Delaware Department of Education

CTE & STEM Office

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**DELAWARE CTE PROGRAM OF STUDY APPLICATION**

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| LOCAL EDUCATION AGENCY INFORMATION | | |
| **Local Education Agency (LEA):** | | |
| **School(s) where the Program of Study will be Located:** | | **Program of Study Start Date:** |
| **LEA CTE Coordinator Name:** **Phone:** **E-Mail Address:** | | |
| **Career Cluster Title:**  Agriculture, Food, and Natural Resources | **Career Pathway Title:**  Power, Structural and Technical Systems | **Program of Study Title:**  Agricultural Power and Engineering |
| **CTE Program of Study Course Titles & Sequence:**   1. Fundamentals of Agricultural Power and Engineering (FAPE) 2. Agricultural Welding and Fabrication (AWF) 3. Power and Mechanical Systems (PMS) | | |
| **CTE Program of Study Request:**  State-model CTE Program of Study  Local CTE Program of Study | | |
| ASSURANCES & SIGNATURES | | |
| CTE Program of Study approval and funding is contingent upon the following assurances:   1. The LEA will comply with Delaware Administrative Code, 14 DE Admin. 525, Requirements for Career and Technical Education Programs and the Delaware State Plan for the Carl D. Perkins Career and Technical Education Act of 2006; 2. The LEA will submit CTE program data as required by the Delaware Department of Education; 3. All teachers are certified in the appropriate CTE area and participate in program specific professional learning; 4. The LEA will convene and engage a program advisory committee for the purposes of program development, implementation, and continuous improvement; 5. All students have equal access to the program of study as well as early career/early college options; 6. Career and Technical Student Organizations are integral components of the program of study; 7. The LEA will maintain safe facilities and equipment aligned with the program of study goals; and 8. A process for continuous improvement has been established, which includes a model of evaluation and program improvement. | | |
| **LEA CTE Coordinator Signature: Date:** | | |
| **LEA Chief School Officer Signature: Date:** | | |
| PROGRAM ADVISORY COMMITTEE MEMBER INFORMATION | | | |
| Complete the list of program advisory committee members. Program of study representatives should include, but are not limited to: CTE and academic teachers, CTE/curriculum district coordinators, school counselors, business and industry representatives, labor representatives, and post-secondary partners. Community stakeholders including parents and students can also be considered. *Attach additional information if applicable*. | | | |
| Name: Title: | | | |
| Affiliation: | | | |
| Address: | | | |
| Phone: E-Mail: | | | |
| Area of Expertise:  Agricultural Education | | | |
| Representing:  Business/Industry  Secondary Education  Post-Secondary Education  Community/Other | | | |
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| Representing:  Business/Industry  Secondary Education  Post-Secondary Education  Community/Other |

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| LABOR MARKET DEMAND |
| Certify that a labor market needs analysis has been completed for the proposed CTE program of study. Attach the *Labor Market Information (LMI) Review* document. |
| Access the [*Labor Market Information (LMI) Review*](http://www.doe.k12.de.us/Page/435) document (see [Appendix A](#Appendix_A)).  The LEA certifies that regional, state, and local labor market data have been reviewed to assure a demand exists for the POS occupations and that the number of POS completers will not significantly exceed this demand. Department of Labor data are available and/or documented. Supporting evidence of supply and demand is submitted with this proposal.  No data exist for POS due to a unique labor market demand. Supporting evidence of demand is submitted with this proposal. Evidence may include, but is not limited to: real-time labor market information, documentation of national, regional, state, or local labor trends, or letters from employers or workforce agencies documenting projected employment specific to the Career Cluster and Career Pathway. |

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| ACADEMIC AND TECHNICAL SKILL STANDARDS |
| List the academic, technical, and workplace skills and knowledge used to develop the program of study. |
| **Title and source of academic standards:**  [Common Core State Standards (CCSS)](http://www.corestandards.org/)  The Common Core State Standards (CCSS) are national standards that set clear college- and career-ready expectations for kindergarten through 12th grade in English language arts/literacy and Mathematics. The standards help to ensure that students graduating from high school are prepared to take credit bearing introductory courses in two- or four-year college programs and enter the workforce. The standards were developed by the nation's governors and education commissioners, through their representative organizations, the National Governors Association Center for Best Practices (NGA) and the Council of Chief State School Officers (CCSSO). Teachers, parents, school administrators, and experts from across the country provided input into the development of the standards. The implementation of the Common Core, including how the standards are taught, the curriculum developed, and the materials used to support teachers as they help students reach the standards, is led entirely at the state and local levels. For more information on CCSS, please visit the link above.  [Next Generation Science Standards (NGSS)](http://www.nextgenscience.org/)  The Next Generation Science Standards (NGSS) are national standards for science that lay out the disciplinary core ideas, science and engineering practices, as well as crosscutting concepts that students should master in preparation for college and careers. The standards were developed through a state-led effort that was managed by Achieve. The development of the NGSS involved the National Research Council (NRC), the National Science Teachers Association (NSTA), the American Association for the Advancement of Science (AAAS), and other critical partners such as K–12 teachers, state science and policy staff, higher education faculty, scientists, engineers, cognitive scientists, and business leaders. For more information on the NGSS, please visit the link above. |
| **Title and source of technical skill standards:**  [Agriculture, Food, and Natural Resources (AFNR) Career Cluster Content Standards](https://www.ffa.org/thecouncil/afnr)  These standards are intended to shape the design of an agricultural education program including:  1) Classroom and laboratory instruction; 2) Work-based learning experiences such as Supervised Agricultural Experience (SAE) Programs and internships; and 3) Career and Technical Student Organization (CTSO) experiences through organizations such as the National FFA Organization. For more information on the AFNR standards, please visit the link above.  [National Center for Construction Education & Research (NCCER)](https://www.nccer.org/)  NCCER is a standardized construction and maintenance curriculum and assessments with portable credentials. These credentials are tracked through NCCER’s registry system that allows organizations and companies to track the qualifications of their craft professionals and/or check the qualifications of possible new hires. NCCER's registry system also assists craft professionals by maintaining their records in a secure database. |
| **Title and source of workplace or other skill standards, as applicable:**  [Common Career Technical Core (CCTC)](http://www.careertech.org/CCTC)  The Common Career Technical Core (CCTC) are national standards for Career & Technical Education (CTE) that help inform the establishment of state standards and/or programs of study. The CCTC were developed by educators, school administrators, representatives from business and industry, faculty from higher education, as well as workforce and labor markets economists. The CCTC includes a set of standards for each of the sixteen (16) Career Clusters and the corresponding Career Pathways that help to define what students should know and be able to do after completing instruction in the ENRS program of study. Within the ENRS program of study, the CCTC standards for the Agriculture, Food, and Natural Resource (AFNR) Career Cluster have been embedded in each course. The program has students apply the CCTC AFNR standards, specifically the Environmental Service Systems Career Pathway standards. For more information on the CCTC, please visit the link above.  [Career Ready Practices (CRP)](http://www.careertech.org/career-ready-practices)  The Career Ready Practices (CRP) are a component of the CCTC framework and includes twelve (12) statements that address the knowledge, skills, and dispositions that are important to becoming career ready. The CRP describes the career-ready skills that educators should seek to develop in their students. These practices are not exclusive to a Career Pathway, program of study, discipline, or level of education and should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a career pathway. Within the ENRS program of study, the CRP statements are embedded throughout the program to ensure students display the appropriate workplace and soft skills required to be successful in a career. For more information on the CRP, please visit the link above.  [The National FFA Organization](https://www.ffa.org/home)  The National FFA Organization (FFA) makes a positive difference in the lives of its members by developing their potential for premier leadership, personal growth, and career success through agricultural education. To accomplish the FFA mission, FFA instruction will focus on: developing competent and assertive agricultural leaders; increasing awareness of the global and technological importance of agriculture and its contribution to our well-being; strengthening the confidence of agricultural students in themselves and their work; promoting the intelligent choice and establishment of an agricultural career; encouraging achievement in supervised agricultural experience programs; encouraging wise management of economic, environmental and human resources of the community; developing interpersonal skills in teamwork, communications, human relations and social interaction; building character and promotes citizenship, volunteerism and patriotism; promoting cooperation and cooperative attitudes among all people; promoting healthy lifestyles; encouraging excellence in scholarship. |

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| EARLY CAREER AND EARLY COLLEGE OPPORTUNITIES |
| Identify CTE program of study early career opportunities, industry-recognized certifications and licenses, options for early college credit, two- and four-year degree and certification program alignment, and the technical skill attainment measures for the program of study. *Attach all Memorandum of Understanding that serve as articulation/dual enrollment agreement(s)*. |
| **Describe early career opportunities (i.e. work-based learning experiences and industry-mentored projects):**  The Agricultural Power and Engineering is a three (3) course program of study that provides students with the mathematical, scientific, and engineering principles and methods required to understand dynamic power systems and metal fabrication. Students participating in this pre-apprenticeship program will be prepared to enter into a Delaware Registered Apprenticeship program in one of the following areas: maintenance mechanic, iron worker, machinist, pipe welding, sheet metal, welding, mechanic, or metal fabrication.  Local business partners and agencies work with educators by serving on advisory boards and as mentors to provide a real-world connection to Power, Structural and Technical Systems coursework. Work-based learning experiences and industry-mentored projects are included in each course and will be reviewed with the LEA Program Advisory Council (PAC) to further identify opportunities to engage the community.    The Supervised Agriculture Experience (SAE) program provides students with the opportunity to consider multiple careers and occupations, demonstrate workplace behavior, develop skills within the environmental and natural resource sciences, and apply academic and occupational skills in the workplace or a simulated workplace environment. Supervised Agriculture Experience (SAE) programs are classified in six different categories: Ownership/Entrepreneurship, Placement/Internship, Research, Exploratory, School-Based Enterprise, or Service Learning. |
| **List industry-recognized certifications and/or licenses, as appropriate (include the partner organization and credential):**  [NCCER Credentialed Craft Professional’s Training](https://www.nccer.org/workforce-development-programs/credentials-registry)  The National Center for Construction & Engineering Research (NCCER) provides industry-recognized credentials for students and craft professionals that have national portability of skills through the  [NCCER Credentialed Craft Professional’s Training](https://www.nccer.org/workforce-development-programs/credentials-registry). NCCER maintains credentialing and certification through its registry system. The NCCER curriculum provides industry-based, end of module assessments. NCCER will report valid and reliable scores on overall student performance for each course. The end of module assessment(s) give students an objective evaluation of their achievement and stakeholders the opportunity to obtain and use data to make informed decisions.  [Occupational Safety and Health Administration (OSHA) 10-Hour Construction Certification](https://www.osha.gov/)  The Occupational Safety and Health Administration ([OSHA](https://www.osha.gov/)) 10-Hour Construction certification covers a broad spectrum of valuable health and safety workplace topics that will familiarizes students with OSHA construction standards. Topics included in the OSHA 10-Hour Construction certification are: fall protection, electrocution hazards, struck-by hazards, caught-in hazards, personal protective equipment (PPE), health hazards, material handling, and tools. |
| **Describe early college credit options (i.e. advanced placement, dual enrollment, Tran scripted and/or articulated credit, credit by exam, pre-apprenticeship, other) and options for two- and four-year degree and/or certification program alignment (attach articulation/dual enrollment agreement). The partner organization and hours of credit earned should be included, as applicable:**  Students completing the Agricultural Power and Engineering program of study will receive credentials for the NCCER Core Curriculum coursework (72 hours) and will be granted advanced placement in Delaware registered apprenticeship programs through the adult education divisions of the New Castle County, Polytech, and Sussex Technical systems. Qualifying apprenticeable trades include: maintenance mechanic, iron worker, machinist, pipe welding, sheet metal, welding, mechanic, and metal fabrication.  The Department of Education is currently negotiating articulation agreements with Delaware Technical Community College (DTCC). |
| **List technical skill attainment measures for the program of study (i.e. industry recognized certification or license, advanced placement, dual enrollment, transcripted and/or articulated credit, credit by exam):**  Certification/credentialing exam (specify): NCCER Credentialed Craft Professional’s Training – Core Curriculum  Licensing exam (specify):  Nationally recognized exam (specify):  Advanced standing (specify): Delaware Registered Apprenticeship programs:  Maintenance Mechanic, Iron Worker, Machinist, Pipe Welding, Sheet Metal, Welding, Mechanic, and Metal Fabrication.  Other (specify): |

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| POS OVERVIEW, COURSE DESCRIPTIONS, END-OF-COURSE, AND PROGRAM ASSESSMENTS |
| Provide a CTE program of study overview that broadly describes the program and student expectations. Identify end-of-program assessment(s) and opportunities for students to participate in early college and early career experiences. List each course title in the CTE program of study. Provide an overview of each course and define what students should know and be able to demonstrate upon completion of each level. Identify appropriate end-of-course assessment(s). |
| **CTE Program of Study Overview:**  The Agricultural Power and Engineering is a three (3) course program of study that provides students with the mathematical, scientific, and engineering principles and methods required to understand dynamic power systems and metal fabrication. Students practice real world applications, communication skills, and problem solving skills associated with dynamic power systems and metal fabrication. Students are prepared for a variety of careers including engineering, welding technicians, mechanical and industrial technicians, maintenance technicians, mechanical engineering, metal fabrication, CNC operators, power technology repair and troubleshooting, and green energy technologies.   * **Fundamentals of Agricultural Power and Engineering (FAPE)** introduces students to the skills needed in the occupational area of agricultural power and engineering. This course offers hands-on opportunities in workplace safety, communication skills, application of construction math, reading and developing construction plans, tool usage and safety practices, and cutting and gouging processes of metals using oxyfuels and plasma. * **Agricultural Welding and Fabrication (AWF)** enables students tobuild on the knowledge and experiences gained in FAPE. Students learn shielded metal arc welding, gas metal arc welding, and gas tungsten arc welding agricultural welding, and metal fabrication. AWF includes hands-on experiences for students to learn metallurgy as well as how to read welding drawings and identify welding symbols. * **Power and Mechanical Systems (PMS)** enables students to apply principles of dynamic power and mechanical systems while incorporating the scientific and engineering principles to be employed in power mechanical and related agricultural industries. Students learn about energy principles, engine theory, engine systems troubleshooting, electrical motor principles, hydraulic systems, and electronics. |
| **End-of-Program Assessment(s):**  Certification/credentialing exam (specify):  NCCER Credentialed Craft Professional’s Training – Core Curriculum  OSHA 10 Hour Training for Construction  Licensing exam (specify):  Nationally recognized exam (specify):  Other (specify): |
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| **Course title:**  Fundamentals of Agricultural Power and Engineering (FAPE) |
| **Course description (include prerequisites):**  Fundamentals of Agricultural Power and Engineering (FAPE) introduces students to the skills needed in the occupational area of agricultural power and engineering. This course offers hands-on opportunities in workplace safety, communication skills, application of construction math, reading and developing construction plans, tool usage and safety practices, and cutting and gouging processes of metals using oxyfuels and plasma. |
| **Course knowledge and skills (what students will know and be able to do):**   1. Describe the importance of safety, the causes of workplace incidents, and the process of hazard recognition and control; identify the safe work requirements for elevated work, including fall protection guidelines; explain how to avoid struck-by and caught-in-between hazards; Identify common energy-related hazards and explain how to avoid them; demonstrate the proper use of personal protective equipment (PPE); and describe other specific job-site safety hazards. *(Basic Safety - Module One - 00101-15)* 2. Identify various tools used to measure length and show how they are used; convert units of length, weight, volume, and temperature between the imperial and metric systems of measurement; calculate area and volume of angles and geometric shapes. *(Introduction to Construction Math - Module Two - 00102-15)* 3. Demonstrate the proper way to use various types of hand tools; demonstrate the proper way to use various types of measurement and layout tools; demonstrate the proper way to use various types of cutting and shaping tools. *(Introduction to Hand Tools - Module Three - 00103-15)* 4. Demonstrate the proper way to use various types of power drills and impact wrenches, the power saws, grinders, and grinder attachments.*(Introduction to Power Tools - Module Four - 00104-15)* 5. Identify fundamental components and features of construction drawings; describe the purpose of the five basic construction drawing components; explain the significance of various drawing elements, such as lines of construction, symbols, and grid lines; demonstrate the use of dimensions and various drawing scales; and demonstrate how to use engineer’s and architect’s scales. *(Introduction to Construction Drawings - Module Five - 00105-15)* 6. Describe various types of rigging slings, hardware, and equipment; describe various types of slings; inspect various types of slings; inspect common rigging hardware; identify and describe various types of hoists; and demonstrate basic rigging hitches and the related Emergency Stop hand signal. *(Introduction to Basic Rigging - Module Six - 00106-15)* 7. Describe the communication, listening, and speaking processes and their relationship to job performance; describe the communication process and the importance of listening and speaking skills; describe the listening process and identify good listening skills; describe the speaking process and demonstrate good speaking skills; describe good reading and writing skills and their relationship to job performance; describe the importance of good reading and writing skills; describe job-related reading requirements and identify good reading skills; and escribe job-related writing requirements and identify good writing skills. *(Basic Communication Skills - Module Seven - 00107-15)* 8. Describe the opportunities in the construction business and how to enter the construction workforce; describe the construction business and the opportunities offered by the trades, explain how workers can enter the construction workforce; explain the importance of critical thinking and how to solve problems; describe critical thinking and barriers to solving problems; describe how to solve problems using critical thinking; describe problems related to planning and scheduling; explain the importance of social skills and identify ways good social skills are applied in the construction trade; identify good personal and social skills; explain how to resolve conflicts with co-workers and supervisors; explain how to give and receive constructive criticism, identify and describe various social issues of concern in the workplace; and work in a team environment and demonstrate effective leader skills. *(Basic Employability Skills - Module Eight - 00108-15)* 9. Demonstrate proper material handling and common safety precautions; tie knots commonly used in material handling, identify various types of material handling equipment and demonstrate how they are used; identify non-motorized material-handling equipment and demonstrate how they are used; and identify motorized material-handling equipment and demonstrate how they are used. *(Introduction to Material Handling - Module Nine - 00109-15)* 10. Describe basic welding processes, the welding trade, and training/ apprenticeship programs; describe NCCER standardized training and explain apprenticeship programs; demonstrate the proper use of personal protective equipment (PPE) related to the welding trade; describe welding safety practices related to specific hazards or environments; identify potential factors related to accidents; explain hot work permits and fire watch requirements; describe confined spaces and their related to welding equipment, identify respiratory hazards, respiratory safety equipment, and ways to ventilate welding work areas. *(Welding Safety - Module One - 29101-15)* 11. Describe oxyfuel cutting and identify related safe work practices; describe oxyfuel cutting equipment and consumables; identify specialized cutting equipment; set up, light, and shut down oxyfuel equipment; conduct a leak test for oxyfuel equipment; light the torch and adjust for the proper flame; shut down a oxyfuel torch; identify the appearance of good and inferior cuts and their causes; cut thick and thin metal; bevel, wash, and gouge metal; complete oxyfuel cuts based on provided specifications. *(Oxyfuel Cutting - Module Two - 29102-15)* 12. Explain plasma arc cutting processes and identify related safety precautions; identify plasma arc power units; identify plasma arc torches and accessories; identify plasma arc cutting gases and gas control devices; set up plasma arc cutting equipment and adjacent work area; set the amperage and gas pressures or flow rates for the types and thickness of metal to be cut using plasma arc equipment; complete a bevel cut metal using plasma arc equipment; pierce and cut slots in metal using plasma arc equipment; describe how to care for and store the equipment; complete plasma arc cuts based on provided specifications. *(Plasma Arc Cutting - Module Three - 29103-15)* 13. Define air-carbon arc cutting and identify the related equipment and consumables; identify the various types of electrodes; identify safety practices related to air-carbon arc cutting; set up, safely operate, and care for air-carbon arc cutting equipment; properly prepare the equipment and work area for air-carbon cutting; wash and gouge metal; describe how to care for air-carbon cutting equipment; perform storage and housekeeping activities for air-carbon arc cutting equipment; complete air-carbon arc cuts based on specifications provided.  *(Air-Carbon Arc Cutting and Gouging - Module Four - 29104-15)* |
| **End-of-Course Assessment(s):**  Teacher designed assessment  LEA designed assessment  Certification/credentialing exam (specify): NCCER Credentialed Craft Professional’s Training – Core Curriculum  Licensing exam (specify):  Nationally recognized exam (specify):  Other (specify): Supervised Agriculture Experience (SAE) Program |
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| **Course title:**  Agricultural Welding and Fabrication (AWF) |
| **Course description (include prerequisites):**  Agricultural Welding and Fabrication (AWF) enables students to build on the knowledge and experiences gained in FAPE. Students learn shielded metal arc welding, gas metal arc welding, and gas tungsten arc welding agricultural welding, and metal fabrication. AWF includes hands-on experiences for students to learn metallurgy as well as how to read welding drawings and identify welding symbols.  Prerequisite: Fundamentals of Agricultural Power and Engineering (FAPE) |
| **Course knowledge and skills (what students will know and be able to do):**   1. Identify safety practices related to preparing base metals and describe basic cleaning procedures; describe the basic properties and types of carbon and stainless steel; describe basic metal cleaning procedures and concerns; identify basic welding joint designs and types of welds; identify the loads that are routinely placed on weld joints; describe a welding procedure specification (WPS) and the information in provides; describe how to mechanically and thermally prepare welding joints for welding; complete welding joint preparation; complete base metal preparation to be use for Shielded Metal Arc Welding (SMAW). *(Base Metal Preparation - Module Five - 29105-15)* 2. Identify the basic provisions of welding codes; identify weld discontinuities in welds; identify acceptable and unacceptable weld profiles; visually inspect a weld using proper methods including measuring devices and liquid penetrants; describe weld inspection processes; describe destructive testing processes; identify the qualification of welders by position; describe welder qualification testing to meet American Welding Society (AWS) and American Society of Mechanical Engineers (ASME) requirements; list the process for completing a weld test; perform a visual inspection (VT) on a fillet and/or groove weld and complete an inspection report. *(Weld Quality - Module Six - 29106-15)* 3. Identify Shielded Metal Arc Welding (SMAW) related safety practices and explain how various electrical characteristics apply; describe various types of SMAW machines; identify SMAW welding cables and connectors; use common tools needed to clean a weld; explain how to set up SMAW welding equipment; complete the setup and maintenance of SMAW equipment. *(SMAW Equipment and Setup - Module Seven - 29107-15)* 4. Describe SMAW electrode classification system and how to select the proper electrodes based on physical and chemical properties; describe the AWS filler metal specifications and various electrode characteristics; define ductility, traceability, alloy, flux, and heat affected zone; describe the characteristics of the four main electrode groups; explain how to select electrodes and describe their proper care and handling; identify various considerations in the selection of the proper electrode; utilize correct electrodes based on their characteristics to SMAW weld. *(SMAW Electrodes - Module Eight - 29108-15)* 5. Describe the composition and classification systems for a variety of metals; describe the physical and mechanical characteristics of metals and explain how to identify base metals; identify the common structural shapes of metal. *(Physical Characteristics and Mechanical Properties of Metals – Module Three – 29203-15)* 6. Identify safe practices related to SMAW; demonstrate how to prepare the area and equipment for welding; demonstrate how to strike an arc and respond to arc blow; demonstrate how to properly restart and terminate a weld pass; describe the technique used to produce stringer beads; describe the techniques required to produce weave and overlapping beads; describe the techniques required to produce fillet welds in various positions; demonstrate how to create a stringer bead, weave, and overlapping beads using an E6013, E6011, E6010, and E7018 electrodes; demonstrate how to make fillet welds using E6010 and E7018 in the flat, horizontal, vertical, and overhead positions. *(SMAW-Beads and Fillet Welds - Module Nine - 29109-15)* 7. Describe various types of fit-up and alignment tools; define weldment distortion; identify various fit-up gauges and measuring devices; describe common weldment positions equipment; identify various plate alignment tools; identify various pipe and flange alignment tools; describe the causes of weldment distortion; describe the techniques and tools used to control weldment distortion; describe the role of codes and specification in welding procedures and techniques; produce joints using fit-up methods and tools; inspect joint for proper fit up and alignment using proper gauges and measuring devices. *(Joint Fit-up and Alignment - Module Ten - 29110-15)* 8. Interpret welding symbols and their structure; describe welding drawings and identify basic drawing elements and features; explain how to interpret dimensional information, notes, and a bill of materials; and design and create a computer aided drafting project using the CNC table. *(Welding Symbols – Module One – 29201-15 and Reading Welding Detail Drawings – Module Three – 29202-15)* 9. Identify various types of groove welds and describe how to prepare for groove welding; demonstrate how to prepare for groove welding; describe the technique required for to produce groove welds in the 1G (flat), 2G (horizontal), and 3G (vertical) positions; set up arc welding equipment for making groove welds; complete flat welds with backing on V-groove joints using E7018 electrodes; complete horizontal welds with backing on V-groove joints using E7018 electrodes; complete vertical welds with backing on V-groove joints using E7018 electrodes. *(Groove Welds with Backing - Module Eleven - 29111-15)* 10. Identify various type of groove welds and define related terms; define feather and root face; demonstrate how to prepare the work area and plate for groove welding; produce an open V-groove welds in the 1G (flat), 2G (horizontal), and 3G (vertical) positions; complete open V-groove welds with E6010 and E7018 electrodes in 1G, 2G, and 3G positions. *(Open Root Groove Welds- Plate - Module Twelve - 29112-15)* 11. Describe GMAW/FCAW processes and safety practices; describe various metal transfer modes; describe GMAW and FCAW welding equipment; set up welding equipment for GMAW and FCAW welding; identify various GMAW and FCAW; describe equipment control and welding procedures for GMAW; produce basic weld beads; and produce proper fillet and V-groove welds using GMAW welding techniques. (*GMAW and FCAW – Equipment and Filler Metals – Module Five – 29205-15 and GMAW – Plate – Module Six – 29209-15)* 12. Identify GTAW related safety practices; describe the electrical characteristics that affect GTAW; identify and describe GTAW equipment and consumables; set up for GTAW welding; describe welding techniques for GTAW; produce basic bead welds; produce proper fillet and open V-groove welds using GTAW welding techniques. *(GTAW – Equipment and Filler Metals – Module Eight – 29201-15 and GTAW Plate – Module Nine – 29208-15)* |
| **End-of-Course Assessment(s):**  Teacher designed assessment  LEA designed assessment  Certification/credentialing exam (specify): NCCER Credentialed Craft Professional’s Training – Welding Level One  Licensing exam (specify):  Nationally recognized exam (specify):  Other (specify): Supervised Agriculture Experience (SAE) Program |
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| **Course title:**  Power and Mechanical Systems (PMS) |
| **Course description (include prerequisites):**  Power and Mechanical Systems (PMS) enables students to apply principles of dynamic power and mechanical systems while incorporating the scientific and engineering principles to be employed in power mechanical and related agricultural industries. Students learn about energy principles, engine theory, engine systems troubleshooting, electrical motor principles, hydraulic systems, and electronics.  Prerequisite: Agricultural Welding and Fabrication (AWF) |
| **Course knowledge and skills (what students will know and be able to do):**   1. Explain basic engine theory of a four stroke and two stroke engine cycle; identify potential fuel sources to power an internal combustion; explain how potential energy becomes kinetic energy and how this relates to agricultural power applications; demonstrate how energy is converted into torque, force, work pressure, and power; explain safety procedures of power production and repair; demonstrate safe practices; apply safety procedures and analyze situations for safety readiness; demonstrate the use of the tools associated with engine repair and maintenance. 2. Identify the major components of an internal combustion engine and explain their significance; demonstrate how major components operate with one another; explain the function of each component. 3. Describe the major events of the four stroke internal combustion, two stroke internal combustion engine, and a diesel engine; compare the differences between a four stroke internal combustion, two stroke internal combustion engine, and a diesel engine; measure the output of an internal combustion engine; and apply techniques to change the output of an internal combustion engine. 4. Troubleshoot the compression system of an internal combustion engine; analyze internal combustion engine data; and interpret compression system data to determine the problem and perform repairs. 5. Identify the type of fuel system on an internal combustion engine; explain the different types and components of each system; explain the function of each component; describe and compare how each system works; troubleshoot and repair the components of the system; explain the scientific principal of carburetion and fuel injection; describe an electronic fuel injection (EFI) system and discuss the differences between EFI and carburation; explain the importance of a governor on agricultural equipment and how they function; and explain the importance of pollution control systems to reduce and eliminate air pollution. 6. Compare the types of cooling systems; explain the function and components of a cooling system; describe the effects of heat on an engine; and assess the effects of a failed cooling system. 7. Identify the components of the lubrication system; explain how a lubrication system relates to engine wear; maintain and service the lubrication system; analyze the components of the lubrication system for wear/failure; collect data on the lubrication system and determine possible issues; describe lubricants and their properties, selection, and applications; and test the lubrication system warning systems. 8. Test the components of a charging system, ignition system, and a starting system; describe the importance of electricity in the engine operation; describe how electricity flows through the engine; compare AC/DC electrical circuits; measure voltage; define current, resistance, amperage, voltage, circuits, and Ohm’s Law; construct and test various circuits while interpreting diagrams and schematics; troubleshoot and repair various circuits. 9. Describe the advantages and disadvantages of electric motors as a power source; explain how electric motors operate; identify common components of an electric motor; identify common types of electric motors; interpret a motor nameplate; select and electric motor for a given agricultural application; install an electric motor; identify and install basic electric motor controls; demonstrate proper electric motor maintenance; describe variable-frequency drives and their function. 10. Describe basic fluid power principles and systems; calculate the multiplication of force in a fluid power system; identify the components of a hydraulic system; describe the operation of gear, rotary, and piston fluid pumps; explain how system controls operate a fluid power system; describe the characteristics of hydraulic pipe, tubing, and hoses, design and build a hydraulic system; and troubleshoot and test a hydraulic system. 11. Identify the basic tools and test equipment used to construct, troubleshoot, and maintain electronic circuits and systems; explain the construction and application of circuit configurations; describe the appearance and general operating principles of multiple electronic components and electrical devices such as capacitors, resistors, inductors, semiconductors, integrated circuits (ICs), generators, motors, and transformers; describe the applied electronics principles used to develop circuitry and circuit-systems; construct an electronic circuit. 12. Inspect machinery to identify repairs or upgrades required for efficient operation; analyze inspection data and create a work order outlining the needed repairs or upgrades necessary for efficient operation; develop a bill of materials and budget for the work order; and perform repairs or upgrades on machinery. |
| **End-of-Course Assessment(s):**  Teacher designed assessment  LEA designed assessment  Certification/credentialing exam (specify): OSHA 10-Hour Training for Construction  Licensing exam (specify):  Nationally recognized exam (specify):  Other (specify): Supervised Agriculture Experience (SAE) Program |

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| PROGRAM OF STUDY CURRICULUM |
| Identify the method of technical and academic curriculum development (adopted, adapted, or developed in accordance with guidance from the program advisory committee). |
| **POS technical and academic curriculum will be:**  Adopted (specify source): State model program of study  Adapted (specify source):  Developed locally (describe):  Other (specify): |

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| TEACHER CERTIFICATION |
| Provide valid teacher certification(s), candidate experience, pre-requisite and requisite licensure or certification requirement(s) for POS teachers. |
| **POS teacher requirements include:**  Teacher certification(s) (list): AgriScience Education or Skilled and Technical Sciences (STS) in Power, Structural & Technical Systems.  Candidate experience (describe): Candidate may have experience in applying knowledge of engineering technology and biological science to agricultural problems concerned with power and machinery, electrification, structures, soil and water conservation, and processing of agricultural products; driving and controlling farm equipment to till soil and to plant, cultivate, and harvest crops. For more information, please see the Bureau of Labor Statistics: Agricultural Engineering and Agricultural Mechanics and Machinery Operation.  Pre-requisite professional licensure or certification requirement(s) (list): NCCER Instructor Certification Training (24 Hrs)  Requisite professional licensure or certification requirement(s) (list):  Other (describe): |

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| VALUE-ADDED OPPORTUNITIES |
| List extended early career and college credit opportunities available during the student’s senior year. Document transition services, cooperative learning experiences, additional dual enrollment, or other. |
| **Opportunities for extended and accelerated learning include:**  Cooperative education (describe):  Structured internship (describe):  Dual enrollment (list):  Advanced Placement (list):  Transition services (describe):  Other (describe): |

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| CAREER AND TECHNICAL STUDENT ORGANIZATIONS |
| Indicate the Career and Technical Student Organization (CTSO) that will be offered by checking the appropriate box. |
| FFA |

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| PROGRAM OF STUDY MATRIX |
| Complete the program of study matrix to demonstrate the alignment of academic and technical courses, culminating early career and early college experiences. Identify appropriate certification and licensure options, opportunities for obtaining early college credit (courses with articulated or dual enrollment credit agreements should be appropriately designated within the matrix), the post-secondary program sequence, and potential career options. *Attach the Program of Study Matrix*. |
| Access the [Program of Study Matrix](http://www.doe.k12.de.us/domain/384) (see [Appendix A](#Appendix_A)). |

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| DEPARTMENT OF EDUCATION PROGRAM OF STUDY APPROVAL | | |
| The following section will be completed by staff from the Delaware Department of Education, CTE & STEM Office and reported to the LEA as part of the CTE program of study approval process. | | |
| **Date Delaware CTE Program of Study Application Received:** | | |
| **Local Education Agency (LEA):**    **School(s):** | | **Program of Study Start Date:** |
| **LEA CTE Coordinator Name:** **Phone:** **E-Mail Address:** | | |
| **Career Cluster & Code:**  Agriculture, Food, and Natural Resources / 1 | **Career Pathway & Code:**  Power, Structural, & Technical Systems / 1.04 | **Program of Study Title & Code:**  Agricultural Power and Engineering / 1.04604 |
| **CTE Program of Study Course Titles, Course Codes, and Funding Levels:**  1. Fundamentals of Agricultural Power and Engineering (FAPE) / 1.04604011 / 2  2. Agricultural Welding and Fabrication (AWF) / 1.04604022 / 3  3. Power and Mechanical Systems (PMS) / 1.04604033 / 3 | | |
| **CTE Concentrator/Completer Course Titles:**  Concentrator Course: Agricultural Welding and Fabrication (AWF) / 1.04604022  Completer Course: Power and Mechanical Systems (PMS) / 1.04604033 | | |
| **CTE Program of Study Request:**  State-model CTE Program of Study  Local CTE Program of Study | | |
| **CTE Program of Study Attachments:**  Labor Market Information (LMI) Review;  Articulation/Dual Enrollment Agreement(s); and  Program of Study Matrix. | | |
| DDOE CTE & STEM Director Signature: Date: | | |
| DDOE Chief Academic Officer Signature: Date: | | |