Autocollimators

Electro Optical metrology in the shipbuilding industry

"The Micro Alignment Telescope is typically used to align the position of the ship's engine in relation to propellor shafting and stern tubes."

Used in a range of applications across the shipbuilding and repair industry, our electro optical product range includes alignment telescopes, autocollimators, levels and clinometers. This application report demonstrates some of the ways electro-optical metrology can benefit the shipbuilding and repair industry:

Positioning marine engines in relation to propellor shafting and stern tube using autoreflection

THE PROBLEM: Shipbuilders and marine engineers are well aware of the problems in verifying that the alignment of a ships propulsion machinery is correct.

This particular problem is to align the position of a ships engine in relation to the propellor shafting and stern tube.

THE SOLUTION: The principle of the method is to set up a Micro Alignment Telescope coaxial to the engine axis. This is carried out by mounting a mirror target directly on to the engine coupling flange, and checking the concentricity by rotating the crankshaft and sighting the mirror target through the Telescope.

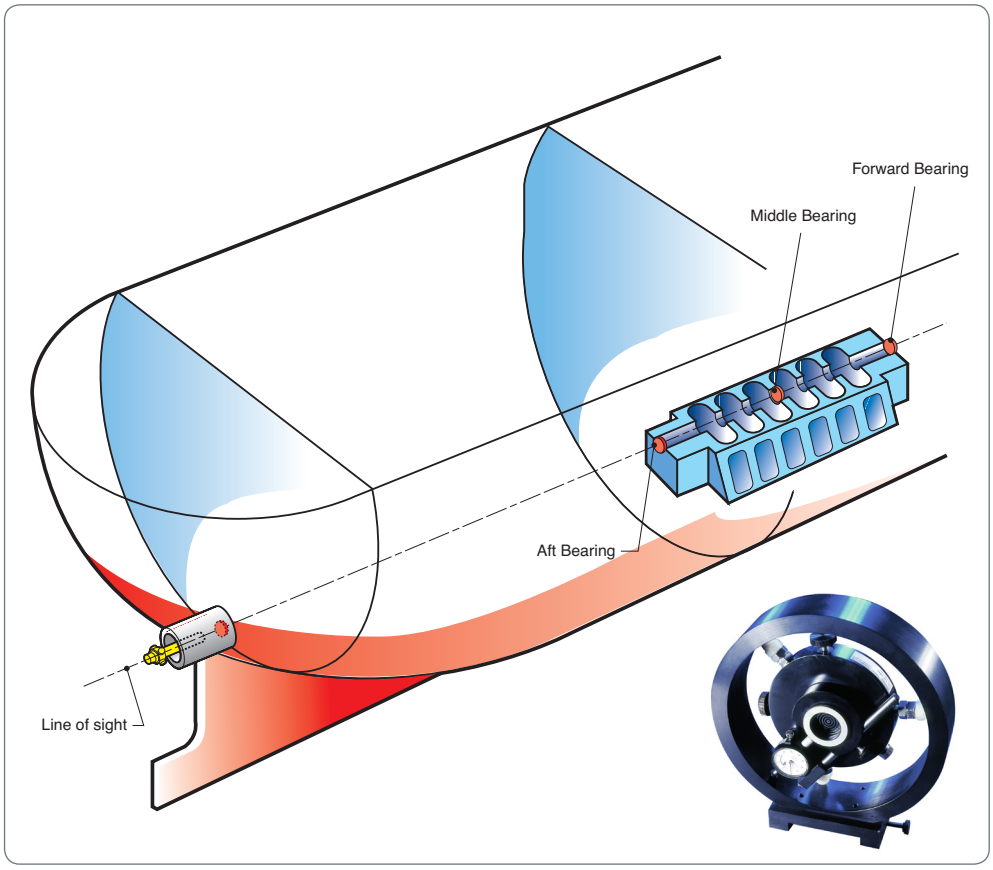
The Micro Alignment Telescope is fitted with its lamphouse and, using auto-reflection, the squareness of the mirror target face with respect to the rotation of the axis of the crankshaft is measured. On rotating the crankshaft the mirror target is adjusted radially to set it concentric, and also tilted until the reflected image is stationary in all rotational positions.

At this point the telescope is coaxial to the crankshaft and hence marine engine axis. This line of sight is extended aft through the stern tube with all alignments normally made from this reference line of sight.

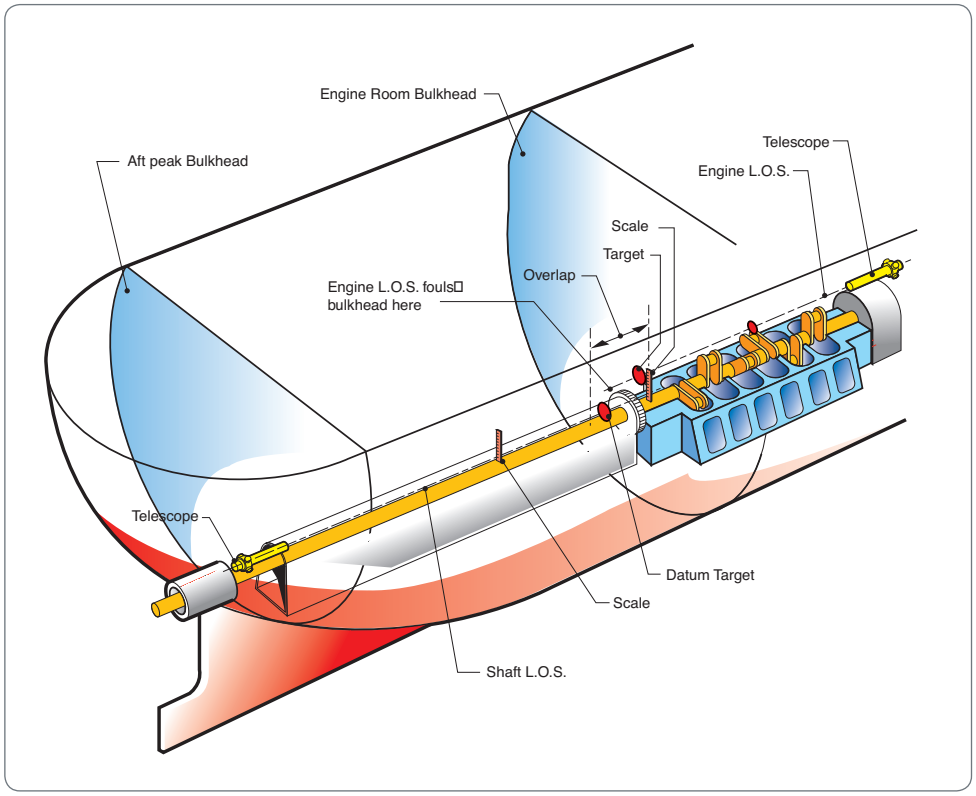
Alignment of marine engine to stern tube

THE PROBLEM: Misalignment between propellor shafting and engine can lead to excessive vibration and deflections both of the engine and transmission system and of the surrounding structure.

THE SOLUTION: The telescope is located concentrically in the aft end of the stern tube using the bore fixture. A target is mounted in an adaptor located at the forward end of the stern tube. The telescope is adjusted vertically and horizontally about its axis until the target is centred with the telescope crosslines. This setting establishes a telescope line of sight coincident with and parallel to the stern tube axis. The extension of this line should pass through the centres of all the engine bearing. Targets are now placed in adaptors (or in spider fixtures, see photo opposite) located centrally in the forward, middle and aft bearings, the telescope being focused on each in turn.



Alignment of propellor shafting to marine engine



THE PROBLEM: Checking the alignment of shafting and engine bearings is relatively straightforward, however alignment of shafting to engine is complicated because the construction of many ships makes a line of sight from the forward end of the engine through to the tail shaft impossible. A line of sight over the engine can be measured from a fixed height above the engine but the sighting is usually impeded by the shaft tunnel roof a few feet aft of the engine room bulkhead.

THE SOLUTION: Two lines of sight can be used: one from the forward end of the engine sighting aft, and one from the last intermediate shaft bearing sighting forward. These lines of sight overlap between aft of the engine and forward of the shaft tunnel roof.

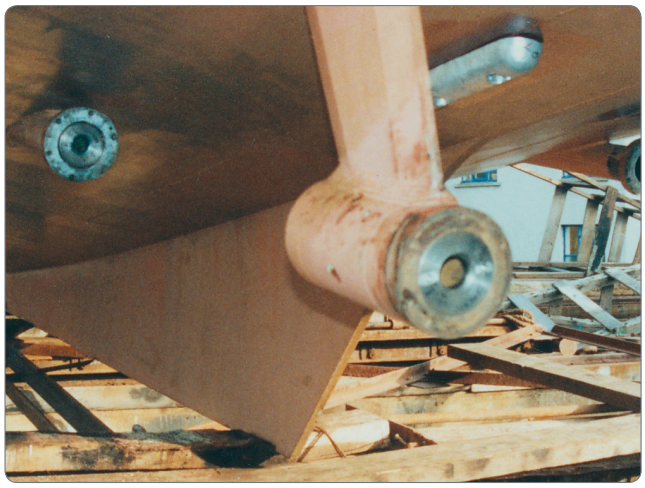
'P' brackets

THE PROBLEM: After collision with an object, it is important to check that the engine/ gearbox, propellor shaft bearings and 'P' bracket bearings are all still aligned.

THE SOLUTION: A mirror target is mounted in an adjustable holder which is mounted onto the gearbox spindle. The telescope, with lamphouse fitted, is set square and in line with the mirror target. The spindle is rotated and the mirror target in its adjustable holder and telescope are further adjusted to ensure the telescope is:

a) concentric with the spindle rotation and
b) on the centre line of the mirror and hence the gearbox.

All bearings including the 'P' bracket are then sighted with the telescope to be in line with the mirror and hence gearbox.



Checking the alignment of the engine/gearbox, propellor shaft bearings and 'P' bracket bearings

Refurbishment of ships' engines

THE PROBLEM: Worn bearings need to be realigned before being rebushed and recut using a boring bar.

THE SOLUTION: A reference line of sight is made by sighting through the front and rear bearing. Bushes (shells) are then placed in all the bearings and all aligned in anticipation of the boring bar; normally a hollow boring bar is used and wire targets are placed inside the bar at regular intervals to monitor its straightness.

Without moving the telescope, the telescope is refocused on the boring at the various cutting positions to ensure the boring bar is travelling in a straight line and that any sag is removed.

A CCTV makes the adjustment of the boring bar easier since the image can be viewed by the operator as adjustments are made.

Alignment of bearings in a large diesel engine prior to machining of bore

Bulk head

THE PROBLEM: To ensure a watertight seal, the door and bulkhead not only need to be flat but also in the same plane.

THE SOLUTION: A Telescope with optical square was used to sweep a plane at 90° to the telescope line of sight. This plane is set using the bulkhead as the reference. The door is then checked to ensure it is in the same plane. Any out of flatness of both the door and bulkhead can be measured with the telescope and adjustments made.

Checking a watertight seal on the bulkhead

Rudder bearings

THE PROBLEM: Alignment of rudder bearings.

THE SOLUTION: The straight line of sight made by the telescope can be used to align the bearings in the ships rudder.

Our electro-optical metrology product range comprises:

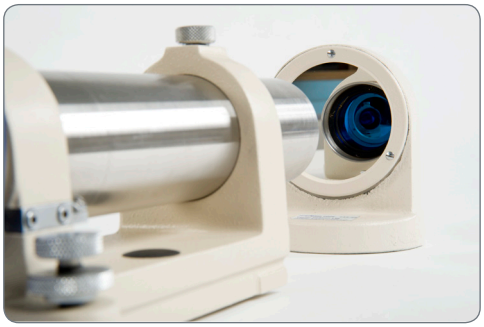
Micro-Alignment Telescope

Used for checking and setting for example:

- Alignment: (series of bores or bearings)
- Squareness: (column to a base)
- Parallelism: (series of rollers)
- Level/flatness: (machine bed foundation)
- Straightness: (rails or guideways)

...with its optical and mechanical axes aligned to within 3 seconds, a typical accuracy of 50–70 um at 30 m is achievable.

Autocollimators

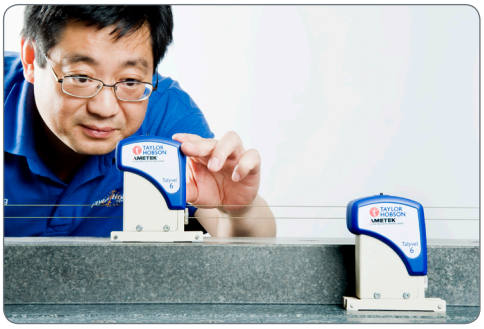


Used for measuring for example:

- Angle: (indexing head accuracy)
- Straightness: (machine tool slides in two axes)
- Squareness: (spindles to slideways)
- Parallelism: (slideways)

...from inexpensive visual to dual axis digital systems capable of measuring 0.01 second, equivalent to 50 nm per m.

Electronic Levels and Clinometers



Used for angle and level measurements:

- Level/flatness: (granite tables)
- Straightness & twist: (machine slides)
- Squareness: (of machine columns)
- Angle: (remote monitoring of movement of structures)

...from full 360 degree measurement to level measurements to 0.1 second.

This application note demonstrates just one of the applications for the Taylor Hobson electro-optical metrology range.

Contact Spectrum Metrology to discuss your own measurement requirements.

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