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from specialty «Mechanical Engineering»

Discipline RT 4319 «Repair technology»

Module AP 9 «Production automation»

LECTURE NOTES

Topic 7. Shaft alignment

1. Introduction to Shaft Alignment

Shaft alignment is the process of accurately positioning the rotational centerlines of two or more shafts belonging to connected machine components, such as electric motors, pumps, compressors, turbines, and gearboxes. These components form a machine drive train, in which mechanical power is transmitted from the driving machine to the driven equipment.

The main objective of shaft alignment is to achieve a common rotational axis under normal operating conditions. In practice, alignment is accomplished by adjusting the position of one or more machine components through shimming, horizontal movement, or a combination of both. These adjustments ensure that the rotational centerlines of the connected shafts are properly positioned relative to each other.

Shaft alignment is one of the most important preventive maintenance activities in industrial facilities. Even relatively small alignment errors can produce significant mechanical loads, especially in high-speed rotating equipment. Therefore, shafts must be aligned as accurately as possible to maximize equipment reliability, operational efficiency, and service life.

Proper alignment is important not only for directly coupled shafts but also for machine trains in which connected components are separated by some distance. The use of flexible couplings does not eliminate the need for accurate alignment.

Although flexible couplings can accommodate a limited amount of angular and parallel displacement, they are not designed to compensate for excessive misalignment.

2. Importance of Proper Shaft Alignment

Incorrect shaft alignment is one of the common causes of premature equipment failure. When two connected shafts are not properly aligned, additional forces are generated during rotation. These forces are transmitted through the coupling to the shafts, bearings, seals, and machine housings.

As a result, equipment may experience increased vibration, abnormal noise, excessive bearing temperatures, and accelerated wear of mechanical components. In severe cases, misalignment can lead to coupling damage, shaft fatigue, seal leakage and unexpected equipment shutdowns.

Proper shaft alignment provides several important benefits:

- Increased equipment reliability. Correct alignment reduces additional mechanical loads and helps prevent premature failures of rotating components.

- Extended bearing service life. Bearings operate under their intended load conditions, reducing friction, overheating, and fatigue damage.

- Reduced vibration and noise. Proper positioning of shafts minimizes abnormal dynamic forces and improves the stability of rotating machinery.

- Lower energy consumption. Misalignment creates additional resistance and mechanical losses. Correct alignment helps reduce unnecessary power consumption.

- Improved coupling performance. Couplings operate within their specified limits, reducing wear and the need for frequent replacement.

- Extended seal life. Proper alignment reduces shaft movement and excessive loading on mechanical seals and other sealing elements