Architecture and Construction Career Cluster
Fluid Power and Piping Systems
Course Number: 46.42000

Course Description:
This course provides instruction in the fundamentals of safely operating hydraulic pneumatic and pump and piping systems. Theory and practical application concepts are discussed. Topics include hydraulic system principles and components, pneumatic system principles, and components and the installation, maintenance, and trouble shooting of pump and piping systems. *The prerequisite for this course is Industrial Maintenance.*

Course Standard 1

AC-FPPS-1

The following standard is included in all CTAE courses adopted for the Career Cluster/Pathways. Teachers should incorporate the elements of this standard into lesson plans during the course. The topics listed for each element of the standard may be addressed in differentiated instruction matching the content of each course. These elements may also be addressed with specific lessons from a variety of resources. This content is not to be treated as a unit or separate body of knowledge but rather integrated into class activities as applications of the concept.

Standard: Demonstrate employability skills required by business and industry.

The following elements should be integrated throughout the content of this course.

1.1 Communicate effectively through writing, speaking, listening, reading, and interpersonal abilities.

Person-to-Person Etiquette	Telephone and Email Etiquette	Cell Phone and Internet Etiquette	Communicating At Work	Listening
Interacting with Your Boss	Telephone Conversations	Using Blogs	Improving Communication Skills	Reasons, Benefits, and Barriers
Interacting with Subordinates	Barriers to Phone conversations	Using Social Media	Effective Oral Communication	Listening Strategies
Interacting with Co-workers	Making and Returning Calls		Effective Written Communication	Ways We Filter What We Hear
Interacting with Suppliers	Making Cold Calls		Effective Nonverbal Skills	Developing a Listening Attitude
	Handling Conference Calls		Effective Word Use	Show You Are Listening
	Handling Unsolicited Calls		Giving and Receiving Feedback	Asking Questions
				Obtaining Feedback
				Getting Others to Listen

Nonverbal Communication	Written Communication	Speaking	Applications and Effective Résumés
Communicating Nonverbally	Writing Documents	Using Language Carefully	Completing a Job Application
Reading Body Language and mixed Messages	Constructive Criticism in Writing	One-on-One Conversations	Writing a Cover Letter
Matching Verbal and Nonverbal communication		Small Group Communication	Things to Include in a Résumé
Improving Nonverbal Indicators		Large Group Communication	Selling Yourself in a Résumé

Nonverbal Feedback		Making Speeches	Terms to Use in a Résumé
Showing Confidence Nonverbally		Involving the Audience	Describing Your Job Strengths
Showing Assertiveness		Answering Questions	Organizing Your Résumé
		Visual and Media Aids	Writing an Electronic Résumé
		Errors in Presentation	Dressing Up Your Résumé

1.2 Demonstrate creativity by asking challenging questions and applying innovative procedures and methods.

Teamwork and Problem Solving	Meeting Etiquette
Thinking Creatively	Preparation and Participation in Meetings
Taking Risks	Conducting Two-Person or Large Group Meetings
Building Team Communication	Inviting and Introducing Speakers
	Facilitating Discussions and Closing
	Preparing Visual Aids
	Virtual Meetings

1.3 Exhibit critical thinking and problem solving skills to locate, analyze and apply information in career planning and employment situations.

Problem Solving	Customer Service	The Application Process	Interviewing Skills	Finding the Right Job
Transferable Job Skills	Gaining Trust and Interacting with Customers	Providing Information, Accuracy and Double Checking	Preparing for an Interview	Locating Jobs and Networking
Becoming a Problem Solver	Learning and Giving Customers What They Want	Online Application Process	Questions to Ask in an Interview	Job Shopping Online
Identifying a Problem	Keeping Customers Coming Back	Following Up After Submitting an Application	Things to Include in a Career Portfolio	Job Search Websites
Becoming a Critical Thinker	Seeing the Customer's Point	Effective Résumés:	Traits Employers are Seeking	Participation in Job Fairs
Managing	Selling Yourself and the Company	Matching Your Talents to a Job	Considerations Before Taking a Job	Searching the Classified Ads
	Handling Customer Complaints	When a Résumé Should be Used		Using Employment Agencies
	Strategies for Customer Service			Landing an Internship
				Staying Motivated to Search

1.4 Model work readiness traits required for success in the workplace including integrity, honesty, accountability, punctuality, time management, and respect for diversity.

Workplace Ethics	Personal Characteristics	Employer Expectations	Business Etiquette	Communicating at Work
Demonstrating Good Work Ethic	Demonstrating a Good Attitude	Behaviors Employers Expect	Language and Behavior	Handling Anger
Behaving Appropriately	Gaining and Showing Respect	Objectionable Behaviors	Keeping Information Confidential	Dealing with Difficult Coworkers
Maintaining Honesty	Demonstrating Responsibility	Establishing Credibility	Avoiding Gossip	Dealing with a Difficult Boss
Playing Fair	Showing Dependability	Demonstrating Your Skills	Appropriate Work Email	Dealing with Difficult Customers

Using Ethical Language	Being Courteous	Building Work Relationships	Cell Phone Etiquette	Dealing with Conflict
Showing Responsibility	Gaining Coworkers' Trust		Appropriate Work Texting	
Reducing Harassment	Persevering		Understanding Copyright	
Respecting Diversity	Handling Criticism		Social Networking	
Making Truthfulness a Habit	Showing Professionalism			
Leaving a Job Ethically				

1.5 Apply the appropriate skill sets to be productive in a changing, technological, diverse workplace to be able to work independently and apply team work skills.

Expected Work Traits	Teamwork	Time Management
Demonstrating Responsibility	Teamwork Skills	Managing Time
Dealing with Information Overload	Reasons Companies Use Teams	Putting First Things First
Transferable Job Skills	Decisions Teams Make	Juggling Many Priorities
Managing Change	Team Responsibilities	Overcoming Procrastination
Adopting a New Technology	Problems That Affect Teams	Organizing Workspace and Tasks
	Expressing Yourself on a Team	Staying Organized
	Giving and Receiving Constructive Criticism	Finding More Time
		Managing Projects
		Prioritizing Personal and Work Life

1.6 Present a professional image through appearance, behavior and language.

On-the-Job Etiquette	Person-to-Person Etiquette	Communication Etiquette	Presenting Yourself
Using Professional Manners	Meeting Business Acquaintances	Creating a Good Impression	Looking Professional
Introducing People	Meeting People for the First Time	Keeping Phone Calls Professional	Dressing for Success
Appropriate Dress	Showing Politeness	Proper Use of Work Email	Showing a Professional Attitude
Business Meal Functions		Proper Use of Cell Phone	Using Good Posture
Behavior at Work Parties		Proper Use in Texting	Presenting Yourself to Associates
Behavior at Conventions			Accepting Criticism
International Etiquette			Demonstrating Leadership
Cross-Cultural Etiquette			
Working in a Cubicle			

Support of CTAE Foundation Course Standards and Georgia Standards of Excellence L9-10RST 1-10 and L9-10WHST 1-10:

Georgia Standards of Excellence ELA/Literacy standards have been written specifically for technical subjects and have been adopted as part of the official standards for all CTAE courses.

Course Standard 2

AC-FPPS-2

Demonstrate appropriate safety procedures in an Industrial Environment.

2.1 Wear approved PPE (shoes, eye wear, gloves, hard hats, etc.).
2.2 Understand the importance of lockout/tag-out procedures to control various energy types (i.e. electrical, thermal (steam), hydraulic, pneumatic, or gravitational). Practice correct lockout/tag-out procedures using a padlock and tag as described under OSHA's 29 CFR 1910.147 standard, the Control of Hazardous Energy (Lockout/Tag-out).
2.3 Discuss the Material Safety Data Sheets (MSDS) Right-to-Know Law.
2.4 Identify types of fires, types of fire extinguishers, and types of protective clothing.
2.5 Identify the appropriate action for reporting fires and appropriate firefighting procedures.
2.6 Demonstrate Use of Lab Emergency Power Disconnect ("Kill Switch").
2.7 Demonstrate an understanding of safety precautions and procedures.
2.8 Demonstrate the safe use of test equipment.
2.9 Understand safety rules to follow when working with mechanical and electrical systems.
2.10 Identify and discuss the potential safety hazards and precautions of working with mechanical and electrical systems.

Course Standard 3

AC-FPPS-3

Explain hydraulic system principles.

3.1 Define and discuss the following basic hydraulic terms; hydraulic, force, weight, mass, work, and pressure.
3.2 Explain how hydraulic power is transmitted.
3.3 Discuss conservation of energy as it applies to a hydraulic system.
3.4 State the laws of physics that relate to hydraulic applications.
3.5 Explain how force, weight, mass, and pressure are used in the operation of hydraulic devices.
3.6 Use formulas to compute solutions for single variable problems relating to hydraulic systems where force, weight, mass, pressure, and work are the unknowns.
3.7 Identify the advantages of hydraulic power when compared to other methods of power transmission.
3.8 Identify the symbols used to represent components in a hydraulic system.
3.9 Identify the purpose of a hydraulic system using circuit diagrams.
3.10 Draw a complete hydraulic system schematic using the appropriate symbols.
3.11 Read and interpret a hydraulic system schematic.

Course Standard 4

AC-FPPS-4

Demonstrate proper operation of hydraulic system components.

4.1 Check for symptoms of binding rods and pistons.
4.2 Align a piston in a hydraulic cylinder.
4.3 Discuss the purpose and use of servo-proportional valves (SPV).
4.4 Discuss troubleshooting procedures for actuators in a hydraulic system.
4.5 Inspect a pressure control relief valve.
4.6 Measure the pressure in a hydraulic system.
4.7 Measure the flow of fluid in a hydraulic system.
4.8 Null a hydraulic servo valve.
4.9 Replace valves in hydraulic system.
4.10 Adjust the hydraulic pressure at a valve.

4.11 Test the accumulator charge in a hydraulic system.
4.12 Recharge an accumulator.
4.13 Replace a defective accumulator.
4.14 Explain how hydraulic fluid is manufactured.
4.15 Identify types of hydraulic fluids and discuss their characteristics.
4.16 Explain viscosity ratings.
4.17 Select hydraulic fluids appropriate to the types of seals used in the system.
4.18 Check the fluid level in a hydraulic system.
4.19 Replace and clean hydraulic filters and strainers.
4.20 Drain and refill a hydraulic system with the correct fluid.
4.21 Discuss the types and purposes of reservoirs in a hydraulic system.
4.22 Identify the various pumps used in industry.
4.23 Discuss gear, vane, and piston pump principles of operations.
4.24 Discuss the operation of various pumps used in industry.
4.25 Discuss cavitation in a hydraulic system.
4.26 Discuss pseudo cavitation in a hydraulic system.
4.27 Discuss the effects of atmospheric pressure of the suction side of the pump.
4.28 Inspect a hydraulic pump for proper operation before and after an installation.
4.29 Determine the type of pump required for a specific operation.
4.30 Install, maintain and trouble shoot an industrial pump.

Course Standard 5

AC-FPPS-5
Explain pneumatic system principles.

5.1 Define the terms force, weight, mass, pressure, volume, work, PSI, PSIA, PSIG, compressibility pneumatic energy, and kinetic energy as they relate to pneumatic systems.
5.2 Describe the relationship between the following: force and area, work and time, volume and pressure, temperature and pressure, and temperature, volume, and pressure.
5.3 Describe the effects of air viscosity on velocity.
5.4 Explain Bernoulli's Principle.
5.5 Describe the relationship between pneumatic leverage and travel.
5.6 Use formulas to compute pneumatic output force when given input force and cylinder areas.
5.7 Use formulas to compute work when given cylinder bore, stroke, and air pressure.
5.8 Use formulas to compute output cylinder travel when given input cylinder travel and leverage increase ratio.
5.9 Identify the symbols used to represent components of pneumatic systems.
5.10 Describe the operation of pneumatic systems when supplied with a system schematic.
5.11 Verify air logic with a pneumatic system diagram.
5.12 Explain the principles of vacuum physics.

Course Standard 6

AC-FPPS-6
Demonstrate proper operation of pneumatic system components.

6.1 Describe the various types of compressors.
6.2 Analyze the functions of compressors.
6.3 Service pneumatic system compressors.
6.4 Disassemble and reassemble a pneumatic system compressor.
6.5 Describe the various types of valves used in pneumatic systems.

6.6 Analyze the function of commonly used types of pneumatic valves.
6.7 Verify pneumatic valve operation.
6.8 Identify commonly used types of actuators.
6.9 Describe the operation of commonly used types of actuators.
6.10 Verify the proper operation of an air motor.

Course Standard 7

AC-FPPS-7
Identify basic fundamentals of pumps and piping systems.

7.1 Discuss and identify the various materials used in piping systems.
7.2 Identify various fittings used in piping systems.
7.3 Discuss and Calculate fitting allowances and pipe measurements.
7.4 Cut, ream, and thread steel pipe.
7.5 Prepare tubing for installation by flaring, brazing and using compression fittings.
7.6 Identify and discuss the types of valves used in piping systems.
7.7 Install various valves used in piping systems.
7.8 Refer to the proper section of the ASME Codes for information on code requirements for industrial pumps.

Course Standard 8

AC-FPPS-8
Demonstrate how to correctly rebuild hydraulic and pneumatic components.

8.1 Use systematic trouble shooting techniques to determine cylinder operation.
8.2 Demonstrate proper procedures to bring the system to a zero energy state.
8.3 Demonstrate proper removal of component to be replaced.
8.4 Properly rebuild component to industry standards.
8.5 Test component to insure proper operation.
8.6 Explain the proper process to reinstall hydraulic and pneumatic components.

Course Standard 9

AC-FPPS-9
Examine how related student organizations are integral parts of career and technology education courses through leadership development, school and community service projects, and competitive events.

9.1 Explain the purpose, mission, objectives, motto, colors, official dress and other distinguishing characteristics of SkillsUSA.
9.2 Explain how participation in SkillsUSA can promote lifelong responsibility for community service, professional growth and development.
9.3 Explore the impact and opportunities SkillsUSA can develop to bring business and industry together with education in a positive working relationship through innovative leadership and career development programs.
9.4 Explore the local, state, and national opportunities available to students through participation in SkillsUSA including but not limited to conferences, competitions, community service, philanthropy, and other SkillsUSA activities.