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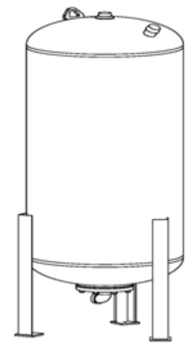
# TECHNICAL BULLETIN

Form 002

# Sizing and Selection Guide



## ASME Bladder Type Hydro-Pneumatic Tanks For Potable Water Systems

### APPLICATION

ASME Bladder Type Hydro-Pneumatic Tanks can be used in a variety of applications ranging from well water and pressure boosting systems to sprinkler systems. The tanks control system shock and pressure fluctuations and provide pump protection by reducing surge pressures and by dampening pressure spikes. The tanks deliver water under pressure between pump cycles to meet the required demand. By minimizing pump starts the benefits include extended pump motor service life and energy cost savings.

These tanks utilize a flexible full acceptance butyl rubber bladder to separate the incoming water from the compressible air cushion. Butyl has proven superior for application with water storage tanks for several reasons:

1. The bladder can be flexed repeatedly with little wear or stress during normal operation.
2. The material does not foster bacterial growth.
3. The material has a very low air permeability characteristic.
4. The material generally does not impart taste and odor into the treated water.

### OPERATION

The air charge pressure in the tank is typically set 2 PSI below the pressure switch pump cut-in pressure or 10% to 20% below the system pressure for surge applications. Upon operation of the system, water is pumped into the flexible bladder in the tank. As the bladder fills with water the air cushion is compressed, causing a rise in the pressure in the system. The pressure continues to rise until it reaches the desired maximum system pressure (pump cut-out setting), causing the pump to shut off. Water remains in the system piping and the tank until required. As water is drawn down from the system, the air pressure in the tank decreases. When the system pressure reaches the minimum pressure setting (pump cut-in setting), the pump will turn on and start the cycle again.

### SIZING

Proper tank sizing requires a basic understanding of compressible gases – in this case, air. If a gas is held in a sealed container at constant temperature, the gas pressure increases at the same rate as the volume of the gas is reduced. As water fills the bladder, the volume of the air cushion is reduced. As the volume is reduced, the pressure will rise. If the air cushion is reduced to half its original volume, the pressure will rise to two times its original value. If the air cushion is further squeezed to one-third of its original volume, the pressure will rise to 3 times the original value.

Boyle's law is commonly used to predict the result of introducing a change in volume and pressure to the initial state of a fixed quantity of gas. The "before" and "after" volumes and pressures of the fixed amount of gas are related by the equation:

$$p_1V_1=p_2V_2$$

Forcing the volume $V$ of the fixed quantity of gas to increase, the pressure $p$ must decrease proportionally. Conversely, reducing the volume of the gas increases the pressure.

### SIZING INFORMATION REQUIREMENTS

Proper tank sizing is important for two reasons:

1. The system will run more efficiently and as a result, use less electricity.
2. The system will last longer – providing long term cost savings through reduced maintenance charges and fewer replacement parts.

Determine the following:

1. Maximum drawdown required
2. Minimum operating pressure
3. Maximum operating pressure

# ASME Bladder Type Hydro-Pneumatic Tanks Sizing and Selection Guide

| STEP 1: DETERMINE THE REQUIRED DRAWDOWN |
|---|

1. Pump delivery rate: _________ GPM

2. Desired minimum pump run time: __________ minutes
   (example: 1 minute, 15 seconds = 1.25 minutes)

3. Multiply Line #1 times Line #2: __________ GPM x ___________ minutes = ____________ Gallons
   (This is the minimum drawdown or available water volume required in Gallons)

| STEP 2: DETERMINE THE REQUIRED TANK SIZE |
|---|

1. Enter the following:
   - Maximum drawdown required (A) ___________ Gallons
   - Minimum system pressure (pump cut-in) (B) ___________ PSIG
   - Maximum system pressure (pump cut-out) (C) ___________ PSIG
   - Air precharge pressure (if different than minimum system pressure) (D) ___________ PSIG

2. Find the drawdown factor from Table 1 on page 3 (E) ___________
   NOTE: If the precharge pressure does not equal the minimum system pressure or if the minimum and maximum operating pressures are not listed in Table 1, use the following formula to determine the drawdown factor:

$$\text{Drawdown factor} = \frac{(D) + 14.7}{(B) + 14.7} - \frac{(D) + 14.7}{(C) + 14.7}$$

3. Determine the minimum total volume required (F) ___________

   Divide the maximum drawdown required (A) by the drawdown factor (E):

   (A) __________Gallons ÷ (E)___________Drawdown factor = (F)___________ Gallons

| STEP 3: SELECT THE REQUIRED BLADDER TANK |
|---|

1. Select a bladder tank from Table 2, 3, or 4. Choose the tank with the lowest tank capacity greater than or equal to the minimum total volume required (G). Standard pressure ratings are listed. Higher working pressures are available upon request.

| EXAMPLE |
|---|

1. Select a bladder tank for an application with a 50 GPM pump with a minimum run time of 2 minutes and a 20 to 50 PSIG system operating pressure range.

| | | |
|---|---|---|
| Determine the maximum drawdown required (50 GPM x 2 minutes) | A | 100 Gallons |
| Minimum system pressure | B | 20 PSI |
| Maximum system pressure | C | 50 PSI |
| Air precharge pressure | D | 18 PSI |
| Use the formula shown in Step 2 to determine the drawdown factor | E | 0.437 |
| Divide the required drawdown (A) by the drawdown factor (E) (100 Gallons ÷ 0.437) | F | 228.8 Gallons |
| Select the required bladder tank from Table 2, 3, or 4 | G | 264 Gallons |

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TABLE 1

| MAXIMUM OPERATING PRESSURE PSIG | MINIMUM OPERATING PRESSURE AT TANK LOCATION (PSIG) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 | 10 | 12 | 15 | 20 | 30 | 40 | 50 | 60 | 70 | 80 |
| 27 | 0.527 | 0.408 | 0.360 | 0.288 | 0.168 | | | | | | |
| 30 | 0.560 | 0.447 | 0.403 | 0.336 | 0.224 | | | | | | |
| 35 | 0.604 | 0.503 | 0.463 | 0.403 | 0.302 | 0.101 | | | | | |
| 40 | 0.640 | 0.548 | 0.512 | 0.457 | 0.366 | 0.183 | | | | | |
| 45 | 0.670 | 0.586 | 0.553 | 0.503 | 0.419 | 0.251 | 0.084 | | | | |
| 50 | 0.696 | 0.618 | 0.587 | 0.541 | 0.464 | 0.309 | 0.155 | | | | |
| 55 | 0.717 | 0.646 | 0.617 | 0.574 | 0.502 | 0.359 | 0.215 | 0.072 | | | |
| 60 | 0.736 | 0.669 | 0.643 | 0.602 | 0.536 | 0.402 | 0.268 | 0.134 | | | |
| 65 | 0.753 | 0.690 | 0.665 | 0.627 | 0.565 | 0.439 | 0.314 | 0.188 | 0.062 | | |
| 70 | 0.767 | 0.708 | 0.685 | 0.649 | 0.590 | 0.472 | 0.354 | 0.236 | 0.118 | | |
| 75 | 0.780 | 0.725 | 0.702 | 0.669 | 0.613 | 0.502 | 0.390 | 0.279 | 0.167 | 0.056 | |
| 80 | 0.792 | 0.739 | 0.718 | 0.686 | 0.634 | 0.528 | 0.422 | 0.317 | 0.211 | 0.106 | |
| 90 | 0.812 | 0.764 | 0.745 | 0.716 | 0.669 | 0.573 | 0.478 | 0.382 | 0.287 | 0.191 | 0.096 |
| 100 | 0.828 | 0.785 | 0.767 | 0.741 | 0.698 | 0.610 | 0.523 | 0.436 | 0.347 | 0.261 | 0.174 |
| 110 | 0.842 | 0.802 | 0.786 | 0.762 | 0.723 | 0.642 | 0.561 | 0.481 | 0.401 | 0.321 | 0.241 |

TABLE 2 (ASME Bladder Type Hydro-Pneumatic Tanks with Top Connection / Type IV – see Submittal Sheet No. 621)

| MODEL NUMBER | MAWP | TANK VOLUME | | DIAMETER | | OVERHEADS | | SYS. CONN | BASE DIAMETER | | SHIPPING WEIGHT | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PSIG | GAL | L | IN | MM | IN | MM | INCH (NPT) | IN | MM | LBS | KG |
| JAPR-20-601 | 150 | 10 | 40 | 12 | 305 | 23 | 584 | 1 | 8⅝ | 219 | 50 | 23 |
| JAPR-20-602 | 150 | 15 | 60 | 12 | 305 | 33½ | 851 | 1 | 8⅝ | 219 | 65 | 30 |
| JAPR-20-603 | 150 | 24 | 90 | 12 | 305 | 52 | 1321 | 1 | 8⅝ | 219 | 90 | 41 |
| JAPR-20-604 | 150 | 30 | 110 | 14 | 356 | 48 | 1219 | 1 | 8⅝ | 219 | 90 | 41 |
| JAPR-20-605 | 150 | 35 | 130 | 14 | 356 | 55½ | 1410 | 1 | 8⅝ | 219 | 100 | 45 |
| JAPR-20-606 | 150 | 40 | 150 | 14 | 356 | 63 | 1600 | 1 | 8⅝ | 219 | 115 | 52 |
| JAPR-20-607 | 150 | 60 | 230 | 16 | 406 | 72⅜ | 1838 | 1½ | 11½ | 292 | 155 | 70 |
| JAPR-20-608 | 125 | 80 | 300 | 20 | 508 | 63 | 1600 | 1½ | 18 | 457 | 175 | 79 |
| JAPR-20-668 | 125 | 105 | 400 | 24 | 610 | 56 | 1422 | 1½ | 18 | 457 | 225 | 102 |
| JAPR-20-609 | 125 | 120 | 450 | 24 | 610 | 66 | 1676 | 1½ | 18 | 457 | 255 | 116 |
| JAPR-20-610 | 125 | 135 | 500 | 24 | 610 | 72 | 1829 | 1½ | 18 | 457 | 285 | 129 |

TABLE 3 (ASME Bladder Type Hydro-Pneumatic Tanks with Top Connection / Type I – see Submittal Sheet No. 615)

| MODEL NUMBER | MAWP | TANK VOLUME | | DIAMETER | | OVERHEADS | | SYS CONN | BASE DIAMETER | | SHIPPING WEIGHT | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PSIG | GAL | L | IN | MM | IN | MM | INCH (NPT) | IN | MM | LBS | KG |
| JBPR-22-011 | 125 | 158 | 600 | 30 | 762 | 58 | 1473 | 1½ | 24 | 610 | 380 | 172 |
| JBPR-22-012 | 125 | 211 | 800 | 30 | 762 | 76 | 1930 | 1½ | 24 | 610 | 450 | 204 |
| JBPR-22-013 | 125 | 264 | 1000 | 36 | 914 | 67 | 1702 | 2 | 30 | 762 | 650 | 295 |
| JBPR-22-014 | 125 | 317 | 1200 | 36 | 914 | 78½ | 1994 | 2 | 30 | 762 | 750 | 340 |
| JBPR-22-015 | 125 | 370 | 1400 | 36 | 914 | 91 | 2311 | 2 | 30 | 762 | 865 | 392 |
| JBPR-22-016 | 125 | 422 | 1600 | 48 | 1219 | 63½ | 1613 | 2 | 42 | 1067 | 1050 | 476 |
| JBPR-22-017 | 125 | 528 | 2000 | 48 | 1219 | 77¼ | 1962 | 2 | 42 | 1067 | 1225 | 556 |
| JBPR-22-018 | 125 | 660 | 2500 | 48 | 1219 | 94 | 2388 | 2½ | 42 | 1067 | 1445 | 655 |

TABLE 4 (ASME Bladder Type Hydro-Pneumatic Tanks with Bottom Connection / Type I – see Submittal Sheet No. 645)

| MODEL NUMBER | MAWP | TANK VOLUME | | DIAMETER | | OVERHEADS | | SYS CONN | LEG CLEARANCE | | SHIPPING WEIGHT | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PSIG | GAL | L | IN | MM | IN | MM | INCH (NPT) | IN | MM | LBS | KG |
| JOPR-22-080 | 125 | 80 | 300 | 20 | 508 | 62⅞ | 1597 | 2 | 14 | 356 | 230 | 104 |
| JOPR-22-105 | 125 | 105 | 400 | 24 | 610 | 56 | 1422 | 2 | 14 | 356 | 325 | 147 |
| JOPR-22-009 | 125 | 120 | 450 | 24 | 610 | 66 | 1676 | 2 | 14 | 356 | 335 | 152 |
| JOPR-22-135 | 125 | 135 | 500 | 24 | 610 | 71½ | 1816 | 2 | 14 | 356 | 340 | 154 |
| JOPR-22-011 | 125 | 158 | 600 | 30 | 762 | 58 | 1473 | 2 | 14 | 356 | 435 | 197 |
| JOPR-22-012 | 125 | 211 | 800 | 30 | 762 | 76 | 1930 | 2 | 14 | 356 | 515 | 234 |
| JOPR-22-013 | 125 | 264 | 1000 | 36 | 914 | 67 | 1702 | 2 | 14 | 356 | 715 | 324 |
| JOPR-22-014 | 125 | 317 | 1200 | 36 | 914 | 78½ | 1994 | 2 | 14 | 356 | 815 | 370 |
| JOPR-22-015 | 125 | 370 | 1400 | 36 | 914 | 91 | 2311 | 2 | 14 | 356 | 935 | 424 |
| JOPR-22-016 | 125 | 422 | 1600 | 48 | 1219 | 63½ | 1613 | 2 | 14 | 356 | 1075 | 488 |
| JOPR-22-017 | 125 | 528 | 2000 | 48 | 1219 | 77⅜ | 1965 | 2 | 14 | 356 | 1235 | 560 |
| JOPR-22-018 | 125 | 660 | 2500 | 48 | 1219 | 94 | 2388 | 2 | 14 | 356 | 1435 | 651 |
| JOPR-22-019 | 125 | 793 | 3000 | 48 | 1219 | 122⅞ | 3121 | 2 | 14 | 356 | 1900 | 862 |
| JOPR-22-020 | 125 | 1056 | 4000 | 54 | 1372 | 132 | 3429 | 2½ | 14 | 356 | 2400 | 1089 |
| JOPR-22-021 | 125 | 1320 | 5000 | 54 | 1372 | 151 | 3835 | 2½ | 14 | 356 | 2700 | 1225 |
| JOPR-22-022 | 125 | 1600 | 6050 | 72 | 1829 | 107 | 2718 | 2½ | 14 | 356 | 3425 | 1554 |
| JOPR-22-023 | 125 | 2000 | 7600 | 72 | 1829 | 130 | 3302 | 2½ | 14 | 356 | 4000 | 1814 |
| JOPR-22-024 | 125 | 2640 | 10000 | 72 | 1829 | 164 | 4166 | 2½ | 14 | 356 | 4875 | 2211 |
| JOPR-22-028 | 125 | 2800 | 10600 | 72 | 1829 | 174 | 4420 | 3 | 14 | 356 | 5300 | 2404 |
| JOPR-22-030 | 125 | 3000 | 11400 | 72 | 1829 | 186 | 4724 | 3 | 14 | 356 | 5700 | 2585 |
| JOPR-22-039 | 125 | 3963 | 15000 | 72 | 1829 | 230 | 5842 | 3 | 14 | 356 | 7100 | 3220 |