## vApplyHD procedure for setting a pump with "Constant PWM" with 20|20 Gen3

This procedure is for using the manual test to find a good setting to use when the 20|20 is controlling the pump but a constant speed is desired. Some users find with their pump for various reasons that using a pump calibration where the 20|20 can speed up or slow down the pump is not desired and it is a simpler setup to have the pump run a constant speed. This may be because of a plumbing issue causing a pump to cavitate or a pump sized such that a constant speed is desired. Some users find that centrifugal pumps and electric pumps operate well with a constant speed. The disadvantage of a constant speed is the pump will not slow down when rows swath off.

Step 1 – Flush the lines (both new installs and existing systems)

- Disconnect the supply lines from the vApplyHD modules
- Enter the vApplyHD manual test on the 20|20
- Set the "Duty Cycle Adjust" to manual and a PWM % that will run the pump smoothly and output a strong amount of flow
- Flush until clean, clear fluid is achieved on all rows
- Stop the pump and reattach the supply lines to the vApplyHD modules
- If row strainers are installed, verify the screens are clean

Step 2 – Set the bypass

**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.**

- Turn bypass valve all the way out
- Enter the vApplyHD manual test for this product
- Make sure the "Rate Adjust" is set to a rate of 0.00 gal/acre
- Change the "Duty Cycle Adjust" to manual and 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).
- 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.
    - Electric pumps generally 20-25 psi
    - Most hydraulic pumps 50-60 psi is sufficient
    - **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
    - Very high volume systems may need 80 psi.
    - 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.
    - Always set below 100 psi. Above this fittings may leak.

    - The setting for maximum pump pressure in the vApply rate control module settings should be at least 10-20 psi above the pressure you set at the bypass
- Check that the bypass is sized to handle the full volume of the pump output
    - Increase "Duty Cycle Adjust" by 5-10% at a time and observe the pump pressure does not climb substantially (up to 10 psi higher is ok)
    - 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%
        - If the pump pressure increases dramatically, then a change to the bypass system is needed
            - 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
            - Option 1 - if pump is 35 GPM or less, increase the size of the return line
            - Option 2 - if the pump is 35 GPM or more, add a second bypass valve and line
            - Option 3 – Set the "maximum PWM" setting in the vApply rate control module settings at a PWM % that will not cause pressure to exceed 100 psi.
- The bypass is now set and should not need to be adjusted further for most pumps.

Step 3 – Find the constant PWM % – The goal in this step is to check the health of the system and find the best setting for the constant PWM %. NOTE: try and have system voltage as close to field conditions as possible – tractor lights on, Speedtubes running, ect to draw system volts down.

- Continue with the manual test
- Change the "Rate Adjust" to the maximum rate the system will need to apply
- Change the "Speed Adjust" to the maximum speed that the tractor will go in field
- Change the "Duty Cycle Adjust" to a speed that the pump will run smoothly
- Verify that all rows are outputting "Flow"
    - If not, stop the test and investigate the problem on that row
- Check all rows have healthy encoder readings
    - If not stop the test and clean the affected turbines
- Check all rows the "Flow" matches the "Flow Command"
    - If it does not, observe if there is sufficient pressure, generally 20+ psi is enough, but higher flow systems may need more to achieve the needed rate. If there is not good pressure, increase the "Duty Cycle Adjust" until you have good pressure.
        - Note: Centrifugal pumps will likely have much less pressure than set in step 2.
    - 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).
    - 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.

- Once you have the "Flow" matching the "Flow Command", then you want to optimize the PWM % for the maximum rate. Try various settings for the "Duty Cycle Adjust" to find the optimum PWM %.
  **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.
    - Check the "Ball Position" 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 "Duty Cycle Adjust" and see if "Ball Position" can be lowered. If any ball positions are at 75 degrees, this is a problem as this is maximum position and the rate is not likely to be achieved. Generally lower ball positions are better.
    - 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 should be greater than 85%. If you can change "Duty Cycle Adjust" up or down and increase the "Flow Stability" this is better. Also check "Pressure Stability" and try to have it greater than 85% as well.
    - 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 "Rate Adjust" of 0 and "Duty Cycle Adjust" at your maximum PWM %.
- Now change the "Rate Adjust" to the minimum rate the system will need to apply and change the "Speed Adjust" to the minimum speed that the tractor will go in field
    - Observe the "Flow Stability" and "Pressure Stability" on the rows. Higher is better. It should be greater than 85%. If you can change the speed of the pump (or output setting) up or down and increase the "Flow Stability" and "Pressure Stability" this is better. However you cannot lower so much that it affects the ability for the system to meet all of the parameters discussed under the maximum rate and maximum speed that you observed earlier. If you slow the pump at this point, you will need to recheck the system at maximum rate and maximum speed to verify the system is still healthy at those settings.
- If you are comfortable with the speed of the pump and all of the above settings, the value in the "Duty Cycle Adjust" is your value for the Constant PWM
    - You may want to exit the tractor and listen to the pump for "hammering" or cavitation.
    - 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.
- Observe the final "Duty Cycle Adjust" percentage that you have chosen. Write down this number as the constant PWM here_____. You will enter it during step 4 in settings.

Step 4 – Enter the settings

- Turn the pump off by moving the Master and Section switches to the down position.
- Click “Done” on the manual test
- Navigate to the Setup – systems – (name for this system) – vApply Rate Control – Continue – Settings and scroll down.
    - PWM Control Style - set to “Constant PWM”
    - PWM Control Setpoint – enter the value you used for “Duty Cycle Adjust” in the manual test. This is the PWM that will be output to run the pump.