



Program of Study Guide: **Marine Maintenance and Repair**

Comprehensive guidelines and course standards for the Marine Maintenance and Repair pathway

Office of College and Career Pathways

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MARYLAND STATE DEPARTMENT OF EDUCATION

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Purpose

The purpose of this document is to communicate the required Career and Technical Education (CTE) academic standards for the Marine Maintenance and Repair Program of Study. The academic standards in this document are theoretical and performance based. The standards contain content from multiple state departments of education, industry related resources and have been reviewed and vetted by members of the Maryland business and industry community.

In addition to academic standards, the Maryland State Department of Education (MSDE) has incorporated into this document Labor Market Information (LMI) definitions and explanations for the Program of Study; program aligned Industry Recognized Credentials; and Work-Based Learning resources and requirements by course level.

Standards Sources

The following sources collectively support a progression of standards from foundational to advanced Marine Maintenance and Repair concepts in a high school context, preparing students for industry-aligned certifications like ABYC Marine Service Technician, NCCER Maritime Electrical Level 1 Certificate, OSHA 10/30, with the necessary knowledge and skills for career readiness in Marine Maintenance and Repair careers.

Here are the key standards sources for Marine Maintenance and Repair curriculum:

1. American Boat & Yacht Council (ABYC)

- A. **Description:** ABYC is the premier organization developing safety standards and technical education for the marine industry in North America. They are recognized globally for establishing standards of construction, maintenance, and repair for recreational boats. Their curriculum is developed through industry consensus and is continuously updated to reflect current technology and best practices.
- B. **Usage:** ABYC provides comprehensive curriculum materials designed for both secondary and post-secondary marine technology programs. Their resources include instructor guides and lesson plans, student workbooks and textbooks, online learning modules, hands-on lab exercises, assessment tools, certification exams, and professional development for instructors. Their materials are particularly strong in areas like electrical systems, marine systems, composite repair, and standards compliance.
- C. **Source:** <https://abycinc.org/page/educationprograms>

2. National Center for Construction Education and Research (NCCER) Maritime Program

- A. **Description:** NCCER's Maritime Program was developed in partnership with industry experts to address the critical workforce shortage in the maritime industry. While NCCER is primarily known for construction trades, their maritime curriculum maintains their signature standardized, competency-based approach.
- B. **Usage:** NCCER provides a structured curriculum pathway that includes training modules with performance profiles, PowerPoint presentations, module exams, skills assessments, instructor resources, and industry-recognized credentials. The program is particularly strong in areas like maritime safety, tools, and basic maintenance skills.
- C. **Source:** <https://www.nccer.org/workforce-development-programs/disciplines/maritime>

3. Yamaha Marine Service

- A. **Description:** Yamaha Marine Service Training materials are manufacturer-specific but widely recognized in the industry. Their curriculum is developed directly from their service department's expertise and covers both outboard and personal watercraft maintenance and repair.
- B. **Usage:** Yamaha provides educational resources through Yamaha Marine University including online training modules, hands-on training materials, service manuals and technical documentation, diagnostics training, and certification pathways from apprentice to master technician. Their materials are particularly valuable for outboard motor maintenance and repair, fuel systems, and electronic control systems.
- C. **Source:** <https://www.yamahamarineuniversity.com>

Course Descriptions

Course Level	Course Information	Description
Core: Course 1	Marine Maintenance and Repair I SCED: Pending Grades: 9-12 Prerequisite: None Credit: 1	This foundational course introduces students to the marine industry while developing essential boat building and service skills. Students learn to safely operate shop equipment, interpret basic boat plans, and work with various marine materials including wood, composites, and metals. Through hands-on projects, students develop basic lofting techniques, learn proper material handling, and gain understanding of fundamental boat systems. The course emphasizes shop safety, proper documentation procedures, and quality workmanship while providing an overview of marine industry career pathways.
Core: Course 2	Marine Maintenance and Repair II SCED: Pending Grades: 10-12 Prerequisite: Marine Maintenance and Repair I Credit: 1	Building on foundational skills, this course combines boat construction techniques with marine electrical systems installation. Students learn basic electrical theory while developing hands-on skills in marine wiring, circuit testing, and system integration. Construction skills include advanced composite layup, marine woodworking, and basic metal fabrication. Students apply these integrated skills to plan and execute electrical system installations during the construction process, with emphasis on marine standards compliance and quality control procedures.

Course Level	Course Information	Description
Optional Flex: Course 1	Marine Maintenance and Repair III SCED: Pending Grades: 11-12 Prerequisite: Marine Maintenance and Repair II Credit: 1	This course deepens students' understanding of marine power systems with a focused study of diesel engine theory, drive systems, and integrated propulsion components. Students develop essential diagnostic and maintenance skills across both diesel and gasoline fuel systems while mastering drive system principles including shaft alignment, propeller theory, and stern drive maintenance. Through hands-on experience with cooling systems, steering components, and control mechanisms, students learn to perform comprehensive system maintenance, troubleshooting, and seasonal servicing. The course emphasizes ABYC standards compliance while teaching students to integrate various propulsion-related systems, perform precise measurements, and maintain detailed service documentation. Students gain proficiency in engine and drive system theory while developing practical skills in system testing, diagnostic procedures, and safe maintenance practices that align directly with industry certification requirements.
Optional Flex: Course 2	Marine Maintenance and Repair IV SCED: Pending Grades: 11-12 Prerequisite: Marine Maintenance and Repair III Credit: 1	This capstone course develops advanced troubleshooting and repair skills across all marine systems. Students learn complex diagnostic procedures for electrical and electronic systems while developing expertise in structural and system repairs. The course covers advanced composite repair techniques, marine woodworking restoration, and metal fabrication for repairs. Students gain experience in system upgrades, electronic equipment installation, and complex problem-solving while maintaining detailed documentation of all repair procedures.

Course Level	Course Information	Description
Optional Flex: Course 3	Career Connected Learning I SCED: Pending Grades: 11-12 Prerequisite: See Course Description Credits: 1-3	Prerequisites: - Alignment to the student's 6-Year Plan - Completion of: - Minimum two sequential courses in a CTE pathway; OR - Minimum two years of the same world language; OR - Minimum two sequential courses in a comprehensive arts program; OR - Inclusion in the IEP/504 transition plan with supporting documentation (as required) - Endorsement from an educator, mentor, employer, or career coach - No more than one course recovery credit in core subjects is needed by the student. This flexible, work-based learning course introduces students to real-world applications of classroom knowledge and technical skills through on-the-job experiences and reflective practices. Students engage in career exploration, skill development, and professional networking by participating in youth apprenticeships, registered apprenticeships, pre-apprenticeships, internships, capstone projects, or other approved career-connected opportunities. Variable credit (1–3) accommodates the required on-the-job training hours and related instruction. By integrating industry standards, employability skills, and personalized learning goals, Career Connected Learning I equips students to make informed career decisions, develop a professional portfolio, and build a strong foundation for success in postsecondary education, training, or the workforce.

Course Level	Course Information	Description
Optional Flex: Course 4	Career Connected Learning II SCED: Pending Grades: 11-12 Prerequisite: Career Connected Learning I Credits: 1-3	Building on the foundational experiences of Career Connected Learning I, this advanced work-based learning course provides students with deeper on-the-job practice, leadership opportunities, and refined career exploration. Students continue to enhance their technical and professional skills, expanding their industry networks and aligning personal goals with evolving career interests. Variable credit (1–3) remains aligned with the required training hours and related instruction. Through elevated responsibilities and skill application, Career Connected Learning II prepares students to confidently transition into higher-level postsecondary programs, apprenticeships, or the workforce.

Dual Enrollment and Career Connected Learning Experiences Must be Aligned to the CTE Core.

Industry-Recognized Credentials and Career-Connected Learning

The *Blueprint for Maryland's Future* and the High School Level of a Registered Apprenticeship

The Maryland State Department of Education recognizes the high-school level of a Registered Apprenticeship (RA), defined as a State-approved Registered Apprenticeship begun during high school in which students complete at least 144 hours of related technical instruction and 250 hours of paid on-the-job training before graduation, with the remaining required apprenticeship hours completed post-graduation, as the gold standard of Career Connected Learning.

The CTE Committee of the Governor's Workforce Development Board, in alignment with federal apprenticeship standards, requires 144 hours of RTI for all high school RA participants, and the Apprenticeship Maryland Program (AMP) defines the minimum RTI as **one course credit equivalent**. This high-school-level Registered Apprenticeship is the preferred career-connected learning option for students to meet the Blueprint's goal that 45% of public high school graduates complete either the high-school level of a Registered Apprenticeship or another industry-recognized credential.

To the extent practicable, the greatest number of students should achieve this goal through participation in a high-school level Registered Apprenticeship, with schools ensuring these requirements are scheduled, completed, and documented for transcript and reporting purposes.

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Career-Connected Learning Resources

Course 1: Career Awareness	Course 2: Career Preparation	Flex Courses: Career-Connected Learning
- Industry Visits - Guest Speakers - Participation in Career and Technical Student Organizations - Postsecondary Visits – Program Specific Site Tours - Mock Interviews	- All of Career Awareness plus the following: - Job Shadow - Employer Mentoring	- Registered Apprenticeship - Internship - School-Based Enterprise - Employer-Directed Capstone

Industry-Recognized Credentials

By the end of Marine Maintenance and Program: ABYC Marine Service Technician

Labor Market Information: Definitions and Data

Labor market information (LMI) plays a crucial role in shaping Career and Technical Education (CTE) programs by providing insights into industry demands, employment trends, and skills gaps. This data helps education leaders assess the viability of existing programs and identify opportunities for new offerings. By aligning CTE programs with real-time labor market needs, schools can better prepare students for in-demand careers and ensure that resources are effectively utilized to support pathways that lead to high-quality, sustainable employment.

Standard Occupational Code (SOC) and Aligned Industry:

Indicator	Definition	Pathway Labor Market Data
High Wage¹	Those occupations that have a 25th percentile wage equal to or greater than the most recent MIT Living Wage Index for one adult in the state of Maryland, and/or leads to a position that pays at least the median hourly or annual wage for the DC-VA-MD-WV Metropolitan Statistical Area (MSA). <i>Note: A 25th percentile hourly wage of \$24.74 or greater is required to meet this definition.</i>	Standard Occupational Code: 49-3051: Motorboat Mechanics and Service Technicians Hourly Wage/Annual Salary: 25 th Percentile: \$22.25/\$46,280 50 th Percentile: \$29.42/\$61,194 75 th Percentile: \$34.78/\$72,342
High Skill	Those occupations located within the DC-VA-MD-WV Metropolitan Statistical Area (MSA) with the following education or training requirements: completion of an apprenticeship program; completion of an industry-recognized certification or credential; associate's degree, bachelor's degree, or higher.	Typical Entry-Level Education: While there are several organized training programs in the region, there is no formal post-secondary training necessary to enter the workforce for students who have completed this program.
In-Demand	Annual growth plus replacement, across all Maryland occupations, is <u>405</u> openings between 2024-2029.	Annual Openings 82

Lightcast Data Updated August 2025

¹ Living Wage Calculator: <https://livingwage.mit.edu/states/24>

Labor Market Information Data Source

Lightcast occupation employment data are based on final Lightcast industry data and final Lightcast staffing patterns. Wage estimates are based on Occupational Employment Statistics (QCEW and Non-QCEW Employees classes of worker) and the American Community Survey (Self-Employed and Extended Proprietors). Occupational wage estimates are also affected by county-level Lightcast earnings by industry. Foundational data for the state of Maryland is collected and reported by the Maryland Department of Labor.

Methodology for High Wage Calculations

To combine labor market data across multiple Standard Occupational Classifications (SOCs), a weighted average approach was used to ensure accurate representation of the marketplace. Median wages for each SOC were weighted based on their respective employment levels, reflecting the relative demand for each occupation. This method ensures that occupations with higher employment contribute proportionately to the overall wage calculation. Additionally, job openings from all relevant SOCs were summed to determine the total projected demand. For example, if Mechanical Engineers account for 67% of total employment and Electrical Engineers for 33%, their respective wages are weighted accordingly, and job openings are aggregated to provide a comprehensive view of labor market opportunities. This approach delivers a balanced and accurate representation of both wages and employment demand for the program.

Methodology for In-Demand Calculations

The baseline for annual job openings, taking into account new positions and replacement positions, was determined by taking the average of all annual job openings between 2024 and 2029 across all 797 career sectors at the 5-digit SOC code level. For the 2024-2029 period, average job openings (growth + replacement) is 405.

Course Standards: Marine Maintenance and Repair I

1. GENERAL REQUIREMENTS. This course is recommended for students in Grades 9-12.

2. INTRODUCTION

- A. Career and Technical Education (CTE) instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
- B. The Supply Chain & Transportation Career Cluster encompasses the transfer, coordination, and management of goods from production to consumption, ensuring efficient movement across various modes of transportation including air, ground, and water, as well as maintenance of the respective transport modes. This Cluster integrates logistics and distribution networks to facilitate the seamless flow of materials and products, playing a crucial role in global commerce, economic development, and community health.
- C. The Marine Maintenance and Repair program is a comprehensive four course sequence that prepares students for careers in marine service and boat building. Through hands-on experience with industry-standard tools and equipment, students develop essential skills in boat construction, electrical systems installation, engine and propulsion system service, and advanced marine system repair. The program integrates fundamental construction techniques with complex systems integration, teaching students to build, maintain, and repair modern vessels aligned to American Boat and Yacht Council standards. Students learn to work with diverse materials including composites, marine-grade woods, and metals while mastering electrical system design, engine installation, and advanced diagnostics. Upon completion, graduates are prepared for entry-level positions in marine service, boat building, or yacht repair facilities, and are equipped with the knowledge needed to successfully complete the ABYC Marine Service Technician Certification examination.
- D. The Marine Maintenance and Repair I course introduces students to the marine industry while developing essential boat building and service skills. Students learn to safely operate shop equipment, interpret basic boat plans, and work with various marine materials including wood, composites, and metals. Through hands-on projects, students develop basic lofting techniques, learn proper material handling, and gain understanding of fundamental boat systems. The course emphasizes shop safety, proper documentation procedures, and quality workmanship while providing an overview of marine industry career pathways.
- E. Students will participate in at least two Career-Connected Education and Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.
- F. Students are encouraged to participate in extended learning experiences through aligned Career and Technical Student Organizations (CTSOs). CTSOs are a cocurricular requirement in the Carl D. Perkins Act, and alignment to CTSO activities is an expectation for CTE programs in the state of Maryland.

3. KNOWLEDGE AND SKILLS

- A. The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:**
 - 1. Identify and demonstrate positive work behaviors that enhance employability and job advancement, such as regular attendance, promptness, proper attire, maintenance of a clean and safe work environment, and pride in work.

2. Demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, active listening, and a willingness to learn.
3. Employ effective reading, writing, and technical documentation skills.
4. Solve problems using critical thinking techniques and structured troubleshooting methodologies.
5. Demonstrate leadership skills and collaborate effectively as a team member.
6. Implement safety procedures, including proper handling of hardware and following OSHA guidelines.
7. Exhibit an understanding of legal and ethical responsibilities in the Marine Maintenance and Repair field, following applicable laws and best practices for safety.
8. Demonstrate time-management skills and the ability to prioritize tasks in a technical setting.

B. The student identifies various career pathways in the Marine Maintenance and Repair field. The student is expected to:

1. Develop a career plan that includes the necessary education, certifications, job skills, and experience for specific roles as a technician or in the Marine Maintenance and Repair field.
2. Create a professional resume and portfolio that reflects skills, projects, certifications, and recommendations.
3. Demonstrate effective interview skills for roles in the Marine Maintenance and Repair field.

C. The student identifies the issues associated with Marine Maintenance and Repair hazards found on a jobsite. The student is expected to:

1. Demonstrate safe working procedures in a lab/shop environment.
2. Explain the purpose of the Occupational Safety and Health Administration (OSHA) and how it promotes safety on the job.
3. Identify Marine Maintenance and Repair related workplace hazards and how to avoid or minimize them.
4. Explain safety issues concerning lockout and tagout procedures, personal protection using assured grounding and isolation programs, automotive lift safety, and other equipment related safety protocols.

D. The student integrates core academic skills into Marine Maintenance and Repair practices. The student is expected to:

1. Demonstrate the use of clear communication techniques, both written and verbal, that are consistent with industry standards.
2. Apply geometric principles to calculate hull dimensions and displacement, utilize scale measurements and conversions, and perform basic construction calculations including material quantities and angles.
3. Understand principles of buoyancy and displacement, analyze material properties including tensile strength and flexibility, and apply concepts of chemical reactions in composite materials and adhesives.

E. The student understands marine industry fundamentals and safety practices. The student is expected to:

1. Identify career pathways and opportunities within the marine service industry by researching job roles, creating career progression maps, and analyzing local market demands.

2. Demonstrate proper use of marine-specific personal protective equipment by selecting appropriate gear for tasks, inspecting equipment condition, and wearing PPE correctly during all shop activities.
3. Apply shop safety procedures specific to marine environments by conducting safety inspections, using ventilation systems properly, and maintaining clean workspaces with proper chemical storage.
4. Execute proper documentation and record-keeping procedures by completing work orders, maintaining material logs, and documenting safety inspections using industry-standard forms.

F. The student analyzes basic boat design and construction principles. The student is expected to:

1. Interpret basic boat plans and design documents by identifying standard symbols, taking measurements from scaled drawings, and explaining design features to others.
2. Explain the principles and characteristics of hull forms by identifying common designs, describing their purposes, and comparing performance characteristics.
3. Calculate basic boat dimensions and measurements by using appropriate measuring tools, applying marine measurement standards, and converting between measurement systems.
4. Demonstrate understanding of boat terminology and nomenclature by correctly identifying boat parts, using proper terms in documentation, and communicating effectively with peers using industry terminology.

G. The student demonstrates proficiency with marine materials. The student is expected to:

1. Differentiate between various marine construction materials by identifying specific properties, explaining appropriate applications, and selecting materials for specific tasks.
2. Demonstrate proper material handling and storage procedures by organizing materials correctly, maintaining proper environmental conditions, and following safety data sheets.
3. Execute basic techniques for working with marine woods by selecting appropriate types, cutting with proper tools, and applying marine-grade finishes.
4. Perform fundamental composite layup procedures by preparing surfaces, mixing resins with proper ratios, and applying materials in correct sequence.
5. Identify various marine metals and their properties by conducting basic tests, explaining corrosion factors, and selecting appropriate metals for specific applications.

H. The student develops fundamental boat building skills. The student is expected to:

1. Perform basic lofting techniques by creating full-size drawings of boat components, using proper tools to develop curves, and transferring measurements accurately to materials.
2. Execute precise material layout and cutting procedures by using appropriate marking tools, measuring twice before cutting, and maintaining accuracy within 1/16 inch tolerance.
3. Demonstrate proper marine joinery methods by selecting appropriate joints for specific applications, cutting joints to proper fit, and assembling with marine-grade adhesives.
4. Apply marine-grade fastening techniques by selecting appropriate fasteners, preparing materials properly, and installing fasteners using correct methods and sequences.
5. Perform quality control inspections by using industry-standard checklists, documenting findings accurately, and identifying areas needing correction.

I. The student comprehends basic boat systems. The student is expected to:

1. Identify major boat systems and their components by creating system diagrams, explaining component functions, and describing system relationships.
2. Explain basic system integration principles by mapping system interconnections, identifying potential conflicts, and describing proper installation sequences.
3. Demonstrate understanding of system installation requirements by interpreting manufacturer specifications, following ABYC standards, and maintaining proper clearances.
4. Perform basic system inspections and tests by using appropriate testing equipment, following manufacturer procedures, and documenting results properly.

Course Standards: Marine Maintenance and Repair II

1. **GENERAL REQUIREMENTS.** This course is recommended for students in Grades 10-12.
2. **INTRODUCTION**
 - A. Career and Technical Education (CTE) instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
 - B. The Supply Chain & Transportation Career Cluster encompasses the transfer, coordination, and management of goods from production to consumption, ensuring efficient movement across various modes of transportation including air, ground, and water, as well as maintenance of the respective transport modes. This Cluster integrates logistics and distribution networks to facilitate the seamless flow of materials and products, playing a crucial role in global commerce, economic development, and community health.
 - C. The Marine Maintenance and Repair program is a comprehensive four course sequence that prepares students for careers in marine service and boat building. Through hands-on experience with industry-standard tools and equipment, students develop essential skills in boat construction, electrical systems installation, engine and propulsion system service, and advanced marine system repair. The program integrates fundamental construction techniques with complex systems integration, teaching students to build, maintain, and repair modern vessels aligned to American Boat and Yacht Council standards. Students learn to work with diverse materials including composites, marine-grade woods, and metals while mastering electrical system design, engine installation, and advanced diagnostics. Upon completion, graduates are prepared for entry-level positions in marine service, boat building, or yacht repair facilities, and are equipped with the knowledge needed to successfully complete the ABYC Marine Service Technician Certification examination.
 - D. Students in the Marine Maintenance and Repair II course combine boat construction techniques with marine electrical systems installation. Students learn basic electrical theory while developing hands-on skills in marine wiring, circuit testing, and system integration. Construction skills include advanced composite layup, marine woodworking, and basic metal fabrication. Students apply these integrated skills to plan and execute electrical system installations during the construction process, with emphasis on marine standards compliance and quality control procedures.
 - E. Students will participate in at least two Career-Connected Education and Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.
 - F. Students are encouraged to participate in extended learning experiences through aligned Career and Technical Student Organizations (CTSOs). CTSOs are a cocurricular requirement in the Carl D. Perkins Act, and alignment to CTSO activities is an expectation for CTE programs in the state of Maryland.
3. **KNOWLEDGE AND SKILLS**
 - A. The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:**
 1. Identify and demonstrate positive work behaviors that enhance employability and job advancement, such as regular attendance, promptness, proper attire, maintenance of a clean and safe work environment, and pride in work.

2. Demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, active listening, and a willingness to learn.
3. Employ effective reading, writing, and technical documentation skills.
4. Solve problems using critical thinking techniques and structured troubleshooting methodologies.
5. Demonstrate leadership skills and collaborate effectively as a team member.
6. Implement safety procedures, including proper handling of hardware and following OSHA guidelines.
7. Exhibit an understanding of legal and ethical responsibilities in the automotive field, following applicable laws and best practices for safety.
8. Demonstrate time-management skills and the ability to prioritize tasks in a technical setting.

B. The student identifies various career pathways in the Marine Maintenance and Repair field. The student is expected to:

1. Develop a career plan that includes the necessary education, certifications, job skills, and experience for specific roles as a technician or in the Marine Maintenance and Repair field.
2. Create a professional resume and portfolio that reflects skills, projects, certifications, and recommendations.
3. Demonstrate effective interview skills for roles in the Marine Maintenance and Repair field.

C. The student identifies the issues associated with Marine Maintenance and Repair hazards found on a jobsite. The student is expected to:

1. Demonstrate safe working procedures in a lab/shop environment.
2. Explain the purpose of the Occupational Safety and Health Administration (OSHA) and how it promotes safety on the job.
3. Identify Marine Maintenance and Repair related workplace hazards and how to avoid or minimize them.
4. Explain safety issues concerning lockout and tagout procedures, personal protection using assured grounding and isolation programs, automotive lift safety, and other equipment related safety protocols.

D. The student integrates core academic skills into Marine Maintenance and Repair practices. The student is expected to:

1. Demonstrate the use of clear communication techniques, both written and verbal, that are consistent with industry standards.
2. Solve algebraic equations using Ohm's Law, calculate power requirements and voltage drops, and apply mathematical principles to determine wire sizing and circuit loads.
3. Understand principles of electrical current flow, analyze electromagnetic principles, comprehend galvanic corrosion processes, and apply concepts of thermal conductivity in electrical systems.

E. The student understands marine electrical theory and safety. The student is expected to:

1. Explain basic electrical principles in marine applications by demonstrating understanding of voltage, current, and resistance relationships through calculations and practical demonstrations.
2. Calculate basic electrical values using Ohm's law by solving circuit problems, measuring actual values with meters, and comparing calculated vs. measured results.

3. Demonstrate proper electrical safety procedures by using appropriate PPE, following lockout/tagout procedures, and maintaining safe working conditions around electrical systems.
4. Identify marine-specific electrical hazards by conducting risk assessments, explaining galvanic corrosion principles, and implementing appropriate safety measures.

F. The student demonstrates proficiency in marine electrical systems. The student is expected to:

1. Install basic DC electrical circuits by selecting proper wire sizes, following ABYC color codes, and making correct connections with marine-grade components.
2. Test electrical circuits using appropriate equipment by selecting proper meter settings, taking accurate readings, and interpreting results correctly.
3. Interpret marine electrical diagrams by identifying standard symbols, tracing circuits correctly, and explaining system operation to others.
4. Demonstrate proper wire selection and routing by using ABYC tables, calculating voltage drops, and securing wires appropriately.
5. Apply marine electrical standards and codes by referencing appropriate documentation, following installation requirements, and documenting compliance.

G. The student executes marine construction techniques. The student is expected to:

1. Perform advanced composite layup procedures by calculating material quantities, preparing complex molds, and achieving proper fiber-to-resin ratios.
2. Execute marine-grade woodworking techniques by selecting appropriate materials, using proper tools, and achieving professional-quality results.
3. Demonstrate basic metal fabrication skills by cutting, shaping, and joining metals using appropriate tools and techniques while maintaining accuracy.
4. Apply proper bonding and sealing methods by preparing surfaces correctly, selecting appropriate materials, and ensuring watertight integrity.
5. Perform quality control procedures by conducting appropriate tests, documenting results, and making necessary corrections.

H. The student integrates electrical systems during construction. The student is expected to:

1. Plan electrical system layouts by creating detailed wiring diagrams, determining component locations, and developing installation sequences that accommodate construction phases.
2. Install electrical components during construction by coordinating with other trades, protecting components from construction hazards, and ensuring proper access for future maintenance.
3. Perform system integration procedures by connecting multiple electrical systems, implementing proper grounding methods, and ensuring compatibility between components.
4. Execute proper testing and documentation by conducting voltage checks, performing continuity tests, and creating detailed as-built documentation including panel schedules and wire routes.
5. Demonstrate compliance with marine standards by following ABYC guidelines, maintaining proper wire support and chafe protection, and completing required inspection forms.

Course Standards: Marine Maintenance and Repair III

1. **GENERAL REQUIREMENTS.** This course is recommended for students in Grades 11-12.

2. **INTRODUCTION**

- A. Career and Technical Education (CTE) instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
- B. The Supply Chain & Transportation Career Cluster encompasses the transfer, coordination, and management of goods from production to consumption, ensuring efficient movement across various modes of transportation including air, ground, and water, as well as maintenance of the respective transport modes. This Cluster integrates logistics and distribution networks to facilitate the seamless flow of materials and products, playing a crucial role in global commerce, economic development, and community health.
- C. The Marine Maintenance and Repair program is a comprehensive four course sequence that prepares students for careers in marine service and boat building. Through hands-on experience with industry-standard tools and equipment, students develop essential skills in boat construction, electrical systems installation, engine and propulsion system service, and advanced marine system repair. The program integrates fundamental construction techniques with complex systems integration, teaching students to build, maintain, and repair modern vessels aligned to American Boat and Yacht Council standards. Students learn to work with diverse materials including composites, marine-grade woods, and metals while mastering electrical system design, engine installation, and advanced diagnostics. Upon completion, graduates are prepared for entry-level positions in marine service, boat building, or yacht repair facilities, and are equipped with the knowledge needed to successfully complete the ABYC Marine Service Technician Certification examination.
- D. The Marine Maintenance and Repair III course deepens students' understanding of marine power systems with a focused study of diesel engine theory, drive systems, and integrated propulsion components. Students develop essential diagnostic and maintenance skills across both diesel and gasoline fuel systems while mastering drive system principles including shaft alignment, propeller theory, and stern drive maintenance. Through hands-on experience with cooling systems, steering components, and control mechanisms, students learn to perform comprehensive system maintenance, troubleshooting, and seasonal servicing. The course emphasizes ABYC standards compliance while teaching students to integrate various propulsion-related systems, perform precise measurements, and maintain detailed service documentation. Students gain proficiency in engine and drive system theory while developing practical skills in system testing, diagnostic procedures, and safe maintenance practices that align directly with industry certification requirements.
- E. Students will participate in at least two Career-Connected Education and Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.
- F. Students are encouraged to participate in extended learning experiences through aligned Career and Technical Student Organizations (CTSOs). CTSOs are a cocurricular requirement in the Carl D. Perkins Act, and alignment to CTSO activities is an expectation for CTE programs in the state of Maryland.

3. **KNOWLEDGE AND SKILLS**

A. The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:

1. Identify and demonstrate positive work behaviors that enhance employability and job advancement, such as regular attendance, promptness, proper attire, maintenance of a clean and safe work environment, and pride in work.
2. Demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, active listening, and a willingness to learn.
3. Employ effective reading, writing, and technical documentation skills.
4. Solve problems using critical thinking techniques and structured troubleshooting methodologies.
5. Demonstrate leadership skills and collaborate effectively as a team member.
6. Implement safety procedures, including proper handling of hardware and following OSHA guidelines.
7. Exhibit an understanding of legal and ethical responsibilities in the Marine Maintenance and Repair field, following applicable laws and best practices for safety.
8. Demonstrate time-management skills and the ability to prioritize tasks in a technical setting.

B. The student identifies various career pathways in the Marine Maintenance and Repair field. The student is expected to:

1. Develop a career plan that includes the necessary education, certifications, job skills, and experience for specific roles as a technician or in the Marine Maintenance and Repair field.
2. Create a professional resume and portfolio that reflects skills, projects, certifications, and recommendations.
3. Demonstrate effective interview skills for roles in the Marine Maintenance and Repair field.

C. The student identifies the issues associated with Marine Maintenance and Repair hazards found on a jobsite. The student is expected to:

1. Demonstrate safe working procedures in a lab/shop environment.
2. Explain the purpose of the Occupational Safety and Health Administration (OSHA) and how it promotes safety on the job.
3. Identify Marine Maintenance and Repair related workplace hazards and how to avoid or minimize them.
4. Explain safety issues concerning lockout and tagout procedures, personal protection using assured grounding and isolation programs, automotive lift safety, and other equipment related safety protocols.

D. The student integrates core academic skills into Marine Maintenance and Repair practices. The student is expected to:

1. Demonstrate the use of clear communication techniques, both written and verbal, that are consistent with industry standards.
2. Complete compression ratio calculations, fuel consumption rates, shaft angle geometry, propeller pitch calculations, and measurement conversions for alignment specifications. Additional mathematical applications include calculating fuel flow rates, interpreting diagnostic measurements, and determining proper clearances for shaft installations.

3. Understand scientific principles including diesel engine thermodynamics, combustion chemistry, Pascal's law in hydraulic systems, principles of mechanical advantage in drive systems, fluid dynamics in cooling systems, and metallurgical principles in shaft and propeller design. Additional scientific concepts include understanding chemical properties of different fuel types, principles of electromechanical systems in engine controls, and physics of torque transfer through drive systems.

E. The student comprehends diesel engine theory and maintenance principles. The student is expected to:

1. Demonstrate comprehensive knowledge of diesel engine theory by explaining operational principles, identifying key components, and describing system relationships.
2. Perform basic diesel fuel system maintenance by servicing filters, bleeding fuel systems, and maintaining injection equipment according to manufacturer specifications.
3. Execute proper safety procedures when working around diesel engines by implementing appropriate protocols and identifying specific hazards.
4. Plan maintenance schedules by developing comprehensive service timelines and documenting maintenance procedures according to manufacturer requirements.
5. Analyze engine performance by conducting diagnostic tests, interpreting results, and recommending appropriate service actions.

F. The student performs drive system operations and maintenance. The student is expected to:

1. Demonstrate knowledge of drive system theory by explaining operational principles of conventional shaft drives, stern drives, and propulsion systems.
2. Define and address key service concerns for conventional shaft drives by identifying common issues, performing inspections, and implementing maintenance procedures.
3. Execute engine and shaft alignment procedures by using appropriate measurement tools, making precise adjustments, and documenting specifications.
4. Demonstrate comprehensive knowledge of propeller theory and operation by explaining propeller characteristics, selecting appropriate propellers, and diagnosing propeller-related issues.
5. Perform drive system maintenance by following manufacturer specifications, using appropriate tools, and documenting service procedures.

G. The student implements fuel system service procedures. The student is expected to:

1. Service gasoline fuel systems by performing maintenance tasks, diagnosing issues, and ensuring compliance with safety regulations.
2. Service diesel fuel systems by conducting maintenance procedures, testing fuel quality, and maintaining system integrity.
3. Perform fuel system testing by using appropriate diagnostic equipment, interpreting results, and documenting findings.
4. Implement fuel system safety procedures by following ABYC standards, applying environmental protection measures, and maintaining proper documentation.
5. Execute fuel system repairs by diagnosing problems, replacing components, and verifying proper operation.

H. The student performs integrated system maintenance. The student is expected to:

1. Maintain engine cooling systems by servicing components, testing operation, and ensuring proper flow rates.
2. Service batteries and electrical systems by performing tests, maintaining connections, and ensuring proper charging.
3. Conduct steering and control system maintenance by inspecting components, lubricating moving parts, and verifying proper operation.
4. Execute winterizing and commissioning procedures by following manufacturer protocols, documenting procedures, and ensuring proper seasonal preparation.
5. Perform comprehensive system troubleshooting by analyzing symptoms, diagnosing causes, and implementing appropriate repairs.

Course Standards: Marine Maintenance and Repair IV

1. **GENERAL REQUIREMENTS.** This course is recommended for students in Grades 11-12.

2. **INTRODUCTION**

- A. Career and Technical Education (CTE) instruction provides content aligned with challenging academic standards and relevant technical knowledge and skills for students to further their education and succeed in current or emerging professions.
- B. The Supply Chain & Transportation Career Cluster encompasses the transfer, coordination, and management of goods from production to consumption, ensuring efficient movement across various modes of transportation including air, ground, and water, as well as maintenance of the respective transport modes. This Cluster integrates logistics and distribution networks to facilitate the seamless flow of materials and products, playing a crucial role in global commerce, economic development, and community health.
- C. The Marine Maintenance and Repair program is a comprehensive four course sequence that prepares students for careers in marine service and boat building. Through hands-on experience with industry-standard tools and equipment, students develop essential skills in boat construction, electrical systems installation, engine and propulsion system service, and advanced marine system repair. The program integrates fundamental construction techniques with complex systems integration, teaching students to build, maintain, and repair modern vessels aligned to American Boat and Yacht Council standards. Students learn to work with diverse materials including composites, marine-grade woods, and metals while mastering electrical system design, engine installation, and advanced diagnostics. Upon completion, graduates are prepared for entry-level positions in marine service, boat building, or yacht repair facilities, and are equipped with the knowledge needed to successfully complete the ABYC Marine Service Technician Certification examination.
- D. The Marine Maintenance and Repair IV course develops advanced troubleshooting and repair skills across all marine systems. Students learn complex diagnostic procedures for electrical and electronic systems while developing expertise in structural and system repairs. The course covers advanced composite repair techniques, marine woodworking restoration, and metal fabrication for repairs. Students gain experience in system upgrades, electronic equipment installation, and complex problem-solving while maintaining detailed documentation of all repair procedures.
- E. Students will participate in at least two Career-Connected Education and Work-Based Learning experiences in this course, which might include informational interviews or job shadowing relevant to the program of study.
- F. Students are encouraged to participate in extended learning experiences through aligned Career and Technical Student Organizations (CTSOs). CTSOs are a cocurricular requirement in the Carl D. Perkins Act, and alignment to CTSO activities is an expectation for CTE programs in the state of Maryland.

3. **KNOWLEDGE AND SKILLS**

- A. **The student demonstrates the necessary skills for career development, maintenance of employability, and successful completion of course outcomes. The student is expected to:**
 - 1. Identify and demonstrate positive work behaviors that enhance employability and job advancement, such as regular attendance, promptness, proper attire, maintenance of a clean and safe work environment, and pride in work.

2. Demonstrate positive personal qualities such as flexibility, open-mindedness, initiative, active listening, and a willingness to learn.
3. Employ effective reading, writing, and technical documentation skills.
4. Solve problems using critical thinking techniques and structured troubleshooting methodologies.
5. Demonstrate leadership skills and collaborate effectively as a team member.
6. Implement safety procedures, including proper handling of hardware and following OSHA guidelines.
7. Exhibit an understanding of legal and ethical responsibilities in the Marine Maintenance and Repair field, following applicable laws and best practices for safety.
8. Demonstrate time-management skills and the ability to prioritize tasks in a technical setting.

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1. Develop a career plan that includes the necessary education, certifications, job skills, and experience for specific roles as a technician or in the Marine Maintenance and Repair field.
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3. Identify Marine Maintenance and Repair related workplace hazards and how to avoid or minimize them.
4. Explain safety issues concerning lockout and tagout procedures, personal protection using assured grounding and isolation programs, automotive lift safety, and other equipment related safety protocols.

D. The student integrates core academic skills into Marine Maintenance and Repair practices. The student is expected to:

1. Demonstrate the use of clear communication techniques, both written and verbal, that are consistent with industry standards.
2. Analyze complex electrical measurements using advanced mathematical principles, calculate load requirements across integrated systems, and apply statistical analysis to diagnostic data.
3. Understand principles of electronic signal transmission, analyze wave propagation in marine electronics, comprehend chemical processes in advanced materials repair, and apply concepts of structural mechanics in repair procedures.

E. The student performs advanced electrical diagnostics. The student is expected to:

1. Execute complex electrical troubleshooting procedures by using advanced diagnostic equipment, interpreting test results, and documenting findings systematically.
2. Diagnose integrated system problems by analyzing multiple system interactions, using logical troubleshooting sequences, and isolating faults accurately.

3. Perform advanced electrical testing by using oscilloscopes and specialized test equipment, interpreting complex waveforms, and documenting results properly.
4. Implement electrical system repairs by following manufacturer procedures, using appropriate repair methods, and testing systems thoroughly after repairs.
5. Document diagnostic procedures by maintaining detailed repair records, creating clear client reports, and recommending preventive measures.

F. The student demonstrates advanced repair techniques. The student is expected to:

1. Perform structural damage assessment by using appropriate inspection techniques, documenting findings with photos and measurements, and developing detailed repair plans.
2. Execute complex composite repairs by matching materials properly, following correct layup sequences, and achieving structural integrity and cosmetic quality.
3. Implement marine woodworking repairs by selecting appropriate materials, using proper restoration techniques, and maintaining original strength and appearance.
4. Perform metal component repairs by selecting appropriate repair methods, executing proper welding or fabrication techniques, and ensuring structural integrity.
5. Apply proper finishing techniques by preparing surfaces correctly, using appropriate marine finishes, and achieving professional-quality results.

G. The student executes marine electronics procedures. The student is expected to:

1. Install marine electronic systems by following manufacturer specifications, ensuring proper mounting and connections, and maintaining appropriate clearances.
2. Perform system integration procedures by connecting multiple devices, configuring network settings, and ensuring proper communication between systems.
3. Execute proper calibration procedures by following manufacturer protocols, adjusting settings accurately, and documenting final configurations.
4. Implement testing protocols by conducting systematic function checks, verifying proper operation, and documenting all test results.
5. Demonstrate proper documentation procedures by creating detailed installation records, maintaining calibration logs, and preparing client operation guides.

H. The student performs complex system repairs. The student is expected to:

1. Diagnose complex system failures by using advanced diagnostic equipment, creating detailed fault trees, and systematically analyzing multiple system interactions to identify root causes.
2. Execute advanced troubleshooting procedures by implementing manufacturer diagnostic protocols, interpreting complex error codes, and using logical problem-solving methodologies to isolate faults.
3. Implement system repair procedures by selecting appropriate repair methods, following manufacturer specifications, and ensuring repairs restore system to original functionality while maintaining vessel integrity.
4. Perform system upgrades by evaluating compatibility requirements, planning integration with existing systems, and implementing updates according to manufacturer specifications while maintaining proper documentation.
5. Document repair procedures by creating detailed repair reports with photos, maintaining service records, and providing customers with comprehensive documentation including preventive maintenance recommendations.