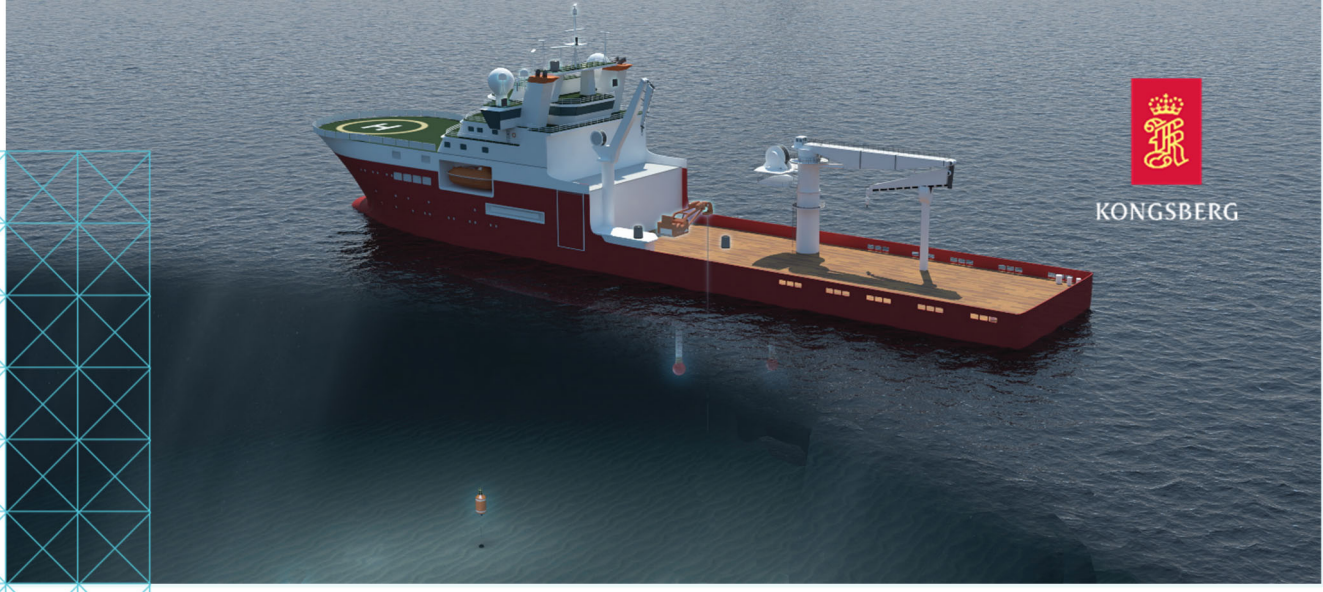
APPLICATION NOTE



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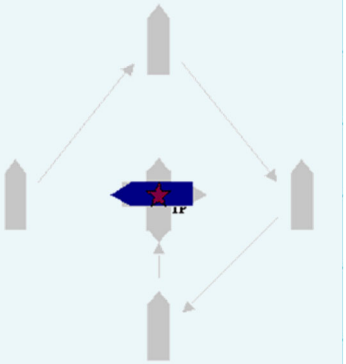
Transducer alignment/"HiPAP calibration"

The transducer alignment is an acoustic alignment of the transducer with respect to the vessel's reference frame. Reference sensors (motion sensor, heading sensor and GNSS) are used in the process. The main purpose of the transducer alignment is to determine the offsets between the heading/roll/pitch sensors and the HiPAP transducer for the HiPAP system to provide an accurate position of subsea transponders in any water depth.

The built-in transducer alignment function in APOS will automatically calculate new installation parameters from the logged data when the alignment is completed. The function is found in Utility-Transducer alignment. See the Help files in APOS for detailed explanation and step-by-step information.



Alignment pattern

The recommended transducer alignment pattern is 4 cardinal points and 4 headings on top of the transponder. This static alignment method has several advantages over dynamic patterns.

For non-DP vessels, a dynamic Figure-8 pattern is recommended.

The transducer alignment function in APOS is not limited to the two methods recommended above but can be used for any alignment pattern.

Pre-checks

Prior to starting up, a dimensional control or lever arm verification should be performed on the transducer and GNSS antenna location, gyro heading and roll/pitch values. Note that the acoustic system usually has the same reference point as the dynamic positioning system (centre of gravity-CG).

If more than one gyro/motion sensor is interfaced to the acoustic system, select the sensors with the highest accuracy for the transducer alignment.

The GNSS system is used as a position reference for the alignment and must be using correction data (dGNSS/RTK/PPP). If several GNSS systems are available on board, the one with the highest accuracy should be used.

For areas with large change in tide, tide correction can be enabled in APOS and selected in the setup for the transducer alignment.

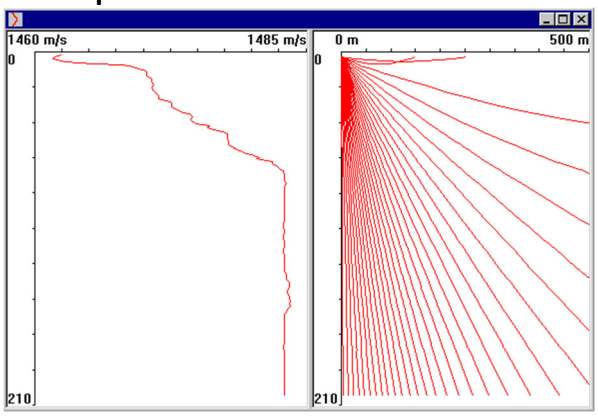
Alignment area

The water depth where the alignment is conducted is important. The acoustic position errors and not the GNSS errors must be dominant. Typical water depth for a HiPAP502 system should be 200m or deeper. Selecting an extremely deep area (1000's of meters) will make the alignment take considerable time due to the distance the vessel must move between cardinal points, and the acoustic signal might be weak and unstable due to the distance, so this is not recommended.

The transponder used for the alignment must be suited with respect to the beam pattern. In shallow water transponders with 180 degrees coverage should be used. For deeper water, a transponder with 30 degrees vertical coverage should be used.

The vessel must be able to move freely around the transponder. Typical distances from the transponder to the cardinal points will be 50-100% of water depth when using a 180 degrees transponder and not more than 25% of water depth when using a 30 degrees transponder. This is to be within the coverage area of the transponder.

Sound profile



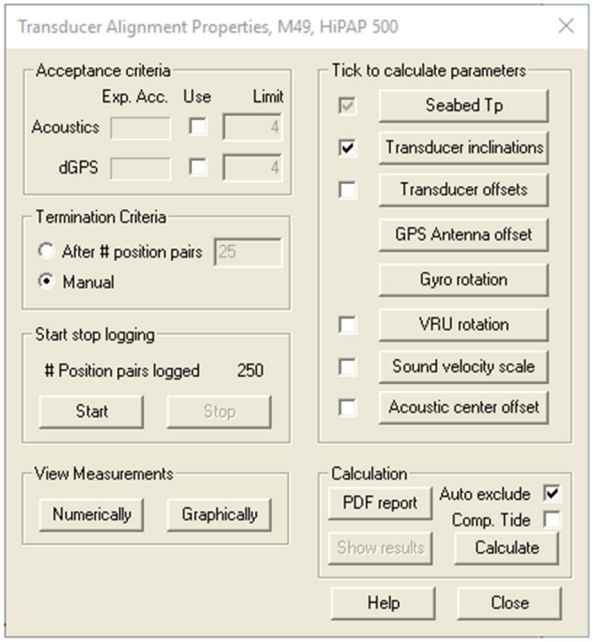
For best results of an alignment a fresh sound velocity profile of the area should be loaded into APOS so real-time ray bending compensation can be done.

The alignment can be done without a full sound profile by using average sound velocity instead, but this will not give as accurate calibration result. In this case, the average sound velocity for the water column should be entered.

Data logging

When doing the transducer alignment, typically 200 samples are logged in each location/heading, giving a total of 1600 samples (4x 200 samples in the cardinal points and 1x 200 samples for each of the 4 headings on top of the transponder). Outliers will normally be automatically excluded during calculation.

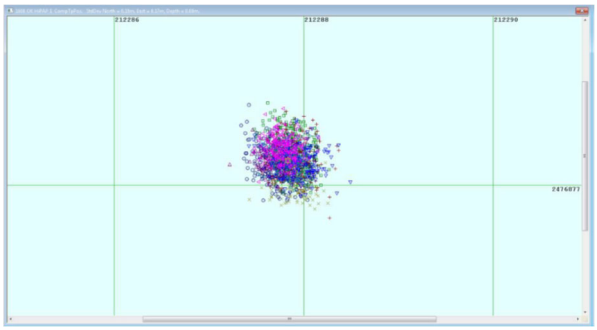
Calibration result/evaluation



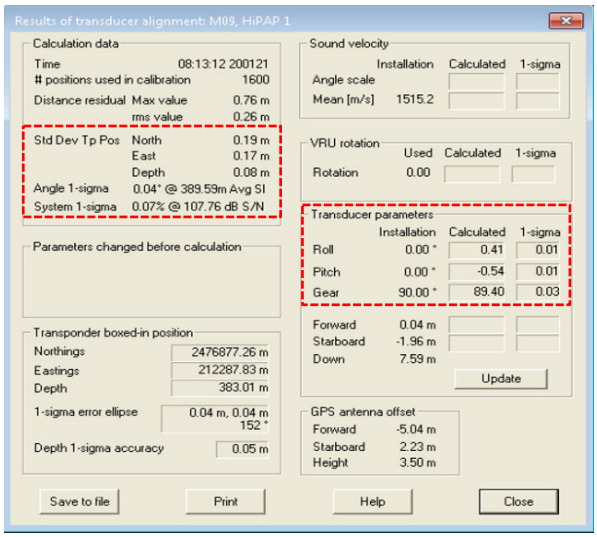
Several installation parameters can be calculated from the transducer alignment. As a rule of thumb, do not calculate parameters that are already known/measured. Calculating several parameters, and not only the transducer heading/ roll/pitch will distribute the measured errors to all parameters calculated. This is why a dimensional control (or previous report) and a fresh sound velocity profile is strongly recommended.

If a sound velocity profile is not available, it is possible to tick the Sound velocity scale to let APOS calculate the sound velocity.

If the alignment has been carried out with wrong offsets, these can be corrected, and new result calculated without doing a new transducer alignment logging.



Graphic presentation of the calibration result is available through scatterplots which display measured positions and corrected positions, so it is easy to judge the quality of the logged data and effect of the new corrections.



The calculated installation parameters should be very close to the old values if the alignment is a verification. If some values have changed significantly, it indicates changes to the reference sensors (motion sensor/gyro) or a potential problem with the transducer. For the transducer, it can be as simple as marine growth on the transducer if it hasn't been maintained for a while.

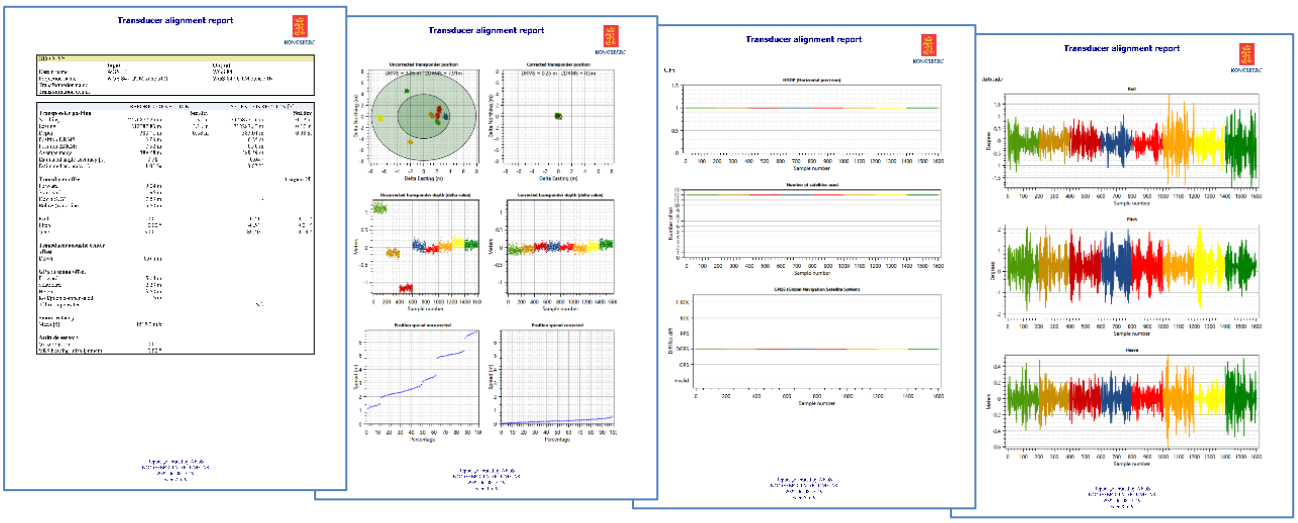
Observe the standard deviation for the calibrated transponder position. This should be withing the expected accuracy for the complete system including GNSS and attitude sensors (and not only the specification for the acoustic system alone). If so, the calibration result can be applied to the transducer installation parameters APOS.

Alignment validity

A properly executed transducer alignment, where a dimensional control of the installation has been performed in advance and a fresh sound velocity profile being used, will be valid for any water depth, so no re-calibration is required if the vessel is moving from e.g., deep water to shallow water.

The alignment is valid if there are no changes to the reference sensors (motion sensor and heading sensor). If these sensors are changed or re-calibrated/adjusted, a new transducer alignment must be carried out.

It is recommended to do a transducer alignment verification (run the transducer alignment) at least once per year to verify system performance and accuracy. APOS 6 has a built-in function to generate a complete transducer alignment report in PDF format after the alignment has been executed. In addition to the acoustic result the report gives detailed QC information on the sensors used. This report can be used as documentation of performance for the acoustic system. Below are examples of some of the pages from the 8-page transducer alignment report.



Kongsberg Maritime
P.O.Box 111
NO-3191 Horten
Norway

Switchboard: +47 815 73 700
Global support 24/7: +47 33 03 24 07
E-mail sales: subsea@km.kongsberg.com
E-mail support: km.support.hpr@kongsberg.com