

MATRIX-MAN. DRAFT-IV

MATRIX –MANUFACTURING TECHNOLOGY

CLUSTER MODEL 1/99 by Jerry Atkinson
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COMPETENCIES/SKILLS	COLORADO CORE MEASURE (B)	COLORADO CONTENT STANDARD (1313) (C)	ASSESS- MENT METHOD (D)	ACHIEVE- MENT LEVEL (E)
SKILLS FOR ADVANCED HIGH PERFORMANCE MANUFACTURING				
We should read each skill as a completion to the statement: "A good competent skilled worker/learner can..."				
Manufacturing Fundamentals				
1. Demonstrate basic mechanical skills.	1-le 2-t 3	III-R2	P IBT	80% PR
2. Describe the importance of correct fixturing and work holding devices.	1-w, s 2-s, t 3	III-R2, R5	W O	75%
3. Describe the function of specific manufacturing equipment.	1-w, s 2-t 3	I-R1.3	W O	80%
4. Inspect machine tools for defects.	1-r, d 2-t, i 3	III-R2	P W	85%
5. Perform minor maintenance on company-provided manufacturing equipment.	1-r, d 2-r, i 3	I-R1.3, R4	P	85%
6. Locate and retrieve production materials specific to process flow and delivery schedule.	1-r 2-s, t 3	I-R2, R4, R5 II-R2, R3, R6	P	80%
7. Receive and communicate process flow instructions and delivery schedules.	1-w, s, r, l 2-is, s, t, i 3	I-M1.3. R3, R4, R5	P W O	80%
8. Operate hand tools in a safe , prescribed manner.	1-r, d, re, i, sm 2-t, i 3	I-R1, R4, R5 III-R2	P	100%
9. Inspect hand tools for defects.	1-d 2-i 3	I-R1, R4, R5 III-R2	P W	80%
10. Maintain company-provided hand tools.	1-d, so, i 2-i 3	I-R1, R4, R5 III-R2	P W	80%
11. Interpret prints to determine appropriate tool usage.	1-r 2-i 3	I-R5	P W O	80%
12. Follow electrical troubleshooting procedures.	1-r, m, p 2-t 3	I-R5 III-R2 II-R2, R5, R6	P W	80%
13. Identify types of work-saving devices used in manufacturing.	1-w, r, s 2-i, r, s, t 3	I-R1, R4, R5 III-R1, R5	W O	75%
14. Describe scenarios in which work-savings devices can be used.	1-w, s 2-r, is, s, i 3	I-R2, R3, R4, R5 II-R3	W O	S
15. Describe the fundamental properties and characteristics of basic engineering materials, including, but not limited too; ferrous metals, non-ferrous metals, polymers, ceramics, wood, insulators and semiconductors.	1-w, r, s 2-i 3	I-R5 III-R2, R5	W O	75%
16. Describe how materials are selected for various applications in manufactured products.	1-w, r, s 2-i, t 3	I-R5 III-R2, R5, R6	W O	75%
17. Demonstrate the ability to safely operate common manufacturing equipment.	1-rs, i 2-r, i, t 3	I-R4 II-R1, R2, R3, R4, M5 III-R2	P IBT	100% S PR
18. Manufacture parts on manufacturing equipment safely and effectively.	1-le, p, d, re 2-r, t 3	II-R1, R2, R3, R4, M5 III-R2	P IBT	92% PR

19. Manufacture parts within tolerances in a timely manner.	1-le, p, d 2-r, t 3	II-R1, R2, R3, R4, M5 III-R2	P PF IBT	92% PR
Measurement Tools and Techniques				
1. Match measurement activities to manufacturing process.	1-w, r, m, rs 2-t, i 3	I-R4, R5 III-R5 II-R2, M3, R5, R6	P W O	80%
2. Select and use appropriate measurement techniques and instruments.	1-w, r, m, rs 2-t, i 3	I-R5 III-R1, R5 II-R2, R3, R5, R6	P W O IBT	80% S PR
3. Describe measurements' role in manufacturing.	1-s, m 2-t, i 3	I-R4, R5 III-R5, R6 II-R2, R3, R5, R6	W	75%
4. Distinguish between direct and calculated measurements.	1-r, m 3	I-R5 II-R2, M5, R6	W O	80%
5. Compute calculated measurements.	1-m 3	II-R1, R2, R5, R6	W	95%
6. Demonstrate proper general measurement techniques.	1-w, s, m 3	II-M5, R6	P	85%
7. Demonstrate proper precision measurement techniques.	1-w, s, m 3	II-M5, R6 III-R5	P	85%
8. Describe the appropriate application and use of precision measurements in manufacturing.	1-w, s, m 2-t, i 3	I-R4 III-R5 II-R2, R5, R6	W O	80%
9. Explain calibration requirements of various precision instruments.	1-s, m 3	I-R2, R5 III-R5 II-R2, R5, R6	O	80%
10. Illustrate measurement differences when taken with calibrated and non-calibrated instruments.	1-s, m 3	II-R2, R5, R6 III-R5	P	80%
11. Match appropriate measurement tools with various types of measurement requirements.	1-r, m, rs 2i 3	II-R2, R6 III-R5	P	80%
12. Demonstrate proper measurement tool usage.	1-s, m 3	II-R2	P	80% S
13. State selection criteria for measurement tools	1-r, m, rs 2-t, i 3	I-R1.3, R4, R5 II-R2, R6	W O	80%
14. Convert between US and metric measurement systems.	1-w, r, m 2-s	II-R2, R5, R6	P W	95%
15. Convert fractional measurement to decimal measurement.	1-r, m	II-M1, R2, R5, R6	P W	95%
16. Compute within measurement systems.	1-m 2-s	II-M1, R2, R5, R6	P W	90%
17. Interpret results of measurements and calculations.	1-w, s, r, m, d 2-i 3	II-R2, R3, R5, M6 III-R5	W O	90%
18. Distinguish between general and precision measurement.	1-r, m 3	II-R2, R5, R6	W O	80%
Manufacturing Computer Skills				
1. List possible computer applications in manufacturing processes.	1-w 2-i, t 3	I-R5 II-R5, R6 III-M5	W PF	75%
2. Identify possible effects of introducing computers into manufacturing processes.	1-w, s, r 2-i, s, t 3	I-R4, R5 II-R5, R6 III-R1, M5	W O	75%
3. List various methods of tracking inventory quantities.	1-w, s 2-r, i, s, t 3	I-R5 III-M5 II-R2, R3, R5, R6	W	75%
4. List factors that determine inventory demand.	1-w, s 2-r, i 3	I-R5 II-R2, R3, R5, R6 III-R5	W	80%
5. Demonstrate use of an industry-accepted word processing software package.	1-r, s, le 2-i, s, t 3	I-M1.3, R5 II-R3 III-R5	P W PF	85%
6. Demonstrate use of an industry-accepted spreadsheet software package.	1-r, s, le 2-i, s, t 3	I-M1.3, R5 II-R3, R5, R6 III-R5	P W PF	85%

7. Demonstrate use of an industry-accepted database software package.	1-r, s, s, le 2-s, t, i 3	I-M1.3, R5 III-R2, R5 II-R3, R5, R6	P W PF	85%
8. Demonstrate use of an industry-accepted graphic software package.	1-r, s, le 2-s, t, i 3	I-M1.3, R5 II-R4 III-R5	P W PF	85%
9. Demonstrate the use of an industry-accepted Internet browser and how to obtain information on the Internet.	1-r, s, le, p 2-s, t, i 3	I-M1.3, R5 III-R1, R5	P W PF	85%
10. Demonstrate use of an industry-accepted statistical process control software package.	1-r, s, le 2-s, t, i 3	I-M1.3, R5 III-R1, R5 II-R3, R4, R5, R6	P W PF	90%
11. Demonstrate use of an industry-accepted three dimensional solid computer aided design (3D CAD) software package.	1-r, s 2-s, t, i 3	I-M1.3, R5 II-R3, R6 III-M5	P W PF IBT	90% PR
12. Demonstrate an understanding of a turnkey microcomputer system.	1-s, r le 2-s, t, i 3	I-M1.3, R5 III-R5	P W O	70%
Engineering Graphics				
1. Define basic engineering drawing terminology.	1-w, s 2-s, i 3	II-R2, R4, R5, R6 III-R5	W O	90%
2. Identify different dimension methodologies.	1-r, s, m 2-s 3	II-R2, R4, R5, R6 III-R5	W O	80%
3. Identify general note symbols.	1-w, r 2-i, s 3	II-R2, R5	W O	90%
4. Locate notes on a print.	1-r 2-s, i 3	II-R6	P	S
5. Interpret commonly used abbreviations and terminology.	1-w, s, r 2-s, i 3	I-R5 II-R2	W O	85%
6. Determine tolerances associated with dimensions on a drawing.	1-m 2-i, s 3	II-R2, R3, R4, R5	P	92%
7. Identify types of lines within a drawing.	1-w 2-s 3	I-R2, R4, R5	W O	90%
8. List the essential components found in the title block.	1-w, s 2-s, i 3	I-R2, R4, R5	W	80%
9. List the essential components found in the revision block.	1-w, s 2-s, i 3	I-R2, R4, R5	W	80%
10. Identify orthographic views.	1-w, r, s 2-s 3	II-R4	W O	80%
11. Identify isometric views.	1-w, r, s 2-s 3	II-R4	W O	80%
12. Identify position of views top, front, side, auxiliary and section.	1-r 2-s 3	II-R2, R4	W O IBT	80% PR
13. Visualize one or more views from a given isometric or pictorial representation of an object, or from the actual object.	1-w 2-s 3	II-R3, R4	P PF W	80%
14. Determine the scale of the view or section.	1-r, m 2-s 3	II-R2, R4, R6	W O	95%
15. Check for revisions.	1-r 2-s, i 3	I-R2, R3, R4, R5 II-R2	P W	80%
Quality Assurance				
1. Explain the effect of quality on profit.	1-w, s, m 2-s	I-R2, R4, R5 II-R3 III-R6	O	75%
2. Identify influences of a quality systems on specific manufacturing processes.	1-w, s, r 2-r, s, t, i 3	I-R4, R5 II-R2, R3 III-R1, R6	W O PF	75%
3. Identify the effects of continuous quality improvement.	1-w, s, r 2-r, s	I-R4, R5 II-R2, R3, R5, R6	W O	75%
4. Demonstrate the ability to apply continuous quality improvement to manufacturing processes.	1-r, c, p 2-r, s, t, i 3	I-R5 II-R3, R5, R6	P O X	80% S
5. Integrate improvement processes.	1-s, l, rs, p 2-s	I-R4 II-R5	P IBT	PR S

6. Apply quality assurance tools to specific production processes.	1-w, r, rs, d, p 2-r, s, t, i 3	I-R5 III-R5 II-R2, R3, R4, R6	P X	S
7. Analyze production specific processes.	1-l, r, p 2-r, s, t	I-R1.3, R4, R5 II-R2, R5, R6 III-R1, R5	W	85%
8. Analyze and interpret test data for compliance to specification.	1-s, l, w, r, m, p 2-s, i	I-R1.3, M5 III-M1, R5 II-R2, R3, R5, R6	P O	90%
9. Improve production process (if indicated by analysis of data), including data from field failures.	1-s, r, c, p 2-r, s, i 3	I-R1.3, M5 III-R5, M6 II-R2, R3, R5, R6	P	80% S
10. Apply data collection techniques.	1-w, r, m, p 2-s, i	I-R4, R5 III-M1, R5 II-R3, R5, R6	P W O X	80% S
11. Apply statistical terms and charts needed for interpretation of continuous improvement processes.	1-r, m, p 2-r, s, i	I-R1.3, M4, M5 II-R3, R5, R6 III-M1, R5, M6	P W PF IBT	80% S PR
12. Integrate improvement processes into each critical function.	1-s, w, p, c 2-s	I-R4, M5 II-R5, R6	P	S
13. Select, set up and perform diagnostic tests.	1-r, s, m, rs, d, p 2-I, i	I-R5 III-M5 II-R2, R5, R6	P W	80%
14. Analyze and interpret test data for problems that require corrective actions and for compliance with specifications.	1-w, r, m, rs, d, p 2-r, i	I-M1.3, R5 II-R2, R3, R5, R6 III-M1, R5, R6	P W	85%
Critical Thinking/Problem Solving Skills				
1. Explain the value of applying a problem solving system.	1-s, le 2-s, i	I-M4, R5 II-R2, R3 III-R1	O	80% S
2. Apply a system of problem solving.	1-s, l, r, p 2-s, i	I-M4, R5 II-R2, R3, R6 III-R1	P	S
3. Identify opportunities for applying problem solving techniques.	1-s, l, c, d, p 2-is, s	I-R4, R5 II-R4, R5	W O	80%
4. Demonstrate the proper process in applying a problem solving technique.	1-s, l, c, d, p 2-is, s	I-R1.3, R4, R5 III-R1 II-R3, R4, R5, R6	P X PF IBT	S PR
5. Participate in brainstorming sessions to generate new ideas and solve problems.	1-s, l, r, c, p, i, so 2-s, is, i	I-M4, R5	P O X	S
Teamwork				
1. Identify interpersonal characteristics of a team player.	1-w, s 2-is, s	I-R4	W O	85%
2. Demonstrate the characteristics of a team player.	1-s, l, r, so, i, se 2-is, s	I-M4, R5	P X	S
3. Contrast the role of a team with the role of an individual.	1-w, s 2-is, s	III-R6	W O	75%
4. Perform techniques used as a team leader.	1-s l, r, d, i, so, se 2-is, s	I-M4 II-R2	P PF	S
5. Demonstrate productive relationships within the work group.	1-s, l, d, se, i, so 2-is, s	I-M4 II-R6	P X	S
6. Apply group dynamic principles to manufacturing situations.	1-s, l, r, d 2-is, s 3	I-M4, R5	P	S

7. Identify various team processes.	1-w, s, r 2-is, s, i	I-R5 II-R2	W O	80% S
8. Recognize the difference between a team environment workplace and a traditional workplace.	1-s 2-is, s	II-R2 III-R6	W O	S
9. Create and enhance effective, productive relationships within the team	1-s, l, r, rs, p, d, so, i 2-is, s	I-M4, R5	P X	S
10. Demonstrate an understanding of how and why successful teams are more effective than working groups or people working as individuals.	1-w, s, r 2-ie, s	I-M4, R5 III-R6	P W O PF	S
11. Identify the primary characteristics of a successful team.	1-w, s 2-is, i	I-R4, R5	W	85%
Workplace Skills (work ethic and employability)				
1. Demonstrate consistently punctual arrival.	1-d, re, i, sm 2-r	I-R5	P PF	98%
2. Document regular attendance.	1-w, m, re 2-i	I-R2	P W PF	98%
3. Demonstrate enthusiasm and confidence about work and learning new tasks.	1-le, se, so	I-R2	P O	S
4. Demonstrate safe, careful use, treatment and maintenance of tools, equipment and machines.	1-re, i 2-r,t 3	I-R2	P W	85%
5. Demonstrate appropriate dress and hygiene for successful employment.	1-d, re, se, sm, so 2-s	III-R3	P X	S
6. Demonstrate the ability to act in a polite and respectful way towards co-workers.	1-s, l, so, se, sm 2-is, s	I-M2, R4	P O X	S
7. Demonstrate the ability to complete tasks on time and accurately.	1-le, d, I, sm, re 2-r	II-R2,R6	P W PF	85%
8. Demonstrate the ability to make career decisions.	1-s, r, d, re, sm 2-i	I-M2, R4	P W PF	S
9. Demonstrate the ability to use labor market information.	1-w, r 2-s, i	I-R1.3, R2, R4, R5 II-R3, R6 III-R1	P W	85% S
10. Prepare a resume and letter of application/interest.	1-w, r, d, sm 2-i	I-R2, R3, R4, R5	P W PF	90% S
11. Fill out an application for employment.	1-w, r, sm 2-i	I-R2, R3, R4, R5	P W PF	90% S
12. Participate in an employment interview.	1-s, l, so 2-i	I-R2, R3, R4	P W O X IBT	S PR
13. Follow directions and procedures.	1-l, r, i, so 2-i	I-R4	P O	90%
14. Be depended on not to steal equipment and materials.	1-d, i, re, sm 2-r, s 3	I-R4	P X	100%
15. Be truthful in all communications with co-workers and supervisors.	1-s, l, se, so, i 2-is, s, i	I-R4, R5	P W O X	100%
16. Accept constructive criticism.	1-l, s, se, so, i 2-is, s	I-R4	O	85%
17. Demonstrate an ability to learn new skills and behaviors.	1-r, le, re, so, s, i	I-R2, R4, R5	P O PF	S
18. Demonstrate a willingness to work.	1-le, re, sm, so, i	I-R5	P O X	S

19. Work with minimal supervision.	1-l, r, c, i, sm, se 2-r	I-R5	P	S
20. Plan and organize work.	1-w, rs, d, le, sm, re, i 2-r, i	I-R4, R5	P W PF	S
Mathematics				
1. Add, subtract, multiply and divide four digit numbers without the use of a calculator.	1-r, a	II-M1, R6	W	97%
2. Add, subtract, multiply and divide four digit numbers with the use of a calculator.	1-r, a	II-M1, R6	P W	100%
3. Apply basic math functions to solve problems.	1-r, a, p 2-i	II-M1, R2, R3, R6	W	95%
4. Create and interpret basic graphs and charts commonly used in manufacturing.	1-r, w, m, rs 2-i	I-R4, R5 II-M2, R3, R5, R6	W PF	85%
5. Determine if a solution is reasonable.	1-r, m, rs	I-R4, R5 II-M1, R2, R3, R5, R6	W	85%
6. Round and/or truncate numbers to designated place value.	1-a, d	II-M1, R2, R6	W	90%
7. Compare order and determine equivalencies of real number (e.g., fractions, decimals and percentages)	1-r, m	II-M1, R2, R6	W	90%
8. Solve problems and make applications involving integers, fractions, decimals, percentages and ratios using order of operations.	1-r, m, p	I-R5 II-M1, R2, R3, R5, R6	W	95%
9. Translate written and/or verbal statements into mathematical expressions.	1-w, l, r, m, c	I-R4 III-R2 II-M1, R2, R3, R5, R6	P W	90%
10. Compare problems involving binary, octal, decimal and hexadecimal numbering systems.	1-r, m	I-R5 II-M1, R2, R5, R6	W O	90%
11. Convert, compare and compute with common units of measurement within and across measurement systems.	1-r, m	I-R5 III-R2 II-M1, R2, R5, R6	W O	90%
12. Read scale on measurement device(s) and make interpolations where appropriate.	1-r, m, rs	II-M1, R2, R3, R5, R6	W O	95%
13. Identify patterns, note trends and/or draw conclusions from tables, charts, maps and/or graphs.	1-w, r, m, rs, p 2-i	I-R1.3, R4, R5 III-M6 II-M2, M3, R5, R6	P W O PF	80%
14. Compute and interpret mean, median and/or mode.	1-r,m	I-R4 II-M1, M2, R3, R4, R5, R6	W O	97%
15. Simplify and solve algebraic expressions and formulas.	1-r, m, p	I-R4, R5 II-M1, M2, R5, R6	W	97%
16. Select and use formulas appropriately.	1-r, m, p	I-R4, R5 II-R1, M2, R5, R6	W	85%
17. Understand and use scientific notation.	1-r, m	I-R4 III-R2 II-R1, M2, R5, R6	W	85%
18. Use properties of exponents and logarithms.	1-r, m	II-R1, M2, R5, R6 III-R2	W	85%
19. Determine slope, midpoint and distance.	1-m, p	II-R1, M2, R4, R5, R6	P W	97%
20. Graph functions.	1-r, m	II-R1, M2, R4, R5, R6	P W	90%
21. Use Boolean algebra to solve problems.	1-r, w, m	II-R1, M2, R3, R5, R6	W	90%
22. Determine perimeters and areas of geometric figures.	1-r, a	II-R2, M4, R5, R6	W	95%

23. Determine surface areas and volumes of applicable geometric figures.	1-a	II-R2, M4, R5, R6	W	95%
24. Recognize, classify and use properties of lines and angles.	1-r, m	II-R2, M4, R5, R6	W	80%
25. Recognize, classify and use properties of two- and three- dimensional figures (e.g., circles, triangles, rectangles and cylinders).	1-r, m	II-R2, M4, R5	W PF	80%
26. Apply Pythagorean theorem.	1-r,m	I-R4, R5 II-R2, R4, R6	P	90%
27. Compute and solve problems using basic trigonometric functions.	1-r, m	II-R2, M4, R5, R6	P W PF	95%
28. Graph basic functions using polar and/or Cartesian Coordinate systems.	1-w, r, m 2-i	II-M2, M4, R5, R6 III-R2	P W PF	90%
Communication				
1. Identify possible electronic communication uses.	1-r, s 2-t, i	I-R5 III-M5	O	75%
2. Select appropriate communication methods.	1-r 2-s, i	I-R4, R5 III-M5	P W O	S
3. Read, process information and follow instructions.	1-r, s, l, le, d, p 2-i	I-R2, R4. M5 III-R6	P W O	85%
4. Read documentation, such as a computer manual, to determine actions for specific situations.	1-r, d, p 2-i, t 3	I-M1.3, R2, M4, M5 III-R1, R5, R6	P IBT	85% PR
5. Research, organize and write the steps of a process using sentences and statements as appropriate with correct punctuation, correct spelling, accuracy, brevity and clarity.	1-w, r, rs 2-i	I-M1.3, R2, M3, M5 III-R6	P W PF	85%
6. Organize and deliver persuasive oral presentation.	1-r, s, l, rs, c, se 2-is, i	I-M2, R3. M4, R5	P O PF	S
7. Demonstrate good speaking characteristics.	1-s, l, se, so 2-is, i	I-R2, R3, R4	P O X	S
8. Demonstrate appropriate presentation demeanor.	1-s, l, r, so, se 2-is, i	I-R4	P O X	S
9. Interpret and clarify directions prepared by others.	1-l, s, r, rs 2-is, i	I-R1.3, R2, M4, M5	W O	90%
10. Effectively communicate outside the work team.	1-w, s, l, r, so 2-is, i	I-R2, R3, M4, R5	P W O X PF	S
Contemporary Workforce Issues				
1. Explain how organizational structure affects a manufacturing process.	1-s, r 2-r, s, i 3	I-R5, R6	O	85%
2. Identify the characteristics of a diverse work force.	1-w, s 2-i	I-R5	W O	80%
3. Identify organized labor's role in employee wages, benefits and safety issues.	1-w, s, r, rs 2-i, s 3	I-R5, R6 II-R3	W O	80%
4. Compare (explain differences, advantages, disadvantages, etc.) a traditional unionized workplace to an open shop workplace.	1-w, s, r, rs 2-i, s 3	I-R2, M4, M5, R6 II-R3 III-R6 IV-R4	W O	75%
5. Compare (explain differences, advantages, disadvantages, etc.) a traditional workplace environment to a team working environment.	1-w, s, r, rs 2-s, i	I-R2, M4, M5, R6 II-R3 III-R6 IV-R4	W O	75%
6. List steps of a grievance or dispute resolution procedure.	1-w, s, l, r 2-i	I-R1.3, R3, R4, R5	W IBT	85% PR
7. Demonstrate good personal ethics, characteristics and behaviors.	1-s, l, d, re, se, sm, so, i 2-is,	I-R4	P X PF	S

8. Identify good ethical business behavior.	1-w, s, r, re, se, sm, so, i 2-is, s, i	I-R4	W O PF	85%
9. Match employee responsibilities to employer expectations.	1-w, s, r 2-s	III-R6	P W	85%
10. Define discrimination, harassment and equity.	1-w, s, r 2-is, s	I-M4, R5, R6	W O PF	90%
11. Demonstrate non-discriminatory behavior.	1-s, l, w, d, i, sm, se 2-is, s	I-R4	P X PF	S
Customer Focus				
1. Identify the components that lead to customer satisfaction.	1-w, s, r 2-is	I-R4, R5 III-R1	W O	85%
2. Identify possible actions that may lead to customer satisfaction.	1-w, s, r 2-is	I-R4, R5	W O	85%
3. Identify the ways that the level of customer satisfaction may affect company success.	1-w, s 2-is, s	I-R4, R5 II-R3	W O PF	80%
4. Identify the importance of a business reputation.	1-w, s 2-s	I-R4, R5 III-R1	W O	80%
5. Identify the ways that customer satisfaction influences a business reputation.	1-w, s 2-is	I-R4, R5 III-R1	W O PF	80%
6. Identify possible actions that may be used to correct customer dissatisfaction.	1-w, s 2-is	I-R4, R5	W O	80%
7. Define the role of customers in the operation of a manufacturing business.	1-s, s 2-is, s 3	I-R4, R5	W O PF	80%
8. Define the terms “final customer” and “internal customer” in a manufacturing business.	1-w, s 2-is 3	I-R4, R5	W O	80%
9. Define the concept of “value-added, as seen by the customer.”	1-w, s 2-is	I-M4, R5 II-R2, R3, R5, R6	O	85%
10. Identify procedures manufacturing companies can use to determine customers’ needs and expectations.	1-w, s, r 2-r, is 3	I-R4, R5 III-R1, R5, R6	W O PF	80%
11. Interpret and clarify specifications prepared by others.	1-l, s, r, d, p 2-r, is, i	I-M1.3, R3, M4, M5 II-R3, R5, R6 III-R5	P O	90% S
12. Communicate with customer to establish requirements.	1-w, s, l, r, rs, so 2-r, is, i	I-R3, M4, M5 II-R5, R6 III-R5	P W O X	95% S
Science				
1. Apply the principles of classical physics: mechanics, heat, sound, optics, electricity and magnetism in critical thinking/problem solving situations	1-w, s, r, m, rs, p	I-R1.3, R4, R5 II-R1, R2, R3, R5, R6 III-M2, R5	P W	75%
2. Apply the principles of chemistry: inorganic, organic, qualitative and quantitative analysis in critical thinking/problem solving situations.	1-w, s, r, m, rs, p	I-R1.3, R4, R5 II-R1, R2, R3, R5, R6 III-M2, R5	P W	75%
3. Apply the principles of biology and ecology in critical thinking/problem solving situations.	1-r, s, l, rs, c 2-s	I-R1.3, R4, R5 II-R2, R3, R5, R6 III-M2, M3, R5	P W	75%
4. Understand the fundamental principles of modern physics; quantum mechanics, theory of relativity, particle dynamics, etc.	1-r, l, m 2-s	I-R1.3, R4, R5 II-R1, R2, R3, R5, R6 III-M2, R5	W O	75%
5. Apply the fundamental principles of pneumatics and hydraulics.	1-r, l, m, d 2-s	I-R1.3, R4, R5 II- R2, R3, R5 III-M2, M5	P W IBT	75% PR

6. Demonstrate an understanding of working with electromechanical using; servomechanisms, motors and motor control circuits, mechanical power transmission systems, vacuum systems and components, mechanisms, linkages and levers, transducers and instrumentation and automatic controls and robotics.	1-r, m, p 2-s, t	I-R1.3, R4, R5 II-R2, R3, R5, R6 III-M2, M5	P W O PF	75%
7. Apply laser applications including; welding, cutting and drilling, data recording and manipulation, environmental testing and monitoring, nondestructive testing, measurement, communications, fiber optics and lasers and holography/interferometry.	1-w, r, s, l, m, p 2-t, i	I-R1.3, R4, R5 II-M2, R3, R5, R6 III-M2, M5	P W	75%
Workplace Safety and Environment				
1. Accept responsibility for the personal safety of self and others.	1-d, rs, re, se, sm, so, i 2-is, s	I-R4, R5 III-R3, R4	P X	S
2. Maintain a clean and safe work environment.	1-d, re, se, sm, so, i 2-s 3	I-R5 III-R3	P X	S
3. Demonstrate a positive personal attitude towards safety.	1-d, sm, i 2-is 3	I-R5	P X PF	S
4. Comply with established safety practices.	1-w, s, sm, i 2-s	I-R1.3, R4, R5	P W	100%
5. Complete forms and paperwork as required.	1-w, r, sm, i, re 2-r, i	I-R1.3, M3, M4, R5	P W IBT	100% PR
6. Wear protective safety clothing as required.	1-r, re, sm, i 3	I-R5 III-R3, R4, R5	P PF IBT	100% PR
7. Maintain and use protective guards and equipment on machinery.	1-r, sm, i 2-s 3	I-R1, R5	P IBT	100% PR
8. Handle/store flammable (hazardous) materials appropriately.	1-r, m, i 2-t 3	I-R1.3, R4, R5 III-R2 II-R2, R5, R6 III-R4	P IBT	100% PR
9. Use electrical devices correctly and safely.	1-r, m, i 2-i, t	I-R1.3, R4, R5 III-R2 II-R2, R5, R6	P	100%
10. Prevent spontaneous ignition by practicing proper waste disposal habits.	1-r. re 2-i	III-R2, M4	P X	100%
11. Keep marked aisles clear of equipment and materials.	1-sm, so, i 2-r 3	I-R1, R5	P	100%
12. Interpret/display MSDS (Material Data Safety Sheets) as required.	1-r, w, s, m 2-i 3	I-R1.3, R2, R4, R5 II-R2, R3, R5, R6 III-M2, R3, R4	P W IBT PF	100% PR
13. Identify fire exits and fire-fighting equipment.	1-s 2-i	I-R5	W O	100%
14. Report unsafe practices to appropriate personnel.	1-w, s, r, p, sm	I-R2, R3, R4	P W O	S
15. Operate equipment in a safe, prescribed manner.	1-r, sm 2-t 3	I-R1.3	P PF	100%
16. Locate power shutoff controls for all machinery/equipment.	1-r 2-t 3	I-R1, R4, R5	P	90%
17. Report malfunctions to appropriate personnel.	1-w, s 3	I-R2, R4, R5 II-R2	P W O	85%
18. Inspect material/equipment/fixtures for defects.	1-w, r, sm 2-t 3	I-R4 III-R1 II-R3, R5	P	80%
19. Determine weight/operating limits of equipment.	1-r, s, m 3	I-R1.3, R5 II-R2, R5, R6	P W IBT	85% PR
20. Perform periodic checks during operation to assure proper function.	1-r, d 2-t, i 3	I-R4	P	85%

21. Determine need for CPR and administer as appropriate.	1-rs, d, p, so 2-is, i	I-R5	P PF IBT	S PR
22. Apply appropriate first aid techniques.	1-r, rs, d, so 2-is	I-R1, R4, R5	P PF IBT	100% PR
23. Define different types of chemical, biological and physical hazards.	1-w, s, r, m 2-i 3	I-R5 II-R2, R5, R6 III-M2, M3, R4, R5	W O PF	90%
24. Respond to emergencies in the appropriate manner.	1-l, s, re, sm, i 2-is	I-R4	P X	S
25. Describe ergonomics and its importance to the manufacturing process.	1-w, s 2-s, t, i 3	I-R4, R5 II-R3, R4 III-R6	W O	75%
26. Demonstrate an understanding of Occupational Safety & Health Administration (OSHA) requirements.	1-w, s, r 2-i 3	I-R1.3, R4, R5 II-R3 III-R2, R3, R4 IV-R4	P O PF	85%
27. Demonstrate an understanding of local, Colorado and U, S. Environmental Protection Agency (EPA) requirements.	1-w, s, r 2-i 3	I-R1.3, R4, R5 II-R3 III-M2, R3, R4	P O PF	85%
28. Define a safe work environment.	1-w, s 2-s 3	I-R4, R5 III-R4	W	100%
29. Identify immediate and real costs of an accident.	1-w, r, s, m 2-i	I-R5 III-R6 II-R1, R2, R3	W O	75%
30. Identify methods of preventing accidents in the workplace.	1-w, s, r 2-t	I-R5	W	95%
31. Follow established safety procedures when using machine tools.	1-r, l, re, sm, i 2-t, i 3	I-R1.3, R5	P PF IBT	100% PR
Electricity and Digital Electronics				
1. Demonstrate an understanding of proper safety techniques for all types of circuits and components (DC circuits, AC circuits, analog circuits, digital circuits, discrete solid-state circuits and microprocessors).	1-r, m, d	I-R1.3, R5 II-R2 III-M2, R5	P PF	100%
2. Demonstrate an understanding of and compliance with relevant OSHA safety standards.	1-r, rs, d, p, I, se 2-i 3	I-R1.3, R2, R4, R5 II-R2, R5 III-R2, R3, R4	P IBT PF	100% PR
3. Demonstrate an understanding of proper troubleshooting techniques.	1-w, r, s, rs 2-t 3	I-R1.3, R5 III-R5	P	80%
4. Demonstrate an understanding of basic assembly skills using hand and power tools.	1-r 3	I-R1.3 III-R5	P IBT	80% PR
5. Demonstrate an understanding of the meaning of and the relationships among and between voltage, current, resistance and power in DC.	1-w, s, r, m	I-R4 III-M2, R5, R6 II-R2, R3, R5, R6	P W	85%
6. Demonstrate an understanding of application of Ohms Law to series, parallel and series-parallel circuits.	1-w, s, m, p	I-R5 II-M2, R3, R5, R6 III-M2, R5, R6	P PF	85%
7. Demonstrate an understanding of sources of electricity in AC circuits.	1-w, s, r	I-R4 III-R2, R5	W O	75%
8. Demonstrate an understanding of basic motor/generator theory and operation.	1-w, s, r, m	I-R1.3 II-R2, R5, R6 III-M2, R5	W O IBT	75% PR
9. Demonstrate an understanding of measurement of power in AC Circuits.	1-w, s, r, m, p	II-R1, M2, R5, R6 III-M2, R5	P W	80%
10. Demonstrate an understanding of the principle and operation of safety grounding systems (lightning arresters, ground fault interrupters, etc.)	1-w, r, s, m, p	I-R1.3 II-R2, R5 III-R2, R5	P W	75%
11. Demonstrate an understanding of the properties of semiconductor materials.	1-w, r, s, m 2-t	II-R2, R5 III-M2, R5	P W	75%

12. Demonstrate an understanding of the characteristics of integrated circuit (IC) logic families.	1-w, s, r, m 2-t	II-R2, R5 III-R2, R5	W O	75%
13. Demonstrate an understanding of microprocessor interfaces.	1-w, s, r, m 2-t	I-R1.3 II-R2, R5 III-R2, R5	P W	75%
14. Demonstrate an understanding of essential microprocessor components.	1-w, s, r, m 2-t	II-R2, R5 III-R2, R5	P W	75%
15. Demonstrate an understanding of microprocessor components and terminology.	1-w, s, r 2-t	II-R2, R5 III-R2, M5	P W	75%
Product and Process Control				
1. List a variety of process control applications.	1-w, s, r 2-i, r, s, t 3	I-R4, R5 III-R1, R5 II-R3, R5, R6	W	75%
2. Collect and analyze information to determine and improve work processes.	1-w, r, s, m, d, p 2-r, s, t, i 3	I-R1.3, M4, M5 II-R2, R3, R5, R6 III-R1, R5, M6	P W O PF	S
3. Explain the advantages and disadvantages of “just in time” inventory.	1-w, s, r 2-i, r, s, t 3	I-R4, R5 III-R5 II-R2, R3, R5	W O	80%
4. Explain the advantages and disadvantages of all “just-in-time” type systems.	1-w, s, r 2-r, s, t, i 3	I-R4, R5 III-R5 II-R2, R3, R5	W O	80%
Manufacturing Business Operations and Economics				
1. Identify the organizational need for profit.	1-w, r, m 2-s, i	I-R4, R5 II-R1, R2, R3 IV-R4	W O PF	75%
2. Identify opportunities for profit in manufacturing processes.	1-w, r 2-r 3	I-R4, R5 II-R2, R5	W O	75%
3. Identify possible barriers to profit in manufacturing processes.	1-w, r 2-r, i 3	I-R4, R5 II-R2, R3, R5, R6	W O	75%
4. Identify strategies that may maximize profit potential manufacturing processes.	1-w, s, p, r 2-s, t 3	I-R4, R5 II-R1, R2, R6	W O	75%
5. Recognize a business plan that provides for an acceptable profit.	1-r, m 2-i	I-R4, R5 II-R1, R2, R3, R5	W O PF	S
6. Define the term “value added”.	1-w, s	I-R4, R5 II-R2, R3 III-R5	W O PF	80%
7. Identify steps within manufacturing processes that determine cost.	1-w, s, r, m 2-r, s, t, i 3	I-R1.3, R4, R5 III-R6 II-R1, R2, M3, R5	W O	80%
8. Define the term profit.	1-w, s	I-R4, R5 II-R2	W	80%
9. Identify the cost of employee benefits.	1-w, s, m 2-i	I-R4, R5 II-R1, R2, R3, R5, R6	W O	75%
10. Explain why cost factors are not constant.	1-w, s 2-i	I-R4, R5 II-R1, R2, R3, R5	W O	75%
11. Explain the role of the manufacturing sector in the Colorado, U.S. and global economies.	1-w, s, r 2-s, i 3	I-R4, R5, R6 IV-R4 II-R2, R3 III-R1, M6	W O PF	75%
12. Compare the services a contract manufacturer provide as to an original equipment manufacture.	1-w, r, s, m 3	I-R4, R5	W O	75%
13. Explain why it is important for contract manufacturers to be able to develop accurate job quotations in regards to quality, delivery schedule and price.	1-w, r, s 3	I-R4, R5 III-R1 II-R2, R3, R5	W O	75%

14. Identify and plan for work group, human resource requirements.	1-r, l, le, d, p 2-is, s	I-R4, R5	W O	80%
15. Assess and meet work group training and development needs.	1-r, l, le, c, p 2-r, is	I-R4, R5	W O IBT	S PR
16. Assess and provide feedback on performance.	1-l, s, r, rs 2-s, i	I-R4, R5	W O	S
17. Determine line and work station set-up.	1-w, r 2-r, t, i 3	I-R5	P	80%
18. Obtain and store materials needed to ensure continuity of workflow.	1-r, l 2-r, s, t, i 3	I-R5 II-R5	P	80%
19. Collect and analyze information to determine and improve work processes.	1-r, l, m 2-r, s, t, i 3	I-R1.3, R4, M5 II-R2, R3, R5 III-M1	P W O	80%
20. Receive and communicate process flow instructions and delivery schedules.	1-w, l, r, s, i so 2-r, s, t, i 3	I-R1.3, R2, R4, M5 II-R2, R5	P W O	80%
21. Locate and retrieve production materials specific to process flow instructions and delivery schedules.	1-r 2-r, s, t 3	I-R1.3, R4, R5 II-R2	P W O PF	80%
22. Prepare resources for production.	1-r 2-r, s 3	I-R5 II-R2, R3, R6	P	S
23. Maintain production according to instructions.	1-r 2-r, s, t, i 3	I-R1.3, R4, R5 II-R2	P O	S
Rapid Product Development				
1. Explain the concepts of time-based competition, time-to-market and agility.	1-w, s, m 2-s, i 3	I-R4, R5 III-R1 II-R2, R3, R5, R6	W O PF	75%
2. Demonstrate an understanding of product life-cycles.	1-w, r, s 2-s, t, i 3	I-R4, R5 II-R2, R3, R5, R6	W O	S
3. Demonstrate an understanding of multi-function product development teams and how manufacturing team members are expected to contribute.	1-w, s, r, le, c 2-i 3	I-R4, R5 IV-R4	W O PF	S
4. Explain the practices known as Quality Function Deployment (QFD) and Benchmarking and the roles of these practices in the product development process.	1-w, s, r, m 2-i, t 3	I-R2, R4, R5 III-R5, R6 II-R2, R3, R5 IV-R4	W O IBT PF	75% PR
5. Demonstrate an understanding of CAD/CAE/CAM and how these technologies are used in the product development process.	1-w, s, r 2-s, t 3	I-R2, R4 IV-R4 II-R4 III-M5, R6	P W O PF	S
6. Explain the practices known as Concurrent Engineering and Design for Manufacturability and how manufacturing team members participate.	1-w, s, r 2-is, s, t 3	I-R2, R4, R5 IV-R4 II-R5 III-M5	W O	75%
7. Demonstrate an understanding of Rapid Prototyping and Virtual Prototyping.	1-w, s, r 2-t 3	I-R4, R5 II-R3, R5 III-M5, R6 IV-R4	W O	S
8. Demonstrate an understanding of Production Changeover and New Product Start-up.	1-w, s 2-r, t 3	I-R4, R5 II-R3, R5 III-M5, R6	W O	S
9. Build processes and prototypes in conjunction with specialist staff.	1-r 2-is, t 3	I-R4 III-R5	P PF	S
10. Assess the prototype and prototype-build process for workability and manufacturability, and recommend improvements.	1-r 2-r, t, i 3	I-R4, R5	P W O	S
Learning Skills				
1. Identify personal preferred learning styles.	1-w, r, l, le, rs, re	I-R5 III-R1	W O PF	S

2. Demonstrate ability to learn new process steps.	1-l, le, d 2-i	I-R5	P PF	S
3. Implement new process steps given oral instructions.	1-l, le, d 2-i	I-M5 II-R6	P O IBT	85% PR
4. Read process instructions and implement appropriate steps.	1-w, r, s, le 2-I	I-M1.3, R2, R4, M5 II-R2	P W	S
5. Participate in product or process specific training and report significant information.	1-w, r, s, l, le 2-i 3	I-R4, R5 II-R6	P W O X IBT PF	S PR
6. Explain the concept of continuous learning or lifelong learning.	1-w, s, r, le, c, re, sm 2-i	I-R4, R5 III-R5	W O PF	S
7. Explain why continuous learning is necessary in a manufacturing career.	1-w, s, r, rs, re, sm 2-i 3	I-R4 IV-R4	W O PF	80%
8. Explain how it is possible to enter a manufacturing career right out of high school and then progress up the career ladder to a high-level engineering or company management position.	1-w, s, r, rs, sm 2-i 3	I-R4, R5 IV-R4	W O PF	80%
9. Demonstrate an understanding of how to develop a continuous learning plan.	1-w, r, s, le, sm	I-R4, R5	P W O X PF	S
10. Explain the statement: "Continuous learning is the only assured source of competitive advantage".	1-s, rs	I-R4, R5, R6 III-R1	W O PF	80%

The U.S. Department of Education commissioned The National Coalition For Advanced Manufacturing to determine and validate occupational skill standards for workers in advanced high-performance manufacturing. The project developed some of the final standards, (above), including the conditions and context for the skill and the level of performance. Version 2.1, April, 1997

These skill standards will enable clear and specific communication between industry, education and students of all ages. This will help to ensure that schools know what to teach, instructors remain up-to-date and students learn what they need to know to succeed in their chosen occupation. The standards will facilitate the alignment between the manufacturing community and the educational system responsible for preparing people to be successful workers.

Assessment method key is:

IBT = Industry Based Test, O = Oral, P = Performance, PF = Portfolio, W = Written, and X - Alternative Assessment

Achievement level key is:

"X" % is the minimum achievement level acceptable

PR is Proficient level, which means the learner is capable of doing the task at the preset Industry Standard Level.

S is Satisfactorily, which means the learner is performing at or above the team/group norm.

The benchmark statement, which defines what a completer will be, could read as follows:

(X) Percent of the completing students will complete (X) percent of the program's competencies/skills at the achievement level identified.

MATRIX FOR MANUFACTURING TECHNOLOGY

In this matrix there are 275 total competencies/skills listed under 19 different heading. The order of the listing or the order of the different headings does not indicate significance between competencies/skills or headings.

The first column lists the competencies/skills as a worker's action.

Matched with each competency or skill in columns:

- (B) where that competency or skill fits in CCCOES's Colorado Core Measures and Standards of Performance,
- (C) where that competency or skill fits in CDE's Colorado Content Standards (bill 1313),
- (D) assessment method or methods that may be used for each competency or skill, *
- (E) achievement level that is the minimum acceptable for that competency or skill. *

*Suggested only

These competencies/skills cover program levels from middle school through postsecondary. These competencies/skills form the base for a seamless pathway. No one program will be comprise of all these competencies/skills, but all programs in the manufacturing area will have some of these competencies/skills.

Manufacturing Fundamentals	19 Competencies/Skills
Measurement Tools and Techniques	18 Competencies/Skills
Manufacturing Computer Skills	12 Competencies/Skills
Engineering Graphics	15 Competencies/Skills
Quality Assurance	14 Competencies/Skills
Critical Thinking/Problem Solving Skills	5 Competencies/Skills
Teamwork	11 Competencies/Skills
Workplace Skills (work ethic and employability)	20 Competencies/Skills
Mathematics	28 Competencies/Skills
Communication	10 Competencies/Skills
Contemporary Workforce Issues	11 Competencies/Skills
Customer Focus	12 Competencies/Skills
Science	7 Competencies/Skills
Workplace Safety and Environment	31 Competencies/Skills
Electricity and Digital Electronics	15 Competencies/Skills
Product and Process Control	4 Competencies/Skills
Manufacturing Business Operations and Economics	23 Competencies/Skills
Rapid Product Development	10 Competencies/Skills
Learning Skills	10 Competencies/Skills

