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National
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Transforming the skill landscape

Sample Test Project

District / Zonal Skill Competitions

Skill- Industrial Control

Category: Manufacturing & Engineering Technology

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Section - A

A. Preface

Skill Explained:

Industrial control describes a variety of Control Systems along with their associated Instrumentation. Industrial controls monitor, control, safeguard and operate Industrial processes like Manufacture of Automobiles, Machines, Chemical, Refineries, Petroleum Products, Pharmaceutical, Steel, Power plants, Water, Waster water etc. to name a few. Typically Industrial control deals with:

- Continuous control, in which the variables and parameters are continuous and analog
- Discrete control, in which the variables and parameters are discrete, mostly binary discrete.

In practice most operations in the process and discrete manufacturing industries tend to include both continuous as well as discrete variables and parameters.

Therefore many industrial controllers are designed with the capability to receive, operate on, and transmit both types of signals and data. Industrial Control contains elements of both electrical installations and automation installations, with greater emphasis on automation installation

An Industrial control practitioner must have an overall knowledge of preparing and interpreting design & engineering documents and drawings and technical skills for installation, testing, commissioning, maintenance and trouble shooting of the industrial controls of the associated plant/project. The industrial control practitioner requires a wide range of technical skills, such as installing conduits, cables, instruments, I/O devices and Programmable Logic Controllers. The industrial control practitioner also designs electrical circuits, programs Programmable Logic Controllers, parameterizes bus systems and configures Human Machine Interfaces.

The working environment is likely to be one that is potentially very dangerous and hazardous. The industrial control practitioner proactively promotes best practices in health and safety and rigorously adheres to health and safety legislation.

Trouble-shooting is an important skill of the industrial control practitioner and includes identifying problems during equipment installations in a new plant or remedying problems within an existing plant.

Eligibility Criteria (for IndiaSkills 2018 and WorldSkills 2019):

Competitors born on or after 01 Jan 1997 are eligible to attend the Competition. The team consists of 2 competitors.

Total Duration: 5 Hrs

Section - B

B.Test Project

Theoretical Test

Objective Questions to check the basic knowledge in 40 Marks

- Electro Pneumatics
- Basic Logic Circuits

1] Pressure Switch [each 2 marks –total 10 marks]

a] A **pressure switch** is a form of **switch** that operates an electrical contact when a certain set fluid **pressure** has been reached on its input. [True /False]

b]The **switch** may be designed to make contact either on **pressure** rise or on **pressure** fall. . [True /False] .




c] In a Pressure Switch set at 50 psig on rising pressure , actual process pressure rises above 50 psig and switch operates and contact opens , Contact then resets and closes when pressure falls to 49.99 psig. . [True /False]

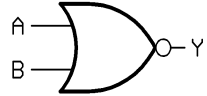
d] In a Pressure Switch set at 50 psig on rising pressure , actual process pressure rises above 50 psig and switch operates and contact opens , Contact then resets and closes only when pressure falls to a lower value –for example 47 psig- which depends on the differential setting of pressure switch [True/False]

e] In a Pressure Switch set at 50 psig on rising pressure , actual process pressure rises above 50 psig and switch operates and contact opens. For resetting the switch to bring it to its normal state , one has to adjust this in a workshop. True/False]

2] Logic Gates [2 marks each -total 8 marks]

In each Logic gate given below mark the right answer

	AND / OR / NOR/ NAND
	AND / OR / NOR/ NAND
	AND / OR / NOR/ NAND

	AND / OR / NOR/ NAND
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3. Basic Circuit –Total 12 marks

3a] Draw a basic start stop circuit working on a 24 Volts DC supply. The circuit should include a green lamp indication for Start and red lamp indication for stop [10 marks]

3b] Draw symbols for Normally open relay contact, and Normally Closed relay contact [2mark]

4. Solenoid Valve [Total 10marks]

a.]Draw details of a five port solenoid pneumatic connection to a standard air cylinder .[8 marks]

b]Mark all the the 5 ports of the solenoid- example “supply port” etc [2 marks]

Project Task

Competitors are required to study, design and operate a “Demo system of a pressure switch for an air receiver operation” on the guidelines of the declared test project. The Sample Test Project is subjected to a 10 to 20% change. However, changes shall not require any change in the infrastructure requirements.

The project is a combination of Electro Pneumatics and Logic Circuit. Purpose of this project is to design a trip logic system for an Air Receiver using a combination of “High Pressure Switch” and two way solenoid valve which responds to a logic circuit.

The project involves the following steps

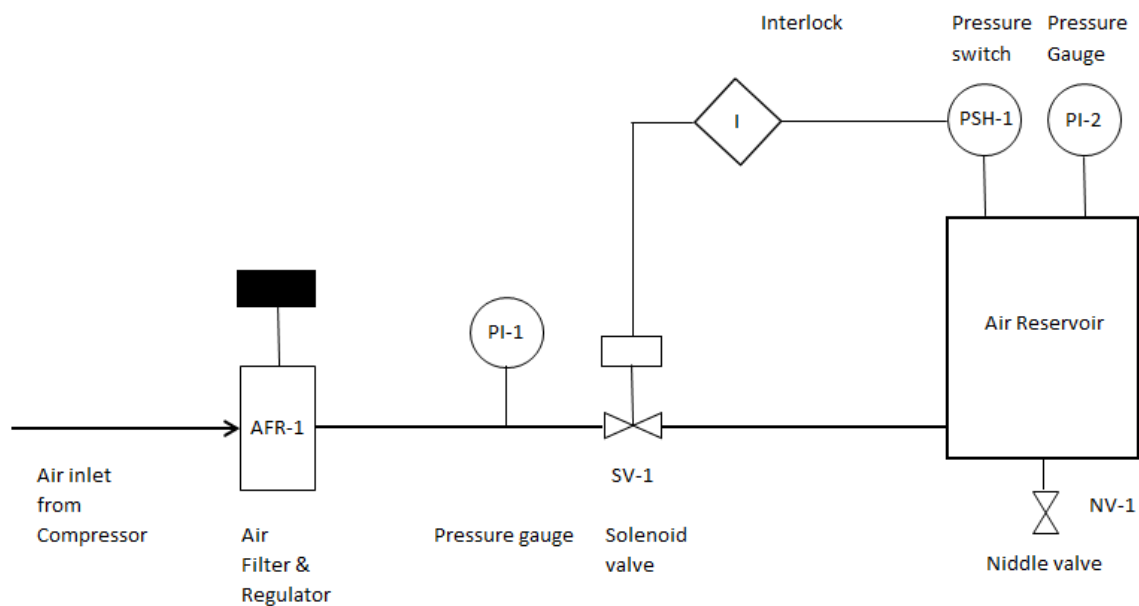
- i. Preparing the schematic diagram of the logic circuit based on the given diagram and process write up.
- ii. Calibrating one Pressure gauge (of the 2 Nos involved) & the Pressure switch
- iii. Testing the Solenoid valve
- iv. Testing the electric circuit
- v. Install the pressure gauge, pressure switch and solenoid valve and accessories used to assemble/build the unit based on the given diagram
- vi. Perform the independent loop testing of the pressure switch and the solenoid valve

- vii. The system is then put in operation and has to be then demonstrated by the contestant to the personnel conducting the test.

The competitors shall be required to submit a soft copy of the technical documentation of the demo system. The documentation shall include

- i. The schematic diagram of the logic circuit
- ii. Calibration procedure for Pressure gauge & Pressure switch
- iii. Testing procedure of Solenoid valve
- iv. Instrument schedule
- v. Data sheets of pressure gauge, pressure switch and solenoid valve

The basic system diagram is given below.



Objective:

The Air Receiver is to be maintained under normal operation at 30 psig and is to be controlled and operated as follows:

- The system is designed to shut the air supply to Air Receiver when pressure rises above 50 psig.
- The Air Receiver is restored to normal state when the Pressure drops to about 47 psig(approx.)

- In the event of pressure rising above 50 psig, the inlet solenoid valve SV-1 is shut. The Air receiver has to be normalised to 30 psig by operating a needle valve NV-1

Operation:

After completing installation and checking out circuit wiring , and ensuring Pressure switch PSH-1 has been set and checked for 50 psig action, open air supply valve.

Adjust air regulator AFR-1 to 30 psig noting Pressure indicators PI-1.

Operate Start Push button of logic circuit - Solenoid valve SV-1 will open and Air Reservoir will get pressurized. Adjust Air regulator so that pressure readings both on PI-1 & PI-2 stabilizes at 30 psig.

High Pressure Test:

Now gradually operate air regulator to slowly increase pressure to 50 psig. When Pressure rises above 50 psig Solenoid valve SV-1 shuts and isolates air supply to air receiver.

Now open needle valve NV-1 and vent gradually and bring pressure to about 20 psig.

Observe that solenoid valve SV-1 is open and air to air receiver is on. Adjust air regulator once again so that pressure stabilizes at 30 psig.

Demo is complete. The circuit may be switched off , air receiver vented and air supply isolated.

Section –C

C. Marking Scheme

Evaluation of documentation and hook up of installation-Project Task

1	Evaluating of circuit diagram, calibration procedure, data sheets, testing & hook up	30		
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Practical Operation Evaluation----total marks=20

Sr.No	Operations	Marks	Score	Remarks
1	Integrity of Installation	2		
2	Starting operation and Stabilizing Air Receiver Pressure to 30 psig	6		
3	Simulating high pressure condition by increasing pressure above 50 psig	4		
4	Solenoid valve SV-1 shuts off at 50 psig and air pressure stabilized to normal pressure to 20 psig by needle valve operation	4		
5	Normalize operation by starting air filling operation again and setting air receiver to normal pressure of 30 psig	2		
6	Shut down system as per procedure	2		

Professional practice----total marks=10

Sr.No	Criteria	Description	Marks	Score	Remarks
1	Safety	Contestant injured himself	0.5		
2	Safety	Contestant injured another person	0.5		
3	Safety	Electrical power supply and	0.5		

Sr.No	Criteria	Description	Marks	Score	Remarks
		circuit integrity with proper insulation, no bare wires or loose connection.			
4	Safety	Pneumatic and mechanical connection integrity firm and no leaks.	0.5		
5	Tools & Equipment usage	Work place neat and as per procedure and neat after completion of task	1.0		
6	Tools & Equipment usage	Used right tools and methods for electrical connections. Mounted hardware and circuit board properly without any make shift arrangements	1.0		
7	Tools & Equipment usage	Used right tools and method for fittings for pneumatic and mechanical connections. Checked for leaks before starting work.	1.0		
8	Tools & Equipment usage	No damage of tools or test equipment used.	1.0		
9	Methodology	Used a check list to ensure all items of Task were available and arranged.[This included all consumables for the exercise]	1.0		
10	Methodology	Used right instrument fittings for pneumatic and mechanical connections	1.0		
11	Methodology	Used proper terminal board and ferrules as required. Ensured proper mounting of control circuit and Solenoid	1.0		

Sr.No	Criteria	Description	Marks	Score	Remarks
		Valve			
12	Methodology	Used right length of plastic tubing and cables/wires. Used electric insulation tapes as required for electrical work.	1.0		
		Professional Practice	10		
		Total			

Section - D

D. Infrastructure List

Workshop Installation-Tools & Equipment provided by Organizers of Test Project

Mechanical equipment & Tubing

[1] Air Receiver [typical 12 inch diameter and 12 inch height] OR equivalent–suitable for 150 psig operation at ambient temperature.

Air Receiver to have one inlet connection, two tapping points (one for pressure indicator & second one for pressure switch) and on at bottom (for needle valve)

All tapping points and inlet connection shall have isolation valves.

Preferred end connection ½ in NPT [screwed]

[2] Plastic tubing of ½ inch to handle 150 psig air of approximately 10 meters length

[3] Screwed fittings and unions as required

[4] Consumables, cleaning material etc

Instruments & Electrical items

[1] Pressure gauges, ½ inch end connection, 0 to 100 psig range, 2 Nos

[2] Pressure switch, ½ inch end connection, 0 to 100 psig range, 1 No.

[3] Air Pressure Regulator, ½ inch end connection, Upstream Pressure 150 psig downstream regulation 0 to 60 psig

[4] 2-way solenoid valve, ½ inch, 24 V D.C

[5] Electric circuit board housing 2 nos of 24 V D.C relays, Start/Stop push button, Green and Red lamps (for status indication of solenoid valve), terminal strips, suitable wires and mounting board.

24 V D.C. Electrical power supply source

Instrument air supply source, 150 psig.

Tool Kit-Tool & Equipment allowed to be brought by competitors for competitions

- Set of Screw drivers
- Tester
- Nose plier

- Multimeter
- Teflon tape

All other tools not mentioned in the list above to be provided by the organizers

Section –E

E. Instructions for candidates

Competitors have to complete writing circuit within the time of first session

Competitors have to connect the same circuit has written by them in answer paper, change in circuit with lead for reduction in points

During practical session change in the written circuit is not allowed

Time will be allocated to check the working condition of the component, declaration on not working condition should be done that time

The working methodologies are considered for marking

Any damage in the component will not be replaced if declared after starting of the competition

Competitors can check for the working of the circuit any number of time before declaration

Competitors can check for the working of the circuit any number of time before declaration

If found short circuit in the circuit during evaluation, the evaluation will be stopped

Section –F

F. Health, Safety, and Environment

Health, Safety, and Environment

1. All accredited participants, and supporting volunteers will abide by rules and regulations with regards to Health, Safety, and Environment of the Competition venue.
2. All participants, technicians and supporting staff will wear the required protective Personnel clothing.
3. All participants will assume liability for all risks of injury and damage to property, loss of property, which might be associated with or result from participation in the event. The organizers will not be liable for any damage, however in case of Injury the competitor will immediately inform the immediate organizer for medical attention