



Manufacturing Career Cluster Maintenance, Installation and Repair Pathway Knowledge and Skill Statements

The Pathway Knowledge and Skills Chart describes what all/most learners/workers need to know and be able to do to demonstrate competence within a career pathway. Following the pathway description, there are four sets of knowledge and skill expectations:

A. Foundational Academic Expectations
B. Essential Knowledge and Skills
C. Cluster (Foundation) Knowledge and Skills
D. Pathway Knowledge and Skills

PATHWAY DESCRIPTION

Maintenance, Installation and Repair Pathway: People with careers in Maintenance, Installation and Repair perform preventive maintenance procedures on machines tools and equipment. These are performed routinely and on a regular basis. They also troubleshoot and repair electrical, electronic and mechanical systems. This will include mechanical repair as well as using computer-based inventory control systems, retrieving information histories on each machine from computer records, and recording repair activities on the system to keep accurate records of repairs performed on each machine.

A. FOUNDATIONAL ACADEMIC EXPECTATIONS

All secondary students should meet their state's academic standards. All Essential Cluster and Pathway Knowledge and Skills are predicated on the assumption that foundational academic skills have been attained. Some knowledge and skill statements will further define critical linkages and applications of academics in the cluster and/or pathway.

A. Foundational Academic Expectations
B. Essential Knowledge and Skills
C. Cluster (Foundation) Knowledge and Skills
D. Pathway Knowledge and Skills

B. ESSENTIAL KNOWLEDGE AND SKILLS

The following Essential Knowledge and Skill statements apply to careers in all clusters and pathways. Persons preparing for careers in this pathway should be able to demonstrate these skills in the context of this cluster and pathway.

A. Foundational Academic Expectations
B. Essential Knowledge and Skills
C. Cluster (Foundation) Knowledge and Skills
D. Pathway Knowledge and Skills



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Essential Topic	
ESS01	ACADEMIC FOUNDATIONS: <i>Achieve additional academic knowledge and skills required to pursue the full range of career and postsecondary education opportunities within a career cluster.</i>
ESS01.01	Complete required training, education, and certification to prepare for employment in a particular career field.
ESS01.01.01	Identify training, education and certification requirements for occupational choice.
ESS01.01.02	Participate in career-related training and/or degree programs.
ESS01.01.03	Pass certification tests to qualify for licensure and/or certification in chosen occupational area.
ESS01.02	Demonstrate language arts knowledge and skills required to pursue the full range of post-secondary education and career opportunities.
ESS01.02.01	Model behaviors that demonstrate active listening.
ESS01.02.02	Adapt language for audience, purpose, situation. (i.e. diction/structure, style).
ESS01.02.03	Organize oral and written information.
ESS01.02.04	Compose focused copy for a variety of written documents such as agendas, audio-visuals, bibliographies, drafts, forms/documents, notes, oral presentations, reports, and technical terminology.
ESS01.02.05	Edit copy to create focused written documents such as agendas, audio-visuals, bibliographies, drafts, forms/documents, notes, oral presentations, reports, and technical terminology.
ESS01.02.06	Comprehend key elements of oral and written information such as cause/effect, comparisons/contrasts, conclusions, context, purpose, charts/tables/graphs, evaluation/critiques, mood, persuasive text, sequence, summaries, and technical subject matter.
ESS01.02.07	Evaluate oral and written information for accuracy, adequacy/sufficiency, appropriateness, clarity, conclusions/solutions, fact/opinion, propaganda, relevancy, validity, and relationship of ideas.
ESS01.02.08	Identify assumptions, purpose, outcomes/solutions, and propaganda techniques.
ESS01.02.09	Predict potential outcomes and/or solutions based on oral and written information regarding trends.
ESS01.02.10	Present formal and informal speeches including discussion, information requests, interpretation, and persuasive arguments.
ESS01.03	Demonstrate mathematics knowledge and skills required to pursue the full range of post-secondary education and career opportunities.
ESS01.03.01	Identify whole numbers, decimals, and fractions.
ESS01.03.02	Demonstrate knowledge of basic arithmetic operations such as addition, subtraction, multiplication, and division.
ESS01.03.03	Demonstrate use of relational expressions such as equal to, not equal, greater than, less than, etc.



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- ESS01.03.04 Apply data and measurements to solve a problem.
- ESS01.03.05 Analyze Mathematical problem statements for missing and/or irrelevant data.
- ESS01.03.06 Construct charts/tables/graphs from functions and data.
- ESS01.03.07 Analyze data when interpreting operational documents.

ESS01.04 Demonstrate science knowledge and skills required to pursue the full range of post-secondary and career education opportunities.

- ESS01.04.01 Evaluate scientific constructs including conclusions, conflicting data, controls, data, inferences, limitations, questions, sources of errors, and variables.
- ESS01.04.02 Apply scientific methods in qualitative and quantitative analysis, data gathering, direct and indirect observation, predictions, and problem identification.

Essential Topic
ESS02
COMMUNICATIONS: Use oral and written communication skills in creating, expressing and interpreting information and ideas including technical terminology and information.

ESS02.01 Select and employ appropriate reading and communication strategies to learn and use technical concepts and vocabulary in practice.

- ESS02.01.01 Determine the most appropriate reading strategy for identifying the overarching purpose of a text (i.e. skimming, reading for detail, reading for meaning or critical analysis).
- ESS02.01.02 Demonstrate use of content, technical concepts and vocabulary when analyzing information and following directions.
- ESS02.01.03 Select the reading strategy or strategies needed to fully comprehend the content within a written document (i.e., skimming, reading for detail, reading for meaning or critical analysis).
- ESS02.01.04 Interpret information, data, and observations to apply information learned from reading to actual practice.
- ESS02.01.05 Transcribe information, data, and observations to apply information learned from reading to actual practice.
- ESS02.01.06 Communicate information, data, and observations to apply information learned from reading to actual practice.

ESS02.02 Demonstrate use of the concepts, strategies, and systems for obtaining and conveying ideas and information to enhance communication in the workplace.

- ESS02.02.01 Employ verbal skills when obtaining and conveying information.
- ESS02.02.02 Record information needed to present a report on a given topic or problem.
- ESS02.02.03 Write internal and external business correspondence that conveys and/or obtains information effectively.
- ESS02.02.04 Communicate with other employees to clarify workplace objectives.



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ESS02.02.05 Communicate effectively with customers and employees to foster positive relationships.

ESS02.03 Locate, organize and reference written information from various sources to communicate with co-workers and clients/participants.

ESS02.03.01 Locate written information used to communicate with co-workers and customers.

ESS02.03.02 Organize information to use in written and oral communications.

ESS02.03.03 Reference the sources of information.

ESS02.04 Evaluate and use information resources to accomplish specific occupational tasks.

ESS02.04.01 Use informational texts, Internet web sites, and/or technical materials to review and apply information sources for occupational tasks.

ESS02.04.02 Evaluate the reliability of information from informational texts, Internet Web sites, and/or technical materials and resources.

ESS02.05 Use correct grammar, punctuation and terminology to write and edit documents.

ESS02.05.01 Compose multi-paragraph documents clearly, succinctly, and accurately.

ESS02.05.02 Use descriptions of audience and purpose when preparing and editing written documents.

ESS02.05.03 Use correct grammar, spelling, punctuation, and capitalization when preparing written documents.

ESS02.06 Develop and deliver formal and informal presentations using appropriate media to engage and inform audiences.

ESS02.06.01 Prepare oral presentations to provide information for specific purposes and audiences.

ESS02.06.02 Identify support materials that will enhance an oral presentation.

ESS02.06.03 Prepare support materials that will enhance an oral presentation.

ESS02.06.04 Deliver an oral presentation that sustains listeners' attention and interest.

ESS02.06.05 Align presentation strategies to the intended audience.

ESS02.06.06 Implement multi-media strategies for presentations.

ESS02.07 Interpret verbal and nonverbal cues/behaviors to enhance communication with co-workers and clients/participants.

ESS02.07.01 Interpret verbal behaviors when communicating with clients and co-workers.

ESS02.07.02 Interpret nonverbal behaviors when communicating with clients and co-workers.

ESS02.08 Apply active listening skills to obtain and clarify information.

ESS02.08.01 Interpret a given verbal message/information.

ESS02.08.02 Respond with restatement and clarification techniques to clarify information.



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ESS02.09 Develop and interpret tables, charts, and figures to support written and oral communications.

- ESS02.09.01 Create tables, charts, and figures to support written and oral communications.
- ESS02.09.02 Interpret tables, charts, and figures used to support written and oral communication.

ESS02.10 Listen to and speak with diverse individuals to enhance communication skills.

- ESS02.10.01 Apply factors and strategies for communicating with a diverse workforce.
- ESS02.10.02 Demonstrate ability to communicate and resolve conflicts within a diverse workforce.

ESS02.11 Exhibit public relations skills to increase internal and external customer/client satisfaction.

- ESS02.11.01 Communicate effectively when developing positive customer/client relationships.

Essential Topic PROBLEM-SOLVING AND CRITICAL THINKING: *Solve problems using ESS03 critical thinking skills (analyze, synthesize, and evaluate) independently and in teams. Solve problems using creativity and innovation.*

ESS03.01 Employ critical thinking skills independently and in teams to solve problems and make decisions (e.g., analyze, synthesize and evaluate).

- ESS03.01.01 Identify common tasks that require employees to use problem-solving skills.
- ESS03.01.02 Analyze elements of a problem to develop creative solutions.
- ESS03.01.03 Describe the value of using problem-solving and critical thinking skills to improve a situation or process.
- ESS03.01.04 Create ideas, proposals, and solutions to problems.
- ESS03.01.05 Evaluate ideas, proposals, and solutions to problems.
- ESS03.01.06 Use structured problem-solving methods when developing proposals and solutions.
- ESS03.01.07 Generate new and creative ideas to solve problems by brainstorming possible solutions.
- ESS03.01.08 Critically analyze information to determine value to the problem-solving task.
- ESS03.01.09 Guide individuals through the process of recognizing concerns and making informed decisions.
- ESS03.01.10 Identify alternatives using a variety of problem-solving and critical thinking skills.
- ESS03.01.11 Evaluate alternatives using a variety of problem-solving and critical thinking skills.

ESS03.02 Employ critical thinking and interpersonal skills to resolve conflicts with staff and/or customers.



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- ESS03.02.01 Analyze situations and behaviors that affect conflict management.
- ESS03.02.02 Determine best options/outcomes for conflict resolution using critical thinking skills.
- ESS03.02.03 Identify with others' feelings, needs, and concerns.
- ESS03.02.04 Implement stress management techniques.
- ESS03.02.05 Resolve conflicts with/for customers using conflict resolution skills.
- ESS03.02.06 Implement conflict resolution skills to address staff issues/problems.

ESS03.03 **Identify, write and monitor workplace performance goals to guide progress in assigned areas of responsibility and accountability.**

- ESS03.03.01 Write realistic performance goals, objectives and action plans.
- ESS03.03.02 Monitor performance goals and adjust as necessary.
- ESS03.03.03 Recognize goal achievement using appropriate rewards in the workplace.

- ESS03.03.04 Communicate goal achievement with managers and co-workers.

ESS03.04 **Conduct technical research to gather information necessary for decision-making.**

- ESS03.04.01 Align the information gathered to the needs of the audience.
- ESS03.04.02 Gather technical information and data using a variety of resources.
- ESS03.04.03 Analyze information and data for value to the research objectives.
- ESS03.04.04 Evaluate information and data to determine value to research objectives.

Essential Topic ESS04	INFORMATION TECHNOLOGY APPLICATIONS: <i>Use information technology tools specific to the career cluster to access, manage, integrate, and create information.</i>
ESS04.01	Use Personal Information Management (PIM) applications to increase workplace efficiency.
ESS04.01.01	Manage personal schedules and contact information.
ESS04.01.02	Create memos and notes.
ESS04.02	Employ technological tools to expedite workflow.
ESS04.02.01	Use information technology tools to manage and perform work responsibilities.
ESS04.03	Operate electronic mail applications to communicate within a workplace.
ESS04.03.01	Use email to share files and documents.
ESS04.03.02	Identify the functions and purpose of email systems.
ESS04.03.03	Use email to communicate within and across organizations.
ESS04.04	Operate Internet applications to perform workplace tasks.
ESS04.04.01	Access and navigate Internet (e.g., use a web browser).
ESS04.04.02	Search for information and resources.
ESS04.04.03	Evaluate Internet resources for reliability and validity.
ESS04.05	Operate writing and publishing applications to prepare business communications.



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ESS04.05.01	Prepare simple documents and other business communications.
ESS04.05.02	Prepare reports and other business communications by integrating graphics and other non-text elements.
ESS04.05.03	Prepare complex multi-media publications.
ESS04.06	Operate presentation applications to prepare presentations.
ESS04.06.01	Prepare presentations for training, sales and information sharing.
ESS04.06.02	Deliver presentations with supporting materials.
ESS04.07	Employ spreadsheet applications to organize and manipulate data.
ESS04.07.01	Create a spreadsheet.
ESS04.07.02	Perform calculations and analyses on data using a spreadsheet.
ESS04.08	Employ database applications to manage data.
ESS04.08.01	Manipulate data elements.
ESS04.08.02	Manage interrelated data elements.
ESS04.08.03	Analyze interrelated data elements.
ESS04.08.04	Generate reports showing interrelated data elements.
ESS04.09	Employ collaborative/groupware applications to facilitate group work.
ESS04.09.01	Facilitate group work through management of shared schedule and contact information.
ESS04.09.02	Facilitate group work through management of shared files and online information.
ESS04.09.03	Facilitate group work through instant messaging or virtual meetings.
ESS04.10	Employ computer operations applications to manage work tasks.
ESS04.10.01	Manage computer operations.
ESS04.10.02	Manage file storage.
ESS04.10.03	Compress or alter files.
ESS04.11	Use computer-based equipment (containing embedded computers or processors) to control devices.
ESS04.11.01	Operate computer driven equipment and machines.
ESS04.11.02	Use installation and operation manuals.
ESS04.11.03	Troubleshoot computer driven equipment and machines.
ESS04.11.04	Access support as needed to maintain operation of computer driven equipment and machines.

Essential Topic
ESS05

SYSTEMS: *Understand roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment. Identify how key organizational systems affect organizational performance and the quality of products and services. Understand global context of industries and careers.*

ESS05.01	Describe the nature and types of business organizations to build an understanding of the scope of organizations.
ESS05.01.01	List the types and functions of businesses.



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- ESS05.01.02 Describe the types and functions of businesses.
- ESS05.01.03 Explain the functions and interactions of common departments within a business.

ESS05.02 Implement quality control systems and practices to ensure quality products and services.

- ESS05.02.01 Describe quality control standards and practices common to the workplace.

Essential Topic
ESS06

SAFETY, HEALTH AND ENVIRONMENTAL: *Understand the importance of health, safety, and environmental management systems in organizations and their importance to organizational performance and regulatory compliance. Follow organizational policies and procedures and contribute to continuous improvement in performance and compliance.*

ESS06.01 Implement personal and jobsite safety rules and regulations to maintain safe and healthful working conditions and environments.

- ESS06.01.01 Assess workplace conditions with regard to safety and health.
- ESS06.01.02 Align safety issues with appropriate safety standards to ensure a safe workplace/jobsite.
- ESS06.01.03 Identify safety hazards common to workplaces.
- ESS06.01.04 Identify safety precautions to maintain a safe worksite.
- ESS06.01.05 Select appropriate personal protective equipment as needed for a safe workplace/jobsite.
- ESS06.01.06 Inspect personal protective equipment commonly used for selected career pathway.
- ESS06.01.07 Use personal protective equipment according to manufacturer rules and regulations.
- ESS06.01.08 Employ a safety hierarchy and communication system within the workplace/jobsite.
- ESS06.01.09 Implement safety precautions to maintain a safe worksite.

ESS06.02 Complete work tasks in accordance with employee rights and responsibilities and employers obligations to maintain workplace safety and health.

- ESS06.02.01 Identify rules and laws designed to promote safety and health in the workplace.
- ESS06.02.02 State the rationale of rules and laws designed to promote safety and health.

ESS06.03 Employ emergency procedures as necessary to provide aid in workplace accidents.

- ESS06.03.01 Use knowledge of First Aid procedures as necessary.
- ESS06.03.02 Use knowledge of CPR procedures as necessary.
- ESS06.03.03 Use safety equipment as necessary.

ESS06.04 Employ knowledge of response techniques to create a disaster and/or emergency response plan.



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- ESS06.04.01 Complete an assessment of an emergency and/or disaster situation.
- ESS06.04.02 Create an emergency and/or disaster plan.

Essential Topic **LEADERSHIP AND TEAMWORK: *Use leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.***
ESS07

ESS07.01 Employ leadership skills to accomplish organizational goals and objectives.

- ESS07.01.01 Analyze the various roles of leaders within organizations (e.g. contribute ideas; share in building an organization; act as role models to employees by adhering to company policies, procedures, and standards; promote the organization's vision; and mentor others).
- ESS07.01.02 Exhibit traits such as empowerment, risk, communication, focusing on results, decision-making, problem solution, and investment in individuals when leading a group in solving a problem.
- ESS07.01.03 Exhibit traits such as compassion, service, listening, coaching, developing others, team development, and understanding and appreciating others when acting as a manager of others in the workplace.
- ESS07.01.04 Exhibit traits such as enthusiasm, creativity, conviction, mission, courage, concept, focus, principle-centered living, and change when interacting with others in general.
- ESS07.01.05 Consider issues related to self, team, community, diversity, environment, and global awareness when leading others.
- ESS07.01.06 Exhibit traits such as innovation, intuition, adaptation, life-long learning and coachability to develop leadership potential over time.
- ESS07.01.07 Analyze leadership in relation to trust, positive attitude, integrity, and willingness to accept key responsibilities in a work situation.
- ESS07.01.08 Describe observations of outstanding leaders using effective management styles.
- ESS07.01.09 Participate in civic and community leadership and teamwork opportunities to enhance skills.

ESS07.02 Employ organizational and staff development skills to foster positive working relationships and accomplish organizational goals.

- ESS07.02.01 Implement organizational skills when facilitating others' work efforts.
- ESS07.02.02 Explain how to manage a staff that satisfies work demands while adhering to budget constraints.
- ESS07.02.03 Describe how staff growth and development to increase productivity and employee satisfaction.
- ESS07.02.04 Organize team involvement within a group environment.
- ESS07.02.05 Work with others to develop and gain commitment to team goals.
- ESS07.02.06 Distribute responsibility and work load fairly.
- ESS07.02.07 Model leadership and teamwork qualities to aid in employee morale.
- ESS07.02.08 Identify best practices for successful team functioning.



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ESS07.02.09	Explain best practices for successful team functioning.
ESS07.03	Employ teamwork skills to achieve collective goals and use team members' talents effectively.
ESS07.03.01	Work with others to achieve objectives in a timely manner.
ESS07.03.02	Promote the full involvement and use of team members' individual talents and skills.
ESS07.03.03	Employ conflict-management skills to facilitate solutions.
ESS07.03.04	Demonstrate teamwork skills through working cooperatively with co-workers, supervisory staff, and others, both in and out of the organization, to achieve particular tasks.
ESS07.03.05	Demonstrate teamwork processes that provide team building, consensus, continuous improvement, respect for the opinions of others, cooperation, adaptability, and conflict resolution.
ESS07.03.06	Develop plans to improve team performance.
ESS07.03.07	Demonstrate commitment to and a positive attitude toward team goals.
ESS07.03.08	Take responsibility for shared group and individual work tasks.
ESS07.03.09	Assist team members in completing their work.
ESS07.03.10	Adapt effectively to changes in projects and work activities.
ESS07.03.11	Negotiate effectively to arrive at decisions.
ESS07.04	Establish and maintain effective working relationships with all levels of personnel and other departments in order to accomplish objectives and tasks.
ESS07.04.01	Build effective working relationships using interpersonal skills.
ESS07.04.02	Use positive interpersonal skills to work cooperatively with co-workers representing different cultures, genders and backgrounds.
ESS07.04.03	Manage personal skills to accomplish assignments.
ESS07.04.04	Treat people with respect.
ESS07.04.05	Provide constructive praise and criticism.
ESS07.04.06	Demonstrate sensitivity to and value for diversity.
ESS07.04.07	Manage stress and control emotions.
ESS07.05	Conduct and participate in meetings to accomplish work tasks.
ESS07.05.01	Develop meeting goals, objectives and agenda.
ESS07.05.02	Assign responsibilities for preparing materials and leading discussions.
ESS07.05.03	Prepare materials for leading discussion.
ESS07.05.04	Assemble and distribute meeting materials.
ESS07.05.05	Conduct meeting to achieve objectives within scheduled time.
ESS07.05.06	Demonstrate effective communication skills in meetings.
ESS07.05.07	Produce meeting minutes including decisions and next steps.
ESS07.05.08	Use parliamentary procedure, as needed, to conduct meetings.
ESS07.06	Employ mentoring skills to inspire and teach others.
ESS07.06.01	Use motivational techniques to enhance performance in others.
ESS07.06.02	Provide guidance to enhance performance in others.



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Essential Topic	ETHICS AND LEGAL RESPONSIBILITIES: <i>Know and understand the importance of professional ethics and legal responsibilities.</i>
ESS08	
ESS08.01	Apply ethical reasoning to a variety of workplace situations in order to make ethical decisions.
ESS08.01.01	Evaluate alternative responses to workplace situations based on legal responsibilities and employer policies.
ESS08.01.02	Evaluate alternative responses to workplace situations based on personal or professional ethical responsibilities.
ESS08.01.03	Identify personal and long-term workplace consequences of unethical or illegal behaviors.
ESS08.01.04	Explain personal and long-term workplace consequences of unethical or illegal behaviors.
ESS08.01.05	Determine the most appropriate response to workplace situations based on legal and ethical considerations.
ESS08.01.06	Explain the most appropriate response to workplace situations based on legal and ethical considerations.
ESS08.02	Interpret and explain written organizational policies and procedures to help employees perform their jobs according to employer rules and expectations.
ESS08.02.01	Locate information on organizational policies in handbooks and manuals.
ESS08.02.02	Discuss how specific organizational policies and procedures influence a specific work situation.
Essential Topic	EMPLOYABILITY AND CAREER DEVELOPMENT: <i>Know and understand the importance of employability skills. Explore, plan, and effectively manage careers. Know and understand the importance of entrepreneurship skills.</i>
ESS09	
ESS09.01	Identify and demonstrate positive work behaviors and personal qualities needed to be employable.
ESS09.01.01	Demonstrate self-discipline, self-worth, positive attitude, and integrity in a work situation.
ESS09.01.02	Demonstrate flexibility and willingness to learn new knowledge and skills.
ESS09.01.03	Exhibit commitment to the organization.
ESS09.01.04	Identify how work varies with regard to site, from indoor confined spaces to outdoor areas, including aerial space and a variety of climatic and physical conditions.
ESS09.01.05	Apply communication strategies when adapting to a culturally diverse environment.
ESS09.01.06	Manage resources in relation to the position (i.e. budget, supplies, computer, etc).
ESS09.01.07	Identify positive work-qualities typically desired in each of the career cluster's pathways.



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ESS09.01.08 Manage work roles and responsibilities to balance them with other life roles and responsibilities.

ESS09.02 Develop a personal career plan to meet career goals and objectives.

ESS09.02.01 Develop career goals and objectives as part of a plan for future career direction.

ESS09.02.02 Develop strategies to reach career objectives.

ESS09.03 Demonstrate skills related to seeking and applying for employment to find and obtain a desired job.

ESS09.03.01 Use multiple resources to locate job opportunities.

ESS09.03.02 Prepare a résumé.

ESS09.03.03 Prepare a letter of application.

ESS09.03.04 Complete an employment application.

ESS09.03.05 Interview for employment.

ESS09.03.06 List the standards and qualifications that must be met in order to enter a given industry.

ESS09.03.07 Employ critical thinking and decision-making skills to exhibit qualifications to a potential employer.

ESS09.04 Maintain a career portfolio to document knowledge, skills and experience in a career field.

ESS09.04.01 Select educational and work history highlights to include in a career portfolio.

ESS09.04.02 Produce a record of work experiences, licenses, certifications and products.

ESS09.04.03 Organize electronic or physical portfolio for use in demonstrating knowledge, skills and experiences.

ESS09.05 Demonstrate skills in evaluating and comparing employment opportunities in order to accept employment positions that match career goals.

ESS09.05.01 Compare employment opportunities to individual needs and career plan objectives.

ESS09.05.02 Evaluate employment opportunities based upon individual needs and career plan objectives.

ESS09.05.03 Demonstrate appropriate methods for accepting or rejecting employment offers.

ESS09.06 Identify and exhibit traits for retaining employment to maintain employment once secured.

ESS09.06.01 Model behaviors that demonstrate reliability and dependability.

ESS09.06.02 Maintain appropriate dress and behavior for the job to contribute to a safe and effective workplace/jobsite.

ESS09.06.03 Complete required employment forms and documentation such as I-9 form, work visa, W-4 and licensures to meet employment requirements.

ESS09.06.04 Summarize key activities necessary to retain a job in the industry.



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ESS09.06.05 Identify positive work behaviors and personal qualities necessary to retain employment.

ESS09.07 Identify and explore career opportunities in one or more career pathways to build an understanding of the opportunities available in the cluster.

ESS09.07.01 Locate and identify career opportunities that appeal to personal career goals.

ESS09.07.02 Match personal interest and aptitudes to selected careers.

ESS09.08 Recognize and act upon requirements for career advancement to plan for continuing education and training.

ESS09.08.01 Identify opportunities for career advancement.

ESS09.08.02 Pursue education and training opportunities to acquire skills necessary for career advancement.

ESS09.08.03 Examine the organization and structure of various segments of the industry to prepare for career advancement.

ESS09.08.04 Research local and regional labor (workforce) market and job growth information to project potential for advancement.

ESS09.08.05 Manage employment relations to make career advancements.

ESS09.09 Continue professional development to keep current on relevant trends and information within the industry.

ESS09.09.01 Use self assessment, organizational priorities, journals, Internet sites, professional associations, peers and other resources to develop goals that address training, education and self-improvement issues.

ESS09.09.02 Read trade magazines and journals, manufacturers' catalogues, industry publications and Internet sites to keep current on industry trends.

ESS09.09.03 Participate in relevant conferences, workshops, mentoring activities and in-service training to stay current with recent changes in the field.

ESS09.10 Examine licensing, certification and credentialing requirements at the national, state and local levels to maintain compliance with industry requirements.

ESS09.10.01 Examine continuing education requirements related to licensing, certification, and credentialing requirements at the local, state and national levels for chosen occupation.

ESS09.10.02 Examine the procedures and paperwork involved in maintaining and updating licensure, certification and credentials for chosen occupation.

ESS09.10.03 Align ongoing licensing, certification and credentialing requirements to career plans and goals.

ESS09.11 Examine employment opportunities in entrepreneurship to consider entrepreneurship as an option for career planning.

ESS09.11.01 Describe the opportunities for entrepreneurship in a given industry.

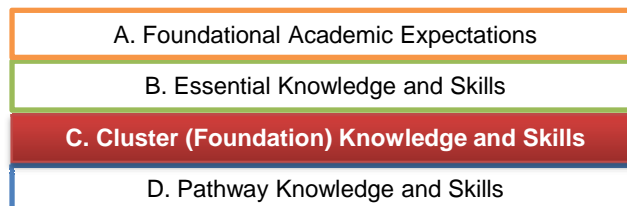


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Essential Topic ESS10	TECHNICAL SKILLS: <i>Use of technical knowledge and skills required to pursue careers in all career cluster, including knowledge of design, operation, and maintenance of technological systems critical to the career cluster.</i>
ESS10.01	Employ information management techniques and strategies in the workplace to assist in decision-making.
ESS10.01.01	Use information literacy skills when accessing, evaluating and disseminating information.
ESS10.01.02	Describe the nature and scope of information management.
ESS10.01.03	Maintain records to facilitate ongoing business operations.
ESS10.02	Employ planning and time management skills and tools to enhance results and complete work tasks.
ESS10.02.01	Develop goals and objectives.
ESS10.02.02	Prioritize tasks to be completed.
ESS10.02.03	Develop timelines using time management knowledge and skills.
ESS10.02.04	Use project-management skills to improve workflow and minimize costs.

C. CLUSTER (FOUNDATION) KNOWLEDGE AND SKILLS

The following Cluster (Foundation) Knowledge and Skill statements apply to all careers in the Manufacturing Cluster. Persons preparing for careers in the Manufacturing Cluster should be able to demonstrate these skills in addition to those found on the Essential Knowledge and Skills Chart.



Cluster Topic MNC01	ACADEMIC FOUNDATIONS: <i>Achieve additional academic knowledge and skills required to pursue the full range of career and postsecondary education opportunities within a career cluster.</i> <i>No additional statements in this topic beyond those found in the Essential Knowledge and Skills Chart.</i>
Cluster Topic MNC02	COMMUNICATIONS: <i>Use oral and written communication skills in creating, expressing and interpreting information and ideas including technical terminology and information.</i> <i>No additional statements in this topic beyond those found in the Essential Knowledge and Skills Chart.</i>
Cluster Topic MNC03	PROBLEM-SOLVING AND CRITICAL THINKING: <i>Solve problems using critical thinking skills (analyze, synthesize, and evaluate) independently and in teams. Solve problems using creativity and innovation.</i> <i>No additional statements in this topic beyond those found in the Essential Knowledge and Skills Chart.</i>



Manufacturing Career Cluster
Maintenance, Installation and Repair Pathway
Knowledge and Skill Statements

Cluster Topic
MNC04

INFORMATION TECHNOLOGY APPLICATIONS: *Use information technology tools specific to the career cluster to access, manage, integrate, and create information.*

No additional statements in this topic beyond those found in the Essential Knowledge and Skills Chart.

Cluster Topic
MNC05

SYSTEMS: *Understand roles within teams, work units, departments, organizations, inter-organizational systems, and the larger environment. Identify how key organizational systems affect organizational performance and the quality of products and services. Understand global context of industries and careers.*

MNC05.01

Summarize and explain how manufacturing businesses operate to demonstrate an understanding of key functions within organizations in the industry.

MNC05.01.01

Sample Indicators

Identify the role and major functions of manufacturing businesses.

Explain the importance of manufacturing to society.

Identify the mission, major internal functions and structure of manufacturing businesses. Identify the customers, suppliers, and stakeholders of manufacturing businesses, their roles, and how they relate.

Explain the major competitive challenges faced by the manufacturing businesses.

Identify and describe types of manufacturing systems.

Analyze current trends in manufacturing systems.

MNC05.01.02

Sample Indicators

Describe how manufacturing businesses manage performance.

Explain how financial performance is measured.

Explain how market performance is gauged.

Explain how service and internal operations performance is determined.

Explain how compliance and performance related to health, safety, and environment are evaluated.

MNC05.01.03

Sample Indicators

Describe how changes outside the manufacturing business impact the manufacturing business.

Explain the impact of economic changes.

Explain the impact of social changes.

Explain the impact of technology changes.

MNC05.01.04

Sample Indicators

Explain the role of risk management in reducing risks and improving performance in manufacturing businesses.

Explain the objectives of risk management programs.

Explain the major types of loss exposure for manufacturing businesses.

Explain the approaches for managing organizational risks.

MNC05.01.05

Sample Indicators

Identify the roles and functions of government in regulating and supporting manufacturing businesses.

Explain the roles in regulating domestic operations.

Explain the roles in regulating international operations.

Explain the roles in managing the infrastructures of manufacturing businesses.

Explain the roles in health, safety, and environmental management.



Manufacturing Career Cluster
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MNC05.02 Analyze and summarize how manufacturing businesses improve performance to demonstrate an understanding of various methods for enhancing production.

MNC05.02.01 Describe how manufacturing businesses manage customer relationships.

Sample Indicators Identify needs and requirements of internal and external customers.
Describe customer satisfaction and fulfillment of customer requirements.

MNC05.02.02 Describe how planning and budgeting are used to accomplish organizational goals and objectives.

Sample Indicators Explain how manufacturing businesses respond to customer problems and complaints.
Explain how work plans and budgets are used to allocate people and resources.
Identify reports used to track performance and resource and explain how they are used.
Explain how plans and budgets are revised to meet goals and objectives.

MNC05.02.03 Explain how planning is used to improve overall business performance.

Sample Indicators Identify and describe the most critical performance problems that manufacturing businesses typically face.
Describe how improvements are identified.

Cluster Topic
MNC06

SAFETY, HEALTH AND ENVIRONMENTAL: *Understand the importance of health, safety, and environmental management systems in organizations and their importance to organizational performance and regulatory compliance. Follow organizational policies and procedures and contribute to continuous improvement in performance and compliance.*

MNC06.01 Maintain safe and healthful working conditions and environment to ensure employee safety.

MNC06.01.01 Assess workplace conditions according to specified safety and health requirements.

Sample Indicators Identify the types of risk of injury/illness at work.
Identify those who are susceptible to risk of injury/illness at work.
Describe ways to positively impact occupational safety and health.

MNC06.02 Understand employee rights and responsibilities and employer obligations concerning occupational safety and health.

MNC06.02.01 Demonstrate knowledge of rules and laws designed to promote safety and health and their rationale.

Sample Indicators Identify key rights of employees related to occupational safety and health.
Identify the responsibilities of employers related to occupational safety and health.
Explain the role of government agencies in providing a safe workplace.

MNC06.03 Assess types and sources of workplace hazards in order to maintain safe working conditions in a manufacturing business environment.

MNC06.03.01 Demonstrate methods to correct common hazards following appropriate safety procedures.

Sample Indicators Identify and describe common hazards in the workplace.



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Identify and describe major sources of information about hazards in the workplace (e.g., MSDS, work procedures, exposure control plans, training materials, labels, and signage).

Identify sources of combustible/flammable materials, fire and emergencies to establish a fire safe environment.

Interpret safety signs and symbols.

Control workplace hazards in order to maintain safe working conditions in a manufacturing business environment.

MNC06.04

MNC06.04.01

Demonstrate safe workplace practices that promote personal and group health.

Sample Indicators

Identify procedures necessary for maintaining a safe work area.

Identify methods to correct common hazards.

Identify methods for disposing of hazardous materials.

Demonstrate principals of safe physical movement to avoid slips, trips, and spills.

Inspect and use protective equipment (PPE).

Summarize safety, health, and environmental management systems to build an understanding of compliance with governmental policies and procedures for manufacturing businesses.

MNC06.05

MNC06.05.01

Identify the major federal and state regulatory areas.

Sample Indicators

Identify specific health and safety laws and regulations that impact manufacturing and the major topics they address.

Identify specific environmental management laws and regulations and the major topics they address.

MNC06.05.02

Explain how government agencies ensure compliance with environmental regulations and promote improved performance.

Sample Indicators

Provide examples of the major regulations and types of data used by government to measure and monitor performance.

Provide examples of how manufacturing organizations ensure their compliance.

Provide examples of consequences that manufacturing organizations suffer when they fail to comply.

MNC06.05.03

Demonstrate workplace activities that comply with safety, health, and environmental policies and procedures.

Sample Indicators

Promote and maintain knowledge of organizational safety, health, and environmental management policies and procedures.

Follow organizational policies and procedures.

Educate and orient other workers.

Maintain a safe work area.

Identify, describe, and report workplace hazards.

Perform and participate in regular audits and inspections.

Provide and maintain documentation needed for compliance.

Conduct and participate in accident/incident investigations.

MNC06.05.04

Develop plans to improve safety performance.

Sample Indicators

Use structured problem-solving process to develop improvement plans.

Cluster Topic
MNC07

LEADERSHIP AND TEAMWORK: Use leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.



Manufacturing Career Cluster Maintenance, Installation and Repair Pathway Knowledge and Skill Statements

No additional statements in this topic beyond those found in the Essential Knowledge and Skills Chart.

Cluster Topic MNC08 **ETHICS AND LEGAL RESPONSIBILITIES:** *Know and understand the importance of professional ethics and legal responsibilities.*

No additional statements in this topic beyond those found in the Essential Knowledge and Skills Chart.

Cluster Topic MNC09 **EMPLOYABILITY AND CAREER DEVELOPMENT:** *Know and understand the importance of employability skills. Explore, plan, and effectively manage careers. Know and understand the importance of entrepreneurship skills.*

No additional statements in this topic beyond those found in the Essential Knowledge and Skills Chart.

Cluster Topic MNC10 **TECHNICAL SKILLS:** *Use the technical knowledge and skills required to pursue the targeted careers for all pathways in the career cluster, including knowledge of design, operation, and maintenance of technological systems critical to the career cluster.*

MNC10.01 **Describe and employ technical skills and knowledge required for careers in manufacturing in order to perform basic workplace activities common to manufacturing.**

MNC10.01.01 Demonstrate the planning and layout processes (e.g., designing, print reading, measuring) used in manufacturing.

Sample Indicators Read prints and use the information to play, lay out, and produce parts or products.

MNC10.01.02 Summarize how materials can be processed using tools and machines.

Sample Indicators Use tools and the processes of cutting, shaping, combining, forming, etc. of materials to manufacture a part or product.

MNC10.01.03 Describe various types of assembling processes (e.g., mechanical fastening, mechanical force, joining, fusion bonding, adhesive bonding) used in manufacturing.

Sample Indicators Apply appropriate fastening or joining procedure to the design and production of a manufactured part or product.

MNC10.01.04 Explain finishing processes (e.g., types of finishing materials, surface preparation, methods of application) used in manufacturing.

Sample Indicators Select a finishing process for a product appropriate to the job it must perform environment in which it functions, and its aesthetic appeal.

MNC10.01.05 Explain the processes of inspection and quality control used in manufacturing.

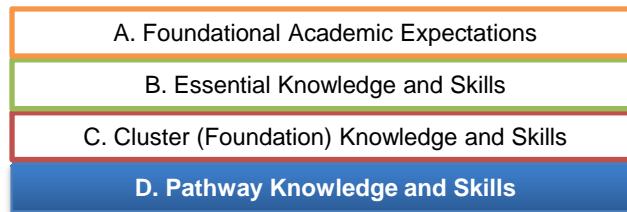
Sample Indicators Perform continuous on line inspections to ensure that parts or products meet design specifications.

D. PATHWAY KNOWLEDGE AND SKILLS

The following knowledge and skill statements apply to all careers in the Maintenance, Installation and Repair Pathway. The statements are organized within eight topics.



**Manufacturing Career Cluster
Maintenance, Installation and Repair Pathway
Knowledge and Skill Statements**



**Pathway Topic
MNPC01 SAFETY**

MNPC01.01 Employ maintenance, repair processes and protocols to maintain a safe and productive workplace.

MNPC01.01.01 Perform environmental and safety inspections following local, federal and company regulations.

- Sample Indicators*
- Identify, report and monitor potential hazards in the workplace.
 - Take corrective action to correct potential hazards.
 - Review health, safety, and environmental documentation and policies thoroughly and regularly.
 - Ensure that inspections meet all relevant, health, safety, and environmental laws and regulations.
 - Completed inspections according to company schedule and procedures.
 - Document inspection records and store them correctly.

MNPC01.01.02 Perform emergency drills as part of an emergency response team.

- Sample Indicators*
- Confirm that first aid training and certification on emergency and first aid procedures are complete and up-to-date.
 - Comply with company and regulatory policies and procedures to respond to emergencies.
 - Document emergency drills and incidents according to company and regulatory procedures promptly.

MNPC01.01.03 Identify unsafe conditions according to safety standards.

- Sample Indicators*
- Identify, report, and document conditions presenting a threat to health, safety, and the environment.
 - Identify corrective actions.
 - Consult appropriate parties about corrective actions and take corrective actions following company procedures promptly.
 - Track and report ongoing safety concerns until corrective action is taken.

MNPC01.01.04 Implement corrective action following safety protocols.

MNPC01.01.05 Implement safety orientation to train other employees in safe practices and emergency procedures.

- Sample Indicators*
- Verify that all topics and procedures are covered in orientation to facilitate employee safety.

- Observe orientation to ensure that it makes clear the need and processes for employees to raise safety concerns, ask questions, and receive additional training.
- Use company requirements to document orientation.
- Verify that orientation meets all relevant laws, policies, and regulations.
- Deliver safety instruction and updates on a regular schedule.

**Pathway Topic
MNPC02 COMMUNICATION**



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MNPC02.01	Communicate with others regarding maintenance, installation and repair issues and trends to meet business needs.
MNPC02.01.01	Educate others about benefits of predictive and preventive maintenance. <i>Sample Indicators</i> Use various techniques to clearly communicate the goals and benefits of predictive and preventive maintenance. Include information on operator responsibility for predictive and preventive maintenance in a training program. Make sure that education of production schedulers and managers promotes their understanding of the priorities and benefits of predictive and preventive maintenance.
MNPC02.01.02	Consult with others to set repair and maintenance priorities and schedule. <i>Sample Indicators</i> Make sure all parties agree on priorities, scheduling conflicts, and task associated with repair and maintenance prior to shutdown. Resolve repair and maintenance scheduling conflicts with all appropriate parties. Use project management tools and feedback where applicable. Take staffing requirements into account. Solicit operator input and consider it appropriately. Give operators appropriate lead-time when notifying them that maintenance is scheduled. Respond to reports of critical problems in a timely way.
MNPC02.01.03	Communicate maintenance and repair resource needs. <i>Sample Indicators</i> Hold a meeting with stakeholders to determine the timetable, roles, parts, and equipment needs during the pre-planning process. Place resource requests with the appropriate parties. Coordinate with other departments to ensure all resources are on hand, access to equipment is available as needed, and disruptions to the production line are minimized.
MNPC02.01.04	Prepare maintenance and repair logs for shift-to-shift communication. <i>Sample Indicators</i> Complete documentation in a timely way. Clearly communicate all important information to the next shift. Submit repair report and preventive maintenance reschedule on time. Make documentation accessible to all appropriate parties. Clearly communicate status reports from shift-to-shift.
MNPC02.01.05	Suggest ways to prevent future equipment malfunctions. <i>Sample Indicators</i> Make suggestions to appropriate parties. Make suggestions based on appropriate and accurate data or observations made during repairs. Document suggestions properly and include all supportive materials. Submit suggestions for improvements accurately and on time. Notify proper authorities fast enough to permit them to correct an urgent problem.

Pathway Topic MNPC03	HANDS-ON KNOWLEDGE
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MNPC03.01	Maintain hands-on knowledge of equipment operation to identify maintenance needs and maximize performance.
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MNPC03.01.01	Observe equipment operation during normal operating cycle to identify potential problems.
<i>Sample Indicators</i>	Perform observations of equipment regularly. Report all unusual behaviors or unsafe conditions immediately to appropriate personnel. Document all aspects of equipment operations. Make sure that all safety requirements are in place during observations. Observe equipment and process operations a number of times for consistency. Analyze equipment and process data regularly.
MNPC03.01.02	Maintain up-to-date knowledge of all documentation related to equipment.
<i>Sample Indicators</i>	Make all relevant materials easily available. Use machine identifiers, equipment lists, and process data to locate relevant information. Use all relevant databases in a timely manner. Retrieve relevant information to the requirements of the work to be performed from documents quickly. Use only information that is up-to-date. Discuss interpretations and questions on materials, specifications, and diagnostics.
MNPC03.01.03	Maintain information about equipment use and reliability.
<i>Sample Indicators</i>	Accurately maintain data on equipment life. Keep documentation up-to-date. Accurately document tool change data. Ensure that contact information on tool vendor is readily available. Gather information to identify the proper tool for maintenance and repair tasks.
MNPC03.01.04	Maintain all relevant equipment operation and repair certifications.
<i>Sample Indicators</i>	Properly plan certifications and schedule them in advance. Make sure that only qualified personnel perform certifications. Document certifications properly and report them to the correct parties. Follow all applicable laws and regulations when performing equipment inspections and documenting them. Keep records current and accurate. Verify that level of detail of certification documentation is appropriate. Forward information related to tool and equipment obsolescence to certify the repair, rebuild, or replacement.
MNPC03.01.05	Maintain personal certification and licensure.
<i>Sample Indicators</i>	Make sure that certifications are performed by the appropriate parties as required. Update certifications as appropriate. Communicate new requirements appropriately. Ensure that documentation is available to appropriate personnel. Identify training requirements needed for certifications. Obtain all necessary training.

Pathway Topic
MNPC04 **EQUIPMENT SAFETY**



Manufacturing Career Cluster
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MNPC04.01 Demonstrate the safe use of manufacturing equipment in order to ensure safety in the maintenance, installation and repair work environment.

- MNPC04.01.01 Train others to use equipment following safe operation practices.
Sample Indicators Give new operators a complete orientation of equipment.
 Communicate clearly and effectively all important information regarding equipment safety.
 Help maintenance workers obtaining certification to train others in technical skills and knowledge.
 Suggest training materials and content to appropriate parties.
 Use evaluation and feedback to improve training materials and methods.
 Make sure trainees have the correct tools to do the job during training.
- Conduct post-training evaluation to assure that workers can operate equipment safely.
 Verify that training and facilitation techniques are appropriate for the audience.
 Assure that quality and effectiveness of training are documented appropriately.
- MNPC04.01.02 Suggest processes and procedures to support safety and effectiveness in the work environment on a regular basis.
Sample Indicators Consult health and safety representatives for suggestions.
 Solicit operator feedback to evaluate training and create a safer, more effective work environment.
 Make sure suggestions for training improvement are documented and sent to the appropriate parties.
 Make suggestions that address safety, quality and productivity issues.
- MNPC04.01.03 Conduct safety and health audit as it relates to maintenance, installation, and repair.
Sample Indicators Make regular safety communications to all employees.
 Review job safety analyses regularly according to company policy.
 Explain the ramifications of failure to accurately follow hazardous materials procedures and policies such as Material Safety Data Sheet and "right to know."
 Confirm that environmental testing of workplace is performed on a regular basis as required by company policy or regulation.
- Confirm that equipment is audited to ensure there are no by-passes of safety guards.
 Verify that regulatory and company safety procedures are followed including lock-out/tag-out, confined space, and ergonomics.
 Evaluate good housekeeping procedures.
 Verify that safety and personal protective equipment is available, performs correctly, and has current certification.
- MNPC04.01.04 Monitor equipment and operator performance according to both company and national workplace safety regulations.
Sample Indicators Verify that monitoring is being performed regularly.
 Report out-of-compliance or unsafe conditions immediately.
 Take corrective action when out-of-compliance or unsafe conditions exist.
 Check equipment to ensure it is operating according to specifications and that tools are checked for compliance with specifications.
 Forward accident and injury data to appropriate personnel for inclusion in OSHA recordables.
 Gather information on equipment use from operators to reveal existing or potential problems.
 Adjust equipment and processes as required.



Manufacturing Career Cluster
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Accurately document all monitored data.

Pathway Topic MNPC05	EQUIPMENT PROBLEMS
MNPC05.01	Identify and diagnose equipment problems in order to effectively repair manufacturing equipment.
MNPC05.01.01	Gather equipment information and history that can assist in identifying and diagnosing problems.
<i>Sample Indicators</i>	Consult operator and operator logs to determine the symptoms of the problem. Check reports on equipment, repair and diagnostics for previous problems. Check equipment to identify problems. Gather the most appropriate information need to rapidly diagnose the problem. Consult appropriate and accurate sources of information including prints, OEM manuals, process diagrams, and engineering department calibrations.
MNPC05.01.02	Isolate system and component failure following diagnostic procedures.
<i>Sample Indicators</i>	Draw on available information, past experience, operator feedback, and knowledge of equipment to identify possible causes of failure. Use visual inspection, observation of equipment during operations, and disassembly of equipment to systematically gather information about the nature and possible causes of failure. Perform and repeat diagnostic tests as necessary to determine the symptoms of the problem. Make diagnosis in a timely and effective manner. Use manufacturer's performance specifications when evaluating equipment performance.
MNPC05.01.03	Identify root cause of problem using diagnostic procedures.
<i>Sample Indicators</i>	Initiate procedure for isolating problems correctly and complete follow through properly. Use appropriate root cause identification process to determine contributing factors. Perform the correct tests and inspections on failed component(s). Analyzed data gathered through diagnostic procedures to develop a hypothesis regarding possible root causes. Repeat analysis until problem is solved.
MNPC05.01.04	Develop corrective action plan to fix the problem.
<i>Sample Indicators</i>	Correctly specify all repairs and modifications required to address underlying causes. Use the action plan to address the need for timely repair. Include proper repair procedures, proper tools and parts, and estimated time required for repair in the plan. Inform and involve the right people needed for the repair. Make sure that plan reflects production needs.
MNPC05.01.05	Execute corrective action plan.
<i>Sample Indicators</i>	Make sure that plan accounts for variables in schedule, staffing, and availability of parts. Use applicable safety procedures. Wear proper personal protective equipment. Follow existing repair procedures in accordance with OEM manuals or company procedures. Use correct disassembly, repair/replacement, and reassembly procedures.



Manufacturing Career Cluster
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Safety check equipment and perform a test run prior to return to production.

Make sure that post-repair tests confirm that equipment performs to requirements.

Complete repairs within specified time frames.

Devote appropriate staffing and parts to effectively execute the plan.

MNPC05.01.06 Document diagnosis, case history plan, and repair outcome according to company protocols.

Sample Indicators

Perform documentation and verification according to company and department policies and procedures.

Input documents and appropriate files into database before filing them or distributing to correct parties.

Conduct post repair review to determine if customer is satisfied.

Adjust preventive maintenance schedule to reflect repairs made.

Notify equipment manufacturer of any reliability and maintainability issues.

Pathway Topic MNPC06	EQUIPMENT
MNPC06.01	Employ installation, customization, or upgrading techniques in order to ensure the proper functioning of manufacturing equipment.
MNPC06.01.01	Coordinate preparation for the installation, customization, or upgrading of equipment.
<i>Sample Indicators</i>	<p>Provide appropriate input on equipment, environmental impact, and material needs. Include the time, equipment, and personnel required to do the job in the plan. Determine proper customization, upgrade needs, and capacity limits. Obtain all appropriate approvals. Make sure that plan provides for the availability and use of proper materials and relevant vendor information. Make sure that plan anticipates the need for future modifications and likelihood of mechanical or operator errors. Make sure that plan addresses issues related to ergonomics, safety requirements, and environmental impact.</p>
MNPC06.01.02	Obtain machine information from vendors related to proper installation, customization, or upgrade.
<i>Sample Indicators</i>	<p>Determine availability of in-house personnel and outside contractors. Contact appropriate vendor personnel to determine facility, parts, equipment, and materials needs prior to installation. Verify materials and parts against vendor specifications prior to initiating installation, customization, or upgrading equipment.</p> <p>Obtain needed information from vendors including safety and quality considerations.</p> <p>Ensure that accurate blueprints, specifications, and documentation are available. Review maintenance manuals, check them for completeness, and modify them as necessary.</p>
MNPC06.01.03	Install, customize, or upgrade equipment.
<i>Sample Indicators</i>	<p>Follow all safety procedures. Organize tools, equipment, and personnel efficiently to do the job. Follow blueprint and plan of action to customize or upgrade equipment.</p>



Manufacturing Career Cluster
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	Perform follow-up to ensure completeness of installation. Complete equipment installation, customization, or upgrade to specification and schedule.
MNPC06.01.04 <i>Sample Indicators</i>	Equip team with information and resources needed to complete task. Schedule the proper workers to ensure effectiveness, efficiency, and safety. Ensure that personnel are trained on the proper procedures and equipment maintenance. Involve vendors appropriately.
MNPC06.01.05 <i>Sample Indicators</i>	Move or remove equipment following manufacturing protocols. Schedule the proper workers to ensure effectiveness, efficiency, and safety. Ensure that personnel are trained on the proper procedures and equipment maintenance. Involve vendors appropriately. Move or remove equipment completely, safely, and according to company and vendor procedures. Verify that equipment works properly following its move.
MNPC06.01.06 <i>Sample Indicators</i>	Test the equipment to ensure proper function after installation, customization or upgrading. Select proper testing procedures and methods. Administer test procedures and methods properly. Perform test safely. Interpret test results. Notify all appropriate parties that equipment is functioning properly. Make sure that equipment tests indicate that equipment performs to specification and meets safety standards. Document test results.

Pathway Topic MNPC07	PREVENTIVE MAINTENANCE
MNPC07.01	Create and follow a preventative maintenance schedule to maintain manufacturing equipment, tools and workstations.
MNPC07.01.01 <i>Sample Indicators</i>	Conduct a pre-job consultation with the person/people who requested the maintenance or repair. Verify that preventive maintenance is performed to schedule and documented completely in a timely manner. Use the right procedures and forms to communicate repair needs to the correct parties. Follow-up to verify that necessary repair work was completed. Predict the results of failing to implement all elements of the preventive maintenance schedule. Follow all safety regulations when doing repairs.
MNPC07.01.02 <i>Sample Indicators</i>	Verify supplies are available to perform preventative maintenance and routine repair. Have necessary supplies available to perform preventive maintenance.
MNPC07.01.03 <i>Sample Indicators</i>	Monitor equipment indicators to ensure it is operating correctly. Compare equipment performance to optimal equipment operations on a regular schedule. Investigate and correct abnormal equipment conditions in a timely manner. Monitor equipment to ensure that the corrective action solved the problem. Keep equipment repair history complete, up-to-date, and accurate.



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Maintenance, Installation and Repair Pathway
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MNPC07.01.04	Document training of maintenance activities according to company maintenance regulations.
<i>Sample Indicators</i>	Conduct training in an effective and appropriate manner. Document and make available preventive maintenance training materials. Keep training records updated and readily available. Examine the relevancy of training for use of equipment, tools, materials, and processes at the workstation. Provide cross-training when appropriate. Verify that training and training documentation meet all company and regulatory requirements.
MNPC07.01.05	Maintain production schedules by completing daily housekeeping activities.
<i>Sample Indicators</i>	Store tools and materials safely in proper locations. Identify and report unsafe conditions promptly. Keep workstations clean and clear of safety hazards. Verify that scheduled housekeeping inspections are passed. Organize workstations to maximize efficiency. Verify that safety equipment is present and in proper working order.

Pathway Topic MNPC08	PRODUCTION PROCESS
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MNPC08.01	Coordinate predictive and preventive maintenance to ensure that production process runs smoothly.
MNPC08.01.01	Develop the maintenance schedule.
<i>Sample Indicators</i>	Schedule routine jobs that need to be completed in a timely way. Make sure that schedule is sufficiently flexible to include plans for fall-back if tasks take longer and to add fill-in work if tasks are shorter than expected. Use company procedures for production needs, output, and critical equipment to schedule priorities. Verify that preventive maintenance requirements for all equipment are included in the schedule. Distribute scheduled task lists appropriately. Make sure that the schedule provides adequate time for preventive maintenance. Make parts required for maintenance available when needed.
MNPC08.01.02	Identify special maintenance and repair needs.
<i>Sample Indicators</i>	Ask operators appropriate questions to determine needs. Review tool and equipment histories to find evidence of intermittent or chronic problems. Refer to job safety analysis sheets as appropriate. Observe operators to verify that they are setting up and operating according to the job safety analysis. Review repair histories to see if correct repairs were done in the past. Review repair histories to determine current repair needs. Identify worn or malfunctioning equipment accurately and in a timely way to prevent breakdowns.
MNPC08.01.03	Verify availability of workers and other resources based on schedules and inventory records.
<i>Sample Indicators</i>	Locate special tools and parts.



Manufacturing Career Cluster Maintenance, Installation and Repair Pathway Knowledge and Skill Statements

Access existing preventive maintenance protocols from the preventive maintenance sheets.

Make decisions on staffing requirements based on the tasks that need to be performed.
Make sure that retooled parts meet specifications.

Make sure that follow-up occurs to ensure that adequate supplies are maintained.

MNPC08.01.04
Sample Indicators

Perform predictive and preventive maintenance procedures.

Follow procedures when handling and disposing hazardous materials.

Follow safety procedures and wear/use proper personal protective equipment.

Follow preventive maintenance sheets completely.

Assign maintenance to trained workers to ensure that the job is performed safely and efficiently.

Gather required parts, tools, and equipment prior to starting the maintenance.

Use required parts, tools, and equipment to perform work safely and efficiently.

Use company or department procedure to document and verify maintenance job.

Use policy and procedures to maintain documentation.

Direct documentation to the correct parties for processing.

Perform maintenance on time.

Perform housekeeping when job is finished.

Use repair histories to revise preventive maintenance plan.

MNPC08.01.05
Sample Indicators

Check that equipment is working to specifications prior to releasing the equipment to the operator.

Complete safety checklist thoroughly.

Document results of safety checklist.

Test-run equipment to ensure that it is operating properly and safely.

Take corrective measures if equipment is not operational.

Communicate readiness of equipment to come back onto production to correct parties before departing the site.

Use the preventive maintenance sheet to inspect and verify the appropriate items.