Why does the AP34 need an expansion tank?

A demand pump such as the AP34 is designed to turn on and off as the system demand for water changes. It does this with a pressure switch.
When the pump is first turned on in a closed system, the pump will run, the water will flow into the system until the system pressure increases past the pump pressure switch shutoff point and then the pump turns off.
When a valve is opened demanding water, the system pressure drops below the pump pressure switch shutoff point, the pump turns back on and pumps water to meet the water flow demand.
When the valve is again closed the pump will continue to run until the system pressure again reaches the pump pressure switch shutoff point and the pump again will turn off.

If there are only two states in the demand flow, **ON – Full flow** and **OFF – No flow**, there would be no need for an expansion tank. In water supply systems using electric solenoid fill valves this is true and no expansion tank is needed.

However in systems using mechanical float valve this is not true. As a mechanical float valve opens and closes the size of the opening through which the water flows changes in size. When it is all the way open or completely closed there is no problem, it is the transition from open to closed which causes the problem.

As the valve outlet opening gets smaller, though water is still flowing, the system pressure increases. Eventually the pressure will increase to the pump shutoff point and the pump will turn off. But since some water is still flowing, the pressure will rapidly drop and the pump will quickly turn back on, re-pressurize the system and turn back off. The pump will repeat this cycle until the float valve closes completely.

This rapid ON-OFF cycle, referred to as CYCLING, can cause the pressure switch to overheat, melt and stick in the ON or OFF position. If the pressure switch is stuck in the OFF position, obviously the pump stops running and the water flow demand cannot be met. If the pressure switch is stuck in the ON position, the pump can over pressurize the system causing the pump to leak or causing damage to the motor from overheating.

An expansion tank, also called an accumulator, is a tank with a bladder and a pressurized chamber inside. The air pressure chamber is on one side of the bladder and the other side of the bladder the chamber is connected to the water flow system.

When the system water flow is high and the pressure is low the pressurized bladder forces the water out of the expansion tank into the water flow stream. As the float valve starts to close and the system pressure increases the system water pressure pushes back on the bladder, filling the tank with water. As the tank fills the increased flow keeps the pump running longer before the system pressure reaches the shutoff point.
With the pump off and water still flowing from the valve, since it is not yet closed, the system pressure starts to drop. As the system pressure drops, the bladder starts to push water out of the tank into the water flow stream. This keeps the flow higher so the pressure does not drop as fast. This slows the pressure drop and keeps the pump off longer, before the pressure drops below the pump shutoff point and it turns back on. So the expansion tank or accumulator reduces the cycling and protects the pump.

There are other types of pumps which can be used in this type of system without using an expansion tank:
AP38 – This pump does not have a pressure switch, it has a pressure sensor that slows the pump down as the pressure increases and then turns the pump off once the shutoff pressure is reached.
As the float valve starts to close, the valve outlet opening gets smaller and the system pressure increases. The pump senses the increased pressure and slows the pump down, the flow decreases and the system pressure stabilizes, or at least it does not increase as fast. Once the valve closes the pump shuts off. This prevents cycling and protects the pump.

AP63 – This pump still has a pressure switch, but also has an internal by-pass system that keeps the pump running as the pressure increases which allows the pump to run longer before it shuts off.
When the float valve is fully open, the system pressure is low and the internal by-pass valve is closed allowing the full flow of the pump to go out into the system. As the float valve starts to close, the valve outlet opening gets smaller and the system pressure increases. The internal by-pass valves then open up, the pump flow decreases and the system pressure does not increase as fast. Once the valve closes the system pressure increases to the shutoff point and the pump shuts off. This prevents cycling and protects the pump.