Crank-Angle Phased Engine Cylinder Vibration

A Comparison Between the 6400 vs. 6320 Analyzer's Data.

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Engine Vibration

Internal Vibration – Vibration of the engine parts relative to each other.

- Identify and isolate forcing functions of components of the engine.
- Measurement techniques include “windowing” or compartmentalizing vibration and phasing to crank-angles.

External Vibration – Movement of the engine as a whole.

- Identify prime locations for engine movement and engine-forced vibration.
- Measurement techniques include FFT analysis, where Fmax and LOR will focus on run speeds or MNF.

Power Cylinder Vibration

Internal vibration techniques to focus on specific components or faults of each power cylinder.

- Valve events
- Piston/liner vibration
- Looseness in bushings/pins
- Leakage

Accelerometer & Ultrasound Probe

Accelerometer – Piezoelectric device that converts vibration into an electric signal.

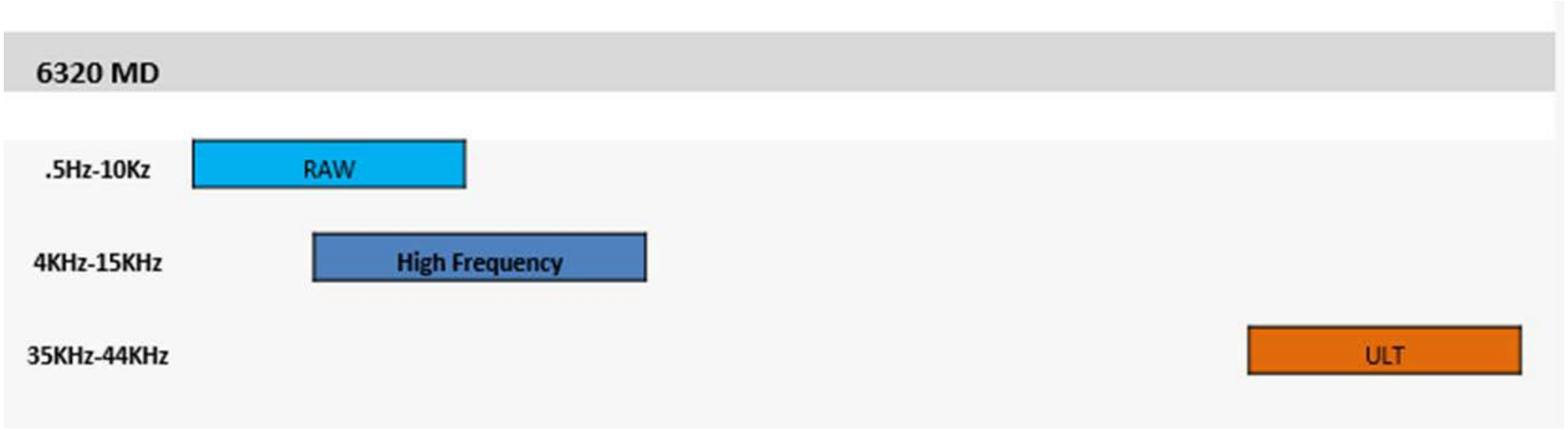
- Ranges from .5 Hz to 25 kHz
- Analyzers use filters to increase the visibility of components or faults.
  - Raw
  - Hi
  - VH2

Ultrasound Probe – Ultrasonic microphone that converts acoustics into an electric signal.

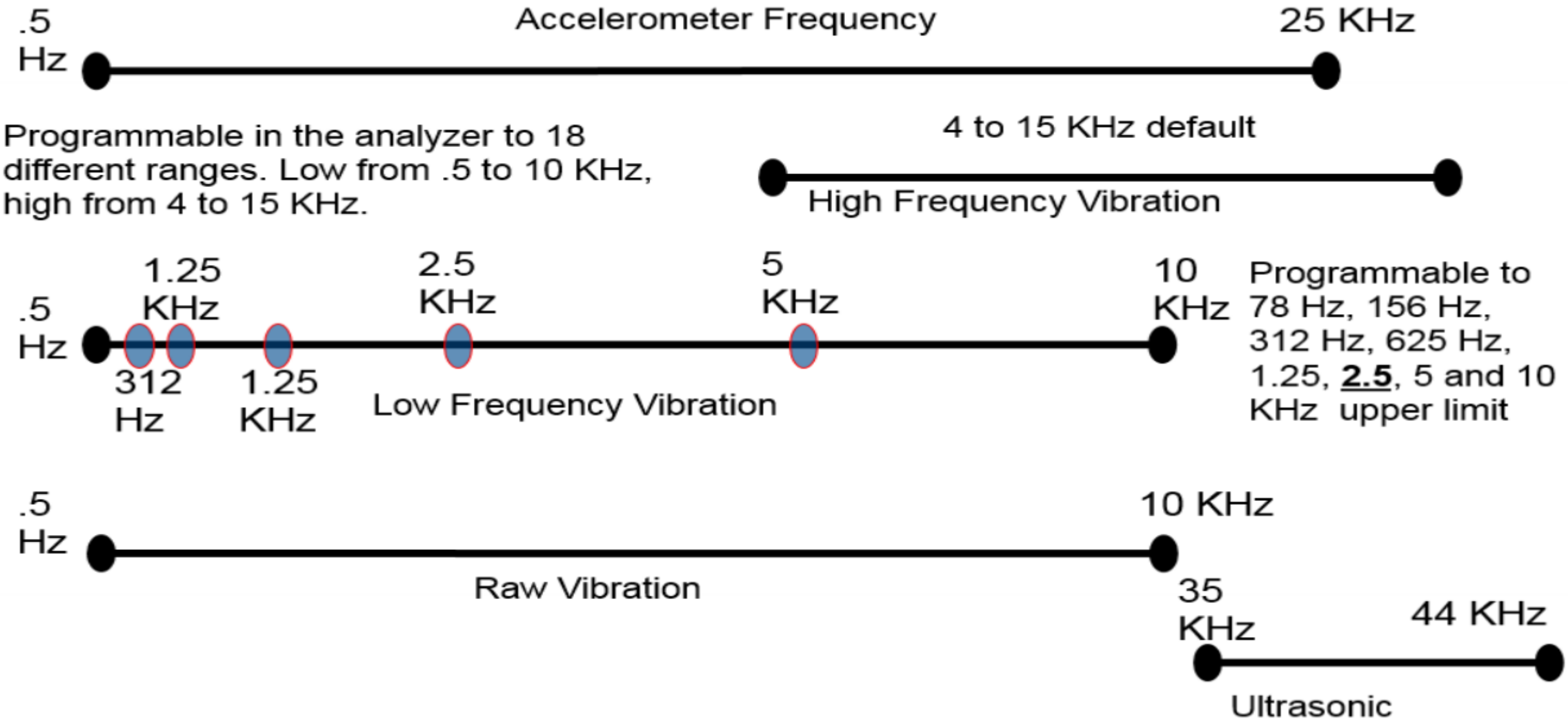
Windrock's ultrasound probe is only for "gas pass" frequencies only.

- Ranges from 35 kHz to 44 kHz
  - ULT

Filtering Vibration



Vibration and Ultrasonic Frequency Ranges



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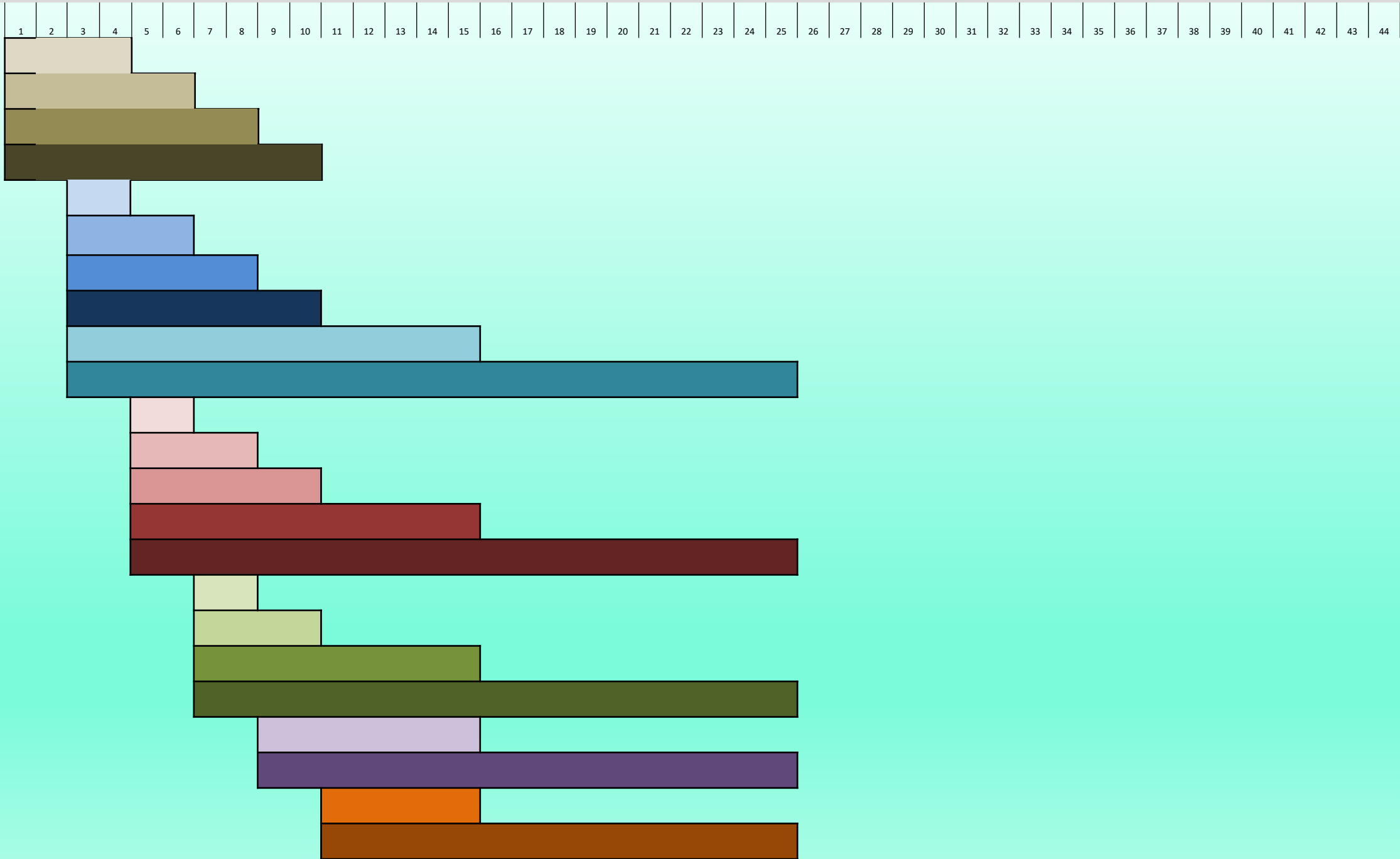
6320 High Frequency Filter Options



A Comparison of Vibration and Ultrasound
6320 vs. 6400

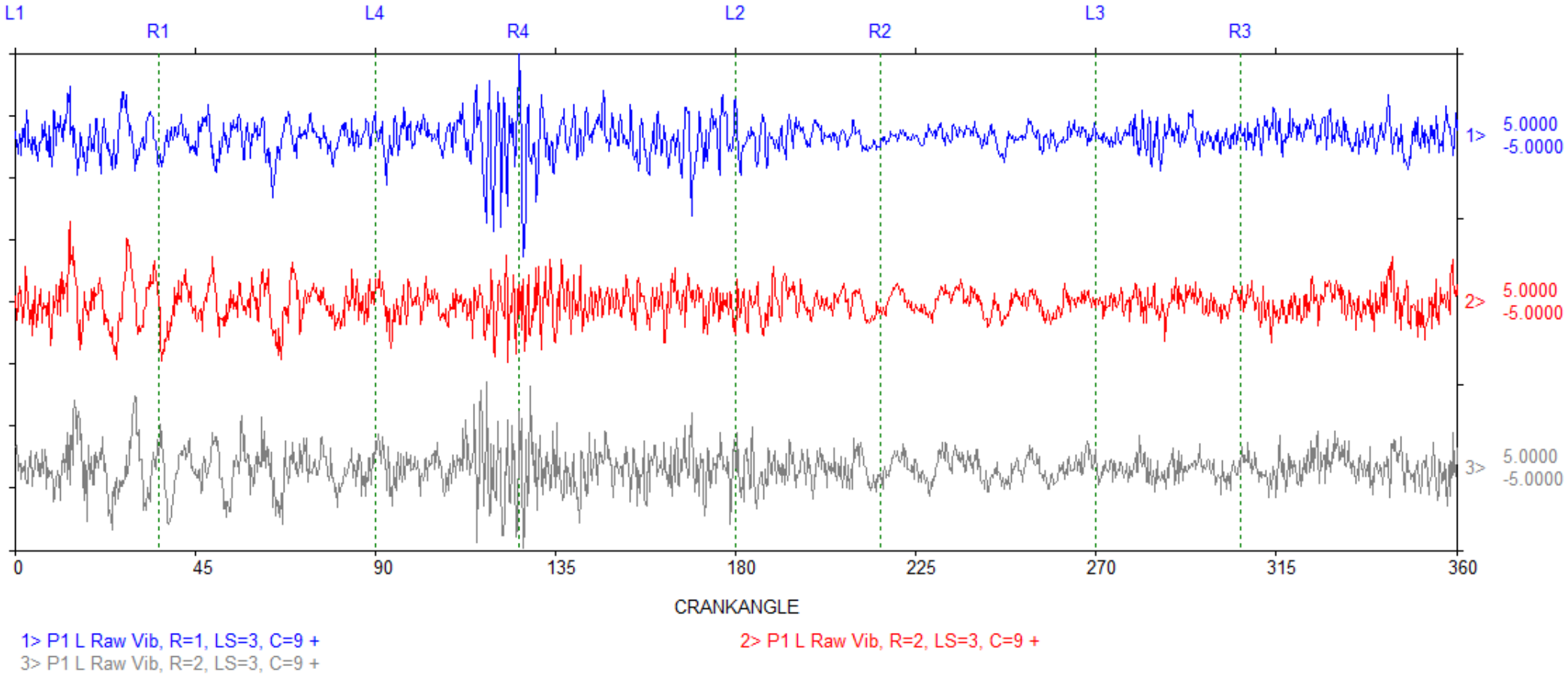
- Raw Vibration
- Low Frequency Vibration
- High Frequency Vibration
- Ultrasound (Acoustic Noise)

Raw Vibration

.5 Hz – 10 kHz

Top two are VL1 Raw Vibration (4 samples per degree) 6320 Bottom is VL1 Raw Vibration (4 samples per degree) 6400 Slow Speed GMWC-8

Station: Franklinton Station 9 Machine: Unit 901



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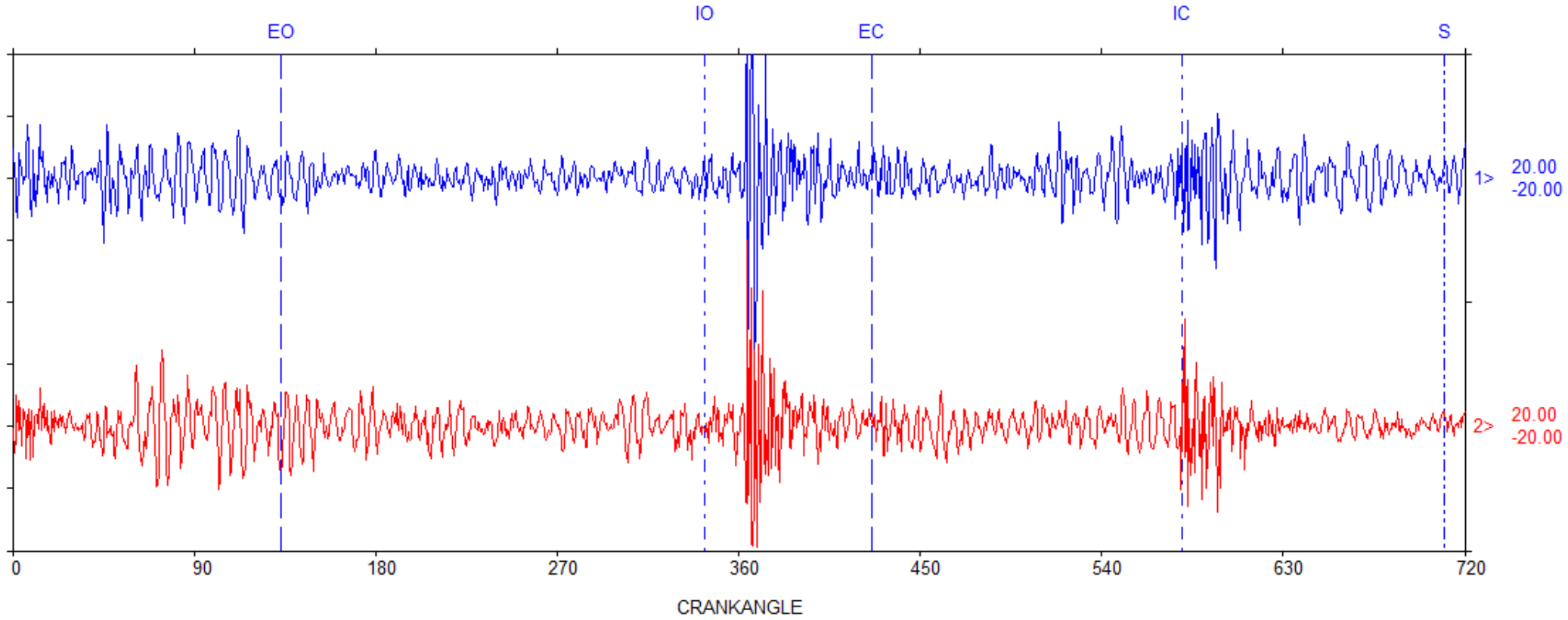
Top is VL1 Raw Vibration (2 samples per degree) 6320
Bottom is VL1 Raw Vibration (2 samples per degree) 6400
High Speed Waukesha 7042

Station: Gas Gathering Machine: Waukesha-7042 6320 vs 6400



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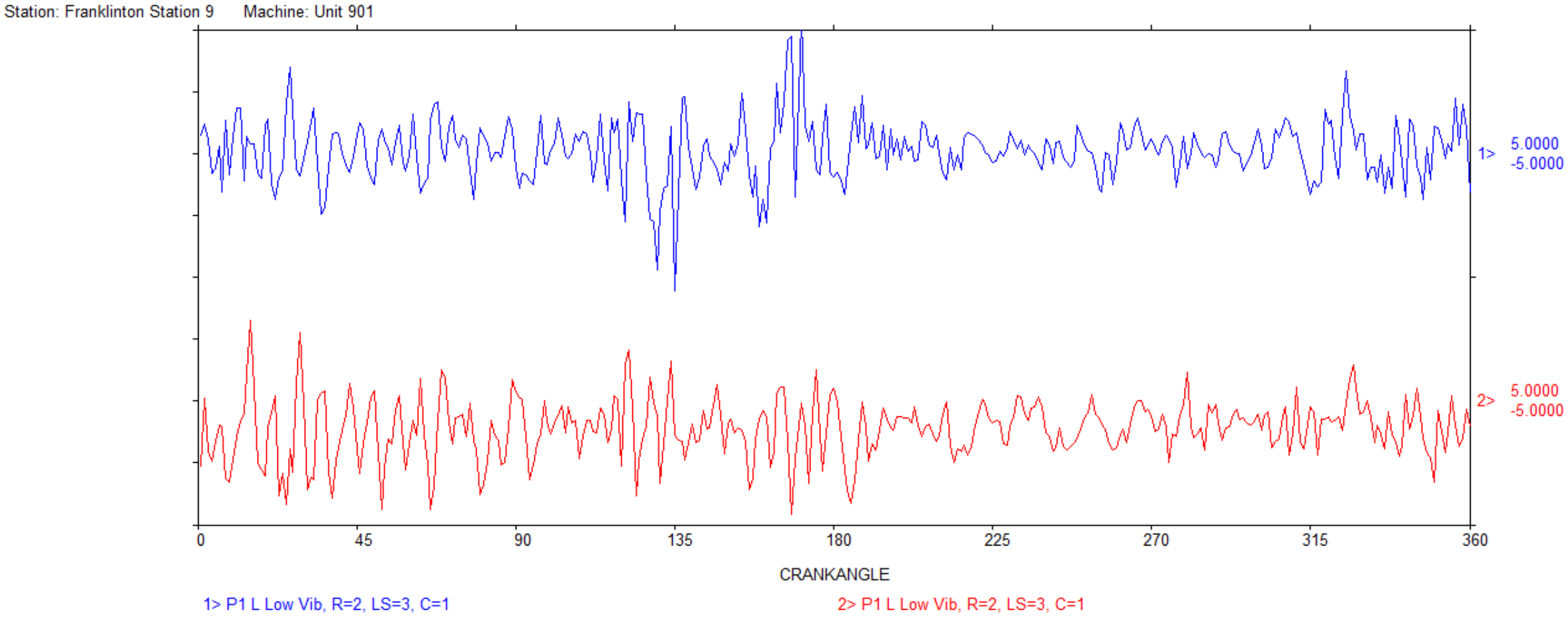
Low Vibration

VL1 .5 Hz – 10 kHz

VL2 183 Hz – 10 kHz

Top is VL1 Low Vibration 6320
Bottom is VL1 Low Vibration 6400
Slow Speed GMWC-8



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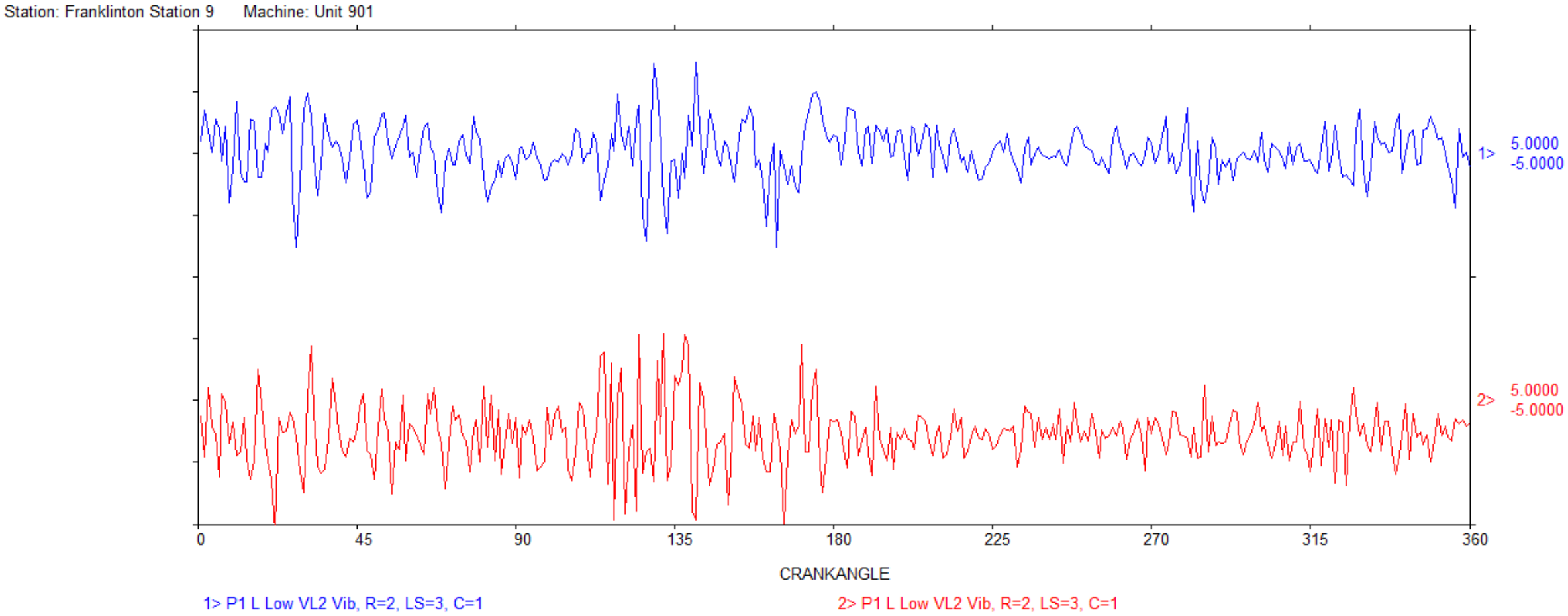
Top is VL2 Low Vibration 6320
Bottom is VL2 Low Vibration 6400
Slow Speed GMWC-8



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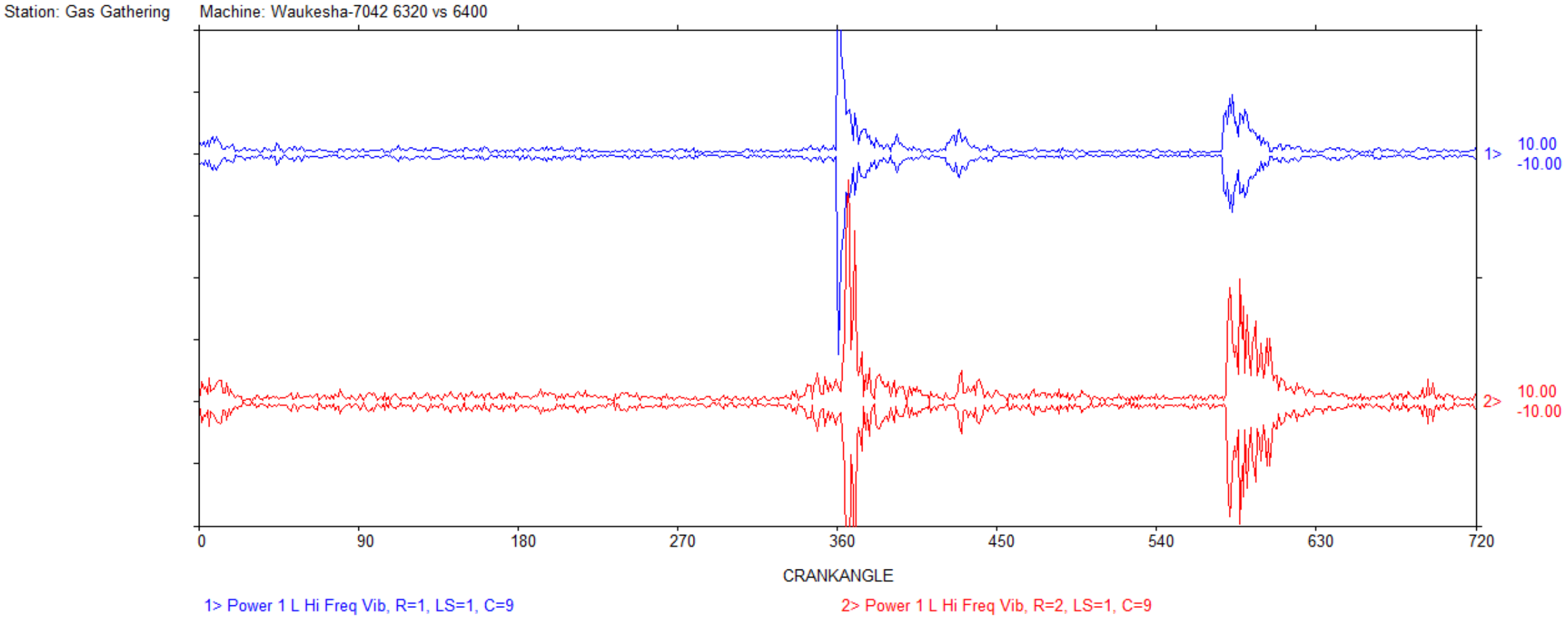
High Vibration

VH1 4 kHz – 15 kHz

VH2 6 kHz – 25 kHz

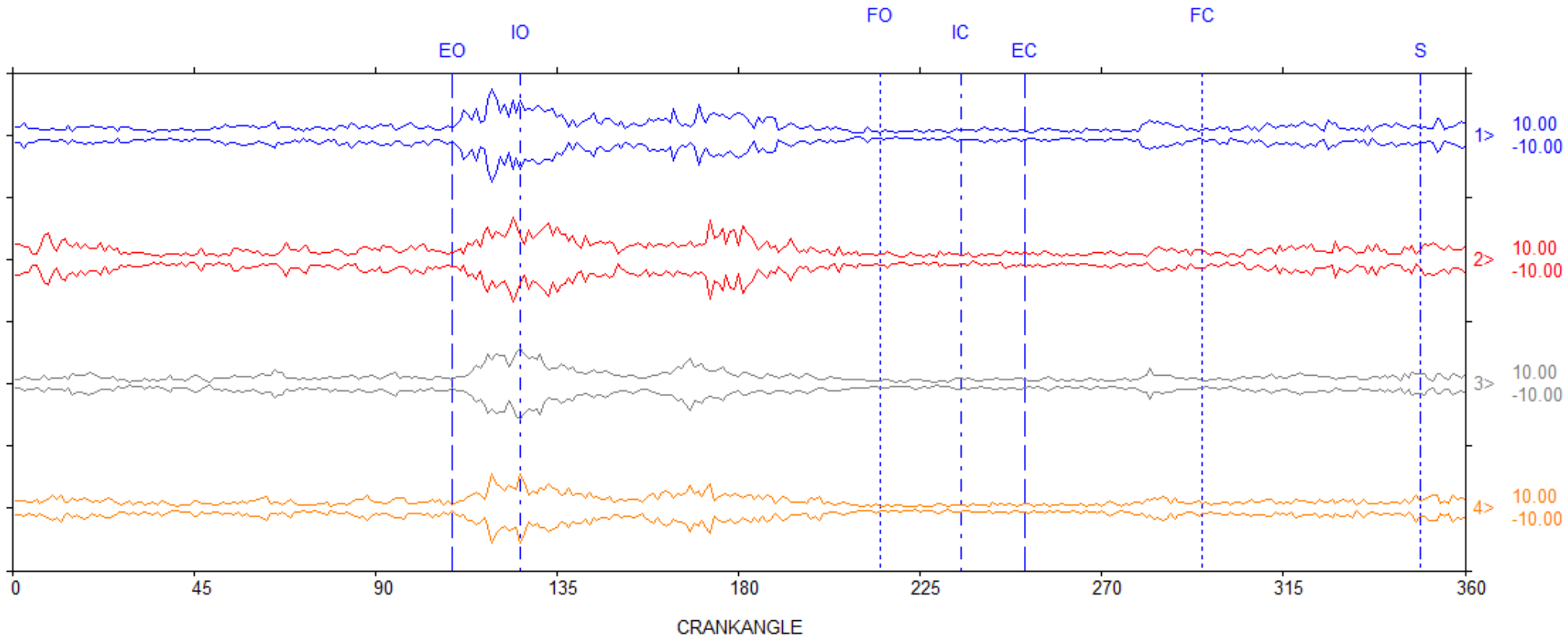
VH3 8 kHz – 25 kHz

Top is VL2 High Vibration 6320
Bottom is VL2 High Vibration 6400
High Speed Waukesha 7042



Top two are VH1 High Vibration 6320
Bottom two are VH1 High Vibration 6400
Slow Speed GMWC-8

Station: Franklinton Station 9 Machine: Unit 901



1> P1 L Hi Freq Vib, R=1, LS=3, C=30
2> P1 L Hi Freq Vib, R=2, LS=3, C=30
3> P1 L Hi Freq Vib, R=2, LS=3, C=30
4> P1 L Hi Freq Vib, R=2, LS=3, C=30

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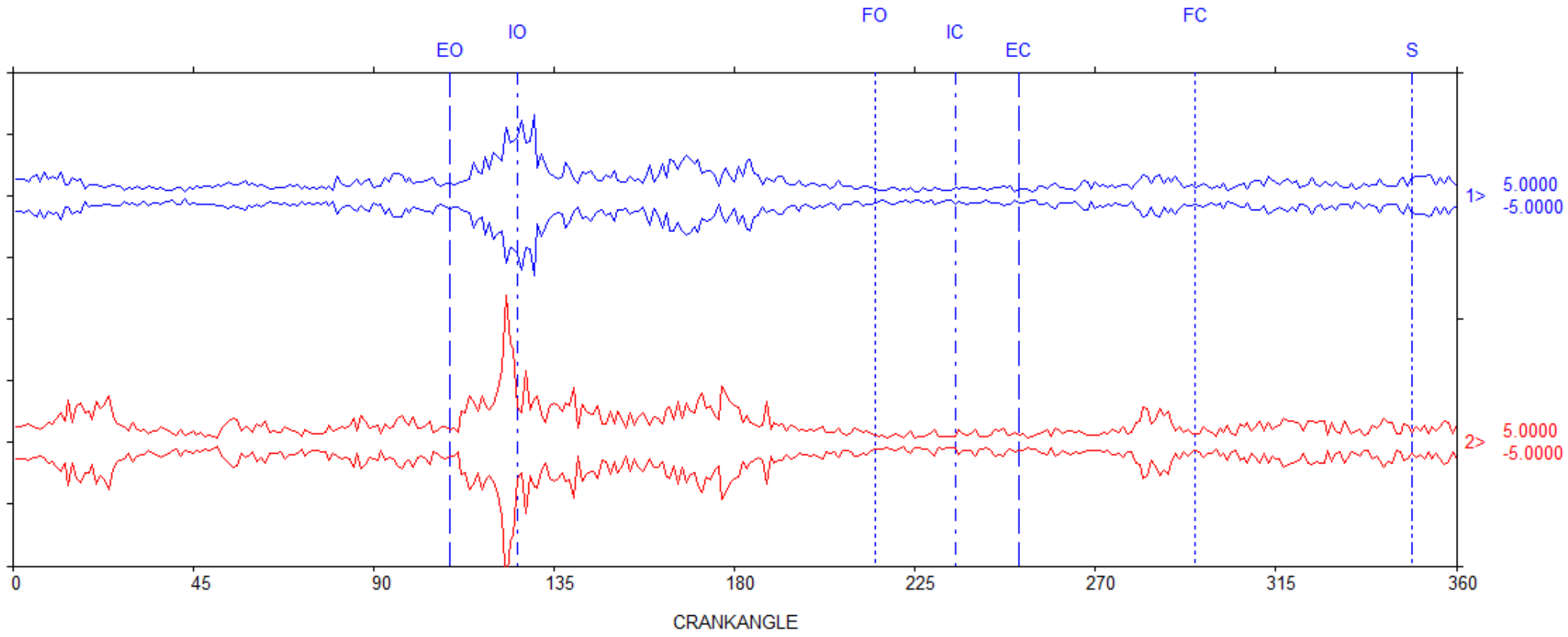
Top is VH2 High Vibration 6320
Bottom is VH2 High Vibration 6400
Slow Speed GMWC-8

Station: Franklinton Station 9 Machine: Unit 901

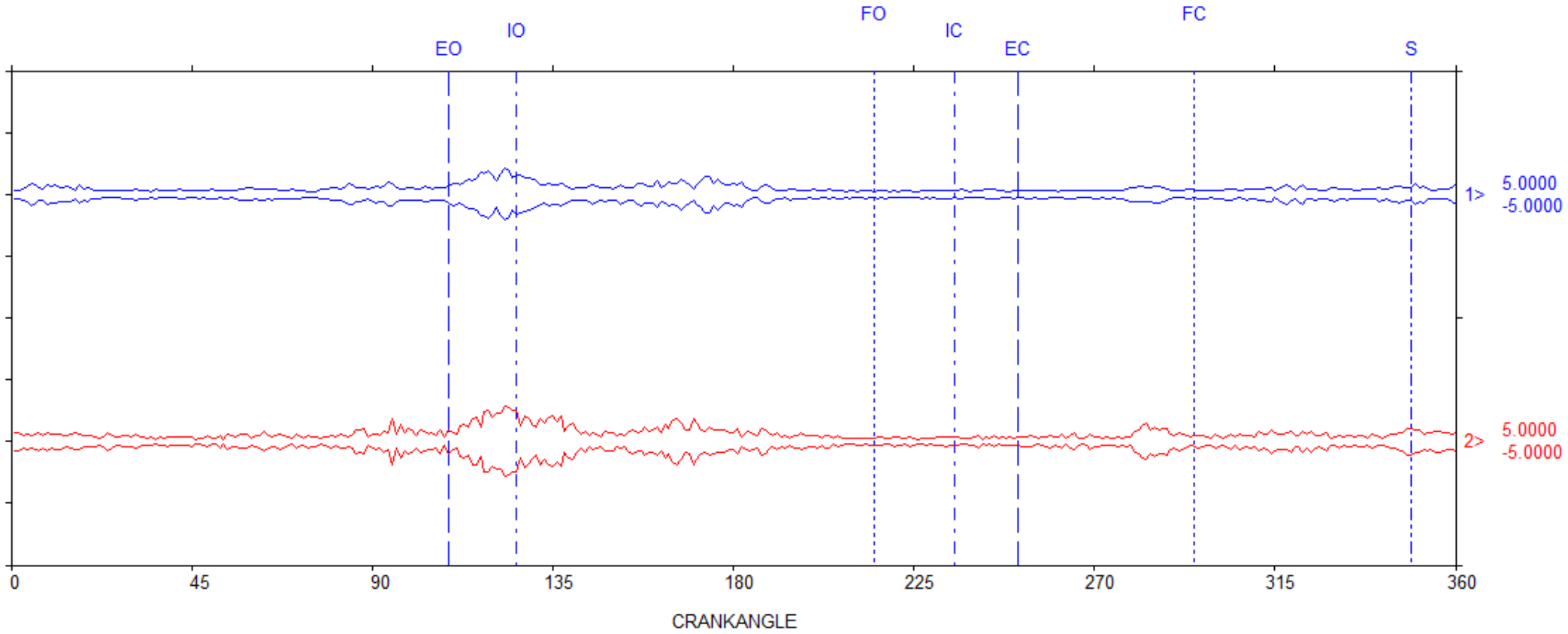


1> P1 L Hi Freq VH2 Vib, R=2, LS=3, C=1

2> P1 L Hi Freq VH2 Vib, R=2, LS=3, C=1

Top is VH3 High Vibration 6320
Bottom is VH3 High Vibration 6400
Slow Speed GMWC-8

Station: Franklinton Station 9 Machine: Unit 901



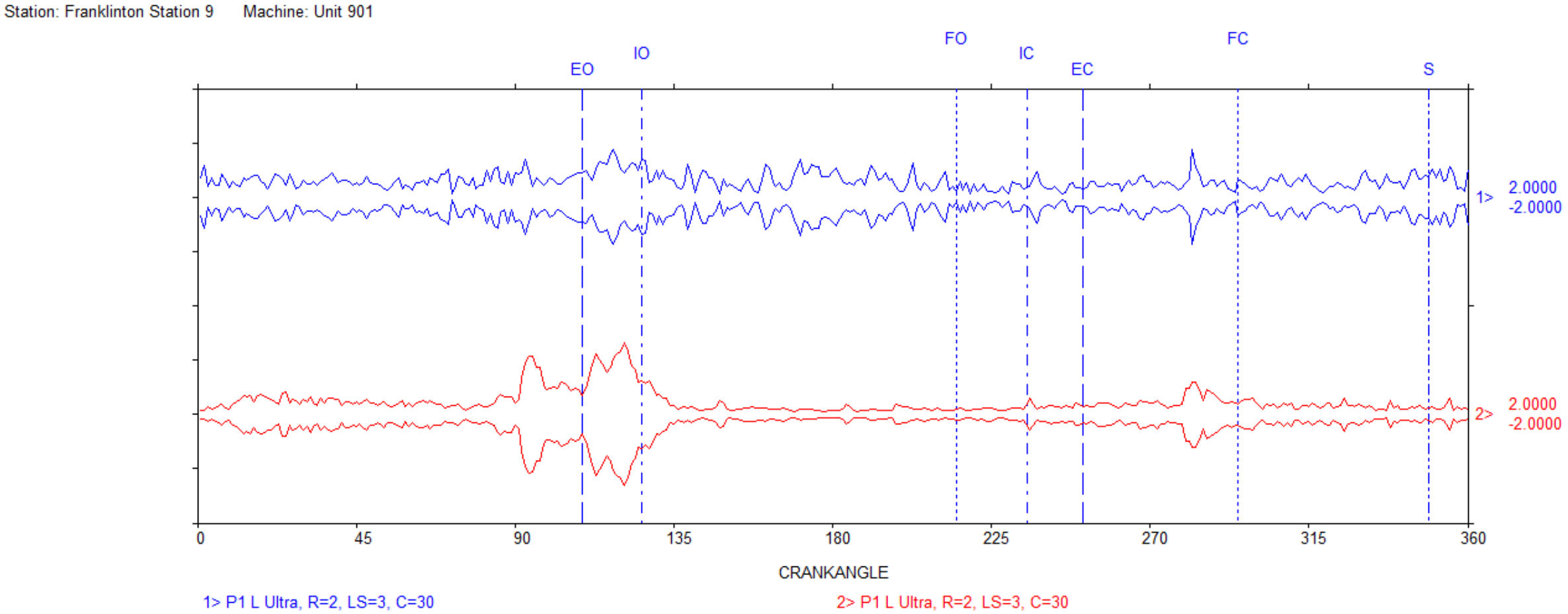
1> P1 L Hi Freq VH3 Vib, R=2, LS=3, C=1

2> P1 L Hi Freq VH3 Vib, R=2, LS=3, C=1

Ultrasound

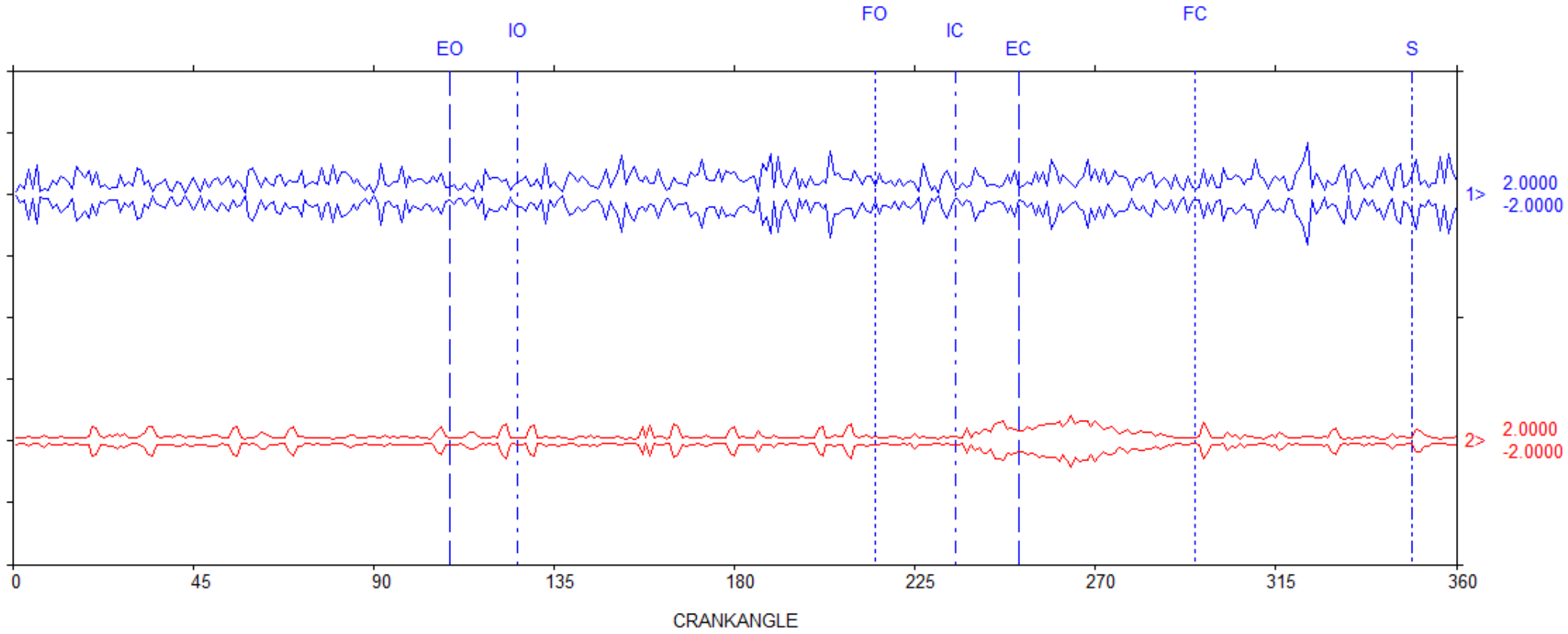
Ultrasonic 35 kHz – 44 kHz

Top is Ultrasound 6320
Bottom is Ultrasound 6400
Slow Speed GMWC-8/Head Bolt



Top is Ultrasound 6320
Bottom is Ultrasound 6400
Slow Speed GMWC-8/Fuel Valve Piping

Station: Franklinton Station 9 Machine: Unit 901



1> P1 L Fuel Valve Ultra, R=2, LS=3, C=9

2> P1 L Fuel Valve Ultra, R=2, LS=3, C=9

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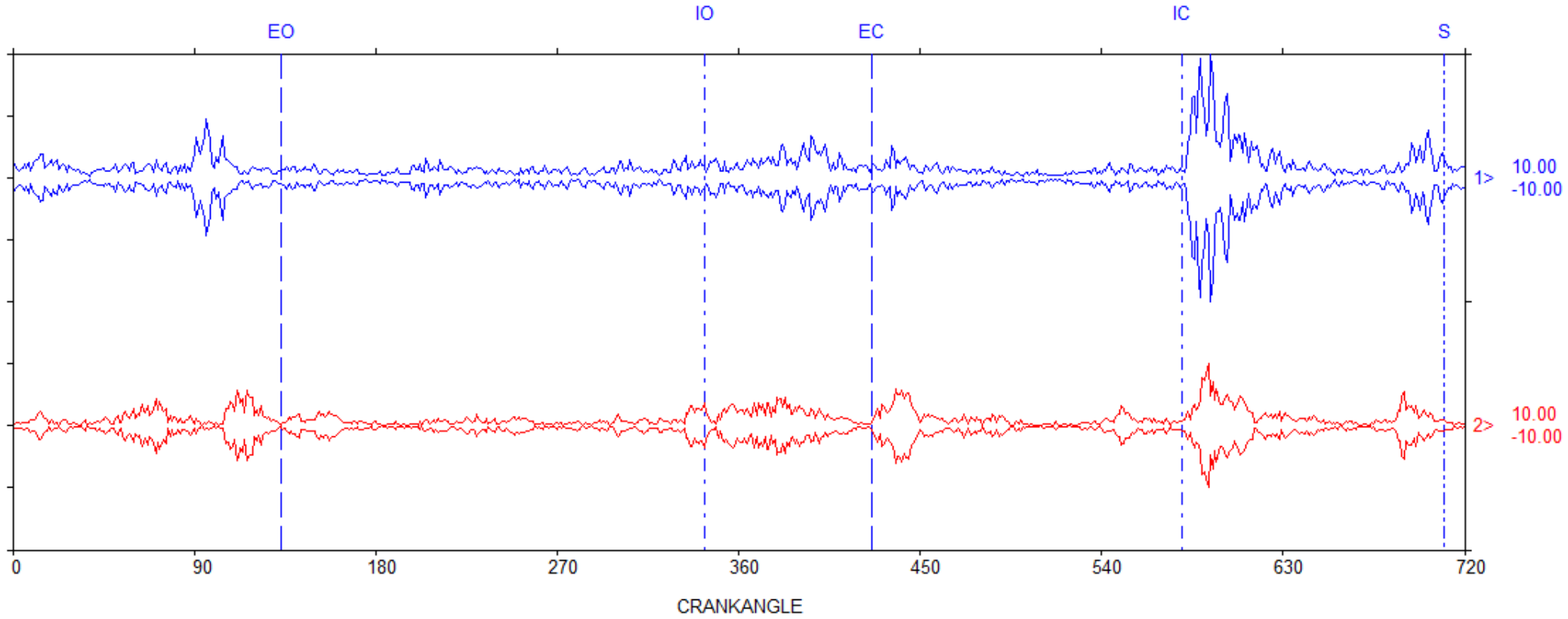
Top is Ultrasound 6320
Bottom is Ultrasound 6400
High Speed Waukesha 7042

Station: Gas Gathering Machine: Waukesha-7042 6320 vs 6400



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Conclusion

Raw/Low vibration are about the same between both analyzers.

High frequency has more resolution with the 6400.

- The higher filter ranges have more noticeable changes with less noise.

Ultrasound data has significantly changed with the 6400.

- Noise on the baseline is reduced so leakage can be seen clearly.
- Less noise will make analysis easier.
- Hidden events can now be seen with the 6400.

Thanks!