

# **Standards & Measurement Criteria**

## **Industrial Manufacturing Plastics Manufacturing - Option B CIP NO. 15.0600**

These state standards are designed to be delivered in a sequence of courses. \*Standards 1-15 are to be taught as an introduction within the Industrial Manufacturing program.

### **\*1.0 EXPLORE PERSONAL AND PROFESSIONAL DEVELOPMENT REQUIREMENTS FOR CAREERS IN MANUFACTURING**

- 1.1 Identify work activities associated with careers in manufacturing
- 1.2 Relate interests, skills and personal orientation to career choices
- 1.3 Relate professional development and lifelong learning to job success
- 1.4 Develop a portfolio of career opportunity information

### **\*2.0 PARTICIPATE IN LEADERSHIP ACTIVITIES SUCH AS THOSE SUPPORTED BY THE CAREER AND TECHNICAL STUDENT ORGANIZATION SkillsUSA**

- 2.1 Determine the roles and responsibilities that leaders and members bring to an organization
- 2.2 Demonstrate procedures to ensure an orderly and business-like meeting
- 2.3 Demonstrate business etiquette
- 2.4 Demonstrate cooperation with leaders
- 2.5 Participate in career development events

### **\*3.0 DEMONSTRATE APPROPRIATE WORK HABITS FOR SUCCESSFUL EMPLOYMENT**

- 3.1 Demonstrate regular attendance and punctual arrival
- 3.2 Exhibit appropriate dress and hygiene
- 3.3 Demonstrate enthusiasm and confidence about work and learning new tasks
- 3.4 Plan and organize appropriate resources
- 3.5 Complete tasks on time and accurately
- 3.6 Follow directions and procedures
- 3.7 Give and receive constructive feedback
- 3.8 Work with minimal supervision
- 3.9 Develop productive, collaborative relationships with members of work group
- 3.10 Adapt to change in the workplace

### **\*4.0 DEMONSTRATE APPROPRIATE TEAMWORK FOR THE WORKPLACE**

- 4.1 Discuss how manufacturing teams work together to solve problems
- 4.2 Discuss the “individual and collective responsibility” of each member of a team
- 4.3 Evaluate characteristics and importance of an effective team player
- 4.4 Evaluate characteristics of effective teams
- 4.5 Practice techniques to involve different behavioral styles in a team
- 4.6 Cross-train another team member

---

#### **Career Preparation**

## **\*5.0 DEVELOP READING AND WRITING SKILLS**

- 5.1 Conduct informal research to collect appropriate topical information
- 5.2 Using information, develop an outline
- 5.3 Define established rules for grammar, spelling and sentence construction
- 5.4 Write business communications using appropriate format for the situation

## **\*6.0 UTILIZE TECHNOLOGY IN THE WORKPLACE**

- 6.1 Explain the uses of technology in industrial manufacturing workplaces
- 6.2 Communicate using telecommunication tools
- 6.3 Demonstrate intermediate usage of computers (input, storage, output)
- 6.4 Use industry-standard software applications for word processing, database, spreadsheet and presentation
- 6.5 Access and transmit information electronically (e.g., Internet, computer network, CD-ROM, etc.)

## **\*7.0 PRACTICE SAFE USE OF HAND AND POWER TOOLS**

- 7.1 Demonstrate safe use of basic hand tools in manufacturing
- 7.2 Demonstrate safe use of power tools and equipment in manufacturing
- 7.3 Practice basic procedures for safe storage and maintenance of tools

## **\*8.0 EXPLORE MANUFACTURING INDUSTRIES**

- 8.1 Analyze the systems common to manufacturing organizations
- 8.2 Utilize correct terminology in context
- 8.3 Examine potential implications of technological innovation on manufacturing organizations and individuals in those organizations
- 8.4 Discuss future trends in manufacturing

## **\*9.0 EXPLORE MANUFACTURING SYSTEMS**

- 9.1 Explain rapid prototyping processes and give examples
- 9.2 Explain the major separating processes and give examples
- 9.3 Explain the major powder/liquid processes and give examples
- 9.4 Explain the major metal-forming processes and give examples
- 9.5 Explain the major plastic-forming procedures and give examples
- 9.6 Explain the major fastening processes and give examples
- 9.7 Explain the major conditioning processes and give examples
- 9.8 Explain the major finishing processes and give an example

## **\*10.0 EXAMINE THE ROLE OF MANUFACTURING IN THE ECONOMY**

- 10.1 Examine the role of manufacturing organizations in local, state, national and international economies
- 10.2 Examine the basic economic principles that impact manufacturing operations
- 10.3 Describe steps manufacturing companies use to ensure they are competitive in today's international market
- 10.4 Examine the process of developing a business plan for a small manufacturing business
- 10.5 Analyze the impact of manufacturing process, customer service and customer satisfaction on the growth of a business

## **\*11.0 EXAMINE LEADERSHIP ROLES IN MANUFACTURING**

- 11.1 Compare/contrast leadership and management styles
- 11.2 Discuss manufacturing supervision principles and techniques, including employee and labor relations
- 11.3 Discuss how management culture relates to personal success
- 11.4 Describe how cultural/ethnic differences affect interpersonal interactions/communications within a group
- 11.5 Practice conflict management

## **\*12.0 APPLY SAFETY RULES, REGULATIONS AND PROCEDURES**

- 12.1 Compare/contrast unsafe behavior versus unsafe conditions in industrial accidents
- 12.2 Adhere to clothing safety guidelines and regulations (e.g., hard hat, hardsoled shoes, eye protection, long trousers, shirt with sleeves)
- 12.3 Use and care for appropriate personal protective equipment, including gloves, glasses, breathing apparatus and other identified equipment
- 12.4 Identify and apply appropriate OSHA and EPA regulations to an industrial work environment
- 12.5 Explain lockout/tagout procedures for inoperable tools and equipment
- 12.6 Identify fire hazards and methods for fire prevention
- 12.7 Demonstrate safe working practices related to electrical hazards
- 12.8 Demonstrate appropriate techniques for handling and/or disposing of hazardous materials
- 12.9 Follow safe procedures for lifting heavy objects
- 12.10 Report unsafe behavioral, environmental, and equipment safety hazards
- 12.11 Utilize procedures to report an accident/injury

## **\*13.0 SELECT AND USE APPROPRIATE MEASUREMENT TECHNIQUES AND INSTRUMENTS**

- 13.1 Utilize precision measurement tools and gauges to measure appropriate dimensions, mass, weight, volume, and temperature
- 13.2 Convert from one unit in a measuring system to another unit within the same system
- 13.3 Recognize and use metric units of length, weight, volume, and temperature
- 13.4 Convert between metric and standard measurements

## **\*14.0 EXPLORE ETHICAL AND PROFESSIONAL CONDUCT IN MANUFACTURING**

- 14.1 Identify examples of unethical behavior (e.g., plagiarism, copyright-, software-, and patent infringement, cheating, gossiping, breach of confidentiality)
- 14.2 Define ethics as applicable for a worker and a leader in manufacturing
- 14.3 Differentiate between “ethical” and “legal”
- 14.4 Understand the implications of product or service quality, warranty, and reliability

## **\*15.0 READ AND INTERPRET BLUEPRINTS, TECHNICAL DRAWINGS, GRAPHS AND DIAGRAMS**

- 15.1 Visualize and describe objects from drawings
- 15.2 Interpret various detail drawings (e.g., part detail, assembly, electrical, hydraulic/pneumatic, machine, cam/gear and electrical/electronic prints)
- 15.3 Interpret orthographic blueprints with Geometric Dimensioning and Tolerances (GD&T)
- 15.4 Identify tolerance stack-up problems in drawings
- 15.5 Check drawings and diagrams for dimensional accuracy, completeness and note detail
- 15.6 Identify conflicting data on manufacturing-related drawings and diagrams

## **16.0 DEVELOP A PLAN FOR A CAREER IN INDUSTRIAL MANUFACTURING**

- 16.1 Investigate career options including entrepreneurship
- 16.2 List educational requirements for careers in manufacturing
- 16.3 Develop career goals based on interests, aptitudes, and research
- 16.4 Manage personal and career goals

## **17.0 DEMONSTRATE JOB SEARCH SKILLS**

- 17.1 Explain the steps in a job search
- 17.2 Develop a resume
- 17.3 Research a company as a potential employer
- 17.4 Complete the job application process
- 17.5 Demonstrate interviewing skills, including pre-interview preparation and post-interview follow-up

## **18.0 PARTICIPATE IN LEADERSHIP ACTIVITIES SUCH AS THOSE SUPPORTED BY THE CAREER AND TECHNICAL STUDENT ORGANIZATION SkillsUSA**

- 18.1 Determine the roles and responsibilities that leaders and members bring to an organization
- 18.2 Demonstrate procedures to ensure an orderly and business-like meeting
- 18.3 Demonstrate business etiquette
- 18.4 Demonstrate cooperation with leaders
- 18.5 Participate in career development events

## **19.0 DEMONSTRATE LISTENING AND SPEAKING SKILLS**

- 19.1 Demonstrate active listening with customers, employers and co-workers
- 19.2 Use questioning techniques to obtain needed information
- 19.3 Identify personal barriers to listening
- 19.4 Give and follow oral instructions
- 19.5 Employ conflict resolution skills in workplace situations
- 19.6 Give suggestions or ideas in an appropriate manner
- 19.7 Deliver a presentation incorporating both appropriate verbal and nonverbal communication techniques
- 19.8 Communicate using equitable and culturally sensitive language
- 19.9 Demonstrate effective telephone technique

## **20.0 DEMONSTRATE READING AND WRITING SKILLS**

- 20.1 Conduct formal/informal research to collect appropriate topical information
- 20.2 Organize information and develop an outline
- 20.3 Using appropriate technology, draft a document using established rules for grammar, spelling and sentence construction
- 20.4 Write business communications using appropriate format for the situation

## **21.0 DEMONSTRATE MATHEMATICAL CONCEPTS RELATING TO MANUFACTURING**

- 21.1 Present numerical data in an accurate, appropriate form
- 21.2 Apply basic mathematical skills, both standard and metric, using whole numbers, decimals, fractions, and percents
- 21.3 Perform algebraic calculations in manufacturing problems
- 21.4 Create and interpret basic graphs and charts commonly used in manufacturing
- 21.5 Utilize Statistical Process Control (SPC) terminology (e.g., range, x-bar chart, order of operations, variation, mean, tolerance)

## **22.0 EXAMINE BUSINESS PLANNING AND OPERATIONS IN MANUFACTURING**

- 22.1 Examine Lean Manufacturing and Just-in-Time (JIT) production principles
- 22.2 Explain the significance of Enterprise Resource Planning (ERP) and Material Requirements Planning (MRP) systems
- 22.3 Explore examples of economic analysis (e.g., make vs. buy, variable vs. fixed costs, capital budgeting, cost/benefit analysis, value engineering, forecasting)
- 22.4 Explore work measurement and time studies to determine work standards
- 22.5 Utilize management information systems software (e.g., production and inventory management, MRP/ERP, work measurement and standards)

## **23.0 PARTICIPATE IN INTERNAL/EXTERNAL CUSTOMER SERVICE FUNCTIONS**

- 23.1 Identify customer needs/constraints
- 23.2 Communicate customer needs to others
- 23.3 Explain how to add value to customer needs
- 23.4 Review customer needs on a regular basis
- 23.5 Discuss factors that contribute to poor customer relationships

## **24.0 PARTICIPATE IN WORK-BASED LEARNING EXPERIENCES**

- 24.1 Use technology appropriate for the job
- 24.2 Use terminology appropriate for the manufacturing workplace
- 24.3 Attend work-based organization functions, events, trade shows, competitions and field trips
- 24.4 Participate in a variety of work-based experiences, including a paid or non-paid job

## **25.0 APPLY CREATIVE AND INNOVATIVE THINKING TO PROBLEMS IN MANUFACTURING**

- 25.1 Apply brainstorming techniques
- 25.2 Evaluate alternative ideas according to multiple criteria
- 25.3 Utilize various graphic organizer techniques (e.g., Venn diagrams, fishbone diagrams, cause-and-effect diagrams)

## **26.0 DEMONSTRATE A SYSTEMATIC PROCESS TO SOLVING A PROBLEM**

- 26.1 Specify goals, objectives, constraints, and supporting factors
- 26.2 Apply the problem-solving method to a manufacturing problem
- 26.3 Produce a viable solution for a problem in the allotted time
- 26.4 Evaluate problem solutions to achieve group consensus
- 26.5 Establish a control plan to monitor a solution

## **27.0 ACCESS, RECORD, ORGANIZE AND EVALUATE INFORMATION TYPICAL OF A MANUFACTURING WORKPLACE**

- 27.1 Differentiate among various manufacturing-related documentation formats
- 27.2 Utilize various manufacturing-related documents (e.g., bills of materials, production routings, set-up, assembly and operational instructions, preventive maintenance procedures, material safety data sheets, process flow diagrams, engineering change control records, etc.)
- 27.3 Interpret various manufacturing-related documents
- 27.4 Use operator's and manufacturer's manuals

## **28.0 EXPLORE MECHANICAL SYSTEMS USED IN MANUFACTURING**

- 28.1 Identify the essential components of a mechanical system
- 28.2 Identify the essential components of mechanical machinery and their function
- 28.3 Utilize mechanical machinery
- 28.4 Explain mechanical safety

## **29.0 EXPLORE FLUID SYSTEMS USED IN MANUFACTURING**

- 29.1 Identify the essential components of a hydraulic/pneumatic system
- 29.2 Explain the function of hydraulic/pneumatic machinery, systems, and components
- 29.3 Utilize hydraulic/pneumatic machinery, systems and components
- 29.4 Explain hydraulic/pneumatic safety

## **30.0 EXPLORE ELECTRICAL/ELECTRONIC SYSTEMS USED IN MANUFACTURING**

- 30.1 Identify electrical/electronic systems and components
- 30.2 Explain the functions and applications of basic electrical/electronic systems and components
- 30.3 Utilize electrical/electronic systems and components
- 30.4 Explain electrical/electronic safety

## **31.0 EXPLORE CHEMICAL SYSTEMS USED IN MANUFACTURING**

- 31.1 Identify the essential components of a chemical processing system
- 31.2 Explain the function of chemical processing machinery, and components
- 31.3 Utilize chemical processing machinery, systems and components
- 31.4 Explain chemical processing safety

## **32.0 EXPLORE POWER SYSTEMS USED IN MANUFACTURING**

- 32.1 Explain the essential components of a power delivery system
- 32.2 List the voltage classifications used in industry
- 32.3 Distinguish between low-voltage, medium voltage, high-voltage and RF systems
- 32.4 Discuss safety issues with power systems, equipment and components

## **33.0 USE MANUFACTURING EQUIPMENT TO PRODUCE A PRODUCT**

- 33.1 Identify customer needs
- 33.2 Assemble raw materials against a work order
- 33.3 Assemble tools and equipment against a work order
- 33.4 Set up equipment for the production process
- 33.5 Document set and first piece of production to ensure repeatability
- 33.6 Create job aids (operating instructions) to identify proper operation of machines
- 33.7 Perform production process
- 33.8 Monitor production process
- 33.9 Inspect final product against specifications
- 33.10 Make recommendations and adjust process as needed

## **34.0 EXPLORE AUTOMATED MANUFACTURING SYSTEMS**

- 34.1 Differentiate Computer-Aided Engineering (CAE), Computer-Integrated Manufacturing (CIM), Computer-Aided Manufacturing (CAM) and Computer Numerical Control (CNC)
- 34.2 Identify basic characteristics of a manufacturing operation that lend themselves to automated manufacturing
- 34.3 Recognize the benefits and problems associated with automated manufacturing and how they affect the manufacturing process
- 34.4 Explain the function of the major components of a CNC machine tool
- 34.5 Explain various applications of a Programmable Logic Controller (PLC)
- 34.6 Demonstrate an automated manufacturing system

## **35.0 EXPLORE QUALITY ASSURANCE, QUALITY STANDARDS AND TOTAL QUALITY MANAGEMENT**

- 35.1 Explain the need for quality control
- 35.2 Distinguish between characteristics of quality in a final product and the control of quality in each step of a process
- 35.3 Define the concepts and principles of Total Quality Management
- 35.4 Interpret statistically analyzed data to ensure product quality
- 35.5 Communicate quality problems
- 35.6 Suggest or perform corrections to quality problems

## **36.0 PERFORM PREDICTIVE AND PREVENTIVE MAINTENANCE**

- 36.1 Explain the purpose of predictive and preventive maintenance
- 36.2 Perform preventive maintenance to schedule
- 36.3 Document preventive maintenance
- 36.4 Communicate repair needs to others
- 36.5 Insure that the workstation is clean and free from safety hazards

## **37.B EXAMINE THE CHEMISTRY OF PLASTICS**

- 37.1b Describe the chemical foundations of plastics
- 37.2b Describe the chemical foundations of fabrication methods
- 37.3b Describe the main classifications of thermoplastics, their structure and properties
- 37.4b Explain how additives affect the properties and processing of thermoplastics
- 37.5b Describe the chemistry and manufacturing of foams
- 37.6b Discuss the variables in testing plastic products

## **38.B PERFORM INJECTION MOLDING OPERATIONS**

- 38.1b Identify the advantages and disadvantages of injection molding processes, including decoupled molding
- 38.2b Discuss the factors that control the injection molding process
- 38.3b List the four stages of the injection molding process
- 38.4b Describe mold basics, including construction, action areas, runners, gates, venting, etc.
- 38.5b Set up and operate injection molding machinery
- 38.6b Demonstrate injection molding
- 38.7b Identify common defects that can occur during injection molding and their causes

## **39.B PERFORM BLOW MOLDING OPERATIONS**

- 39.1b Describe the advantages and disadvantages of different types of blow molding
- 39.2b Examine different types of blow molding dies and how they affect the size and shape of the parison
- 39.3b Relate blow ratio to part wall thickness
- 39.4b Set up and operate blow molding machinery
- 39.5b Demonstrate blow molding
- 39.6b Identify common defects that can occur during blow molding and their causes

## **40.B PERFORM EXTRUSION OPERATIONS**

- 40.1b Explain the advantages and disadvantages of using the extrusion process
- 40.2b Identify variables in the extrusion process and their effect on production
- 40.3b Explain the mechanics of the extrusion process
- 40.4b Examine the cooling systems used in the extrusion process
- 40.5b Set up and operate extrusion equipment
- 40.6b Demonstrate the extrusion process

## **41.B EXPLORE TOOLS AND DIES FOR PLASTICS PROCESSING METHODS**

- 41.1b Describe the use of molds in plastic parts production
- 41.2b Differentiate between machined molds and cast molds
- 41.3b Describe the major components of machined molds
- 41.4b Describe the major components of cast molds
- 41.5b Describe rapid prototyping to create tools and dies for short production runs

## **42.B PERFORM JOINING AND FASTENING OF PLASTICS**

- 42.1b Demonstrate the use of mechanical fasteners
- 42.2b Demonstrate snap fit assembly
- 42.3b Demonstrate press fit assembly
- 42.4b Demonstrate welding methods of assembly
- 42.5b Examine ultrasonic assembly

## **43.B PERFORM FINISHING AND DECORATING PROCESSES**

- 43.1b Differentiate in-mold decorating, pad printing, screen printing and hot stamping methods for finishing plastic parts
- 43.2b List the various components of a plastic finish specification
- 43.3b Describe key paint concepts, application methods and applications equipment
- 43.4b Demonstrate the in-mold decorating process
- 43.5b Demonstrate the pad printing process
- 43.6b Demonstrate the screen printing process
- 43.7b Demonstrate the coatings application process
- 43.8b Identify common defects that can occur in finishing and their causes