

Tech Notes- Control Valves

What's really in control?



As Field Techs, we've all been there. Laying on the fender of an old spreader box or crawling on the frame of a planter or sprayer trying to determine if the valve was working or why the motor drive or sprayers not running. It's panic time, in season, and they're waiting on you. Several hours and miles back to the shop to get parts later, it turned into, "the problem is all software related and there "IS NO HARDWARE PROBLEM". Maybe you just needed to re-start the software or needed to re-open a field. In the photo, Tim Grigsby in the field with my former company Agri-Tech.

Software Issues

There are a lot of software issues that can cause the control valves to not work as intended.

Valve Selection is the first step. Make sure you are sure of the type of valve and enter it correctly as that tells the software how to "drive" the valve. We'll look at the types shortly.

Valve Usage tells the system more detail of how to make the valve work. In-Line versus Bypass, or Close with No Flow are a couple.

Valve Set-up gives the final details of the valve operation. Entries like, "Minimum Threshold" tells the system where to start controlling. It's very important in setting up PWM Valves.

The lesson is, "don't assume it's a hardware problem" and "make absolutely sure you understand why you're making or changing an entry".

In my experience the folks building the display software are getting much better at providing set-up information and selectable set up files but to fine tune the performance, you need a full understanding of making adjustments and doing troubleshooting.

The Hardware Side

Let's take a look at the various valves you will encounter and look at some troubleshooting methods for the field.

Solenoid Valves



Solenoid valves have been used for many years in agriculture for controlling the On-Off function for spray control and hydraulic control. They are basically a coil of wire wrapped around a tube with a metal shaft going through the tube. When

12 volts is applied to the coil it creates a magnet. The shaft is pulled into the coil when 12 volts is applied then returned by a spring with 12 volts removed.

Lots of places for failure including shorted or burned coil, defective or worn out spring assembly, no power supplied, bad electrical connection, corroded or rusted parts.

Many of these can be dis-assembled and cleaned. Coils can many times be replaced. You can check the operation by applying 12 volts to the coil. Polarity doesn't matter.

Motorized Ball Valves



Motorized Ball Valves became popular to avoid the issues of solenoid valves not reliably opening in all conditions on liquid booms. The ball valve has a motor attached that controls full open and full closed. Internal limit switches stop the motion at full open/close.

The simplest will be wired with three active wires. There's a minus 12Volt or Ground wire, a plus 12V wire and a signal wire. 12 volts is applied to the signal wire to open, with no voltage to close.

Today these valves may have additional wires which are connected to switches in the valve the signal "full open" and "full close".

Testing these valves is pretty simple but you've got to know the correct wiring or colors being used. Raven valves typically use White for ground, Red for +12V and Black for the signal line. KZ Valves typically use Black for Ground, Red for +12V and the white for signal.

Four wire boom valves will have a ground, a +12V and two signal wires. One wire activated to open and the second wire activated to close the valve.

KZ builds a lot of the boom control valves used on the new machines. KZ has a great actuator wiring diagram document along with a cross reference manual that allows you to identify the valve your working with.

Servo Control Valves



Servo control valves are used to control the rate of flow in either a liquid system or a hydraulic system. They operate using 12volts to run at maximum speed and as little as

3 or 4 volts to fine tune position. When they fail, it's normally a situation where the valve runs fine at full speed but it won't control when near the target.

With the controllers today you can enter a "test" mode where the sprayer will run at a programmed rate and speed. You can test these valves by setting a target at mid flow, say 8 gallons per acre, then watch the sprayer respond as you vary the rate in small increments, say one gallon per acre, or one mile per hour.

Bench testing requires having the ability to vary the drive voltage.

Some servo control valves use PWM Drive to activate the control. Some techs call this current control.

PWM Valves



PWM or “pulse width modulated” control valves are the chosen method of controlling hydraulic flow used on planters, sprayers and spreaders. To “modulate” means to change. The pulse width changes for control.

PWM Valves work like a highly controllable solenoid valve. They use the same coil/ movable shaft construction used with solenoid valves except they can be cycled at high speeds and can accurately repeat the open/closed relationship.

The controlling signal to a PWM valve goes from zero to 12 volts at a rate of typically about 100 times per second. Like turning a switch on and off 100 times per second or 100 “pulses” per second.

Pulse width is the relationship between the on to off signal. To open the valve slightly a pulse width of 30 percent might be used where the typical operating position of the valve might be closer to 40 or 50 percent. This on to off relationship is called the “duty cycle”. A 50 percent duty cycle would mean the signal is on or 12 volts, 50 percent of the time and off the other 50 percent. Again, this is happening at a rate of 100 times per second.

Capstan Liquid PWM Control valves operate at 10 Hz or Pulses per second.

The valves respond very smoothly to the commands of the “pulse width modulated”, PWM drive signal giving very smooth control for hydraulic circuits.

Set-up functions in the display will have a lot to do with the performance. I would suggest, once you have the system performing properly, take a minute to shoot and save a photo of the set-up screen for future use.

Some systems have an “auto-learn” calibration mode. Use that whenever possible. I’ve not seen a valve not respond properly to 100 Hz, PWM Frequency, or 100 Pulses Per Second. You will see entries like minimum PWM drive. That’s the Pulse Width needed to “start hydraulic flow”. Entering Zero will cause the system to start slower where 30 or so may be needed to start a liquid pump running.

Hooking 12 volts to the valve coil will fully open the valve. That can be useful when troubleshooting systems but remember you’ll be instantly opening hydraulic flow. Be Careful!

Thanks for your attention! I hope this was helpful! Please send along your question and comments. John Dignan....

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