

# Offset Measurements

## 1 Lever Arm Measurement – Offsets

Each component or sensor that produces information, unique to its position, will have a point that is considered the reference point of that sensor. The Sonic 2024, the motion sensor, and the GPS antenna will have a documented point from which to measure. The gyrocompass' data is not dependent on its position on the vessel so, therefore, does not require an offset measurement.

### 1.1 Vessel Reference System

When all equipment (Sonic 2024 sonar head, motion sensor, gyrocompass and GPS) have been permanently mounted, the physical offsets to a central reference point (CRP) must be measured. The central reference point (CRP) or vessel reference point (VRP) is that point that the surveyor chooses to be the origin for the X and Y grid that will define the horizontal relationship between all of the sensors. The vertical or Z reference can be the water line or other logical vertical reference. Generally, the CRP corresponds to the centre of gravity or rotation of the vessel. All of the sensors must have their physical relationship to each other measured and entered into the data collection software or the processing software.

All offsets, between sensors, are defined by an X, Y and Z offset from a reference (CRP or VRP) point. The X axis runs athwartship, i.e. from the port side to the starboard side. The Y axis runs alongship from the bow to the stern (some software may reverse these axes). The Z axis runs perpendicular through the reference. The origin can be any point; the origin will remain the same for all sensors. Some surveyors take the GPS antenna as the origin for all measurements, others take the sonar head itself, while others might take the motion sensor (especially if it on the centre of rotation for the vessel). The sign convention is standard for a Cartesian plane, translated to a vessel: starboard of the reference point is positive, forward of the reference point is positive. The sign for Z may differ, depending on the data collection or processing software.

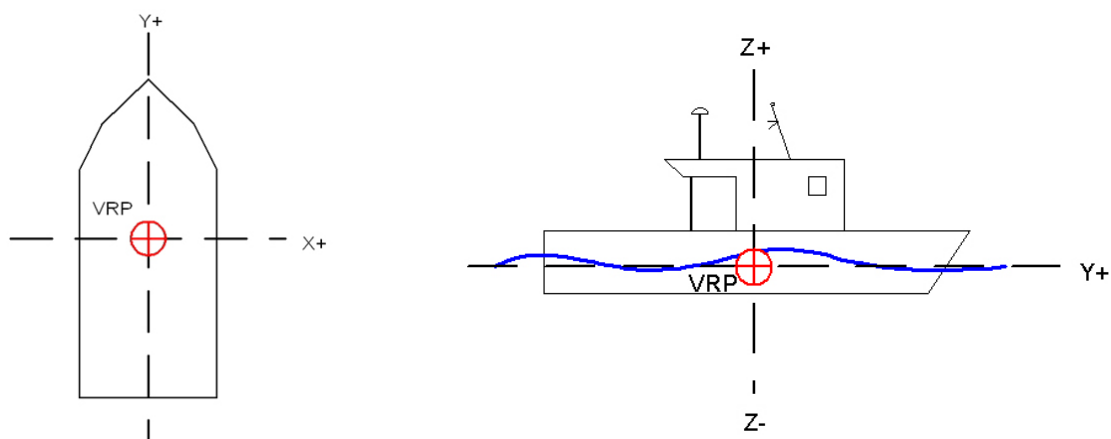


Figure 1: Vessel Horizontal and Vertical reference system



## 1.2 Measuring Offsets

The accurate measurement of offsets is vital to the accuracy of the survey data. If possible, the vessel will be put on a hard stand so that it can be very accurately measured using standard land survey equipment, such as a total station. However, this may not be possible and the offsets will have to be measured using a tape and plumb-bob, which is detailed below.

### 1.2.1 Sonic 2024 Acoustic Centre

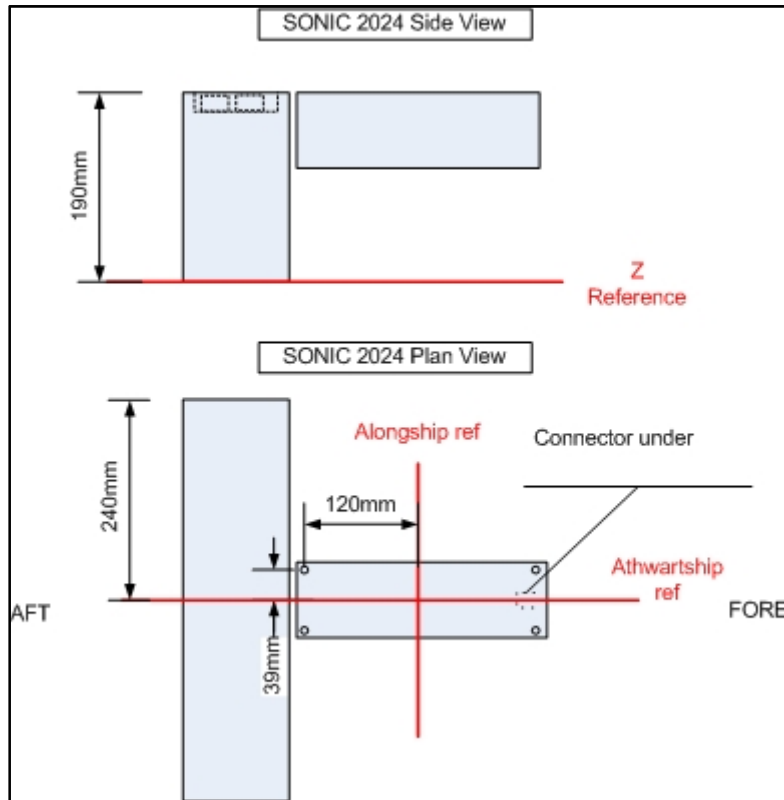


Figure 2: Sonic 2024 Acoustic Centre

### 1.2.2 Horizontal Measurement

All measurements should be made with a metal tape measure. A cloth tape can stretch, it can also be knotted or kinked, unknown to the persons making the measurements. At a minimum two people should be assigned to take the measurements, three people will work better with the third person writing down the measurements. One person will be the holder and the other will be the reader. Starting at either the reference point or the sensor the distance will be measured. When either the reference point or the sensor is reached, the two people will reverse roles: the holder is now the reader and the reader is the holder, the transverse is made back to the point of beginning, but not using the same path. If reference marks were made on the first leg, they should not be used on the second leg back. If the measurement from the sensor to the reference point, in one direction, agrees with the measurement in the opposite direction, made by a different reader and holder, then the offset is good. If there is a small disagreement in measurements, the two measurements can be averaged. If there is a large disagreement then the process should be repeated. What is a small disagreement? A few centimetres can be expected.



### 1.2.3 Vertical Measurement

To measure elevations or the Z offset, the use of a plumb bob is required. This can be something as simple as a spanner tied to a length of line and lowered from one deck to the next. The plumb bob will also allow for accurate measurements in the X and Y direction when transposing them from one deck to the other.

The plumb bob works, of course, by gravity so generally points to the centre of the earth. This being the case, if the vessel is not in good trim, i.e. has a list, the resting position of the plumb bob may not be at the true vertical point under the place from which it is being held. This is very critical when transposing X and Y measurements from one deck to another.

The draft of a vessel will not be constant. Prior to going out on a survey, the fuel and water may be filled up, causing the vessel to settle lower in the water. Possibly less people are on board causing the vessel to rise higher in the water. The main concept here is that the draft of the sonar head changes. All X and Y offsets remain the same as long as the sensors are not moved, but the Z offset changes constantly depending on the draft of the vessel.

If possible the pole should be marked to show the depth of the head. Measuring up from the sonar head's acoustical reference, rings can be painted on the pole in 10 cm (or other) increments, with 2 cm hatching between rings. The surveyor may have to observe the pole over the course of a few minutes to determine where the water line is and would then estimate the depth by interpolating between the 10 cm depth rings.

Another method would be for the surveyor to initially measure from the sonar head's acoustical reference to the top of the hydrophone pole. This is the total pole measurement. At the start of a survey day the surveyor will go to the pole and measure from the top of the pole to the water line (using the tape measure and plumb bob or similar weight), this is called the dry measurement. Taking the dry measurement from the total pole measurement yields the wet measurement, which is the draft of the sonar head. Due to wave motion, the surveyor may have to take a series of measurements to ensure an accurate reading.

When the draft or Z of the sonar head is determined the Z for the GPS antenna and the motion sensor can be adjusted accordingly, if the Z reference is the water line. In most data collection software a Z shift, in relation to the water surface, can be entered in for the CRP, which will do the vertical adjustment for all offsets

It is very important that when measuring the draft on small vessels that the person taking the measurement does not unduly cause the vessel to list towards that side. Having someone counter balance the weight of the person taking the measurement is a good idea. This is also true of any temporary list the vessel is experiencing. On small survey vessels, a person leaning over the side, to take the draft measurement, can induce upwards, or exceeding a 10cm error in depth readings during survey operation.

On some vessels it is advisable to take draft readings during the survey or immediately after completion of the survey, as the draft will change that much.

All offset information should be recorded in the daily survey log and the vessel's permanent survey record.