ELECTRONIC CALIBRATORS

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Electronic calibrators are fast becoming the benchmark for measurement and are replacing mechanical types of instruments for testing and calibration checks.

Techniques, usage, traceability requirements, and problems are changing quickly as technology advances in the development of these instruments. Information concerning these issues is often outdated by the time the technician receives it.

Electronic calibrators use a microprocessor with digital measurement. What is the difference between analog and digital? Analog is a continuous signal whereas digital is an analog signal converted into numerical data or bits that computers can understand change and store. The numerical values are converted from the analog signal at intervals of time. As the amount of time becomes shorter and shorter between the intervals of conversion, it becomes close to impossible to distinguish it from the original analog signal. Stephan Schuster chairman of the Rainier Corp., summed it up as follows: Analog is the real world and digital is a numerical representation of the real world."

Computers are the driving force behind the digital revolution because information must be digital to be used on a computer. Just like any other computer, technology is often obsolete by the time an instrument is designed, manufactured, marketed, sold, and shipped to the end user.

ASSOCIATED TECHNIQUES

The best technique for using an electronic calibrator is to have a solid knowledge of the mechanical aspects of the system it is being used on. There are some procedures that can be implemented to save some time and preserve the integrity of the information. Temperature is of utmost importance for measuring pressure or calculating flow. For temperature checks the most critical aspect is to see the same temperature as the gas stream. One method to ensure a closer test is to fill the test well with a non-interfering liquid, such as a light oil, to maintain a more constant measurement. In extreme ambient temperature differences with the gas, the measurement temperature is lost very quickly when the test well is opened to atmosphere. The result can be an average temperature shown instead of the actual gas temperature.

Temperature drift plays a significant role in the operation of pressure calibrators. Most portable electronic calibrators should remain at ambient temperature for a period of time before the test is performed in order to allow the sensor to adjust changes between the temperature inside the vehicle and ambient. To avoid this time lag, the calibrator could be placed in a location in the vehicle that is neither cooled nor heated. Another technique to help avoid temperature drift is to insulate the tubing from the line to the instrument For low pressures, a refrigerant type of hose can be used and for higher pressures a material such as Armaflex could be placed on the outside of the tubing or hose to insulate the gas temperature from ambient warming or cooling.

USES

Electronic calibrators are used for a variety of applications from flow measurement to safety monitors. Electronic flow meters require pressure, temperature, and differential. Many manufacturers are offering an all in one instrument and some are adding communication capabilities. Most offer the option of passing data through to a computer. Fixed monitoring equipment is the most common application that comes to mind for portable calibrators, but they are also being used to test the integrity of other portable instrumentation with lesser accuracy. Transmitters require not only pressure or temperature, but also electrical. The onset of calibrators with both capabilities has become very useful for this application. New portable calibrators on the market include chromatographs and high flow samplers. The uses of electronic calibrators are becoming infinite and present many challenges to the technician trying to keep up with changing technology while maintaining good mechanical aptitude.

TRACEABILITY

Traceability as it applies to the natural gas industry means that an instrument has been tested at the National Institute of Standards Technology with the numbered report of the test on file at NIST Once an instrument has been tested and has received this report number, this instrument can then be used to test other instruments that can also become traceable to the same test report number as the original instrument tested at N.I.S.T. Generally, a standards lab' uses instruments for testing which have been tested against an instrument that has been sent to N.I.S.T. and are not necessarily the original ones tested at N.I.S.T. with the report number assigned.

Having a definition of the term doesn't mean that the traceability of the instrument is understandable to the lay person with any certainty. Accuracy statements made by the manufacturers of electronic calibrators play an important and significant role in determining what instrument to use in different applications but does not indicate the actual performance in a particular situation. An accuracy statement made by a manufacturer is the theoretical accuracy" compiled by taking physical uncertainties into consideration. Actual accuracy would include all of the measurement uncertainties such as operator bias, leaks, temperature gradients, gravity changes, barometric pressure. etc. The Federal Energy Regulatory Commission (F has determined that instruments being used for test purposes must have traceability and must be twice as accurate as the item being tested, for example: Electronic flow meters have a stated accuracy 0.1% for pressure, meaning that the calibrator being used for testing should be 0.05% or better. Many manufacturers are offering calibrators with stated accuracies of 0.025%. It is important to note how the manufacturer arrived at this statement. Accuracies are determined in a laboratory environment and these laboratory conditions are usually mentioned in conjunction with this accuracy statement of the calibrator. These conditions are sometimes impossible to duplicate in the field giving a very real potential far a much greater error that the technician expects. Often the technician doesn realize an error is present unless the test instrument is drifting or the results vary greatly from previous tests. Temperature is the leadIng culprit in pressure measurement errors using electronic calibrators. Accuracy is usually stated as percent full scale, percent span, or percent of reading. Percent full scale and percent span are the same. Accuracy statements do not mean that the instrument has an error equal to the stated tolerance, but rather will not have an error greater than the stated accuracy. Example one: If the full scale range is 1000 psi and the stated accuracy is percent of reading. then the reading shown would be multiplied by 0.0005 to determine if the instrument is within tolerance. Then when temperature specifications are thrown in, an instrument with a stated accuracy of 0.05% and is temperature compensated from 30 to 130 deg. F could be much more accurate and reliable than an instrument with a stated accuracy of 0.02 and is calibrated at 60 deg F without compensation. It is important to remember the differences In accuracies between the test instrument and the instrument being tested, testing an instrument with a stated accuracy of 0.1% with an instrument with a stated accuracy of 0.025% gives the potential for thinking there may be a problem with the instrument being tested, when in reality it is well within the stated tolerance.

The instrument being tested probably would not show the error anyway because the decimal place digits wouldn't be available. The resolution of a calibrator is the number of digits available on the display. Some have four-digit display some have five digits, and some even six digit. Testing an instrument with a four-digit display with an instrument that has six, gives information that can neither be substantiated nor used.

PROBLEMS

Just as mechanical instruments have a set of problems connected with use, so do electronic calibrators. Electronic calibrators will show better results in measurement testing than will mechanical instrumentation except in extreme ambient temperature conditions. In the techniques section a few ways to overcome these problems were discussed, but temperature extreme is a serious problem with all electronic instruments.

Isolated sensors are almost mandatory in electronic calibrators because of liquids in the gas. Many sensor replacements are caused by liquid destruction rather than overpressure. A major problem is dust, dirt, and/or sand. This problem is very prominent in instruments with changeable modules. Field change outs of modules causes a buildup of grit or dust around the pins. After a period of time the instrument ceases to perform well or not at all. There is no way to prevent this from happening. Careful use and module changes will prolong the ill effects. Build up along the walls of the line in valve trees, straightening vanes, and etc. are not seen by electronic instruments. Changes in metal thickness, or orifice plates are also a factor. Volumes are calculated based on the meter tube size with at particular orifice. Electronic flow meters are calibrated based on these calculations. When build up or corrosion/erosion changes occur, tile instrumentation cannot compensate for these changes. A lot of lost or unaccounted for gas is shown because of these changes. Pipeline maintenance is very critical when using electronic instruments. Even though accounting procedures may show a tremendous amount of "lug", the truth is there is probably less now than ever before due to new technology showing where it is or that it's there at an. User friendliness is extremely important, Too many buttons to push, buttons being to small, too difficult to program, pods not labeled correctly, these issues are at the top of the list when selecting an electronic calibrator, If the instrument is too complicated for quick, efficient learning curves, the full potential of the purchase cannot be realized. The technician has so many different applications and/or instruments to keep up with, along with the integrity of mechanical parts, that ease of operation is primary to saving time and labor to get the job done correctly and efficiently.

Measurement uncertainties are showing up in areas where local gravity is being implemented on dead weight and pk testers. Most all electronic calibrators are calibrated to a national or international standard for gravity and temperature. When dw or pk testers are set to local gravity standards, the temperature used is generally still 80 degrees F, but the gravity difference can show an error where there really isn't one according to manufacturers' specifications. If a primary standard is used to calibrate an electronic calibrator, the primary standard should be in a climate controlled area and in a fixed position, with the gravity correction being the same as the electronic calibrator or corrections should be applied to the results before the measurement is assumed correct. According to many manufacturers, the gravity reference cannot be changed on electronic calibrators, therefore a correction factor should be used when using a primary standard set for local gravity.