# VIBRATION DATA CAPTURE

## How to Eliminate Poor Vibration Data Samples

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by Jude Iyinbor, CEng.

## Introduction

The introduction of vibration monitoring to aid machinery fault identification without unnecessary intrusion into machinery internals has seen a lot of benefits (fault prediction, machinery reliability improvement, reduction in downtimes, etc.). However, some plant managers, reliability and maintenance personnel still find it very challenging to maximize the value of a route-based Machinery Vibration Analysis program. The quality of vibration data collected manually from a given piece of equipment is one of the most important criteria to consider when looking at ways to maximize the value of any vibration analysis program. In this article, we look at how to identify and eliminate poor vibration data samples.

## What is poor vibration data and how can it be identified?

A poor vibration data is a set of data that is not a true representation of the actual signature taken from the machine during normal operation. This is usually a mis-representation of the actual signature coming from the machine. Since machinery vibration analysis relies heavily on data to provide solutions to problems and specify the health status of rotating equipment, poor data can lead to a false call or wrong diagnosis of a machine's condition. This can further lead to unnecessary actions (carrying out a maintenance action in error or doing nothing also in error) that often affect the financial bottom line.

Poor data can be identified during data collection or analysis by the type of spectra that is collected from the machinery. As opposed to a normal spectrum (figure 1), it usually shows up as flat-lined spectra (figure 2: with almost no energy) or a ski sloped spectra (figure 3) with outrageous energy levels that are sometimes 10 times more than historic levels. Even if there are no historic values to compare with, a typical ski-sloped spectral data is a

give-away sign that the spectral plot is because of poor data. Hidden poor data can also be identified as a complete deviation from historical or base line levels.

Think about it as a situation that occurs when someone visits their local bank to withdraw money and the bank customer advisor notices that the signature does not match the copy they have on file (historic or baseline signature). You will be immediately advised to try signing again or questions may be asked to confirm that you are the true owner of the bank account. Your identity will need to be verified. The same applies to machinery vibration signature, an obvious deviation from the expected outcome is a sign of poor data and a re-sampling will be advised to verify the source and solve the issue. This is not to be confused with a deviation that connotes a developing fault in the machinery. Faults can easily be distinguished by identifying fault frequencies and looking at their amplitude levels.

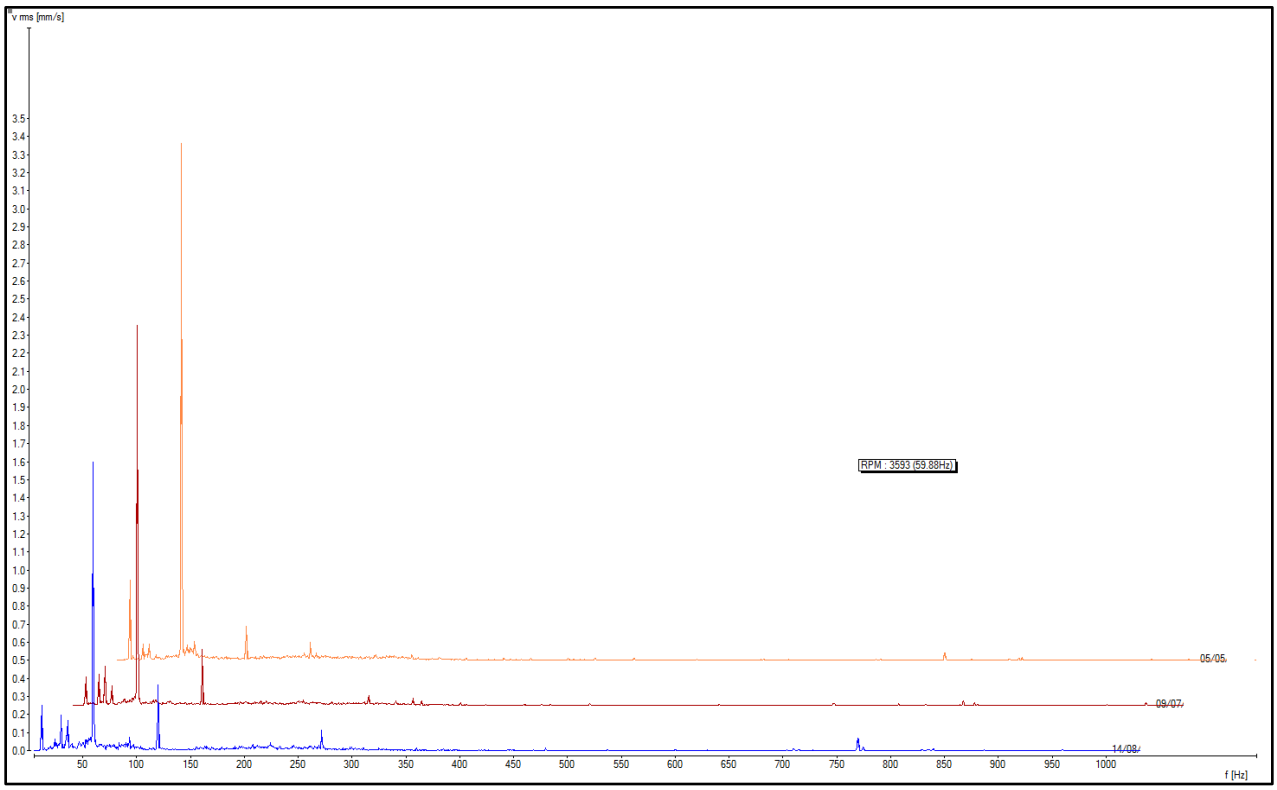


Figure 1: Normal spectral data with frequency peaks at varying amplitude levels

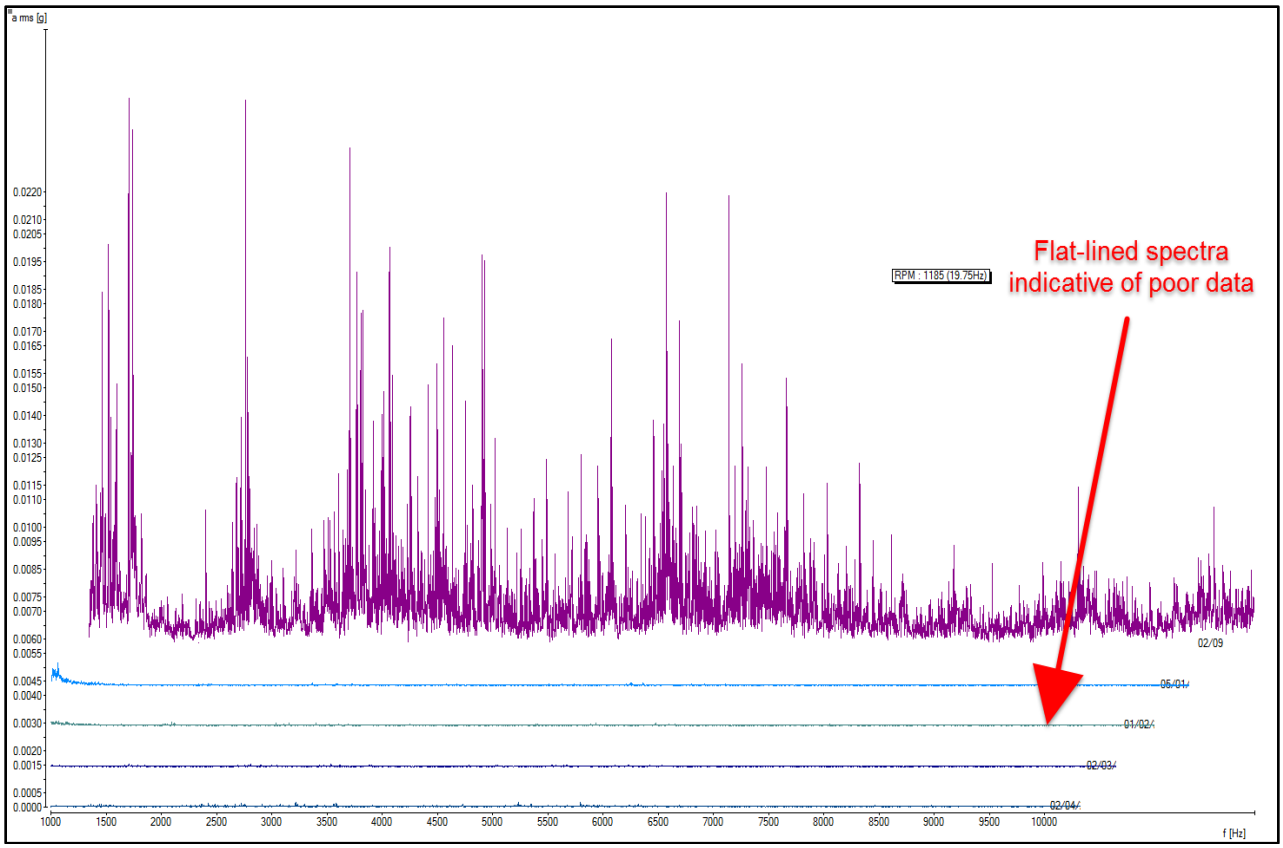


Figure 2: Flat-lined spectra signifies poor data

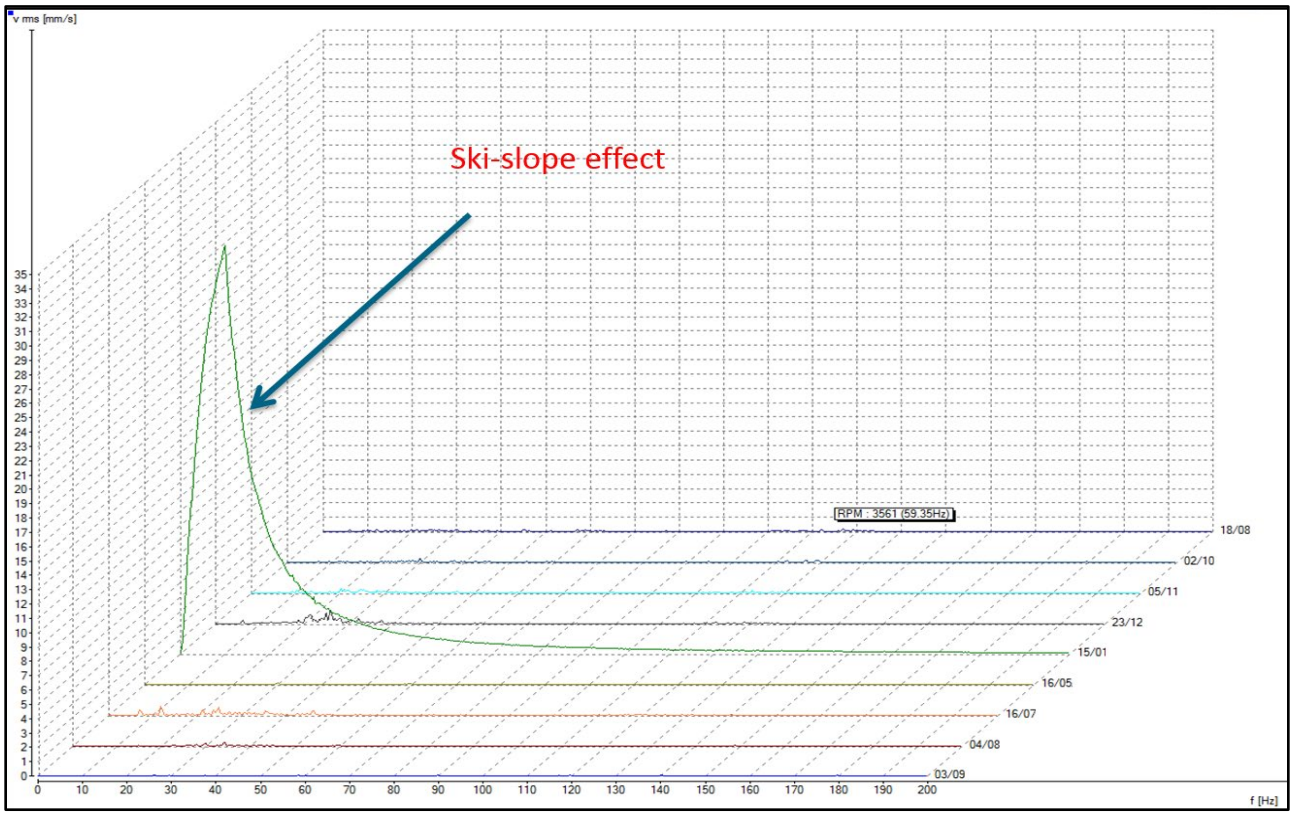


Figure 3: Ski Slope effect is evidence of poor data

## Causes of poor vibration data and how to mitigate them

There are several causes of poor vibration data, however we will focus briefly in this article on the primary ones:

## Damaged Accelerometer

If an accelerometer becomes damaged (due to being dropped or otherwise), it will obviously not give a credible outcome because of malfunctioning of the piezoelectric crystals and the internal circuitry. A broken circuit on the accelerometer cablings (open line drive) will also cause the device to malfunction. If the accelerometer is not properly connected to the data collector (through the designated channel port), a poor data sample will be collected.

To mitigate this issue, accelerometers should be maintained properly by ensuring they are not dropped. Also avoid procedures that can have heavy impact on the accelerometers. Magnets are usually connected to the accelerometers to make it easier to place them on the data collection points. If the accelerometer is allowed to be drawn too quickly by a magnetic data collection surface, it will affect it due to heavy impact from the surface. Ensure to control how the accelerometer is placed on the data collection surface. This must be done gently. If the accelerometer is damaged or cables are not functioning properly, it is pertinent to replace any damaged accelerometer / cabling.

## Machine not in operation

In plants and mining environment where noise levels are high, it is often easy to think a machine is in operation when it is not. If data is collected from a machine that is not running, it will show up as flat-lined spectra with almost no energy.

This is a form of poor data that can be avoided by ensuring that the machine of intent is in operation before commencing the process of data collection.

## Wrong Data Location Point

If data is collected from the wrong machine or the wrong data collection point (of the correct machine), this data will be a mis-representation. Since the digital acquisition unit have routes and machinery layout that mimics the actual data location on the physical machine, it is often possible to highlight the wrong machine or wrong location on the data collector while placing the accelerometer on the correct machine or location.

To avoid this from happening, ensure that the accelerometer is placed on the same machine or location that is highlighted on the data collector prior to data collection. Always double check that both what is highlighted on the data collector and where the sensor is placed are in sync.

### Insufficient Settling Time and Abrupt End to Data Collection process

When an accelerometer is placed on the data collection point, the corresponding location on the route downloaded inside the Digital Acquisition Unit (Data Collector) must be located and activated to start collecting data. Both Accelerometer and Data Collector must work together as a system until all waveform sampling characteristics programmed in the system (overlapping, averaging, etc.) have been completed and data collected successfully. Insufficient settling time will occur if this process is done too quickly. Abrupt end to the data collection process can occur if the accelerometer is removed (too early) from the data collection point before all parameters have been collected or before the system has gone through the instructions it was programmed to go through. If the sampling iteration process is still in progress, any sudden sensor removal can lead to a distortion as the recorded average speed (RPM) of the machine becomes unstable and reduced tremendously. It is sometimes like a loss of proper signature and flat-lined spectra are a possibility in this scenario. Poor data will also result if

the data collector is activated too early prior to placing the accelerometer on the designated location (even if it is a few seconds too early).

To prevent this from happening, ensure to allow a sufficient settling time, by placing the accelerometer on the data collection point gently. Then activating the corresponding point on the data collector. Finally removing the accelerometer only after data collection process is completed on the digital acquisition unit. A consistent representative scenario must be maintained throughout the data collection process to allow the system to go through the sampling procedure.

## Poor Data Collection Surface

If the surface of a data collection point is not properly prepared to hold the accelerometer during the data collection process, the resulting data will be a poor one. The same effect will occur if the accelerometer via the magnet is not properly fixed to the data collection point.

If the surface is not magnetic, it will be a struggle to physically hold the accelerometer in place during the entire data collection process. Likewise, if the accelerometer is not mounted with a rare earth magnet at the end of it, the result will also be a poor data. Shaky hands and unstable accelerometer placement will lead to poor vibration data.

A surface covered in rust, dirt and dust is also not helpful as this can provide a damping effect leading to a signal that is not a true representation of the actual machinery signature.

In an Electric Motor for example, collecting data from the Motor Cowling can result in an amplification of the signature due to structural resonance. In some cases, we have experienced up to 5 times the usual amplitude levels when collecting data from the Motor Cowling. Hence it advisable to avoid collecting data from such places. If machines are not equipped with magnetic steel

identification tags, then opt for a more rigid location (such as the fin) with lower possibilities of structural resonance (figure 4).

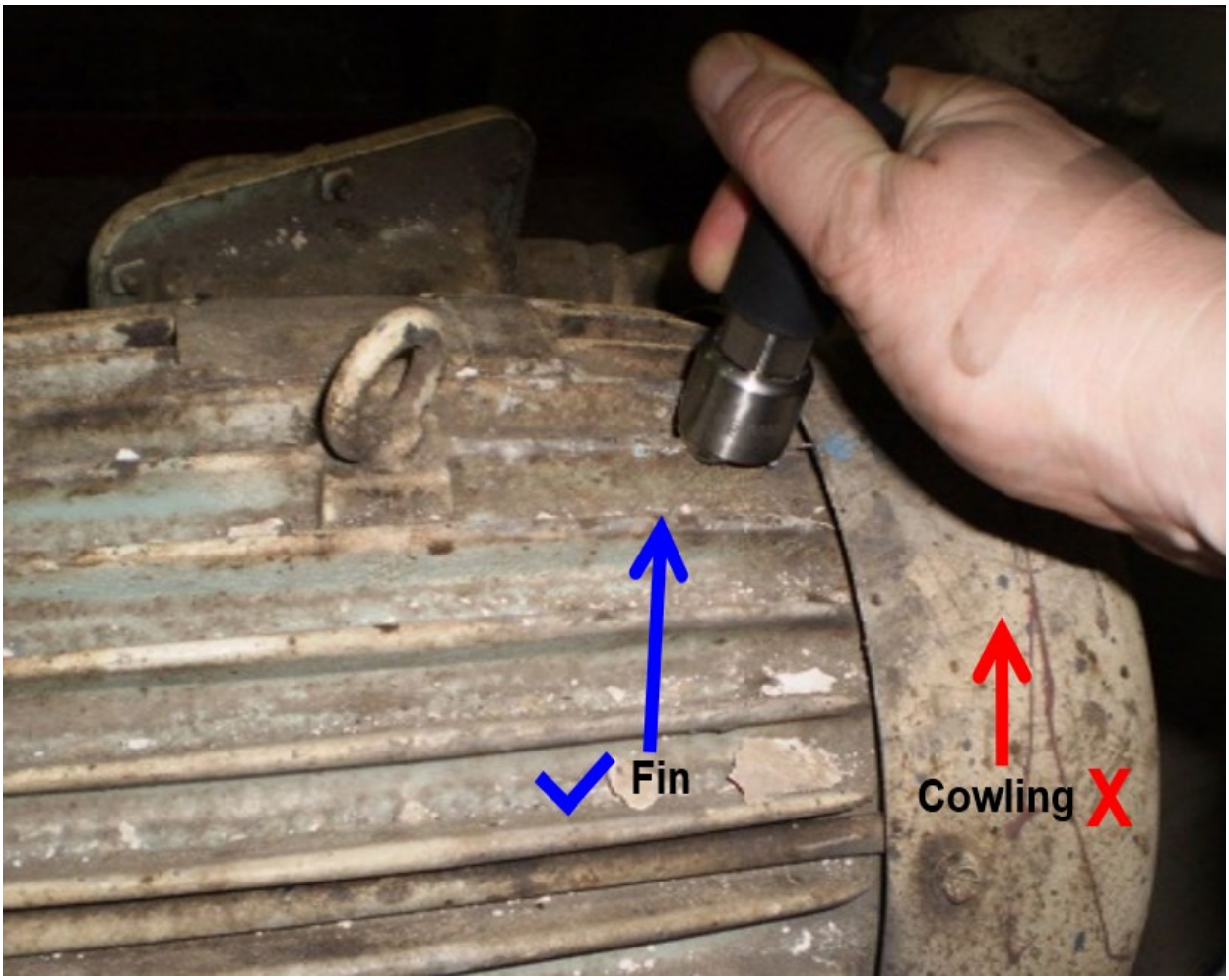


Figure 4: Data collection is not advisable from the Motor Cowling

To mitigate this, ensure that the accelerometer is mounted with a magnet. Ensure also that a magnetic steel identification tag (figure 5) is mounted on the data collection point. This helps in two ways. First, it provides a well labelled designated point (to avoid erroneous data collection). Second, it provides a solid magnetic location that can hold the accelerometer. Clean the surface and use adhesive glue to mount the metallic tags. Ensure that there is not too much adhesive glue beneath the tags to avoid damping.

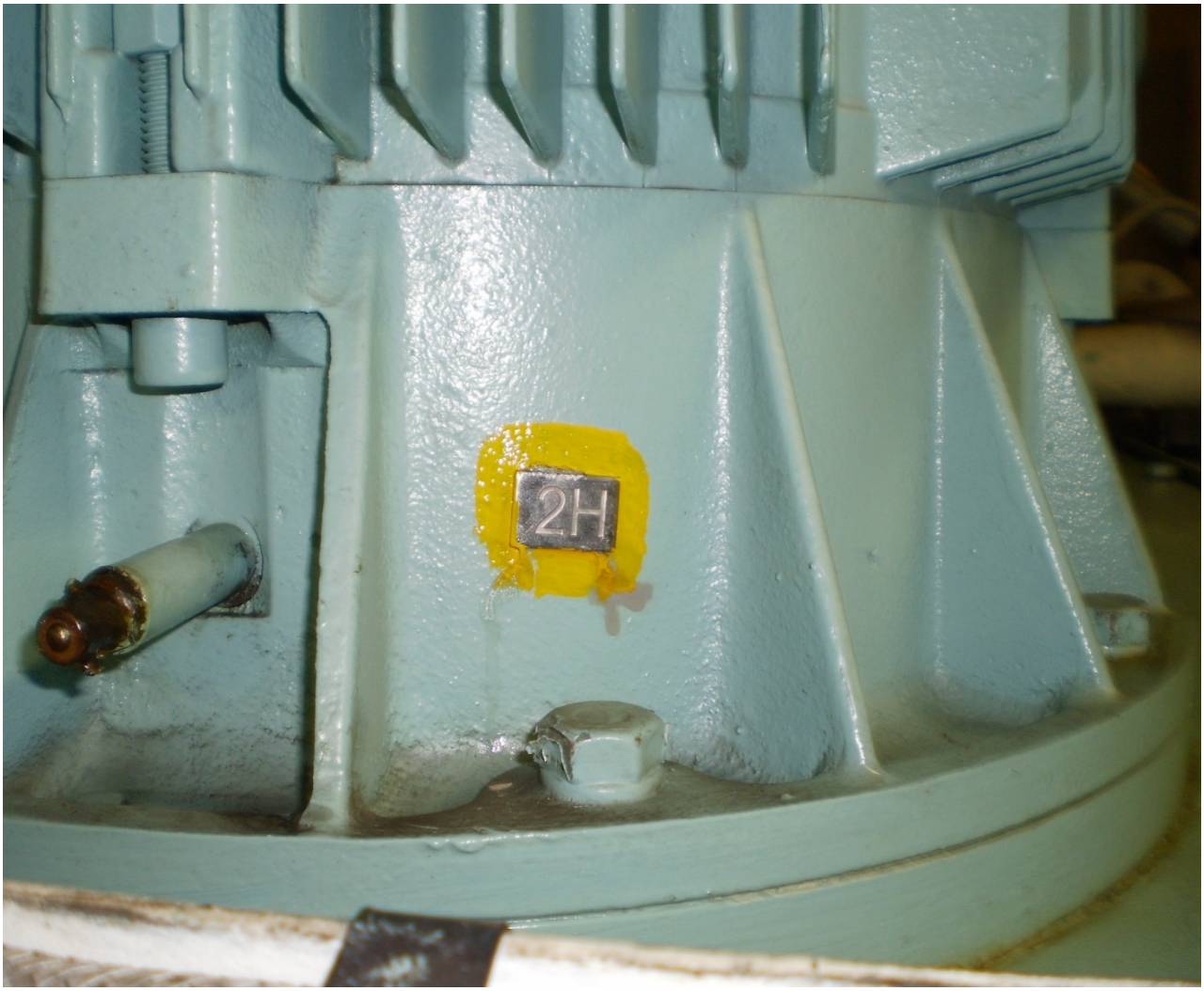


Figure 5: Steel Identification Tag labelled 2H

## Brain Teasers: Check your Comprehension

**Q1:** Which one of the following is not a sign of poor data? (A): Ski slope effect (B): Flat lined spectral content (C): Frequency peaks with varying amplitude levels

**Q2:** When manually collecting vibration data from an Electric Motor, which one of the following is not a good location? (A): Motor Cowling (B): Fin (C): Solid rigid spot close to the bearing as possible

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