

**SKILLS FRAMEWORK FOR PRECISION ENGINEERING
TECHNICAL SKILLS AND COMPETENCIES (TSC) REFERENCE DOCUMENT**

TSC Category	Automation Management					
TSC	Automated System Design					
TSC Description	Design and commission automated systems as well as evaluate the system design specification against functional requirements					
TSC Proficiency Description	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
	PRE-RAO-1003-1.1-1	PRE-RAO-2003-1.1-1	PRE-RAO-3003-1.1-1	PRE-RAO-4003-1.1	PRE-RAO-5003-1.1	
	Select, assemble and test handling systems for automated manufacturing systems	Programme, test and debug programmable logic controllers (PLCs)	Apply robots and robotic systems in manufacturing operations	Develop automation systems, taking into account space constraints, process constraints, unique process tool requirements and priority loading	Design automation controls by applying the fundamental of pneumatic, electro-pneumatic, programmable logic controllers (PLCs) and factory automation during the design stage	
Knowledge	<ul style="list-style-type: none"> 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) 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 process steps 	<ul style="list-style-type: none"> 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 	

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<p>Abilities</p>	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Plan and develop routes for robots Use statistical and automation software to monitor robots' performances Establish acceptance criteria, specifications and standard operating procedures (SOPs) 	<ul style="list-style-type: none"> 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 	
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