



TENNESSEE DEPARTMENT OF

EDUCATION

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Collision Repair: Non-Structural

Primary Career Cluster:	Transportation, Distribution & Logistics
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6062
Prerequisite(s):	<i>Introduction to Collision Repair</i>
Credit:	1 – 3 (See Recommended Credit below)
Grade Level:	10 – 12
Graduation Requirements:	This course satisfies up to three credits of three credits required for an elective focus when taken in conjunction with other Transportation, Distribution & Logistics courses.
Programs of Study and Sequence:	This is the second course in the <i>Automotive Collision Repair</i> program of study.
Necessary Equipment:	Please visit http://www.natef.org for necessary equipment list.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.org Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov
Coordinating Work-Based Learning:	If a teacher has completed work-based learning training, appropriate student placement can be offered. To learn more, please visit http://www.tn.gov/education/cte/work_based_learning.shtml .
Available Student Industry Certifications:	Automotive Service Excellence (ASE) Student Certification or Professional Certification, or I-CAR Non-Structural Technician ProLevel 1
Dual Credit or Dual Enrollment Opportunities:	Students who obtain the ASE student certification may be able to articulate hours at Tennessee Colleges of Applied Technology.
Teacher Endorsement(s):	507
Required Teacher Certifications/Training:	ASE Industry Certification- B-3 or I-CAR Industry Certification
Teacher Resources:	http://www.tn.gov/education/cte/TransportationDistributionLogistics.shtml

Course Description

Collision Repair: Non-Structural is for students who wish to obtain in-depth knowledge and skills in repair procedures for non-structural repairs in preparation for postsecondary training and careers as collision repair technicians. Upon completion of this course, proficient students will be able to analyze non-structural collision damage and write and revise repair plans. Students will read and interpret technical texts to determine, understand, and safely perform appropriate repair techniques and

procedures. Standards in this course include preparing vehicles for repair, removing and replacing panels and body components, metal finishing, body filling, removing and replacing moveable glass and hardware, metal welding and cutting, and repair of plastics. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and to the National Automotive Technicians Education Foundation (NATEF) standards, a national framework of industry-benchmarked standards.* Students completing the Collision Repair program of study will be eligible to take the examination for Automotive Student Excellence (ASE) Student Certification in Collision Repair. Students completing this course will be eligible to take the examination for ASE Professional Certification in Non-Structural Analysis and Damage Repair (B3). Some tasks are assigned a "High Priority (HP)" designation. NATEF accredited programs must include at least 95% of the HP-I (Individual) tasks and 90% of the HP-G (Group) tasks in the curriculum.

Program of Study Application

This is the second course in the *Automotive Collision Repair* program of study. For more information on the benefits and requirements of implementing this program in full, please visit the Transportation, Distribution & Logistics website at <http://www.tn.gov/education/cte/TransportationDistributionLogistics.shtml>.

Recommended Credits

If all standards in the course are covered, the course is recommended for three credits. If one or two credits are offered the following options are recommended.

1 Credit Option

Content	Standards
Safety	1- all
Preparation	2- all 3- e, f, g
Outer Body Panel Repairs, Replacements, and Adjustments	4- all 5- b
Metal Welding and Cutting	9- f, g, h, 10- a 11- a, b 12- b, c 13- b
Plastics and Adhesives	14-a, b

2 Credit Option

Content	Standards
Safety	1-all
Preparation	2- all 3- all
Outer Body Panel Repairs, Replacements, and Adjustments	4- all 5- all 6- c, g
Metal Finishing and Body Filling	7- a, b, c, f, g, h, i, j
Moveable Glass and Hardware	8-b
Metal Welding and Cutting	9- all 10- all 11- a, b 12- all 13- all
Plastics and Adhesives	14- all



Course Standards

Safety

For every task in *Collision Repair: Non-Structural*, the following safety requirement must be strictly enforced:

- 1) Comply with personal and environmental safety practices associated with clothing and the use of gloves; respiratory protection; eye protection; hearing protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations. Identify vehicle manufacturer's SRS types, locations, and recommended procedures before inspecting or replacing components. (TN Reading 3, 4)
 - a. Use and inspect personal protective equipment every time equipment is used.
 - b. Inspect, maintain, and employ safe operating procedures with tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment.
 - c. Assume responsibilities under HazCom (Hazard Communication) regulations.
 - d. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
 - e. Maintain a portfolio record of written safety examinations and equipment examination for which the student has passed an operational checkout by the instructor.
 - f. Utilize MSDSs (material safety data sheets), and identify the health hazards associated with hazardous material.

Preparation

- 2) Read and interpret a damage report and observe damages to create a basic repair plan for a damaged automobile. Citing resources such as instructional manuals, textbooks, example work orders, and other resources, create a written overview of the steps necessary to repair the vehicle. (TN Reading 1, 2, 3, 4, 6, 9; TN Writing 2, 4, 9)
 - a. Review damage report and analyze damage to determine appropriate methods for overall repair; develop and document a repair plan. HP-I
- 3) Analyze the steps necessary to prepare an automobile for non-structural repair. Synthesize information gathered from textbooks, online resources, and firsthand experiences observing a qualified technician to create a list of tools, equipment, and materials needed for each step of preparation. Write a description of the responsibilities and procedures of the repair technician, emphasizing safety procedures in each of the following. (TN Reading 2, 3, 4, 5, 6, 9; TN Writing 2, 4, 9)
 - a. Inspect, remove, label, store, and reinstall exterior trim and moldings. HP-I
 - b. Inspect, remove, label, store, and reinstall interior trim and components. HP-I
 - c. Inspect, remove, label, store, and reinstall body panels and components that may interfere with or be damaged during repair. HP-I
 - d. Inspect, remove, label, store, and reinstall vehicle mechanical and electrical components that may interfere with or be damaged during repair. HP-G
 - e. Protect panels, glass, interior parts, and other vehicles adjacent to the repair area. HP-I



- f. Soap and water wash entire vehicle; complete pre-repair inspection checklist. HP-I
- g. Prepare damaged area using water-based and solvent-based cleaners. HP-I
- h. Remove corrosion protection, undercoatings, sealers, and other protective coatings as necessary to perform repairs.
- i. Inspect, remove, and reinstall repairable plastics and other components for off-vehicle repair. HP-I

Outer Body Panel Repairs, Replacements, and Adjustments

- 4) Read and interpret technical information regarding direct and indirect/hidden damage and direction of impact. Examine case studies to create a library of various damages incurred on a range of vehicle types. Hypothesize the direction of impact of each, citing evidence to justify claims. Use the information to investigate and report on the damage incurred in outer body panels of given vehicles. Drawing on research and feedback from instructors and peers, review, edit, and revise repair plans generated in standard 2. (TN Reading 1, 2, 3, 4, 5; TN Writing 2, 4, 5, 9)
 - a. Determine the extent of direct and indirect/hidden damage and direction of impact; develop and document a repair plan. HP-I

- 5) Distinguish among the various panels and components of a vehicle's outer body. Compare and contrast the tools, equipment, and procedures for inspecting, removing, replacing, and aligning each of the following. Summarize the key considerations and procedures an automotive technician should discern when performing the following processes in a written, oral, or visual presentation, citing evidence from resources such as instructional videos, manuals, tutorials, and other resources. (TN Reading 1, 2, 3, 4, 5, 8, 9; TN Writing 2, 4, 9)
 - a. Inspect, remove and replace bolted, bonded, and welded steel panel or panel assemblies. HP-G
 - b. Determine the extent of damage to aluminum body panels; repair or replace. HP-G
 - c. Inspect, remove, replace, and align hood, hood hinges, and hood latch. HP-I
 - d. Inspect, remove, replace, and align deck lid, lid hinges, and lid latch. HP-I
 - e. Inspect, remove, replace, and align doors, latches, hinges, and related hardware. HP-I
 - f. Inspect, remove, replace and align tailgates, hatches, liftgates, and sliding doors. HP-G
 - g. Inspect, remove, replace, and align bumper bars, covers, reinforcement, guards, isolators, and mounting hardware. HP-I
 - h. Inspect, remove, replace and align fenders, and related panels. HP-I

- 6) Utilize the proper tools and procedures to repair outer body panels. (TN Reading 3, 4)
 - a. Straighten contours of damaged panels to a suitable condition for body filling or metal finishing using power tools, hand tools, and weld-on pulling attachments. HP-I
 - b. Weld damaged or torn steel body panels; repair broken welds. HP-G
 - c. Restore corrosion protection. HP-I
 - d. Replace door skins. HP-G
 - e. Restore sound deadeners and foam materials. HP-G
 - f. Perform panel bonding and weld bonding. HP-G
 - g. Diagnose and repair water leaks, dust leaks, and wind noise. HP-G
 - h. Identify one-time use fasteners. HP-G



Metal Finishing and Body Filling

- 7) Examine the processes, tools, and materials involved in applying body filling and finishing metal. Read and interpret instructions to prepare materials such as mixing instructions for body filler. Consult a range of resources which outline minor body repair processes for a variety of damage types. Assess the authors' claims and determine the usefulness of each source. Appropriately use the research to recommend the proper repair procedures for given body panel damages. (TN Reading 1, 2, 3, 4, 6, 8, 9; TN Writing 1, 4, 8, 9)
- Remove paint from the damaged area of a body panel. HP-I
 - Locate and repair surface irregularities on a damaged body panel. HP-I
 - Demonstrate hammer and dolly techniques. HP-I
 - Heat shrink stretched panel areas to proper contour. HP-I
 - Cold shrink stretched panel areas to proper contour. HP-I
 - Prepare and apply body filler. HP-I
 - Identify different types of body fillers. HP-G
 - Rough sand body filler to contour; finish sand. HP-I
 - Determine the proper metal finishing techniques for aluminum. HP-G
 - Determine proper application of body filler to aluminum. HP-G

Moveable Glass and Hardware

- 8) Read and interpret technical information to define the structure, purpose, and function of moveable glass and hardware system components. Create a written, oral, or visual presentation describing the proper procedures for each of the following, drawing on information from textbooks, OEM manuals, diagrams, demonstrations, and other instructional narratives. (TN Reading 1, 2, 3, 4, 7, 9; TN Writing 2, 4, 9)
- Inspect, adjust, repair or replace window regulators, run channels, glass, power mechanisms, and related controls. HP-I
 - Inspect, adjust, repair, remove, reinstall or replace weather-stripping. HP-G
 - Inspect, repair or replace, and adjust removable power operated roof panel and hinges, latches, guides, handles, retainer, and controls of sunroofs. HP-G
 - Inspect, remove, reinstall, and align convertible top and related mechanisms. HP-G
 - Initialize electrical components as needed. HP-G

Metal Welding and Cutting

- 9) Compare and contrast the different tools, procedures, and welding methods used to weld and cut aluminum, high-strength steels, and other steels, noting when substrates are weldable. Create a chart or other visual display describing the tools, tool settings, procedures, and methods for welding in a variety of situations.
- Identify weldable and non-weldable substrates used in vehicle construction. HP-I
 - Weld and cut high-strength steel and other steels. HP-I
 - Weld and cut aluminum. HP-G
 - Determine the correct GMAW (MIG) welder type, electrode/wire type, diameter, and gas to be used in a specific welding situation. HP-I
 - Set up and adjust the GMAW (MIG) welder to "tune" for proper electrode stickout, voltage, polarity, flow rate, and wire-feed speed required for the substrate being welded. HP-I



- f. Store, handle, and install high-pressure gas cylinders. HP-I
 - g. Determine work clamp (ground) location and attach. HP-I
 - h. Use the proper angle of the gun to the joint and direction of gun travel for the type of weld being made in the flat, horizontal, vertical, and overhead positions. HP-I
- 10) Examine strategies used to prepare vehicle body components for welding. Write persuasively to describe the key procedures, justifying the need for each by citing information gathered from textbooks, online resources, and other resources. (TN Reading 1, 2, 3, 4; TN Writing 1, 4, 9)
- a. Protect adjacent panels, glass, vehicle interior, etc. from welding and cutting operations. HP-I
 - b. Protect computers and other electronic control modules during welding procedures. HP-I
 - c. Clean and prepare the metal to be welded, assure good metal fit-up, apply weld through primer if necessary, clamp or tack as required. HP-I
- 11) Distinguish among the various types of weld and joint type. Emphasizing proper safety equipment and techniques, implement the appropriate tools, equipment, techniques, and procedures to perform a variety of welds. (TN Reading 2, 3, 4)
- a. Determine the joint type (butt weld with backing, lap, etc.) for weld being made. HP-I
 - b. Determine the type of weld (continuous, stitch weld, plug, etc.) for each specific welding operation. HP-I
 - c. Perform the following welds: continuous, plug, butt weld with and without backing, fillet, etc. HP-I
- 12) Identify and demonstrate basic inspection and troubleshooting strategies appropriate for evaluating welds. Use the knowledge to remedy the problem. (TN Reading 3)
- a. Perform visual and destructive tests on each weld type. HP-I
 - b. Identify the causes of various welding defects; make necessary adjustments. HP-I
 - c. Identify cause of contact tip burn-back and failure of wire to feed; make necessary adjustments. HP-I
- 13) Research and explore a range of procedures used to cut and attach non-structural components, Note when each method is commonly used based on information gathered from textbooks and online resources. (TN Reading 1, 2, 3, 4; TN Writing 2, 9)
- a. Identify cutting process for different substrates and locations; perform cutting operation. HP-I
 - b. Identify different methods of attaching non-structural components (squeeze type resistant spot welds (STRSW), riveting, non-structural adhesive, silicon bronze, etc.). HP-G

Plastics and Adhesives

- 14) Given damaged plastic components, use resources such as textbooks, OEM manuals, diagrams, and material instructions to identify the nature of the problem and develop repair plans. Develop a graphic illustration to identify and describe the types of plastic repair procedures, emphasizing the conditions which require each type of procedure. Select the appropriate repair procedures and justify the selection with evidence drawn from the resources listed above. (TN Reading 1, 3, 4; TN Writing 1, 4)
- a. Identify the types of plastics; determine repairability. HP-I



- b. Clean and prepare the surface of plastic parts; identify the types of plastic repair procedures. HP-I
- c. Repair rigid, semi-rigid, or flexible plastic panels. HP-I
- d. Remove or repair damaged areas from rigid exterior composite panels. HP-G
- e. Replace bonded rigid exterior composite body panels; straighten or align panel supports. HP-G

Standards Alignment Notes

*References to other standards include:

- TN Reading: [Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects](#); Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
 - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 7 and 10 at the conclusion of the course.
- TN Writing: [Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects](#); Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
 - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 6, 7, and 10 at the conclusion of the course.
- TN Math: [Tennessee State Standards for Mathematics](#); Math Standards for High School: Number and Quantity, Geometry, and Statistics (pages 58-83).
 - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative, geometric, and statistical reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- National Automotive Technicians Education Foundation (NATEF) standards for [Non-Structural Analysis and Damage Repair](#) (pages 62 – 65).
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
 - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.





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FIRST TO THE TOP

Collision Repair: Painting & Refinishing

Primary Career Cluster:	Transportation, Distribution & Logistics
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	6063
Prerequisite(s):	<i>Introduction to Collision Repair, Collision Repair: Non-Structural (optional)</i>
Credit:	1-3 (See Recommended Credit below)
Grade Level:	10-12
Graduation Requirements:	This course satisfies up to three credits of three credits required for an elective focus when taken in conjunction with other Transportation, Distribution & Logistics courses.
Programs of Study and Sequence:	This is the second or third course in the <i>Automotive Collision Repair</i> program of study.
Necessary Equipment:	Please visit http://www.natef.org for necessary equipment list.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.org Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov
Coordinating Work-Based Learning:	If a teacher has completed work-based learning training, appropriate student placement can be offered. To learn more, please visit http://www.tn.gov/education/cte/work_based_learning.shtml .
Available Student Industry Certifications:	Automotive Service Excellence (ASE) Student Certification or Professional Certification, or I-CAR Refinish Technician ProLevel 1
Dual Credit or Dual Enrollment Opportunities:	Students who obtain the ASE student certification may be able to articulate hours at Tennessee Colleges of Applied Technology.
Teacher Endorsement(s):	507
Required Teacher Certifications/Training:	ASE Industry Certification- B-4 or I-CAR Industry Certification
Teacher Resources:	http://www.tn.gov/education/cte/TransportationDistributionLogistics.shtml

Course Description

Collision Repair: Painting & Refinishing is for students who wish to obtain in-depth knowledge and skills in automotive painting and refinishing procedures in preparation for postsecondary training and careers as collision repair technicians. Upon completion of this course, proficient students will be able to develop, document, and implement refinishing plans for given vehicles. Students will read and interpret technical texts to determine, understand, and safely perform appropriate repair techniques and

procedures. Standards in this course include surface preparation, spray gun and related equipment operation, paint mixing, matching, and applying; diagnosis and correction of paint defects; and final detailing. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and to the National Automotive Technicians Education Foundation (NATEF) standards, a national framework of industry-benchmarked standards.* Students completing the Collision Repair program of study will be eligible to take the examination for Automotive Student Excellence (ASE) Student Certification in Collision Repair. Students completing this course will be eligible to take the examination for ASE Professional Certification in Painting & Refinishing (B2). Some tasks are assigned a "High Priority (HP)" designation. NATEF accredited programs must include at least 95% of the HP-I (Individual) tasks and 90% of the HP-G (Group) tasks in the curriculum.

Program of Study Application

This is the second or third course in the *Automotive Collision Repair* program of study. If *Collision Repair: Non-Structural* is offered in the program of study, this course should be the third course following *Collision Repair: Non-Structural*. If the program of study is focused solely on Painting and Refinishing, this course will be the second course following *Introduction to Collision Repair*. For more information on the benefits and requirements of implementing this program in full, please visit the Transportation, Distribution & Logistics website at <http://www.tn.gov/education/cte/TransportationDistributionLogistics.shtml>.

Recommended Credits

If all standards in the course are covered, the course is recommended for three credits. If one or two credits are offered the following options are recommended.

1 Credit Option

Content	Standards
Safety	1- all 2- all
Surface Preparation	3- c 4- f, h, j, k, l, m, n, t, u
Spray Gun and Related Equipment Operation	5- all
Paint Mixing, Matching, and Applying	6- a, m, o

2 Credit Option

Content	Standards
Safety	1- all 2- all
Surface Preparation	3- all 4- a, b, c, d, e, f, h, i, j, k, l, m, n, p, q, r, t, u
Spray Gun and Related Equipment Operation	5- all
Paint Mixing, Matching, and Applying	6- a, b, e, h, l, m, n, o
Final Detail	8- c, d, e



Course Standards

Safety

For every task in *Collision Repair: Painting & Refinishing*, the following safety requirement must be strictly enforced:

- 1) Comply with personal and environmental safety practices associated with clothing and the use of gloves; respiratory protection; eye protection; hearing protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations. Identify vehicle manufacturer's SRS types, locations, and recommended procedures before inspecting or replacing components. (TN Reading 3, 4)
 - a. Use and inspect personal protective equipment every time equipment is used.
 - b. Inspect, maintain, and employ safe operating procedures with tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment.
 - c. Assume responsibilities under HazCom (Hazard Communication) regulations.
 - d. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
 - e. Maintain a portfolio record of written safety examinations and equipment examination for which the student has passed an operational checkout by the instructor.
 - f. Utilize MSDSs (material safety data sheets), and identify the health hazards associated with hazardous material.

- 2) Locate, read, and interpret federal, state, and local regulations impacting the painting and refinishing of vehicles. Follow regulations and procedures to work safely around materials and equipment. (TN Reading 2, 3, 4, 6, 9)
 - a. Identify and take necessary precautions with hazardous operations and materials according to federal, state, and local regulations. HP-I
 - b. Identify safety and personal health hazards according to OSHA guidelines and the "Right to Know Law". HP-I
 - c. Inspect spray environment and equipment to ensure compliance with federal, state and local regulations, and for safety and cleanliness hazards. HP-I
 - d. Select and use a NIOSH approved air purifying respirator. Inspect condition and ensure fit and operation. Perform proper maintenance in accordance with OSHA Regulation 1910.134 and applicable state and local regulation. HP-I
 - e. Select and use a NIOSH approved supplied air (Fresh Air Make-up) respirator system. Perform proper maintenance in accordance with OSHA Regulation 1910.134 and applicable state and local regulation. HP-I
 - f. Select and use the proper personal safety equipment for surface preparation, spray gun and related equipment operation, paint mixing, matching and application, paint defects, and detailing (gloves, suits, hoods, eye and ear protection, etc.). HP-I



Surface Preparation

- 3) Create a plan for refinishing using a total product system. Perform inspections to determine the condition of the vehicle. Examine resources such as instructional manuals, textbooks, case studies, and other resources to determine the considerations and steps to include in the refinishing plan, citing evidence to justify elements of the plan. Consult with the instructor and peers to edit and revise the plan. (TN Reading 1, 2, 3, 4, 9; TN Writing 2, 4, 5, 6, 9)
 - a. Inspect, remove, store, and replace exterior trim and components necessary for proper surface preparation. HP-I
 - b. Soap and water wash entire vehicle; use appropriate cleaner to remove contaminants. HP-I
 - c. Inspect and identify type of finish, surface condition, and film thickness; develop and document a plan for refinishing using a total product system. HP-G

- 4) Diagram the steps necessary to prepare the surfaces of a vehicle for painting. Synthesize information gathered from textbooks, online resources, and firsthand experiences observing a qualified technician to create a list of tools, equipment, and materials needed for each step of preparation. Create a visual display with supporting text outlining the responsibilities and procedures of the repair technician, noting the appropriate timing of each task. (TN Reading 2, 3, 4, 5, 6, 7, 9; TN Writing 2, 4, 9)
 - a. Strip paint to bare substrate (paint removal). HP-I
 - b. Dry or wet sand areas to be refinished. HP-I
 - c. Featheredge areas to be refinished. HP-I
 - d. Apply suitable metal treatment or primer in accordance with total product systems. HP-I
 - e. Mask and protect other areas that will not be refinished. HP-I
 - f. Mix primer, primer-surfacer or primer-sealer. HP-I
 - g. Identify a complimentary color or shade of undercoat to improve coverage. HP-G
 - h. Apply primer onto surface of repaired area. HP-I
 - i. Apply two-component finishing filler to minor surface imperfections. HP-I
 - j. Block sand area to which primer-surfacer has been applied. HP-I
 - k. Dry sand area to which finishing filler has been applied. HP-I
 - l. Remove dust from area to be refinished, including cracks or moldings of adjacent areas. HP-I
 - m. Clean area to be refinished using a final cleaning solution. HP-I
 - n. Remove, with a tack rag, any dust or lint particles from the area to be refinished. HP-I
 - o. Apply suitable sealer to the area being refinished. HP-I
 - p. Scuff sand to remove nibs or imperfections from a sealer. HP-I
 - q. Apply stone chip resistant coating. HP-G
 - r. Restore caulking and seam sealers to repaired areas. HP-G
 - s. Prepare adjacent panels for blending. HP-I
 - t. Identify the types of rigid, semi-rigid or flexible plastic parts to be refinished; determine the materials needed, preparation, and refinishing procedures. HP-I
 - u. Identify metal parts to be refinished; determine the materials needed, preparation, and refinishing procedures. HP-I



Spray Gun and Related Equipment Operation

- 5) Read and interpret instructional manuals and other technical texts and observe demonstrations of qualified technicians to understand the proper procedures involved in operating a spray gun and related equipment. Use these texts to create a training document to instruct a new technician on maintaining and operating spray guns and related equipment. (TN Reading 2, 3, 4, 5; TN Writing 2, 4)
 - a. Inspect, clean, and determine condition of spray guns and related equipment (air hoses, regulators, air lines, air source, and spray environment). HP-I
 - b. Select spray gun setup (fluid needle, nozzle, and cap) for product being applied. HP-I
 - c. Test and adjust spray gun using fluid, air and pattern control valves. HP-I
 - d. Demonstrate an understanding of the operation of pressure spray equipment. HP-G

Paint Mixing, Matching, and Applying

- 6) Identify paint mixing procedures by interpreting technical information such as technical manuals and manufacturer's websites. Differentiate the effects of paint ratios on the color and composition of paint to hypothesize possible outcomes of each ratio. Calculate proper formulations of paint based upon label directions using formulas. Demonstrate in a live setting or in a presentation the ability to follow painting instructions precisely as they pertain to selection, mixing, handling, and application. Demonstrate procedures to apply paint and refinish plastic parts using the appropriate tools, equipment, and materials. (TN Reading 3, 4; TN Math N-Q, A-CED)
 - a. Identify color code by manufacturer's vehicle information label. HP-I
 - b. Shake, stir, reduce, catalyze/activate, and strain refinish materials. HP-I
 - c. Apply finish using appropriate spray techniques (gun arc, angle, distance, travel speed, and spray pattern overlap) for the finish being applied. HP-I
 - d. Apply selected product on test or let-down panel; check for color match. HP-I
 - e. Apply single stage topcoat. HP-G
 - f. Apply basecoat/clearcoat for panel blending and panel refinishing. HP-I
 - g. Apply basecoat/clearcoat for overall refinishing. HP-G
 - h. Remove nibs or imperfections from basecoat. HP-I
 - i. Refinish rigid or semi-rigid plastic parts. HP-G
 - j. Refinish flexible plastic parts. HP-I
 - k. Apply multi-stage coats for panel blending and overall refinishing. HP-G
 - l. Identify and mix paint using a formula. HP-I
 - m. Identify poor hiding colors; determine necessary action. HP-G
 - n. Tint color using formula to achieve a blendable match. HP-I
 - o. Identify alternative color formula to achieve a blendable match. HP-I
 - p. Identify the materials, equipment, and preparation differences between solvent and waterborne technologies. HP-G

Paint Defects - Causes and Cures

- 7) Create a listing of a wide array of paint defects possible including detailed descriptions, causes, and solutions. Compare and contrast the characteristics and solutions of paint defects in a chart or other visual display. Demonstrate troubleshooting strategies appropriate for identifying and evaluating paint defects in given scenarios including consulting technical documents (such as



textbooks and paint manufacturers' websites). Document findings in a technical report, citing evidence to recommend and justify the necessary correction procedures and methods to prevent future occurrences. Perform proper procedures to correct paint defects. (TN Reading 1, 2, 3, 4, 5, 8, 9; TN Writing 1, 4, 9)

- a. Identify blistering (raising of the paint surface, air entrapment); determine the cause(s) and correct the condition. HP-G
- b. Identify a dry spray appearance in the paint surface; determine the cause(s) and correct the condition. HP-I
- c. Identify the presence of fish-eyes (crater-like openings) in the finish; determine the cause(s) and correct the condition. HP-I
- d. Identify lifting; determine the cause(s) and correct the condition. HP-G
- e. Identify clouding (mottling and streaking in metallic finishes); determine the cause(s) and correct the condition. HP-I
- f. Identify orange peel; determine the cause(s) and correct the condition. HP-I
- g. Identify overspray; determine the cause(s) and correct the condition. HP-I
- h. Identify solvent popping in freshly painted surface; determine the cause(s) and correct the condition. HP-G
- i. Identify sags and runs in paint surface; determine the cause(s) and correct the condition. HP-I
- j. Identify sanding marks or sandscratch swelling; determine the cause(s) and correct the condition. HP-I
- k. Identify contour mapping/edge mapping while finish is drying; determine the cause(s) and correct the condition. HP-G
- l. Identify color difference (off-shade); determine the cause(s) and correct the condition. HP-G
- m. Identify tape tracking; determine the cause(s) and correct the condition. HP-G
- n. Identify low gloss condition; determine the cause(s) and correct the condition. HP-G
- o. Identify poor adhesion; determine the cause(s) and correct the condition. HP-G
- p. Identify paint cracking (shrinking, splitting, crowsfeet or line-checking, micro-checking, etc.); determine the cause(s) and correct the condition. HP-G
- q. Identify corrosion; determine the cause(s) and correct the condition. HP-G
- r. Identify dirt or dust in the paint surface; determine the cause(s) and correct the condition. HP-I
- s. Identify water spotting; determine the cause(s) and correct the condition. HP-G
- t. Identify finish damage caused by bird droppings, tree sap, and other natural causes; correct the condition. HP-G
- u. Identify finish damage caused by airborne contaminants (acids, soot, rail dust, and other industrial-related causes); correct the condition. HP-G
- v. Identify die-back conditions (dulling of the paint film showing haziness); determine the cause(s) and correct the condition. HP-G
- w. Identify chalking (oxidation); determine the cause(s) and correct the condition. HP-G
- x. Identify bleed-through (staining); determine the cause(s) and correct the condition. HP-G
- y. Identify pin-holing; determine the cause(s) and correct the condition. HP-G
- z. Identify buffing-related imperfections (swirl marks, wheel burns); correct the condition. HP-I
- aa. Identify pigment flotation (color change through film build); determine the cause(s) and correct the condition. HP-G



Final Detail

- 8) Explain the proper procedures to complete the final detailing for painting and refinishing projects. Create a checklist and guide a beginning technician could use to plan and perform procedures, noting common mistakes to avoid. (TN Reading 2, 3, 4; TN Writing 2, 4)
 - a. Apply decals, transfers, tapes, woodgrains, pinstripes (painted and taped), etc. HP-G
 - b. Sand, buff and polish fresh or existing finish to remove defects as required. HP-I
 - c. Clean interior, exterior, and glass. HP-I
 - d. Clean body openings (door jambs and edges, etc.). HP-I
 - e. Remove overspray. HP-I
 - f. Perform vehicle clean-up; complete quality control using a checklist. HP-I

Standards Alignment Notes

*References to other standards include:

- TN Reading: [Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects](#); Reading Standards for Literacy in Science and Technical Subjects 6-12; Grades 9-10 Students (page 62).
 - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standard 10 at the conclusion of the course.
- TN Writing: [Tennessee State Standards for English Language Arts & Literacy in History/Social Studies, Science, and Technical Subjects](#); Writing Standards for Literacy in History/Social Studies, Science, and Technical Subjects 6-12; Grades 9-10 Students (pages 64-66).
 - Note: While not directly aligned to one specific standard, students who are engaging in activities outlined above should be able to also demonstrate fluency in Standards 3, 7, 8, and 10 at the conclusion of the course.
- TN Math: [Tennessee State Standards for Mathematics](#); Math Standards for High School: Number and Quantity, Algebra (pages 58-83).
 - Note: The standards in this course are not meant to teach mathematical concepts. However, the concepts referenced above may provide teachers with opportunities to collaborate with mathematics educators to design project based activities or collaborate on lesson planning. Students who are engaging in activities listed above should be able to demonstrate quantitative and algebraic reasoning as applied to specific technical concepts. In addition, students will have the opportunity to practice the habits of mind as described in the eight Standards for Mathematical Practice.
- National Automotive Technicians Education Foundation (NATEF) standards for [Painting and Refinishing](#) (pages 73-77).
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
 - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.





TENNESSEE DEPARTMENT OF

EDUCATION

FIRST TO THE TOP

Introduction to Collision Repair

Primary Career Cluster:	Transportation, Distribution & Logistics
Consultant:	Rachel Allen, (615) 532-2835, Rachel.Allen@tn.gov
Course Code(s):	TBD
Prerequisite(s):	None
Credit:	1
Grade Level:	9
Graduation Requirements:	This course satisfies one of three credits required for an elective focus when taken in conjunction with other Transportation, Distribution & Logistics courses.
Programs of Study and Sequence:	This is the first course in the <i>Automotive Collision Repair</i> program of study.
Necessary Equipment:	Please visit http://www.natef.org for necessary equipment list.
Aligned Student Organization(s):	SkillsUSA: http://www.tnskillsusa.org Brandon Hudson, (615) 532-2804, Brandon.Hudson@tn.gov
Coordinating Work-Based Learning:	If a teacher has completed work-based learning training, appropriate student placement can be offered. To learn more, please visit http://www.tn.gov/education/cte/work_based_learning.shtml .
Available Student Industry Certifications:	Automotive Service Excellence (ASE) Student or Professional Certification or I-CAR Refinish Technician ProLevel 1 or I-CAR Non-Structural Technician ProLevel 1
Dual Credit or Dual Enrollment Opportunities:	Students who obtain the ASE student certification may be able to articulate hours at Tennessee Colleges of Applied Technology.
Teacher Endorsement(s):	507
Required Teacher Certifications/Training:	ASE B-3 or ASE B-4 or I-CAR Industry Certification
Teacher Resources:	http://www.tn.gov/education/cte/TransportationDistributionLogistics.shtml

Course Description

Introduction to Collision Repair is a foundational course in the Collision Repair program of study for students interested in learning more about automotive collision repair technician careers. Upon completion of this course, proficient students will be able to identify and explain the basic steps in the collision repair process, emphasizing the tools, equipment, and materials used. They are able to describe the major parts of an automobile body. They will be able to safely perform basic procedures in preparing

automotive panels for repair, applying body filling, and preparing surfaces for painting. Standards in this course include career investigation of the opportunities in automotive collision repair as well as an overview of the history of automobile design and construction. Standards in this course are aligned with Tennessee State Standards for English Language Arts & Literacy in Technical Subjects, Tennessee State Standards in Mathematics, and to the National Automotive Technicians Education Foundation (NATEF) standards, a national framework of industry-benchmarked standards.* Students completing the Collision Repair program of study will be eligible to take the examination for Automotive Student Excellence (ASE) Student Certification in Collision Repair. Some tasks are assigned a "High Priority (HP)" designation. NATEF accredited programs must include at least 95% of the HP-I (Individual) tasks and 90% of the HP-G (Group) tasks in the curriculum.

Program of Study Application

This is the foundational course in the *Automotive Collision Repair* program of study. For more information on the benefits and requirements of implementing these programs in full, please visit the Transportation, Distribution & Logistics website at <http://www.state.tn.us/education/cte/TransportationDistributionLogistics.shtml>.

Course Standards

Safety

For every task in *Collision Repair: Non-Structural*, the following safety requirement must be strictly enforced:

- 1) Comply with personal and environmental safety practices associated with clothing and the use of gloves; respiratory protection; eye protection; hearing protection; hand tools; power equipment; proper ventilation; and the handling, storage, and disposal of chemicals/materials in accordance with local, state, and federal safety and environmental regulations. Identify vehicle manufacturer's SRS (supplemental restraint system) types, locations, and recommended procedures before inspecting or replacing components. (TN Reading 3, 4)
 - a. Use and inspect personal protective equipment every time equipment is used.
 - b. Inspect, maintain, and employ safe operating procedures with tools and equipment, such as hand and power tools, ladders, scaffolding, and lifting equipment.
 - c. Assume responsibilities under HazCom (Hazard Communication) regulations.
 - d. Adhere to responsibilities, regulations, and Occupational Safety & Health Administration (OSHA) policies regarding reporting of accidents and observed hazards, and regarding emergency response procedures.
 - e. Maintain a portfolio record of written safety examinations and equipment examination for which the student has passed an operational checkout by the instructor.
 - f. Utilize MSDs (material safety data sheets), and identify the health hazards associated with hazardous material.

History of Automobiles

- 2) Synthesize research from textbooks, automotive magazines, and professional journals to create an annotated timeline or visual graphic illustrating significant time periods in the development



of automobile design and construction, emphasizing the changing collision repair methods. (TN Reading 3, 7; TN Writing 4, 9)

Career Investigation

- 3) Cite supporting evidence from multiple career information sources, such as O*NET OnLine, to summarize the essential knowledge and skills required for collision repair technicians. Identify and analyze areas of specialization within the Collision Repair field such as metal technician, structural technician, refinish technician, and detailing technician. Produce a chart or other graphic detailing the aptitudes and training needed for a collision repair technician career. Devise a tentative career plan to reach employment goals. (TN Reading 1, 2, 7, 9; TN Writing 2, 4, 8, 9)
- 4) Compile and analyze real-time and projected labor market data from public sources such as the U.S. Bureau of Labor Statistics to investigate local and regional occupational opportunities and trends in the field of collision repair. Synthesize collected data to develop a written summary outlining education requirements, job availability, salaries, and benefits. (TN Reading 2, 7; TN Writing 4, 8, 9; TN Math S-ID)

Overview of Collision Repair Operations

- 5) Research collision repair processes described in textbooks, repair center websites, or by interviewing technicians. Citing research, create a written, oral, or visual presentation describing the major steps involved in the collision repair process including estimating, disassembling, performing repairs, refinishing, reassembling, detailing, and final inspection. Discriminate between the different types of repair work such as metal work, structural repairs, mechanical and electrical repairs, and refinishing. (TN Reading 1, 2, 3, 4; TN Writing 4, 6, 8, 9)

Vehicle Construction

- 6) Utilize appropriate terminology to classify and describe vehicles based on vehicle size, roof design, drive system type, and engine location. Compare and contrast the major types of body frames (i.e. body-over-frame, unibody, and space frame). Create a visual display with supporting text to describe the major structural parts, sections, and assemblies of each type of body frame. (TN Reading 2, 3, 4, 7; TN Writing 2)
- 7) Identify and describe the major parts and components which make up an automobile body, analyzing the purpose of and interrelationships among each component and explaining the sequence in which each is put together in assembly. (TN Reading 2, 3, 4, 5)

Tools & Equipment

- 8) Accurately identify a wide range of hand tools, power tools, and equipment used in the collision repair industry. Hand tools should include metric and SAE sizes, such as wrenches, sockets, screwdrivers, pliers, files, holding tools, punches, chisels, and hammers. Power tools include air tools, grinders, polishers, blasters, and spray guns. Equipment includes spray booths, paint drying equipment, straightening systems, and lifts. (TN Reading 2, 3, 4)



- 9) Assess a variety of situations requiring the use of hand tools, power tools, and equipment. Select the proper tool, critique the readiness of the tool, use the tool to accomplish the desired task, clean the tool, and then return the tool to its proper storage according to correct size and nomenclature. For example, demonstrate the ability to safely use an air ratchet to remove hood hinge bolts. (TN Reading 3; TN Math N-Q)
- 10) Use physical measurement devices typically employed in collision repair to complete accurate field measurements. Determine the appropriate units and record accurate measurements of lengths, angles, pressure, volume, and other measurements. Tools should include, but are not limited to: fractional rule, metric rule, measuring tape, dial caliper, micrometer, dial indicators, pressure gauges, and mixing cups. (TN Reading 3; TN Math N-Q)
- 11) Apply mathematics concepts to solve collision repair problems, distinguishing which principles apply to a given automotive problem. Concepts should include, but are not limited to:
 - a. Operating with whole numbers, fractions, and decimals. (TN Math N-Q)
 - b. Performing conversions between fractions, decimals, and percent. For example, convert a decimal to a fraction to prepare a unit for measurement on a fractional scale to the precision of 1/16 of an inch. (TN Math N-Q)
 - c. Working with units such as feet, inches, meters, centimeters, and millimeters, and determining appropriate units for a given repair task. For example, convert fractions of an inch into millimeters to determine the appropriate size metric wrench to use to loosen a bolt. (TN Math N-Q)
 - d. Performing proportionate reasoning to estimate quantities. (TN Math N-Q)

Collision Repair Materials

- 12) Distinguish between the various types of fasteners commonly used in vehicle construction, such as bolts, nuts, washers, screws, nonthreaded fasteners, and adhesives, by creating a visual display outlining the properties and uses of each type. Define torque and describe the procedures for applying the appropriate torque to tighten bolts. Demonstrate the ability to accurately remove, reinstall, and select the appropriate fastener in a variety of situations. For example, consult torque specifications to determine the torque value for a given size and grade of bolt and perform proper tightening sequences to secure bolts. (TN Reading 2, 4, 5, 7)
- 13) Compare and contrast the properties and uses of basic materials employed in collision repair processes, such as body fillers, putty, mashing materials, abrasives, sandpapers, primers, paint types, drying and curing materials, sealers. Describe common procedures used by collision repair centers to clean and properly dispose of materials and supplies. (TN Reading 3, 4, 9)

Preparation of Non-Structural Body Components

- 14) Gather information from a variety of print and digital sources (such as textbooks, OEM manuals, and online instructional materials) as well as firsthand experiences observing a qualified technician on the basic steps necessary to prepare non-structural body components for repair. Write a summary of the steps involved in the process, as if explaining the process to a new automotive collision repair student. (TN Reading 2, 3, 4, 5, 6, 8; TN Writing 2, 4, 7, 9)
 - a. Review damage report and analyze damage to determine appropriate methods for overall repair; develop and document a repair plan. HP-I



- b. Inspect, remove, label, store, and reinstall exterior trim and moldings. HP-I
- c. Protect panels, glass, interior parts, and other vehicles adjacent to the repair area. HP-I
- d. Soap and water wash entire vehicle; complete pre-repair inspection checklist. HP-I

Metal Finishing and Body Filling of Non-Structural Body Components

- 15) Read and interpret textbooks, OEM manuals, and other instructional materials to determine the basic steps necessary to properly repair surface irregularities on a damaged body panel. Apply the appropriate tools, equipment, and procedures to safely perform panel repairs. (TN Reading 2, 3, 4)
- a. Remove paint from the damaged area of the body panel. HP-I
 - b. Locate and repair surface irregularities on a damaged body panel. HP-I
 - c. Heat shrink stretched panel areas to proper contour. HP-I
 - d. Identify different types of body fillers. HP-G
 - e. Prepare and apply body filler. HP-I
 - f. Rough sand body filler to contour; finish sand. HP-I

Surface Preparation for Painting and Refinishing

- 16) Read and interpret textbooks, OEM manuals, and other instructional materials to determine the basic steps necessary to prepare a surface for painting. Apply the appropriate tools, equipment, and procedures to safely prepare a surface for painting. (TN Reading 2, 3, 4)
- a. Mix primer, primer-surfacer, or primer-sealer. HP-I
 - b. Apply primer onto surface of repaired area. HP-I
 - c. Block sand area to which primer-surfacer has been applied. HP-I
 - d. Dry sand area to which finishing filler has been applied. HP-I
 - e. Clean area to be refinished using a final cleaning solution. HP-I

Standards Alignment Notes

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- National Automotive Technicians Education Foundation (NATEF) standards for [Non-Structural Analysis and Damage Repair](#) (pages 62-65) and [Painting and Refinishing](#) (pages 73-77).
- P21: Partnership for 21st Century Skills [Framework for 21st Century Learning](#)
 - Note: While not all standards are specifically aligned, teachers will find the framework helpful for setting expectations for student behavior in their classroom and practicing specific career readiness skills.

