

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

TSC Category	Manufacturing and Operations					
TSC	Precision Measurement					
TSC Description	Perform precision measurements with relevant techniques and equipment to meet requirements for product conformity					
TSC Proficiency Description	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6
	PRE-MPR-1034-1.1	PRE-MPR-2034-1.1	PRE-MPR-3034-1.1	PRE-MPR-4034-1.1	PRE-MPR-5034-1.1	
	Select, clean and check the measuring equipment to determine and check for dimensional and geometric conformance of components, equipment and machines against desired standards	Set up and operate coordinate measuring machines (CMM)	Manage hands-on practical and measuring techniques using various types of precision metrology equipment	Review measurements and conduct error analyses to correct inaccuracies	Assess the need for, and utilise, advanced measurement systems to achieve measurement requirements	
Knowledge	<ul style="list-style-type: none"> • Technical and engineering drawings • Calculation techniques for measurements • Types and specifications of precision measuring equipment • Limits and tolerances of precision measuring equipment • Correct usage of precision measuring equipment • Reference temperature for high accuracy measurement • Causes of measuring errors and common faults and defects in precision measuring equipment • Safe practices in using precision measuring equipment • Proper maintenance and storage of precision measuring equipment • Standard operating procedures (SOP) for marking of faulty and/or unsafe precision measuring equipment 	<ul style="list-style-type: none"> • Technical and engineering drawings • Principles and application of CMM • Procedures for setting CMM • Types of tools and fixtures • Types and application of probes • Methods and techniques of measurement • Use of equipment, machines, protective clothing and eyewear, in accordance with safety and health procedures • Potential hazards and their relevant minimisation and control methods • Quality assurance procedures at the workplace • Procedures for documentation and maintenance of measurement records 	<ul style="list-style-type: none"> • Technical and engineering drawings • Metrology standards and terminologies • Types of measuring errors • Interpretation of geometric dimensioning and tolerancing (GD&T) • Methods of inspection using coordinate measuring machines (CMM) • Measurement techniques for roundness • Measurement techniques for surface textures • Statistical methods relevant to precision measurements • Concept of process capability index 	<ul style="list-style-type: none"> • Principles of precision engineering • Types of precision metrology technology • Types of precision measurement errors • Methods of error analysis • Principles and applications of precision measurement instruments • Principles and applications of surface roughness measurement instruments • Precision measurement and calibration of machine tools 	<ul style="list-style-type: none"> • Principles of precision engineering • Types of precision metrology technology • Principles and applications of scanning electron microscopes, electron microprobes, atomic force microscopy, and other forms of advanced metrology systems 	

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<p>Abilities</p>	<ul style="list-style-type: none"> • Interpret drawing and component specifications • Plan work activities and requirements in accordance with organisational procedures • Select and set up appropriate precision measuring equipment according to work specifications • Calibrate measuring equipment and record in reports in accordance with organisational procedures • Anticipate possible failure of measuring equipment and measures to take corrective actions • Read results from measuring equipment and compare results against component requirements • Report dysfunctional equipment for repair or replacement, where appropriate • Maintain good housekeeping and compliance with workplace safety and health (WSH) practices 	<ul style="list-style-type: none"> • Inspect equipment for serviceability, in accordance with workplace safety and health (WSH) and organisational procedures • Identify relevant drawings, job sheets, job specifications and additional documentation for the tasks, in accordance with job requirements • Conduct pre-operation checks and set up CMM and components to optimise measurement access • Select and verify appropriate part programs • Set up probes in accordance with specifications • Edit CMM programs to incorporate component specification changes and to compensate for errors • Run and validate part programs • Measure, record and verify results for conformance to specification within tolerances • Shut down part programs and remove components in accordance with organisational procedures • Shut down CMM and perform housekeeping in accordance with WSH and organisational procedures 	<ul style="list-style-type: none"> • Define metrology standards for length measurement according to quality requirements • Interpret measurement terminologies for the field of calibration and measurement • Analyse measuring errors to evaluate calibration and measurement capabilities • Interpret GD&T symbols on technical drawings for conformity in measurements • Perform layout inspections using CMM for product conformity • Measure and analyse cylindrical parts using roundness measuring machines, for verification of product quality • Measure surface finishes of parts for verification of surface conformity • Document processes using basic statistical methods for measurement reports and quality assurance (QA) records • Document process capability indices for records 	<ul style="list-style-type: none"> • Review measurement results to identify sources of error • Conduct error analyses to identify system errors, random errors, measurement repeatability and/or uncertainties • Determine potential methodologies for reducing measurement errors • Select proper instruments to measure precision engineering components • Calibrate precision measurement machines • Measure component dimensions using coordinate measurement machines (CMM) • Measure surface primary forms, roughness and surface profiles using stylus-based contact instruments • Propose alternative measurement methods to optimise measurement activities' values in different situations 	<ul style="list-style-type: none"> • Analyse measurement requirements to determine need to utilise advanced metrology systems • Review technologies for scanning electron microscopes, microprobes and/or atomic force microscopy, to evaluate suitability of applications to meet measurement requirements • Develop plans to implement advanced metrology systems in manufacturing processes to meet measurement requirements • Propose alternative measurement methods to optimise measurement activities' values in different situations 	
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