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Building on a solid foundation

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Machinery installation is the start of a trouble-free process

Proper machinery installation is a fundamental element of high equipment reliability and low life cycle cost. Conversely, improper installation ensures machinery will become a chronic source of downtime, poor product quality, reduced capacity and high cost. While installation requirements vary depending on the type of machine and its function, basic, best practices always must be followed.

Foundation

The first step in proper installation is to ensure the support structure or foundation has sufficient mass and stiffness to permit the machine to operate in, or near, a state of equilibrium. Lack of mass or stiffness permits the normal operating forces to produce abnormal vibration levels that reduce machine life and increase maintenance.

The foundation must be capable of carrying the applied load without settling, flexing or crushing. Foundations for heavy machinery usually are fabricated of concrete or structural steel. Normal practice is to pour an independent concrete pad with sufficient mass and stiffness to support the machine train and to absorb forces generated during normal operation. As a guideline, the total mass of the foundation and its related support structure should be at least five times the total mass of the machine train.

Out of necessity, some machines must be mounted on a mezzanine or upper floor. In general, these machines don't have an adequate support structure. In addition, mounting machines directly on concrete or deck plate floors introduces a resonance problem. The machine's normal operating forces are transmitted directly into the floor, which acts as a soundboard and amplifies these energies. In the best case, amplified energy only results in higher than normal noise levels. In many cases, this energy resonates with one or more natural machine or foundation frequencies and can result in serious, chronic problems.

Anchoring

Normally, anchor bolts tie the machine to its foundation. Proper anchors ensure parts mate rigidly and permanently. If the machine is anchored to concrete, permanently fix J-bolts in the concrete. Size them for adequate holding torque to ensure they won't work loose over time. Select the proper grade and mounting pattern that's sufficient to lock the machine's mounting plate to the foundation rigidly. But, using hydraulic concrete and straight mounting bolts is not recommended because they tend to loosen with time and result in chronic problems.

Type and configuration of anchor bolts is even more critical for machines mounted on mezzanines or upper floors. These anchor bolts must perform two critical functions: fix the machine in place so that it can't flex, bend or deflect; and isolate the machine from the foundation so that generated energies are not transmitted in the foundation.

Isolation

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Machinery produces vibration as an integral part of its operation. The machine foundation must absorb this energy or it must be trapped inside the machine. Cross talk energy generated by one machine and transmitted to another is a chronic source of reliability problems. This is especially true in plants with multiple continuous process lines, such as paper machines, high-speed printing and metal processing lines.

If the machine is mounted on concrete, the pad should be independent of the surrounding floor. Normally, the pad will be formed and poured directly on bedrock. A separation of 0.5 in. to 1 in. between the pad and surrounding floor ensures isolation. This approach serves two purposes: it absorbs energies the machine generates and it prevents outside sources of vibration from entering the machine.

If the machine must be mounted directly on the floor, isolation must be achieved through springs or elastomeric pads specifically designed to absorb or stop vibration. But, take care in the selection. These isolators are designed for specific, relatively narrow frequency bands, 18 to 21 hertz for example, and will do little to isolate frequencies outside that range. When properly sized and installed, these mounting components do a good job of protecting machines from both generated and outside energies that could be detrimental to long-term reliability. Improperly sized or installed, they are absolutely worthless.

Leveling

With few exceptions, machinery is designed to operate in a true horizontal plane. Normally, a spirit level is sufficient to level a machine properly, but new techniques, such as laser alignment devices, also can be used. The entire machine train must be level and in the proper horizontal plane.

The most common failure is related to the method used to shim the mounting feet. Be sure to use shim packs that provide full footprint support for leveling machinery. Failing to do so almost always results in chronic reliability problems. Shim packs must be designed to provide a rigid connection between the machine's mounting feet and the foundation. The surfaces of both the feet and foundation must be flat and parallel to eliminate voids or flexing in the final bolted joints.

Alignment

The final requirement is proper alignment between driver and driven units. Where leveling ensures the entire machine train is level to the earth, alignment ensures motor and machine shafts are collinear. Generally, reverse-dial indicators or laser alignment instruments guide the required alignment adjustments.

Alignment specifications depend on the machine type, but normally the shafts must be parallel and in the same plane within 0.001 in. to 0.002 in.

The vendor's installation, operation and maintenance manual provides installation requirements for the machinery. Follow these recommendations to ensure proper, trouble-free operation. Installation short cuts or omissions guarantee the machine will become a chronic maintenance headache.

One final word - check the installation periodically. Foundations settle, bolts corrode or loosen, shim packs deteriorate and alignment drifts. By checking the condition of the installation periodically, many problems that result in lost production time, poor product quality or elevated costs can be prevented or at least mitigated.

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