

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

<b>TSC Category</b>	Manufacturing and Operations					
<b>TSC</b>	Production Line Set-Up					
<b>TSC Description</b>	Design mechanism units, systems and drives for industrial manufacturing applications					
<b>TSC Proficiency Description</b>	<b>Level 1</b>	<b>Level 2</b>	<b>Level 3</b>	<b>Level 4</b>	<b>Level 5</b>	<b>Level 6</b>
		<b>PRE-OPR-2059-1.1</b>	<b>PRE-OPR-3059-1.1</b>	<b>PRE-OPR-4059-1.1</b>	<b>PRE-OPR-5059-1.1</b>	<b>PRE-OPR-6059-1.1</b>
		Design electric drives and electromechanical systems in a range of industrial applications at the workplace	Design mechanism units of machines for a range of industrial applications	Design mechanical and electrical systems for standalone automated industrial machines	Design equipment and products of high precision, accuracy and reliability	Evaluate plant-wide production machinery and automation systems for effectiveness and reliability
<b>Knowledge</b>		<ul style="list-style-type: none"> <li>Types and usage of electric drives, electromechanical system devices and electrical circuit diagrams</li> <li>Types of hardware and software for design drawing</li> <li>Interpretation of control requirements and ISO circuit diagram symbols</li> <li>Industry standards used in operating electric drives and electromechanical systems</li> <li>Design principles of electrical circuit operations of electric drives and electromechanical system components</li> <li>Procedures for checking, verifying and amending completed electrical control circuit</li> <li>Industrial health and safety risks involved in designing electric drives and electromechanical systems</li> <li>Organisational procedures for</li> </ul>	<ul style="list-style-type: none"> <li>Essential stages of the design process</li> <li>Fundamentals of machine mechanisms</li> <li>Association between assembly drawings, detailed drawings and bills of material (BOM)</li> <li>Surface roughness obtainable from manufacturing processes</li> <li>Limits and fits</li> <li>Hole basis and shaft basis of tolerance</li> <li>Applications of geometric dimensioning and tolerancing (GD&amp;T) to engineering drawings</li> <li>Tolerance stacking analysis</li> <li>Machine elements selection in machine design</li> <li>Part and assembly modelling</li> </ul>	<ul style="list-style-type: none"> <li>Principles of alternating and direct electrical currents (AC/DC)</li> <li>Types of electrical controls used in industrial machines</li> <li>Electrical safety and protection</li> <li>Electrical loading calculations</li> <li>Types of electrical sub-systems, electrical drawings, enclosures and wiring accessories</li> <li>Tolerance stacking analysis</li> <li>Concept of electrical interference</li> <li>Electrical connection techniques and grounding principles</li> <li>Electrical system functional tests procedures</li> <li>Mechanical power transmissions, hydraulic and pneumatic systems</li> <li>Concept of computer-based and programmable logic control (PLC)</li> </ul>	<ul style="list-style-type: none"> <li>Concepts of exact constraints and over-constraints</li> <li>Principles of elastic averaging and Herzian stress</li> <li>Types of materials for precision machine structures</li> <li>Characteristics of rotary and linear bearings, couplings, linear drives, gears and gear transmissions</li> <li>Principles of guideway design to achieve precision linear motion</li> <li>Types of guideway systems and their characteristics</li> <li>Concepts of degrees of freedom for planar linkage mechanisms</li> <li>Kinematic design procedures of linkage mechanisms</li> <li>Performance characteristics of flexure-based mechanisms</li> <li>Homogeneous transformation matrix (HTM) model of a machine</li> </ul>	<ul style="list-style-type: none"> <li>Principles of precision engineering</li> <li>Methods and tools for evaluating machinery and automation systems</li> <li>Evaluation criteria for machinery and automation systems</li> <li>Types and impact of recommendations on engineering processes</li> <li>Organisational and legislative requirements</li> </ul>

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		<p>submission of completed circuit diagrams, part list and control requirements, for reporting faulty electric drives and electromechanical system devices, recording and compiling of work documentation</p> <ul style="list-style-type: none"> <li>• Proper disposal of waste materials and housekeeping procedures</li> </ul>			<ul style="list-style-type: none"> <li>• Combinational rules of errors</li> </ul>	
<b>Abilities</b>		<ul style="list-style-type: none"> <li>• Identify control sequences based on control requirements and electrical diagrams</li> <li>• Identify and select required electric drive components and electromechanical system devices based on control requirements</li> <li>• Design electric drives and electromechanical systems in accordance with control requirements</li> <li>• Check completed circuit diagrams to ensure control requirements are met</li> <li>• Connect electrical drives, electromechanical system and test equipment, in accordance with specifications of completed circuit diagram and approved written work instructions</li> <li>• Test electric drives and electromechanical systems, in accordance with established organisational procedures</li> </ul>	<ul style="list-style-type: none"> <li>• Produce statements of function and design requirements for devices, in accordance with machine specifications</li> <li>• Identify machine mechanisms, according to design specifications</li> <li>• Identify geometric features of engineering drawings</li> <li>• Interpret types of dimensioning, datum references, dimension limits, surface sign and finish applied on components</li> <li>• Interpret the basis and class of fit applied on components</li> <li>• Size out appropriate machine elements to accomplish desired designs</li> <li>• Produce the parametric models of parts and assemblies in accordance with the assignment specifications</li> <li>• Visualise practical phenomena of vibration and solve related problems</li> </ul>	<ul style="list-style-type: none"> <li>• Interpret component datasheets</li> <li>• Perform analyses to determine mechanical power and transmission requirements of machines</li> <li>• Perform calculations to determine electrical loading requirements for mechanical power and transmission</li> <li>• Establish electrical requirements from the machines' other internal systems</li> <li>• Produce electrical design drafts of machines' electrical systems, in accordance with design processes</li> <li>• Analyse the strengths and weaknesses of the designs against design criteria</li> <li>• Recommend improvements to engineering designs that may improve machine performance</li> </ul>	<ul style="list-style-type: none"> <li>• Perform analyses to determine precision machines' requirement performance</li> <li>• Perform performance specification analyses on sensors and actuators, automation control systems, electrical systems and human-machine interface (HMI) systems</li> <li>• Design system integration for selected components, in accordance with precision machine requirements</li> <li>• Report on the selected components used to meet machine system requirements, encompassing economics, environment and safety considerations</li> <li>• Develop machine design specification drawings</li> <li>• Suggest modifications to existing systems and develop new and/or alternative systems to improve performance</li> </ul>	<ul style="list-style-type: none"> <li>• Evaluate methods of analyses used to determine requirements of precision machine performance</li> <li>• Evaluate findings from performance specification analyses pertaining to selection of sensors and actuators</li> <li>• Evaluate findings from performance specification analyses pertaining to automation control systems, electrical systems and human-machine interface (HMI) systems</li> <li>• Evaluate system designs for integration of selected components, in accordance with precision machine requirements</li> <li>• Evaluate final reports on the selected components used to meet the machine system requirements</li> <li>• Evaluate machine design specification drawings</li> </ul>

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		<ul style="list-style-type: none"> <li>• Maintain documentation of testing results and records</li> <li>• Shut down electric drives and electromechanical systems, in accordance with established organisational procedures</li> <li>• Disconnect electric drives, electromechanical system devices and test equipment</li> <li>• Label, isolate and report clearly any faulty components or devices identified during work activities</li> </ul>	<ul style="list-style-type: none"> <li>• Account for vibration analysis in designs</li> <li>• Produce the engineering drawings from the models of parts and assemblies, with appropriate presentations, in accordance with the assignment specifications</li> </ul>			<ul style="list-style-type: none"> <li>• Conduct costs-of-quality analyses related to products to identify areas for improvement</li> </ul>
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