
FOR FOOD MANUFACTURING
SKILL
STANDARDS
MAINTENANCE MECHANICS

A cooperative effort for California's Central Valley by:

Merced College

College of the Sequoias

Washington State University Energy Program

California Community Colleges Central Region Consortium

Central California Community Colleges Committed to Change

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Project Development and Coordination

- Alan Hardcastle, Sally Zeiger Hanson, Melinda Spencer and Gerry Rasmussen, WSU Energy Program
- Terryll Bailey, The Allison Group
- Becky Barabé, Seferina Ramirez and Katherine Zamarripa, Merced College
- Louann Waldner, Ray Rawn and Lacey Henderson, College of the Sequoias

Advisory Committee

The Advisory Committee met on February 1, 2013, and consisted of 15 managers who designed, oversaw, and reviewed the project from startup through completion of the final document. Many thanks to the following committee members for contributing their expertise and resources, and for providing leadership in support of this project:

- Bud Hendrickson, Dole Packaged Food LLC
- Gurminder Sangha, International Paper
- Jay Latronica, Morning Star Packing Company (Liberty packing location)
- Jeff Adams, Morning Star Packing Company (Liberty packing location)
- Joe Gray, Nichols Farms
- Joe Kupcha, Saputo Cheese USA, Inc.
- John Coate, Hilmar Cheese Company
- Michelle Mendonca, California Dairies, Inc.
- Mike Alles, California Dairies, Inc.
- Raul Franco, Marquez Brothers International, Inc.
- Rebecca Bettencourt, E. & J. Gallo Winery
- Stephanie Thiessen, Saputo Cheese USA, Inc.
- Tim Sluder, Marquez Brothers International, Inc.
- Tre Robinson, Ruiz Foods, Inc.

Focus Group Participants

The focus group participants consisted of nine maintenance mechanic workers, plant supervisors, and subject matter experts from food processing manufacturers within California's Central Valley. They met over a two-day period at Clovis Center, and determined the critical work functions and key activities performed by manufacturing maintenance mechanics. They then identified the performance indicators, technical knowledge, skills and abilities, and employability skills required to succeed in this field. Their insights were an invaluable contribution and formed the foundation of this work. Participants included:

- Adam Mendoza, Ruiz Foods, Inc.
- Jack Burks, E. & J. Gallo Winery
- Jim Hurd, Saputo Cheese USA, Inc.
- Michael Leyva, Hilmar Cheese Company
- Peter Xiong, The Wine Group, LLC
- Preston Cary, Sconza Candy Company
- Richard Ulmer, Dole Packaged Food LLC
- Vince Nunes, Morning Star Packing Company (Liberty Packing Location)
- Zak Kulwitsky, Nichols Farms

College Participants

The California community colleges in California's Central Valley that contributed to the Skill Standards process are:

- Bakersfield College
- College of the Sequoias (Visalia)
- Columbia College (Sonora)
- Fresno City College
- Gavilan College (Gilroy)
- Merced College
- Modesto Junior College
- Porterville College
- Reedley College
- San Joaquin Delta College (Stockton)
- Taft College
- West Hills College, Coalinga
- West Hills College, Lemoore

Business & Industry Participants

The business and industry partners in California's Central Valley region that contributed to the Skill Standard process are:

- Blue Diamond Growers
- California Dairies, Inc.
- Dole Packaged Food LLC
- E. & J. Gallo Winery
- Foster Farms (Porterville location)
- Harris Woolf Almonds
- Hilmar Cheese Company
- International Paper
- Land O'Lakes, Inc.
- Leprino Foods (Lemoore East location)
- Morning Star Packing Company (Liberty Packing location)
- Lyons Magnus
- Marquez Brothers International, Inc.
- Nestlé (Dreyer's Ice Cream, Tulare location)
- Nichols Farms
- Paramount Citrus
- Ruiz Foods, Inc.
- Saputo Cheese USA, Inc.
- Sconza Candy Company
- Sun-Maid Growers of California
- Tulare Workforce Investment Board
- The Wine Group, LLC

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Special thanks to College of the Sequoias, Merced College, and the Central California Community Colleges Committed to Change Consortium (C6) for providing the photos of business and industry participants in action used throughout this document.

COLLEGE of the SEQUOIAS
the first step to success

MC

Central California
Community Colleges
Committed to Change

Acronyms Used in this Publication

AC..... Alternating Current
CAD..... Computer-Aided Design
CNC..... Computer Numerical Control
CTE..... Career and Technical Education
DC ..... Direct Current
HAZMAT ..... Hazardous Materials
MIG ..... Gas Metal Arc Welding
MSDS..... Material Safety Data Sheet
NSSB ..... National Skill Standards Board
OSHA ..... U.S. Occupational Safety and Health Administration
PM ..... Preventive Maintenance
PMG ..... Permanent Magnet Generator
PPE ..... Personal Protective Equipment
SCANS ..... Secretary's Commission on Achieving Necessary Skills (U.S. Secretary of Labor)
SPCC ..... Spill Prevention Control and Countermeasures
TIG ..... Gas Tungsten Arc Welding
UPS..... Uninterruptible Power Supply
USDA..... U.S. Department of Agriculture
WSU ..... Washington State University

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FOR FOOD MANUFACTURING
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MAINTENANCE MECHANICS

Industry Perspectives

One of the biggest challenges in manufacturing is getting qualified maintenance candidates. There are many candidates who apply, but most have little experience and some are laid off operations employees who have taken maintenance classes at the local community/junior college. As employers, we struggle with how to assess prospective employees and, due to the high demands of our current workforce, have difficulty properly developing our current and future maintenance workforce. Another trend is of aging workers who are not able to retire and have limited computer knowledge, making it difficult for them to work with current computerized maintenance systems.

As manufacturers, our core competency is to process and package food. Developing and assessing employees' progress and abilities is a challenge to us but important in developing the workforce we need to meet the current and future challenges of our business.

The value I see with the development of the Food Manufacturers Maintenance Skill Standards is that we have identified the skills that are important to all manufacturers and it has allowed the colleges and manufacturing companies to get on the same page as to what the needs are. Now that they are identified, the challenge is to continue the partnership to ensure candidates get the proper classroom knowledge and match it with appropriate work experience. The next step will also include methods needed to assess and put together developmental plans for current employees and future candidates.

Enjoy,

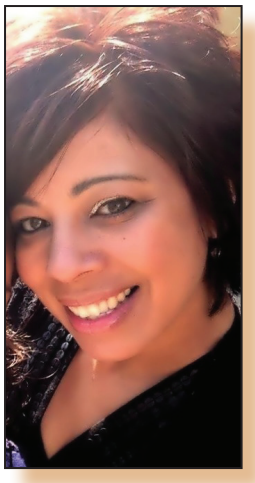
Bud Hendrickson
Sr. Maintenance Manager
Dole Packaged Food LLC
Atwater, CA

It is critical that industry and education work together to define the skills, knowledge and abilities required for individuals to succeed in the manufacturing workplace. Although each employer is unique, there is a commonality about what students, job seekers and current employees must know and be able to do to be a successful industrial maintenance worker within the food manufacturing industry in the Central Valley. Ruiz Foods, along with many other regional food manufacturers, participated in the Skill Standards effort outlined in this report because we are dedicated to growing the workforce of the Central Valley. Our participation allowed us to document the skill needs required of our industry. This document will serve as a common communication tool to colleges, high schools and training organizations to make sure that their programs are up-to-date and will attract students to opportunities in our industry.

Finding qualified maintenance workers is an on-going challenge for all manufacturers. This effort was has allowed us to document the industry-based skills needed for entry-level positions. However, by coming together and discussing the challenges, it also has created conversations to help us all realize the complexities of our workforce issues and that the best way of solving them is to work and communicate together.

Sincerely,

Tre Robinson
Maintenance Manager
Ruiz Foods
Dinuba, CA



I've been involved in the Manufacturing Cluster for the Central Valley since 2004. This Skill Standards effort is the most practical and headstrong movement that I have either worked with or come across. My management team, including maintenance managers at The Wine Group, are excited about this effort and I am excited that we were involved. It is critical that we, as employers, work cooperatively to guide the effort to improve the workforce that we are recruiting. We need to utilize educational programs that are practical for our industries. Partnering with education for future candidates who are interested in the mechanical field will improve our retention and, thus, our productivity.

With the aging of the workforce and the continued demand for skilled workers in maintenance within the food manufacturing industry, it is critical that manufacturers, colleges, workforce boards, and economic development agencies are on the same page about the skills needed by our regional workforce. This Skill Standards effort is set forth to systematically document the skills needed by maintenance mechanics within food manufacturing in California's Central Valley. By documenting these skills, we are helping our training partners (colleges) clearly understand our needs which will, in turn, give them the best data to train the workforce we are seeking. This cooperative effort between education and industry is a vision I have been striving for and hoping to achieve during my involvement in regional manufacturing groups over the last 10 years. I am pleased with the end-product of our efforts and hope you will find it valuable. I also hope it will inspire you to work cooperatively in local/regional efforts to strengthen partnerships among education, training and industry.

Sincerely,

Stephanie Moreno
HR Manager South Valley Operations
The Wine Group
Madera, CA

Background on the Skill Standards Project

This project was a collaboration of Merced College, College of the Sequoias, the Central Region Consortium, and the Central California Community Colleges Committed to Change (C6) Consortium. The project goal was to ensure that a standards-based approach will be used as a foundation for defining competencies and measurable skills of maintenance mechanics in food manufacturing companies, an occupation that is expected to change significantly in the coming years. The standards also help to ensure that proposed training and degree programs for maintenance mechanics incorporate current foundational skills.

National Context

The National Skill Standards Board (NSSB) was established by Congress in 1994 to encourage the creation and adoption of a national system of voluntary skill standards that would enhance the ability of the U.S. to compete effectively in a global economy. By the time the NSSB sunset in 2003, several national voluntary skill standards projects were developed by various industries in full partnership with education, organized labor and community-based organizations. The intent was to have voluntary skill standards that are flexible, portable, and continuously updated and improved.

Washington State was an early leader in the development and use of industry-defined skill standards, contributing to the development of a national model and creating skill standards to align the needs of industry with the provision of workforce education and training.

What are Skill Standards?

Skill standards are performance specifications that identify the knowledge, skills and abilities an individual needs to succeed in the workplace. They are critical to improving workforce skills, raising living standards and improving the competitiveness of the U.S. economy. To be effective, skill standards must reflect the consensus of maintenance mechanic professionals.

Skill standards provide measurable benchmarks of skill and performance achievement. They answer two critical questions:

- What do workers need to know and be able to do to succeed in today's workplace?
- How do we know when workers are performing well?

Without this fundamental information:

- Employers do not know whom to hire or where to focus their training dollars,
- Employees and new entrants to the workforce do not know what they need to do to improve their performance, and
- Educators do not know how to prepare students for the challenge of the workplace.

Why are Skill Standards Important?

In today's workplaces, the only constant is change. Jobs that once were relatively simple now require high-performance work processes and enhanced skills. Because skill standards reflect changing workplace realities, they are a tool that can be used by applicants and employees to access greater career opportunities.

National recognition of skill standards in career fields provides a common basis for certifying achievement against those standards, thereby allowing for the portability of skills across geographic areas, companies and careers.

Updating skills and knowledge is now a lifelong endeavor, causing many employers and employees to spend more effort, time and money on education and training. Skill standards provide benchmarks for making education and training decisions, shaping curricula, and directing funds toward highest-value education and training investments.

The Benefits and Uses of Skill Standards

Skill standards benefit all of the stakeholders – business, labor, educators, government, students and employees. The success of a skill standards development project and its usefulness to the community depends on the full participation and commitment of all stakeholders. These benefits can be used as a benchmark for evaluating the effectiveness of collaborative efforts.

How Skill Standards Benefit Employers

Employers can use skill standards to establish personnel qualification requirements. In interviews and performance reviews, potential and actual productivity can be assessed with a higher degree of accuracy and efficacy. Employers are also able to identify core competencies and workers' abilities to demonstrate competencies. By matching competencies to critical work functions and key activities, employers can significantly improve efficiencies and productivity. Performance-based skill standards also provide a vehicle for varying degrees of job certainty and the structure for establishing competency-based pay scales.

Employers use skill standards to:

- Align personnel qualification requirements with nationally adopted certificates of competence.
- Modify employee training.
- Simplify measurement of employee training effectiveness.
- Assess employee skill levels based on industry standards.
- Match employee skills to the work needed.
- More easily document employee skills, training needs and performance criteria.
- Improve consumer satisfaction and confidence through better-developed evaluation skills for customer contact personnel.
- Improve employee satisfaction and morale by clarifying expectations.
- Improve quality, productivity, time-to-market and competitiveness.
- Achieve business goals.
- Partner with education and labor in developing school-to-work initiatives.

How Skill Standards Benefit Labor Unions

Labor unions can use skill standards to gain support for company-sponsored worker training programs and to identify career paths for workers within companies and industries. Unions can provide this information to union members and develop strategies to improve career mobility and stability.

Skill standards help unions to:

- Improve member value to the company.
- Provide a greater worker voice in the company.
- Link skill standards to increased training and upward career mobility for union members.
- Help employers match employee skills to the work needed.
- Develop skills-based training and certification initiatives that complement union apprenticeship programs.
- Communicate effectively with employers about worker training and retraining needs.
- Cooperate with education and industry in developing school-to-work initiatives.

How Skill Standards Benefit Educators

Educators can identify core competencies and assessments based on the skill standards and implement them in their curricula. Students can then be required to demonstrate competency throughout their coursework. Academia and industry can build a cohesive relationship through a like-minded expectation of student competencies and work readiness. This enhances an instructor's ability to teach information consistent with industry's entry-level expectations and needs.

Educators use skill standards to:

- Partner with business and labor in developing school-to-work initiatives.
- Provide effective, targeted instruction.
- Develop benchmarks for certificates of competence earned by students.
- Communicate what companies expect of employees.
- Develop new and evaluate existing curricula and programs based on industry needs.
- Develop assessments to evaluate skills, knowledge, and abilities in classrooms and internships.
- Develop a common language about workforce preparation with business and labor.
- Improve relationships with local businesses, labor unions, other educators and agencies.
- Provide students with relevant career education and counseling.

How Skill Standards Benefit Government

Government can provide information that will ensure a better skill match between workers and employers and initiate education reform to better educate future members of the workforce. Skill standards enable agencies to provide options for career and job mobility and link learning to the needs of the workplace.

Government can use skill standards to:

- Assist in the development of a highly skilled and competitive workforce.
- Evaluate the effectiveness of publicly funded education and training.
- Increase opportunities for under-represented populations by releasing the information that defines the skills required for success and by facilitating the national adoption of those definitions and their use.
- Support the creation of high-performance organizations that improve living standards for all members of the organization.
- Facilitate collaboration between educators and industry.
- Communicate the need and basis for education reform to business, education, labor, and the public at local and national levels.

How Skill Standards Benefit Students and Workers

Skill standards assist students in making career choices by providing industry expectations for success in the workplace. In addition, standards-based curriculum and assessments provide students with credentials that certify work-readiness. Work-ready students can anticipate being hired at higher rates of pay and can experience faster advancement in their chosen fields.

Workers can accurately assess their skills against those required for career advancement and plan effectively for their career pathways. They can

determine the skills and abilities needed for advancement or transfer within industries, and determine the continuous learning and training they need to upgrade their skills.

Students and workers can use skill standards to:

- Achieve clarity regarding what they are expected to learn and how to prepare for work.
- Enter and re-enter the workforce with better understanding of the skills required to attain high-paying jobs.
- Accurately assess business expectations of the skills needed for positions and careers of their choice.
- Improve mobility and portability of their credentials.
- Obtain certification of competence of the skills they gain through experience, school, training or self-study.
- Enhance their performance and achievement by self-evaluation against known standards.
- Be active contributors to the activities that make their organizations successful.

Skill Standards to Training: A Continuous Development Process

The skill standards generated in this project are designed to be used by:

- Participating food manufacturing partners to develop or modify training modules, or
- Educators to develop curriculum at the high school and community college levels.

By providing the necessary input from industry, this skill standards document is a first step in developing training materials to serve the food manufacturing industry in particular and demonstrating what can be done across industries.

In order to keep current with a rapidly changing workplace, standards need to be re-evaluated and updated regularly, with full participation of the partners at each step. New technological developments impact the ways that workers organize and apply their skills, including time management and interpersonal relationships. Increased technological complexity may simplify some of the job tasks but make others more intricate. Today's successful maintenance mechanics are challenged to acquire a broader range of decision-making and teamwork skills, as well as keep current with emerging technologies. Ongoing changes like these must be reflected in curriculum to meet the needs of industry, where expectations for workers are evolving.

A Model of Continuous Improvement for Economic Development

With cooperative effort on local and national levels, we can begin to resolve the current workforce skill shortages in the food manufacturing industry.

Using Skill Standards

A continuous updating process is necessary: all partners must revise and verify skill standards regularly. For national economic development to succeed, curriculum and current training methods must be updated to meet workplace standards. Individual workers must have access to clearly stated competency goals and direct access to skill development assistance.

Step 1: Skill Standards Identification

- Compile and research existing standards in related jobs and careers.
- Conduct focus groups to identify critical work functions and key activities; define key activity performance indicators; and identify technical knowledge, foundation skills and personal qualities.
- Conduct a survey of current workers to determine level of employ-ability SCANS (Secretary's Commission on Achieving Necessary Skills) required for the job.
- Develop work-related scenarios to place the skill standards in the context of the work environment.
- Verify the data gathered from focus groups.
- Disseminate skill standards information to involved parties from industry, education and labor for their review and revision.

Step 2: Assessment

- Develop assessments through the collaboration of industry and education to reflect competent performance as defined by the skill standards.
- Collect evidence of a person's ability to perform at the levels determined by the skill standards.
- Determine present skill level through direct and indirect evidence by assessing a student, trainee, apprentice, prospective worker or worker seeking additional training.
- Use products and items produced by the person being assessed as direct evidence.
- Gather supporting information to use as indirect evidence.
- Assess results using the criteria of validity, currency, authenticity and sufficiency.
- Demonstrate validity using tangible items or records of action.
- Demonstrate authenticity by having the individual being assessed produce the item or specific piece of a team effort.
- Demonstrate sufficiency by providing enough evidence to match key tasks and performance criteria of the skill standards.

Step 3: Training and Curriculum Development

- Identify necessary competencies based on the skill standards information and assessments.
- Develop program outcomes for specific academic and training programs, including Career and Technical Education (CTE), two-year, pre-apprenticeship and apprenticeship programs.
- Perform gap analysis to determine changes or additions to be made to curriculum.
- Revise existing curriculum to better meet the current and future needs of the industry.
- Develop new curriculum and establish new training programs based on these competencies.

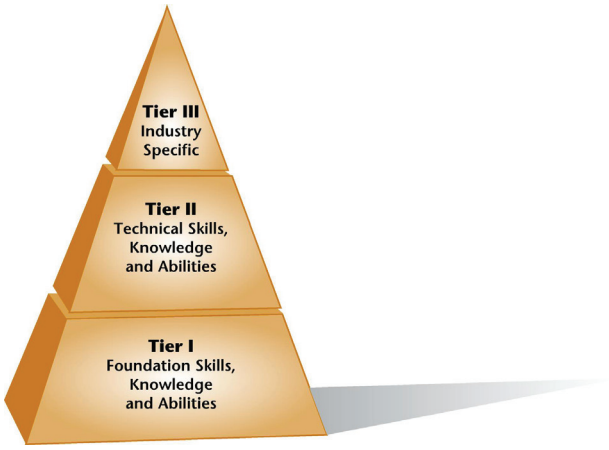
Step 4: Articulation

- Develop models to support the articulation of program outcomes and competencies among academic and training systems.
- Establish articulation agreements among existing programs to ensure portability of skills.
- Connect competencies and Certificates of Competence with benchmark documentation to build national portability systems.

Pyramid of Competencies

The Pyramid of Competencies is a depiction of skill standards in three broad skill categories.

- **Tier I** represents the broadest level of competencies, and is the set of employability (SCANS) skills, knowledge, abilities and personal qualities required of all workers to be successful in today's workplace. These are the universal skills that are needed to apply technical knowledge and tools effectively.
- **Tier II** represents technical skills, knowledge and abilities common to jobs within a cluster across all industries or industry sectors.
- **Tier III** represents industry-specific technical skills, knowledge and abilities that are unique to individual jobs or clusters and are the most prone to rapid change. For example, many workers need to upgrade their skills based on sudden market shifts.



Skill Standards Development Process

Advisory Committee and Initial Focus Group

An Advisory Committee consisting of food manufacturing managers and leaders from firms throughout California's Central Valley was convened by Alan Hardcastle of the WSU Energy Program to provide oversight for this project. The Advisory Committee nominated participants for the focus group process.

The initial two-day focus group, led by Terryll Bailey of The Allison Group, included nine experienced food manufacturing maintenance mechanics representing different companies across California's Central Valley. There was broad diversity in terms of participants' ages and years of experience in the industry.

The first step in the focus group process was to identify the primary functions and key activities that constitute the work of a competent, entry-level maintenance mechanic. Working with a draft of sample critical work functions, prepared from background research and input from the Advisory Committee, the group revised and adapted functions and tasks to meet the needs of maintenance mechanics throughout California's Central Valley. Participants freely made changes and recommendations, and crafted seven critical work functions with correlating key activities.

Performance Criteria

The second step was to identify the performance indicators for each key activity, answering the question: "How do you know when this is performed well?" The group also identified the tools, knowledge and foundation skills required to meet the performance criteria. The draft skill standards generated through the focus group process were reviewed by members of the Advisory Committee with respect to current industry trends and requirements.

Survey Verification

Third, a survey of SCANS* skills and personal qualities for maintenance mechanics was administered to focus group members, and later to a larger sample of maintenance mechanics from food manufacturers across the region. A total of 107 SCANS competency surveys were returned; survey results are provided on pages 26 to 28.

Finally, a verification survey of critical work functions and key activities derived from the standards was sent to maintenance mechanics at food manufacturing companies across the region. All critical work functions and key activities were verified, and each key activity was rated for its level of importance. Response data were compiled and averaged to find the level of importance of each critical function. Surveys were returned by 114 respondents from 20 employers. The results of all the focus groups, surveys

** SCANS are foundation employability skills required of workers in all occupations at varying levels specific to their jobs. See: http://wdr.doleta.gov/SCANS/whatwork/*

and feedback were compiled and analyzed, and a draft of the document was reviewed by the Advisory Committee (see list of members on page III).

Employability Skills: SCANS Profile

During the data-gathering process of this project, employability skills for maintenance mechanics were identified. Employability, or workplace skills, are basic academic and foundation skills needed to build more advanced competencies. The foundation skills are based on broad workplace categories, known as SCANS (from the U.S. Department of Labor, Secretary's Commission on Achieving Necessary Skills). This federal report, issued in 1991, identifies 37 foundation and workplace competencies required for work readiness.

SCANS are comprised of a three-part foundation – basic skills, thinking skills and personal qualities – and five workplace competencies needed for successful job performance in today's workforce, as listed in Table 1. Professionals currently working in the field were asked to identify the level of difficulty for each of the 37 SCANS skills most often required for successful work performance by maintenance mechanics. Sample survey questions are provided in Figure 1 (page 16). The *Importance of Critical Work Functions* information in Figure 2 (page 57) was compiled by taking a weighted average of their responses. This summary information provides a general view of the key ***workplace*** skills deemed relevant and necessary for the front-line worker in machine maintenance and defines the foundation for the employability skills within the skill standards.

Table 1.
SCANS Skills

Basic Skills	Thinking Skills	Personal Qualities	Worksite Competencies
Reading	Creative Thinking	Responsibility	Utilizing Resources
Writing	Decision Making	Self-Worth	Interpersonal Skills
Arithmetic	Problem Solving	Sociability	Utilizing Information
Listening	Visualization	Self-Management	Using Systems
Speaking	Knows/Learns	Integrity/Honesty	Using Technology
	Reasoning		

Figure 1.

Sample Survey Questions from the Workplace Standards Skill Inventory

Exhibiting Leadership

1 ☐	Understands standards Adheres to standards
2 ☐	Encourages others to adopt new concepts Demonstrates commitment to excellence Leads by example Interprets positions on issues
3 ☐	Motivates others to extend their capabilities Displays enthusiasm/positive attitudes Develops minority/majority views
4 ☐	Persuades others to reverse negative attitudes/behaviors Maximizes strengths/minimizes limitations Consolidates varied viewpoints/positions
5 ☐	Empowers individuals/teams to achieve excellence Judges leadership styles Justifies positions/policies

Negotiating

1 ☐	Understands negotiations process Recalls basic rules/principles Identifies conflicts
2 ☐	Moderates discussion Demonstrates composure Interprets complaints/concerns
3 ☐	Analyzes group dynamics Distinguishes between facts and inferences Detects underlying issues
4 ☐	Summarizes/paraphrases both sides of issues Analyzes underlying issues Resolves technical issues
5 ☐	Appraises negotiated outcomes Resolves critical and emotionally charged issues

Skill Standards Results

Job Summary

Maintenance and repair of all plant equipment including, but not limited to, electrical, pneumatic and hydraulic systems.

Competencies

- Able to use basic hand and power tools.
- Able to read blue prints and do layout work/sketches.
- Basic knowledge of gas, gas tungsten (TIG), gas metal (MIG) and arc welding. Also able to use plasma cutter.
- Timely analysis and repair of all breakdowns in plants using basic troubleshooting skills.
- Able to troubleshoot and wire a 3-phase motor.
- Able to troubleshoot and repair 110-volt and 24-volt control wiring.
- Able to rebuild centrifugal and positive displacement pumps.
- Ensure all safety procedures are followed according to company safety policies.
- Computer literate and proficiency with email, word processor, and computerized maintenance management system application (CMMS-MP2).
- Demonstrate a high level of communication, cooperation and teamwork with production operators to maintain and repair plant equipment. Must treat production operators as a customer.
- Properly prioritize issues and take personal accountability to make sure all repairs fit the core value of "excellence."
- English skills must be proficient to understand, read, write and speak English.
- Promote company culture.
- Each employee must know their role in the manufacture and distribution of safe, wholesome and high-quality products because food safety is a company-wide responsibility.

Minimum Qualifications

High school diploma or equivalent.

Physical Demands

The physical demands described here are representative of those that must be met by an employee to successfully perform the essential functions of this job. Reasonable accommodations may be made to enable individuals with disability to perform the essential functions.

- Effectively handle lifting of various objects weighing up to 50 pounds.

Work Environment

The work environment characteristics described here are representative of those an employee encounters while performing the essential functions of the job. Reasonable accommodations may be made to enable individuals

with disabilities to perform the essential functions.

- The noise level in the work environment is very loud. Ear plugs are provided for safety.
- Regular exposure to elements such as odor, noise, dust, heat, cold or chemicals.

Definitions

The skill standards template beginning on page 29 contains the following components.

Critical Work Functions represent the general tasks that would be performed by a fully competent food manufacturing maintenance mechanic with at least one year of experience.

Employability Skills are basic academic and personal skills that are needed to build more advanced competencies. They are required by all workers to obtain meaningful work and to participate in the modern workplace.

Key Activities are the tasks related to the critical work functions, composed of work activities that are measurable and observable and that result in a decision, product or service.

Level of Importance – Professionals who are actively working in this occupation rated the level of importance for each critical work function and key activity, ranging from not important to critical. All critical work functions were rated as important, very important or critical.

Performance Indicators are specific behavioral evidence of a worker's achievement of skills, knowledge and tasks. Performance indicators provide the standard of performance required to produce the necessary outcomes of key activities, and help answer the question: "How do we know when this key activity is performed well?"

Technical Skills, Knowledge, Abilities and Tools are those areas of expertise that workers must have in order to perform a given occupational task with excellence. A collection of skills, knowledge, abilities and tools comprise competencies.

- Skills refer to proficiency in an applied activity. This activity could be physical, mental or interpersonal in nature.
- Knowledge refers to information and skills acquired through experience or education; the theoretical or practical understanding of a subject.
- Abilities are broad human characteristics that result from natural talent, training or experience.
- Tools are materials, equipment and implements a worker must be able to use competently to meet the requirements of the job.

Theories, Concepts and Equipment

Focus group participants emphasized that the theoretical and conceptual knowledge taught in community college maintenance mechanics training programs provides a critical foundation for mechanics entering the workplace. With this theoretical foundation in place, mechanics are well-equipped to learn and practice the application of these concepts through on-the-job training. While both theory and application are important, for most companies it is difficult to also teach theoretical content within a production environment.

Foundational science engineering concepts and theories essential to performing functions required of food manufacturing maintenance mechanics are listed below, and are important supplements to the technical knowledge and skills listed with each key activity.

Science and Engineering Theories and Concepts

- Basic physics
- Gases and liquids
- Mechanical energy
- Introductory mechanical engineering concepts
- Levers, pulleys, machines
- Hydraulics, pneumatics
- Basic system design and components: hydraulics, pneumatics, terminology, symbols, functions
- Alternating current (AC) circuit electronics, direct current (DC) power, circuit analysis
- Environmental stewardship
- Machines, friction and bearings
- Lubrication and cooling
- Mechanical and electrical safety standards and requirements
- Computer process applications and networking
- Instrumentation and controls logic theory

Math for Maintenance Mechanics

- Measurement, diagrams, layout, computation, formulae, functions
- Basic logic
- Algebra
- Solid geometry
- Computational technology (software applications)
- Principles of alignment
- Torque
- Properties and behavior of motion
- Trigonometry (sin/cosine)

Components and Equipment

- Breakers (station service, air blast, vacuum, oil and field)
- Electrical controls
- Generators and permanent magnet generator (PMG)
- Shop machinery
- Manual and electrical power tools
- Cranes and forklifts
- Battery chargers and inverters
- Stationary and auxiliary battery banks
- Heating, ventilation and air conditioning systems
- AC and DC motors
- Annunciators/alarms
- Auxiliary equipment
- Distribution panels
- Auxiliary power-generating equipment and controls
- Oil pump motors, starters and controls
- Relays
- Switchboards, panels
- Switching and grounding equipment
- Distribution circuits
- Uninterruptible power supply (UPS)
- Transfer switches
- Voltage regulators
- Motor starters and circuits
- Relay circuits
- Programmable logic controllers and programs
- Emission control systems
- Diesel generators
- Emergency lighting
- Instrumentation systems and devices

Mechanical Knowledge, Systems and Components
Must be able to inspect, dismantle and repair all mechanical, hydraulic, pneumatic, water/steam, and control systems to ensure proper operation. Must have the ability to learn and use a computerized maintenance recording system. Must be able to interpret mechanical prints, drawings, and schematics needed for maintenance and repair of plant equipment and machinery, including:

- Hydraulics
- Pneumatics
- Welding
- Power transmission (gears, belts)
- Lubrication
- Pumps
- Piping
- Mechanical maintenance
- Shop machines, tools and equipment (grinders, drill press, bearing puller)
- Electrical/electronics
- Motors
- Digital electronics
- Analog electronics
- Power supplies
- Both AC and DC motors and equipment
- Programmable logic controllers
- Computer systems
- Regulators
- Calibration systems
- Power distribution systems
- Combustion systems
- Control circuits and automated systems

Critical Work Functions

Table 2.

Skill Standards for Food Manufacturing Maintenance Mechanics

Critical Work Functions	Key Activities	
A. Maintain a Safe, Healthy and Environmentally Conscious Work Environment	A1 Perform environmental and safety inspections	A2 Perform emergency drills and participate in emergency response teams
B. Maintain and Repair Plant Equipment	B1 Perform troubleshooting	B2 Perform preventive maintenance
C. Install and/or Modify Equipment	C1 Support the installation, move/removal, customization or upgrade of equipment	C2 Assist with testing to ensure functionality after installation, move/removal, customization or upgrade
D. Communicate with Co-Workers to Promote Productivity and Customer Responsiveness	D1 Fill out maintenance and repair logs	D2 Participate in meetings and problem-solving groups
E. Adhere to Company and Regulatory Policies and Standards	E1 Comply with environmental regulations	E2 Adhere to site-specific work practices and procedures, and emergency response and preparedness
F. Perform Technical and Administrative Duties	F1 Maintain manual and electronic records, databases and reports	F2 Assist in training other employees
G. Operate Auxiliary Equipment (e.g., Fork Lift, Aerial Lift)	G1 Inspect equipment	G2 Operate rolling/mobile equipment

Key Activities			
A3 Identify, report and take corrective action on unsafe and out-of-compliance conditions and behaviors regarding personal and food safety, and environmental/ regulatory requirements.	A4 Attend safety meetings	A5 Reclaim, recycle or dispose of fluids, refrigerants, materials and waste	
B3 Gather parts, materials, tools and equipment	B4 Perform diagnostic testing	B5 Perform repairs	B6 Document equipment maintenance & repair
C3 Fabricate parts or components			
D3 Communicate job-specific needs	D4 Suggest ways to prevent future equipment malfunction or improve equipment performance	D5 Promote teamwork and continuous improvement	
E3 Comply with safety requirements and standards			
F3 Perform housekeeping	F4 Obtain and maintain proficiency in current and new technologies		

Table 3.

SCANS Survey Results

Foundation Skills and Personal Qualities	Key: 1 = Basic Competency Level; 5 = Advanced Competency Level. 1	2	3	4	5	Critical Competencies
Basic Skills						
Demonstrates Effective Reading Strategies						Identifies relevant details, facts, specifications, follows set of instructions and probes to gain knowledge/information.
Demonstrates Effective Writing Strategies						Records information accurately, completes forms and writes simple documents.
Applies Arithmetic Processes						Performs basic computations and measurements, performs measurements and predicts arithmetic results.
Applies Mathematics Processes						Utilizes mathematical formulas and processes, summarizes and translates mathematical data.
Demonstrates Effective Listening Skills						Listens attentively and confirms and interprets communication.
Demonstrates Effective Speaking Skills						Communicates appropriate verbal/non-verbal messages, presents basic ideas/information, explains concepts and actively participates in discussion.
Thinking Skills						
Applies Creative Thinking/ Generates Ideas						Demonstrates creative thinking process while problem solving and develops creative solutions.
Applies Decision-Making Strategies						Understands decision-making process, analyzes situation/information and considers risks/implications.
Recognizes and Solves Problems						Identifies the problem, analyzes possible causes/reasons, generates/evaluates solutions and devises/implements plan of action.
Demonstrates Visualization						Translates blueprints, drawings and diagrams; applies appropriate principles and theories to situations; and utilizes previous training/experience to predict outcomes.
Knows How to Learn						Translates blueprints, drawings and diagrams; applies appropriate principles and theories to situations; and utilizes previous training/experience to predict outcomes.
Applies Reasoning Skills						Identifies the problem, applies principles to process/procedure, extracts information/data and uses logic to draw conclusions.

Table 3. *(Continued)*

Foundation Skills and Personal Qualities	Key: 1 = Basic Competency Level; 5 = Advanced Competency Level. 1	2	3	4	5	Critical Competencies
Personal Qualities						
Demonstrates Responsibility						Follows procedures and pays attention to details, follows up on assigned tasks, works with minimal supervision, and demonstrates initiative.
Demonstrates Belief in Self Worth						Maintains a positive self-image, responds assertively, defends own viewpoints, accepts constructive criticism, and accepts responsibility for own behavior.
Demonstrates Sociability in Groups						Responds appropriately to others, takes active interest in and willingly helps others, and modifies behavior to environment.
Demonstrates Self-Management						Maintains self-control, accepts responsibility for own behavior, accepts constructive criticism and sets well-defined/realistic goals.
Demonstrates Integrity/Honesty						Demonstrates honesty and trustworthiness, accepts responsibility for own behavior and recommends ethical course of action.
Management of Resources						
Manages Time						Starts on time, efficiently manages time, prioritizes daily tasks, and monitors/adjusts task sequence.
Manages Money						*Not applicable*
Manages Materials/ Facilities						Uses materials in a safe and efficient manner and acquires and distributes supplies and equipment.
Manages Human Resources						Recognizes job tasks; may distribute work assignments and match talent to positions.
Management / Use of Information						
Acquires and Evaluates Information						Selects data relevant to the task, identifies the need for data and predicts outcomes.
Organizes and Maintains Information						Selects appropriate categories for information, interprets information and applies processes to new information.
Interprets and Communicates Information						Recognizes accuracy of information, provides accurate communication, interprets information and prepares basic summaries.
Uses Computers to Process Information						Understands computer operation, performs basic data entry, locates and retrieves information, and uses integrated/multiple software.

Table 3. *(Continued)*

Foundation Skills and Personal Qualities	Key: 1 = Basic Competency Level; 5 = Advanced Competency Level. 1	2	3	4	5	Critical Competencies
Interpersonal Skills						
Participates as Team Member						Actively participates in team activities, volunteers for special tasks, demonstrates commitment, works to improve team skills and encourages/supports team members.
Teaches Others						Models proper performance/ attitudes, conducts task-specific training and coaches others to apply related concepts.
Serves Customers						Responds to customer needs and demonstrates sensitivity to customer concerns and interests
Exhibits Leadership						Adheres to standards, encourages others to adopt new concepts, demonstrates commitment to excellence and leads by example.
Negotiates Agreements						Understands negotiation process, identifies conflicts and demonstrates composure.
Works with Diversity						Understands the legal aspects of discrimination, respects the rights of others and demonstrates awareness of diversity.
Understanding / Management of Systems						
Understands Systems						Understands system organization/ hierarchy and follows procedures.
Monitors/Corrects System Performance						Identifies system discrepancies, monitors and adjusts system performance and troubleshoots system malfunction/failure.
Improves/Designs Systems						Suggests system modifications/ improvements and determines system components to be improved.
Use of Technology						
Selects Appropriate Technology						Knows available technology and understands requirements of the task and technological results.
Applies Technology to Task						Understands technology applications, follows proper procedures, understands the operation and manipulates technology for desired results.
Maintains/ Troubleshoots Technology						Follows specified maintenance, identifies and corrects malfunctions, troubleshoots failures, and evaluates performance of technology.

Food Manufacturing Maintenance Mechanics
Critical Work Function:

A. Maintain a Safe, Healthy and Environmentally Conscious Work Environment

Key Activity **A1. Perform environmental and safety inspections**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Reference is made to technical manuals during the course of inspections. • Checklists and procedures are followed. • The environment is scanned for hazardous conditions. • Documentation is complete and accurate and submitted to appropriate personnel in a timely manner. • Personal protective equipment (PPE) is worn as required. • Visual inspections are conducted correctly and in a timely manner. • Inspections occur within required frequency specifications. • Food safety policies are adhered to (Good Manufacturing Practices) according to company, customer and U.S. Department of Agriculture (USDA) guidelines. • Safety and environmental testing equipment is properly calibrated/certified and used correctly. • Spill Prevention Control and Countermeasures (SPCC) plans are up to date. • Spill remediation supplies and kits are inspected and maintained.	• Knowledge of food manufacturing terminology including tools, equipment and systems. • Knowledge of food safety and sanitation policies and procedures and use of safety equipment. • Knowledge of the components and processes utilized in a safe work environment. • Knowledge of typical hazards. • Ability to identify and use personal protective equipment. • Knowledge of procedures for storing hazardous materials. • Knowledge of documentation procedures. • Knowledge of procedures for visual inspection. • Knowledge of required frequency for inspections. • Knowledge of food safety policies, Good Manufacturing Practices and company, customer and USDA guidelines, including material safety data sheets (MSDSs) and their locations. • Knowledge of calibration procedures for safety and environmental testing equipment and ability to determine if it is certified. • Knowledge of procedures for using safety and environmental testing equipment. • Knowledge of SPCC plans and requirements. • Knowledge of contents of spill remediation supplies and kits.	• Records information accurately, completes forms and writes simple documents. • Selects data relevant to the task, identifies the need for data and predicts outcomes. • Records information accurately, completes forms and writes simple documents. • Translates blueprints, drawings and diagrams; applies appropriate principles to the situation; and utilizes previous training/experience to predict outcomes. • Starts on time, efficiently manages time, prioritizes daily tasks, and monitors/adjusts task sequence.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
A. Maintain a Safe, Healthy and Environmentally Conscious Work Environment – *Continued*

Key Activity **A2. Perform emergency drills and participate in emergency response teams**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Training and certification on relevant emergency, first aid and CPR procedures are complete and up to date. • Emergency response complies with company and regulatory policies and procedures. • PPE is used as required.	• Ability to obtain and maintain certifications on respirators and other emergency response equipment. • Knowledge of procedures to use emergency equipment. • Knowledge of emergency policies and procedures. • Knowledge of emergency responses. • Knowledge of emergency personnel, phone numbers and address/locations within facilities. • Knowledge of guidelines for and how to use PPE.	• Listens attentively and confirms and interprets communication. • Actively participates in team activities, volunteers for special tasks, demonstrates commitment, works to improve team skills and encourages/supports team members. • Understands system organization/ hierarchy and follows procedures. • Translates blueprints, drawings and diagrams; applies appropriate principles to the situation; and utilizes previous training/experience to predict outcomes.

Key Activity **A3. Identify, report and take corrective action on unsafe and out-of-compliance conditions and behaviors regarding personal and food safety, and environmental / regulatory requirements.**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Conditions that present a threat to health, safety and the environment are identified, reported to appropriate parties, and documented promptly. • Corrective actions are identified, and documentation is completed once corrective actions are taken. • Appropriate parties are consulted about corrective actions. • Corrective actions are taken promptly according to company procedures. • Follow-up procedures are followed. • Food safety policies are adhered to (Good Manufacturing Practices) according to company, customer and USDA guidelines.	• Knowledge of plant equipment and processes. • Ability to identify an unsafe condition. • Knowledge of the components, conditions and procedures utilized in a safe working environment. • Knowledge of the consequences of safety situations such as systems under pressure and stored energy systems vs. low risk maintenance items. • Knowledge of documentation procedures and reporting requirements for unsafe and out of compliance conditions, behaviors and environmental/ regulatory requirements. • Knowledge of procedures for taking corrective actions. • Knowledge of Good Manufacturing Practices and company, customer and USDA policies and guidelines for food safety policies.	• Translates blueprints, drawings and diagrams; applies appropriate principles to the situation; and utilizes previous training/experience to predict outcomes. • Communicates appropriate verbal/non-verbal messages, presents basic ideas/ information, explains concepts and actively participates in discussion. • Records information accurately, completes forms and writes simple documents. • Identifies the problem, analyzes possible causes/ reasons, generates/evaluates solutions and devises/implements plan of action. • Maintains a positive self-image, responds assertively, defends own viewpoints, accepts constructive criticism, and accepts responsibility for own behavior

Food Manufacturing Maintenance Mechanics
Critical Work Function:
A. Maintain a Safe, Healthy and Environmentally Conscious Work Environment – *Continued*

Key Activity **A4. Attend safety meetings.**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Meetings are attended in an effective and focused manner with full participation. • Information regarding safety is accurately given and received. • Information regarding unsafe behavioral/ work practices and/or work areas is accurately given and received. • Issues are accurately discussed and solutions are defined. • Communication is respectful and without discrimination. • Follow-up on assigned safety tasks is completed. • Safety needs are communicated effectively and in a timely manner.	• Knowledge of company procedures and standards. • Knowledge of meeting/ training protocols. • Knowledge of work area safety requirements. • Knowledge of food manufacturing plant terminology. • Knowledge of work environment and safety policies. • Knowledge of company safety program.	• Actively participates in team activities, volunteers for special tasks, demonstrates commitment, works to improve team skills and encourages/supports team members. • Listens attentively and confirms and interprets communication. • Responds appropriately to others, takes active interest in and willingly helps others, and modifies behavior to environment. • Communicates appropriate verbal/non-verbal messages, presents basic ideas/ information, explains concepts and actively participates in discussion. • Maintains a positive self-image, responds assertively, defends own viewpoints, accepts constructive criticism and accepts responsibility for own behavior. • Understands the legal aspects of discrimination, respects the rights of others and demonstrates awareness of diversity.

Key Activity **A5. Reclaim recycle or dispose of fluids, refrigerants, materials and waste.**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Fluids, refrigerants, materials and waste that can be reclaimed are correctly identified. • Proper recycling, reclaiming and disposal procedures are followed. • Hazardous materials regulations are followed. • No fluids are spilled or fluid spills are handled in accordance with food safety guidelines. • Safety procedures are followed in accordance with company policies and procedures. • All laws and regulations and company policies are followed and compliance requirements met regarding reclaiming, recycling and disposal of fluids, refrigerants, materials and waste. • Appropriate PPE equipment is worn. • Information regarding problems with fluid, refrigerant, material and waste reclamation, recycling and disposal locations is communicated to appropriate personnel effectively and in a timely manner.	• Knowledge of laws, regulations and company policies regarding reclaiming, recycling and disposal of fluids, refrigerants, materials and waste. • Knowledge of guidelines for and how to use PPE. • Ability to discern fluids, refrigerants, materials and waste that can be reclaimed and recycled. • Knowledge of recycling, reclaiming and disposal procedures and locations. • Knowledge of hazardous materials regulations.	• Follows procedures and pays attention to details, follows up on assigned tasks, works with minimal supervision, and demonstrates initiative. • Maintains self-control, accepts responsibility for own behavior, accepts constructive criticism and sets well-defined/realistic goals. • Uses materials in a safe and efficient manner, and acquires and distributes supplies and equipment.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
B. Maintain and Repair Plant Equipment

Key Activity **B1. Perform troubleshooting**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Blueprints and schematics are consulted as necessary. • Information about the nature and possible causes of failure is systematically gathered through visual inspection, experience, operator feedback, observation of plant equipment during operation and disassembly of plant equipment, as appropriate. • Proper diagnostic tests and root cause analysis are performed and repeated as necessary and solutions correctly identified. • Diagnosis is timely and effective. • Troubleshooting processes and outcomes are properly documented in accordance with company procedures. • Manufacturer's performance specifications are used when evaluating plant equipment performance. • Procedures for isolating problems are initiated correctly and followed through completely. • Proper procedures and precautions are followed with respect to food safety in accordance with customer, company and USDA specifications and regulations. • Trades and craft boundaries are adhered to where applicable. • Issues are escalated in accordance with company policies and procedures.	• Knowledge of the system and plant equipment, and how it interacts with other systems and sequence of operations. • Knowledge of and ability to perform diagnostic tests, use test equipment and interpret the output. • Knowledge of basic troubleshooting processes and procedures such as visual inspection, experience, operator feedback and observation of plant equipment during operation and disassembly. • Knowledge of root cause analysis and ability to diagnose problems and identify their solutions. • Ability to access and read equipment logs and histories to gain knowledge of typical problems, symptoms and causes. • Ability to execute isolation procedures. • Ability to read blueprints and schematics. • Knowledge of multiple trades and crafts and their functional boundaries and nomenclature. • Ability to read and understand manufacturer's specifications and manuals. • Knowledge of and ability to apply customer, company and USDA food safety specifications and regulations. • Knowledge of food-compliant maintenance materials and processes. • Knowledge of escalation procedures.	• Identifies the problem, analyzes possible causes/reasons, generates/evaluates solutions and devises/implements plan of action. • Identifies the problem, applies principles to process/procedure, extracts information/data and uses logic to draw conclusions. • Identifies system discrepancies, monitors and adjusts system performance and troubleshoots system malfunction/failure. • Listens attentively, and confirms and interprets communication. • Demonstrates creative thinking process while problem solving and develops creative solutions. • Follows specified maintenance, identifies and corrects malfunctions, troubleshoots failures, evaluates performance of technology. • Utilizes mathematical formulas and processes, summarizes and translates mathematical data. • Recognizes job tasks and may distribute work assignments and match talent to positions.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
B. Maintain and Repair Plant Equipment – *Continued*

Key Activity **B2. Perform preventive maintenance (PM)**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Safety procedures (including lockout tagout) are followed and proper PPE is worn or used. • PM sheet guides and procedures are completely followed. • Maintenance job is documented and verified according to company procedure. • Required maintenance is performed correctly, completed on time and meets the required frequency. • Suggestions to revise maintenance plan are made to appropriate personnel effectively and in a timely manner. • Food safety is maintained according to customer, company and USDA specifications and regulations. • Equipment is properly calibrated. • Hazardous materials and waste are recycled, reclaimed and/or disposed of in accordance with all applicable laws, regulations and company policies and procedures. • Tests for functionality and safety of plant equipment and systems are completed and documented in accordance with all applicable laws, regulations and company policies and procedures. • PM projects or tasks are coordinated with operators and other production staff.	• Knowledge of food manufacturing equipment, components, processes and sequence of operations. • Ability to read and interpret manufacturer's specifications, recommendations and PM sheets. • Ability to identify tolerances within the PM. • Knowledge of tools and equipment used for PM. • Knowledge of hazardous materials and waste recycling, reclaiming and disposal laws; regulations; and relevant company policies and procedures. • Knowledge of PM requirements and frequency. • Knowledge of PM documentation procedures. • Knowledge of company safety policies and procedures, including lockout tagout concepts and procedures. • Ability to use PPE. • Knowledge of and ability to apply customer, company and USDA food safety specifications and regulations. • Knowledge of food-compliant maintenance materials and processes. • Ability to calibrate equipment. • Knowledge of cyber security procedures. • Knowledge of tests for functionality and safety of plant equipment and system; and related laws, regulations, policies and procedures. • Ability to interact with operators and other production staff.	• Identifies relevant details, facts, specifications; follows set of instructions and probes to gain knowledge/ information. • Recognizes accuracy of information, provides accurate communication, interprets information and prepares basic summaries. • Records information accurately, completes forms and writes simple documents. • Follows procedures and pays attention to details, follows up on assigned tasks, works with minimal supervision and demonstrates initiative. • Maintains self-control, accepts responsibility for own behavior, accepts constructive criticism and sets well-defined/realistic goals. • Follows specified maintenance, identifies and corrects malfunctions, troubleshoots failures, and evaluates performance of technology. • Performs basic computations and measurements, performs measurements and predicts arithmetic results.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
B. Maintain and Repair Plant Equipment – *Continued*

Key Activity **B3. Gather parts, materials, tools and equipment**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Tools, parts, materials and equipment are located in a timely manner. • If a part is not available, follow-up occurs to ensure that adequate supplies are maintained. • Calibration and certification of tools is ensured where applicable. • Tool box is properly stocked. • Tools and equipment are checked to insure they are in safe and proper working order. • Procedures regarding nonfunctioning tools and equipment are followed. • Recommendations for acquisition of new tools are made to appropriate personnel. • Tools are returned to the proper location in accordance with company procedures. • Where required, tool boxes, tools and parts are properly sanitized. • Paperwork for all required permits is correctly filled out, posted and turned in, and required equipment is assembled at the work site.	• Knowledge of tool terminology and the locations of tools, parts, materials and equipment. • Knowledge of tools such as hand tools and precision measuring tools. • Knowledge of different types of materials used in maintenance, parts and their application. • Ability to inspect and calibrate tools, determine whether certifications are current, and submit nonfunctional tools for repair. • Ability to plan and organize relevant materials and tools prior to job site work. • Ability to use prior documentation for planning and organizing work. • Ability to anticipate new equipment, tools and requisitions needed to perform necessary work and improve efficiency and safety. • Knowledge of established policies and procedures regarding tools, parts, materials and equipment. • Knowledge of sanitation requirements and procedures for tools, tool boxes and parts. • Knowledge of permits required, and the associated procedures and equipment required for each permit.	• Translates blueprints, drawings and diagrams; applies appropriate principles to the situation, and utilizes previous training/experience to predict outcomes. • Uses materials in a safe and efficient manner, and acquires and distributes supplies and equipment. • Identifies relevant details, facts and specifications; follows set of instructions; and probes to gain knowledge/information. • Understands decision-making process, analyzes situation/information and considers risks/implications. • Utilizes mathematical formulas and processes, summarizes and translates mathematical data. • Understands technology applications, follows proper procedures, understands the operation and manipulates technology for desired results. • Follows specified maintenance, identifies and corrects malfunctions, troubleshoots failures, and evaluates performance of technology.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
B. Maintain and Repair Plant Equipment – *Continued*

Key Activity **B4. Perform diagnostic testing**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• All required test equipment is identified and located. • Test equipment is used correctly. • Testing procedures are gathered from company or technical manuals. • Calibration and certification of test equipment is ensured where applicable. • Tests are conducted in accordance with company, customer and USDA specifications and regulations. • Test results are compared with baseline operating data of the plant equipment, and anomalies are corrected or referred to appropriate personnel or departments. • Test results are properly documented and filed. • Safety procedures and regulations are completely followed. • Sights, sounds, feel and smell of plant equipment is used to verify that it is operating normally.	• Knowledge of plant equipment being tested and location of information about equipment and the characteristics/conditions of normal operations. • Knowledge of location and proper operation of test equipment. • Knowledge of functions of test equipment. • Ability to calibrate test equipment and determine whether certifications are current. • Knowledge of baseline operating data of the plant equipment. • Knowledge of test result documentation procedures. • Knowledge of electronics including analog, digital and logic theory. • Knowledge of the manufacturing process and how testing impacts food safety. • Knowledge of food-compliant maintenance materials and processes. • Ability to perform diagnostic testing with no adverse impact on food safety. • Knowledge of tests that put the manufacturing process at risk. • Knowledge of when to make corrections and when to refer problems to other individuals or departments. • Knowledge of company, customer and USDA specifications and regulations regarding diagnostic testing. • Knowledge of safety procedures and regulations. • Ability to identify plant equipment malfunctions using technical indicators, gauges and human sensory inputs (sight, sound, smell, feel).	• Knows available technology and understands requirements of the task and technological results. • Understands technology applications, follows proper procedures, understands the operation and manipulates technology for desired results. • Identifies relevant details, facts and specifications; follows set of instructions; and probes to gain knowledge/information. • Identifies the problem, applies principles to process/procedure, extracts information/data and uses logic to draw conclusions. • Selects appropriate categories for information, interprets information and applies processes to new information. • Starts on time, efficiently manages time, prioritizes daily tasks and monitors/adjusts task sequence. • Follows specified maintenance, identifies and corrects malfunctions, troubleshoots failures, and evaluates performance of technology.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
B. Maintain and Repair Plant Equipment – *Continued*

Key Activity **B5. Perform repairs**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Work is performed safely in accordance with company policies and procedures (including lockout tagout) and in accordance with all applicable laws and regulations. • Repair procedures are followed. • During repair process, plant equipment is thoroughly inspected to identify other repair needs. • Where appropriate, repair plan and job safety/hazard analysis are effectively communicated to appropriate personnel in a timely manner. • Replaced parts are properly disposed of or refurbished and returned to service. • Repairs are conducted and documented in accordance with company, USDA and industry regulations, and in such a way as to minimize negative impact on product flow and food safety and quality. • Equipment is properly calibrated and certifications are current. • Components are correctly programmed, integrated into the plant system and backed up, and all security procedures are followed. • Hazardous materials and waste are recycled, reclaimed and/or disposed of in accordance with all applicable laws, regulations and company policies and procedures. • Tests for functionality and safety of plant equipment and systems are completed and documented in accordance with all applicable laws, regulations and company policies and procedures. • All documentation is completed and submitted in accordance with company policies and procedures.	• Ability to track how components and equipment are disassembled so they can be correctly put back together. • Knowledge of safe work practices with respect to repairs, including lockout tagout. • Knowledge of company policies and procedures regarding documentation and safety. • Knowledge of technical requirements for specifications of parts to be repaired and manufacturer's recommended procedures. • Knowledge of plant equipment function, purpose within the system, and sequence of operations and how they affect other plant systems • Knowledge of plant equipment inspection procedures. • Knowledge of proper disposal and refurbishing procedures for parts and components. • Knowledge of and ability to apply customer, company and USDA food safety specifications and regulations. • Knowledge of food-compliant maintenance materials and processes. • Ability to identify unacceptable product. • Ability to calibrate tools and determine whether certifications are current. • Ability to program components, integrate them into the plant system and execute backup protocols. • Knowledge of cyber security procedures. • Knowledge of tests for functionality and safety of plant equipment and system; and related laws, regulations, policies and procedures.	• Starts on time, efficiently manages time, prioritizes daily tasks, and monitors/adjusts task sequence. • Identifies relevant details, facts and specifications; follows set of instructions; and probes to gain knowledge/information. • Records information accurately, completes forms and writes simple documents. • Uses materials in a safe and efficient manner, and acquires and distributes supplies and equipment. • Follows procedures and pays attention to details, follows up on assigned tasks, works with minimal supervision and demonstrates initiative. • Recognizes job tasks and may distribute work assignments and match talent to positions.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
B. Maintain and Repair Plant Equipment – *Continued*

Key Activity **B6. Document equipment maintenance and repair**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Documentation is performed according to company and department policies and procedures. • Documents and appropriate files are input into database, filed or distributed to correct parties. • Preventive maintenance schedule is properly adjusted to reflect repairs made. • Documentation is accurate, legible and complete and is completed in a timely manner. • Documentation is understandable and succinct.	• Knowledge of documentation policies and procedures. • Ability to input relevant and accurate data into manual and electronic systems. • Understanding of how documentation and procedures affect critical operations and timelines. • Ability to report findings and make recommendations based on documented history and findings. • Understanding of the operational system and how equipment maintenance issues can adversely impact operations, food safety and food quality. • Ability to use correct terminology.	• Identifies the problem, applies principles to process/procedure, extracts information/data and uses logic to draw conclusions. • Records information accurately, completes forms and writes simple documents. • Selects data relevant to the task, identifies the need for data and predicts outcomes. • Selects appropriate categories for information, interprets information and applies processes to new information.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
C. Install and/or Modify Equipment

Key Activity **C1. Support the installation, move/removal, customization or upgrade of equipment**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Installation, move/removal, customization or upgrade of plant equipment is performed safely, including lockout tagout, and in accordance with all applicable laws and regulations. • Plan of action is followed. • Installation, move/removal, customization or upgrade of plant equipment is completed to specification and in a timely manner. • Proper procedures and precautions are followed with respect to food safety in accordance with customer, company and USDA specifications and regulations.	• Knowledge of safety regulations, requirements and policies regarding plant equipment, including lockout tagout concepts and procedures. • Ability to implement and follow a plan of action. • Ability to suggest modification to plans of action as needed. • Knowledge of the system and equipment, and how it interacts with other systems. • Ability to understand and follow vendors' equipment requirements and recommendations. • Knowledge of plant equipment installation, move/removal, customization or upgrade procedures. • Knowledge of vendor, equipment and system terminology. • Ability to understand as-built and layout diagrams and blueprints. • Knowledge of procedures and precautions with respect to food safety. • Knowledge of food-compliant maintenance materials and processes. • Knowledge of customer, company and USDA specifications and regulations.	• Identifies relevant details, facts and specifications; follows set of instructions; and probes to gain knowledge/information. • Recognizes accuracy of information, provides accurate communication, interprets information and prepares basic summaries. • Follows procedures and pays attention to details, follows up on assigned tasks, works with minimal supervision and demonstrates initiative. • Actively participates in team activities, volunteers for special tasks, demonstrates commitment, works to improve team skills and encourages/supports team members. • Adheres to standards, encourages others to adopt new concepts, demonstrates commitment to excellence and leads by example. • Translates blueprints/drawings/diagrams, applies appropriate principles and theories to situations and utilizes previous training/experience to predict outcomes. • Understands the legal aspects of discrimination, respects the rights of others and demonstrates awareness of diversity.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
C. Install and/or Modify Equipment – *Continued*

Key Activity **C2. Assist with testing to ensure functionality after installation, move/removal, customization or upgrade**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Prior to starting the test, communications are made to appropriate parties regarding the test. • Testing is performed in accordance with company, equipment manufacturer and industry protocols (including lockout tagout) and procedures. • Test procedures and results are properly documented and submitted. • Test equipment is checked, calibrated and used properly. • Proper procedures and precautions are followed with respect to food safety in accordance with customer, company and USDA specifications and regulations.	• Knowledge of testing procedures and parameters and company policies and procedures. • Knowledge and application of relevant safety policies and procedures, including lockout tagout concepts and procedures. • Knowledge of submittal procedures for test results. • Ability to input test results manually and electronically. • Knowledge of test equipment calibration and use. • Knowledge of food-compliant maintenance materials, precautions and processes. • Knowledge of customer, company and USDA specifications and regulations.	• Identifies relevant details, facts and specifications; follows set of instructions; and probes to gain knowledge/information. • Identifies system discrepancies, monitors and adjusts system performance, and troubleshoots system malfunction/failure. • Understands decision-making process, analyzes situation/information and considers risks/implications. • Suggests system modifications/improvements and determines system components to be improved. • Performs basic computations and measurements, performs measurements, and predicts arithmetic results. • Understands technology applications, follows proper procedures, understands the operation and manipulates technology for desired results. • Follows specified maintenance, identifies and corrects malfunctions, troubleshoots failures, evaluates performance of technology.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
C. Install and/or Modify Equipment – *Continued*

Key Activity **C3. Fabricate parts or components**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Work is performed safely, and PPE is used in accordance with company policies and procedures. • Proper tools and materials are used correctly. • Where applicable, specifications are written in accordance with industry standards. • Measurements and quantity estimates are accurate. • Documentation is completed accurately and submitted according to procedure, as required. • Fabricated parts and components are designed and tested to ensure they are functional, aesthetically acceptable and conform to design specifications. • All required permits are completed, posted and turned in, and all associated equipment is assembled.	• Knowledge of the purpose and proper functionality of plant equipment and systems. • Knowledge of fabrication equipment, tools and processes. • Ability to design, produce and fit fabricated parts and components to existing or new equipment. • Knowledge of layout techniques and procedures. • Ability to read blueprints and schematics. • Knowledge of safety standards, PPE and how to use it, permits, and permit processes and requirements. • Ability to measure accurately. • Ability to estimate quantities and write specifications. • Knowledge of documentation requirements and procedures. • Knowledge of materials such as hardware, lubricants, cutting fluids and fasteners, metals, plastics, and fittings. • Knowledge of functionality testing procedures and equipment.	• Identifies relevant details, facts and specifications; follows set of instructions; and probes to gain knowledge/information. • Utilizes mathematical formulas and processes, and summarizes and translates mathematical data. • Demonstrates creative-thinking process while problem solving and develops creative solutions. • Understands decision-making process, analyzes situation/information and considers risks/implications. • Knows available technology and understands requirements of the task and technological results. • Understands technology applications, follows proper procedures, understands the operation and manipulates technology for desired results. • Uses materials in a safe and efficient manner and acquires and distributes supplies and equipment.

Food Manufacturing Maintenance Mechanics
Critical Work Function:

D. Communicate with Co-Workers to Promote Productivity and Customer Responsiveness

Key Activity **D1. Fill out maintenance and repair logs**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Status reports are clearly communicated from shift to shift. • Documentation is performed according to company and department policies and procedures. • Documents and appropriate files are input into database, filed or distributed to correct parties. • Documentation is accurate, legible and complete, and is completed in a timely manner. • Documentation is understandable and succinct.	• Knowledge of plant equipment, system and maintenance terminology. • Knowledge of status reports and repair logs. • Knowledge of documentation policies and procedures. • Ability to use internal company computer maintenance management system.	• Records information accurately, completes forms and writes simple documents. • Selects data relevant to the task, identifies the need for data and predicts outcomes. • Demonstrates honesty and trustworthiness, accepts responsibility for own behavior, and recommends ethical course of action. • Identifies system discrepancies, monitors and adjusts system performance, and troubleshoots system malfunction/failure. • Communicates appropriate verbal/non-verbal messages, presents basic ideas/information, explains concepts and actively participates in discussion. • Understands computer operation, performs basic data entry, locates and retrieves information, and uses integrated/multiple software. • Selects appropriate categories for information, interprets information and applies processes to new information.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
D. Communicate with Co-Workers to Promote Productivity and Customer Responsiveness – *Continued*

Key Activity **D2. Participate in meetings and problem-solving groups**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Meetings are attended with active participation and with adequate preparation. • Information is accurately given and received. • Questions are asked and answered in a courteous and respectful manner. • Issues are accurately and thoroughly discussed and solutions are defined. • Communication is respectfully performed without discrimination.	• Meetings are attended with active participation and with adequate preparation. • Information is accurately given and received. • Questions are asked and answered in a courteous and respectful manner. • Issues are accurately and thoroughly discussed and solutions are defined. • Communication is respectfully performed without discrimination.	• Identifies the problem, analyzes possible causes/reasons, generates/evaluates solutions and devises/implements plan of action. • Actively participates in team activities, volunteers for special tasks, demonstrates commitment, works to improve team skills and encourages/supports team members. • Translates blueprints/drawings/diagrams, applies appropriate principles and theories to situations, and utilizes previous training/experience to predict outcomes. • Responds appropriately to others, takes active interest in and willingly helps others, and modifies behavior to environment. • Listens attentively and confirms and interprets communication. • Understands decision-making process, analyzes situation/information and considers risks/implications. • Understands the legal aspects of discrimination, respects the rights of others and demonstrates awareness of diversity. • Communicates appropriate verbal/non-verbal messages, presents basic ideas/information, explains concepts and actively participates in discussion.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
D. Communicate with Co-Workers to Promote Productivity and Customer Responsiveness – *Continued*

Key Activity **D3. Communicate job-specific needs**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• On-the-job issues and concerns are discussed with appropriate parties. • Communication demonstrates knowledge of operators and other production staff and business needs. • Communication is clear and relevant to the situation. • Communication is made in a timely and accurate manner to the correct parties.	• Knowledge of operators/other production staff and business needs. • Knowledge of the roles and responsibilities of company personnel and departments. • Knowledge of industry, plant, company, equipment, safety, regulatory, maintenance, repair and personnel terminology.	• Communicates appropriate verbal/non-verbal messages, presents basic ideas/ information, explains concepts and actively participates in discussion. • Selects data relevant to the task, identifies the need for data and predicts outcomes. • Understands system organi-zation/hierarchy and follows procedures. • Records information accurately, completes forms and writes simple documents. • Responds to customer needs and demonstrates sensitivity to customer concerns and interests. • Follows procedures and pays attention to details, follows up on assigned tasks, works with minimal supervision, and demonstrates initiative. • Recognizes job tasks, and may distribute work assignments and match talent to positions.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
D. Communicate with Co-Workers to Promote Productivity and Customer Responsiveness – *Continued*

Key Activity **D4. Suggest ways to prevent future equipment malfunction or improve equipment performance**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Suggestions are made to adjust maintenance scheduling or maintenance plan based on evidence from the last preventive maintenance for the plant equipment. • Communication is clear and relevant to the situation. • Communication is made in a timely and accurate manner to the correct parties. • Suggestions take the internal needs of operators and other production staff into account.	• Knowledge of scheduling and maintenance plans and challenges. • Knowledge of the needs of operators and other production staff • Knowledge of plant equipment and repair histories. • Knowledge of industry, plant, company, equipment, safety, regulatory, maintenance, repair and personnel terminology. • Knowledge of the roles and responsibilities of company personnel and departments. • Knowledge of how maintenance procedures affect critical operations and timelines.	• Communicates appropriate verbal/non-verbal messages, presents basic ideas/information, explains concepts and actively participates in discussion. • Records information accurately, completes forms and writes simple documents. • Suggests system modifications/improvements and determines system components to be improved. • Follows procedures and pays attention to details, follows up on assigned tasks, works with minimal supervision and demonstrates initiative. • Translates blueprints/drawings/diagrams, applies appropriate principles and theories to situations and utilizes previous training/experience to predict outcomes. • Maintains a positive self-image, responds assertively, defends own viewpoints, accepts constructive criticism, and accepts responsibility for own behavior. • Understands negotiation process, identifies conflicts and demonstrates composure.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
D. Communicate with Co-Workers to Promote Productivity and Customer Responsiveness – *Continued*

Key Activity **D5. Promote teamwork and continuous improvement**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Supervisor and co-workers are kept informed of events, requests and problems in the plant. • Company policies, goals and targets are clearly communicated and supported. • Information is accurately given, received and understood and is appropriate to the situation and timely. • Oral and written communication is concise and courteous. • Proper terminology is used to communicate with team and other personnel. • Input is given to promote teamwork and continuous improvement. • Operators and production staff are contacted to obtain input on maintenance issues.	• Knowledge of company policies, goals and targets. • Ability to determine when and how to consult with supervisor and co-workers. • Knowledge of industry, facility/plant, agency, system, plant equipment, scientific, technical, tool, safety and personnel terminology. • Ability to locate and use communications devices such as telephones, radios, public address systems, email and mobile devices. • Ability to identify and report problems. • Ability to interact with operators and other production staff.	• Adheres to standards, encourages others to adopt new concepts, demonstrates commitment to excellence and leads by example. • Demonstrates honesty and trustworthiness, accepts responsibility for own behavior, and recommends ethical course of action. • Models proper performance/attitudes, conducts task-specific training and coaches others to apply related concepts. • Recognizes accuracy of information, provides accurate communication, interprets information and prepares basic summaries. • Responds to customer needs and demonstrates sensitivity to customer concerns and interests. • Maintains a positive self-image, responds assertively, defends own viewpoints, accepts constructive criticism and accepts responsibility for own behavior. • Understands the legal aspects of discrimination, respects the rights of others and demonstrates awareness of diversity.

Food Manufacturing Maintenance Mechanics
Critical Work Function:

E. Adhere to Company and Regulatory Policies and Standards

Key Activity **E1. Comply with environmental regulations**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Environmental regulations are supported and followed. • Non-compliant conditions are reported to proper personnel and authorities in accordance with all applicable laws, regulations and company policies. • Procedures to prevent non-compliant conditions are implemented in an effective manner.	• Knowledge of procedures to prevent or reduce emissions and spills. • Knowledge of Hazardous Materials (HAZMAT) procedures information. • Knowledge of emergency policies and procedures and ability to use emergency equipment. • Knowledge of PPE requirements. • Knowledge of regulations protecting the environment. • Knowledge of reporting procedures.	• Demonstrates honesty and trustworthiness, accepts responsibility for own behavior, and recommends ethical course of action. • Identifies relevant details, facts and specifications; follows set of instructions; and probes to gain knowledge/information. • Identifies the problem, applies principles to process/ procedure, extracts information/ data and uses logic to draw conclusions. • Follows procedures and pays attention to details, follows up on assigned tasks, works with minimal supervision, and demonstrates initiative.

Key Activity **E2. Adhere to site-specific work practices and procedures, and emergency response and preparedness.**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Site-specific work practices and procedures are thoroughly followed. • Emergency response and preparedness procedures are followed.	• Knowledge of site-specific work practices and procedures. • Knowledge of emergency response and preparedness.	• Identifies relevant details, facts and specifications; follows set of instructions; and probes to gain knowledge/information. • Selects appropriate categories for information, interprets information and applies processes to new information. • Selects data relevant to the task, identifies the need for data and predicts outcomes. • Maintains a positive self-image, responds assertively, defends own viewpoints, accepts constructive criticism and accepts responsibility for own behavior. • Starts on time, efficiently manages time, prioritizes daily tasks and monitors/adjusts task sequence.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
E. Adhere to Company and Regulatory Policies and Standards – *Continued*

Key Activity **E3. Comply with safety requirements and standards.**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Safety and OSHA (Occupational Safety and Health Administration) regulations are supported and followed. • Mandatory safety training is attended with active participation. • Potential job hazards are accurately identified and clearly discussed with all appropriate personnel. • Safety violations are reported to appropriate personnel in a timely manner and in accordance with company policies. • Cooperation with safety department or other personnel is provided in an effective manner.	• Knowledge of site-specific work practices and procedures. • Knowledge of emergency response and preparedness.	• Identifies relevant details, facts and specifications; follows set of instructions; and probes to gain knowledge/information. • Selects appropriate categories for information, interprets information and applies processes to new information. • Selects data relevant to the task, identifies the need for data and predicts outcomes. • Maintains a positive self-image, responds assertively, defends own viewpoints, accepts constructive criticism and accepts responsibility for own behavior. • Starts on time, efficiently manages time, prioritizes daily tasks and monitors/adjusts task sequence.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
F. Perform Technical and Administrative Duties

Key Activity **F1. Maintain manual and electronic records, databases and reports.**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Records and reports are accurate and are filed in proper locations. • Records and reports are submitted in a timely manner to appropriate personnel and departments. • Records and reports are kept up to date. • Records and reports are maintained in accordance with company and regulatory policies. • Security and retention protocols are accurately followed. • Data files are correctly uploaded to server, intranet or other designated archive location. • PCs and mobile devices are used in a secure and prudent manner in accordance with company policies and procedures.	• Knowledge of policies and requirements regarding records, databases and reports. • Knowledge of data-upload procedures and locations. • Knowledge of company policies, procedures and protocols with respect to security and use of computers and mobile devices.	• Understands computer operation, performs basic data entry, locates and retrieves information, and uses integrated/multiple software. • Identifies relevant details, facts and specifications; follows set of instructions; and probes to gain knowledge/information. • Records information accurately, completes forms and writes simple documents. • Selects data relevant to the task, identifies the need for data and predicts outcomes. • Selects appropriate categories for information, interprets information and applies processes to new information.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
F. Perform Technical and Administrative Duties – *Continued*

Key Activity **F2. Assist in training other employees.**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Mentoring / training provided is accurate, relevant and timely. • Questions are answered in a courteous and respectful manner. • Communication is appropriate and proper terminology is used. • Receptivity and support are provided to all trainees to help them advance. • Proficiency in subject matter is maintained. • Company goals are supported through effective mentorship.	• Knowledge of company, industry and regulatory terminology. • Ability to identify and support trainee's needs. • Knowledge of subject matter (such as manufacturing plant equipment, maintenance requirements, how to use tools). • Ability to demonstrate approved company techniques, practices and procedures.	• Communicates appropriate verbal/non-verbal messages, presents basic ideas/ information, explains concepts and actively participates in discussion. • Responds appropriately to others, takes active interest in and willingly helps others, and modifies behavior to environment. • Models proper performance/ attitudes, conducts task-specific training and coaches others to apply related concepts. • Adheres to standards, encourages others to adopt new concepts, demonstrates commitment to excellence and leads by example. • Maintains a positive self-image, responds assertively, defends own viewpoints, accepts constructive criticism, and accepts responsibility for own behavior. • Understands the legal aspects of discrimination, respects the rights of others and demonstrates awareness of diversity. • Understands negotiation process, identifies conflicts and demonstrates composure.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
F. Perform Technical and Administrative Duties – *Continued*

Key Activity **F3. Perform housekeeping.**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Materials are kept in a safe manner. • Unsafe conditions are identified and reported promptly. • Workstation/work area and/or shop are clean and clear of safety hazards. • All appropriate safety equipment is present and in proper working order. • Housekeeping protocols are followed. • Tools and equipment are cleaned, returned to proper location and tagged if broken. • All hazardous materials procedures are followed in accordance with applicable laws and regulations.	• Knowledge of proper cleaning, organizing and storage procedures. • Ability to perform inspection of tools, materials and equipment (restock, recycle or repair). • Knowledge and ability to identify and report or correct for unsafe conditions. • Understanding of housekeeping protocols and requirements. • Knowledge of hazardous material laws, rules and regulations. • Ability to identify nonfunctional tools for repair, and knowledge of communications and tagging requirements for nonfunctioning tools. • Knowledge of safety equipment and its proper working order.	• Follows procedures and pays attention to details, follows up on assigned tasks, works with minimal supervision and demonstrates initiative. • Maintains self-control, accepts responsibility for own behavior, accepts constructive criticism and sets well-defined/realistic goals. • Starts on time, efficiently manages time, prioritizes daily tasks and monitors/adjusts task sequence. • Adheres to standards, encourages others to adopt new concepts, demonstrates commitment to excellence and leads by example.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
F. Perform Technical and Administrative Duties – *Continued*

Key Activity **F4. Obtain and maintain proficiency in current and new technologies.**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Technical trainings and working demonstrations are attended with full participation. • Initiative is demonstrated to participate in continuous learning opportunities. • Initiative is demonstrated to recommend and request training opportunities from management and gain knowledge on an individual basis. • All required certifications are kept up to date.	• Ability to access information on continuous learning opportunities. • Knowledge of location of food manufacturing plant equipment instruction manuals and how to use them. • Ability to obtain and maintain required certifications.	• Identifies relevant details, facts and specifications; follows set of instructions; and probes to gain knowledge/ information. • Selects data relevant to the task, identifies the need for data and predicts outcomes. • Understands computer operation, performs basic data entry, locates and retrieves information, and uses integrated/multiple software. • Suggests system modifications/ improvements and determines system components to be improved. • Knows available technology and understands requirements of the task and technological results. • Demonstrates creative thinking process while problem solving and develops creative solutions.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
G. Operate Auxiliary Equipment (e.g., Fork Lift, Aerial Lift)

Key Activity **G1. Inspect equipment.**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Pre start-up checks/inspections are thoroughly performed. • The correct checklists are efficiently located and used properly. • Equipment is signed off and sheets are submitted in accordance with company procedures. • Proper tools are used and measurements are accurate. • Safety procedures are followed. • Inspection documentation is filled out completely and in a timely manner. • Equipment malfunctions and readiness are communicated to appropriate personnel effectively and in a timely manner.	• Knowledge of equipment function and use. • Knowledge of approved company and manufacturers' inspection procedures, specifications, checklists and sign-offs, including OSHA (U.S. Occupational Safety and Health Administration) and Cal-OSHA. • Ability to use proper tools for inspection and to measure accurately. • Ability to accurately complete inspection documentation manually and electronically. • Knowledge of inspection results and equipment terminology. • Ability to identify equipment malfunctions.	• Translates blueprints, drawings and diagrams; applies appropriate principles to the situation; and utilizes previous training/experience to predict outcomes. • Selects data relevant to the task, identifies the need for data and predicts outcomes. • Records information accurately, completes forms and writes simple documents. • Identifies relevant details, facts and specifications; follows set of instructions; and probes to gain knowledge/information. • Demonstrates honesty and trustworthiness, accepts responsibility for own behavior, and recommends ethical course of action. • Communicates appropriate verbal/non-verbal messages, presents basic ideas/ information, explains concepts and actively participates in discussion. • Follows procedures and pays attention to details, follows up on assigned tasks, works with minimal supervision, and demonstrates initiative. • Identifies system discrepancies, monitors and adjusts system performance, and trouble-shoots system malfunction/ failure.

Food Manufacturing Maintenance Mechanics
Critical Work Function:
G. Operate Auxiliary Equipment (e.g., Fork Lift, Aerial Lift) – *Continued*

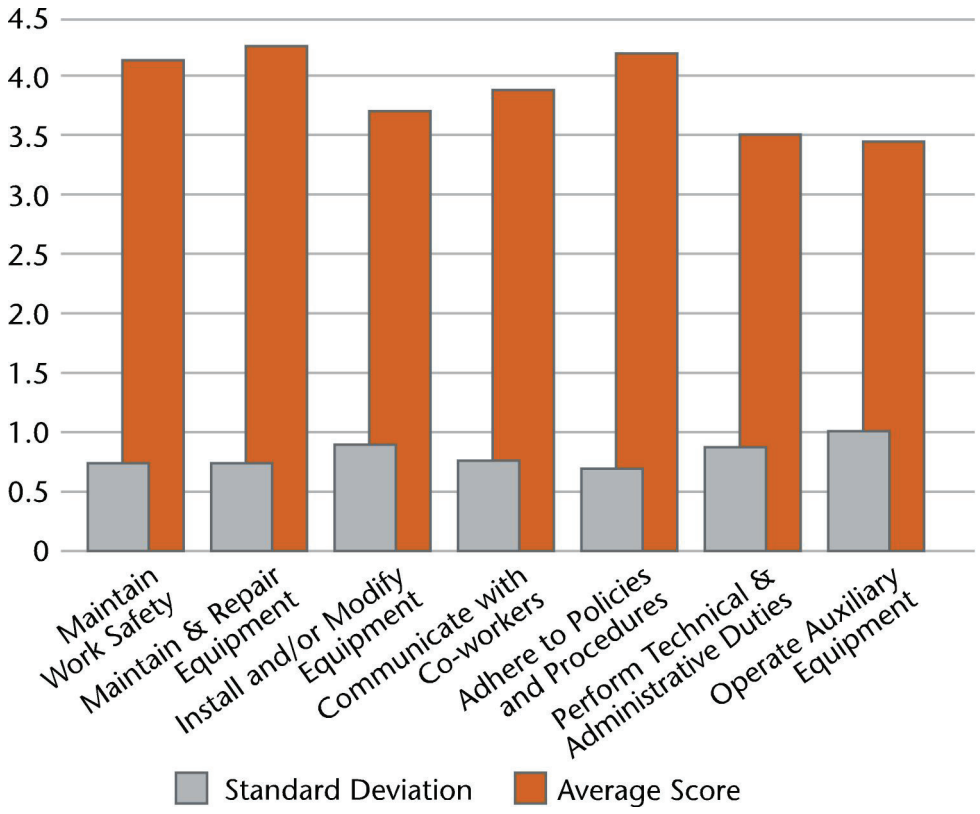
Key Activity **G2. Operate rolling/mobile equipment.**		
Performance Indicators – *How do we know when the task is performed well?*	**Technical Knowledge** – *Skills, Abilities, Tools*	**Employability Skills** – *SCANS Skills and Foundational Abilities*
• Proper endorsement, licensing and authorization requirements are met. • Equipment is operated safely, in accordance with all applicable laws and regulations. • Proper training and certification for operating and rigging has been obtained. • Rigging requirements are followed. • Lift plans are followed. • Gauges and indicators fall within normal operating parameters. • Sights, sounds, feel and smell of equipment is used to verify that equipment is operating normally. • Malfunctions are noted or reported and corrective actions are initiated • Safety regulations are followed in accordance with all applicable laws and regulations.	• Knowledge of and ability to obtain licenses, certifications and authorizations. • Knowledge of safe equipment operation and manufacturers' specifications. • Knowledge of company and OSHA/Cal-OSHA safety regulations, policies and processes, and equipment operation procedures. • Knowledge of and ability to apply proper rigging techniques. • Ability to understand and implement a lift plan. • Ability to identify equipment malfunctions using technical indicators and gauges, and human sensory inputs (sight, sound, smell, feel). • Knowledge of company policies and procedures for reporting and correcting equipment malfunctions.	• Selects data relevant to the task, identifies the need for data and predicts outcomes. • Identifies relevant details, facts and specifications; follows set of instructions; and probes to gain knowledge/information. • Demonstrates honesty and trustworthiness, accepts responsibility for own behavior, and recommends ethical course of action. • Identifies the problem, applies principles to process/ procedure, extracts information/ data and uses logic to draw conclusions. • Understands system organization/hierarchy and follows procedures. • Follows procedures and pays attention to details, follows up on assigned tasks, works with minimal supervision, and demonstrates initiative.

Verification Survey Results

Figure 2 shows the average importance and standard deviation (variation) among each function, rated on a scale from 1 (not important) to 5 (critical). These results generally verify that the critical work functions included in the skill standards document are relevant to the industry at large. The results show that Critical Work Function B, Maintain and Repair Equipment, had the highest average score (4.277) among all critical work functions. The lowest-rated critical work function was Critical Work Function G, Operate Auxiliary Equipment (3.429).

The standard deviation scores for all items show a modest variation among respondents. It should be noted that all critical work functions had scores considerably above 3.25, which confirms that respondents view all six of the critical work functions as important or very important to the work of maintenance mechanics.

Figure 2.
Food Manufacturing Maintenance Mechanics: Importance of Critical Work Functions



Future of Food Manufacturing Maintenance Mechanics

The process of creating the 2013 skill standards for food manufacturing maintenance mechanics underscored how ongoing modernization of the manufacturing industry will alter the skill requirements and expectations of those mechanics in the future.

Manufacturing facilities and plants have changed a great deal in the past decade. Information technologies are being integrated into manufacturing, which increases the use of computers to monitor and control manufacturing processes and equipment. Today, this means an increase in devices such as robotics and computer numerical control (CNC) machines. This is compounded by innovations in technology such as rapid prototyping (3-D printing) and implementation of virtual environments. The equipment in use today in food manufacturing plants, as well as equipment that will come on line in the near future, requires a more technically oriented skill set for maintenance and repair mechanics. Some have coined the phrase "Maintenance Technician" to describe this specialization in maintenance.

The Advisory Committee, focus group participants and industry thought leaders anticipate the following changes for the food manufacturing maintenance mechanic.

Maintenance mechanics will need to be able to program CNC devices.

CNC devices are becoming more commonplace as manufacturing plants continue to automate. CNC devices automate machinery using programmed commands to control the motion of machines on the plant floor. As the existence of CNC devices becomes more ubiquitous, the ability to program CNC devices will become a core skill for maintenance mechanics.

Maintenance mechanics will need to know computer-aided design.

Computer-aided design (CAD) tools are increasingly used to control CNC devices, interfacing with CNCs directly from 2-D and 3-D blueprints. This means that there is greater integration of design and manufacturing processes. Maintenance mechanics will need to understand CAD in order to perform repair and maintenance on manufacturing equipment.

Maintenance mechanics will need to be able to program and maintain robots.

Robots have been used for some time to perform highly repetitive actions; in the future, robots will collaborate with humans, and maintenance mechanics will need to be able to program and maintain robots. Early versions of next-generation robots came on the market at the end of 2012; these robots are mobile and can work alongside humans. In the manufacturing environment, it will be the job of maintenance mechanics to maintain and program these robots.

Maintenance mechanics will need to work collaboratively in new ways.

Manufacturing plants that engage with lean manufacturing programs are moving to a new model for plant design called cellular manufacturing. In cellular manufacturing plants, machines are grouped by the types of products produced (as opposed to traditional plant design in which machines are grouped by function). The distances that materials and inventory must travel are reduced, saving lead times at each transition point and significantly improving material flow.

Cellular manufacturing provides the tools for workers to manage multiple processes and be multifunctional. Teams work together to operate and maintain the equipment in their cell, and they are accountable for quality improvements and waste reduction. Maintenance mechanics will need to possess more complex teamwork and communication skills, be able to troubleshoot maintenance issues with non-maintenance personnel, and engage more fully in continuous improvement.

This means that maintenance mechanics will need additional education and/or additional specialized training. Today, many programming functions are performed by software engineers; in the future, maintenance of programs and computerized machines and devices will be part of the job description for food manufacturing maintenance mechanics.


SKILL
STANDARDS
FOR FOOD MANUFACTURING
MAINTENANCE MECHANICS

Food Processing Maintenance Mechanics Scenarios

Routine Scenario

I start the day with a turn-over meeting, in which we receive information passed down from the technicians and mechanics at the end of the previous shift. I refer to the log book, where work completed during that shift is documented, including preventive maintenance (PM), events and issues of the day. The log also provides notes of upcoming work.

I then perform rounds to conduct system checks and make sure machines have the proper settings and are operating correctly. I record machine data, file documentation and communicate with other maintenance mechanics and production personnel about machine operation.

Once rounds are complete, I consult the scheduled work orders and see that a gearbox rebuild is next on the list. I gather the personal protective equipment (PPE) so I can perform the job safely. Then I refer to the manuals and schematic to determine the parts needed, and I make sure I have collected the parts and tools required for the job. I double check the specifications and procedures as I perform the gearbox rebuild. I take the old parts and waste material (oil) to the disposal site and document the work completed and the disposal procedures that were followed.

I return to the scheduled work orders and the next one up is to perform a PM oil change. I use the manual to locate the specifications for the correct type and amount of oil. I perform lockout/tagout and make sure I have the proper PPE so I can perform the work safely. Once the oil change is complete, I test the equipment to make sure it is operating properly according to company and manufacturer specifications. I dispose of the waste following the proper protocols and document the work performed and the disposal processes.

The end of my shift has arrived. I make sure all the work I performed is documented and attend a turn-over meeting to clearly communicate information about the plant equipment, parts or personnel needs to the next shift of mechanics.

Table 4.

Primary Tasks and Functions Involved in Routine Scenario

Critical Work Functions	Key Activities						
A. Maintain a Safe, Healthy and Environmentally Conscious Work Environment	A1 Perform environmental and safety inspections	A2 Perform emergency drills and participate in emergency response teams	A3 Identify, report and take corrective action on unsafe and out-of-compliance conditions and behaviors regarding personal and food safety, and environmental/ regulatory requirements.	A4 Attend safety meetings	A5 Reclaim, recycle or dispose of fluids, refrigerants, materials and waste		
B. Maintain and Repair Plant Equipment	B1 Perform troubleshooting	B2 Perform preventive maintenance	B3 Gather parts, materials, tools and equipment	B4 Perform diagnostic testing	B5 Perform repairs	B6 Document equipment maintenance & repair	
C. Install and/or Modify Equipment	C1 Support the installation, move/removal, customization or upgrade of equipment	C2 Assist with testing to ensure functionality after installation, move/removal, customization or upgrade	C3 Fabricate parts or components				
D. Communicate with Co-Workers to Promote Productivity and Customer Responsiveness	D1 Fill out maintenance and repair logs	D2 Participate in meetings and problem-solving groups	D3 Communicate job-specific needs	D4 Suggest ways to prevent future equipment malfunction or improve equipment performance	D5 Promote teamwork and continuous improvement		
E. Adhere to Company and Regulatory Policies and Standards	E1 Comply with environmental regulations	E2 Adhere to site-specific work practices and procedures, and emergency response and preparedness	E3 Comply with safety requirements and standards				
F. Perform Technical and Administrative Duties	F1 Maintain manual and electronic records, databases and reports	F2 Assist in training other employees	F3 Perform housekeeping	F4 Obtain and maintain proficiency in current and new technologies			
G. Operate Auxiliary Equipment (e.g., fork lift, aerial lift)	G1 Inspect equipment	G2 Operate rolling/mobile equipment					

Crisis Scenario

I arrive at the plant and see that, for the day, I've been assigned to the team that deals with machine breakdowns. I spend the morning doing routine PM, then my cell phone rings and I answer the call. The message is clear: "The main machine that is feeding product to the conveyor is down."

I gather my PPE and head over to the machine that is down. Soon I'm joined by the other member of the breakdown team – a mechanical/electrical team always works together. We perform lockout/tagout, put on our PPE and begin to look for the cause of the breakdown.

We always want to find the root cause, and not just band-aid the situation, otherwise it will likely reoccur. The goal is to get the machine back up and running, with the cause repaired and the machine running as well or better than it did before the breakdown.

Mechanical repairs are more straightforward than electrical repairs, and we can usually find the cause by hearing it or seeing it. If it is an electrical problem, it is harder to identify. It could be something small or a combination of factors. We must systematically break down the system until we find the root cause.

We start with the motors and controls and move on from there to find the breakdown. We then work from there to find the root cause. Usually, when mechanical and electrical teams work together, the cause is discovered fairly quickly, and this is the case today. The problem is the thermostat, and our next step is to see if we have a new one in inventory. We do find the thermostat in inventory, and we use it to replace the one that is acting up. We use test equipment to test the machine and make sure it is running properly based on company and manufacturer specifications.

We remove lockout/tagout and return the machine to production. I dispose of old parts and waste, and document the work we did and the disposal procedures. We return the machine to full operation in less than an hour.

Table 5.

Primary Tasks and Functions Involved in Crisis Scenario

Critical Work Functions	Key Activities						
A. Maintain a Safe, Healthy and Environmentally Conscious Work Environment	A1 Perform environmental and safety inspections	A2 Perform emergency drills and participate in emergency response teams	A3 Identify, report and take corrective action on unsafe and out-of-compliance conditions and behaviors regarding personal and food safety, and environmental/ regulatory requirements.	A4 Attend safety meetings	A5 Reclaim, recycle or dispose of fluids, refrigerants, materials and waste		
B. Maintain and Repair Plant Equipment	B1 Perform troubleshooting	B2 Perform preventive maintenance	B3 Gather parts, materials, tools and equipment	B4 Perform diagnostic testing	B5 Perform repairs	B6 Document equipment maintenance & repair	
C. Install and/or Modify Equipment	C1 Support the installation, move/removal, customization or upgrade of equipment	C2 Assist with testing to ensure functionality after installation, move/removal, customization or upgrade	C3 Fabricate parts or components				
D. Communicate with Co-Workers to Promote Productivity and Customer Responsiveness	D1 Fill out maintenance and repair logs	D2 Participate in meetings and problem-solving groups	D3 Communicate job-specific needs	D4 Suggest ways to prevent future equipment malfunction or improve equipment performance	D5 Promote teamwork and continuous improvement		
E. Adhere to Company and Regulatory Policies and Standards	E1 Comply with environmental regulations	E2 Adhere to site-specific work practices and procedures, and emergency response and preparedness	E3 Comply with safety requirements and standards				
F. Perform Technical and Administrative Duties	F1 Maintain manual and electronic records, databases and reports	F2 Assist in training other employees	F3 Perform housekeeping	F4 Obtain and maintain proficiency in current and new technologies			
G. Operate Auxiliary Equipment (e.g., fork lift, aerial lift)	G1 Inspect equipment	G2 Operate rolling/mobile equipment					

Long-Term Scenario

Hiring a new, entry-level maintenance mechanic can be challenging. The biggest challenge is to instill the skills, culture, values and expectations needed to satisfy the demands of the company. It is also important to develop a training program unique to that individual's strengths.

Recently we had a turnover where we lost one of our skilled maintenance mechanics. We knew we needed to fill the void with a new entry-level hire. We began our search, and after interviewing several candidates, we found a solid candidate. We understood that the person we hired was an entry-level mechanic who didn't have much applied experience, so we knew we would have to provide the training needed to mold the new-hire into an effective and efficient maintenance mechanic.

Our training plan began with having the employee learn how to operate the machines and familiarize himself with the production process and all safety procedures and equipment. From there, he learned how our PM program works. We initially double-teamed him with more experienced veterans while performing PM.

After the new employee became familiar with the PM program, we expected him to work independently and we continued to mentor him to improve his efficiency.

Eventually, we will evaluate the employee and, depending on where his strengths lie, we will place the new employee in more specialized training like electrical, welding or machining to complete the training program and produce the type of maintenance mechanic we need.

Table 6.

Primary Tasks and Functions Involved in Long-Term Scenario

Critical Work Functions	Key Activities						
A. Maintain a Safe, Healthy and Environmentally Conscious Work Environment	A1 Perform environmental and safety inspections	A2 Perform emergency drills and participate in emergency response teams	A3 Identify, report and take corrective action on unsafe and out-of-compliance conditions and behaviors regarding personal and food safety, and environmental/ regulatory requirements.	A4 Attend safety meetings	A5 Reclaim, recycle or dispose of fluids, refrigerants, materials and waste		
B. Maintain and Repair Plant Equipment	B1 Perform troubleshooting	B2 Perform preventive maintenance	B3 Gather parts, materials, tools and equipment	B4 Perform diagnostic testing	B5 Perform repairs	B6 Document equipment maintenance & repair	
C. Install and/or Modify Equipment	C1 Support the installation, move/removal, customization or upgrade of equipment	C2 Assist with testing to ensure functionality after installation, move/removal, customization or upgrade	C3 Fabricate parts or components				
D. Communicate with Co-Workers to Promote Productivity and Customer Responsiveness	D1 Fill out maintenance and repair logs	D2 Participate in meetings and problem-solving groups	D3 Communicate job-specific needs	D4 Suggest ways to prevent future equipment malfunction or improve equipment performance	D5 Promote teamwork and continuous improvement		
E. Adhere to Company and Regulatory Policies and Standards	E1 Comply with environmental regulations	E2 Adhere to site-specific work practices and procedures, and emergency response and preparedness	E3 Comply with safety requirements and standards				
F. Perform Technical and Administrative Duties	F1 Maintain manual and electronic records, databases and reports	F2 Assist in training other employees	F3 Perform housekeeping	F4 Obtain and maintain proficiency in current and new technologies			
G. Operate Auxiliary Equipment (e.g., fork lift, aerial lift)	G1 Inspect equipment	G2 Operate rolling/mobile equipment					


FOR FOOD MANUFACTURING
SKILL
STANDARDS
MAINTENANCE MECHANICS

Integration

Assessment and Certification: A Vital Connection

Skill standards, while useful on their own, are just one part of a much larger equation. Skill standards establish the standard of competent performance, but they do not tell a person whether he or she has succeeded in meeting that standard.

For this reason, developing skill standards does not end with publication of those standards. Next steps should include developing voluntary assessments and certifications, which will make it possible for students, workers and any interested persons to determine their strengths and weaknesses based on the standards, and to earn certification showing that they can perform work competently as established by the skill standards.

In today's fast-moving technological economy, assessments and certification are crucial. The demand for both technical and employability skills is escalating as work becomes more complex. In addition, the workforce is more mobile, with workers moving freely between jobs and industries. This job mobility requires that workers must be able to communicate their qualifications to potential employers. They must keep up with technological change through continuous learning and worker retraining, and must be able to prove they have kept pace. All of these factors mean more training and education for individuals, and the ability to show evidence that this training translates to performance on the job.

Voluntary assessments and certifications based on skill standards will help us address all of these needs because of the guiding principles upon which skill standards are based and because of the stakeholders – employers, labor, educators, workers, students and government – who have needs that skill standards are designed to meet.

A step toward a statewide system of assessments and certifications is to develop assessments that measure an individual's ability to perform work competently as defined by the skill standards. Once these assessments are developed, curriculum can be reviewed to determine that all necessary topics and practicums sufficiently cover the items in the assessment. As gaps are identified, learning activities and content adjustments can be made, and post/summative assessments can be administered.

Finally, it is critical that industry be involved every step of the way, and that standards are continuously reviewed and updated. Figure 3 provides a summary of this process.

Assessment Strategies

Upon completion of skill standards development, performance assessments can be created to assess the criteria identified (see Table 7). Sample assessments and standards may be distributed to instructors and curriculum developers who will be educated on the skill standards elements.

Figure 3.
Integrating Skill Standards

Please Note: *To ensure that the use of standards and related assessments and certifications do not contradict U.S. employment law, employers will need to conduct an internal validation of the standards before using the skill standards to make hiring and promotion decisions. The purpose of this validation is to ensure that the knowledge, skills and performance described by the standards are needed for competent performance in an employer's organization. The need to validate the standards internally is a key requirement of U.S. employment law, which seeks to protect individuals from discrimination in hiring and promotion.*

Assessments based on the skill standards may include pre- and post-evaluations of the student to measure skill progression and to track the success rate of obtaining certification, where applicable.

Within a skill standards or competency-based system, assessment is defined as the generation and collection of evidence of performance that can be matched to specified explicit standards that reflect expectations of performance in the workplace. The two main forms of evidence are evidence of

actual performance and evidence of underpinning knowledge, skills and abilities.

The types of evidence may vary and will include:

- Direct evidence – products and items produced by the performer, and
- Indirect evidence – supporting evidence and information about the performer

Evidence can be collected in a wide variety of educational or business settings. The range of opportunities available for demonstration will determine the most appropriate setting. Often, it is difficult to actually perform the task in the authentic work setting. In this case, evidence generated during an educational course or an in-house training session can be collected by individuals and added to their overall portfolios.

By requesting that the student or trainee produce tangible results in the form of take-away products (videos, tapes, paper and electronic products), the participant will have created real evidence, which can be shown to human resource personnel, hiring managers, supervisors or assessors. When assessing these products, the trained assessor will seek validity, currency, authenticity and sufficiency.

Therefore, when designing a skill standards-based assessment for an educational course or training session, the assessment process and results will meet these four criteria:

- **Validity:** The assessment instrument/process clearly relates to the relevant standards.
- **Currency:** The assessment instrument/process calls for a demonstration of the current standards in the industry.
- **Authenticity:** The individual being assessed produces the assessment results; it is his or her own work. Team activities will be useful to demonstrate the skills and abilities to work effectively with others, but not necessarily the end results. The individual can, if possible, identify his or her part of the team project to demonstrate evidence of his or her own results.
- **Sufficiency:** Enough evidence is collected to match the key task and the performance criteria included in the skill standards.

When designing/revising the curriculum for maintenance mechanic careers, students will be assisted in generating high-quality evidence of performance or of underpinning skills, knowledge and abilities, which will help them to be assessed as fully competent.

The preceding section was adapted from Skill Standards Volume 2: Assessment, 1999, Washington State Board for Community and Technical Colleges, and Designing Competency-Based Training, Shirley Fletcher, 1991, Pfiffer & Company, pp. 86-88.

Table 7.

Assessment Design

Type of Authentic Assessment	Description of Authentic Assessment Strategies
Project	Hands-on demonstration of knowledge, skills and attitudes that reveals a student's ability to plan, organize and create a product or an event.
	Documentation of process of development from initial steps to final presentation.
Portfolio	Collection of pieces of evidence of a student's knowledge, skills and attitudes.
	Showcase of best work, work-in-progress.
	Record of student's progress over time.
	Content selection by student in collaboration with the teacher.
	Centerpiece for parent conferences.
On-Demand Demonstrations	Hands-on performance by a student, which illustrates level of knowledge, skills and attitudes.
	Typically involve a "real life" problem or situation to solve.
	Focus on the application of knowledge and skills learned in one situation as it connects to a new and different one.
Case Studies	Analysis of events and individuals in light of established criteria.
	Synthesis of evidence to support generalizations based on individual cases.
Paper/Pencil Tests	Multiple-choice, essay, true-false questions that rely on extended responses to further clarify a student's understanding of the knowledge being assessed.
	Graphic representations that reveal a student's understanding of connections among ideas.
Structured Observation	Observation of events, groups and individuals that focuses on the salient traits of the skill or attitude being observed.
Scenarios	A problematic or challenging situation presented in the context of a career-technical perspective.
	Study required to analyze or evaluate a situation.
	Apply relevant knowledge or skills.
	Prepare and justify a reasonable solution.
Critical Incident	An interview where the assessee is asked to describe past experiences that demonstrate skill standards.

From Center for Occupational Research and Development, November 1996, and Skill Standards Volume 2: Assessment, 1999, Washington State Board for Community and Technical Colleges.

Notes

The California Central Valley region business and industry partners that contributed to this Skill Standard process:

- Blue Diamond Growers
- California Dairies, Inc.
- Dole Packaged Food LLC
- E. & J. Gallo Winery
- Foster Farms (Porterville location)
- Harris Woolf Almonds
- Hilmar Cheese Company
- International Paper
- Land O'Lakes, Inc.
- Leprino Foods (Lemoore East location)
- Morning Star Packing Company (Liberty Packing location)
- Lyons Magnus
- Marquez Brothers International, Inc.
- Nestlé (Dreyer's Ice Cream, Tulare location)
- Nichols Farms
- Paramount Citrus
- Ruiz Foods, Inc.
- Saputo Cheese USA, Inc.
- Sconza Candy Company
- Sun-Maid Growers of California
- Tulare Workforce Investment Board
- The Wine Group, LLC