

Automotive Technology/Ground Transportation CTAG Alignments

This document contains information about two Career-Technical Articulation Numbers (CTANs) for the Ground Transportation Career-Technical Assurance Guide (CTAG). The CTANs are:

1. Introduction to Automotive Service and Repair
2. Introduction to Medium and Heavy Transportation Equipment Technology

1. Introduction to Automotive Service and Repair: CTAN alignment with the Tech Prep Ground Transportation Automotive Technician Pathway in the Career Field Technical Content Standards of the Ohio Department of Education.

Course Description: This course introduces students to the automotive service and repair industry. It also includes basic tool usage and shop safety information. The students will learn to effectively perform basic automotive preventive maintenance as well.

Outcomes marked with an asterisk(*) are essential and must be taught.

Learning Outcomes	Outcomes and/or Competencies in ODE’s Revised Career Field Technical Content Standards
<p>The student will be able to:</p> <p>1. Demonstrate the ability to work safely in the automotive shop environment.*</p>	<p>2.1.1 Use Occupational Safety and Health Administration (OSHA)-defined procedures for identifying employer and employee responsibilities, situations that require working in confined spaces, and safety labeling.</p> <p>2.1.2 Identify and communicate hazards associated with slippery surfaces and lighting</p> <p>2.1.5 Identify the reason to use ground fault interrupter circuits (GFCIs), sources of electrical hazards, and established shutdown and lock-out/tag-out procedures.</p> <p>2.1.6 Identify and eliminate workplace clutter and maintain clearance and boundaries.</p> <p>2.1.7 Identify symptoms of exposure to health-threatening environments (e.g., temperature; chemical; biological; noise, vibrations, harshness [NVH] hazards)</p> <p>2.1.8 Identify procedures for handling, storage, and disposal of hazardous materials.</p> <p>2.1.9 Identify the locations of emergency flush showers, eyewash fountains, Material Safety Data Sheets (MSDSs) fire alarms and exits.</p>

	<p>2.1.10 Describe the interactions of incompatible substances when measuring and mixing chemicals.</p> <p>2.1.11 Select and operate fire extinguishers based on the classes of fires.</p> <p>2.1.12 Conduct safety inspection of workspace.</p> <p>2.1.13 Identify the types of ergonomic workflow and the need for them.</p> <p>2.1.14 Inspect air and exhaust systems, intake filters, fans and other mechanical components.</p> <p>2.2.1. Interpret personal safety rights according to the employee Right to Know plan.</p> <p>2.2.2. Describe the risk factors associated with working under the influence of drugs and alcohol and how it increases the risk of accident, lowers productivity, raises insurance costs, and reduces profits.</p> <p>2.2.3. Select, use, maintain, and dispose of Personal Protective Equipment (PPE) appropriate to job tasks, conditions, and materials.</p> <p>2.2.4. Identify workplace risk factors associated with repetitive motion, lifting, operating and moving heavy objects.</p> <p>2.2.5. Demonstrate appropriate body mechanics in lifting and moving heavy objects.</p>
<p>2. Identify and demonstrate proper use of hand tools and equipment commonly used in the automotive service and repair industry. *</p>	<p>2.3.1 Identify the types of hand tools, power tools and stationary equipment and describe their function.</p> <p>2.3.2 Identify potential hazards and limitations related to the use of hand tools, power tools and stationary equipment.</p> <p>2.3.3. Operate power tools and stationary equipment in accordance with established procedures and safety standards.</p>

	<p>2.3.4. Ensure the presence and functionality of safety systems and hardware.</p> <p>2.3.5. Clean, lubricate, and adjust power tools and stationary equipment.</p> <p>2.3.6. Identify, select, and maintain fluids and filters.</p> <p>2.3.7. Inspect and maintain fluid conveyance and storage components (e.g. hoses and lines, valves, nozzles).</p> <p>2.3.8. Identify the requirements for calibrating metering, monitoring, and sensing equipment.</p>
3. Students will be able to list common careers in the automotive service and repair industry.*	<p>1.1.2 Identify the scope of career opportunities and the requirements for education, training, certification, licensure, and experience.</p> <p>1.1.6 Explain the importance of work ethic, accountability, and responsibility and demonstrate associated behaviors in fulfilling personal, community, and workplace roles.</p>
4. Identify the skills necessary to work in the automotive industry.*	<p>1.1.1 Identify the knowledge, skills, and abilities necessary to succeed in careers.</p> <p>1.1.2. Identify the scope of career opportunities and the requirements for education, training, certification, licensure, and experience.</p> <p>1.1.6 Explain the importance of work ethic, accountability, and responsibility and demonstrate associated behaviors in fulfilling personal, community, and workplace roles.</p> <p>1.1.6 Explain the importance of work ethic, accountability, and responsibility and demonstrate associated behaviors in fulfilling personal, community, and workplace roles¹.</p>
5. Perform an oil change on a vehicle.*	<p>2.4.5 Perform engine oil and filter change</p> <p>2.4.20. Lubricate all suspension and chassis grease fittings.</p>
6. Perform a cooling system basic inspection,	3.1.5 Inspect engine assembly for fuel, oil, coolant and other leaks and determine

¹ 1.1.6 added after finalization.

flush and fill on a vehicle.*	<p>potential causes.</p> <p>3.5.4 Inspect, test, and replace radiator, pressure cap, coolant recovery tank and hoses.</p> <p>3.5.5 Inspect and replace engine cooling and heater system hoses.</p> <p>3.5.6 Inspect, test and replace thermostat and gasket.</p> <p>3.5.7 Test, drain, flush, and refill coolant and bleed cooling system.</p> <p>3.5.8 Inspect, remove, and replace water pump.</p> <p>3.5.9 Inspect and test mechanical and electrical fans, fan clutches, fan shrouds, and air dams.</p> <p>4.7.4 Inspect, adjust or replace alternator drive belts, pulleys and tensioners and check pulley and belt alignment</p>
7. Perform transmission and transaxle maintenance.*	2.4.10 Drain and replace drive train fluids and filters.
8. Demonstrate basic usage of a service manual and/or service information system.*	1.4.6 Use electronic database to access and create business and technical information.
9. Perform tire and wheel service*	<p>2.4.19 Inspect, repair to industry standards, and rotate tires and reset the tire pressure monitor system (TPMS).</p> <p>5.8.4 Balance wheel and tire assembly.</p> <p>5.8.5 Remove, inspect and reinstall tire and wheel assembly and calibrate tire pressure monitoring system.</p>
10. Perform brake system inspection*	<p>4.2.3 Remove, clean, inspect, and measure drums and rotors.</p> <p>4.2.6 Remove, clean, inspect, and lubricate brake shoes, retaining hardware, and</p>

	<p>adjustment hardware.</p> <p>4.2.7 Pre-adjust brake shoes, seat the pads, and adjust parking brake system.</p> <p>4.2.8 Lubricate drum and disc brake assembly components; reinstall and inspect for leaks.</p> <p>4.2.9 Check condition and operation of parking brake and clean, lubricate or replace as needed.</p>
11. Perform starting and charging system inspection and test	<p>2.4.15 Inspect and service battery and battery cables, connectors, clamps, and hold downs.</p> <p>4.5.2 Measure source voltage and perform voltage drop and current draw tests in electrical and electronic circuits.</p> <p>4.6.2 Test battery performance using state-of-charge and conductance tests and record test results.</p> <p>4.6.4 Maintain or restore electronic memory functions.</p> <p>4.6.5 Perform a battery charge.</p> <p>4.6.6 Start a vehicle using jumper cables and a battery or auxiliary power supply using manufacturer's jumping techniques and precautions.</p> <p>4.7.3 Perform charging system output tests to diagnose causes of undercharge, no charge and overcharge conditions.</p> <p>4.7.6 Identify the high voltage circuit of electric or hybrid electric vehicles and related safety precautions.</p>
12. Access onboard diagnostic system codes	<p>3.2.1 Retrieve and record stored on-board diagnostics (OBD) trouble codes and clear codes where applicable.</p>

2. Introduction to Medium and Heavy Transportation Equipment Technology

CTAN alignment with the Tech Prep Ground Transportation Medium Duty / Heavy Duty Truck Pathway in the Career Field Technical Content Standards of the Ohio Department of Education.

Course Description: This course introduces the student to information about the medium and heavy transportation service and repair industry. It also includes basic tool usage and shop safety information. The students will also learn how to effectively perform basic preventive maintenance to medium and heavy duty vehicles.

Outcomes marked with an asterisk(*) are essential and must be taught.

Learning Outcomes	
The student will be able to:	
1. Orientation to the Medium and Heavy Transportation Industry.*	<p>1.1.2 Identify the scope of career opportunities and the requirements for education, training, certification, licensure, and experience.</p> <p>1.2.3 Develop a career plan that reflects career interests, pathways, and secondary and postsecondary options.</p> <p>1.2.4 Describe the role and function of professional organizations, industry associations, and organized labor and use networking techniques to develop and maintain professional relationships.</p> <p>1.11.1 Identify the economic principles that guide geographic location of an industry's facilities (e.g., manufacturing, administration, supply chain).</p> <p>1.11.2 Identify the difference between monetary and nonmonetary incentives and explain how changes in incentives cause changes in behavior.</p> <p>1.11.3 Use economic indicators to measure economic trends and conditions (e.g., relative scarcity, price, quantity of products and services).</p>
2. Determine the skills needed to work in the medium and heavy transportation industry.*	<p>1.1.1 Identify the knowledge, skills, and abilities necessary to succeed in careers.</p> <p>1.1.2 Identify the scope of career opportunities and the requirements for education, training, certification, licensure, and experience.</p> <p>1.1.3 Develop a career plan that reflects career interests, pathways, and secondary and postsecondary options.</p> <p>1.1.4 Describe the role and function of professional organizations, industry</p>

	<p>associations, and organized labor and use networking techniques to develop and maintain professional relationships.</p> <p>1.1.5 Develop strategies for self-promotion in the hiring process (e.g., filling out job applications, résumé writing, interviewing skills, portfolio development).</p> <p>1.1.6 Explain the importance of work ethic, accountability, and responsibility and demonstrate associated behaviors in fulfilling personal, community, and workplace roles.</p> <p>1.1.7 Apply problem-solving and critical-thinking skills to work-related issues when making decisions and formulating solutions.</p>
3. Identify basic tools and equipment appropriate to the medium and heavy transportation industry.*	<p>2.3.1 Identify the types of hand tools, power tools and stationary equipment and describe their function.</p> <p>2.1.13 Identify the types of ergonomic workflow and the need for them.</p>
4. Demonstrate the appropriate use of basic hand tools to complete work functions.*	<p>2.3.2 Identify potential hazards and limitations related to the use of hand tools, power tools and stationary equipment.</p> <p>2.3.3 Operate power tools and stationary equipment in accordance with established procedures and safety standards.</p>
5. Operate power tools and stationary equipment.*	<p>2.3.1 Identify the types of hand tools, power tools and stationary equipment and describe their function.</p> <p>2.3.3 Operate power tools and stationary equipment in accordance with established procedures and safety standards.</p>
6. Maintain hand and power tools appropriate to the medium and heavy transportation industry. *	<p>2.3.4 Ensure the presence and functionality of safety systems and hardware.</p> <p>2.3.5 Clean, lubricate, and adjust power tools and stationary equipment.</p> <p>2.3.6 Identify, select, and maintain fluids and filters.</p> <p>2.3.6 Identify, select, and maintain fluids and filters.</p> <p>2.3.7 Inspect and maintain fluid conveyance and storage components (e.g. hoses and lines, valves, nozzles).</p> <p>2.3.8 Identify the requirements for calibrating metering, monitoring, and sensing equipment.</p>
7. Use appropriate personal protective	2.2.1 Interpret personal safety rights according to the employee Right to Know plan.

equipment (PPE) *	<p>2.2.2 Describe the risk factors associated with working under the influence of drugs and alcohol and how it increases the risk of accident, lowers productivity, raises insurance costs, and reduces profits.</p> <p>2.2.3 Select, use, maintain, and dispose of Personal Protective Equipment (PPE) appropriate to job tasks, conditions, and materials.</p> <p>2.2.4 Identify workplace risk factors associated with repetitive motion, lifting, operating and moving heavy objects.</p> <p>2.2.5 Demonstrate appropriate body mechanics in lifting and moving heavy objects.</p>
8. Perform basic mechanical skills. *	2.3.5 Clean, lubricate, and adjust power tools and stationary equipment.
9. Perform preventive powertrain system maintenance including: engine system, fuel system, air induction and exhaust system, cooling system, and lubrication system. *	<p>2.4.1 Inspect for leakage at seals, gaskets, and bushings.</p> <p>2.4.2 Inspect fluid levels and fluid conditions on all mechanical systems.</p> <p>2.4.3 Select engine, power train, power steering and brake system oils and coolants based on their characteristics and applications.</p> <p>2.4.4 Describe characteristics of engine fuels and fuel additives.</p> <p>2.4.5 Perform engine oil and filter change.</p> <p>2.4.6 Replace fuel filters.</p> <p>2.4.7 Flush and fill engine cooling system.</p> <p>2.4.8 Inspect, service, or replace air filters, filter housings, and intake duct work.</p> <p>2.4.9 Drain and replace drive train fluids and filters.</p> <p>2.4.10 Flush, fill and bleed power steering system and replace filters.</p> <p>2.4.11 Flush, fill and bleed brake system.</p> <p>2.4.12 Store mechanical systems fluids and waste products.</p>

	<p>2.4.13 Inspect and replace drive belts.</p> <p>2.4.14 Identify the sources of air conditioner (A/C) system odors.</p> <p>2.4.15 Inspect and service battery and battery cables, connectors, clamps and hold downs.</p> <p>2.4.16 Inspect interior and exterior lamps and sockets.</p> <p>3.4.1 Explain principles of exhaust intake and turbocharger design and operations.</p> <p>3.4.3 Check fuel for contaminants and quality.</p> <p>3.4.4 Inspect and test fuel pumps and pump control systems for pressure, regulation and volume.</p> <p>3.4.5 Inspect and test cold enrichment system and components.</p> <p>3.4.6 Inspect throttle body, air induction system, intake manifold and gaskets for vacuum leaks and/or unmeasured air</p> <p>3.4.7 Inspect and service governor systems.</p> <p>3.4.8 Explain fuel injection theory.</p> <p>3.4.9 Inspect and test fuel injectors.</p> <p>3.4.10 Inspect the integrity of the exhaust manifold, exhaust pipes, mufflers, catalytic converters, resonators, tail pipes, and heat shields.</p> <p>3.4.11 Perform exhaust system back-pressure test.</p> <p>3.4.12 Evaluate and repair exhaust gas recirculation and exhaust gas treatment systems.</p> <p>3.4.14 Identify the parts and functions of evaporative emissions controls systems.</p>
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	<p>3.5.1 Explain principles of engine lubrication and cooling.</p> <p>3.5.2 Perform lubrication, cooling system, and pressure and sensor tests.</p> <p>3.5.4 Inspect, test, and replace radiator, pressure cap, coolant recovery tank and hoses.</p> <p>3.5.5 Inspect and replace engine cooling and heater system hoses.</p> <p>3.5.6 Inspect, test and replace thermostat and gasket.</p> <p>3.5.7 Test, drain, flush, and refill coolant and bleed cooling system.</p> <p>3.5.8 Inspect, remove, and replace water pump.</p> <p>3.5.9 Inspect and test mechanical and electrical fans, fan clutches, fan shrouds, and air dams.</p> <p>4.3.9 Inspect and test system pressure controls (i.e. governor, unloader assembly valves, intake screens, filters, lines, hoses and fittings).</p> <p>5.1.4 Inspect, replace and align powertrain mounts.</p>
<p>10. Perform preventive instruments and controls maintenance. *</p>	<p>2.4.17 Verify operation of instrument panel gauges and warning/indicator lights and reset maintenance indicators.</p> <p>2.4.20 Lubricate all suspension and chassis grease fittings and body lubrication points.</p> <p>4.8.6 Inspect and test gauges and gauge sending units for causes of abnormal gauge readings.</p> <p>4.8.4 Identify and inspect brake light circuit switches, wiring, and connectors.</p> <p>4.8.2 Inspect, replace and aim headlights and bulbs</p> <p>4.8.3 Inspect and diagnose incorrect turn signal or hazard light operation.</p>

11. Perform preventive safety equipment maintenance. *	4.8.7 Identify incorrect horn operation.
12. Perform preventive hardware maintenance. *	4.8.8 Identify incorrect wiper and washer operation and replace. 4.8.9 Identify incorrect operation of motor-driven accessories. 4.8.10 Identify incorrect heated glass, mirror, or seat operation and repair.
13. Perform preventive heating, ventilation and air conditioning (HVAC) maintenance. *	4.9.1 Identify the major components of the HVAC system, their functions, and the overall operation of the system. 4.9.3 Identify air conditioning (A/C) system mufflers, hoses, lines, fittings, O-rings, seals, condenser, and service valves.
14. Perform preventive electrical system maintenance including: battery and starting systems, charging systems and lighting systems*	4.6.2 Test battery performance using state-of-charge and conductance tests and record test results. 4.6.3 Confirm proper battery capacity for vehicle application and perform battery capacity test. 4.6.4 Maintain or restore electronic memory functions . 4.6.5 Perform a battery charge . 4.6.6 Start a vehicle using jumper cables and a battery or auxiliary power supply using manufacturer's jumping techniques and precautions. 4.7.1 Differentiate between electrical and engine mechanical problems that cause a slow-crank or no-crank condition. 4.7.2 Inspect, test, and replace low and high current side components. 4.7.3 Perform charging system output tests to diagnose causes of undercharge, no-charge and overcharge conditions. 4.7.4 Inspect, adjust or replace alternator drive belts, pulleys and tensioners and check pulley and belt alignment

	<p>4.7.5 Remove, inspect and install alternator. Identify battery construction and principles of operation.</p> <p>4.8.1 Identify the cause of brighter than normal, intermittent, dim, or no light operation.</p> <p>4.8.2 Inspect, replace and aim headlights and bulbs</p> <p>4.8.3 Inspect and diagnose incorrect turn signal or hazard light operation.</p> <p>4.8.4 Identify and inspect brake light circuit switches, wiring, and connectors.</p> <p>4.8.5 Identify system voltage and safety precautions associated with high intensity discharge headlights</p>
<p>15. Perform preventive brake system maintenance including: air and hydraulic braking systems. *</p>	<p>4.1.1 Identify pressure concerns in the brake system using hydraulic principles (Pascal's Law).</p> <p>4.1.2 Identify poor stopping, pulling, or dragging concerns caused by malfunctions in the hydraulic system.</p> <p>4.1.3 Measure brake pedal height and test pedal free play.</p> <p>4.1.4 Check master cylinder for internal and external leaks and proper operations.</p> <p>4.1.5 Remove, bench bleed and reinstall master cylinder.</p> <p>4.1.6 Inspect brake lines for damage and wear.</p> <p>4.2.1 Diagnose poor stopping, noise, vibration, premature wear, pulling, grabbing, dragging or pedal pulsation concerns.</p> <p>4.2.2 Remove caliper assembly , clean, inspect for leaks, pad condition and damage and replace.</p> <p>4.2.3 Remove , clean, inspect, and measure drums and rotors.</p>

	<p>4.2.4 Refinish drums and rotors.</p> <p>4.2.5 Remove, inspect, and replace wheel cylinders.</p> <p>4.2.6 Remove, clean, inspect, and lubricate brake shoes, retaining hardware, and adjustment hardware.</p> <p>4.2.7 Pre-adjust brake shoes, seat the pads, and adjust parking brake system.</p> <p>4.2.8 Lubricate drum and disc brake assembly components; reinstall and inspect for leaks.</p> <p>4.2.9 Check condition and operation of parking brake and clean, lubricate or replace as needed.</p> <p>4.2.10 Check the operation of parking brake indicator light and brake stop light systems.</p> <p>4.3.1 Identify poor stopping, air leaks, premature wear, pulling, grabbing, or dragging problems caused by supply and service system malfunctions.</p> <p>4.3.2 Inspect and test tractor protection valve.</p> <p>4.3.3 Inspect and test emergency (spring) brake control and modulator valve(s), low pressure warning devices, wiring and connectors.</p> <p>4.3.4 Inspect and test air pressure gauges, lines, and fittings and replace as needed.</p> <p>4.3.5 Check air system buildup time.</p> <p>4.3.6 Drain air reservoir tanks and check for oil, water and foreign material.</p> <p>4.3.7 Inspect, adjust and align compressor drive belts, pulleys and tensioners.</p> <p>4.3.8 Inspect , repair, or replace compressor, air cleaner and air supply, oil supply</p>
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	<p>and coolant lines, fittings and mounting brackets.</p> <p>4.3.9 Inspect and test system pressure controls (i.e. governor, unloader assembly valves, intake screens, filters, lines, hoses and fittings).</p> <p>4.3.10 Inspect air system lines, hoses, fittings and couplings.</p> <p>4.3.11 Inspect and test air tank relief (safety) valves, one-way (single) check valves, two-way (double) check-valves, manual and automatic drain valves.</p> <p>4.3.12 Inspect and clean air drier systems, filters, valves, heaters, wiring and connectors.</p> <p>4.3.13 Inspect and test air pressure gauges, lines and fittings.</p>
<p>16. Perform preventive drive train maintenance. *</p>	<p>5.3.1 Identify clutch noise, binding, slippage, pulsation and chatter.</p> <p>5.3.2 Inspect clutch pedal linkage, cables, automatic adjuster mechanisms, brackets, bushings, pivots and springs.</p> <p>5.3.3 Inspect hydraulic clutch slave and master cylinders, lines, and hoses.</p> <p>5.3.5 Bleed clutch hydraulic system.</p> <p>5.3.7 Check and adjust clutch master cylinder levels and check for leaks</p> <p>5.2.1 Diagnose noise, hard shifting, jumping out of gear and fluid leakage concerns.</p> <p>5.4.2 Service and replace shaft, yokes, boots and joints.</p> <p>5.4.3 Replace drive axle seals, bearings and retainers.</p> <p>5.4.5 Inspect and replace drive axle housing cover plates, gaskets, sealants, vents, plugs and seals.</p>
<p>17. Perform preventive suspension and steering systems maintenance. *</p>	<p>5.4.1. Identify and inspect drive axle and differential assemblies for noise, vibration, and</p>

	<p>fluid leakage concerns.</p> <p>5.4.2. Service and replace shaft, yokes, boots, and joints.</p> <p>5.4.5. Inspect and replace drive axle housing cover plates, gaskets, sealants, vents, plugs, and seals.</p> <p>5.5.3 Inspect steering shaft universal joints and flexible couplings.</p> <p>5.6.10 Remove, inspect and install leaf springs, leaf spring insulators (silencers), shackles, brackets, bushings and mounts.</p> <p>5.6.11 Inspect, remove and replace shock absorbers.</p> <p>5.7.2 Replace front rear wheel bearings</p> <p>5.7.3. Identify vehicle wander, drift, pull, hard steering, bump steer, memory steer, torque steer, ride height, and steering return concerns</p> <p>5.7.4 Check and adjust wheel caster, camber and toe, and center steering wheel.</p> <p>5.8.2. Identify bearing noises and wheel vibration, shimmy, and noise.</p>
<p>18. Perform preventive tires and wheels maintenance. *</p>	<p>5.8.1 Identify tire wear patterns and tire construction.</p> <p>5.8.2 Identify bearing noises and wheel vibration, shimmy and noise.</p> <p>5.8.3 Measure wheel, tire, axle and hub run out.</p> <p>5.8.4 Balance wheel and tire assembly.</p> <p>5.8.5 Remove, inspect and reinstall tire and wheel assembly and calibrate tire pressure monitoring system.</p> <p>5.8.6 Inspect and replace wheel studs.</p>
<p>19. Perform preventive frame and fifth</p>	<p>2.4.20 Lubricate all suspension and chassis grease fittings and body lubrication points.</p>

wheel maintenance. *	2.4.21 Test, inspect, and service fifth wheel mounting bolts, air lines and locks.
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