Solving the Mystery of Compression Tank Sizing

It is an accepted fact that any closed system handling fluids must provide for the changes in liquid volume caused by the changes in its temperature. Ignoring these changes or not allowing adequate compensation for them can lead to ruptured pipes or damaged equipment.

The standard method of compensating for volume changes in a closed system is to take advantage of a gas cushion, so that as the liquid expands, the gas is compressed; and as the gas expands, the liquid volume shrinks.

This principle is the same whether you use precharged tanks or standard tanks. The only difference is that, in precharged tanks, the gas and liquids are physically separated by a membrane. In the standard tank, the gas and liquid are actually in contact.

Although the method of sizing tanks was established years ago, to many system designers it still belongs in the "black magic" category. To help specifiers better understand this "black magic," we have developed the following tips on sizing tanks. (See Table 1).

The accepted equation for sizing tanks (both precharged and standard) is:

$$Vt = \frac{(Ew-Ep)Vs}{(Pa/Pf - Pa/Po)}$$

Vt = Required tank size
Vs = Volume of system
Ew-Ep = Unit expansion of system water
Pa = Pressure in tank before water fill, PSIA
Pf = Design fill pressure in tank, PSIA
Po = Max. operating pressure in tank, PSIA

Table 1

This equation simply means that the required tank volume (Vt) depends upon the change in volume of the system [(Ew-Ep)Vs] and to what extent the gas pressure can vary (Pa/Pf - Pa/Po).

In other words, the numerator is the change in system volume due to the change in temperature. The numerator would provide us with the required tank size if we had an open compression tank. But, since most systems are pressurized, the tank size must be larger in order to accommodate the gas cushion. The denominator adjusts the tank size to provide a gas cushion adequate to keep the system pressure within the range between the "fill" and "max" operating values. When sizing precharged tanks, the precharge pressure is substituted for Pa and the denominator is given the name Acceptance Factor.

So you can see, the mystery is solved!

To make tank sizing even easier, Bell & Gossett offers two training bulletins and the recently introduced Equipment Selection Software Program (ESP-PLUS).

Bell & Gossett's Bulletin No. TEH-575 "Air Control for Hydronic Systems" provides a great deal of information about standard compression tanks, including a table of tank selections for various system temperatures for standard operating conditions. Tables of correction factors for other pressures are also provided.

There also is a bulletin that can be used to select precharged tanks, No. TEH-981 "Pressurized Expansion Tank Sizing/Installation." Tables are available for both the expansion factor and the acceptance factor. Examples of step by step selections make it very easy to select the proper tank.

To solve your compression tank sizing mystery, contact your local representative or circle #6 on the enclosed reply card.