July 2026

Klem Acoustic Consulting LLC
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[Client Info Redacted]

Re: Vibrating Water Pipes Assessment and Remediation

Dear [Redacted],

The summary report for the assessment and remediation of your home's vibrating water pipes is below.

Problem and Background:

Klem Acoustic Consulting (KAC) was asked to provide an on-site acoustical assessment for excessive noise in water pipes in a single-family residential dwelling. The chief concern was to decrease the vibrating noise of these pipes against floor joists.

Assessment:

An on-site assessment was conducted on July 14, 2026. Baseline sound and vibration levels were measured at two locations inside the home; the furnace room where the water supply enters the home (from a well pump elsewhere on the property) and a location on the main floor of the home directly above the furnace room. The well pump motor, located outside the residence, was not generating appreciable noise, and the owner was primarily interested in minimizing the vibration induced by the well pump on the copper piping rather than replacing the pump motor that appeared to be functioning “fine, other than the noise (Client).”

Sound Measurements:

Baseline measurements were obtained at two locations inside the home; the furnace room and main floor directly above the furnace. A Class 1 sound level measurement system was used for all measurements and was calibrated directly prior to and after all measurements. The values measured are as follows: LAeq, LAFmax, LZeq at 100, 125 and 160 Hz.

LAeq, or A-weighted equivalent continuous sound level, is a measure of the average sound level over a specified period, adjusted to reflect the sensitivity of human hearing (A weighting). It is commonly used in noise assessments to represent overall noise exposure. The time averaging allows sound measurements of different lengths of time to be comparable.

LAFmax: A-weighted maximum sound level measured with a time window of 125ms in order to accurately represent sound with either a ‘fast’ onset (attack) or decay, such as a gun shot or a single hand clap.

LZeq represents an equivalent continuous level without any weighting. It is useful to describe sound with a particular tonal quality, such as a low frequency hum from a motor. It can be further specified as to the range of frequencies (one third of an octave band) by noting the frequency value in the name, e.g., LZeq @ 125 Hz.

Sound Measurement Equipment:

Sound Level Meter: NTi XL3, Serial No. A3A-02481-F0, FW1.56, KAC_XL3
Microphone: NTi Audio M2230 (MA220 preamplifier + MC230A microphone capsule), Serial No. 16192.
NTi Class 1 microphone calibrator (Larson Davis CAL200), Serial No. 24009
This Class 1 system was successfully calibrated by NTI on June 12, 2026, and field calibrated immediately prior to and following all field measurements on 2026-07-07 at 12:41 and 19:08; Delta from initial calibration -0.0dB. Mic Sensitivity: 44.75 mV/Pa

Vibration Measurement Equipment:

AMC Mecanocaucho VIP Accelerometer: MEMS-based 3 axis measurement from DC to 500Hz, Sensitivity 100 mV/g, Sampling Rate 1024 Hz. The value measured is the rate of movement, (millimeters per second) in three relative directions: width or left to right (X axis), height or up and down (Z axis) and forward to backward (Y axis).

Measurement Locations:

Furnace room: microphone directly below a vibrating water pipe and ceiling joist. Microphone capsule 63" above concrete floor and > 24" from each wall in compliance with ASA/ANSI S12.2-2019. Accelerometer was placed directly onto a water pipe directly above the microphone position.

Figures 1 and 2: Measurement Locations

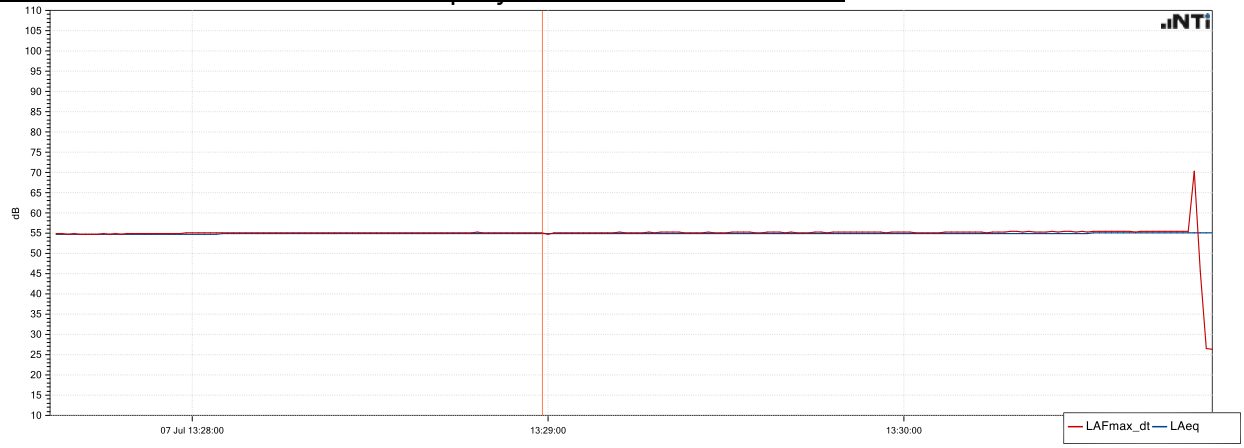
Ambient Conditions:

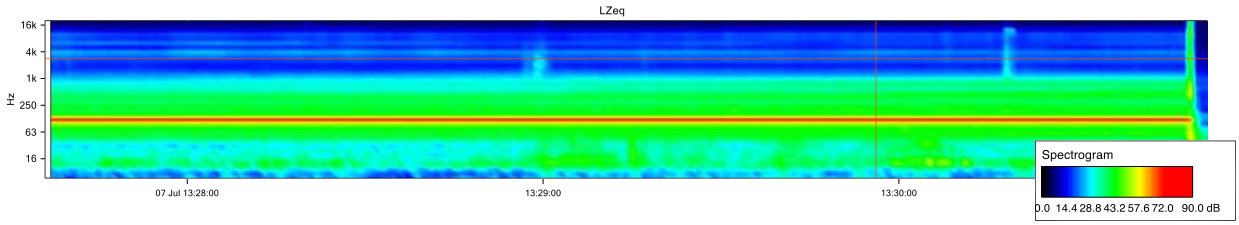
Temperature 74 degrees F, relative humidity 40%, wind speed 0-5 MPH. interior rooms with no open windows and HVAC turned off during all measurements.

Sampling Period:

Each sound measurement period lasted approximately 30 minutes. From this larger measurement a single machine operating cycle/period (AKA 'cycle on') was selected that contained the least amount of extraneous noise. Each accelerometer sample period lasted a few seconds.

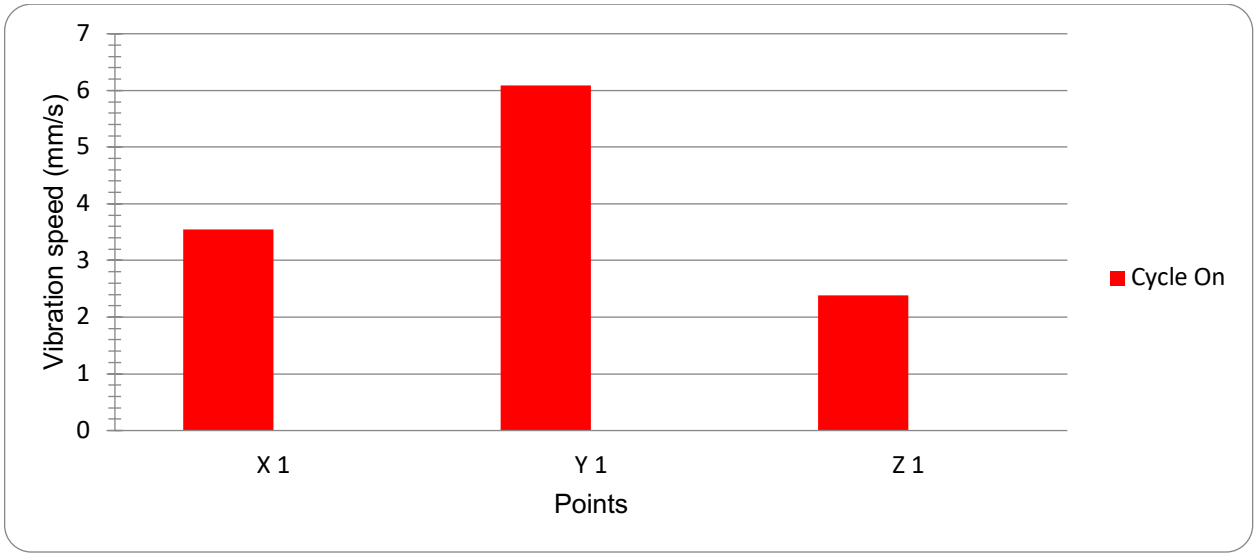
Baseline Sound Levels – Well Pump Cycle On – Furnace location:

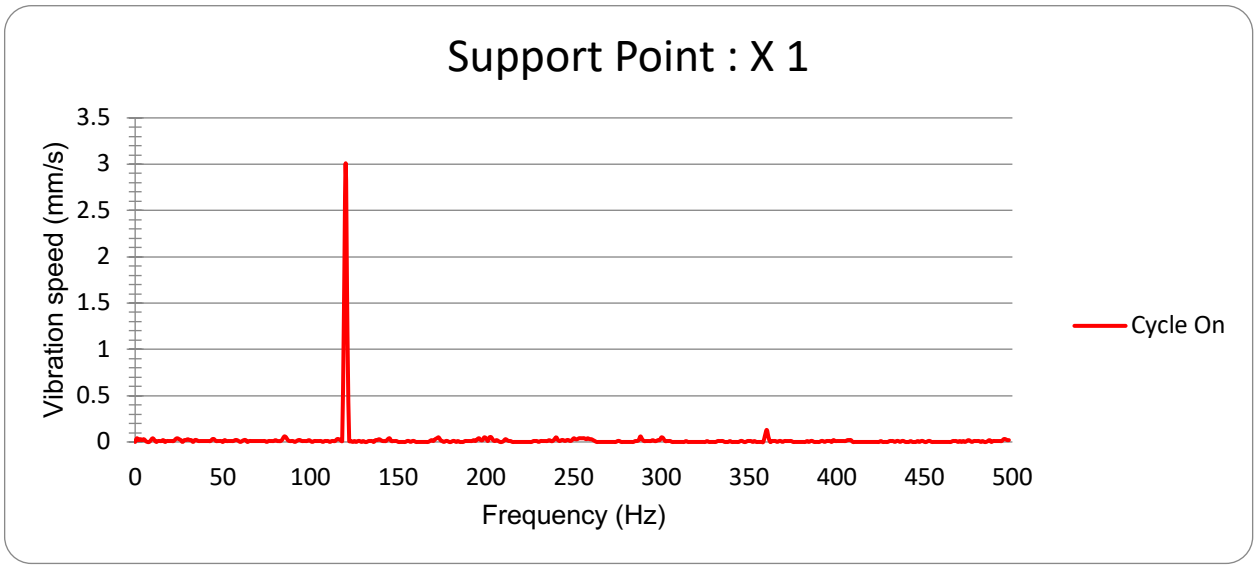


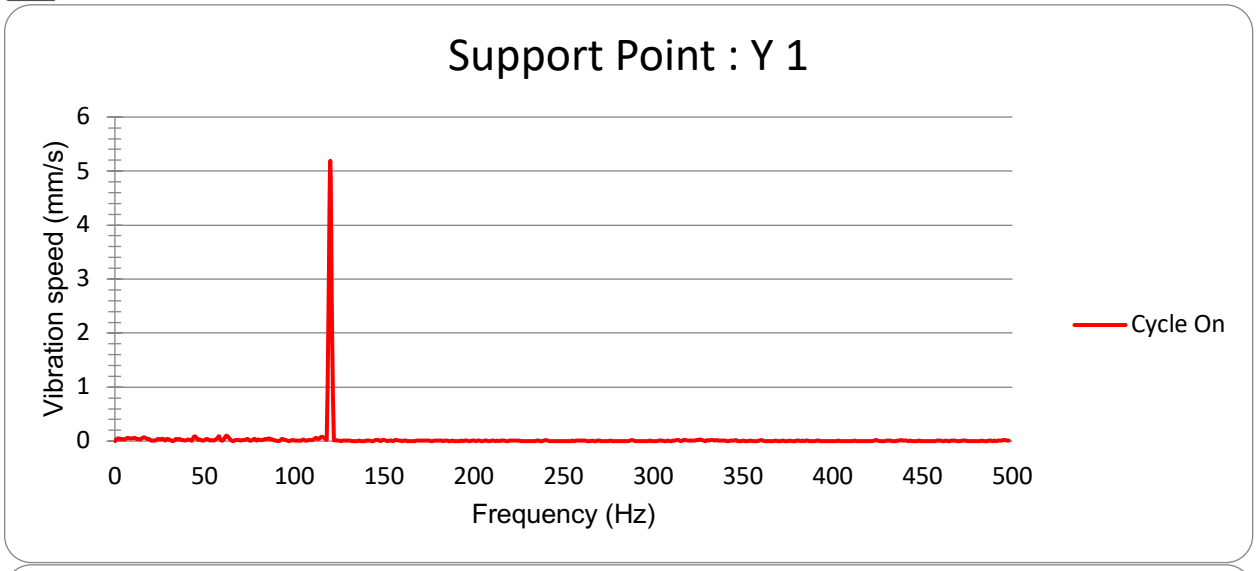


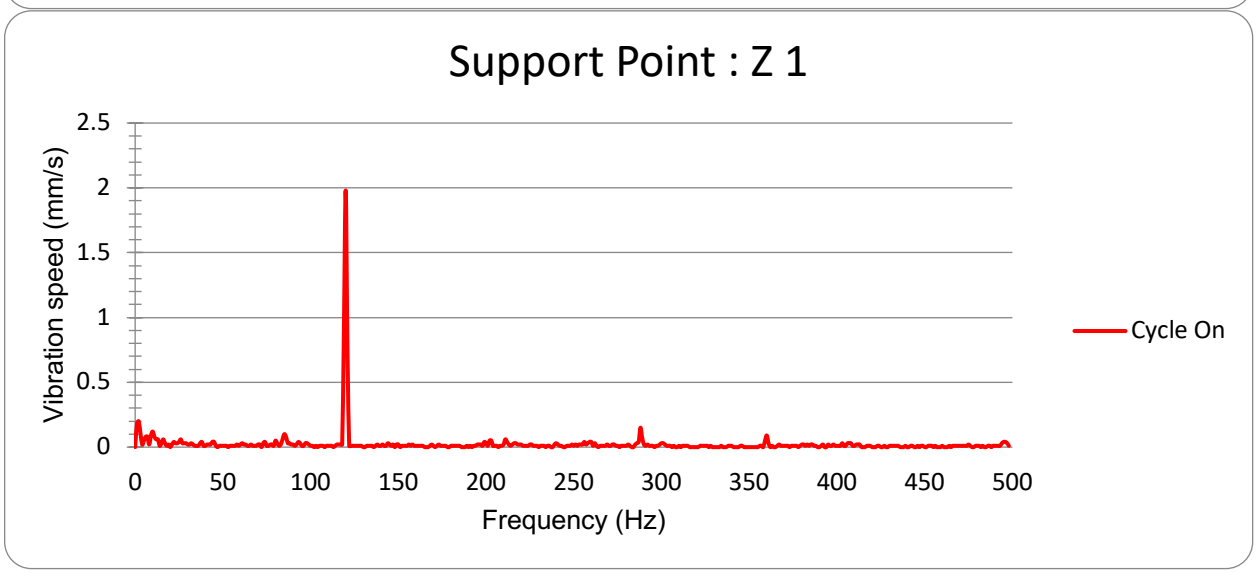
Well Pump at Furnace	Duration	LAFmax [dB]	LAeq [dB]	Lzeq @ 100 Hz [dB]	Lzeq @ 125 Hz [dB]	Lzeq @ 160 Hz [dB]
Cycle On	**0:03:16**	**70.3**	**55.1**	**52.3**	**71.4**	**43.0**

Baseline Vibration Levels – Well Pump Cycle On - Furnace location:









Findings from Baseline Measurements:

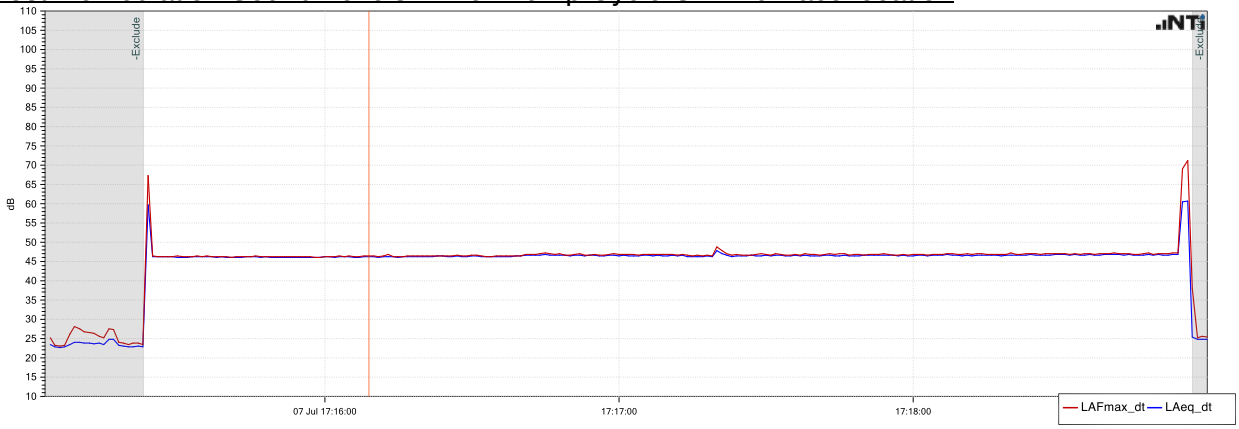
Elevated noise and vibration were observed, primarily composed of tonal noise and vibration at 120 Hz. The noise occurs at an elevated level from background noise, is intermittent (cycles on depending on water tank level), and is primarily comprised of a steady-state tonal low frequency. These noise characteristics are all associated with human annoyance per ASTM E 1686-16 and ANSI S12.9.4.

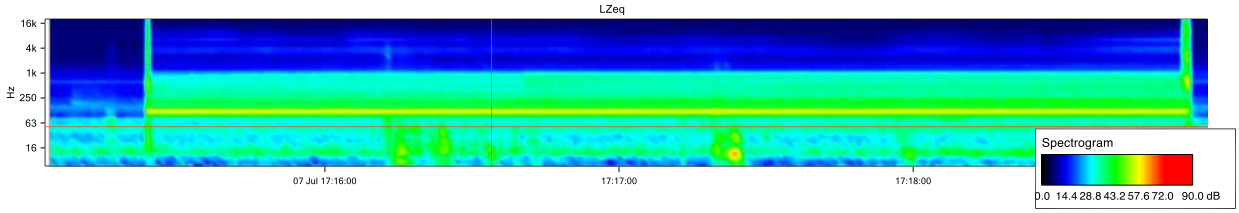
Treatment Plan:

KAC proposed replacing all pipe hangers / brackets (wherever accessible) with AMC-Mecanocaucho® Akustik Pipe Isolators. The product's data sheet is shown in Attachment A ('pipe_en.pdf'). A total of 28 isolators, ranging in size from 5/8" to 1-3/8", were directly substituted at the location of all accessible original pipe suspension brackets. Gypsum wall board (GWB; AKA drywall) was removed at two locations to access brackets 'upstream' from the primary vibration point. It was impossible to access any additional coupling points without removing significantly more GWB. The client felt the tonal noise was "significantly less with the isolators" and chose to not remove additional GWB. The same series of acoustic measurements

were then repeated.

Post-Remediation Sound Levels – Well Pump Cycle On - Furnace location:





With Isolators

Well Pump at Furnace	Duration	LAFmax [dB]	LAeq [dB]	Lzeq @ 100 Hz [dB]	Lzeq @ 125 Hz [dB]	Lzeq @ 160 Hz [dB]
Cycle On	**0:03:34**	**71.2**	**47.7**	**43.0**	**62.1**	**37.2**

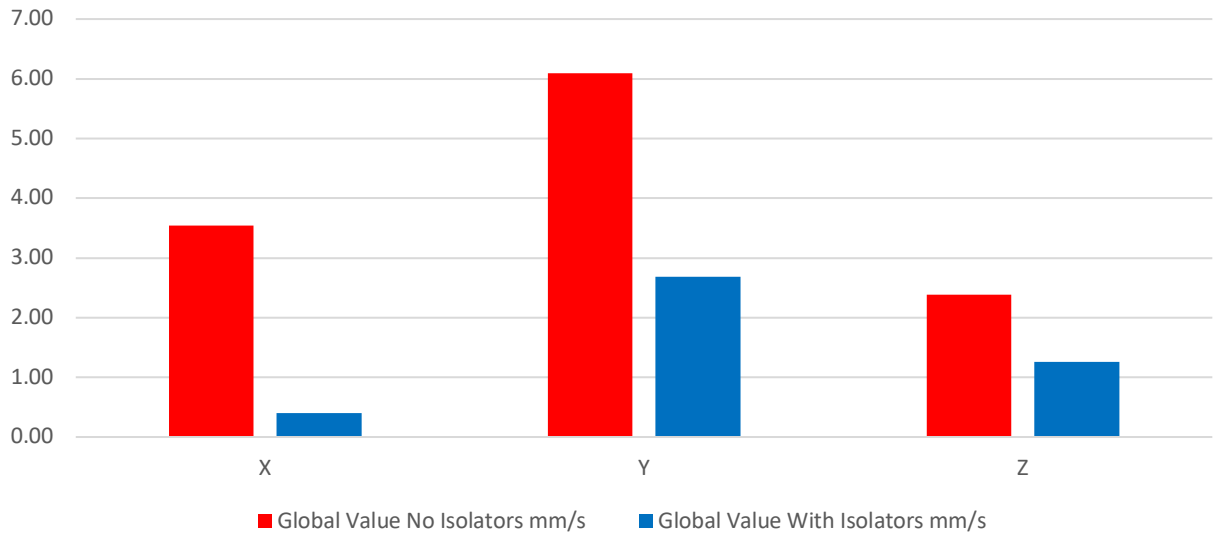
Impact of Remediation:

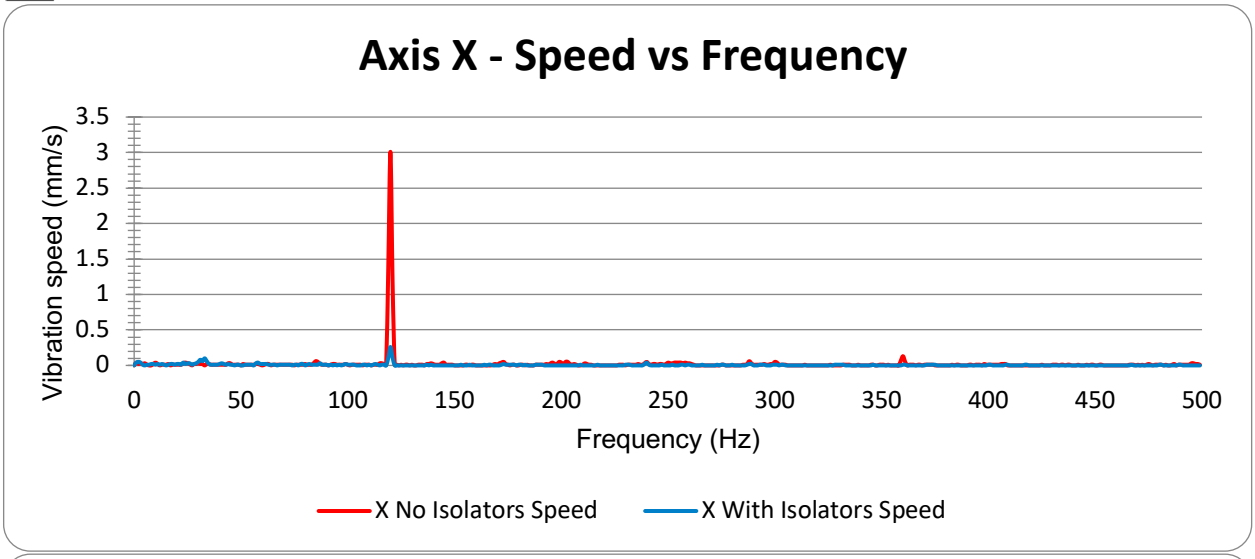
Noise Reduction from Isolators

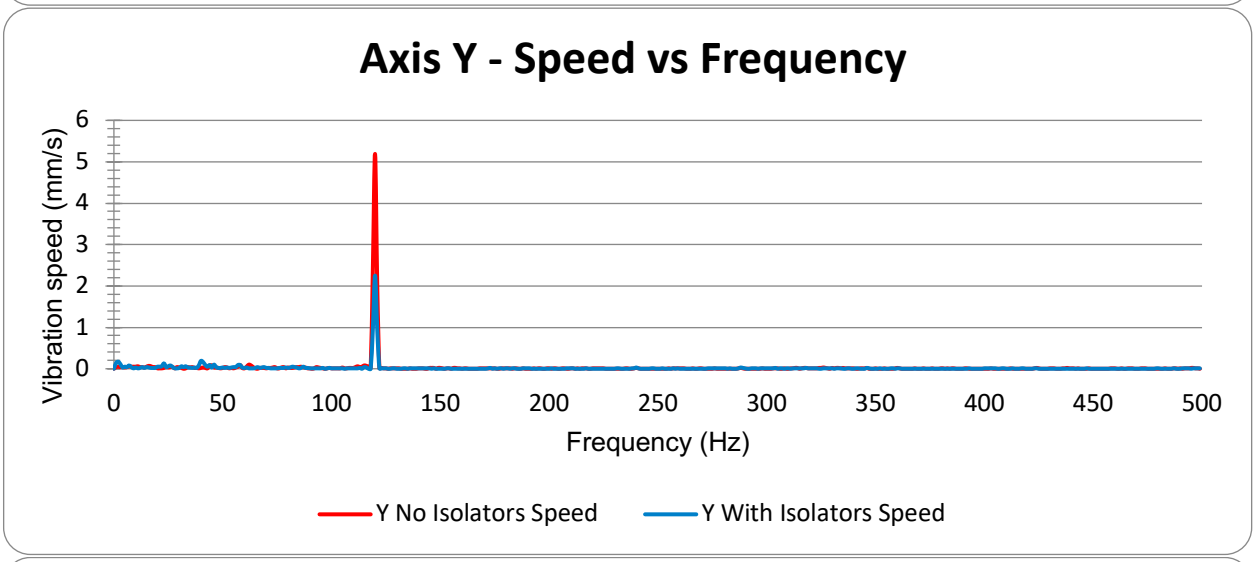
Well Pump at Furnace	Duration	LAFmax [dB]	LAeq [dB]	Lzeq @ 100 Hz [dB]	Lzeq @ 125 Hz [dB]	Lzeq @ 160 Hz [dB]
Delta		**-0.9**	**7.4**	**9.3**	**9.3**	**5.8**

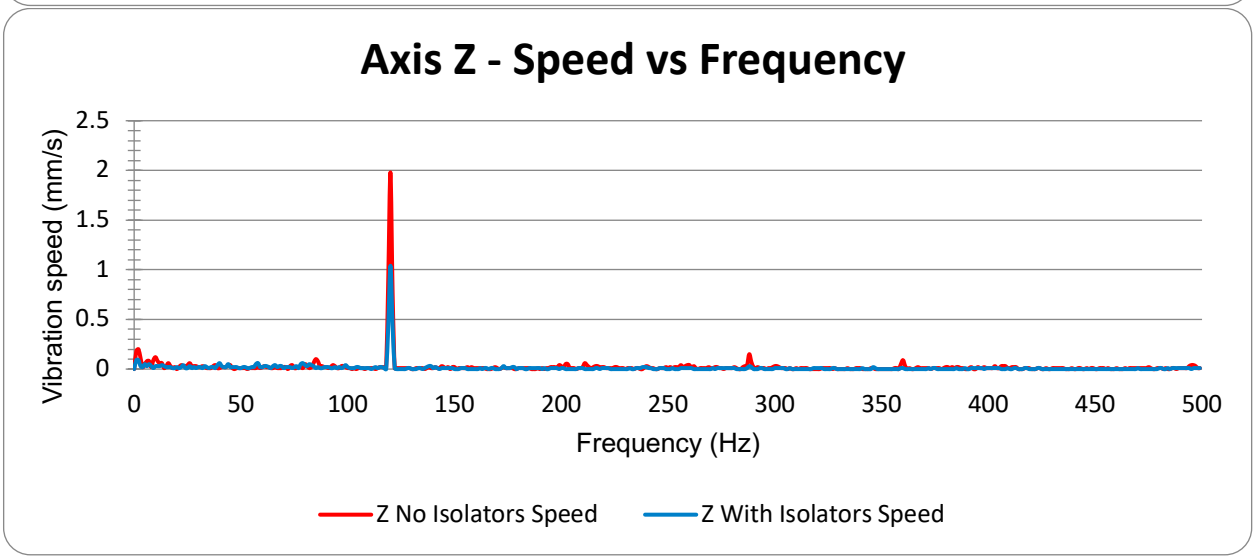
Vibration Reduction from Isolators

Global Value Baseline mm/s	Global Value With Isolators mm/s	Global Isolation %
3.54	0.40	88.80
6.09	2.69	55.85
2.39	1.26	47.20




Axis X - Speed vs Frequency
Vibration speed (mm/s)
3.5
3
2.5
2
1.5
1
0.5
0
0 50 100 150 200 250 300 350 400 450 500
Frequency (Hz)
X No Isolators Speed
X With Isolators Speed


Axis Y - Speed vs Frequency
Vibration speed (mm/s)
6
5
4
3
2
1
0
0 50 100 150 200 250 300 350 400 450 500
Frequency (Hz)
Y No Isolators Speed
Y With Isolators Speed


Axis Z - Speed vs Frequency
Vibration speed (mm/s)
2.5
2
1.5
1
0.5
0
0 50 100 150 200 250 300 350 400 450 500
Frequency (Hz)
Z No Isolators Speed
Z With Isolators Speed

Conclusions:

The Post-Remediation Measurements show a clear reduction in both the vibration and airborne sound levels. The vibration levels of the pipes were reduced by nearly 90% (X axis) to 50% (Z axis). Overall airborne noise (measured by LAeq) was reduced in the furnace room by 7.4 LAeq (55.1 to 47.7 dB). Tonal noise at 125 Hz was decreased in the Furnace room by 9.3 LZeq (71.4 to 62.1dB).

The significant amount of variance in reduced vibration levels as well as modest sound reduction may be explained by the lack of access to all transmission paths / points of coupling between the pipes and the home structure. Since isolation was achieved at up 90% in one plane, it is reasonable to assume that further treatment with the AMC pipe isolation products at any coupling points that were inaccessible at the time of intervention would further reduce both vibration and sound levels.

Should you have any questions or want to further discuss this project, please feel free to contact me.

Sincerely,

Patrick Klem, MPH, CPH
Owner, Klem Acoustic Consulting LLC