

Mathematic Standards Matrix
MECHANICAL DRAFTING
January 13, 2009

MECHANICAL DRAFTING Standards/Measurement Criteria		MATH STANDARDS
		Strand #, Concept #, Grade Level Performance Objective # (<i>College Work Readiness Level Standards are italicized</i>)
STANDARD 1.0 – APPLY MEASUREMENT AND SCALE CONCEPTS IN DESIGN DRAFTING		
1.1	Identify types of measurement used in design drafting	See Note
1.2	Select proper measurement tools	See Note
1.3	Perform measurements with hand held instruments	See Note
1.4	Determine and apply appropriate scale	<p>Strand 4: Geometry and Measurement, Concept 1: Geometric Properties, High School Level PO 1: Use the basic properties of a circle (relationships between angles, radii, intercepted arcs, chords, tangents, and secants) to prove basic theorems and solve problems. PO 2: Visualize solids and surfaces in 3-dimensional space when given 2-dimensional representations and create 2-dimensional representations for the surfaces of 3-dimensional objects. PO 6: Solve problems using angle and side length relationships and attributes of polygons.</p> <p>Strand 4: Geometry and Measurement, Concept 4: Measurement, High School Level PO 1: Use dimensional analysis to keep track of units of measure when converting.</p>
1.5	Transcribe illustrations accurately	<p>Strand 4: Geometry and Measurement, Concept 2: Transformation of Shapes, High School Level PO 4: Determine the effects of a single transformation on linear or area measurements of a 2-dimensional figure.</p> <p>Strand 4: Geometry and Measurement, Concept 4: Measurement, High School Level PO 1: Use dimensional analysis to keep track of units of measure when converting.</p>
STANDARD 2.0 – INTERPRET ENGINEERING DOCUMENTS AND CONTROL DOCUMENTS		
2.1	Interpret dimensions, symbols, legends, scales, and directions/orientations	See Note
2.2	Analyze how content and information are communicated in schematics, blueprints, and technical drawings	See Note

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2.3	Analyze schematics, blueprints, and technical drawings for clarity, completeness, and accuracy	See Note
2.4	Recognize cross-referencing on technical drawings	See Note
2.5	Identify and describe basic types of drawings by trade	See Note
2.6	Locate and interpret information on specific documents	See Note
2.7	Check prints for dimensional accuracy, completeness, and note detail	See Note
2.8	Compare schematics to dimensional drawings	See Note
2.9	Verify drawing elements	See Note
2.10	Identify conflicting data	Strand 5: Structure and Logic, Concept 2: Logic, Reasoning, Problem Solving and Proof, High School Level PO 3: Evaluate a solution for reasonableness and interpret the meaning of the solution in the context of the original problem. PO 6: Synthesize mathematical information from multiple sources to draw a conclusion, make inferences based on mathematical information, evaluate the conclusions of others, analyze a mathematical argument, and recognize flaws or gaps in reasoning.

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STANDARD 3.0 – CREATE TECHNICAL DRAWINGS		
3.1	Identify, select, and use fundamental drafting techniques for drawings	See Note
3.2	Demonstrate freehand lettering technique	See Note
3.3	Identify "Alphabet of Lines" by name, line type variation, order of usage and application on technical drawings	See Note
3.4	Create title blocks	See Note
3.5	Format borders	See Note
3.6	Apply notes and dimensions	See Note
3.7	Plot or print drawings using correct layout	See Note
3.8	Organize and maintain drawings and supporting documents	See Note

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STANDARD 4.0 – UTILIZE BASIC COMPUTER CONCEPTS, OPERATIONS, AND INFORMATION TECHNOLOGY APPLICATIONS		
4.1	Use computer hardware and input/output devices for design drafting problems	See Note
4.2	Apply basic commands of operating system software	See Note
4.3	Apply file and disk management techniques	See Note
4.4	Import and export data files using different formats (dxf, dxb, Tiff, gif, pcx, eps, spd, or other formats as required)	See Note
4.5	Prepare files for electronic transfer	See Note
4.6	Access and use the Internet for file transfer	See Note
4.7	Access and use a computer network for file management and transfer	See Note

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STANDARD 5.0 – USE A CADD/VDCM (VIRTUAL DESIGN AND CONSTRUCTION MODELING) SYSTEMS AND PROCEDURES		
5.1	Explore and determine applicability of CADD/VDCM systems to the project	See Note
5.2	Analyze drawings using CADD/VDCM software functions/commands	See Note
5.3	Use CADD/VDCM software commands to set up drawing scale, format, dimensioning, etc.	See Note
5.4	Apply layers/visible items, colors, line types, editing commands, and grouping techniques	See Note
5.5	Control entity properties	See Note
5.6	Incorporate standard parts, symbol libraries, and/or templates	See Note
5.7	Control viewing commands	See Note
5.8	Create and manipulate views by modifying coordinate system settings	See Note
5.9	Minimize a drawing file for storage and transmission	See Note

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STANDARD 6.0 – DETAIL PROJECTION VIEWS/COMPONENTS		
6.1	Determine views for projection (i.e., plan, top, front, etc.)	See Note
6.2	Identify, create, and place views for orthographic features	See Note
6.3	Identify, create, and place auxiliary views to determine true size, shape, and location of non-orthogonal features	See Note
6.4	Identify, create, and place appropriate section views	See Note
6.5	Construct full, half, and offset section of an object	See Note
6.6	Utilize various material hatch patterns in section views	See Note

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STANDARD 7.0 – EXPLORE AND DRAFT MECHANICAL DESIGN DRAFTING CONCEPTS AND PROBLEMS		
7.1	Use manufacturing and machining terminology in context	See Note
7.2	Use precision measuring equipment	See Note
7.3	Solve design problems in trigonometry	<p>Strand 1: Number and Operations, Concept 3: Estimation, <i>College Work Readiness Level</i> <i>PO 1: Recognize the limitations of estimations by assessing the amount of error resulting from estimation and determining whether the error is within acceptable tolerance limits.</i></p> <p>Strand 4: Geometry and Measurement, Concept 1: Geometric Properties, High School Level PO 11: Solve problems using the sine, cosine, and tangent ratios of the acute angles of a right triangle</p>
7.4	Use industry standards, codes, and regulations software for mechanical drafting to solve a problem	<p>Strand 3: Patterns, Algebra, and Functions, Concept 3: Algebraic Representations, High School Level PO 2: Solve formulas for specified variables.</p> <p>Strand 5: Structure and Logic, Concept 2: Logic, Reasoning, Problem Solving and Proof, High School Level PO 1: Analyze a problem situation, determine the question(s) to be answered, organize given information, determine how to represent the problem, and identify implicit and explicit assumptions that have been made. PO 3: Evaluate a solution for reasonableness and interpret the meaning of the solution in the context of the original problem.</p>
7.5	Apply mechanical symbols to a drawing	See Note
7.6	Prepare detail and assembly working drawings	<p>Strand 5: Structure and Logic, Concept 2: Logic, Reasoning, Problem Solving and Proof, High School Level PO 3: Evaluate a solution for reasonableness and interpret the meaning of the solution in the context of the original problem.</p>
7.7	Prepare an engineering change order and revise the applicable drawings	See Note

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STANDARD 8.0 – DEMONSTRATE DESIGN DRAFTING CONCEPTS AS RELATED TO BASIC MANUFACTURING PROCESSES		
8.1	Design and detail a foundry produced product	<p>Strand 4: Geometry and Measurement, Concept 1: Geometric Properties, High School Level PO 2: Visualize solids and surfaces in 3-dimensional space when given 2-dimensional representations and create 2-dimensional representations for the surfaces of 3-dimensional objects.</p> <p>Strand 4: Geometry and Measurement, Concept 4: Measurement, High School Level PO 1: Use dimensional analysis to keep track of units of measure when converting.</p> <p>Strand 5: Structure and Logic, Concept 2: Logic, Reasoning, Problem Solving and Proof, High School Level PO 1: Analyze a problem situation, determine the question(s) to be answered, organize given information, determine how to represent the problem, and identify implicit and explicit assumptions that have been made.</p>
8.2	Design and detail a machine tooled product	<p>Strand 4: Geometry and Measurement, Concept 1: Geometric Properties, High School Level PO 2: Visualize solids and surfaces in 3-dimensional space when given 2-dimensional representations and create 2-dimensional representations for the surfaces of 3-dimensional objects.</p> <p>Strand 4: Geometry and Measurement, Concept 4: Measurement, High School Level PO 1: Use dimensional analysis to keep track of units of measure when converting.</p> <p>Strand 5: Structure and Logic, Concept 2: Logic, Reasoning, Problem Solving and Proof, High School Level PO 1: Analyze a problem situation, determine the question(s) to be answered, organize given information, determine how to represent the problem, and identify implicit and explicit assumptions that have been made.</p>
8.3	Design and detail a welded product	<p>Strand 4: Geometry and Measurement, Concept 1: Geometric Properties, High School Level PO 2: Visualize solids and surfaces in 3-dimensional space when given 2-dimensional representations and create 2-dimensional representations for the surfaces of 3-dimensional objects.</p> <p>Strand 4: Geometry and Measurement, Concept 4: Measurement, High School Level PO 1: Use dimensional analysis to keep track of units of measure when converting.</p> <p>Strand 5: Structure and Logic, Concept 2: Logic, Reasoning, Problem Solving and Proof, High School Level PO 1: Analyze a problem situation, determine the question(s) to be answered, organize given information, determine how to represent the problem, and identify implicit and explicit assumptions that have been made.</p>

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8.4	Design and detail a sheet metal part	<p>Strand 4: Geometry and Measurement, Concept 1: Geometric Properties, High School Level PO 2: Visualize solids and surfaces in 3-dimensional space when given 2-dimensional representations and create 2-dimensional representations for the surfaces of 3-dimensional objects.</p> <p>Strand 4: Geometry and Measurement, Concept 4: Measurement, High School Level PO 1: Use dimensional analysis to keep track of units of measure when converting.</p> <p>Strand 5: Structure and Logic, Concept 2: Logic, Reasoning, Problem Solving and Proof, High School Level PO 1: Analyze a problem situation, determine the question(s) to be answered, organize given information, determine how to represent the problem, and identify implicit and explicit assumptions that have been made.</p>
8.5	Prepare models for computer numerical control (CNC) processes	<p>Strand 4: Geometry and Measurement, Concept 1: Geometric Properties, High School Level PO 2: Visualize solids and surfaces in 3-dimensional space when given 2-dimensional representations and create 2-dimensional representations for the surfaces of 3-dimensional objects.</p> <p>Strand 4: Geometry and Measurement, Concept 4: Measurement, High School Level PO 1: Use dimensional analysis to keep track of units of measure when converting.</p> <p>Strand 5: Structure and Logic, Concept 2: Logic, Reasoning, Problem Solving and Proof, High School Level PO 1: Analyze a problem situation, determine the question(s) to be answered, organize given information, determine how to represent the problem, and identify implicit and explicit assumptions that have been made.</p>
8.6	Identify types of parts to be detailed (cast, machined, forged, sheet metal, welded)	See Note
8.7	Incorporate piping, welding, and instrumentation symbols in mechanical drawings	See Note
8.8	Draft, locate, and label fasteners on production, assembly drawings, and parts lists	See Note
8.9	Draft, locate, and label spring assemblies	See Note
8.10	Draft, identify, and label characteristics and requirements of jig and fixture tooling	<p>Strand 1: Number and Operations, Concept 3: Estimation, College Work Readiness Level <i>PO 1: Recognize the limitations of estimations by assessing the amount of error resulting from estimation and determining whether the error is within acceptable tolerance limits.</i></p>

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8.11	Denote manufacturing treatments of materials in drawings	See Note
8.12	Denote shop processes to be used	See Note
8.13	Prepare bill of materials for drawings	13A2, 3 – Strand 1: Number and Operations, Concept 3: Estimation, High School Level PO 2: Use estimation to determine the reasonableness of a solution. PO 3: Determine when an estimate is more appropriate than an exact answer. Strand 3: Patterns, Algebra, and Functions, Concept 3: Algebraic Representations, High School Level PO 2: Solve formulas for specified variables.
STANDARD 9.0 – INCORPORATE GEOMETRIC DIMENSIONING AND TOLERANCING (GDT) STANDARDS		
9.1	Determine appropriate datum features	See Note
9.2	Use standard fit tables to determine tolerances and fits	See Note
9.3	Calculate tolerance stack ups	Strand 1: Number and Operations, Concept 3: Estimation, <i>College Work Readiness Level</i> <i>PO 1: Recognize the limitations of estimations by assessing the amount of error resulting from estimation and determining whether the error is within acceptable tolerance limits.</i> Strand 3: Patterns, Algebra, and Functions, Concept 3: Algebraic Representations, High School Level PO 2: Solve formulas for specified variables.
9.4	Interpret tolerance dimensions	Strand 1: Number and Operations, Concept 3: Estimation, <i>College Work Readiness Level</i> <i>PO 1: Recognize the limitations of estimations by assessing the amount of error resulting from estimation and determining whether the error is within acceptable tolerance limits.</i>
9.5	Dimension fit tolerances	See Note
9.6	Apply dimensioning rules correctly and in compliance with ASME Y14 standards	See Note

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9.7	Apply metric and/or dual dimensions to drawing in compliance with ASME Y14 standards	See Note
9.8	Select/set/draw appropriate dimension features (i.e., arrowhead, text sizes, extension lines)	See Note
9.9	Draw/select appropriate dimensioning practices (e.g., conventional, tabular, datum, ordinate, aligned, rectangular coordinate, polar systems)	<p>Strand 4: Geometry and Measurement, Concept 3: Coordinate Geometry, <i>College Work Readiness Level</i> <i>PO 6: Describe how changing the parameters of a linear function affect the shape and position of its graph.</i></p> <p>Strand 5: Structure and Logic, Concept 2: Logic, Reasoning, Problem Solving, and Proof, <i>College Work Readiness Level</i> <i>PO 1: Analyze a problem situation, determine the question(s) to be answered, organize given information, determine how to represent the problem, and identify implicit and explicit assumptions that have been made.</i></p>
9.10	Apply geometric tolerances (e.g., true position, form, material conditions, datum points)	See Note

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STANDARD 10.0 – DRAFT ASSEMBLIES OF COMPONENTS		
10.1	Draft an aligned section	Strand 5: Structure and Logic, Concept 2: Logic, Reasoning, Problem Solving and Proof, High School Level PO 3: Evaluate a solution for reasonableness and interpret the meaning of the solution in the context of the original problem.
10.2	Draft an assembly section	Strand 5: Structure and Logic, Concept 2: Logic, Reasoning, Problem Solving and Proof, High School Level PO 3: Evaluate a solution for reasonableness and interpret the meaning of the solution in the context of the original problem.
10.3	Draft a cross section	Strand 5: Structure and Logic, Concept 2: Logic, Reasoning, Problem Solving and Proof, High School Level PO 3: Evaluate a solution for reasonableness and interpret the meaning of the solution in the context of the original problem.
10.4	Draft intersections	Strand 5: Structure and Logic, Concept 2: Logic, Reasoning, Problem Solving and Proof, High School Level PO 3: Evaluate a solution for reasonableness and interpret the meaning of the solution in the context of the original problem.
10.5	Draft developments	Strand 5: Structure and Logic, Concept 2: Logic, Reasoning, Problem Solving and Proof, High School Level PO 3: Evaluate a solution for reasonableness and interpret the meaning of the solution in the context of the original problem.
10.6	Draft revolution drawings	Strand 5: Structure and Logic, Concept 2: Logic, Reasoning, Problem Solving and Proof, High School Level PO 3: Evaluate a solution for reasonableness and interpret the meaning of the solution in the context of the original problem.
10.7	Draft patterns, including radial and parallel line patterns	Strand 5: Structure and Logic, Concept 2: Logic, Reasoning, Problem Solving and Proof, High School Level PO 3: Evaluate a solution for reasonableness and interpret the meaning of the solution in the context of the original problem.

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