Implementation date
Fall 2010

PROGRAM CONCENTRATION: Architecture, Construction, Communications & Transportation
CAREER PATHWAY: Collision Repair
COURSE TITLE: Structural Analysis and Damage Repair I
PREREQUISITE: Non Structural Damage and Body Repair II

Course Description: Structural Analysis and Damage Repair 1 is the starting point in the Structural Repair career pathway. This course will prepare the student for an entry level position in a specialized area of Collision Repair. The student will learn, through theoretical and practical applications, to analyze and restore vehicle structural damage to factory specifications.

ACCT-SDRI-1 Frame Inspection and Repair: Students will be able to analyze structural Frame damage relative to factory specifications, determine and undertake the proper procedures to restore damaged areas to the correct specifications. Students will recognize the difference between Frame and Unibody vehicles and understand that each type require different repair procedures.

a. Diagnose and measure structural damage using tram and self-centering gauges.
b. Attach vehicle to anchoring devices
c. Analyze, straighten and align mash (collapse) damage.
d. Analyze, straighten and align sag damage.
e. Analyze, straighten and align sideway damage.
f. Analyze, straighten and align twist damage.
g. Analyze, straighten and align diamond frame damage.
h. Remove and replace damaged structural components.
i. Restore corrosion protection to repaired or replaced frame areas.
j. Analyze and identify misaligned or damaged steering, suspension, and powertrain components that can cause vibration, steering, and wheel alignment problems.
k. Align or replace misaligned or damaged steering, suspension, and powertrain components that can cause vibration, steering, and wheel alignment problems.
l. Identify heat limitations in structural components.
m. Restore structural foam.
n. Diagnose and measure structural damage using a universal measuring system (mechanical, electrical, laser).

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o. Diagnose and measure structural damage to vehicles using a dedicated (fixture) measuring system.
p. Determine the extent of the direct and indirect damage and the direction of impact; document the methods and sequence of repair.
q. Analyze and identify crush/collapse zones.

Academic Standard(s):

SCSH2- Students will use standard safety practices for all classroom, laboratory and field investigations.

c. Follow correct protocol for identifying and reporting safety problems and violations.

SCSH3- Students will identify and investigate problems scientifically.

a. Suggest reasonable hypotheses for identified problems.
b. Develop procedures for solving scientific problems.
c. Collect organize and record appropriate data.
e Develop reasonable conclusions based on data collected.
f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

SPS8. Students will determine relationships among force, mass, and motion.

a. Calculate velocity and acceleration.
b. Apply Newton's three laws to everyday situations by explaining the following:
• Inertia
• Relationship between force, mass and acceleration
• Equal and opposite forces
d. Explain the difference in mass and weight.
e. Calculate amounts of work and mechanical advantage using simple machines.

SP3. Students will evaluate the forms and transformations of energy.

c. Measure and calculate the vector nature of momentum.
d. Compare and contrast elastic and inelastic collisions.

M6G1. Students will further develop their understanding of plane figures.

a. Determine and use lines of symmetry.
b. Investigate rotational symmetry, including degree of rotation.
c. Use the concepts of ratio, proportion and scale factor to demonstrate the relationships between similar plane figures.
d. Interpret and sketch simple scale drawings.

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e. Solve problems involving scale drawings.

MM3P1- Students will solve problems (using appropriate technology)

a. Build new mathematical knowledge through problem solving.
b. Solve problems that arise in mathematics and in other contexts.
c. Apply and adapt a variety of appropriate strategies to solve problems.

MM3P3- Students will communicate mathematically.

a. Organize and consolidate their mathematical thinking through communication.
b. Communicate their mathematical thinking coherently and clearly to peers, teachers and others.

MM3P4- Students will make connections among mathematical ideas and to other disciplines.

d. Recognize and apply mathematics in contexts outside of mathematics.

ELA10RL1 The student demonstrates comprehension by identifying evidence (i.e., examples of diction, imagery, point of view, figurative language, symbolism, plot events and main ideas) in a variety of texts representative of different genres (i.e., poetry, prose [short story, novel, essay, editorial, biography], and drama) and using this evidence as the basis for interpretation.

<u>The student identifies, analyzes, and applies knowledge of the purpose, structure, and elements of nonfiction and/or informational materials and provides evidence from the text to support understanding; the student:</u>

a. Analyzes and explains the structures and elements of nonfiction works such as newspaper articles and editorials, magazine articles, journal articles, and/or other informational texts.

ELA10RL5 The student understands and acquires new vocabulary and uses it correctly in reading and writing.

National Academic Standards (NATEF)

SC041- Applies and uses laboratory safety techniques.
SC042- Applies and uses tables and graphs.
SC044- Applies and uses scientific method.
SC052 Converts Measurement Units English/Metric

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- The technician can convert measurements taken in the English or metric system to specifications stated in terms of either system.

SC236 Describes/Explains Energy Momentum

- The technician can explain how energy is dissipated through the body based on the momentum of the vehicle at the time of the impact.

SC248 Describes/Explains Force

- The technician can explain the principles of force as it applies to the realignment of a component.

SC249 Describes/Explains Energy Force, Balanced/Unbalanced

- The technician can demonstrate an understanding of the role of balanced and unbalanced forces on linear or rotating vehicle assemblies.

SC253 Describes/Explains Force Inertia

- The technician can explain how the rate of a force in motion can impact on an automobile body in a variety of ways.

SC255 Describes/Explains Force Pressure

- The technician can demonstrate an understanding of the concept of pressure in relation to the concept of force.

SC280 Describes/Explains Heat Insulation

- The technician can explain the role of insulation in maintaining stable temperatures or in preventing the transfer of heat to an unwanted area.

SC395 Describes/Explains Solutions Solvent

- The technician understands the use and safety requirements of all solvents used in an autobody environment.

SC447 Describes/Explains Work Levers

- The technician can explain how levers can be used to increase an applied force over distance.

SC448 Describes/Explains Work Pulleys

- The technician can explain how pulleys can be used to increase an applied force over distance.

SC492- Measures force.

SC499- Uses computers for information gathering and estimating.

SC513- Describes and explains torque

SC528 Describes/Explains Adhesives/Sealants

- The technician can demonstrate an understanding of how surface processes and cohesive/adhesive forces aid in glues, tapes, and sealants.

MA014 Calculates/Evaluates Measurement Precision

- The technician uses a variety of techniques to determine if selected measurements are precise and in congruence with manufacturer's specifications.

MA026 Computes Addition Decimals

- The technician can add numbers that include decimals to determine conformance with the manufacturer's specifications.

MA028 Computes Addition Mentally

- The technician can mentally add two or more numbers to determine conformance with the manufacturer's specifications.

MA034 Computes Addition Whole Numbers

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- The technician can add whole numbers to accurately determine measurement conformance with the manufacturer's specifications.

MA039 Computes Division Decimals
- The technician can divide decimals to determine measurement conformance with the manufacturer's specifications.

MA047 Computes Division Whole Numbers
- The technician can divide whole numbers to determine differences for comparison with the manufacturer's specifications.

MA065 Computes Multiplication Decimals
- The technician can multiply numbers that include decimals to determine conformance with the manufacturer's specifications.

MA067 Computes Multiplication Mentally
- The technician can mentally multiply numbers that include decimals to determine conformance with the manufacturer's specifications.

MA073 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.

MA084 Computes Subtraction Decimals
- The technician can subtract numbers that include decimals to determine conformance with the manufacturer's specifications.

MA086 Computes Subtraction Mentally

MA092 Computes Subtraction Whole Numbers
- The technician can subtract whole numbers to determine differences for comparison with the manufacturer's specifications.

MA126 Converts Units English/Metric -- Feet/Meters, e.g.
- The technician can measure/test with tools designed for English or metric measurements and then convert the resulting measurement to the system used by the manufacturers for specifying the correct measurement or tolerance.

MA128 Distinguishes Angles/Circles/Arcs
- The technician must be highly skilled in determining if certain angles, circles, or arcs have the proper shape and relationship after an impact has distorted or misaligned them.

MA129 Distinguishes Congruence/Similarity Geometric Figures
- The technician can distinguish whether or not the angle between related parts (e.g. body or suspension components) is within the manufacturer's specifications.

MA131 Distinguishes Equal/Not Equal
- The technician can distinguish when a measurement or tolerance is not equal to the manufacturer's specification.

MA132 Distinguishes Estimate/Exact Value
- The technician can distinguish the need to use an exact value versus an estimated value, depending upon the structural damage and integrity of the system.

MA140 Estimates/Rounds Expected Outcomes Everyday Occurrences
- The technician estimates the anticipated performance outcome of a normally operating system as well as the expected outcome of everyday occurrences such as the result of a body parameter being out of conformance with the manufacturer's specifications.

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MA146 Estimates/Rounds Numbers Add/Subtract/Divide/Multiply
- The technician can estimate the results of basic arithmetic operations, and can accurately round up or down depending on the appropriate rule for the situation.

MA153 Formulates/Verifies Angles
- The technician can visually formulate an angle (e.g. suspension system, chassis, or body component alignment) and verify its conformance to the manufacturer's specified angle as well as the angle of the spray pattern or spray equipment.

MA161 Identifies English Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and any other appropriate measurements in the English system.

MA168 Identifies Lines Parallel/Perpendicular
- The technician can use measurement devices to determine the parallelism or perpendicularity of chassis, suspension, and other vehicle dimension requiring geometric alignment principles.

MA170 Identifies Lines Vertical/Horizontal
- The technician must be very skilled in determining if the lines of an automobile are vertical or horizontal as specified in the original design specifications.

MA171 Identifies Metric Measures Length/Volume/Weight
- The technician can determine the degree of conformance to the manufacturer's specifications for length, volume and other appropriate measurements using the metric system.

MA174 Interprets Charts/Tables/Graphs
- The technician can interpret charts, tables, or graphs to determine the manufacturer's specifications for a given system.

MA176 Interprets Symbols <, >, =, e.g.
- The technician interprets symbols to determine compliance with the manufacturer's specifications.

MA177 Interprets System of Numbers Place Value
- The technician is able to interpret place value (tenths, hundredths, and thousandths) when conducting precision measurements.

MA180 Measures Direct Angles
- The technician can use angle measurement equipment and techniques to determine any vehicle angle measurement variance from the manufacturer's specifications.

MA181 Measures Direct Distance
- The technician can measure distance using a variety of devices to determine conformance to the manufacturer's tolerances and specifications.

MA182 Measures Direct Temperature
- The technician can use appropriate temperature measurement tools to determine the existing temperature of ambient air and that of paints and inhibitors.

MA186 Measures Indirect
- The technician can use various forms of indirect measurement to determine if components are in conformance with manufacturer's specifications.

MA190 Measures Metric Distance

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- The technician can use metric measurement instruments to determine correct sizes or distances in the metric system.

MA229- Solves problems. Generates conclusions. Demonstrates deductive reasoning.
MA244 Understands Geometric Figures Visual Perception
- The technician can visually perceive the geometric relationships of systems and sub-systems requiring alignment or verification.

MA245 Understands Line/Angle Relationships
- The technician understands the necessity of verifying that the relationship of parallel lines and angles concur with the manufacturer's specifications when diagnosing the alignment of a body component, chassis, or steering and suspension system.

MA275 Identifies Temperatures Fahrenheit/Centigrade
-The technician can identify whether a temperature measurement should be made using a Fahrenheit or Centigrade measuring device.

MA271- Determines proper operation.
MA273- Computes tolerances/ranges mentally.
MA274- Computes proper operations mentally
LA038 Collects/Organizes Information-Oral/Written
- The technician collects and organizes oral and written information based on discussions, notes, observations, personal experiences, and data collection that will assist in the problem analysis and solution process.

LA069 Composes/Edits Notes
- The technician makes notes regarding symptoms, possible causes of problems, and other data that will aid in the diagnosis and problem solving process.

LA278 Uses Text Resources
- The technician uses text resources such as glossaries of terms, service manual indexes, database menus, and tables of contents to gather data for diagnosis and repair.

LA283 Uses Media Resources Databases
- The technician uses computerized and other databases to obtain system information.

LA285 Comprehends Information-Written Operator's Manual
- The technician can comprehend

ACCT-SDR1-2 Unibody Inspection, Measurement, and Repair:

Students will be able to analyze structural Unibody damage relative to factory specifications, determine and undertake the proper procedures to restore damaged areas to the correct specifications. Students will recognize the difference between Frame and Unibody vehicles and understand that each type require different repair procedures.

a. Analyze and identify misaligned or damaged steering, suspension, and powertrain components that can cause vibration, steering, and chassis alignment problems.

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b. Realign or replace misaligned or damaged steering, suspension, and powertrain components that can cause vibration, steering and chassis alignment problems.
c. Diagnose and measure unibody damage using tram and self-centering gauges.
d. Determine and inspect the locations of all suspension, steering, and powertrain component attaching points on the vehicle.
e. Diagnose and measure unibody vehicles using a dedicated (fixture) measuring system.
f. Diagnose and measure unibody vehicles using a universal measuring system (Mechanical, electronic, and laser).
g. Determine the extent of the direct and indirect damage and the direction of impact; plan and document the methods and sequence of repair.
h. Attach anchoring devices to vehicle; remove or reposition components as necessary.
i. Straighten and align cowl assembly.
j. Identify heat limitations in unibody vehicles.
k. Identify proper cold stress relief methods.
l. Repair damage using power tools and hand tools to restore proper contours and dimensions.
m. Remove and replace damaged sections of structural steel body panels.
n. Restore corrosion protection to repaired or replaced unibody structural areas.
o. Determine the extent of damage to aluminum structural components; repair, weld, or replace.
p. Analyze and identify crush/collapse zones

Academic Standard(s):

SCSH2- Students will use standard safety practices for all classroom, laboratory and field investigations.
c. Follow correct protocol for identifying and reporting safety problems and violations.

SCSH3- Students will identify and investigate problems scientifically.
a. Suggest reasonable hypotheses for identified problems.
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f. Evaluate whether conclusions are reasonable by reviewing the process and checking against other available information.

SPS8. Students will determine relationships among force, mass, and motion.
a. Calculate velocity and acceleration.
b. Apply Newton's three laws to everyday situations by explaining the following:
- Inertia
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c. Relate falling objects to gravitational force
d. Explain the difference in mass and weight.
e. Calculate amounts of work and mechanical advantage using simple machines.

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e. Build new mathematical knowledge through problem solving.
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- The technician can use appropriate temperature measurement tools to determine the existing temperature of ambient air and that of paints and inhibitors.

MA186 Measures Indirect

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- The technician can use various forms of indirect measurement to determine if components are in conformance with manufacturer's specifications.

MA190 Measures Metric Distance
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MA229- Solves problems. Generates conclusions. Demonstrates deductive reasoning.
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- The technician uses text resources such as glossaries of terms, service manual indexes, database menus, and tables of contents to gather data for diagnosis and repair.

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- The technician uses computerized and other databases to obtain system information.

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- The technician can comprehend

Reading Across the Curriculum

Reading Standard Comment
After the elementary years, students engage in reading for learning. This process sweeps across all disciplinary domains, extending even to the area of personal they experience text in all genres and modes of discourse. In the study of various disciplines of learning (language arts, mathematics, science, social studies), students must learn

through reading the communities of discourse of each of those disciplines. Each subject has its own specific vocabulary, and for students to excel in all subjects, they must learn the specific vocabulary of those subject areas in context.

Beginning with the middle grades years, students begin to self-select reading materials based on personal interests established through classroom learning. Students become curious about science, mathematics, history, and literature as they form contexts for those subjects related to their personal and classroom experiences. As students explore academic areas through reading, they develop favorite subjects and become confident in their verbal discourse about those subjects.

Reading across curriculum content develops both academic and personal interests in students. As students read, they develop both content and contextual vocabulary. They also build good habits for reading, researching, and learning. The Reading Across the Curriculum standard focuses on the academic and personal skills students acquire as they read in all areas of learning.

Students will enhance reading in all curriculum areas by:

a. Reading in all curriculum areas
   - Read a minimum of 25 grade-level appropriate books per year from a variety of subject disciplines and participate in discussions related to curricular learning in all areas.
   - Read both informational and fictional texts in a variety of genres and modes of discourse.
   - Read technical texts related to various subject areas.

b. Discussing books
   - Discuss messages and themes from books in all subject areas.
   - Respond to a variety of texts in multiple modes of discourse.
   - Relate messages and themes from one subject area to messages and themes in another area.
   - Evaluate the merit of texts in every subject discipline.
   - Examine author's purpose in writing.
   - Recognize the features of disciplinary texts.

c. Building vocabulary knowledge
   - Demonstrate an understanding of contextual vocabulary in various subjects.
   - Use content vocabulary in writing and speaking.
   - Explore understanding of new words found in subject area texts.

d. Establishing context
   - Explore life experiences related to subject area content.
   - Discuss in both writing and speaking how certain words are subject area related.
   - Determine strategies for finding content and contextual meaning for unknown words.

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CTAE Foundation Skills

The Foundation Skills for Career, Technical and Agricultural Education (CTAE) are critical competencies that students pursuing any career pathway should exhibit to be successful. As core standards for all career pathways in all program concentrations, these skills link career, technical and agricultural education to the state's academic performance standards.

The CTAE Foundation Skills are aligned to the foundation of the U. S. Department of Education's 16 Career Clusters. Endorsed by the National Career Technical Education Foundation (NCTEF) and the National Association of State Directors of Career Technical Education Consortium (NASDCTEc), the foundation skills were developed from an analysis of all pathways in the sixteen occupational areas. These standards were identified and validated by a national advisory group of employers, secondary and postsecondary educators, labor associations, and other stakeholders. The Knowledge and Skills provide learners a broad foundation for managing lifelong learning and career transitions in a rapidly changing economy.

CTAE-FS-1 Technical Skills: Learners achieve technical content skills necessary to pursue the full range of careers for all pathways in the program concentration.

CTAE-FS-2 Academic Foundations: Learners achieve state academic standards at or above grade level.

CTAE-FS-3 Communications: Learners use various communication skills in expressing and interpreting information.

CTAE-FS-4 Problem Solving and Critical Thinking: Learners define and solve problems, and use problem-solving and improvement methods and tools.

CTAE-FS-5 Information Technology Applications: Learners use multiple information technology devices to access, organize, process, transmit, and communicate information.

CTAE-FS-6 Systems: Learners understand a variety of organizational structures and functions.

CTAE-FS-7 Safety, Health and Environment: Learners employ safety, health and environmental management systems in corporations and comprehend their importance to organizational performance and regulatory compliance.

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CTAE-FS-8 Leadership and Teamwork: Learners apply leadership and teamwork skills in collaborating with others to accomplish organizational goals and objectives.

CTAE-FS-9 Ethics and Legal Responsibilities: Learners commit to work ethics, behavior, and legal responsibilities in the workplace.

CTAE-FS-10 Career Development: Learners plan and manage academic-career plans and employment relations.

CTAE-FS-11 Entrepreneurship: Learners demonstrate understanding of concepts, processes, and behaviors associated with successful entrepreneurial performance.