



Vocational Technical Education Framework



Transportation Occupational Cluster

Diesel Technology (VDIESL)

CIP Code 470605

June 2014

Massachusetts Department of Elementary and Secondary Education

Office for Career/Vocational Technical Education

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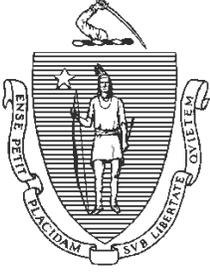
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Commissioner's Letter



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Mitchell D. Chester, Ed.D.
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Dear Colleagues,

I am pleased to present to you the *Massachusetts Vocational Technical Education Frameworks*, adopted by the Department of Elementary and Secondary Education in June 2014. These frameworks, one for each of the 44 vocational technical programs, include standards in multiple strands representing all aspects of the industries that students in the vocational technical education program are preparing to enter.

The frameworks also include a crosswalk between the technical standards and relevant standards in Massachusetts Curriculum Frameworks to support effective integration of academic and technical content.

The comments and suggestions received during revision of the 2007 *Massachusetts Vocational Technical Education Frameworks* have strengthened these frameworks. We will continue to work with schools and districts to implement the 2014 *Massachusetts Vocational Technical Education Frameworks* over the next several years, and we encourage your comments.

I want to thank everyone who worked with us to create challenging learning standards for Massachusetts students. I am proud of the work that has been accomplished.

Sincerely,

Mitchell D. Chester, Ed.D.
Commissioner of Elementary and Secondary Education

Introduction

Overview & Organization and Key Changes

Overview

The Massachusetts Department of Elementary and Secondary Education understands the necessity of maintaining current Vocational Technical Education Frameworks which ensure career/vocational technical education students across the Commonwealth are taught the most rigorous standards aligned to the needs of business and industry.

With the advent of the Massachusetts Teaching & Learning System the Office for Career/Vocational Technical Education (CVTE) recognized the significance of including career/vocational technical education in the system and developed a comprehensive plan for including vocational technical education. The plan was designed in a Two Phase Process. Phase One included the revision of strands two, three, and six, of all of the Vocational Technical Education Frameworks. Phase Two consisted of three major components (projects) all equally crucial;

1. The revision of Strands One, Four, and Five to complete the revision of all six strands of the Vocational Technical Education Frameworks;
2. Statewide Professional Development on all revised strands, with training on strands two, three, and six delivered fall 2013, and training on strands one, four, and five delivered spring 2014;
3. The creation and development of additional Model Curriculum Unit (MCU) Teams.

The Office for Career/Vocational Technical Education Framework Team, with support from consultants, began Phase One in the 2012-2013 school year, to revise three of the six strands contained in all of the Vocational Technical Education (VTE) Frameworks. The state was organized into “Collaborative Partnerships” comprised of teams of project administrators, highly qualified subject matter educators, and business and industry partners, whose task was to revise Strand Two – Technical, Strand Three – Embedded Academics, and Strand Six – Technology Literacy. Each team met with a vocational advisory committee which included business and industry representatives and postsecondary education professionals, whose mission was to review and revise the team’s draft document during the revisionary process. Once strand two was revised, academic teachers (typically one English Language Arts teacher, one Mathematics teacher, and one Science teacher) worked with the technical subject matter teachers to develop a crosswalk between academic curricula standards and the technical standards, and provided examples of embedded academic content.

The Office for Career/Vocational Technical Education solicited statewide input from technical and academic teachers and administrators at the annual Massachusetts Association of Vocational Administrators (MAVA)/Massachusetts Vocational Association (MVA) - Connecting for Success Conference. Each framework team met with their content colleagues and reviewed the draft revisions and obtained

valuable feedback. Additionally, all drafts were reviewed and revised by the Massachusetts Vocational Technical Teacher Testing Program, to ensure appropriate measurable language.

Project consultants designed a new template to ensure all framework teams entered new standards and additional resources in a consistent manner. The framework teams created an “Appendix” listing potential industry recognized credentials attainable by secondary students; lists of professional, student, and relevant government organizations; and useful resources and websites. ** It is important to note that although most Framework Teams provided information for the “Appendix”, not all teams did. Therefore, sub-headings within the “Appendix” without information have been deleted. Disclaimer: Reference in the Appendices Section to any specific commercial products, processes, or services, or the use of any trade, firm or corporation name is for the information and convenience of the public, and does not constitute endorsement or recommendation by the Massachusetts Department of Elementary and Secondary Education.*

The Office for Career/Vocational Technical Education facilitated a comprehensive vetting process throughout the Commonwealth. During the fall of 2012 districts throughout Massachusetts solicited feedback from each Vocational Program’s Advisory Committee members at the Fall Board meetings. Additionally, the Office for Career/Vocational Technical Education met with various licensing boards at the Massachusetts Division of Professional Licensure and provided the applicable draft framework to each board for review. All framework drafts were posted on the CVTE website for public comment. Comments and suggested revisions received were shared with each framework team for response and edits, as appropriate.

The Phase I Process was completed on an accelerated timetable and resulted in all Vocational Technical Education Frameworks; Strand Two and Strand Six, revised with current, rigorous, relevant standards. Strand Three has been redesigned into a crosswalk which directly correlates academic and technical standards. An appendix of useful material for technical teachers recommended by their peers was added to each framework.

Phase II of the Framework Revision Process consisted of three major projects;

1. The Strands One, Four & Five Project, to complete the revision of all six strands of the Vocational Technical Education Frameworks;
2. Statewide Professional Development on all revised strands, with training on strands two, three, and six delivered fall 2013, and training on strands one, four, and five delivered spring 2014;
3. The creation and development of additional Model Curriculum Unit (MCU) Teams.

The Strands One, Four, & Five Project began in the fall of 2013 with the formation of a leadership team and three work groups. Co-Managers led the leadership team comprised of three Strand Coordinators who facilitated work teams and reviewed, researched, and revised these common strands. All skills specific to the vocational technical program have been included into Strand Two Technical.

The Strand One Team revised the safety knowledge and skills that all students need to acquire. The team included relevant issues (i.e., bullying, climate), laws, regulations, guidelines and policies pertaining to safety.

The Strand Four Team revised the Employability Knowledge and Skills that all students need to acquire. Teams considered current research on career readiness, including the work of the College Career Readiness Task Force convened by the Department, changes in workplace, technological changes that impact how people perform their work (i.e., communications methods), and included standards that emphasize the need for lifelong learning and adaptability given the multiple career changes over and an individual's working life. The team recommended this strand be renamed to: Career Readiness.

The Strand Five Team revised the Management & Entrepreneurship Knowledge and Skills that all students need to acquire. All business owners and employees must possess management and financial skills to be productive members of society. Skills included financial knowledge and basic business management skills.

All Strand One, Four and Five Project Teams worked collaboratively with staff from the Department of Elementary and Secondary Education and the Advisors of the Massachusetts Career and Technical Student Organizations to crosswalk standards to national Career & Technical Student Organizations Curricula, as applicable.

The Office for Career/Vocational Technical Education contracted the MAVA Consultant Team to work closely with the office to complete all of the work accomplished during Phase II of the Project.

A remarkable amount of work was accomplished through the efforts of hundreds of professionals who collaborated and diligently supported this work. The Office for Career/Vocational Technical Education is grateful for all the support received from the field, particularly all of the teachers (technical and academic), administrators, advisory committee members, business and industry representatives, the Division of Professional Licensure - boards, the Massachusetts Association of Vocational Administrators, the MAVA Consultants, and the Massachusetts Vocational Association, whose contributions were tremendous.

Special thanks to all staff in the Office for Career/Vocational Technical Education and the CVTE Framework Revision Team who provided guidance and numerous contributions during Phase One of the project.

Organization and Key Changes

This section contains the following:

- Highlights of Changes to the Vocational Technical Education Frameworks; which includes a summary of changes made to each strand.
- Organization of the Frameworks – Strand Two illustrates structure of topic headings, standards and objectives, and performance examples.

Highlights of Changes to the Vocational Technical Education Frameworks:

Strand One:

Safety and Health Knowledge and Skills have been revised to contain the safety standards that are common to all programs. The Strand One Team worked collaboratively with staff from the Department of Elementary and Secondary Education and the Advisors of the Career and Technical Student Organizations (CTSO) to crosswalk standards to national CTSO Curricula, as applicable.

- No objectives were deleted, only modified.
- Language and wording was clarified.
- Additions included a focus on maintaining a safe school and workplace in terms of creating a positive climate/environment.
- Student safety credential program has been revised.
- Safety attire has been revised.
- Emergency equipment and fire safety has been revised.
- Many new Performance Examples have been included.
- Within each strand, standards and objectives were grouped under Topic Headings, which are displayed in bold. Each standard is followed by a performance example. See the section below titled: "Organization of the Frameworks – Strand Two". All strands were organized in that manner, with the exception of the former Strand Three.

Strand Two:

The Technical Standards Knowledge and Skills have been revised to reflect business and industry changes since the adoption of the 2007 Vocational Technical Education Frameworks (VTEF). There are additional changes to Strand Two below:

- The Technical Knowledge and Skills (Strand Two) section contains standards specific to the particular vocational program; suffix "a" (as common to all programs) and suffix "c" (as common within a cluster) have been removed.
- Each VTEF Strand Two begins with safety and health knowledge and skills specific to the particular vocational program.
- Within each strand, standards and objectives were grouped under Topic Headings, which are displayed in bold. Each standard is followed by a performance example. See the section below titled: "Organization of the Frameworks – Strand Two". All strands were organized in that manner, with the exception of the former Strand Three.

- Strand Two of the Frameworks for Animal Science, Environmental Science and Technology, and Horticulture, begin with core standards required for all participants in the programs, followed by a series of standards organized in concentrations. See the section below titled: “Organization of the Frameworks – Strand Two” for more information.
- An update to some of the vocational programs framework is the addition of advanced or supplemental standards which are noted in Strand Two by an asterisk (*). *These standards are not required, but are provided as suggestions that districts may choose to use to increase the depth of a particular topic, or add additional topics, particularly for advanced students or for those seniors who do not participate in cooperative education.* See the section below titled: “Organization of the Frameworks – Strand Two” for more information.

Strand Three:

Since the purpose of Strand Three was to correlate academic content that was *embedded* in the knowledge and skills necessary to perform certain technical skills, it was logical to highlight those connections through a crosswalk between the academic curriculum standards and the technical standards (Strand Two). The crosswalk directly correlates the English Language Arts (2011) and Mathematics (2011) Frameworks, incorporating the Common Core Standards and the Science and Technology/Engineering Frameworks. The crosswalk can be found in the appendix of each vocational framework. The crosswalk also includes performance examples which illustrate integrated academic and technical content.

- Embedded Academics has been replaced with a crosswalk between the academic curriculum standards and the technical knowledge and skills standards. The crosswalk is located in the Appendices.

Strand Four:

Employability (and Career Readiness) Knowledge and Skills focused on providing students with general knowledge and skills to be college and career ready. The Strand Four Team worked collaboratively with staff from the Department of Elementary and Secondary Education and the Advisors of the Career and Technical Student Organizations to crosswalk standards to national CTSO Curricula, as applicable.

- Language and wording were clarified.
- Additions included a focus on providing students with skills for employability/career readiness.
- Modifications included Career Exploration & Navigation, Communication in the Workplace, and Work Ethic & Professionalism.
- New Performance Examples have been included.
- Within each strand, standards and objectives were grouped under Topic Headings, which are displayed in bold. Each standard is followed by a performance example. See the section below titled: “Organization of the Frameworks – Strand Two”. All strands were organized in that manner, with the exception of the former Strand Three.

Strand Five:

Strand Five contains Management and Entrepreneurship Knowledge and Skills that are general for all students. The Strand Five Team worked collaboratively with staff from the Department of Elementary and Secondary Education and the Advisors of the Massachusetts Career and Technical Student Organizations to crosswalk standards to national Career & Technical Student Organizations Curricula, as applicable.

- Language and wording were clarified and organized into a logical format.
- The Strand Five Team felt that the 2007 curriculum remained valid.
- Additions included a focus on providing students with skills for management and entrepreneurship applicable to all vocational programs.
- Modifications included Starting and Managing a Business, Marketing, and Financial Concepts & Applications in Business, and Legal/Ethical/Social Responsibilities.
- New Performance Examples have been included.
- Within each strand, standards and objectives were grouped under Topic Headings, which are displayed in bold. Each standard is followed by a performance example. See the section below titled: "Organization of the Frameworks – Strand Two". All strands were organized in that manner, with the exception of the former Strand Three.

Strand Six

Strand Six Technology Literacy Knowledge and Skills has been replaced with the 2008 Massachusetts Technology Literacy Standards and Expectations Framework.

Appendix¹

Each framework contains an “Appendix” section which includes an Embedded Academic Crosswalk, Industry Recognized Credentials, Statewide Articulation Agreements, Professional, Governmental, and Student Organizations, Resources, and relevant websites.

The Appendix² contains:

- Embedded Academic crosswalks for English Language Arts, Mathematics, and Science & Technology/Engineering.
- Statewide Articulations: Current statewide Articulation Agreements and/or Apprenticeship Programs available to the specific vocational program are listed on this page. The development of new statewide articulations continues, and therefore these pages will be revised as new agreements are finalized.
- Industry-Recognized Credentials: Technical Teacher Teams generated lists of credentials for the vocational programs. Program Advisory Committees throughout the state reviewed and provided recommendations through the validation process. *The credential list has been provided as a resource only and districts are not obligated to provide all of the specified credentials for students.*
- Other: These pages provide lists of reference materials, government agencies, professional and student organizations, and useful websites created by each framework team. These are intended as helpful resources for technical teachers, identified by peers. These are not recommended or required by the Department of Elementary & Secondary Education.

¹ *Note: Although most Framework Teams provided information for the “Appendix”, not all teams did. Therefore, sub-headings within the “Appendix” without information have been deleted.*

Disclaimer: Reference in the Appendices Section to any specific commercial products, processes, or services, or the use of any trade, firm or corporation name is for the information and convenience of the public, and does not constitute endorsement or recommendation by the Massachusetts Department of Elementary and Secondary Education.

Organization of the Frameworks – Strand Two

The Vocational Technical Education Frameworks contain knowledge and skills covering all aspects of industry, reflected in six strands: Safety and Health, Technical, Embedded Academics, Employability, Management and Entrepreneurship, and Technological.

Within each strand, standards and objectives were grouped under topic headings, which are displayed in bold. Each standard is followed by a performance example. In the excerpt below, 2.A is the topic; 2.A.01 is the first standard and 2.A.01.01 and 2.A.01.02 are the objectives under that standard.

2.A Automotive Technology Specific Safety Practices

- 2.A.01 Identify and describe safety procedures when dealing with different types of automotive lifts according to current industry standards.
- 2.A.01.01 Demonstrate procedures for safe lift operations.
 - 2.A.01.02 Demonstrate safe use, placement and storage of floor jacks and jack stands.

2.A.01 Performance Example:

- Student will set up lift using manufacturer’s suggested lift points.

- 2.A.02 Demonstrate and describe safety procedures when dealing with high pressure systems including necessary ventilation according to current industry standards.
- 2.A.02.01 Describe and demonstrate the importance of safety procedures to be used when servicing high pressurized systems (fuel systems, brakes, air conditioning, suspension, hydraulic systems, etc.).
 - 2.A.02.02 Describe and demonstrate safe use of oxygen/acetylene torches and electric welding equipment.
 - 2.A.02.03 Demonstrate ventilation procedures to be followed when working in the lab/shop area.

2.A.02 Performance Example:

- Student will relieve fuel system pressure to perform necessary repairs.

- 2.A.03 Identify and describe safety procedures when dealing with electrical circuits according to current industry standards.
- 2.A.03.01 Describe safety procedures to be followed when servicing supplemental restraint systems.
 - 2.A.03.02 Demonstrate safety awareness of high voltage circuits of electric or hybrid electric vehicles and related safety precautions.

2.A.03 Performance Example:

- Safely disable Supplemental Restraint System (SRS) air bag for repair using manufacturer’s recommendations.

There are additional changes to some of the Frameworks Strand Two (Technical Knowledge and Skills). Specifically, Strand Two of the Frameworks for Animal Science, Environmental Science and Technology and Horticulture begin with core standards required for all participants in the programs, followed by a series of standards organized in concentrations. For example, Strand Two of the Horticulture Framework begins with the core standards required of all Horticulture students

(Topics 2.A through 2.I). These standards are followed by the three concentrations: Arboriculture (Topics 2.J through 2.L), Greenhouse Management and Floriculture (Topics 2.J. through 2.L) and Landscape and Turf Management (Topics 2.M through 2.Q).

Advanced / Supplemental Standards (Not Required)

Another variation that is new to the revised Strand Two Frameworks is the addition of advanced or supplemental standards which are noted with the use of an asterisk (*). *These standards are not required, but are provided as suggestions that districts may choose to use to increase the depth of a particular topic, or add additional topics, particularly for advanced students or for those seniors who do not participate in cooperative education.*

The following is an example from Automotive Technology, where entire topics were added:

Advanced Automotive Technology Technical Knowledge and Skills

Note: The following competencies are optional, supplementary competencies suitable for advanced students. These are not required.

2.CC Demonstrate appropriate engine repair techniques.

2.CC.01 Perform appropriate cylinder Head Repair.

2.CC.01.01* Diagnose, remove and replace cylinder head(s).

2.CC.01.02* Clean and visually inspect a cylinder head for cracks; check gasket surface areas for warpage and surface finish; check passage condition; determine necessary action.

The following is an example from the Strand Two Radio and Television Broadcasting Framework that shows the addition of an advanced objective, 2.B.04.08*:

2.B.04 Explain concepts fundamental to shooting in cinema and video.

- 2.B.04.01 Compare and contrast a single-camera and a multiple-camera production.
- 2.B.04.02 Explain the importance of shooting for the edit (i.e., match on action, sequencing, coverage).
- 2.B.04.03 Explain the importance of continuity.
- 2.B.04.04 Explain the 180° Rule line, and its application in various cinema scenarios.
- 2.B.04.05 Identify and establish a specific point-of-view when shooting from a script.
- 2.B.04.06 Analyze the methods in which specific shots can evoke emotion from an audience.
- 2.B.04.07 Define drop frame and non-drop frame code shooting and explain how to account for both when preparing for an edit.
- 2.B.04.08* Describe various cinematographic methods necessary when shooting scenes that incorporate post-production visual effect

2.B.04 Performance Examples:

- Students will list similarities and differences of single-camera and multiple-camera shoots.
- Students will describe multiple shooting considerations that are useful in streamlining the editing process.

Transportation Occupational Cluster

Diesel Technology Framework (VDIESL)

Strand 1: Safety and Health Knowledge and Skills

1.A Fundamentals of Health and Safety

- 1.A.01 Describe and apply health and safety regulations.
- 1.A.01.01 Identify, describe and apply health and safety regulations that apply to specific tasks and jobs. Students must complete a safety credential program, e.g., Occupational Safety and Health Administration 10, CareerSafe and ServSafe.
 - 1.A.01.02 Identify, describe and apply Environmental Protection Agency (EPA) and other environmental protection regulations that apply to specific tasks and jobs in the specific occupational area.
 - 1.A.01.03 Identify, describe and apply Right-To-Know (Hazard Communication Policy) and other communicative regulations that apply to specific tasks and jobs in the specific occupational area.
 - 1.A.01.04 Explain procedures for documenting and reporting hazards to appropriate authorities.
 - 1.A.01.05 Identify and describe potential consequences for non-compliance with appropriate health and safety regulations.
 - 1.A.01.06 Identify and list contact information for appropriate health and safety agencies and resources.

1. A.01 Performance Examples:

- List and define OSHA Health and Safety Regulations, EPA and other environmental protection regulations to occupational area.
- List and define Right-to-Know regulations and reporting of hazards and contact information for appropriate health and safety agencies.
- List the laws and rules of regulatory agencies governing sanitation and safety.
- Utilize OSHA as well as health and safety websites for purposes of research.

- 1.A.02 Demonstrate appropriate health and safety practices based on the specific occupational area.
- 1.A.02.01 Identify, describe and demonstrate the effective use of Safety Data Sheets (SDS).
 - 1.A.02.02 Read and interpret chemical, product and equipment labels to determine appropriate health and safety considerations.
 - 1.A.02.03 Identify, describe and demonstrate personal, shop and job site safety practices and procedures.
 - 1.A.02.04 Demonstrate safe dress and use of relevant safety gear, personal protective equipment (PPE) and ergonomics, e.g., wrist rests, adjustable workspaces, equipment, gloves, proper footwear, earplugs, eye protection and breathing apparatus.
 - 1.A.02.05 Demonstrate appropriate safe body mechanics, including appropriate lifting techniques and ergonomics.

- 1.A.02.06 Locate emergency equipment, first aid kit, SDS information directories and emergency action/response plan/escape routes in your lab, shop and classroom, including labels and signage that follow OSHA Hazard Communication Program (HAZCOM), eyewash stations, shower facilities, sinks, fire extinguishers, fire blankets, telephone, master power switches and emergency exits.
- 1.A.02.07 Demonstrate the safe use, storage, and maintenance of every piece of equipment in the lab, shop and classroom, e.g., the OSHA Lockout/Tagout Program (LOTO).
- 1.A.02.08 Describe safety practices and procedures to be followed when working with and around electricity, e.g., ground fault circuit interrupter (GFCI) and frayed wiring.
- 1.A.02.09 Handle, store, dispose of and recycle hazardous, flammable and combustible materials, according to EPA, OSHA and product specifications.
- 1.A.02.10 Demonstrate appropriate workspace cleaning, sanitation, disinfection and sterilization procedures required in specific occupational areas, e.g., Workplace Housekeeping OSHA Regulations.

1. A.02 Performance Examples:

- Identify, describe and demonstrate the use of SDS.
- List and demonstrate shop dress code, safety procedures and location of emergency equipment in labor classroom.
- Define and demonstrate safe storage and maintenance of equipment and proper disposal or recycling of hazardous, flammable and combustible materials.
- Identify, describe and demonstrate the Universal Precautions set of guidelines.

- 1.A.03 Demonstrate appropriate responses to situations that may threaten health and safety.
 - 1.A.03.01 Describe First Aid procedures for potential injuries and other health concerns in the specific occupational area.
 - 1.A.03.02 Describe the importance of emergency preparedness and an emergency action/response plan.
 - 1.A.03.03 Describe procedures used to handle emergency situations, defensive measures and accidents, including identification, reporting, response, evacuation plans and follow-up procedures.
 - 1.A.03.04 Identify, describe and demonstrate safety practices in specific occupational areas used to avoid accidents.
 - 1.A.03.05 Identify and describe fire protection, protection, precautions and response procedures.
 - 1.A.03.06 Discuss the role of the individual and the company/organization in ensuring workplace safety including transportation to and from school, school activities and the workplace.
 - 1.A.03.07 Discuss ways to identify, prevent and report school and workplace violence, discrimination, harassment and bullying.
 - 1.A.03.08 Demonstrate positive and appropriate behavior that contributes to a safe and healthy environment in school and the workplace.

1. A.03 Performance Example:

- Define first aid procedures and protocols used to handle emergency situations and practices used to avoid accidents.
- View safety videos and discuss the role of workplace safety.
- Attend or participate in a human rights alliance organization presentation.
- Observe and/or demonstrate the appropriate use of a fire extinguisher using the (PASS) technique: Pull, Aim, Squeeze, Sweep.
- Review and discuss specific policies, procedures and protocols regarding discrimination, harassment and bullying.
- Discuss and/or role-play proper and respectful behavior that contributes to a positive climate.
- Discuss and/or demonstrate behavior that contributes to a collaborative/teamwork environment.

Selected Websites

- Bullying Prevention and Intervention Resources : www.doe.mass.edu/bullying
- Centers for Disease Control and Prevention: www.cdc.gov
- Environmental Protection Agency : www.epa.gov
- “Lost Youth – Four Stories of Injured Young Workers” – WorkSafeBC:
<http://www2.worksafebc.com/Publications/Multimedia/Videos.asp?reportid=34291>
- Massachusetts Department of Elementary and Secondary Education. (2011). Career/Vocational Technical Education Safety Guide: www.doe.mass.edu/cte
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- Massachusetts General Law: www.malegislature.gov
- Massachusetts Health and Human Services: www.mass.gov/dph
- Massachusetts Right to Know Law Summary:
<http://www.mass.gov/lwd/docs/dos/mwshp/hib397.pdf>
- Safety Data Sheet: www.sdsonline.com
- National Fire Protection Association: www.nfpa.org
- Protection of Student Rights: Massachusetts General Law:
<https://malegislature.gov/Laws/GeneralLaws/PartI/TitleXII/Chapter76/Section5>
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- Readiness and Emergency Management for Schools: www.rems.ed.gov
- Safe and Healthy Learning Environments: www.doe.mass.edu/ssce/safety.html

Strand 2: Technical Knowledge and Skills

2.A Diesel Technology Safety and Health

- 2.A.01** Implement safety knowledge and skills according to current industry and OSHA standards.
- 2.A.01.01 Demonstrate procedure for safe lift operations.
 - 2.A.01.02 Demonstrate safe use and storage of hydraulic floor jacks and safety stands.
 - 2.A.01.03 Identify and comply with environmental concerns relating to refrigerants and coolants according to current industry and OSHA standards.
 - 2.A.01.04 Describe and demonstrate safety procedures when using pneumatic tools.
 - 2.A.01.05 Describe and demonstrate safety procedures when using electric tools.
 - 2.A.01.06 Describe and demonstrate safety procedures when using hand tools.

2.A.01 Performance Example:
▪ Students will be able to define OSHA and perform diesel technology tasks safely.

2.B Fasteners

- 2.B.01** Compare and contrast fasteners and explain the principle and applications of torque.
- 2.B.01.01 Identify all commonly used threaded fasteners.
 - 2.B.01.02 Identify Society of Automotive Engineers (SAE) metric bolt head markings.
 - 2.B.01.03 Identify commonly used nuts, washers, flat, and lock washers.
 - 2.B.01.04 Identify and describe commonly used snap rings.
 - 2.B.01.05 Explain the concept of fastener torque and torque specifications chart.
 - 2.B.01.06 Explain what torque sequence refers to.
 - 2.B.01.07 Describe the various types of torque wrenches, sequences, and basic rules.

2.B.01 Performance Example:
▪ Students will be able to identify and compare fasteners.

2.C Precise Measuring Equipment

- 2.C.01** Demonstrate measuring procedures.
- 2.C.01.01 Describe and use common low precision measuring tools (steel rule, tape measure, ruler, and combination square).
 - 2.C.01.02 Identify and use an outside and inside caliper.
 - 2.C.01.03 Identify and use a feeler gauge, hole gauge, telescoping gauge, snap gauge, and dial indicator.
 - 2.C.01.04 Identify a vernier caliper and demonstrate its use.
 - 2.C.01.05 Identify an outside/inside micrometer and demonstrate its use.
 - 2.C.01.06 Identify a depth indicator gauge and demonstrate its use.

2.C.01 Performance Example:
▪ Students will demonstrate measurement skills using both the American and metric systems with a variety of tools.

2.D Hand Tools

- 2.D.01** Demonstrate the appropriate use of hand tools according to current industry and OSHA standards.
- 2.D.01.01 Identify and demonstrate the proper use of screwdrivers and pliers.
 - 2.D.01.02 Identify and demonstrate the proper use of combination wrenches, open-end wrenches, box-end wrenches, pipe wrenches, and adjustable wrenches.
 - 2.D.01.03 Identify and demonstrate the proper use of hammers, punches, and chisels.

- 2.D.01.04 Identify and demonstrate the proper use of sockets and extensions.
- 2.D.01.05 Identify and demonstrate the proper use of torque wrenches.
- 2.D.01.06 Identify and demonstrate the proper use of Allen wrenches.
- 2.D.01.07 Identify and demonstrate the proper use of various types of files, hacksaws, thread cutting taps, thread cutting dies, wire brushes, gasket scrapers, and bench vises.

2.D.01 Performance Example:

- Students choose the correct tools and demonstrate the appropriate use of those tools to match the assigned task.

2.E Power Tools

- 2.E.01 Demonstrate the appropriate use of power tools according to current industry and OSHA standards.
 - 2.E.01.01 Drill holes to given specifications using an electric drill.
 - 2.E.01.02 Identify types of drill bits.
 - 2.E.01.03 Describe the difference in drilling speed for different metals.
 - 2.E.01.04 Describe and demonstrate appropriate safety procedures to be followed when using an electric drill.
 - 2.E.01.05 Identify and explain the purpose of an air impact wrench.
 - 2.E.01.06 Identify and explain the purpose of impact sockets.
 - 2.E.01.07 Describe and demonstrate appropriate maintenance needs of an impact wrench.
 - 2.E.01.08 Describe and demonstrate appropriate safety procedures when using an air impact wrench.
 - 2.E.01.09 Identify and explain the purpose of an electric soldering iron.
 - 2.E.01.10 Describe and demonstrate appropriate safety procedures when using an electric soldering iron.
 - 2.E.01.11 List the type of solder to use when soldering an electrical component.
 - 2.E.01.12 Identify and explain the purpose of a bench grinder.
 - 2.E.01.13 Describe and demonstrate appropriate safety procedures when using a bench grinder.
 - 2.E.01.14 Identify and demonstrate the appropriate use of drill bits, differences in drilling speeds for different metals and drilling holes to specifications.
 - 2.E.01.15 Identify, explain the purpose and demonstrate the appropriate use of an air impact wrench, maintenance, and impact sockets.

2.E.01 Performance Examples:

- Students will select and use the proper power tool for the task, while demonstrating appropriate safety procedures.
- Students will explain the different drill speeds associated with each task.

2.F Engine (Mechanical)

- 2.F.01 Diagnose generic engine malfunctions.
 - 2.F.01.01 Inspect fuel, oil, coolant levels, condition, consumption, leaks, and exhaust leaks; determine needed action.
 - 2.F.01.02 Interpret engine noises; observe engine smoke color and quantity; determine needed action.
 - 2.F.01.03 Inspect belts, tensioners, pulleys, and adjust belt(s).
 - 2.F.01.04 Test for air intake system restriction and leakage; determine needed action.
 - 2.F.01.05 Perform intake manifold pressure (boost) test, test crankcase pressure, and test cylinder compression.

- 2.F.01.06 Diagnose no cranking, cranks but fails to start, hard starting, and starts but does not continue to run problems and determine needed action.
- 2.F.01.07 Diagnose surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and shutdown problems; determine needed action.
- 2.F.01.08 Inspect engine mounts for looseness and deterioration.

2.F.01 Performance Example:

- Students will verify the complaint, road/dyno test vehicle; review driver/customer interview and past maintenance documents (if available); determine further diagnosis.
- Students will diagnose no cranking, cranks but fails to start, hard starting, and starts but does not continue to run problems; determine needed repairs.

2.G Cylinder Head and Related Components

2.G.01 Diagnose and repair cylinder head and valve train.

- 2.G.01.01 Remove, clean, inspect for visible damage, and replace cylinder head(s) assembly.
- 2.G.01.02 Clean and inspect threaded holes, studs, and bolts for serviceability; determine needed action.
- 2.G.01.03 Disassemble head and inspect valves, guides, seats, springs, retainers, rotators, locks, and seals; determine needed action.

2.G.01 Performance Example:

- Students will measure cylinder head deck-to-deck thickness, and check mating surfaces for warpage and surface finish; inspect for cracks/damage; check condition of passages; inspect core, gallery, and plugs; service as needed.

2.H Lubrication System

2.H.01 Diagnose and repair lubrication systems.

- 2.H.01.01 Check engine oil level & test engine oil pressure and check operation of pressure sensor, gauge, and/or sending unit and determine needed action.
- 2.H.01.02 Inspect and measure oil pump, drives, inlet pipes, and pick-up screens and determine needed action.
- 2.H.01.03 Inspect turbocharger lubrication system and determine needed action.
- 2.H.01.04 Determine proper lubricant and perform oil and filter change.

2.H.01 Performance Examples:

- Students will inspect, measure, repair/replace oil pump, drives, inlet pipes, and screens.

2.I Coolant System

2.I.01 Diagnose and repair cooling systems.

- 2.I.01.01 Check engine coolant type, additives, freeze level, supplemental coolant additive (SCA) level, condition, and consumption and determine needed action.
- 2.I.01.02 Test coolant temperature and check operation of temperature sensor, gauge, and/or sending unit and determine needed action.
- 2.I.01.03 Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment.
- 2.I.01.04 Inspect thermostat(s), by-passes, housing(s), and seals; replace as needed.
- 2.I.01.05 Inspect radiator; pressure test, recover, flush, and refill with recommended coolant/additive package; bleed cooling system.

- 2.I.01.06 Inspect coolant conditioner/filter assembly, valves, lines, fittings, water pump, hoses, clamps, thermostat, radiator cap, radiator, overflow/surge tanks; determine needed action.
- 2.I.01.07 Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; replace as needed.

- 2.I.01 Performance Example:
- Students will inspect and replace thermostat(s), bypasses and seals.
 - Students will inspect thermostat(s), bypasses, housing(s), and seals; replace, as needed.

2.J Air Intake and Exhaust System

- 2.J.01 Diagnose and repair air induction and exhaust systems.
 - 2.J.01.01 Inspect turbocharger(s), wastegate, and piping systems; determine needed action.
 - 2.J.01.02 Check air induction system: piping, hoses, clamps, and mounting; check for air restrictions and leaks; service or replace air filter as needed.
 - 2.J.01.03 Remove and reinstall turbocharger/wastegate assembly.
 - 2.J.01.04 Inspect, clean, and test charge air cooler assemblies; replace as needed.
 - 2.J.01.05 Inspect exhaust manifold, piping, mufflers, exhaust after-treatment device(s), and mounting hardware; repair or replace as needed.

- 2.J.01 Performance Examples:
- Perform air intake system restriction and leakage tests; determine needed repairs.
 - Inspect, service/replace air induction piping, air cleaner, and element; check air restriction.
 - Inspect intake manifold, gaskets, and connections; repair or replace as needed.

2.K Fuel System (Mechanical)

- 2.K.01 Diagnose and repair fuel systems.
 - 2.K.01.01 Check fuel level, quality, and consumption; determine needed action.
 - 2.K.01.02 Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, supply and return lines and fillings; determine needed action.
 - 2.K.01.03 Inspect, clean, and test fuel transfer (lift) pump, pump drives, screens, fuel/water separators/indicators, filters, heaters, coolers, electronic control module (ECM) cooling plates, and mounting hardware; determine needed action.
 - 2.K.01.04 Inspect and test low pressure regulator systems (check valves, pressure regulator valves, and restrictive fillings); determine needed action.
 - 2.K.01.05 Check fuel system for air; determine needed action; prime and bleed fuel system; check primer pump.

- 2.K.01 Performance Example:
- Students will be able to identify and explain the fuel system's major components.

2.L Engine Brake and Related Components

- 2.L.01 Diagnose and repair engine brakes.
 - 2.L.01.01 Inspect and adjust engine compression/exhaust brakes; determine needed action.
 - 2.L.01.02 Inspect, test, and adjust engine compression/exhaust brake control circuits, switches, and solenoids; repair or replace as needed.

2.L.01 Performance Examples:

- Students will inspect, test, and adjust engine/exhaust brakes.
- Students will inspect, test, adjust, and repair/replace engine/exhaust brake control circuits, switches, and solenoids.
- Students will inspect, repair/replace engine/exhaust brake housing, valves, seals, screens, lines, and fittings.

2.M Driveshaft Assemblies

2.M.01 Diagnose and repair driveshafts and universal joints.

2.M.01.01 Inspect, diagnose, service, and replace driveshaft, center support bearings, universal joint, slip joints, yokes, and drive flanges for noise, proper phasing, and vibration problems; determine needed action.

2.M.01.02 Measure and adjust drive line angles.

2.M.01 Performance Example:

- Students will demonstrate knowledge of precise measuring tools and be able to diagnose common driveshaft complaints by measuring the drive line angle of a given drive shaft and determining the corrective action.

2.N Heavy Duty Axle Service and Repair

2.N.01 Diagnose and repair drive axles.

2.N.01.01 Diagnose drive axle(s) drive unit noise and overheating problems; determine needed action.

2.N.01.02 Check and repair fluid level & condition, fluid leaks; inspect and replace drive axle housing cover plates, gaskets, sealants, vents, magnetic plugs, and seals.

2.N.01.03 Remove and replace differential carrier assembly.

2.N.01.04 Inspect, repair, or replace 2-speed axle shift control system, speedometer adapters, motors, axle shift units, wires, air lines, and connectors.

2.N.01.05 Inspect power divider (inter-axle differential) assembly; determine needed action.

2.N.01.06 Inspect, adjust, repair, or replace air operated power divider (inter-axle differential) lockout assembly including diaphragms, seals, springs, yokes, pins, lines, hoses, fittings, and controls.

2.N.01.07 Inspect, repair, or replace drive axle lubrication system: pump, troughs, collectors, slingers, tubes, and filters.

2.N.01.08 Remove, inspect and replace/adjust drive axle shafts, rear wheel seals, and rear wheel bearings.

2.N.01.09 Inspect and test drive axle temperature gauge and sending unit/sensor; determine needed action.

2.N.01 Performance Example:

- Students will diagnose unit noise and overheating complaints and perform entry level repairs.

2.O Truck Brake Systems

2.O.01 Diagnose and repair air brakes.

2.O.01.01 Diagnose poor stopping, air leaks, premature wear, pulling, grabbing, or dragging problems caused by supply and service system malfunctions; determine needed action.

2.O.01.02 Check air system build-up time; determine needed action.

- 2.0.01.03 Drain air reservoir tanks; check for oil, water, and foreign material; determine needed action.
- 2.0.01.04 Inspect air compressor, drive belts, pulleys, tensioners, air cleaner/supply; inspect oil supply and coolant lines, fittings, and mounting brackets; repair or replace as needed.
- 2.0.01.05 Inspect and test governor, high pressure relief, air system lines, hoses, fittings, and couplings; replace as needed.
- 2.0.01.06 Inspect and test air tank relief (safety) valves, one-way (single) check valves, two-way (double) check-valves, manual and automatic drain valves; replace as needed.
- 2.0.01.07 Inspect and clean air drier systems, filters, valves, heaters, wiring, and connectors; repair or replace as needed.
- 2.0.01.08 Inspect and test brake application (foot) valve and hand brake, fittings, and mounts; adjust or replace as needed.
- 2.0.01.09 Inspect and test stop light and low pressure warning circuit switches, wiring, and connectors; repair or replace as needed.
- 2.0.01.10 Inspect and test brake relay valve, quick release valve, tractor protection valve, parking brake valve, & air pressure gauges; replace as needed.

2.0.01 Performance Example:

- Students will identify and inspect truck brake systems, then cage and un-cage brake chambers and adjust slack adjusters.

2.P Foundation Truck Brakes

- 2.P.01 Diagnose and repair air brake mechanical/foundation problems.
 - 2.P.01.01 Diagnose poor stopping, brake noise, premature wear, pulling, grabbing, or dragging problems caused by the foundation brake, slack adjuster, and brake chamber problems; determine needed action.
 - 2.P.01.02 Inspect and test service brake chambers, pushrod, clevis, mounting brackets, manual & automatic slack adjusters, & camshafts repair or replace as needed.
 - 2.P.01.03 Inspect and measure brake shoe linings or pads, brake drums, and brake rotors; perform needed action.

2.P.01 Performance Example:

- Students will be able to diagnose poor stopping, brake noise, and inspect, and measure machine drums and rotors.

2.Q Parking Brake Systems

- 2.Q.01 Diagnose and repair parking brakes.
 - 2.Q.01.01 Inspect and test parking (spring) brake application and release valve, parking (spring) brake chamber, diaphragm and seals, parking (spring) brake check valves, lines, hoses, & fittings; replace as needed.
 - 2.Q.01.02 Replace parking (spring) brake chamber; dispose of removed chambers in accordance with local regulations.
 - 2.Q.01.03 Manually release (cage) and reset (uncage) parking (spring) brakes in accordance with manufacturers' recommendations.

2.Q.01 Performance Examples:

- Students will inspect, test, adjust, repair, or replace brake application (foot) valve, fittings, and mounts.
- Students will diagnose poor stopping, premature wear, brake noises, air leaks, pulling, grabbing, or dragging problems caused by supply and service system malfunctions; determine needed repairs.

2.R Hydraulic Brakes

- 2.R.01 Diagnose and repair hydraulic brakes.
 - 2.R.01.01 Diagnose poor stopping, premature wear, pulling, dragging and/or pedal feel problems caused by the hydraulic system; determine needed action.
 - 2.R.01.02 Inspect and test master cylinder for internal/external leaks and damage; replace as needed.
 - 2.R.01.03 Inspect brake lines, flexible hoses, and fillings for leaks and damage; replace as needed.
 - 2.R.01.04 Inspect and test brake stop light switch, brake pressure differential valve and warning light circuit switch, bulbs, wiring, and connectors, metering (hold-off), load sensing/proportioning, proportioning, and combination; repair or replace as needed.
 - 2.R.01.05 Inspect and clean disc brake caliper assemblies; replace as needed.
 - 2.R.01.06 Inspect/test brake fluid; bleed and/or flush system; determine proper fluid type.

2.R.01 Performance Example:

- Student will inspect and diagnose poor stopping, premature wear, brake noises, air leaks, pulling, grabbing, or dragging problems caused by supply and service systems malfunctions; and determine needed repairs.

2.S Mechanical Brakes

- 2.S.01 Diagnose and repair mechanical brake foundation problems.
 - 2.S.01.01 Check parking brake operation; inspect and measure transmission mounted or driveline mounted parking brake drums and shoe linings, cables, adjusters, and backing plates; perform needed action.

2.S.01 Performance Example:

- Student will inspect and adjust the parking brake mechanisms.

2.T Diesel Services – Hydraulic Brake System Components

- 2.T.01 Diagnose and repair power assist units.
 - 2.T.01.01 Diagnose stopping problems caused by the brake assist (booster) system; determine needed action.
 - 2.T.01.02 Inspect, test, repair, or replace power brake assist (booster), hoses, and control valves; determine proper fluid type.
 - 2.T.01.03 Check emergency (back-up, reserve) brake assist system.

2.T.01 Performance Example:

- Student will inspect, diagnose, and repair the brake assist booster.

2.U Anti Brake System

- 2.U.01 Diagnose and repair air and hydraulic antilock brake systems (ABS) and automatic traction control (ATC).
 - 2.U.01.01 Monitor antilock brake system (ABS) warning light operation (includes dash mounted trailer ABS warning light); determine needed action.
 - 2.U.01.02 Diagnose antilock brake system (ABS) electronic control(s) and components using self-diagnosis and/or specified test equipment (scan tool, personal computer/PC); determine needed action.

- 2.U.01.03 Inspect, test, and replace antilock brake system (ABS) air, hydraulic, electrical, and mechanical components; perform needed action.
- 2.U.01.04 Bleed the ABS hydraulic circuits following manufacturers' procedures.
- 2.U.01.05 Diagnose automatic traction control (ATC) electronic control(s) and components using self-diagnosis and/or specified test equipment (scan tool) PC computer; determine needed action.

2.U.01 Performance Examples:

- Students will diagnose poor stopping, pulling, premature wear, noise, or dragging complains caused by hydraulic system problems; determine needed repairs.
- Students will diagnose antilock brake system (ABS) electronic control(s) and components using self-diagnosis and/or recommended test equipment; determine needed repairs.

2.V Power Steering System

2.V.01 Diagnose and repair steering systems.

- 2.V.01.01 Diagnose fixed and driver adjustable steering column and shaft, shaft U-joint(s), slip joints, bearings, bushings, and seals; phase shaft U-joints for noise, looseness, and binding problems; determine needed action.
- 2.V.01.02 Inspect and align pitman arm, drag link, tie rod ends, and tube, steering arms; replace as needed.
- 2.V.01.03 Check and adjust wheel stops.
- 2.V.01.04 Lubricate steering linkage joints, as needed.
- 2.V.01.05 Check and adjust cab mounting and ride height.
- 2.V.01.06 Center the steering wheel, as needed.
- 2.V.01.07 Disable and enable supplemental restraint system (SRS) in accordance with manufacturers' recommended procedures.

2.V.01 Performance Example:

- Student will properly identify adjustable and fixed steering.

2.W Power Steering System Units

2.W.01 Diagnose and repair steering units.

- 2.W.01.01 Diagnose power steering system noise, steering binding, darting/oversteer, reduced wheel cut, steering wheel kick, pulling, non-recovery, turning effort, looseness, hard steering, overheating, fluid leakage, and fluid aeration problems; determine needed action.
- 2.W.01.02 Determine recommended type of power steering fluid; check level and condition; determine needed action. Flush and refill power steering system.
- 2.W.01.03 Perform power steering system pressure, temperature, and flow tests; determine needed action.
- 2.W.01.04 Inspect, adjust, service, or replace power steering reservoir including filter, seals, and gaskets, power steering pump & mounting bracket, pulleys, tensioners, drive belts, system cooler, lines, hoses, clamps, and fittings; determine needed action.

2.W.01 Performance Examples:

- Students will perform power steering system pressure and flow tests; determine needed repairs.
- Students will inspect, adjust, or replace drag link (relay rod) and tie rod ends (ball and adjustable socket type).

2.X Suspension Systems

- 2.X.01 Diagnose and repair suspension systems.
 - 2.X.01.01 Inspect front axles, U-bolts, and nuts; determine needed action.
 - 2.X.01.02 Inspect and service king pin, steering knuckle bushings, locks, bearings, seals, and covers; determine needed action.
 - 2.X.01.03 Inspect shock absorbers, bushings, brackets, and mounts; replace as needed.
 - 2.X.01.04 Inspect leaf springs, center bolts, clips, eye bolts and bushings, shackles, slippers, insulators, brackets, and mounts; determine needed action.
 - 2.X.01.05 Inspect torque arms, bushings, and mounts; determine needed action.
 - 2.X.01.06 Inspect axle aligning devices such as radius rods, track bars, stabilizer bars, and related bushings, mounts, shims, and cams; determine needed action.
 - 2.X.01.07 Inspect walking beams, center (cross) tube, bushings, mounts, load pads, and saddles/caps; replace as needed.
 - 2.X.01.08 Inspect and test air suspension pressure regulator and height control valves, lines, hoses, dump valves, and fittings; adjust, repair or replace as needed.
 - 2.X.01.09 Inspect and test air springs, mounting plates, springs, suspension arms, and bushings; replace as needed.
 - 2.X.01.10 Measure vehicle ride height; determine needed action.

2.X.01 Performance Example:

- Student will inspect service, adjust, or replace kingpin, steering knuckle bushings, locks, bearings, seals, and covers.

2.Y Wheels and Tires

- 2.Y.01 Diagnose and repair wheel adjustment problems.
 - 2.Y.01.01 Diagnose vehicle wandering, pulling, shimmy, hard steering, and off-center steering wheel problem(s); adjust and repair as needed.
 - 2.Y.01.02 Check toe; adjust as needed.
 - 2.Y.01.03 Check rear axle(s) alignment (thrustline/centerline) and tracking; adjust or repair as needed.
 - 2.Y.01.04 Check front axle alignment (centerline); adjust or repair as needed.

2.Y.01 Performance Example:

- Student will diagnose wheel shimmy and hard steering.

2.Z Tire Repair

- 2.Z.01 Diagnose and repair wheel and tire problems.
 - 2.Z.01.01 Diagnose unusual tire wear patterns, check tread depth, mismatched tread design; determine needed action.

2.Z.01 Performance Examples:

- Students will check and adjust caster.
- Students will check and adjust toe.

2.AA Vehicle Chassis Frame

- 2.AA.01 Service and repair frames.
 - 2.AA.01.01 Inspect and adjust fifth wheel, pivot pins, bushings, locking jaw mechanisms, and mounting bolts; determine needed action.
 - 2.AA.01.02 Inspect sliding fifth wheel, tracks, stops, locking systems, air cylinders, springs, lines, hoses, and controls.

- 2.AA.01.03 Inspect frame and frame members for cracks, breaks, corrosion, distortion, elongated holes, looseness, and damage; determine needed repairs.
- 2.AA.01.04 Inspect, repair, or replace pintle hooks and thaw bars.

2.AA.01 Performance Example:

- Students will inspect, adjust, service, repair, or replace fifth wheel, pivot pins, bushings, locking jaw mechanisms, and mounting bolts.

2.BB General Electrical System

- 2.BB.01 Diagnose and repair general electrical system problems.
 - 2.BB.01.01 Read, interpret, and diagnose electrical/electronic circuit problems using wiring diagrams.
 - 2.BB.01.02 Check continuity in electrical/electronic circuits using appropriate test equipment.
 - 2.BB.01.03 Check applied voltages, circuit voltages, and voltage drops in electrical/electronic circuits using a digital multimeter (DMM).
 - 2.BB.01.04 Check current flow in electrical/electronic circuits and components using a digital multimeter (DMM) or clamp-on ammeter.
 - 2.BB.01.05 Check resistance in electrical/electronic circuits and components using a digital multimeter (DMM).
 - 2.BB.01.06 Find shorts, grounds, and opens in electrical/electronic circuits.
 - 2.BB.01.07 Diagnose parasitic (key-off) battery drain problems.
 - 2.BB.01.08 Inspect and test fusible links, circuit breakers, relays, solenoids, and fuses; replace as needed.

2.BB.01 Performance Examples:

- Students will check continuity in electrical/electronic circuits using appropriate test equipment.
- Students will check applied voltages, circuit voltages, and voltage drops in electrical/electronic circuits using a digital multimeter (DMM), or clamp-on ammeter.
- Students will check current flow in electrical/electronic circuits and components using an ammeter, digital multimeter (DMM), or clamp-on ammeter.

2.CC Batteries

- 2.CC.01 Diagnose and repair batteries according to current industry and OSHA standards.
 - 2.CC.01.01 Perform battery load and capacitance test; determine needed action.
 - 2.CC.01.02 Determine battery state of charge using an open circuit voltage test.
 - 2.CC.01.03 Inspect, clean, and service battery, battery cables, connectors battery box, mounts, and hold downs; replace as needed.
 - 2.CC.01.04 Charge battery using slow or fast charge method as appropriate.
 - 2.CC.01.05 Jump start a vehicle using jumper cables and a booster battery or auxiliary power supply.

2.CC.01 Performance Examples:

- Students will perform battery load test; determine needed service.
- Students will determine battery state of charge by measuring terminal post voltage using a digital multimeter (DMM).
- Students will determine battery state of charge using an open circuit voltage test.

2.DD Starting Systems

2.DD.01 Diagnose and repair starting systems.

- 2.DD.01.01 Perform starter circuit cranking voltage and voltage drop tests; determine needed action.
- 2.DD.01.02 Inspect and test components (key switch, push button and/or magnetic switch) and wires in the starter control circuit; replace as needed.
- 2.DD.01.03 Inspect and test starter relays and solenoids/switches; replace as needed.
- 2.DD.01.04 Remove and replace starter; inspect flywheel ring gear or flex plate.

2.DD.01 Performance Examples:

- Students will perform starter circuit voltage drop tests; determine needed repairs.
- Students will inspect, test, and replace components (key switch, push button, and/or magnetic switch) and wires in the starter control circuit.
- Students will inspect, test, and replace starter relays and solenoids/switches.

2.EE Charging Systems

2.EE.01 Diagnose and repair charging systems.

- 2.EE.01.01 Diagnose instrument panel mounted volt meters and/or indicator lamps that show a no charge, low charge, or overcharge condition; determine needed action.
- 2.EE.01.02 Diagnose the cause of a no charge, low charge, or overcharge condition; determine needed action.
- 2.EE.01.03 Inspect and replace alternator drive belts, pulleys, fans, tensioners, and mounting brackets; adjust drive belts and check alignment.
- 2.EE.01.04 Perform charging system voltage and amperage output tests; determine needed action.
- 2.EE.01.05 Perform charging circuit voltage drop tests; determine needed action.
- 2.EE.01.06 Remove and replace alternator.
- 2.EE.01.07 Inspect, repair, or replace connectors and wires in the charging circuit.

2.EE.01 Performance Examples:

- Students will diagnose the cause of a no charge, low charge, or overcharge condition; determine needed repairs.
- Students will perform charging circuit voltage drop tests; determine needed repairs.

2.FF Lighting Systems

2.FF.01 Diagnose and repair lighting systems.

- 2.FF.01.01 Diagnose the cause of brighter than normal, intermittent, dim, or no headlight and daytime running light (DRL) operation.
- 2.FF.01.02 Test, aim, and replace headlights.
- 2.FF.01.03 Test headlight and dimmer circuit switches, relays, wires, terminals, connectors, sockets, and control components; repair or replace as needed.
- 2.FF.01.04 Inspect and test switches, bulbs/LEDs, sockets, connectors, terminals, relays, and wires of parking, clearance, and taillight circuits; repair or replace as needed.
- 2.FF.01.05 Inspect and test instrument panel light circuit switches, relays, bulbs, sockets, connectors, terminals, wires, and printed circuits/control modules; repair or replace as needed.
- 2.FF.01.06 Inspect and test interior cab light circuit switches, bulbs, sockets, connectors, terminals, and wires; repair or replace as needed.

- 2.FF.01.07 Inspect and test tractor-to-trailer multi-wire connector(s); repair or replace as needed.
- 2.FF.01.08 Inspect and test turn signal and hazard circuit flasher(s), switches, relays, bulbs/LEDs, sockets, connectors, terminals, and wires; repair or replace as needed.
- 2.FF.01.09 Inspect, test, and adjust backup lights and warning device circuit switches, bulbs/LEDs, sockets, horns, buzzers, connectors, terminals, and wires; repair or replace as needed.

2.FF.01 Performance Examples:

- Students will check headlights, daytime running lights, parking, clearance, tail, cab, and dash lights.
- Students will test, repair, and replace headlight and dimmer switches, wires, connectors, terminals, sockets, relays, and control components.
- Students will inspect, test, repair or replace top lights, turn signals, hazard lights, and backup lights.
- Students will inspect, test, adjust, repair or replace stoplight circuit switches, bulbs, sockets, connectors, terminals, relays, and wires.
- Students will inspect, test, repair or replace turn signal and hazard circuit flashers, switches, bulbs, sockets, connectors, terminals, relays, and wires.

2.GG Warning Systems

2.GG.01 Diagnose and repair gauges and warning systems.

- 2.GG.01.01 Perform diagnostic procedure with vehicle's on-board computer, using recommended electronic diagnostic equipment and tools (including PC based software and/or data scan tools); determine needed action.
- 2.GG.01.02 Diagnose the cause of intermittent, high, low, or no gauge readings; determine needed action.
- 2.GG.01.03 Diagnose the cause of data bus-driven gauge malfunctions; determine needed action.
- 2.GG.01.04 Inspect and test gauge circuit sending units, gauges, connectors, terminals, and wires; repair or replace as needed.
- 2.GG.01.05 Inspect and test warning devices (lights and audible), circuit sending units, bulbs/LEDs, sockets, connectors, wires, and printed circuits/control.

2.GG.01 Performance Example:

- Students will inspect, test, adjust, repair, or replace gauge circuit sending units, gauges, connectors, terminals, and wires.

2.HH Related Electrical Areas

2.HH.01 Diagnose and repair related electrical systems.

- 2.HH.01.01 Diagnose the cause of constant, intermittent, or no horn operation; determine needed action.
- 2.HH.01.02 Inspect and test horn circuit relays, horns, switches, connectors, and wires; repair or replace as needed.
- 2.HH.01.03 Diagnose the cause of constant, intermittent, or no wiper operation; diagnose the cause of wiper speed control and/or park problems; determine needed action.
- 2.HH.01.04 Inspect and test wiper motor, resistors, park switch, relays, switches, connectors, and wires; repair or replace as needed.

- 2.HH.01.05 Inspect wiper motor transmission linkage, arms, and blades; adjust or replace as needed.
- 2.HH.01.06 Inspect and test sideview mirror motors, heater circuit grids, relays, switches, connectors, terminals, and wires; repair or replace as needed.
- 2.HH.01.07 Inspect and test heater and alternating current (A/C) electrical components including: A/C clutches, motors, resistors, relays, switches, connectors, terminals, and wires; repair or replace as needed.
- 2.HH.01.08 Diagnose the cause of slow, intermittent, or no power side window operation; determine needed action.
- 2.HH.01.09 Inspect and test motors, switches, relays, connectors, terminals, and wires of power side window circuits; repair or replace as needed.
- 2.HH.01.10 Inspect and test engine cooling fan electrical control components; repair or replace as needed.

2.HH.01 Performance Example:

- Students will inspect, test, repair, or replace heater and A/C electrical components including: A/C clutches, motors, resistors, relays, switches, controls, connectors, terminals, and wires.

2.II Cab and Hood

2.II.01 Inspect cab and hood.

- 2.II.01.01 Inspect ignition key condition and operation of ignition switch.
- 2.II.01.02 Check warning indicators.
- 2.II.01.03 Check instruments; record oil pressure and system voltage.
- 2.II.01.04 Check mechanical, electronic, and emergency shutdown operation.
- 2.II.01.05 Check mechanical and electronic engine speed controls.
- 2.II.01.06 Check heater, ventilation, and air conditioning (HVAC) controls.
- 2.II.01.07 Check operation of all accessories.
- 2.II.01.08 Extract engine monitoring information using diagnostic tool or on-board diagnostic system.

2.II.01 Performance Example:

- Student will perform pre-trip inspection of the cab interior and hood area.

2.JJ Safety Equipment

2.JJ.01 Inspect safety equipment.

- 2.JJ.01.01 Check operation of electric/air horns and back-up warning devices.
- 2.JJ.01.02 Check condition and documentation of safety flares, spare fuses, triangles, fire extinguisher, and all required decals.
- 2.JJ.01.03 Inspect seat belts and sleeper restraints.

2.JJ.01 Performance Example:

- Student will be able to identify and inspect horns, seat belts, sleeper restraints, and safety equipment.

2.KK Hardware

2.KK.01 Inspect and service hardware.

- 2.KK.01.01 Check wiper and washer operation.
- 2.KK.01.02 Inspect windshield glass for cracks or discoloration; check sun visor.
- 2.KK.01.03 Check seat condition, operation, and mounting.
- 2.KK.01.04 Check door glass and window operation.
- 2.KK.01.05 Inspect steps and grab handles.
- 2.KK.01.06 Inspect mirrors, mountings, brackets, and glass.

- 2.KK.01.07 Record all observed physical damage.
- 2.KK.01.08 Lubricate all cab and hood grease fittings.
- 2.KK.01.09 Inspect and lubricate door and hood hinges, latches, strikers, lock cylinders, safety latches, linkages, and cables.
- 2.KK.01.10 Inspect cab mountings, hinges, latches, linkages, and ride height; service as needed.
- 2.KK.01.11 Inspect tilt cab hydraulic pump, lines, and cylinders for leakage; inspect safety devices; service as needed.

2.KK.01 Performance Example:

- Student will be able to conduct a pre-trip inspection on vehicle hardware.

2.LL Heavy-Duty Ventilation and Air Conditioning Systems

- 2.LL.01 Diagnose and repair heating, ventilation, & air conditioning (HVAC).
 - 2.LL.01.01 Inspect A/C condenser and lines for condition and visible leaks; check mountings.
 - 2.LL.01.02 Inspect A/C compressor and lines for condition and visible leaks; check mountings.
 - 2.LL.01.03 Check A/C system condition and operation; check A/C monitoring system, if applicable.
 - 2.LL.01.04 Check HVAC air inlet filters and ducts; service as needed.

2.LL.01 Performance Example:

- Student will be able inspect the heating and AC systems and identify the possible defects.

Advanced Technical Skills in Diesel Technology

Students that wish to excel and broaden their knowledge may apply their Diesel Technology knowledge and skills in the following areas noted below. These technical competencies are not required, but rather are supplemental.

2.MM* Engine Malfunctions

- 2.MM.01* Diagnose generic engine malfunctions.
 - 2.MM.01.01* Check, record, and clear electronic diagnostic (fault) codes, monitor electronic data; determine needed action.
 - 2.MM.01.02* Check electrical wiring, routing, and hold-down clamps, including Engine Control Module/Powertrain Control Module (ECM/PCM).

2.MM.01 Advanced Performance Example:

- Student will inspect, test, repair, or replace heater and A/C electrical components including: A/C clutches, motors, resistors, relays, switches, controls, connectors, terminals, and wires.

2.NN* Cylinder Head and Related Components

- 2.NN.01* Diagnose and repair cylinder head and valve train.
 - 2.NN.01.01* Inspect and adjust valve bridges (crossheads) and guides; perform needed action.

- 2.NN.01.02* Inspect pushrods, rocker arms, rocker arm shafts, cam followers, electronic wiring harness, and brackets for wear, bending, cracks, looseness, and blocked oil passages; perform needed action.
- 2.NN.01.03* Adjust valve clearance.

- 2.NN.01 Advanced Performance Example:
- Student will inspect valve train and adjust valve clearances.

2.00* Engine Block

- 2.00.01* Diagnose and repair engine block.
 - 2.00.01.01* Remove, inspect, service and install pans, covers, vents, gaskets, seals and wear rings.
 - 2.00.01.02* Disassemble, clean, and inspect engine block for cracks/damage; measure mating surfaces for warpage; check condition of passages, core/expansion and gallery plugs; inspect threaded holes, studs, dowel pins, and bolts for serviceability; determine needed action.
 - 2.00.01.03* Inspect cylinder walls or sleeve and counterbore and lower bore for wear and damage; determine needed action.
 - 2.00.01.04* Replace/reinstall cylinder liners and seals; check and adjust liner height (protrusion).
 - 2.00.01.05* Inspect in-block camshaft, camshaft bearings for wear and damage; measure/adjust end play; determine needed action.
 - 2.00.01.06* Clean and inspect crankshaft for surface cracks and journal damage; check condition of oil passages and vibration damper; check passage plugs; measure journal diameter determine needed action.
 - 2.00.01.07* Inspect main bearings and connecting rod bearings for wear patterns and damage; replace as needed; check bearing clearances; check and adjust crankshaft end play.
 - 2.00.01.08* Inspect, install, and time gear train, measure gear backlash; determine needed action.
 - 2.00.01.09* Assemble pistons and connecting rods, install in block, install rod bearings and check clearances.
 - 2.00.01.10* Check condition of piston cooling jets (nozzles); determine needed action.

- 2.00.01 Advanced Performance Example:
- Student will inspect cylinder sleeve counterbore and lower bore; check bore distortion; determine needed service.

2.PP* Air Intake and Exhaust System

- 2.PP.01* Diagnose and repair air induction and exhaust systems.
 - 2.PP.01.01* Inspect and test preheater/inlet air heater, or glow plug system and controls; perform needed action.
 - 2.PP.01.02* Inspect and test exhaust gas recirculation (EGR) system; determine needed action.
 - 2.PP.01.03* State all applicable emission standards for diesel systems.

- 2.PP.01 Advanced Performance Example:
- Student will state all applicable emission standards for diesel systems.

2.QQ* Electronic Fuel System

- 2.QQ.01* Diagnose and repair electronic fuel management systems.
 - 2.QQ.01.01* Inspect and test power and ground circuits and connections; measure and interpret voltage, voltage drop, amperage, and resistance readings using a digital multimeter (DMM); determine needed action.
 - 2.QQ.01.02* Perform diagnostic procedures with vehicle's on-board computer, using recommended electronic diagnostic equipment and tools (to include PC based software and/or data scan tools); determine needed action.
 - 2.QQ.01.03* Locate and use relevant service information (to include diagnostic procedures, flow charts, and wiring diagrams).
 - 2.QQ.01.04* Inspect and replace electrical connector terminals, seals, and locks.
 - 2.QQ.01.05* Inspect and test switches, sensors, controls, actuator components, and circuits; adjust or replace as needed.
 - 2.QQ.01.06* Access and change customer parameters using recommended electronic diagnostic tools (to include PC based software and/or data scan tools).
 - 2.QQ.01.07* Inspect, test, and adjust electronic unit injectors (EUI); determine needed action.
 - 2.QQ.01.08* Remove and install electronic unit injectors (EUI) and related components; recalibrate ECM (if applicable).
 - 2.QQ.01.09* Perform cylinder contribution test utilizing recommended electronic diagnostic tool.
 - 2.QQ.01.10* Perform on-engine inspections and tests on hydraulic electronic unit injectors and system electronic controls; determine needed action.
 - 2.QQ.01.11* Perform on-engine inspections and tests on hydraulic electronic unit injector high-pressure oil supply and control systems; determine needed action.
 - 2.QQ.01.12* Perform on-engine inspections and tests on distributor-type injection pump electronic controls; determine needed action.
 - 2.QQ.01.13* Perform on-engine inspections and tests on in-line type injection pump electronic controls; determine needed action.
 - 2.QQ.01.14* Perform on-engine inspections and tests on common rail type injection systems; determine needed action.

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| 2.QQ | Advanced Performance Example: <ul style="list-style-type: none">▪ Students will inspect, clean, test, repair/replace fuel transfer (lift) pump, pump drives, screens, fuel/water separators/indicators, filters, heaters and associated mounting hardware.▪ Students will inspect, clean, test fuel transfer (lift) pump, pump drives, screens, water separators, filters, heaters and mounting hardware; determine needed repairs. |
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2.RR* Clutches

- 2.RR.01* Diagnose and repair clutches.
 - 2.RR.01.01* Diagnose clutch noise, binding, slippage, pulsation, vibration, grabbing, dragging, and chatter problems; determine needed action.
 - 2.RR.01.02* Inspect and adjust clutch linkage, cables, levers, brackets, bushings, pivots, springs, and clutch safety switch (includes push and pull-type assemblies); check pedal height and travel; perform needed action.
 - 2.RR.01.03* Inspect, adjust, repair, or replace hydraulic clutch slave and master cylinders, lines, and hoses; bleed system.

- 2.RR.01.04* Inspect, adjust, lubricate, or replace release (throw-out) bearing, sleeve, bushings, springs, housing, levers, release fork, fork pads, rollers, shafts, and seals.
- 2.RR.01.05* Inspect, adjust, and replace single-disc clutch pressure plate and clutch disc.
- 2.RR.01.06* Inspect, adjust, and replace two-plate clutch pressure plate, clutch discs, intermediate plate, and drive pins/lugs.
- 2.RR.01.07* Inspect and/or replace clutch brake assembly; inspect input shaft and bearing retainer; perform needed action.
- 2.RR.01.08* Inspect, adjust, and replace self-adjusting/continuous-adjusting clutch mechanisms.
- 2.RR.01.09* Inspect and replace pilot bearing.
- 2.RR.01.10* Inspect flywheel mounting area on crankshaft, rear main oil seal, and measure crankshaft end play; determine needed action.
- 2.RR.01.11* Inspect flywheel and starter ring gear and measure flywheel face and pilot bore runout; determine needed action.
- 2.RR.01.12* Inspect flywheel housing(s) to transmission housing/engine mating surface(s) and measure flywheel housing face and bore runout; determine needed action

2.RR Advanced Performance Example:

- Students will diagnose clutch noise, binding, slippage, pulsation, vibration, grabbing, dragging, and chatter problems; determine needed action.

2.SS* Transmissions

- 2.SS.01* Diagnose and repair transmissions.
 - 2.SS.01.01* Diagnose transmission noise, shifting, lockup, jumping-out-of-gear, overheating, and vibration problems; determine needed action.
 - 2.SS.01.02* Diagnose transmission component failure cause, both before and during disassembly procedures; determine needed action.
 - 2.SS.01.03* Inspect, adjust, service, repair, or replace transmission shift controls both air and hydraulic.
 - 2.SS.01.04* Inspect for leakage and replace transmission cover plates, gaskets, seals, and cap bolts; inspect seal surfaces and vents; repair as needed.
 - 2.SS.01.05* Check transmission fluid level and condition; determine needed service; add lubricant according to manufacturer's specifications.
 - 2.SS.01.06* Inspect, adjust, and replace transmission shift lever, cover, rails, forks, levers, bushings, sleeves, detents, interlocks, springs, and lock bolts/safety wires.
 - 2.SS.01.07* Remove and reinstall transmission.
 - 2.SS.01.08* Inspect input-output-reverse idler shafts, gears, thrust washers, spacers, bearings, retainers, keys, and slingers; replace as needed.
 - 2.SS.01.09* Inspect synchronizer hub, sleeve, keys (inserts), springs, blocking rings, synchronizer plates, blocker pins, and sliding clutches; replace as needed.
 - 2.SS.01.10* Inspect transmission oil filters and coolers; replace as needed.
 - 2.SS.01.11* Inspect mechanical and electronic speedometer components; temperature gauge and sending unit; determine needed action.
 - 2.SS.01.12* Inspect and test function of backup light, neutral start, and warning device circuits; repair as needed.

- 2.SS.01.13* Inspect, test operation of, adjust, repair, or replace automated mechanical transmission and manual electronic shift controls, shift, range and splitter solenoids, shift motors, indicators, speed and range sensors, electronic/transmission control units (ECU/TCU), neutral/in gear and reverse switches, and wiring harnesses.
- 2.SS.01.14* Diagnose automated mechanical & automatic transmission problems using appropriate diagnostic tools and procedures; check and record diagnostic codes, clear codes, and interpret digital multimeter (DMM) readings; determine needed repairs.

- 2.SS Advanced Performance Example:
- Students will diagnose transmission noise, shifting, lockup, jumping out of gear, overheating and vibration problems, determine needed action.

Strand 3: Embedded Academics

Strand 3: Embedded Academics, a critical piece of a Vocational Technical Education Framework, are presented as Crosswalks between the Massachusetts Vocational Technical Education Frameworks and the Massachusetts Curriculum Frameworks. These Crosswalks are located in the Appendix of this Framework.

Academic Crosswalks

[Appendix A:](#) [English Language Arts](#)

[Appendix B:](#) [Mathematics](#)

[Appendix C:](#) [Science and Technology/Engineering](#)

Earth and Space Science

Life Science (Biology)

Physical Science (Chemistry and Physics)

Technology/Engineering

Strand 4: Employability and Career Readiness

4.A Career Exploration and Navigation

- 4.A.01 Develop a career plan and portfolio.
 - 4.A.01.01 Develop and revise career plan annually based on workplace awareness and skill attainment.
 - 4.A.01.02 Assess personal strengths and interest areas to determine potential careers, career pathways and career ladders.
 - 4.A.01.03 Examine potential career field(s)/discipline(s) and identify criteria to select, secure and keep employment in chosen field(s).
 - 4.A.01.04 Research and evaluate a variety of careers utilizing multiple sources of information and resources to determine potential career(s) and alternatives.
 - 4.A.01.05 Identify training and education requirements that lead to employment in chosen field(s) and demonstrate skills related to evaluating employment opportunities.
 - 4.A.01.06 Explore and evaluate postsecondary educational opportunities including degrees and certifications available, traditional and nontraditional postsecondary pathways, technical school and apprenticeships, cost of education, financing methods including scholarships and loans and the cost of loan repayment.
 - 4.A.01.07 Create a portfolio showcasing academic and career growth including a career plan, safety credential, resume and a competency profile demonstrating the acquisition of the knowledge and skills associated with at least two years of full-time study in the Chapter 74 program.

- 4.A.02 Demonstrate job search skills.
 - 4.A.02.01 Conduct a job search and complete written and electronic job applications, resumes, cover letters and related correspondence for a chosen career path.
 - 4.A.02.02 Explore and evaluate postsecondary job opportunities and career pathways specific to career technical areas.
 - 4.A.02.03 Identify role and use of social media and networking for staying current with career and employment trends as well as networking, job seeking and career development opportunities.
 - 4.A.02.04 Demonstrate ability to use social media and networking to develop useful occupational contacts, job seeking and career development opportunities.

- 4.A.03 Demonstrate all phases of the job interview process.
 - 4.A.03.01 Gather relevant information about potential employer(s) from multiple print and digital sources, assessing the credibility and accuracy of each source.
 - 4.A.03.02 Identify employment eligibility criteria, such as drug/alcohol free status, clean driving record, etc.

- 4.A.03.03 Practice effective interviewing skills: appearance, inquiry and dialogue with interviewer, positive attitude and evidence of work ethic and skills.
- 4.A.03.04 Explore and evaluate employment benefit packages including wages, vacation, health care, union dues, cafeteria plans, tuition reimbursement, retirement and 401K.

4. A Performance Examples:

- Conduct research to analyze and present on specific careers within a cluster.
- Conduct web-based job search using sites such as Monster.com, CareerBuilder.com, Indeed.com, Snagajob.com, Simplyhired.com and others.
- Create profile on social media/networking site such as LinkedIn and/or LinkedIn University for postsecondary research and employment opportunities.
- Complete online job application.
- Conduct and videotape practice interviews for instructor and student analysis.
- Provide students with sample employment and benefit packages for evaluation.

4.B Communication in the Workplace

- 4.B.01 Demonstrate appropriate oral and written communication skills in the workplace.
 - 4.B.01.01 Communicate effectively using the language and vocabulary appropriate to a variety of audiences within the workplace including coworkers, supervisors and customers.
 - 4.B.01.02 Read technical and work-related documents and demonstrate understanding in oral discussion and written exercise.
 - 4.B.01.03 Demonstrate professional writing skills in work-related materials and communications (e.g., letters, memoranda, instructions and directions, reports, summaries, notes and/or outlines).
 - 4.B.01.04 Use a variety of writing/publishing/presentation applications to create and present information in the workplace.
 - 4.B.01.05 Identify, locate, evaluate and use print and electronic resources to resolve issues or problems in the workplace.
 - 4.B.01.06 Use a variety of financial and data analysis tools to analyze and interpret information in the workplace.
 - 4.B.01.07 Orally present technical and work-related information to a variety of audiences.
 - 4.B.01.08 Identify and demonstrate professional non-verbal communication.
- 4.B.02 Demonstrate active listening skills.
 - 4.B.02.01 Listen attentively and respectfully to others.
 - 4.B.02.02 Focus attentively, make eye contact or other affirming gestures, confirm understanding and follow directions.
 - 4.B.02.03 Show initiative in improving communication skills by asking follow-up questions of speaker in order to confirm understanding.

4. B Performance Examples:
- Read and analyze technical instructions to learn what makes them effective.
 - Read and analyze technical instructions to follow directions and/or solve a problem.
 - Examine a technical document and use it to write a set of instructions for another student to follow and evaluate.
 - Analyze websites for effective technical writing and design.
 - Create brochures and presentations using software and/or Web 2.0 tools to convey technical information.
 - Conduct research using the Internet, print documents, observations and interviews to create a technical guide.

4.C Work Ethic and Professionalism

- 4.C.01 Demonstrate attendance and punctuality.
- 4.C.01.01 Identify and practice professional time-management and attendance behaviors including punctuality, reliability, planning and flexibility.
- 4.C.02 Demonstrate proper workplace appearance.
- 4.C.02.01 Identify and practice professional appearance specific to the workplace.
- 4.C.02.02 Identify and practice personal hygiene appropriate for duties specific to the workplace.
- 4.C.02.03 Identify and wear required safety gear specific to the workplace.
- 4.C.03 Accepts direction and constructive criticism.
- 4.C.03.01 Demonstrate ability (both verbally and non-verbally) to accept direction and constructive criticism and to implement solutions to change behaviors.
- 4.C.03.02 Ask appropriate questions to clarify understanding of feedback.
- 4.C.03.03 Analyze own learning style and seek instructions in a preferred format that works best for their understanding (such as oral, written or visual instruction).
- 4.C.04 Demonstrate motivation and initiative.
- 4.C.04.01 Evaluate assigned tasks for time to completion and prioritization.
- 4.C.04.02 Demonstrate motivation through enthusiasm, engagement, accurate completion of tasks and activities.
- 4.C.04.03 Demonstrate initiative by requesting new assignments and challenges.
- 4.C.04.04 Explain proposed solutions to challenges observed in the workplace.
- 4.C.04.05 Demonstrate the ability to evaluate multiple solutions to problems and challenges using critical reasoning and workplace/industry knowledge and select the best solution to the problem.
- 4.C.04.06 Implement solution(s) to challenges and/or problem(s) observed in the workplace.
- 4.C.04.07 See projects through completion and check work for quality and accuracy.
- 4.C.05 Demonstrate awareness of workplace culture and policy.

- 4.C.05.01 Display ethical behavior in use of time, resources, computers and information.
- 4.C.05.02 Identify the mission of the organization and/or department.
- 4.C.05.03 Explain the benefits of a diverse workplace.
- 4.C.05.04 Demonstrate a respect for diversity and its benefit to the workplace.

- 4.C.06 Interact appropriately with coworkers.
 - 4.C.06.01 Work productively with individuals and in teams.
 - 4.C.06.02 Develop positive mentoring and collaborative relationships within work environment.
 - 4.C.06.03 Show respect and collegiality, both formally and informally.
 - 4.C.06.04 Explain and follow workplace policy on the use of cell phones and other forms of social media.
 - 4.C.06.05 Maintain focus on tasks and avoid negative topics or excessive personal conversations in the workplace.
 - 4.C.06.06 Negotiate solutions to interpersonal and workplace conflicts.

4. C Performance Examples:

- Complete a learning style analysis tool.
- Develop a rubric to assess work ethic and professionalism as detailed in the standards above.

Student Organizations

Business Professionals of America

www.bpa.org

Selected Websites

- 5 Ways to Ace a Job Interview: http://kidshealth.org/teen/school_jobs/jobs/tips_interview.html
- America's Career Resource Network: <http://acrn.ovae.org/teachers/careerexpclassrm.htm>
- Career Cruiser – Florida Department of Education: <http://www.fldoe.org/workforce/pdf/cruiser.pdf>
- Career Development Guide and Glossary: <http://www.doe.mass.edu/connect/cde.html>
- Career One Stop: <http://www.careeronestop.org/>
- Career Plan: <http://www.doe.mass.edu/cd/plan/intro.html>
- Career Plan Model: http://www.doe.mass.edu/ccr/epp/samples/cpmodel_11x17.pdf
- Checklist: <http://www.doe.mass.edu/cd/plan/checklist.pdf>
- Career Tech: http://www.okcareertech.org/cac/Pages/resources_products/ethics_web_sites.htm
- Ethics Resource Center: <http://www.ethics.org/>
- Interaction in the Workplace: <http://hrweb.berkeley.edu/guides/managing-hr/interaction/communication>
- Individual Learning Plans: How-to Guide: “Promoting Quality Individualized Learning Plans: A How to Guide on the High School Years” <http://www.ncwd-youth.info/ilp/how-to-guide>

- ILP Fact Sheet: <http://www.ncwd-youth.info/fact-sheet/individualized-learning-plan>
- ILP Policy Brief: <http://www.ncwd-youth.info/ilp/produce-college-and-career-ready-high-school-graduates>
- ILP Resources Home Page: <http://www.ncwd-youth.info/ilp>
- Interview Skills Lesson Plans:
<http://www.amphi.com/media/1220281/interview%20skills%20lesson%20plan.doc>
- Labor and Workforce Development: <http://www.mass.gov/lwd/employment-services/preparing-for-your-job-search/>
- Maine Community College System – Center for Career Development:
http://www.ccd.me.edu/careerprep/CareerPrepCurriculum_LP-6.pdf
- Massachusetts Work-Based Learning: <http://skillspages.com/masswbl>
- North Dakota Association of Agriculture Educators:
http://www.ndaae.org/attachments/File/Preparing_students_for_a_Job_Interview.pptx
- NY CTE Learning Standards—Career Development and Occupational Studies (CDOS) Resource Guide with Core Curriculum : <http://www.p12.nysed.gov/cte/cdlearn/cdosresourceguide.html>
- Occupational Outlook Handbook: <http://www.bls.gov/ooh/>
- Purdue OWL Job Search Resources (for writing resumes, applications, and letters):
<https://owl.english.purdue.edu/engagement/34/>
- Soft Skills to Pay the Bills — Mastering Soft Skills for Workplace Success:
<http://www.dol.gov/odep/topics/youth/softskills/>
- US Department of Labor: <http://www.dol.gov/dol/audience/aud-unemployed.htm>
- Workplace Communication:
<http://www.regionalskillstraining.com/sites/default/files/content/WC%20Book%201.pdf>
- Your Plan For the Future: <http://www.yourplanforthefuture.org>

Strand 5: Management and Entrepreneurship Knowledge and Skills

5.A Starting a Business

- 5.A.01 Demonstrate an understanding of the practices required to start a business.
 - 5.A.01.01 Define entrepreneurship and be able to recognize and describe the characteristics of an entrepreneur.
 - 5.A.01.02 Compare and contrast types of business ownership (i.e., sole proprietorships, franchises, partnerships, corporations).
 - 5.A.01.03 Identify and explain the purpose and contents of a business plan.
 - 5.A.01.04 Demonstrate an understanding of the principles and concepts of a business's supply chain (i.e., suppliers, producers and consumers).

5. A Performance Examples:

- Develop a presentation pertaining to an entrepreneur and their business.
- Communicate with a business owner and discuss the pros and cons of starting and owning a business. Summarize the main points of the discussion.
- Choose a product or service and describe the process leading to distribution.
- Write a business plan for a business in your community.

5.B Managing a Business

- 5.B.01 Demonstrate an understanding of managing a business.
 - 5.B.01.01 Formulate short- and long-term business goals.
 - 5.B.01.02 Demonstrate effective verbal, written and visual communication skills.
 - 5.B.01.03 Utilize a decision-making process to make effective business decisions.
 - 5.B.01.04 Identify a business's chain of command and define its organizational structure.
 - 5.B.01.05 Identify and apply effective customer service skills and practices.
 - 5.B.01.06 Identify, interpret and develop written operating procedures and policies.
 - 5.B.01.07 Track inventory, productivity and labor cost.
 - 5.B.01.08 Demonstrate business meeting skills.
 - 5.B.01.09 Identify professional organizations and explore their benefits.

5. B Performance Examples:

- Working as a team, role-play situations that an entrepreneur might face in dealing with customers or employees.
- Contact a relevant professional organization and request information about its benefits, membership requirements and costs.
- Plan and conduct a business meeting.
- Identify companies that are known for customer service and list the practices that help differentiate themselves from all others in their industry.

5.C Marketing a Business

- 5.C.01 Demonstrate an understanding of marketing and promoting a business.
 - 5.C.01.01 Explain the role of business in the economy.
 - 5.C.01.02 Describe the relationship between business and community.
 - 5.C.01.03 Describe methods of market research and identifying target markets.

- 5.C.01.04 Describe and apply the concepts of a marketing mix (the 4Ps of marketing: product, price, place and promotion).
- 5.C.01.05 Compare and contrast the promotional tools and techniques used to sell products, services, images and ideas.
- 5.C.01.06 Describe the impact of supply and demand on a product or business.
- 5.C.01.07 Identify direct and indirect competition on a business.
- 5.C.01.08 Identify and use sales techniques to meet client needs and wants.
- 5.C.01.09 Discuss strategies to acquire and retain a customer base.

5. C Performance Examples:
- Research reliable sources to identify marketing and industry data related to a business.
 - Conduct market research by developing a survey and presenting the results.
 - Create a promotional campaign using a variety of media.
 - Write a marketing plan for a product.

5.D Financial Concepts and Applications in Business

- 5.D.01 Demonstrate an understanding of financial concepts and applications.
 - 5.D.01.01 Identify essential financial reports and understand their purpose (i.e., budget, balance sheet and income statement).
 - 5.D.01.02 Describe payroll practices (i.e., deductions – federal, FICA and state taxes and insurances).
 - 5.D.01.03 Identify the importance of maintaining accurate records.
 - 5.D.01.04 Apply practices related to pricing, purchasing and billing.
 - 5.D.01.05 Maintain and reconcile a checking account.
 - 5.D.01.06 Identify the options for funding a business.

5. D Performance Examples:
- Given an employee time card and rate of pay, calculate gross pay, taxes, deductions and net pay.
 - Develop a budget for a simulated business or project.
 - Analyze and discuss financial documents from a company.
 - Research various methods of funding a business.

5.E Legal/Ethical/Social Responsibilities

- 5.E.01 Demonstrate an understanding of legal, ethical and social responsibility for businesses.
 - 5.E.01.01 Identify state and federal laws and regulations related to managing a business.
 - 5.E.01.02 Describe and identify ethical business practices.
 - 5.E.01.03 Demonstrate an understanding of business contracts.
 - 5.E.01.04 Explain the role of diversity in the workplace.
 - 5.E.01.05 Explain the role of labor organizations.
 - 5.E.01.06 Identify practices that support clean energy technologies and encourage environmental sustainability.
 - 5.E.01.07 Demonstrate an understanding of how technology advancements impact business practices.

- 5.E Performance Example:
- Read and interpret a contract.
 - Complete an application for a license, permit or certificate.
 - Research federal, state and local regulations and laws required for a business.
 - Participate in and summarize a discussion with a member of a labor or civil rights organization.

Selected Websites

- CVTE Strand 1, 4, and 5 Resources: <https://sites.google.com/a/mccanntech.org/cvte-strands-1-4-and-5-resources/>
- Entrepreneur: <http://www.entrepreneur.com>
- Inc. Magazine: <http://www.inc.com/>
- Junior Achievement “Be Entrepreneurial Program”: <https://www.juniorachievement.org/web/ja-usa/home>
- Kahn Academy Interviews with Entrepreneurs: <https://www.khanacademy.org/economics-finance-domain/entrepreneurship2/interviews-entrepreneurs>
- Kauffman Founders School: <http://www.entrepreneurship.org/en/founders-school.aspx>
- National Federation of Independent Business: www.nfib.com
- National Foundation for Teaching Entrepreneurship (NFTE): www.nfte.com
- SBA Loans: <http://www.sba.gov>
- SkillsUSA Professional Development Program Competency List: <http://www.skillsusa.org/downloads/PDF/lessons/professional/PDPPreview.pdf>
- Small Business Administration: www.sba.gov

Glossary

Term	Definition
Balance sheet	A statement of the assets, liabilities and capital of a business at a particular point in time.
Budget	An estimate of income and expenditure for a set period of time.
Business Ownership	Types of business ownership refer to the legal structure of an organization. Legal structures include: Sole Proprietorship, Partnerships, Corporations and Limited Liability Companies.
Business Plan	A written document that describes in detail your business goals and how you are going to achieve them from a marketing, operational and financial point of view.

Term

Chain of Command and Organizational Structure

**Definition**

Refers to the management structure of an organization. It identifies lines of authority, lines of communication, and reporting relationships. Organizational structure determines how the roles, power and responsibilities are assigned and coordinated and how information flows between the different levels of management. (A visual representation of this structure is called an org chart).

FICA

Federal Insurance Contributions Act requires taxes deducted from pay for supporting Social Security.

Income Statement

A financial statement providing operating results for a specific time period showing a business's revenues, expenses and profit or loss.

Market Research

- Primary: Surveys, Focus Groups, Observation
- Secondary: Websites, Internet

Marketing Mix

A set of controlled variables that formulate the strategic position of a product or service in the marketplace. These variables are known as the 4 P's of marketing and include product, place, price and promotion.

Methods to Track Inventory, Productivity and Labor Cost

Refers to the processes a business uses to account for: 1) the inflows and outflows of inventory and materials related to inventory; 2) the efficiency of operations and 3) the cost of labor including salary and benefits.

Promotional Tools and Techniques

The six elements of a promotional mix are: advertising, visual merchandising, public relations, publicity, personal selling and sales promotion.

Supply Chain

The supply chain, or channel of distribution, describes how the product is handled and/or distributed from suppliers with materials, to the manufacturer, wholesaler or retailer and finally to the consumer.

Target Market

Those who are most likely to buy your product or service.

Strand 6: Technology Literacy Knowledge and Skills

6.A Technology Literacy Knowledge and Skills (Grades 9 through 12)

- 6.A.01 Demonstrate proficiency in the use of computers and applications, as well as an understanding of the concepts underlying hardware, software, and connectivity.
 - 6.A.01.01 Use online help and other support to learn about features of hardware and software, as well as to assess and resolve problems.
 - 6.A.01.02 Install and uninstall software; compress and expand files (if the district allows it).
 - 6.A.01.03 Explain effective backup and recovery strategies.
 - 6.A.01.04 Apply advanced formatting and page layout features when appropriate (e.g., columns, templates, and styles) to improve the appearance of documents and materials.
 - 6.A.01.05 Use editing features appropriately (e.g., track changes, insert comments).
 - 6.A.01.06 Identify the use of word processing and desktop publishing skills in various careers.
 - 6.A.01.07 Identify the use of database skills in various careers.
 - 6.A.01.08 Define and use functions of a spreadsheet application (e.g., sort, filter, find).
 - 6.A.01.09 Explain how various formatting options are used to convey information in charts or graphs.
 - 6.A.01.10 Identify the use of spreadsheet skills in various careers.
 - 6.A.01.11 Use search engines and online directories.
 - 6.A.01.12 Explain the differences among various search engines and how they rank results.
 - 6.A.01.13 Explain and demonstrate effective search strategies for locating and retrieving electronic information (e.g., using syntax and Boolean logic operators).
 - 6.A.01.14 Describe good practices for password protection and authentication.
- 6.A.02 Demonstrate the responsible use of technology and an understanding of ethics and safety issues in using electronic media at home, in school, and in society.
 - 6.A.02.01 Demonstrate compliance with the school's Acceptable Use Policy.
 - 6.A.02.02 Explain issues related to the responsible use of technology (e.g., privacy, security).
 - 6.A.02.03 Explain laws restricting the use of copyrighted materials.
 - 6.A.02.04 Identify examples of plagiarism, and discuss the possible consequences of plagiarizing the work of others.
- 6.A.03 Design and implement a personal learning plan that includes the use of technology to support lifelong learning goals.
 - 6.A.03.01 Evaluate the authenticity, accuracy, appropriateness, and bias of electronic resources, including Web sites.
 - 6.A.03.02 Analyze the values and points of view that are presented in media messages.
 - 6.A.03.03 Describe devices, applications, and operating system features that offer accessibility for people with disabilities.

- 6.A.03.04 Evaluate school and work environments in terms of ergonomic practices.
- 6.A.03.05 Describe and use safe and appropriate practices when participating in online communities (e.g., discussion groups, blogs, social networking sites).
- 6.A.03.06 Explain and use practices to protect one's personal safety online (e.g., not sharing personal information with strangers, being alert for online predators, reporting suspicious activities).
- 6.A.03.07 Explain ways individuals can protect their technology systems and information from unethical users.
- 6.A.04 Demonstrate the ability to use technology for research, critical thinking, problem solving, decision making, communication, collaboration, creativity, and innovation.
 - 6.A.04.01 Devise and demonstrate strategies for efficiently collecting and organizing information from electronic sources.
 - 6.A.04.02 Compare, evaluate, and select appropriate electronic resources to locate specific information.
 - 6.A.04.03 Select the most appropriate search engines and directories for specific research tasks.
 - 6.A.04.04 Use a variety of media to present information for specific purposes (e.g., reports, research papers, presentations, newsletters, Web sites, podcasts, blogs), citing sources.
 - 6.A.04.05 Demonstrate how the use of various techniques and effects (e.g., editing, music, color, rhetorical devices) can be used to convey meaning in media.
 - 6.A.04.06 Use online communication tools to collaborate with peers, community members, and field experts as appropriate (e.g., bulletin boards, discussion forums, listservs, Web conferencing).
 - 6.A.04.07 Plan and implement a collaborative project with students in other classrooms and schools using telecommunications tools (e.g., e-mail, discussion forums, groupware, interactive Web sites, video conferencing).

Appendices

The framework teams created an “Appendix” listing potential industry recognized credentials attainable by secondary students; lists of professional, student, and relevant government organizations; and useful resources and websites. **** It is important to note that although most Framework Teams provided information for the “Appendix”, not all teams did. Therefore, sub-headings within the “Appendix” without information have been deleted.***

Disclaimer: Reference in the Appendices Section to any specific commercial products, processes, or services, or the use of any trade, firm or corporation name is for the information and convenience of the public, and does not constitute endorsement or recommendation by the Massachusetts Department of Elementary and Secondary Education.

Embedded Academic Crosswalks

Embedded English Language Arts and Literacy

CVTE Learning Standard Number	Strand Coding Designation Grades ELAs Learning Standard Number	Text of English Language Arts Learning Standard
Performance Example: <ul style="list-style-type: none"> Students will discuss ways to identify and prevent workplace/school violence. 		
2.EE.01	RI Grades 11-12 #7	Integrate and evaluate multiple sources of information presented in different media or formats (e.g. visually, quantitatively) as well as in words in order to address a question or solve a problem.
Performance Example: <ul style="list-style-type: none"> Students using the aid of a digital multimeter (DMM), online diagrams, and text books will be able to diagnose the cause of brighter than normal, intermittent, dim, or no headlight and daytime running light (DRL) operation. 		
2.NN.07	W Grades 9-10 #2d	Use precise language and domain-specific vocabulary to manage the complexity of the topic.
Performance Example: <ul style="list-style-type: none"> Students will utilize visuals handed to them by their instructor to visually inspect main bearings and connecting rod bearings for wear patterns and damage; the students will then utilize online data along with micrometers to measure bearing clearances. 		
4.A.01	W Grades 9-12 #7	Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Performance Example: <ul style="list-style-type: none"> Students will utilize online webpages/sites to evaluate industries, organizations, and careers based on multiple sources of research and information. They will then provide written and verbal feedback to the instructor. 		
6.A.01 6A.03	SL Grades 9-12 #5	Make strategic use of digital media (e.g. textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning and evidence and to add interest. Integrate and evaluate multiple sources of information presented in different media or formats (e.g. visually, quantitatively) as well as in words in order to address a question or solve a problem.

Performance Example:

- Students will demonstrate proficiency in the use of computers and applications, as well as an understanding of the concepts underlying hardware, software, and connectivity during activities such as career cruising, motor all data online, and during construction of related power point projects.

Embedded Mathematics

CVTE Learning Standard Number	Math Content Conceptual Category and Domain Code Learning Standard Number	Text of Mathematics Learning Standard
2.A.05	Introductory Physics, High School 1.5	Use a free-body force diagram to show forces acting on a system consisting of a pair of interacting objects. For a diagram with only co-linear forces, determine the net force acting on a system and between the objects.
Performance Example:		
<ul style="list-style-type: none"> • Students will be asked to identify, explain, and demonstrate outside/inside micrometer. 		
2.I.01	Introductory Physics, High School 3.2	Explain how heat energy will move from a higher temperature to a lower temperature until equilibrium is reached.
Performance Example:		
<ul style="list-style-type: none"> • Using Digital Multi-meter digital-multimeter (DMV's) and electrical diagrams, students will be able to check operation of electric/air horns and back-up warning devices. Students will also utilize Ohm's Law to calculate electrical differences. 		
2.I.05	Introductory Physics, High School 3.3	Describe the relationship between average molecular kinetic energy and temperature. Recognize that energy is absorbed when a substance changes from a solid to a liquid to a gas, and that energy is released when a substance changes from a gas to a liquid to a solid. Explain the relationships among evaporation, condensation, cooling, and warming.
Performance Example:		
<ul style="list-style-type: none"> • Students will be required to measure angles and then mount exhaust piping and hardware so that the exhaust system operates properly. 		
2.L.01	Introductory Physics, High School 5.1	Recognize that an electric charge tends to be static on insulators.
Performance Example:		
<ul style="list-style-type: none"> • Students will perform inspection, diagnoses, service, and replacement of the driveshaft, center support bearings, universal joint, slip joints, yokes, and drive flanges. Students will demonstrate proper phasing of the driveshaft to prevent vibration. 		
2.L.02	Introductory Physics, High School 5.3	Analyze simple arrangements of electrical components in both series and parallel circuits. Recognize symbols and understand the functions of common circuit elements (battery, connecting wire, switch, fuse, resistance) in a schematic diagram.
Performance Example:		
<ul style="list-style-type: none"> • Students will demonstrate the ability to measure and adjust drive line angles. 		
2.G.01	6.RP3	Use ratio and rate reasoning to solve real-world and mathematical

2.G.02 2.G.03 2.G.04		problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations.
Performance Example: <ul style="list-style-type: none"> Students will demonstrate proper diagnosis and repair of the lubrication systems through information in their student manuals. 		
2.L.01	5.NBT3	Read, write, and compare decimals to thousandths.
Performance Example: <ul style="list-style-type: none"> Students will measure angles using the proper tool. 		
2.M.01	5.NBT7	Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.
Performance Example: <ul style="list-style-type: none"> Students will be able to check fluid levels and leakage along with diagnosing driveline noise. 		
2.M.02	A-CED4	Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.
Performance Example: <ul style="list-style-type: none"> Students' will be able to read and interpret the compression ratios they receive during compression testing of a cylinder. 		
2.N.02	5.NF1	Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.
Performance Example: <ul style="list-style-type: none"> Students' will be able to read and interpret driveline angles and adjust according to their readings. 		
2.N.10 2.N.11 2.N.12	5.NBT7	Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.
Performance Example: <ul style="list-style-type: none"> Students will be able to physically identify all airbrake components, adjust air pressure, adjust leveling valves, and diagnose air leaks. 		
2.P.02	4.MD7	Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real-world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.

Performance Example:		
<ul style="list-style-type: none"> Students will perform caging and un-caging of air brake chambers safely. 		
2.S.02	5.NBT7	Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.
Performance Example:		
<ul style="list-style-type: none"> Students will inspect and diagnose power booster. 		
2.N.02	5.NF1	Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.
Performance Example:		
<ul style="list-style-type: none"> Students' will perform tests on the air compressor and be able to adjust the air governor. 		
2.N.10 2.N.11 2.N.12	5.NBT7	Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.
Performance Example:		
<ul style="list-style-type: none"> Students will be able to physically identify all airbrake components, adjust air pressure, adjust leveling valves, and diagnose air leaks. 		
2.P.02	4.MD7	Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real-world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.
Performance Example:		
<ul style="list-style-type: none"> Students will perform caging and un-caging of air brake chambers safely. 		
2.N.02	5.NF1	Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.
Performance Example:		
<ul style="list-style-type: none"> Students will perform tests on the air compressor and be able to adjust the air governor. 		
2.N.10	5.NBT7	Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.
Performance Example:		

<ul style="list-style-type: none"> Students will be able to physically identify all airbrake components, adjust air pressure, adjust leveling valves, and diagnose air leaks. 		
2.P.02	4.MD7	Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real-world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.
Performance Example: <ul style="list-style-type: none"> Students will perform caging and un-caging of air brake chambers safely. 		
2.S.03	5.NF1	Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.
Performance Example: <ul style="list-style-type: none"> Students will inspect emergency back- up reserve brake system. 		
2.BB.02 2.BB.03 2.BB.04	5.NBT7 5.NF1 4.MD7	<p>Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.</p> <p>Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.</p> <p>Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real-world and mathematical problems, e.g., by using an equation with a symbol for the unknown angle measure.</p>
Performance Example: <ul style="list-style-type: none"> Students will inspect and adjust the fifth wheel pivot pins, and bushings. 		
2.CC.01	5.NF1	Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.
Performance Example: <ul style="list-style-type: none"> Students will check continuity in electrical circuits using appropriate test equipment. Students will perform a voltage drop tests. Inspect, test, and replace components (key switch, push button, and/or magnetic switch and wires in the starter control circuit Inspect, test, and replace starter relays and solenoids/switches. 		
2.GG.01	A-CED4	Rearrange formulas to highlight a quantity of interest, using the

2.GG.02		same reasoning as in solving equations.
2.GG.03		
Performance Example: <ul style="list-style-type: none"> Students will diagnose the cause of brighter than normal headlamps and the reasoning behind the fault. 		
2.OO.03	5.NBT7 5.NF1	Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. Add and subtract fractions with unlike denominators (including mixed numbers) by replacing given fractions with equivalent fractions in such a way as to produce an equivalent sum or difference of fractions with like denominators.
Performance Example: <ul style="list-style-type: none"> Students will measure interference angles of valves and adjust valve clearances. 		
2.S.02	5.NBT7	Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used.
Performance Example: <ul style="list-style-type: none"> Students will measure and adjust clutch pedal free play. 		

Physical Science (Chemistry)

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Chemistry Learning Standard
2.D.01C	Chemistry, High School 1.1	Identify and explain physical properties (e.g., density, melting point, boiling point, conductivity, malleability)
Performance Examples: <ul style="list-style-type: none"> Students will select the correct tool to drill a 5/16 hole and select the proper tap to thread the hole. Students will select the correct tools and supplies to solder an electrical connection and will explain the soldering procedure to include: safety, preparation, joining the wires mechanically, tinning, soldering and then sleeving. 		

Physical Science (Physics)

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Physics Learning Standard
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2.A.01	Introductory Physics, High School 1.5	Use a free-body force diagram to show forces acting on a system consisting of a pair of interacting objects. For a diagram with only co-linear forces, determine the net force acting on a system and between the objects.
Performance Example: <ul style="list-style-type: none"> Students will be asked to identify, explain, and demonstrate safe use of hand, power, electric, and pneumatic tools. 		
2.I.01	Introductory Physics, High School 3.2	Explain how heat energy will move from a higher temperature to a lower temperature until equilibrium is reached.
Performance Example: <ul style="list-style-type: none"> Students will explain low and high temperatures of the lubrication system and the effects it has on the components. 		
2.L.01	Introductory Physics, High School 5.1	Recognize that an electric charge tends to be static on insulators and can move on and in conductors. Explain that energy can produce a separation of charges.
Performance Example: <ul style="list-style-type: none"> Students will identify major components in the fuel system and explain their purpose. 		
2.O.03	Introductory Physics, High School 2.1	Interpret and provide examples that illustrate the law of conservation of energy.
Performance Example: <ul style="list-style-type: none"> Students will perform an inspection and diagnose drive axle(s), drive unit noise and overheating noise. 		
2.HH.04	Introductory Physics, High School 5.2	Develop qualitative and quantitative understandings of current, voltage, resistance, and the connections among them (Ohm's law).
Performance Example: <ul style="list-style-type: none"> Students will explain and demonstrate ohms law utilizing digital multi-meters (DMM). 		

Technology/Engineering

CVTE Learning Standard Number	Subject Area, Topic Heading and Learning Standard Number	Text of Technology/Engineering Learning Standard
2.C.01.04 – 2.C.16.06	Technology/Engineering, High School , 2.5	Identify and demonstrate the safe and proper use of common hand tools, power tools, and measurement devices used in construction.
Performance Example: <ul style="list-style-type: none"> Students will demonstrate measurement skills using both American and metric system using variety of tools. 		
2.L.01	Technology/Engineering, High School , 5.1	Explain how to measure and calculate voltage, current, resistance, and power consumption in a series circuit and in a parallel circuit. Identify the instruments used to measure

		voltage, current, power consumption, and resistance.
Performance Example: <ul style="list-style-type: none"> Students will perform inspections on the fuel pump and determine needed action. 		
2.U.01	Technology/Engineering, High School , 3.2	Explain the differences and similarities between hydraulic and pneumatic systems, and explain how each relates to manufacturing and transportation systems.
Performance Example: <ul style="list-style-type: none"> Students will be able to diagnose stopping issues utilizing a vacuum gauge. 		
2.EE.01 2.EE.02	Technology/Engineering, High School , 5.1, 5.2	Explain how to measure and calculate voltage, current, resistance, and power consumption in a series circuit and in a parallel circuit. Identify the instruments used to measure voltage, current, power consumption, and resistance. Identify and explain the components of a circuit, including sources, conductors, circuit breakers, fuses, controllers, and loads. Examples of some controllers are switches, relays, diodes, and variable resistors.
Performance Example: <ul style="list-style-type: none"> Students will perform a starter circuit voltage drop; determine needed action. 		
2.EE.03	Technology/Engineering, High School , 5.3	Explain the relationships among voltage, current, and resistance in a simple circuit, using Ohm's law.
Performance Example: <ul style="list-style-type: none"> Students will explain Ohm's law as it relates to voltage drops. 		

DESE Statewide Articulation Agreements

No Statewide Articulation Agreements at this time.

Industry Recognized Credentials (Licenses and Certifications/Specialty Programs)

National Institute for Automotive Service Excellence (ASE)

Occupational Safety and Health Administration (OSHA) 10 hour General Industry Card

- Graduates of this program can expect to be able to find positions in the diesel field as entry level technicians and with experience and continued education will be able to work their way to becoming Master Technicians.

Other

Reference Materials

- National Automotive Technicians Education Foundation (NATEF)
- ALLDATA online
- MOTOR Information Systems
- Bennet, S. (2010). Heavy Duty Truck Systems, Fifth Edition. New York: Cengage Learning.
- Norman, A., Corinchok, J. (2007). Diesel Technology: Fundamentals, Service, and Repair Seventh Edition. Illinois: Goodheart-Willcox Company.
- Fundamentals of Technology Principles of Hydraulics

Related National, Regional, and State Professional Organizations

- National Automotive Technicians Education Foundation (NATEF)
- Occupational Safety and Health Administration (OSHA)
- Automotive Service Excellence (ASE)

Student Organizations

- Skills USA www.maskillsusa.org

Selected Websites

- National Automotive Technicians Education Foundation (NATEF) – www.natef.org
- Automotive Service Excellence (ASE) – www.ase.com