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ABSTRACT

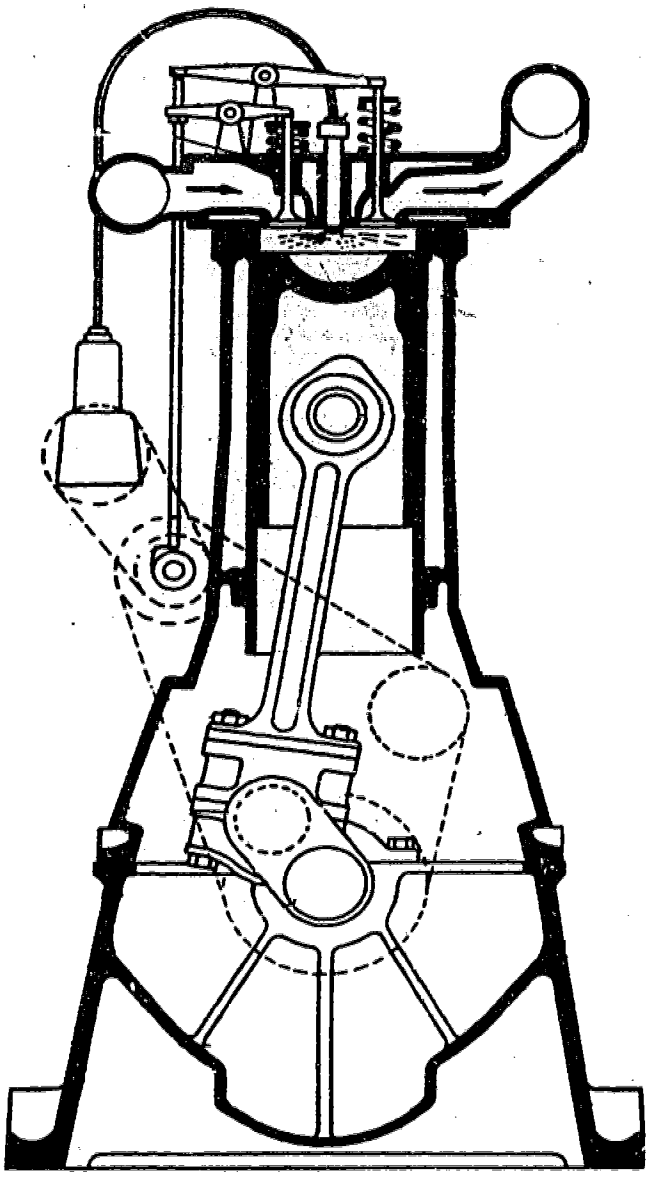
Several intermediate performance objectives and corresponding criterion measures are listed for each of six terminal objectives for an intermediate diesel mechanics course (two semesters, 3 hours daily) designed for high school students who upon completion would be ready for an on-the-job training experience in diesel service and repair. Through shop manipulative practice in addition to related classroom instruction, the course covers operation and safety, electricity, intake and exhaust systems, starting methods, oil and gaseous fuels, tune-up and troubleshooting, engine rating and performance, and mechanical and hydraulic drives. Titles of the six terminal objectives are Orientation--Human Relations and Safety, Electrical System, Starting Methods, Power Trains, Brake Systems, and Chassis Components. (This manual and 54 others were developed for various secondary level vocational courses using the System Approach for Education (SAFE) guidelines.) (HD)

# diesel mechanics



## PERFORMANCE OBJECTIVES

INTERMEDIATE COURSE







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Revised: December, 1974

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DIESEL MECHANICS-INTERMEDIATE
Accreditation No.: 9245
Length of Course: 2 Semesters
Time Block: 3 Hours Daily

## COURSE DESCRIPTION

This course is prepared to train intermediate students who intend to become diesel service and repair mechanics. The training includes shop manipulative practice in addition to related classroom instruction. Intermediate instruction includes: operation and safety, electricity, intake and exhaust systems, starting methods, oil and gaseous fuels, tune-up and trouble-shooting, engine rating and performance, mechanical and hydraulic drives. Students who have at least 540 hours of instruction in basic and intermediate courses and exhibit necessary skills and attitudes may be placed in the S.I.E. Program on recommendation of the instructor.

540 Hours

9245

# DIESEL MECHANICS-INTERMEDIATE

## Syllabus of Terminal Performance Objectives

13.0 Orientation, Human Relations & Safety

14.0 Electrical System

15.0 Starting Methods

16.0 Power Trains

17.0 Brake Systems

18.0 Chassis Components

COURSE DIESEL MECHANICS-INTERMEDIATE

TERMINAL PERFORMANCE OBJECTIVE NO. 13.0

Orientation, Human Relations & Safety

Upon completion of the unit on orientation, human relations and safety, 90% of the students will demonstrate 80% correct responses to a criterion test objective knowledge of orientation, human relations and safety.

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| | | 13.0 | Test attached. |
| 13.1 | The student will demonstrate, by stating orally or in writing with 80% accuracy, knowledge of school shop foreman's assignment and routing relating to:<br>1. Starting and dismissal time of class.<br>2. Rest room check out procedure.<br>3. Tool room check out assignment and regulations. | 13.1 | Correctly state, orally or in writing with 80% accuracy, shop foreman's duties:<br>1. Starting and dismissal time of class.<br>2. Rest room check out procedure.<br>3. Tool room and shop clean-up detail duties.<br>4. Student locker assignment and regulations. |
| 13.2 | The student will demonstrate, by stating orally on in writing with 80% accuracy, his knowledge of tool room management and inventory relating to:<br>1. Knowing what is in the shop.<br>2. Knowing where each item is.<br>3. Have proper storage and keep each item in its place.<br>4. Have a procedure to systematically replace items and material lost, broken and consumed. | 13.2 | Correctly state, orally or in writing with 80% accuracy, knowledge of tool room management and inventory:<br>1. What is in the shop.<br>2. Knowing where each item is.<br>3. Have proper storage and keep each item in its place.<br>4. Have a procedure to systematically replace items and material lost, broken or consumed. |

COURSE: DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE OBJECTIVE NO. 13.0 (cont'd) Orientation, Human Relations & Safety

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 13.3 | The student will demonstrate his commitment to participate in the S.I.E. program by completing the SIE program application upon completing the basic and intermediate course objectives with 80% proficiency and minimum of 540 shop hours and being recommended by his instructor. | 13.3 | Complete the basic and intermediate course objectives with 80% proficiency and 540 shop hours. After being recommended by instructor, complete the SIE program application. |
| 13.4 | The student will exhibit his ability to prepare for and to carry out a job interview with a rating of 80% or better using the VICA rating scale. | 13.4 | Using job interview information by VICA and Kiwanis Club prepare for and carry out a dots interview. Attain a rating of 80% using the VICA Rating Scale. |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE OBJECTIVE NO. 13.0 (cont'd) Orientation, Human Relations & Safety

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 13.5 | The student will demonstrate his knowledge of Human Relations relating to job performance by stating in writing, his understanding of "Why We Work", by submitting a written report of at least two hundred words or by giving an oral presentation for at least ten minutes responding to oral questions from the class correctly. | 13.5 | Correctly state orally or in writing knowledge of Human Relations "Why we Work" by submitting a written report of 200 words or give a ten minute oral presentation and respond to oral questions on the topic. |
| 13.6 | The student will demonstrate his knowledge of safety by stating orally or in writing his understanding of the basic causes contributing to accidents: "Unsafe Acts" and "Unsafe Conditions." The student will submit a written report of at least one hundred words or by giving an oral presentation of five minutes and respond to oral questions from the class correctly. | 13.6 | Correctly demonstrate knowledge of safety by stating orally or in writing, understanding two basic causes of accidents: "Unsafe Conditions" and "Unsafe Acts." Submit a written report of 100 words or give a five minute oral presentation and respond to oral questions on the topic. |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE OBJECTIVE NO. 13.0 (cont'd) Orientation, Human Relations & Safety

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 13.7 | The student will demonstrate his understanding of shop Eye Injury Sources by stating in writing his understanding of the following by submitting a written report of at least two hundred words or oral presentation of ten minutes and respond to oral questions from the class correctly.<br>1. Flying metal chips, fragments of striking tools, nails, rivits and splinters of wood.<br>2. Small flying particles grinding and scaling operations and air-bone dust.<br>3. Splashes of Molten Metal during soldering, brazing, welding, furnace operations, casting and pouring.<br>4. Splashes of liquids, handling acids, alkalies, and corrisive from hot tanks.<br>5. Poisonous dust, gases and vapors which effect the eye directly.<br>6. Radiant Energy and Welding. | 13.7 | Correctly demonstrate understanding of eye injury sources orally or in writing with 80% accuracy the following:<br>1. Flying Metal Chips, fragment of striking tools, nails, rivits and splinters of wood.<br>2. Small flying particles from grinding and scaling operations and air-born dust.<br>3. Splashes of Molten metal during soldering, brazing, welding, furnace operations, casting and pouring.<br>4. Splashes of liquids, handling acids, akalies and corrosives from hot tanks.<br>5. Poisonous dust, gases and vapors which effect the eye directly.<br>6. Radiant Energy and Welding. |

COURSE DIESEL MECHANICS -INTERMEDIATE

TERMINAL PERFORMANCE
OBJECTIVE NO. 14.0 Electric System

Upon completion of the unit on Electrical System consisting of: Fundamentals of Electricity, Magnetism, Electrical Measuring Instruments, Storage Battery Ignition System, Cranking System, and Charging System 90% of the students will demonstrate through 80% correct responses to a criterion test, Objective Knowledge of the Electrical System. The student will demonstrate his ability to perform required service operations on components during laboratory assignments. Using service manuals tools,

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 14.1 | Given a list of ten terms related to fundamentals by explaining orally or in writing seven of ten terms with 100% accuracy.<br>1. Atom<br>2. Electron Theory<br>3. Conductors<br>4. Insulators<br>5. Voltage<br>6. Ampere<br>7. Resistance<br>8. Series Circuits<br>9. Parallel Circuits<br>10. Series Parallel | 14.0<br>14.1 | Test Attached<br>Correctly explain the following related to fundamentals of Electricity:<br>1. Atom<br>2. Electron Theory<br>3. Conductor<br>4. Insulators<br>5. Voltage<br>6. Ampere<br>7. Resistance<br>8. Series Circuits<br>9. Parallel Circuits<br>10. Series Parallel Circuits |
| 14.2 | Given a list of four terms related to magnetism the student will demonstrate his understanding of magnetism by explaining orally or in writing three or four terms with 100% accuracy.<br>1. Magnetism<br>2. Permanent Magnets<br>3. Electromagnets<br>4. Solenoids | 14.2 | Correctly explain the following four terms related to magnetism:<br>1. Magnetism<br>2. Permanent gnets<br>3. Electromag. ts<br>4. Solenoids |
| 14.3 | Given a shop laboratory of customer engine the student will demonstrate his understanding and ability to use voltmeter, ammeter and ohmmeter by checking voltage at starter. | 14.3 | Use Voltmeter, Ammeter, and Ohmmeter correctly and accurately during test on Engine starter. |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE OBJECTIVE NO. 14.0 (cont'd) Electric System

parts and materials; voltage measurement must be .1 volt, clearance measurement .002 ± no abnormal time used.

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 14.3 | Amperage, Draw at starter and ground reading with Ohmmeter. Starter voltage must be 10 volts at starter. Amperage draw must not exceed 45 amperes. With ground brushes insulated or field coil ground disconnected check field windings with Ohmmeter reading should be 100,000 OHMS or higher. Take two reading on all test readings should be within 5% of above values. | | |
| 14.4 | Given an illustration of storage battery the student will demonstrate his understanding of storage battery by stating the function of the battery and identifying 10 of 14 components correctly. | 14.4 | Correctly state function of the storage battery and identify 10 of 14 components correctly. |
| 14.5 | Same Performance Objective. | 14.5 | Using cell tester check battery for shorted cell correctly and accurately. Take two readings using Hydrometer Test and Electrolyte Specific Gravity correctly and accurately. Take two readings. |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE
OBJECTIVE NO. 14.0 (cont'd) Electrical System

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 14.6 | Given a shop laboratory or customer engine the student will demonstrate his ability to replace brushes of a starter motor. Using brushes necessary tools and cleaning materials. Test starter under no load, end play must be .025 ± .005 and run free, starter must not exceed 45 amps underload on vehicle. | 14.6 | Install brusher in starting motor correctly. Test starter for no load running, end thrust and starting load amperace. |
| 14.7 | Install contact points in ignition distributor correctly and set contact dwell accurately. | | |
| 14.8 | Given a shop laboratory or customer engine the student will demonstrate his ability to service the charging system by replacement alternaton tools, ammerer and tachometer. Check alternator output at 1,500 RPM. For 16 volts must be above 12.5 | 14.8 | Install alternator correctly and check correctly the alternator output for 16 volts at 1,500 RPM. |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE
OBJECTIVE NO. 15.0 Starting Methods

Upon completion of the unit on Starting Methods, 90% of the students will demonstrate through 80%, correct responses to a criterion test; objective knowledge of starting methods. The student will demonstrate his ability to perform required service operations on components during laboratory assignments. Using service manuals, parts, and materials. Clearance measurements must be to specifications ± .002 and no abnormal times used.

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| | | 15.0 | Test Attached |
| 15.1 | Given a list of six methods of starting diesel engines, the student will demonstrate his understanding of starting methods by explaining orally or in writing four of the six methods with 100% accuracy.<br>1. Hand Starting<br>2. Electric Starting<br>3. Compressed Air<br>4. Small Gas Engines<br>5. Hydraulic<br>6. Inertia | 15.1 | Correctly explain four of the six methods of starting diesel engines.<br>1. Hand Starting<br>2. Electric Starting<br>3. Compressed Air<br>4. Small Gas Engines<br>5. Hydraulic<br>6. Inertia |
| 15.2 | Given a shop laboratory the student will demonstrate his ability to wire up the electrical starting system. Using battery, battery wire leads, solonoid, starter button, and leads, tools, materials and shop manual. Wiring hook up must conform to manufacturers wiring diagram and starting amperage not exceed 50 amps. | 15.2 | Correctly hook up electrical starting system on shop laboratory engine. |
| 15.3 | Given a diagram of a air starting system employing five components on the engine. The student will demonstrate his understanding of air starting methods by identifying and explaining | 15.3 | Correctly identify and explain the function of the four of five air starting system components.<br>1. Air Starting Control Valve<br>2. Air Starting Manifold<br>3. Air Starting Distributor Valves |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE OBJECTIVE NO. 15.0 (cont'd) Starting Methods

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 15.3 (Cont) | the function of four of the five components correctly. | 15.3 | 4. Air Starting Supply Lines<br>5. Air Starting Check Valves |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE OBJECTIVE NO. 15.0 (cont'd) Starting Methods

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 15.4 | Given a shop laboratory or customer engine the student will demonstrate his ability to remove, inspect, adjust and replace a gasoline engine starting pinion used on a caterpillar diesel. Using necessary tools, materials, and shop manual. Check clutch plate; Thickness. 125 ± .002 starting pinion clutch must release at 5,000 RPM maximum. | 15.4 | Correctly remove, inspect, reinstall and adjust gasoline starting engine pinion and clutch for caterpillar diesel. |
| 15.5 | Given a diagram of a hydraulic engine starting system employing five components. The student will demonstrate his understanding of hydraulic starting system methods by identifying and explaining the function of four of the five components correctly. | 15.5 | Correctly identify and explain the function of four of five hydraulic starting system components.<br>1. Starter assembly<br>2. Accumulator<br>3. Hand pump<br>4. Engine driven pump<br>5. Reservoir |
| 15.6 | Given a diagram of an inertia engine starting system, the student will demonstrate his knowledge of inertia starting methods by explaining inertia starting and correctly identify three of four components. | 15.6 | Correctly identify three of four components and explain inertia starting method.<br>1. Wind handle and housing<br>2. Spring<br>3. Release<br>4. Bendix drive assembly. |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE OBJECTIVE NO. 15.0 (cont'd) Starting Methods

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 15.7 | Given a list of four methods of starting diesel engines in cold weather, the student will demonstrate his understanding of cold weather starting aids, orally or in writing, by explaining three of four methods.<br>1. Grid resistor<br>2. Glow plug<br>3. Flame primer<br>4. Ether capsule primer. | 15.7 | Correctly explain, orally or in writing, three of four methods of starting diesel engines in cold cold weather.<br>1. Grid resistor<br>2. Glow plugs<br>3. Flame primer<br>4. Ether capsule primer |
| 15.8 | The student given a shop laboratory or customer engine electric starter will demonstrate his abilility to perform the required operations to replace armature brushes, inspect commutator and replace armature bushings. Using necessary tools, parts, and material. Commutator segments must show no grounds on test or wear deeper than .005. Replace brushes 50% worn and armature bushing clearance must be .004 ± .001. | 15.8 | Correctly perform the required service operations on a electric starting motor to replace armature brushes, check commutator segments for wear and grounds and replace worn armature shaft bushings. |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE OBJECTIVE NO. 16.0 — Power Trains

Upon completion of this unit on power trains, 90% of the students will demonstrate through 80% correct responses to a criterion test; objective knowledge of power trains. The student will demonstrate his ability to perform required service operations on components during laboratory assignments. Using service manuals, tools, parts, and materials. Clearance measurements must be to manufacturers shop manual specifications + .002 and no abnormal times used.

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| | | 16.0 | Test Attached |
| 16.1 | Given an illustration of a power train employing eight components, the student will demonstrate his knowledge of power trains, orally or in writing, by defining and explaining the function of six of eight power train components. | 16.1 | Correctly define and explain the function of the following eight power train components:<br>1. Clutch<br>2. Transmission<br>3. Universal Joints<br>4. Propeller Shaft<br>5. Axle Housing<br>6. Axle Shaft<br>7. Differential<br>8. Propeller Shaft Support Bearing. |
| 16.2 | Given a shop laboratory or customer engine the student will demonstrate his ability to perform the required service operations to remove and replace a clutch plate and inspect the clutch release bearing. Using manufacturers shop manuals, necessary tools, parts and material. Flywheel surface must show no heat cracks or scores deeper than .025 in clutch plate contact area and the pressure plate contact face. Clutch shaft splines no wear in excess of .015 deep. Release bearing must be quiet and have no rough spots when rotated; clutch reassembled and tested; must release and operate quietly. | 16.2 | Correctly perform the required service operations to remove, inspect and replace a clutch plate and clutch release yoke and bearing. |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE OBJECTIVE NO. 16.0 (cont'd) Power Trains

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 16.3 | Given as illustration of a sliding gear transmission and a constant mesh transmission, the student will demonstrate his knowledge of transmissions, orally or in writing, by identifying each type and stating the major differences of each type with 100% accuracy. | 16.3 | Correctly identify sliding gear and constant mesh type transmissions and state the major difference of each type. |
| 16.4 | Given a shop laboratory or customer engine the student will demonstrate his ability to perform the required service operations to remove, disassemble, install and test for proper operations. A transmission gear must be inspected for excessive wear .025 backlash and tooth failure. Splines no wear exceeding .025, bearings must be quiet and have no rough spots when rotated. Reassemble, install, and test. Transmission must shift smoothly and operate quietly. | 16.4 | Correctly perform the required service operations to remove, disassemble, clean, inspect for wear, or faulty parts. Reassemble and install; and test a transmission. |

COURSE DIESEL ENGINES - INTERMEDIATE

TERMINAL PERFORMANCE OBJECTIVE NO. 16.0 (cont'd) Power Trains

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 16.5 | Given an illustration of two types of propeller shaft arrangements and four gear arrangements used in final drives, the student will demonstrate his knowledge, orally or in writing, by identifying and explaining the design characteristics of the two propeller shafts and four final drive gear arrangements with 100% accuracy. | 16.5 | Correctly identify and explain the design characteristics of the two type propeller shafts and four final drive gear arrangements illustrated.<br>Propeller Shafts<br>1. Torgue Tube Type<br>2. Hotchkiss Drive<br>Final Drive Gears<br>1. Worm Gear<br>2. Spiral Bevel Gear<br>3. Spur Bevel Gear<br>4. Hypoid Gear |
| 16.6 | Given a shop laboratory or customer engine the student will demonstrate his ability to perform the required service operations to remove and replace a propeller shaft universal joint. Using the manufacturers shop manual, necessary tools, parts, and material. Remove lock rings, bearings, and cross from joint. Inspect trunnion bearings for broken needles and pitted areas cross for wear, cracked, or pitted journals, yokes for cracks or excessive bearing clearance in yoke bore .002+<br>1. Replace grease seals if damaged in disassembly, grease and reassemble universal joint, it must flex freely with no backlash and operated quietly under load. | 16.6 | Correctly perform the required service operations to remove, inspect, lubricate, and replace a propeller shaft universal joint. |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE OBJECTIVE NO. 16.0 (cont'd) Power Trains

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 16.7 | Given an illustration of a differential the student will demonstrate his knowledge of differentials by explaining the function orally or in writing, and identify seven of ten components. | 16.7 | Correctly explain the function of differentials and identify the following ten components:<br>1. Companion Flange<br>2. Pinion Shaft<br>3. Pinion Bearing<br>4. Bevel Drive Pinion<br>5. Bevel Drive Gear<br>6. Differential Pinions<br>7 Differential Side Gears<br>8. Differential Case<br>9. Tapered Roller Bearings<br>10. Axle Shaft |
| 16.8 | Given a shop laboratory or customer differential assembly the student will demonstrate his ability to perform the required services operations to remove, disassemble, inspect for wear or faulty parts, reassemble, install, and test for proper operation, gears must be inspected for excessive wear or failure .115 backlash with dial indicator. Bearings must be quiet and have no rough spots when rotated bearing cups must have no pitted areas. Reassemble, install, and test. Differential must operate smoothly and quietly. | 16.8 | Correctly perform the required service operations to remove, disassemble, clean, inspect for wear or faulty parts. Reassemble, install, and test a differential. |
| 16.9 | Given an illustration of a torgue converter the student will demonstrate his knowledge of it by explaining the principle of operations, orally or in writing, and identify seven of the ten parts. | 16.9 | Correctly explain the operating principle of a torgue converter and identify the following ten parts:<br>1. Flywheel<br>2. Pump Cover<br>3. Turbine<br>4. Secondary Stator<br>5. Primary Stator<br>6. Secondary Pump |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE OBJECTIVE NO. 16.0 (cont'd) Power Trains

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| | | 16.9 | 7. Primary Pump<br>8. Input Shaft<br>9. Free Wheeling Clutches<br>10. Reaction Shaft |
| 16.10 | Given an illustration of a simple gear system the student will demonstrate his knowledge by identifying the four members of the system and stating the three conditions that must be met for power to be transmitted in a planetary gear system with 100% accuracy.<br>Members:<br>1. Planetary Sun Gear<br>2. Planetary Pinion<br>3. Planetary Carrier<br>4. Planetary Ring Gear<br><br>Conditions:<br>1. Engine delivering power to one of the three members.<br>2. The propeller shaft is connected to one of the other members.<br>3. The remaining member is held against rotation. | 16.10 | Correctly identify the four members of a simple planetary gear system and correctly state three conditions that must be met for power to be transmitted. |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE
OBJECTIVE NO. 17.0 Brake Systems

Upon completion of this unit on Brake Systems 90% of the students will demonstrate through 80% correct responses to a criterion test; objective knowledge of Brake Systems. The student will demonstrate his ability to perform required service operations on components during laboratory assignment; using service manuals, tools, parts, and materials. Clearance measurements must be to manufacture shop manual specification ±.002 and no abnormal times used.

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| | | 17.0 | Test Attached |
| 17.1 | The student will demonstrate his knowledge of Brake Systems by stating four types of Brake Systems with 100% accuracy. | 17.1 | Correctly state four types of Brake Systems:<br>A. Mechanical<br>B. Hydraulic<br>C. Air<br>D. Electric |
| 17.2 | Given an illustration of External Contracting and internal expanding mechanical brakes the student will state their use and identify the components, with 100% accuracy. | 17.2 | Correctly state the use of External Contracting and Internal Expanding Mechanical Brakes and identify the components illustrated. |
| 17.3 | The student will demonstrate his knowledge of Hydraulic Brake Systems by explaining the operating principle and identifying five of six major components. | 17.3 | Correctly explain the operating principle of Hydraulic Brakes and identify five of six components:<br>1. Pedal<br>2. Master-cylinder<br>3. Brake-line<br>4. Wheel Cylinders<br>5. Brake Shoes<br>6. Brake Drums |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE OBJECTIVE NO. 17.0 (cont'd) Brake Systems

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 17.4 | Given a shop laboratory or customer job the student will demonstrate his ability to perform the required service operations to remove, repair, replace, and adjust wheel units of a Hydraulic Brake System. Using manufacturers shop manual, necessary equipment, tools and parts, hone wheel cylinder units bore must be free of pits. Check piston in cylinder bore .025 maximum clearance. Install new piston cups; Return spring must be free of pits; Install new wheels, cylinder boots, replace brake shoes and lining assemblies. Turn brake drums to removed scored surface areas not to exceed .090. Reassemble brake, adjust and test, must not drag, grab, or be noisy in operation. | 17.4 | Correctly perform the required service operations to remove, repair, replace, and adjust wheeel units of a Hydraulic Brake System. |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE OBJECTIVE NO. 17.0 (cont'd) Brake Systems

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 17.5 | The student will demonstrate his knowledge of air brake systems by explaining the operating principle and identifying nine of twelve major components. | 17.5 | Correctly explain the operating principle of Air Brake Systems and identify the following twelve major components:<br>1. Brake Chamber<br>2. Slack Adjuster<br>3. Rubber Hose<br>4. Quick Release Valve<br>5. Compressor<br>6. Reservoir<br>7. Governor<br>8. Guage<br>9. Brake Pedal<br>10. Brake Valve<br>11. Relay Valve<br>12. Copper Tubing |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE OBJECTIVE NO. 17.0 (cont'd) Brake Systems

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 17.6 | Given a shop laboratory or customer job the student will demonstrate his ability to perform the required services, replace and adjust wheel units of an air brake system. Using manufacturers shop manual, necessary equipment, tools, parts, and material, remove brake drum, brake shoe and lining assemblies, slack adjusters, brake camshaft and wheel bearings. Turn brake drums to remove score surface areas; not to exceed .120 student must inspect and reject faulty parts and measure clearance to within ±.002 and work at an acceptable rate. Reassemble air brake wheel unit, adjust and test, must not drag, grab, or operate noisily. | 17.6 | Correctly perform the required service operations to remove, repair, replace, and adjust wheel units of an Air Brake System. |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE
OBJECTIVE NO. 17.0 (cont'd) Brake Systems

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 17.7 | The student will demonstrate his knowledge of a vacuum power brake cylinder by explaining the operating principle and identifying nine of twelve components of a Hydraulic vacuum brake system. | 17.7 | Correctly explain the operating principle of vacuum power brake cylinder and identify the following components:<br>1. Wheel Cylinder<br>2. Brake Lines<br>3. Hydraulic Slave Cylinder<br>4. Brake Pedal & Master-cylinder<br>5. Engine Intake Manifold<br>6. Vacuum Check Valve<br>7. Relay Valve<br>8. Front and Rear Pistons<br>9. Center Plate<br>10. Piston Rod<br>11. Push Rod<br>12. Piston Return Spring |
| 17.8 | The student will demonstrate his knowledge of electric brake system by explaining the operating principle and identifying four of the six components in an electric brake wheel unit. | 17.8 | Correctly explain the operating principle of electric brake system and identify the following components in the brake wheel unit:<br>1. Armature or Disk<br>2. Electromagnet<br>3. Lug<br>4. Cam Lever<br>5. Brake Band<br>6. Brake Drum |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE
OBJECTIVE NO. 18.0 Chassis Components

Upon completion of the unit on Chassis Components 90% of the students will demonstrate through 80% correct response to a criterion test, objective knowledge of Chassis Components. The student will demonstrate his ability to perform required service operations during laboratory assignment. Using service manuals, tools, parts, and materials. Clearance measurements must be to manufacturers specifications .002 and no abnormal times used.

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| | | 18.0 | Test Attached |
| 18.1 | The student will demonstrate his knowledge of the Vehicle Chassis by stating orally or in writing the six major components that make up the chassis with 100% accuracy. | 18.1 | Correctly state the function of the Chassis and the six major components:<br>1. Frame<br>2. Springs<br>3. Shock absorbers<br>4. Steering Mechanism<br>5. Wheels<br>6. Brakes |
| 18.2 | Given an illustration of a frame the student will identify five or six main strength members correctly:<br>1. Side Member<br>2. X member<br>3. Front Cross member<br>4. Rear Engine Support<br>5. Rear Cross Member<br>6. Body to Frame Attachment | 18.2 | Correctly identify the six main strength members of the frame on the illustrations. |
| 18.3 | Given a shop laboratory or customer job the student will demonstrate his ability to perform the required service operations to remove, repair, replace either a leaf or coil spring unit of the suspension system. Inspect spring leaves or coils for cracks of excessive pits, shackle pins, and bushings must show no excessive wear. | 18.3 | Correctly perform the required service operations to remove, repair, replace, and test a leaf or coil spring unit of the suspension system. |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE
OBJECTIVE NO. 18.0 (cont'd) Chassis Components

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 18.3 | To within ±.002 and work at an acceptable rate, spring unit must operate properly and without excessive noise. | | |
| 18.4 | The student will demonstrate his knowledge of wheel rims and tires by stating, orally or in writing, the two basic type of wheel rims and the function of four of five tire components correctly. | 18.4 | Correctly state the two basic type wheel rims and the function of four of five tire components:<br>1. Tread<br>2. Breaker<br>3. Cushion<br>4. Plies<br>5. Bead Wires |
| 18.5 | Given a shop laboratory or customer job the student will demonstrate his ability to perform the required service operations to remove, disassemble, clean, inspect for wear or damaged parts a cam and lever type or recirculating ball type steering gear unit. Using manufacturers shop manual, tools, parts, and material. The student must be able to reject faulty parts and measure clearance to within ±.002 and work at an acceptable rate. Steering gear unit must operate freely and quietly throughout the entire turning range. | 18.5 | Correctly perform the required service operations to remove, clean, inspect, repair, and replace a cam and lever or recirculating ball type steering gear unit. |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE OBJECTIVE NO. 18.0 (cont'd) Chassis Components

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 18.6 | The student will demonstrate his knowledge of wheel alignment by explaining orally or in writing four of the five terms related to vehicle wheel alignment:<br>1. Pivot Inclination<br>2. Wheel Caster<br>3. Wheel Camber<br>4. Toe-In<br>5. Toe-Out | 18.6 | Correctly explain four of the five terms related to Vehicle Wheel Alignment.<br>1. Pivot Inclination<br>2. Wheel Caster<br>3. Wheel Camber<br>4. Toe-In<br>5. Toe-Out |
| 18.7 | Given an illustration of a Hydraulic Power steering System employing thirteen components, the student will identify and explain the function of ten of the thirteen components correctly:<br>1. Steering Arm<br>2. Piston Arm Assembly<br>3. Power Cylinders<br>4. Roller and Worm<br>5. Spur Gears<br>6. Valve Operating Block<br>7. Left Turn Reaction Valve<br>8. Right Turn Distribution Valve<br>9. Left Turn Distribution Valve<br>10. Right Turn Reaction Valve<br>11. Flexible Coupling<br>12. Oil Pump<br>13. Oil Pump Drive | 18.7 | Correctly identify and explain the function each of the thirteen components in the Hydraulic power system shown on the illustration. |
| 18.8 | Given a shop laboratory or customer job the student will demonstrate his ability to perform the required service operations on a vehicle body window lift unit. Remove, disassemble, inspect for worn or damaged parts; the door window lift unit. | 18.8 | Correctly perform the required service operations to remove disassemble, inspect and repair a vehicle body window regulator unit. |

COURSE DIESEL MECHANICS - INTERMEDIATE

TERMINAL PERFORMANCE
OBJECTIVE NO. 18.0 (cont'd) Chassis Components

| NO. | INTERMEDIATE PERFORMANCE OBJECTIVES | NO. | CRITERION MEASURES |
|---|---|---|---|
| 18.8 | (Cont'd)<br><br>Using manufacturers shop manual, tools, parts, and material, students must be able to reject faulty parts and measure clearance to within ±.002 and work at an acceptable rate. Window lift unit must operate freely throughout lift range and have no rattles in the unit. | | |