Troubleshooting process loops in potentially explosive atmospheres

Application Note

Tracking down problems within a process loop can be a difficult challenge in the best of environments. Doing so in an area that has the potential for explosion takes the degree of difficulty to another level – one where the technician needs proper training and equipment. This article will demonstrate the practical application of loop calibrators designed to troubleshoot process loops in intrinsically safe environments.

What is "intrinsically safe?"

Intrinsic safety is a protection standard employed in potentially explosive atmospheres. Devices certified as "intrinsically safe" are designed to be unable to release sufficient energy, by either thermal or electrical means, to cause ignition of flammable material (gas, dust/particulates).

Intrinsically safe standards apply to all equipment that can create one or more of a range of defined potential explosion sources:

- Electrical sparks
- Electrical arcs
- Flames
- Hot surfaces
- Static electricity
- Electromagnetic radiation
- Chemical reactions
- Mechanical impact
- Mechanical friction
- Compression ignition
- Acoustic energy
- Ionizing radiation

Intrinsic safety is particularly important for technicians working in industries like petrochemical and pharmaceutical, around bulk materials such as grain, mining, or any environment where explosive gases are present.

The importance of safety in these environments can't be stressed enough. It takes a very small amount of energy to cause an ignition; e.g., a mixture of hydrogen in air requires only 20 uJ of energy. The proper practices and tools will minimize the inherent risk involved in working around these hazards.

Intrinsically safe loop calibration

To conduct loop calibrations in potentially explosive environments, you need a loop calibrator that is certified as intrinsically safe. Intrinsically safe loop calibrators, such as the Fluke 707Ex, must be certified in accordance with the European ATEX ("**At**mosphères **Ex**plosibles," French for explosive atmospheres) directive (Ex II 2 G Ex ia IIC T4) in Zones 1 and 2 for use in Europe and NEC 500; N.I. Class 1, Division 2 areas Group A-D for use in the U.S.

In addition to an intrinsically safe loop calibrator, strict adherence to calibration procedures is recommended, including:

Lock out: Make sure the system is shut down and other workers are notified that a potentially dangerous operation will be taking place.

Tape off area: Tape the work area off to prevent workers from entering with potentially dangerous electrical devices (cell phones, handheld computers, non-intrinsically safe tools).

Purge or vent the systems: Safely purge or vent the system to remove any gases that may remain.

Use a gas detector: In an environment where explosive gas may be present, the use of a gas detector is a prudent step before starting a loop calibration. Gas "sniffers" are available for a wide variety of applications and from handheld to larger, carted models.

Calibrate: Perform your calibration using an intrinsically safe loop calibrator.

Clean up and reactivate: At the conclusion of calibration, reverse the process and reactivate the system.

Loop calibration

The 707Ex Loop Calibrator has the ability to replace the power source in a current loop so you can power and read a transmitter at the same time without carrying a digital multimeter (DMM).

With the calibrator in control of the current, you can accurately set the current between 4 and 20 mA, controlling the loop and the device connected to it. This makes it possible to test valve positioners (see below), mechanical position indicators, flow indicators and mA signal conditioners.

For testing devices requiring a voltage input, like a signal conditioner or PLC, you can use the source mode of a calibrator in conjunction with a precision resistor to generate accurate voltages.

Simply taking a precision resistor and placing it across the output leads of a loop calibrator creates a voltage across the resistor that is directly controlled by the source current from the calibrator. For example, placing a 250 Ω resistor across the source output jacks and driving it with a 4 to 20 mA current will produce 1 to 5 V across the resistor. Place this voltage on the input of a signal conditioner and we have created a test system to set linearity as well as the zero and span points of the conditioner. With a DMM or ProcessMeter™ instrument like the Fluke 789, you can measure the output of the signal conditioner and ensure the proper levels are coming out of the conditioner with a corresponding input voltage.

Testing valve positioners

Electronic valve positioners should receive periodic in-field calibrations as part of preventative maintenance programs. Fluke loop calibrators are the ideal process tool for these checks. Valve positioners vary in design and valve type and should be calibrated using specific instructions from the individual manufacturer.

Quick operational checks can be performed using a field calibrator as a signal source while observing the valve stem position, mechanical position indicators, or flow indicators as input changes are made. Fluke loop calibrators provide a convenient source for simulating the controller output to a valve positioner.

The following example (using a Fluke 707Ex calibrator) shows a general method for an in-field operational check of a valve fitted with an electronic valve positioner. These methods may be adapted to various types of valves, however manufacturer's specific instructions should always be consulted for proper and appropriate techniques. In the following example, valve operation and movement is checked either by feel or by observing valve stem movement.

Step 1: Basic set-up. Setting the Fluke 707Ex Loop Calibrator current output.
Place the calibrator in the 4-20 mA output current mode. Connect the 707Ex to the input terminals of the valve positioner.

Step 2: Zero adjustment
Set the 707Ex to an output of 4 mA and allow some time for valve stem movement to stabilize. Quickly decrease the current from 4 mA to 3.9 mA by depres-sing and turning the vernier knob in a counter-clockwise direction. You can operate the 707Ex with one hand while feeling the valve stem with your free hand to check for any sign of movement. Adjust for zero movement between these two current settings by using the Zero adjustment on the positioner.

Increase and decrease current from 4 mA to 4.1 mA using the vernier knob in the depressed position. Insure that the valve stem just begins movement above the 4.1 mA setting and fully closed at 4 mA.

Step 3: Span (full open) position check
Using the 25 % button, step the valve input to 20 mA and allow the valve to stabilize. Step the input to 24 mA while watching or feeling for movement of the valve stem. Minimize this movement using the Span adjustment on the valve positioner.

Using the vernier knob in the depressed position, adjust current up and down between 20.10 mA and 19.9 mA. There should be no movement of the valve stem above 20 mA and a slight movement below 20 mA.

Step 4: Check zero and span again
Many positioners have interactive Zero and Span controls. This step will help ensure proper valve position adjustment.

Repeat Step 2 and Step 3.

Step 5: Linearity check
For valves with linear action, linearity can be checked by setting the 707Ex to 4 mA and stepping current to 12 mA (50 %) while observing valve travel. If your valve is of a nonlinear type, refer to the valve manual for proper operational checks.

Step 6: Stroking the valve
Checking for smooth valve operation is easy to accomplish using the Slow Ramp function of the 707Ex.

- Set the calibrator to mA source mode and select the Slow Ramp function (⩘) by depressing the 25 % and 0-100 % buttons simultaneously.
- Allow the calibrator to ramp through several cycles while watching or feeling for any abnormal operation of the valve such as sticking in one position momentarily or erratic movement.

Summary

Calibrating process loops is an essential part of regular plant maintenance made all the more difficult in potentially explosive environments. Using intrinsically safe tools and the proper procedures to safeguard the working area minimizes the risks involved.

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