Alignment & Vibration

Align the motor to the driven machine, especially if the two are direct-coupled. Misalignment can cause high vibration levels that damage bearings and loosen mountings. Laser instruments are available for aligning both coupled and belted drives. If alignment tolerances aren't available from the machinery manufacturers, use the suggested alignment tolerances here:

Table 1. Suggested alignment tolerances for directly coupled shafts.

	RPM	Installation		In service	
		Mils	mm	Mils	mm
Soft foot*	All	±1.0	±0.025	±1.5	±0.038
Short couplings					
Parallel offset	1200	±1.25	±0.032	±2.0	±0.051
	1800	±1.0	±0.025	±1.5	±0.038
	3600	0.5	0.013	0.75	0.019
Angular misalignment**	1200	0.5	0.013	0.8	0.020
	1800	0.3	0.008	0.5	0.013
	3600	0.2	0.005	0.3	0.008
Couplings with spacers					
Parallel offset per inch of spacer length	1200	0.9	0.023	1.5	0.038
	1800	0.6	0.015	1.0	0.025
	3600	0.3	0.008	0.5	0.013

* "Soft foot" describes the condition where the mounting feet are not all in the same plane. Measured in mils (1 mil = .001 in) or millimeters (mm).

** To find the angular misalignment in mils/inch (mm), measure the widest opening in mils (mm), then subtract the narrowest opening in mils (mm) and divide by the diameter of the coupling in inches (mm). Note: Up and down motion of the driving and driven shafts with temperature may be in either direction.

Learn More

For more considerations regarding the installation process, see EASA's materials on:

- Basic system considerations
- Motor data & verification
- Safety & environment considerations
- Motor foundation & base
- Electrical connections

Content adapted from EASA's "Getting The Most From Your Electric Motors." Access the full publication at **http://go.easa.com/electricmotors**.

What Is Soft Foot?

Alignment procedures include testing for and correcting a "soft foot" – a common problem where the mounting feet aren't coplanar and therefore do not all sit flat on the motor base.

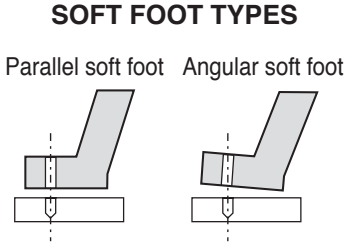
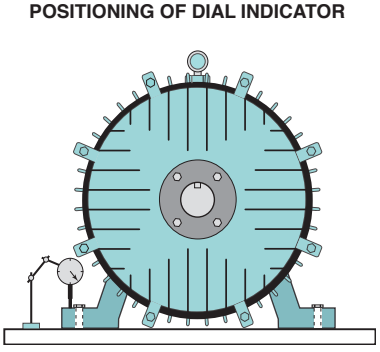


Figure 1. Types of "soft foot."

Unless this problem is identified and corrected with shims, tightening the mounting bolts could twist the motor frame.



Place a dial indicator to sense upward movement of a motor foot and then loosen the mounting bolt to check for deflection.

Figure 2. Using a dial indicator to detect "soft foot."

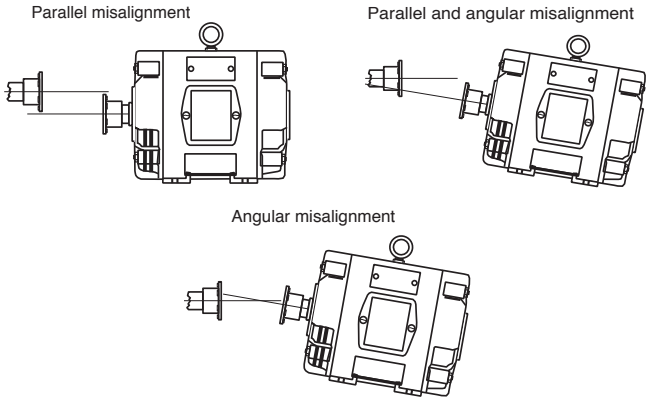


Figure 3. Types of angular misalignment.

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Installation: Alignment & Vibration

- **Alignment of directly coupled shafts.** Using the tolerances in **Table 1**, place shims appropriately under entire motor feet. For most direct-coupled applications, driving and driven shafts should be collinear under full load. If the driven machine operates at a much higher or lower temperature than the motor, expect to provide an initial "at rest" misalignment that will correct itself as the driven machine heats or cools. To confirm the effect, bring the equipment to full operating temperature, shut off the motor and immediately check the alignment, making any correction necessary.
- **Alignment of belt-driven machines.** Poor belt alignment may place excessive axial load on the motor bearings. It also may cause belts to be over tensioned, increasing the radial load on the bearings. Belt alignment is simpler than coupling alignment but still must be done accurately. The correct tool could be a simple straightedge or, for longer center shaft distances, a laser.

  Set belt tension to the range specified by the belt manufacturer and check it after one day of operation. Depending on the belt type, belt tension commonly decreases shortly after installation, particularly if the belts are new.

  For sheaves with multiple belts, the belts must be matched sets. Otherwise some of them will have insufficient tension, causing them to slip and squeal. Increasing the tension to eliminate the squealing will over-tension the other belts.
- **Vibration levels.** A motor that is properly mounted and aligned will operate with very little vibration–typically below 0.15 in/sec pk (2.5 mm/sec rms) when measured in the horizontal, vertical and axial directions at the motor bearings. Higher readings on new motor installations warrant a thorough vibration analysis. They may indicate mounting or alignment problems, an unbalanced sheave or coupling, or trouble with the driven machine.

  Solid, secure mounting and proper alignment will ensure reliable operation and the maximum value from your electric motor. Operating conditions, load, temperature and alignment may change over time, however, so check vibration levels at least quarterly.
- **Shaft-mounted devices and couplings**
  - Before installing belts or connecting the load's half coupling, confirm the motor's direction of rotation by momentarily applying power.
  - Install shaft-mounted devices (half-couplings, pulleys and gears) using appropriate equipment to avoid damaging the device or the shaft.

If possible, install shaft-mounted devices after the motor has been shimmed and the direction of rotation has been determined.

  - Special considerations for sleeve bearing motors:
    - To avoid bearing damage, use couplings that limit end float.
    - Install couplings with the rotor at the scribed magnetic center.

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