ON SITE ALIGNMENT

CALL · MEASURE · DETECT · SOLVE

THE NETHERLANDS USA SINGAPORE UK MIDDLE EAST

We are innovative thinkers, have in-depth knowledge and 35 years of field experience. We do not just know how to align machines, we also know why we align them the way we do. You can say: alignment is our nature.

On Site Alignment, OSA, offers all the assistance you may need when faced with questions around alignment, engineering, mounting or troubleshooting of critical machinery. Our company is fully familiar with alternatives and the consequences.

Our working area is mostly the maritime industry. OSA has offices in the Netherlands, the United States, Singapore, United Kingdom and the Middle East. Our dedicated team of engineers works worldwide. They know what they are talking about and are supported by the best experts in this field.

In this publication we have summarized what we do and how we do that. From alignment and FEM modeling to 3D scanning. Do not hesitate to call us for more specific information, because no alignment job is the same.

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ALIGNMENT IS OUR NATURE

WHAT WE DO

OSA carries out shaft alignment on all types of rotating equipment, including engines, gear-boxes, generators, shaft (support) bearings, pump sets, winches and bow thrusters. We also measure and correct crankshaft web deflections. Alignment checks whether measurements can be performed during different states of operational conditions so that thermal growth and hull deformation are measured too. We perform dimensional checks with laser or other optical equipment, measures bending stresses by using the wireless strain gauges and jack load technique in order to calculate bearing load, offset and gap & sag values in propeller, intermediate and high speed shafts.

Every specific machine demands a specific alignment technique. First, we must determine the appropriate one. OSA knows and uses all known high-quality techniques. Feeler gauges, rulers and dial indicators are used when shaft rotation is difficult or non-existent. Laser equipment is used for rotating equipment, line bore and dimensional surveys. Wireless torque measurement is used for measuring shaft power. We use electronic measurement of bearing reaction forces for accessible stern tube bearings, shaft support bearings, gearbox bearings and main engine bearings.

We determine the best option in close partnership with our customers.
What the endless possibilities are,we explain on the next pages.

CHALLENGES WE ACCEPT

- Damaged stern tube bearings
- Failing generator sets
- High vibration levels on equipment
- Pre-mature bearing failures on shaft generators
- Re-alignment and chocking of all rotating equipment
- Installation of complete shaft lines
- On site machining

CALL
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ROTATING EQUIPMENT
PROPELLER SHAFT
ON SITE MACHINING
DIMENSIONAL SURVEYS

ALIGNMENT AND 3D MEASUREMENTS

We carry out shaft alignment on all types of rotating equipment, including engines, gearboxes, generators, shaft support bearings, pump sets, winches and bow thrusters. With a laser tracker or total station we measure the geometry of an object both in itself and in relation to other objects. For example, we can ascertain the flatness of a flange and its exact position and angle in relation to the surrounding structures.

CRANKSHAFT WEB DEFLECTION

Inside piston engines and compressors, a linear movement of a piston is transformed to a rotational movement of a shaft by using a crankshaft. In order to avoid excessive wear and/or fatigue to the crankshaft, maximum bending of the crankshaft caused by bearing offset or external forces, must be within the manufacturer's limits. Measurements at regular intervals are, therefore, required. The bending of the crankshaft is measured by using a (digital) crankshaft web deflection reader.

VIBRATION MEASUREMENT AND ANALYSIS

We can ascertain the precise condition of rotating machinery and diagnose the causes of structural vibrations/resonance and recommend practical solutions.

THERMOGRAPHIC MEASUREMENT

Thermal imaging techniques allow us to visualize heat distribution in machinery, structures and switchboards, to identify and prevent the root causes of failures.

DYNAMIC MACHINE MOVEMENT MEASUREMENT

By precisely quantifying the movement of machinery such as propulsion systems in different loading conditions, engine outputs and manoeuvring scenarios, we can optimize its position to ensure proper alignment in all circumstances.

CHOCKING

We work with solid steel chocks, epoxy resin chocks, mechanical re-adjustable solutions and resilient rubber mounts. We also provide pre-cut stainless steel shims.

BOLT TORQUEING AND TENSIONING

We perform controlled tightening of bolted connections, calculating the torque according to industry best practices and classification rules.

MOTION AMPLIFICATION®

Motion Amplification® enables us to see and measure motion that is impossible to see with the human eye and could previously only be measured by contacting sensors. This technology turns every pixel in the camera's view into a sensor capable of measuring vibration or movement with high levels of accuracy. Then we take all of that data and amplify this in the video so that you can actually see the problem. We combine the power of a modern camera with software to turn what used to be complex charts and graphs into easy to understand video data. This enables our engineers to quickly and safely solve the toughest problems and communicate the results with our customers.

ALIGNMENT CALCULATION AND ENGINEERING

We can provide the following services:

- Develop and implement chocking plans, including approval of relevant classification societies.
- Create manuals for the alignment of new and existing propulsion shafts, including advise about important milestones during the process and alignment reports.
- Design and design reviews of shaft lines.
- Troubleshoot vibration problems.

ROTATING EQUIPMENT

ALIGNMENT AND 3D MEASUREMENTS

CRANKSHAFT WEB DEFLECTION

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THERMOGRAPHIC MEASUREMENT

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CHOCKING

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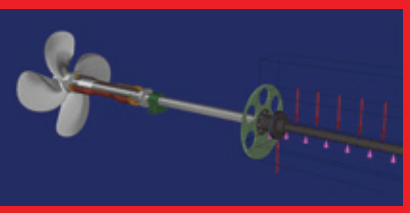
ALIGNMENT CALCULATION AND ENGINEERING

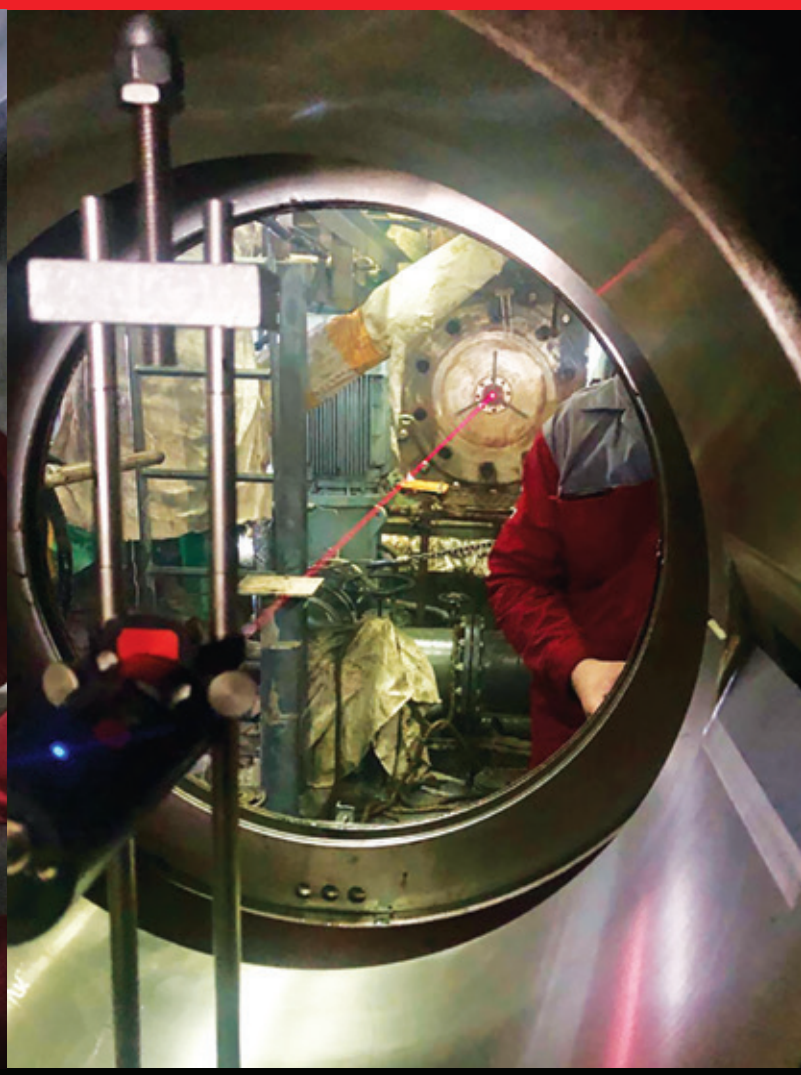


ALIGNMENT FEM MODELING

Before the actual alignment of rotating equipment can take place, all parameters must be investigated and calculated. Examples of this are thermal growth, static and dynamic shaft movements, dynamic movements and/or deformations of components.

OSA offers the following services:

- Shaft alignment gap and sag calculations and analyses.
- Bearing reaction force calculation services.
- Thermal growth calculation services.
- Relative hull deformation calculation services.
- Dynamic movement /deformation calculation services.
- Engineering of chocking plans including the approval of the related classification society.
- New build and repair propulsion shaft alignment manuals including advise, important notices and alignment reports.
- Troubleshooting services related to vibration problems.



PROPELLER SHAFT

ALIGNMENT CHECK BY LASER TO DETERMINE THE POSITION OF THE PROPELLER SHAFT BEARINGS

When the propeller shafts are removed we install a laser at the flywheel and extend the centreline of the crankshaft. We position a laser receiver at the bearing position and measure the position of the bearings in relation the engine. We do this measurement in dry dock and afloat condition. With the help of a computer model of the shaft line we analyse the existing situation and can advice what to change to get an optimal alignment.

BEARING REACTION FORCES BY PERFORMING JACK-BEARING LOAD TEST

To check whether the loads on bearings are correct, we perform a jack-bearing load test enabling us to cross-check the outcomes with theoretical loads. Improving loads, alignment of the shaft line and making it possible to find problems in the installation rapidly.

SHAFT ALIGNMENT WITH STRAIN GAUGES BY MEASURING BENDING STRESS

- Set up FEM model of the shaftline with the Shaft Designer software.
- Measure the bending strain in way of every bearing location. When needed we can also collect the data dynamic instead of static. Thus sailing with the vessel.
- The measured data will be entered into the FEM model, and the actual alignment will be calculated by means of reverse engineering. The software will indicate also if the outcome is within the tolerances stated by class and OEM.
- By taking the practical bearing loads, the result of the FEM model and strain gauge data collection will be validated.
- The software will allow you to change the offset per bearing to determine what need to be changed to come back within the tolerances. This for an efficient as possible repair plan.

DYNAMIC SHAFT ALIGNMENT USING THE STRAIN GAUGE TECHNIQUE

By using the strain gauges and FEM computer program, bending stress of the propulsion shaft is measured under different loading conditions such as cold ballast condition and cold fully loaded condition. A difference in bending stress can only be caused by hull deformation and, therefore, a different position of the gearbox/two-stroke engine because of draft differences. The difference of these two conditions is the relative hull deformation between the stern tube and gearbox or two-stroke engine. The optimum bearing offset can be calculated suitable for all investigated operational conditions with the results of the measurements.

SHAFT ORBIT MEASUREMENT

By measuring the lateral movement of a rotating shaft, we can find out the dynamic behaviour. With this information we can quantify whirling, identify why stern tube seals leak and check if the alignment targets in static condition are correct.

SHAFT POWER AND TORSIONAL VIBRATION MEASUREMENT

A shaft line transferring energy by rotation is exposed to torsional moment. To avoid fatigue damage it is necessary to keep a sufficiently low torsional moment in the critical parts of the shaft as well. This means that the shafting arrangement must be examined for torsional vibration, whirling and bending stresses during the development stage. The weakest part of the shaft line is found in coupling flanges and bolt connection. By using strain gauges, bending, axial and torsional forces and shear stresses can be measured under load. In combination with shaft speed and torsional stresses, the transferred power though the shaft can then be calculated. Measuring torsional vibration is also crucial to understanding problems like coupling failures and shaft fractures.

WE COMBINE EXPERIENCE AND ENGINEERING TO BACK UP OUR RECOMMENDATIONS.

LINE BORING

By using portable machining tools, the seating surface of stern tube bearings are machined to a target offset and slope. This is first calculated by using FEM model calculation software in order to obtain the perfect load distribution of the bearings under different operational conditions.

MILLING

When objects or machinery are to be placed directly on the foundations, milling has to be performed. This must be done based on the results of a flatness deviation survey by using laser or 3D measurement equipment if proved to be out of tolerance.

ON SITE MACHINING

FLANGE FACING

The same arguments as for milling hold true for a flange of a thruster or crane pedestal and this must be measured and brought within the tolerance values before the machinery or bearing can be mounted. If required, the flange must be machined by using portable flange facing tools.

DRILLING/REAMING

Drilling and reaming of foundation bolt holes on a ship is never an easy job. The available space is most of the time very limited over the years we have developed our own reamers. For almost every situation we have drilling machines available so we can get the job done quickly!

3D MEASUREMENT WITH TOTALSTATION OR TRACKER

The 3D measurement system determines the relative position of points while measuring the flatness to determine the deviation of surfaces, flanges and bearing faces. 3D equipment is also used to measure machines, installations and/or structures. These 3D measurements are usually performed during repairs, modifications or new builds and can be done with totalstation or laser trackers.

3D SCANNING

3D scanning is like a digital 3D photography of the real world – but where each pixel in a digital photo only contains information about colour, each pixel in our '3D images' further contains information about it's position in XYZ coordinates in space.

STRAIGHTNESS

The straightness of rails, foundations and hull bottoms are measured using an offset placed reference line. From this straight reference line, the object can be measured quickly and simply.

LINE BORE MEASUREMENT

Bores are always positioned or aligned relative to each other in structures and machinery. They are mainly used to hold roller bearings or plain bearings in position. Bores are found in all types of rotating equipment such as engines, gearboxes, generators, shaft support bearings, stern tubes and rudder installations. The centreline measurement or line boring measurement is measured using an in-centre-placed reference line. From this straight reference line, the bores can be measured in vertical, horizontal, fore and aft direction.

FLATNESS

For a long and problem free operation of e.g. slewing bearings and machines, the flatness of a pedestal seating or top plate has a great impact. In general, a flatness measurement survey is performed before installing a machine or component on its seating. We do this in order to determine whether the seating is still within the OEM's tolerances. If necessary, OSA will machine the surface until it again fits within the specified tolerances.

PARALLELITY

In e.g. gearboxes, gearwheel drives need accurately machined parallel bores. After the removal of the gears and shafts, OSA can measure the bores for parallelism. This is also required for rollers of e.g. conveyor belts. They must also be placed parallel to each other for a friction-free operation.

PERPENDICULAR

Most rudder machines, rudder actuators and seal housings must be positioned perpendicular to the rudderstock and/or stern tube centreline. It is of the utmost importance that this is done. Misalignment will cause friction and/or leakage. An OSA perpendicular measurement can prevent this.

WE OFFER CONSULTANCY AND TRAINING SERVICES FOR VARIOUS TECHNICAL ISSUES RELATING TO ALIGNMENT AND MOUNTING. LET US TRAIN YOUR STAFF.

DIMENSIONAL SURVEYS

3D MEASUREMENT WITH TOTALSTATION OR TRACKER

3D SCANNING

STRAIGHTNESS

LINEBORE MEASUREMENT

FLATNESS

PARALLELITY

PERPENDICULAR

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