Integrated Manufacturing Systems Troubleshooting

Troubleshooting Exercises – Instructor Directions

The first time through these exercises must be instructor led. Use the second version once the students know what to expect. This can be a homework assignment.

There are presently 2 sets of troubleshooting exercises (Version 1 and 2). Each set will be leveraged twice. This will give the instructor a total of 26 exercises to use in the classroom.

(In all cases) – Part 1: With the Logic. (Version 1)

1. The following exercise must be preceded with a lecture on the troubleshooting methods that use the PLC logic to support troubleshooting.
2. Have the students develop the sequence diagram first for the version. In each set there are 2 templates that reflect the circuit and logic with no highlighting. Issue the blank sequence diagram, the circuit template and logic template to the students and have them construct a sequence diagram.
3. Review the sequence diagram on the board and ensure that all students have a correct diagram.
4. Start with the circuits and logic. Give the students the operator description of the faulted machine. Ask them to isolate the faulted component.
5. Give the class time to work on the exercise. Ask them to write down the answer on the bottom of the sheet and not share the answer with other students. The Instructor should circulate around the room verifying answers.
6. With the troubleshooting methodology on the board and the circuit and the logic on the overhead, discuss with the class the methodology that should have been used to isolate the problem.
7. Q & A
8. Issue the second exercise and repeat.
9. Go through all of the exercises and continue to develop the troubleshooting flow chart and imprint the methodology in their minds.

At a later time in the class or the next day, continue with the second part of the troubleshooting exercises. (Without the Logic)

Part 2: Without the Logic

1. The following exercises must be preceded with a lecture on the troubleshooting methodology when the PLC Logic is not available.
2. Again start with a sequence diagram. The students can use the diagram that they have previously created for the circuit.
3. Issue the first exercise. Give the operator complaint and ask the students to isolate the fault.
4. Again remind the students to work alone and not share their answers. Again, the students should write their answers down and the instructor should circulate throughout the room verifying the answers.
5. Again, with the methodology on the board and the circuit on the overhead, go over the steps that they should have taken to isolate the fault.
6. Q & A
7. Repeat for the next exercise.

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Instructor note: Always start with the logic first and then take away the logic and repeat. This may seem a little counterintuitive… but it works well. With the logic a bad input or output module can be isolated. Without the logic, it is known that all the triggers are present, the output you want is off and you have no communications fault or processor fault. You cannot isolate the fault to a single module. Therefore change the output module first and then the input module. If that doesn't work, the troubleshooter will have to access the logic.
Also, the output lights are normally in parallel with the load. For the troubleshooting exercises, this assumption is allowed. In cases where dry contact output modules are used (relay outputs) and some isolated output module, the output light is up stream and not in parallel with the load. With these modules, a meter check on the output is required to ensure that the PLC is trying to turn on the output. A meter check of the output is always a good idea. This action also catches "switched - motion causing output" power supply issues.

Two versions of exercises are provided for the class. If class time is insufficient, the instructor may want to use one of the versions for homework or for remediation, or as filler material when other students are troubleshooting in lab and there is insufficient equipment to lab all students at once.

Remember: Keep expanding the troubleshooting methodology with each iteration. For example: all fluid power directional control valves have a manual operator that can be used to help isolate a fault. Additionally, normally open push buttons will never have their input module lights illuminated unless they are being depressed at that time. This implies two troubleshooters working together to determine whether the input device is passing power (On any large system). Etc.

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