Maine Department of Education
Career and Technical Education
CTE Intersections with College and Career Readiness Standards-Mathematics
with
Auto Body; CIP: 47.0603
Non-Structural Analysis and Damage Repair (NATEF)

Non-Structural Analysis and Damage Repair Framework, Duties, and Tasks	**Standards for Mathematical Content; Standards for Mathematical Practice (CCSS)**	**Criteria for Demonstration of Proficiency (possible but not required; must be determined at the District level)**	**Maine Learning Results – Guiding Principles** And **Career and Education Development (optional)**
A. Preparation			
1. Review damage report and analyze damage to determine appropriate methods for overall repair; develop and document a repair plan 2. Inspect, remove, label, store, and reinstall exterior trim and moldings. 3. Inspect, remove, label, store, and reinstall interior trim and components. 4. Inspect, remove, label, store, and reinstall body panels and components that may interfere with or be damaged during repair. 5. Inspect, remove, label, store, and reinstall vehicle mechanical and electrical components that may interfere with or be damaged during repair.	**Math.A-CED.A.1:** Create equations and inequalities in one variable and use them to solve problems. **Math.A-CED.A.2:** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. **Math.A-CED.A.3:** Represent constraints by equations or inequalities, and by systems of equations, and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. **Math.A-REI.A.1:** Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original	1. Estimating - cost, labor rates, hours, mark-ups, percentages sublet, tax, **formulas** for overlap & blending & clear. 2. Creating formulas from word problems. 3. Understanding equations related to overlap, clear coat times, etc.	*Guiding Principles* **A. A clear and effective communicator who:** 1. Demonstrates organized and purposeful communication in English and at least one other language 2. Uses evidence and logic appropriately in communication 3. Adjusts communication based on the audience 4. Uses a variety of modes of expression (spoken, written and visual and performing including the use of technology to create and share the expressions) **B. A self-directed and lifelong learner who:**

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6. Protect panels, glass, interior parts, and other vehicles adjacent to the repair area. 7. Soap and water wash entire vehicle; complete pre-repair inspection checklist. 8. Prepare damaged area using water-based and solvent-based cleaners. 9. Remove corrosion protection, under-coatings, sealers, and other protective coatings as necessary to perform repairs. 10. Inspect, remove, and reinstall repairable plastics and other components for off-vehicle repair.	equation has a solution. Construct a viable argument to justify a solution method.		1. Recognizes the need for information and locates and evaluates resources 2. Applies knowledge to set goals and make informed decisions 3. Applies knowledge in new contexts 4. Demonstrates initiative and independence 5. Demonstrates flexibility including the ability to learn, unlearn and relearn 6. Demonstrates reliability and concern for quality 7. Uses interpersonal skills to learn and work with individuals from diverse backgrounds **C. A creative and practical problem solver who:** 1. Observes and evaluates situations to define problems 2. Frames questions,

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			makes predictions and designs data/information collection and analysis strategies 3. Identifies patterns, trends and relationships that apply to solutions 4. Generates a variety of solutions, builds a case for a best response and critically evaluates the effectiveness of the response 5. Sees opportunities, finds resources and seeks results 6. Uses information and technology to solve problems 7. Perseveres in challenging situations **D. A responsible and involved citizen who:** 1. Participates positively in the community and designs creative solutions to meet human needs and wants 2. Accepts responsibility

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			for personal decisions and actions 3. Demonstrates ethical behavior and the moral courage to sustain it **E. An integrative and informed thinker who:** 4. Applies systems thinking to understand the interaction and influence of related parts on each other and on outcomes *CED* **A2 Beliefs and Behaviors that Lead to Success** Students demonstrate and evaluate strategies to improve their personal traits, behaviors, and the belief that one can successfully complete tasks/goals required for success in career and school. **A3 Interpersonal Skills** Students demonstrate behaviors that reflect positive interpersonal

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			skills and evaluate successful strategies that improve positive interpersonal skills in ways that lead to success in a variety of school, work, and community settings. **B3 Education and Career Information** Students use previously acquired knowledge and skills to evaluate and utilize a variety of resources to articulate a plan and make decisions for post-secondary education, training, and career choices.
B. Outer Body Panel Repairs, Replacements, and Adjustments			
1. Determine the extent of direct and indirect/hidden damage and direction of impact; develop and document a repair plan. 2. Inspect, remove and replace bolted, bonded, and welded steel panel or panel assemblies. 3. Determine the extent of	**Math.G-MG.A.3**: Apply geometric methods to solve design problems (i.e., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios). **Math.G-CO.A.5:** Given a geometric figure and a rotation, reflection, or translation, draw the	Aligning of panels using symmetry, angles, and planes.	*Guiding Principles* **B. A self-directed and lifelong learner who:** 1. Recognizes the need for information and locates and evaluates resources 2. Applies knowledge to set goals and make informed decisions 3. Applies knowledge in new

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damage to aluminum body panels; repair or replace. 4. Inspect, remove, replace, and align hood, hood hinges, and hood latch. 5. Inspect, remove, replace, and align deck lid, lid hinges, and lid latch. 6. Inspect, remove, replace, and align doors, latches, hinges, and related hardware. 7. Inspect, remove, replace and align tailgates, hatches, liftgates and sliding doors. 8. Inspect, remove, replace, and align bumper bars, covers, reinforcement, guards, isolators, and mounting hardware. 9. Inspect, remove, replace and align fenders, and related panels. 10. Straighten contours of damaged panels to a suitable condition for body filling or metal finishing using power tools, hand tools, and weld-on	transformed figure using, e.g., graphic paper, tracing paper, or geometry software. Specify a sequence of transformations that will carry a given figure onto another. **Math.G-CO.B.6:** Use geometric descriptions of rigid motions to transform figures and t predict the effect of a given rigid motion on a given figure; given two figures, use the definition of congruence in terms of rigid motions to decide if they are congruent.		contexts 4. Demonstrates initiative and independence 5. Demonstrates flexibility including the ability to learn, unlearn and relearn 6. Demonstrates reliability and concern for quality 7. Uses interpersonal skills to learn and work with individuals from diverse backgrounds **C. A creative and practical problem solver who:** 1. Observes and evaluates situations to define problems 2. Frames questions, makes predictions and designs data/information collection and analysis strategies 3. Identifies patterns, trends and relationships that apply to solutions 4. Generates a variety of solutions, builds a case for a best response and critically evaluates the

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pulling attachments. 11. Weld damaged or torn steel body panels; repair broken welds. 12. Restore corrosion protection. 13. Replace door skins. 14. Restore sound deadeners and foam materials. 15. Perform panel bonding and weld bonding. 16. Diagnose and repair water leaks, dust leaks, and wind noise. 17. Identify one-time use fasteners.			effectiveness of the response 5. Sees opportunities, finds resources and seeks results 6. Uses information and technology to solve problems 7. Perseveres in challenging situations **D. A responsible and involved citizen who**: 2. Accepts responsibility for personal decisions and actions 3. Demonstrates ethical behavior and the moral courage to sustain it **E. An integrative and informed thinker who:** 4. Applies systems thinking to understand the interaction and influence of related parts on each other and on outcomes *CED* **A1 Self-Knowledge and Self-Concept**

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			Students reflect on and/or analyze interests, skills, habits of mind, and experiences to maintain a positive self-concept and to aid them in making career and life decisions. **A4 Career and Life Roles** Students demonstrate and evaluate successful strategies for accomplishing tasks, balancing career and life roles, and reducing stress in a variety of school, work, and community settings.
C. Metal Finishing and Body Filling			
1. Remove paint from the damaged area of a body panel. 2. Locate and repair surface irregularities on a damaged body panel. 3. Demonstrate hammer and dolly techniques. 4. Heat shrink stretched panel			*Guiding Principles* **B. A self-directed and lifelong learner who:** 4. Demonstrates initiative and independence 6. Demonstrates reliability and concern for quality **C. A creative and practical**

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areas to proper contour. 5. Cold shrink stretched panel areas to proper contour. 6. Prepare and apply body filler. 7. Identify different types of body fillers. 8. Rough sand body filler to contour; finish sand. 9. Determine the proper metal finishing techniques for aluminum. 10. Determine proper application of body filler to aluminum.			**problem solver who:** 1. Observes and evaluates situations to define problems 2. Frames questions, makes predictions and designs data/information collection and analysis strategies 3. Identifies patterns, trends and relationships that apply to solutions 4. Generates a variety of solutions, builds a case for a best response and critically evaluates the effectiveness of the response 5. Sees opportunities, finds resources and seeks results 6. Uses information and technology to solve problems 7. Perseveres in challenging situations **D. A responsible and involved citizen who:** 2. Accepts responsibility for

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			personal decisions and actions 3. Demonstrates ethical behavior and the moral courage to sustain it **E. An integrative and informed thinker who:** 4. Applies systems thinking to understand the interaction and influence of related parts on each other and on outcomes *CED* **A1 Self-Knowledge and Self-Concept** Students reflect on and/or analyze interests, skills, habits of mind, and experiences to maintain a positive self-concept and to aid them in making career and life decisions. **A3 Interpersonal Skills** Students demonstrate behaviors that reflect positive interpersonal skills and evaluate successful strategies that

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			improve positive interpersonal skills in ways that lead to success in a variety of school, work, and community settings. c. Working as a member of a team f. Accepting responsibility for personal behavior g. Demonstrating ethical behavior i. Demonstrating safe behavior **C1 The Planning Process** Students use the planning process to make school-to-school and school-to-work decisions. a. Self-knowledge b. Looking for and creating personal career options c. Decision-making skills **C2 Decision- Making** Students determine and apply effective decision-making strategies for accomplishing short-term and long-term goals related to school-to-

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			school and school-to-work decisions.
D. Moveable Glass and Hardware			
1. Inspect, adjust, repair or replace window regulators, run channels, glass, power mechanisms, and related controls. 2. Inspect, adjust, repair, remove, reinstall or replace weather-stripping. 3. Inspect, repair or replace, and adjust removable power operated roof panel and hinges, latches, guides, handles, retainer, and controls of sunroofs. 4. Inspect, remove, reinstall, and align convertible top and related mechanisms. 5. Initialize electrical components as needed.			*Guiding Principles* **B. A self-directed and lifelong learner who:** 1. Recognizes the need for information and locates and evaluates resources 2. Applies knowledge to set goals and make informed decisions 3. Applies knowledge in new contexts 4. Demonstrates initiative and independence 5. Demonstrates flexibility including the ability to learn, unlearn and relearn 6. Demonstrates reliability and concern for quality 7. Uses interpersonal skills to learn and work with individuals from diverse backgrounds

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			C. A creative and practical problem solver who: 1. Observes and evaluates situations to define problems 5. Sees opportunities, finds resources and seeks results 6. Uses information and technology to solve problems 7. Perseveres in challenging situations *CED* **A1 Self-Knowledge and Self-Concept** Students reflect on and/or analyze interests, skills, habits of mind, and experiences to maintain a positive self-concept and to aid them in making career and life decisions. **C1 The Planning Process** Students use the planning process to make school-to-school and school-to-work decisions.

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			a. Self-knowledge b. Looking for and creating personal career options c. Decision-making skills
HE. Metal Welding and Cutting			
1. Identify weldable and non-weldable substrates used in vehicle construction. 2. Weld and cut high-strength steel and other steels. 3. Weld and cut aluminum. 4. Determine the correct GMAW (MIG) welder type, electrode/wire type, diameter, and gas to be used in a specific welding situation. 5. 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. 6. Store, handle, and install high-pressure gas cylinders. 7. Determine work clamp	**Math.A-CED.A.2:** Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.	Using equations in welding. Amperage to metal thickness & wire speed. Using conversion charts. Measuring thickness of steel or aluminum. Considering factors when welding.	*Guiding Principles* **B. A self-directed and lifelong learner who:** 4. Demonstrates initiative and independence 6. Demonstrates reliability and concern for quality **C. A creative and practical problem solver who:** 1. Observes and evaluates situations to define problems 2. Frames questions, makes predictions and designs data/information collection and analysis strategies 3. Identifies patterns, trends and relationships that apply to solutions 4. Generates a variety of solutions, builds a case for

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(ground) location and attach. 8. 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. 9. Protect adjacent panels, glass, vehicle interior, etc. from welding and cutting operations. 10. Protect computers and other electronic control modules during welding procedures. 11. Clean and prepare the metal to be welded, assure good metal fit-up, apply weld-through primer if necessary, clamp or tack as required. 12. Determine the joint type (butt weld with backing, lap, etc.) for weld being made. 13. Determine the type of weld (continuous, stitch weld, plug, etc.) for each specific welding operation. 14. Perform the following welds:			a best response and critically evaluates the effectiveness of the response 5. Sees opportunities, finds resources and seeks results 6. Uses information and technology to solve problems 7. Perseveres in challenging situations **D. A responsible and involved citizen who:** 2. Accepts responsibility for personal decisions and actions 3. Demonstrates ethical behavior and the moral courage to sustain it **E. An integrative and informed thinker who:** 4. Applies systems thinking to understand the interaction and influence of related parts on each other and on outcomes *CED*

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continuous, plug, butt weld with and without backing, fillet, etc. 15. Perform visual and destructive tests on each weld type. 16. Identify the causes of various welding defects; make necessary adjustments. 17. Identify cause of contact tip burn-back and failure of wire to feed; make necessary adjustments. 18. Identify cutting process for different substrates and locations; perform cutting operation. 19. Identify different methods of attaching non-structural components (squeeze type resistant spot welds (STRSW), riveting, non-structural adhesive, silicon bronze, etc.).			**A1 Self-Knowledge and Self-Concept** Students reflect on and/or analyze interests, skills, habits of mind, and experiences to maintain a positive self-concept and to aid them in making career and life decisions. **A4 Career and Life Roles** Students demonstrate and evaluate successful strategies for accomplishing tasks, balancing career and life roles, and reducing stress in a variety of school, work, and community settings. a. Time management c. Resource management **B2 Skills for Individual/ Personal Success in the 21st Century** Students evaluate strategies to improve skills that lead to lifelong learning and success in the classroom,

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			and the achievement of schoolwork, work and career, and personal life goals. c. Critical thinking skills **C1 The Planning Process** Students use the planning process to make school-to-school and school-to-work decisions. a. Self-knowledge c. Decision-making skills
F. Plastics and Adhesives			
1. Identify the types of plastics; determine repairability. 2. Clean and prepare the surface of plastic parts; identify the types of plastic repair procedures. 3. Repair rigid, semi-rigid, or flexible plastic panels. 4. Remove or repair damaged areas from rigid exterior composite panels. 5. Replace bonded rigid exterior			*Guiding Principles* **B. A self-directed and lifelong learner who:** 4. Demonstrates initiative and independence 6. Demonstrates reliability and concern for quality **C. A creative and practical problem solver who:** 1. Observes and evaluates situations to define problems 2. Frames questions, makes

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composite body panels; straighten or align panel supports.			predictions and designs data/information collection and analysis strategies 3. Identifies patterns, trends and relationships that apply to solutions 4. Generates a variety of solutions, builds a case for a best response and critically evaluates the effectiveness of the response 5. Sees opportunities, finds resources and seeks results 6. Uses information and technology to solve problems 7. Perseveres in challenging situations **D. A responsible and involved citizen who:** 2. Accepts responsibility for personal decisions and actions 3. Demonstrates ethical behavior and the moral courage to sustain it

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			E. An integrative and informed thinker who: 4. Applies systems thinking to understand the interaction and influence of related parts on each other and on outcomes *CED* **A1 Self-Knowledge and Self-Concept** Students reflect on and/or analyze interests, skills, habits of mind, and experiences to maintain a positive self-concept and to aid them in making career and life decisions. **A4 Career and Life Roles** Students demonstrate and evaluate successful strategies for accomplishing tasks, balancing career and life roles, and reducing stress in a variety of school, work, and community settings. a. Time management

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			c. Resource management **B2 Skills for Individual/ Personal Success in the 21st Century** Students evaluate strategies to improve skills that lead to lifelong learning and success in the classroom, and the achievement of schoolwork, work and career, and personal life goals. c. Critical thinking skills **C1 The Planning Process** Students use the planning process to make school-to-school and school-to-work decisions. a. Self-knowledge c. Decision-making skills