



2019 Award Nomination

Title of Innovation:

Hexcorder Pro CIPS/DCVG/GPS Survey Instrument

Nominee(s)

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Category: Integrity Assessment

Dates of Innovation Development: from August 2013 to September 2017

Web site: www.cath-tech.com

Summary Description:

The Cath-Tech Hexcorder Pro provides state of the art pipe coating condition data (DCVG) &/or pipeline cathodic protection data (CIPS) with GPS coordinates. The Hexcorder may be operated in numerous modes, DCVG only, CIPS only, combined DCVG & CIPS, multi-person DCVG mode etc.

The Hexcorder Pro utilizes a ruggedized tablet for the display and keypad resulting in an optimal user experience working with the free Android based Cath-Tech survey app. The operator has the choice of viewing any two of 5 available survey screens to display survey data. Survey data can be displayed as a graph, numerically, as analogue gauges, birds eye view of the survey team or in real time on maps! Data is exported to a computer as a .csv file via USB connection and may be graphed using Excel or similar spreadsheet programs and is fully PODS compatible, with no special software required. The Hexcorder Pro is also Bluetooth enabled to pair with Radio Detection and Vivax Metrotech pipe locators to capture the depth of cover data and store it seamlessly correlated into the survey data. Each reading taken during a survey with the Hexcorder Pro is tagged with Latitude, Longitude, Altitude, voltage gradient, PDOP, TR OFF, TR ON, date, time, chainage and any operator inserted notes or comments.

The four key features are:

- 1) Perform DCVG & CIPS in various combinations simultaneously with all data gathered at the exact same geographic locations at the exact same moment in time under the exact same field conditions & seamlessly correlated!
- 2) Rich graphics and data display in real time for maximum operator experience.
- 3) No special software required, utilizes standard MS programs & Android app.
- 4) The Hexcorder Pro is purpose built by corrosion engineers for corrosion engineers specifically designed to do nothing but pipeline integrity surveys.



Full Description:

(Please provide complete answers to the questions below. Graphs, charts, and photos can be inserted to support the answers.)

1. What is the innovation?

The Hexcorder Pro represents the next generation of CIPS and DCVG survey instrumentation. The Hexcorder Pro consists of a black box of specialized circuitry connected to a rugged Android tablet via Bluetooth.

2. How does the innovation work?

The Hexcorder Pro has many new features:

- 2 CIPS and 4 DCVG channels
- 10 different survey modes
- Can perform double impedance surveys for difficult ground
- Tablet interface allows the field operator to customize the data display
- Bluetooth interface with pipe locators to add depth of cover to data stream
- AC waveform capture documents any AC that may be on the structure and helps to confirm interrupters are synchronized and reading delays are appropriate. File records 4000 readings per second for the duration of the interruption cycle and is then stored to memory for future reference.



The Hexcorder Pro measures and records close interval potential (CIPS) data and direct current voltage gradient (DCVG) data along with the corresponding GPS coordinates and stores this to a ruggedized tablet memory. The data is displayed via a free “CATH-TECH” app available for Android on Google Play Store. If the app is updated, customers receive automatic free updates the next time their equipment is powered on and connected to WIFI. Survey files are simply cut & pasted from the tablet and are .csv format for ease of interpretation. The tablet will display survey data in real time giving the field surveyor a rich information environment.

The Hexcorder Pro was developed with the following abilities:

- 10 different survey modes including Close Interval (CIPS), multiple DCVG channels, multiple impedance
- Integrated GPS to synchronize seamlessly with current interrupters and stationary data loggers.
- Work with interruption cycles as fast as 1 second
- User customizable alarms for change in potential, DCVG indication & broken trailing wire can be enabled to help ensure data integrity

- Records chainage, date, time, altitude and GPS location data with each reading
- Integrate with all Bluetooth enabled Radio Detection and Vivax Metrotech pipe locators to store depth of cover and signal strength data with CIPS & DCVG readings
- Active AC filter to remove the effect of induced AC up to 100V
- Run time of Hexcorder Pro is 24 hours, tablet is 11 hours under field conditions at maximum brightness, optional extra batteries are available for the tablet.
- Rugged, IP66, quick connect push-pull connectors
- Reads and stores AC waveforms
- Comments can be easily entered into the data stream
- User programmable GPS offset to work in local time
- Large rugged Mil Spec touchscreen tablet user interface
- Free custom graphics-based App, easy to navigate, easy to learn
- Multiple languages supported
- View any 2 of 5 available screens; Table, Graph, Map, Bird's Eye, Analog Gauge

3. Describe the corrosion problem or technological gap that sparked the development of the innovation? How does the innovation improve upon existing methods/technologies to address this corrosion problem or provide a new solution to bridge the technology gap?

Survey instruments currently available on the market did not offer the survey operator enough information or detail in real time. Survey types were limited. Surveyors often had to juggle many instruments and attempt to integrate different data streams post survey.

The Hexcorder Pro project focused on two fundamental problems. How to improve the effectiveness of surveys in congested or difficult areas and how to display and manage the data.

All prior survey equipment on the market is single channel CIPS and/or DCVG. By adding channels, the

Hexcorder Pro allows one survey crew to gather more data points. For example, when performing a DCVG survey on parallel pipelines, the gradient must be obtained to both the left and the right side



of the pipe to confirm which pipe has the defect. The Hexcorder Pro has 4 DCVG channels, allowing simultaneous gradient recording of any combination of the left, right, front and rear. The Hexcorder Pro can also record CIPS measurements at two different input impedances, 25

MΩ and 250 MΩ in one pass. In dry and difficult conditions, this allows the analyst to calculate the true polarized potential to provide a more accurate assessment of the cathodic protection.

One of the challenges in the field has always been visualizing the data in real time. Prior technology displays were limited and often small. A 10" rugged Android tablet was chosen for suitability in the field and a large graphical user interface. The app was developed to make the selection of the survey options intuitive to the user. The user can choose any 2 of 5 survey data screens: table, graph, GPS map, DCVG needle, and Bird's Eye views.

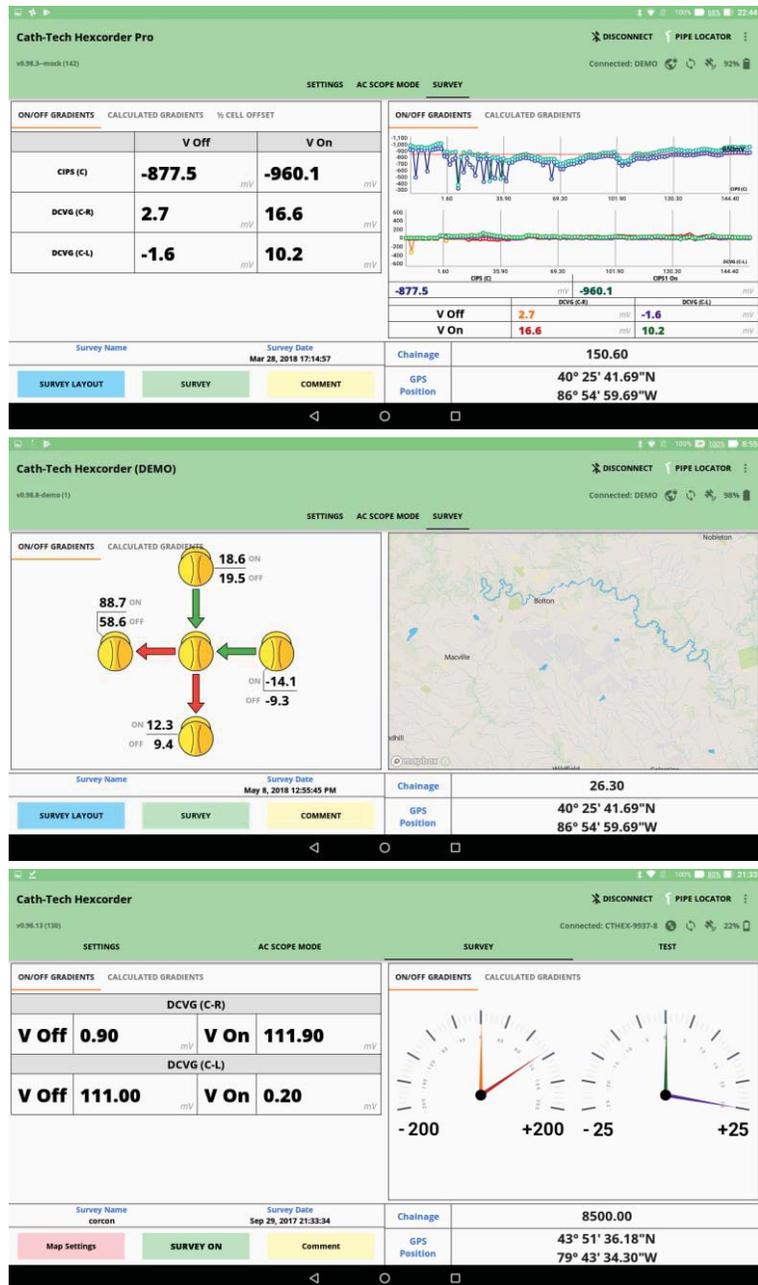
The 5 survey screens are:

1 A numerical table of the survey data displaying the CIPS and DCVG values. The DCVG can be displayed as On/Off readings or the calculated gradient.

2 Data may also be displayed in graph mode with each channel independently displayed. The user can pinch and zoom to drill down into the onscreen data allows the operator to take a closer look at the previous data.

3 Birds eye view shows an aerial representation looking down on the survey crew. This is especially useful in DCVG mode to visualize the direction of current flow.

4 A street map of the survey area is cached to the tablet memory for use in the field so no Wi-Fi or internet connection is required during the survey hours. The surveyor can see their



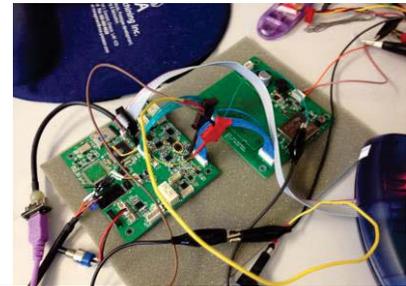
position in real time. KML files can be created/imported into the map from previous survey GPS coordinates and a previous route followed.

5 Analog style DCVG gauges that are autoscaling for each DCVG channel and have Hi/Low needles to represent the pulsing of the CP current. Even for fast survey cycles, the operator can detect defects as the gap between the needles grows larger.

At any time, the operator can change the screen choice on the fly without having to start a new file. Improving the user's ability to interpret the data in the field also improves their ability to record accurate data, reducing the amount of post-processing later.

4. Has the innovation been tested in the laboratory or in the field? If so, please describe any tests or field demonstrations and the results that support the capability and feasibility of the innovation.

Initial bench testing was used on many prototype variations to prove the abilities and accuracy of the various measurement channels. Challenges in design included fast AC filtering, integrating multiple channels and obtaining a 0.1mV precision on the readings.

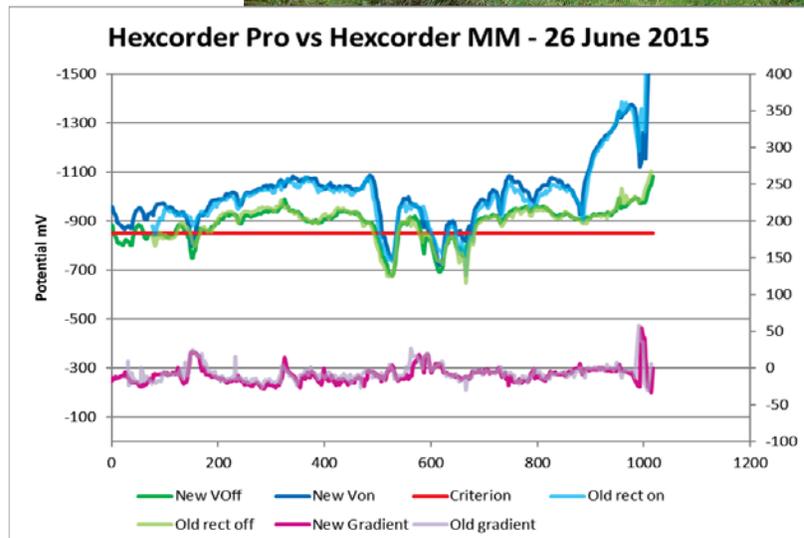


Prototype units were extensively field tested on numerous occasions at a ski hill in Ontario, Canada using their ICCP system for the snow making lines in the summer months. Initial tests were conducted with the new Hexcorder Pro and an older Hexcorder Millennium performing a CIPS + DCVG survey to allow for later data



comparison. The integrating GPS in both units was used to correlate the data post survey and then graph the results. Both units performed well in the field. With the success of the first tests, two more testing days were set up in the fall of 2015 for the more advanced functions of the Hexcorder Pro with satisfactory results.

However, the field tests revealed some weaknesses in the overall design that resulted in significant changes to the box and connectors.



After the physical redesign, the Hexcorder Pro was sent out for further field testing in 2017 in Poland, China and Alberta, Canada. Connectors continued to be an issue. The cables must be connected and disconnected multiple times in the field, so the connectors must be watertight and easy to use with gloves on. Threaded connectors were too difficult and prone to damage from mud. A metal push/pull waterproof connector was tested.



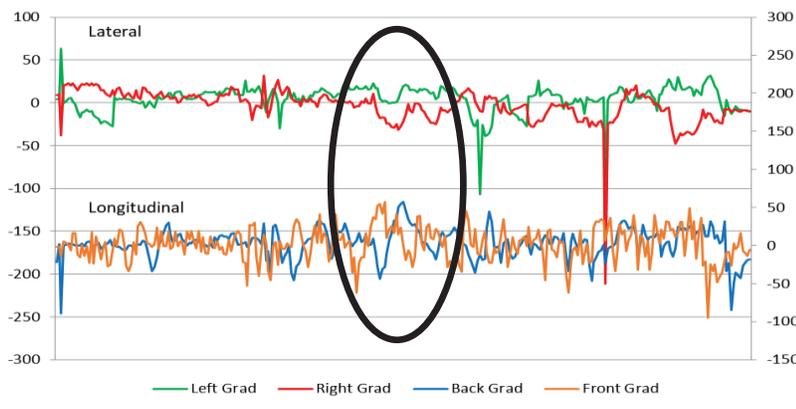
With a final round of field testing in the summer of 2017, the metal push/pull waterproof connectors and mil-spec ruggedized tablet were approved and the project was handed off to production.

5. How can the innovation be incorporated into existing corrosion prevention and control activities and how does it benefit the industry/industries it serves (i.e., does it provide a cost and/or time savings; improve an inspection, testing, or data collection process; help to extend the service life of assets or corrosion-control systems, etc.)?

The state of CIPS and DCVG survey instruments had been very stagnant for many years. The Hexcorder Pro takes advantage of many innovations in other industries, particularly the tablet computer. It was also an opportunity to address some difficult survey issues by adding new features. The Hexcorder Pro replaces the role of the Hexcorder Millennium, which already had worldwide use in the CP survey industry. The increased abilities provide an advantage to the field surveyor, the analyst and the pipeline owner.

The field surveyor now has more options to adapt the survey to changing conditions. They have a large graphical user interface that can be customized and changed based on their needs. This allows for an easier survey experience and more reliable data.

The analyst receives better data from the field, requiring less processing. The integration of the pipe locator depth of cover information adds useful data without requiring manual data entry. Using some of the advanced survey features, the analyst and the owner will have more confidence that potential problems are properly identified. As a result, the analyst can provide a better report to the pipeline owner.



6. Is the innovation commercially available? If yes, how long has it been utilized? If not, what is the next step in making the innovation commercially available? What are the challenges, if any, that may affect further development or use of this innovation and how could they be overcome?

The Hexcorder Pro was successfully introduced to the market at NACE CorCon 2017 in Mumbai India and is in use around the World. Units are currently in the field in Canada, USA, Brazil, Nigeria, China, Kazakhstan, India, Argentina & Turkey.

An innovative aid to introducing the Hexcorder Pro to the market and seasoned users was to develop a demo version of the app, available on Google Play Store, that allows end users to view preloaded data on a continuous loop. They can change survey setup parameters, interruption cycles and display settings to see what is now available on the market.

https://play.google.com/store/apps/details?id=com.cath_tech.demo

7. Are there any patents related to this work? If yes, please provide the patent title, number, and inventor.

No