

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

<b>TSC Category</b>	Engineering and Manufacturing Fundamentals					
<b>TSC</b>	Computer-aided Manufacturing					
<b>TSC Description</b>	Manage computer-aided manufacturing systems and perform computer numerical control part programming to manufacture components and products					
<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-MPR-1032-1.1</b>	<b>PRE-MPR-2032-1.1</b>	<b>PRE-MPR-3032-1.1</b>	<b>PRE-MPR-4032-1.1</b>		
	Apply computer numerical control (CNC) part programming for turning and/or milling tasks	Use computer-aided manufacturing (CAM) systems to generate and optimise computer numerical control (CNC) part programs for CNC machining, to achieve competitive component cycle times	Manufacture parts using computer numerical control (CNC) machining techniques, based on product specifications	Produce tool path information through the use of three-dimensional (3D) geometric models of product parts, and post-process the tool path data into machine-specific codes for 3-axis and multi-axis computer-numerical control (CNC) machining		
<b>Knowledge</b>	<ul style="list-style-type: none"> <li>• Technical drawing specifications of work pieces</li> <li>• Machine tool limitations</li> <li>• Alpha-numerical addresses and functional codes in CNC programs</li> <li>• Application of canned cycles and sub-routines for relevant tasks</li> <li>• Types of measuring and cutting tools appropriate for the tasks</li> <li>• Types of work holding fixtures</li> <li>• Cutting speed, feed rate, work piece, cutter revolution and other relevant machining parameters</li> <li>• Workplace safety and health (WSH) procedures and industrial health and safety regulations related to general machining</li> <li>• Approaches to verify CNC part programs</li> </ul>	<ul style="list-style-type: none"> <li>• Engineering tables and catalogues</li> <li>• Machining processes, and sequences</li> <li>• Machining tool limitations, machining time and influencing factors</li> <li>• Technical drawing specifications of work pieces</li> <li>• Types of measuring tools and cutters required for work tasks</li> <li>• Applicable workplace safety and health (WSH) procedures for general machining</li> <li>• Alpha-numerical addresses and functional codes in CNC</li> <li>• Quick set-up concept and CNC machining parameters</li> <li>• Computer specifications, graphic and processing requirements</li> <li>• Computer-aided design/computer-aided</li> </ul>	<ul style="list-style-type: none"> <li>• Classification of CNC machines</li> <li>• CNC lathes and CNC machining centres</li> <li>• 3-axis and multi-axis machining techniques</li> <li>• 5-axis positional machining vs 5-axis continuous machining</li> <li>• CNC control systems and part programming</li> <li>• Part programmes transfer between data servers and CNC machines</li> <li>• Relevant legislation and regulatory requirements</li> </ul>	<ul style="list-style-type: none"> <li>• Computer-aided manufacturing (CAM) programming technology</li> <li>• 3-axis and multi-axis machining techniques</li> <li>• Principles and characteristics of 5-axis positional machining</li> <li>• Principles and characteristics of 5-axis continuous machining</li> <li>• CAM modules</li> <li>• Operation and parameter settings used in CAM</li> <li>• Programme generation and verification</li> <li>• Post-processing in manufacturing environments</li> <li>• Concepts and principles of multi-axis machining, associated parameters and strategies</li> </ul>		

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	<ul style="list-style-type: none"> <li>Types of defects in tools and equipment</li> </ul>	<p>manufacturing (CAD/CAM) software and systems</p> <ul style="list-style-type: none"> <li>Electronic data input and storage</li> </ul>				
<b>Abilities</b>	<ul style="list-style-type: none"> <li>Interpret international drawing conventions and standards</li> <li>Determine job requirements from the blue prints</li> <li>Write and verify CNC part programmes</li> <li>Check to ensure correct work materials are used and work pieces are secured</li> <li>Test machining parameters with different cutting tool materials to optimise outcomes</li> <li>Select appropriate cutting tools to be mounted onto the tool magazine</li> <li>Perform tool setting and compensation</li> <li>Set appropriate machining parameters</li> <li>Carry out operational dry runs</li> <li>Check work pieces for conformance with specifications</li> </ul>	<ul style="list-style-type: none"> <li>Interpret international drawing conventions and standards</li> <li>Create work piece geometry using CAD/CAM software</li> <li>Configure system variables and defaults for processing tool paths</li> <li>Select cutting tools and machining parameters for the tool paths</li> <li>Convert CAD data to create tool paths and check for possible cutting or galling errors</li> <li>Convert the tool paths into CNC part programs</li> <li>Optimise CNC program sequence to optimise the production time</li> <li>Select appropriate machining and/or fine-tuning to optimise machining parameters</li> <li>Use suitable measuring instruments and/or gauges to check the components for conformance with specifications</li> <li>Store optimised programme and store the data for repeat orders</li> </ul>	<ul style="list-style-type: none"> <li>Review CNC machining techniques for suitability to required tasks, and to improve efficiency in manufacturing of parts</li> <li>Perform part programming on CNC systems</li> <li>Verify correctness of manufactured parts against specifications</li> <li>Minimise material consumption by adhering to specifications</li> </ul>	<ul style="list-style-type: none"> <li>Interpret machining parameters and strategies</li> <li>Assess accuracy of two-dimensional (2D) and 3D tool path generation using objects for 3-axis CNC machining</li> <li>Assess accuracy of 3D tool path generation using objects for multi-axis CNC machining</li> <li>Apply CAM techniques for precision components and mould inserts</li> <li>Produce safe and efficient tool paths for machining processes, adhering strictly to specifications</li> <li>Evaluate post-process tool path data to generate machine specific codes</li> </ul>		