WHAT'S 4-20 ma ALL ABOUT?

4-20 milliamps is a lot simpler and straightforward than you may think. It's a simple and reliable way to transfer information and control a system that was developed more than 50 years ago. It's an *analog* system. This means that the information is represented by the signal intensity rather than with 0's and 1's as is done in *digital* systems. For those of us who can remember, vinyl LP's were analog recordings and today's CD's are digital recordings of music. When an LP was damaged it still played but had more noise than before (clicks, hiss, pops) making it harder to hear. CD's are pretty durable by comparison and when they get a scratch, it usually doesn't effect their sound. But if an old record player started to act up, it usually only needed a "needle" replaced by you. If a CD player acts up, you either buy a new one or pay a tech to fix it if it's an expensive unit.

The same pros and cons exists for process monitoring and control. Analog is cheap and easy to understand and fix but it has limits imposed on it because it is vulnerable to electrical noise created by surrounding equipment. Digital is pretty much immune to noise and can do more complicated things, but very often is overkill. A good analog system is cheaper, easier to maintain and gets the job done without a hassle.

So, let's talk about what 4-20 means and how it works. You can relax, the subject really isn't complicated and in another five minutes you will have a working knowledge of what it is and how it's used. To begin with, a milliamp (1 ma.) is 1/1000 of an amp. At 120 volts, the average hair dryer operates on 10 Amps or 10,000 milliamps. So we're not working with much power at 4-20 milliamps (it's pretty safe). As a fluid-handling specialist, you know that while the pressure in a piping system drops along its path, the flow is constant along the same path. In the same way, an instrument specialist knows that while the voltage drops along a wire, the current (the amperage) in that wire stays constant end to end. So if you want to use an electrical signal to supply information, you use the property that doesn't change along the way; the current. If you put a 4 milliamp signal in one end of a wire, 4 milliamps will be seen at the other end.

If we were to set the low current at 0 ma, then we wouldn't be able to tell if the "loop" was at zero or had a broken wire or maybe a failed power supply. By making 4 ma. the lower limit, we now know if the "loop" is working. Why was 20 ma. picked as the highest value? I have no idea, but it is a nice round number. Let's use an example to show how this all works. An instrument tech installs a pH sensor to monitor a waste-stream who's starting pH is always less than 6.0. The sensor has a range of 0-7 pH. It sends out a signal of 4-20 ma. 4 ma equals a pH of 0 and 20 ma. equals a pH of 7. Every value in between is proportional. For example, a pH of 3.5 will produce a 12 ma. signal.

Let's take the signal from that pH sensor and supply it to a Model 420^{tm} pump controller. Let's program the controller to run a pump at 0 strokes/minute (i.e. stopped) at 18 ma. (equals pH of 6.0). Let's also program the controller to run a pump at 100 strokes/minute at 4 ma. Let's also hook the controller up to a small Solenoid-Controlled pump delivering a neutralizing alkali solution upstream of the sensor to the waste-stream to mix with it and neutralize it. When the pH is low (acidic), the pump runs fast delivering a lot of alkali. When the pH is nearer the target (6.0), the pump runs slower delivering less alkali, and when the target is hit, the pump stops. **We have just automated the process of neutralizing a waste-stream**. The controller never gets bored or sleepy , doesn't need lunch and always does its job the same way.

pH	Ma.	Speed	Delivery*
0	4.0	100	0.40 gpm
1	6.3	83	0.33 gpm
2	8.6	66	0.26 gpm
3	10.9	49	0.20 gpm
4	13.2	32	0.13 gpm
5	15.6	15	0.06 gpm
6	18.0	0	0.0 gpm

EXAMPLE VALUES

Of course, values in-between those is this chart would be calculated by the controller and intermediate speeds sent to the pump.

The 4-20 signal is offered with a great variety of sensors and can communicate to a great variety of instruments. It's simple to setup and run. You can do hundreds of different automation chores using this technology and not have to learn another thing; **not bad**.

*estimated fluid delivery on a small pump

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