CTC UNIVERSITY

LEVEL 3, LESSON 6

MEASURING
FAN AND MOTOR
VIBRATIONS

Introduction

Welcome to **Level 3, Lesson 6 – Measuring Fan And Motor Vibrations**, part of CTC's free online vibration analysis training series.

We hope you enjoyed and benefitted from the previous course and will continue to build your vibration analysis knowledge as you progress through Level 3.

Training Objectives

Upon completion of this lesson, you will understand:

1. The fundamentals of using vibration monitoring to analyze faults and prevent machine failure of fans and motors in industrial environments.

Understanding Fans And Motors

Quite often we view the fans and motors we rely on as very common machines.

We forget they provide critical air flows for industrial processes, and cooling, heating, dehumidification, and humidification for office buildings, convention centers, theatres, recreational facilities, and hotels.

Understanding Fans And Motors – Common Mode Of Failure

Although they come in many shapes and sizes, fans and motors share a common mode of failure.

Bearings are often overlooked and overworked, suffering from lack of lubrication, too much heat, or poor applications. When this happens, the bearings wear and deteriorate, generating vibrations.

Measuring the vibrations and analyzing the faults will prevent catastrophic failures, as shown in these photos.

Understanding Fans And Motors – Preventing Failure

A good routine vibration program using a portable data collector, or permanent online vibration monitoring, will become the foundation of any predictive maintenance initiative.

Measuring, trending, alarming, and analyzing fan and motor vibration will provide earlier warning of developing problems and will allow replacement parts to be ordered.

Bearings can be replaced during scheduled downtimes prior to non-repairable damage occurring.

Sensor Placement For Fans And Motors

Accelerometers are typically placed at key locations on the motor and fan bearings.

Since the bearings are the load-carrying part of the mechanical drive train, accelerometers should be placed on the input and output bearing housing to measure the vibration levels.

In this photo, you can see permanent accelerometers mounted on motor and fan bearings.

Sensor Placement For Fans And Motors

Vibration sensors should be placed in radial (horizontal and vertical) and axial locations on the motor and fan bearings.

This will provide the best detection of all vibration components, including:

- Bearing vibration
- Misalignment
- Blade pass (aerodynamic disturbances)
- Unbalance
- Electrical faults
- Belt frequencies

Portable Mounting Methods

There are three common mounting methods used with portable vibration measurements:

Curved Surface Magnet

Quick Disconnect

Flat Surface Magnet And Target

Portable Mounting – Curved Surface Magnets

- Mounting sensors with a curved surface magnet is convenient for rounded surfaces.
- Maximum frequency response: 2,000 Hz (120,000 CPM)
- Offers repeatability based on user mounting – user must take care to place the magnet in the same spot every time to ensure repeatable results.

Portable Mounting – Quick Disconnects

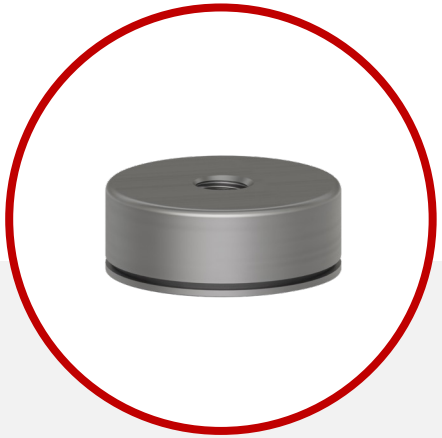
- Mounting sensors with quick disconnects is convenient for mounting on a permanent target.
- Maximum frequency response: 6,500 Hz (390,000 CPM)
- Offers excellent repeatability – the permanently mounted stud creates a consistent mounting location for portable routes. The receptacle features a triaxial locating notch and ¼-turn engagement onto the stud, ensuring the sensor is oriented in the same position when connected to the stud for every reading.

Portable Mounting – Flat Surface Magnet And Target

- Mounting sensors with a flat surface magnet and target is convenient for mounting on a permanent target.
- Maximum frequency response: 10,000 Hz (600,000 CPM)
- Offers excellent repeatability – target makes for a permanently affixed, magnetically attractive mounting base for repeatable measurements.

Permanent Mounting Methods

There are two common mounting methods used with permanent vibration measurements:



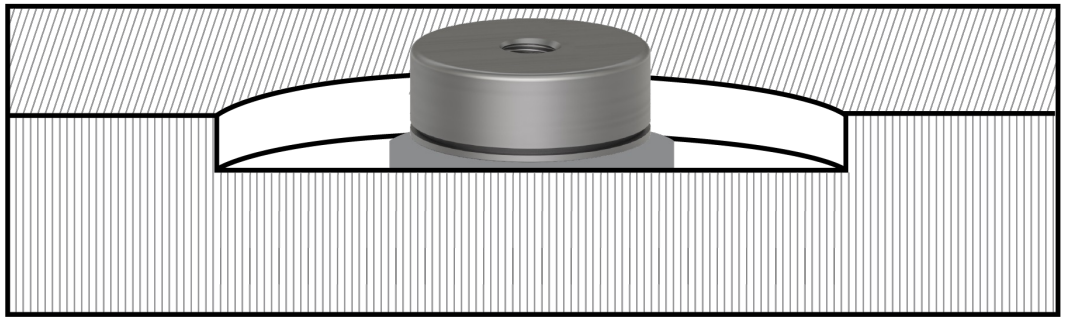
Adhesive Surface Mounting

Stud Mounting

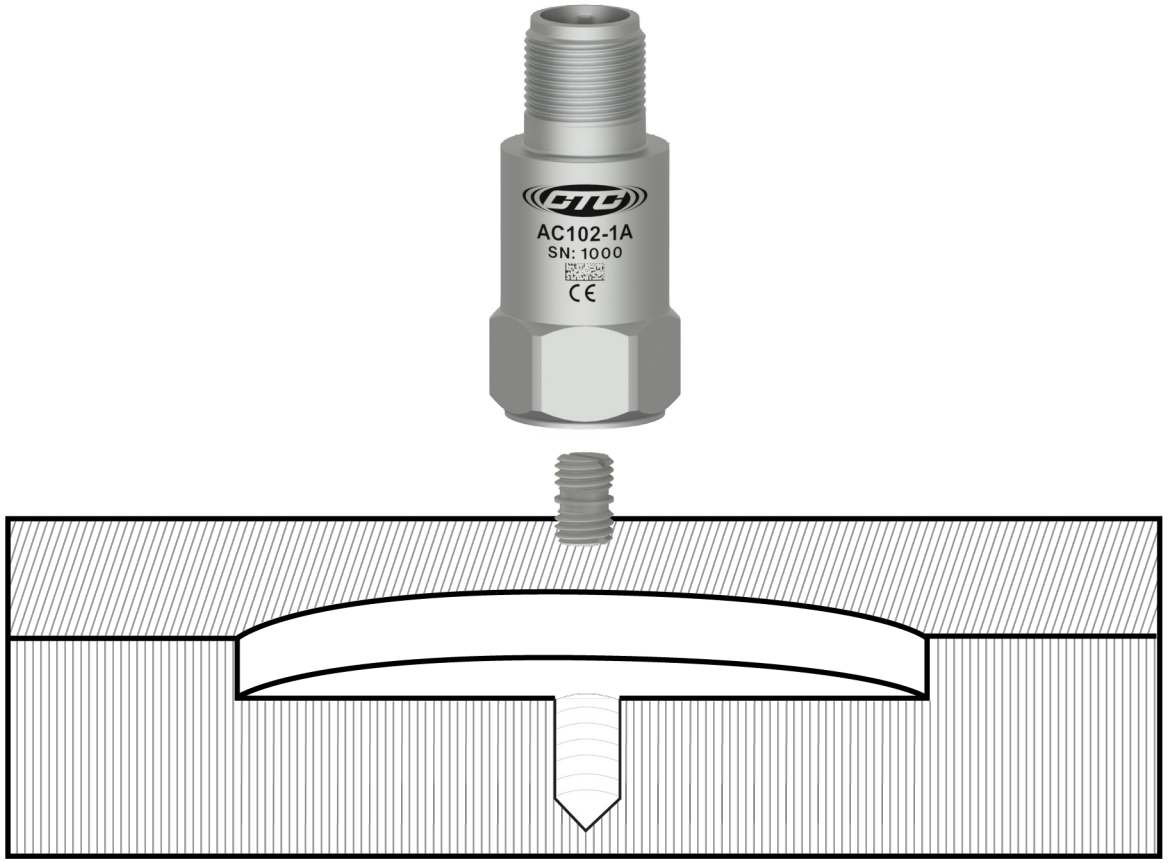
Both methods require surface preparation prior to mounting the sensor.

Permanent Mounting – Adhesive Surface Mounting

Adhesive surface mounting requires a clean, dry, and flat surface before adhering the mounting pad to the machine.



Permanent Mounting – Stud Mounting



Stud mounting requires a spot face with a drilled and tapped hole.

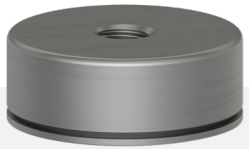
Permanent Mounting – Spot Facing

Since both methods require a flat, prepared surface for mounting, spot facing is the easiest way to accomplish this.

A spot facing tool can provide the flat surface and drill the hole in one operation.

Permanent Mounting – Frequency Response

If the correct care is taken during permanent mounting:



a frequency response of 15,000 Hz (900,000 CPM) should be achievable using an adhesive mount

the maximum frequency response of the accelerometer should be achievable using a stud mount

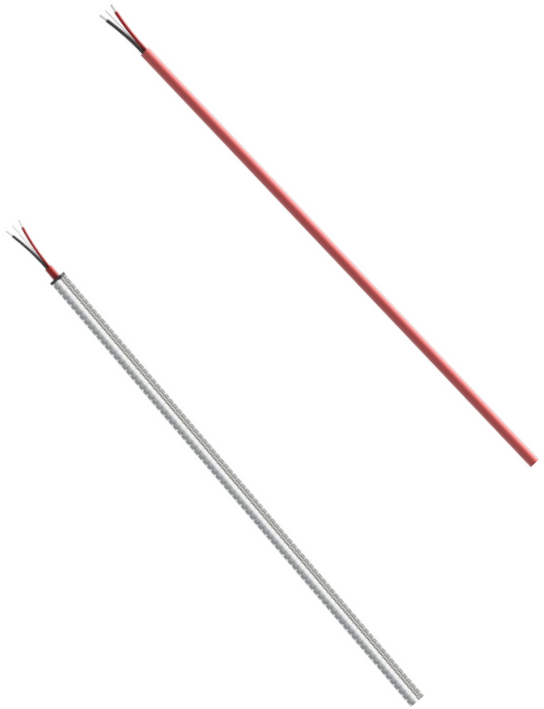
Portable
Cables And Connectors

- Portable data collection requires a flexible cable and connector with a good strain relief.
- It needs to be easy to use, but also very rugged for repetitive bending and stretching.
- The twisted wiring pairs minimize noise.

Portable Cables And Connector

The sensor connector on the cable should be soldered, have a good strain relief, and fit comfortably in your hand.

Permanent
Cables And Connectors



Permanent data collection utilizes a very rugged cable and connector that is intended to stay in place for the life of the machine.

Cables should have heavy-duty jackets to protect them from abrasion and the surrounding environment.

Many applications utilize FEP jackets, and for severe environments, stainless steel armor jackets can be used.

Permanent Cables And Connectors

- Connectors for permanent data collection should also be chosen based on the application and environment.
- Temperature and Ingress Protection (IP) against liquids and dust should always be considered.
- Chemical contact should also be reviewed and planned for when choosing a connector or cable.
- Choose the cable connector that fits your application to avoid a weak link in the vibration measurement and data collection.

Cable Termination

The opposite end of the sensor cable needs to be organized and connected to portable or permanent vibration data collection.

Wiring should be well laid out and labeled with identification tags.

Cable Termination – Portable Data Collection

Simple portable data collection with an individual sensor and portable mount usually takes care of itself by directly mounting to the data collector.

Using a portable data collector to measure permanently mounted sensors requires organization and termination of the sensor cables – a switch box is a convenient method.

Permanent monitoring also requires organization and termination of the sensor cables. These can be organized as individual cables or combined in a cable reduction box with a large multi-conductor cable.

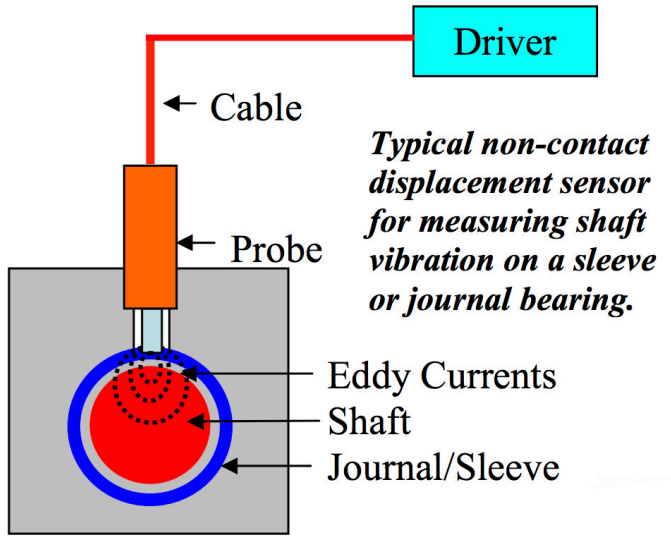
Plain Bearings

Some fans and motors have plain bearings, often referred to as sleeve bearings or journal bearings.

There are no rolling elements in plain bearings, and typically the shaft is supported by a film or wedge of foil.

In most cases, the primary measurement is the movement of the shaft inside the journal or sleeve.

This type of measurement should be made with a displacement sensor (eddy current probe) – these non-contact sensors provide valuable information on shaft vibration and the gap between the shaft and journal or sleeve.



Typical non-contact displacement sensor for measuring shaft vibration on a sleeve or journal bearing.

Conclusion

Vibration monitoring on fans and motors can be very beneficial. It doesn't matter if it is route-based portable measurements or permanent monitoring – both methods can achieve success in providing better reliability and improved performance for any predictive maintenance program.

Mechanical and electrical defects can be identified through vibration analysis. Choosing the right sensor, mounting method, cable, and connector will provide quality data. Organizing the sensor wiring in a switch box or cable reduction box reduces measurement errors.

Operator safety should never be compromised – permanent sensors and cables keep your fingers and hands out of harm's way.

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