### SKILLS FRAMEWORK FOR PRECISION ENGINEERING

**TECHNICAL SKILLS AND COMPETENCIES (TSC) REFERENCE DOCUMENT**

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<thead>
<tr>
<th>TSC Category</th>
<th>Automation Management</th>
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<tbody>
<tr>
<td>TSC Description</td>
<td>Automated System Design</td>
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<tr>
<td><strong>TSC Description</strong></td>
<td>Design and commission automated systems as well as evaluate the system design specification against functional requirements</td>
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<tr>
<th>TSC Proficiency Description</th>
<th>Level 1</th>
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<tr>
<td>Select, assemble and test handling systems for automated manufacturing systems</td>
<td>Programme, test and debug programmable logic controllers (PLCs)</td>
<td>Apply robots and robotic systems in manufacturing operations</td>
<td>Develop automation systems, taking into account space constraints, process constraints, unique process tool requirements and priority loading</td>
<td>Design automation controls by applying the fundamental of pneumatic, electro-pneumatic, programmable logic controllers (PLCs) and factory automation during the design stage</td>
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**Knowledge**

- Types and usage of pneumatic components, electrical devices and handling systems
- Displacement-step diagrams and electrical diagrams
- Interpretations of control requirements and ISO circuit diagram symbols
- Design principles of pneumatic circuits, electro-pneumatic circuits and operations of associated components
- Procedures for checking, verifying and amending completed pneumatic control circuits
- Industry standards and industrial health and safety risks in designing handling systems in industrial automation
- Types of personal protective equipment (PPE)
- Control requirements for automation systems
- Types, characteristics and operating principles of binary and analogue input and output devices
- Types and characteristics of PLC, programming devices and programming software
- Types of inputs and outputs, memory, programming languages and PLC communications
- Operation and use of programming devices
- Programming software syntax
- Connection of programming device to PLC
- Use of programme performance checklists
- Definitions and classifications of robots
- Trends for robotics in different applications
- Robot components, degrees of freedom, joints, coordinates, reference frames and workspaces
- Principles for path and trajectory planning
- Principles for design of point-to-point motion planning
- Programming for robots utilised in manufacturing settings
- Project management flow from design, requirement specification, installation, commissioning to final acceptance of automated material handling systems (AMHS)
- AMHS capacity (from-to table) moves, derived from process moves and storage patterns
- Risk assessment analysis for new AMHS equipment roll-in, and/or working procedure to be performed
- Two-dimensional (2D) and/or three-dimensional (3D) mechanical drawings
- AMHS simulation tools
- AMHS semiconductor equipment and materials international (SEMI) specifications
- Computer-aided design (CAD) software
- Manufacturing processes steps
- Preparation methods of compressed air
- Principles of pneumatic systems
- Types of pneumatic components
- Operation principles of pneumatic systems
- Principles of electro-pneumatic systems
- Types of electro-pneumatic components
- Operation principles of electro-pneumatic systems
- Principles of PLCs
- Components of PLC
- Types of programming languages
- PLC programming
### Abilities

- Identify control sequences based on control requirements
- Select required handling components and electrical devices, based on control requirements
- Design pneumatic and electro-pneumatic circuits and handling circuits, in accordance with control requirements
- Prepare parts list of all components to be used in handling systems
- Connect pneumatic components, electrical devices, test equipment and handling components, in accordance with circuit diagrams
- Test handling systems and record testing results
- Shut down handling systems in accordance with established organisational procedures
- Disconnect all pneumatic components, electrical devices, handling components and test equipment

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- Interpret details of control requirements for systems
- Identify number and types of inputs and outputs, based on control requirements
- Identify models of PLC, programming devices and software required to be used with PLC
- Carry out syntax tests during programme writing processes to identify syntax errors
- Compile and save software programmes after writing processes are completed
- Obtain relevant information from built-in software documentation
- Connect programming devices to PLC for testing of software programmes
- Download software programmes using programming devices in accordance with manufacturers’ procedures
- Verify software programme performance in accordance with control sequence and requirements using programme performance checklist
- Debug and modify software programmes to meet control requirements

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- Select appropriate robots based on the mechanisms and applications
- Determine the direct kinematics transfer and work spaces of robots
- Design appropriate paths and trajectories for manufacturing robots
- Programme robots for point-to-point movement and path following

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- Plan and develop routes for robots
- Use statistical and automation software to monitor robots’ performances
- Establish acceptance criteria, specifications and standard operating procedures (SOPs)

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- Perform analyses to determine control requirements of machines
- Establish pneumatic, electro-pneumatic, PLC requirements from design specifications
- Produce graphical user interface (GUI) for automation control of machines’ systems, in accordance with design specifications
- Monitor the operation of automation systems
- Analyse the strengths and weaknesses of engineering designs against design criteria
- Submit full evaluation reports on whether engineering designs meet functional requirements