



# Transportation Industry Sector

## *Career Pathways*

- ◆ Aviation and Aerospace Transportation Services
- ◆ Collision Repair and Refinishing
- ◆ Vehicle Maintenance, Service, and Repair



# Transportation Industry Sector

The Transportation sector is designed to provide a foundation in transportation services for all industrial technology education students in California. The pathways emphasize real-world, occupationally relevant experiences of significant scope and depth in Aviation and Aerospace Transportation Services, Collision Repair and Refinishing, and Vehicle Maintenance, Service, and Repair. The standards are designed to integrate academic and technical preparation and focus on career awareness, career exploration, and skill preparation in the three pathways. Integral components include classroom, laboratory, hands-on contextual learning, and project- and work-based instruction as well as internship, community classroom, cooperative career technical education, and leadership development. The Transportation sector standards prepare students for continued training, postsecondary education, and entry to a career.

## FOUNDATION STANDARDS

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### 1.0 Academics

Students understand the academic content required for entry into postsecondary education and employment in the Transportation sector.

*(The standards listed below retain in parentheses the numbering as specified in the mathematics, science, and history–social science content standards adopted by the State Board of Education.)*

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#### 1.1 Mathematics

Specific applications of Number Sense standards (grade seven):

- (1.1) Read, write, and compare rational numbers in scientific notation (positive and negative powers of 10) with approximate numbers using scientific notation.
- (1.2) Add, subtract, multiply, and divide rational numbers (integers, fractions, and terminating decimals) and take positive rational numbers to whole-number powers.
- (1.3) Convert fractions to decimals and percents and use these representations in estimations, computations, and applications.

- (1.4) Differentiate between rational and irrational numbers.
- (1.5) Know that every rational number is either a terminating or a repeating decimal and be able to convert terminating decimals into reduced fractions.
- (1.6) Calculate the percentage of increases and decreases of a quantity.
- (1.7) Solve problems that involve discounts, markups, commissions, and profit and compute simple and compound interest.

Specific applications of Algebra and Functions standards (grade seven):

- (1.1) Use variables and appropriate operations to write an expression, an equation, an inequality, or a system of equations or inequalities that represents a verbal description (e.g., three less than a number, half as large as area A).
- (3.4) Plot the values of quantities whose ratios are always the same (e.g., cost to the number of an item, feet to inches, circumference to diameter of a circle). Fit a line to the plot and understand that the slope of the line equals the quantities.

Specific applications of Measurement and Geometry standards (grade seven):

- (1.1) Compare weights, capacities, geometric measures, times, and temperatures within and between measurement systems (e.g., miles per hour and feet per second, cubic inches to cubic centimeters).
- (2.4) Relate the changes in measurement with a change of scale to the units used (e.g., square inches, cubic feet) and to conversions between units (1 square foot = 144 square inches or  $[1 \text{ ft}^2] = [144 \text{ in}^2]$ , 1 cubic inch is approximately 16.38 cubic centimeters or  $[1 \text{ in}^3] = [16.38 \text{ cm}^3]$ ).

Specific applications of Mathematical Reasoning standards (grade seven):

- (2.1) Use estimation to verify the reasonableness of calculated results.
- (2.2) Apply strategies and results from simpler problems to more complex problems.
- (2.3) Estimate unknown quantities graphically and solve for them by using logical reasoning and arithmetic and algebraic techniques.
- (2.4) Make and test conjectures by using both inductive and deductive reasoning.
- (2.5) Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.
- (2.6) Express the solution clearly and logically by using the appropriate mathematical notation and terms and clear language; support solutions with evidence in both verbal and symbolic work.
- (2.7) Indicate the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.
- (2.8) Make precise calculations and check the validity of the results from the context of the problem.
- (3.1) Evaluate the reasonableness of the solution in the context of the original situation.
- (3.2) Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.
- (3.3) Develop generalizations of the results obtained and the strategies used and apply them to new problem situations.

Specific applications of Algebra I standards (grades eight through twelve):

- (1.1) Students use properties of numbers to demonstrate whether assertions are true or false.
- (5.0) Students solve multistep problems, including word problems, involving linear equations and linear inequalities in one variable and provide justification for each step.
- (8.0) Students understand the concepts of parallel lines and perpendicular lines and how those slopes are related. Students are able to find the equation of a line perpendicular to a given line that passes through a given point.
- (12.0) Students simplify fractions with polynomials in the numerator and denominator by factoring both and reducing them to the lowest terms.
- (24.1) Students explain the difference between inductive and deductive reasoning and identify and provide examples of each.
- (24.2) Students identify the hypothesis and conclusion in logical deduction.
- (24.3) Students use counterexamples to show that an assertion is false and recognize that a single counterexample is sufficient to refute an assertion.

Specific applications of Geometry standards (grades eight through twelve):

- (11.0) Students determine how changes in dimensions affect the perimeter, area, and volume of common geometric figures and solids.

Specific applications of Algebra II standards (grades eight through twelve):

- (6.0) Students add, subtract, multiply, and divide complex numbers.
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## 1.2 Science

Specific applications of Physics standards (grades nine through twelve):

- (1.d) Students know that when one object exerts a force on a second object, the second object always exerts a force of equal magnitude and in the opposite direction (Newton's third law).
- (3.a) Students know heat flow and work are two forms of energy transfer between systems.
- (5.a) Students know how to predict the voltage or current in simple direct current (DC) electric circuits constructed from batteries, wires, resistors, and capacitors.
- (5.b) Students know how to solve problems involving Ohm's law.

Specific applications of Investigation and Experimentation standards (grades nine through twelve):

- (1.a) Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
- (1.d) Formulate explanations by using logic and evidence.
- (1.1) Analyze situations and solve problems that require combining and applying concepts from more than one area of science.

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### 1.3 History–Social Science

Specific applications of United States History and Geography: Continuity and Change in the Twentieth Century standards (grade eleven):

- (5.5) Students analyze the major political, social, economic, technological, and cultural developments of the 1920s.
  - (11.5.7) Discuss the rise of mass production techniques, the growth of cities, the impact of new technologies (e.g., the automobile, electricity), and the resulting prosperity and effect on the American landscape.
  - (11.8) Students analyze the economic boom and social transformation of post-World War II America.
  - (11.8.7) Describe the effects on society and the economy of technological developments since 1945, including the computer revolution, changes in communication, advances in medicine, and improvements in agricultural technology.
  - (11.11) Students analyze the major social problems and domestic policy issues in contemporary American society.
  - (11.11.3) Describe the changing roles of women in society as reflected in the entry of more women into the labor force and the changing family structure.
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## 2.0 Communications

Students understand the principles of effective oral, written, and multimedia communication in a variety of formats and contexts.

*(The standards listed below retain in parentheses the numbering as specified in the English–language arts content standards adopted by the State Board of Education.)*

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### 2.1 Reading

Specific applications of Reading Comprehension standards (grades nine and ten):

- (2.1) Analyze the structure and format of functional workplace documents, including the graphics and headers, and explain how authors use the features to achieve their purposes.
- (2.2) Prepare a bibliography of reference materials for a report using a variety of consumer, workplace, and public documents.
- (2.6) Demonstrate use of sophisticated learning tools by following technical directions (e.g., those found with graphic calculators and specialized software programs and in access guides to World Wide Web sites on the Internet).

Specific applications of Reading Comprehension standards (grades eleven and twelve):

- (2.3) Verify and clarify facts presented in other types of expository texts by using a variety of consumer, workplace, and public documents.
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### 2.2 Writing

Specific applications of Writing Strategies standards (grade eight):

- (1.4) Plan and conduct multiple-step information searches by using computer networks and modems.

- (1.5) Achieve an effective balance between researched information and original ideas.
- (1.6) Revise writing for word choice; appropriate organization; consistent point of view; and transitions between paragraphs, passages, and ideas.

Specific applications of Writing Strategies and Applications standards (grades nine and ten):

- (1.3) Use clear research questions and suitable research methods (e.g., library, electronic media, personal interview) to elicit and present evidence from primary and secondary sources.
- (1.4) Develop the main ideas within the body of the composition through supporting evidence (e.g., scenarios, commonly held beliefs, hypotheses, definitions).
- (1.5) Synthesize information from multiple sources and identify complexities and discrepancies in the information and the different perspectives found in each medium (e.g., almanacs, microfiche, news sources, in-depth field studies, speeches, journals, technical documents).
- (1.7) Use appropriate conventions for documentation in the text, notes, and bibliographies by adhering to those in style manuals (e.g., *Modern Language Association Handbook*, *The Chicago Manual of Style*).
- (1.8) Design and publish documents by using advanced publishing software and graphic programs.
- (2.6) Write technical documents (e.g., a manual on rules of behavior for conflict resolution, procedures for conducting a meeting, minutes of a meeting):
  - a. Report information and convey ideas logically and correctly.
  - b. Offer detailed and accurate specifications.
  - c. Include scenarios, definitions, and examples to aid comprehension (e.g., troubleshooting guide).
  - d. Anticipate readers' problems, mistakes, and misunderstandings.

Specific applications of Writing Strategies and Applications standards (grades eleven and twelve):

- (1.7) Use systematic strategies to organize and record information (e.g., anecdotal scripting, annotated bibliographies).
- (1.8) Integrate databases, graphics, and spreadsheets into word-processed documents.
- (2.5) Write job applications and résumés:
  - a. Provide clear and purposeful information and address the intended audience appropriately.
  - b. Use varied levels, patterns, and types of language to achieve intended effects and aid comprehension.
  - c. Modify the tone to fit the purpose and audience.
  - d. Follow the conventional style for that type of document (e.g., résumé, memorandum) and use page formats, fonts, and spacing that contribute to the readability and impact of the document.

- (2.6) Deliver multimedia presentations:
- a. Combine text, images, and sound and draw information from many sources (e.g., television broadcasts, videos, films, newspapers, magazines, CD-ROMs, the Internet, electronic media-generated images).
  - b. Select an appropriate medium for each element of the presentation.
  - c. Use the selected media skillfully, editing appropriately and monitoring for quality.
  - d. Test the audience's response and revise the presentation accordingly.

### 2.3 *Written and Oral English Language Conventions*

Specific applications of English Language Conventions standards (grades nine and ten):

- (1.4) Produce legible work that shows accurate spelling and correct use of the conventions of punctuation and capitalization.
- (1.5) Reflect appropriate manuscript requirements, including title page presentation, pagination, spacing and margins, and integration of source and support material (e.g., in-text citation, use of direct quotations, paraphrasing) with appropriate citations.

### 2.4 *Listening and Speaking*

Specific applications of Listening and Speaking Strategies and Applications standards (grade eight):

- (1.1) Analyze oral interpretations of literature, including language choice and delivery, and the effect of the interpretations on the listener.
- (1.2) Paraphrase a speaker's purpose and point of view and ask relevant questions concerning the speaker's content, delivery, and purpose.
- (1.3) Organize information to achieve particular purposes by matching the message, vocabulary, voice modulation, expression, and tone to the audience and purpose.
- (1.4) Prepare a speech outline based upon a chosen pattern of organization, which generally includes an introduction; transitions, previews, and summaries; a logically developed body; and an effective conclusion.
- (1.5) Use precise language, action verbs, sensory details, appropriate and colorful modifiers, and the active rather than the passive voice in ways that enliven oral presentations.
- (1.6) Use appropriate grammar, word choice, enunciation, and pace during formal presentations.
- (1.7) Use audience feedback (e.g., verbal and nonverbal cues):
  - a. Reconsider and modify the organizational structure or plan.
  - b. Rearrange words and sentences to clarify the meaning.
- (1.8) Evaluate the credibility of a speaker (e.g., hidden agendas, slanted or biased material).

- (1.9) Interpret and evaluate the various ways in which visual image makers (e.g., graphic artists, illustrators, news photographers) communicate information and affect impressions and opinions.
- (2.1) Deliver narrative presentations (e.g., biographical, autobiographical):
  - a. Relate a clear, coherent incident, event, or situation by using well-chosen details.
  - b. Reveal the significance of, and the subject's attitude about, the incident, event, or situation.
  - c. Employ narrative and descriptive strategies (e.g., relevant dialogue, specific action, physical description, background description, comparison or contrast of characters).
- (2.2) Deliver oral responses to literature:
  - a. Interpret a reading and provide insight.
  - b. Connect the students' own responses to the writer's techniques and to specific textual references.
  - c. Draw supported inferences about the effects of a literary work on its audience.
  - d. Support judgments through references to the text, other works, other authors, or personal knowledge.
- (2.3) Deliver research presentations:
  - a. Define a thesis.
  - b. Record important ideas, concepts, and direct quotations from significant information sources and paraphrase and summarize all relevant perspectives on the topic, as appropriate.
  - c. Use a variety of primary and secondary sources and distinguish the nature and value of each.
  - d. Organize and record information on charts, maps, and graphs.
- (2.4) Deliver persuasive presentations:
  - a. Include a well-defined thesis (i.e., one that makes a clear and knowledgeable judgment).
  - b. Differentiate fact from opinion and support arguments with detailed evidence, examples, and reasoning.
  - c. Anticipate and answer listener concerns and counterarguments effectively through the inclusion and arrangement of details, reasons, examples, and other elements.
  - d. Maintain a reasonable tone.
- (2.5) Recite poems (of four to six stanzas), sections of speeches, or dramatic soliloquies, using voice modulation, tone, and gestures expressively to enhance the meaning.

Specific applications of Listening and Speaking standards (grades eleven and twelve):

- (1.8) Use effective and interesting language, including:
    - a. Informal expressions for effect
    - b. Standard American English for clarity
    - c. Technical language for specificity
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### **3.0 Career Planning and Management**

Students understand how to make effective decisions, use career information, and manage personal career plans:

- 3.1 Know the personal qualifications, interests, aptitudes, knowledge, and skills necessary to succeed in careers.
  - 3.2 Understand the scope of career opportunities and know the requirements for education, training, and licensure.
  - 3.3 Develop a career plan that is designed to reflect career interests, pathways, and postsecondary options.
  - 3.4 Understand the role and function of professional organizations, industry associations, and organized labor in a productive society.
  - 3.5 Understand the past, present, and future trends that affect careers, such as technological developments and societal trends, and the resulting need for lifelong learning.
  - 3.6 Know important strategies for self-promotion in the hiring process, such as job applications, résumé writing, interviewing skills, and preparation of a portfolio.
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### **4.0 Technology**

Students know how to use contemporary and emerging technological resources in diverse and changing personal, community, and workplace environments:

- 4.1 Understand past, present, and future technological advances as they relate to a chosen pathway.
- 4.2 Understand the use of technological resources to gain access to, manipulate, and produce information, products, and services.
- 4.3 Understand the influence of current and emerging technology on selected segments of the economy.
- 4.4 Understand the role and function of tools, equipment, and machines in the latest technology.
- 4.5 Know important aspects of the current economy and labor market, including the type of goods and services produced, the type of skills workers need, the effects of rapid technological change, and the impact of international competition.

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## 5.0 Problem Solving and Critical Thinking

Students understand how to create alternative solutions by using critical and creative thinking skills, such as logical reasoning, analytical thinking, and problem-solving techniques:

- 5.1 Apply appropriate problem-solving strategies and critical thinking skills to work-related issues and tasks.
- 5.2 Understand the systematic problem-solving models that incorporate input, process, outcome, and feedback components.
- 5.3 Use critical thinking skills to make informed decisions and solve problems.
- 5.4 Apply troubleshooting strategies, including failure analysis procedures, to issues as they arise.
- 5.5 Understand and demonstrate the ability to plan and solve problems in a systematic manner and apply the learned skills to real-world situations.

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## 6.0 Health and Safety

Students understand health and safety policies, procedures, regulations, and practices, including the use of equipment and handling of hazardous materials:

- 6.1 Know the policies, procedures, and regulations regarding health and safety in the workplace, including employers' and employees' responsibilities.
- 6.2 Understand critical elements for health and safety practices related to storing, cleaning, and maintaining tools, equipment, and supplies.
- 6.3 Use tools, equipment, and machinery safely and appropriately.
- 6.4 Know the local, state, and federal laws, and the requirements of regulatory agencies, that affect the transportation industry.

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## 7.0 Responsibility and Flexibility

Students know the behaviors associated with the demonstration of responsibility and flexibility in personal, workplace, and community settings:

- 7.1 Understand the qualities and behaviors that constitute a positive and professional work demeanor.
- 7.2 Understand the importance of accountability and responsibility in fulfilling personal, community, and workplace roles.
- 7.3 Understand the need to adapt to varied roles and responsibilities.
- 7.4 Understand that individual actions can affect the larger community.

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## 8.0 Ethics and Legal Responsibilities

Students understand professional, ethical, and legal behavior consistent with applicable laws, regulations, and organizational norms:

- 8.1 Know the major local, district, state, and federal regulatory agencies and entities that affect the industry and how they enforce laws and regulations.

- 8.2 Understand the concept and application of ethical and legal behavior consistent with workplace standards.
  - 8.3 Understand the role of personal integrity and ethical behavior in the workplace.
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## 9.0 Leadership and Teamwork

Students understand effective leadership styles, key concepts of group dynamics, team and individual decision making, the benefits of workforce diversity, and conflict resolution:

- 9.1 Understand the characteristics and benefits of teamwork, leadership, and citizenship in the school, community, and workplace settings.
  - 9.2 Understand the ways in which preprofessional associations, such as SkillsUSA, and competitive career development activities enhance academic skills, promote career choices, and contribute to employability.
  - 9.3 Understand how to organize and structure work individually and in teams for effective performance and the attainment of goals.
  - 9.4 Know multiple approaches to conflict resolution and their appropriateness for a variety of situations in the workplace.
  - 9.5 Understand how to interact with others in ways that demonstrate respect for individual and cultural differences and for the attitudes and feelings of others.
  - 9.6 Participate as a member of a team and contribute to a group effort.
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## 10.0 Technical Knowledge and Skills

Students understand the essential knowledge and skills common to all pathways in the Transportation sector:

- 10.1 Understand how to use and maintain transportation technological products and systems.
  - 10.2 Understand the applications of transportation technology in relation to land, water, and air/space.
  - 10.3 Understand the resources used to transport people and goods.
  - 10.4 Understand various systems and processes related to transportation.
  - 10.5 Operate, maintain, and troubleshoot equipment.
  - 10.6 Understand how to acquire, store, and use materials and to allocate space efficiently.
  - 10.7 Understand how to select and use information and communication technologies.
  - 10.8 Understand the need to participate in sector-related professional improvement activities, SkillsUSA, other career technical education and skills associations, and professional improvement activities related to career pathway specializations.
  - 10.9 Understand the need to obtain and maintain industry-standard, technical certifications significant to an industry sector.
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## 11.0 Demonstration and Application

Students demonstrate and apply the concepts contained in the foundation and pathway standards.

## PATHWAY STANDARDS

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### A. Aviation and Aerospace Transportation Services Pathway

The Aviation and Aerospace Transportation Services Pathway prepares students for postsecondary education and employment in the aviation and aerospace industries.

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*A1.0 Students understand the value and necessity of practicing personal and occupational safety and protecting the environment by using materials and processes in accordance with manufacturer and industry standards:*

- A1.1 Practice fundamental, application-specific work processes, safety concepts, and required behaviors.
  - A1.2 Practice fundamental, application-specific biological health-hazard safety concepts and required behaviors.
  - A1.3 Understand the generation of waste gasses, emissions, and other environmentally destructive gasses and substances and the effect of such substances on the environment.
  - A1.4 Understand the advantages and disadvantages of aviation and aerospace transportation systems and the effects of those systems on the environment.
  - A1.5 Understand new and emerging aviation and aerospace transportation energy systems, materials resources, and technology (e.g., carbon fiber) and the related implications on the environment.
  - A1.6 Understand the elements of combustion, fire classifications, and fire-fighting equipment and techniques specific to the aviation and aerospace industries.
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*A2.0 Students understand the safe and appropriate use of tools and equipment common to the aviation and aerospace industries:*

- A2.1 Understand how aviation/aerospace industry tools and equipment are used to perform systems and component maintenance and repair operations.
  - A2.2 Understand current industry practices and strategies for work processes.
  - A2.3 Use appropriate tools, equipment, and machines common to aviation/aerospace components and systems.
  - A2.4 Use tools, equipment, and machines to safely measure, test, diagnose, and analyze aviation/aerospace components and systems (e.g., electrical and electronic circuits, alternating- and direct-current applications, fluid/hydraulic, and air/pneumatic systems).
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*A3.0 Students understand and apply measurement systems and the mathematical functions necessary to perform required maintenance and operation procedures:*

- A3.1 Understand industry-standard measurement scales, devices, and systems used to perform design, fabrication, diagnostic, maintenance, and repair procedures.
- A3.2 Use technical vocabulary, technical reports and manuals, electronic systems, and related technical data resources specific to components and systems in the aviation/aerospace transportation industry.

- A3.3 Understand the importance of calibration processes, systems, and techniques in using various measurements and testing devices.
- A3.4 Understand the mathematical functions associated with the production and maintenance of aircraft.
- A3.5 Understand mathematical functions at a proficiency level specified by Federal Aviation Administration Regulations, Part 147, Appendix B.

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*A4.0 Students understand scientific principles in relation to chemical, mechanical, and physical functions:*

- A4.1 Understand the operating principles of internal and external combustion engines.
- A4.2 Understand the basic principles and the applications of pneumatic and hydraulic power.
- A4.3 Understand the potential application of alternative power sources.
- A4.4 Understand the basic principles of electricity, electronics and electrical power generation, and distribution as commonly applied.
- A4.5 Understand the principles of converting energy from one form to another and their applications.
- A4.6 Know the basic terms, characteristics, and concepts of physical and chemical processes.

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*A5.0 Students understand and perform maintenance procedures for aviation and aerospace vehicles:*

- A5.1 Understand electrical applications, weight and balance specifications, and drawings and schematics at the proficiency level specified by Federal Aviation Administration Regulations, Part 147, Appendix B.
- A5.2 Understand fluid lines and fittings, materials and processes, ground operation and servicing, cleaning and corrosion control, and maintenance forms and records at the specified proficiency level.
- A5.3 Know the conditions under which service and maintenance are required for aviation vehicles by Federal Aviation Administration Regulations, Part 147, Appendix B.
- A5.4 Maintain and document the maintenance of aviation and aerospace vehicles in accordance with the recommendations of the manufacturer.

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*A6.0 Students understand the basic business practices of their employment environment:*

- A6.1 Understand work-related systems of the aviation and aerospace industries.
- A6.2 Maintain accurate records for the pilot, tower, and so forth, as applicable.
- A6.3 Understand how guidelines, rules, regulations, and laws control aviation and aerospace industry practices and how they are overseen by local, state, federal, and international aviation agencies.
- A6.4 Understand the practices of acceptable customer relations services.
- A6.5 Understand the production and use of industry-generated documents, records, and forms as well as related management skills used in aviation and aerospace transportation industries.

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## B. Collision Repair and Refinishing Pathway

The Collision Repair and Refinishing Pathway prepares students for postsecondary education and employment in the transportation industry, including, but not limited to, body and frame straightening, estimating, painting, and refinishing.

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*B1.0 Students understand the value and necessity of practicing personal and occupational safety and the environmental effects of collision repair and refinishing practices:*

- B1.1 Understand industry environmental conservation practices and their applications.
  - B1.2 Practice the safe handling and storage of chemicals and hazardous wastes as required by the Occupational Safety and Health Administration, Air Resources Board, Air Quality Management Districts, and other regulatory agencies.
  - B1.3 Understand the generation of waste products and other environmentally destructive substances.
  - B1.4 Use appropriate materials and repair technologies.
  - B1.5 Understand the environmental implications of using new and emerging materials, resources, and technologies.
  - B1.6 Understand the safety practices applied when servicing vehicle-body electronics and other vehicle systems.
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*B2.0 Students understand the safe and appropriate use of tools, equipment, and work processes:*

- B2.1 Understand how certain tools and equipment are used to perform maintenance and repair operations.
  - B2.2 Use tools, equipment, and machines to safely measure, test, diagnose, and analyze components and systems (e.g., electrical and electronic circuits, alternating- and direct-current applications, fluid/hydraulic and air/pneumatic systems).
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*B3.0 Students understand and apply measurement systems and the mathematical functions necessary to perform required fabrication, maintenance, and operation procedures:*

- B3.1 Understand industry-standard measurement scales, devices, and systems used to perform design, fabrication, diagnostic, maintenance, and repair procedures.
- B3.2 Use technical vocabulary, technical reports and manuals, electronic systems, and related technical data resources, as appropriate, to determine repairs and estimates.
- B3.3 Understand the different types of welding and heat processes used in repair processes and procedures.
- B3.4 Understand the mathematical functions associated with collision repair and refinishing.

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*B4.0 Students understand scientific principles in relation to chemical, mechanical, and physical functions and in relation to industry and manufacturer standards:*

- B4.1 Understand the principles of mechanical, electrical, hydraulic, and pneumatic power in relation to collision repair and refinishing.
- B4.2 Understand the physical and chemical characteristics of metals, plastics, and other materials.
- B4.3 Understand the principles of electricity and electronics.
- B4.4 Know the basic terms, characteristics, and concepts of physical and chemical processes.
- B4.5 Understand body and frame construction.
- B4.6 Understand the importance of calibration processes, systems, and techniques in using various measurement and testing devices.

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*B5.0 Students perform and document repair procedures in accordance with manufacturer recommendations and industry standards:*

- B5.1 Understand the recommended procedures and practices of various manufacturers.
- B5.2 Document repair procedures accurately, as required by the Bureau of Automotive Repair and other regulatory agencies.
- B5.3 Use reference books and materials, technical service bulletins, and other related documents to determine repairs and rate of pay.

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*B6.0 Students understand basic business practices:*

- B6.1 Understand work-related systems.
- B6.2 Know the laws and regulations applicable to the recordkeeping and handling of hazardous materials.
- B6.3 Understand the importance of and procedures for maintaining accurate records.
- B6.4 Understand the concept and application of accepted ethical business practices.
- B6.5 Understand the concept and application of acceptable customer relations services.

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*B7.0 Students understand structural and nonstructural analysis and damage repair:*

- B7.1 Understand how to perform frame inspection and repair.
- B7.2 Know applications, installations, and removal of fixed and moveable glass and hardware.
- B7.3 Know how to perform the principles of metal welding and cutting.
- B7.4 Understand and know how to prepare and analyze vehicles for repair.
- B7.5 Know how to perform outer body panel repairs, replacements, and adjustments.
- B7.6 Understand and know how to prepare vehicles for metal finishing and body filling.

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*B8.0 Students understand mechanical and electrical components in relation to industry and manufacturer standards:*

- B8.1 Understand how to perform steering and suspension analysis and repairs.
- B8.2 Know how to perform electrical repairs.
- B8.3 Know how to perform brake analysis and repairs.
- B8.4 Know how to perform heating, air conditioning, and cooling system repairs.
- B8.5 Understand the operation of drivetrain, fuel, intake, and exhaust systems.
- B8.6 Understand the operation of restraint systems.

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*B9.0 Students understand the concepts, principles, and practices of painting and refinishing:*

- B9.1 Understand how to identify, use, and repair plastics and adhesives.
- B9.2 Know how to prepare surfaces for painting and finishing.
- B9.3 Understand the operation of spray guns and related equipment.
- B9.4 Know how to mix, match, and apply paint.
- B9.5 Understand the causes and cures of paint defects.
- B9.6 Understand how to prepare vehicles for final detail.

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## C. Vehicle Maintenance, Service, and Repair Pathway

The Vehicle Maintenance, Service, and Repair Pathway prepares students for postsecondary education and employment in the transportation industry, which includes, but is not limited to, motor vehicles, rail systems, marine applications, and outdoor power equipment.

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*C1.0 Students understand the value and necessity of practicing personal and occupational safety and protecting the environment by using materials and processes in accordance with manufacturer and industry standards:*

- C1.1 Know and understand common environmental conservation practices and their applications.
  - C1.2 Practice the safe handling and storage of chemicals and hazardous wastes in accordance with material safety data sheets and the requirements of local, state, and federal regulatory agencies.
  - C1.3 Understand the way in which waste gasses, emissions, and other environmentally destructive substances are generated and their effects on the environment.
  - C1.4 Evaluate the advantages and disadvantages of existing, new, and emerging systems and the effects of those systems on the environment.
  - C1.5 Use appropriate personal protective equipment and safety practices.
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*C2.0 Students understand the safe and appropriate use of tools, equipment, and work processes:*

- C2.1 Understand and use appropriate tools and equipment, such as wrenches, sockets, and pliers, to maintain and repair systems and components.
  - C2.2 Use tools, equipment, and machines to safely measure, test, diagnose, and analyze components and systems (e.g., electrical and electronic circuits, alternating- and direct-current applications, fluid/hydraulic and air/pneumatic systems).
  - C2.3 Select and use the appropriate measurement device(s) and use mathematical functions necessary to perform required fabrication, maintenance, and operation procedures.
  - C2.4 Know and understand the elements of precision measuring using standard and metric systems.
  - C2.5 Use measurement scales, devices, and systems, such as dial indicators, and micrometers to design, fabricate, diagnose, maintain, and repair vehicles and components following appropriate industry standards.
  - C2.6 Know and understand how to access technical reports, manuals, electronic retrieval systems, and related technical data resources.
  - C2.7 Comprehend the importance of calibration processes, systems, and techniques using various measurement and testing devices.
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*C3.0 Students understand scientific principles in relation to chemical, mechanical, and physical functions for various engine and vehicle systems:*

- C3.1 Understand the operating principles of internal and external combustion engines.

- C3.2 Understand the function and principles of air conditioning and heating systems.
- C3.3 Understand the basic principles of pneumatic and hydraulic power and their applications.
- C3.4 Understand the applications of alternative power sources.
- C3.5 Understand the basic principles of electricity, electronics and electrical power generation, and distribution systems.
- C3.6 Understand the principles of converting energy from one form to another.
- C3.7 Perform necessary procedures to maintain, diagnose, service, and repair vehicle systems and malfunctions.

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*C4.0 Students perform and document maintenance procedures in accordance with the recommendations of the manufacturer:*

- C4.1 Understand the procedures and practices of various manufacturers regarding repair and maintenance schedules.
- C4.2 Know how to properly document maintenance procedures in accordance with applicable rules, laws, and regulations (e.g., Bureau of Auto Repair [BAR], Occupational Health and Safety Administration [OSHA], and the California Air Resources Board [CARB]).
- C4.3 Use reference books, technical service bulletins, and other documents and materials related to the automotive service industry available in print and through electronic retrieval systems to accurately diagnose and repair vehicles.
- C4.4 Complete a work order, including customer information, description of repairs, and billing information, in accordance with applicable rules, laws, and regulations.

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*C5.0 Students understand and apply appropriate business practices:*

- C5.1 Understand work-related systems common to the transportation service industry.
- C5.2 Know the laws and regulations applicable to recordkeeping and the appropriate handling and disposal of hazardous materials.
- C5.3 Understand the importance of and the procedures for maintaining accurate records (e.g., business licenses, repair orders, billing and tax records).
- C5.4 Understand the concept and application of accepted ethical business practices.
- C5.5 Understand the concept and application of acceptable customer relations practices.
- C5.6 Understand the need for maintenance of components and systems and the conditions under which service and maintenance are required

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*C6.0 Students understand the application, operation, maintenance, and diagnosis of engines, including but not limited to two- and four-stroke and supporting subsystems:*

- C6.1 Perform general engine maintenance, diagnosis, service, and repair in accordance with portable national industry standards, such as the National Automotive Technicians Education Foundation and the Equipment and Engine Training Council.

- C6.2 Maintain, diagnose, service, and repair lubrication and cooling systems.
- C6.3 Understand how to maintain, diagnose, and repair computerized engine control systems and other engine-related systems.
- C6.4 Maintain, diagnose, service, and repair ignition, electronic, and computerized engine controls and fuel management systems.

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C7.0 *Students understand the function, principles, and operation of electrical and electronic systems using manufacturer and industry standards:*

- C7.1 Understand how to maintain, diagnose, and repair electrical systems.
- C7.2 Maintain, diagnose, repair, and service batteries.
- C7.3 Understand how to maintain, diagnose, service, and repair starting and charging systems.
- C7.4 Diagnose, service, and repair lighting systems.
- C7.5 Diagnose, service, and repair heating and air conditioning systems and components.
- C7.6 Diagnose, service, and repair horns, wipers/washers, and other accessories.
- C7.7 Perform necessary procedures to maintain, diagnose, service, and repair vehicle electrical and electronic systems and malfunctions.

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C8.0 *Students understand the function and principles of automotive drivetrain, steering and suspension, brake, and tire and wheel components and systems in accordance with portable national industry standards, such as the National Automotive Technicians Education Foundation.*

- C8.1 Understand how to maintain, diagnose, service, and repair hydraulic and power assist systems.
- C8.2 Diagnose, service, and repair disc brakes, drum brakes, antilock brakes, and other brake systems as developed.
- C8.3 Diagnose, service, and repair steering and suspension systems.
- C8.4 Understand the function and operation of automatic and manual transmissions and transaxles.
- C8.5 Understand tire and rim sizing to select appropriate wheels and tires for vehicles.
- C8.6 Maintain, diagnose, service, and repair under-vehicle systems and malfunctions.