Wireline **Similarities** and **polarity data analyses**

1 PURPOSE

Hardwire similarities can be as monthly test of vibrators or vibrato audit

2 wireline signals

2.1 legacy model

In this model hardwire test all the vibrators are physically connected to the line electronics, one recording channel per vibrator signal recorded. As the listed in table 1.

Recorded with Pelton System.

	Signal Type	Signal Source	Type of Record
1	Vibrator Reference	Vibrator	Uncorrelated Sweep
2	Reaction Mass accelerometer	Vibrator	Uncorrelated Sweep
3	Baseplate accelerometer	Vibrator	Uncorrelated Sweep
4	Weighted sum (Ground Force)	Vibrator	Uncorrelated Sweep
5	Correlation pilot	Recorder	Uncorrelated Sweep
6	Reaction Mass accelerometer	Vibrator	Pulse
7	Baseplate accelerometer	Vibrator	Pulse

Table 1 – Recorder/Vibrator hardwire setup.

2.2 New model

Because all the vibrators signals can be save in Decoder, include vibrator Mass accelerometer, Baseplate accelerometer, vibrator Reference, we also can get relevance correlation pilot from Encoder. We can put all the signals together just like hardwire test, By this way we get all of the signals in table 1.

3 Accelerometer Tap Test - Accelerometer Polarity

3.1 First we need verify polarity of recording system by performing a tap test on several geophones on the recording spreads. Polarity of geophone tap test should be as per SEG Standard System Polarity， the recording system can be G3 or 508, or Sandwich box it depend on crew.

3.2 We need let the Decoder working but without pressure up the vibrator when did the Tap test.

3.3 Send the accelerometer signals to the recording system.

3.4 Verify polarity of vibrator accelerometers by performing tap test on the accelerometers de-mounted to the vibrator base-plate and reaction mass.
1) The accelerometers are de-mounted from the vibrator in order to get accelerate when tap the accelerometers. If the accelerometers mounted on the Mass, we cannt not get right accelerate when tap due to Mass is very heavy.
2) The accelerometer should be held in the palm of the book or hard.
3) Tap the top of the accelerometer with a finger or a soft object such as a pencil eraser.
4) Repeat several times to minimize risk of erroneous results.
5) Determine polarity of accelerometers as figure 1

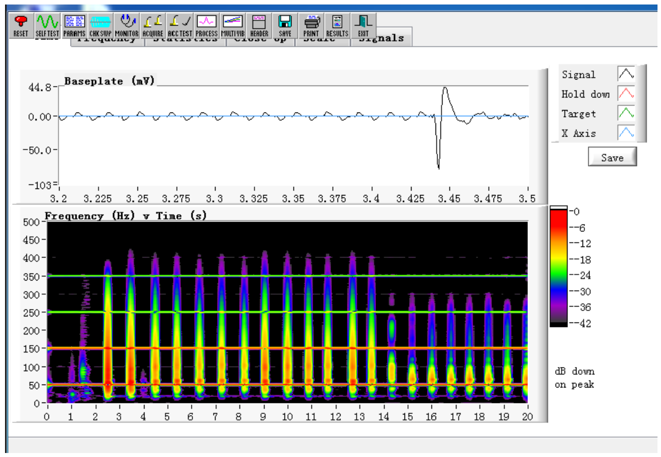


Figure 1 Inova Acc tap result

4 Pulse test

3.1 We need make sure the initial upward motion of the mass which results in an initial downward motion of the baseplate when did the pulse test.

3.2 In this test the phase relationship of VibReference 、MASS ACC 、BP ACC、 Ground Force as Figure 2 showing.

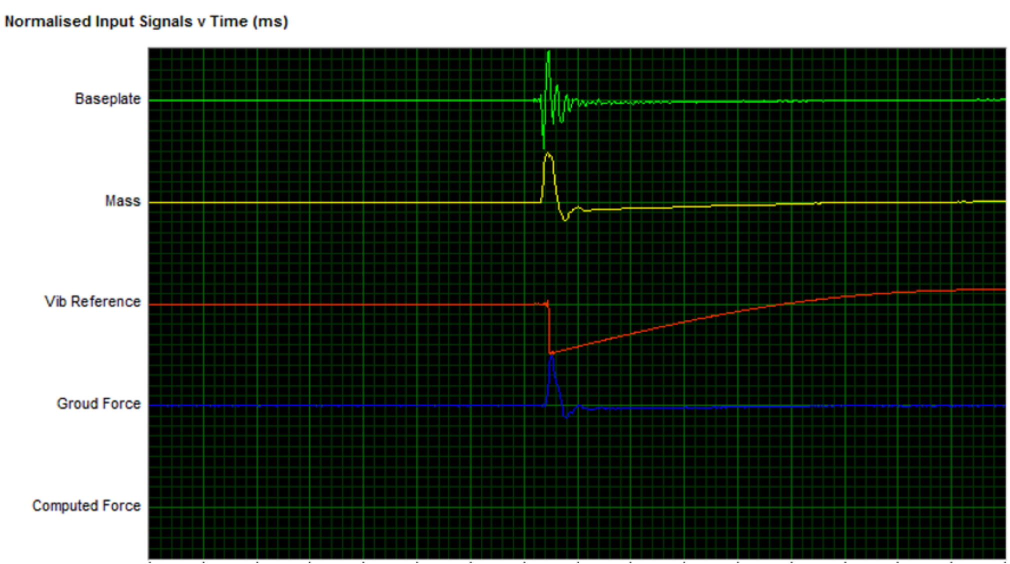


Figure 2 – Typical Pulse Test using INOVA Accelerometers

Because the INOVA accelerometers is no SEG standard, the Mass accelerometer single is up, Baseplate accelerometers is down, Ground force is down.
For Sercel accelerometers, it is standard SEG polarity so the Mass/Baseplate/ Force signals are opposite with Inova accelerometers, but the Reference signal in same direction, we can't reversed the Reference in the pulse test.

5 Vibrator reference and correlation pilot test

Seg standard : for SEG Reversed Accelerometers (Inova ACC), then correlation pilot is opposite phase (180 degrees) with the weighted sum signal. So the correlation is negative , As figure 3 showing.

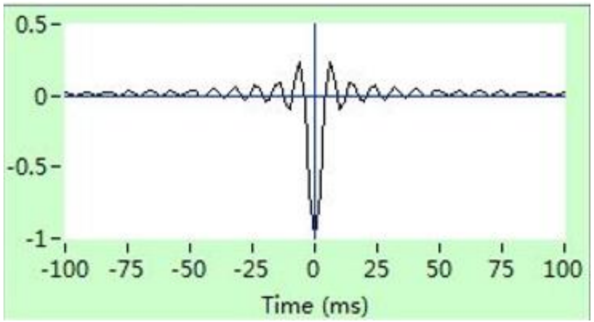


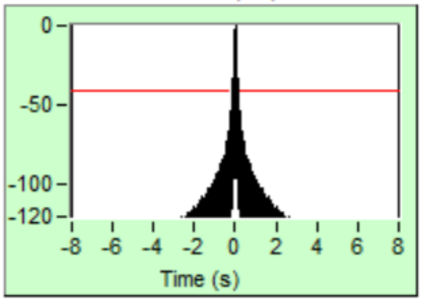
Figure3 NO SEG Polarity Accelerometers correlation

6 Wire line date analyses

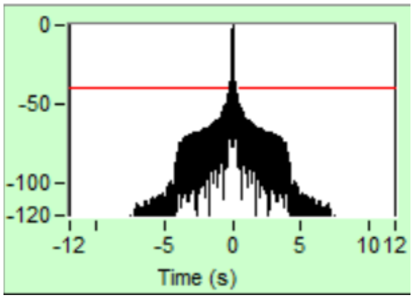
6.1 vibration reference signal check

1) Noise check

The pilot should be auto correlated and examined for frequency content and distortion. The display scales on the frequency-time plots (FT plots) for the correlation wavelet (in dB) should allow at least 100 dB to be seen ensuring distortion is visible. Figure 4 showing linear and low dwell sweep reference noise check. For linear sweep we need make sure no noise at −100db, other kinde of sweep should no noise at −80db.



(a) linear sweep



(b) low dwell sweep

Figure 4 Ref noise check

2）The start time error

The start time error should be less +/- 10 microseconds**, For Electronics using the GPS satellite timing, the start time errors are around 0 time**) as figure 5.

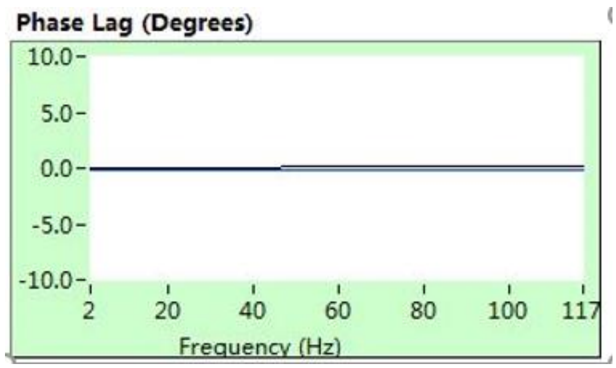


Figure 5 time error

The phase lag is frequency dependent and can be calculated using formula 1.

Phase lag [°] = (Start Time Error [s])(Frequency [Hz])*360° (1)*

The start time error can be calculated if the phase lag in degrees is known for at a given frequency, see formula 2.

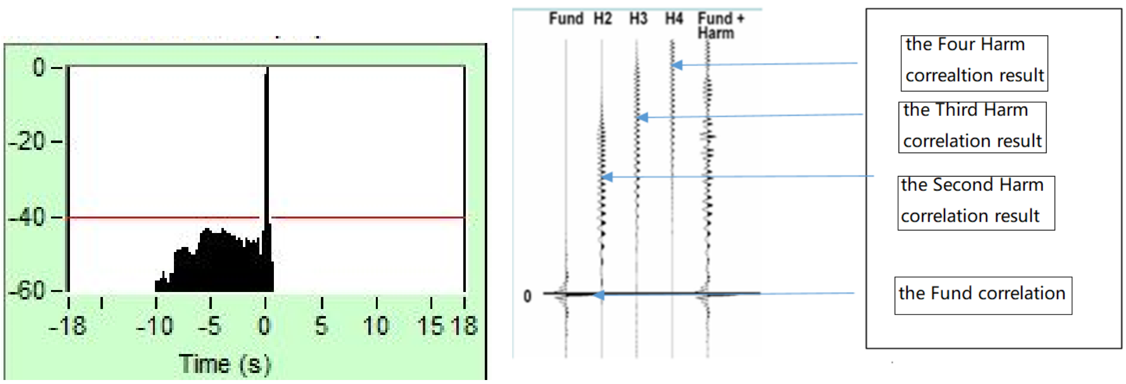
$$\text{Start Time Error} = \frac{(\text{Phase lag})}{(\text{Freq}*360)} \qquad (2)$$

6.2 Vibrator quality analyses

1) the correlation wavelet (dB)

The harmonics seen in negative time on the correlation wavelet, dB scale, should typically be below -40 dB relative to the correlation peak amplitude.
The negative time result come from harmonic as the picture 6 showing.

If all vibrators in the fleet show distortion higher than this then further investigation should be done regarding the terrain effect on vibrator performance or the due to the low frequency sweep.



(a) Negative noise **(b) harmonic noise colleration resulet**

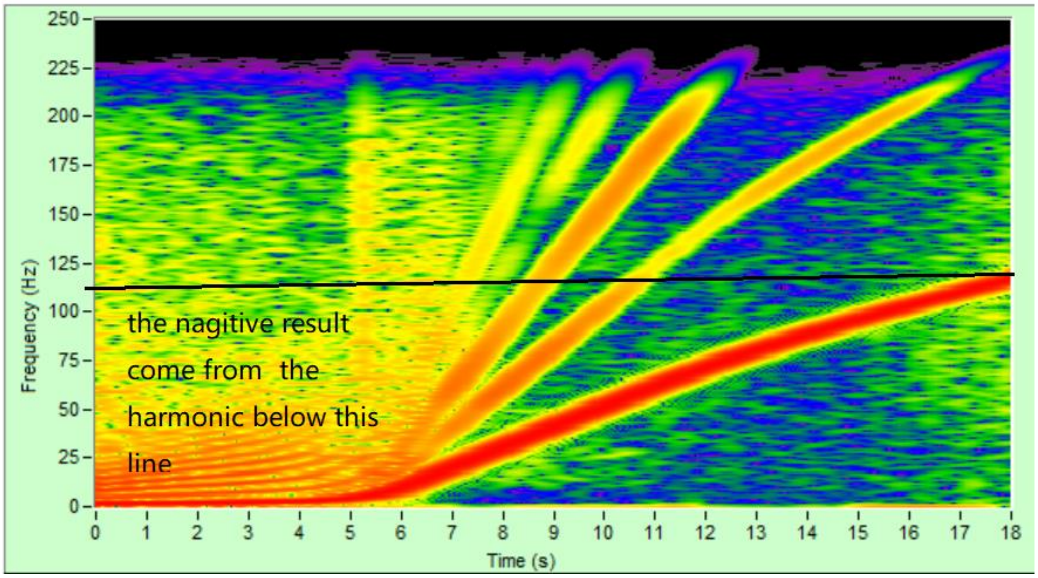


Figure 6

The positive of correlation should lower than the -60 dB, it usually come from sup-harmonics.

2) The phase

Phase lag should be within ±5 ° or ±10 ° when out of taper. It depend on the client and sweep parameters. If all vibrators show high phase then it could be related to terrain but when only one vibrator shows high phase then it indicates a problem.

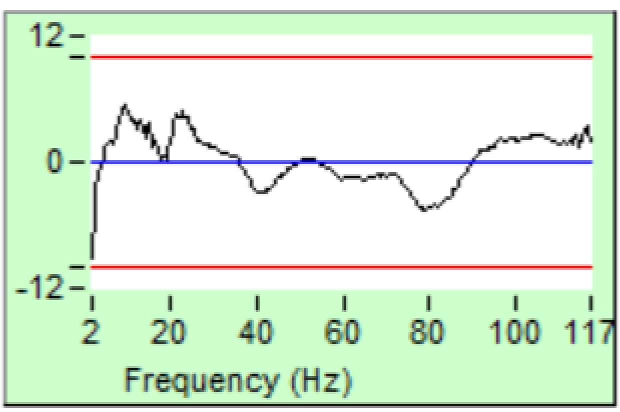


Figure 7 phase

3) Post correlation Amplitude (dB)

The amplitude spectrum should contain all expected frequencies in the sweep signal and the lever no drop in all the frequency. If it have drop means the force get low at this frequency.

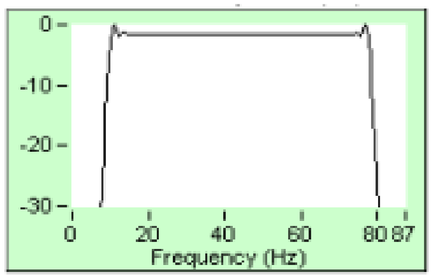


Figure 8 post correlation amplitued

4) Distortion

Distortion varies greatly with terrain and sweep parameters are hard to define. But typically peak distortion between all vibs should less than 15%, if one vibrator peak distortion very higher it means it have something wrong.

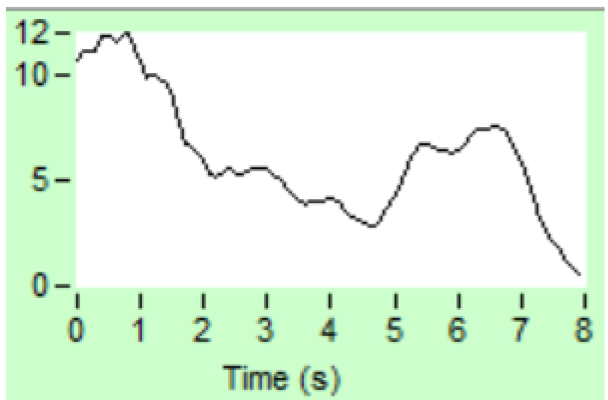


Figure 9 distortion

5) the F-T diplay

This display is useful in identifying what types of distortion which in the force signal。

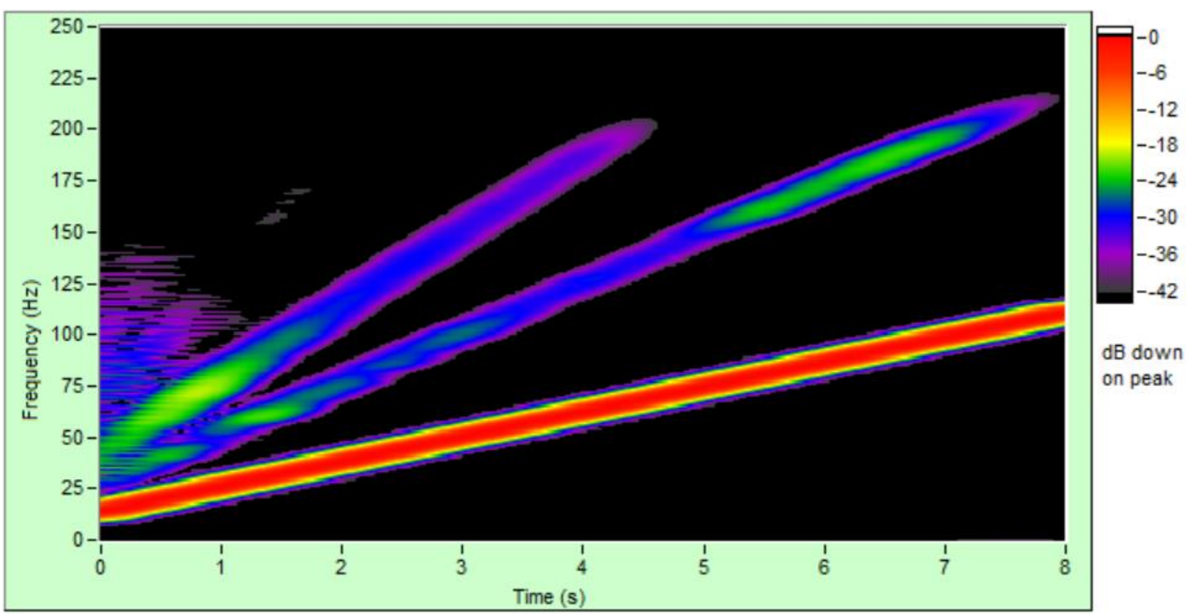


Figure 10 F-T display

5.1) The even (second 、 fourth) harmonic distortion is mainly due to three reasons

a) Ground and base plate. It usually happened from middle to high frequency
b) Hydraulic noise.
c) Mass air big, if the mass air big pressure low it will cause even harmonic around 4-6 Hz

5.2) The odd (third、fifth) harmonic is mainly come from servo valve, more valve displacement more distortion, more load more distortion.

5.3) Hydraulic rips it also cause noise, usually happened at high frequency, because it is hydraulic hammer, so we can see the noise in all frequency range.

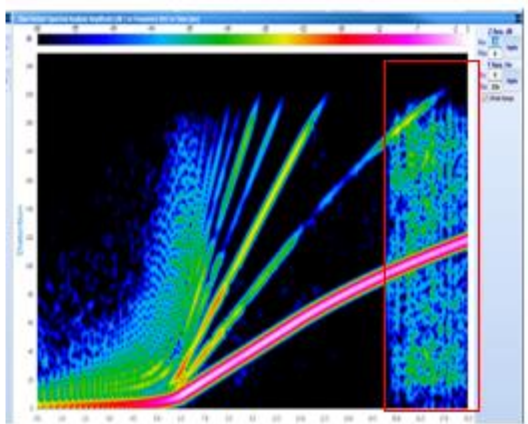


Figure 11 hydraulic hammer noise