WORLDSKILLS SINGAPORE 2027
TECHNICAL DESCRIPTION

MECHATRONICS

Skill Competition

1. This competition covers system control in the use of electromechanical, pneumatic, electronic equipment and the control software in a manufacturing or assembly plant involving the design, installation, commissioning, and maintenance of software-driven, electronically controlled systems.
2. Conducted as a 2-person team event, competitors are given 10 hours over 2 days to complete the Test Projects for this competition.

Scope of Work

3. The project will be structured in modules. Competitors must be able to demonstrate competencies in the following areas:
   - 3.1. Solve logic problems
   - 3.2. Carry out system design and/or optimization or complete the system
   - 3.3. Assemble a machine according to documentation
   - 3.4. Design a program for controlling a machine
   - 3.5. Connect a machine to its control system
   - 3.6. Commission the machine to carry out its correct function to solve a series of practical operational problems
   - 3.7. Interpret appropriate forms of technical documentation (e.g. circuits, displacement-step diagram, sequence instructions)
   - 3.8. Design electrical and pneumatic circuits by hand or by using commercially available software

Practical Work

4. The Test Projects may include the following aspects of practical work:
   - 4.1. Design
     The project is to be designed using the industrial components in accordance with specifications. Optimisation may be included in the project.
   - 4.2. Assembly and Connection
     a. The project is to be assembled using the industrial components in accordance with the instructions and documentation or own design.
     b. The speed of assembly of known stations will not be a criterion. The assessment of the quality of assembly must reflect industrial standards and professional practice.
     c. Connections are to be made according to instructions and documentation to ensure correct function of the machine. Any circuit diagrams necessary for successful completion of the project are to be included.

4.3. Commissioning
   a. The machine must be made to function in accordance with the instructions, documentation and professional practices.
   b. No deliberate faults will be introduced.

4.4. Troubleshooting
   a. There may be a series of multiple problem troubleshooting sections which will draw on a prepared set of faults, preferably with computer generated random selection immediately prior to their use or a selected group of jury panel at the competition.
   b. This section may also include the introduction of the principles of Total Productive Maintenance (commonly referred as TPM or the equivalent) to ensure the machine operation is capable of self-monitoring etc.
   c. It may also consist of repairing or replacing faulty components.

4.5. Information Technology
   a. Tasks will be included to test the competitor's ability to carry out system programming.
   b. Documentation produced by competitors and communication may also be included.

4.6. Optimisation
Improved processes to increase operational efficiency of a system may be evaluated.

4.7. Maintenance
Competitors' ability to carry out maintenance of MPS system may be tested.

Theoretical Knowledge

5. The theoretical knowledge required for the Test Projects covers the following areas:

5.1. Mechanical Design
Design of mechanical systems, including knowledge of pneumatic and hydraulic systems, their standards and their documentation

5.2. Circuit Design
Design of electrical circuits in machine/ controller systems using analogue and digital devices

5.3. Industrial Controllers
   a. Configuration of the industrial controller and how a software program relates to a machine action
   b. Configuration of all aspects of the Programmable Logic Controller (PLC) as required and the associated control circuitry for correct operation
   c. Configuration and programming of Human Machine Interface (HMI) to operate and control MPS modules.

5.4. Software Programming
Writing of programs to control machine and visualize the process and operation using software

5.5. Analytical Techniques
Mastering of problem solving techniques to ensure correct and safe machine operation

Assessment

6. Competition teams are required to complete all of the following sections within the maximum time allocated for each section:
   6.1. Mechanical assembly (Pneumatic and Electrical connections) & Commissioning
   6.2. Programming
   6.3. Re-programming
   6.4. Troubleshooting by individuals and team
   6.5. Optimization
7. Marking is designed to be progressive and will be based on time and tasks in accordance with the marking scale.

Major Equipment, Tools and Materials

8. The following tools and equipment will be used in the competition:
   8.1. Tools & Equipment
      a. Air compressor system will be provided
      b. *Each participating polytechnic is to provide a FESTO Modular Production System (MPS) comprising of
         - Distribution Station
         - Measuring Station
         - Sorting Station
         - Pick-and-Place Station
         - Joining Station and
         - Stepper Handling Station

      Stations should be complete with controllers, communication cables, I/O cables, and the required workpiece set. All stations shall conform to the approved competition hardware specifications and professional practice requirements, including the use of cable tie cable holders where applicable. Fluid Master equipment shall not be used in the competition.

c. * Controller
   - Competitors must supply their own PLC and spare parts
   - One programmable logic controller with digital inputs/ outputs and an Analogue Unit for per station.
   - All PLCs must support ethernet communication with other PLCs.
   - All PLCs must have all the necessary cables to operate and function as intended.
   - Controller must be loaded with an empty program/project.

d. * HMI
   - Competitors must supply one HMI (7" to 10") with mounting brackets.
   - To be mounted in front of the MPS station
   - Maker and brand as per competitor's discretion
   - The HMI must be loaded with an empty program/project.

e. *Simulation Box with the following
   - Syslink cable
   - Power supply cable.
   - Analog cable

f. *Network switch
   - Must be sufficient to link all MPS stations.
   - LAN cables

g. * Power Supply
   - 24 VDC 2 A (min) power supply unit for each station.

h. *Profile plate connectors
   - With enough quantities to be able to secure MPS stations with different configurations

i. *Safety cables
   - For connecting MPS station digital IOs.

j. * Any commercially available tools may be used (with the exception of power-driven hand tools). This is subject to approval by the Shopmaster (Safety Officer).

Competitors must also provide the following items
- Supply their own tools
- Bring all software required for the PLC they have selected

It is the responsibility of their team manager to check software compatibility with the PC's provided. The competitors are also responsible for the provision of connectors, adapters, plugs and interfaces suitable for the competition site.

8.2. *Materials

a. Cable ties (75 mm) – 100 nos
b. Cable ties (140 mm) – 50 nos
c. PVC multicore wires (blue, black, brown) – 0.5mm2; (blue) – 1.25 mm2
d. Ferrule
e. Pneumatic air tubings and distribution fittings

(* Note: Items to be provided by competitors)

Safety

9. Competitors shall supply and use their own Personal Protective Equipment as required during the competition, specifically:

9.1. Shoes

Fully enclosed work shoes or boots must be worn at all times.

9.2. Clothing

a. Legs must be covered at all times, by either long work trousers or overalls
b. Upper body must be covered at all times
c. Arms must be covered with long sleeves, when brazing and using refrigerants

9.3. Clear Safety Glasses

a. Must be worn, when necessary to protect the eyes;
b. Must be worn when brazing, soldering, filing, reaming, hack-sawing, drilling, grinding & using refrigerant, dry nitrogen & compressed air.

9.4. Gloves

a. Must be worn, when brazing and using refrigerants.
b. Work clothes and accessories must comply with relevant safety codes.

9.5. First Aid Kit

A first aid kit must be available throughout the competition.