November 23, 2015

Acceptance Volume vs. Usable Volume in a Hydro-pneumatic Expansion Tank

This week our R. L. Deppmann Monday Morning Minute article answers a question about acceptance volume vs. usable volume in a hydro-pneumatic expansion tank.

I recently received the following question from Ken in Cleveland, Ohio: "(A recent) Monday Morning Minute article...has an example selecting a B&G Model WTA-404. The submittal sheet shows 34 gallons of acceptance. The literature shows an acceptance 'factor' of 0.5. Your example says I only get 3 gallons of storage. Why all the different numbers and why can't I expect 34 gallons of storage?"

SCHEDULE

PART NUMBER	MODEL NUMBER	TANK VOLUME GALLONS (LITERS)	ACCEPTANCE VOLUME GALLONS (LITERS)
1BN151LF	WTA-401	18 (68)	11 (42)
1BN152LF	WTA-402	25 (95)	11 (42)
1BN153LF	WTA-403	34 (129)	11 (42)
1BN154LF	WTA-404	68 (257)	34 (129)

From Xylem – B&G submittal A315D

MODEL NUMBER	PART NUMBER	TANK VOLUME	ACCEPTANCE FACTOR
WTA-401	1BN151LF	18 (68)	0.65
WTA-402	1BN152LF	25 (95)	0.45
WTA-403	1BN153LF	34 (129)	0.33
WTA-404	1BN154LF	68 (258)	0.50

From Xylem – B&G literature A348A

Understanding Acceptance Volume and Tank Volume

This is a question we get often. Let's start with some important terms.

- **Tank Volume:** This is the total volume of the tank including air and water
- **Acceptance Volume:** This is the maximum amount of water volume of the tank
- **Acceptance Factor:** Sometimes rather than show the acceptance volume, the literature will show a multiplier against tank volume to arrive at the acceptance volume.
- **Drawdown Volume:** This is the volume of water which leaves the tank from a starting tank pressure down to the minimum pressure

The acceptance volume of a tank is the maximum water volume that the tank can hold if it starts with 0PSIG on the air side (theoretically) and ends with the air side compressed to the maximum pressure that the tank could stand (theoretically). In plumbing systems, we can't start at maximum pressures and we can't allow pressures to drop to zero, so there are limits. We charge the tank air side to the minimum pressure we need in the system and then allow water to fill the tank until we reach the maximum pressure we require in the plumbing system.

As the pressure drops in the plumbing system due to use, water leaves the tank and the pressure drops until the tank is empty and the air pressure in the tank is at its minimum. The minimum and final pressures are needed to determine the factor or multiplier we use to find the percentage of tank volume that can be drawn out and used in the plumbing system.

Understanding Acceptance Volume and Tank Volume

Here's a simple illustration of a hydro-pneumatic tank in a plumbing system. In the example we used in the last MMM, there's a required drawdown volume of 3 gallons. If the tank air side pressure is too low, there will be less storage in the tank. If the air side pressure is too high, no water will enter the tank since the air pressure is greater than the water pressure at the discharge of the pump.

Tank is at maximum pressure and water is in the balloon. Example: 83 PSIG

3 gallons of water have left the tank and the air side pressure is at its minimum of 78 PSIG

Understanding Acceptance Volume and Tank Volume

The drawdown is determined by finding the drawdown multiplier. You can use a chart on page 36 of the B&G TEH1096A manual or download the B&G tank selection program ESP-Tanks.

In our example from last week, we had a maximum pressure of 83 PSIG and a minimum pressure of 78 PSIG. This gives a chart multiplier of about 0.05. The tank volume was 68 so 68 x.05 = 3.4 gallons. The program gives the exact numbers. By the way, if the tank volume times this factor gives you a number greater than the acceptance volume of the tank, you need to select a larger tank. The engineer should include the drawdown volume required and the tank minimum pressure and maximum pressure on the schedule.

INITIAL TANK PRESSURE PSI

FINAL	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90
30	.447	.336	.224	.112													
35	.503	.402	.302	.201	.101												
40	.548	.457	.366	.274	.183	.091											
45	.586	.503	.419	.335	.251	.168	.084										
50	.618	.541	.464	.386	.309	.232	.155	.077									
55	.646	.574	.502	.430	.359	.287	.215	.143	.072								
60	.689	.602	.535	.489	.402	.335	.268	.201	.134	.067							
65	.690	.627	.565	.502	.439	.376	.314	.251	.168	.125	.063						
70	.708	.649	.590	.531	.472	.413	.354	.295	.236	.177	.118	.059					
75	.725	.669	.613	.557	.502	.446	.390	.334	.279	.223	.167	.111	.056				
80	.739	.686	.634	.581	.528	.475	.422	.370	.317	.264	.211	.158	.106	.053			
85	.752	.702	.652	.602	.552	.502	.451	.401	.351	.301	.251	.201	.150	.100	.050		
90	.764	.716	.669	.621	.573	.525	.476	.430	.362	.334	.267	.239	.191	.143	.096	.048	

A good understanding of these terms will always result in the best tank selection and solution for your client.