6 Common Hydrodynamic Testing Mistakes

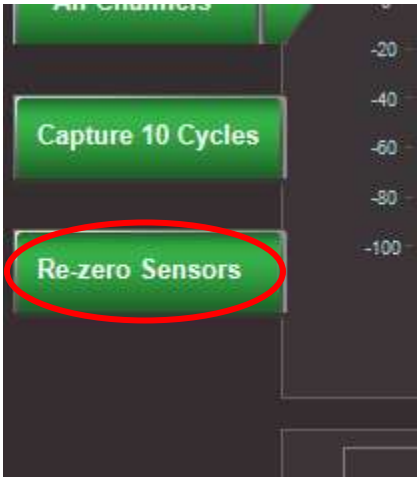
Joe McMahen

Many common mistakes made during hydrodynamic testing are easily avoided. Below are 6 Hydrodynamic Testing mistakes we see regularly along with guidance on how to avoid them when using ViVitro equipment.

1. **Failing to 'Re-zero Sensors' before collecting data**

   Prior to each data collection, the system sensors should be re-zeroed in ViVitest.

   Pressure transducers must be opened to atmospheric pressure, the flow probe must be full of fluid, and the flow meter must be on when the sensors are zeroed. The system should then be brought up to operating conditions and the data collected without delay to ensure the best possible sensor zero accuracy.



Sensors should be re-zeroed prior to each data collection.

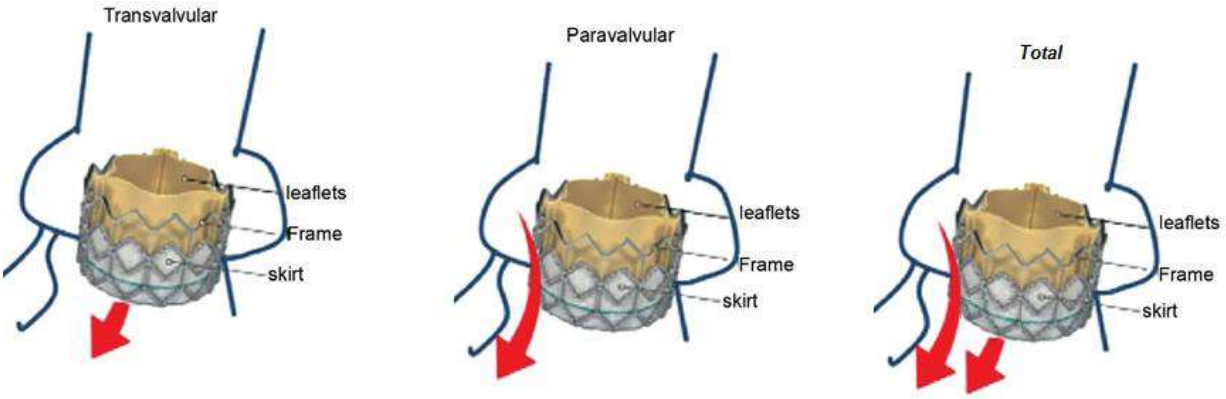
2. **Device Fixturing**

   Fixturing your device is extremely important. Fixturing is the only way a device contacts the rest of the tester. This is similar to the old saying: your tires are the only part of your car that touch the road.

   During testing it is important to test the device in a fixture appropriate to the needs of the test you are trying to perform. Depending on the intent of the test, this could be a very realistic simulation of the native anatomy, or a simplification that only recreates critical aspects.

   For example, to test for paravalvular leakage, valves could be deployed first without sealing around the valve. Test them again with sealing around the valve perimeter to characterize the leakage.

For a sealed valve, Total Leakage = Transvalvular Leakage
For an unsealed valve, Total Leakage = Paravalvular + Transvalvular Leakage

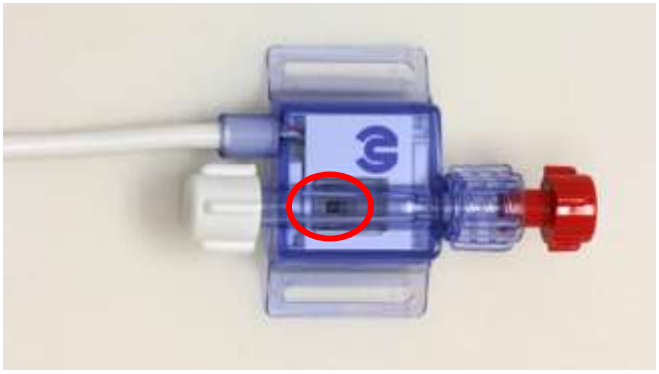


Device fixturing will affect the total leakage of the device.

Fixtures intended to test for total leakage (left) and transvalvular leakage only (right).

3. Bubbles left in pressure transducers

Bubbles trapped in a pressure transducer are a common source of noise in a pressure tracing. Any time the system is drained and filled, pressure transducers should be flushed and checked for trapped bubbles, particularly around the sensor crystal.



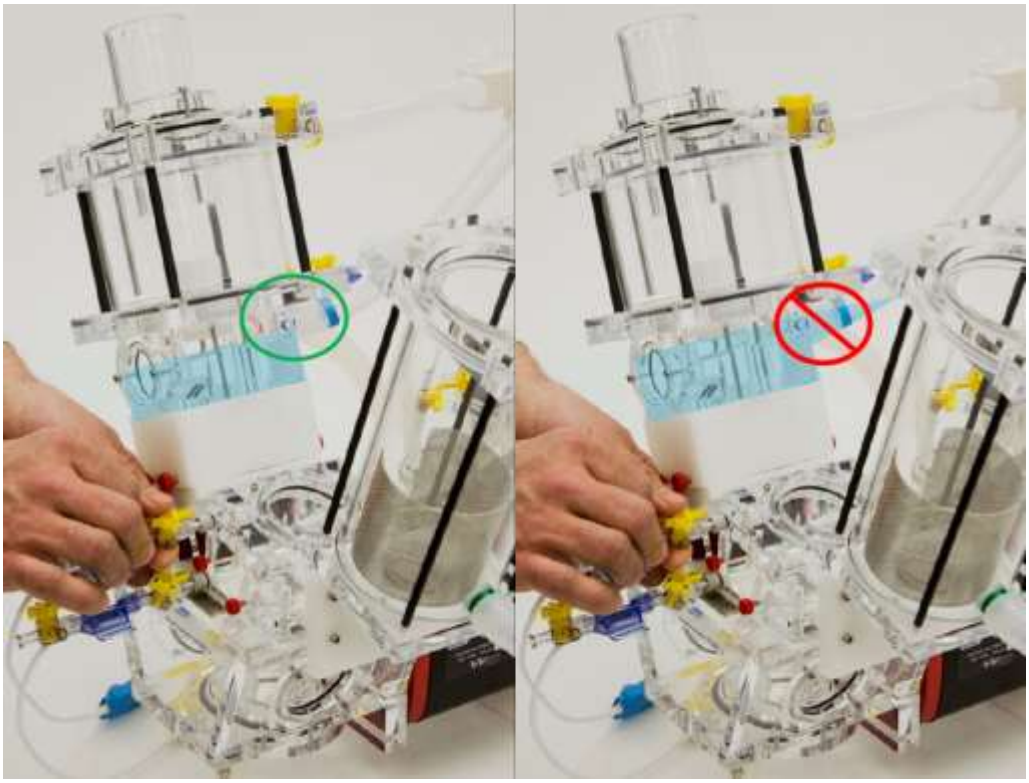
Bubbles may be trapped at the pressure transducer crystal if not flushed properly.

4. Compliance not adjusted properly

When the system is brought up to operating pressure it is important to check that the compliance pressure is adjusted properly. If the compliance is inadequately pressurized, fluid will begin to fill into the Aortic Root compliance tube with each pulse. This will result in excess noise in the aortic pressure (shown in red below).

Aortic pressure (red) noise due to improper Aortic Root Compliance pressurization.

When tuning the system before collection, ensure the aortic root compliance chamber is pressurized enough so that no test fluid gets into the compliance tank tube.

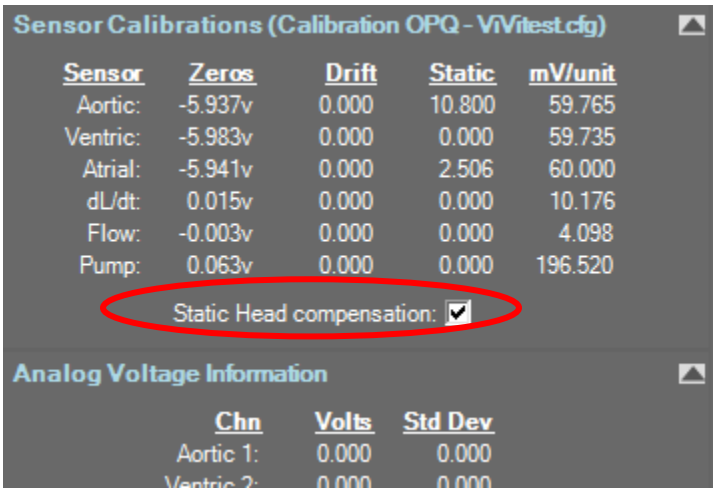


Aortic Root Compliance air pressure should be pressurized to prevent test fluid from sloshing into the air compliance line.

The volume of air in the compliance tanks has been set so that at a mean aortic pressure of 100mmHg, the system will produce systolic and diastolic pressures of 120/80. Different compliance tank volumes are available depending on different testing needs including right heart or paediatric.

5. Static Head Compensation not used

The Static Head Compensation checkbox should be checked in the ViVitest ACQUIRE tab to compensate for pressure reading discrepancies between transducer sites due to the differing static head. This ensures accuracy of transvalvular pressures under pulsatile flow conditions.



Static Head compensation should be selected during standard tests.

ViVitest normalizes all of the pressures to the level of the ventricular pressure (the highest static pressure). During pressure calibration, care should be taken to ensure that all steps are followed correctly.

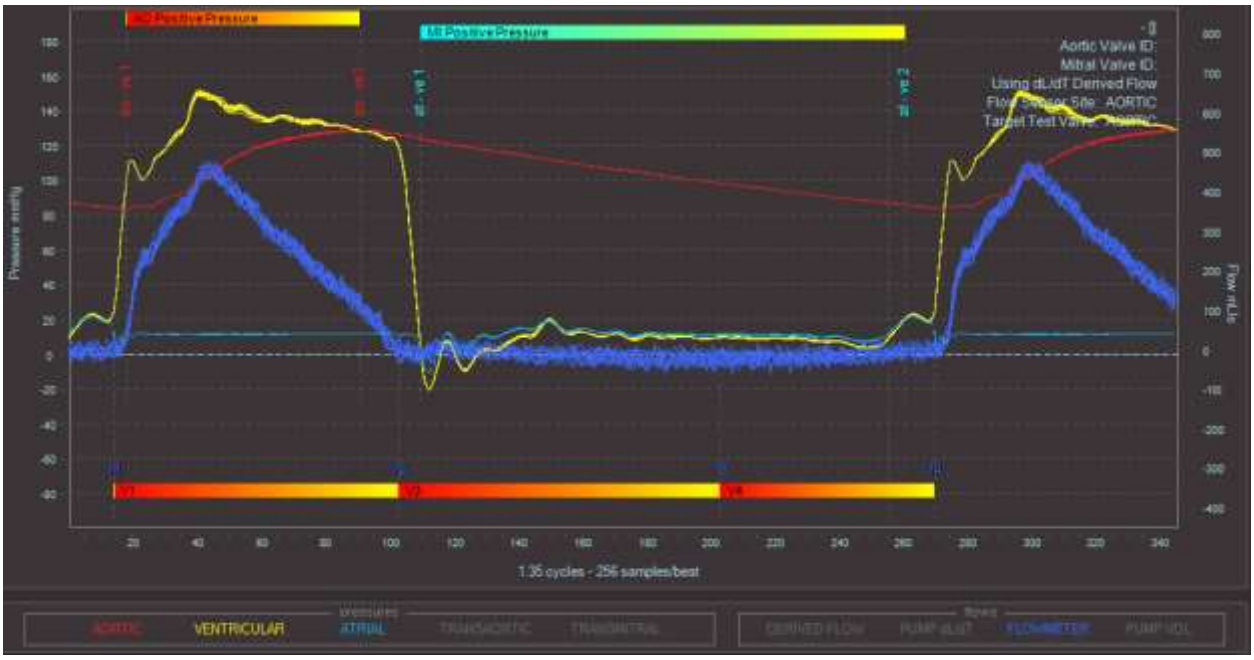
You will know that you have calibrated the static head correctly when all pressure readings are at the same level as the ventricular pressure. This level may vary depending on the amount of fluid you have in the atrium of the system.

Properly calibrated Static Head compensation will yield equal pressure signals when the system is filled and static.

6. Electrical Noise in Measurements

It is important to ensure you have a good electrical grounding connection for all components of the system. When in doubt, hire a qualified electrician.

Most physiological waveforms and those found with ViVitro systems should be free of High frequency noise. Curves should look generally smooth. If they are not, this might indicate a problem with the system setup.



Noise from an improperly grounded flow meter (blue).

In general, if the noise is consistently seen throughout the entire cycle, it is most likely electrical noise. The user should check that the filter frequency is correctly set on the AmPack pressure amplifier, the ground cable is connected correctly to the Flow Meter and Model Heart, all cables are securely connected, and whether an external piece of equipment may be injecting noise into the system.

If the noise is seen repeatedly at the same part of the cycle, it is most likely due to mechanical or fluidic disturbances. The user should then check for excess bubbles in the system, movement in the valve fixturing, or excessive fluid sloshing due to an improperly filled or tuned system.

Use the tips above and you will avoid the 6 most common Hydrodynamic Testing mistakes when using ViVitro equipment.