Practical Tips to Identifying and Troubleshooting
Portable Measurement Cables for Vibration Analysis

By Tom LaRocque, CTC

Troubleshooting vibration analysis hardware is an important tool in the vibration analyst toolbox. Knowing what to look for and how to isolate the problem with vibration analysis cables contributes to the prevention of other problems in the future. This article focuses on cabling problems in portable systems.

Problems with vibration analysis hardware can be very frustrating. Some examples of typical frustrations are:

1. Collecting measurement points all day, and downloading the information only to find that the data cannot be used.
2. Downloading the data into a database and not being able to remove the measurement point because of a suspect reading. *(Figure 10)*
3. Trying to collect data with one cable while the system is showing erroneous readings with the spare cable miles away.

The following article is intended to provide some tips and insights into what could be wrong with your cabling and how to correct the problems.

Portable Data Cables
The cabling provides the path for the accelerometer output to the data collector. It is also the path for powering the accelerometer. Connectors attach the cable from the accelerometer to the data collector or a junction box.

Troubleshooting Tips/Techniques
Here are some troubleshooting tips on how to determine where to start and what to look for, as well as some corrective actions/solutions and tips on how to extend cable life.

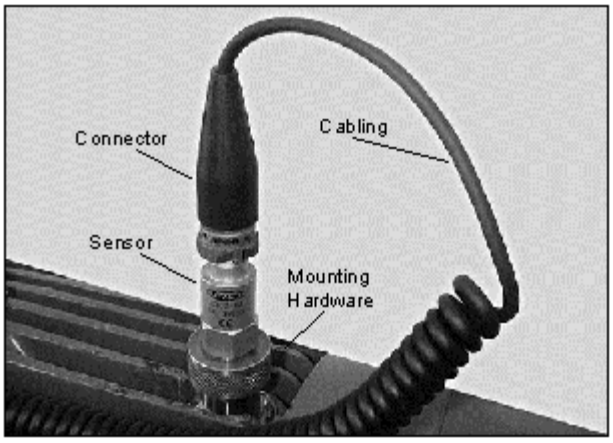

Figure 1 - Portable Data Collection System

Identify the problem:

Fault ID/Visual Inspection of the Cables: It is very important to understand what the problem is, and to identify what exactly the fault is. A few questions to consider:

- What types of error(s) are being observed?
- Are there any nicks, cuts, scratches or burn marks any where on the cable?
- Check both connectors - are they intact and in good condition?
- Is there any corrosion on the connector sockets?

The following troubleshooting chart was developed to help an analyst determine a fault by matching data collected (Spectrum and/or Time Wave-form) or by matching the situation to what is being observed in the field.

Note: You will see the importance of using both the Time Wave-form & Spectrum to help understand the full picture. For instance, the Time Wave-form in Figure 8 does not change from

the Time Wave-form of the baseline data in Figure 2, but when referring to the applicable Spectrum Data in Figure 9, a problem is evident.

Troubleshooting Chart

Situation	Typical Time Wave-form	Typical Spectrum	Cause(s)	Corrective Action/Solution(s)	Notes/Remarks
Normal Operation (Baseline, Reference)	Figure 2	Figure 3	N/A	N/A	Taken from a HP Feed Water Pump, 50 Hz
Sensor Not Present	N/A	N/A	Problem with electronics of accelerometer or cable not attached to sensor.	Check cable for continuity and ensure cable is to sensor. If yes, suspect sensor and contact manufacturer.	Data collectors will not collect data if a sensor cannot be detected.
High Peak Reading/ Ski Slope	N/A	Figures 5, 7& 9	Figure 5 - Cut/burnt outer jacket of cable; Figure 7 - Loose internal solder joint in connector; Figure 9 - Broken / Damaged insert of accelerometer connector.	If it is a loose connector or broken insert, repairing the cable by replacing the damaged end may be the only required action. For damaged cable, entire cable must be replaced.	Ski slope can vary in degree. Note - Other possible causes could be accelerometer shock/overload if a magnet mount is being used and not enough time was allowed for the sensor to stabilize.
Flat Frequency Response	N/A	Figure 9	Flat frequency response is due to the extreme scaling of the data due to the ski-slope effect. Same causes as High Peak Reading/Ski slope apply here.	If it is a loose connector or broken insert, repairing the cable by replacing the damaged end may be the only required action. For damaged cable, entire cable must be replaced.	Due to the resolution of the graph due to the high ski-slope, it appears that there is no higher frequency influences, they are still there, they just can't be resolved due to the auto ranging of the data collector.
High Overall Readings	N/A	Figure 7	The high overall readings can be attributed to a damaged or loose connector or damaged cable.	If it is a loose connector or broken insert, repairing the cable by replacing the damaged end may be the only required action. For damaged cable, entire cable must be replaced.	See notes section from High Peak Reading/ Ski Slope and/or Flat Frequency Response, if applicable.
Fluctuation Observed in Overall Readings	Figure 4&5	N/A	Damaged or loose	Repair or replace connector(s) or	Indication of cable problem, of which time-wave form or

During Data Collection			connector or damaged cable.	entire cable assembly.	spectrum data (below) would indicate if not caught prior to storing data.
High Single-Point Trend Observed During Trend Analysis	Figure 10	Figure 10	Faulty Cable (Damaged Connector Insert) caused false high vibration reading that was still under the set alarm limits of the analyst.	If you suspect a problem, re-take the measurement point, or observe for any increase in vibration amplitude by using the real-time function of the data collector, if available. If you are still experiencing a problem, or if is at a higher rate, repair or replace the cable.	Because it was under the set alarm limits, the analyst was not alerted that it could have been a problem, so the data was stored. Upon the following reading, (after the cable had been replaced) the data went back to “normal”.

Further explanation of Causes:

- **Connector Problems.**
  - A broken connector insert is very common for two socket connectors using a hard plastic isolation insert. Constant handling of cables and sensors weakens the inserts, leading to cracks or inserts completely falling out. Once the insulation is gone or damaged, interference can show on either of the pins from the accelerometer, causing very high overall readings and suspect data.

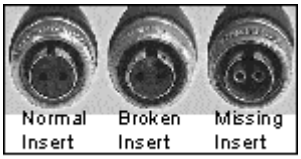

Figure 11-2 Socket Connectors

  - Looseness in solder joints are harder to pinpoint. The indicator is generally the presence of erratic or intermittent readings while moving the cable or the wire. Since the solder joints for some connectors are potted with adhesive, the solder joint cannot be observed or reviewed without destroying the connector.
- **Damaged Cable.**
  - Cut or burnt cable. Cut or burnt cable causes the shielding of the cable to become exposed, and could cut or burn one of the twisted- shielded pair of wires inside the cable. This in turn causes contamination of the signal, which can cause fluctuations of the signal observed by the data collector. These fluctuations commonly create the “ski-slope” effect seen in spectrums.

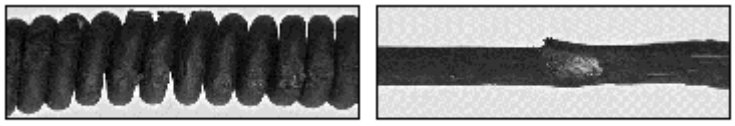
Figure 12-Damaged Cables

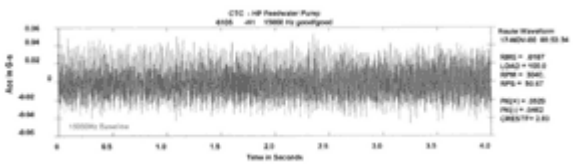
Figure 2

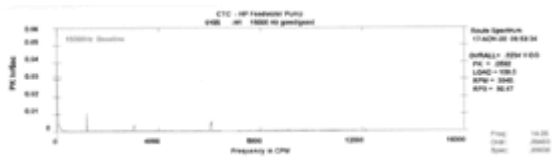
Figure 3

Base Line. new Cable Assembly.

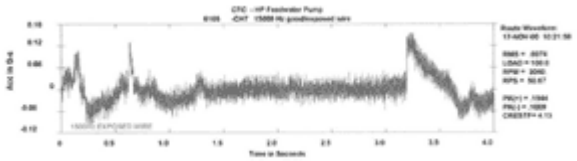

Figure 4

Figure 5

Cut outer Jacket of Cable Assembly - Exposed Wire (Time Wave-Form While Moving Cable) Figure 4.

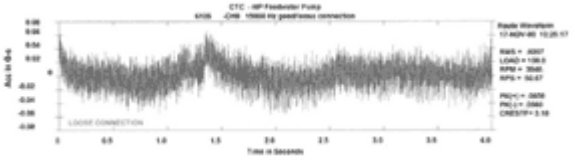

Figure 6

Figure 7

Loose Connection - Internal to Connector (Time Wave-Form While Moving Cable).

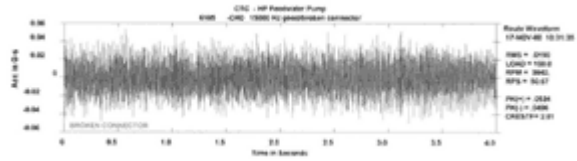

Figure 8

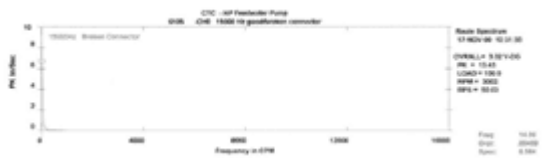

Figure 9

Broken Insert of Accelerometer 2 Socket Connector. Looks ok , however, review spectrum - Figure 2.

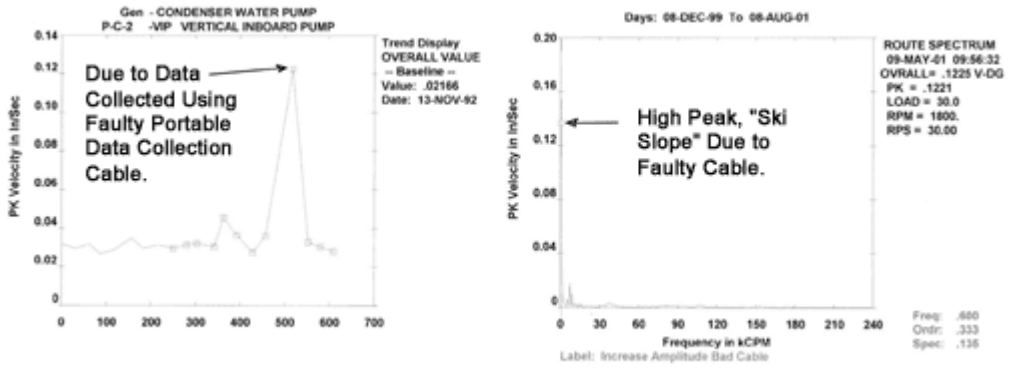

Figure 10

Extending Cable Life/Tips on Preparing for Cable Faults: Corrective Actions/Solutions for problem cables in the field almost invariably comes down to repairing or replacing the cable. Below are some factors and tips on extending the life of any cable assembly

- **Have spare cables on hand.**
    - Ensure you have some spare cables on hand in order to switch out cables that may be faulty or failing and for troubleshooting purposes.
- **Maintenance/Inspection of Cable and Connectors**
    - Keep the condition of the cable assemblies free of dirt, oils, greases or other type of contaminant build-up.
    - Clean out connector contacts and ensure contacts/pins are not showing signs of corrosion.
    - Ensure connectors are not damaged or inserts are not cracked periodically/prior to use.
    - Ensure cables are not cut, nicked or burnt. Ensure elongation of coiled cables is also kept to a minimum.
- **Care During Use.**
    - Take care not to have cables lay on or near hot surfaces, such as steam pipes or hot equipment, with surface temperature > 250° F (temperature rating of the cable). Note: If data will be collected around hot equipment, contact your supplier for a special high temperature cable assembly.

Figure 13
High Quality Cable

- **Cable Manufacturer Warranty.**
    - The manufacturers warranty is important in ensuring that a good cable is used during data collection. A lifetime warranty cable will protect you from having to purchase a repair or replacement if your cable begins to fail. Choose a manufacturer that has high-quality cables that are built for extended life and that have a warranty to back them up.
- **Proactive Connector Development.**
    - Proper strain relief and connector reinforcements are very important to the extension of the cable life. Custom strain reliefs for connectors are available that relieve the stresses on the solder joints of the connector and the cable. Filling the rear cavity of a connector with an adhesive helps structurally reinforce the connectors, preventing exposure to the environment and potential damage.
    - Material changes are also important to consider. To help alleviate problems with broken two socket inserts, a soft neoprene isolation material (insert) can be used instead of the hard plastic isolation material that cracks and breaks easily.

Figure 14
Material Improvements

Conclusion.

The condition of your cabling has a direct impact on the quality of the data collected. Many false alarms and/or time spent trying to track down a machine fault that really isn't there can be avoided if you know what to look for when observing data that seems out of the ordinary. A good first step to any problem or observed problem is to isolate the problem and start looking at possible causes and solutions.

Typical Observed Data.

- High overall vibrations for measurements.
- Significant changes in recorded vibration.
- "Ski sloping" of data in the spectrum at points <1 Hz (60 CPM) and/or intermittent signals as indicated by the data collector.

Typical Causes.

- Damaged cable (burnt or cut cables).
- Damaged connector (2 socket isolation material/insert).

- Looseness of solder joints.

Typical Solutions. Repair or replace the cable.

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