

TransCanada Turbines Test Cell repairs and services gas turbines in a unique test facility. The turbines are used primarily for compression, power generation and marine applications. After repair and servicing, the Test Cell undertakes performance tests of the turbines. In this case, the Test Cell needed to align aeroderivative gas turbines to a steady pedestal bearing prior to the performance test.

Test Cell

As part of the load performance tests, the turbines drive a generator to simulate a load. The turbines are connected to the generator through a bearing pedestal. To accommodate the large thermal growth allowances potentially experienced with these turbines, a 90" long dual flex spacer coupling is used.

The Test Cell was designed to facilitate a quick alignment setup of each turbine to the bearing pedestal prior to the simulated load performance test. The turbines are mounted on special dollies designed to ensure the outboard or cold end of the turbines are fixed and require no adjustment in either the vertical or horizontal planes.

The inboard end of the turbine is supported by two angled struts with turnbuckles. These are used to change their length and in so doing simultaneously adjust both the inboard vertical and horizontal alignment. The bearing pedestal and generator have a pressurized lube system to allow the generator to be rotated and to load the bearings in the pedestal.

Alignment Solution

The customer recently upgraded their alignment system to a ROTALIGN® touch featuring the unique sensALIGN® single laser bi-detector technology. While the ROTALIGN® Ultra 2 worked well, the larger detectors within the sensALIGN® 7 sensors allow for greater flexibility when dealing with large thermal growth offsets.

The standard functions of the ROTALIGN® touch make it ideally suited for performing this type of alignment job. These include:

- sensALIGN® 7, with dual detectors a fixed distance apart minimizes the effects of excessive coning due to the large angular thermal growth allowance.
- Multipoint measurement mode minimizes the effects of the shaft

floating due to pressurized lubrication system

- Thermal growth allowances in both machines
- Measurement table with averaging
- Move simulator allows the achievable horizontal and vertical alignment corrections to be quickly determined given the fixed nature of the outboard foot.
- Setting own alignment tolerances
- The use of inclined turnbuckles as the inboard supports on the turbine make the ability to monitor both vertical and horizontal corrections simultaneously imperative.

“The ROTALIGN® touch with its larger detector, Move Simulator and ease of use have made the alignments in the test cell that much easier. Given the use of turn-buckles on the inboard end of the engine for adjustment, the ability in the ROTALIGN® touch to show both vertical and horizontal adjustments live at the same time is essential.”

Darren Hall, Test Cell Technician
TransCanada Turbines Limited

Setup

Mounting the laser on the turbine with its large angular thermal growth setting would cause excessive coning. The sensALIGN® 7 sensor is therefore mounted on the turbine coupling flange by removing a few bolts and using a magnetic bracket (Fig. 1). By mounting the laser on the output shaft of the pedestal bearing which is level using a universal magnetic bracket (Fig. 2), and adjusting the beam angles, coning of the laser beam is minimized or eliminated.



Fig 1: Sensor Mounting



Fig 2: Laser Mounting

The tolerances as specified by the OEM are more stringent than industry standards for a dual flex coupling. Being able to set one's own tolerances in the ROTALIGN® touch gives a clear indication of when the alignment meets the customer's required tolerances.

The large dimensions for the spacer coupling between the feet of the turbine for this alignment can be seen in Figs. 3 and 4. The long distances magnify the effect of angular thermal growth allowances and any corrections.

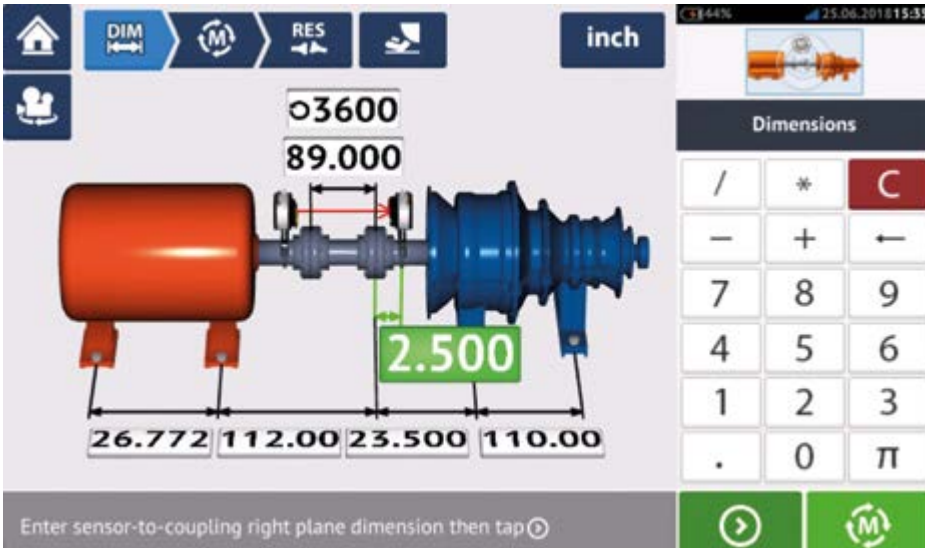


Fig 3: Setup Dimensions



Fig 4: Spacer Coupling

Thermal Growth

The thermal growth allowances call for a large angular cold misalignment as shown in Figs. 5 and 6 below. Fig. 5 is the Specification Results View of the ROTALIGN® touch and illustrates the effective combined thermal growth of both the bearing pedestal and the turbine. It shows the required cold alignment of the two shafts and illustrates the large vertical angular misalignment.

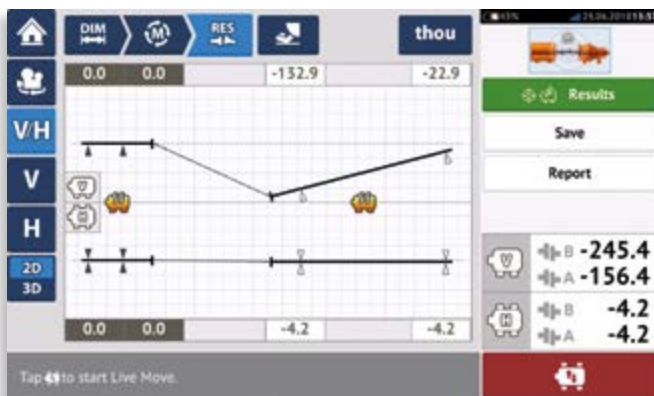


Fig 5: Specification Results view or Cold Alignment



Fig 6: Thermal Growth Allowances

Measurement

To allow for the larger than normal displacement of the beam in the detectors as the shafts are rotated, the beam is initially adjusted to be above the center of the detector in the 12 o'clock start position. To eliminate the effect of the shafts floating due to the pressurized lubrication system, Multipoint Measurement mode is used with the lubrication system deactivated for each measurement. Multiple readings (seven to nine) are taken and averaged in the Measurement Table as required. The bearing clearances in the pedestal bearing exceed 0.015".

Results

The alignment of the gas turbines to the pedestal bearing is usually achieved in less than an hour including setup and adjustments. The ability to view both the vertical and horizontal coupling results simultaneously while in live move allows them to be optimized even though the outboard support cannot be adjusted. As can be seen in Fig. 7, the outboard feet were 0.048' too high but given the large dimensions of the turbine, there was no problem achieving the required alignment tolerances.

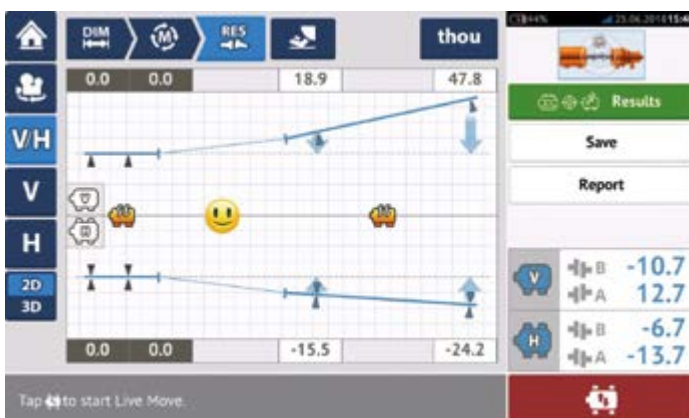


Fig 7: As Left Alignment result

Corrections

The large dimensions of the machines and coupling magnify any variations in readings and corrections. Consequently, while the design of the test cell sought to ensure the outboard supports would always be in line with the rotational centerline of the pedestal bearing shaft, this is not always the case.

The Move Simulator allows the technicians to determine the corrections required in the vertical and horizontal directions to achieve an optimum alignment. This is useful to know given that both the vertical and horizontal corrections are made simultaneously using the turnbuckles. Unlocking, loosening, adjusting and locking the turnbuckles causes changes in the alignment. The changes are observed and allowances made before tightening and locking down the turnbuckles.

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