Horticultural Spraying Specialists
helping growers make better decisions

Technical tips - Hortspray Off Season Check ✓

Don Thorp
M: +61 (0) 448 511 771
E: don@hortspray.com
www.hortspray.com

What exactly is an off-season full sprayer health check? Essentially, it is making sure your horticultural sprayer is in the right shape to get the job done. A few hours in the off-season will go a long way to making a much more successful start to your season. Breakdowns are stressful and costly.

Different sprayers will have different set-ups and components, but the fundamentals are the same. Let's get started – from the front to the back.

Key things to check:

• **Pump** – when did you last do a maintenance check on your pump?	• **Electrical connections** – how to clean and check
• **Controls** – have you checked your manual or electric controls in the last 12 months? Are your valves and flowmeter working?	• **PTO shaft** – a once a year check is a must do for safety
• **Suction plumbing** – an annual check is easy to do	• **Agitation** – ensure it's all working ready for the season
• **Filters** – new o-rings each season is cheap insurance	• **Fan gearbox** – any oil leaks? Ensure oil is at the correct level
• **Pressure hoses** – what to look for	• **Nozzle bodies** – check and clean out
• **Belts –** Check your belts, pulleys and tensioners	• **Nozzles –** critical to good spray coverage – easy to check

The next few pages give you more detail on the "how-to" of your sprayer health check

Diaphragm Pumps – General check

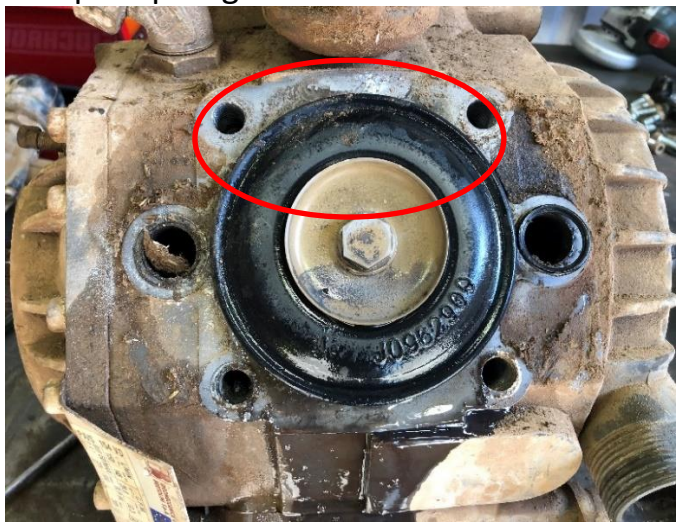
Left:
Poor maintenance may lead to a breakdown during the season

Regular checking of the oil sight-glass, a good clean, and above all, flushing the sprayer with water after spraying makes a huge difference to pump longevity

Key points:

- After <u>every</u> spray, flush 200-300 litres of water through the pump by engaging the PTO, running the pump at your normal operating RPM's and opening your taps/valves to spray fresh water through the pressure plumbing and nozzles
- Twice per season, put a commercial grade tank cleaner through the system (such as Nufarm Tank & Equipment Cleaner®, or Agnova All Clear®- see appendix ②). Flush thoroughly
- Prior to winter, flush with tank cleaner, then mix 500mls of mineral spraying oil (summer or winter oil) with 200 litres of water in the tank and flush the whole system
- Drain the tank and store for the off-season

Pump Diaphragms



By regular flushing with fresh water, you will ensure you get a long life from your pump diaphragms.
At left is an example of swollen diaphragms after several seasons of use. Note the wear (top right of picture).
Replace all o-rings.

Key points:

- Diaphragms can last several seasons if you look after your pump and flush with water after each spray
- Diaphragms will rupture if punctured by pieces of broken valve spring (see below) or simply from old age
- Over time, Gomma (rubberized – see left) diaphragms will swell and wear, eventually rupturing
- Desmopan (clear, more rigid) diaphragms will eventually crack and rupture
- A suggested interval for checking diaphragms is approximately every 500 hours* (2 average seasons). If they appear in good shape, re-check and replace at 1000 hours*

*Guideline only. Harsher materials may wear diaphragms more quickly.

Left – milky oil is a sign you pump has at least one ruptured diaphragm

Valves (in Diaphragm pumps)

Valves will wear over time.
Far left: new valves

Left: valve with broken springs. Pieces of the spring entered the diaphragm chamber and punctured the diaphragm

Key points:

- It's good idea to replace the valves when you replace diaphragms
- If there is little sign of wear on the valve springs and seats, you may be able to re-install your valves. Always replace the valve o-rings
- If air is able to enter the suction side of a diaphragm pump, your suction valves won't last long. Evidence of this is a "shaky" pressure gauge needle, a pulsing & noisy pump, and a much lower pump output

Pump check summary:

- Maintain your pump. It will last for years if looks after – especially if it is flushed after each spray with water for several minutes.
- Log your hours (even a good estimate is fine). After 500 hours, take off the top diaphragm heads and check the diaphragm wear and check the valves. At the same time, check your suction hoses (more on this below).
- Don't over-rev your pump. Almost all diaphragm pumps are rated to 540 RPM maximum. Check pump mounts regularly.
- Check the oil sight-glass on your pump every spray. If you see no oil, check for leaks in the pump housing. If you see an oil slick in your tank when filling or after spraying, you have an issue with diaphragms. If the oil is milky in colour (see above page), you have a ruptured diaphragm. Stop until you get this fixed or internal pump damage will occur.
- If you are not confident to fix your own pump, take to your dealer or service agent. $500-$1000 every 2-3 seasons is a lot less expensive than a new pump.

Suction hoses

Nothing damages a pump more quickly than air getting into the suction side of a diaphragm pump.
Check hoses regularly.
Far left – a suction hose almost worn through.

Key points:

- If you take your pump off to replace diaphragms, check the suction hoses. Preferably replace them – it's not an expensive exercise (typically less than $100 for all suction hoses). Replace hose clamps at the same time
- Coat the suction fittings with Rectorseal and heat the suction hose to make it easier to get over the fitting. Rectorseal will ensure your hoses are well sealed and will stop any air entering the system

Filters

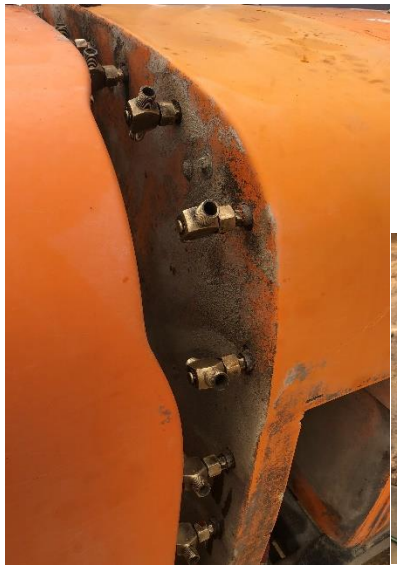
Left: a badly blocked pressure filter.
In this particular case, it had a dramatic effect on the output of the nozzles on one side of a sprayer.

Suction filters can also block, usually as a result of poor product mixing or an incompatible spray tank mix.

Key points:

- Check and clean your filters every spray round. It's a good idea to do this after flushing the sprayer
- Replace the main filter bowl o-ring every spray season
- Replace the sealing o-rings on each end of the filter strainer (if applicable) every season or when they go missing
- Soak your filters in a citric acid solution at the end of every season for a day or so, then wash, replace to o-rings and store them ready for next season
- Use some Vaseline or rubber grease on the filter bowl o-rings regularly to make it easier to undo and to tighten the filter bowl, and to assist sealing

Nozzle bodies



Left – open all nozzle bodies and flush for 5 minutes.
Below – individually flush if nozzle bodies are blocked or have residue build-up

Key points:

- Many sprayers will have taps on the boom tubes – these should be opened, and fresh water flushed through the system under pressure prior to flushing the nozzle bodies.
- Nozzle bodies, and the tubes on which they are mounted, are often overlooked as a point of restricted flow. Thorough flushing – by taking out the nozzles and pumping water and/or tank cleaner through – is a key strategy for removing residues.
- Flush for at least 5 minutes. Observe the output of each outlet – any that appear to have a low flow should be removed, cleaned, and individually flushed.
- Older sprayers are most at risk of blockages at the nozzle body point. If you have never checked these, an hour or two removing, disassembling, and cleaning your nozzle bodies would be a great thing to do during your sprayer health check.

Left:
A non-drip brass nozzle body, designed to hold three nozzles. Commonly used on airblast orchard sprayers.
The non-drip assembly shown disassembled at right show the non-drip cap (bottom) and the diaphragm (above, brown in colour).
Replace the diaphragms when you replace your nozzles

Nozzles

Left: a very worn nozzle, showing cracks in the housing where liquid will spray out without producing effective droplets.

This was one of a full set of nozzles more than 10 years old. The spray droplet spectrum and pattern contributed to very poor spray coverage

Key points:

- Nozzles are the foremost important part of producing effective spray coverage. Worn nozzles will produce a poor spray coverage result
- To check if nozzles are worn, measure their output at a known pressure (say, 10-bar), and compare to the relevant nozzle chart. If the output of the nozzle is 10% or more than the chart figure, the nozzle must be replaced. Check several nozzles on the sprayer every year
- If you are using ceramic nozzles (now the industry standard for canopy spraying), you should check your nozzles every year, and regardless of wear, consider changing them every 3 years. Polyacetal nozzles should be changed annually (①see wear chart – appendix 1)

Nozzle check (blockages etc)

Left:
Two nozzles – one operating correctly, the other partially blocked.

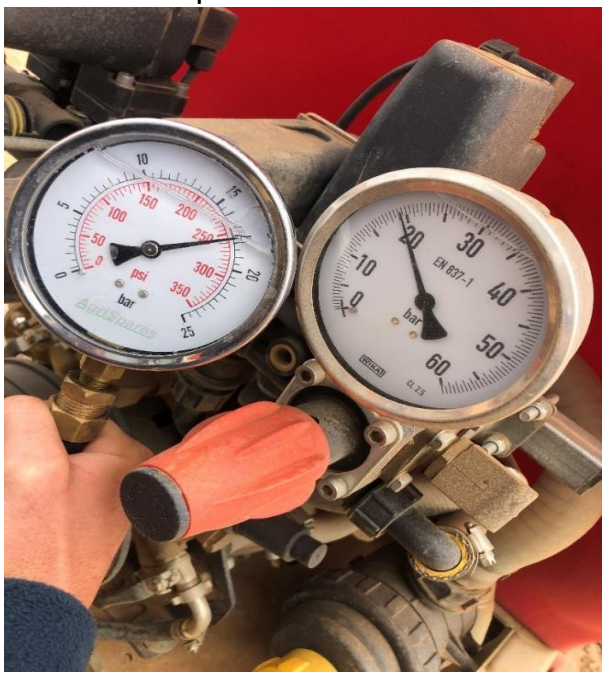
Inspection of all the nozzles should be carried out during the flushing process after each spray – check for blocked or partially blocked nozzles

Filter screens behind the nozzles should also be checked regularly

Key points:

- A blocked nozzle in a critical place on the spray ring could cause some serious disease issues by causing a vital part of the canopy to be missed altogether
- If you check your nozzles and filters when flushing a the end of your spray round, the sprayer will be ready for next time
- Invest in a good pressure filter (or one each side) on the pressure side of your pump and check it/them regularly
- If you don't use a pressure filter, invest in some slotted nozzle strainers or good quality cup strainers for each nozzle

Left: Cup strainer for use with compact nozzle bodies
Right: Slotted strainer, for use in longer shank nozzle bodies

Blocked hoses Residues in the tank & fittings 	**Far Left:** This is what can happen when hoses are not checked. In this case, this hose was the pressure feed to the tank agitator. See “Agitation” below **Left:** chemical residue will build up in fittings and in the tank	**Key points:** • Chemical residues will quickly build up inside hoses and fittings • If left unchecked, issues such as reduced flow to the agitators or the spray ring/nozzles can result – this could mean that whilst the pressure gauge matches your calibrated spray output, the flow coming from the nozzles may be significantly lower than you think. At Hortspray, we see this issue regularly, sometimes with disastrous results • Flushing the sprayer out after every spray will make a huge difference and avoid this becoming an issue • Using a good quality tank cleaner② regularly will also make a significant difference to your sprayer’s overall performance and “health” (② see appendix 2)
Pressure drop check 	**Left:** The gauge on the right is the one that was fitted to the sprayer. It reads the pressure at the manifold at the front of the sprayer – showing 19.5 bar pressure in this instance. The gauge on the left is s test gauge, with a hose and connection to the nozzle body at the rear of the sprayer (at the fan). It reads 17.5 bar. There is a 2 bar (29psi) pressure drop from the manifold to the nozzle. This is not uncommon	**Key points:** • Setting up a pressure test kit takes about an hour and costs around $70 (Talk to us at Hortspray – we can sort one out for you) • The benefit of knowing the pressure drop from the gauge at the front (where they are typically fitted by the manufacturer) to the nozzle, is that it allows you to compensate and ensure your nozzle output is correct *at the nozzle* • If you use manual or basic electric controls, this is important as you can mark the front gauge to where it needs to be to ensure the correct pressure at the nozzle – this will ensure accuracy in your calibration • The other main outcome of performing a pressure test each year is to see if you have issues with buildup of residues in your hoses, nozzles and nozzle bodies. In our experience at Hortspray, once you have more than a 10% variation in pressure from front to back, it’s time to start looking for where this buildup might be. Start with the nozzle bodies and nozzles – this is usually the cause (in our experience) • See “nozzle bodies” above for more information

Agitation

Left, top: This picture shows a "Supamix" venturi agitator in action. For around 14 litres per minute in-flow, it can turn over around 570 litres/min outflow – turning a 2000 litre tank over around every 3 ½ minutes

Left, bottom: This is another venturi agitator, more commonly used in sprayers in Australia. Often two are fitted in larger tanks, achieving 300 L/min outflow per minute (each)

Key points:

- Tank agitation <u>is critical</u> to ensure your tank mix stays in solution. Without agitation, the tank mix will begin to settle out in minutes. During a spray application of an hour in duration, thus could have a big impact on the last half of the tank mix being very under-strength – a huge risk in spray application
- To check if your agitator(s) are working, ensure they are turned on (look for a tap on the pump manifold), put around 200 litres of fresh water in the tank, and observe from above. It should look like the image, top left.
- Because the in-flow into the venturi agitator is a small 2-3mm jet (inside the body of the agitator), it is prone to causing residue build-up in the hose that feeds the agitator. Check these hoses thoroughly every off-season (see "blocked hoses" above)
- If your sprayer has mechanical agitation – often call "paddle" agitation, it is easy to check. Ensure the belts and pulleys that drive the mechanical agitator are kept in good order and checked regularly

Water Quality & pH

Far left:
Believe it or not, this is water used for spraying – in this picture nothing has yet been mixed with it. Not great

Left:
Jaycar sell a great little digital pH meter. Checking your water pH regularly is important

Key points:

- What you mix your products with is just as important as the chemicals and nutrients you are applying
- In general, product labels will specify the preferred pH for your water before mixing. Usually this will be between 6.5 and 8
- Commercial "buffer" products are available should your pH be too high or too low. They should be added to the tank first
- If you are outside the label range for pH, the likelihood of reduced effectiveness of the products you are applying is high
- For around $60, you can order a pH meter online

Fans and fan gearboxes

Top left:
Most orchard sprayers have a single, axial fan. A physical check of the blades, guards and structure (mounts, back-plate) is a simple process that should be done each spray. Between the fan and the tank will be a step-up gearbox. It should have a sight-glass to check the oil level

Far left: Hydraulic drive fans are mostly used in grapes. Checking hydraulic lines regularly is important

Left: Tangential fans are also hydraulically driven

Key points:

- Checking the fan on your sprayer is a simple process of looking for damage to any blades, checking the guards are secure, ensuring the oil level in the gearbox is where it should be using the sight glass – and looking for any tell-tale oil leaks
- For hydraulically driven fans, look for any signs of oil leaks and of wear to the hydraulic hoses. If hoses show signs of rubbing and wear, replace them. A burst hose is a recipe for more damage to the machine and the crop
- Some sprayers – particularly air-shear designs – have a turbine fan. They look a bit like a snail-shell. These fans are designed to rotate as high RPM to produce high-speed air – usually fed through tubes to the nozzle outlets. They need to be cleaned regularly to ensure good performance. Usually, they will be driven by a large pulley and a large belt with a tensioner. Inspect these regularly to ensure they are running true and are tight.
- With centrifugal turbine fan sprayers, regularly check the hose ducting to ensure it is in good order. Replace if required
- ALL fan types should be cleaned regularly.

Flowmeters

Far left: "Paddle-type" flowmeter showing obvious signs of wear on the paddles

Left: The more common "turbine" type flowmeter with multiple vanes, like a propellor.

Both types spin and send pulses to a controller or flow monitor

Key points:

- Flowmeters are a great way to measure how much liquid is being applied (in total) through the nozzles
- Using the flow information in litres per minute (L/min), a spray controller can adjust the liquid flow to match speed and the litres per hectare or litres per 100 metres that is required
- In lieu of a controller, a monitor displaying the information is very useful – but requiring the operator to adjust speed or pressure to maintain the desired application rate.
- NOTE – flowmeters **will** wear out and can send incorrect information. A calibration③ is required <u>at least once per season</u> to check accuracy – see appendix 3

Air-shear outlets

Left:
On an air-shear type sprayer, the droplets are formed when high-speed air is directed past a liquid outlet.
These outlets are usually fed by small hoses (see far left) and "metered" for flow – this is how the output of the nozzles are calibrated to achieve the desired litres/min desired in the sprayer calibration process.
Keeping the small tubes, nozzle outlets and all relevant feed-in plumbing clean is vital. Regular flushing is vital.

Key points:

- Air-shear sprayers typically are designed for lower volume (up to say 500 L/ha) spray application
- This lower volume spraying often means that the spray mix is quite concentrated (using a concentrate spray method). For this reason, good agitation and regular flushing is vital, as the plumbing that supplies the air-shear nozzles is often a small diameter tube(s) and quite small fittings and taps
- Like any air outlet (fan, nozzle body, etc) regular cleaning and flushing will go a long way to avoiding issues with output and irregular flow.
- Air-shear systems operate at low pressure (20-45 psi or 1-3 bar, typically) so residue buildup affects them greatly
- These systems are often fed by centrifugal pumps – ideal for this type of low-pressure system. Centrifugal pumps often have high flow capability – and the small amount used for the actual spray application allows a large amount of bypass to the tank to provide good agitation
- The main thing to look for are broken lines, blocked outlets, and to keep it all clean and flushed out

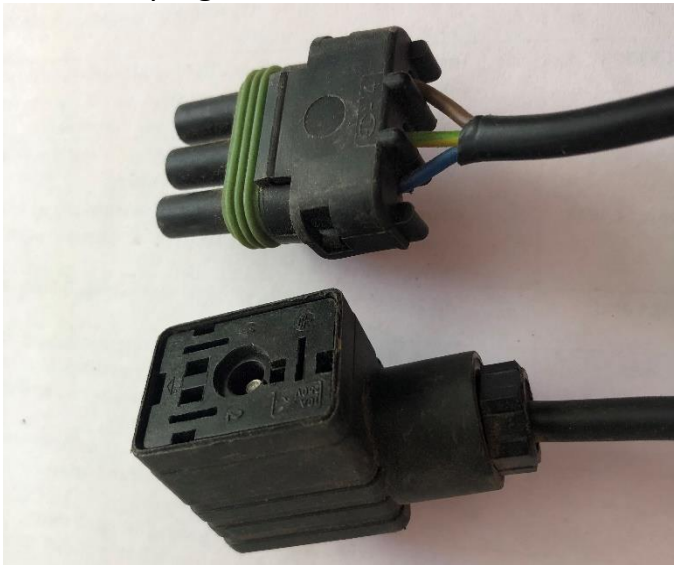
Fittings

Far Left: damaged fittings should be replaced immediately

Key points:

- Fittings are inexpensive. Any that are damaged, or showing signs of old age, should be replaced
- Undo fittings and check/grease o-rings
- Ensure you find the matching fitting to ensure a correct seal. Many sprayer fittings a specific to the job and have o-rings to provide a perfect seal
- **Left** – a new elbow fitting with cap nut and new o-ring
- Check hose clamps – are they still tight? Do they need replacing? They are very inexpensive to replace

Electrical plugs and looms



Left:
Two common types of electrical connectors found on sprayers.
The top one is a MetriPak-type with individual pins

The bottom one is called a DIN connector and is usually used to connect electrical wires to an electric valve of some type

Key points:

- Wherever possible, keep any electrical connections away from moisture such as spray drift or when you are pressure cleaning the sprayer after use
- Inspect wiring and connectors regularly and look for signs of any moisture getting in, seals breaking down or wires rubbed through
- During the winter check, it's a great idea to use a commercial electrical connector cleaning/lubricating product to help keep connectors in good condition. Jaycar have a great range – a spray on type we use does a great job
- Electrical wiring, especially on sprayers applying such products as sulphur and copper compounds, will get "ingress" over time, into the wiring. Check a few connections in winter to see if this is an issue on your sprayer
- You will know when there's a problem – something will stop working. Keep your connections in good shape

Safety

Key points:

- Part of every sprayer health check should include a safety audit

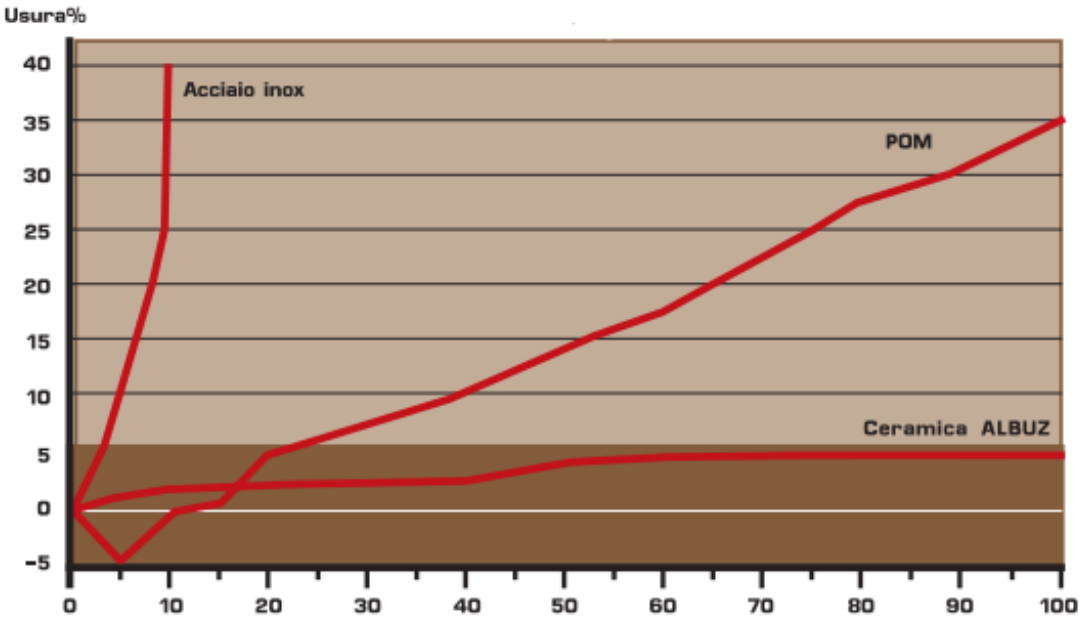
Far left: A fan with no guard. This poses major risks to both the fan blades (risk of a branch entering and destroying the fan), and to any person on the orchard. This is an absolute NO. Fans MUST be guarded
Left: A PTO with most of the safety guards and chains missing. If a workplace Health & Safety officer came across this, a major fine would result. PTO shafts are a massive injury risk (often fatal)

<u>DO NOT</u> let your sprayer fall into this state of disrepair

Controls		
	**Left:** Two common examples of motor valves from Braglia (orange top) and Arag (black with blue band). These valves are designed to shut off flow within 0.6 seconds using a motor on the top to drive a spindle in the valve body. Other brands include TeeJet & Raven	**Key points:** • Electric motor valves are probably the pick for electric control as they do not continuously draw power from the battery. They activated when switched on or off, reversing their motor direction accordingly. The motor is separate from the liquid chamber. Usually these valves are "banked together" for multiple sections. In horticulture, these are used for systems capable of 0-20 bar, or 0-40 bar, depending on the pressure required of the sprayer. • Braglia valves can be repaired, or the motor replaced, which is the most common repair method. • Arag electric valves can also have the motor replaced, although a complete new valve is almost the same cost. • If they stop working you will know straight away. Check & clean electric connections regularly. Fully inspect every third season.
	**Left:** an example of a manual pressure regulating valve (PRV). **Far left:** An Arag electric PRV designed to allow liquid to flow back to tank with adjustability either manually, or by an auto-rate controller which automatically adjusts the flow	**Key points:** • Electric pressure regulating valves do a lot of work in an auto-rate control system. If they stop working, the auto rate controller will no longer adjust for flow/pressure. To test, go into manual mode on the controller and use the pressure up/down keys to see if the valve is working. If no pressure increase or decrease is possible, replace the Electric PRV. • The manual PRV is used to protect the liquid system from over-pressure or damage using a spring-loaded diaphragm. It also regulates the liquid flow for the sprayer to meet the target spray volume. Disassemble every off-season to check the diaphragm (shown at bottom of pic), and lubricate all components.
	**Left:** Solenoid valves continously draw power, so good battery power is needed.	**Key points:** • Brass solenoids are often used in higher pressure situations. They draw continuous power to remain open, so a good power source is important (controller cables direct to battery is best) • They are affected by any small grit that enters them, so very good pressure filtration is important so they can shut off correctly

①Appendix 1: Nozzle wear chart

- Y axis = wear percentage; X axis = hours
- Acciaio Inox = stainless steel; POM = polyacetal; Albuz Ceramico = Albuz Ceramic
- Typically, in horticulture, ceramic nozzles will be at the 10% wear threshold after 500 hours of use. As shown below, polyacetal nozzles reach that threshold at around 40-45 hours, and stainless-steel nozzles at less than 10 hours of use



②Appendix 2: Tank cleaners

Tank cleaners:

There are two products Hortspray can recommend to clean out your tank, spray lines and nozzles.

- ✓ All Clear DS® is a fairly new formulation specifically designed to remove crop protection chemical deposits and other debris, including oily substances from tanks, hoses, booms, transfer and mixing systems, filters, screens and nozzles.
- ✓ Nufarm Tank & Equipment cleaner has been around for many years and is also a trusted product for tank cleaning.

Either way – use a good quality tank cleaner regularly to prolong the life of your sprayer components.

Appendix ③ - Checking flowmeters for accuracy

Checking flowmeters for accuracy – method 1 – tank refill method

Step 1. Park the sprayer on level ground

Step 2. Fill sprayer so that water is right up to the rim of the filling lid

Step 3. Put the spray controller into manual mode, ensure the "litres pumped" is set to zero and then spray for two minutes at your normal spray pressure

Step 4. Check the "litres pumped" on the spray controller

Step 5. Refill the tank back to the level you started at (right up to the rim on of the tank fill point/lid) – measure exactly how much you put back in

Compare the amount shown as being pumped out through the nozzles vs how much is measured back into the tank. If there is 5% or more discrepancy, the calibration factor for the flowmeter will require adjusting.

Checking flowmeters for accuracy – method 2 – into a bucket method

Step 1. Remove a hose for one section of the sprayer (off one side of the sprayer, for example, that connects to the spray ring or spray boom) and have a good-sized container handy (say, 50-100 litre capacity)

Step 2. Put the spray controller into manual mode, ensure the "litres pumped" is set to zero and then turn on that section you have selected to take the hose from. Pump the liquid from the hose into your container for one or two minutes

Step 3. Measure accurately how much has been pumped into the container using a measuring jug – add up the total pumped

Step 4. Check the "litres pumped" on the spray controller

Step 5. Compare the amount shown as being pumped (from your controller screen) vs how much you measured from the container. The amounts should match closely. If there is 5% or more discrepancy, the calibration factor for the flowmeter will require adjusting.

If your measured value is different to your "litres pumped" value (i.e. measured is 31 litres, and displayed value is 27 litres = 13% difference, follow your spray controller manual to adjust the calibration value. Once done, repeat the process of checking to be sure you have the new value within 5%. If you can get it within 1-2% - even better!

Above – on your spray controller, select manual mode.
Above middle – zero the litres pumped (follow your manual instructions)
Above right – after you have had your unit pumping for 1-2 minutes, you will have recorded the amount in litres on the controller. This will be compared to what you either a) measure back into the tank – method 1, or b) measure what you capture in your container – method 2



Above – method 1, fill your tank to the brim. Middle – after pumping in manual for 1-2 minutes, your tank will have emptied out some liquid. Right – measure back in what you pumped out & compare to the amount the controller tells you that you have used/pumped out.



Your flowmeter will have a calibration number on a tag or on the body. This number may need adjustment if your measured volume does not match your controller info

Above & middle – method 2, removing a hose from one sprayer section, pump for 1-2 minutes into a container. Then measure that amount, and compare to the controller information