
| Kilometers/hr. | 27.78 | Centimeters/sec. |
| Kilometers/hr. | 54.68 | Feet/min. |
| Kilometers/hr. | 0.9113 | Feet/sec. |
| Kilometers/hr. | .5399 | Knots |
| Kilometers/hr. | 16.67 | Meters/min. |
| Kilowatts | 56.907 | B.T.U./min. |
| Kilowatts | 4.425×10^4 | Foot-lbs./min. |
| Kilowatts | 737.6 | Foot-lbs./sec. |
| Kilowatts | 1.341 | Horsepower |
| Kilowatts | 10^3 | Watts |
| Kilowatt-hours | 3414.4 | B.T.U. |
| Kilowatt-hours | 2.655×10^6 | Foot-lbs. |
| Kilowatt-hours | 1.341 | Horsepower-hrs. |
| Kilowatt-hours | 3.671×10^5 | Kilogram-meters |
| Liters | 10^3 | Cubic centimeters |
| Liters | 0.03531 | Cubic feet |
| Liters | 61.02 | Cubic inches |
| Liters | 10^{-3} | Cubic meters |
| Liters | 1.308×10^{-3} | Cubic yards |
| Liters | 0.2642 | Gallons |
| Liters | 2.113 | Pints (liq.) |
| Liters | 1.057 | Quarts (liq.) |
| Liters/min. | 5.886×10^{-4} | Cubic ft./sec. |
| Liters/min. | 4.403×10^{-3} | Gals./sec. |
| Lumber Width (in.) x Thickness (in.) | Length (ft.) | Board feet |
| 12 | | |
| Meters | 100 | Centimeters |
| Meters | 3.281 | Feet |
| Meters | 39.37 | inches |
| Meters | 10^{-3} | Kilometers |
| Meters | 10^3 | Millimeters |
| Meters | 1.094 | Yards |
| Miles | 1.609×10^5 | Centimeters |
| Miles | 5280 | Feet |
| Miles | 1.609 | Kilometers |
| Miles | 1760 | Yards |
| Miles/hr. | 44.70 | Centimeters/sec. |
| Miles/hr. | 88 | Feet/min. |
| Miles/hr. | 1.467 | Feet/sec. |
| Miles/hr. | 1.609 | Kilometers/hr. |
| Miles/hr. | 0.8689 | Knots |



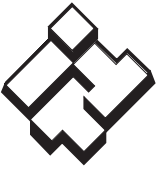
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GOULDS PUMPS Residential Water Systems

Conversion Charts

| Multiply | By | To Obtain |
|--------------------------------------|------------------------|-------------------------|
| Miles/hr. | 26.82 | Meters/min. |
| Miles/min. | 2682 | Centimeters/sec. |
| Miles/min. | 88 | Feet/sec. |
| Miles/min. | 1.609 | Kilometers/min. |
| Miles/min. | 60 | Miles/hr. |
| Ounces | 16 | Drams |
| Ounces | 437.5 | Grains |
| Ounces | 0.0625 | Pounds |
| Ounces | 28.3495 | Grams |
| Ounces | 2.835×10^{-5} | Tons (metric) |
| Parts/million | 0.0584 | Grains/U.S. gal. |
| Parts/million | 0.07015 | Grains/Imp. gal. |
| Parts/million | 8.345 | Lbs./million gal. |
| Pounds | 16 | Ounces |
| Pounds | 256 | Drams |
| Pounds | 7000 | Grains |
| Pounds | 0.0005 | Tons (short) |
| Pounds | 453.5924 | Grams |
| Pounds of water | 0.01602 | Cubic feet |
| Pounds of water | 27.68 | Cubic inches |
| Pounds of water | 0.1198 | Gallons |
| Pounds of water/min. | 2.670×10^{-4} | Cubic ft./sec. |
| Pounds/cubic foot | 0.01602 | Grams/cubic cm. |
| Pounds/cubic foot | 16.02 | Kgs./cubic meters |
| Pounds/cubic foot | 5.787×10^{-4} | Lbs./cubic inch |
| Pounds/cubic inch | 27.68 | Grams/cubic cm. |
| Pounds/cubic inch | 2.768×10^4 | Kgs./cubic meter |
| Pounds/cubic inch | 1728 | Lbs./cubic foot |
| Pounds/foot | 1.488 | Kgs./meter |
| Pounds/inch | 1152 | Grams/cm. |
| Pounds/sq. foot | 0.01602 | Feet of water |
| Pounds/sq. foot | 4.882 | Kgs./sq. meter |
| Pounds/sq. foot | 6.944×10^{-3} | Pounds/sq. inch |
| Pounds/sq. inch | 0.06804 | Atmospheres |
| PSI | 2.307 | Feet of water |
| PSI | 2.036 | Inches of mercury |
| PSI | 703.1 | Kgs./sq. meter |
| Quarts (dry) | 67.20 | Cubic inches |
| Quarts (liq.) | 57.75 | Cubic inches |
| Square feet | 2.296×10^{-5} | Acres |
| Square feet | 929.0 | Square centimeters |
| Square feet | 144 | Square inches |
| Square feet | 0.09290 | Square meters |
| Square feet | 3.587×10^{-4} | Square miles |
| Square feet | 1/9 | Square yards |
| $\frac{1}{\text{sq. ft./gal./min.}}$ | 8.0208 | Overflow rate (ft./hr.) |
| Square inches | 6.452 | Square centimeters |
| Square inches | 6.944×10^{-3} | Square feet |
| Square inches | 645.2 | Square millimeters |

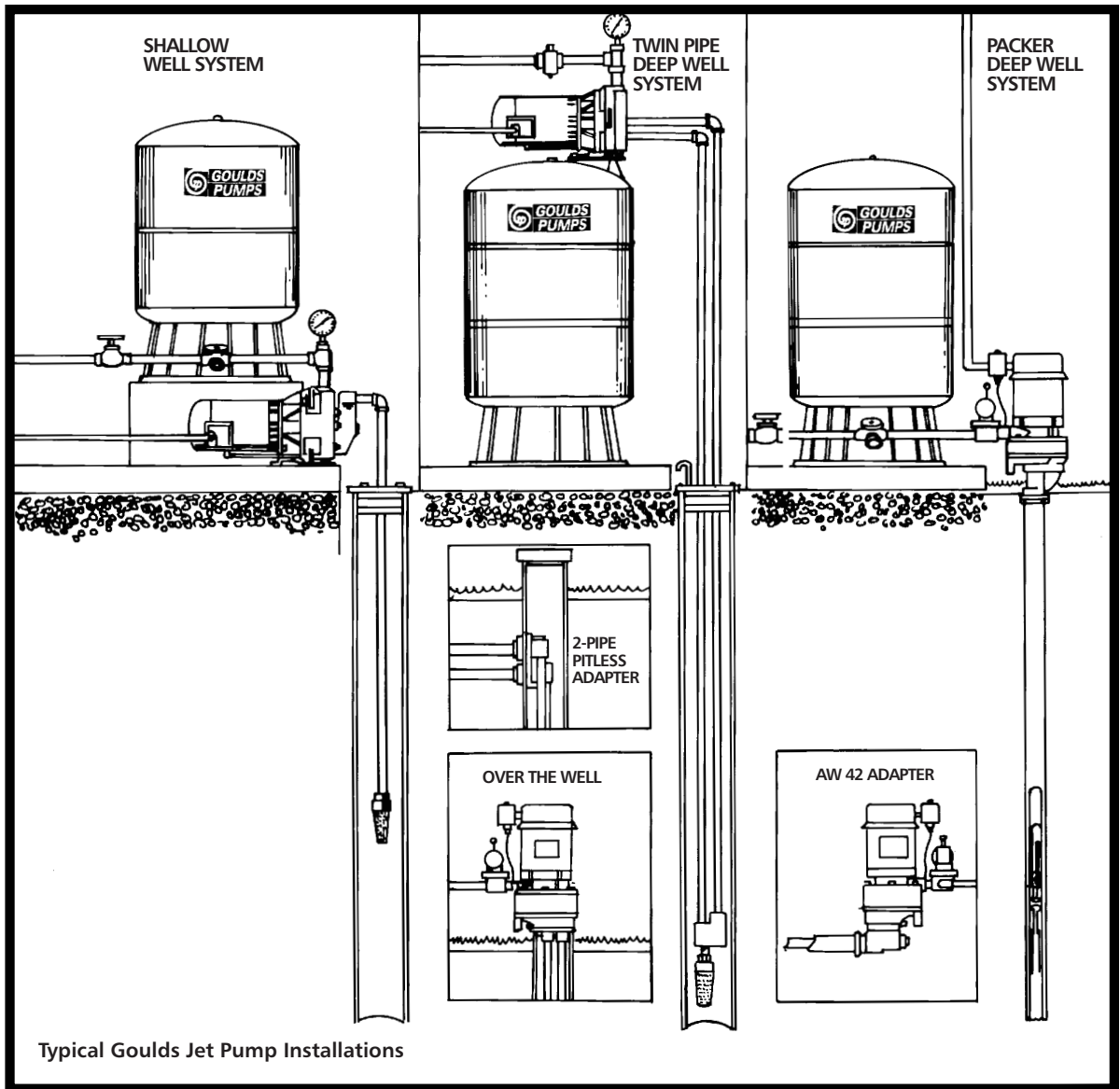
| Multiply | By | To Obtain |
|-----------------------|------------------------|-------------------|
| Square kilometers | 247.1 | Acres |
| Square kilometers | 10.76×10^6 | Square feet |
| Square kilometers | 10^6 | Square meters |
| Square kilometers | 0.3861 | Square miles |
| Square kilometers | 1.196×10^6 | Square yards |
| Square meters | 2.471×10^{-4} | Acres |
| Square meters | 10.76 | Square feet |
| Square meters | 3.861×10^{-7} | Square miles |
| Square meters | 1.196 | Square yards |
| Square miles | 640 | Acres |
| Square miles | 27.88×10^6 | Square feet |
| Square miles | 2.590 | Square kilometers |
| Square miles | 3.098×10^6 | Square yards |
| Square yards | 2.066×10^{-4} | Acres |
| Square yards | 9 | Square feet |
| Square yards | 0.8361 | Square meters |
| Square yards | 3.228×10^{-7} | Square miles |
| Temp (°C)+273 | 1 | Abs. temp. (°C) |
| Temp. (°C)+17.78 | 1.8 | Temp. (°F) |
| Temp. (°F)+460 | 1 | Abs. temp. (°F) |
| Temp. (°F)-32 | 5/9 | Temp (°C) |
| Tons (metric) | 10^3 | Kilograms |
| Tons (metric) | 2205 | Pounds |
| Tons (short) | 2000 | Pounds |
| Tons (short) | 32,000 | Ounces |
| Tons (short) | 907.1843 | Kilograms |
| Tons (short) | 0.89287 | Tons (long) |
| Tons (short) | 0.90718 | Tons (metric) |
| Tons of water/24 hrs. | 83.333 | Pounds water/hr. |
| Tons of water/24 hrs. | 0.16643 | Gallons/min. |
| Tons of water/24 hrs. | 1.3349 | Cu. ft./hr. |
| Watts | 0.05686 | B.T.U./min. |
| Watts | 44.25 | Foot-lbs./min. |
| Watts | 0.7376 | Foot-lbs./sec. |
| Watts | 1.341×10^{-3} | Horsepower |
| Watts | 0.01434 | Kg.-calories/min. |
| Watts | 10^{-3} | Kilowatts |
| Watt-hours | 3.414 | B.T.U. |
| Watt-hours | 2655 | Foot-lbs. |
| Watt-hours | 1.341×10^{-3} | Horsepower-hrs. |
| Watt-hours | 0.8604 | Kilogram-calories |
| Watt-hours | 367.1 | Kilogram-meters |
| Watt-hours | 10^{-3} | Kilowatt-hours |
| Yards | 91.44 | Centimeters |
| Yards | 3 | Feet |
| Yards | 36 | Inches |
| Yards | 0.9144 | Meters |

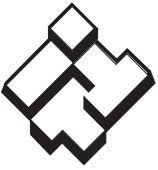


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GOULDS PUMPS Residential Water Systems

Jet Pumps Typical Installations

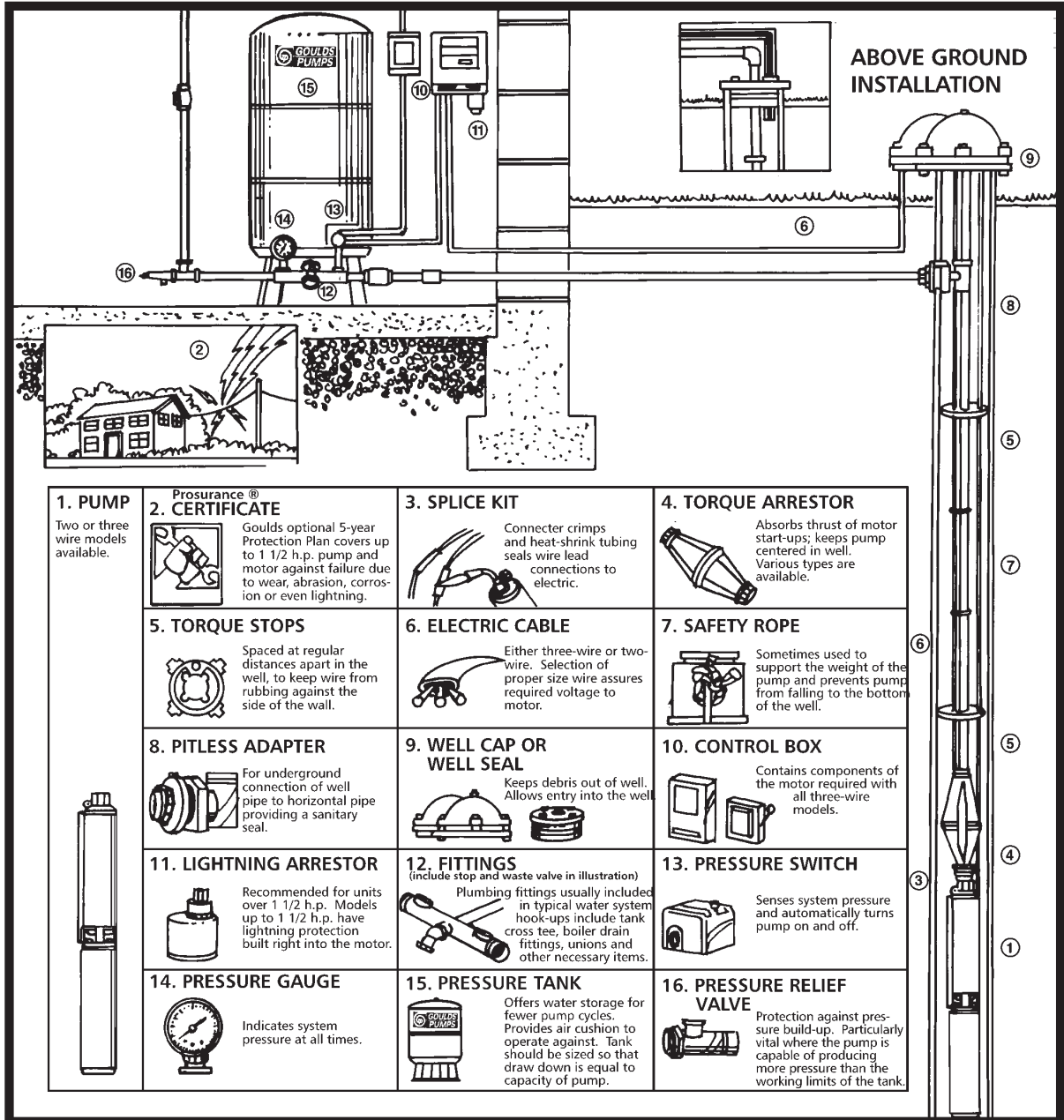




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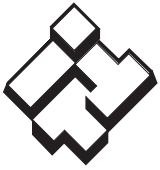
GOULDS PUMPS Residential Water Systems

4" Submersibles Typical Installations



| | | | |
|--|---|---|---|
| 1. PUMP Two or three wire models available. | 2. CERTIFICATE Prosurance® Goulds optional 5-year Protection Plan covers up to 1 1/2 h.p. pump and motor against failure due to wear, abrasion, corrosion or even lightning. | 3. SPLICE KIT Connector crimps and heat-shrink tubing seals wire lead connections to electric. | 4. TORQUE ARRESTOR Absorbs thrust of motor start-ups; keeps pump centered in well. Various types are available. |
| 5. TORQUE STOPS Spaced at regular distances apart in the well, to keep wire from rubbing against the side of the wall. | 6. ELECTRIC CABLE Either three-wire or two-wire. Selection of proper size wire assures required voltage to motor. | 7. SAFETY ROPE Sometimes used to support the weight of the pump and prevents pump from falling to the bottom of the well. | 8. PITLESS ADAPTER For underground connection of well pipe to horizontal pipe providing a sanitary seal. |
| 9. WELL CAP OR WELL SEAL Keeps debris out of well. Allows entry into the well. | 10. CONTROL BOX Contains components of the motor required with all three-wire models. | 11. LIGHTNING ARRESTOR Recommended for units over 1 1/2 h.p. Models up to 1 1/2 h.p. have lightning protection built right into the motor. | 12. FITTINGS (include stop and waste valve in illustration) Plumbing fittings usually included in typical water system hook-ups include tank cross tee, boiler drain fittings, unions and other necessary items. |
| 13. PRESSURE SWITCH Senses system pressure and automatically turns pump on and off. | 14. PRESSURE GAUGE Indicates system pressure at all times. | 15. PRESSURE TANK Offers water storage for fewer pump cycles. Provides air cushion to operate against. Tank should be sized so that draw down is equal to capacity of pump. | 16. PRESSURE RELIEF VALVE Protection against pressure build-up. Particularly vital where the pump is capable of producing more pressure than the working limits of the tank. |

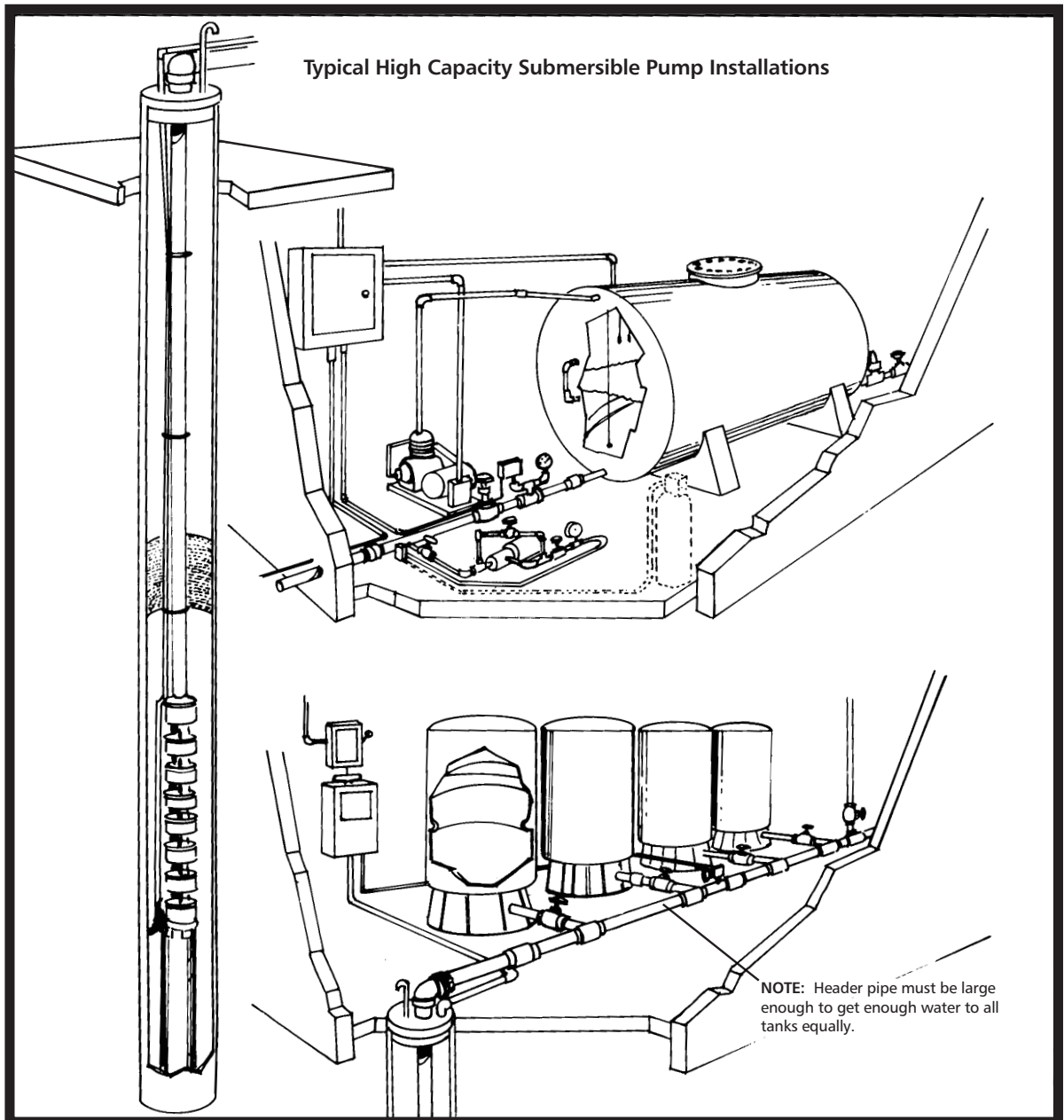
Typical Goulds Submersible Pump Installations

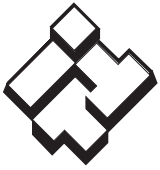


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GOULDS PUMPS
Residential Water Systems

High Capacity Submersible Pumps Typical Installations



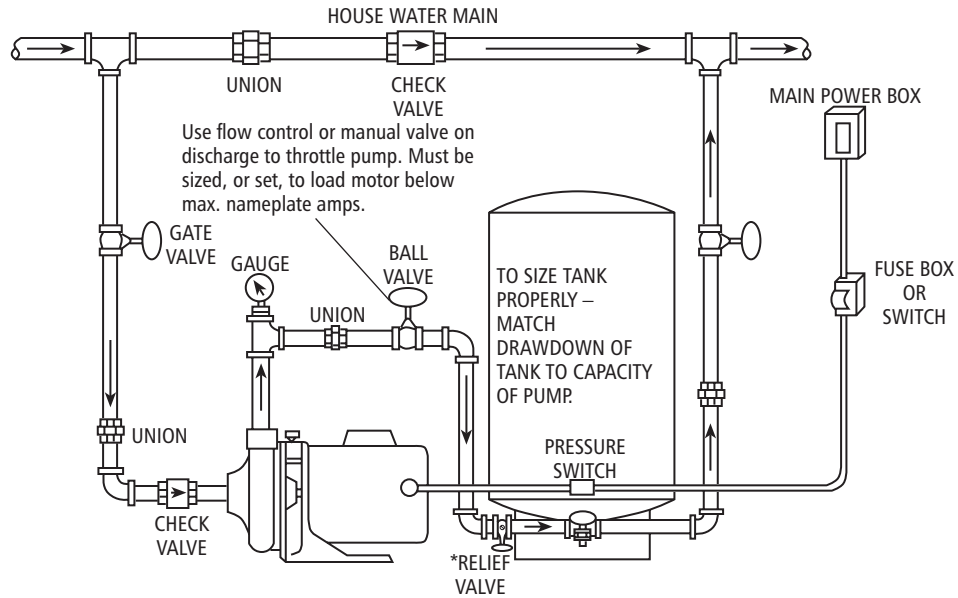


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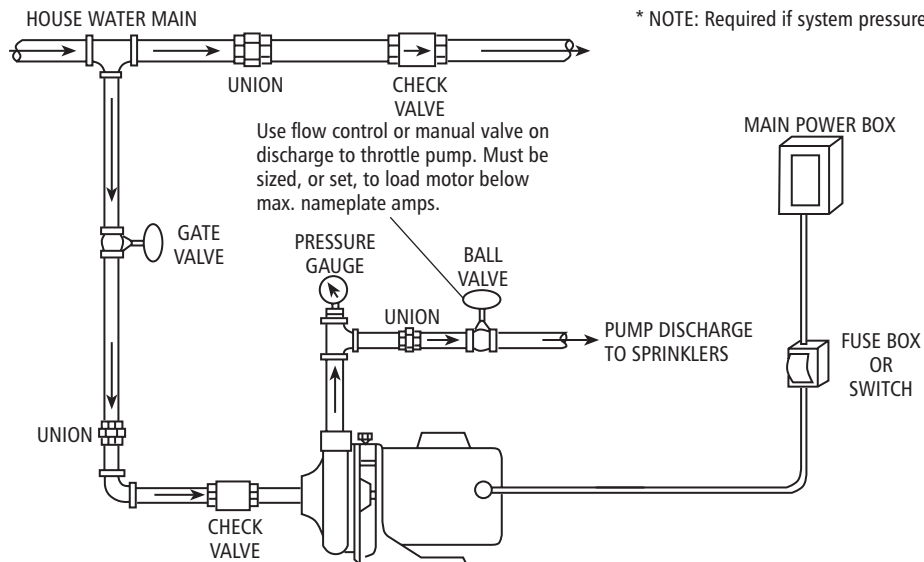
GOULDS PUMPS Residential Water Systems

Centrifugal Booster Pump Installations

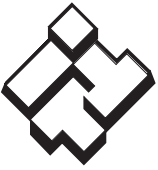
AUTOMATIC OPERATION



MANUAL OPERATION



* NOTE: Required if system pressure can exceed 100 PSI.



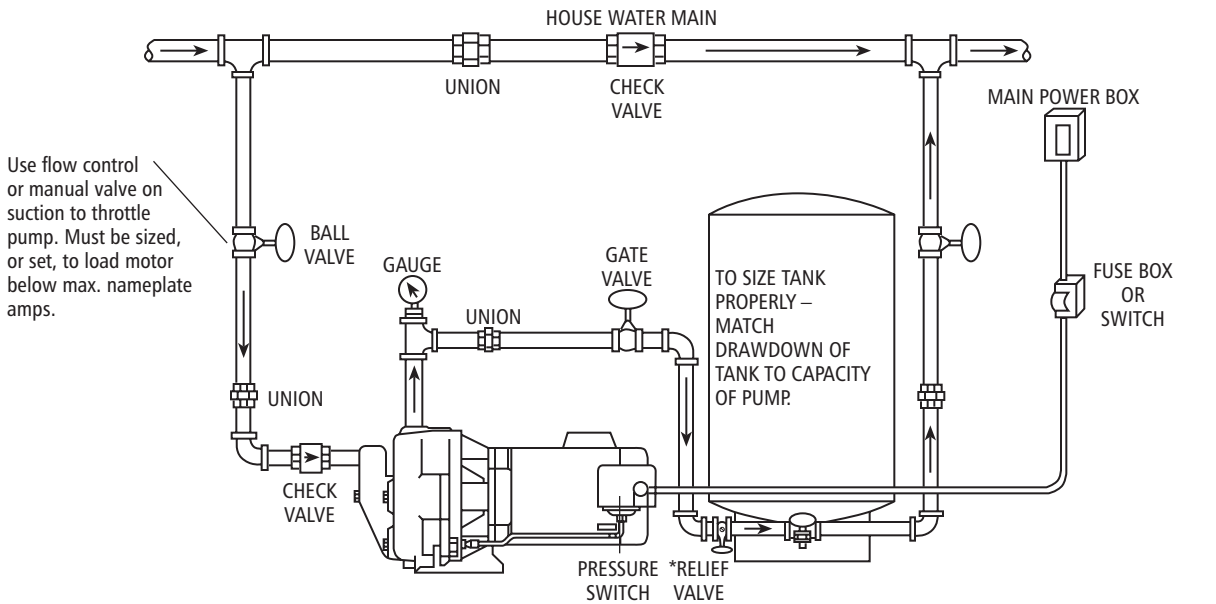
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GOULDS PUMPS Residential Water Systems

Jet Booster Pump Installations

AUTOMATIC OPERATION

JET PUMP - SHALLOW WELL OR CONVERTIBLE WITH INJECTOR



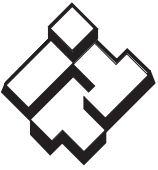
* NOTE: Required if system pressure can exceed 100 PSI.

SIZING THE BOOSTER PUMP

Booster system pumps are sized the same as shallow well jet pumps with the exception being, we add the incoming city pressure to what the pump provides. The required flow is determined by the number of bathrooms or number of fixtures being used at any given time. City water is supplied under pressure, low incoming pressure is caused by undersized, crushed or severely corroded pipes or large elevation differences, such as a hill, between the city water line and the house.

Verify the incoming pressure with the water flowing to find the "dynamic suction pressure", static pressure is what you see with no water flowing. Use the dynamic suction pressure to calculate pump performance and selection. The J5S and the high pressure version, J5SH are very popular as booster pumps. The J5SH is a good choice for booster applications because of its narrow flow range and higher pressure capability. In the absence of performance data for 0' we use the 5' Total Suction Lift performance data. Add the incoming dynamic pressure to the pump's discharge pressure to find the total discharge pressure. Make a chart showing the flow, incoming dynamic pressure, pump discharge pressure and total discharge pressure for each job. It would look like this if using a J5SH pump with 15 PSI of incoming dynamic pressure:

| Flow Rate GPM | Pump Discharge Pressure (PSI) | Incoming Dynamic Pressure (PSI) | Total Discharge Pressure (PSI) |
|------------------|----------------------------------|------------------------------------|-----------------------------------|
| 11.5 | 20 | 15 | 35 |
| 11.3 | 30 | 15 | 45 |
| 11 | 40 | 15 | 55 |
| 7.7 | 50 | 15 | 65 |
| 4.8 | 60 | 15 | 75 |
| 0 | 83 | 15 | 98 |



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GOULDS PUMPS Residential Water Systems

Pipe Volume and Velocity

STORAGE OF WATER IN VARIOUS SIZE PIPES

| Pipe Size | Volume in Gallons per Foot | Pipe Size | Volume in Gallons per Foot |
|-----------|----------------------------|-----------|----------------------------|
| 1¼ | .06 | 6 | 1.4 |
| 1½ | .09 | 8 | 2.6 |
| 2 | .16 | 10 | 4.07 |
| 3 | .36 | 12 | 5.87 |
| 4 | .652 | | |

MINIMUM FLOW TO MAINTAIN 2FT./SEC. *SCOURING VELOCITY IN VARIOUS PIPES

| Pipe Size | Minimum GPM | Pipe Size | Minimum GPM |
|-----------|-------------|-----------|-------------|
| 1¼ | 9 | 6 | 180 |
| 1½ | 13 | 8 | 325 |
| 2 | 21 | 10 | 500 |
| 3 | 46 | 12 | 700 |
| 4 | 80 | | |

* Failure to maintain or exceed this velocity will result in clogged pipes. Based on schedule 40 nominal pipe.

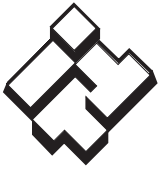
STORAGE OF WATER IN VARIOUS SIZES OF WELLS

$$\frac{D^2}{24.5} = \text{Gals. of Storage per Foot}$$

Where: D = Inside diameter of well casing in inches

Examples:

| | |
|--|--|
| 2" Casing = .16 Gals. per ft. Storage | 8" Casing = 2.6 Gals. per ft. Storage |
| 3" Casing = .36 Gals. per ft. Storage | 10" Casing = 4.07 Gals. per ft. Storage |
| 4" Casing = .652 Gals. per ft. Storage | 12" Casing = 5.87 Gals. per ft. Storage |
| 5" Casing = 1.02 Gals. per ft. Storage | 14" Casing = 7.99 Gals. per ft. Storage |
| 6" Casing = 1.4 Gals. per ft. Storage | 16" Casing = 10.44 Gals. per ft. Storage |



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GOULDS PUMPS Residential Water Systems

Jet Pump Motor Data and Electrical Components

GOULDS PUMPS AND A.O. SMITH MOTOR DATA

| GP Number | Where Used | A.O. Smith | HP | Volts | Phase | Service Factor | Max. Load Amps | Watts | Circuit Breaker |
|------------|----------------------------------|---------------|----|---------|-------|----------------|----------------|-------|-----------------|
| J04853 | J05, HB705 | C48J2DB11C3HF | ½ | 115/230 | 1 | 1.6 | 10.8/5.4 | 880 | 25/15 |
| J05853 | JL07N, HJ07, XSH07, HB | C48K2DB11A4HH | ¾ | 115/230 | 1 | 1.5 | 14.8/7.4 | 1280 | 30/15 |
| J06853 | JL10N, HJ10, SJ10, XSH10, HB | C48L2DB11A4HH | 1 | 115/230 | 1 | 1.4 | 16.2/8.1 | 1440 | 30/20 |
| J07858 | HJ15, SJ15, HB, XSH15 | C48M2DB11A1HH | 1½ | 115/230 | 1 | 1.3 | 20.0/10.0 | 1866 | 40/20 |
| J08854 | HJ20, HSC20, XSH20 | K48N2DB11A2HH | 2 | 115/230 | 1 | 1.2 | 22.6/11.3 | 2100 | 25/15 |
| ② J09853 | XSH30, GT30 | C56P2U11A3HH | 3 | 230 | 1 | 1.15 | 17.2 | 3280 | 30 |
| ② J04853L | J5(S), GB | C48A93A06 | ½ | 115/230 | 1 | 1.6 | 10.8/5.4 | 968 | 25/15 |
| ② J05853L | J7(S), GB, GT07, (H)SJ07, HSC07 | C48A94A06 | ¾ | 115/230 | 1 | 1.5 | 14.8/7.4 | 1336 | 30/15 |
| ② J06853L | J10(S), GB, GT10, (H)SJ10, HSC10 | C48A95A06 | 1 | 115/230 | 1 | 1.4 | 16.2/8.1 | 1592 | 30/20 |
| ② J07858L | J15(S), GB, GT15, HJ15, HSC15 | C48M2DC11A1 | 1½ | 115/230 | 1 | 1.3 | 21.4/10.7 | 1950 | 40/20 |
| ①② J08854L | HJ20, GB, GT20, HSC20 | K48A34A06 | 2 | 230 | 1 | 1.2 | 12.9 | 2100 | 25 |
| SFJ04853 | JB05 | S48A90A06 | ½ | 115/230 | 1 | 1.6 | 9.4/4.7 | 900 | 20/10 |
| SFJ05853 | JB07 | C48A77A06 | ¾ | 115/230 | 1 | 1.5 | 13.6/6.8 | 1160 | 25/15 |
| SFJ06853 | JB10 | C48A78A06 | 1 | 115/230 | 1 | 1.4 | 15.8/7.9 | 1400 | 30/20 |
| ② SFJ04860 | JRS5, JRD5, JB05 | C48C04A06 | ½ | 115/230 | 1 | 1.6 | 12.6/6.3 | 990 | 25/15 |
| ② SFJ05860 | JRS7, JRD7, JB07 | C48C05A06 | ¾ | 115/230 | 1 | 1.5 | 14.8/7.4 | 1200 | 30/15 |
| ② SFJ06860 | JRS10, JRD10, JB10 | C48C06A06 | 1 | 115/230 | 1 | 1.4 | 16.2/8.1 | 1400 | 30/20 |

① Effective July, 1998, 230 V only.

② Current production motor

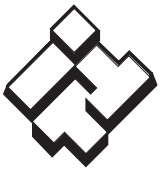
ELECTRICAL COMPONENTS

| GP Motor Model | A.O. Smith Motor Model | Motor Overload with Leads | | | Run Capacitor and MFD | Start Capacitor MFD Rating | Switch ^⑤ |
|----------------|------------------------|---------------------------|--------------|-------------|-----------------------|----------------------------|---------------------|
| | | ④ Old Number | ③ New Number | T.I. Number | | | |
| J04853 | C48J2DB11C3HF | 614246 71 | | MET38ABN | | 610807 1: 124/148 | 629002 2 |
| J05853 | C48K2DB11A4HH | 614246 20 | | CET63ABN | | 610807 2: 161/192 | 629002 2 |
| J06853 | C48L2DB11A4HH | 614246 9 | | CET52ABN | | 610807 2: 161/192 | 629002 2 |
| J07858 | C48M2DB11A1HH | 614246 79 | | CET38ABM | | 610807 2: 161/192 | 629002 2 |
| J08854 | K48N2DB11A2HH | 611307 29 | | BRT44ABM | 614529 4: 25 | 610807 1: 124/148 | 629002 2 |
| J09853 | C56P2U11A3HH | 611106 22 | 611106 36 | BRB2938 | | 610807 32: 189/227 | 629002 2 |
| J04853L | C48A93A06 | 614246 98 | 627121 43 | MET39ABN-CL | | 610807 1:124/148 | 629002 2 |
| J05853L | C48A94A06 | 614246 20 | 627121 38 | CET63ABN | | 610807 2:161/192 | 629002 2 |
| J06853L | C48A95A06 | 614246 9 | 627121 7 | CET52ABN | | 610807 2:161/192 | 629002 2 |
| J07858L | C48C53A06 | | 611123 21 | BRT45ABM | | 610807 7:189/227 | 629002 2 |
| J08854L | K48A34A06 | 616861 10 | 627119 10 | CET31ABN | 623450 8: 30 | 610807 33: 64-77 | 629002 2 |
| SFJ04853 | S48A90A06 | 621863 1 | | MEJ38ABN | | N/A | 3945C91A01 |
| SFJ05853 | C48A77A06 | 621863 4 | | CET55ABN | | 610807 2: 161/192 | 3945C91A01 |
| SFJ06853 | C48A78A06 | 621863 5 | | CET49ABN | | 610807 2: 161/192 | 3945C91A01 |
| SFJ04860 | C48C04A06 | 614246 67 | 627121 48 | MET36ABN | | 610807 2: 161/192 | 629002 2 |
| SFJ05860 | C48C05A06 | 614246 20 | 627121 38 | CET63ABN | | 610807 2: 161/192 | 629002 2 |
| SFJ06860 | C48C06A06 | 614246 9 | 627121 7 | CET52ABN | | 610807 2: 161/192 | 629002 2 |

③ These new overload part numbers are for use with the new plastic terminal board with the quick change voltage plug.

④ Use this suffix if your motor has the old style brown terminal board without quick change voltage plug.

⑤ 629002 2 replaces 614234 1, 2, and 6.



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GOULDS PUMPS Residential Water Systems

Jet Pump Motor Wiring A.O. Smith Motors

TERMINAL BOARD AND VOLTAGE CHANGE PLUG

A change has been made to use a new terminal board on the A.O. Smith two compartment motor models. This terminal board is used on both dual voltage and single voltage motors.

FEATURES

■ **Voltage Plug:** Dual voltage motors use a voltage plug that retains the terminals for the Black and Black Tracer leads. To change voltage, lift the black plug and align the arrow with the desired voltage on terminal board. See Figure 1 for an example of the dual voltage connection diagram.

■ **Screws with 1/4" drive:** The terminal screw accepts either a 1/4" nut driver or a slotted screw driver.

■ **Line Wire Connection:** The space under the screw will accept #16, #14, #12, #10, or #8 wire. The rib at the bottom edge of the screw allows the wire to be placed straight into the space under the screw. This rib retains the wire under the head of the screw and for #12, #10, or #8 wire it is not necessary to wrap the wire around the screw.

■ 1/2 HP wired 115 V, 3/4 HP and up wired 230 V at factory.

■ **Quick Connect Terminals:** Each terminal has provision for 1/4" quick connect terminals in addition to the screw.

■ **Molded Plastic Material:** The terminal board is made from an extremely tough white plastic material with L1, L2, and A markings molded into the board.

■ **Lead Channel:** A channel adjacent to the conduit hole directs wiring to the top of the board.

■ **Governor Guard:** An integral backplate prevents leads from entering the area around the governor.

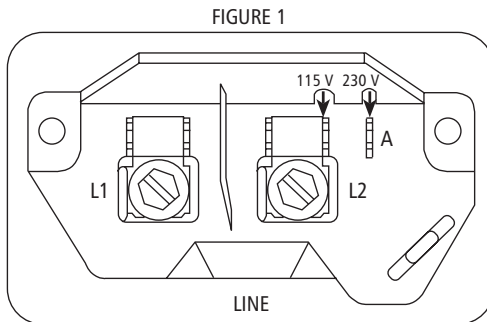
■ **Ground Guard:** To prevent the bare ground wire from touching the "live" L2 terminal, the ground wire must be placed above this guard.

VOLTAGE CHANGES ARE MADE INSIDE THE MOTOR COVER NOT IN THE PRESSURE SWITCH.

WARNING:
DISCONNECT POWER SOURCE BEFORE CHECKING. DO NOT MAKE ANY CHANGES WITH POWER ON.

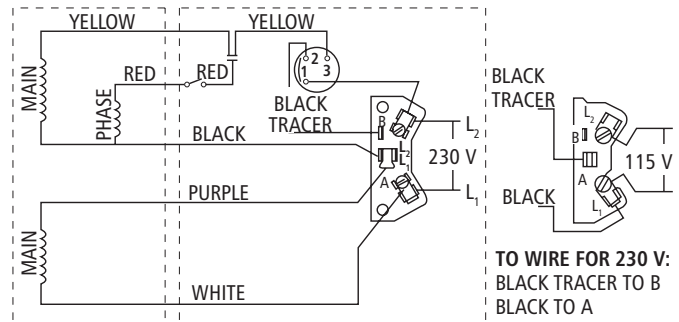
CAPACITOR START INDUCTION RUN – SINGLE SPEED (NEW STYLE – AFTER APRIL, 1999)

CAPACITOR START INDUCTION RUN – SINGLE SPEED (OLD STYLE – UP TO APRIL, 1999)



○ GRD ● Green (Ground)

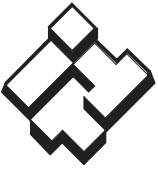
Align black plug to 115 V or 230 V arrow.
1/2 HP wired 115 V, 3/4 HP and up wired 230 V at factory.



TO WIRE FOR 230 V:
BLACK TRACER TO B
BLACK TO A

TO WIRE FOR 115 V:
BLACK TRACER TO A
BLACK TO L₁

"Black Tracer" is a black and white wire



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GOULDS PUMPS Residential Water Systems

Emerson Motor Wiring

115/230 VOLTAGE CONNECTIONS

115 Voltage

Black — A
 Wht./Blk. Tracer — 1
 Line 1 — 2
 Line 2 — A
 (Blue — 3)

230 Voltage

Black — 1
 Wht./Blk. Tracer — B
 Line 1 — 2
 Line 2 — A
 (Blue — 3)

TO CHANGE MOTOR VOLTAGE:

Models without a Switch

115V to 230V

Move Wht./Blk. tracer to B
 Move Blk. to 1

230V to 115V

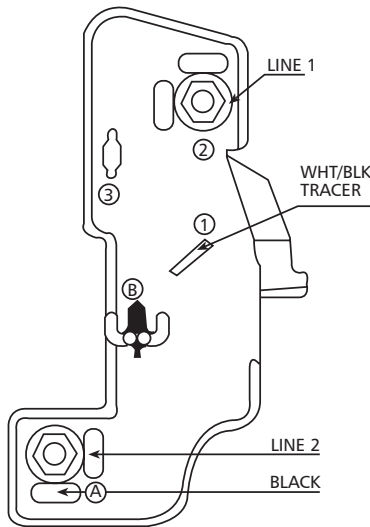
Move Blk. to A
 Move Wht./Blk. tracer to 1

Models with Voltage Change Switch

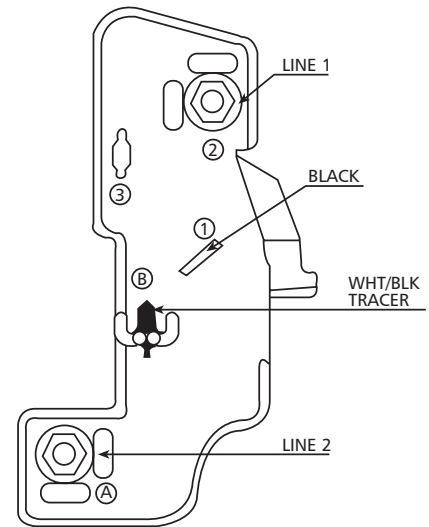
- Move toggle switch between 115V or 230V.

CONNECTIONS

115 VOLTAGE



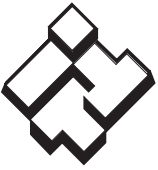
230 VOLTAGE



- A – has 2 male connectors and 1 screw connector
- 2 – has 2 male connectors and 1 screw connector
- B – is a dummy terminal used to hold the Wht./Blk. Tracer for 230V wiring

Motor is non-reversible CCW rotation shaft end.

Supply connections, use wires sized on the basis of 60°C ampacity and rated minimum 90°C.

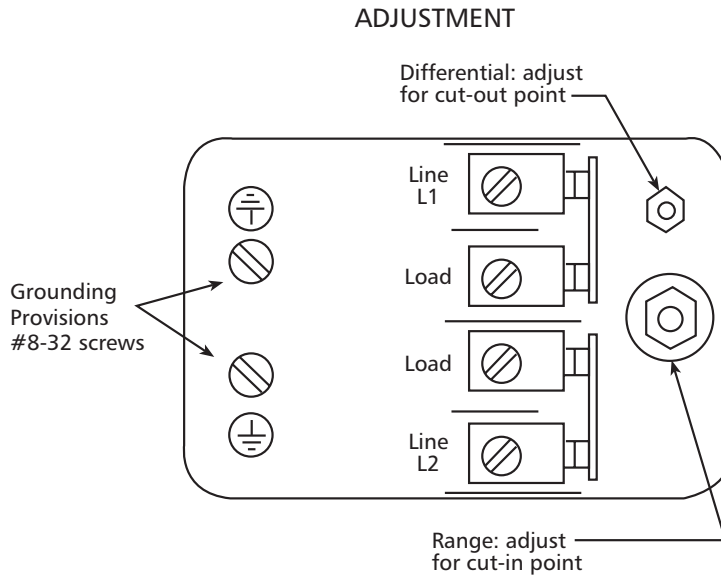


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Pressure Switch Wiring and Adjustments

SQUARE "D" SWITCHES

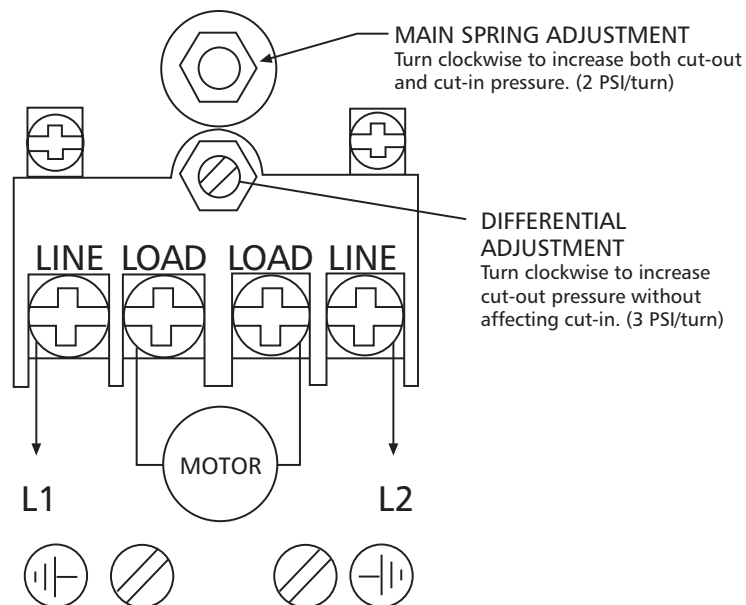


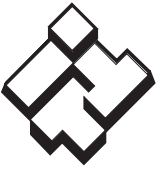
Adjust in proper sequence:

1. CUT-IN: Turn nut down for higher cut-in pressure, or up for lower cut-in.
2. CUT-OUT: Turn nut down for higher cut-out pressure, or up for lower cut-out.

CAUTION: TO AVOID DAMAGE, DO NOT EXCEED THE MAXIMUM ALLOWABLE SYSTEM PRESSURE. CHECK SWITCH OPERATION AFTER RESETTING.

HUBBELL (FURNAS) PRO CONTROL SWITCH



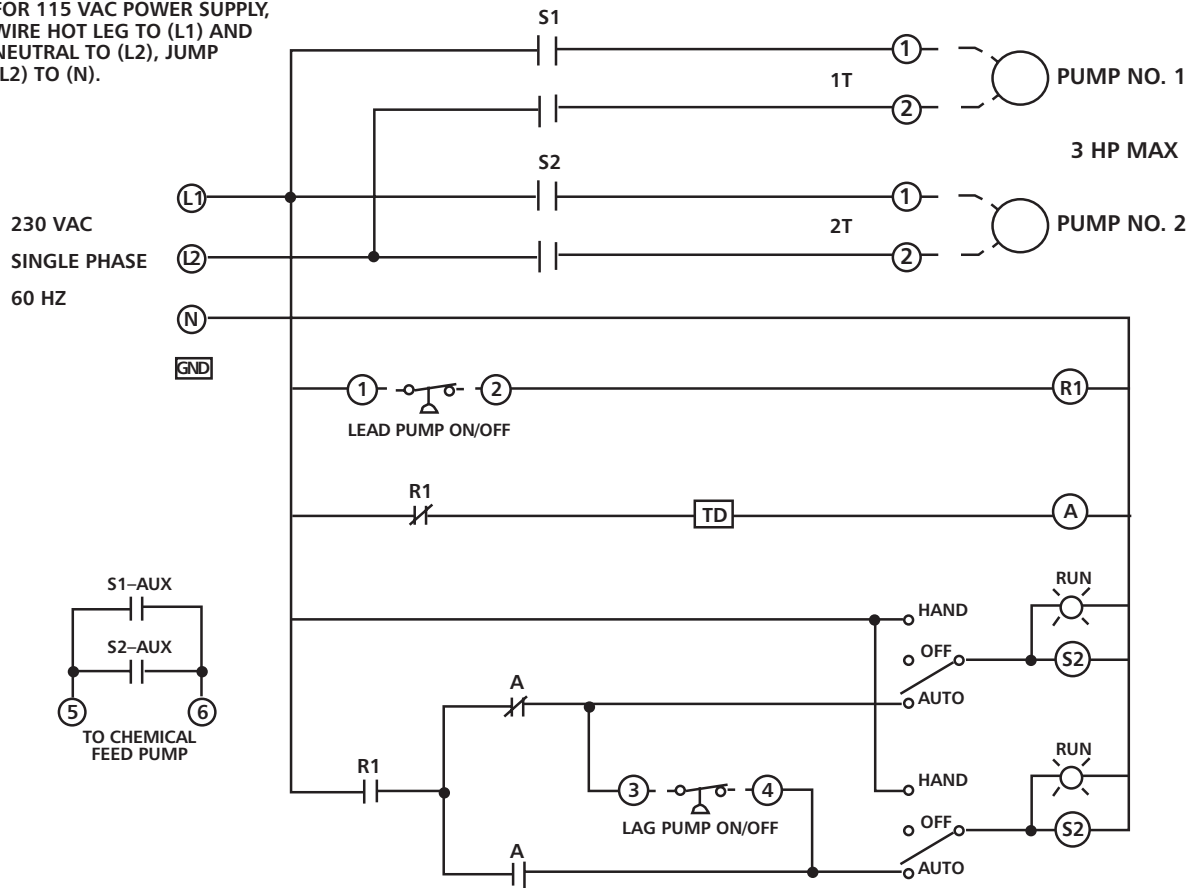


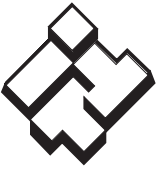
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Wiring Diagrams AWA501/AWA502

FACTORY WIRED FOR 230 VAC.
FOR 115 VAC POWER SUPPLY,
WIRE HOT LEG TO (L1) AND
NEUTRAL TO (L2), JUMP
(L2) TO (N).



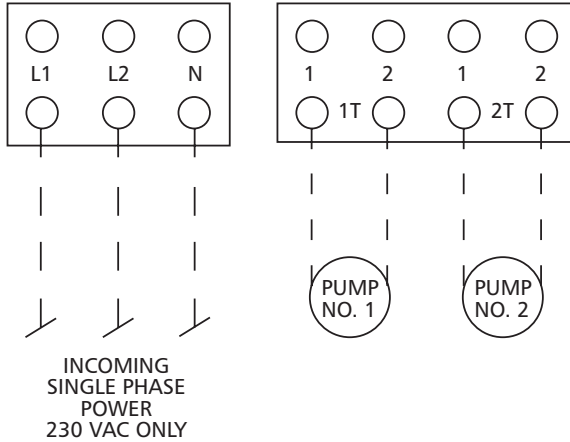


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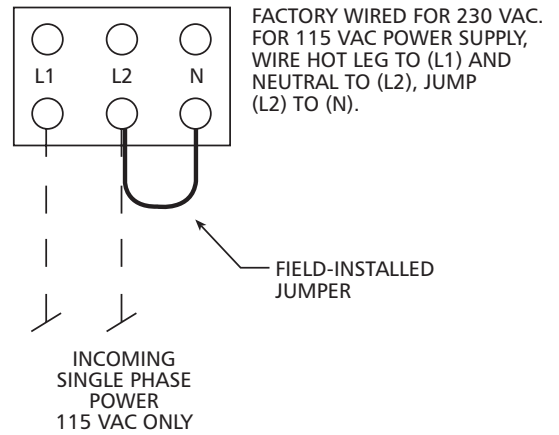
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Wiring Diagrams Power/Pump Connections: AWA501/AWA502

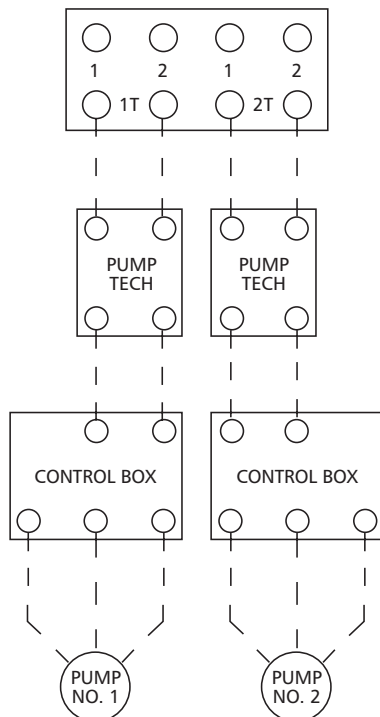
POWER CONNECTION 230 VOLT AWA501, AWA502



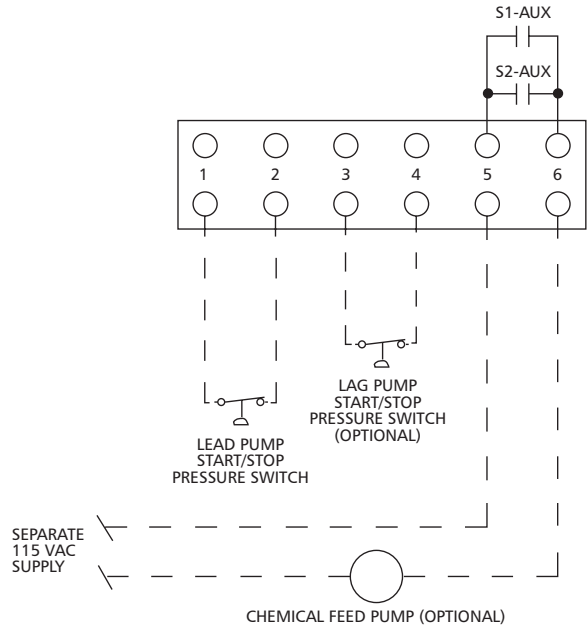
POWER CONNECTION AWA501 115 VOLT

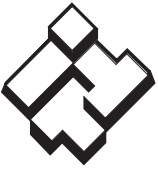


OPTIONAL FRANKLIN CONTROL BOX AND PUMPTEC WITH AWA501 AND AWA502 ONLY



FIELD CONNECTIONS: AWA501, AWA502





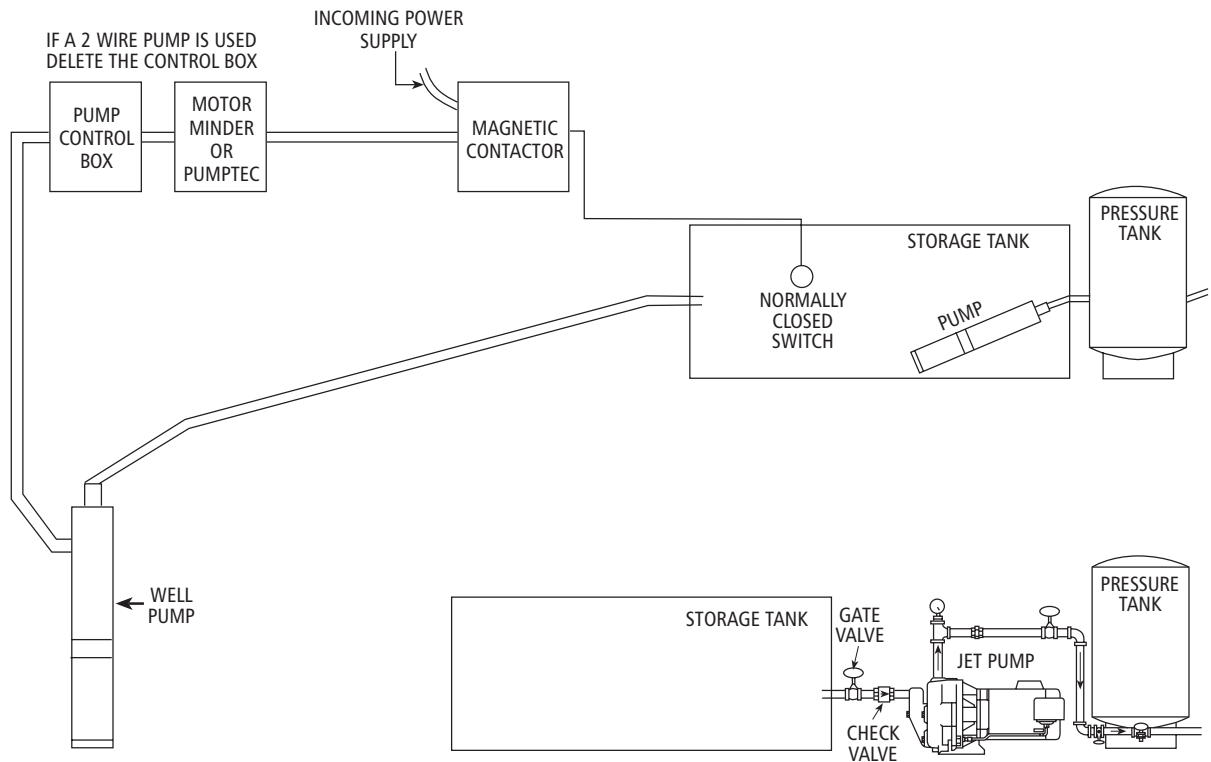
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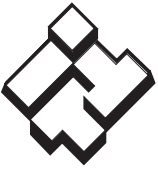
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Low Yield Well Components

COMPONENTS FOR A LOW YIELD WELL WITH A BOOSTER SYSTEM

- Submersible or jet pump to fill atmospheric tank
- Storage tank - usually at least a 500 gallon size
- Magnetic contactor - makes wiring simple and fast
- Normally closed float switch for automatic operation
- Booster pump - sub or jet to pressurize water from storage tank
- Pressure tank sized for 1 minute minimum pump cycle
- Pressure switch
- Check valve and gate valve between the open storage tank and jet pump, or a gate valve between the submersible and pressure tank



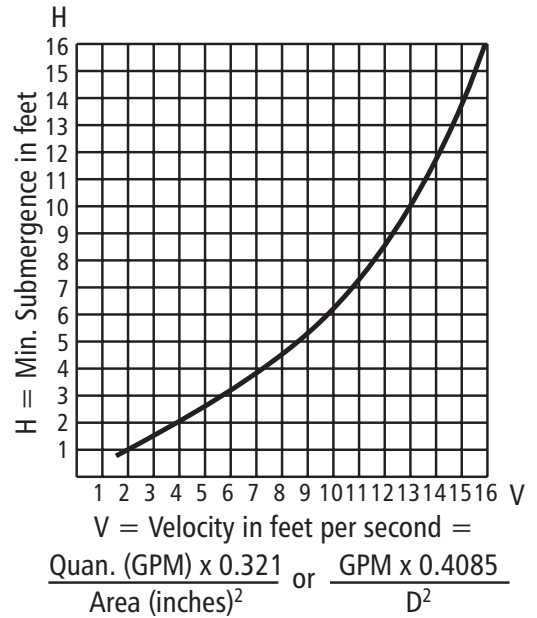
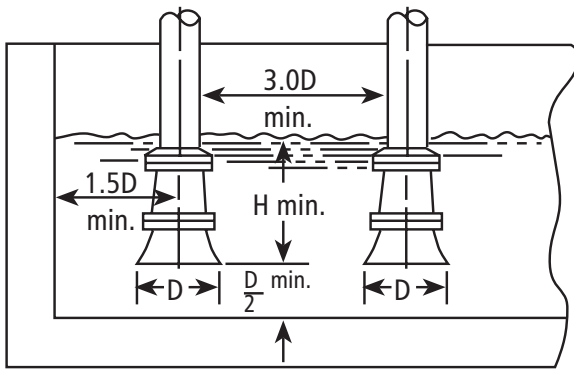
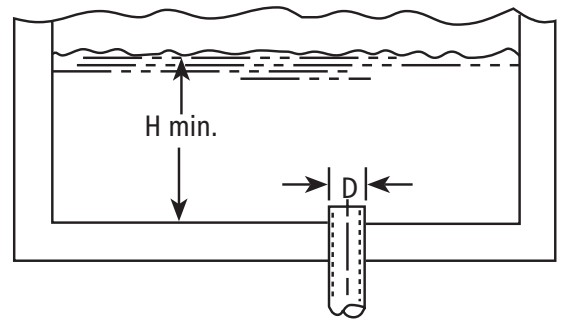
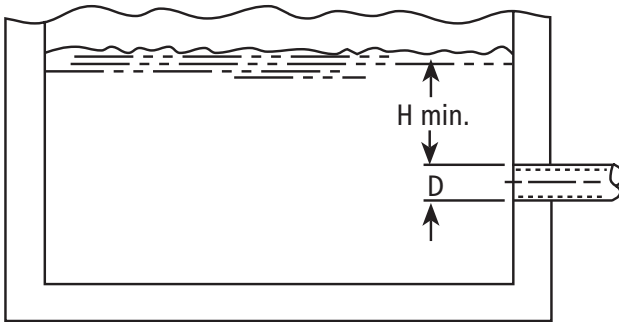


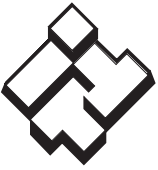
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To Prevent a Suction Vortex

- Insure that the size and minimum liquid submergence, over the suction inlet, is sufficient to prevent air from entering suction through a suction vortex. See typical intake piping arrangement in following diagrams.





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GOULDS PUMPS Residential Water Systems

Operation and Maintenance Submersible Pump Check Valves

OPERATION

Flomatic check valves are designed to give years of trouble free operation without maintenance when properly installed and in a properly selected pumping application with regards to flow and maximum system pressures.

CONSTRUCTION

The Flomatic check valve body has been constructed to handle the rated system flow and pressures as stated and in addition support the weight of the submersible pump, pipe and the water in the riser pipe. In addition the valves have been uniquely designed to absorb some of the hydraulic water shocks associated with well water pumping when the check valve installation instruction are followed below.

IMPORTANT INSTALLATION INSTRUCTIONS

If the installation instructions are not followed warranty or any warranty claims may be void.

NOTE: On initial system start-up gradual priming of vertical water column is recommended to avoid valve damage due to water shock.

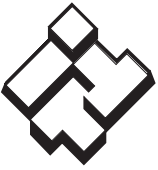
It is very important to install a check valve properly to help insure a trouble free water system. If the installation instructions are not followed warranty or any warranty claims may be void. On the back of this page is a diagram of a typical submersible valve installation (Fig. 1). For the CL valves please refer to Certa-Loks Installation instructions.

- A. Pipe flow:** When selecting a submersible check valve insure that the valve is sized properly to flows normally not to exceed 10 feet per second. Higher flow velocities will increase friction losses, hydraulic shocks and the possibility of destructive water hammer (explained below in more detail) leading to severe system failure.
- B. System pressure:** It is important to take the total system hydraulics into the calculation and not only the pump's well setting when selecting valve type and model. In general Flomatic valves are pressure rated 400psi or 920 feet of water pressure. This does not mean that a valve can be set at a well depth of 920 feet. To elevate and reduce the hydraulic shocks in the riser pipe it is recommended that a check valve be installed every 200 feet in the riser pipe. See Recommend Check Valve Installation chart below.
- C. Prior to installing check valve:** Make sure that the check valve is free from defects and that the valve's spring-loaded poppet mechanism is operating freely. Remove any foreign material (IE. PIPE DOPE) from valve seat.
- D.** Install check valve vertically with arrow pointed up in direction of liquid flow.
- E.** In submersible pump applications, the first check valve should be installed directly on the discharge head of the pump or maximum one pipe length (20 feet) above pump.
- F.** If the pump has a built-in check valve, the second check valve should be installed no more than 25 feet above the lowest pumping level in the well

| Submersible pump setting in well | Recommended Check Valve Installation | Type Check Valve |
|---|--|--|
| 200 feet or less | One check valve on pump discharge and one on surface of well. | Series 80E, 80SS, 80S6, 80DI, 80MDI, 80DIX, 100E, 100MP, 100SS |
| 200 feet to 600 feet | One check valve on pump discharge and additional check valves installed at maximum 200ft intervals and one at the surface of well. | Series 80E, 80SS, 80S6, 80DI, 80MDI, 80DIX, 100E, 100MP, 100SS |
| 600 feet to 800 feet For deeper settings contact factory | One check valve on pump discharge and additional check valves installed at maximum 200ft intervals and one at the surface of well. | Series 80SS, 80S6, 80DI, 80MDI, 80DIX, 100E, 100SS |

Note: 3" – 10" DIX valves may be used vertically or horizontally all others contact factory.

12" DIX is designed for vertical installation ONLY



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Residential Water Systems

Operation and Maintenance Submersible Pump Check Valves **WATER HAMMER**

Water pumped and flowing through a piping system has a certain amount of energy (weight x velocity). If the pumping is stopped, the water continues to move and its remaining energy must be absorbed in some way. This absorption of energy can sometimes create undesirable noise and/or damage. This is called water hammer.

Water hammer can destroy piping systems, valves and related equipment. Water hammer varies in intensity depending on the velocity with which the water is traveling when the pump shuts down. It is very important for the installer to realize water hammer potential, and he must take this into consideration when sizing the system and deciding what material the valves should be made from.

It has been proven that for every foot per second of velocity 54 psi of backpressure is created. This means, in a 1" pipe, a flow of only 10 gpm could create a back pressure of 370 psi or more when the pump shuts down and the water column reverses. In a 4" pipe, a flow of 350 gpm could create a backpressure of 860 psi. This does not take in consideration the weight of the water column in the well. Flomatic valves are designed to help lessen the sometimes-damaging effects of water hammer on piping and related equipment.

Check valve installation instructions provided courtesy of Danfoss Flomatic Corp.

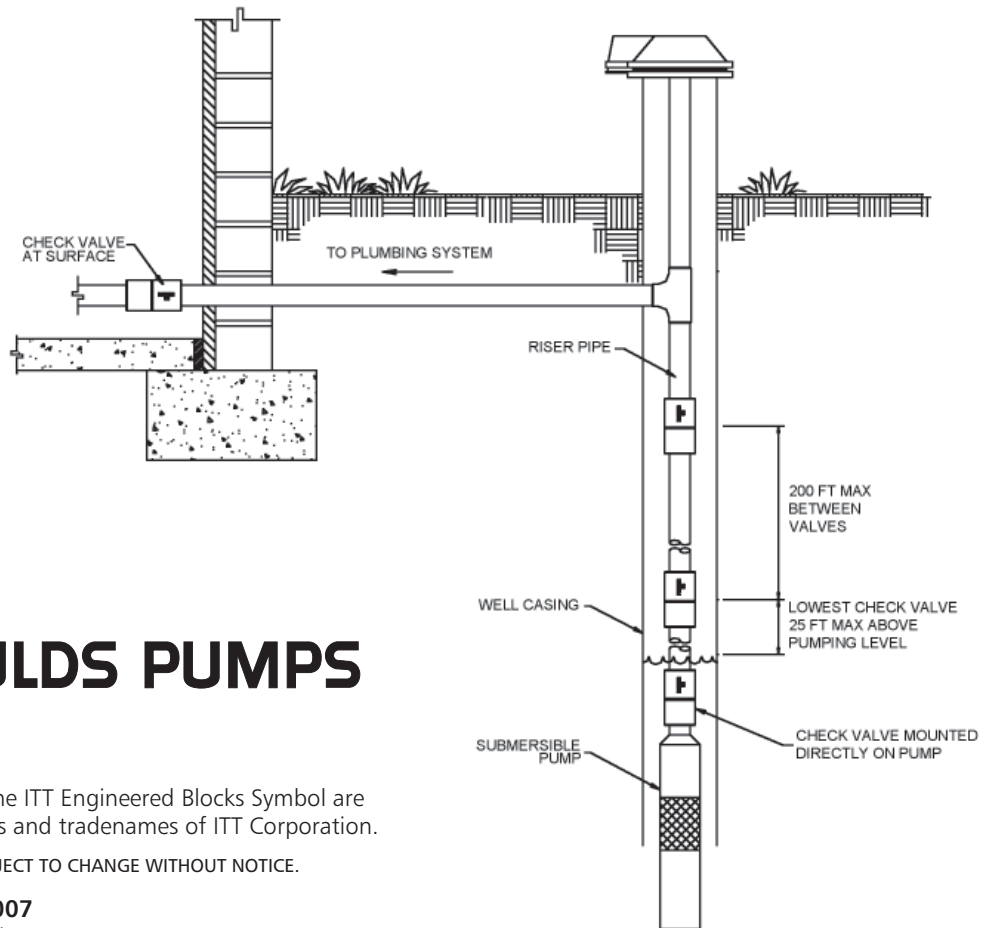


Figure 1



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TTECHWP April, 2007

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Engineered for life