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***CTE Standards Unpacking***
***Brakes/Manual Drivetrain & Axles***

**Course:** Brakes/Manual Drivetrain & Axles
**Course Description:** Students in this course will learn theory and operation as well as diagnosis and repair of brake systems and manual drive trains. Completion of this course will aid students as they continue their education at the post-secondary level or in the workforce and in the preparation for their ASE certification test. (The examples are NATEF (National Automobile Technician Education Foundation) tasks that the student may complete for ASE (Automotive Service Excellence) certification.)
**Career Cluster:** Transportation, Distribution & Logistics
**Prerequisites:** Introduction to Vehicle Systems and Maintenance or Maintenance and Light Repair - Recommended
**Program of Study Application:** Brakes/Manual Drivetrain & Axles is an advanced pathway course in the transportation, distribution and logistics career cluster, automotive technology pathway.

<table>
<tr><td colspan="3">INDICATOR #AB 1: Students will demonstrate automotive technology safety practices, including Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) requirements, for an automotive repair facility.</td></tr>
<tr><td colspan="3">SUB-INDICATOR 1.1 (Webb Level: 2 Skill/Concept): Demonstrate automotive technician safety practices.</td></tr>
<tr><td>Knowledge (Factual):<br>-Shop and personal safety requirements<br><br>-The proper use of hand and power tools<br><br>-The proper use of Safety Data Sheet (SDS)<br><br>-Basic shop safety using OSHA standards.<br><br>-Dangers that exist in the auto shop environment</td><td>Understand (Conceptual):<br>-Need for shop safety rules<br><br>-Need for proper use of personal safety equipment</td><td>Do (Application):<br>-Use protective clothing and safety equipment according to OSHA and EPA requirements.<br><br>-Maintain a portfolio of successfully completed safety and equipment exams</td></tr>
<tr><td colspan="3">Benchmarks:<br>Students will be assessed on their ability to:<ul><li>Successfully pass safety test.</li><li>Locate and explain proper usage of all shop safety equipment.</li></ul></td></tr>
</table>

| *Academic Connections* | |
|---|---|
| **ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):**<br><br>W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. | **Sample Performance Task Aligned to the Academic Standard(s):**<br><br>Students will write a paragraph that explains the consequences of not following safety guidelines in the work place. |

| ***INDICATOR #AB 2:*** **Students will demonstrate knowledge of brake system theory and procedure.** | | |
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| ***SUB-INDICATOR 2.1 (Webb Level: 2 Skill/Concept):*** Analyze and diagnose automotive brake hydraulic and friction systems. | | |
| **Knowledge (Factual):**<br>-Brake system operations<br><br>-Identify brake system components and configuration. | **Understand (Conceptual):**<br>-The procedure for performing a road test to check brake system operation including an anti-lock brake system (ABS).<br><br>-The vehicle service information including fluid type, vehicle service history, service precautions, and technical service bulletins. | **Do (Application):**<br>-Diagnose and interpret brake system concerns; determine needed action. |
| **Benchmarks:**<br>*Students will be assessed on their ability to:*<br>• Diagnose and make needed repairs to brake system. | | |

| *Academic Connections* | |
|---|---|
| **ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):**<br>SL4. Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task. | **Sample Performance Task Aligned to the Academic Standard(s):**<br><br>Students will explain how to diagnose needed repairs to a brake system. |

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| A-REI 3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. | Students will calculate the amount of wear of brake pads and amount of time they can last |

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| ***INDICATOR #AB 3:*** **Students will demonstrate knowledge and procedure of the hydraulic brake system.** | | |
| ***SUB-INDICATOR 3.1 (Webb Level: 3 Strategic Thinking):*** Analyze and draw conclusions concerning malfunctions of brake hydraulic systems. | | |
| ***SUB-INDICATOR 3.2 (Webb Level: 2 Skill/Concept):*** Apply repair skills to correct malfunctions of brake hydraulic systems. | | |
| **Knowledge (Factual):**<br>-Brake hydraulic systems<br><br>-Brake warning light electronic system<br><br>-Brake lines, hoses, fittings, and supports.<br><br>-Master cylinder for internal/external leaks and proper operation.<br><br>-Brake lines using proper material and flaring procedures.<br><br>-Bleed and/or flush brake system. | **Understand (Conceptual):**<br>-Proper brake system operation | **Do (Application):**<br>-Diagnose pressure concerns in the brake system using hydraulic principles (Pascal's Law)<br><br>-Remove, bench bleed, and reinstall master cylinder.<br><br>-Inspect, test, and/or replace components of brake warning light system.<br><br>-Test brake fluid for contamination.<br><br>-Measure brake pedal height, travel, and free play (as applicable); determine needed action.<br><br>-Select, handle, store, and fill brake fluids to proper level; use proper fluid type per manufacturer specification. |

**Benchmarks:**
*Students will be assessed on their ability to:*

- Perform maintenance and repair on brake hydraulics system.
- Diagnose and repair brake warning light system.

| ***Academic Connections*** | |
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| **ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):** | **Sample Performance Task Aligned to the Academic Standard(s):** |
| SL1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led). | Students will discuss how to diagnose brake warning lights |
| A-CED4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations | Students will calculate ideal brake pedal height |

***INDICATOR #AB 4:*** **Students will demonstrate knowledge of theory and repair procedures for drum brake systems.**

***SUB-INDICATOR 4.3 (Webb Level: 3 Strategic Thinking):*** Assess and evaluate operation of drum brake systems.

***SUB-INDICATOR 4.2 (Webb Level: 2 Skill/Concept):*** Repair drum brake systems.

| **Knowledge (Factual):** | **Understand (Conceptual):** | **Do (Application):** |
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| -Drum Brake System<br><br>-Brake drum; measure brake drum diameter; determine serviceability.<br><br>-Wheel cylinders for leaks and proper operation. | -Brakes stop the vehicle | -Refinish brake drum and measure final drum diameter; compare with manufacturer's specification.<br><br>-Pre-adjust brake shoes and parking brake; install brake drums or drum/hub assemblies and wheel bearings; perform final checks and adjustments. |

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| | | -Diagnose poor stopping, noise, vibration, pulling, grabbing, dragging or pedal pulsation concerns; determine needed action. |

**Benchmarks:**
*Students will be assessed on their ability to:*

- Perform repair and maintenance on brake drum, brake shoes and drum brake system.

***Academic Connections***

| **ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):** | **Sample Performance Task Aligned to the Academic Standard(s):** |
|---|---|
| SL1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led).<br><br>A-CED 1. Create equations and inequalities in one variable and use them to solve problems. | Students will role play customer and technician do discuss issues with brake system<br><br>Students can calculate the desired thickness for refinished brake drum |

***INDICATOR #AB 5:*** **Students will demonstrate knowledge of theory and repair procedures for disc brake systems.**

***SUB-INDICATOR 5.1 (Webb Level: 3 Strategic Thinking):*** Assess and evaluate operation of disc brake systems.

***SUB-INDICATOR 5.2 (Webb Level: 2 Skill/Concept):*** Repair disc brake systems.

| **Knowledge (Factual):** | **Understand (Conceptual):** | **Do (Application):** |
|---|---|---|
| -Disc brake systems<br><br>- Caliper, brake pads, and related hardware; seat brake pads. | -The importance of operating vehicle to burnish/break-in replacement brake pads according to manufacturer's recommendations. | -Remove, inspect, and/or replace brake pads and retaining hardware; determine needed action.<br><br>-Remove and reinstall/replace rotor. |

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| -Rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine needed action<br><br>-Brake pad wear indicator; determine needed action. | | -Refinish rotor on vehicle; measure final rotor thickness and compare with specification.<br><br>-Refinish rotor off vehicle; measure final rotor thickness and compare with specification.<br><br>-Retract and re-adjust caliper piston on an integrated parking brake system.<br><br>-Remove and clean caliper assembly; inspect for leaks, damage, and wear; determine needed action. |

**Benchmarks:**
*Students will be assessed on their ability to:*

- Perform repair and maintenance on rotors, calipers and brake pads on a disc brake system

***Academic Connections***

| **ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):** | **Sample Performance Task Aligned to the Academic Standard(s):** |
|---|---|
| W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience | Students create a powerpoint that compares and contrasts the different types of brake systems |

| ***INDICATOR #AB 6:*** **Students will demonstrate knowledge of theory and repair procedures for power assist units.** | | |
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| ***SUB-INDICATOR 6.1 (Webb Level: 2 Skill/Concept):*** Analyze power-assist units. | | |
| **Knowledge (Factual):**<br>-vacuum brake power assist<br><br>-hydraulic brake power assist | **Understand (Conceptual):**<br>-proper function of power assist system | **Do (Application):**<br>-Check brake pedal travel with and without engine running to verify proper power booster operation.<br><br>-check vacuum supply to vacuum-type power booster |
| **Benchmarks:**<br>*Students will be assessed on their ability to:*<br>• Diagnose and repair brake power assist system. | | |
| ***Academic Connections*** | | |
| **ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):**<br><br>SL1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led). | **Sample Performance Task Aligned to the Academic Standard(s):**<br><br>Students will explain the purpose of checking brake pedal travel with and without engine running. | |

| ***INDICATOR #AB 7:*** **Students will demonstrate knowledge of theory and repair procedures for related systems – Wheel Bearings, Parking Brakes, Electrical** | | |
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| ***SUB-INDICATOR 7.1 (Webb Level: 2 Skill/Concept):*** Diagnose related systems (i.e., wheel bearings, parking brakes, electrical). | | |
| ***SUB-INDICATOR 7.2 (Webb Level: 2 Skill/Concept):*** Repair related systems | | |
| **Knowledge (Factual):**<br>-Wheel bearings<br><br>-Parking brake system | **Understand (Conceptual):**<br>-Proper operation of systems. | **Do (Application):**<br>-Check parking brake system components for wear, binding, and corrosion; clean, |

| | | |
|---|---|---|
| -Brake electrical system | | lubricate, adjust and/or replace as needed.<br><br>-Check operation of brake stop light system.<br><br>-Inspect and replace wheel studs.<br><br>-Remove, reinstall, and/or replace sealed wheel bearing assembly.<br><br>-Remove, clean, inspect, repack, and install wheel bearings; replace seals; install hub and adjust bearings. |

**Benchmarks:**
*Students will be assessed on their ability to:*

- Perform maintenance, repair and diagnose wheel bearings, parking brake and brake electrical system

***Academic Connections***

| **ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):** | **Sample Performance Task Aligned to the Academic Standard(s):** |
|---|---|
| G-MG 2. Apply concepts of density based on area and volume in modeling situations | Students will calculate the percentage of wear on brake pads |
| SL1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led). | Students will discuss the process of diagnosing wheel noise |

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| ***INDICATOR #AB 8:*** **Students will demonstrate knowledge of theory and repair procedures for related systems – Antilock Brake Systems (ABS), Traction Control Systems (TCS), Electronic Stability Control (ESC).** | | |
| ***SUB-INDICATOR 8.1 (Webb Level: 2 Skill/Concept):*** Diagnose Electronic Brake Control Systems: ABS, TCS and ESC Systems | | |
| **Knowledge (Factual):**<br>-Antilock Brake System (ABS)<br><br>-Traction Control Systems (TCS)<br><br>-Electronic Stability Control (ESC)<br><br>-Repair procedures related to individual systems. | **Understand (Conceptual):**<br>-Relationship between repair procedures and automotive safety | **Do (Application):**<br>-Identify and inspect electronic brake control system components (ABS, TCS, ESC); determine needed action.<br><br>-Describe the operation of a regenerative braking system. |

**Benchmarks:**
*Students will be assessed on their ability to:*

- Diagnose and repair electronic brake control systems.

***Academic Connections***

| **ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):** | **Sample Performance Task Aligned to the Academic Standard(s):** |
|---|---|
| W4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. | Students will create a blog about inspecting brake control components |
| HS-PS2-5 Plan and carry out an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current | Students will analyze the electronics of the brake system |

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| ***INDICATOR #AB 9:*** **Students will demonstrate knowledge of theory and repair procedures for manual drive train and axles.** | | |
| ***SUB-INDICATOR 9.1 (Webb Level: 1 Recall):*** Identify manual transmission information | | |
| ***SUB-INDICATOR 9.2 (Webb Level: 2 Skill/Concept):*** Perform general maintenance procedures | | |
| **Knowledge (Factual):**<br>-Manual transmissions/transaxles operation | **Understand (Conceptual):**<br>-Relationship between maintenance and repair of major components. | **Do (Application):**<br>-Research vehicle service information including fluid type, vehicle service history, service precautions, and technical service bulletins.<br><br>-Check fluid condition; check for leaks.<br><br>-Drain and refill manual transmission/transaxle and final drive unit; use proper fluid type per manufacturer's specification |

**Benchmarks:**
*Students will be assessed on their ability to:*

- Perform maintenance, service and repair on manual transmission/transaxle

***Academic Connections***

| **ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):** | **Sample Performance Task Aligned to the Academic Standard(s):** |
|---|---|
| SL1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) | Students will explain the importance of vehicle service history to determine current maintenance |

| ***INDICATOR #AB 10:*** **Students will perform maintenance procedures for hydraulic clutches.** | | |
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| ***SUB-INDICATOR 10.1 (Webb Level: 2 Skill/Concept):*** Check clutch hydraulic system. | | |
| **Knowledge (Factual):**<br>-Clutch hydraulic system operation | **Understand (Conceptual):**<br>-Maintenance and adjustments ensures proper clutch operation | **Do (Application):**<br>-Check and adjust clutch master cylinder fluid level; use proper fluid type per manufacturer specification.<br><br>-Check for hydraulic system leaks. |
| **Benchmarks:**<br>*Students will be assessed on their ability to:*<br>• Perform clutch hydraulic maintenance and repair. | | |
| ***Academic Connections*** | | |
| **ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):**<br><br>SL1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led)<br><br>A-CED4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations | **Sample Performance Task Aligned to the Academic Standard(s):**<br><br>Students will explain the how to check hydraulic leaks<br><br>Students will calculate the hydraulic system pressure | |

| ***INDICATOR #AB 11:*** **Students will define the operation of electronic manual transmission/transaxle.** |
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| ***SUB-INDICATOR 11.1 (Webb Level: 1 Recall):*** Research Manual Transmission/Transaxle. |

| **Knowledge (Factual):** -Manual transmission/transaxle electronics. | **Understand (Conceptual):** -Component identification related to the function of transmission/transaxle. | **Do (Application):** -Describe the operational characteristics of an electronically-controlled manual transmission/transaxle. |
|---|---|---|
| **Benchmarks:** *Students will be assessed on their ability to:* • Identify components and operation of the transmission/transaxle. | | |
| ***Academic Connections*** | | |
| **ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):** SL1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) | **Sample Performance Task Aligned to the Academic Standard(s):** Students will discuss the advantages of an automatic transmission versus a manual transmission | |

| ***INDICATOR #AB 12:*** **Students will inspect, diagnose, and perform repair procedures for drive train components.** | | |
|---|---|---|
| ***SUB-INDICATOR 12.1 (Webb Level: 2 Skill/Concept):*** Inspect, diagnose, and repair drive shaft, half shafts, universal joints and constant-velocity (CV) joints | | |
| **Knowledge (Factual):** -Diagnostics of driveshafts, universal joints and cv joints | **Understand (Conceptual):** -Provide safe vehicle operation | **Do (Application):** -Inspect, remove, and/or replace bearings, hubs, and seals.<br><br>-Inspect, service, and/or replace shafts, yokes, boots, and universal/CV joints.<br><br>-Inspect locking hubs. |

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| | | -Service drive assembly and transfer case seals; check vents; check fluid level; use proper fluid type per manufacturer specification. |

**Benchmarks:**
*Students will be assessed on their ability to:*

- Identify, repair and diagnose drivetrain components.

| ***Academic Connections*** | |
|---|---|
| **ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):**<br><br>W4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience. | **Sample Performance Task Aligned to the Academic Standard(s):**<br><br>Students will create a checklist of factors to look for possible damage to the drive assembly |

| ***INDICATOR #AB 13:*** **Students will inspect, diagnose, and perform repair procedures for the differential assembly.** | | |
|---|---|---|
| ***SUB-INDICATOR 13.1 (Webb Level: 2 Skill/Concept):*** Perform maintenance on differential case assembly | | |
| **Knowledge (Factual):**<br>-Differential components, repair procedures and maintenance. | **Understand (Conceptual):**<br>-Function of differential case assembly front and rear components. | **Do (Application):**<br>-Clean and inspect differential case; check for leaks; inspect housing vent.<br><br>-Check and adjust differential case fluid level; use proper fluid type per manufacturer's specification.<br><br>-Drain and refill differential housing.<br>-Inspect and replace drive axle wheel studs. |

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**Benchmarks:**
*Students will be assessed on their ability to:*

- Identify and service components in differential case assembly.

| ***Academic Connections*** | |
|---|---|
| **ELA Literacy and/or Math Standard (if applicable, Science and/or Social Studies Standard):** | **Sample Performance Task Aligned to the Academic Standard(s):** |
| SL1. Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) | Students will describe how to replace drive axle wheel studs |
| A-CED1. Create equations and inequalities in one variable and use them to solve problems. | Students will create formulas to model proper case fluid levels in various vehicles |

**Additional Resources**
Please list any resources (e.g., websites, teaching guides, etc.) that would help teachers as they plan to teach these new standards.