Maryland CTE Program of Study

## Construction Maintenance

## Secondary CTE Program of Study Proposal Form

Maryland State Department of Education

Division of Career and College Readiness

200 West Baltimore Street

Baltimore, Maryland 21201-2595

This agreement is between the Division of Career and College Readiness (DCCR), Maryland State Department of Education, and the local school system (LSS) listed below.

**LOCAL SCHOOL SYSTEM INFORMATION**

Complete the information requested below, including the original signature of the CTE Local Director.

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| Local School System (LSS) and Code: |       |
| Name of CTE Local Director: |       | Phone: |       |
| LSS Career Cluster: |       |
| LSS Program Title: |       |
| Pathway Options: | **1. Heating, Ventilation, Air Conditioning (HVAC)** | **2. Industrial Maintenance** | **3. Welding** |
| Value Added Options: | [x]  Yes [ ]  No | This program provides students the opportunity to earn early college credit. The academic and technical course sequences for both secondary and postsecondary programs are included herein. |
| [ ]  Yes [ ]  No | Enclosed is a copy of the articulation agreement (Copy required for CTE program approval if the program is articulated with a postsecondary education provider). |
| [x]  Yes [ ]  No | This program provides students with the opportunity to earn an industry-recognized credential. The credential is identified herein. |
| Program Start Date: |       |  |  |
| Signature of CTE Local Director: |  | Date: |       |
| Signature of Local Superintendent: |  | Date: |       |

**TO BE COMPLETED BY MSDE/DCCR**

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| --- | --- |
| Date Program Proposal received by CTE Systems Branch: |       |
| CTE Control Number: |       | Fiscal Year: |       |
| CIP Number: | Program: **Construction Maintenance** | Pathway Option 1:**HVAC 47.5200** | Pathway Option 2:**Maintenance 47.5100** | Pathway Option 3:**Welding 47.5300** |
| MSDE Cluster Title: | **Construction and Development** |

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| **Approval Starts FY:** |  |  |
|  |  |  |
| Signature, Assistant State Superintendent, Career and College Readiness |  | Date |

**CTE Secondary Program Proposal Contents**

**STEP 1A: PROGRAM ADVISORY COMMITTEE MEMBERS AND THEIR AFFILIATIONS**

Complete the list of the Program Advisory Committee (PAC) members. Members should include employers, local workforce development representatives, economic development personnel, business, or labor representatives, and the remainder should include secondary and postsecondary, academic and technical educators and other stakeholders. Place a check in the appropriate box to indicate the role each person plays. Include all of the information requested for each entry. Use this form or a locally developed form – either one is acceptable as long as all information is provided.

# Program Advisory Committee List

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| **Membership: First entry should be the industry representative who is leading the PAC.** |
| PAC Leader Name: |       | Representation: |
| Title: |       | [ ]  Industry [ ]  Secondary [ ]  Postsecondary  |
| Affiliation: |       |
| Address1: |       |
| Address2: |       |
| City: |       | State: |       | Zip |       |
| Phone: |       | Fax: |       |
| Email: |       |
| Area of Expertise: |       |
| Role: | [ ]  Work-based Learning [ ]  Curriculum Development [ ]  Skills Standards Validation [ ]  Staff Development |
| [ ]  Program Development  | [ ]  Other (specify):  |       |

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| Name: |       | Representation: |
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| Area of Expertise: |       |
| Role: | [ ]  Work-based Learning [ ]  Curriculum Development [ ]  Skills Standards Validation [ ]  Staff Development |
| [ ]  Program Development  | [ ]  Other (specify):  |       |

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| [ ]  Program Development  | [ ]  Other (specify):  |       |

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| Role: | [ ]  Work-based Learning [ ]  Curriculum Development [ ]  Skills Standards Validation [ ]  Staff Development |
| [ ]  Program Development  | [ ]  Other (specify):  |       |

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| Role: | [ ]  Work-based Learning [ ]  Curriculum Development [ ]  Skills Standards Validation [ ]  Staff Development |
| [ ]  Program Development  | [ ]  Other (specify):  |       |

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| [ ]  Program Development  | [ ]  Other (specify):  |       |

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| Name: |       | Representation: |
| Title: |       | [ ]  Industry [ ]  Secondary [ ]  Postsecondary  |
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| Area of Expertise: |       |
| Role: | [ ]  Work-based Learning [ ]  Curriculum Development [ ]  Skills Standards Validation [ ]  Staff Development |
| [ ]  Program Development  | [ ]  Other (specify):  |       |

STEP 1B: DOCUMENTED LABOR MARKET DEMAND

Check the appropriate box below.

[x]  **Demand exists**

The PAC will review labor market information on a local, regional and/or state basis. Check this box if demand exists for the identified occupations. The labor market information does not need to be provided with the proposal as long as there is a demand for employees according to data provided by the [Department of Labor, Licensing and Regulation](http://www.dllr.state.md.us/lmi/) (DLLR) or documented by employers in letters or other correspondence.

[ ]  **If evidence for labor market demand is not readily available, attach documentation to the proposal.**

Check this box if there is a unique labor market demand for a program and data are not available from the DLLR. If the occupation is new or emerging and no data exist, supporting evidence is submitted with the proposal (i.e., document local, national, or regional trends, local circumstances, or provide letters from employers or local economic/workforce development offices documenting employment demand including the projected number of openings by pathway).

**STEP 2A: PROGRAM OVERVIEW**

After determining the cluster and pathway options, identify the standards used to develop the CTE program of study. Describe the program to be developed in detail based on what students are expected to know and be able to demonstrate as a result of participating in the program.

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| **Indicate the title and source of the skills standards for this program:** * National Center for Construction Education and Research (NCCER) provides standards, curriculum, and assessment for these program areas.
* North America’s Building Trades Unions, through the local Building Trades Councils (BTC), provides standards, curriculum, and assessment for the first Core course, equivalent to the NCCER Core.
 |
| **Program Overview:**The Maryland program of study Construction: Maintenance follows NCCER curricula, accessed via [this link](http://www.nccer.org/curriculum?mID=86), with an option to follow the BTC’s core course.  Within Construction: Maintenance are 3 pathway options: Heating, Ventilation, Air Conditioning (HVAC); Industrial Maintenance; and Welding.Each Construction: Maintenance pathway option starts with a 1 credit core curriculum course that provides a strong foundation for all students entering this career field. NCCER’s core course, *Foundations of Building and Construction,* aligns with the NCCER national standards and related work-based learning opportunities, and is designed to be completed in approximately 100 hours (80 hours of instruction with an additional estimated 20 hours of related hands-on applications/work-based learning opportunities to reinforce and extend learning). BTC’s core course, *Multi-Craft Core Curriculum – MC3*, is 120 hours of apprentice readiness training developed and approved by the Building Trades National Apprenticeship and Training Committee. After successful completion of *Foundations of Building and Construction*, if this is the core course chosen by the LSS, students must pass the National Construction Career Test (NCCT) for the Core in order to be entered into NCCER’s National Registry (required for these program options).  Once registered, students may proceed into a specific pathway option and take Craft Level 1 (1 credit) and the associated NCCER certification exam, and then Craft Level II (2 credits) and the associated NCCER certification exam.  In support of the curriculum package, students in the program spend approximately 25% of their time in integrated hands-on experience working on construction projects at the school and on the work-site. As students successfully complete each level of the curriculum and related NCCT exam, their NCCER National Registry status is updated.  The National Registry provides a nationally recognized certification in the industry.If the LSS chooses to offer the BTC *Multi-Craft Core Curriculum – MC3* core option, students must still be registered with NCCER’s national Registry before proceeding to NCCER Levels I and II.Additional curriculum modules covering project management and project supervision as it relates to all areas of Construction Maintenance are offered as supplemental resources and support articulation to postsecondary Construction Management programs.The NCCER Contren™ Learning Series prepares students for entry into their selected career pathway and for further study and training through apprenticeship providers and through articulation agreements with community colleges.  Craft Levels I and II meet the Apprenticeship Training requirements, as specified by the Employer and Labor Services (formerly Bureau of Apprenticeship Training) for classroom-related training.Schools offering the Construction: Maintenance program must complete the NCCER accreditation process and ensure students have access to certification through the NCCER National Registry.  As part of the accreditation process, NCCER has developed the Instructor Certification Training Program (ICTP).  This program ensures the uniform delivery of training.  All teachers in the program receive training and are certified as an instructor and to administer NCCER assessments. The CTE Pathway Programs are supported by an industry sponsor as required by NCCER. The sponsor provides oversight to the program, specifically providing assurances for instructor certification, assessment administration, and on-going support and evaluation of program quality. The Accredited Training Sponsor, **Insert Sponsor Name**, was declared as an Accredited Training & Education Facility, **Insert Date** |

**STEP 2B: COURSE DESCRIPTIONS AND END-OF-COURSE ASSESSMENTS**

Insert each CTE completer course title. Describe each course based on what students are expected to know and be able to demonstrate as a result of their participation. Check the assessment instrument(s) that will be used to document student attainment of the knowledge and skills included in each course and specify additional information as appropriate.

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| **CORE OPTION #1:****Course Title: Foundations of Building and Construction Technology (NCCER Core)** – all pathway options (one credit)**Course Description**:The Foundations of Building and Construction course (ed. 2015) is the Core Curriculum of the Construction and Development Cluster. The NCCER Core Curriculum is taught within this course and is the basis for all construction skills. NCCER strongly recommends that students successfully complete the Core Curriculum before advancing to Level One of their chosen field. The course of study descriptions correlate to the modules of the NCCER national standards and related work-based learning opportunities. The following modules are designed to be completed in approximately 80 hours of instruction and allows for an estimated 20 hours of related “hand-on” applications/work-based learning opportunities to reinforce and extend the learning.The course of study includes demonstration of student mastery of the following topics:* Basic Safety (12.5 hrs). Includes personal protective equipment, performance safety, and what to do if an accident occurs.
* Introduction to Construction Math (10 hrs). From basic addition to multiplying fractions, this module prepares students to do the calculations they’ll be performing on the job site.
* Introduction to Hand Tools (10 hrs). Covers basic tools and equipment used in the field. Also covers maintenance instructions and safety tips.
* Introduction to Power Tools (10 hrs). Provides instructions for tools powered by electricity, batteries, and pressurized air, such as drills, saws, grinders and sanders, and other common construction equipment. Also covers maintenance instructions and safety tips.
* Introduction to Construction Drawings (10 hrs). Introduces students to different types of plans and how they represent a finished building. Shows the parts of blueprint in detail, including symbols, title block, and gridlines.
* Introduction to Basic Rigging (7.5 hrs). Covers the slings, hardware, hoists, and hitches used in rigging operations. Also highlights critical safety issues and accepted rigging techniques and practices.
* Basic Communication Skills (7.5 hrs). Covers information and skills needed to communicate effectively and clearly.
* Basic Employability Skills (7.5 hrs). Provides guidance related to finding and securing a position in the construction trades.
* Introduction to Material Handling (5 hrs). Covers safety guidelines for workers handling materials on the job site.
* Hands-On Experiences (20 hrs). Provides hands-on experiences in each of the trades areas, Carpentry, Masonry, Construction Electricity and/or HVAC so that students can gain a working knowledge of the construction industry.

Given the emphasis on providing a broad introduction to the Career Cluster in this course, a module from the Level One curriculum will be provided (listed below). Additional modules and/or academic remediation (including communication and employability skills) may be provided given an estimated additional 35 hours of instructional time in the first credit/course. * Orientation to the Trade/Introduction to HVAC, industrial Maintenance and other Construction Pathways. Covers the basic principles of heating, ventilation, and air conditioning; and industrial maintenance as well as career opportunities in construction, training, and apprenticeship programs.
* Schools may explore the use of SkillsUSA Professional Development Program (PDP) resources to enhance career development and workplace readiness knowledge and skills.

**End of Course Assessment**Check the assessment instruments that will be used to document student attainment of the course knowledge and skills.[ ]  Teacher-designed end-of-course assessment[ ]  School system-designed end-of-course assessment[ ]  Vendor-developed exam: (specify)      [ ]  Licensing exam: (specify)      ☒ Certification or credentialing exam: (specify) (see description below)☒ Nationally recognized examination: (specify)      Students must pass the module assessments for the **Construction Core** to be entered into NCCER’s National Registry. The National Registry provides a nationally recognized certification in the industry. Upon completion of the Core, students move to the Craft Level curriculum and assessments for their chosen option/trade. |
| **CORE OPTION #2:****Course Title: Multi-Craft Core Curriculum – MC3 (BTC Core)** – all pathway options (one credit)**Course Description**:The Building Trades Unions use this Multi-Craft Core Curriculum (MC3) in their apprentice readiness programs. It is a 120-hour comprehensive training program developed and approved by the Building Trades National Apprenticeship and Training Committee, and it is recognized by the US Department of Labor. The MC3 prepares people to enter into apprenticeship programs, and is only offered in cooperation with state and local Building Trades Councils (BTC). To offer this BTC Multi-Craft Core Curriculum – MC3, contact your local BTC.The Multi-Craft Core Curriculum contains 84 hours of required coursework, and 36 hours of electives:* Required:
* Orientation and Industry Awareness- 8 hours
* Construction Trade Awareness- 8 hours
* Tools and Materials Hands on Training- 8 hours
* Basic Math for Construction- 40 hours
* Heritage of the American Worker- 8 hours
* Diversity in the Construction Industry- 12 hours (Diversity Awareness- 4 hours/Sexual Harassment- 8 hours)
* Electives options:
* Construction Health and Safety- 22 hours (CPR and First Aid- 8 hours/Osha-10- 10 hours/Women’s Health and Safety- 4 hours)
* Blueprint Reading- 24 hours
* Green Construction- 4-8 hours
* Financial Responsibility- 4-8 hours

**End of Course Assessment**Check the assessment instruments that will be used to document student attainment of the course knowledge and skills.☒ Teacher-designed end-of-course assessment[ ]  School system-designed end-of-course assessment☒ Vendor-developed exam: (specify) Maryland BTI developed MC3 examination[ ]  Licensing exam: (specify)      [ ]  Certification or credentialing exam: (specify) (see description below)[ ]  Nationally recognized examination: (specify)      Students must pass the assessments for the MC3, and be entered into NCCER’s National Registry prior to sitting for NCCER Craft Level I and II examinations for their chosen option/trade. |

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| **The PATHWAY OPTION 1** **Heating, Ventilation, and Air Conditioning** (HVAC) program option provides students with an opportunity to learn about the industry as it relates to residential and commercial building. Participants master a variety of HVAC skills. Students apply their knowledge and skills by participating in the “student-built” house project. The course of study descriptions correlate to the modules of the NCCER national standards.**Course Title: HVAC 1 -- Level I includes a minimum of 120+ hours of NCCER** (ed. 2013 one credit)Course Description: The course of study for HVAC 1 includes demonstration of student mastery of the following topics:* Introduction to HVAC (7.5 hrs). A broad introduction to the world of the HVAC technician. The most basic operating principles of HVAC systems are presented along with a review of technician licensing and trade-governing regulations. The final portion of the module describes potential career paths for the well-trained HVAC technician.
* Trade Math (10 hrs). Explains how to solve problems involving the measurement of lines, area, volume weights, angles, pressure, vacuum, and temperature. Also scientific notation, powers, roots, and basic algebra and geometry.
* Basic Electricity (12.5 hrs). Teaches power generation and distribution, electrical components, DC circuits, and electrical safety.
* Introduction to Heating (15 hrs). Covers heating fundamentals, types and designs of furnaces and their components, and basic procedures for installing and servicing furnaces.
* Introduction to Cooling (30 hrs). Covers the basic principles of heat transfer, refrigeration, and pressure-temperature relationships and describes the components and accessories used in air conditioning systems.
* Basic Copper and Plastic Piping Practices (10 hrs). Covers the selection, preparation, joining, and support of copper and plastic piping and fittings.
* Soldering and Brazing (10 hrs). Covers tools, materials, and safety precautions and depicts step-by-step procedures for soldering and brazing piping.
* Basic Carbon Steel Piping Practices (10 hrs). Provides the basic knowledge and skills needed to thread and install carbon steel piping systems. In addition, the concepts of assembling and installing grooved piping systems are also presented.

**End of Courses Assessment**Check the assessment instruments that will be used to document student attainment of the program knowledge and skills.[ ]  Teacher-designed end-of-program assessment[ ]  School system-designed end-of-program assessment[ ]  Vendor-developed exam: (specify)      [ ]  Licensing exam: (specify)      [x]  Certification or credentialing exam: (specify)      [x]  Nationally recognized examination: (specify) See BelowStudents must pass the NCCT for the **HVAC** through the NCCER’s National Registry to advance to Level II certification. Upon completion of the Craft Level curriculum and assessments (NCCT), students meet classroom instruction requirements of the related apprenticeship program(s).  |
| **Course Title: HVAC 2 – Level II includes a minimum of 170+ hours of NCCER** (2 credits)Course Description: The course of study for HVAC 2 includes demonstration of student mastery of the following topics:* Alternating Current (10 hrs). Covers transformers, single-phase and three-phase power distribution, capacitors, the theory and operation of induction motors, and the instruments and techniques used in testing AC circuits and components. Also reviews electrical safety.
* Compressors (12.5 hrs). Explains the operating principles of the different types of compressors used in comfort air conditioning systems as well as basic installation service and repair procedures for these compressors.
* Refrigerants and Oils (12.5 hrs). Discusses the refrigerants and oils used in modern refrigeration and air conditioning systems.
* Leak Detection, Evacuation, Recovery, and Charging (30 hrs). Provides students with guidance related to servicing the refrigerant circuit of HVAC systems. The four essential service tasks—leak detection, evacuation, recovery, and charging—are covered in detail.
* Metering Devices (12.5 hrs). Covers the operating principles, applications, installation, and adjustment of the various types of fixed and adjustable expansion devices used in air conditioning equipment.
* Heat Pumps (20 hrs). Covers the principles of reverse cycle heating, describes the operation of the various type of heat pumps, and helps the student learn how to analyze heat pump control circuits. Includes heat pump installation and service procedures.
* Basic Maintenance (20 hrs). Introduces students to the common tasks associated with basic maintenance activities. Specific tasks, such as lubrication and belt installation, are reviewed in detail.
* Chimneys, Vents, and Flues (5 hrs). Describes the principles of furnace venting of fossil-fuel furnaces and the proper methods for selecting and installing vent systems for gas-fired heating equipment.
* Sheet Metal Duct System (10 hrs). Covers sheet metal duct systems. While other materials can be used to fabricate air ducts, sheet metal has been and continues to be one of the most popular materials for this purpose.
* Fiberglass and Fabric Duct Systems (7.5 hrs). Reviews the application and methods of fabricating fiberglass duct systems, the installation guidelines for installing a fiberglass system, methods to repair damaged components, and concludes with coverage of fabric-based duct systems.
* Commercial Airside Systems (12.5 hrs). Introduces the air distribution systems used in commercial structures such as schools and office buildings that are divided into comfort heating and cooling zones.
* Air Quality Equipment (5 hrs). Introduces the factors related to indoor air quality and human comfort, the equipment used to control humidity, air filtration materials, and the introduction of outside air into the indoor environment.
* Introduction to Hydronic Systems (12.5 hrs). Introduces students to hydronic heating systems.

Individual programs may place greater emphasis on additional requirements of **HVAC** with modules from Level III curriculum or standards required by the sponsor and/or advisory board. Additional modules from **HVAC Level III** will provide preparation for the NCCT Exams/Certification and may include the following modules for an additional 97.5 hours of instruction:* Planned Maintenance. Describes the purpose of planned maintenance and outlines the procedures for servicing gas as oil furnaces, electric heating equipment, cooling equipment, and heat pumps.
* Troubleshooting Gas Heating. Covers tools and instruments used in troubleshooting gas-heating appliances and offer students the opportunity to isolate and correct faults.
* Troubleshooting Electric Heating. Reviews the operation of electric heating appliances. Students will spend time in the lab learning to isolate and correct faults in this equipment under the instructor’s supervision.
* Troubleshooting Oil Heating. Teaches students to identify the common causes of problem in oil furnaces and offers hands-on experience in isolating and correcting oil furnace malfunctions.
* Troubleshooting Cooling. Covers the basic techniques and equipment used in troubleshooting cooling equipment; explains how to troubleshoot cooling equipment malfunctions.
* Troubleshooting Heat Pumps. Following a review of heat pump operation and heat pump control circuits, the student will work with the instructor in the lab to isolate and correct faults in the heating, cooling, auxiliary heat, and defrost function of heat pumps.
* Troubleshooting Accessories. In hands-on lab sessions, students learn how to troubleshoot humidifiers, electronic air cleaners, economizers, zone controls, and heat recovery ventilators.
* Troubleshooting Electronic Controls. Explains how to analyze circuit diagrams for electronic and microprocessor-based controls used in comfort heating and cooling equipment, and how to troubleshoot systems that use these controls.

**End of Courses Assessment**Check the assessment instruments that will be used to document student attainment of the program knowledge and skills.[ ]  Teacher-designed end-of-program assessment[ ]  School system-designed end-of-program assessment[ ]  Vendor-developed exam: (specify)      [ ]  Licensing exam: (specify)      [x]  Certification or credentialing exam: (specify)      [x]  Nationally recognized examination: (specify) See BelowStudents must pass the NCCT for **HVAC** through the NCCER’s National Registry for certification. Upon completion of the Craft Level curriculum and assessments (NCCT), students meet classroom instruction requirements of the related apprenticeship program(s). |
| **The PATHWAY OPTION 2** **Industrial Maintenance** program option provides students with an opportunity to learn about the industry as it relates to commercial building maintenance. Participants master a variety of electrical and maintenance skills including cutting, piping and lubrication of equipment and systems. The course of study descriptions correlate to the modules of the NCCER national standards.**Course Title: Industrial Maintenance 1 -- Level I includes a minimum of 120+ hours NCCER** (ed. 2007, 1 credit)Course Description: The course of study for Industrial Maintenance 1 includes demonstration of student mastery of the following topics:* Tools of the Trade (5 Hours). Provides an introduction to the hand and power tools used in industrial maintenance. Covers safety procedures and techniques for use of these tools.
* Fasteners and Anchors (5 Hours). Covers the hardware and systems used by an industrial maintenance craftsperson. Describes various types of anchors and supports, their applications, and how to install them safely.
* Oxyfuel Cutting (17.5 Hours). Explains the safety requirements for oxyfuel cutting. Identifies oxyfuel cutting equipment and provides instructions for setting up, lighting, and using the equipment. Includes straight line cutting, piercing, beveling, washing, and gouging.
* Gaskets and Packing (10 Hours). Introduces types of gaskets and gasket material, types of packing and packing material, and types of O-ring material. Explains the use of gaskets, packing, and O-rings, and teaches how to fabricate a gasket.
* Craft-Related Mathematics (15 Hours). Explains how to use ratios and proportions, solve basic algebra, area, volume, and circumference problems, and solve for right triangles using the Pythagorean theorem.
* Construction Drawings (12.5 Hours). Introduces plot plans, structural drawings, elevation drawings, as-built drawings, equipment arrangement drawings, P&IDs, isometric drawings, basic circuit diagrams, and detail sheets.
* Pumps and Drivers (5 Hours). Explains centrifugal, rotary, reciprocating, metering, and vacuum pump operation and installation methods, as well as types of drivers. Also covers net positive suction head and cavitation.
* Valves (5 Hours). Identifies and provides installation methods for different types of valves. Also covers valve storage and handling.
* Introduction to Test Instruments (7.5 Hours). Introduces the basic test equipment for industrial maintenance, including tachometers, pyrometers, strobe meters, voltage testers, and automated diagnostic tools.
* Material Handling and Hand Rigging (15 Hours). Introduces the equipment and techniques of material handling, and describes the procedures for rigging and communicating with riggers.
* Mobile and Support Equipment (10 Hours). Introduces the safety procedures and methods of operation for motorized support equipment, including forklifts, manlifts, compressors, and generators.
* Lubrication (12.5 Hours). Explains lubrication safety, storage, and classifications. Also explains selecting lubricants, additives, lubrication equipment, and lubricating charts.

**End of Courses Assessment**Check the assessment instruments that will be used to document student attainment of the program knowledge and skills.[ ]  Teacher-designed end-of-program assessment[ ]  School system-designed end-of-program assessment[ ]  Vendor-developed exam: (specify)      [ ]  Licensing exam: (specify)      [x]  Certification or credentialing exam: (specify)      [x]  Nationally recognized examination: (specify) See BelowStudents must pass the NCCT for the **Industrial Maintenance** through the NCCER’s National Registry to advance to Level II. Upon completion of the Craft Level curriculum and assessments (NCCT), students meet classroom instruction requirements of the related apprenticeship program(s).  |
| **Course Title: Industrial Maintenance 2 – Level II includes a minimum of 160+ hours NCCER** (2 credits)Course Description: The course of study for Industrial Maintenance 2 includes demonstration of student mastery of the following topics:* Basic Layout (20 Hours). Discusses the tools used in layout. Explains how to lay out baselines using the arc method and 3-4-5 method.
* Introduction to Piping Components (5 Hours). Introduces chemical, compressed air, fuel oil, steam, and water systems. Explains how to identify piping systems according to color codes.
* Copper and Plastic Piping Practices (5 Hours). Covers the selection, preparation, joining, and support of copper, plastic piping, and fittings.
* Introduction to Ferrous Metal Piping Practices (5 Hours). Covers various types of iron and steel pipe and fittings and provides step-by-step instructions for cutting, threading, and joining ferrous piping.
* Identify, Install, and Maintain Valves (10 Hours). Explains how to remove and install threaded and flanged valves, how to replace valve stem O-ring and bonnet gaskets, and how to repack a valve stuffing box. Also discusses the purpose of valve packing.
* Hydrostatic and Pneumatic Testing (10 Hours). Describes non-destructive and pressure testing of systems and equipment.
* Introduction to Bearings (15 Hours). Introduces plain, ball, roller, thrust, guide, flanged, pillow block, and takeup bearings. Discusses bearing materials and designations.
* Low-Pressure Steam Systems (10 Hours). Introduces the components and functions of basic steam systems, including boilers, steam traps, and blowdown recovery systems.
* High-Pressure Steam Systems and Auxiliaries (20 Hours). Explains the functioning of high-pressure steam systems used in industry.
* Distillation Towers and Vessels (20 Hours). Introduces the various types and functioning of distillation towers and vessels, including recovery vessels and condensate processing.
* Heaters, Furnaces, Heat Exchangers, Cooling Towers, and Fin Fans (30 Hours). Introduces the student to the equipment used to transfer and remove heat from systems in process.
* Introduction to Tube Work (10 Hours). Covers the basics of working with heat exchanger and furnace tubing and tube sheets.

**End of Courses Assessment**Check the assessment instruments that will be used to document student attainment of the program knowledge and skills.[ ]  Teacher-designed end-of-program assessment[ ]  School system-designed end-of-program assessment[ ]  Vendor-developed exam: (specify)      [ ]  Licensing exam: (specify)      [x]  Certification or credentialing exam: (specify)[x]  Nationally recognized examination: (specify) See BelowStudents must pass the NCCT for the **Industrial Maintenance** through the NCCER’s National Registry. Upon completion of the Craft Level curriculum and assessments (NCCT), students meet classroom instruction requirements of the related apprenticeship program(s). |
| **The PATHWAY OPTION 3** **Welding** program option provides students with an opportunity to learn about the industry as it relates to welding. Participants master a variety of welding skills including oxyfuel cutting and welding including SMAW. The course of study descriptions correlate to the modules of the NCCER national standards. NCCER meets the American Welding Society (AWS) Entry Level Welder—Phase One and Phase Two requirements of the AWS QC-10 and AWS EG2.0-95 guidelines.**Course Title: Welding -- NCCER Level I includes a minimum of 427.5+ hours NCCER – in addition to Core** (ed. 2015, 4 credits)Course Description: Students will master the following content/skill areas as outlined in NCCER materials. Topics include:* Welding Safety (5 hrs). Introduces students to the all-important topic of safety in the welding trade.
* Oxyfuel cutting (17.5 hrs). Covers the methods and procedures of the oxyfuel cutting process.
* Plasma Arc Cutting (7.5 hrs). Introduces the students to the methods and procedures related to the plasma arc cutting process.
* Air-Carbon Arc Cutting and Gouging (10 hrs). Provides information on the methods and procedures related to air-carbon arc cutting and gouging processes.
* Base Metal Preparation (12.5 hrs). The methods and procedures related to preparing base metal for welding.
* Weld Quality (10 hrs). Covers the methods and procedures to produce high-quality welds. Includes welding codes and provisions, discontinuities, examination practices, and weld procedure testing.
* SMAW Equipment and Setup (5 hrs). Introduces the students to methods and procedures related to setting up SMAW equipment.
* SMAW Electrodes (2.5 hrs). Covers the selection, classification, and use of electrodes for arc welding.
* SMAW Beads and Fillet Welds (100 hrs). Introduces the methods and procedures related to SMAW beads and fillet welding. Hands-on practice and the completion of welding-related Performance Tasks complete the learning process.
* Joint Fit-Up and Alignment (7.5 hrs). Techniques and procedures to perform proper joint fit-up and inspection.
* SMAW Groove Welds with Backing (60 hrs). Introduces the students to the method and procedures related to the SMAW groove welding process. Students will learn safety procedures, welding joint preparation, specifications, identification of physical characteristics, mechanical properties, and cleaning techniques of SMAW groove welds.
* SMAW – Open-Root Groove Welds – Plate (60 hrs). Covers the methods and procedures of the SMAW open-root groove welding process. Students will learn about safety procedures and groove joint preparation, and practice open-root groove welding techniques.

Program standards are aligned to the requirements of the American Welding Society (AWS). Completion of the instructional modules listed above, including students demonstrating mastery of the skills, meets AWS Entry Level Welder certification requirements. A significant amount of instructional time is dedicated to the following skill development:* SMAW Beads and Fillet Welds (120 hours),
* SMAW Groove Welds with Backing (120 hours), and
* SMAW Open-Root Groove Welds (120 hours).

**End of Courses Assessment**Check the assessment instruments that will be used to document student attainment of the program knowledge and skills.[ ]  Teacher-designed end-of-program assessment[ ]  School system-designed end-of-program assessment[ ]  Vendor-developed exam: (specify)      [ ]  Licensing exam: (specify)      [x]  Certification or credentialing exam: (specify)[x]  Nationally recognized examination: (specify) See BelowStudents must pass the NCCT for **Welding** through the NCCER’s National Registry. Upon completion of the Craft Level curriculum and assessments (NCCT), students meet classroom instruction requirements of the related apprenticeship program(s). |

**STEP 2C: END-OF-PROGRAM ASSESSMENT**

Check the assessment instruments that will be used to document student attainment of the program knowledge and skills. Include and identify assessments leading to industry recognized credentials if available and appropriate.

[ ]  Teacher-designed end-of-program assessment

[ ]  School system-designed end-of-program assessment

[ ]  Partner-developed exam: (specify)

[ ]  Licensing exam: (specify)

[x]  Certification or credentialing exam: (specify)

[x]  Nationally recognized examination: (specify)

Regardless of area of specialization, all students will complete 3 NCCT examinations through the NCCER’s National Registry: **Construction Core, Level I, and Level II**.

**STEP 2D: Program Sequence Matrix**

(Include the program sequences for High School, Associate’s Degree, and Bachelor’s Degree programs.) Identify the pathway options. Complete the matrix for the 9-12 CTE program of study, plus, for Tech Prep programs include the matrix for the two- or four-year college program of study. Indicate which courses receive CTE credit by placing the number of credits in parentheses after each CTE course title. Place an asterisk (\*) next to the course identified as the concentrator course indicating that the student has completed 50% of the program.

The CTE program matrix defines a planned, sequential program of study that consists of a minimum of four credits in CTE coursework in high school including work-based learning and/or industry-mentored projects. Work-based learning (WBL) experiences or industry-mentored projects must be included in the program to obtain approval. The program matrix includes the recommended academic and CTE courses identified for the pathway and postsecondary linkages (i.e., dual enrollment, Tech Prep, transcripted and articulated credit).

CTE programs typically begin after ninth grade and do not include career exploration courses. Courses such as computer applications and keyboarding are not included in the completer sequence because they provide prerequisite skills for both academic courses and CTE programs. Academic courses are counted only if they are tailored to serve mainly CTE students and have been revised to reflect industry skill standards. Technology Education or Advanced Technology Education courses are not acceptable for credit in the career and technology education program sequence.

|  |
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| **The LSS program title should be the same one that appears on the cover page. If more than one pathway option is offered in the program, complete a matrix for each program option (MSDE will insert the CIP number). Example: An Academy of Information Technology program may include options in web design & programming.** |
| **Pathway/Program:** | **Construction MaintenanceThree Options: 1-HVAC;** **2-Industrial Maintenance;** **3-Welding**  | **CIP Numbers(for MSDE Use)** | **HVAC****Maintenance****Welding** | **47.5200****47.5100****47.5300** |
| **Graduation Requirements** | **Grade 9** | **Grade 10** | **Grade 11** | **Grade 12** |
| English – 4 |  |  |  |  |
| Social Studies – 3 |  |  |  |  |
| Mathematics – 3  | **Algebra I** | **Geometry** | **Algebra II** | Trig./Pre-Calc. |
| Science - 3 | Earth Science (or) Biology | Biology (or)**Chemistry** | Chemistry (or)**Physics** | Physics |
| Physical Education -.5Health Education - .5 |  |  |  |  |
| Fine Arts - 1 |  |  |  |  |
| Technology Education – 1 |  |  |  |  |
| CTE Completer Program – 4 \*concentrator course |  | **Construction Core (1 credit)**All pathways start with this 1 credit foundation course | **HVAC I** (1 credit) or **Maintenance I** (1 credit) or**Welding I** (1 credit) | **HVAC II\*** (2 credits)or **Maintenance II**\* (2 credits)or**Welding II**\* (2 credits) |
| **If LSS sequence differs from the State-approved sequence in the previous row, identify the LSS sequence here. in an attachment, provide a justification for the variation.** |  |  |  |  |
| Foreign Language – 2and/or Advanced Tech Ed - 2 |  |  |  |  |
| **Provide a list of examples of careers students are preparing to enter and postsecondary options:**Program options provide documentation through the NCCER national registry for articulation of program requirements for registered apprenticeship programs across the country. All programs identify an industry sponsor and apprenticeship options as part of the NCCER Certification process. Additional A.A.S. programs are available at several Maryland Community Colleges.* **HVAC** – HVAC Technician, Industrial Maintenance Technician, Building Management, Construction Management
* **Industrial Maintenance** – Industrial Maintenance Technician, Building Management, Construction Management
* **Welding** – NCCER meets the American Welding Society (AWS) Entry Level Welder—Phase One and Phase Two requirements of the AWS QC-10 and AWS EG2.0-95 guidelines.
 |

**Program Sequence Matrix**

Two Year College Program Sequence – Program Overview

|  |
| --- |
| **Many local school systems provide postsecondary matrices in their program of study guides to inform students, parents, and counselors of the opportunities available to those enrolled in the program. Section 2E must be completed before an articulated CTE program of study can be approved. A copy of the Articulation Agreement is required to be submitted with the proposal prior to program approval.****Describe the program to be developed in detail based on what students are expected to know and be able to demonstrate as a result of participating in the program.**      |
| **Program Title:**      **Description of College/Institution and Program:**       |
| **Recommended Sequence**Complete the program matrix for the postsecondary sequence for the articulated CTE program of study. Indicate which courses receive articulated or transcripted credit by PLACING THE NUMBER OF CREDITS IN PARENTHESES after each course title.  |
| **Semester 1** | **Semester 2** |
| Course Title (# Articulated/Transcripted Credits)Course Description | Course Title (# Articulated/Transcripted Credits)Course Description |
| **Semester 3** | **Semester 4** |
| Course Title (# Articulated/Transcripted Credits)Course Description | Course Title (# Articulated/Transcripted Credits)Course Description |
| **Provide a list of career options for students who complete the program:**       |

**Program Sequence Matrix**

Four Year College Program Sequence – Program Overview

|  |
| --- |
| *Complete this matrix if the program includes a four year degree option***Many local school systems provide postsecondary matrices in their program of study guides to inform students, parents, and counselors of the opportunities available to those enrolled in the program. Section 2E must be completed before an articulated CTE program of study can be approved. A copy of the Articulation Agreement is also required to be submitted with the proposal prior to program approval.****Describe the program to be developed in detail based on what students are expected to know and be able to demonstrate as a result of participating in the program.** |
| **Program Title:**      **Description of College/Institution and Program:**       |
| **Recommended Sequence**Complete the program matrix for the postsecondary sequence for the articulated CTE program of study. Indicate which courses receive articulated or transcripted credit by PLACING THE NUMBER OF CREDITS IN PARENTHESES after each course title.  |
| **Semester 5** | **Semester 6** |
| Course Title (# Articulated/Transcripted Credits)Course Description | Course Title (# Articulated/Transcripted Credits)Course Description |
| **Semester 7** | **Semester 8** |
| Course Title (# Articulated/Transcripted Credits)Course Description | Course Title (# Articulated/Transcripted Credits)Course Description |
| **Provide a list of career options for students who complete the program:**       |

STEP 2E: VALUE-ADDED OPTIONS

Fill in the name of the partnering college or agency. Specify the credential that students will earn. Under value-added, indicate the number of credits or hours granted. This information is required before a program can be designated as a CTE articulated program of study.

|  |  |  |  |
| --- | --- | --- | --- |
| **Option** | **Partner** | **Credential** | **Value added for CTE completers** |
| Dual Enrollment |       |       |       |
| Transcripted Credit |       |       |       |
| Articulated Credit | Programs currently offered at Anne Arundel, Baltimore and Montgomery Community Colleges | Associate of Applied Science (A.A.S) in Construction Technology-Montgomery CC |  |
| Credit by Exam |       |       |       |
| Advanced Placement |       |       |       |
| Apprenticeship Approved by MATC\* | Related classroom instruction provided in partnership with several community colleges.  | Leads to requirements for Journeyman and Master status | Level II completion meets requirements for first year apprenticeship |
| Certification(s) | NCCER Certification Level I and II | National Registry (NCCER) | Credit awarded through apprenticeship programs |
| License |       |       |       |
| Degree |       |       |       |
| Other (specify) |       |       |       |

\*MD Apprenticeship and Training Council

**STEP 2F: INDUSTRY-MENTORED PROJECT OR WORK-BASED LEARNING (WBL) OPPORTUNITIES**Check each box that applies.

PAC members and other industry partners provide supervised WBL experiences and/or industry-mentored projects for all students who demonstrate performance of the competencies necessary to enter into this phase of the program. Supervised work-based learning experiences are required for all students demonstrating readiness to participate. For the few who do not participate, alternative capstone experiences should be provided (i.e., in school work experiences, a culminating project, or another experience comparable in rigor). Each type of work-based learning is defined in the glossary. Job shadowing is **not** acceptable for credit in a CTE program.

1. [x]  Integrated WBL 2. [ ]  Capstone WBL 3. [x]  Registered Apprenticeship
4. [ ]  Internship 5. [x]  Industry-Mentored Project 6. [ ]  In-school clinic or school-based enterprise

**STEP 2G: STUDENT ORGANIZATIONS PROVIDED TO STUDENTS IN THE PROGRAM**

Check each box that applies, or specify if “Other” is selected.

Students will develop and apply technical and academic skills, as well as Skills for Success, through participation in:

[ ]  DECA [ ]  FFA [x]  SkillsUSA [ ]  FBLA [ ]  OTHER (specify)

STEP 3: COMPLETE THE INSTRUCTIONAL PROGRAM DATA SHEET

|  |  |
| --- | --- |
| Local School System (LSS) and Code: |       |
| Name of CTE Local Director: |       | Phone: |       |
| LSS Program Title: |       | CIP Code: |       |

*STEP 3.1 - DATA SHEET: Pathway Options*

|  |  |
| --- | --- |
| 1. | Heating, Ventilation, and Air Conditioning |
| 2. | Industrial Maintenance |
| 3. | Welding |

STEP 3.2 - DATA SHEET: *Instructional Program Credit by Grade(s)*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *Credits per year per pathway option as* *reflected by Course Sequences* | **9** | **10** | **11** | **12** | **TOTAL** |
| 1. Heating, Ventilation, and Air Conditioning
 |  | 1 | 1 | 2 | 4 |
| 1. Industrial Maintenance
 |  | 1 | 1 | 2 | 4 |
| 1. Welding
 |  | 1 | 1 | 2 | 4 |

Total number of credits for program completion: **4**

STEP 3.3 - DATA SHEET: Career and Technology Education Program Sites

|  |  |  |
| --- | --- | --- |
| **Pathway Options** | **School Name(s) Sites** | **School Number** |
|       |       |       |
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