Replacing a Standard Expansion Tank With a Pressurized Tank

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This happens every year—an older hot water boiler fails and needs to be replaced. Not always, but most times, the other components accompanying the boiler get replaced as well. The circulators get upgraded; the flow control valves and the air separator get replaced; and, of course, a new expansion tank replaces the old one.

In most of these systems, there is an existing (albeit older) diaphragm expansion tank. In the process of upgrading the tank, typically you just get the model number of the existing tank and replace it with the same, newer version.

MODEL NUMBER	TANK VOLUME GALLONS (LITERS)	ACCEPTANCE VOLUME GALLONS (LITERS)
HFT-15	2 (7.5)	1.0 (3.7)
HFT-30	4.4 (16.6)	2.5 (9.4)
HFT-60	7.6 (28.7)	2.5 (9.4)
HFT-90	14 (53)	11.3 (43)
HFT-30V	14 (53)	11.3 (43)
HFT-40V	20 (76)	11.3 (43)
HFT-60V	32 (121)	11.3 (43)
HFT-90V	44 (165)	34 (129)
HFT-110V	62 (235)	34 (129)
HFT-160V	86 (326)	46 (174)

Chart 1: *The diaphragm tanks' acceptance volume and total tank volume for the various sizes.*

What happens if that hot water system you are working on has one of those old steel compression tanks? You know the ones—installed up near the ceiling, usually suspended with strapping of some sort in between the floor joists? We call them "old-style" because they were invented before the concept of using a flexible butyl membrane was introduced.

These steel tanks had air and water "touching" each other in the tank. The job of the air volume was to act like a spring on the system to maintain adequate pressure throughout the closed system. It was important to always have a certain volume of air in the tank to allow for the expanding system water to "squeeze" against while keeping the pressure below the relief valve's setting. We certainly don't want water splashing onto the boiler room floor from the relief valve every time the boiler heats up the system on a call for heat.

When the time comes to replace this "old-style" tank, you have two options. However, before you replace it, you must confirm a few things: the original tank worked properly (and was therefore sized properly) and there will be no changes to the application. Once these are confirmed you can:

1) Replace the old tank with the exact same size and style tank; or

2) Replace it with the common "diaphragm style" expansion tank that the industry has been frequently using for the last 40+ years. This style tank design has separate compartments for the air and system water that are separated by the flexible butyl diaphragm.

Terminology

When expansion tanks are sized properly, formulas are used to come up with the correctly-sized tank and sometimes they can be intimidating and hard to follow. When converting from the old-style tank to a modern diaphragm tank, a lot of the "heavy lifting" has already been done for us—that is, how the original tank was selected. We just have to apply some information that would be pertinent to our particular system to select the correct diaphragm tank.

Before we get there, let's talk about some terminology that deals with expansion tanks. Here are two common terms:

1) Full Acceptance Tanks: the tank is big enough to accept *all* of the system's expanded water volume while keeping the pressure range within working conditions (fill and relief valve pressure). This would include the old steel tanks as well as most commercial bladder-style tanks.

2) Partial Acceptance Tanks: the diaphragm style has a limited amount of expanding system water storage capability. This amount of water that can be stored is called the *acceptance volume*. This style tank is the most common type used in residential applications.

It quickly becomes apparent that when sizing a diaphragm tank, there are two criteria that need to be satisfied:

1) The total tank volume has to be large enough to keep the system pressure within operating range.

2) The acceptance volume has to be as large as the system's expansion volume. The actual amount of expansion volume must be known. Fortunately, the original tank was sized with this piece of information.

Specifications

Model Number	Part Number	Capcity Gallons	Required Airtrol Fitting	Tank Dia. Inches	Tank Length Inches	Approx. Shpg. Wt. (Lbs)
15	116029	15	ATF-12	12	33	50
24	116030	24			51	72
30	116031	30		14	48	80
40	116032	40			63	104
60	116033	60	ATF-16	16	72	134
80	116034	80	ATF-20	20	62	160
100	116035	100	ATF-20		78	186
120	116036	120	ATF-24	24	65	217
135	116037	135			72	230
175	116038	175	ATFL	30	62-1/4	320
220	116039	220			77	370
240	116040	240			84	420
305	116041	305			105-3/4	482
400	116042	400			93	656
505	116840	505		36	116	745

Chart 2: *The dimensions and gallons for the old steel compression tanks.*

A sizing example

Let's walk through a sizing example to see how you can select a replacement *diaphragm tank* once you know the size of the original old-style steel tank. For this example, the system's fill pressure will be 12 pounds per square inch gauge (psig) and the relief valve setting is 30psig.

1) The first formula establishes the total tank volume:
   a. The formula is Vt pressurized = Vt standard (Pa/Pfill)
   b. Where Vt psi = Total tank volume of pressurized tank
   c. Vt standard = Size of existing old-style steel tank in gallons
   d. Pa = Atmospheric pressure
   e. Pfill = Fill pressure in absolute pressure (gauge pressure + atmospheric pressure)
      i. 60 gals (old-style tank volume) x 14.7/(14.7 + 12)
      ii. 60 gals x 14.7/26.7 = 60 gals x .551 = 33 gallons
      iii. Vt psi = 33 gallons

2) The second formula establishes the actual system expansion volume:
   a. Ve = acceptance volume
   b. Ve = Vt (Pa/Pfill) – (Pa/Pmaxop)
   c. Vt = Size of existing old steel tank in gallons
   d. Pa = Atmospheric pressure
   e. Pfill = Fill pressure in absolute pressure (gauge pressure + atmospheric pressure)
   f. Pmaxop = Maximum Operating Psi (Relief Valve Setting + atmospheric pressure)
      i. 60 (14.7/26.7) – (14.7/44.7)
      ii. 60 x (.551 - .329)
      iii. 60 x .222 = 13.3 gallons
   g. Ve = 13.3 gallons

In this example, if the existing old-style steel tank had a volume of 60 gallons, the fill pressure requirements were for 12psig (most two-story residential applications) and the boiler's relief valve was set for 30psig, the replacement diaphragm tank specifications would require a tank with a:

- Total tank volume of 33 gallons
- Acceptance volume of 13.3 gallons

Not that this happens every day, but here at FIA, we do come across this question often enough. Also, remember to pre-charge the diaphragm tank to the system's required fill pressure *before* it gets connected to the heating system.

See **Chart 1** for details on the diaphragm tanks' acceptance volume and total tank volume for the various sizes; see **Chart 2** for details on the dimensions and gallons for the old steel compression tanks.

If you have any questions or comments, e-mail me at *gcarey@fiainc.com*, call me at FIA 1-800-423-7187 or follow me on Twitter at *@Ask_GCarey*. **ICM**