

# BASIC VIBRATION

1. Introduction

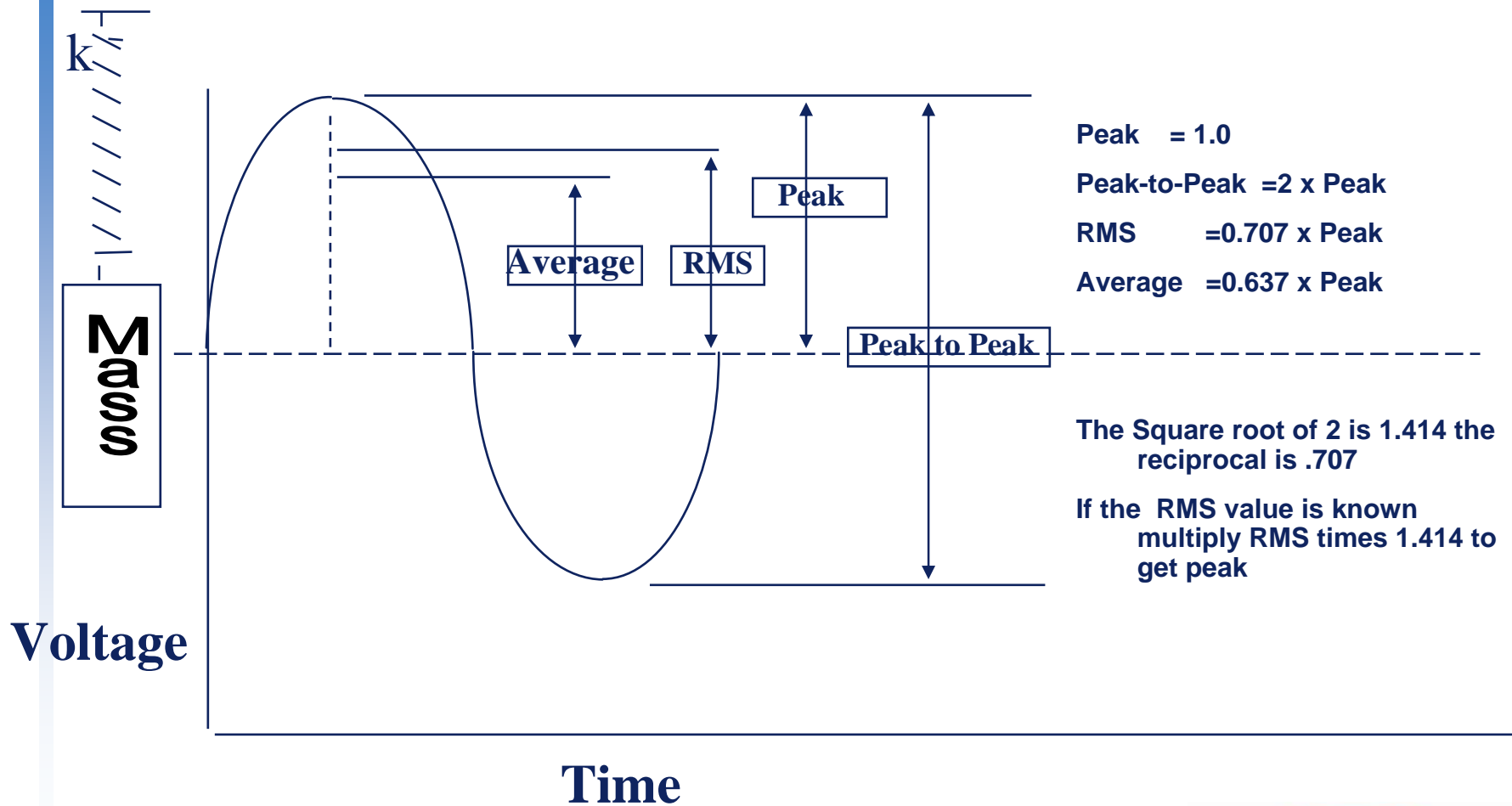
2. Free Vibration



## Basic Vibration - Definition

- ❄ Vibration is a mechanical motion or oscillation about a reference point of equilibrium.
- ❄ Vibration has amplitude, frequency and phase components.
- ❄ Vibration is a symptom not a root cause .
- ❄ Vibration is expressed in terms of acceleration, velocity or displacement.

# Vibration Basics - Output Signals



## Vibration Basics - Measurands

- ↪ **Displacement**    microns (mils), pk-pk  
Actual pk-pk movement from a rest position.  
Displacement is a distance measurement.
- ↪ **Velocity**        mm/s (ips), rms or pk  
The change of displacement with respect to time.  
Velocity is a speed measurement
- ↪ **Acceleration**    m/s<sup>2</sup> (g's) rms or pk  
The change of velocity with respect to time.  
Acceleration is a change of speed measurement.  
1 g = approximately 10 m/s<sup>2</sup>

# Vibration Terminology

## ❄ Absolute Vibration

- ❄ Vibration measured relative to a point in space.
- ❄ It can be absolute shaft or absolute casing.

## ❄ Relative Vibration

- ❄ Vibration of the shaft measured relative to a point on the machine.

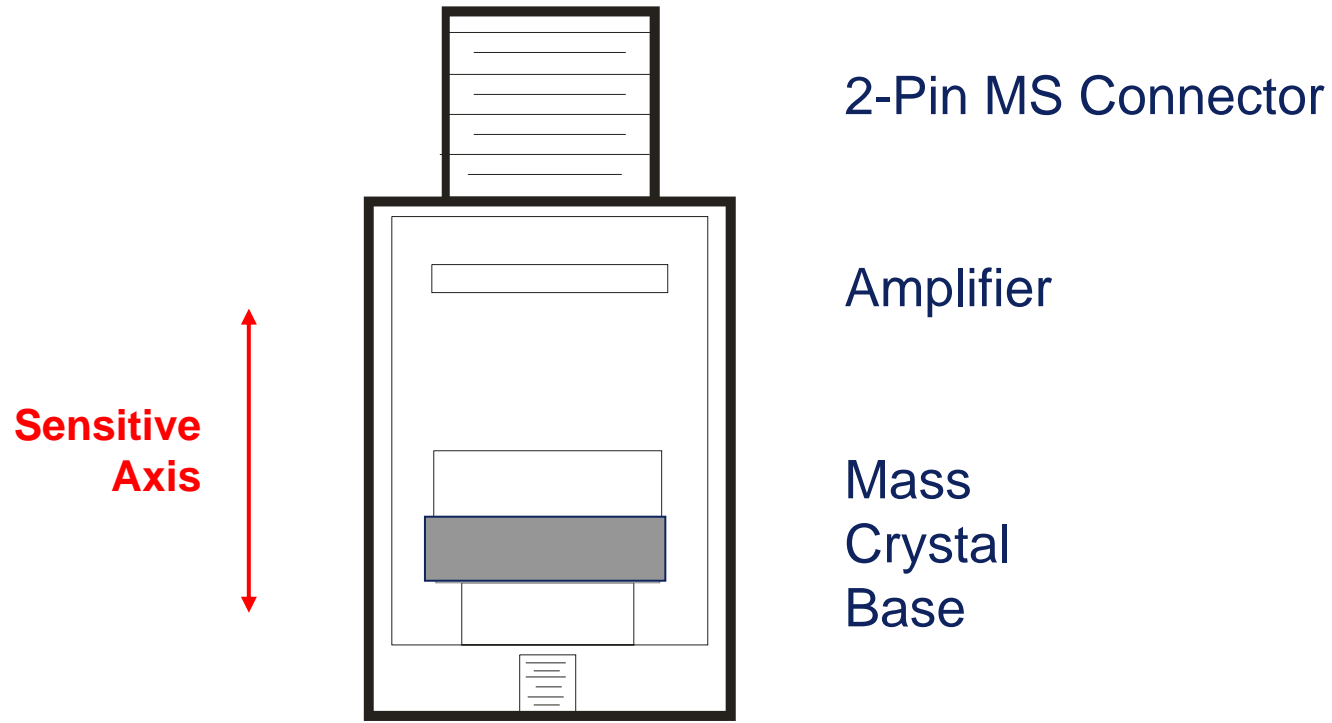
The logo for METRIX, featuring the word "METRIX" in a bold, white, sans-serif font with a black outline, centered within a blue oval with a gradient and a drop shadow.

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## Case vs. Shaft Vibration

- ❄ Case Measurement – is an absolute measurement taken on the bearing case using a seismic sensor and is a measure of the vibration of the whole machine relative to a point in space.
- ❄ Shaft Measurement – is a non contact proximity measurement which measures the relative displacement of the shaft with respect to a fixed point on the machine (typically shaft to sleeve bearing).

# Vibration Basics - Accelerometer



2-Pin MS Connector

Amplifier

Mass  
Crystal  
Base

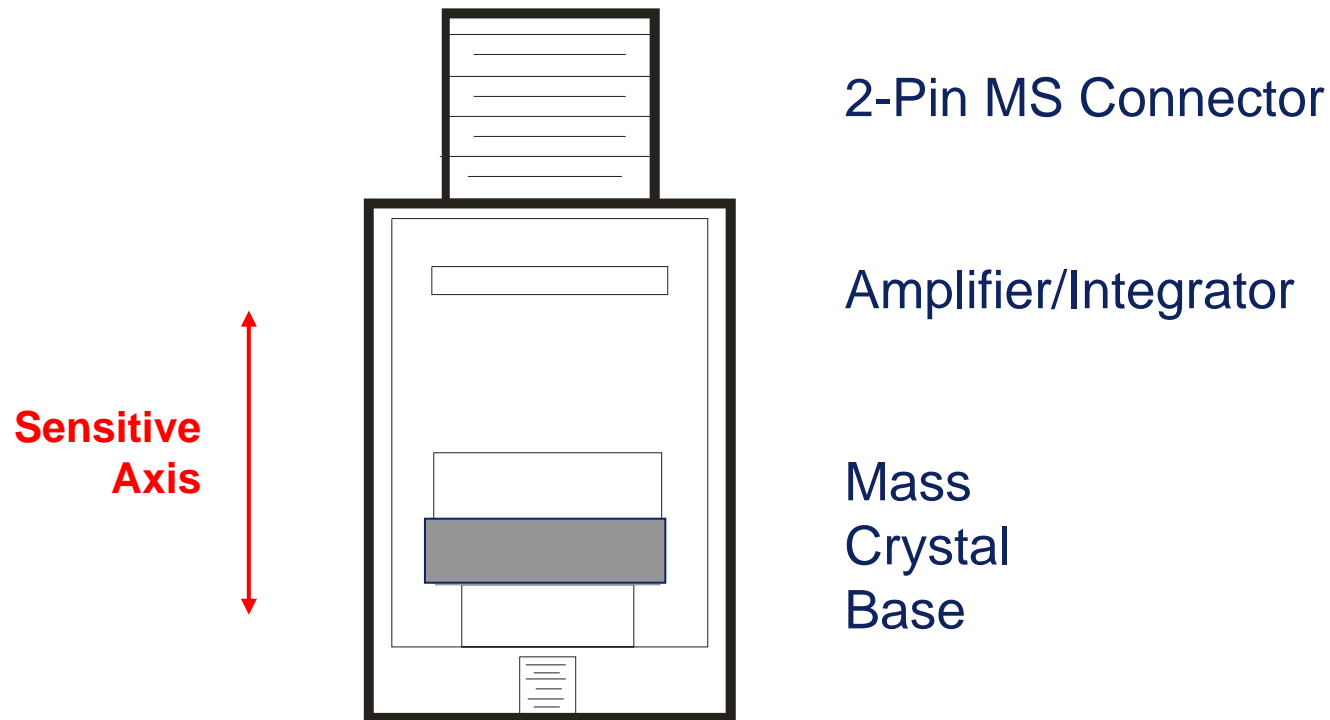
**Sensitive  
Axis**

Industrial Accelerometer

**Output = 100 mV/g**



## Vibration Basics – Seismic Velocity Sensor

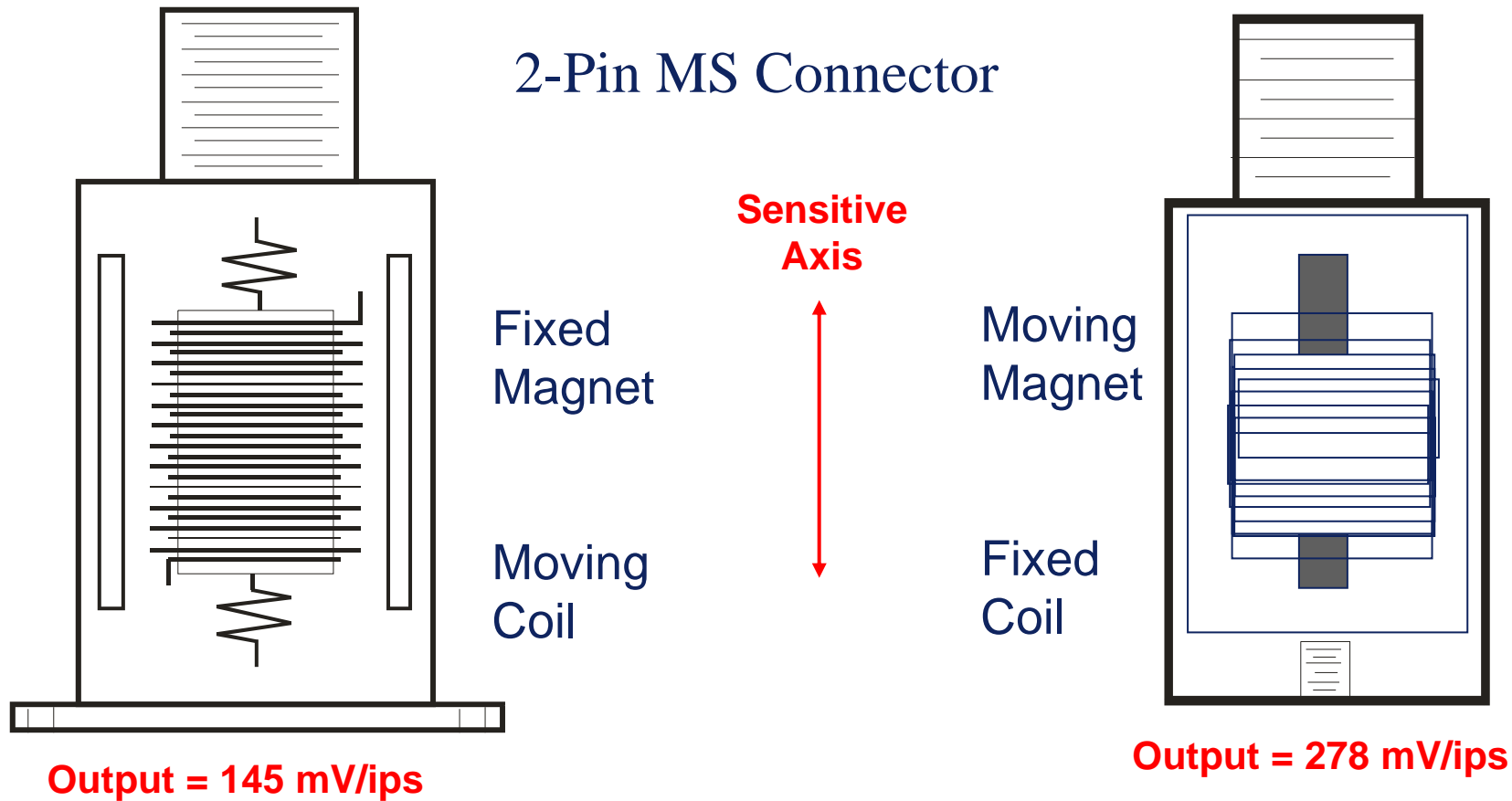


Industrial Constant Current Type Velocity Pickup

**Output = 100 mV/ips**

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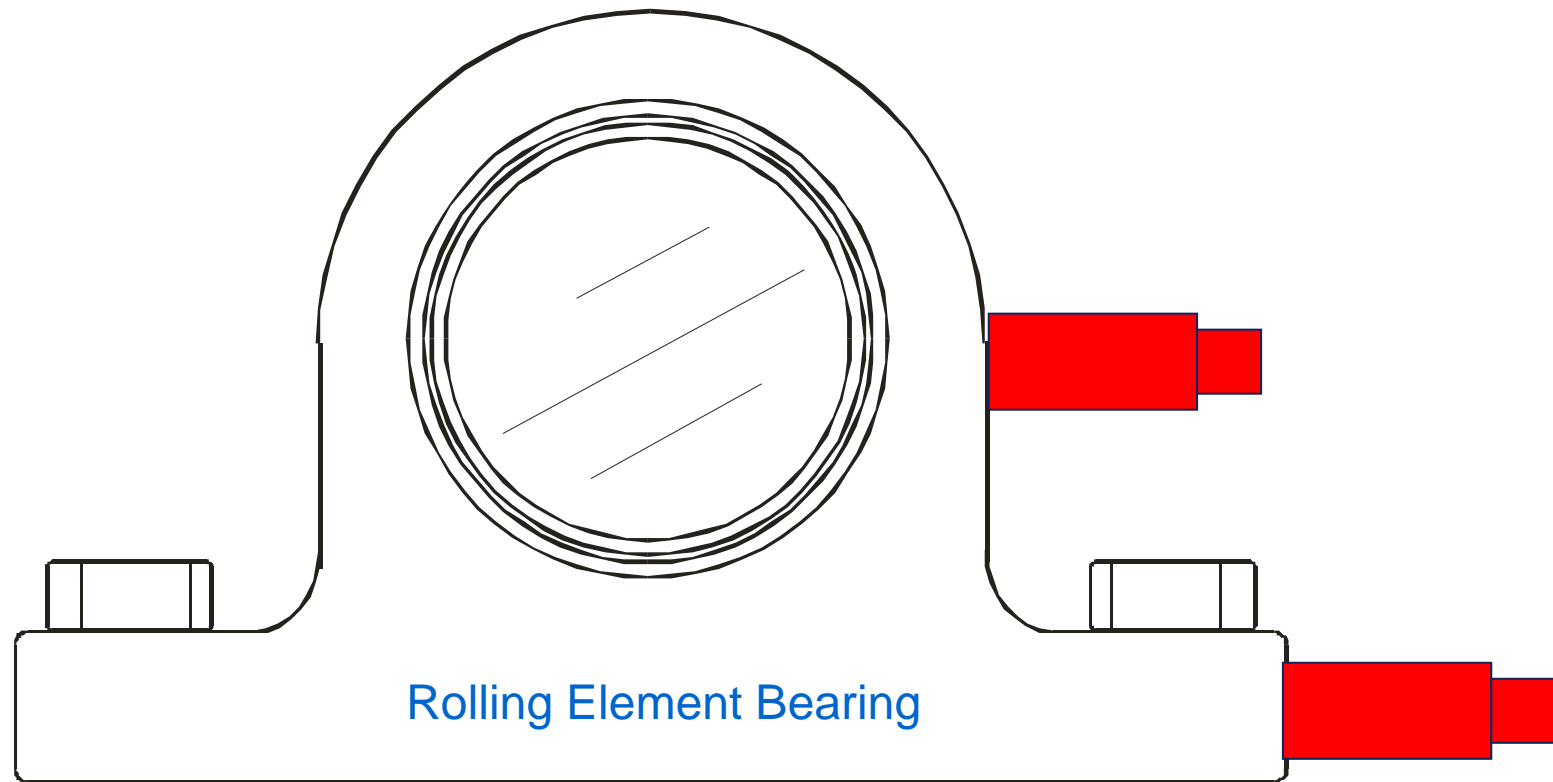
# Vibration Basics – Velocity Pickup



Industrial Self Generating Velocity Pickup



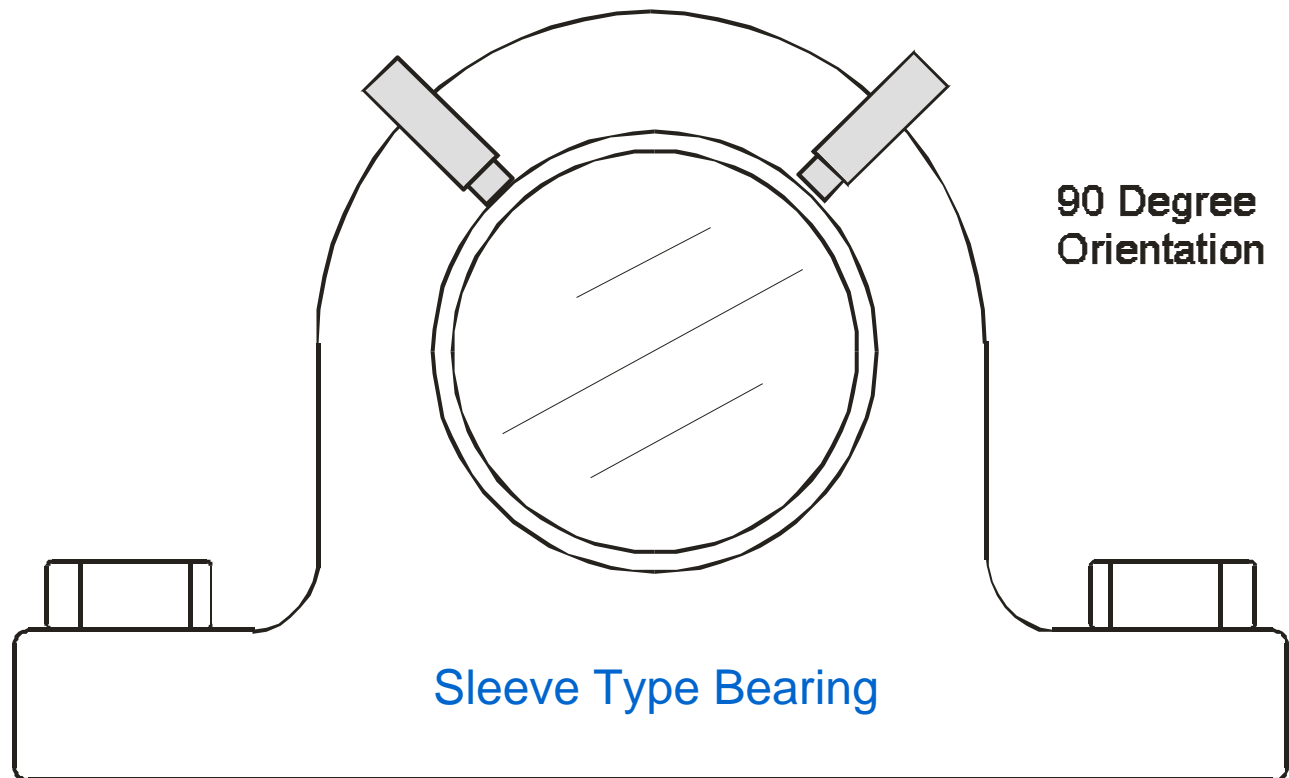
## Vibration Basics – Mounting Seismic Sensors



Accelerometer Mounting on Rolling Element Bearing



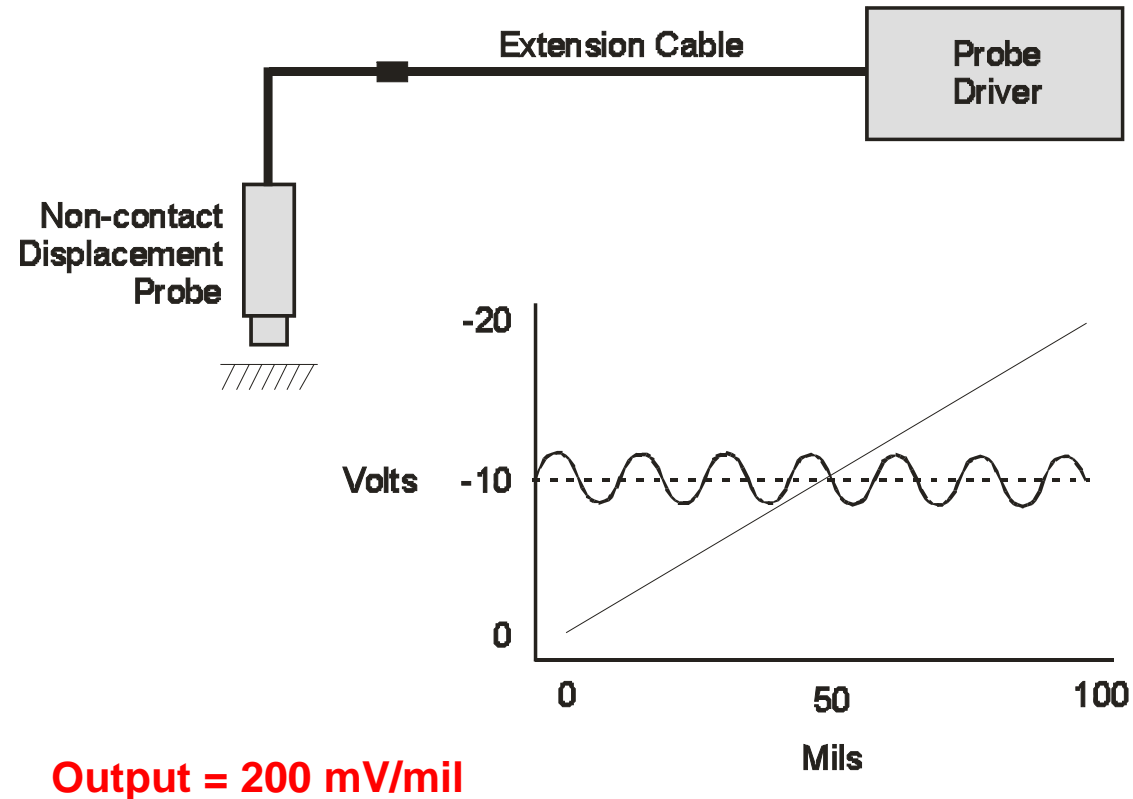
## Vibration Basics – Mounting Proximity Probes



Eddy Probe Mounting on Sleeve Bearing



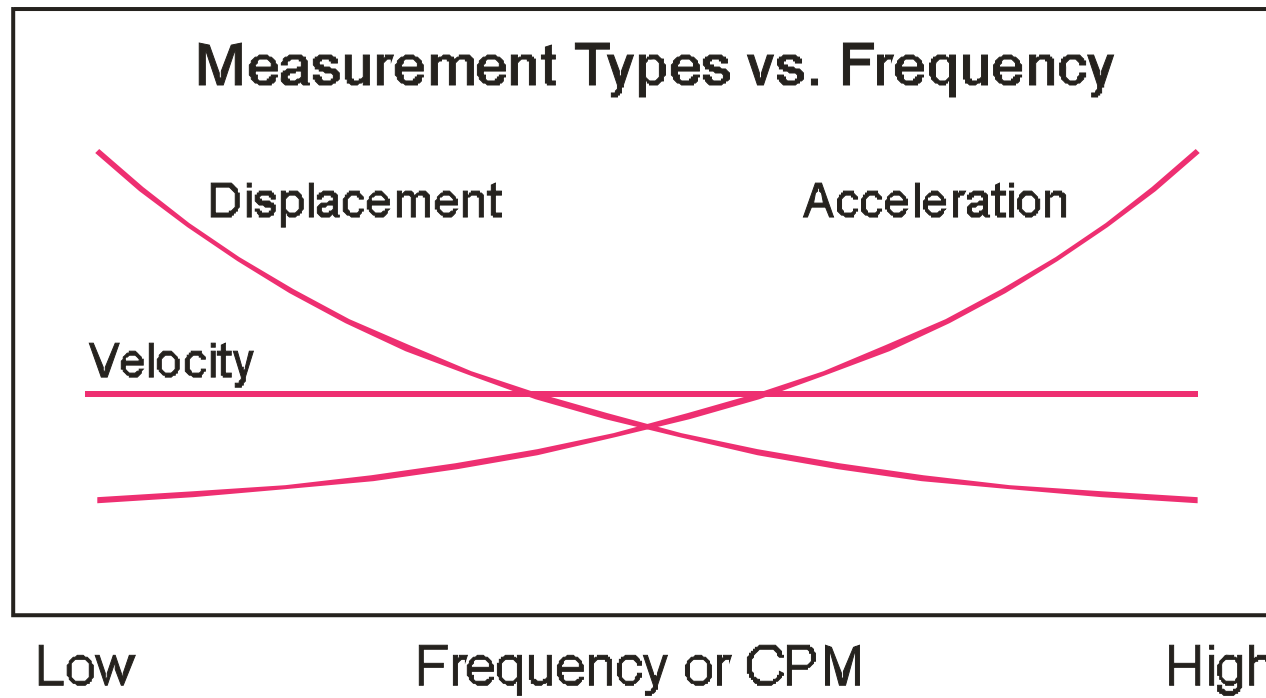
# Vibration Basics – Proximity Probe



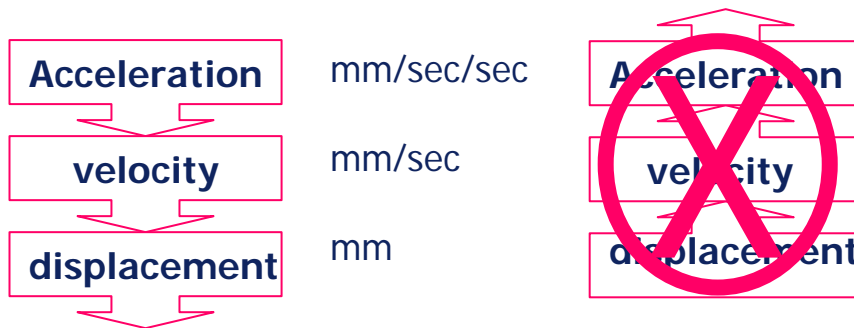
Non-contact Displacement Measurement



## Vibration Basics – Relative Signal Strength



## Vibration Basics – Integration



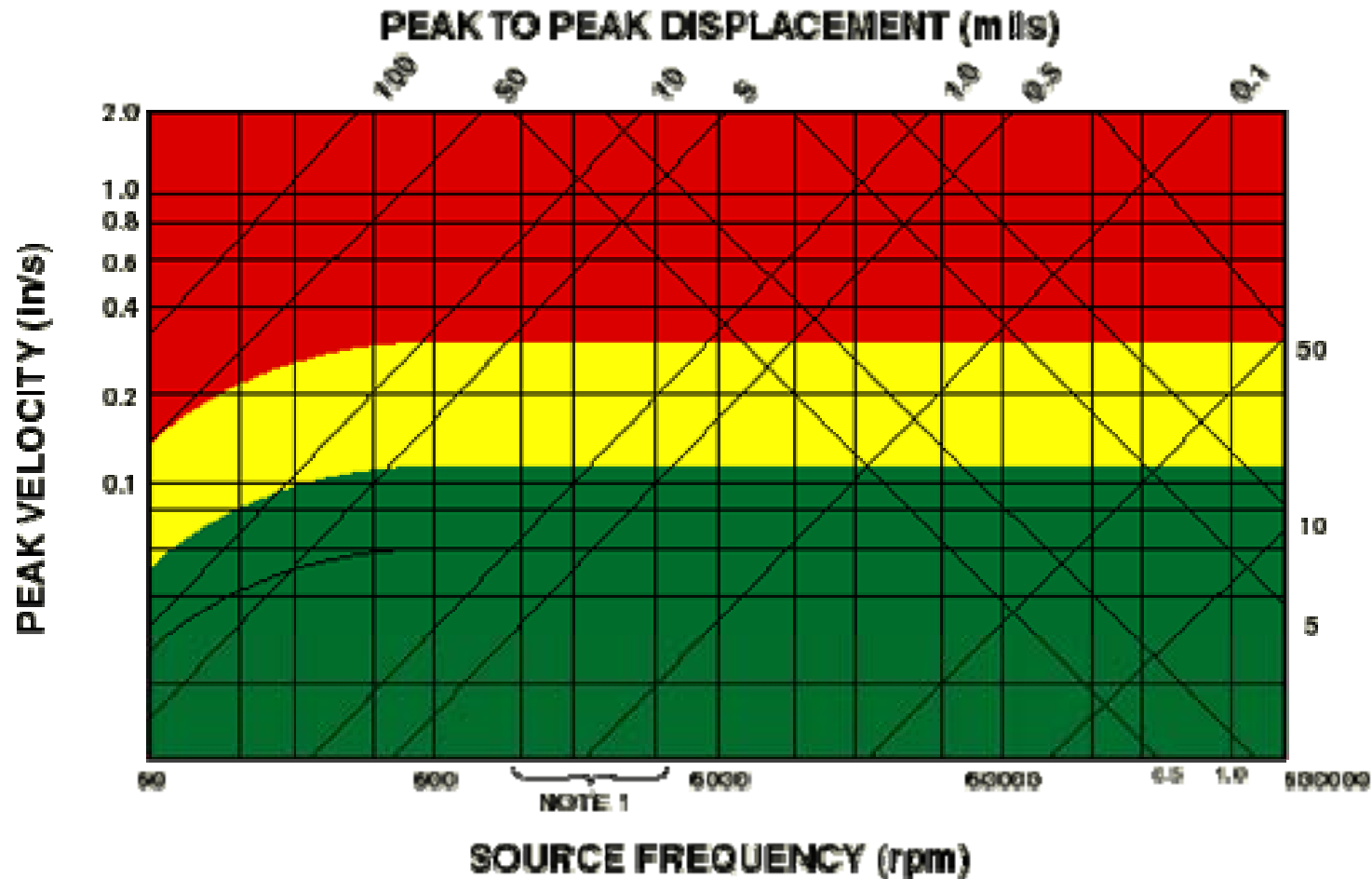
*Integrate, yes; differentiate, no.*

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## What Unit of Measure is Best

- ❄ For general purpose rotating machinery operating in the range of 400 to 6,000 RPM **Velocity** is the best measure of overall vibration severity.
- ❄ The significance of vibration severity levels measured in units of velocity is independent of machine speed.

# Vibration Severity Chart



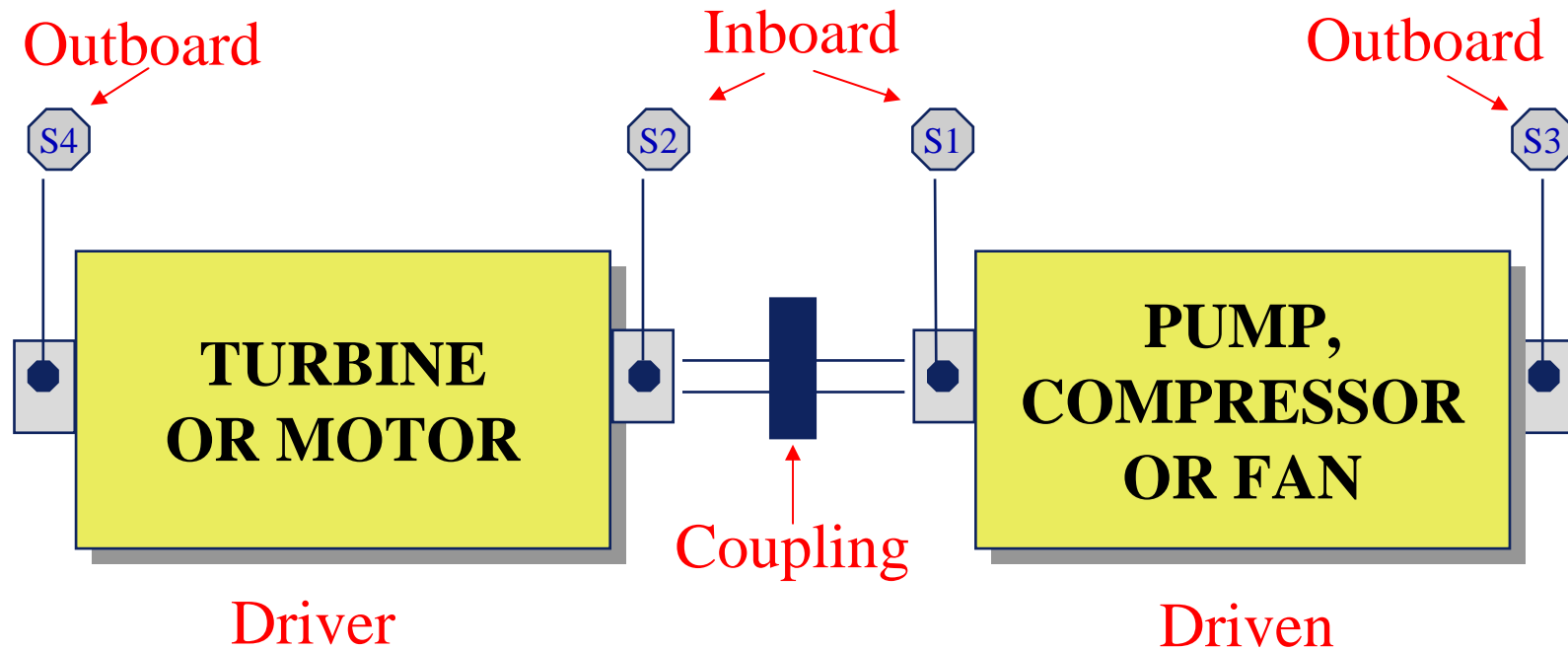
- NOTE 1 - COMMON MOTOR SPEEDS (1200-1800-3600)**
- GREEN AREA - GOOD TO VERY GOOD
  - YELLOW AREA - FAIR
  - RED AREA - ROUGH / VERY ROUGH



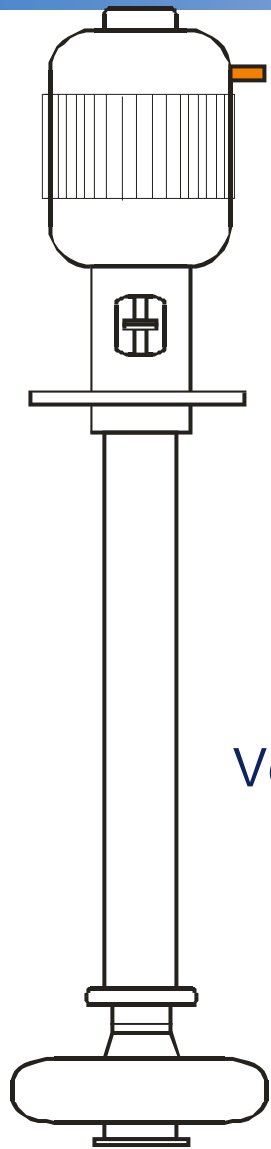
# Where To Mount

S= SENSOR

S1 Most Critical Sensor    S4 Least Critical

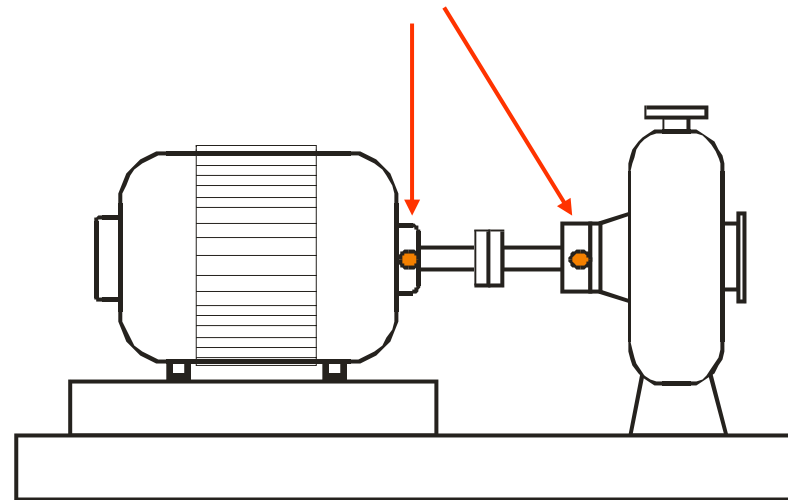


# Vertical Pump Exception



Vertical Pump

Horizontal Measurement Locations

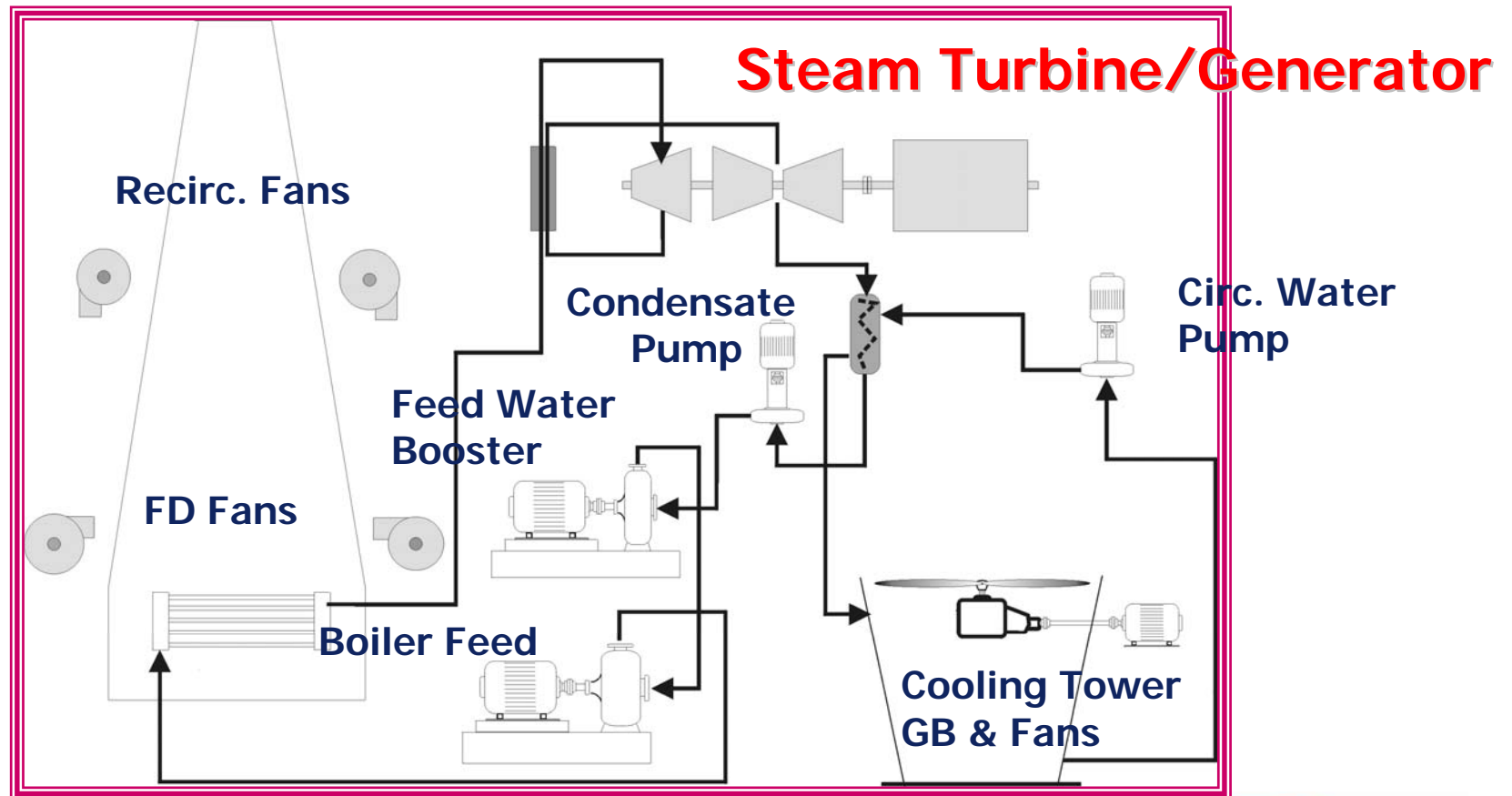


Horizontal Pump

Typical Seismic Sensor Locations on Pumps



# Typical Power Generation Station



**Thank you**

**The End**

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