TECH NOTE 14

Rev 0.1 Ludeca, Inc. • Miami, Florida No.14

Measuring the Effects of Pipe Strain on Shaft Alignment

This technote describes the procedure for checking for strain from external forces acting on machines. It allows you to measure the effects of pipe strain on shaft alignment and to quantify these in terms of offset and angularity in the vertical and horizontal planes. Although lengthy, the procedure is straightforward and quite simple. The procedure makes use of the Actual Coordinate Values Function (M, H/V) to help establish repeatability. It is designed to help you prove the existence of pipe strain on a pump, or conduit strain on a motor for instance. As such it supplements but does not replace the Soft Foot Function.

Overview

To implement the procedure, select the machine you wish to check for strain. Set up the Optalign as usual, but with the prism installed on this machine, even if it is considered the stationary machine for alignment purposes. This allows relative movement to be monitored correctly, since the other machine's shaft will represent the stationary reference for this procedure.

You zero the beam at 12 o'clock, activate the Actual Coordinate Values Function and record the displayed values for the X and Y coordinates. These values establish your starting reference for determining repeatability of the starting position of your machine shaft prior to loosening pipes. At this time a reading (M, 0, ENT) is also taken, again to establish the starting reference from which the changes in vertical offset and horizontal angularity will be measured. Now the piping is loosened and three further readings are taken (M, 3, ENT; M, 6, ENT; and M, 9, ENT)*without* turning the shafts. Now you obtain "coupling alignment condition results" which will display the measured shift in position of the machine, regarding vertical offset and horizontal angularity. These values displayed are half the amount the machine actually shifted (since the shafts were never rotated and the "TIR" effect does not apply), and are reversed as to sign. This means that positive offsets and angularities actually represent shifts towards 6 o'clock and 9 o'clock respectively. Now the piping is retightened and repeatability is determined by once again viewing the X and Y coordinates in the Actual Coordinate Values Function.

Now you repeat the entire procedure with the laser and prism positioned at 3 o'clock. This will yield the observed shifts in position as regards horizontal offset and vertical angularity, as described above. For more details and an exact step-by-step description of the procedure, see the instructions that follow. The results of the movement from pipe

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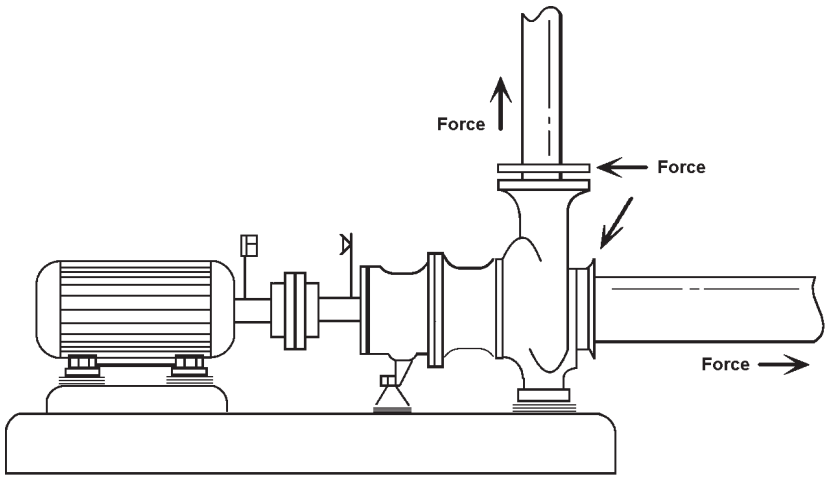

strain can be seen at steps 9, 12, 22 and 23. The repeatability of this movement should be within 0.002" and is established at steps 14, 15, 27 and 28.

Checking Procedure

1) Install prism on the shaft of the machine whose movement you wish to monitor (pump). Install laser transducer on the motor shaft. (Note that this is opposite to the setup you would normally use for alignment purposes.)

2) Press ON (turns on computer), press / (switches to inches), press ENT (shows dimensions display).

Note: The clock positions are defined by looking towards the laser from the prism.

3) Enter distance laser to prism, then press ENT two times for the remaining two dimensions. (This will automatically enter them as zero), and the laser is now turned on automatically.

4) With your piping tight, rotate shafts to 12 o'clock and zero the beam (coordinates X and Y to read 0.0 0.0).

   Press H/V (activates the 'actual coordinate values' function). This displays the actual position of the reflected beam in the laser's target area to the nearest 0.0001" (tenths of mils). The first value seen represents the X coordinate. This is shown in the display with the horizontal view of the machines and face indicator symbol (angularity). *Record the displayed X value*.

   Now press H/V. (Switches to display the Y coordinate). This is shown in the display with the vertical view of the machines, and the rim indicator symbol (offset). *Record the displayed Y value*. (Pressing H/V again will return display to the X coordinate.)

   These displays reflect the fact that in the 12 o'clock position, the roof prism is only sensitive to changes in horizontal angularity and vertical offset (but not vertical angularity and horizontal offset) insofar as it affects the reflected beam.

   The Optalign is now ready to monitor changes in shaft alignment that occur as you loosen or tighten external connections on your machine (such as piping):

5) Press M, and take a reading at 12 o'clock. (Press M, 0, ENT).

6) Now loosen your piping completely.

7) Without turning shafts (still at 12 o'clock), take 3 more readings as follows: Press (M), 3, ENT; (M), 6, ENT; (M), 9, ENT.

8) Press RUN, (gap), 1, /, ENT (0.1") for the distance coupling center to prism, then 1, 0, ENT, for the coupling diameter.

9) Press RCL, RCL, RCL. The first 4result displayed is Vertical Offset. The value displayed represents one half of the shift in position of the pump shaft in the vertical plane, *at the location of the prism*. Positive means an offset move towards 6 o'clock. Negative means an offset move towards 12 o'clock.

10) Press RCL. This result is Horizontal Offset. It should read zero.

11) Press RCL. This result is Vertical Angularity. It should read zero.

12) Press RCL. This result is Horizontal Angularity. It represents half the angular shift in position of the pump shaft in the horizontal plane. This is shown as a gap difference at the entered diameter of 10". Positive means a shift that opened a gap at 9 o'clock. Negative means open at 3 o'clock.

13) Press (M), H/V.

14) *Retighten your piping* completely. The displayed value for the X coordinate should return to the X value you recorded in step 4. This confirms that the loosening and tightening procedure for the piping is consistent and repeatable in regards to horizontal angularity. Generally speaking, any observed change (or lack of repeatability) greater than 0.002" can be considered unsatisfactory.

15) Press H/V. The displayed value for the Y coordinate should also now read the value you recorded for Y in step 4. This confirms that the loosening and tightening procedure for the piping is consistent and repeatable in regards to vertical offset.

16) Rotate shafts to the 3 o'clock position.

17) With your piping tight, press (M) and zero the beam (coordinates X and Y to read 0.0 0.0).

Press H/V (activates the 'actual coordinate values' function). The first value seen represents the X coordinate. This is shown in the display with the horizontal view of the machines with the face indicator symbol (angularity). *Record this X value.*

Now press H/V again. (Switches to display the Y coordinate). This is shown in the display with the vertical view of the machines, and the rim indicator symbol (offset). *Record this Y value.*

18) Press (M) again, and take a reading at 3 o'clock. (Press (M), 3, ENT).

19) Now *loosen your piping* completely.

20) Without turning shafts (still at 3 o'clock), take 3 more readings as follows: Press (M), 6, ENT; (M), 9, ENT; (M), 0, ENT.

21) Press RUN, (gap), RCL. The first result displayed is Vertical Offset. It should read zero.

22) Press RCL. This result is Horizontal Offset. The value displayed represents one half of the shift in

position of the pump shaft in the horizontal plane, *at the location of the prism*. Positive means an offset move towards 9 o'clock. Negative means an offset move towards 3 o'clock.

23) Press RCL. This result is Vertical Angularity. It represents half the angular shift in position of the pump shaft in the vertical plane. This is shown as a gap difference at the entered diameter of 10". Positive means a shift that opened a gap at 6 o'clock. Negative means open at 12 o'clock.

24) Press RCL. This result is Horizontal Angularity. It should read zero.

25) Press M, H/V.

26) *Retighten your piping* completely.

27) The displayed value for the X coordinate should return to the X value you recorded in step 17. This confirms that the loosening and tightening procedure for the piping is consistent and repeatable in regards to vertical angularity. Generally speaking, any observed change (or lack of repeatability) greater than 0.002" can be considered unsatisfactory.

28) Press H/V. The displayed value for the Y coordinate should also now read the value you recorded for Y in step 17. This confirms that the loosening and tightening procedure for the piping is consistent and repeatable in regards to horizontal offset.❑