

Performance Indicators for Drafting

A Bridge to Selected Instructional Materials



- **National Skill Standards • Missouri Competencies**
- **Show-Me Standards • All Aspects of the Industry Objectives**
- **Pre-Employment/Work Maturity Skills • VICA/SCANS Competencies**

Instructional Materials Laboratory
University of Missouri-Columbia

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INTRODUCTION

This curriculum project includes two parts: an updated Drafting competency profile and this performance indicator document. The updated profile contains more information than before. It is cross-referenced to national skill standards (see page 12); core/essential skills are indicated by an asterisk (*); and task IDs for VAMS (Missouri’s Vocational Administrative Management System) are shown in brackets.

The Performance Indicator Chart connects technical drafting skills with other important, but more general, skills needed by students. This document also provides instructors and administrators with links between newly updated drafted competencies and (1) previous Mo. Competencies (2) Show-Me Standards for students in Missouri public schools, (3) All Aspects of the Industry objectives, (4) Pre-Employment/Work Maturity Skills, and (5) SCANS competencies (addressed in National VICA’s Total Quality Curriculum). These sets of skills are listed after the Performance Indicator Chart.

To use the Drafting Performance Indicator Chart, consider the following example. Duty bands (umbrella-like categories for competencies) are in **bold** type and shaded.

	Page 15 ↓	Page 16 ↓	Page 19 ↓	Page 20 ↓	
Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
1. Drafting Room Procedures					
1.5 Apply record-keeping procedures (filing and record retrieval) [A05]	A5	Goal 1	E1		3

The second column (Previous Mo. Competencies) is helpful for anyone with curriculum tied to the previous Missouri competency list. As indicated by the chart, competency #5 in Drafting Room Procedures is related to previous competency A5. Drafting Room Procedures #5 is also related to the first Show-Me Standard, AAOI Objective E1, and VICA/SCANS Competency 3.

For more detail, obtain or contact the following resources.

- *National Occupational Skill Standards for Computer Aided Drafting and Design (CADD)*. Washington, DC: Foundation for Industrial Modernization, 1994. * Contact: Foundation for Industrial Modernization, 1331 Pennsylvania Ave. NW, Suite 1410 North, Washington, DC 20004, 202/662-8912 (CADD Project office), 202/662-8960 (main FIM office).
- Drafting competency profile (70-4000-C), test-item bank (70-4000-E) and curriculum guide (70-4000-I). Contact: Instructional Materials Laboratory, 2316 Industrial Drive, Columbia, MO 65211, 800/669-2465, FAX 573-882=1992.

- *Pre-Employment/Work-Maturity Skills Instructional Resource Guide* (30-6000-1). University of Missouri-Columbia: Instructional Materials Laboratory, 1992. Contact: IML (See Above)
- *All Aspects of the Industry* (65-9000-I). University of Missouri-Columbia: Instructional Materials Laboratory, 1994. Contact: IML (see above)
- *Learning a Living: A Blueprint for High Performance* (A SCANS Report for America 2000). Washington, DC, U.S. Department of Labor, 1992.*
- *Total Quality Curriculum*. Leesburg, VA: National VICA, 1993.* Contact: Education Dept., National VICA, PO Box 3000, Leesburg, VA 22075, 800/321-VICA (8422).
- VIMS/VAMS Support Center, 324 Townsend Hall, UMC, Columbia, MO 65211, 573/882/2951, FAX 573/884=5455.

These resources are available to Missouri educators for free loan from the Missouri Vocational Resource Center (MVRC), University of Missouri-Columbia, 8 London Hall, Columbia, MO 65211 (800/392-7217, Fax 573/882=9935).

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Drafting Performance Indicator Chart

Notes: * = Core competencies (essential for the first day on the job)
 Numbers in brackets (e.g., AO1) reflect the IDs used in computerized tracking software.

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
1. Drafting Room Procedures					
*1.1 Apply safety policies and procedures [AO1]	A1 (same)	Goal 1	H4		
*1.2 Identify drafting terminology [AO6]	A6 (same)		E1		3,5
*1.3 Identify American National Standards Institute, Inc. (ANSI) and International Standards Organization (ISO) standards (terminology) [AO3]	A3 (same)		E1		3
*1.4 Identify drafting occupations and related fields [AO4]	A4 (same)		F1	A2	3
1.5 Apply record-keeping procedures (filing and record retrieval) [AO5]	A5	Goal 1	E1		3
1.6 Identify and apply ergonomic considerations [AO7]		Goal 1	H7		3
2. Tools and Equipment					
*2.1 Select proper drawing instruments and equipment to complement the drafting media (e.g., Mylar, vellum) [BO1]	B1 (same)	Goal 1		F4	5
*2.2 Demonstrate proper use, care, and adjustment of drawing instruments and equipment and computer equipment [BO2]	B2	Goal 1	D8, E1, E2	F4	5
*2.3 Produce copies (e.g., stick-on decals, sepia and blue-line copies) [BO3]	B3	Goal 1		F4	5
*2.4 Operate and adjust input devices (e.g., mouse, keyboard, digitizer, scanner) [BO7]	R2	Goal 1	D8	F4	3, 5
*2.5 Operate and adjust output devices (e.g., printers, plotters, data transfer) [BO8]	R2, R3	Goal 1	D8	F4	3, 5
*2.6 Identify and use data storage, retrieval and back-up systems [BO9]	R4	Goal1	D8	F4	3, 5
2.7 Identify operating systems and procedures [B10]		Goal 1	D8	F4	3, 5
3. Basic Drawing Skills					
* 3.1 Lay out drawing [CO1]	C1 (same)	Goals 1, 3	D7	F4	3
* 3.2 Construct borders and information blocks [CO2]	C2 (same)	Goal 3	D7	F4	3

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
* 3.3 Construct freehand sketches [CO3]	C3 (same)	Goal 3	D7	F4	3
* 3.4 Read and transfer measurements (English and metric) [CO4]	C4	Goals 1, 3	D2	F4	3
* 3.5 Letter freehand (letters and numerals) [CO5]	C5 (same)	Goal 2	D7	F4	3
* 3.6 Demonstrate techniques in line construction (e.g., weights,, types and uniformity) [CO6]	C6	Goals 1,2	D7	F4	3
* 3.7 Construct a reproducible drawing with mechanical pencils [CO8]	C8	Goals 1, 2, 3	D7	F4	3
3.8 Construct a reproducible drawing with technical ink pens [CO9]	C9	Goals 1, 2, 3	D7	F4	3
* 3.9 Perform basic geometric construction (e.g., line dividing, angles, tangents, polygons, arcs) [C11]	D1, D2, D3, D5	Goals 1, 3	D7	F4	3
3.10 Identify and use various annotation methods [C12]		Goals 1, 2, 3	D7	F4	3
4. Orthographic Projections: Multiviews [E]					
* 4.1 Identify use and application of orthographic drawings (3 rd angle) [EO4]	E4 (same)	Goal 1	D7	F4	3
* 4.2 Identify 1 st and 3 rd angle projection drawings [EO5]	E5 (same)	Goal 1	D7	F4	3
* 4.3 Interpret an orthographic projection (3 rd angle) [EO1]	E1 (same)	Goals 1, 3	D7	F4	3
* 4.4 Sketch multiview drawings (3 rd angle) [EO2]	E2	Goals 1, 3	D7	F4	3
* 4.5 Prepare orthographic drawings (3 rd angle) [EO3]	E3	Goals 1, 3	D7, D8	F4	3
5. Auxiliary Views [F]					
* 5.1 Identify use and application of auxiliary views [F04]	F4 (same)	Goals 1, 3	D7	F4	3
* 5.2 Construct primary auxiliary views [F01]	F1 (same)	Goals 1, 3	D7, D8	F4	3
5.3 Construct secondary auxiliary views [F03]	F3 (same)	Goals 1, 3	D7, D8	F4	3
6. Descriptive Geometry/Revolutions [I]					
6.1 Perform graphic solutions of points, lines, and planes	I1, I2, I3	Goals 1, 3	D7	F4	3
6.2 Solve true length of lines, bearing and slope of lines [IO7]		Goals 1, 3	D7	F4	3
6.3 Perform graphic solutions of solids [IO4]	I4 (same)	Goals 1, 3	D7	F4	3
6.4 Perform graphic solutions of intersections (e.g., lines, planes and solids) [IO5]	I5	Goals 1, 3	D7	F4	3
6.5 Construct drawings using the revolution method [IO8]		Goals 1, 3	D7	F4	3
7. Sectional Views/Conventions [G]					
* 7.1 Identify and draw standard sectional views [GO1]	G1 (same)	Goal 2	D7	F4	3

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
* 7.2 Identify the symbols used to represent different materials [GO2]	G2 (same)	Goals 1, 3	D7	F4	3
* 7.3 Identify and use cutting planes [GO3]	G3 (same)	Goals 1, 2, 3	D7	F4	3
*7.4 Identify and use conventional breaks [GO4]	G4 (same)	Goals 1, 2	D7	F4	3
* 7.5 Identify use and application of sectional views [GO5]	G5 (same)	Goal 1	D7	F4	3
8. Pictorial Drawings [J]					
* 8.1 Identify use and application of pictorial drawings [JO3]	J3 (same)	Goal 1	D7	F4	3
* 8.2 Sketch pictorial drawings [JO4]		Goals 1, 2	D7	F4	3
* 8.3 Construct axonometric, oblique, and perspective drawings [JO5]	J2	Goals 1, 2, 3	D7	F4	3
9. Dimensioning and Tolerancing as Applied to Specific Drafting Fields [H]					
* 9.1 Construct the lines used to dimension drawings [HO2]	H2 (same)	Goals 1, 2	D7	F4	3
* 9.2 Identify and apply dimensioning practices [HO1]	H1	Goal 1	D7	F4	3
* 9.3 Identify and apply tolerancing [HO8]	H4	Goal 1	D7	F4	3
9.4 Identify and apply geometric dimensioning and tolerancing techniques [HO7]	H6, H7	Goal 1	D7	F4	3
* 9.5 Dimension drawing using ANSI and ISO Standards [HO9]		Goals 1, 2, 3	D7	F4	3
10. Applied Mathematical Skills [S]					
* 10.1 Apply basic mathematic principles [SO1]	S1 (same)	Goals 1, 3	D2	F4	3
* 10.2 Apply basic geometric principles [SO2]	S2 (same)	Goals 1, 3	D2	F4	3
* 10.3 Apply basic trigonometric principles [SO3]	S3 (same)	Goals 1, 3		F4	3
* 10.4 Solve problems using formulas [SO4]		Goals 1, 3		F4	3
11. Basic CAD Skills [U]					
* 11.1 Create new 2-D drawings [UO1]	R3	Goals 1, 2, 3	D7, D8	F4	3, 5
* 11.2 Perform drawing setup to applicable standards (e.g., settings, layers, line types and widths) [UO2]		Goal 1	D8	F4	3, 5
* 11.3 Identify and use view and display commands (e.g., settings, layers, line types and widths) [UO3]		Goal 1	D8	F4	3, 5
* 11.4 Use query commands to extract drawing data (e.g., entity characteristics, distance, area, status) [UO4]		Goal 1	D8	F4	3, 5
* 11.5 Edit, copy, and manipulate drawing entities (e.g., entity characteristics, distance, area, status) [UO4]	R3	Goal 1	D8	F4	3, 5
* 11.6 Save, retrieve and manage drawings [UO6]	R4	Goal 1	D8	F4	3, 5

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
* 11.7 Dimension drawings [U07]	R3	Goals 1, 2, 3	D7, D8	F4	3, 5
* 11.8 Set and change dimensioning variables [U08]	R3	Goals 1, 3	D8	F4	3, 5
* 11.9 Enter and edit text [U09]	R3	Goals 1, 2, 3	D8	F4	3, 5
* 11.10 Plot drawings to proper scale [U10]	R3	Goals 1, 2, 3	D7, D8	F4	3, 5
* 11.11 Identify backup and archival methods [U11]	R4	Goal 1	D8	F4	3, 4, 5
* 11.12 Create, edit and retrieve component/symbol libraries (e.g., groups, blocks, symbols, third-party libraries) [U12]	R4	Goals 1, 3	D8	F4	3, 5
* 11.13 Identify and apply layering techniques [U13]	R3	Goal 1	D8	F4	3, 5
* 11.14 Identify methods of sharing drawings (e.g., team projects) [U14]	R4	Goals 1, 3	D8	F4	3, 5
12. Advanced CAD Skills [V]					
12.1 Create 3-D drawings using extrusions and wireframes [VO1]		Goals 1, 3	D7, D8	F4	3, 5
12.2 Create surface and solid models [VO2]		Goals 1, 3	D8	F4	3, 5
12.3 Create joined and offset surfaces [VO3]		Goals 1, 3	D8	F4	3, 5
12.4 Edit solids, curves, and surfaces [VO4]		Goals 1, 3	D8	F4	3, 5
12.5 Create 2-D geometry from 3-D models [VO5]		Goal 2	D8	F4	3, 5
12.6 Import and export various file formats (e.g., DXF, IGES, raster) [VO6]	R4	Goal 1	D8	F4	3, 5
12.7 Extract geometric and attribute data (e.g., database and component information) [VO7]		Goals 1, 3	D8	F4	3, 5
12.8 Perform customization to improve productivity [VO8]		Goals 1, 3	D8	F4	3, 5
12.9 Install and configure software [VO9]		Goals 1, 3	D8, E2	F4	3, 5
12.10 Install and configure hardware [V10]		Goals 1, 3	D8, E2	F4	3, 5
12.11 Extract surface and mass properties (e.g., area, perimeter, moments of inertia, centroids) [V11]		Goals 1, 3	D8	F4	3, 5
12.12 Develop geometry using parametric programs [V12]		Goal 1	D8	F4	3, 5
13. Introduction to Production Manufacturing Drawing [O]					
13.1 Identify use and application of threads and fasteners (e.g., bolts, pins, keys) [O04]	O3	Goals 1, 3	D15	F4	3, 5
13.2 Identify manufacturing processes (e.g., machine processes, metal forming, CNC		Goals 1, 3	D15	F4	3, 5
13.3 Produce detail drawings applying standard machine fits, finishes and tolerances [O06]	O1	Goals 1, 3	D1, D15	F4	3, 5

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
13.4 Produce machine assembly drawing [O07]	O1	Goals 1, 3	D7, D8, D15	F4	3, 5
13.5 Apply standard fits, finishes and tolerances to machine drawing [O08]	O1	Goals 1, 3	D1, D15	F4	3, 5
13.6 Develop a parts list [O02]	O2 (same)	Goal 1	D7, D15	F4	3, 5
13.7 Produce drawings for welded component parts [O09]	HI	Goals 1, 3	D6, D7, D15	F4	3, 5
13.8 Produce drawings for metal bending and fabricating [O10]	HI	Goals 1, 2, 3, 4	D6, D7, D15	F4	3, 5
13.9 Produce drawings for non-steel materials [O11]	E3, H1	Goals 1, 2, 3, 4	D6, D7, D15	F4	3, 5
13.10 Produce drawings for CAD/CAM applications [O12]	E3, H1	Goals 1, 2, 3, 4	D6, D7, D15	F4	3, 5
13.11 Produce drawings for cams [O13]	E3, H1	Goals 1, 2, 3, 4	D6, D7, D15	F4	3, 5
13.12 Produce drawing for gears [O14]	E3, H1	Goals 1, 2, 3, 4	D6, D7, D15	F4	3, 5
14. Introduction to Architectural Drawings [K]					
14.1 Construct architectural symbols [KO1]	K1 (same)	Goal 1	D7, D15	F4	3
14.2 Identify architectural design and planning principles [KO5]		Goals 1, 3, 4	D7, D15	F4	3
14.3 Identify basic construction terminology and materials [KO6]		Goal 1	D2, D7, D8, D9, D10, D15	F4	3
14.4 Produce site plan [KO7]		Goals 1, 3, 4	D15	F4	3
14.5 Identify applicable building codes [KO8]			D1, D7, D15	F4	3
14.6 Prepare a schedule using a freehand architectural style lettering [KO9]			D1, D2, D6, D7, D8, D9, D10, D11, D15	F4	3
14.7 Measure, sketch and draft an as-built floor plan [K10]	K2		D1, D7, D8, D9, D15	F4	3
14.8 Produce typical wall and building sections with necessary details [K11]	K4		D1, D7, D8, D9, D15	F4	3
14.9 Produce floor plans [KO2]	K2		D1, D7, D8, D9, D15	F4	3
14.10 Produce elevation drawings [K12]	K2		D1, D7, D8, D9, D15	F4	3
15. Introduction to Residential and Commercial Wiring Drawings [W]					
15.1 Identify electrical symbols [WO1]	L1	Goal 1	D7, D15	F4	3
15.2 Identify applicable codes (e.g., IEC, NEC and IEEE) [WO2]		Goal 1	D7, D15	F4	3
15.3 Produce wiring schematics [WO3]	L2	Goal 1, 3, 4	D1, D7, D8, D9, D15	F4	3, 4

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
16. Introduction to Electronic Drawings [X]					
16.1 Identify electronic symbols [XO1]	L1	Goal 1	D7, D15	F4	3
16.2 Produce electronic/electrical schematics and diagrams [XO2]	L2	Goals 1, 3, 4	D1, D7, D8, D9, D15	F4	3, 4
17. Introduction to Pipe/Plumbing Drawings [M]					
17.1 Identify piping symbols, fittings, fixtures and valves [MO1]	M1	Goal 1	D7, D15	F4	3
17.2 Identify applicable codes [MO3]		Goal 1	D7, D15	F4	3
17.3 Identify principles of pneumatics and hydraulics [MO4]		Goal 1	D15	F4	3
17.4 Produce orthographic drawings [MO5]	M2	Goals 1, 3, 4	D1, D7, D8, D9, D15	F4	3
17.5 Produce isometric drawings [MO6]	M2	Goals 1, 3, 4	D1, D7, D8, D9, D15	F4	3
18. Introduction to Structural Steel Drawings [N]					
18.1 Identify structural steel shapes [NO1]	N1 (same)	Goal 1	D15	F4	3
18.2 Identify applicable codes (OSHA, AWS, SJI and BOCA) [NO4]		Goal 1	D15	F4	3
18.3 Identify and apply welding symbols [NO5]		Goal 1	D7, D15	F4	3
18.4 Identify open-web joist types and applications [NO6]		Goal 1	D7, D15	F4	3
18.5 Produce a steel framing plan drawing [NO2]	N2	Goals 1, 3, 4	D6, D7, D8, D15	F4	5
18.6 Produce a detail and assembly drawing (including beam connections) with bill of materials [NO3]	N3	Goals 1, 3, 4	D1, D7, D8, D10, D11, D15	F4	3, 5
18.7 Sketch complex connections [NO7]		Goals 1, 3	D1, D7, D8, D10	F4	3, 5
19. Introduction to Civil/GIS (Geographic Information System) Drawings [Y]					
19.1 Identify symbols [YO1]	P1	Goal 1	D7, D15	F4	3
19.2 Identify uses of GIS and GPS (global positioning systems) [YO2]		Goal 1	D7, D15	F4	3
19.3 Produce a contour plan [YO3]	P2	Goals 1, 3, 4	D1, D7, D8, D9, D15	F4	3
19.4 Produce a profile drawing [YO4]	P2	Goals 1, 3, 4	D1, D7, D8, D9, D15	F4	3
19.5 Produce a land survey plot from written description [YO5]	P3	Goals 1, 3, 4	D1, D7, D8, D9, D15	F4	3
20. Introduction to Sheet Metal/HVAC Drawings [Q]					
20.1 Identify applicable codes (e.g., ASHRAE0 [QO4])		Goal 1	D15	F4	3

Missouri Competency	Previous Mo. Competencies	Show-Me Standards	AAOI Objectives	Pre-Employment/ Work Maturity Skills	VICA/SCANS Competencies
20.2 Produce representative sheet metal drawings [QO2]	Q2 (same)	Goals 1, 3, 4	D1, D2, D6, D7, D8, D9, D15	F4	3
20.3 Identify sheet metal layout procedures [QO3]	Q3 (same)	Goal 1	D7, D15	F4	3
20.4 Identify HVAC symbols [QO6]		Goal 1	D7, D15	F4	3
20.5 Produce sheet metal drawings for CAD/CAM applications [QO6]		Goals 1, 3, 4	D1, D6, D7, D8, D9, D15	F4	3, 5
20.6 Prepare HVAC ductwork plan [QO7]		Goals 1, 3, 4	D1, D6, D7, D8, D9, D15	F4	3, 4
21. Leadership Competencies [T]					
21.1 Demonstrate an understanding of VICA, its structure and activities [TO1]	T1	Goal 1			
21..2 Demonstrate an understanding of one's personal values [TO2]	T2	Goal 1			
21.3 Perform tasks related to effective personal management skills [TO3]	T3	Goal 4	I4		
21.4 Demonstrate interpersonal skills [TO4]	T4	Goal 2	I4	G1	2
21.5 Demonstrate etiquette and courtesy [TO5]	T5	Goal 2			2
21.6 Demonstrate effectiveness in oral and written communication [TO6]	T6	Goal 2		G1	2
21.7 Develop and maintain a code of professional ethics [TO7]	T7	Goal 4			
21.8 Maintain a good professional appearance [TO8]	T8	Goal 4	I5	F5	
21.9 Perform basic tasks related to securing and terminating employment [TO9]	T9	Goals 2, 4			
21.10 Perform basic parliamentary procedures in a group meeting [T10]	T10	Goals 2, 4			2, 4

DRAFTING OCCUPATIONAL SKILLS STANDARDS

Source: National Occupational Skill Standards for Computer Aided Drafting and Design (CADD). Washington, DC: Foundation for Industrial Modernization, 1994.

Fundamental Drafting Skills

1.2 Drafting Skills

- 1.2.1. Use drawing media and related drafting materials (e.g., papers, vellum, mylar; plotter pens, toner cartridges)
- 1.2.2. Use basic measurement systems (e.g., fractions, decimals, and metric measurements)
- 1.2.3. Add correct annotation to drawing
- 1.2.4. Identify line styles and weights
- 1.2.5. Prepare title blocks and other drafting formats
- 1.2.6. Apply metric and/or dual dimensioning drawing standards
- 1.2.7. Identify and use appropriate standard symbols
- 1.2.8. Reproduction of originals using different methods (e.g., photocopy, plot, blueprint)
- 1.2.9. Create freehand technical sketches

1.3 Orthographic Projections

- 1.3.1. Identify, create, and place appropriate orthographic views

- 1.3.2. Identify, create, and place appropriate auxiliary views
- 1.3.3. Identify, create, and place appropriate section views

1.4 Pictorial Drawings

- 1.4.1. Identify and create axonometric drawings (e.g., isometric, diametric, trimetric)
- 1.4.2. Identify and create oblique drawings (e.g., cabinet, cavalier)
- 1.4.3. Identify perspective drawings (e.g., 1-point, 2-point, 3-point)

1.5 Dimensioning

- 1.5.1. Apply dimensioning rules correctly (e.g., avoid redundant dimensioning, avoid dimensioning to hidden lines)
- 1.5.2. Use correct dimension line terminators (e.g., arrowheads, ticks, slashes)
- 1.5.3. Dimension objects (e.g., lines, arcs, angles, circular)
- 1.5.4. Dimension complex shapes (e.g., spheres, cylinders,

- tapers, pyramids)
- 1.5.5. Dimension features from a center line
- 1.5.6. Dimension a theoretical point of intersection
- 1.5.7. Use appropriate dual dimensioning standards
- 1.5.8. Use size and location dimension practices
- 1.5.9. Use various dimensioning styles (e.g., Cartesian, polar, ordinate, datum)
- 1.5.10. Place tolerance dimensioning and Geometric Dimensioning and Tolerancing (GD&T) on drawings when appropriate

Fundamental Computer Skills

2.1 Hardware

- 2.1.1. Demonstrate proper care of equipment
- 2.1.2. Operate and adjust input devices (e.g., mouse, keyboard, digitizer)
- 2.1.3. Operate and adjust output devices (e.g., printers, plotters, modems)
- 2.1.4. Correct handling and operation of storage media, retrieval, and backup
- 2.1.5. Adjust monitor controls for maximum comfort and usability
- 2.1.6. Recognize availability of information services (e.g., electronic mail, bulletin boards)

2.2 Physical and Safety Needs

- 2.2.1. Demonstrate an understanding of ergonomic considerations (e.g., keyboard position, screen position, lighting)
- 2.2.2. Demonstrate personal safety (e.g., electrical and mechanical hazards)

2.3 Operating Systems

- 2.3.1. Start and exit a software program as required
- 2.3.2. Demonstrate proper file management techniques (e.g., copying, deleting)

- 2.3.3. Format floppy disk
- 2.3.4. Identify, create, and use directory structure and change directory paths
- 2.3.5. Demonstrate proper file maintenance and backup procedures
- 2.3.6. Translate, import, and export data files between formats (e.g., IGES, DXF)
- 2.3.7. Use on-line help
- 2.3.8. Save drawings to storage devices

Basic CADD Skills

3.1 Create

- 3.1.1. Create new drawing
- 3.1.2. Perform drawing set up
- 3.1.3. Construct geometric figures (e.g., lines, splines, circles, and arcs)
- 3.1.4. Create text using appropriate style and size to annotate drawings
- 3.1.5. Use and control accuracy enhancement tools (e.g., entity positioning methods such as snap and XYZ)
- 3.1.6. Identify, create, store, and use appropriate symbols/libraries
- 3.1.7. Create wireframe/solid models
- 3.1.8. Create objects using primitives
- 3.1.9. Create 2-D geometry from 3-D models
- 3.1.10. Revolve a profile to create a 3-D object
- 3.1.11. Create 3-D wireframe models from 2-D geometry

3.2 Edit

- 3.2.1. Utilize geometry editing commands (e.g., trimming, extending, scaling)
- 3.2.2. Utilize non-geometric editing commands (e.g., text, drawing format)

3.3 Manipulate

- 3.3.1. Control coordinates and display scale
- 3.3.2. Control entity properties (e.g., color, line type)

- 3.3.3. Use viewing commands (e.g., dynamic rotation, zooming, panning)
- 3.3.4. Use display commands (e.g., hidden line removal, shading)
- 3.3.5. Use standard parts and/or symbol libraries
- 3.3.6. Plot drawings on media using correct layout and scale
- 3.3.7. Use layering techniques
- 3.3.8. Use grouping techniques
- 3.3.9. Minimize file size

3.4 **Analyze**

Use query commands to interrogate database (e.g., entity characteristics, distance, area, status)

3.5 **Dimensioning**

Use associative dimensioning correctly

Advanced CADD Skills

4.1 **Create**

- 4.1.1. Create wireframe and/or solid models
- 4.1.2. Create non-analytic surfaces using appropriate modeling (e.g., non-analytic: NURBS, B-spline, Gordon, Bezier, Coons)
- 4.1.3. Create analytic surfaces using appropriate modeling with planes and analytic curves (e.g., conic, cylinder, revolution, ruled)
- 4.1.4. Create offset surfaces
- 4.1.5. Find intersection of two surfaces
- 4.1.6. Create joined surfaces
- 4.1.7. Create a fillet or blend between two surfaces
- 4.1.8. Create feature based geometry (e.g., holes, slots, rounds)
- 4.1.9. Create cut sections
- 4.1.10. Construct and label exploded assembly drawings
- 4.1.11. Perform Boolean operations (e.g., union, subtraction, intersection)

4.2 **Edit**

- 4.2.1. Trim surface
- 4.2.2. Manipulate surface normals
- 4.2.3. Extend surface
- 4.2.4. Edit control points (e.g., surfaces, Bezier)
- 4.2.5. Modify geometry via Boolean operations
- 4.2.6. Edit primitives (e.g., moving, copying, resizing)

4.3 **Manipulate**

- 4.3.1. Perform axis view clipping
- 4.3.2. Extract wireframe data from surface/solid geometry
- 4.3.3. Shade/render object (e.g., reflectivity, opacity)

4.4 **Analyze**

- 4.4.1. Extract geometric data
- 4.4.2. Extract attribute data
- 4.4.3. Identify gaps in non-intersecting surfaces
- 4.4.4. Obtain surface properties (e.g., area, perimeter, bounded volume)
- 4.4.5. Obtain mass properties data (e.g., moments of inertia, centroids)

4.5 **CADD Productivity and Work Habits**

- 4.5.1. Perform customization to improve productivity (e.g., customize menus, function keys, script files, macros)
- 4.5.2. Manipulate associated non-graphical data
- 4.5.3. Use template and library files to establish drawing standard presets
- 4.5.4. Develop geometry using parametric programs

SHOW-ME STANDARDS

The new educational goals and standards are a result of the Outstanding Schools Act of 1993, which calls on Missouri citizens and educators....to define appropriate, rigorous expectations for children's learning. Committees of teachers, citizens, parents, lawmakers and state officials have been working on the proposed goals and standards since then.

To lead productive and fulfilling lives and to continue learning, students in Missouri public schools will acquire the knowledge and skills to:

Goal 1: Gather, analyze and apply information and ideas;

Goal 2: Communicate effectively within and beyond the classroom;

Goal 3: Recognize and solve problems; and

Goal 4: Make decisions and act as responsible members of society

Source: "The Show-Me Standards." Jefferson City, MO: Missouri Department of Elementary and Secondary Education, January 1996.

ALL ASPECTS OF THE INDUSTRY

Recent national legislation requires that vocational education programs provide a strong experience in “all aspects of the industry” (AAOI) for industries that students are preparing to enter. AAOI’s ultimate goal is to give future workers a sense of the issues involved in the world of work. Such knowledge can empower future workers to make informed decisions about their career paths. This knowledge can also allow workers to make meaningful contributions to the industry, instead of performing mindlessly like another piece of equipment. The main areas of AAOI include:

- Planning
- Management
- Finance
- Technical and Production Skills
- Principles of Technology
- Labor and Community Issues
- Health/Safety/Environment
- Personal Conduct

Duty Bands and Objectives

A. Planning

- A1 Describe why industries respond to customer wants and expectations.
- A2 List differences in how companies deliver products versus delivering services.
- A3 Describe ways a worker can influence company decision-making.
- A4 Identify benefits in anticipating technology and market trend changes.
- A5 Identify an example of how regulatory laws can impact

how a business operates.

- A6 Identify an example of how a political organization can impact how a company operates.

B. Management

- B1 Identify key components of a company “mission statement.”
- B2 Identify how a corporate “chain of command” works
- B3 Describe the significance of a company’s “corporate culture.”

- B4 Describe how a company organizes its departments.
- B5 List typical ways company departments communicate.
- B6 Cite examples of why a worker should adjust to different management styles.
- B7 Cite an example of how companies are dependent on the national economy.
- B8 Cite an example of how a company is dependent upon the local economy.
- B9 Describe the importance of achieving internal and external customer satisfaction.
- B10 Identify examples of how cultural diversity can affect an industry.
- B11 Identify key differences in how private companies and government agencies operate.
- B12 List reasons why written policies are used in industry
- B13 Identify resources available from professional organizations.
- B14 Identify how roles and responsibilities in a family business are different than in larger companies.
- B15 List benefits a worker can get by participating in meetings.
- B16 List key differences in how a family farm operates versus how another small business operates.
- B17 Describe how a company's marketing affects all its employees.

C. Finance

- C1 List typical ways a business obtains capital.
- C2 Describe the importance of accounting in a business.
- C3 Describe key implications for a company which grants credit
- C4 Describe how a company estimates and bids for a contract.
- C5 Describe how paycheck deductions affect a worker.
- C6 Describe the importance of cost containment in a company.

D. Technical and Production Skills

- D1 Demonstrate a basic math ability.
- D2 Demonstrate the capability to measure quickly and accurately.

- D3 Demonstrate the ability to speak and write the English language effectively.
- D4 Demonstrate the ability to listen effectively.
- D5 Demonstrate the ability to use effective negotiation skills.
- D6 Demonstrate the ability to manage time effectively.
- D7 Demonstrate the ability to read blueprints and drawings.
- D8 Demonstrate the ability to perform basic computer operation.
- D9 Describe the importance of deadlines and schedules.
- D10 Demonstrate the ability to use team player skills.
- D11 Demonstrate the ability to use supervisory and delegation skills.
- D12 Demonstrate the ability to utilize good public speaking skills.
- D13 Describe the importance of using troubleshooting techniques.
- D14 Cite one example of a job that is inter-related with another job.
- D15 Demonstrate the ability to obtain technical information.
- D16 Identify certification requirements for a specific job.

E. Principles of Technology

- E1 Describe the key characteristics of the technology used in your industry.
- E2 Describe the importance of analyzing new equipment for possible use.
- E3 Describe the importance of continuously upgrading one's job skills.
- E4 Describe the importance of adaptability and learning from experience.
- E5 Describe the importance of acquiring and analyzing information effectively and making sound decisions.
- E6 Describe the importance of cross-training.

F. Labor

- F1 Describe the importance of a written job description.
- F2 Describe the importance of knowing your rights as a worker.

- F3 Describe the role labor organizations play in your industry (if any).
- F4 List advantages/disadvantages of hourly and salaried pay.
- F5 List differences between being a self-employed worker and a worker employed by a company.
- F6 Describe the importance of participating in quality enhancement programs.
- F7 Describe the importance of understanding why a worker is asked to occasionally work longer hours.
- F8 Describe the importance of cultural sensitivity.

G. Community

- G1 Describe the importance of recognizing a worker should contribute special skills through volunteer work.
- G2 Identify key ways a company helps its community.
- G3 Identify key ways a community helps a company.
- G4 Identify an impact of buying outside the community.
- G5 Describe how a company's public perception is important.
- G6 Describe the importance of providing for the access needs of the physically challenged.

H. Health, Safety, and Environment

- H1 Describe the importance of complying with federal agency regulations.
- H2 Describe why it is important to avoid job-specific health threats.

- H3 Read and comprehend major components of a Material Safety Data Sheet
- H4 Identify basic safety training (tornado, fire, first aid) techniques
- H5 Describe the importance of participating in preventive medicine programs.
- H6 Describe the importance of handling stress effectively.
- H7 Describe the importance of good workplace ergonomics.
- H8 Identify any effects weather could have on an industry.
- H9 Describe the importance of management's responsibility for a safe workplace.

I. Personal Conduct

- I1 Describe the importance of recognizing the dignity of all work.
- I2 Describe the importance of producing quality and effective work.
- I3 Describe the importance of being fit for duty (no drugs, no alcohol)
- I4 Describe the importance of exhibiting good attitude, enthusiasm, integrity.
- I5 Describe the importance of exhibiting good grooming and appearance.
- I6 Describe the importance of good personal financing.

Source: All Aspects of the Industry (65-9000-1). University of Missouri-Columbia: Instructional Materials Laboratory, 1994.

PRE-EMPLOYMENT/WORK MATURITY SKILLS

In 1992, three Missouri agencies co-published the Pre-Employment and Work Maturity Competencies: A Guide for Practitioners. The Missouri competencies identified in the practitioner's guide are endorsed by all three agencies: the Missouri Department of Elementary and Secondary Education, the Department of Labor and Industrial Relations, and the Department of Economic Development. The list includes seven core competencies and related employability skills. Locally developed learner outcomes may, of course, be added, and local groups are encouraged to utilize the identified state competencies for development of their own pre-employment and work maturity skills.

- A. Making Career Decisions**
 - A1. Perform self assessment
 - A2. Explore occupational information
 - A3. Perform decision-making process
- B. Using Labor Market Information**
 - B1. Identify sources of information
 - B2. Use labor market information
- C. Preparing a Resume**
 - C1. Collect resume data
 - C2. Develop a resume
- D. Completing the Job Application Process**
 - D1. Prepare letters of inquiry
 - D2. Provide accurate educational data
 - D3. Provide accurate work history data
 - D4. Provide accurate personal data
 - D5. Provide accurate reference information
 - D6. Fill out job application form
- E. Demonstrating Effective Interviewing Skills**
 - E1. Present proper appearance
 - E2. Prepare for interview
 - E3. Greet the interviewer
 - E4. Participate in the interview
 - E5. Respond to interview closure
 - E6. Prepare a letter of follow-up

F. Demonstrating Knowledge of the Proper Work Attitudes and Behaviors

- F1. Be dependable
- F2. Be punctual
- F3. Maintain a positive attitude and behavior
- F4. Complete tasks effectively with or without supervision
- F5. Practice good grooming and personal hygiene
- F6. Recognize legal issues in the workplace

G. Demonstrating Knowledge of Effective Interpersonal Skills

- G1. Communicate with others
- G2. Maintain relationships with others

SCANS COMPETENCIES

SCANS foundation skills identified by the U.S. Department of Labor describe generic skills needed by nearly everyone. The SCANS competencies, however, are more specific in nature and are listed below. (SCANS is the acronym for the Secretary [of Labor]’s Commission on Achieving Necessary Skills.) National VICA’s Total Quality Curriculum incorporates SCANS competencies and Total Quality Management (TQM) principles in a 17-module set of activities.

Works with cultural diversity

1. Resources

- Allocates time
- Allocates money
- Allocates material and facility resources
- Allocates human resources

2. Interpersonal

- Participates as a member of a team
- Teaches others
- Serves clients/customers
- Exercises leadership
- Negotiates to arrive at a decision

3. Information

Acquires and evaluates information
Organizes and maintains information
Interprets and communicates information
Uses computers to process information

4. Systems

Understands systems
Monitors and corrects performance
Improves and designs systems

5. Technology

Selects technology
Applies technology to task
Maintains and troubleshoots equipment