DOCUMENT RESUME

ED 107 983 95 CE 004 196

AUTHOR Salsbury, Robert C.; Kline, Charles R.
TITLE An Analysis of the Small Engine Repair Occupation.
INSTITUTION Ohio State Dept. of Education, Columbus. Div. of Vocational Education.; Ohio State Univ., Columbus. Trade and Industrial Education Instructional Materials Lab.
SPONS AGENCY Office of Education (DHEW), Washington, D.C.
PUB DATE [75]
NOTE 145p.; For related documents, see CE 004 160-195, CE 004 197-206, CE 004 263-268, and CE 004 425-427

EDRS PRICE MF-$0.76 HC-$6.97 PLUS POSTAGE
DESCRIPTORS Auto Mechanics; Auto Mechanics (Occupation); Communication Skills; *Equipment Maintenance; *Job Analysis; Knowledge Level; *Machine Repairmen; *Occupational Information; Safety; Skill Analysis; Skill Development; Skilled Occupations; *Task Analysis; Task Performance; Work Attitudes
IDENTIFIERS *Small Engine Repair

ABSTRACT

The general purpose of the occupational analysis is to provide workable, basic information dealing with the many and varied duties performed in the small engine repair occupation. The document opens with a brief introduction followed by a job description. The bulk of the document is presented in table form. Sixteen duties are broken down into a number of tasks and for each task a two-page table is presented, showing on the first page: tools, equipment, materials, objects acted upon; performance knowledge (related also to decisions, cues and errors); safety--hazard; and on the second page; science; math--number systems; and communications (performance modes, examples, and skills and concepts). The duties include: testing performance of engine; maintaining and repairing ignition, fuel system, governors, starter systems, charging system, cooling system, lubrication system, valve train, short block assemblies, crankcase breathers, exhaust system, and shop equipment and tools; storing equipment for off season; maintaining small engine powered equipment; and operating a business. A glossary of terms related to small engine repair is appended. (BP)

Occupational Analysis

SMALL ENGINE REPAIR

Instructional Materials Laboratory
Trade and Industrial Education
The Ohio State University

5150

AN ANALYSIS OF THE SMALL ENGINE REPAIR OCCUPATION

Developed By

Robert C. Salsbury
Instructor, Engine Repair
Four County J.V.S.
Archbold, Ohio

Charles R. Kline
Instructor, Small Engine Repair
Roosevelt High School
Kent, Ohio

Occupational Analysis
E.P.D.A. Sub Project 73402
June 1, 1973 to December 30, 1974
Director: Tom L. Hindes
Coordinator: William L. Ashley

The Instructional Materials Laboratory
Trade and Industrial Education
The Ohio State University

"The activity which is the subject of this report was supported in whole or in part by the U.S. Office of Education, Department of Health, Education, and Welfare. However, the opinions expressed herein do not reflect the position or policy of the U.S. Office of Education, and no official endorsement by the U.S. Office of Education should be inferred."

TABLE OF CONTENTS

FOREWORD

The occupational analysis project was conducted by The Instructional Materials Laboratory, Trade and Industrial Education, The Ohio State University in conjunction with the State Department of Education, Division of Vocational Education pursuant to a grant from the U.S. Office of Education.

The Occupational Analysis project was proposed and conducted to train vocational educators in the techniques of making a comprehensive occupational analysis. Instructors were selected from Agriculture, Business, Distributive, Home Economics and Trade and Industrial Education to gain experience in developing analysis documents for sixty-one different occupations. Representatives from Business, Industry, Medicine, and Education were involved with the vocational instructors in conducting the analysis process.

The project was conducted in three phases. Phase one involved the planning and development of the project strategies. The analysis process was based on sound principles of learning and behavior. Phase two was the identification, selection and orientation of all participants. The training and workshop sessions constituted the third phase. Two-week workshops were held during which teams of vocational instructors conducted an analysis of the occupations in which they had employment experience. The instructors were assisted by both occupational consultants and subject matter specialists.

The project resulted in producing one hundred two trained vocational instructors capable of conducting and assisting in a comprehensive analysis of various occupations. Occupational analysis data were generated for sixty-one occupations. The analysis included a statement of the various tasks performed in each occupation. For each task the following items were identified: tools and equipment; procedural knowledge; safety knowledge; concepts and skills of mathematics, science and communication needed for successful performance in the occupation. The analysis data provided a basis for generating instructional materials, course outlines, student performance objectives, criterion measures as well as identifying specific supporting skills and knowledge in the academic subject areas.

PREFACE

The overall scope of this project was to analyze the different tasks that a Small Engine Mechanic performs in the job. The steps under each task are only specific enough to help select the subject matter for writing a course curriculum. It should be understood that this is a document that another Small Engine Instructor or Mechanic could use to gather information for writing curriculum and is not intended to be used to teach from directly.

It is felt that the main duty of a small engine mechanic is to repair the engine and in this document, the equipment that the engine is used on and the business operating aspects are secondary. The duties of maintaining equipment and business procedures were done very generally and could be separate task analyses of their own.

Because of the complexity and depth of the material covered, it was not possible to handle all of the material in proper sequence.

We hope that our efforts will be of value to other people in the teaching and small engine professions.

ACKNOWLEDGMENT

We wish to acknowledge the valuable assistance rendered by the following subject matter specialists. They provided input to the vocational instructors in identifying related skills and concepts of each respective subject matter area and served as training assistants in the analysis process during the two-week workshops.

Rollin M. Barber, Psychology
The Ohio State University
Columbus, Ohio

Jodi Beittel, Communications
Columbus, Ohio

Diana L. Buckeye, Mathematics
University of Michigan
Avon Lake, Ohio

Rick Fien, Chemistry
The Ohio State University
Beachwood, Ohio

N.S. Gidwani, Chemistry
Columbus Technical Institute
Columbus, Ohio

Bruce A. Hull, Biology
The Ohio State University
Columbus, Ohio

Donald L. Hyatt, Physics
Worthington High School
Worthington, Ohio

Glenn Mann, Communications
Columbus, Ohio

Jerry McDonald, Physical Sciences
Columbus Technical Institute
Reynoldsburg, Ohio

Colleen Osinski, Psychology
Columbus Technical Institute
Columbus, Ohio

David Porteous, Communications
University of Connecticut
Colchester, Connecticut

James A. Sherlock, Communications
Columbus Technical Institut
Columbus, Ohio

Jim VanArsdall, Mathematics
Worthington High School
Worthington, Ohio

Lillian Yontz, Biology
The Ohio State University
Caldwell, Ohio

Acknowledgment is extended to the following I.M.L. staff members for their role in conducting the workshops; editing, revising, proofing and typing the analyses.

Faith Justice	Research Associate
Sheila Nelson	Administrative Assistant
Marsha Opritza	Editorial Consultant
Rita Buccilla	Typist
Peg Bushelman	Typist
Carol Fausnaugh	Typist
Mindy Fausnaugh	Typist
Rita Hastings	Typist
Carol Hicks	Typist
Sue Holsinger	Typist
Barbara Hughes	Typist
Carol Marvin	Typist
Patti Nye	Typist
Kathy Roediger	Typist
Mary Salay	Typist

JOB DESCRIPTION

The small engine repair mechanic's main duties are to troubleshoot, maintain and repair air and water cooled engines used on different types of equipment such as lawn and garden equipment, agriculture equipment, off-the-road equipment, recreational equipment, etc. The mechanic's other duties are to maintain and repair the equipment that the engines are used on and establish and maintain customer relations. Other aspects that a mechanic has knowledge of is purchasing and selling of engines, equipment and parts, buying and maintaining tools and ship equipment and keeping business records.

Duty A Testing Performance of Engine

1 Start and operate engine
2 Determine cause of engine knock or ping
3 Operate dynamometer

//

(TASK STATEMENT) START AND OPERATE ENGINE

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Operators manual Engine Gasoline Oil Mechanic's tool set (see appendix) Measuring cup Fuel container	Read operator's manual Prepare engine for starting Start engine Operate engine	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Clean area Disengage clutch Personal injury from operating engine and equipment Fire potential Exhaust

DECISIONS	CUES	ERRORS
Decide type of fuel and oil and amount Decide if fuel shut off value is on and how to choke or prime Determine if ignition is on	Operator's manual Fuel/Oil ratios Position of switch	Damage engine Engine will not start Engine will not start

(TASK STATEMENT) START AND OPERATE ENGINE

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Screwdriver for checking oil] Centrifugal forces developed by bodies in rotation [Rotating engine] Inertia and momentum [Reciprocating parts]	Positive rationals Use of Numbers (without calculation) Indexing [Use of operators manual] Basic Arithmetic Skills and Concepts Ratio and proportion [Fuel/Oil mixtures] Measurement: non-geometric Liquid [Liquid measurement]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Operators manual	Comprehension, Process - Instructional

(TASK STATEMENT) DETERMINE CAUSE OF ENGINE KNOCK OR PING

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Engine Load source	Operate engine Apply load source Analyze results	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Moving parts Fire
DECISIONS	**CUES**	**ERRORS**
Decide location of noise Decide type of noise	Knock in crankcase or combustion chamber Knock in combustion chamber Sound of noise	Repair of wrong part Wasted time

(TASK STATEMENT) DETERMINE CAUSE OF ENGINE KNOCK OR PING

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Levers] Centrifugal forces developed by bodies in rotation [Rotating engine] Inertia and momentum [Reciprocating parts]	Basic Logic Deductive and inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Listening	Running engine	Noise discrimination

(TASK STATEMENT) OPERATE DYNAMOMETER

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Dynamometer Engine Paper and pencil	Prepare dynamometer and engine Start and warm up engine Apply load and record data Interpret test data	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Noise Fire Moving parts Physical burns
DECISIONS	**CUES**	**ERRORS**
Decide proper connections Decide when engine is warm Decide speed and load Decide which formula to use Decide if engine is within manufacturer specifications	Operators manual for dynamometer Time Manufacturer's rated horse power at rated revolutions per minute Specifications Operator's manual 80% - 90% rated horse power	Improper reading Accidents Lubrication failure False torque reading False horse power

(TASK STATEMENT) OPERATE DYNAMOMETER

SCIENCE	MATH – NUMBER SYSTEMS
Function of Dynamometer Simple machines used to gain mechanical advantage [Torque arm on dynamometer] Work input, work output, friction and efficiency in simple machines [Principles of dynamometer] Fluids under pressure [Hydraulic pressure in dynamometer]	Whole numbers Positive fractions and decimal fractions Use of Numbers (without calculation) Recording [Recording data] Fundamental Operations (Calculation) Addition, Subtraction, Multiplication, Division [Compute formula] Basic Arithmetic Skills and Concepts Reduction of fractions, Finding a percent of a number and what percent one number is of another, Changing fractions to decimal and decimals to fractions [Computing horse power] Instruments: [Tachometer] Measurement: non-geometric Speed [Force] Time Estimating horse power Computing cubic inch displacement Computing compression ratio

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Operator's manual	Comprehension, Informational reports, Terminology, Process-Instructional
Writing	Data	Penmanship
Listening	Engine overload	Noise discrimination

Duty B Maintaining and Repairing Ignition

1 Test ignition output
2 Test ignition components
3 Replace ignition components
4 Adjust and test ignition timing

18

(TASK STATEMENT) TEST IGNITION OUTPU

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Spark jump gap tool	Connect tool Pull engine through and observe spark Evaluate spark	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Potential shock Personal injury

DECISIONS	CUES	ERRORS
Determine if spark is satisfactory	Brightness and color, distance and size, and sound	Poor or no performance

(TASK STATEMENT) TEST IGNITION OUTPUT

SCIENCE	MATH – NUMBER SYSTEMS
Resistance of materials to flow of electrical current [Air resistance to current flow, air gap size related to voltage requirements. and function of insulating materials]	Fractions and decimal fractions Measurement: geometric Linear [Spark gap] Basic Logic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Viewing	Spark	Visual analysis
Listening	Spark	Auditory discrimination

(TASK STATEMENT) TEST IGNITION COMPONENTS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Ignition analyzer Continuity tester Service manual Components Points Condenser Coil Rotor Distributor Wires Pulse pack Switches	Check manufacturer's specifications Test components for proper function and values Evaluate test results and determine item to be replaced	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Personal injury Shock potential Shorts Equipment damage
DECISIONS	**CUES**	**ERRORS**
Decide if components are satisfactory	Test results compared with manufacturer specifications	Poor performance Early failure

(TASK STATEMENT) TEST IGNITION COMPONENTS

SCIENCE	MATH – NUMBER SYSTEMS
Magnetic fields of force [Magnetic field of coil] Resistance of materials to flow of electrical current [Electrical connections and insulation] Functions of ignition tester	Whole numbers and decimal fractions Use of Numbers (without calculation) Counting, Indexing [Service manuals] Instruments [Volt Ohm's meter] Measurement: non-geometric [Electrical measure]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Locating information Meters	Terminology Visual analysis, Detail/Inference

(TASK STATEMENT) REPLACE IGNITION COMPONENTS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Flywheel pullers Air Cleaning solution Lubricant Service manual Parts manual Spark plug chart Parts Plugs Points Condenser Coils Wires Pulse pacts Switches Rotor Cam wick	Pick items from supply source Install items Adjust as required to specifications Test run	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Shock and burns
DECISIONS	**CUES**	**ERRORS**
Decide which components are correct or should be used Determine specifications	Parts manual, Spark plug chart, specific use of equipment Manufacturer's manual	Poor performance, damaged equipment Poor performance, would not run

(TASK STATEMENT) REPLACE IGNITION COMPONENTS

SCIENCE	MATH – NUMBER SYSTEMS
Transfer of heat form one body to another [Select spark plug heat range] Resistance of materials to flow of electrical current [Avoid short circuits, clean and tighten connections] Function of ignition components	Whole numbers Fractions and decimals Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding, Measurement [Uses parts manual] Instruments [Feeler gauge] Measurement: geometric Linear [Point gap] Read and interpret tables, charts and graphs [Specification charts]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Parts manual	Locate information
	Service manual	Locate information
Touching	Adjust points	Drag

(TASK STATEMENT) ADJUST AND TEST IGNITION TIMING

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Timing light Continuity tester Timing fixture Service manual Parts Centrifugal advance Vacuum advance Timing fixtures Degree wheel	Check manufacturer's specifications Clean and set points on dwell Check timing marks on gears, belts, impulse couplings and starter plates Make timing adjustments Check timing advance devices Synchronize ignition to carburetion	Stay clear of rotating parts Personal injury Damaged equipment
DECISIONS	**CUES**	**ERRORS**
Decide to set point gap and then timing Decide which procedure to follow	Point gap effects timing Manufacturer's procedures and equipment available	Incorrect timing Accuracy of setting

25

(TASK STATEMENT) ADJUST AND TEST IGNITION TIMING

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Simple machines, screwdriver, incline plane on point cam] Addition and subtraction of whole numbers [Synchronize, timing relation of spark to piston position and carburetion]	Integers Fractions/Decimals Basic Arithmetic Skills and Concepts Reduction of fractions, Changing fractions to decimal and decimals to fractions [Piston location] Instruments [Steel rule] Measurement: geometric Linear [Piston location], Angle [Crankshaft rotation] Measurement: non-geometric Time

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Touching	Service manual Adjust points	Terminology Drag

Duty C Maintaining and Repairing Fuel System

1 Service or replace air cleaner
2 Adjust carburetor
3 Inspect, repair, or replace carburetor
4 Inspect, repair or replace fuel tank
5 Inspect, repair or replace fuel line
6 Inspect, service or replace fuel filter
7 Test, repair or replace fuel pump
8 Mix fuel and oil mixtures and refuel engine
9 Inspect and service intake manifold

27

(TASK STATEMENT) SERVICE OR REPLACE AIR CLEANER

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Cleaning solvent Brush Air Rag Detergent soap Water New filter	Inspect air cleaner Select method of cleaning Clean and service or replace air cleaner	Use correct solvent Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Fire Air Solvents
DECISIONS	**CUES**	**ERRORS**
Determine whether to replace or clean air cleaner Determine to service or replace Determine correct filter to use Determine method of cleaning	Condition of air cleaner Type of air cleaner Manufacturer's recommendations Time of service Type of engine Type of parts manual	Damage to air cleaner Damage to engine Poor fuel consumption

(TASK STATEMENT) SERVICE OR REPLACE AIR CLEANER

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Screwdriver for removing screws, gasoline can break down air cleaner through continuous flooding] Function of air cleaner	Measurement: non-geometric Liquid [Liquid measurement] Positive rationals Basic Arithmetic Skills and Concepts Ratio and proportion [Cleaning solution]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Service manual	Locating data, Comprehension
	Parts manual	Locating data, Terminology, Detail
Viewing	Condition of	Analyze condition
	Air cleaner	Comparing used to new

(TASK STATEMENT) ADJUST CARBURETOR

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Tachometer Load source	Make initial manufacturer's recommended adjustment Operate engine under normal revolutions per minute; load and adjust high speed mixture screw and high speed limit screw Idle engine at manufacturer's recommended revolutions per minute; adjust idle mixture and idle stop screw	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Keep hands from moving parts Operating engine Moving parts
DECISIONS Determine type of carburetor Determine which screw is high speed mixture, low speed mixture and idle stop screw Determine which way to turn screw	**CUES** Where screws should be set before starting engine Position of screw Performance and revolutions per minute of engine Black smoke from exhaust	**ERRORS** Engine will not start Loss of power Overheating Eratic operation

(TASK STATEMENT) ADJUST CARBURETOR

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Use of screwdriver] Fluids under pressure [Pushing of fuel through nozzle by differential of pressure] Function of carburetion	Use of Numbers (without calculation) Ratio Measurement: non-geometric Speed Rate ''Measure sense''/role of ''unit'' Rational numbers Instruments Tachometer

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Manufacturer's specifications	Comprehension, Locate data
Viewing	Tachometer Position of screw	Speed/Rate Rotation Exhaust
Listening	Engine Performance	Noise discrimination
Touching	Engine, screws	Vibration, tightness

(TASK STATEMENT) INSPECT, REPAIR OR REPLACE CARBURETOR

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Gasoline Squirt can Paper and pencil Mechanic's tool set (see appendix) Service manual Carburetor cleaning solvent Gauges Drill bits 6-inch steel scale Air Carburetor parts	Test for fuel getting to combustion chamber Diagram linkage hook-up before removal Remove carburetor Disassemble carburetor Analyze carburetor Clean and make repairs to carburetor Assemble and install carburetor	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Solvents Air (see appendix) Flamable materials

DECISIONS	CUES	ERRORS
Determine test method Determine sequence in removing of parts Determine if carburetor is to be cleaned, rebuilt or repaired Determine method of cleaning Determine manufacturer's specifications Determine correct parts to use	Ways to administer fuel or find out if fuel is in combustion chamber Type of carburetor Condition of carburetor Position of floats Position of adjusting screws Type of engine and carburetor	Repair carburetor unnecessarily when fault may be in other part of engine Damage to carburetor Improper operation of carburetor Parts will not fit

(TASK STATEMENT) INSPECT, REPAIR OR REPLACE CARBURETOR

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Screwdriver/lever] Function of carburetor Effect of heating and cooling on state of matter [Vaporization of fuel] Fluids under pressure [Effects of atmospheric pressure on fuel] Forces acting on a body immersed or floating in a liquid [Force that raises float] Motion resulting from two or more forces acting on a point in a body [Float push needle against seat - closing fuel pressure] Corrosion - gums - rust Function of carburetion	Positive fractions Basic Arithmetic Skills and Concepts Reduction of fractions Fractions to decimals Fundamental Operations (Calculation) Addition, Subtraction Measurement: geometric Linear [inches] Instruments [Gauges, steel tape] Use of Numbers Counting, Ordering, Indexing, Coding, Measurement [Parts manual] Basic Logic Deductive reasoning

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Service manual	Comprehension, Process, Description, Information
	Parts manual	Detail, Terminology
Viewing	Carburetor condition	Visual analysis
Smelling	Fuel	Odor of bad fuel
Touching	Float adjustment	Drag

(TASK STATEMENT) INSPECT, REPAIR OR REPLACE FUEL TANK

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Cleaning solvents Steam cleaning Solder and soldering iron Torch Epoxy Sheet metal screws O-ring Rocks Glass bead blasting Air	Inspect fuel tank Analyze condition of fuel tank Clean, repair or replace fuel tank	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Dirt Gasoline Air (see appendix)
DECISIONS	**CUES**	**ERRORS**
Determine method of repair or if replacement is necessary	Dirt, rust, leaks, gum and plugged vent Availability of equipment Type of leak or damage Type of material tank is made from	Waste of time Other damage to tank

(TASK STATEMENT) INSPECT, REPAIR OR REPLACE FUEL TANK

SCIENCE	MATH – NUMBER SYSTEMS
Effect of heating and cooling on expansion of materials [Soldering and brazing] Transfer of heat from one body to another [Soldering] Corrosion - rust - gums - varnish Simple machines used to gain mechanical advantage [Lever, screwdriver] Function of carburetion	Measurement: non-geometric Temperature Positive rationals [Properties of solder] Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Smelling	Fuel tank	Odor of gum and varnish
Viewing	Tank and dirt	Visual analysis
Touching	Soldering	Temperature
	Mixing epoxy	Texture
Listening	Tap on tank	Determination of material
Reading	Parts manual	Comprehension, Terminology

(TASK STATEMENT) INSPECT, REPAIR OR REPLACE FUEL LINE

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Fuel container Mechanic's tool set (see appendix) Tubing cutter Flaring tool Air Copper line Neopreme line Compression fittings	Inspect condition of fuel line Analyze condition Repair or replace fuel line	Safety glasses Proper dress Ear protection Air (see appendix) Safety standard equipment (see appendix)
DECISIONS Determine what type of repair is needed or replacement Determine method of repair	**CUES** Leaks, dirt, plugged or kinked Type of connections Material of lines Tools and material available	**ERRORS** Other damage to line Future trouble with engine

(TASK STATEMENT) INSPECT, REPAIR OR REPLACE FUEL LINE

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Pliers to remove clamp] Effect of heating and cooling on state of matter [Vapor lock in fuel line] Resistance of materials to change in shape [Flaring tubing] Function of fuel line	Whole Numbers Positive fractions Measurement: geometric Linear Basic Logic Deductive reasoning

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Viewing	Condition of line	Visual analysis

(TASK STATEMENT) INSPECT, SERVICE OR REPLACE FUEL FILTER

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Cleaning solvents Fuel container Air Fuel filter	Visually inspect filter and test fuel flow Analyze condition of filter Clean and/or replace filter	Safety glasses Proper dress Ear protection Fire extinguisher Safety standard equipment (see appendix) Combustion of fuel
DECISIONS	**CUES**	**ERRORS**
Determine to service or replace Determine method of cleaning Determine correct part	Dirt, time in service, absence of fuel or small amount of flow of fuel, damaged filter or type of filter Type of engine and filter Manufacturers recommendations	Poor engine performance Part will not fit

(TASK STATEMENT) INSPECT, SERVICE OR REPLACE FUEL FILTER

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Use of pliers removing clamps] Forces acting on a body immersed or floating in a liquid [Water and dirt - settle in sediment bowl] Function of fuel filter	Whole Numbers Use of Numbers (without calculation) [Finding parts] Counting, Indexing, Ordering, Coding Deductive/Inductive [Deductive reasoning] Basic Arithmetic Skills and Concepts Ratio and proportion [Cleaning solutions]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Viewing Reading	Condition of filter Parts number Parts manual	Analysis Memory Detail

(TASK STATEMENT) TEST, REPAIR AND REPLACE FUEL PUMP

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Measuring cup Pressure - vacuum gauge	Read manufacturer's specifications and procedures Test flow of fuel Test pressure and vacuum Evaluate test results Repair or replace pump	Safety glasses Proper dress Ear protection Safety standard equipment Fuel combustion
DECISIONS	**CUES**	**ERRORS**
Decide if fuel pump is within manufacturer's specifications Decide to repair or replace Determine which parts or pump to use	Type of fuel pump Rate of flow, low pressure, low vacuum availability of parts Dirty fuel system Type of engine	Poor engine operation Wrong parts or pump

(TASK STATEMENT) TEST, REPAIR AND REPLACE FUEL PUMP

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Use of pliers for removing clamps] Pressure differential - Pressure per square inch - from pumping action Forces acting on a body immersed or floating in a liquid [Force acting upon bodies opening and closing of valve] Function of fuel pump	Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding, Recording [Ordering parts] Whole Numbers Measurement of pressure Measurement of vacuum - inches Read and interpret tables, charts and graphs [Specification charts] Basic Logic Deductive reasoning

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Writing Reading Viewing	Recording part numbers Manufacturer's specifications Service manual Rate of flow	Penmanship Detail Process report Visual analysis

(TASK STATEMENT) MIX FUEL AND OIL MIXTURES AND REFUEL ENGINES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Fuel containers Measuring cup Funnel	Select proper fuel and oil Mix proper amount of oil with fuel Pour fuel or mixture into tank	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Splashing of fuel Combustion of fuel

DECISIONS	CUES	ERRORS
Decide type of fuel and/or oil to use Decide amount of oil and fuel to use	Types of fuel and oil recommended by manufacturer Manufacturer's specifications	Engine overheating Loss of power Detonation Physical damage to engine

(TASK STATEMENT) MIX FUEL AND OIL MIXTURES AND REFUEL ENGINES

SCIENCE	MATH – NUMBER SYSTEMS
Ability of chemical mixture - ability of oil to mix with fuel Function of fuel and oil	Whole Numbers Positive fractions Positive rationals Use of Numbers (without calculation) Ratio [Mixing ratio] Fundamental Operations (Calculation) Addition, Subtraction Basic Arithmetic Skills and Concepts Reduction of fractions, Changing mixed numbers to improper fractions, Ratio and proportion, Rounding off decimals and whole numbers [Mixing ratio] "Measure sense"/role of "unit" Instruments [Measuring cup] Measurement: non-geometric [Liquid] Conversion from one standard unit to another [Gallons to quarts] Read and interpret tables, charts and graphs [Gas/Oil mixture charts]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Manufacturer's specifications	Comprehension, Amount/Rate, Recommend charts

43

(TASK STATEMENT) INSPECT AND SERVICE INTAKE MANIFOLD

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Squirt can Gas Oil Tachometer	Test for leak Evaluate test Repair or replace manifold and gasket	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Operating engine Combustion of fuel
DECISIONS Decide material to use to test with Decide if repair or replacement is necessary Decide what part to use	**CUES** Location of exhaust Location of ignition wires Location of leak Blue smoke from exhaust Change of revolutions per minute	**ERRORS** Poor performance of engine

44

(TASK STATEMENT) INSPECT AND SERVICE INTAKE MANIFOLD

SCIENCE	MATH -- NUMBER SYSTEMS
Effect of heating and cooling on expansion of materials [Warpage of manifold]	Whole Numbers Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding, Recording [Use of parts manual] Basic Logic Deductive or Inductive [Deductive reasoning] "Measure sense"/role of "unit" Instruments Measurement: non-geometric Speed [Tachometer]

45

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Listening Viewing	Parts manual Performance of engine Bluesmoke	Comprehension, Terminology Noise comparison Visual analysis

45

Duty D Maintaining and Repairing Governors

1 Inspect and test governor operation
2 Adjust governor
3 Repair or replace governor

(TASK STATEMENT) INSPECT AND TEST GOVERNOR OPERATION

47

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Tachometer Service manual Load source	Inspect linkage Check revolutions per minute specifications Connect tachometer Operate engine Read tachometer Apply load Observe tachometer response	Safety glasses Proper dress Ear Protection Operating engine
DECISIONS	**CUES**	**ERRORS**
Select best type tachometer Evaluate tachometer readings	Ease of use, time factor Revolutions per minute to: high low fluctuates recovers	Wasted time, false revolutions per minute readings Engine damage, poor performance

47

(TASK STATEMENT) INSPECT AND TEST GOVERNOR OPERATION

SCIENCE	MATH -- NUMBER SYSTEMS
Centrifugal forces developed by bodies in rotation [Centrifugal force working against force of spring] Motion resulting from two or more forces acting on a point in a body [Governor force working against spring force] Function of governor	Counting Numbers Whole Numbers Use of Numbers (without calculation) Counting, Recording Fundamental Operations (Calculation) Addition, Subtraction Rate Measurement: non-geometric Speed Instruments Tachometer Read and interpret tables, charts and graphs [Revolutions per minute, specification charts]

A8

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Listening Viewing	Service manual Tachometer Engine Carburator throttle	Comprehension, Information Detail Noise discrimination Visual analysis

AR

(TASK STATEMENT) ADJUST GOVERNOR

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Special tool Tang bending tool Gauges Governor springs	Check manufacturer's specifications, specific procedure, revolutions per minute Adjust linkage Adjust spring tension	Safety glasses Proper dress Ear protection Injury from over-speeding engine

DECISIONS	CUES	ERRORS
Determine position of throttle Determine direction - increase or decrease tension of spring	Type of equipment and engine Freeplay in linkage Speed of engine	Incorrect revolutions per minute Eratic operation

(TASK STATEMENT) ADJUST GOVERNOR

SCIENCE	MATH – NUMBER SYSTEMS
Function of governors Centrifugal forces developed by bodies in rotation [Fly-weights working against spring] Motion resulting from two or more forces acting on a point in a body [Air working against spring] Simple machines used to gain mechanical advantage [Pliers as simple lever]	Whole Numbers Positive fractions and decimals Fundamental Operations (Calculation) Addition, Subtraction Basic Arithmetic Skills and Concepts Reduction of fractions, Changing fractions to decimal and decimals to fractions Measurement: geometric Linear Read and interpret tables, charts and graphs [Revolutions per minute, specification charts]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Service manual	Comprehension, Informational report, Process report, Instruction

(TASK STATEMENT) REPAIR OR REPLACE GOVERNOR

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Parts Service manual Special tools as required Paper and pencil Links Springs Air vane Fly-weights Governor spool Bell crank	Diagram linkage before removal Remove governor Evaluate repairs needed Repair or replace governor	Safety glasses Proper dress Ear protection
DECISIONS	**CUES**	**ERRORS**
Determine repairs required Decide to repair or replace	Loose, worn, damaged or binding linkage Time and cost	Poor performance Too costly

(TASK STATEMENT) REPAIR OR REPLACE GOVERNOR

SCIENCE	MATH — NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Pliers used as simple lever, bellcrank used as lever] Centrifugal forces developed by bodies in rotation [Fly-weights - working against spring] Motion resulting from two or more forces acting on a point in a body [Air working against spring] Function of governor	Whole Numbers Positive fractions and decimals Fundamental Operations (Calculation) Addition, Subtraction Basic Arithmetic Skills and Concepts Reduction of fractions, Changing fractions to decimal and decimal to fractions Measurement: geometric Linear Basic Logic Deductive/Inductive [Deductive reasoning] Measurement: non-geometric Time

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Service manual	Comprehension, Informational report, Process report, Instructional

Duty E Maintaining and Repairing Starter System

1 Repair manually operated starters
2 Test and repair electric starters
3 Test and service battery
4 Test and repair electric starter circuits
5 Test and repair starter drive mechanisms

53

(TASK STATEMENT) REPAIR MANUALLY OPERATED STARTERS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Parts manual Solvents Lubricants Rope Handle Recoil spring Spindle Dog springs Spool	Inspect for proper operation and worn or damaged parts Disassemble and service as required Lubricate Reassemble and test	Safety glasses Proper dress Ear protection Personal injury from recoiled spring

DECISIONS	CUES	ERRORS
Determine if operation is satisfactory Determine lubricant and location Determine spring tightness by procedure or number of turns	Binding, chatter, frayed rope Service manual and availability Service manual	Poor operation, premature failure Faulty operation

(TASK STATEMENT) REPAIR MANUALLY OPERATED STARTERS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Simple machines: pulleys and hand tools] Effect of heating and cooling on expansion of materials [Effects of temperature in the recoil spring] Transfer of energy from one form to another [Potential energy in recoil spring] Effects of friction on work processes and product quality [Friction used to engage dogs] Resistance of materials to change in shape [Resistance of the recoil spring to being wound up]	Positive rationals Fractions Use of Numbers (without calculation) Counting [Number of turns on recoil spring] Indexing [Parts manual] Instruments [Tape] Measurement: geometric Linear [Rope length]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Service manual Parts manual	Terminology, Comprehension, Description of mechanism
Listening	Operation	Noise discrimination
Viewing	Operation	Visual analysis, Detail/Inference

(TASK STATEMENT) TEST AND REPAIR ELECTRIC STARTERS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Growler Lubricants Soldering kit Small lath Service manual Parts manual Parts Brushes End caps Armature Field	Test starter operation Disassemble and inspect for worn or burnt parts Test armature, field and connections Clean, repair or replace as required Install or retest	Safety glasses Proper dress Ear protection Equipment grounded Burns, shock

DECISIONS	CUES	ERRORS
Determine if satisfactory Decide which parts to replace	How it operates Wear, sloppy binding Burnt	Faulty operation Poor performance Early failure

(TASK STATEMENT) TEST AND REPAIR ELECTRIC STARTERS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Hand tools, gears and pulleys] Work input, work output, friction and efficiency in simple machines [Work input - output] Effect of heating and cooling on state of matter [Solder melting] Magnetic fields of force [Magnetism] Inertia and momentum	Positive rationals Fractions/Decimals Use of Numbers (without calculation) Counting [Armature segments] Indexing [Parts manual] Coding [Wires and terminals] Ratio [Reduction gears] Instruments [Electrical meters] Measurement: non-geometric [Electric measurements] Basic Logic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Service manual Parts manual Starter operation	Comprehension Description of mechanism Visual analysis

(TASK STATEMENT) TEST AND SERVICE BATTERY

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Battery tools Battery charger Hydrometer Electrical load Volt Ohm's meter Soda Brushes Water Air Rags	Check fluid level Test battery Clean and inspect Charge if necessary	Safecy glasses Proper dress Ear protection Safety standard equipment (see appendix) No flames in area Release vent caps Ventilate gases Explosion Acid burns Acid damage to equipment

DECISIONS	CUES	ERRORS
Determine correct level	Visual check of battery construction	Damaged battery
Decide if cells are satisfactory	Test results	Low performance, battery failure
Determine battery charge	Test results	Battery freezing, failure to operate starter

(TASK STATEMENT) TEST AND SERVICE BATTERY

SCIENCE	MATH – NUMBER SYSTEMS
Indestructibility of energy and matter [Chemical to electrical energy] Simple machines used to gain mechanical advantage [Hand tools] Effect of heating and cooling on expansion ofmaterials [Excess heat will warp the plates] Forces acting on a body immersed or floating in a liquid [Principle of specific gravity] Resistance of materials to flow of electrical current [Continuity and insulation of components] Function of battery	Positive rationals Fractions/Decimals Use of Numbers (without calculation) Counting [Cell number] Coding [Hydrometer] Ratio [Specific gravity] Fundamental Operations (Calculation) Addition, Subtraction [Correction for temperature] Instruments [Hydrometer, thermometer] Measurement: non-geometric Temperature, Weight [Hydrometer] Basic Arithmetic Skills and Concepts Guess and check method, Rule of thumb [Electrolyte] Interpret hydrometer readings

59

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Viewing Touching	Meters Battery temperature	Visual analysis

59

(TASK STATEMENT) TEST AND REPAIR ELECTRIC STARTER CIRCUIT

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Hydrometer Volt Ohm's Meter Continuity light or tester Tap Parts manual Service manual Switches Solenoids Wire Terminals	Test starter operation Test battery charge Make voltage, continuity or load test on circuit Clean connections and check insulation Replace damaged parts	Safety glasses Proper dress Ear protection Standard safety equipment (see appendix) Burns, shock
DECISIONS	**CUES**	**ERRORS**
Decide if components are servicable	Test results	Failure or potential failure

(TASK STATEMENT) TEST AND REPAIR ELECTRIC STARTER CIRCUIT

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Hand tools] Magnetic fields of force [Solenoids] Resistance of materials to flow of electrical current [Continuity and insulation of components] Function of electrical components	Positive rationals Fractions/Decimals Check battery: Use of Numbers (without calculation) Counting, Coding, Ratio Fundamental Operations (Calculation) Addition, Subtraction Basic Arithmetic Skills and Concepts Guess and check method, Rule of thumb Instruments [Hydrometer, Volt Ohm's meter] Measurement: non-geometric [Electrical measure] Interpret specific gravity readings

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Listening Viewing	Solenoid Meters, starter operation	Noise discrimination Visual analysis, Detail

(TASK STATEMENT) TEST AND REPAIR STARTER DRIVE MECHANISMS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Solvents Lubricants Service manual Parts manual (Starter drive parts too numerous to list)	Energize starter and check starter drive operation Disassemble and check parts for serviciability Clean, lubricate and reassemble Install and retest	Safety glasses Proper dress Ear protection Personal injury
DECISIONS	**CUES**	**ERRORS**
Determine if parts are satisfactory	Worn or damaged binding	Potential failure, intermittent failure non-operative

(TASK STATEMENT) TEST AND REPAIR STARTER DRIVE MECHANISMS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Hand tool, gears, pulleys] Magnetic fields of force [Solenoid engaged drives] Centrifugal forces developed by bodies in rotation [Centrifugal engaged drives] Inertia and momentum [Concept of inertia and momentum] Effects of friction on work processes and product quality [Use of friction in starter drives] Function of starter drive	Positive rationals Fractions/Decimals Use of Numbers (without calculation) Counting, Indexing, Coding, Ratio [Gear ratios] Basic Logic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS		
PERFORMANCE MODES	**EXAMPLES**	**SKILLS/CONCEPTS**
Reading Viewing	Parts manual Service manual Operation	Comprehension Terminology Visual analysis

Duty F Maintaining and Repairing Charging System

1 Diagnose charging system output
2 Repair and replace direct current (D.C.) generator
3 Adjust regulator
4 Repair alternating current (A.C.) charging circuit

(TASK STATEMENT) DIAGNOSE CHARGING SYSTEM OUTPUT

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set Service manual Volt Ohm's meter Direct current (D.C.) generator Regulator Rectifier Ammeter Indicator light Alternator	Test total output and evaluate results Test individual components and circuits Evaluate test results Clean, repair and/or replace components	Safety glasses Proper dress Ear protection Operating engine - moving parts

DECISIONS	CUES	ERRORS
Determine how to hook-up meter Determine which component is at fault Determine if test results is satisfactory	Leads on tester Different circuits in charging system No charge or low charge Test results - manufacturer's specifications	Improper readings Damage to meter Too high, too low or no output

59

(TASK STATEMENT) DIAGNOSE CHARGING SYSTEM OUTPUT

SCIENCE	MATH – NUMBER SYSTEMS
Function of charging system Simple machines used to gain mechanical advantage [Pulley to gain speed] Magnetic fields of force [Magnets as used in alternator] Transfer of energy from one form to another [Generator transfers mechanical energy to electrical energy] Resistance of materials to flow of electrical current [Corrosion on wire connections] Ohm's Law	Whole Numbers Decimals Use of Numbers (without calculation) Counting Measurement of electricity Volts, amps and Ohm's Instruments [Volt Ohm's meter, ammeter] Use of Ohm's Law Use of variables in formulae Manipulation of formulae Basic Logic Deductive reasoning

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Service manual	Comprehension, Informational report, Terminology, Process report, Instructional

(TASK STATEMENT) REPAIR AND REPLACE DIRECT CURRENT (D.C.) GENERATOR

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Parts manual Solder Soldering gun or iron Wire and terminals Generator Brushes Rags Solvent Growler Volt Ohm's meter Air	Remove and disassemble generator Clean generator Inspect and test components Make necessary repairs or replace Assemble and install generator Polarize generator	Safety glasses Proper dress Ear protection Solvents and dirt

DECISIONS	CUES	ERRORS
Decide if bearings are good Decide if brushes are usable Decide whether to turn and cut armature or replace Decide whether to replace fields Decide which wires connect to which terminals	Loose - Noisy bearings Brush ½ '' of original length Opens and shorts in armature Opens and grounds in fields Armature and field terminals Thrown solder	Rubbing of armature Poor contact No output or low output Part will not fit

(TASK STATEMENT) REPAIR AND REPLACE DIRECT CURRENT (D.C.) GENERATOR

SCIENCE	MATH – NUMBER SYSTEMS
Function of generator Simple machines used to gain mechanical advantage [Use of wrench as simple lever] Effect of heating and cooling on state of matter [Soldering of brushes] Magnetic fields of force [Magnetic field as used in fields and armature] Transfer of heat from one body to another [Soldering of wires]	Whole Numbers Positive rationals Use of Numbers (without calculation) Ordering, Counting, Indexing, Coding, Ratio, Recording [Use of parts manual] Ratio of tin and lead in solder Instruments [Volt Ohm's meter] Measurement: non-geometric [Measurement of electricity] Basic Logic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Parts manual Armature	Locating data, Terminology, Detail Visual analysis

(TASK STATEMENT) ADJUST REGULATOR

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Volt Ohm's meter Regulator Adjusting tools	Check and adjust air gaps Adjust voltage output Adjust amperage output	Safety glasses Proper dress Ear protection Moving parts - operating engine
DECISIONS	**CUES**	**ERRORS**
Determine size of air gap Determine what voltage output should be Determine amperage output and what it should be	Manufacturer's specifications Voltage readings Amperage readings	Burn out of generator Low or no output Continual discharge of battery

(TASK STATEMENT) ADJUST REGULATOR

SCIENCE	MATH – NUMBER SYSTEMS
Function of regulator Simple machines used to gain mechanical advantage [Screwdriver as simple lever] Effect of heating and cooling on expansion of materials [Temperature compensation with cover on regulator] Magnetic fields of force [Magnetic field closes contacts] Resistance of materials to flow of electrical current [Electrical current passing through resistors]	Decimal fractions Measurement: geometric Linear Instruments [Volt Ohm's meter] Measurement: non-geometric [Measurement of electricity]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Service manual	Comprehension, Informational, Process report, Instructional
Touching	Feeler gauge	Drag

(TASK STATEMENT) REPAIR ALTERNATING CURRENT (AC) CHARGING CIRCUIT

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Parts manual Volt Ohm's meter Diodes Regulator Wires and terminals Alternator Rectifier Ammeter Indicator light Switch Solder and gun	Test current output Test diodes and rectifier Test regulator Check wiring circuit Test stator windings Check bearings Clean, repair, or replace components	Safety glasses Proper dress Ear protection Battery explosion Shorts and burns
DECISIONS	**CUES**	**ERRORS**
Determine which component is at fault Determine if components should be repaired or replaced	Evaluate test results Service manual Part availability Labor cost to repair versus cost of replacement	Replace wrong components Inoperable charging circuit Cost over runs

(TASK STATEMENT) REPAIR ALTERNATING CURRENT (A.C.) CHARGING CIRCUITS

SCIENCE	MATH – NUMBER SYSTEMS
Function of circuits Simple machines used to gain mechanical advantage [Screwdriver used as lever] Effect of heating and cooling on state of matter [Soldering] Magnetic fields of force [Magnetic field as in field coil of generator] Transfer of heat from one body to another [Soldering of wire] Resistance of materials to flow of electrical current [Resistance in corroded connections] Ohm's Law	Whole Numbers/Rationals Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding, Recording [Use of parts manual] Fundamental Operations (Calculation) Addition, Subtraction, Multiplication, Division Measurement of electricity [Volts, Ohms and amps] Instruments Volt Ohm's meter, ammeter Use of Ohm's Law Use of variables in formulae Manipulation of formulae Basic Logic [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Service manual	Comprehension, Terminology, Process report, Instructional
	Parts manual	Detail, Terminology
Viewing	Connections	Visual analysis

Duty G Maintaining and Repairing Cooling System

1 Clean and repair air-cooled system
2 Clean, inspect and test water-cooled system
3 Repair and replace water-cooled system components

73

(TASK STATEMENT) CLEAN AND REPAIR AIR-COOLED SYSTEMS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Wood scraper Brushes Solvents Soap Water Air Torch Brazing rods	Remove shrouds, baffles, deflectors and screens Scrape off heavy deposits Apply cleaning solvent Wash items and blow dry Repair breaks and cracks in baffles Reassemble	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Vent fumes Flying material Slippery floor Burns, fire
DECISIONS	**CUES**	**ERRORS**
Determine type of solvent	Type dirt and availability of solvent	Poor job Wasted time

(TASK STATEMENT) CLEAN AND REPAIR AIR-COOLED SYSTEMS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Hand tools] Effect of heating and cooling on expansion of materials [Function of cooling system] Transfer of heat from one body to another [Heat dissipation]	Positive rationals Use of Numbers (without calculation) Counting, Coding [Parts] Ratio [Mixing ratio] Measurement: non-geometric Pressure Basic Logic Deductive/Inductive [Deductive Reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Viewing	Parts	Visual analysis

(TASK STATEMENT) CLEAN, INSPECT AND TEST WATER-COOLED SYSTEM

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Air Solvents Soap Water Hot plate Brushes Chemical cleaner Service manual Parts manual Parts Thermostat Gaskets Hoses Clamps Radiator Radiator cap Tubes Gromets Water pump assemblies Fan belts Anti-freeze Sealers	Clean external fins on radiator Clean internal water passageways Inspect system for leaks and potential leaks Test thermostat, temperature indicators, pressure caps and water pump output Acquire replacement item from parts source	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Chemical burns High temperature burns

DECISIONS	CUES	ERRORS
Determine method of cleaning Determine servicability of items Decide which parts to repair or replace Select hot or cool thermostat	Type of accumulation Deterioration, corrosion Test results, condition and extent of repair Engine use and season	Ineffective tub Wasted time Potential failure Excessive cost Will run too cool, over heating

97

(TASK STATEMENT) CLEAN, INSPECT AND TEST WATER-COOLED SYSTEM

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Hand tools] Effect of heating and cooling on expansion of materials [Thermostat and coolant] Fluids under pressure [Pressure increase from expansion] Transfer of heat from one body to another [Radiator fins] Centrifugal forces developed by bodies in rotation [Water pump]	Positive rationals Whole Numbers Use of Numbers (without calculation) Counting, Indexing, Coding [Parts manual] Instruments [Thermometer] Measurement: non-geometric Temperature [Thermostat test] Liquid [Water pump output] Pressure [Radiator cap]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Service manual Parts manual Part Test	Comprehension Terminology Visual analysis Detail/Inference

(TASK STATEMENT) REPAIR AND REPLACE WATER-COOLED SYSTEM COMPONENTS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Hydrometer Sealer Torch Solder Flux Service manual Parts manual Parts Thermostat Gaskets Hoses Clamps Radiator Radiator cap Water tubes Gromets Water pump assemblies Fan belt Anti-freeze Freeze-out plugs	Drain coolant Remove components Make necessary repairs Install components Add antifreeze Adjust fan belt	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Freeze damage Rotating parts
DECISIONS	**CUES**	**ERRORS**
Determine amount of anti-freeze Determine belt tension	Volume of system, temperature protection Service manual Manufacturer's specifications	Freeze-up, damage equipment Slippage, bearing stress

(TASK STATEMENT) REPAIR AND REPLACE WATER-COOLED SYSTEM COMPONENTS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Hand tools] Effect of heating and cooling on expansion of materials [Thermostat and coolant] Fluids under pressure [Pressure increase from expansion] Centrifugal forces developed by bodies in rotation [Water pump] Transfer of heat from one body to another [Water passage-ways, radiator fins]	Positive rationals Fractions Use of Numbers (without calculation) Counting, Indexing, Coding, Recording [Parts manual] Basic Arithmetic Skills and Concepts Ratio and proportion/Estimation [Antifreeze amount] Instruments [Hydrometer, ruler] Measurement: non-geometric Liquid [System capacity] Read and interpret tables, charts and graphs [Antifreeze chart] Measurement: geometric Linear [Fan belt size and tension]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Parts manual Service manual Parts	Comprehension Terminology Visual analysis, Logic

Duty H Maintaining and Repairing Lubrication System

1 Inspect and change oil
2 Test and replace oil pumps

80

(TASK STATEMENT) INSPECT AND CHANGE OIL

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Lubrication charts Oil Measuring containers Drain container	Inspect oil Analyze level and condition of oil Drain and refill crankcase	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Oil spills

DECISIONS	CUES	ERRORS
Decide how full crankcase should be Decide when to check Decide if oil is dirty Determine type of oil Determine amount of oil	Manufacturer's recommendation and time engine has been in service Metal particles in oil American petroleum recommendations Service conditions that engine is operated in Oil viscosity available	Poor lubrication Oil in compustion chamber Scoring of internal parts Hydraulic lock

(TASK STATEMENT) INSPECT AND CHANGE OIL

SCIENCE	MATH – NUMBER SYSTEMS
Function of lubrication Simple machines used to gain mechanical advantage [Screwdriver as simple lever] Fluids under pressure [Effects of hydraulic lock, pressure on bearings] Effects of friction on work processes and product quality [Effect of friction on moving parts] Chemical reactions - oil prevents corrosion Transfer of heat from one body to another [Cooling effect of oil]	Whole Numbers Fractions Use of Numbers (without calculation) Ratio [Fuel/Oil mixtures] Basic Arithmetic Skills and Concepts Reduction of fractions, Ratio and proportion [Measuring oil] Measurement: non-geometric Liquid Conversion from one standard unit to another [Converting gallons to quarts to pints] Read and interpret tables, charts and graphs [Lubrication charts]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Service manual	Comprehension, Recommendation reports, Detail, Locating data
Viewing	Condition of oil	Visual analysis
Touching	Condition of oil	Consistency

(TASK STATEMENT) TEST AND REPLACE OIL PUMP

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Parts manual Air Cleaning solvent Lines Oil pump Screen Pressure tester	Test pump pressure Analyze test results Clean or replace parts	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Fire Spillage

DECISIONS	CUES	ERRORS
Decide if pump is delivering proper pressure Decide to clean or replace Decide what parts to replace	Manufacturer's specifications Dirty screens and lines Broken parts Type of engine	Poor lubrication Scored internal parts Part will not fit

(TASK STATEMENT) TEST AND REPLACE OIL PUMP

SCIENCE	MATH – NUMBER SYSTEMS
Function lubrication systems Simple machines used to gain mechanical advantage [Oil pump plunger as lever] Fluids under pressure [Oil pump pressure] Centrifugal forces developed by bodies in rotation [Oil slinger throws oil] Forces acting on a body immersed or floating in a liquid [Oil pump float]	Whole Numbers Fractions Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding, Recording, [Use of parts manual] Measurement: non-geometric Pressure Basic Logic Deductive/Inductive [Deductive reasoning] Instruments [Pressure tester]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Service manual	Comprehension, Locating data, Process - Instructional
Viewing	Parts manual Parts	Detail, Terminology Visual analysis

84

Duty I Maintaining and Repairing Valve Train

1 Test compression
2 Inspect and replace camshaft
3 Inspect and replace compression release mechanisms
4 Inspect and replace reel valves
5 Inspect, repair and replace cylinder head
6 Grind valves and seats

85

(TASK STATEMENT) TEST COMPRESSION

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Compression tester Spark plug air adapter Finger Air Oil	Select method of testing Remove spark plug Test compression Evaluate compression test	Ground ignition Safety glasses Proper dress Ear protection Rotating parts Electrical shock Burns

DECISIONS	CUES	ERRORS
Determine method of testing Determine if compression is within manufacturer's specifications Determine what parts of engine are cause of loss of compression	Availability of specifications Type of engine Availability of tools Rebound of flywheel Air passing through carburetor, exhaust, crankcase or cylinder head	Engine lacks power Repair or replacement of wrong part

(TASK STATEMENT) TEST COMPRESSION

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Spark plug wrench - lever] Effect of heating and cooling on state of matter [Compressing fuel-air mixture increases] Temperature Function of compressions	Whole Numbers Fractions Measurement: non-geometric Pressure Instruments [Compression tester] Basic Logic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Service manual	Comprehesnion, Locate data, Process Instructional
Listening	Air leaks	Noise, Location of leakage
Touching	Finger	Pressure

(TASK STATEMENT) INSPECT AND REPLACE CAMSHAFT

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Parts manual Camshaft Solvent Air Micrometer	Determine position of valves during rotation Remove camshaft Clean parts Inspection of wear Install new cam if necessary	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Personal injury

DECISIONS	CUES	ERRORS
Determine if cam is in time Decide if lobes, bearings or gears are worn Determine what part number to use Decide which teeth to mesh	Position of valves at dead center Worn lobes, worn bearings, nicked teeth and rough scored area Manufacturer's specifications Type of engine Timing marks	Poor engine performance Noisy cam operation

(TASK STATEMENT) INSPECT AND REPLACE CAMSHAFT

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Gear as simple machine]	Fractions and decimals Whole Numbers Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding, Recording [Use of parts manual] Basic Arithmetic Skills and Concepts Reduction of fractions, Changing fractions to decimal and decimals to fractions [Measuring lobes and bearings] Ratio and proportion [Understand ratio of rotation of cam to crank] Measurement: geometric Linear Instruments [Use of micrometer]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Service manual	Comprehension, Locating data, Informational reports, Process - Instructional
Writing	Work orders	Penmanship
Reading	Parts manual	Terminology, Detail
Touching	Lobes, Feeler gauge	Smoothness (Texture)
	Feeler gauge	Drag

(TASK STATEMENT) INSPECT AND REPLACE COMPRESSION RELEASE MECHANISMS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Parts manual Dial indicator	Determine type of compression release Measure lift of valve Inspect value and value lift device Determine if compression release should be replaced	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Rotating parts

DECISIONS	CUES	ERRORS
Decide which type of compression release is used Determine if within manufacturer's specifications Decide if springs are broken or weights are binding	Type of engine Manufacturer's specifications Inspection	Make wrong test Waste time Faulty operation

(TASK STATEMENT) INSPECT AND REPLACE COMPRESSION RELEASE MECHANISMS

SCIENCE	MATH – NUMBER SYSTEMS
Function of compression release Simple machines used to gain mechanical advantage [Gear as simple machine]	Whole Number Counting Numbers Decimals/Fractions Use of Numbers (without calculation) [Use of parts manual] Counting, Ordering, Indexing, Coding, Recording Fundamental Operations (Calculation) Addition, Subtraction [Reading dial indicator] Basic Arithmetic Skills and Concepts Reduction of fractions, Changing fractions to decimal and decimals to fractions [Measuring lift of valve] Instruments [Dial indicator] Measurement: geometric Linear Basic Logic Deductive/Inductive [Deductive reasoning] Read and interpret tables, charts and graphs [Specification charts]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Service manual	Comprehension, Information report, Process - Instructional
Viewing	Parts manual Air compression release	Looking up data, Detail, Terminology Visual analysis

(TASK STATEMENT) INSPECT AND REPLACE REED VALVES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Parts manual Reeds	Remove air cleaner and spin engine over noting condition of air intake Analyze conditions that exist Remove reed plate and inspect reeds Adjust reed stop Replace reed plate	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Backfire

DECISIONS	CUES	ERRORS
Decide if removal of reeds is necessary Decide if reeds need replacing Decide if stop needs adjusting Determine correct parts to use	Fuel spitting out of carburetor Air passing out of carburetor Broken reeds Bent reeds Manufacturer's specifications Type of engine	Poor engine performance Loss of power

(TASK STATEMENT) INSPECT AND REPLACE REED VALVES

SCIENCE	MATH – NUMBER SYSTEMS
Function of reed valves Simple machines used to gain mechanical advantage [Screwdriver as simple lever] Motion resulting from two or more forces acting on a point in a body [Force of air pressure against reed pressure] Resistance of materials to change in shape [Bending of reeds]	Whole Numbers Fractions and decimals Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding, Recording [Use of parts manual] Fundamental Operations (Calculation) Addition, Subtraction [Measuring reeds and stops] Basic Arithmetic Skills and Concepts Reduction of fractions, Changing fractions to decimal and decimals to fractions [Measuring of reeds and stops] Instruments [Measuring of reeds and stops] Measurement: geometric Linear Basic Logic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Service manual	Comprehension, Detail, Locating data, Process - Instructional
	Parts manual	Terminology
Listening	Air intake	Noise discrimination
Viewing	Air intake	Visual analysis
Touching	Feeler gauge	Drag

(TASK STATEMENT) INSPECT, REPAIR AND REPLACE CYLINDER HEAD

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY -- HAZARD
Mechanic's tool set (see appendix) Service manual Parts manual Cleaning solvent Air Bags Surface plate Emery cloth Cylinder head Head gasket Torque wrench	Remove any necessary shrouds Remove head bolts Remove cylinder head and gasket Clean,head and combustion chamber Look for signs of warpage Install cylinder head, gasket and bolts Torque head bolts in proper sequence	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Air (see appendix) Carbon Solvents

DECISIONS	CUES	ERRORS
Determine location of bolts Decide if head gasket has leaked Decide if head is warped Decide if parts need replaced Decide what parts need replaced Determine position of bolts Determine how tight to tighten bolt	Different lengths of bolts Exhaust burns on head and gasket Areas not touched by emery cloth on surfaced plate Cracked head Type of engine Bolt drap rags Manufacturer's specifications	Warpage of head Stripped thread Twisted off bolt Broken fin Head will leak Parts will not fit

(TASK STATEMENT) INSPECT, REPAIR AND REPLACE CYLINDER HEAD

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Wrench as simple lever] Work input, work output, friction and efficeincy in simple machines [Use of torque wrench] Effects of friction on work processes and product quality [Friction effects torque] Resistance of materials to change in shape [Twisting of bolts]	Whole Numbers Fractions Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding, Recording [Use of parts manual] Instruments [Torque wrench] Measurement: non-geometric [Torque] Conversion from one standard unit to another [Foot pounds to inch pounds] Fundamental Operations (Calculation) Addition, Subtraction, Multiplication, Division [Changing inch pounds to foot pounds] Basic Logic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Service manual	Comprehension, Detailed report
Writing	Parts manual	Terminology, Detail
Viewing	Work order	Penmanship
	Head gasket	Visual analysis
	Head bolts	Memory

(TASK STATEMENT) GRIND VALVES AND SEATS

96

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY -- HAZARD
Mechanic's tool set (see appendix) Service manual, parts manual Valve refacer Seat grinder or seat cutter Valve Valve guide Seat Lapping stick Grinding compound Valve spring compressor Micrometer Square Seat installation tools Wire wheel Solvent Rags Plug gauges	Remove valves Clean and inspect valves, guides and seats Analyze condition of parts Replace any necessary parts Grind valves Cut seats Adjust tappet clearance Lap valves Install valves	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Air (see appendix) Dirt Solvent Grinding equipment

DECISIONS	CUES	ERRORS
Decide what type of spring compressor Decide what part numbers to use Decide what angle to grind Determine tappet clearance Decide if valve will seal	Type of retainer Type of engine Wear of parts Manufacturer's specifications Grey area	Waste of time Parts will not fit Short life of new parts Noisy valve operation Loss of power

(TASK STATEMENT) GRIND VALVES AND SEATS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Valve spring compressor to compress spring] Effect of heating and cooling on expansion of materials [Heat changes tappet clearance] Transfer of heat from one body to another [Cooling of valves]	Whole Numbers Decimals and fractions Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding, Recording [Use of parts manual] Fundamental Operations (Calculation) Addition, Subtraction [Tappet clearance] Instruments [Feeler gauge, micrometer] Measurement: geometric Angle Linear Basic Logic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Service manual	Comprehension, Informational report, Process - Instructional
Viewing	Parts manual	Detail, Terminology
Touching	Condition of valve	Visual analysis
	Feeler gauge	Drag

Duty J Maintaining and Repairing Short Block Assemblies

1 Dissassemble and analyze short block assembly
2 Recondition or replace worn or damage short block components
3 Reassemble short block components

(TASK STATEMENT) DISSASSEMBLE AND ANALYZE SHORT BLOCK ASSEMBLY

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY — HAZARD
Mechanic's tool set (see appendix) Compression gauge Dial indicator Solvent Brushes Air Micrometers Telescoping gauges Parts manual Service manual Arbor press Seal and bearing removers Manufacturer's special gauges Ridge reamer	Make predisassembly checks and measures Disassemble and clean Inspect and measure Inspect and repair valve train Determine manufacturer's specifications Segregate satisfactory items from unsatisfactory items	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Air (see appendix)
DECISIONS	**CUES**	**ERRORS**
Decide which measurements should be taken before dissassembly Determine which items need reconditioned or replaced	Service manual Common sense Test results	Could not make measure Reassemble to measure Poor job, potential failure

99

(TASK STATEMENT) DISSASSEMBLE AND ANALYZE SHORT BLOCK ASSEMBLY

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Hand tool] Effect of heating and cooling on expansion of materials [Cold clearance v. running clearance] Centrifugal forces developed by bodies in rotation [High speed forces] Transfer of heat from one body to another[Dissipating heat] Effects of friction on work processes and product quality [Rubbing surfaces] Function of short block assembly	Positive rationals Decimals and fractions Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding, Ratio, Recording [Use of parts manual] Fundamental Operations Addition, Subtraction [Manufacturer's specification] Instruments Micrometers, calipers Measurement: geometric [Micrometers, calipers] Basic Logic Deductive/Inductive [Deductive reasoning] Measurement: non-geometric Pressure

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Service manual Parts manual	Comprehension Terminology
Viewing	Gauges	Visual analysis
Touching	Gauges Parts	Tightness Smoothness

(TASK STATEMENT) RECONDITION OR REPLACE WORN OR DAMAGED SHORT BLOCK COMPONENTS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY -- HAZARD
Mechanic's tool set (see appendix) Electric drill Deglazing hone Resizing hone Micrometers Telescoping gauges Hone oil Parts manual Service manual Cutters and reamers Heli-Coil inserts Tap and die set Bushings, crankshaft, pistons, and pin, rod, rings, bearings, gaskets and seals Ring grove cleaner	Deglaze or resize cylinder bore Rebush and finish ream as required Have selected items knurled turned or ground as necessary Acquire replacement items from parts source Repair damage threads and bolts	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Personal injury Damaged equipment
DECISIONS	**CUES**	**ERRORS**
Decide on finish size Pick correct reamer Decide method of thread repair	How badly worn or damaged Parts availability Service manual Tools available - material - amount of material	Unsatisfactory job, no replacement part No replacement part for resize item Parts would not fit Damage to block

(TASK STATEMENT) RECONDITION OR REPLACE WORN OR DAMAGED SHORT BLOCK COMPONENTS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Hand tools, tap and die] Effects of friction on work processes and product quality [Friction affected by surface condition wear factor from friction and heat]	Positive rationals Decimals and fractions Use of Numbers (without calculation) Counting, Indexing, Coding, Ratio, Recording [Use of parts manual] Fundamental Operations [Calculation) Addition, Subtraction [Resizing] Basic Arithmetic Skills and Concepts Changing fractions to decimal and decimals to fractions [Convert measurements] Instruments Micrometer [Feeler gauge] Given an instrument of measure, determine precision and/or accuracy with respect to relative error, significant digits and tolerance [Micrometer, feeler gauge] Measurement: geometric Linear Basic Logic [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing Touching	Service manual, parts manual Part Gauges	Comprehension, Terminology Visual analysis, Detail/Inference Drag

(TASK STATEMENT) REASSEMBLE SHORT BLOCK COMPONENTS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Solvents Soap Water Ring compressor Air Arbor press Seal and bearing installers Heat source to expand bearing housing Lubricants Torque wrench Service manual Parts manual	Clean and lay out components Measure items for correct clearance Lubricate and assemble Torque to specifications Check ease of rotation	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Air and solvents Personal injury
DECISIONS	**CUES**	**ERRORS**
Decide if clearance is satisfactory Determine torque valves	Manufacturer's specifications Safety standards	Tight binding engine Loose noisy engine Early failure Stripped threads Warped castings Loose and damaged parts

(TASK STATEMENT) REASSEMBLE SHORT BLOCK COMPONENTS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Hand tools, levers, gears] Work input, work output, friction and efficiency in simple machines [Rotating friction efficiency] Inertia and momentum [Inertia to get parts rotating, momentum, keeping parts rotating]	Positive rationals Decimals and fractions Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding [Parts manual] Fundamental Operations (Calculation) Addition, Subtraction [Resizing] Instruments Micrometers Given and instrument of measure, determine precision and/or accuracy with respect to relative error, significant digits and tolerance [Micrometers] Measurement: geometric Linear [Micrometers] Basic Logic Deductive/Inductive [Deductive reasoning] Basic Arithmetic Skills and Concepts Ratio and proportion [Cleaning solutions] Measurement: non-geometric-Temperature [Heat source]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing Touching	Parts manual Service manual Assemblies Rotating assembly	Comprehension Terminology Visual analysis Drag consistency

Duty K Maintaining and Repairing Crankcase Breathers

1 Inspect and repair crankcase breathers

105

105

(TASK STATEMENT) INSPECT AND REPAIR CRANKCASE BREATHERS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Parts manual Cleaning solvent Air Rags Manometer Vacuum-Pressure gauge Breather valve	Test breather for proper operation Analyze conditions found Remove crankcase breather Determine if any parts are damaged Install crankcase breather	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Air (see appendix) Solvents

DECISIONS	CUES	ERRORS
Decide method of testing Decide if pressure is building Decide if pressure and suction is present Decide where valve is Decide if parts need replacing Decie part numbers to use	Type of engine, Manufacturer's recommendation Oil leaking at seals Pressure and suction felt at hose Type of engine Bent valve Type of engine	Improper test results Waste of time Part will not fit

901

(TASK STATEMENT) INSPECT AND REPAIR CRANKCASE BREATHERS

SCIENCE	MATH – NUMBER SYSTEMS
Function of crankcase breathers Simple machines used to gain mechanical advantage [Screwdriver as lever] Resistance of materials to change in shape [Bending of valve]	Whole Numbers Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding, Recording [Use of parts manual] Basic Logic Deductive/Inductive [Deductive reasoning] Instuments Manometer [vacuum-pressure gauge] Measurement: non-geometric Pressure, vacuum

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing Touching	Service manual Parts manual Oil leaking Breather	Comprehension, Process - Instructional Detail, Terminology Visual analysis Pressure and suction

Duty L Maintaining and Repairing Exhaust System

1 Inspect and repair exhaust heat operated devices
2 Inspect and clean exhaust system
3 Replace exhaust components

108

(TASK STATEMENT) INSPECT AND REPAIR EXHAUST HEAT OPERATED DEVICES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Parts manual Springs	Inspect preheating shields, housings, heat exchangers and air ducts Inspect and adjust heat operated bimetal springs, thermostats and linkage Inspect and repair heat duct baffels; control arms and linkages	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Burns
DECISIONS	**CUES**	**ERRORS**
Determine adjustments required Determine repairs needed	Check operation, service manual Binding, corroded and worn linkage and connections	Improper operation Failure to function

(TASK STATEMENT) INSPECT AND REPAIR EXHAUST HEAT OPERATED DEVICES

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Hand tool, linkage] Effect of heating and cooling on expansion of materials [Bimetal springs and thermostats] Transfer of heat from one body to another [Heat exchanger]	Positive rationals Decimals and fractions Use of Numbers (without calculation) Counting, Indexing, Coding, Recording [Parts manual] Measurement: geometric Linear [Linkage adjustments] Measurement: non-geometric [Tension] Basic Logic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Parts manual Service manual Controls	Comprehension Terminology Visual analysis, Detail/Inference

(TASK STATEMENT) INSPECT AND CLEAN EXHAUST SYSTEM

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Solvents Wood scraper	Inspect exhaust system for accumulation of carbon and dirt Remove carbon build-up from ports, mufflers and baffels Inspect and clean passageways in water cooled exhaust manifolds	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Burns

DECISIONS	CUES	ERRORS
Decide on method of cleaning	Amount of build-up Hardness of carbon	Poor job Wasted effort

(TASK STATEMENT) INSPECT AND CLEAN EXHAUST SYSTEM

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Hand tool] Work input, work output, friction and efficiency in simple machines [Engine efficiency] Transfer of heat from one body to another [Air and water cooled manifolds]	Whole Numbers Basic Logic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Viewing	Parts	Visual analysis, Detail/Inference

(TASK STATEMENT) REPLACE EXHAUST COMPONENTS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Impact tool Easy outs Heating torch Cutting torch Drill and bits Parts manual Parts Mufflers Gaskets Baffels Pipes Fasteners	Remove defective items Remove broken studs Repair damaged threads Acquire replacement items Install replacement items Operate equipment and check for leaks	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Poisonous exhaust gases Burns

DECISIONS	CUES	ERRORS
Decide which tools to use Determine parts needed	Rust corroded How tight Defective items	Twist off bolts Damage equipment Imcomplete job

(TASK STATEMENT) REPLACE EXHAUST COMPONENTS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Hand tools] Effect of heating and cooling on expansion of materials [Remove frozen bolts] Effect of heating and cooling on state of matter [Overheating aluminum casting] Transfer of heat from one body to another [Corrosion and stud removal]	Positive rationals Whole Numbers Use of Numbers (without calculation) Counting, Indexing, Coding, Recording [Parts manual] Basic Logic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Listening Viewing	Parts manual Leaks Parts	Terminology, Comprehension Noise discrimination Visual analysis

Duty M Storing Equipment for Off Season

1 Prepare equipment for storage
2 Return equipment from storage

115

(TASK STATEMENT) PREPARE EQUIPMENT FOR STORAGE

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Parts manual Equipment operators manual Oil Grease Grease gun Equipment and engine Grinder Oil squirt can Hydrometer Fuel container Drain pan Sheets of plastic Air Pressure washer Cleaning solvent Battery charger	Clear and inspect engine and equipment Drain fuel system Make any necessary repair Drain and clean cooling system Drain and add new lubricants to engines and gear boxes Lubricate equipment and engine internal parts Service or remove battery Sharpen any cutting equipment Protect equipment from physical elements	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Fire Air (see appendix) Battery acid Dirt Grinding operation

DECISIONS	CUES	ERRORS
Decide method of cleaning Method of draining Decide what parts need repaired or replaced Decide types of lubricants Decide what parts need lubed Decide type of storage covering is needed	Type and amount of dirt, cleaning method available Type of carburetor-method of lubricating internal engine Worn, cracked, broken, noise Manufacturer's recommendation Service manual Type of weather equipment will be stored in	Dirty equipment Wasted time Improper operation next season Damage to equipment Rust and corrosion will occur Physical damage to equipment

911

(TASK STATEMENT) PREPARE EQUIPMENT FOR STORAGE

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Screwdriver in removing screws] Effect of heating and cooling on state of matter [Rusting through temperature changes] Resistance of materials to flow of electrical current [Resistance of electric current through dirty battery cables]	Whole Numbers Positive fractions and decimal fractions Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding, Ratio, Recording [Use of parts manual] Fundamental Operations (Calculation) Addition, Subtraction, Multiplication, Division [Use of parts manual] Basic Arithmetic Skills and Concepts Reduction of fractions [Measurement of lubricant] Measurement: non-geometric Liquid Conversion from one standard unit to another [Convert gallons to pints] Ratio and proportion/Estimation [Cooling system liquids interpreting hydrometer reading] Measurement: non-geometric Amps

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Operator's manual	Comprehension, Recommendation report, Process - Instructional
Listening	Equipment operation	Noise discrimination
Viewing	Condition of equipment	Visual analysis

(TASK STATEMENT) RETURN EQUIPMENT FROM STORAGE

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Operator's manual for equipment Hydrometer Oil measures Lubricants Engine oil Gear lube	Remove protective covering Inspect and install battery Check lubricant levels Fill fuel and cooling systems Start and test operations Make any necessary adjustments	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Moving parts Battery acid

DECISIONS	CUES	ERRORS
Decide if battery is servicable Decide if levels are proper Decide types of fuel and coolant Decide if operation is satisfactory Decide what adjustments are necessary	Hydrometer readings Service manual and operators manual Manufacturer's recommendation Noise, knocks Service manual	Slow or no cranking Physical damage to engine and equipment Poor operations Wasted time

(TASK STATEMENT) RETURN EQUIPMENT FROM STORAGE

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Wrench to remove level plugs] Work input, work output, friction and efficiency in simple machines [Pulleys] Centrifugal forces developed by bodies in rotation [Rotary mower throwing grass] Chemical action of battery	Whole Numbers Decimals and fractions Fundamental Operations Addition, Subtraction [Reading hydrometer] Instruments [Hydrometer] Measurement: non-geometric Specific gravity, interpretation of hydrometer readings Liquid [Measure oil, liquid measure] Basic Logic Deductive/Inductive [Deductive reasoning] Basic Arithmetic Skills and Concepts Ratio and proportion/Estimation [Cooling system liquids]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Operator's manual	Comprehension, Informational reports, Recommendation reports, Description of mechanism, Process - Instructional
Listening	Operation of equipment	Noise discrimination
Viewing	Equipment	Visual analysis

Duty N Maintaining and Repairing Shop Equipment and Tools

1 Reshape and sharpen hand tools
2 Clean, maintain and adjust shop equipment
3 Inspect and repair electrical and test equipment

120

(TASK STATEMENT) RESHAPE AND SHARPEN HAND TOOLS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Grinding wheel dresser Bunch grinder Drill bits Chisels Punches Screwdrivers Scrapers Drill gauge Chisel gauge	Dress grinding wheel Set up grinder rest Reshape or sharpen tool	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Personal injury Sparks
DECISIONS	**CUES**	**ERRORS**
Decide position of rest Decide how to hold tool Decide when to cool tool	Angle wanted on tool Pressure against wheel Temperature	Poor performance of tool Burn tool Draw temper

121

(TASK STATEMENT) RESHAPE AND SHARPEN HAND TOOLS

SCIENCE	MATH – NUMBER SYSTEMS
Function of tools Simple machines used to gain mechanical advantage [Wheel dresser for shaping grinding wheel] Centrifugal forces developed by bodies in rotation [Grinder wheel throwing sparks] Inertia and momentum [Wheel coming to rest] Effects of friction on work processes and product quality [Burning from friction of wheel] Transfer of heat from one body to another [Cooling tool in water] Heat draws temperature	Whole Numbers Fractions Use of Numbers (without calculation) Coding [Grade of grinding wheel] Instruments [Drill gauge and chisel gauge] Measurement: geometric Angle [Angle of chisel] Measurement: non-geometric Speed [Speed of grinder] Basic Logic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Viewing Touching	End of chisel Drill bit Punch	Visual analysis Logic Temperature

(TASK STATEMENT) CLEAN, MAINTAIN AND ADJUST SHOP EQUIPMENT

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Equipment instruction manuals Air compressor Drill press Valve refacer Floor jacks Hoist Arbor press Grinder Torch Arc welder Outboard test tank Impack wrench Cleaning solvents Oil Rags Steel wool V-belts Hydraulic oil	Determine what is to be done to equipment Clean equipment Replace any necessary parts Lubricate equipment Adjust equipment	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Moving parts Air (see appendix) Dirt Solvents

DECISIONS	CUES	ERRORS
Decide what is to be done Decide method of cleaning Decide what part to replace Decide type of lubricant Decide what adjustments are to be made	Periodic maintenance, manufacturer's recommendations, operation of equipment Type of dirt-manufacturer's recommendations-type of material Wear of part-time of service Manufacturer's recommendation-parts lubricating Manufacturer's instructions	Damage to equipment Dirty equipment Poor operations

(TASK STATEMENT) CLEAN, MAINTAIN AND ADJUST SHOP EQUIPMENT

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Arbor press pushing shafts] Effect of heating and cooling on state of matter [Rusting of equipment in storage] Fluids under pressure [Hydraulic oil and air trapped in jack] Transfer of heat from one body to another [Cooling oil in valve refacer] Simple machines used to gain mechanical advantage [Pulleys on drill press - change speed]	Whole Numbers Fractions Use fo Numbers (without calculation) Ordering [Serial and model numbers of equipment] Ratio [Speeds on drill press] Instruments Tachometer [Speed of equipment] Measurement: geometric Linear [Drill press] Measurement: non-geometric Speed [Speed of equipment], Time [Time of service], Pressure [Air compressor and torch] Basic Logic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Instruction manual	Comprehension, Informational report, Recommendation report, Description of mechanism, Process - Instruction
Listening	Equipment	Noise discrimination
Viewing	Equipment	Visual analysis

(TASK STATEMENT) INSPECT AND REPAIR ELECTRICAL AND TEST EQUIPMENT

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Test equipment instruction manual Rags Volt Ohm's meter tester Ignition analyzer Solder Soldering gun Tape Electric drills Electric motors Batteries	Determine what has to be done to equipment Clean equipment Test and replace batteries Evaluate problems Make minor repairs	Safety glasses Proper dress Ear protection Unplug electrical equipment before working Safety standard equipment (see appendix) Electrical shock
DECISIONS	**CUES**	**ERRORS**
Decide what has to be done Decide on method of cleaning Determine voltage of battery Decide what the exact problems are Decide what minor repairs have to be made Decide if equipment should be repaired by electrical shop	Manufacturer's recommendations - Time of service problem with equipment Material of equipment - meter face Manufacturer's specifications Intermitant readings - low valves - no reading - no operation Low battery voltage - blown fuse - broken leads - damage test clips Ability of repair equipment	Damage to equipment Improper operation of equipment Waste of time Physical damage to equipment

(TASK STATEMENT) INSPECT AND REPAIR ELECTRICAL AND TEST EQUIPMENT

SCIENCE	MATH – NUMBER SYSTEMS
Function of test equipment and electrical motors Simple machines used to gain mechanical advantage [Pliers for cutting wire] Effect of heating and cooling on expansion of materials [Soldering wire] Magnetic fields of force [Fields in electrical motors] Resistance of materials to flow of electrical current [Dirty connections on test leads]	Whole Numbers Decimals and fractions Use of Numbers (without calculation) Counting [Model and serial numbers] Basic Arithmetic Skills and Concepts Changing fractions to decimal and decimals to fractions [Evaluating meter readings 1½ volts - 1.5 volts] "Measure sense"/role of "unit" [Volt meter reading] Instruments [Volt meter] Measurement: non-geometric [Measurement of electrical valves] Time [Time of service of equipment] Basic Logic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Instructional manual	Comprehension, Recommendational report, Process report - Instructional
Listening	Electric drill	Noise discrimination
Viewing	Test leads	Visual analysis

Duty O Maintaining Small Engine Powered Equipment

1 Adjust, repair, replace power engaging mechanism (clutches)
2 Inspect and repair drive line components
3 Lubricate equipment
4 Inspect and repair brake system components
5 Adjust and repair remote controls
6 Sharpen and balance cutter blades
7 Set-up trailer and tow vehicle with safety requirements

127

(TASK STATEMENT) ADJUST, REPAIR, REPLACE POWER ENGAGING MECHANISMS (CLUTCHES)

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Parts manual Lubricants Solvents Hydraulic and mechanical linkage Single plate clutch Multi plate clutch Wet plate clutch Dry plate clutch Centrifugal friction shoe clutches Centrifugal operated pulley clutches Hydraulic couplings Sliding dog couplings Movable idler pulley clutches Electrical mechanical clutches	Check and adjust clutch control linkage Inspect clutch driver parts Inspect clutch driven parts Repair or replace as required	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Personal injury Equipment damage

DECISIONS	CUES	ERRORS
Determine adjustment needed Determine items needing repaired Decide method or type of repair	Operation and service manual Clutch operation, visual inspection, service manual	Failure to disengage Failure to engage Failure to stay engaged Clutch slippage Damage release bearing Unsatisfactory clutch performance

(TASK STATEMENT) ADJUST, REPAIR, REPLACE POWER ENGAGING MECHANISMS (CLUTCHES)

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Levers, gears and pulleys] Magnetic fields of force [Solenoids] Fluids under pressure [Hydraulics] Centrifugal forces developed by bodies in rotation [Fly-weights and springs] Inertia and momentum [Gear ratios] Effects of friction on work processes and product quality [Clutch plates] Addition and subtraction of whole numbers [Shifting gears]	Positive rationals Decimals and fractions Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding, Ratio, Recording [Service manual] Fundamental Operations (Calculation) Addition, Subtraction [Adjustments] Instruments Ruler, micrometers Measurement: geometric Linear [Adjustments] Measurement: non-geometric Speed [Engagement speeds] Basic Logic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Listening	Operation	Noise discrimination, Chatter
Viewing	Operation	Visual analysis, Logic, Detail/Inference, Color
Touching	Parts, operation	Smoothness, Vibration, Chatter

(TASK STATEMENT) INSPECT AND REPAIR DRIVE LINE COMPONENTS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Parts manual Drive shaft, splines and universals Chains and belts Step up and down gear boxes, sprockets and pulleys Centrifugally operated torque convertor Right angle and reversing gear boxes Differentials and axles Wheels, tires and tracks	Test drive line operation Disassemble and inspect Repair or replace worn and damaged parts Reassemble and test	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Personal injury Damaged equipment

DECISIONS	CUES	ERRORS
Decide if operation is satisfactory Determine method of repair and part to be replaced	Noise, operation Amount of wear Type of damage	Component failure Unsatisfactory job

(TASK STATEMENT) INSPECT AND REPAIR DRIVE LINE COMPONENTS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Levers, gears and pulleys] Work input, work output, friction and efficiency in simple machines [Gear boxes] Fluids under pressure [Hydraulics] Centrifugal forces developed by bodies in rotation [Torque convertors] Inertia and momentum [Gear ratios] Motion resulting from tow or more forces acting on a point in a body [Drive line] Addition and subtraction of whole numbers [Gear engagement]	Positive rationals Decimals and fractions Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding, Ratio, Recording [Service manual] Measurement: non-geometric [Ruler, micrometers, tachometer, revolutions per minute] Measurement: geometric [Adjustments] Linear Basic Arithmetic Skills and Concepts Ratio and proportion/Estimation [Power and speed]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Parts manual Service manual	Comprehension Terminology
Viewing	Operation	Visual analysis, Logic, Detail/Inference
Touching	Parts, operation	Smoothness, Vibration

(TASK STATEMENT) LUBRICATE EQUIPMENT

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Lubricants Parts manual Service manual Seals Gaskets Oil cans Grease guns Solvents Brushes Rags	Lubricate to prevent wear and rust Inspect for lubricant leaks and replace seals and gaskets Lubricate: oil holes and cups, linkage pivot points, grease fittings, and cups, splines, inspect and pack wheel bearings Fill gear boxes and differential and hydraulic drives	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Spills Fire

DECISIONS	CUES	ERRORS
Decide what to lube Decide best lubricant to use Decide means of filling and type of lubricant	Service manual lubricant chart Points of wear Points of friction Service manual	Worn parts Eventual failure Improper lubrication Equipment failure

(TASK STATEMENT) LUBRICATE EQUIPMENT

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Grease gun] Fluids under pressure [Grease gun operation] Effects of friction on work processes and product quality [Lubricants to reduce friction and heat]	Positive rationals Fractions Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding, Recording [Service manual] Measurement: non-geometric Liquid [Lubricants] Weight [Grease]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Service manual Parts manual Equipment	Comprehension Terminology Visual analysis, Logic, Detail/Inference

(TASK STATEMENT) INSPECT AND REPAIR BRAKE SYSTEM COMPONENTS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Solvents Service manual Parts manual Brushes Brake fluid Bleeding kit Brake adjusting tool Air Master cylinder Master cylinder rebuild kit Wheel cylinder Wheel cylinder rebuild kit Brake shoes and pads and hardware Lines, hoses and fittings	Check brake operation Disassemble, clean and inspect Determine cause of faulty operation Repair, recondition or replace components Bleed hydraulic system Adjust shoe travel and linkage Protect lines and hoses from damage	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Air (see appendix) Brake fluid spills High pressure

DECISIONS	CUES	ERRORS
Decide what components need repair Determine extent of repair or if items need repair Determine if lines and hoses will be damaged	Leaks, operational check Condition of components Proximity to rotating parts, and physical damage	Repair wrong items Unsatisfactory job, redo job Brake failure

(TASK STATEMENT) INSPECT AND REPAIR BRAKE SYSTEM COMPONENTS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Brake pedal and linkage] Fluids under pressure [Hydraulic brakes] Transfer of energy from one form to another [Cooling drums, brake fade]	Positive rationals Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding, Recording [Parts manual] Instruments Ruler, tape, calipers Measurement: geometric [Drum diameter, tube length] Measurement: non-geometric Liquid [Brake fluid] Basic Logic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Listening Viewing	Parts manual Service manual Operation Parts	Comprehension Terminology Noise discrimination Visual analysis, Logic, Detail/Inference

(TASK STATEMENT) ADJUST AND REPAIR REMOTE CONTROLS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Service manual Parts manual Bowden cable Bowden wire Control handle Mounting hardware Linkage rods, clivis and pins Marine type, push and pull to operate control heads and cables	Inspect remote control operation Inspect for binding and loose mounting Repair or replace defective items Adjust auxiliary shift and safety switch Adjust for full travel and proper engagement Check and adjust electrical and mechanical safety interlocks	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Lose control of equipment
DECISIONS	**CUES**	**ERRORS**
Decide if satisfactory Determine what repairs or replacements are needed Determine adjustments	How it performs Condition and performance Service manual and checking	Poor performance Potential failure Unsatisfactory job Wasted time and money Equipment failure, potential personal injury

(TASK STATEMENT) ADJUST AND REPAIR REMOTE CONTROLS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Levers] Motion resulting from two or more forces acting on a point in a body [Control rods] Addition and subtraction of whole numbers [Safety interlocks]	Positive rationals Use of Numbers (without calculation) Counting, Indexing, Coding, Recording [Parts manual] Fundamental Operations (Calculation) Addition, Subtraction [Making adjustments] Instruments Ruler [Feeler gauge] Measurement: geometric [Adjustments] Basic Lobic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Parts manual Service manual Lingage	Comprehension Terminology Visual analysis, Logic, Detail/Inference

(TASK STATEMENT) SHARPEN AND BALANCE CUTTER BLADES

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see apperdix) Grinder Round file Blade balancer Service manual Parts manual	Disconnect spark plug wire Remove and inspect item Sharpen or replace Clean and balance Install and test	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Personal injury Grinding wheel burns

DECISIONS	CUES	ERRORS
Decide if item is worth sharpening Decide how tight	Wear, nicks, cracks Service manual, safety standards	Poor job, safety hazard Safety hazard

(TASK STATEMENT) SHARPEN AND BALANCE CUTTER BLADES

SCIENCE	MATH -- NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Hand tools] Centrifugal forces developed by bodies in rotation [Force in a moving blade] Inertia and momentum [Grinder]	Positive rationals Fractions Use of Numbers (without calculation) Counting, Ordering, Coding, Indexing, Recording [Parts manual] Instruments Tape Measurement: geometric Linear [Blade length, hole size] Angle [Cutting angle] Basic Logic Deductive/Inductive [Deductive reasoning]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading Viewing	Parts manual Service manual Parts operation	Comprehension Terminology Visual analysis, Logic

(TASK STATEMENT) SET UP TRAILER AND TOW VEHICLE WITH SAFETY REQUIREMENTS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Circuit tester Heavy duty drill Drill bits Wire crimpers Wire Tape Terminals Safety chain Blocks Rope Tie down straps Solder kit	Install adaquate hitch Wire vehicle for safety light Install safety equipment on trailer Balance and secure load on trailer	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix) Short circuit Personal injury

DECISIONS	CUES	ERRORS
Determine load requirements Determine correct turn and tail light wires Determine what equipment is needed Determine load position and method of securing	Tongue weight, gross weight Color code, wire position, trial and error Federal standards Gross weight, tongue weight, gross weight	Unsafe hitch Incorrect light connections Unsafe Sway on the road, loose load

(TASK STATEMENT) SET UP TRAILER AND TOW VEHICLE WITH SAFETY REQUIREMENTS

SCIENCE	MATH – NUMBER SYSTEMS
Simple machines used to gain mechanical advantage [Hand tools] Resistance of materials to flow of electrical current [Electrical circuits] Inertia and momentum [Load distribution]	Positive rationals Fractions Use of Numbers (without calculation) Counting, Ordering, Indexing, Coding, Recording [Use of parts manual] Coding [Wire color code] Basic Arithmetic Skills and Concepts Ratio and proportion/Estimation [Balanced load] Instruments Tape Measurement: geometric Linear [Wire length, coupler size] Measurement: non-geometric [Gross weight]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Parts manual Service manual	Comprehension Terminology
Viewing	Parts	Visual analysis, Color discrimination

Duty P Operating A Business

1 Take care of customer needs
2 Maintain business records and catalogs

160

(TASK STATEMENT) TAKE CARE OF CUSTOMER NEEDS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Mechanic's tool set (see appendix) Clothing Telephone Equipment Parts Sales brochures	Demonstrate personal qualities Greet customer Sell to customer's need Handle customer complaint Make service calls and pick-up and deliver	Safety glasses Proper dress Ear protection Safety standard equipment (see appendix)

DECISIONS	CUES	ERRORS
Decide appropriate personal hygiene and dress Determine type of customer and needs Decide to demonstrate Decide what problem is Decide equipment to take on call	Loss of customers Hostile - pleasant service - parts - equipment Type of equipment Customer misunderstanding Equipment failure Improper service Complaint - type of failure - type of equipment	Lose customers Waste time Failure at making call Damage to equipment - poor operation - customer complains

141

(TASK STATEMENT) TAKE CARE OF CUSTOMER NEEDS

SCIENCE	MATH – NUMBER SYSTEMS
BEHAVIORAL SCIENCE Patience: Customer complaints; Hard-to-get places on equipment; Pressure to get job done Personal appearance: Meeting public Good physical condition; Physical conditions working under; Pressures from tension Cooperative: Getting along with other personnel; Meeting public Consideration: Making things easy and pleasant for others Industry: Careful, thoughtful, energetic attack upon job without loitering or wasting time Initiative: Ability to see what needs to be done and go ahead Reliability and trustworthiness: Security and safety of customer; Financial well-being	Positive rationals Use of Numbers (without calculation) Counting [Telephone] Ordering [House numbers] Fundamental Operations (Calculation) Addition, Subtraction, Multiplication, Division

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Speaking	To customer	Terminology, General vocabulary, Clarity of expression, Gestures, Dress, Poise, Usage
Reading	Sales brochures	Comprehension, Detail, Informational reports, Recommendation reports, Terminology
Listening	To customer	Recognize opinions, Word definition, Concentration, Noise discrimination
Viewing	Equipment, Sales brochures	Visual analysis, Recognition of symbol and codes

(TASK STATEMENT) MAINTAIN BUSINESS RECORDS AND CATALOGS

TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON	PERFORMANCE KNOWLEDGE	SAFETY – HAZARD
Sales slips Work orders Cash register Inventroy cards or system Service manual Parts manual Tax chart Catalog updates and instructions	Make out sales slip or work order Maintain inventory control Maintain daily cash Update service manuals and parts manual	

DECISIONS	CUES	ERRORS
Decide what is merchandise, service, taxable and outside repair Decide what is cash-in for merchandise service and taxes and cash-put or returned merchandise and purchased merchandise Decide incoming and outgoing merchandise Decide location in manual	Objects, operations, tax charts Merchandise direction Purchase orders and sales slips Instruction sheets	Incorrect total amounts Incorrect cash balance Incorrect inventory Failure to find information at later date

(TASK STATEMENT) MAINTAIN BUSINESS RECORDS AND CATALOGS

SCIENCE	MATH – NUMBER SYSTEMS
	Positive rationals Use of Numbers (without calculation) [Inventory and parts manual], Counting-Measurement Fundamental Operations (Calculation) [Cash control], Addition-Division Basic Arithmetic Skills and Concepts Reduction of fractions, Changing mixed numbers to improper fractions, Changing percents to fractions and fractions to percents, Finding a percent of a number and what percent one number is of another, Changing fractions to decimal and decimals to fractions, Ratio and proportion [Taxes] Measurement: non-geometric Time [Time measure] Money [Money measure]

COMMUNICATIONS

PERFORMANCE MODES	EXAMPLES	SKILLS/CONCEPTS
Reading	Work orders Writing	Terminology Penmanship, Spelling, Description, Terminology
Viewing	Parts manual, inventory	Recognition of symbols, codes, emblems

GLOSSARY

Air
  Air compressor
  Air hose
  Blow gun

H.P.
  Horse power

Load sources
  Equipment engine is used on
  Dynomometer
  Outboard test tank
  Electrical load

MTS
  Mechanic's tool set
A. Assorted screwdrivers
B. Assorted pliers
C. Oper and boxend wrenches
D. Socket sets
E. Feeler gauges
F. Steel rule
G. Different types of hammers
H. Carbon scraper
I. Knife
J. Chisel and punch set
K. Allen wrenches
L. Hack saw
M. Tin snips
N. Assorted files

PM
  Parts manual

RPM
  Revolutions per minute

SAE
  Society of Automotive Engineers

SM
  Service manual

Specs.
  Specifications

SSE
  Safety standard equipment
A. Fire extinguisher
B. Fire blanket
C. First aid kit
D. Exhaust ventilation system
E. Personnel evacuation plan
F. Safety containers

SSR
  Safety glasses
  Proper dress
  Ear protection

Tach
  Tachometer

TDC
  Top dead center

VOM
  Volt Ohm's meter

Mfg.
  Manufacturer