



Medium/Heavy Truck

Study Guide

Assessments:

2151 Diesel Engine Repair Technician

2152 Preventative Maintenance Inspection
Technician

2153 Electrical/Electronic Systems Repair
Technician

2154 Brakes Technician

2156 Heating, Ventilation, and
Air Conditioning Repair
Technician

Aligned with the ASE/
NATEF standards



OKLAHOMA
CareerTech

CTTC CareerTech Testing Center

Overview

This study guide is designed to help students prepare for the Medium/Heavy Truck assessments. It not only includes information about the assessments, but also the skills standards upon which the assessments are based, resources that can be used to prepare for the assessments and test taking strategies.

Each of the four sections in this guide provides useful information for students preparing for the Medium/Heavy Truck assessments.

- CareerTech and Competency-Based Education: A Winning Combination
- Medium/Heavy Truck assessments
 - ▶ Assessment Information
 - ▶ Standards and Test Content
 - ▶ Sample Questions
 - ▶ Abbreviations, Symbols, and Acronyms
- Strategies for Test Taking Success
- Notes

These assessments are aligned with the 2023 National Institute for Automotive Service Excellence (ASE)/National Automotive Technicians Education Foundation (NATEF) standards and endorsed by the Oklahoma Automobile Dealers Association (OADA). The assessments measure a student's ability to apply knowledge of the skills necessary for success in the Medium/Heavy Truck sector.

The ASE Education Foundation task list was reviewed and updated in October 2022. A national committee was assembled in Sterling, Virginia to review the standards used in Medium/Heavy Truck accreditation programs. The committee consisted of individuals representing the major truck manufacturers, truck repair shop owners and technicians, truck instructors and trainers, and truck equipment and parts suppliers.

The committee reviewed the standards, task list, tools and equipment list, program hours, and instructor qualifications. The committee also had the most current National Institute for Automotive Service Excellence (ASE) truck task lists for reference purposes.

For more information about NATEF, go to www.natef.org.

The OADA (405-521-1295) is an association of new car and heavy-duty truck dealers in Oklahoma. Its primary purpose is to promote the common business interests of those engaged in the automotive industry.

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CareerTech and Competency-Based Education: A Winning Combination

Competency-based education uses learning outcomes that emphasize both the application and creation of knowledge and the mastery of skills critical for success. In a competency-based education system, students advance upon mastery of competencies, which are measurable, transferable outcomes that empower students.

Career and technology education uses industry professionals and certification standards to identify the knowledge and skills needed to master an occupation. This input provides the foundation for development of curriculum, assessments and other instructional materials needed to prepare students for wealth-generating occupations and produce comprehensively trained, highly skilled employees demanded by the work force.

Tools for Success

CareerTech education relies on three basic instructional components to deliver competency-based instruction: skills standards, curriculum materials, and competency assessments.

Skills standards provide the foundation for competency-based instruction and outline the knowledge and skills that must be mastered in order to perform related jobs within an industry. Skills standards are aligned with national skills standards and/or industry certification requirements; therefore, a student trained to the skills standards is equally employable in local, state and national job markets.

Curriculum materials and textbooks contain information and activities that teach students the knowledge and skills outlined in the skills standards. In addition to complementing classroom instruction, curriculum resources include supplemental activities that enhance learning by providing opportunities to apply knowledge and demonstrate skills.

Certification Assessments test the student over material outlined in the skills standards and taught using the curriculum materials and textbooks. When used with classroom performance evaluations, certification assessments provide a means of measuring occupational readiness.

Each of these components satisfies a unique purpose in competency-based education and reinforces the knowledge and skills students need to gain employment and succeed on the job.

Measuring Success

Evaluation is an important component of competency-based education. Pre-training assessments measure the student's existing knowledge prior to receiving instruction and ensure the student's training builds upon this knowledge base. Formative assessments administered throughout the training process provide a means of continuously monitoring the student's progress towards mastery.

Certification assessments provide a means of evaluating the student's mastery of knowledge and skills. Coaching reports communicate assessment scores to students and provide a breakdown of assessment results by standard area. The coaching report also shows how well the student has mastered skills needed to perform major job functions and identifies areas of job responsibility that may require additional instruction and/or training.

Medium/Heavy Duty Truck Assessment Information

What are the Medium/Heavy Duty Truck assessments?

The Diesel Engine Repair Technician, Preventative Maintenance Inspection Technician, Electrical/Electronic Systems Repair Technician, Brakes Technician, and Heating, Ventilation, and Air Conditioning Repair Technician assessments are end-of-program assessments for students in Medium/Heavy Duty Truck programs. The assessments provide an indication of student mastery of knowledge and concepts necessary for success in careers in this area.

How were the assessment developed?

The assessments were developed by the CareerTech Testing Center. The assessments and standards align with ASE/NATEF's standards and are endorsed by the Oklahoma Automobile Dealers Association. Items were developed and reviewed by a committee of subject matter experts.

The NATEF committee assigned a priority number, which determines the significance of each task for test development: P-1, P-2, or P-3 to all skills. These priority numbers pertain to requirements for instruction on tasks as follows:

P-1: 95% must be taught in the curriculum.

P-2: 80% must be taught in the curriculum.

P-3: 50% must be taught in the curriculum.

What does the assessment cover?

Specifically, the test includes multiple-choice test items over the following areas:

Diesel Engine Repair Technician (55 questions)

General Diesel Engine Diagnosis	8%
Cylinder Head and Valve Train Diagnosis and Repair	5%
Engine Block Diagnosis and Repair	8%
Lubrication Systems Diagnosis and Repair	8%
Cooling System Diagnosis and Repair	20%
Air Induction and Exhaust Systems Diagnosis and Repair	10%
Fuel System Diagnosis and Repair	13%
Engine Brakes Diagnosis and Repair	2%
Emission Controls Diagnosis and Repair	9%
Driveability and Electronic Engine Controls Diagnosis and Repair	17%

Preventative Maintenance Inspection Technician (55 questions)

Engine System	22%
Cab and Hood	16%
Electrical/Electronics	7%
Frame and Chassis	55%

Electrical/Electronic Systems Repair Technician (55 questions)

General Electrical Systems Diagnosis	25%
Battery System Diagnosis and Service	15%
Starting System Diagnosis and Repair	10%
Charging System Diagnosis and Repair	15%
Lighting Systems Diagnosis and Repair	13%
Instrument Cluster and Driver Information Systems Diagnosis and Repair	4%
Cab and Chassis Electrical Systems Diagnosis and Repair	5%
Electrified Vehicle High Voltage Safety	13%

Brakes Technician (55 questions)

General Brake Diagnosis and Repair	9%
Air Brakes: Air Supply and Service Systems Diagnosis and Repair	15%
Air Brakes: Mechanical/Foundation Brake System Diagnosis and Repair	16%
Air Brakes: Parking Brake System Diagnosis and Repair	10%
Hydraulic Brakes: Hydraulic System Diagnosis and Repair	15%
Hydraulic Brakes: Mechanical/Foundation Brake System Diagnosis and Repair	5%
Hydraulic Brakes: Parking Brake System Diagnosis and Repair	2%
Power Assist Systems Diagnosis and Repair	9%
Vehicle Dynamic Brake Systems (Air and Hydraulic): Antilock Brake System (ABS), Automatic Traction Control (ATC) System, and Electronic Stability Control (ESC) System, Automatic Emergency Braking (AEB) System Diagnosis and Repair	15%
Wheel Bearings Diagnosis and Repair	4%

Heating, Ventilation, and Air Conditioning Repair Technician (55 questions)

General HVAC System Diagnosis and Repair	31%
Refrigeration System Components Diagnosis and Repair	33%
Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair	13%
Operating Systems and Related Controls Diagnosis and Repair	13%
Refrigerant Recovery, Recycling, and Handling	10%

What are the benefits of using this assessment?

Students receive a certificate for each assessment that he/she passes. This certificate may be included in his/her portfolio and used to communicate the student's mastery of the subject matter to potential employers.

When should the assessment be taken?

The CareerTech Testing Center recommends that students take these assessments as soon as possible after receiving all standards-related instruction, rather than waiting until the end of the school year.

Are the assessments timed?

No. However, most students finish the assessment within one hour.

What resources can students use on these assessments?

Students are allowed to use calculators and scratch paper on CTTC assessments; however, these items must be provided by the testing proctor and returned to the proctor before the student's exam is submitted for

What accommodations can be made for students with Individualized Education Plans (IEPs)?

Accommodations are allowed for students with an Individualized Education Plan. Examples of allowable accommodations include:

- Extended time — This assessment is not timed; therefore, students may take as much time as needed to finish. The assessment must be completed in one testing session.
- Readers — A reader may be used to read the assessment to a student who has been identified as needing this accommodation.
- Enlarged text — Students needing this accommodation can activate this feature by clicking the  icon in the upper right corner of the screen.

What can students expect on Test Day?

All CTTC assessments are web-based and delivered exclusively by a proctor in the school's assessment center. The proctor **cannot** be an instructor or anyone who was involved with the student during instruction.

Assessments are delivered in a question-by-question format. When a question is presented, the student can select a response or leave the question unanswered and advance to the next question. Students may also flag questions to revisit before the test is scored. All questions must be answered before the test can be submitted for scoring.

After the assessment is scored, the student will receive a score report that shows the student's score on the assessment, but also how the student performed in each standard area.

Can students retake the test?

Students may retake the test unless their school or state testing policies prohibit retesting. Students who retest must wait at least three days between attempts.

Medium/Heavy Truck Skills Standards Instructional Ratings

**MEDIUM/HEAVY TRUCK
2151 DIESEL ENGINE REPAIR TECHNICIAN
SKILLS STANDARDS
TRUCK SERVICE TECHNOLOGY (TST) SKILLS**

For every task in Diesel Engine Repair Technician, the following safety task must be strictly enforced:
Comply with personal and environmental safety practices associated with eye/foot/hand/hearing protection, clothing, hand tools, power equipment, lifting practices, and ventilation. Handle, store, and dispose of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first tasks in Diesel Engines are to listen to and verify the operator’s concern, review past maintenance and repair documents, and determine necessary action.

The NATEF committee assigned a priority number, which determines the significance of each task for test development: P-1, P-2, or P-3 to all skills. These priority numbers pertain to requirements for instruction on tasks as follows:

P-1: 95% must be taught in the curriculum.

P-2: 80% must be taught in the curriculum.

P-3: 50% must be taught in the curriculum.

DUTY A: General Diesel Engine Diagnosis (4 questions)

CODE	TASK	P#
A.01	Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins.	P-1
A.02	Inspect level and condition of fuel, oil, diesel exhaust fluid (DEF), and coolant.	P-1
A.03	Inspect engine assembly for fuel, oil, coolant, air, and other leaks; determine needed action.	P-1
A.04	Identify system components, configurations, and types of the following: cylinder head(s), valve train, engine block, engine lubrication, engine cooling, air induction, exhaust, fuel, and engine braking.	P-1

DUTY B: Cylinder Head and Valve Train Diagnosis and Repair (3 questions)

CODE	TASK	P#
B.01	Inspect electronic wiring harness and brackets for wear, bending, cracks, and proper securement; determine needed action.	P-1
B.02	Inspect valve train components; determine needed action.	P-2
B.03	Adjust valve bridges (crossheads); adjust valve clearances and injector settings.	P-1

DUTY C: Engine Block Diagnosis and Repair (4 questions)

CODE	TASK	P#
C.01	Inspect crankshaft vibration damper; inspect engine mounts; determine needed action.	P-1
C.02	Remove, inspect, service, and install pans, covers, gaskets, seals, wear rings, and crankcase ventilation components.	P-1
C.03	Install and align flywheel housing; inspect flywheel housing(s) to transmission housing/engine mating surface(s); measure flywheel housing face and bore runout; determine needed action.	P-2
C.04	Inspect flywheel/flexplate (including ring gear) and mounting surfaces for cracks and wear; measure runout; determine needed action.	P-2

DUTY D: Lubrication Systems Diagnosis and Repair (4 questions)

CODE	TASK	P#
D.01	Test engine oil pressure; check operation of pressure sensor, gauge, and/or sending unit; test engine oil temperature and check operation of temperature sensor; determine needed action.	P-1
D.02	Check engine oil level, condition, and consumption; take engine oil sample; determine needed action	P-1
D.03	Determine proper lubricant; perform oil and filter service.	P-1
D.04	Inspect, clean, and test oil cooler and components.	P-2
D.05	Inspect turbocharger lubrication systems.	P-2

DUTY E: Cooling System Diagnosis and Repair (11 questions)

CODE	TASK	P#
E.01	Check engine coolant type, level, and condition; test coolant for freeze protection and additive package concentration.	P-1
E.02	Test coolant temperature; test operation of temperature and level sensors, gauge, and/or sending unit; determine needed action.	P-1
E.03	Inspect and reinstall/replace pulleys, tensioners and drive belts; adjust drive belts and check alignment.	P-1
E.04	Recover coolant; flush and refill with recommended coolant/additive package; bleed cooling system.	P-1
E.05	Inspect coolant conditioner/filter assembly for leaks; inspect valves, lines, and fittings; replace as needed.	P-1
E.06	Inspect water pump, hoses, and clamps; determine needed action.	P-1
E.07	Inspect and pressure test cooling system(s); pressure test cap, tank(s), and recovery systems; inspect radiator and mountings; determine needed action.	P-1
E.08	Inspect thermostatic cooling fan system (hydraulic, pneumatic, and electronic) and fan shroud; determine needed action.	P-1
E.09	Identify engine block heater(s).	P-2
E.10	Diagnose engine coolant consumption; determine needed action.	P-1
E.11	Inspect thermostat(s), by-passes, housing(s), and seals; replace as needed.	P-1

DUTY F: Air Induction and Exhaust Systems Diagnosis and Repair (6 questions)

CODE	TASK	P#
F.01	Inspect turbocharger(s), wastegate(s), and piping systems; determine needed action.	P-2
F.02	Check air induction system including: cooler assembly, piping, hoses, clamps, and mountings; replace air filter as needed; reset restriction indicator (if applicable).	P-1
F.03	Inspect intake manifold, gaskets, and connections; determine needed action.	P-1
F.04	Perform air intake system restriction and leakage tests; determine needed action.	P-1
F.05	Check exhaust back pressure.	P-3
F.06	Inspect variable ratio geometry turbocharger (VGT), controls, and actuators (pneumatic, hydraulic, and electronic).	P-2
F.07	Demonstrate knowledge of charge air cooler operation and testing.	P-1
F.08	Inspect and/or replace preheater/inlet air heater or glow plug system and controls.	P-3

DUTY G: Fuel System Diagnosis and Repair (7 questions)

CODE	TASK	P#
G.01	Check fuel level and condition; determine needed action.	P-1
G.02	Inspect fuel tanks, vents, caps, mounts, valves, screens, crossover system, hoses, lines, and fittings; determine needed action.	P-1
G.03	Inspect low pressure fuel system components (fuel pump, pump drives, screens, fuel/water separators/indicators, hoses, lines, filters, heaters, coolers, ECM cooling plates, check valves, pressure regulator valves, restrictive fittings, and mounting hardware); determine needed action.	P-1
G.04	Replace fuel filter; prime and bleed fuel system.	P-1
G.05	Inspect high pressure fuel system components (fuel pump, pump drives, hoses, injection lines, filters, hold-downs, fittings, seals, and mounting hardware).	P-1
G.06	Demonstrate knowledge and understanding of the different types of fuel systems.	P-1
G.07	Perform fuel supply and return system tests; determine needed action.	P-1

DUTY H: Engine Brakes Diagnosis and Repair (1 question)

CODE	TASK	P#
H.01	Demonstrate knowledge of engine compression and/or exhaust brake operation.	P-1
H.02	Inspect and adjust engine compression and/or exhaust brake systems; determine needed action.	P-3
H.03	Inspect, test, and adjust engine compression and/or exhaust brake control circuits, switches, and solenoids; determine needed action.	P-3

DUTY I: Emission Controls Diagnosis and Repair (5 questions)

CODE	TASK	P#
I.01	Inspect engine exhaust system, exhaust gas recirculation (EGR) system, and exhaust aftertreatment system for leaks, mounting, proper routing, and damaged or missing components; determine needed action.	P-1
I.02	Demonstrate knowledge of exhaust gas recirculation (EGR) system operation including: EGR valve, cooler, piping, electronic sensors, controls, and wiring; determine needed action.	P-1
I.03	Inspect and test exhaust aftertreatment system components and controls including diesel oxidation catalyst (DOC), selective catalytic reduction (SCR), diesel exhaust fluid (DEF), diesel particulate filter (DPF), and sensors; check regeneration system operation; determine needed action.	P-1
I.04	Identify emission control system components and configurations.	P-1
I.05	Diagnose emissions and driveability concerns caused by the exhaust gas recirculation (EGR) system; inspect, test, service and/or replace electrical/electronic sensors, controls, wiring, tubing, exhaust passages, cooler(s), and hoses of exhaust gas recirculation (EGR) system; determine needed action.	P-3
I.06	Using manufacturers'/service information, interpret diagnostic trouble codes (DTCs) and scan tool data related to the emissions control systems; determine needed action.	P-1

DUTY J: Driveability and Electronic Engine Controls Diagnosis and Repair (10 questions)

CODE	TASK	P#
J.01	Check engine operation (starting and running) including: noise, vibration, smoke, etc.; determine needed action.	P-2
J.02	Perform cylinder contribution test using electronic service tool(s).	P-1
J.03	Demonstrate knowledge of computerized control system components and configurations.	P-1
J.04	Use appropriate electronic service tool(s) to check and record diagnostic codes; check and record trip/operational data; reset maintenance monitor (if applicable, clear diagnostic codes when appropriate).	P-1
J.05	Access and use service information to perform step-by-step (troubleshooting) diagnosis.	P-1
J.06	Check engine no-crank, cranks but fails to start, hard starting, and starts but does not continue to run problems; determine needed action.	P-2
J.07	Check engine surging, rough operation, misfiring, low power, slow deceleration, slow acceleration, and/or shut down problems; determine needed action.	P-2
J.08	Perform intake manifold pressure (boost) test; determine needed action.	P-2
J.09	Use diagnostic tool, digital multimeter (DMM), and digital storage oscilloscope (DSO) to inspect or test computerized engine control system sensors, actuators, circuits, and electronic control modules (ECM).	P-1
J.10	Demonstrate knowledge of the process for reprogramming or recalibrating the engine control module.	P-2
J.11	Diagnose drivability and emissions problems resulting from malfunctions of interrelated systems (ADAS, HVAC, automatic transmissions, auxiliary power units (APU), non-OEM installed accessories, or similar systems); determine needed action.	P-2
J.12	Demonstrate knowledge of failures in the data communications bus networks.	P-2

**MEDIUM/HEAVY TRUCK
2152 PREVENTATIVE MAINTENANCE INSPECTION TECHNICIAN
SKILLS STANDARDS
TRUCK SERVICE TECHNOLOGY (TST) SKILLS**

For every task in Preventative Maintenance Inspection Technician, the following safety task must be strictly enforced: Comply with personal and environmental safety practices associated with eye/foot/hand/hearing protection, clothing, hand tools, power equipment, lifting practices, and ventilation. Handle, store, and dispose of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first tasks in Preventative Maintenance are to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

The NATEF committee assigned a priority number, which determines the significance of each task for test development: P-1, P-2, or P-3 to all skills. These priority numbers pertain to requirements for instruction on tasks as follows:

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- P-2: 80% must be taught in the curriculum.
- P-3: 50% must be taught in the curriculum.

DUTY A: Inspect Engine Systems (12 questions)

CODE	TASK	P#
A.01	Check engine starting/operation (including unusual noises, vibrations, exhaust smoke, etc.); record idle and governed rpm.	P-1
A.02	Inspect vibration damper.	P-1
A.03	Inspect belts, tensioners, and pulleys; check and adjust belt tension; check belt alignment.	P-1
A.04	Check engine oil level and condition; check dipstick seal.	P-1
A.05	Inspect engine mounts for looseness and deterioration.	P-1
A.06	Check engine for oil, coolant, air, fuel, and exhaust leaks (Engine Off and Running).	P-1
A.07	Check engine compartment wiring harnesses, connectors, and seals for damage and proper routing.	P-1
	Fuel System	
A.08	Check fuel tanks, mountings, lines, caps, and vents.	P-1
A.09	Drain water from fuel system.	P-1
A.10	Service water separator/fuel heater; replace fuel filter(s); prime and bleed fuel system.	P-1

CODE	TASK	P#
	Air Induction and Exhaust System	
A.11	Check exhaust system mountings for looseness and damage.	P-1
A.12	Check engine exhaust system for leaks, proper routing, and damaged or missing components to include exhaust gas recirculation (EGR) system and after treatment devices, if equipped.	P-1
A.13	Check air induction system: piping, charge air cooler, hoses, clamps, and mountings; check for air restrictions and leaks.	P-1
A.14	Inspect turbocharger for leaks; check mountings and connections.	P-1
A.15	Check operation of engine compression/exhaust brake.	P-2
A.16	Service or replace air filter as needed; check and reset air filter restriction indicator.	P-1
A.17	Inspect and service crankcase ventilation system.	P-1
A.18	Inspect diesel exhaust fluid (DEF) system, to include tanks, lines, gauge pump, and filter.	P-1
A.19	Inspect selective catalyst reduction (SCR) system; including diesel exhaust fluid (DEF) for proper levels, leaks, mounting and connections.	P-2
	Cooling System	
A.20	Check operation of fan clutch.	P-1
A.21	Inspect radiator (including air flow restriction, leaks, and damage) and mountings.	P-1
A.22	Inspect fan assembly and shroud.	P-1
A.23	Pressure test cooling system and radiator cap.	P-1
A.24	Inspect coolant hoses and clamps.	P-1
A.25	Inspect coolant recovery system.	P-1
A.26	Check coolant for contamination, additive package concentration, aeration, and protection level (freeze point).	P-1
A.27	Service coolant filter.	P-1
A.28	Inspect water pump.	P-1
	Lubrication System	
A.29	Change engine oil and filters; visually check oil for coolant or fuel contamination; inspect and clean magnetic drain plugs.	P-1
A.30	Take an engine oil sample for analysis.	P-1

DUTY B: Check Cab and Hood Areas (9 questions)

CODE	TASK	P#
	Instruments and Controls	
B.01	Inspect key condition and operation of ignition switch.	P-1
B.02	Check warning indicators.	P-1
B.03	Check instruments; record oil pressure and system voltage.	P-1
B.04	Check operation of electronic power take off (PTO) and engine idle speed controls (if applicable).	P-2
B.05	Check HVAC controls.	P-1
B.06	Check operation of all accessories.	P-1
B.07	Using electronic service tool(s) or on-board diagnostic system; retrieve engine monitoring information; check and record diagnostic codes and trip/operational data (including engine, transmission, ABS, and other systems).	P-1
	Safety Equipment	
B.08	Check operation of electric/air horns and reverse warning devices.	P-1
B.09	Check condition of spare fuses, safety triangles, fire extinguisher, and all required decals.	P-1
B.10	Inspect seat belts and sleeper restraints.	P-1
B.11	Inspect wiper blades and arms.	P-1
	Hardware	
B.12	Check operation of wiper and washer.	P-1
B.13	Inspect windshield glass for cracks or discoloration; check sun visor.	P-1
B.14	Check seat condition, operation, and mounting.	P-1
B.15	Check door glass and window operation.	P-1
B.16	Inspect steps and grab handles.	P-1
B.17	Inspect mirrors, mountings, brackets, and glass.	P-1
B.18	Record all observed physical damage.	P-2
B.19	Lubricate all cab and hood grease fittings.	P-2
B.20	Inspect and lubricate door and hood hinges, latches, strikers, lock cylinders, safety latches, linkages, and cables.	P-1
B.21	Inspect cab mountings, hinges, latches, linkages, and ride height; service as needed.	P-1
	Heating, Ventilation & Air Conditioning (HVAC)	
B.22	Inspect A/C condenser and lines for condition and visible leaks; check mountings.	P-2
B.23	Inspect A/C compressor and lines for condition and visible leaks; check mountings.	P-2
B.24	Check A/C system condition and operation; check A/C monitoring system, if applicable.	P-1
B.25	Check HVAC air inlet filters and ducts; service as needed.	P-1

DUTY C: Inspect Electrical/Electronic Systems (4 questions)

CODE	TASK	P#
	Battery and Starting Systems	
C.01	Inspect battery box(es), cover(s), and mountings.	P-I
C.02	Inspect battery hold-downs, connections, cables, and cable routing; service as needed.	P-I
C.03	Check/record battery state-of-charge (open circuit voltage) and condition.	P-I
C.04	Perform battery test (load and/or capacitance).	P-I
C.05	Inspect starter, mounting, and connections.	P-I
C.06	Engage starter; check for unusual noises, starter drag, and starting difficulty.	P-I
	Charging System	
C.07	Inspect alternator, mountings, cable, wiring and wiring routing; determine needed action.	P-I
C.08	Perform alternator output tests.	P-I
	Lighting System	
C.09	Check operation of interior lights; determine needed action.	P-I
C.10	Check all exterior lights, lenses, reflectors, and conspicuity tape; check headlight alignment; determine needed action.	P-I
C.11	Inspect and test tractor-to-trailer multi-wire connector(s), cable(s), and holder(s); determine needed action.	P-I

DUTY D: Check Frame and Chassis (30 questions)

CODE	TASK	P#
	Air Brakes	P-I
D.01	Check operation of parking brake.	P-I
D.02	Record air governor cut-in and cut-out setting (psi).	P-I
D.03	Check operation of air reservoir/tank drain valves.	P-I
D.04	Check air system for leaks (brakes released).	P-I
D.05	Check air system for leaks (brakes applied).	P-I
D.06	Test one-way and double-check valves.	P-I
D.07	Check low air pressure warning devices.	P-I
D.08	Check emergency (spring) brake control/modulator valve, if applicable.	P-I
D.09	Check tractor protection valve.	P-I
D.10	Test air pressure build-up time.	P-I
D.11	Inspect coupling air lines, holders, and glad hands.	P-I
D.12	Check brake chambers and air lines for secure mounting and damage.	P-I
D.13	Check operation of air drier.	P-I
D.14	Inspect and record brake shoe/pad condition, thickness, and contamination.	P-I
D.15	Inspect and record condition of brake drums/rotors.	P-I

CODE	TASK	P#
D.16	Check antilock brake system wiring, connectors, seals, and harnesses for damage and proper routing.	P-1
D.17	Check operation and adjustment of brake automatic slack adjusters (ASA); check and record push rod stroke.	P-1
D.18	Lubricate all brake component grease fittings.	P-1
D.19	Check condition and operation of hand brake (trailer) control valve, if applicable.	P-2
D.20	Perform antilock brake system (ABS) operational system self-test.	P-1
D.21	Drain air tanks and check for contamination.	P-1
D.22	Check condition of pressure relief (safety) valves.	P-1
	Hydraulic Brakes	
D.23	Check master cylinder fluid level and condition.	P-1
D.24	Inspect brake lines, fittings, flexible hoses, and valves for leaks and damage.	P-1
D.25	Check parking brake operation; inspect parking brake application and holding devices; adjust as needed.	P-1
D.26	Check operation of hydraulic system: pedal travel, pedal effort, pedal feel.	P-1
D.27	Inspect calipers for leakage, binding and damage.	P-1
D.28	Inspect brake assist system (booster), hoses and control valves; check reservoir fluid level and condition.	P-1
D.29	Inspect and record brake lining/pad condition, thickness, and contamination.	P-1
D.30	Inspect and record condition of brake rotors.	P-1
D.31	Check antilock brake system wiring, connectors, seals, and harnesses for damage and proper routing.	P-1
	Drive Train	
D.32	Check operation of clutch, clutch brake, and gearshift.	P-1
D.33	Check clutch linkage/cable for looseness or binding, if applicable.	P-1
D.34	Check hydraulic clutch slave and master cylinders, lines, fittings, and hoses, if applicable.	P-1
D.35	Check clutch adjustment; adjust as needed.	P-1
D.36	Check transmission case, seals, filter, hoses, lines and cooler for cracks and leaks.	P-1
D.37	Inspect transmission breather.	P-1
D.38	Inspect transmission mounts.	P-1
D.39	Check transmission oil level, type, and condition.	P-1
D.40	Inspect U-joints, yokes, drive shafts, boot seals, center bearings, and mounting hardware for looseness, damage, and proper phasing.	P-1
D.41	Inspect axle housing(s) for cracks and leaks.	P-1
D.42	Inspect axle breather(s).	P-1
D.43	Lubricate all drive train grease fittings.	P-1
D.44	Check drive axle(s) oil level, type, and condition.	P-1
D.45	Change drive axle(s) oil and filter/screen, if applicable; check and clean magnetic plugs.	P-2

CODE	TASK	P#
D.46	Check transmission wiring, connectors, seals, and harnesses for damage and proper routing.	P-1
D.47	Change transmission oil and filter, if applicable; check and clean magnetic plugs.	P-2
D.48	Check interaxle differential lock operation.	P-1
D.49	Check transmission range shift operation.	P-1
	Suspension and Steering Systems	
D.50	Check steering wheel operation for free play or binding.	P-1
D.51	Check power steering pump, mounting, and hoses for leaks, condition, and routing; check fluid level.	P-1
D.52	Change power steering fluid and filter.	P-1
D.53	Inspect steering gear for leaks and secure mounting.	P-1
D.54	Inspect steering shaft U-joints, pinch bolts, splines, pitman arm-to-steering sector shaft, tie rod ends, and linkages.	P-1
D.55	Check kingpins for wear.	P-1
D.56	Check wheel bearings for looseness and noise.	P-1
D.57	Check oil level and condition in all non-drive hubs; check for leaks.	P-1
D.58	Inspect springs, pins, hangers, shackles, spring U-bolts, and insulators.	P-1
D.59	Inspect shock absorbers for leaks and secure mounting.	P-1
D.60	Inspect air suspension springs, mounts, hoses, valves, linkage, and fittings for leaks and damage.	P-1
D.61	Check and record suspension ride height.	P-1
D.62	Lubricate all suspension and steering grease fittings.	P-1
D.63	Check axle locating components (radius, torque, and/or track rods).	P-1
	Tires and Wheels	
D.64	Inspect tires for wear patterns and proper mounting.	P-1
D.65	Inspect tires for cuts, cracks, bulges, and sidewall damage.	P-1
D.66	Inspect valve caps and stems; determine needed action.	P-1
D.67	Measure and record tread depth; probe for imbedded debris.	P-1
D.68	Check and record air pressure; adjust air pressure in accordance with manufacturers' specifications.	P-1
D.69	Check wheel mounting hardware condition; determine needed action.	P-1
D.70	Inspect wheels for cracks, damage and proper hand hold alignment.	P-1
D.71	Check tire matching (diameter and tread) on single and dual tire applications.	P-1
	Frame and Fifth Wheel	
D.72	Inspect fifth wheel mounting bolts, air lines, and locks.	P-1
D.73	Test operation of fifth wheel locking device; adjust if necessary.	P-1
D.74	Check quarter fenders, mud flaps, and brackets.	P-1
D.75	Check pintle hook assembly and mounting, if applicable.	P-2
D.76	Lubricate all fifth wheel grease fittings and plate, if applicable.	P-1
D.77	Inspect frame and frame members for cracks and damage.	P-1

**MEDIUM/HEAVY TRUCK
2153 ELECTRICAL/ELECTRONIC SYSTEMS REPAIR TECHNICIAN
SKILLS STANDARDS
TRUCK SERVICE TECHNOLOGY (TST) SKILLS**

For every task in Electrical/Electronic Systems Repair Technician, the following safety requirement must be strictly enforced: Comply with personal and environmental safety practices associated with eye/foot/hand/hearing protection, clothing, hand tools, power equipment, lifting practices, and ventilation. Handle, store, and dispose of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first tasks in Electrical/Electronic Systems are to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

The NATEF committee assigned a priority number, which determines the significance of each task for test development: P-1, P-2, or P-3 to all skills. These priority numbers pertain to requirements for instruction on tasks as follows:

P-1: 95% must be taught in the curriculum.

P-2: 80% must be taught in the curriculum.

P-3: 50% must be taught in the curriculum.

DUTY A: General Electrical System Diagnosis (14 questions)

CODE	TASK	P#
A.01	Research vehicle service information including, vehicle service history, service precautions, and technical service bulletins.	P-1
A.02	Demonstrate knowledge of electrical/electronic series, parallel, and series parallel circuits using principles of electricity (Ohm's Law).	P-1
A.03	Demonstrate operation and proper use of digital multimeters and other test equipment when measuring source voltage, voltage drop (including grounds), current flow, continuity, and resistance.	P-1
A.04	Demonstrate knowledge of the causes and effects of shorts, grounds, opens, and resistance problems in electrical/electronic circuits; identify and locate faults in electrical/electronic circuits.	P-1
A.05	Use wiring diagrams during the diagnosis (troubleshooting) of electrical/electronic circuit problems.	P-1
A.06	Measure parasitic (key-off) battery drain; determine needed action.	P-1
A.07	Demonstrate knowledge of the function, operation, and testing of fusible links, circuit breakers, relays, solenoids, diodes, and fuses; perform inspection and testing; determine needed action.	P-1
A.08	Inspect, test, repair (including solder repair, mechanical crimp repair, and sealed heat shrink), and/or replace components, connectors, seals, terminal ends, harnesses, and wiring; verify proper routing and securement; determine needed action.	P-1

CODE	TASK	P#
A.09	Use appropriate electronic service tool(s) and procedures to diagnose problems; check and record diagnostic codes; interpret digital multimeter (DMM) readings; clear diagnostic codes when appropriate.	P-1
A.10	Check for malfunctions caused by faults in the data bus communications network.	P-2
A.11	Identify electrical/electronic system components and configuration.	P-1
A.12	Demonstrate operation and proper use of oscilloscopes to check frequency, pulse width, and waveforms of electrical/electronic signals; interpret readings; determine needed repairs.	P-2

DUTY B: Battery System Diagnosis and Service (8 questions)

CODE	TASK	P#
B.01	Identify battery type and system configuration.	P-1
B.02	Confirm proper battery capacity for application; perform battery state-of charge test; perform battery capacity test, determine needed action.	P-1
B.03	Inspect and clean battery, battery cables, connectors, battery boxes, mounts, and hold-downs; service, repair or replace as needed.	P-1
B.04	Charge battery using appropriate method for battery type.	P-1
B.05	Jump-start vehicle using a booster battery and jumper cables or using an appropriate auxiliary power supply.	P-1
B.06	Check low voltage disconnect (LVD) systems; determine needed action.	P-2
B.07	Test battery cables and connectors; repair or replace as needed.	P-1
B.08	Identify electrical/electronic modules, radios, and other accessories that require reinitialization or code entry after reconnecting vehicle battery.	P-3

DUTY C: Starting System Diagnosis and Repair (6 questions)

CODE	TASK	P#
C.01	Demonstrate understanding of starter system operation.	P-1
C.02	Perform starter circuit cranking voltage and voltage drop tests; determine needed action.	P-1
C.03	Inspect and test starter control circuit switches (key switch, push button, and/or magnetic switch), relays, connectors, terminals, wires, and harnesses (including over-crank protection); determine needed action.	P-1
C.04	Identify causes of no-crank or slow crank condition; differentiate between electrical and engine mechanical problems; determine needed action.	P-1
C.05	Perform starter current draw tests; determine needed action.	P-3
C.06	Remove and replace starter; inspect flywheel ring gear or flex plate.	P-2

DUTY D: Charging System Diagnosis and Repair (8 questions)

CODE	TASK	P#
D.01	Identify and understand operation of the alternator.	P-1
D.02	Test instrument panel mounted gauges and/or indicator lamps; determine needed action.	P-1
D.03	Inspect, adjust, and/or replace alternator drive belt; check pulleys and tensioners for wear; check fans and mounting brackets; verify proper belt alignment; determine needed action.	P-1
D.04	Inspect cables, wires, and connectors in the charging circuit including remote sense circuit; determine needed action.	P-1
D.05	Perform charging system voltage and amperage output tests; perform AC ripple test; determine needed action.	P-1
D.06	Perform charging circuit voltage drop tests; determine needed action.	P-1
D.07	Remove, inspect, and/or replace alternator.	P-2

DUTY E: Lighting Systems Diagnosis and Repair (7 questions)

CODE	TASK	P#
E.01	Identify causes of brighter-than-normal, intermittent, dim, or no-light operation; determine needed action.	P-1
E.02	Test, replace, and aim headlights.	P-3
E.03	Inspect cables, wires, and connectors in the lighting systems.	P-1
E.04	Inspect tractor-to-trailer electrical connectors, cables, and holders.	P-1
E.05	Inspect switches, relays, bulbs/LEDs, wires, terminals, connectors, sockets, and control components/modules of exterior lighting systems; determine needed action.	P-2
E.06	Inspect switches, relays, bulbs/LEDs, wires, terminals, connectors, sockets, and control components/modules of interior lighting systems; determine needed action.	P-2
E.07	Inspect switches, relays, bulbs/LEDs, wires, terminals, connectors, sockets, and control components/modules of auxiliary lighting circuits; determine needed action	P-2

DUTY F: Instrument Cluster and Driver Information Systems Diagnosis and Repair (2 questions)

CODE	TASK	P#
F.01	Check gauge and warning indicator operation.	P-1
F.02	Identify faults in the sensor/sending units, gauges, switches, relays, bulbs/LEDs, wires, terminals, connectors, sockets, printed circuits, and control components/modules of the instrument cluster, driver information systems, and warning systems; determine needed action.	P-2
F.03	Inspect electronic speedometer, odometer, and tachometer systems.	P-3

DUTY G: Cab and Chassis Electrical Systems Diagnosis and Repair (3 questions)

CODE	TASK	P#
G.01	Check operation of horn(s), wiper/washer, and occupant restraint systems.	P-1
G.02	Demonstrate knowledge of the operation of advanced driver assistance systems (ADAS) and related circuits (such as: speed control, collision avoidance, lane departure warning and assist, and camera systems).	P-3
G.03	Demonstrate knowledge of comfort and convenience systems and related circuits (such as: power windows, power seats, power locks, remote keyless entry, steering wheel controls, and cruise control).	P-3
G.04	Demonstrate knowledge of entertainment systems and related circuits (such as: radio, DVD, navigation, speakers, antennas, and voice-activated accessories).	P-3
G.05	Demonstrate knowledge of power inverter, protection devices, connectors, terminals, wiring, and control components/modules of auxiliary power systems.	P-3
G.06	Demonstrate knowledge of telematics systems.	P-3

DUTY H: Electrified Vehicle High Voltage Safety (7 questions)

CODE	TASK	P#
H.01	Demonstrate knowledge of hazards related to high voltage system/electric vehicles, including electrocution, fire, explosion, arc flash, gases and fumes, hazardous chemicals, and EMF, and how to properly respond to emergency situations.	P-1
H.02	Demonstrate knowledge of high voltage system and component coloring, warning labels, lights, signage, and lock-out/tag-out procedures.	P-1
H.03	Demonstrate ability to identify which components and circuits contain high voltage.	P-1
H.04	Demonstrate knowledge of steps needed to assess possible hazards prior to servicing a high voltage/electric vehicle, including awareness of automatic systems that may operate while the key switch/ignition is off.	P-1
H.05	Understand limitations on which systems, components, and circuits of a high voltage/electric vehicle a technician is capable of safely servicing based on their level of training and qualification.	P-1
H.06	Demonstrate knowledge of special multimeters, insulated tools, and other test equipment required for use in high voltage/electric vehicle circuits.	P-3
H.07	Demonstrate knowledge of personal protective equipment (PPE) required for use in high voltage/electric vehicle circuits.	P-3
H.08	Demonstrate knowledge of proper procedures used to disconnect/isolate the high voltage traction battery.	P-3
H.09	Demonstrate knowledge of the use of a live-dead-live test to verify isolation of the high voltage traction battery.	P-3
H.10	Demonstrate knowledge of the testing and verification of ground circuit isolation between vehicle chassis ground and the high voltage circuits and components.	P-3

**MEDIUM/HEAVY TRUCK
2154 BRAKES TECHNICIAN
SKILLS STANDARDS
TRUCK SERVICE TECHNOLOGY (TST) SKILLS**

For every task in Brakes Technician, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with eye/foot/hand/hearing protection, clothing, hand tools, power equipment, lifting practices, and ventilation. Handle, store, and dispose of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first tasks in Brakes are to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

The NATEF committee assigned a priority number, which determines the significance of each task for test development: P-1, P-2, or P-3 to all skills. These priority numbers pertain to requirements for instruction on tasks as follows:

P-1: 95% must be taught in the curriculum.

P-2: 80% must be taught in the curriculum.

P-3: 50% must be taught in the curriculum.

DUTY A: General Brake Diagnosis and Repair (5 questions)

CODE	TASK	P#
A.01	Research vehicle service information, including fluid type, vehicle service history, service precautions, and technical service bulletins.	P-1
A.02	Identify brake system components and configurations (including air and hydraulic systems, parking brake, power assist, and vehicle dynamic brake systems).	P-1
A.03	Identify brake performance problems caused by the mechanical/foundation brake system (air and hydraulic).	P-1
A.04	Use appropriate electronic service tool(s) and procedures to diagnose problems; check and record diagnostic codes; interpret digital multimeter (DMM) readings; clear diagnostic codes when appropriate.	P-1

DUTY B: Air Brakes: Air Supply and Service Systems Diagnosis and Repair (8 questions)

CODE	TASK	P#
B.01	Inspect and test air supply system components such as compressor, governor, air drier, tanks, and lines; inspect service system components such as lines, fittings, mountings, and valves (hand brake/trailer control, brake relay, quick release, tractor protection, emergency/spring brake control/modulator, pressure relief/safety); determine needed action.	P-1
B.02	Test gauge operation and readings; test low pressure warning alarm operation; perform air supply system tests such as pressure build-up, governor settings, and leakage; drain air tanks and check for contamination; determine needed action.	P-1
B.03	Demonstrate knowledge and understanding of air supply and service system components and operations.	P-1
B.04	Inspect air compressor inlet; inspect oil supply and coolant lines, fittings, and mounting brackets; repair or replace as needed.	P-1
B.05	Inspect and test one-way (single) check valves, two-way (double) check valves, manual and automatic drain valves; determine needed action.	P-1
B.06	Inspect and service air drier systems, filters, valves, heaters, wiring, and connectors; determine needed action.	P-1
B.07	Inspect and test brake application (foot/treadle) valve, fittings, and mounts; check pedal operation; determine needed action.	P-1
B.08	Inspect air compressor drive gear components (gears, belts, tensioners, and/or couplings); determine needed action.	P-3

DUTY C: Air Brakes: Mechanical/Foundation Brake System Diagnosis and Repair (9 questions)

CODE	TASK	P#
C.01	Inspect and test service brake chambers, diaphragms, clamps, springs, pushrods, clevises, and mounting brackets; determine needed action.	P-1
C.02	Identify slack adjuster/brake adjuster type; check free stroke and applied stroke; inspect and lubricate slack adjusters/brake adjusters; perform needed action.	P-1
C.03	Inspect and lubricate camshafts (S-cams), tubes, rollers, bushings, seals, spacers, retainers, brake spiders, shields, anchor pins, and springs; perform needed action.	P-1
C.04	Remove brake drum; clean and inspect brake drum and mounting surface; measure brake drum diameter; measure brake lining thickness; inspect brake lining condition; determine needed action.	P-1
C.05	Inspect rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine needed action.	P-1
C.06	Inspect, clean, and adjust air disc brake caliper assemblies; inspect and measure disc brake pads; inspect mounting hardware; perform needed action.	P-1
C.07	Identify concerns related to the mechanical/foundation brake system including poor stopping, brake noise, premature wear, pulling, grabbing, or dragging; determine needed action.	P-1

DUTY D: Air Brakes: Parking Brake System Diagnosis and Repair (6 questions)

CODE	TASK	P#
D.01	Inspect, test, and/or replace parking (spring) brake chamber.	P-1
D.02	Inspect, test, and/or replace parking (spring) brake valves, lines, hoses, and fittings.	P-1
D.03	Inspect, test, and/or replace parking (spring) brake application and release valve.	P-1
D.04	Manually release (cage) and reset (uncage) parking (spring) brakes.	P-2
D.05	Identify and test anti-compounding brake function.	P-2
D.06	Demonstrate knowledge of electronically applied parking brake systems.	P-3

DUTY E: Hydraulic Brakes: Hydraulic System Diagnosis and Repair (8 questions)

CODE	TASK	P#
E.01	Check master cylinder fluid level and condition; determine proper fluid type for application.	P-1
E.02	Inspect hydraulic brake system for leaks and damage; test, repair, and/or replace hydraulic brake system components.	P-1
E.03	Check hydraulic brake system operation including pedal travel, pedal effort, and pedal feel; determine needed action.	P-1
E.04	Identify poor stopping, premature wear, pulling, dragging, imbalance, or poor pedal feel caused by problems in the hydraulic system; determine needed action.	P-2
E.05	Test master cylinder for internal/external leaks and damage; replace as needed.	P-2
E.06	Test metering (hold-off), load sensing/proportioning, proportioning, and combination valves; determine needed action.	P-3
E.07	Test warning light circuit sensors, switches, bulbs/LEDs, wiring, and connectors; determine needed action.	P-2
E.08	Bleed and/or flush hydraulic brake system.	P-2

DUTY F: Hydraulic Brakes: Mechanical/Foundation Brake System Diagnosis and Repair (3 questions)

CODE	TASK	P#
F.01	Inspect rotor and mounting surface; measure rotor thickness, thickness variation, and lateral runout; determine needed action.	P-1
F.02	Inspect and clean disc brake caliper assemblies; inspect and measure disc brake pads; inspect mounting hardware and slides; perform needed action.	P-1
F.03	Remove brake drum, clean and inspect brake drum and mounting surface; measure brake drum diameter; measure brake lining thickness; inspect brake lining condition; inspect wheel cylinders; perform needed action.	P-3

DUTY G: Hydraulic Brakes: Parking Brake System Diagnosis and Repair (1 question)

CODE	TASK	P#
G.01	Check parking brake operation; inspect parking brake application and holding devices; adjust, repair, and/or replace as needed.	P-1

DUTY H: Power Assist Systems Diagnosis and Repair (5 questions)

CODE	TASK	P#
H.01	Check brake assist/booster system (vacuum or hydraulic) hoses, pump, switches, and control valves; check fluid level and condition (if applicable).	P-1
H.02	Check operation of emergency (back-up/reserve) brake assist system.	P-1
H.03	Identify concerns related to the power assist system (vacuum or hydraulic), including stopping problems caused by the brake assist/booster system; determine needed action.	P-2
H.04	Inspect, test, repair, and/or replace hydraulic brake assist/booster systems, hoses, and control valves.	P-1

DUTY I: Vehicle Dynamic Brake Systems (Air and Hydraulic): Antilock Brake System (ABS), Automatic Traction Control (ATC) System, and Electronic Stability Control (ESC) System, Automatic Emergency Braking (AEB) System Diagnosis and Repair (8 questions)

CODE	TASK	P#
I.01	Observe antilock brake system (ABS) warning light operation including trailer and dash mounted trailer ABS warning light; determine needed action.	P-1
I.02	Observe automatic traction control (ATC) and electronic stability control (ESC) warning light operation; determine needed action.	P-2
I.03	Test vehicle/wheel speed sensors and circuits; adjust, repair, and/or replace as needed.	P-1
I.04	Demonstrate knowledge of Automatic Emergency Braking (AEB) systems.	P-3
I.05	Identify stopping concerns related to the vehicle dynamic brake systems: ABS, ATC, and ESC; determine needed action.	P-2
I.06	Diagnose problems in the vehicle dynamic brake control systems: ABS, ATC, and ESC; determine needed action.	P-3
I.07	Check and test operation of vehicle dynamic brake system (air and hydraulic) mechanical and electrical components; determine needed action.	P-1
I.08	Bleed ABS hydraulic circuits.	P-2
I.09	Verify power line carrier (PLC) operation.	P-3

DUTY J: Wheel Bearings Diagnosis and Repair (2 questions)

CODE	TASK	P#
J.01	Clean, inspect, lubricate, and/or replace wheel bearings and races/cups; replace seals and wear rings; inspect spindle/tube; inspect and replace retaining hardware; adjust wheel bearings; check hub assembly fluid level and condition; verify end play with dial indicator method.	P-1
J.02	Identify, inspect, and/or replace unitized/preset hub bearing assemblies.	P-1

**MEDIUM/HEAVY TRUCK
2156 HEATING, VENTILATION, AND AIR CONDITIONING TECHNICIAN
SKILLS STANDARDS
TRUCK SERVICE TECHNOLOGY (TST) SKILLS**

For every task in Heating, Ventilation and Air Conditioning (HVAC) Technician, the following safety requirement must be strictly enforced:

Comply with personal and environmental safety practices associated with eye/foot/hand/hearing protection, clothing, hand tools, power equipment, lifting practices, and ventilation. Handle, store, and dispose of fuels/chemicals/materials in accordance with federal, state, and local regulations.

The first tasks in Heating, Ventilation, & Air Conditioning are to listen to and verify the operator's concern, review past maintenance and repair documents, and determine necessary action.

The NATEF committee assigned a priority number, which determines the significance of each task for test development: P-1, P-2, or P-3 to all skills. These priority numbers pertain to requirements for instruction on tasks as follows:

P-1: 95% must be taught in the curriculum.

P-2: 80% must be taught in the curriculum.

P-3: 50% must be taught in the curriculum.

DUTY A: General HVAC System Diagnosis and Repair (17 questions)

CODE	TASK	P#
A.01	Research vehicle service information, including refrigerant/oil type, vehicle service history, service precautions and technical service bulletins.	P-1
A.02	Identify heating, ventilation, and air conditioning (HVAC) components and configuration.	P-1
A.03	Use appropriate electronic service tool(s) and procedures to diagnose problems; check and record diagnostic codes; interpret digital multimeter (DMM) readings; clear diagnostic codes when appropriate.	P-1
A.04	Identify and interpret heating and air conditioning problems.	P-1
A.05	Identify refrigerant type; test for contamination; select and connect proper gauge set/test equipment; record temperature and pressure readings.	P-1
A.06	Demonstrate knowledge of A/C system performance test.	P-1
A.07	Demonstrate knowledge of A/C system leak test.	P-1
A.08	Inspect condition of refrigerant oil removed from A/C system; determine needed action.	P-1
A.09	Determine oil and oil capacity for system application and/or component replacement.	P-1

DUTY B: Refrigeration System Components Diagnosis and Repair (18 questions)

CODE	TASK	P#
B.01	Inspect, remove, and replace A/C compressor drive belts, pulleys, and tensioners; verify proper belt alignment.	P-1
B.02	Check A/C system operation including system pressures; visually inspect A/C components for signs of leaks; check A/C monitoring system (if applicable).	P-1
B.03	Inspect A/C condenser for airflow restrictions; determine needed action.	P-1
B.04	Inspect evaporator housing water drain; determine needed action.	P-1
B.05	Inspect A/C compressor assembly; check compressor clutch air gap; determine needed action.	P-1
B.06	Inspect AC system hoses, lines, fittings, O-rings, seals, and service valves; determine needed action.	P-1
B.07	Inspect receiver/drier or accumulator/drier; determine needed action.	P-1
B.08	Inspect expansion valve or orifice (expansion) tube; determine needed action.	P-1
B.09	Demonstrate knowledge of A/C system conditions that cause the protection devices (pressure, thermal, and/or control module) to interrupt system operation.	P-2
B.10	Demonstrate knowledge of procedure to remove and reinstall evaporator.	P-3
B.11	Demonstrate knowledge of procedure to inspect and/or replace condenser.	P-3

DUTY C: Heating, Ventilation, and Engine Cooling Systems Diagnosis and Repair (7 questions)

CODE	TASK	P#
C.01	Inspect engine cooling system and heater system hoses and pipes; determine needed action.	P-1
C.02	Inspect HVAC system heater ducts, doors, hoses, cabin filters, and outlets; determine needed action.	P-1
C.03	Identify the source of A/C system odors; determine needed action.	P-2
C.04	Identify temperature control problems in the HVAC system; determine needed action.	P-2
C.05	Demonstrate knowledge of the procedures to remove, inspect, reinstall, and/or replace engine coolant and heater system components.	P-3

DUTY D: Operating Systems and Related Controls Diagnosis and Repair (7 questions)

CODE	TASK	P#
D.01	Verify HVAC system blower motor operation; confirm proper air distribution; confirm proper temperature control; determine needed action.	P-1
D.02	Inspect and test HVAC system blower motors, resistors, switches, relays, wiring, and protection devices.	P-1
D.03	Demonstrate knowledge of A/C compressor clutch control systems.	P-2
D.04	Demonstrate knowledge of the vacuum, mechanical, and electrical components and controls of the HVAC system.	P-2

DUTY E: Refrigerant Recovery, Recycling, and Handling (6 questions)

CODE	TASK	P#
E.01	Demonstrate knowledge of correct use and maintenance of refrigerant handling equipment.	P-1
E.02	Demonstrate knowledge of how to identify A/C system refrigerant; test for sealants; recover, evacuate, and charge A/C system; add refrigerant oil as required.	P-1
E.03	Demonstrate knowledge of how to recover, recycle, label, and store refrigerant in accordance with EPA Section 609 guidelines.	P-1

Sample Questions

- _____ 1. If the engine oil level is over the full mark, Technician A says the cause could be coolant leaking into the oil. Technician B says the cause could be fuel leaking into the oil. Who is correct?
- a. Technician A
 - b. Technician B
 - c. Both Technician A and Technician B
 - d. Neither Technician A nor Technician B
- _____ 2. What is indicated by a dull knock when the engine is under load?
- a. broken piston ring
 - b. excessive valve lash
 - c. worn main bearing
 - d. worn timing gears
- _____ 3. The purpose of valve rotators is to:
- a. assist in lubrication of the valve stem.
 - b. automatically adjust valve lash.
 - c. prolong life of the valve and seat.
 - d. seal the valve stem.
- _____ 4. Valve clearance can be adjusted when the piston of the cylinder to be adjusted is at:
- a. BDC on the exhaust stroke.
 - b. TDC on the compression stroke.
 - c. TDC on the exhaust stroke.
 - d. TDC on the intake stroke.
- _____ 5. The purpose of a thrust main bearing is to:
- a. absorb clutch pressure and establish crankshaft end play.
 - b. keep the crankshaft from slipping off main bearings.
 - c. locate the crankshaft front pulley.
 - d. raise oil pressure.

- _____ 6. Plastigage is used for measuring:
- a. camshaft end clearances.
 - b. crankshaft bearing clearances.
 - c. crankshaft thrust bearing clearance.
 - d. valve clearance.
- _____ 7. A fan belt that is too tight on a truck can cause:
- a. bearing failure in the water pump.
 - b. fan blade failure.
 - c. fan speeding.
 - d. water pump slippage.
- _____ 8. Most electrical grounds in the vehicle wiring system are attached to the chassis so that current can pass through to ground and back to the:
- a. grounded battery terminal.
 - b. isolated battery terminal.
 - c. load source terminal.
 - d. positive battery terminal.
- _____ 9. Approximately how many volts can each cell of a battery produce?
- a. 1.2
 - b. 2.1
 - c. 3.0
 - d. 6.0
- _____ 10. Technician A says the low pressure switch keeps the A/C clutch from engaging. Technician B says the high pressure switch keeps the A/C clutch from engaging. Who is correct?
- a. Technician A
 - b. Technician B
 - c. Both Technician A and Technician B
 - d. Neither Technician A nor Technician B

Sample Questions — Key

1. If the engine oil level is over the full mark, Technician A says the cause could be coolant leaking into the oil. Technician B says the cause could be fuel leaking into the oil. Who is correct?

- a. Technician A Wrong, but plausible
- b. Technician B Wrong, but plausible
- c. Both Technician A and Technician B Correct
- d. Neither Technician A nor Technician B Wrong, but plausible

2. What is indicated by a dull knock when the engine is under load?

- a. broken piston ring Wrong, but plausible
- b. excessive valve lash Wrong, but plausible
- c. worn main bearing Correct
- d. worn timing gears Wrong, but plausible

3. The purpose of valve rotators is to:

- a. assist in lubrication of the valve stem. Wrong, but plausible
- b. automatically adjust valve lash. Wrong, but plausible
- c. prolong life of the valve and seat. Correct
- d. seal the valve stem. Wrong, but plausible

4. Valve clearance can be adjusted when the piston of the cylinder to be adjusted is at:

- a. BDC on the exhaust stroke. Wrong, but plausible
- b. TDC on the compression stroke. Correct
- c. TDC on the exhaust stroke. Wrong, but plausible
- d. TDC on the intake stroke. Wrong, but plausible

5. The purpose of a thrust main bearing is to:

- a. absorb clutch pressure and establish crankshaft end play. Correct
- b. keep the crankshaft from slipping off main bearings. Wrong, but plausible
- c. locate the crankshaft front pulley. Wrong, but plausible
- d. raise oil pressure. Wrong, but plausible

6. Plastigage is used for measuring:

- a. camshaft end clearances. Wrong, but plausible
- b. crankshaft bearing clearances. Correct
- c. crankshaft thrust bearing clearance. Wrong, but plausible
- d. valve clearance. Wrong, but plausible

7. A fan belt that is too tight on a truck can cause:

- a. bearing failure in the water pump.
- b. fan blade failure.
- c. fan speeding.
- d. water pump slippage.

Correct

Wrong, but plausible

Wrong, but plausible

Wrong, but plausible

8. Most electrical grounds in the vehicle wiring system are attached to the chassis so that current can pass through to ground and back to the:

- a. grounded battery terminal.
- b. isolated battery terminal.
- c. load source terminal.
- d. positive battery terminal.

Correct

Wrong, but plausible

Wrong, but plausible

Wrong, but plausible

9. Approximately how many volts can each cell of a battery produce?

- a. 1.2
- b. 2.1
- c. 3.0
- d. 6.0

Wrong, but plausible

Correct

Wrong, but plausible

Wrong, but plausible

10. Technician A says the low pressure switch keeps the A/C clutch from engaging. Technician B says the high pressure switch keeps the A/C clutch from engaging. Who is correct?

- a. Technician A
- b. Technician B
- c. Both Technician A and Technician B
- d. Neither Technician A nor Technician B

Wrong, but plausible

Wrong, but plausible

Correct

Wrong, but plausible

Abbreviations, Symbols and Acronyms

When abbreviations, symbols or acronyms are more commonly used in written and verbal communications within the medium/heavy truck industry than the words they represent, they will also be used on the written examination required for competency. The following is a list of abbreviations, symbols and acronyms used on the medium/heavy truck examinations.

'	Feet	ISO	International Organization for Standardization
"	Inches		
°	Degrees	kV	kilovolts
\$	Dollars	MIG	metal inert gas
O ₂	Oxygen	MIL	malfunction indicator lamp
%	Percent	mm	millimeter
2K	a coating that needs a hardener	MPH	miles per hour
ABS	anti-lock brake system	MSDS	material safety data sheet
AC	alternating current	NATEF	National Automotive Technicians Education Foundation
A/C	air conditioning		
ASE	Automotive Service Excellence	NIOSH	National Institute for Occupational Safety and Health
ATF	automatic transmission fluid		
BCM	body control module	OBD	On-Board Diagnostics
CAN/BUS	Controller Area Network	OEM	original equipment manufacturer
CCA	cold cranking amp	OSHA	Occupational Safety and Health Administration
CV	constant-velocity		
CVT	continuously variable transmission	PAG	polyalkylene glycol
DC	direct current	PCV	positive crankcase ventilation
DEF	diesel exhaust fluid	PM	permanent generator
DMM	digital multimeter	POA	pilot operated absolute
DTC	diagnostic trouble code	PSI	pounds per square inch
DVOM	digital volt/ohm meter	RPM	revolutions per minute
ECM	electronic control module	SAI	steering axis inclination
EGR	exhaust gas recirculation	SMC	sheet moulded compound
EVAP	evaporative emission	SRS	supplemental restraint system
Ft	feet	STRSW	squeeze type resistance spot welding
FWD	front wheel drive	TDC	top dead center
GTX	a name of a GE developed plastic (Noryl GTX)	TEO	thermoplastic elastomeric olefin
HEPA	high-efficiency particulate arrestance	TIG	tungsten inert gas
Hg	Mercury	TPS	throttle position sensor
HVAC	heating, ventilation, and air conditioning	TSB	Transportation Safety Bulletin
IAC	idle air control	TV	throttle valve
ID	inside diameter	USB	universal serial bus
In	inch	V	volt
IP	instrument panel	VOC	volatile organic compounds

Test Taking Strategies

This section of the study guide contains valuable information for testing success and provides a common-sense approach for preparing for and performing well on any test.

General Testing Advice

1. Get a good night's rest the night before the test — eight hours of sleep is recommended.
2. Avoid junk food and “eat right” several days before the test.
3. Do not drink a lot or eat a large meal prior to testing.
4. Be confident in your knowledge and skills!
5. Relax and try to ignore distractions during the test.
6. Focus on the task at hand — taking the test and doing your best!
7. Listen carefully to the instructions provided by the exam proctor. If the instructions are not clear, ask for clarification.

Testing Tips

1. Read the entire question before attempting to answer it.
2. Try to answer the question before reading the choices. Then, read the choices to determine if one matches, or is similar, to your answer.
3. Do not change your answer unless you misread the question or are certain that your first answer is incorrect.
4. Answer questions you know first, so you can spend additional time on the more difficult questions.
5. Check to make sure you have answered every question before you submit the assessment for scoring — unanswered questions are marked incorrect.

