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VOTES® Infinity - Valve Diagnostic System  
A Breakthrough in Valve Testing Technology



[www.cranenuclear.com](http://www.cranenuclear.com)

# A Breakthrough in Valve Testing Technology



## VOTES® Infinity

A portable, multi-platform, diagnostic system for industrial process valves. It allows the operator to diagnose valve problems. VOTES® Infinity is designed to acquire and analyze data from Motor-Operated Valves (MOV), Air-Operated Valves (AOV), and Check Valves (CV). Operators may use the system to collect, trend and analyze valve data for the life of the plant and to meet regulatory or site requirements.

## System Data Acquisition Unit (DAU)

The DAU is the main component of the VOTES® Infinity system. The DAU conditions and digitizes all incoming signals from various sensors, for further analysis by system software. The DAU communicates with the PC using wired or wireless Ethernet and supports voice communication between the DAU and PC.

The DAU contains 12 universal ports, each with two channel capability for a total of 24 input channels. All 12 ports are identical allowing any port to be used for any sensor. Each port is capable of voltage, current or quadrature (encoder) inputs, voltage or current outputs, and contains a sense input for monitoring of the excitation.

The Sense input is a voltage input signal that is typically used to monitor the reference voltage applied to strain gauges. This feature provides a great improvement in strain sensor accuracy. The system uses universal cables which allows the same cable to be used for connection to any sensor or external module. The universal cables are designed for connection to all CRANE VOTES® Infinity sensors. Adaptors may be provided to connect almost all types of sensors with voltage or current outputs. Adaptors may be provided to connect non-CRANE sensors.

The DAU contains a patent pending feature that allows the DAU to communicate with external sensors and signal-conditioning equipment. This feature, ASSIST™ Technology, significantly reduces operator workload and field errors by allowing the system to automatically configure itself for the sensors being used.

The DAU can run on either the internal battery or an external power supply. When running on the external supply, the internal battery is automatically charged. The unit can run on the battery for up to 4 hours.

The DAU supports both wired and wireless (802.11b) Ethernet. Both wired and wireless modes support DHCP and static I/P addressing, allowing the system to be used either over an existing network or directly, PC-to-DAU without any external network infrastructure.

The DAU is a sealed unit that mitigates dust ingress (contamination) and allows the system to be sprayed with water for cleaning. The unit will withstand up to 40 gallons a minute of water spray.

## VOTES® Infinity Top 5 Attributes:

- Simplified setup
- Reduced test time
- Minimal upkeep
- Reduced Errors
- Compact size



The VOTES® Infinity system comes with universal cables.



VOTES® Infinity can run on an external power supply or the Lithium Ion battery.



A sealed unit helps eliminate internal contamination and is easy to clean.

# Simplified Software and Custom Reporting



ASSIST™ Acquisition Wizard

## Sensors ASSIST™ Technology

**Automatic Sensor Setup Intelligence for System Transducers (ASSIST™)** Sensors equipped with ASSIST™ Technology (patent pending) are automatically detected and configured by VOTES® Infinity. All required information is stored on the sensor and transmitted to the DAU automatically when the sensor is connected. This feature eliminates sensor errors in the collected data. The DAU configuration is software-controlled, providing a plug and play environment, simplifying test setup, eliminating errors and thereby greatly reducing the time spent at the valve as well as time spent on subsequent analysis.

## VOTES® Infinity Software

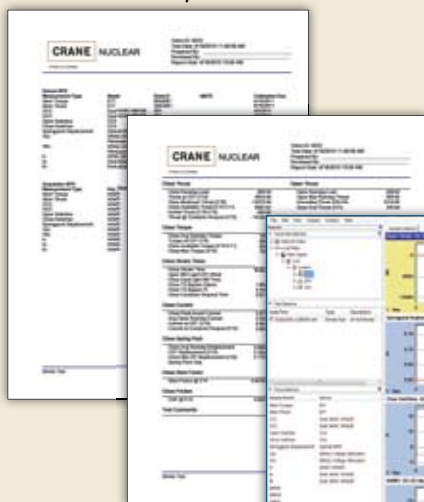
VOTES® Infinity Software handles all configurations and will automatically analyze the data and provide users with a variety of standard reports. Data analysis tools such as trending, filtering, FFT and XY plots, are readily available for performing analysis of all valve types.

The software supports importing of data from Signature Software 5.0 and later. For older data, a routine is provided that allows conversion from any older version of Signature Software to version 5.0 prior to importing into VOTES® Infinity software.

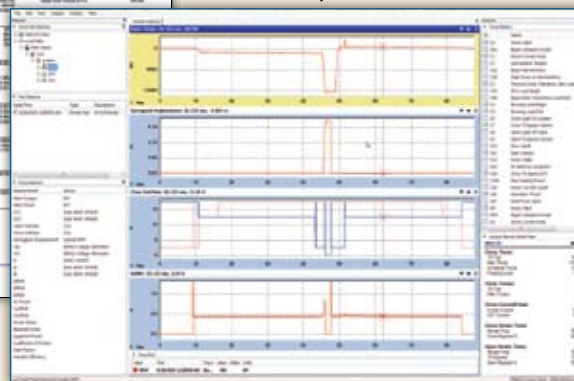
### Features:

- Single screen interface
- Automated and manual analysis
- Multiple analysis open simultaneously
- Automatic calculation of traces (e.g. differential pressure, stem factor)
- Custom reporting
- Valve specific criteria
- All graphs are overlays
- Drag and drop support
- XY graphing
- FFT analysis
- Trace filtering
- Delta function
- Trace alignment on any mark
- Trend plots

### Printable Reports



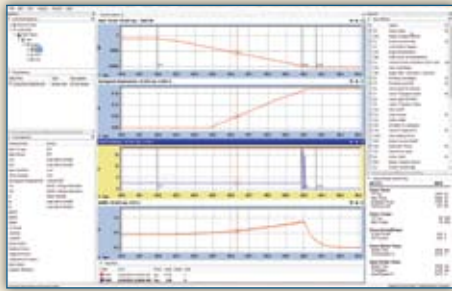
### Toolbar Reports



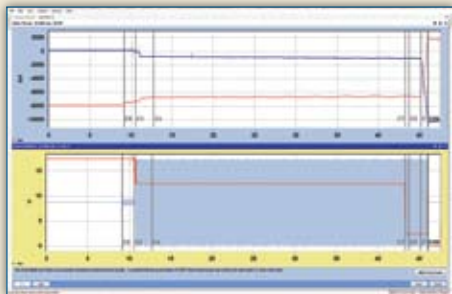
## Custom Reports

All valve types include custom report capability, a powerful feature of the VOTES® Infinity system. The user can include valve-specific criteria with each report template, providing an immediate pass/fail determination on-screen. Two types of reports are used: Toolbar Reports and Printable Reports. The Toolbar Reports are displayed along side the data during analysis and provide immediate results as the analysis is being conducted.

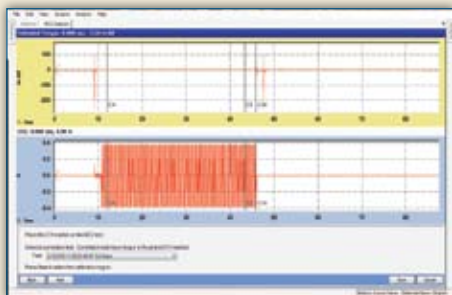
# MOV and MC<sup>2</sup>™ Testing Capabilities



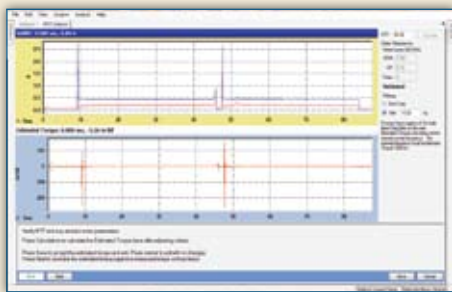
MOV Manual Analysis



MOV Automated-Marking



MC<sup>2</sup> Correlation Method



MC<sup>2</sup>™ Wizard

## Motor-Operated Valve (MOV) Capabilities

CRANE is the world leader in motor-operated valve (MOV) testing. We have been making MOV systems since the mid-80s. VOTES® Infinity is the result of over 3 years of development and includes the best features from all prior systems.

### Data Acquisition

With universal cables and ASSIST™ Technology, data acquisition is as simple as pointing to the desired valve and clicking test valve. The system will automatically detect what sensors are being used, configure the system and notify the user if anything needs attention before collecting the data. The data is then loaded into Automated or Manual Analysis.

### Analysis

Analysis has been greatly simplified while retaining the advanced-analysis capabilities needed for diagnosing problems. For routine testing the system provides an Automated-Marking routine for determining all major events in a MOV test. In addition to the Automated-Marking, VOTES® Infinity software includes a full-featured Manual Analysis routine, allowing the user to display and analyze data. The user can display any number of graphs on the screen and each graph is an Overlay. The user can have multiple analyses open, each displayed on a different tab.

**A breakthrough in valve testing technology.**

## Motor Control Center (MC<sup>2</sup>)™ Testing of MOV's

MC<sup>2</sup>™ testing technology was developed to assist plants in meeting the challenge of reducing valve testing costs. Designed to increase the performance, reliability and safe operation of motor-operated valves (MOV); MC<sup>2</sup>™ technology uses data acquired from the Motor Control Center to determine the condition and operability of the MOV.

### Data Acquisition

Implementation of the MC<sup>2</sup>™ technology allows reduced at-the-valve testing, therefore eliminating unnecessary steps during the outage.

### Analysis

The software automatically uses a patented algorithm to determine the motor output torque, allowing users to verify the availability of sufficient margin (e.g. stem thrust) to operate the MOV under design-basis conditions, thus satisfying the periodic verification/post maintenance requirements set forth in GL 9605.

The software automatically calculates a motor FFT (Fast Fourier Transformer) from the available current data and marks: motor speed, drive sleeve rotation frequency, motor pinion frequency, rotor bar frequency, slip pole frequency, stator slot frequency, and worm gear tooth mesh frequency.

# AOV and Check Valve Capabilities

## Air-Operated Valve (AOV) Capabilities

The VOTES® Infinity system has the ability to schedule a series of AOV Sequential Tests. The user simply needs to determine the tests to be performed and then begins a single acquisition sequence. Each requested test is then executed in sequence and stored automatically as a separate test, ready for analysis.

### Predefined tests include:

- Baseline
- Hysteresis+Deadband+Repeatability+Linearity (HDRL)
- Deadband
- Step Response
- Step Sensitivity
- Step Resolution
- Frequency Response
- Static Calibration

Also included is the ability to create and save custom test profiles. All predefined tests include fully automated analysis. In addition to the Automated Analysis, AOV includes complete Manual Analysis capability.

## Check Valve Capabilities

The VOTES® Infinity portable diagnostic system is designed for universal valve testing applications. For Nuclear applications, the equipment components and software programs have been developed under a 10CFR50, Appendix B Quality Assurance Program, and all software programs employ parameters compliant with IEEE 730. Development of the software in this manner provides traceability and facilitates data integrity.

### Data Acquisition

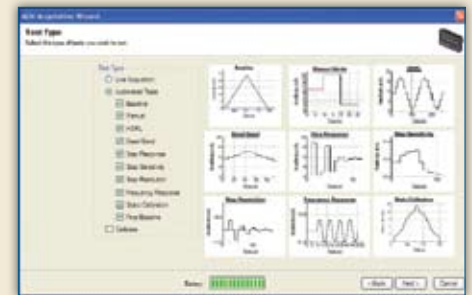
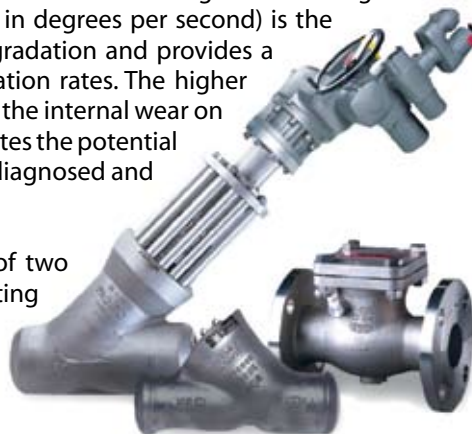
VOTES® Infinity uses several different technologies to collectively fulfill the test methodology requirements:

Noise Technology - the monitoring of Acoustic Emissions (AE) through the output of a pair of charge-type accelerometers.

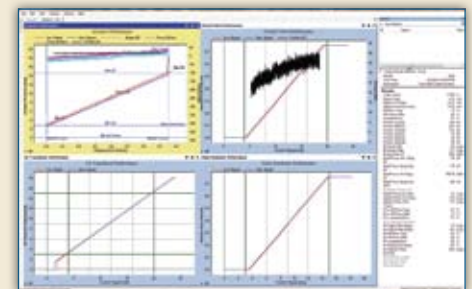
### Viewing Technologies

- Eddy Current (EC) - generates a field disturbance that can be used to identify proper stroking of the valve and a fluttering check valve.
- UT Technology - provides the most quantifiable means for determining valve's open angle and its angular velocity. The valve's open angle is determined through a validated algorithm to within 4 degrees. The angular velocity of the disc (delineated in degrees per second) is the best indicator of hinge pin degradation and provides a method for estimating degradation rates. The higher the angular velocity, the greater the internal wear on the rubbing surfaces, which creates the potential for valve failure, if not properly diagnosed and maintained.

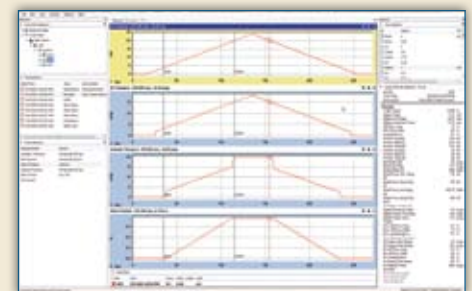
The system allows for the testing of two check valves simultaneously, eliminating the expense and time involved in testing each valve separately.



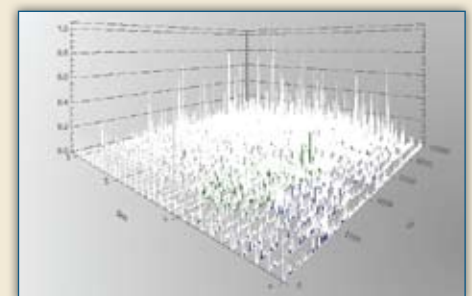
AOV Sequential Tests



AOV Automated Analysis



AOV Manual Analysis



Check Valve Waterfall Plot

## Technical Specifications

**Size:** 8" H x 12" W x 4" D (20.32 cm x 30.48 cm x 10.16 cm)

**Weight:** Approximately 11lbs. (5 kg)

**DAU power supply:** Input 100-240VAC, 50-60 Hz, Output 18VDC 8.3A

**DAU power requirements:** 5 to 30 VDC, up to 60 watts input power, depending on loading.

**Operating temperature:** -4°F to 122°F (32°F to 122°F with battery) -20°C to 50°C (0°C to 50°C with battery)

**Storage temperature:** -40°F to 185°F (-40°C to 85°C)

**Battery:** 10.8V Lithium Ion

**Battery life:** 4 hours typical under normal application load with full charge at temperatures above 0°C.

**Audio port:** AC97 Revision 2.3 compatible audio headset and microphone interface, adapter provided.

**Wired Ethernet port:** IEEE 802.3 compatible, cable provided for connection direct to a PC. Requires VOTES® Infinity Software for operation.

**Optional wireless Ethernet:** IEEE 802.11b compatible

**Channel sample rate:** User configurable 5 hz – 20 khz

**Calibration Interval:** 1 year

### Sensor Connector Ports (1 - 12):

**Channel A/B inputs:** +/- 10V differential, or 200mA, DC or peak AC

**Input impedance:** 100K ohms voltage mode, 10 ohms current mode

**Bandwidth:** DC to 10KHz

**S/N ratio:** 65dB min

**Accuracy:** +/- (0.5% reading + .01% full-scale)

**Sense input:** +/- 24V differential DC or peak AC

**Input impedance:** 100K ohms

**Bandwidth:** DC to 5KHz

**S/N ratio:** 65dB min

**Accuracy:** +/- (0.5% reading + .01% full-scale)

**Excite + output constant voltage mode:** 0-24VDC variable @ 150mA max.

**Accuracy:** +/- (0.5% setting + .01% full-scale) as measured relative to analog ground.

**S/N ratio:** 60dB RMS minimum into a 5K ohm load.

**Output update rate in stored waveform mode:** 1mS

**Excite + output constant current mode:** 0 – 55mA, 24VDC compliant

**Accuracy:** +/- (0.5% setting + .01% full-scale) as measured relative to analog ground.

**S/N ratio:** 60dB RMS minimum into a 1K ohm load.

**Output update rate in stored waveform mode:** 1mS

**Excite – output:** Switchable GND, -15VDC @ 150mA

**Accuracy:** +/- 5%

**Ripple:** less than 15mV RMS into a 5K ohm load.



# Options, Accessories and Upgrading

## Package Options and Accessories

VOTES® Infinity can be offered as a single platform system (e.g. MOV only). However, platform upgrade packages are available that allow the user to purchase one system which can monitor two or three different valve types (e.g. an AOV/MOV system). This allows customers to share systems between departments as systems are rarely fully-utilized throughout the outage cycle.

VOTES® Infinity is designed specifically to eliminate downtime and reduce spare part requirements. As all sensors use the same cable, you carry fewer spare parts. The standard cable length of 10 ft. is provided with the system. However, lengths of 35, 50, and 100 ft. are available options.

## Upgrading Your Existing Sensors

CRANE can schedule a modification during your next calibration cycle to upgrade your old sensor with a new sensor equipped with ASSIST™ Technology upon request. For those customers who would like to continue using the updated sensor with their old system, we also offer interconnection cables from the new ASSIST™ connector placed on the sensor back to your existing system.



VOTES® Infinity Sensors



**For a free demonstration of VOTES® Infinity contact CRANE Nuclear today.**



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EG-VI-CT-EN-L11-52- 1111 CV-1200

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