April 9, 2020

**Inzwa Veva 3 Equivalency Statement**

The Inzwa Veva 3 Vibration Monitor has been designed for use in construction vibration monitoring and geotechnical applications. The Veva 3 meets or exceeds the performance and feature capabilities of competitive vibration monitoring systems.

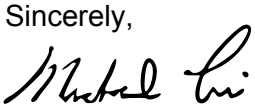
Inzwa contracted with an independent laboratory to validate the Veva 3's frequency response performance to the ISEE 2017 and DIN 45669-1:2010-09 standard. The laboratory determined the Veva 3 meets the ISEE amplitude response standard from 2 - 250Hz and the DIN amplitude response standard from 2 - 315Hz. A report has been prepared and approved by the Professional Engineer directing the test and is available by request.

In addition, the Veva 3 meets or exceeds the specifications for the following baseline features typically found in competitive vibration monitoring systems.

- Three axis vibration measurement.
- Periodic peak particle velocity and peak vector sum recording.
- Alarm threshold configuration.
- Alarm event waveform recording.
- Standard USBM report generation.

Information on additional features of the Veva 3 can be found at inzwa.io. Please do not hesitate to call us with any questions at 844-44-INZWA.

Sincerely,



Michael Crusi
Managing Partner

# Inzwa Technologies

# Veva Vibration Sensor

# Vibration Test

# Conducted on October 29, 2019 & November 14, 2019

Report No. DES-VIB111419

**Report Prepared for:**

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**Date:**

November 22, 2019

## Table of Contents

## 1.0 Test Scope

### 1.1 Introduction

Sinusoidal Vibration Testing was performed by Delserro Engineering Solutions (DES) for Inzwa Technologies on October 29, 2019 and November 14, 2019. The testing was conducted on **(1) Veva Vibration Sensor**.

### 1.2 Test Summary

- The Veva vibration sensor was subjected to sinusoidal vibration at discrete frequencies at a constant velocity of 25.4 mm/second (1.0 inch/second). Testing was performed in 3 orthogonal axes using References [1] and [2] as guidelines. Output from the vibration sensor was monitored and recorded by Inzwa Technologies. Inzwa's results are reported in Table 3 and the appendices.

- In general, better amplitude response accuracy was observed when the sample rate was 10 or more times greater than the reference frequency.

- The Veva vibration sensor was returned with Inzwa Technologies after the testing was completed.

### 1.3 References

[1] Engineering Proposal No. EP102519-2, *Vibration Testing Services* dated October 25, 2019 by Delserro Engineering Solutions.

[2] ISEE Performance Specifications for Blasting Seismographs 2017, Appendix I

## 2.0 Test Specimen Description

The test specimen was (1) Veva vibration sensor, serial number = 328EF1.

## 3.0 Vibration Test

### 3.1 Vibration Test Setup and Procedure

The tests were conducted on DES's UDCO Electrodynamic Shaker system. Figures 1.1 – 1.3 show the test setup on the vibration shaker. The sensor was mounted on an aluminum fixture plate provided by DES. The test vibrations were controlled from one accelerometer located adjacent to the Veva vibration sensor on the slip table for the X and Z axes. For the Y Axis, the control accelerometer was initially on the slip table. It was moved to the angle as shown in Figure 1.2.2, because it was thought to be a more accurate location when compared to the Veva sensor location.

Testing was performed in 3 orthogonal axes using References [1] and [2] as guidelines. The sensor was subjected to sinusoidal vibration at the discrete frequencies in Table 1. The velocity was held constant at 25.4 mm/second (1.0 inch/second) for each frequency. Output from the vibration sensor was monitored and recorded by Inzwa Technologies. Figure 2 shows the axis definition of the Veva Sensor.

The calculated acceleration, velocity and displacement amplitudes vs. frequency are listed in Table 1.

| Hz | Acceleration G | Velocity mmSA/Sec | Displacement inSA |
|---|---|---|---|
| 1 | 0.0163 | 25.4 | 0.159 |
| 2 | 0.0325 | 25.4 | 0.0796 |
| 4 | 0.0651 | 25.4 | 0.0398 |
| 10 | 0.163 | 25.4 | 0.0159 |
| 15 | 0.244 | 25.4 | 0.0106 |
| 30 | 0.488 | 25.4 | $5.31 \times 10^{-3}$ |
| 60 | 0.976 | 25.4 | $2.65 \times 10^{-3}$ |
| 80 | 1.30 | 25.4 | $1.99 \times 10^{-3}$ |
| 125 | 2.03 | 25.4 | $1.27 \times 10^{-3}$ |
| 200 | 3.25 | 25.4 | $7.96 \times 10^{-4}$ |
| 250 | 4.07 | 25.4 | $6.37 \times 10^{-4}$ |
| 315 | 5.13 | 25.4 | $5.05 \times 10^{-4}$ |

SA = Single Amplitude or value from zero to peak

**TABLE 1. Frequency vs. Calculated Acceleration, Velocity & Displacement Amplitudes**

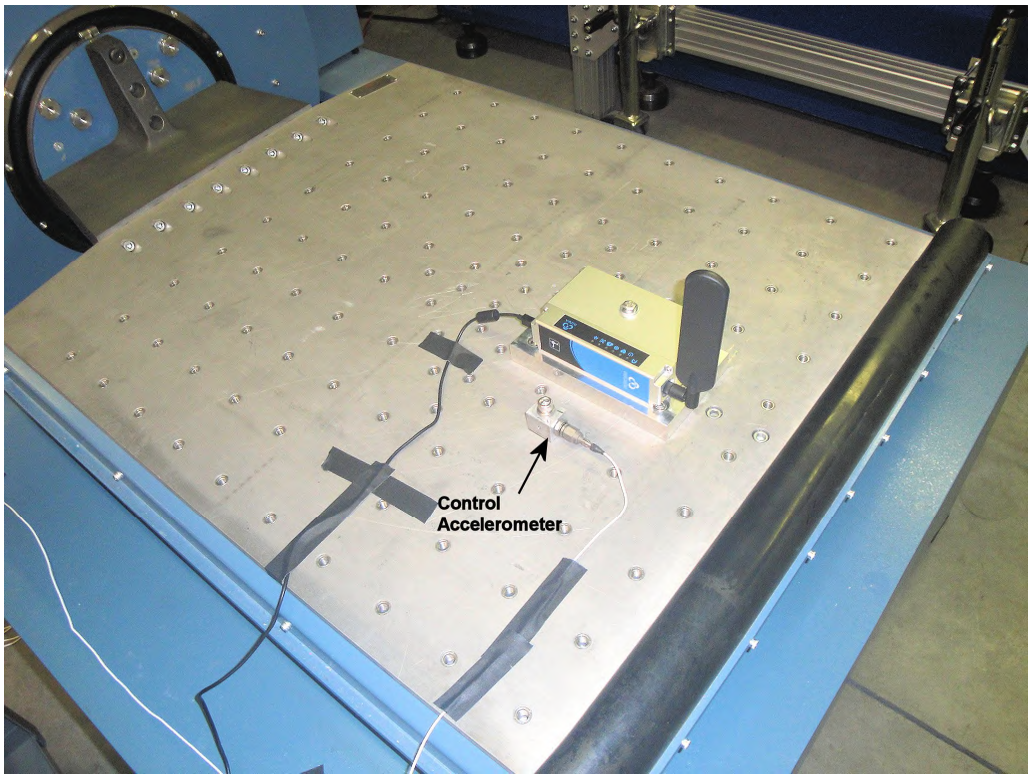


**Figure 1.1. X Axis Setup**

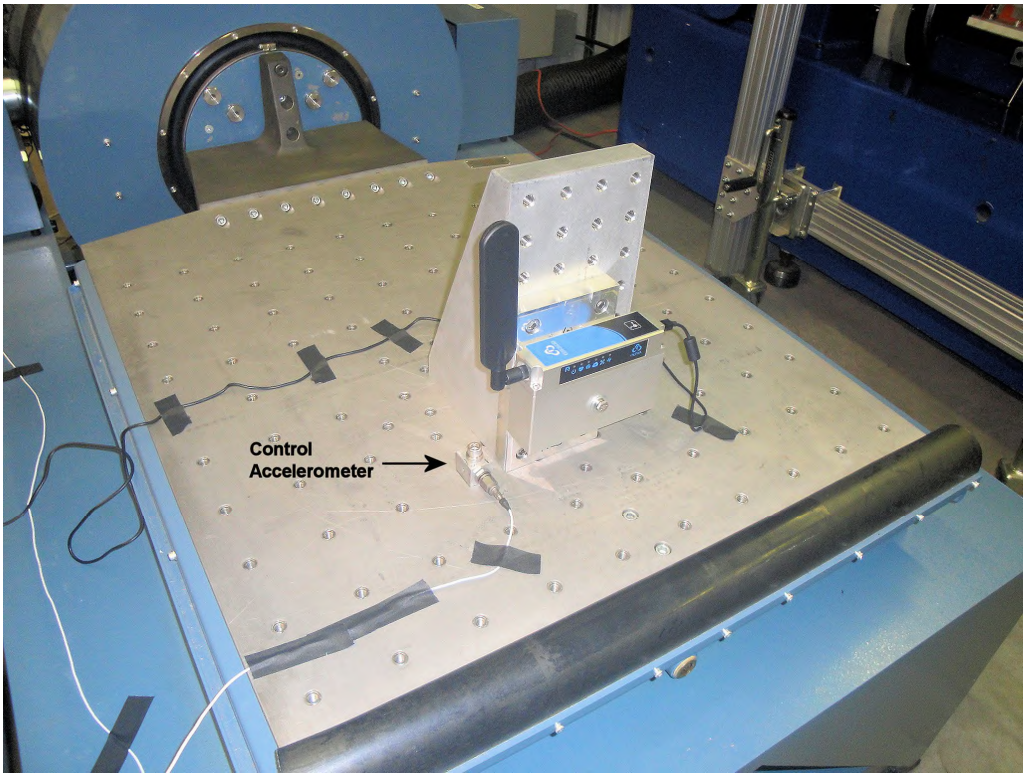


**Figure 1.2.1 Y Axis Setup (Control from Slip Table)**

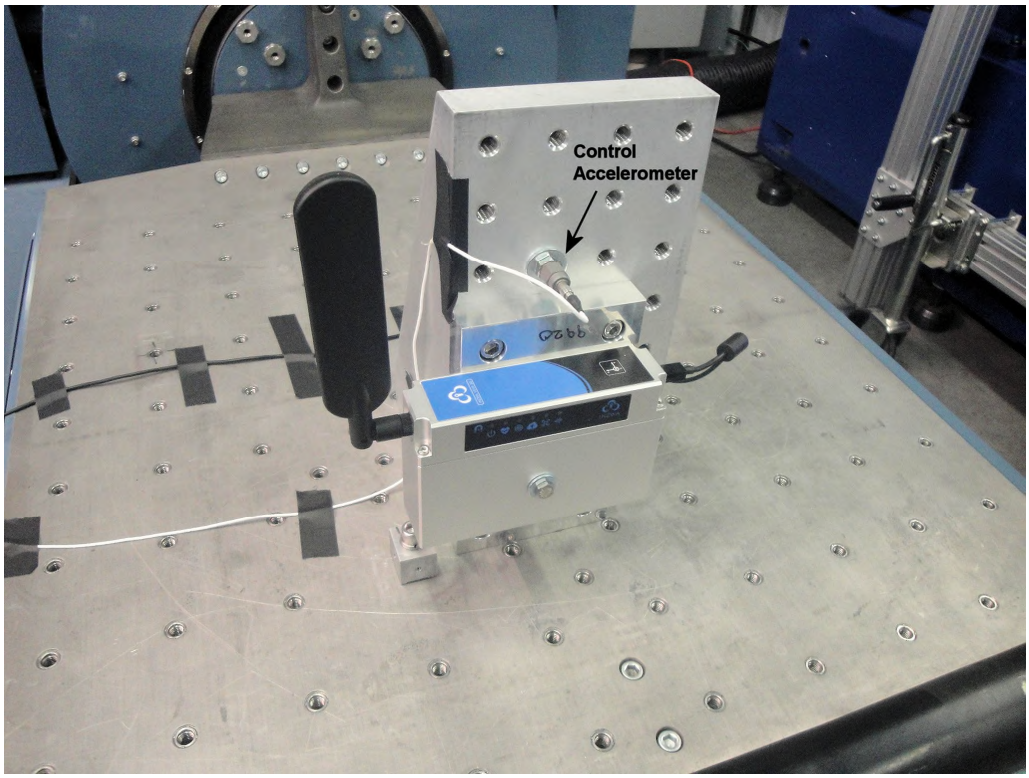


**Figure 1.2.2 Y Axis Setup (Control from Angle)**

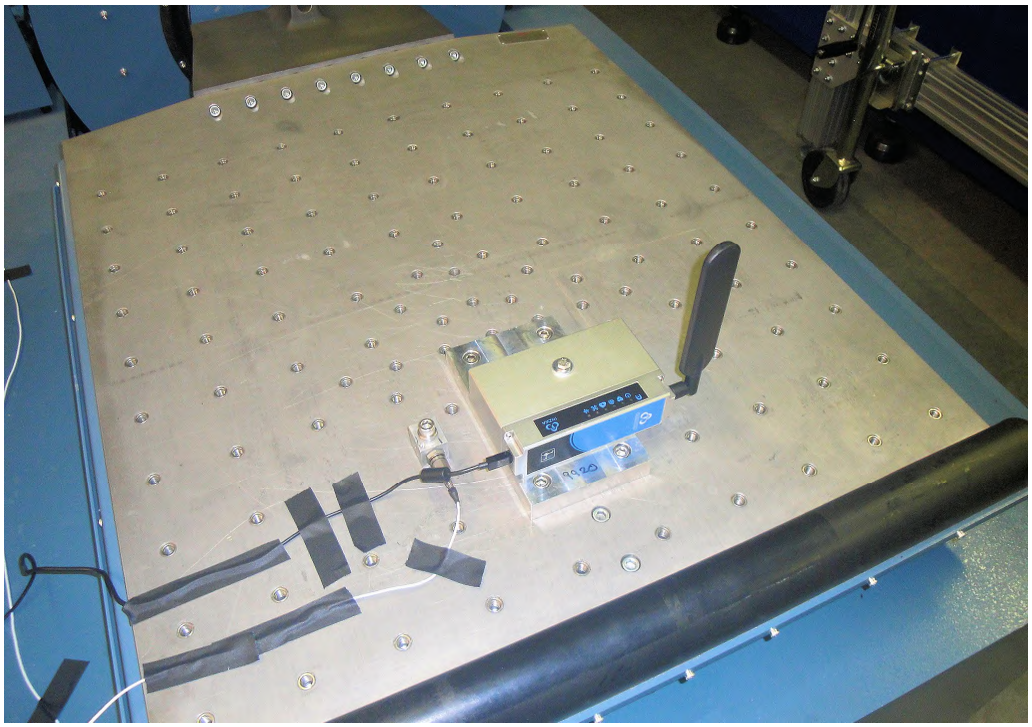

**Figure 1.3. Z Axis Setup**

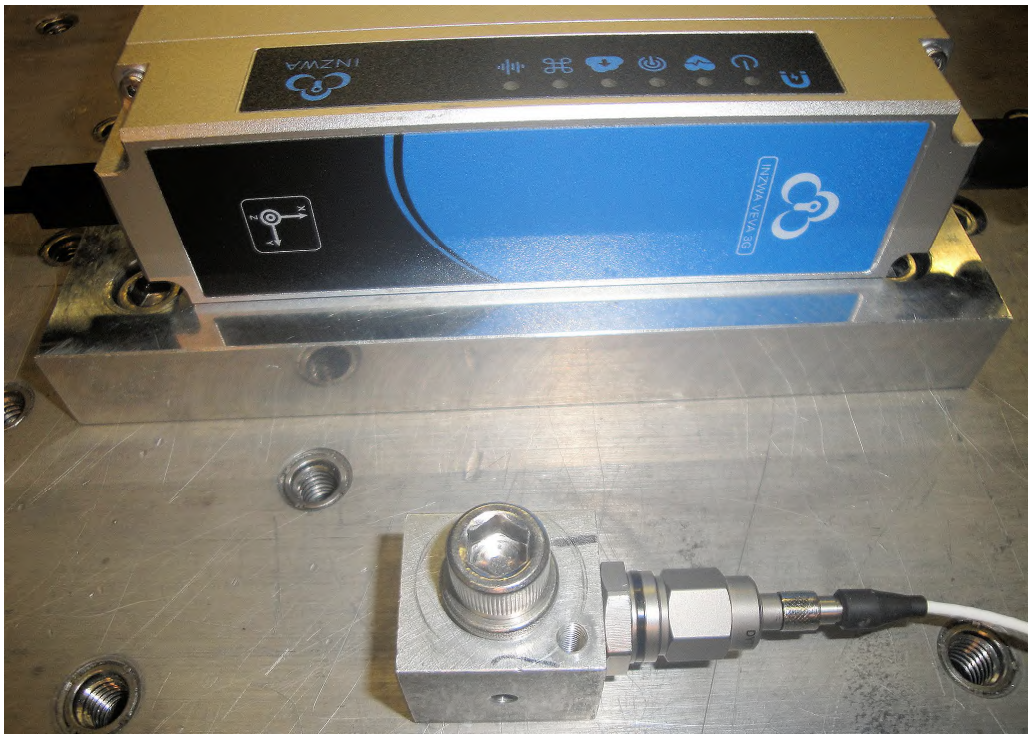


**Figure 2. Veva Axis Definitions**