

## Manual Pump Calibration option for Gen2 vApplyHD systems

There are two options for calibrating the pump with a Gen2 controlled vApplyHD system.

Option 1 is to use the automated pump calibration. This is found by navigating the monitor to Setup - Systems- Calibration- vApplyHD Calibrations- Pump Calibration. The automated pump calibration will ask you to input the minimum rate and speed, and maximum rate and speed. Then the calibration will run the pump in increments of increasing PWM% until it is able to achieve the desired maximum application rate on all rows to determine the maximum PWM% needed for the system. Then it will run the test at the minimum rate and speed in decreasing increments of PWM% until it is unable to hit the rate and speed to determine the minimum pump speed.

The automated pump calibration will fail if any of the following are true. Failed pressure sensor on any row. Failed low flow turbine on any row. Failed total flow turbine on any row. Pressure maximum setting exceeded at any time. Inability to achieve the target rate maximum on all rows.

Option 2 is to manually find the calibration numbers. This can be an option when the monitor is unsuccessful at passing the automated calibration or if you simply prefer the faster speed of a manual calibration. To perform the manual calibration follow the steps below.

### **Step 1:** Flush the lines (both new installs and existing systems)

1. Disconnect the supply lines from the vApplyHD modules.
2. Enter the vApplyHD pump flush health check on the 20/20
3. Speed up the pump by pressing the +5% PWM button until the pump is running smoothly
4. Flush until clean, clear fluid is achieved on all rows
5. Stop the test and reattach the supply lines to the vApplyHD modules.
6. If row strainers are installed, verify the screens are clean.

### **Step 2:** Set the pressure relief bypass valve.

Explanation of this step – In this step you are setting the spring pressure on the bypass valve. This will result in setting the maximum system pressure that the system will have, assuming the plumbing for the return is sized so that it is not a significant restriction.

1. Turn the bypass valve all the way out.
2. Enter the vApplyHD pump flush health check.
3. Change the “+5% PWM” button until you achieve a PWM % that will run the pump at a reasonable speed to run smoothly and output flow. This needs to be a

fairly fast speed but not excessive (hydraulics to the pump on and Master/Section switches must be up to run the pump). NOTE: Centrifugal pumps the procedure is a bit different. Run the pump up to the highest PWM % you may need (while making sure it does not build over 100psi).

4. Adjust the bypass valve until the pump pressure reaches your desired setpoint – Make a note of the pressure that you set so you can refer to it later \_\_\_\_\_ psi.
  - a. Electric pumps generally 20-25 psi.
  - b. Most hydraulic pumps 50-60 psi is sufficient.
  - c. Centrifugal pumps only – set the bypass to the maximum pressure that you want to ever have. You will have less pressure than this when running the pump at slower speeds so set this pressure HIGHER than you want system pressure to be when running
  - d. Very high volume systems may need 80 psi to achieve rate.
  - e. FurrowJet systems should be more than 30 psi as it is desired to have 30 psi at the orifice plate – so system pressure should be 40-50psi or more.
  - f. Always set below 100 psi. Above 100 psi fittings may leak.
  - g. Note: The setting for “pressure maximum” in the vApplyHD “Advanced Setup” must be at least 10-20 psi above the pressure you set at the bypass.
5. Check that the bypass is sized to handle the full volume of the pump output.
  - a. Increase “+5% PWM” by 5-10% at a time and observe the pump pressure does not climb substantially (up to 10 psi higher is ok).
  - b. Continue this until you reach the maximum PWM % that you are comfortable running the pump (not exceeding max pump RPM) or until you reach 100%.

Note: If the pump pressure increases dramatically, then a change to the bypass system is needed.

    - i. First check that there is not a restriction in the return system. \*This could be an agitation bar in the tank on the return port
    - ii. Option 1 - if pump output is 35 GPM or less, increase the size of the return line.
    - iii. Option 2 - if the pump output is 35 GPM or more, add a second bypass valve and line.
    - iv. Option 3 - Set the “maximum PWM” in the vApplyHD Advanced setup page at a PWM % that will not cause pressure to exceed 100 psi.
6. The bypass is now set and should not need to be adjusted further for most pumps.

**Step 3:** Find maximum PWM % for the pump calibration – The goal in this step is to check the health of the system and find the best setting for the maximum PWM %.

NOTE: This will require setting the system pump style to different constant PWM % setpoints. You will be navigating back and forth between two pages

- “Setup - Systems - vApplyHD - Product X setup - Pump Style - Constant PWM - Constant PWM % Setting”
- “Setup - Systems - Health Checks - vApplyHD Nitrogen Health Checks - Manual Test”

NOTE: try and have system voltage as close to field conditions as possible – tractor lights on, Speedtubes running, ect to draw system volts down.

1. Set the constant PWM % to a speed that will run the pump smoothly and is close to a setting that you believe may achieve the rate.
2. Start the manual test.
3. Change the setting for “gal/acre” to the maximum rate that will be needed and the setting for “mph” to the maximum speed that will be used (Note: make sure and use these same settings each time you change PWM % and come back to the manual test)
4. Verify that all rows are outputting “gal/min act”
  - a. If not, stop the test and investigate the problem on that row.
5. Check all rows have healthy encoder readings.
  - a. If not, stop the test and clean the affected turbines.
6. Check that the “gal/min act” matches the “gal/min cmd”
  - a. If it does not, observe if there is sufficient pressure, generally 20+ psi is enough, but higher flow systems may need more pressure to achieve the rate. If there is not good pressure, stop the test and change the Constant PWM % setting to a higher setpoint.
    - i. Note: Centrifugal pumps will likely have much less pressure than set in step 2.
  - b. If there is good pressure at the row, and you cannot achieve the commanded rate, then there is a restriction after the vApplyHD module preventing the rate from being achieved. If there are orifice plates after the vApplyHD increase the size of the orifice plate (or orifice tubing).
  - c. Navigate to the manual test again and check that the system can now achieve the command rate. If not, continue raising the Constant PWM % setting until the rate is achieved.
    - i. Note - if the system is unable to achieve the command rate once you have reached 100% PWM, then you must investigate why the

pump is not producing enough flow (also indicated by very low pressure at the vApplyHD module). This could be due to too small of a pump for the maximum rate, insufficient hydraulic flow to the pump, insufficient product flow to the pump, worn or damaged pump, plumbing restriction.

7. Once the “gal/min act” matches the “gal/min cmd” then you want to optimize the PWM % for the maximum rate.

**IMPORTANT NOTE** – If the pump is hydraulically driven and the tractor hydraulic oil is cold, it is recommended to choose a higher PWM % that you like the results rather than a lower PWM % that you like the results. The reason for this cold hydraulic oil will turn a hydraulically driven pump faster than operating temperature oil. Choosing a higher PWM % that produces good results for the below items will return a better pump calibration for field operation.

- a. Check that the “Act/Cmd Ball deg” is not too high, 75 degrees is the maximum position, if ball position is over 50 degrees there is not much extra flow available. Increase the PWM % and observe if the ball position can be lowered. Generally lower ball positions are better.
  - b. Observe the “Flow Stability” on the rows (if “Pressure Stability” is shown, click on the heading to change to “Flow Stability”). Higher is better. It is preferred to be greater than 85%. If you can adjust the PWM % up or down and increase this value while not negatively affecting the ball position or ability to achieve rate, then this is a better setting. Also check “Pressure Stability” and try to have it greater than 85% as well.
  - c. Centrifugal pumps only – You may need to optimize the PWM % in combination with the pressure relief bypass valve setting. To accomplish this, adjust the speed of the pump and if needed increase the bypass valve spring tension to get additional pressure at lower pump speeds. It is very important to check once you are done that the system cannot build too much pressure with a gal/acre target of 0 and PWM% at your maximum PWM %.
8. If you are comfortable with the speed of the pump and all of the above settings, the value in the “PWM %” is your value for the Pump Cal Max PWM. Record this number here \_\_\_\_\_.
    - a. You may want to exit the tractor and listen to the pump for cavitation or “hammering”.
    - b. You may want to check the speed of the pump against the pump manufacturer recommendations to ensure you are not exceeding the maximum pump RPM specification.
    - c. Find the total maximum flow rate for the planter by taking the “gal/min cmd” for the row and multiply by number of rows – Write down this number

here \_\_\_\_\_ as Pump Cal Max Rate. This can also be found by math by  $(\text{GPA} \times \text{row spacing} \times \text{max speed}) / 5940$  then multiply by the number of rows.

**Step 4:** Find the minimum PWM % for the pump calibration.

1. Continue with the manual test.
2. Change the setting for “gal/acre” to the MINIMUM rate that will be needed and the setting for “mph” to the MINIMUM speed that will be used (Note: make sure and use these same settings each time you change PWM % and come back to the manual test)
3. Lower the PWM % setting by 10% at a time - each time going back to the manual test to make observations.
  - a. Just like step 3, a higher PWM % that the below numbers look good is generally better than a lower PWM % to ensure enough flow in field conditions.
  - b. Watch that the “gal/min act” still matches the “gal/min cmd”
  - c. Observe the “act/cmd ball deg” is not too high - it should not be over 50 degrees and generally lower ball positions are better.
  - d. Observe the “flow stability” on the rows and try to have it as high as possible, over 85% is preferred.
  - e. Observe the “pressure stability” on the rows and try to have it as high as possible, over 85% is preferred.
  - f. Observe the “pressure pump” it should not fall too far. Generally it should be 20+ psi, but higher flow systems may need more to achieve the needed rate. Some systems may have lower pressure and this is ok if the above three items are optimized. Note: Centrifugal pumps the pressure could be significantly lower than the pressure set in step 2.
4. Continue to lower the “PWM %” until the items above are negatively affected. Try to optimize the above items with the “PWM %”. Once you are comfortable with these values, this is your minimum PWM%, record this number here \_\_\_\_\_.
  - a. You may want to check and make sure the pump is not turning too slowly or seem to be laboring. It is ok to run the pump faster if desired and it doesn't negatively affect pressure stability.
5. Find the total minimum flow rate for the planter by taking the “Flow Command” for the row and multiply by the number of rows – Write this number down here \_\_\_\_\_ as Pump Cal Min Rate. This can also be found by math by  $(\text{GPA} \times \text{row spacing} \times \text{max speed}) / 5940$  then multiplied by the number of rows.

**Step 5:** Enter the numbers for the pump calibration into the 20/20 settings

1. Navigate to the pump calibration page by going to “Setup - Systems - Calibration - vApplyHD Calibrations - Pump Calibration - Calibration Results
2. Click “Min PWM” and enter the minimum PWM % that you found in Step 4.
3. Click “Min Rate” and enter the Pump Cal Min Rate value that you found in Step 4.
4. Click “Max PWM” and enter the maximum PWM% that you found in Step 3.
5. Click “Max Rate” and enter the maximum PWM % that you found in Step 3.
6. Click “Save Calibration” If you skip this step the values will not be saved!

**Step 6:** Change the pump style to a controlled pump option

1. Navigate to Setup - Systems - vApplyHD - Product (x) Setup - Pump Style and change the pump style to the appropriate setting (Electric Diaphragm, Hydraulic Diaphragm, Hydraulic Piston, Hydraulic Centrifugal)

**Step 7:** (optional) Verify your pump calibration

1. Navigate back to the manual test
2. Change the application rate and speed to the maximum rates the system will need.
  - a. Verify all rows are able to achieve “gal/min act” matching “gal/min cmd” with good ball position, pressure and pressure stability.
3. Change the application rate and speed to the minimum rates the system will need.
  - a. Verify all rows are able to achieve “gal/min act” matching “gal/min cmd” with good ball position, pressure and pressure stability.