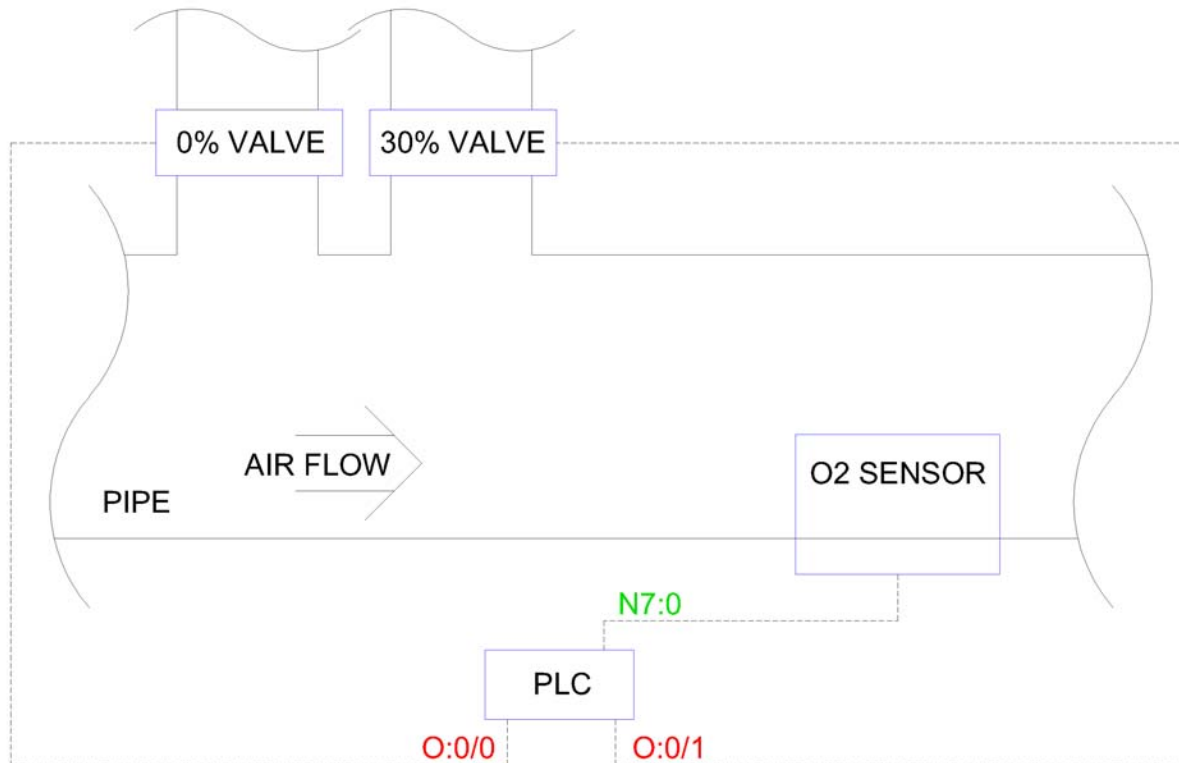


Project 7

PROCESS:



SUMMARY:

This system is at the bottom of a coal mine, and it's measuring the concentration of O₂ in the air (pretty important). The O₂ sensor degrades over time and requires calibration by comparing its readings to known values. Our sensor will read from 0-40%. We have calibration gases which are exactly 0% and 30% O₂. This is advanced, but try it...

Our machine will have two cycles: sampling and calibration. When it's sampling, it just measures the O₂ concentration of the air passing by the sensor. There's nothing special happening there.

When we go into a calibration cycle, it needs to open the 0% gas valve and sample it for 30 seconds. Next it will close the 0% and open the 30% and sample that for 30 seconds. Finally, it will use the average readings it took over those two periods and use them to "tune" its own scaling parameters according to the following calculations.

CALIBRATION CALCULATIONS:

Input Min = O2_Zero_Average

Input Max = ((O2_Maximum_Concentration / O2_Calibration_Gas_Concentration) *
(O2_Test_Gas_Average - O2_Zero_Average)) + O2_Zero_Average

O2_Maximum_Concentration = 40(%)

O2_Calibration_Gas_Concentration = 30(%)

O2_Test_Gas_Average = average reading sampled during 30% gas period

O2_Zero_Average = average reading sampled during 0% gas period

IO / ASSIGNED MEMORY:

N7:0 - O2 sensor input signal

B3:0/0 - Calibrate button

O:0/0 - 0% gas valve (energize open)

O:0/1 - 30% gas valve (energize open)

N7:1 - Measured O2 concentration

N7:2 - O2 input min (for SCP instruction, default value = 0)

N7:3 - O2 input max (for SCP instruction, default value = 16383)

TEST CRITERIA:

To start, run your program on Emulate. Set N7:0 = 8192, N7:2 = 0 and N7:3 = 16383. N7:1 should be approximately equal to 20(%).

The next few steps of this test procedure are going to require some FAST ACTION on your part to get accurate results, so don't be discouraged, but it might take a little practice (or creative programming).

Next, set N7:0 = 0 and toggle B3:0/0 on and then back off immediately after. Watch your calibration cycle! You want to change N7:0 to 12288 at exactly the same moment that your calibration cycle enters its second stage (30% gas). After calibration finishes, N7:1 should be approximately 30(%). Now change N7:0 to 0. N7:1 should also be about 0. Set N7:0 to 16383. N7:1 should be about 40.

Okay, that's half of it. Here comes the hard(er) part!

Last piece - set N7:0 = 100 and toggle B3:0/0 off and then back on immediately after. Watch your calibration cycle! You want to change N7:0 to 11000 at exactly the same moment that your calibration cycle enters its second stage (30% gas). After calibration finishes, N7:1 should be approximately 30(%). Now change N7:0 to 100. N7:1 should also be about 0. Set N7:0 to 14633. N7:1 should be about 40.

NOTES:

Do you hate me? If not, you're about to! Last section was easy. That was your vacation. This... is not. This is going to be a major, advanced hair-pulling, cat-kicking kind of experience, but if you learn it, you'll be able to do some EXCELLENT stuff with your own programs, so whatever you do or don't take from this course – make sure you walk out with a rock-solid understanding of this project. This will put you above many experienced programmers out there.

And who doesn't like to be among the bestest? ☺