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How to use the Fluke 810 Vibration Tester with right-angle gearboxes

Application Note

By John Bernet

The Fluke 810 Vibration Tester can diagnose most common machine faults, including imbalance, misalignment, looseness, and roller bearing wear. Right-angle gearboxes pose a challenge, however, because they change the direction of the energy from the motor to the load.

There are two methods for testing equipment with right-angle drives:

- You can test just the motor and gearbox, skipping measurements on the driven component.
- You can test vibration in the motor, gearbox, and driven element (ignoring the direction change in the gearbox), but only if the driven component is connected directly to the gearbox output shaft.

Test Method 1: Testing only the motor and gearbox

When measurements of the motor and gearbox alone are sufficient, you can simply skip measurements of the driven component. For example, if the speed of the gearbox output shaft (location 6 in Figure 1) is less than 200 RPM, you can skip measuring vibration in the driven component (locations 7 and 8) because low-speed vibrations are usually too small to measure and machine faults at low shaft speeds are less common and less severe.

Testing a system with a conventional gearbox

When you test a system with a conventional gearbox, placement of the sensor follows the flow of energy: first on the motor, then on the gearbox, and finally on the driven component. The sequence of measurements is shown in Figure 1.

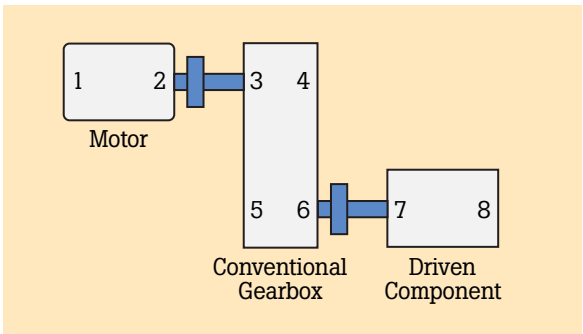

Figure 1. Sensor placement sequence with a conventional gearbox.

Testing a system with a right-angle gearbox

When you test a system with a right-angle gearbox, placement of the sensor follows the flow of energy, just as before. When you use test method 1, however, you skip the measurements on the driven component (locations 7 and 8 in Figure 2).

Note: This technique cannot be used if the gearbox output shaft has excessive vibration or if the gearbox is driving an unstable load that sends vibrations back to the gearbox (for example, when the gearbox is driving a mixing blade in a lumpy solution).

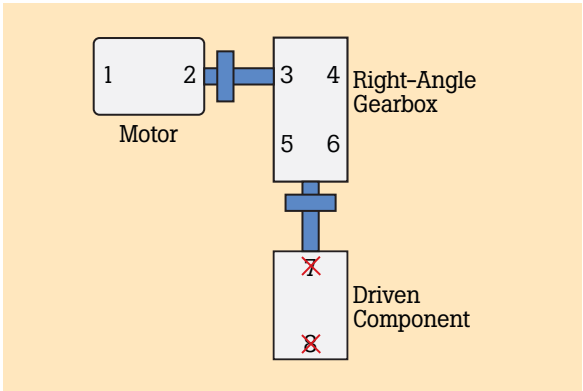

Figure 2. Sensor placement sequence with a right-angle gearbox using test method 1.

Setting up the Fluke 810 for measurements using test method 1

To test a system with a right-angle gearbox without testing the driven component:

1. In the Fluke 810 Vibration Tester, select **Setup**.
2. Following the prompts from the Machine Setup Wizard, enter the required information about the drive train. An example of typical settings is shown in Figure 3.
3. Select **Measurement**.
4. Take measurements at locations on the motor and gearbox (locations 2 and 4 in Figure 2).

   Note: If the motor is greater than 40 horsepower, take two measurements on each component (locations 1 and 2 on the motor, and locations 3 and 6 on the gearbox, as shown in Figure 2).
5. Select **Diagnose**.

   Note: If you receive the following warning, click Yes to proceed to the next step.

   Measurement
   Sufficient measurement data not found for gearbox and spindle. Diagnostic quality will be significantly affected if you continue. Do you want to proceed?
6. Press **Enter**.

   The Fluke 810 Vibration Tester gives a diagnosis of the motor and gearbox.

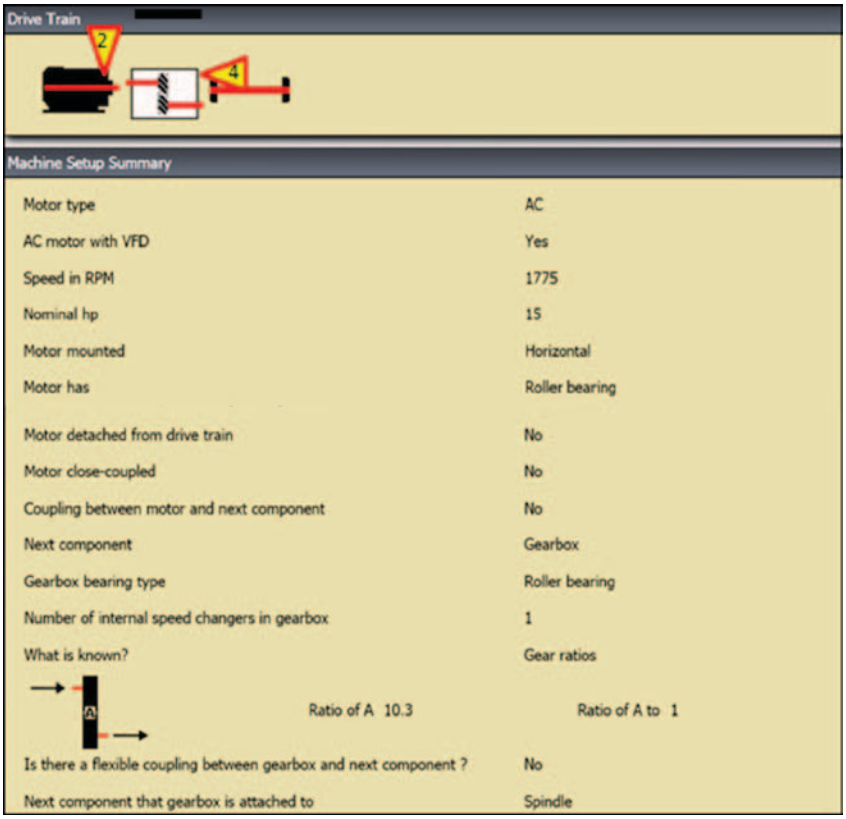

Figure 3. Typical settings for testing a system with a right-angle drive using test method 1.

Test method 2: Testing motor, gearbox, and driven component

When you *do* need to measure the vibration of the driven component, you can do so by monitoring the driven component's vibration *at the gearbox output bearing* using this test method.

Note: You cannot use this test method if the gearbox output shaft connects to the driven component through a flexible coupling because misalignment cannot be diagnosed on shafts in two directions (see Figure 5).

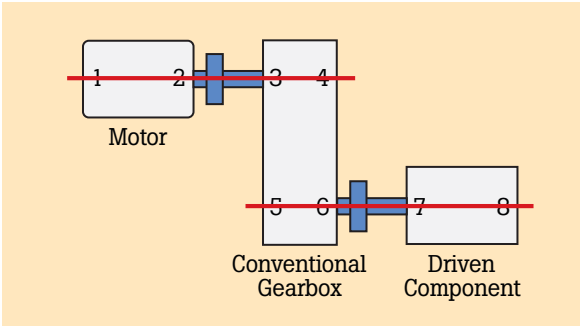

Figure 4. Horizontal shafts (conventional).

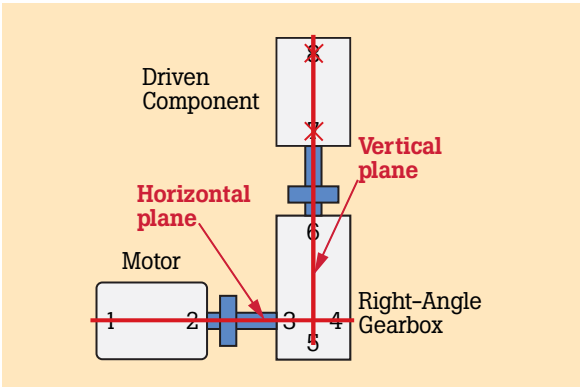

Figure 5. Horizontal and vertical shafts.

Misalignment – Vibration can result when machine shafts (across the coupling) are out of line. Angular misalignment occurs when the axes of, for example, a motor and gearbox are not parallel. When the axes are parallel but not exactly aligned, the condition is known as parallel misalignment.

If the machine orientation is horizontal (as selected in Figure 6) then the diagnostics are referenced to the horizontal plane. In Figure 4, misalignment can be diagnosed across the motor and gearbox coupling, and across the gearbox output shaft and driven component (red lines show shafts that are aligned).

In Figure 5, the coupling on the vertical shaft cannot be diagnosed for misalignment because the diagnostic engine is looking for a machine with a horizontal orientation. The diagnostic rules can reference either horizontal or vertical, but not both.

Example measurement using test method 2

In this example, an electric motor drives a cooling tower fan via a horizontal drive shaft and right-angle gearbox. The vertical fan shaft on which the fan is mounted has no bearings except the upper gearbox bearing (location 5 in Figure 6), and the fan vibration is monitored at the upper gearbox bearing. Gathering vibration data in this way is no different than collecting data from a fan mounted directly on the output shaft of a conventional gearbox.

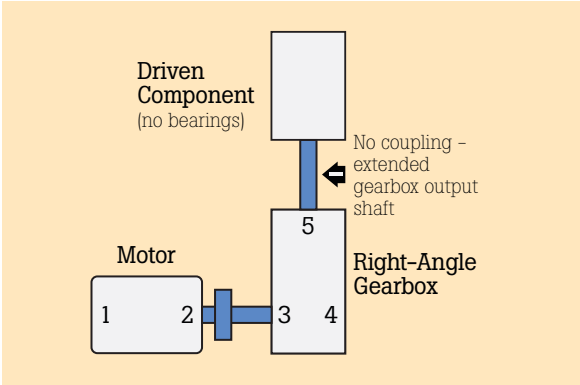

Figure 6. Cooling tower fan driven by a motor and right-angle gearbox.

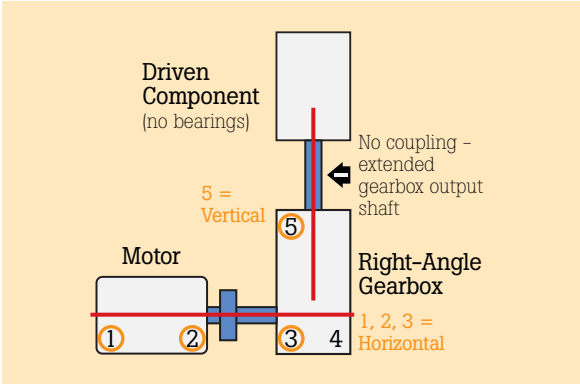

Figure 7. Measurement icons referencing horizontal and vertical shafts.

To test the cooling tower fan:

1. In the Fluke 810 Vibration Tester, select **Setup**.
2. Following the prompts from the Machine Setup Wizard, enter the required information about the system as shown in the example in Figure 8.
3. Select **Measurement**.
4. Take measurements on the motor and gearbox (locations 1, 2, 3, and 5 in Figure 7).
   Reference the horizontal shaft when measuring locations 1, 2 and 3.
   Reference the vertical shaft when measuring location 5. (Figure 7)

5. Select **Diagnose**.

   The Fluke 810 Vibration Tester gives a diagnosis of the motor, right-angle gearbox, and attached fan.

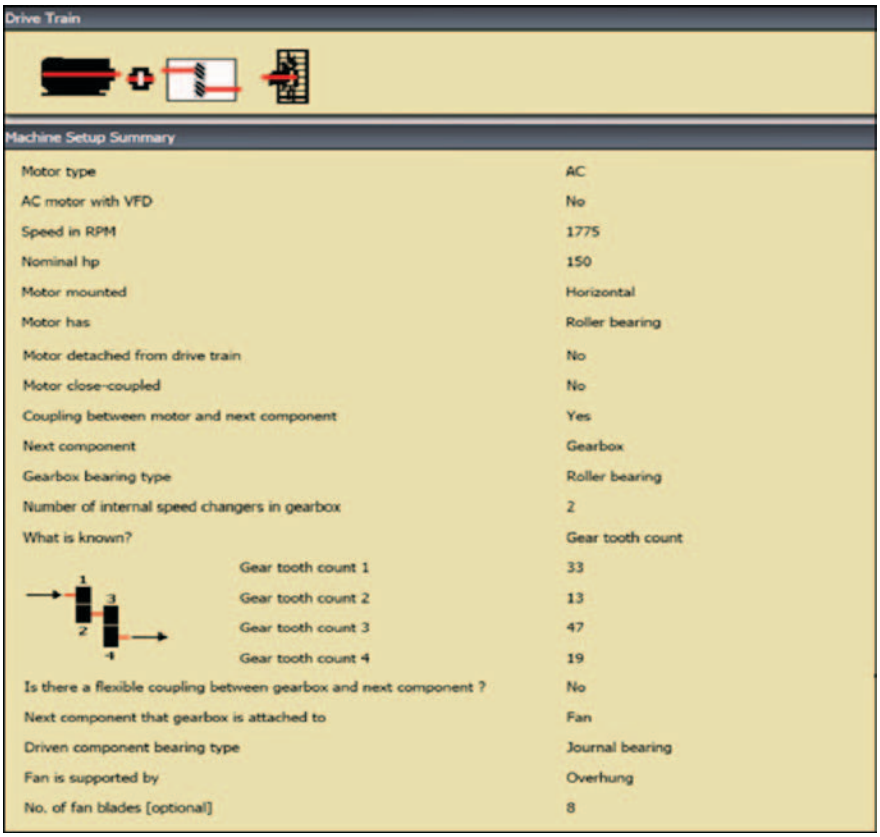

Figure 8. Typical settings for testing a system with a right-angle drive using test method 2.

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