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SonTek Technical Notes

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## Instructions on the compass calibration procedure for SonTek's RiverSurveyor S5 and M9 systems

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When making a discharge measurement using the RiverSurveyor S5 or M9 system, the system's internal compass is used to provide the instrument's heading as it moves across the channel. A proper user-performed compass calibration at the field measurement site prior to collecting data is a critical step for avoiding heading errors during the measurement, as the compass calibration is used to compensate for localized magnetic interference in the vicinity of the instrument. If heading errors are observed during the measurement, then a review should be performed of the methodology used for the compass calibration, and of the local surroundings where the calibration was performed for potential sources of magnetic interference, in order to locate the cause(s) of the heading errors.

A primary consideration is that the compass calibration is designed to be representative of the conditions that will be experienced during the actual measurement. When calibrating the compass, the RiverSurveyor S5/M9 should be rotated through two complete circles while varying the pitch and roll. **The keys to a proper compass calibration are slow rotations in a relatively low magnetic field, using pitch and roll angles similar to what will be experienced on the boat or floating platform during the actual data collection.** For example, if the measurement will be performed at a site with flat surface water conditions, then a compass calibration using smaller pitch and roll angles may be sufficient. However, if the boat or floating platform will be experiencing large pitch and roll angles during the measurement, then the calibration needs to be performed using large pitch and roll angles during the rotations. If smaller pitch and roll angles are used during the compass calibration procedure than what will be experienced during the actual measurement, there will be the potential for significant heading errors. Conversely, calibrating the compass using significantly large pitch and roll angles and then making the actual measurement where very small pitch and roll angles will be experienced could also lead to heading errors.

In addition, the pitch and roll angles applied during the calibration should be done at a relatively slow rate (such as what one might use when operating/panning a video camera). Varying the pitch and roll angles too quickly or erratically will cause the RiverSurveyor S5/M9's internal accelerometers to report unrealistic heading values for a given calibration point, resulting in significant calibration errors.

**It is also important that the compass calibration be performed in the same environment as where the actual measurement will be performed.** For example, it is not adequate to perform a calibration in a parking lot far from the water's edge or on a concrete bridge deck far above the



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water surface, etc. In addition, prior to the calibration it is important to look around to insure that there are not any sources of magnetic interference in the area where the compass calibration will be performed. Potential sources of interference include large ferrous metal objects, metal hulled vessels, concrete structures with rebar, power transmission lines, automobiles, etc.

Specific calibration instructions follow:

1. Prior to the calibration, all magnetic material or sources of interference should be removed from the immediate vicinity, such as cell phones/mobile electronic devices, wristwatches, keys, hand tools, etc.
2. If the RiverSurveyor will be mounted on a floating platform, the compass calibration must be performed with the system installed on the platform along with the other components. If the RiverSurveyor will be used from a manned-boat, the compass calibration must be performed using the entire boat with the RiverSurveyor mounted in the exact place and orientation in which it will be used during the actual measurement. Everything that will be physically attached to the RiverSurveyor system during the actual measurement must be treated as part of the system and therefore rotated along with the S5/M9.
3. The RiverSurveyor S5/M9 and boat/floating platform should be rotated through two complete circles, taking 60 seconds for each rotation. The RiverSurveyor Live software will limit the calibration routine to a maximum of 120 seconds, so the operator should try to perform one rotation per minute.
4. The pitch and roll angles should be varied during the rotations. For the best calibration results, the angles used should be similar to what will be experienced during the measurement transects. When making a measurement, it is important to keep in mind that the calibration will only be valid over the same pitch and roll angles experienced during the compass calibration procedure.
5. After the calibration, there must not be any changes made to the position of engines or mounts, or any other metal components on the boat, such as toolboxes, electronic devices, etc. If any position changes are made, the compass calibration should be repeated so that the system can account for the new, current, magnetic field affects.