The general purpose of the occupational analysis is to provide workable, basic information dealing with the many and varied duties performed in the auto mechanic occupation. It identifies the broad area of skills and knowledge necessary to perform various tasks involved in diagnosis, maintenance, and repair of automotive systems. Selected supervisory tasks involved in running a shop employing several mechanics are included. The document opens with a brief introduction followed by a job description. The bulk of the document is presented in table form. Seventeen 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: keeping records; supervising mechanics lubricating and maintaining vehicles; servicing engine block assemblies; servicing and repairing cooling systems, fuel systems, valve trains, ignition systems, braking systems (drum and disk), steering units and A/C units; repairing and aligning front end assemblies; repairing rear axle and drive line, and standard and automatic transmissions; and maintaining and repairing electrical systems. Abbreviations of automotive terms are appended. (BP)
AUTO MECHANIC
AN ANALYSIS OF THE AUTO MECHANIC OCCUPATION

Developed By

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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
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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

This occupational analysis describes the duties and tasks required of an auto mechanic. It identifies the broad area of skills and knowledge necessary to perform various tasks involved in diagnosis, maintenance, and repair of automotive systems. Selected supervisory tasks involved in running a shop employing several mechanics are included.
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.

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Columbus, Ohio

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University of Michigan  
Avon Lake, Ohio

Rick Fien, Chemistry  
The Ohio State University  
Beachwood, Ohio

N. S. Gidwani, Chemistry  
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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

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Columbus, Ohio

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Colchester, Connecticut

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Columbus, Ohio

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Worthington, Ohio

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Caldwell, Ohio
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Rita Hastings  
Carol Hicks  
Sue Holsinger  
Barbara Hughes  
Carol Marvin  
Kathy Roediger  

Research Associate  
Administrative Assistant  
Editorial Consultant  
Typist  
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The professional Auto Mechanic will be able to maintain, diagnose and repair an automobile. His or her duties will include the following: maintenance and repair of engines, cooling systems, electrical systems, fuel, exhaust and emission control systems, power trains, suspension systems, steering and alignment systems, brakes, standard and automatic transmissions and heating and air-conditioning systems; all of which pertain to the service of the automobile.
DUTY A. KEEPING RECORDS

1. Plan, schedule and control maintenance of vehicles
2. Maintain warranty records and complete P/M sheets
3. Complete work order and post inventory
4. Initiate and complete parts and supplies orders
## Tools, Equipment, Materials, Objects Acted Upon

- Daily shop schedule
- P/M sheets
- Workorders
- Post inventory

## Performance Knowledge

- Complete daily shop schedule
- Perform daily P/M sheets
- Complete workorders
- Maintain inventory

## Safety - Hazard

## Decisions

- Determine if shop schedule is complete
- Determine what equipment needs P/M sheets
- Determine if workorder lists all parts and repairs
- Determine if inventory is adequate to meet needs

## Cues

- Too little or too much work in shop
- Equipment failure
- Loss of income
- No parts on hand for repairs or too large an inventory

## Errors

- Men not making money or can not complete all job
- Loss of equipment use
- Loss of income
- Incomplete jobs or too many parts on hand
**ASK STATEMENT: A-1 PLAN, SCHEDULE AND CONTROL MAINTENANCE OF VEHICLES**

<table>
<thead>
<tr>
<th>SCIENCE</th>
<th>MATH – NUMBER SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>The following principles of behavioral patterns should be included</td>
<td>Basic Measurement Skills and Concepts</td>
</tr>
<tr>
<td>Professionalism</td>
<td>Reading and interpreting tables, charts, and graphs</td>
</tr>
<tr>
<td>Personality conflicts</td>
<td>Logs</td>
</tr>
<tr>
<td>Communications</td>
<td>Measurement: Non-geometric</td>
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<tr>
<td>Respect</td>
<td>Time/calendar</td>
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<tr>
<td>for others</td>
<td>Weight</td>
</tr>
<tr>
<td>for tools and equipment, etc</td>
<td>Liquid</td>
</tr>
<tr>
<td>Loyalty</td>
<td>Set of Real Numbers: Rationals</td>
</tr>
<tr>
<td>To peers</td>
<td>Uses of Numbers (without calculation)</td>
</tr>
<tr>
<td>Customers</td>
<td>Counting</td>
</tr>
<tr>
<td>Company</td>
<td>Indexing</td>
</tr>
<tr>
<td>Co-operative venture</td>
<td>Coding given a coding system, recognize and identify each unit involved by assigning necessary symbols, numerical or literal</td>
</tr>
<tr>
<td>Working together</td>
<td>Use of Computing Devices and Mechanical Aids: Calculators</td>
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<tr>
<td>Encouragement</td>
<td>Basic Statistical Skills and Concepts: Measurement of central tendency via mean (average), median, standard deviation</td>
</tr>
<tr>
<td>Seek help of others: (specialist)</td>
<td>Basic Logic: Deductive Inductive</td>
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<tr>
<td>Housekeeping:</td>
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</table>

<table>
<thead>
<tr>
<th>PERFORMANCE MODES</th>
<th>EXAMPLES</th>
<th>SKILLS/CONCEPTS</th>
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</thead>
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<tr>
<td>Reading</td>
<td>Check PM Sheets</td>
<td>Comprehension</td>
</tr>
<tr>
<td>Writing</td>
<td>Schedule Work Orders</td>
<td>Terminology</td>
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<tr>
<td>Viewing</td>
<td>Post Inventory</td>
<td>Process Report (Instruction)</td>
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<td></td>
<td>Penmanship</td>
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<td>Spelling</td>
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<td>Class</td>
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<td>Clarity</td>
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<td>Session</td>
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<td>Logic</td>
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<td>Visual A.</td>
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<td>Memory</td>
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<td>Detail and Inference</td>
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<tr>
<td></td>
<td></td>
<td>Recognition of Symbols</td>
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</table>
**TASK STATEMENT** A-2 MAINTAIN WARRANTY RECORDS AND COMPLETE P/M SHEETS

<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
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<tbody>
<tr>
<td>Warranty records forms</td>
<td>Maintain warranty record file</td>
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<tr>
<td>P/M sheet forms</td>
<td>Maintain P/M sheet file</td>
<td></td>
</tr>
<tr>
<td></td>
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</tr>
</tbody>
</table>

**DECISIONS**
- Determine if all customers are listed
- Determine if all equipment is listed

**CUES**
- Customer with no card
- Equipment with no sheet

**ERRORS**
- Loss of customer
- Equipment failure
**TASK STATEMENT** A-2 MAINTAIN WARRANTY RECORDS AND COMPLETE P/M SHEETS

### SCIENCE

<table>
<thead>
<tr>
<th>Liability</th>
<th>Liability of P/M records</th>
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<tbody>
<tr>
<td><strong>The following principles of behavioral patterns should be included:</strong></td>
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<tr>
<td>Professionalism</td>
<td>Dependability</td>
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<tr>
<td>Personality conflicts</td>
<td>On time</td>
</tr>
<tr>
<td>Communications</td>
<td>Regularity</td>
</tr>
<tr>
<td>Respect</td>
<td>Accuracy of repair</td>
</tr>
<tr>
<td>for others</td>
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</tr>
<tr>
<td>for tools and equipment, etc</td>
<td>Personal appearance</td>
</tr>
<tr>
<td>Loyalty</td>
<td>Conduct</td>
</tr>
<tr>
<td>To peers</td>
<td>Trade</td>
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<tr>
<td>Customers</td>
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<tr>
<td>Company</td>
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</tr>
<tr>
<td>Cooperative venture</td>
<td></td>
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<tr>
<td>Working together</td>
<td></td>
</tr>
<tr>
<td>Encouragement</td>
<td></td>
</tr>
<tr>
<td>Seek help of others (specialist)</td>
<td></td>
</tr>
<tr>
<td>Housekeeping</td>
<td></td>
</tr>
</tbody>
</table>

### MATH – NUMBER SYSTEMS

| Basic Measurement Skills and Concepts |
| Reading and interpreting tables, charts, and graphs |
| Logs |
| Measurement: Non-geometric |
| Time/calendar |
| Weight |
| Liquid |
| Set of Real Numbers |
| Rationals |
| Uses of Numbers, (without calculation) |
| Counting |
| Indexing |
| Coding – given a coding system, recognize and identify each unit involved by assigning necessary symbols, numerical or literal |
| Use of Computing Devices and Mechanical Aids – Calculators |
| Basic Probability Skills and Concepts |
| Use of probability of mass behavior vs. unpredictability of single events |
| Basic Logic – Deductive Inductive |

### COMMUNICATIONS

<table>
<thead>
<tr>
<th>PERFORMANCE MODES</th>
<th>EXAMPLES</th>
<th>SKILLS/CONCEPTS</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Check PM Sheets</td>
<td>Comprehension</td>
</tr>
<tr>
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<td></td>
<td>Terminology</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Process Report (Instruction)</td>
</tr>
<tr>
<td>Writing</td>
<td>Schedule Work Orders</td>
<td>Penmanship</td>
</tr>
<tr>
<td></td>
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<td>Spelling</td>
</tr>
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<td>Viewing</td>
<td>Post Inventory</td>
<td>Classification</td>
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<td>Reports (Recommendations)</td>
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<td>Terminology</td>
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<td>Clarity of Expression</td>
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<td>Recognition of Symbols</td>
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<td>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</td>
<td>PERFORMANCE KNOWLEDGE</td>
<td>SAFETY – HAZARD</td>
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<tr>
<td>Work Order</td>
<td>Examine W.O. for Errors</td>
<td></td>
</tr>
<tr>
<td>Price List</td>
<td>Extend prices on parts</td>
<td></td>
</tr>
<tr>
<td>Catalog</td>
<td>Check parts numbers</td>
<td></td>
</tr>
<tr>
<td>Inventory Cards</td>
<td>Total parts &amp; labor prices</td>
<td></td>
</tr>
<tr>
<td>Post parts out of stock</td>
<td>Order parts in below stocking level</td>
<td></td>
</tr>
</tbody>
</table>

**DECISIONS**
- Determine if parts are listed correctly
- Determine discounts if allowed
- Determine correct labor costs

**CUES**
- Check catalog
- Customer discount list
- Rate book prices

**ERRORS**
- Wrong parts posted on W.O.
- Wrong parts posted on inventory
- Incorrect labor cost charges
## Task Statement

A-3 Complete Work Order and Post Inventory

<table>
<thead>
<tr>
<th>Science</th>
<th>Math - Number Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

### Communications

#### Performance Modes
- Reading
- Viewing

#### Examples
- Price list
- Parts catalog
- Work order for errors

#### Skills/Concepts
- Comprehension
- Terminology
- Visual Analysis
- Recognition of symbols
### Task Statement A-4: Initiate and Complete Parts and Oils Order

<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parts order form</td>
<td>List part by name and number</td>
<td></td>
</tr>
<tr>
<td>Oil order form</td>
<td>List oils by name, weight and type</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Decisions
- Determine what parts are needed and where to buy
- Determine types and amount of oils needed

### Cues
- No parts or wrong parts on hand
- No oils or wrong type on hand

### Errors
- Job incomplete
- Loss of customers
The following principles of behavioral patterns should be included:

- Professionalism
- Personality conflicts
- Communications
- Respect for others
- Loyalty to peers
- Customers
- Company
- Cooperative venture
- Working together
- Encouragement
- Seek help of others (specialist)
- Housekeeping

<table>
<thead>
<tr>
<th>SCIENCE</th>
<th>MATH – NUMBER SYSTEMS</th>
</tr>
</thead>
</table>
| Specifications
Viscosity
The following principles of behavioral patterns should be included:
- Professionalism
- Personality conflicts
- Communications
- Respect
- Loyalty to peers
- Customers
- Company
- Cooperative venture
- Working together
- Encouragement
- Seek help of others (specialist)
- Housekeeping |
| Dependability
On time
Accuracy of repair |
| Measurement: Non-geometric
Time/calendar
Weight |
| Liquid |
| Set of Real Numbers
Rationals
Uses of Numbers (without calculation) |
| Coding
Given a coding system, recognize and identify each unit involved by assigning necessary symbols, numerical or literal |
| Use of Computing Devices and Mechanical Aids
Calculators |
| Basic Probability Skills and Concepts
Use of probability of mass behavior vs. unpredictability of single events |
| Basic Logic
Deductive
Inductive |
| Basic Measurement Skills and Concepts
Measurement: Geometric |
| Linear |

<table>
<thead>
<tr>
<th>COMMUNICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERFORMANCE MODES</td>
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<td>Reading</td>
</tr>
<tr>
<td>Writing</td>
</tr>
<tr>
<td>Viewing</td>
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</tbody>
</table>
DUTY B. SUPERVISING MECHANICS

1. Maintain work control and monitor workload and down time

2. Prepare time and attendance records and medical accident reports
**TASK STATEMENT** B-1 MAINTAIN WORK CONTROL AND MONITOR WORK

<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY - HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shop foreman check list</td>
<td>Follow shop foreman's check list and assign all duties</td>
<td></td>
</tr>
<tr>
<td>Daily shop schedule</td>
<td>Schedule customer cars for service and repairs</td>
<td></td>
</tr>
<tr>
<td>Part inventory</td>
<td>Maintain part inventory to assure minimum down time</td>
<td></td>
</tr>
</tbody>
</table>

**DECISIONS**
- Determine if all jobs from foreman check list are complete
- Determine if all customer cars are listed on daily shop schedule
- Determine if all parts needed for repair are on hand

**CUES**
- Jobs not being completed and loss of equipment use
- Customer car not being serviced or repaired
- No parts on hand to complete repairs

**ERRORS**
- Loss of time and money, loss of use of shop equipment
- Unsatisfied customers, loss of income
- Too much down time, unsatisfied customers, loss of income
### SCIENCE

**Daily work schedule**

**Part inventory**

The following principles of behavioral patterns should be included:

- **Professionalism**
- **Personality conflicts**
- **Communications**
- **Respect**
- **for others**
- **for tools and equipment, etc.**
- **Loyalty**
- **To peers**
- **To customers**
- **Company**
- **Cooperative venture**
- **Working together**
- **Encouragement**
- **Seek help of others (specialist)**
- **Housekeeping**

### MATH – NUMBER SYSTEMS

- **Basic Measurement Skills and Concepts**
  - Reading and interpreting tables, charts, and graphs
  - Logs
  - Measurement: Non-geometric
  - Time/calendar
  - Weight
  - Liquid
  - Set of Real Numbers: Rationals
  - Uses of Numbers: (without calculation)
  - Counting
  - Indexing
  - Coding: given a coding system, recognize and identify each unit involved by assigning necessary symbols, numerical or literal
  - Use of Computing Devices and Mechanical Aids - Calculators

- **Basic Probability Skills and Concepts**
  - Use of probability of mass behavior v.s. unpredictability of single events
  - Basic Logic: Deductive/Inductive
  - Basic Measurement Skills and Concepts
  - Measurement: Non-geometric
  - Money/Interest
  - Fundamental Operations (Calculation)
  - Basic Arithmetic Skills and Concepts
  - Finding a percent of a number and what percent one number is of another
  - Ratio and proportion

### COMMUNICATIONS

#### PERFORMANCE MODES

- **Reading**
- **Writing**
- **Viewing**
- **Speaking**

#### EXAMPLES

- **Check PM Sheets**
- **Schedule Work Orders**
- **Post Inventory**
- **Instructions to mechanics**

#### SKILLS/CONCEPTS

- **Comprehension**
- **Terminology**
- **Process Report (Instruction)**
- **Penmanship**
- **Spelling**
- **Classification**
- **Reports (Recommendations)**
- **Terminology**
- **Clarity of Expression**
- **Logic**
- **Visual Analysis**
- **Memory**
- **Detail and Inference**
- **Recognition of Symbols**
- **Terminology**
- **Gestures**
- **Dress**
### TOOLS, EQUIPMENT, MATERIALS, OBJECTS, ACTED UPON
- Time cards
- Attendance records
- Medical forms
- Accident reports

### PERFORMANCE KNOWLEDGE
- Check and total time cards weekly
- Check and complete attendance records daily
- Complete medical reports as needed
- Complete accident reports as required

### SAFETY – HAZARD

### DECISIONS
- Determine if time card total matches work completed
- Determine if attendance record are complete
- Determine if medical forms are filled out properly
- Determine if accident report are filled out and completed as required

### CUES
- Number of cards turned in
- Absents do not match attendance reports
- No follow up from insurance company
- No follow up from front office

### ERRORS
- Mistakes in payroll
- Truant personnel
- No payment from insurance company
- Lawsuit, lost time
**SCIENCE**

- Time cards
- Medical reports
- Accident reports

The following principles of behavioral patterns should be included:

- **Professionalism**
  - Dependability
  - On time
  - Regularity
  - Accuracy of repair

- **Personality conflicts**
- **Communications**
  - Communication
  - Image
  - Personal appearance
  - Conduct
  - Trade

- **Respect**
- **Loyalty**
- **Cooperative venture**
- **Working together**
- **Encouragement**
- **Seek help of others (specialist)**
- **Housekeeping**

**MATH - NUMBER SYSTEMS**

- **Set of Real Numbers**
- **Rationals**

**Uses of Numbers (without calculation)**

- Counting
- Indexing
- Recording

**Basic Measurement Skills and Concepts**

- **Time/calendar**
- **Money interest**

**Reading and Interpreting Tables, Charts, and Graphs**

**Fundamental Operations (Calculation)**

**COMMUNICATIONS**

**PERFORMANCE MODES**

- **Reading**
- **Writing**
- **Viewing**
- **Speaking**

**EXAMPLES**

- Check Reports
- Fill in time cards, Medical cards, Accident Reports
- Write business letters

- Check Accident Scene
- Check Hazard

- Report Hazard and Safety Correction

**SKILLS/CONCEPTS**

- **Comprehension**
- **Terminology**
- **Process report (instruction)**

- **Penmanship**
- **Spelling**
- **Classification**
- **Reports (recommendations)**

- **Terminology**
- **Clarity of expression**
- **Logic**

- **Visual analysis**
- **Memory**
- **Detail and inference**
- **Recognition of symbols**

- **Terminology**
- **Gestures**
- **Dress**
DUTY C. LUBRICATING AND MAINTAINING VEHICLES

1. Perform safety inspection, lubricate, and change oil and filters, service hardware

2. Maintain, remove, repair or replace tires
<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY / HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grease pan</td>
<td>Safety inspection</td>
<td>Wear safety glasses</td>
</tr>
<tr>
<td>Drain pan</td>
<td>Lube/chassis</td>
<td>Do not remove radiator cap if engine is hot</td>
</tr>
<tr>
<td>Oil and fuel filter wrench</td>
<td>Change oil</td>
<td>Foreign material may get into eyes</td>
</tr>
<tr>
<td>Oil can</td>
<td>Change oil and fuel filter</td>
<td>Would get burned from steam pressure</td>
</tr>
<tr>
<td>Oil can cutter</td>
<td>Lube hardware</td>
<td></td>
</tr>
<tr>
<td>Chassis &amp; tires</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oil Pan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Filter mountings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hardware</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DECISIONS</th>
<th>CUES</th>
<th>ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine if safety items will meet manufacture specifications</td>
<td>Loose or worn parts</td>
<td>Accidents</td>
</tr>
<tr>
<td>Determine what type of lube to use</td>
<td>Owner's manual</td>
<td>Engine damage</td>
</tr>
<tr>
<td>Determine what type of oil to use</td>
<td>Parts manual</td>
<td>Road failure</td>
</tr>
<tr>
<td>Determine if the replacement filters meet manufacture specifications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Determine what type of lube to use on hardware</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## C-1 PERFORM SAFETY INSPECTION, LUBRICATE, CHANGE OIL & FILTERS AND SERVICE HARDWARE

<table>
<thead>
<tr>
<th>SCIENCE</th>
<th>MATH - NUMBER SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine oils</td>
<td>Basic Logic.</td>
</tr>
<tr>
<td>Lube</td>
<td>Deductive inductive</td>
</tr>
<tr>
<td>Oil pump</td>
<td>Basic Measurement Skills and Concepts</td>
</tr>
<tr>
<td>Engine oils</td>
<td>Instruments, ruler, compass, protractor, micrometer, tape, calipers, barometer, thermometer, tachometer, and others.</td>
</tr>
<tr>
<td>Lube and oils</td>
<td>Metric and English measure and conversion</td>
</tr>
<tr>
<td>Fan belts</td>
<td>Measurement Geometric</td>
</tr>
</tbody>
</table>

The following principles of behavioral patterns should be included:

- **Professionalism**
  - Dependability
  - On time
  - Regularity
  - Accuracy of repair

- **Personality conflicts**
  - Loyalty
  - Respect for others
  - For tools and equipment etc

- **Communications**
  - Personal appearance
  - Conduct

- **Respect**
  - For tools and equipment etc

- **Professionalism**
  - Image

- **For others**
  - To peers
  - Loyalty

- **Company**
  - Professionalism

- **Cooperative venture**
  - Dependability

- **Working together**
  - Professionalism

- **Encouragement**
  - Respect for others

- **Seek help of others (specialist)**

- **Housekeeping**

### COMMUNICATIONS

#### PERFORMANCE MODES

<table>
<thead>
<tr>
<th>Mode</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>Check Lube &amp; Oil Charts</td>
</tr>
<tr>
<td>Writing</td>
<td>Fill in PM report</td>
</tr>
<tr>
<td>Listening</td>
<td>Check Lube &amp; Oil Charts</td>
</tr>
<tr>
<td>Viewing</td>
<td>For Abnormal Sounds: (squeaks; rattles; knocks; etc.)</td>
</tr>
<tr>
<td>Touching</td>
<td>Rust, Bends, Tears, etc</td>
</tr>
<tr>
<td>Smelling</td>
<td>Rough, broken glass</td>
</tr>
</tbody>
</table>

#### EXAMPLES

- For Abnormal Sounds: (squeaks; rattles; knocks; etc.)
- Rust, Bends, Tears, etc
- Rough, broken glass

### SKILLS/CONCEPTS

- **Comprehension**
- **Terminology**
- **Penmanship**
- **Spelling**
- **Reports (Recommendations)**
- **Auditory Discrimination**
- **Visual analysis**
- **Describing**
- **Logic**
- **Detail and inference**
- **Temperature**
- **Consistency**
- **Odor (oil) (coolant)**

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### TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON
- Tire changer
- Rubber lube
- Wheel wrench
- Jack
- Pressure gauge
- Patching
- Wheels
- Tires

### PERFORMANCE KNOWLEDGE
- Inspect
- Check air pressure
- Repair flats
- Replace tires

### SAFETY – HAZARD
- Wear safety glasses
- Proper use of tools
- Foreign materials could get in eyes
- Hands, hair, loose clothing could catch in moving parts

### DECISIONS
- Determine if these tires will provide trouble free performance
- Determine proper air pressure
- Use proper type of repair
- Determine what type tire to replace with

### CUES
- Cuts, breaks, tread wear, air loss

### ERRORS
- Flat tire
- Accident
### C-2 MAINTAIN, REMOVE, REPAIR OR REPLACE TIRES (INSPECT & SERVICE TIRES)

#### SCIENCE
- Fire changer
- Wheel wrench
- Tire
- Road friction
- Tire body

#### MATH - NUMBER SYSTEMS
- Set of Real Numbers
- Whole numbers
- Basic Measurement Skills and Concepts
- Measurement Geometric Volume
- Instruments:
- Measurement Non-geometric
- [Pressure]
- Basic Logic
- Deductive inductive

#### COMMUNICATIONS

##### PERFORMANCE MODES
- Speaking
- Reading
- Writing
- Listening
- Viewing
- Touching

##### EXAMPLES
- Customer complaint
- Charts - tire pressure, size
- Report condition, repairs, & cost
- Air Leak
- Abnormal wear patterns
- Rough trend or lumps, or leatheredging

##### SKILLS/CONCEPTS
- Terminology
- Comprehension
- Terminology
- Penmanship
- Spelling
- Reports
- Auditory discrimination
- Visual analysis
- Logic
- Symbols & codes
- Shape
DUTY D. SERVICING AND REPAIRING COOLING SYSTEMS

1. Diagnose cooling and heating systems problems

2. Replace cooling systems components
**TASK STATEMENT**

D-1 DIAGNOSE COOLING AND HEATING SYSTEMS PROBLEMS

<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light, Inspection mirror, Pressure tester, Belts, Fans, Hoses, Radiator, Heater core, Freeze plugs</td>
<td>Visually inspect belts for cracks, breaks, glazing, and tension. Inspect fans. Inspect hoses for cracks or deterioration. Inspect radiator &amp; heater cores for leaks and mounting problems.</td>
<td>Wear safety glasses. Make sure engine is off and will not start. Do not remove radiator cap if engine is hot. Foreign material or steam could get in eyes. Hands or hair or loose clothing could catch in moving parts. Would get burned by steam pressure.</td>
</tr>
</tbody>
</table>

**DECISIONS**

Determine if these units provide trouble free performance.

**CUES**

Leaks, noises, overheating complaints.

**ERRORS**

Engine overheating, Result: Road breakdown, Engine damage.
### SCIENCE

- Fan belts and pulleys
- Water pump
- Pressure caps
- Water pump
- Hydrometer
- Radiator
- Fan belts and hoses

The following principles of behavioral patterns should be included:

- **Professionalism**
- **Personality conflicts**
- **Communications**
- **Respect**
  - for others
  - for tools and equipment, etc.
- **Loyalty**
  - To peers
  - To customers
  - To company
- **Cooperative venture**
- **Working together**
- **Encouragement**
- **Seek help of others (specialist)**
- **Housekeeping**

### MATH - NUMBER SYSTEMS

- **Basic Logic**
- Deductive inductive
- **Set of Real Numbers**
- **Rationals**
- Uses of Numbers (Without calculation)
- **Ratio**
- **Basic Measurement Skills and Concepts**
  - **Measurement**
  - **Geometric**
  - **Volume**
  - **Measurement Non-geometric**
  - **Temperature**
  - **Liquid (Coolant)**
  - **Reading and Interpreting Tables, Charts, and Graphs**
  - **Logs** (Coolant mixing chart)
  - **Instruments**
  - (Pressure tester, hydrometer)
- **Basic Arithmetic Skills and Concepts**
  - **Ratio and proportion**
  - [Coolant solution]

### COMMUNICATIONS

#### PERFORMANCE MODES

- **Speaking**
- **Reading**
- **Writing**
- **Listening**
- **Viewing**
- **Touching**
- **Smelling**

#### EXAMPLES

- Customer complaint
- Chart, Hydrometer
- Evaluate, cost estimate
- Overheat
- Boiling Sounds
- Visual signs, leaks, etc
- Burning

#### SKILLS/CONCEPTS

- Terminology
- Logic
- Gestures
- Comprehension
- Informational reports
- Terminology
- Penmanship
- Spelling
- Terminology
- Logic
- Auditory discrimination
- Logic
- Visual analysis
- Temperature
- Odor
<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>S I K</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure tester</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water pump</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hoses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Belts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermostat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fan</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radiator core</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heater core</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Freeze plugs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace water pump</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace hoses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heater</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace thermostat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace radiator core</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace heater core</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replace freeze plugs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wear safety glasses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proper use of hand tools</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make sure engine will not start</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wait till engine cools before removing cap</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Foreign material or steam could get in eyes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hands, hair, loose clothing could catch in moving parts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Would get burned by water or steam under pressure</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DECISIONS**

Determine if the cooling system will operate properly
Determine if the coolant mixture is correct

**CUES**

Visible leaks
Coolant not circulating
Hydrometer shows coolant not adequate

**ERRORS**

Heater malfunction
Engine overheating
Engine damage
Engine freeze up
ASK STATEMENT) D-2 REPLACE COOLING SYSTEM COMPONENTS

**SCIENCE**

Simple machines used to gain mechanical advantage: levers, belts, and pulleys.
Work input, work output, friction, and efficiency in simple machines.
Water pump.
Fluids under pressure: pressure caps.
Centrifugal forces developed by rotation: water pump.
Resistance of materials to change in shape: fan belts and hoses.

The following principles of behavioral patterns should be included:
Professionalism
Personality conflicts
Communications
Respect for others
Loyalty to peers, customers, company, cooperative venture
Working together
Encouragement
Seek help of others (specialist)
Housekeeping

**MATH - NUMBER SYSTEMS**

- Basic Logic
- Deductive/inductive
- Set of Real Numbers
- Rationals
- Uses of Numbers: (without calculation)
- Ratio
- Basic Measurements: Skills and Concepts
  - Measurement Geometric: linear [Length of heater hose]
  - Volume
  - Measurement Non-geometric: Temperature, Liquid [Coolant], [Pressure]
  - Decibels: Reading and Interpreting Tables, Charts, and Graphs
  - Logs: [Coolant mixing chart]
  - Instruments: Basic Arithmetic: Skills and Concepts
  - Ratio and proportion: [Coolant solution]
- Basic Algebra: Skills and Concepts
  - Manipulation of formulae: [for every 1 lb. pressure, 30 rise]
  - Substitute given values in order to find the value of the required unknown [in boiling point]

**COMMUNICATIONS**

**PERFORMANCE MODES**
- Speaking
- Reading
- Writing
- Listening
- Viewing
- Touching
- Smelling

**EXAMPLES**
- Customer complaint
  - Chart, Hydrometer
  - Evaluate, Cost estimate
  - Boiling Sounds, Visual signs, leaks, etc
  - Odor

**SKILLS/CONCEPTS**
- Terminology
- Logic
- Gestures
- Comprehension
- Informational Reports
- Terminology
- Penmanship
- Spelling
- Terminology
- Logic
- Auditory discrimination
- Logic
- Visual analysis
- Temperature
- Odor
DUTY E. SERVICING AND REPAIRING FUEL SYSTEMS

1. Diagnose fuel systems problems

- 2. Test repair and/or replace fuel system components
# TASK STATEMENT
E-1 Diagnose Fuel System Problems

## Tools, Equipment, Materials, Objects Acted Upon

<table>
<thead>
<tr>
<th>S.I.K</th>
<th>Fuel pump pressure gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Combustion analyzer</td>
</tr>
<tr>
<td></td>
<td>Vacuum Gauge</td>
</tr>
</tbody>
</table>

- Fuel pump
- Carburetor
- Lines
- Fuel tank
- Fuel filters
- Intake manifold

## Performance Knowledge

- Test fuel pump pressure
- Analyze combustion
- Test manifold vacuum

## Safety – Hazard

- Use safety glasses
- Fire extinguisher handy
- Disconnect & ground coil high tension wire
- Gas spray in eyes
- Fire could result with fuel
- Spark could set fire to spilled fuel

## Decisions

- Determine condition of pump
- Determine combustion efficiency
- Determine vacuum level

## Cues

- Pump pressure as specified
- Correct combustion level
- Correct vacuum level

## Errors

- Car will not run
- Car will run poorly
- Will lose mileage
**ASK STATEMENT**

**E-1 DIAGNOSE FUEL SYSTEM PROBLEMS**

### SCIENCE

- Simple machines used to gain mechanical advantage: Fuel pump
- Transfer of energy from one form to another: Combustion

The following principles of behavioral patterns should be included:

- Professionalism
  - Personality conflicts
  - Communications
  - Respect
  - Loyalty
  - Confidence
  - For tools and equipment, etc.
  - Company

- Cooperative venture
  - Working together
  - Encouragement
  - Seek help of others (specialist)
  - Housekeeping

### MATH – NUMBER SYSTEMS

- Basic Logic
  - Deductive
  - Inductive
- Basic Measurement Skills and Concepts
- Instruments
  - Measurement and Geometry
  - Liquid
  - Pressure (lbs. sq. in.)
  - Vacuum (in of hg)
  - Emission control (combustion analyzer ppm)
- Reading and Interpreting Tables, Charts, and Graphs
  - Time calendar
  - Logs
  - Spec. chart
  - Infrared conversion chart

### COMMUNICATIONS

#### PERFORMANCE MODES

<table>
<thead>
<tr>
<th>Speaking</th>
<th>Customer Complaint</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>Chart – specifications, Gauges</td>
</tr>
<tr>
<td>Writing</td>
<td>Cost Estimate.</td>
</tr>
<tr>
<td>Listening</td>
<td>Uneven idle</td>
</tr>
<tr>
<td>Viewing</td>
<td>Fuel Leak</td>
</tr>
<tr>
<td>Smelling</td>
<td>Fuel Leaks</td>
</tr>
</tbody>
</table>

#### EXAMPLES

- Terminology
- Logic
- Comprehension
- Terminology
- Penmanship
- Spelling
- Reports
- Logic
- Auditory discrimination
- Logic
- Visual analysis
- Logic
- Symbols and codes
- Gasoline Odors
<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.T.K.</td>
<td>Replace carburetor</td>
<td>Use safety glasses</td>
</tr>
<tr>
<td>Fuel pump pressure gauge</td>
<td>Replace lines</td>
<td>Fire extinguisher handy</td>
</tr>
<tr>
<td>Combustion analyzer</td>
<td>Replace fuel pump</td>
<td>Do not crank engine with carburetor off</td>
</tr>
<tr>
<td>Vacuum gauge</td>
<td>Replace fuel filters</td>
<td>Gas spray in eyes</td>
</tr>
<tr>
<td>Fuel pump</td>
<td>Replace intake manifold</td>
<td>Presence of gasoline is always dangerous</td>
</tr>
<tr>
<td>Carburetor</td>
<td></td>
<td>Spark from ignition will ignite fuel</td>
</tr>
<tr>
<td>Lines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel tank</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel filters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intake manifold</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DECISIONS**

Determine if the fuel systems will operate as specified

**CUES**

- Fuel pump pressure is low
- Combustion mixture is wrong
- The fuel lines are pinched or free
- Fuel filters are clear
- There is a vacuum leak

**ERRORS**

- Poor performance
- Poor mileage
**SCIENCE**

Simple machines used to gain mechanical advantage: Fuel pump
Transfer of energy from one form to another: Combustion

The following principles of behavioral patterns should be included:
- Professionalism
- Personality conflicts
- Respect for others
- for tools and equipment, etc.
- Loyalty
- To peers
- Customers
- Company
- Cooperative venture
- Working together
- Encouragement
- Seek help of others (specialist)
- Housekeeping

**MATH: NUMBER SYSTEMS**

- Basic Logic
  - Deductive inductive
- Basic Measurement Skills and Concepts
  - Instruments, ruler, compass, protractor, clinometer, tape, calipers, micrometer, thermometer, barometer, tachometer, fuel pressure gauge, vacuum gauge, combustion analyzer, and others

Measurement: Non-geometric
- Liquid
  - Pressure (lbs. sq. in.)
  - Vacuum (in. of hg)
- Emission control (combustion analyzer)
- Reading and interpreting tables, charts, and graphs
- Time; calendar; Logs, spec. chart
- Infrared conversion chart

Set of Real Numbers
- Rationals

**COMMUNICATIONS**

**PERFORMANCE MODES**

- Speaking
- Reading
- Writing
- Listening
- Viewing
- Smelling

**EXAMPLES**

- Customer Complaint
- Chart—Specifications, Gauges
- Cost estimate
- Uneven idle
- Fuel Leak
- Fuel Leaks

**SKILLS/CONCEPTS**

- Terminology
- Logic
- Comprehension
- Terminology
- Penmanship
- Spelling
- Reports
- Logic
- Auditory discrimination
- Logic
- Visual analysis
- Logic
- Symbols and codes
- Gasoline odors
DUTY F. SERVICING ENGINE BLOCK ASSEMBLIES

1. Diagnose engine problems
2. Clean, disassemble, inspect block assembly components
3. Service piston and reassembly
4. Service crankshaft and bearing
### TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

- Universal oil pressure gauge
- Compression gauge
- Mechanics stethoscope
- Chassis dynamometer
- Cylinder leak tester
- Engine block
- Piston & rod assemblies
- Crankshaft & bearings
- Oil pump

### PERFORMANCE KNOWLEDGE

- Check oil pressure
- Check compression
- Return leak down test
- Listen for noises
- Dyno test

### SAFETY - HAZARD

- Wear safety glasses
- Beware of electric shock
- Care of moving parts
- Dirt or foreign material could fly in eye
- With engine running, stethoscope may touch spark plug or wire
- Running engine could catch loose clothing or long hair, etc

### DECISIONS

- Determine if oil pressure is low
- Determine if wet compression test is low
- Determine if cylinder leakage is correct
- Check noise level
- Determine test results

### CUES

- Low oil pressure
- Abnormal noise
- Poor performance

### ERRORS

- Oil consumption
- Critical engine damage
ASK STATEMENT: F-1 DIAGNOSE ENGINE PROBLEMS (BLOCK)

SCIENCE

Simple machines used to gain mechanical advantage: Gears, levers, pulleys.
Work input, work output, friction and efficiency in simple machines: Horse power output.
Fluids under pressure: Oil and fuel.
Transfer of heat from one body to another: From combustion chamber to water jacket.
Effects of friction on work processes and product quality: Power loss due to friction.

The following principles of behavioral patterns should be included:
- Professionalism
- Personality conflicts
- Communications
- Respect
- Loyalty
- To peers
- To customers
- Company
- Cooperative venture
- Working together
- Encouragement
- Seek help of others (specialist)
- Housekeeping

MATH - NUMBER SYSTEMS

Set of Real Numbers: Rational.
Uses of Numbers (Without calculation):
- Compression Ratio
Basic Arithmetic Skills and Concepts:
- Changing fractions to decimal and decimal to fractions: Bore and crankshaft.
- Rounding off decimals and whole numbers: Crankshaft and camshaft.
Basic Measurement Skills and Concepts:
- Instruments: Micrometer, tachometer.
- Given an instrument of measure: Determine precision and accuracy with respect to relative error, significant digits, and tolerance: Crankshaft and bore.
- Metric and English measure and conversion: Measurement - Non-geometric:
-Liquid: Oil pressure (Pressure).
Basic Algebra Skills and Concepts:
- Uses of variables: In formulas (cubic inch displacement).
Basic Geometry Skills and Concepts:
- Deductive inductive:
- Measurement - Non-geometric:
- Determination of area and volume of cylinders.
- Fundamental Operations (Calculation):
- Use of computing devices and mechanical aids:
- Calculators
- Computers

COMMUNICATIONS

PERFORMANCE MODES
- Speaking
- Reading
- Writing
- Listening
- Viewing
- Touching
- Smelling

EXAMPLES
- Customer Complaint, Special checks:
- Specification Chart, Test Gauges & Instruments:
- Report: Cost estimate
- Squeaks, knocks, rattles
- Oil leaks: Int. leaks
- Rough or worn parts
- Burned or contaminated oil

SKILLS/CONCEPTS
- Terminology
- Logic
- Comprehension
- Terminology
- Penmanship
- Spelling
- Terminology
- Logic
- Auditory discrimination
- Mental analysis
- Symbols and codes
- Size
- Shape
- Temperature
- Engine oil odors
<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>S I K Cleaning solvents Ridge reamer Block</td>
<td>Replace engine Disassemble engine Clean block &amp; parts Inspect component</td>
<td>Wear safety glasses Fire extinguisher handy Secure engine Solvents or other foreign material may lodge in eye Solvents or fuels are flammable May fall and cause bodily injury</td>
</tr>
<tr>
<td>Piston &amp; rod assemblies Crank shaft &amp; bearings Oil pump</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DECISIONS</th>
<th>CUES</th>
<th>ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine if it is necessary to remove the engine Determine what parts are functional</td>
<td>Diagnosis shows need to remove Cracked or broken parts Worn parts</td>
<td>Engine damaged Engine destroyed</td>
</tr>
</tbody>
</table>
F-2 DISASSEMBLE, CLEAN AND INSPECT COMPONENT

SCIENCE

Simple machines used to gain mechanical advantage - Gears, levers, pulleys
Work input, work output, friction and efficiency in simple machines - Horse power output
Fluids under pressure - Oil and fuel
Transfer of heat from one body to another - From combustion chamber to water jackets
Effects of friction on work processes and product quality - Power loss due to friction

The following principles of behavioral patterns should be included in this course:

- Professionalism
- Personality conflicts
- Communications
- Respect
- for others
- for tools and equipment, etc.
- Loyalty
- to peers
- Customers
- Company
- Cooperative venture
- Working together
- Encouragement
- Seek help of others (specialist)
- Housekeeping

MATH - NUMBER SYSTEMS

Set of Real Numbers
- Rationals
- Uses of Numbers (without calculation)
- Ratio - Compression
- Basic Arithmetic Skills and Concepts
  - Changing fractions to decimal and decimal to fractions - Bore and crankshaft
  - Rounding off decimals and whole numbers - Crankshaft and cam-shaft
- Basic Measurement Skills and Concepts
- Instruments - Micrometer tachometer
- Given an Instrument of Measure, determine precision and accuracy with respect to relative error, significant digits, and tolerance - Crankshaft and bore
- Metric and English measure and conversion
- Measurement: Non-geometric
  - Liquid - Oil pressure
  - Reading and interpreting tables, charts, and graphs - Torque spec charts
- Basic Algebra Skills and Concepts
  - Use of variables in formulas (Cubic inch displacement)
  - Basic Logic
  - Deductive - Inductive
  - Basic Geometry Skills and Concepts
  - Determination of area and volume of cylinders
  - Fundamental Operations (Calculation)
  - Use of computing devices and mechanical aids - Calculators - Computers

COMMUNICATIONS

PERFORMANCE MODES

- Speaking
- Reading
- Writing
- Listening
- Viewing
- Touching
- Smelling

EXAMPLES

- Customer complaint, Special checks
- Specification Chart, Test Gauges & Instruments
- Report - Cost estimate
- Squeaks, knocks, rattles
- Oil leaks, fuel leaks
- Rough or worn parts
- Burned or contaminated oil

SKILLS/CONCEPTS

- Terminology
- Logic
- Comprehension
- Terminology
- Penmanship
- Spelling
- Terminology
- Logic

- Auditory discrimination
- Visual analysis
- Symbols and codes
- Size
- Shape
- Engine oil odors
## Task Statement

F-3 Service Piston and Rod Assembly

### Tools, Equipment, Materials, Objects Acted Upon

- S T K.
- Foot pound torque wrench
- Ring groove cleaner
- Thickness gauge
- Ring installation tool
- Pistons
- Rods
- Piston Pins
- Rings

### Performance Knowledge

- Inspect pistons for cracks
- Inspect piston ring groove for width wear
- Inspect piston pins
- Inspect rod alignment
- Install rods and rings on pistons

### Safety - Hazard

- Wear safety glasses
- Correct use of hand tools
- Chips from ring groove tool
- Sharp edges on pistons & rings

### Decisions

- Determine if pistons are operable
- See if piston pins are worn or locks are ok
- Determine if rings will fit correctly
- Determine that rods are not twisted or bent

### Cues

- Cracked piston skirts
- Worn ring grooves
- Abnormal wear pattern on pistons

### Errors

- Pistons cracked will destroy engine
- Bent rods will knock
**SCIENCE**

Simple machines used to gain mechanical advantage - gears, levers, pulleys.
Work input, work output, friction and efficiency in simple machine - Horse power output.
Fluids under pressure - Oil and fuel.
Transfer of heat from one body to another - From combustion chamber to water jacket.
Effects of friction on work processes and product quality - Power loss due to friction.

The following principles of behavioral patterns should be included:

**Professionality**
- Respect
- Communication

**Dependability**
- On time
- Accuracy of repair

**Loyalty**
- To peers
- Customers
- Company

**Cooperative venture**
- Working together
- Encouragement
- Seek help of others (specialists)

**Housekeeping**

---

**MATH - NUMBER SYSTEMS**

<table>
<thead>
<tr>
<th>Set of Real Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rational</td>
</tr>
<tr>
<td>Numbers (Without calculation)</td>
</tr>
</tbody>
</table>

**Compression Ratio**

**Base Arithmetic Skills and Concepts**
- Changing fractions to decimal and decimal to fractions.
- Bore and crankshaft.
- Rounding off decimals and whole numbers.
- Crankshaft and cam-shaft.

**Basic Measurement Skills and Concepts**
- Given an Instrument of Measurement, determine precision and/or accuracy with respect to relative error, significant digits and tolerance.
- Crankshaft and bore.
- Metric and English measure and conversion.
- Measurement Non-geometric.

**Basic Algebra Skills and Concepts**
- In formulas (cubic inch displacement).

**Basic Geometrical Skills and Concepts**
- Determination of area and volume of cylinders.
- Given an Instrument of Measurement, determine precision and/or accuracy with respect to relative error, significant digits, and tolerance.
- Tolerance, clearance, piston skirt.

**Basic Measurement Skills and Concepts**
- Reading and interpreting tables, charts, and graphs.
- Torque specification charts.
- Instruments - Thickness gauge.
- Use of Numbers (Without calculation).
- Coding, Coding - bit sizing.

---

**COMMUNICATIONS**

**PERFORMANCE MODES**
- Speaking
- Reading
- Writing
- Listening
- Viewing
- Touching
- Smelling

**EXAMPLES**
- Customer complaint, Special checks.
- Specification chart, Test gauges & Instruments.
- Report - Cost estimate.
- Squeaks, knocks, rattles.
- Oil leaks, fuel leaks.
- Rough or worn parts.
- Burned or contaminated oil.

**SKILLS/CONCEPTS**
- Terminology
- Logic
- Comprehension
- Terminology
- Penmanship
- Spelling
- Terminology
- Logic
- Auditory discrimination
- Visual analysis
- Symbols and codes
- Size
- Shape
- Engine oil odor.
<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.T.K.</td>
<td>Keep main and rod caps in order</td>
<td>Wear safety glasses</td>
</tr>
<tr>
<td>Torque wrench</td>
<td>Install rear main oil seal</td>
<td>Make sure engine block is secure</td>
</tr>
<tr>
<td>Plastigauge</td>
<td>Use micrometers, check crankshaft</td>
<td>Keep foreign material out of eyes</td>
</tr>
<tr>
<td>Micrometers</td>
<td>Inspect bearing clearance with plastigauge</td>
<td>Engine could drop or roll on hands or feet</td>
</tr>
<tr>
<td>Rear oil seal installer</td>
<td>Torque rod and main bearings to specification</td>
<td></td>
</tr>
<tr>
<td>Engine block</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crankshaft</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bearings</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DECISIONS**

Determine if the crankshaft will operate correctly with new bearings

**CUES**

- Crank measures undersize
- Crank has taper or is out of round
- Crank has too much end play

**ERRORS**

- Engine will not last
- Rods or mains will knock
- Engine could tie up
- Could ruin engine
**SCIENCE**

Simple machines used to gain mechanical advantage: Gears, levers, pulleys.
Work input, work output, friction and efficiency in simple machines.
Horse power output.
Fluids under pressure: Oil and fuel.
Transfer of heat from one body to another: From combustion chamber to water jackets.
Effects of friction on work processes and product quality: Power loss due to friction.

The following principles of behavioral patterns should be included:
- Professionalism
- Respect for others
- Communication
- Loyalty
- To peers
- Professional appearance
- Image
- Conduct
- Trade
- Company
- Cooperative venture
- Encouragement
- Seek help of others (specialist)
- Housekeeping

**MATH – NUMBER SYSTEMS**

Set of Real Numbers
- Rationals
- Uses of Numbers: (Without calculation)
- Compression Ratio
- Basic Arithmetic Skills and Concepts
- Changing fractions to decimal and decimal to fractions.
- Bore and crankshaft
- Rounding off decimals and whole numbers:
- Crankshaft and camshaft
- Basic Measurement Skills and Concepts
- Instruments: Micrometer, Tachometer
- Given an Instrument of Measure, determine precision and or accuracy with respect to relative error, significant digits, and tolerance.
- Crankshaft and bore
- Metric and English measure and conversion
- Measurement: Non-geometric
- Liquid: Oil, Pressure
- Basic Algebra Skills and Concepts
- Uses of variables in formulas (cubic inch displacement)
- Basic Logic
- Deductive, inductive
- Basic Geometry Skills and Concepts
- Determination of area and volume of cylinders
- Fundamental Operations (Calculation)
- Use of computing devices and mechanical aids
- Calculators
- Computers
- Basic Measurement Skills and Concepts
- Instruments: Plastiguage
- Given an Instrument of Measure, determine precision and or accuracy with respect to relative error, significant digits, and tolerance. Oil
- Uses of Numbers (Without calculation)
- Coding

**COMMUNICATIONS**

**PERFORMANCE MODES**

<table>
<thead>
<tr>
<th>Speaking</th>
<th>Customer complaint, special checks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reading</td>
<td>Specification chart, Test gauges &amp; Instruments</td>
</tr>
<tr>
<td>Writing</td>
<td>Report - cost estimate</td>
</tr>
<tr>
<td>Listening</td>
<td>Squeaks, knocks, rattles</td>
</tr>
<tr>
<td>Viewing</td>
<td>Oil leaks, fuel leaks</td>
</tr>
<tr>
<td>Touching</td>
<td>Rough or worn parts</td>
</tr>
<tr>
<td>Smelling</td>
<td>Burned or contaminated oil</td>
</tr>
</tbody>
</table>

**EXAMPLES**

<table>
<thead>
<tr>
<th>Speaking</th>
<th>Customer complaint, special checks</th>
</tr>
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<tbody>
<tr>
<td>Reading</td>
<td>Specification chart, Test gauges &amp; Instruments</td>
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<tr>
<td>Writing</td>
<td>Report - cost estimate</td>
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<td>Listening</td>
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<td>Rough or worn parts</td>
</tr>
<tr>
<td>Smelling</td>
<td>Burned or contaminated oil</td>
</tr>
</tbody>
</table>

**SKILLS/CONCEPTS**

- Terminology
- Logic
- Comprehension
- Terminology
- Penmanship
- Spelling
- Terminology
- Logic
- Auditory discrimination
- Visual analysis
- Symbols and codes
- Size
- Shape
- Engine oil odors
DUTY G. SERVICING AND REPAIRING VALVE TRAINS

1. Diagnose valve train problems

2. Service valve train components
### TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

- **S T K**
  - Oil pressure gauge
  - Compression gauge
  - Stethoscope
  - Cylinder leak down test
- **Valves**
- **Cylinder heads**
- **Rocker arms**
- **Push rods**
- **Lifters**
- **Camshaft**
- **Timing chain**
- **Timing gears**

### PERFORMANCE KNOWLEDGE

- Check oil pressure with gauge
- Check compression
- Run cylinder leak down test
- Test timing chain
- Visually check rocker arm assembly

### SAFETY – HAZARD

- Use safety glasses
- Keep loose clothing or long hair away from cranking engine
- Foreign material in eyes
- Moving parts may catch hair or loose clothing

### DECISIONS

- Determine that the problem is not oil pressure
- Determine if compression is faulty
- Determine if the fault is rings or valves
- Determine that the timing chain is correct
- Determine if the rocker assembly is in place and operable

### CUES

- Noisy lifters
- Low reading on compression gauge
- Air leak at carburetor, exhaust pipe, or oil stone
- Low compression on all cylinders
- Broken or misplaced rocker assembly

### ERRORS

- Engine will not run
- Engine will miss
- Poor performance
- Poor mileage
### SCIENCE

Simple machines used to gain mechanical advantage: gears, levers, pulleys.  
Work input, work output, friction and efficiency in simple machines; horse power output.  
Fluids under pressure: oil and fuel.  
Transfer of heat from one body to another: from combustion chamber to water jackets.  
Effects of friction on work processes and product quality: Power loss due to friction.  

The following principles of behavioral patterns should be included:  

**Professionalism**  
- Personality:  
  - Outlook:  
  - Communications:  
  - Respect:  
  - Flexibility:  
  - Tools and equipment:  
  - Locality:  
  - Peers:  
  - Customers:  
  - Company:  
  - Company:  
  - Cooperate venture:  
  - Working together:  
  - Encouragement:  
  - Seek help of others:  
  - Housekeeping:  

**Dependability**  
- On time:  
- Regularity:  
- Accuracy of repair:  

### MATH - NUMBER SYSTEMS

- Set of Real Numbers  
  - Rationals  
  - Uses of Numbers: (Without calculation)  
    - Compression Ratio  
    - Basic Arithmetic Skills and Concepts  
    - Changing fractions to decimal and decimal to fractions: bore and crankshaft  
    - Rounding of decimals and whole numbers: crankshaft and camshaft  
    - Basic Measurement Skills and Concepts: Micrometer, Tachometer  
    - Given an instrument of measurement, determine precision and accuracy with respect to relative error, significant digits, and tolerance: crankshaft and bore  
    - Metric and English measurement and conversion  
    - Measurement of non-geometric quantities: oil pressure  
    - Basic Algebra Skills and Concepts: (Pressure)  
    - Uses of variables:  
      - In formulas: (cubic inch displacement)  
      - Basic Logic:  
        - Deductive:  
        - Basic:  
          - Geometry Skills and Concepts:  
            - Determination of area and volume of cylinders  
            - Fundamental Operations (Calculation):  
              - Use of computing devices and mechanical aids:  
                - Calculators  
                - Computers  

### COMMUNICATIONS

**PERFORMANCE MODES**  
- Speaking  
- Reading  
- Writing  
- Listening  
- Viewing  
- Touching  
- Smelling  

**EXAMPLES**  
- Customer complaint, special checks:  
  - Specification chart, test gauges, & instruments:  
  - Report-Cost estimate:  
  - Squeaks, knocks, rattles:  
  - Oil leaks, fuel leaks:  
  - Rough or worn parts:  
  - Burned or contaminated oil:  

**SKILLS/CONCEPTS**  
- Terminology  
- Logic  
- Comprehension  
- Terminology  
- Penmanship  
- Spelling  
- Terminology  
- Logic  
- Auditory discrimination  
- Visual analysis  
- Symbols and codes  
- Size  
- Shape  
- Engine oil odors
**TASK STATEMENT**
**G-2 SERVICE VALVE TRAIN COMPONENTS**

<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cleaning Solvents</td>
<td>Face valves</td>
<td>Wear safety glasses</td>
</tr>
<tr>
<td>Valve spring compressor</td>
<td>Seat heads</td>
<td>Wear face shield</td>
</tr>
<tr>
<td>Valve face grinder</td>
<td>Clean and surface rocker arms</td>
<td>Foreign material in eyes</td>
</tr>
<tr>
<td>Valve seat grinder</td>
<td>Service lifters</td>
<td>Grinder emery dust is hazardous</td>
</tr>
<tr>
<td>Spring tension gauge</td>
<td>Check camshart lobe fit</td>
<td></td>
</tr>
<tr>
<td>Damper puller</td>
<td>Set timing chain and gears to specification</td>
<td></td>
</tr>
<tr>
<td>Valves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cylinder heads</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rocker arms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Push rods</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifters</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Camshalt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timing chain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Timing gears</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DECISIONS**
- Determine that the valves will operate correctly
- See that the timing chain is installed correctly
- Determine that the lifters are not at fault

**CUES**
- Check valves with bluing or like substance
- Lifters are sticking or varnished badly

**ERRORS**
- Engine will miss
- Valves will be noisy
- Engine will not start
### SCIENCE

- Simple machines used to gain mechanical advantage: gears, levers, and pulleys
- Work input, work output, friction, and efficiency in simple machines: foot and inch pound of torque
- Fluids under pressure: Oil pressure
- Transfer of heat from one body to another: Heat of combustion
- Effects of friction on work processes and product quality: Power loss due to friction

The following principles of behavioral patterns should be included:
- Professionalism:
  - Competency
  - Communications
  - Respect
  - Loyalty
- Professional contacts: Dependability, On time, Regularity, Accuracy of repair
- Tools and equipment: Image, Personal appearance, Conduct, Trade

### MATH – NUMBER SYSTEMS

- Set of Real Numbers
  - Rationals
  - Irrationals
  - Uses of Numbers (Without calculation)
- Compression Ratio
- Basic Arithmetic Skills and Concepts
  - Changing fractions to decimal and decimal to fractions
  - Bore and crankshaft
  - Rounding off decimals and whole numbers
  - Crankshaft and camshaft
- Basic Measurement Skills and Concepts
  - Instruments: Micrometer, Tachometer
  - Measurement: Non-geometric
  - Metric and English measure and conversion

- Basic Algebra Skills and Concepts
  - Uses of variables
  - In formulas (cubic inch displacement)
- Basic Logic
  - Deductive, inductive
- Basic Geometry Skills and Concepts
  - Determination of area and volume of cylinders

- Fundamental Operations (Calculation)
  - Use of computing devices and mechanical aids
  - Calculators

- Basic Measurement Skills and concepts
  - Measurement
  - Geometric
  - Angle

### COMMUNICATIONS

#### PERFORMANCE MODES

- Speaking
- Reading
- Writing
- Listening
- Viewing
- Touching
- Smelling

#### EXAMPLES

- Customer complaint, Special checks
- Specification chart, Test gauges & Instruments
- Report-Cost estimate
- Squeaks, knocks, rattles
- Oil leaks, fuel leaks
- Rough or worn parts
- Burned or contaminated oil

#### SKILLS/CONCEPTS

- Terminology
- Logic
- Comprehension
- Terminology
- Penmanship
- Spelling
- Terminology
- Logic
- Auditory discrimination
- Visual analysis
- Symbols and codes
- Size
- Shape
- Engine oil odors
DUTY H. SERVICING AND REPAIRING IGNITION SYSTEMS

1. Diagnose ignition system problems
2. Service ignition systems components
3. Service and repair electronic ignition systems
### Task Statement: H-1 Diagnose Ignition System Problems

#### Tools, Equipment, Materials, Objects Acted Upon
- Oscilloscope
- Tach-dwell meter
- Timing light
- Distributor strobe
- Vacuum Gauge
- Combustion analyzer
- STK
- Spark Plugs
- Ignition wires
- Distributor
- Coil
- Resistor
- Ignition switch
- Points
- Condenser

#### Performance Knowledge
- Hook up oscilloscope assembly
- Run unit tests
- Analyze results

#### Safety – Hazard
- Wear safety glasses
- Do not wear loose fitting clothing
- Keep test wires and instruments clear of engine moving parts
- Beware of shock from wires
- Keep foreign objects out of eyes
- Loose fitting clothes or long hair could catch in moving machinery
- Test wires or cables could catch in machinery
- Electrical shock can be dangerous

#### Decisions
- Determine system problem
- Determine needed repair

#### Cues
- Pattern of scope oscillations
- Engine performance

#### Errors
- Poor performance
- Poor or no start
- Poor mileage
<table>
<thead>
<tr>
<th>SCIENCE</th>
<th>MATH – NUMBER SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance of materials to flow of electrical current</td>
<td>Set of Real numbers, Rationals</td>
</tr>
<tr>
<td>Magnetic fields of force to ignition coil</td>
<td>Uses of Numbers (Without calculations)</td>
</tr>
<tr>
<td>The following principles of behavioral patterns should be included</td>
<td>Indexing</td>
</tr>
<tr>
<td>Professionalism</td>
<td>Frame</td>
</tr>
<tr>
<td>Personality conflicts</td>
<td>Fundamental Operations (Calculations)</td>
</tr>
<tr>
<td>Communications</td>
<td>Basic Arithmetic Skills, and Concepts</td>
</tr>
<tr>
<td>Respect</td>
<td>Ratio and proportion</td>
</tr>
<tr>
<td>for others</td>
<td>Basic Measurement Skills, and Concepts</td>
</tr>
<tr>
<td>for tools and equipment, etc.</td>
<td>Instruments: Each-dwell timing light, Scope, etc.</td>
</tr>
<tr>
<td>Loyalty</td>
<td>Measurement, Geometrical</td>
</tr>
<tr>
<td>To peers</td>
<td>Angle dwell</td>
</tr>
<tr>
<td>Customers</td>
<td>Reading and interpreting tables, charts, and graphs</td>
</tr>
<tr>
<td>Company</td>
<td>Logs: Tune-up specifications</td>
</tr>
<tr>
<td>Cooperative ventures</td>
<td>Basic Logic</td>
</tr>
<tr>
<td>Working together</td>
<td>Deductive</td>
</tr>
<tr>
<td>Encouragement</td>
<td></td>
</tr>
<tr>
<td>Seek help of others (specialist)</td>
<td></td>
</tr>
<tr>
<td>Housekeeping</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PERFORMANCE MODES</th>
<th>EXAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speaking</td>
<td>Customer complaint</td>
</tr>
<tr>
<td>Reading</td>
<td>Specification chart</td>
</tr>
<tr>
<td>Writing</td>
<td>Test results, Cost estimate</td>
</tr>
<tr>
<td>Listening</td>
<td>Engine miss, roughness</td>
</tr>
<tr>
<td>Viewing</td>
<td>Spec chart symbols</td>
</tr>
<tr>
<td>Touching</td>
<td>Wiring diagram</td>
</tr>
<tr>
<td></td>
<td>Electric shock</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMMUNICATIONS</th>
<th>SKILLS/CONCEPTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Terminology</td>
<td>Logic</td>
</tr>
<tr>
<td>Comprehension</td>
<td>Terminology</td>
</tr>
<tr>
<td>Penmanship</td>
<td>Spelling</td>
</tr>
<tr>
<td>Spelling</td>
<td>Logic</td>
</tr>
<tr>
<td>Auditory Discrimination</td>
<td>Logic</td>
</tr>
<tr>
<td>Visual analysis</td>
<td>Symbols, codes</td>
</tr>
<tr>
<td>Logic</td>
<td>Safety</td>
</tr>
</tbody>
</table>
## H-2 Service Ignition Systems Components

### Tools, Equipment, Materials, Objects Acted Upon
- S T K
- Spark plug cleaner
- Ohm meter
- Distributor strobe
- Timing light
- Tach-dwell meter
- Oscilloscope
- Spark plugs
- Ignition wires
- Distributor
- Coil
- Resistor
- Points
- Condensor
- Ignition switch

### Performance Knowledge
- Remove and install necessary parts.
- Set distributor on distributor strobe.
- Retest on oscilloscope assembly.
- Adjust to specifications per test results.

### Safety - Hazard
- Wear safety glasses.
- Do not wear loose-fitting clothing.
- Keep test wires and instruments clear of engine moving parts.
- Beware of shock from wires.
- Keep foreign object out of eyes.
- Loose-fitting clothes or long hair could catch in moving engine parts.
- Test wires or cables could catch in engine parts.
- Electric shock can be dangerous.

### Decisions
- Determine from retest results if the ignition system now functions properly.

### Cues
- Poor starting
- Rough idle
- Poor performance

### Errors
- Results in poor performance
- Possible breakdown
- Poor mileage
### SCIENCE

- Resistance of materials to flow of electrical current
- Resistance wire
- Magnetic fields of force
- Ignition coil

The following principles of behavioral patterns should be included:

- **Professionalism**
- Dependability
- On time
- Regularity
- Accuracy of repair

- **Communications**
- Image
- Personal appearance
- Conduct
- Etiquette

- **Cooperation, teamwork**
- Working together
- Encouragement
- Seek help of others (specialist)
- Housekeeping

### MATH - NUMBER SYSTEMS

- **Set of Real numbers**
- **Rationals**
- **Uses of Numbers** (Without calculation)
- **Indexing**
- **Fundamental Operations** (Calculations)
- **Basic Arithmetic Skills and Concepts**
- **Ratio and proportion**
- **Basic Measurement Skills and Concepts**
  - Instruments, tech-dwell, timing light, scope, etc.
- **Measurement Geometric**
- **Angle dwell**
- Reading and interpreting tables, charts, and graphs
- Logs, tune-up specifications
- **Basic Logic**
- Deductive
- **Basic Measurement Skills and Concepts**
- Instruments, Ohm meter

### COMMUNICATIONS

#### PERFORMANCE MODES

- **Speaking**
- **Reading**
- **Writing**

- **Listening**
- **Viewing**
- **Touching**

#### EXAMPLES

- Customer complaint
- Specification chart
- Test results, Cost estimate
- Engine miss, roughness
- Spec chart symbols
- Wiring diagram
- Electric shock

#### SKILLS/CONCEPTS

- **Terminology**
- **Logic**
- **Comprehension**
- **Terminology**
- **Penmanship**
- **Spelling**
- **Logic**
- **Auditory Discrimination**
- **Logic**
- **Visual analysis**
- **Logic**
- **Symbols, codes**
- **Safety**
<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY - HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronic test instruments</td>
<td>Test distributor on strobe instrument</td>
<td></td>
</tr>
<tr>
<td>Ohm meter</td>
<td>Test pulse amplifier</td>
<td></td>
</tr>
<tr>
<td>Volt meter</td>
<td>Test resistor</td>
<td></td>
</tr>
<tr>
<td>Amp meter</td>
<td>Test ignition coil</td>
<td></td>
</tr>
<tr>
<td>Magnetic impulse distributor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amplifier</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resistor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ignition coil</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DECISIONS**
- Determine which part or parts are functioning correctly

**CUES**
- Engine not running
- Determine if test results agree with specification manuals

**ERRORS**
- Road breakdown
- Hard start
- Poor performance

**SAFETY - HAZARD**
- Wear safety glasses
- Beware of high voltage
- Beware of moving parts
- May get foreign material in eyes
- High voltage is dangerous
- Moving parts may catch loose clothing
ASK STATEMENT) H-3 SERVICE AND REPAIR ELECTRONIC IGNITION SYSTEMS

SCIENCE

Resistance of materials to flow of electrical current
Magnetic fields of force
Ignition coil

The following principles of behavioral patterns should be included:

Professionalism
Personality conflicts
Communications
Respect
For others
For tools and equipment etc.
Loyalty
To peers
To customers
To company
Cooperative venture
Working together
Encouragement
Seek help of others (specialist)
Housekeeping

Dependability
On time
Regularity
Accuracy of repair
Image
Personal appearance
Conduct
Trade

PERFORMANCE MODES

Speaking
Reading
Writing
Listening
Viewing
Touching

EXAMPLES

Customer complaint
Specification chart
Test results. Cost estimate

SKILLS/CONCEPTS

Terminology
Logic
Comprehension
Terminology
Penmanship
Spelling
Logic

ENGINE MEASUREMENT

SPEC CHART SYMBOLS

WIRING DIAGRAM

ELEC TRIC SHOCK

COMMUNICATIONS

Math - Number Systems

Set of Real numbers
Rationals
Uses of Numbers (Without calculation)
Indexing
Tuning
Fundamental Operations (Calculations)
Basic, Arithmetic Skills and Concepts
Ratios and proportion
Basic Measurement Skills and Concepts
Instruments: Lux-dwell, timing light, scope etc
Measurement Geometric
Angle dwell
Reading and interpreting tables, charts and graphs
Tops-tune-up specifications
Basic Logic
Deductive
Basic Measurement Skills and concepts
Instruments: Voltmeter, ammeter
DUTY I: SERVICING AND REPAIRING BRAKING SYSTEMS (DRUM TYPE)

1. Diagnose brake system problems (drum type)
2. Overhaul brake components, adjust and bleed
3. Test and repair power brake units
**TASK STATEMENT** 1-1 DIAGNOSE BRAKE SYSTEM PROBLEMS (DRUM TYPE)

<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynometer</td>
<td>Dyno test brake efficiency</td>
<td>Wear safety glasses</td>
</tr>
<tr>
<td>Brake pressure bleeder</td>
<td>Visual inspection</td>
<td>Keep brake fluid off hand and body</td>
</tr>
<tr>
<td>Brake drums</td>
<td>Performance test</td>
<td>Support car on safety stands</td>
</tr>
<tr>
<td>Brake shoes</td>
<td></td>
<td>Keep foreign material out of eyes</td>
</tr>
<tr>
<td>Park brake cables and levers</td>
<td></td>
<td>Brake fluid causes irritation</td>
</tr>
<tr>
<td>Lines and hoses</td>
<td></td>
<td>Hydraulic jacks are not safe</td>
</tr>
<tr>
<td>Wheel and master cylinders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spring and brake linkage</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DECISIONS**

- Determine Dyno test results
- Determine if all components pass visual inspection
- Determine if brakes are in safe operating condition

**CUES**

- Dyno test shows poor brake efficiency
- Brake cylinders are leaking
- Brake shoes are worn or broken

**ERRORS**

- Brake failure
- Brakes pull or fade
- Poor or spongy brake pedal
ASK STATEMENT I-1 DIAGNOSE BRAKE SYSTEM PROBLEMS (DRUM TYPE)

SCIENCE

Simple machines used to gain mechanical advantage: Levers
Work input, work output, friction and efficiency in simple machines: Parking brake cables
Effects of heating and cooling on expansion of materials: Brake fade
Fluids under pressure: Master cylinder and wheel cylinder
Transfer of heat from one body to another: Lining to drum
Effects of friction on work processes and product quality: Brake fade

The following principles of behavioral patterns should be included:

Professionalism
- Personality conflicts
- Communications
- Respect
- Loyalty
- To peers
- Customers
- Company
- Cooperative venture
- Working together
- Encouragement
- Seek help of others (specialists)
- Housekeeping

MATH - NUMBER SYSTEMS

Seat of real numbers
- Rationals
- Fundamental Operations

Basic Arithmetic Skills and Concepts
- Ratio
- Use of computing devices and mechanical aids
- Computers
- Basic
- Measurement Skills and Concepts
- Instruments
- Pressure bleeder
- Basic Logic
- Deductive

COMMUNICATIONS

PERFORMANCE MODES

- Speaking
- Reading
- Writing
- Listening
- Viewing
- Touching
- Smelling

EXAMPLES

Customer Information
- Spec Charts
- Test result, Cost estimate
- Grinding squeaks, squeals, scraping
- Fluid leaks, seepage
- Heat
- Fluid odor, Burning brake lining

SKILLS/CONCEPTS

- Terminology
- Logic
- Comprehension
- Terminology
- Penmanship
- Spelling
- Logic
- Auditory discrimination
- Logic
- Visual analysis
- Symbols, Codes
- Size
- Shape
- Temperature
- Odor burning brake lining
### Task Statement

**I-2 OVERHAUL BRAKE COMPONENTS, ADJUST AND BLEED**

<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>S 1 K brake bleeder, wheel cylinder hone, brake drum lathe, special brake tools, brake drums, brake shoes, brake cables, wheel cylinders, master cylinders, brake springs and linkage</td>
<td>Remove and replace wheels, brake drums and shoes, remove, replace and or overhaul wheel cylinders, remove, replace and or overhaul master cylinder, replace brake shoes and springs as necessary, bleed and adjust system, Dyno test</td>
<td>Wear safety glasses, support car with safety stands, make sure brake has sufficient pedal to safely stop car before test, may get foreign object in eye, car may slip off jack, would damage car or cause accident</td>
</tr>
</tbody>
</table>

### Decisions

Determine if the job will meet safe operating conditions

### Cues

- Spongy pedal
- Brake pull (right or left)
- Pedal low
- Brake fade

### Errors

- Brake failure
- Strong possibility of accident
- Auto damaged or destroyed
- Driver hurt or killed
### Science

Simple machines used to gain mechanical advantage: levers, work input vs. work output; friction and efficiency in simple machines; parking brake cables;

- Effect of heating and cooling on expansion of materials; brake fade
- Fluids under pressure; master cylinder and wheel cylinder
- Transfer of heat from one body to another; fuming to drum;
- Effects of friction on work processes and product quality; brake fade

The following principles of behavioral patterns should be included:

<table>
<thead>
<tr>
<th>Professionalism</th>
<th>Dependability</th>
<th>On time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personal qualities</td>
<td>Regularity</td>
<td>Accuracy of repair</td>
</tr>
<tr>
<td>Communications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respect for others</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools and equipment etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loyalty to peers</td>
<td>Image</td>
<td></td>
</tr>
<tr>
<td>Customers</td>
<td>Personal appearance</td>
<td></td>
</tr>
<tr>
<td>Company</td>
<td>Conduct</td>
<td></td>
</tr>
<tr>
<td>Trade</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooperative venture</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Working together</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encouragement</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seek help of others (specialist)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Housekeeping</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Math - Number Systems

- Set of real numbers
- Rational
- Fundamental Operations (Calculation)
- Basic Measurement Skills and Concepts
- Instruments: Wheel cylinder; brake fade
- Metric and English measure and conversion
- Measurement Geometric
- Volume; Cylinder bore
- Measurement: Non-geometric
- Fluid brake fluid
- Reading and Interpreting tables, charts, and graphs
- Logs; Spec charts
- Use of computing devices and mechanical aids
- Computers; Dyno

### Communications

**Performance Modes**

- Speaking
- Reading
- Writing
- Listening
- Viewing
- Touching
- Smelling

**Examples**

- Customer Information
- Spec charts
- Test result, Cost estimate
- Grinding, squeaks, squeals, scraping
- Fluid leaks; seepage
- Heat
- Fluid odor; Burning brake lining

**Skills/Concepts**

- Terminology
- Logic
- Comprehension
- Terminology
- Penmanship
- Spelling
- Logic
- Auditory discrimination
- Logic
- Visual analysis
- Symbols, codes
- Size
- Shape
- Temperature
- Odor burning brake lining
# TASK STATEMENT: 1-3 TEST AND REPAIR POWER BRAKE UNITS

## TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON
- S.T.K.
- Vacuum gauge
- Power brake unit

## PERFORMANCE KNOWLEDGE
- Test power unit
- Remove, replace or repair
- Check for brake fluid in power unit

## SAFETY - HAZARD
- Wear safety glasses
- Block or support car
- Keep foreign material out of eyes such as brake fluid
  - Car may move

## DECISIONS
- Determine if the unit is malfunctioning
- Determine if unit is repairable
- Determine if master cylinder is leaking fluid into unit

## CUES
- Hard pedal
- Vacuum leak
- Unit sticking

## ERRORS
- Stiff working pedal
- Brakes will not release easily
### SCIENCE

- Simple machines used to gain mechanical advantage. Vacuum operated levers.
- Work input, work output, friction, and efficiency in simple machines. Torque step up from booster.

The following principles of behavioral patterns should be included:

- Professionalism
- Personal conflict
- Communication
- Respect
- Loyalty
- Image
- Professional appearance
- Conduct
- Trade

### MATH - NUMBER SYSTEMS

- Set of Real numbers
- Rationals
- Fundamental Operations (Calculation)
- Basic Measurement Skills and Concepts
- Instruments: Vacuum gauge

### COMMUNICATIONS

#### PERFORMANCE MODES

- Speaking
- Reading
- Writing
- Listening
- Viewing
- Touching
- Smelling

#### EXAMPLES

- Customer Information
  - Test result, Cost estimate
  - Grinding, squeaks, squeals, scraping
  - Fluid leaks, seepage

- Heat
  - Fluid odor, Burning brake lining

#### SKILLS/CONCEPTS

- Terminology
- Logic
- Comprehension
- Terminology
- Penmanship
- Spelling
- Terminology
- Logic
- Auditory discrimination
- Visual analysis
- Symbols and codes
- Size
- Shape
- Engine oil odors
DUTY J. SERVICING AND REPAIRING BRAKING SYSTEMS (DISC TYPE)

1. Diagnose disc brake problems
2. Service disc brake components
## Task Statement
J-1 Diagnose Disc Brake Problems

### Tools, Equipment, Materials
- Dynometer
- TK K
- Brake tool kit
- Calipers
- Pads
- Rotors
- Control valves
- Front wheel bearings

### Performance Knowledge
- Dyno test brake efficiency
- Visual inspection
- Performance test

### Safety - Hazard
- Wear safety glasses
- Observe safety rules in use of dynamometer
- Use sound judgment on performance test
- Foreign objects
- High speed or power operation
- Possible poor brake conditions

### Decisions
Determine need and extent of repair

### Cues
- Worn brake pads
- Damaged or noisy rotor
- Pulsing pedal
- Loose front wheel bearings

### Errors
- Dangerous condition of poor operating brakes
- Damage to car or driver or both
- Needless expensive repairs
### SCIENCE

Simple machines used to gain mechanical advantage: Levers
Work input, work output, friction and efficiency in simple machines: Parking brake cables
Effects of heating and cooling on expansion of materials: Brake fade
Fluids under pressure: Master cylinder and calipers
Transfer of heat from one body to another: Pad to rotor
Effects of friction on work processes and product quality: Brake fade

The following principles of behavioral patterns should be included:

- Professionalism
  - Personal integrity
  - Respect
  - Loyalty
  - Collaboration
  - Cooperation

- Professionalism
  - Dependability
  - Regularity
  - Accuracy of repair
  - Image
  - Conduct
  - Work

### MATH – NUMBER SYSTEMS

Set of Real numbers: Rational
Fundamental Operations (Calculation)
Use of computing devices and mechanical aids: Computers, Dyna
Basic Measurement Skills and Concepts
Reading and interpreting tables, charts, and graphs
Logs, Spec charts
Basic Logic
Deductive

### COMMUNICATIONS

#### PERFORMANCE MODES

- Speaking
- Reading
- Writing
- Listening
- Viewing
- Touching
- Smelling

#### EXAMPLES

- Customer Information
  - Spec Charts
  - Cost estimate
  - Test results
  - Grinding, squeaks, squeals, scraping
  - Fluid leaks: seepage
  - Heat
  - Fluid odor, burning brake lining

#### SKILLS/CONCEPTS

- Terminology
- Logic
- Comprehension
- Terminology
- Penmanship
- Spelling
- Logic
- Auditory discrimination
- Logic
- Visual analysis
- Symbols, codes
- Shape
- Temperature
- Odor, burning brake lining
## J-2 SERVICE DISC BRAKE COMPONENTS

<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>S 1 K</td>
<td>Safety stands</td>
<td>Wear safety glasses</td>
</tr>
<tr>
<td></td>
<td>Brake tool kit</td>
<td>Double check all work</td>
</tr>
<tr>
<td></td>
<td>Brake fluid</td>
<td>Use safety stands</td>
</tr>
<tr>
<td></td>
<td>Caliper assembly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pads</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rotors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Control valves</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Remove and replace components</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Overhaul calipers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Turn rotors</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clean and check control valves</td>
</tr>
</tbody>
</table>

### DECISIONS
- Determine if rotors will turn and remain in specifications
- Determine if calipers are scored or cracked
- Determine if control valves are operable

### CUES
- Rotors scored deeply
- Brake pedal pulses

### ERRORS
- Dangerous brake failure
- Damage to car and occupants
### SCIENCE

Simple machines used to gain mechanical advantage: Levers
Work input \(\rightarrow\) work output \(\rightarrow\) traction and efficiency in simple machines: Parking brake cables
Effect of heating and cooling on expansion of materials: Brake fade
Fluids under pressure: Master cylinder and calipers
Transfer of heat from one body \(\rightarrow\) another: Pad to rotor
Effects of friction on work processes and product quality: Brake fade

The following principles of behavioral patterns should be included:

<table>
<thead>
<tr>
<th>Professionalism</th>
<th>Common Sense</th>
<th>Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personality conflicts</td>
<td></td>
<td>Dependability</td>
</tr>
<tr>
<td></td>
<td></td>
<td>On time</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Regularity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Accuracy of repair</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Respect</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To others</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For tools, and equipment, etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For all</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To peers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To customers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To company</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cooperative venture</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Working together</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Encouragement</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Seek help of others (specialists)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Housekeeping</td>
</tr>
</tbody>
</table>

### MATH - NUMBER SYSTEMS

Set of Real numbers: Rational numbers
Fundamental Operations (Calculation): Use of computing devices and mechanical aids
Basic Measurement Skills and Concepts: Basic Logic
Reading and interpreting tables, charts, and graphs: Basic Logic
Logis and Spec charts: Deductive

### COMMUNICATIONS

#### PERFORMANCE MODES

- Speaking
- Reading
- Writing
- Listening
- Writing
- Touching
- Smelling

#### EXAMPLES

- Customer Information
- Spec Charts
- Test results, Cost estimate
- Grinding, squeaks, squeals, scraping
- Fluid leaks, seepage
- Heat
- Fluid odor, burning brake lining

#### SKILLS/CONCEPTS

- Terminology
- Logic
- Comprehension
- Terminology
- Penmanship
- Spelling
- Logic
- Auditory discrimination
- Logic
- Visual analysis
- Symbols, codes
- Size
- Shape
- Temperature
- Odor burning brake lining
DUTY K. SERVICING AND REPAIRING STEERING UNITS

1. Diagnose steering system problems
2. Service manual steering components
3. Service power steering components
**TASK STATEMENT** K-1 Diagnose Steering System Problems

### TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

- Front end alignment unit
- S, J, K
- Dynometer
- Steering gear
- Wheels
- Ball joints
- Tie rod ends
- Idler arms
- Upper and lower control arms
- Power steering units

### PERFORMANCE KNOWLEDGE

- Dynometer test
- Alignment check
- Lower control arm check
- Ball joint and tie rod check
- Check power steering units

### SAFETY - HAZARD

- Safety glasses
- Clothing and hair may get caught in moving parts

### DECISIONS

- Determine what unit or units are at fault
- Determine if it is alignment only
- Determine if power unit is at fault

### CUES

- Uneven tire wear
- Wear or scuff gauge
- Dyno test results
- Loose units

### ERRORS

- Tire wear
- Accidents
- Road failure
### SCIENCE

Simple machines used to gain mechanical advantage: Gears, levers
Work input: work output: friction and efficiency in simple machines: Gear box
Motion resulting from two or more forces acting on a point: Force vs. Resistance

The following principles of behavioral patterns should be included

<table>
<thead>
<tr>
<th>Professionalism</th>
<th>Dependability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respect</td>
<td>On time</td>
</tr>
<tr>
<td>for others</td>
<td>Regularity</td>
</tr>
<tr>
<td>for tools and equipment</td>
<td>Accuracy of repair</td>
</tr>
<tr>
<td>Loyalty</td>
<td>Image</td>
</tr>
<tr>
<td>to peers</td>
<td>Personal appearance</td>
</tr>
<tr>
<td>Customers</td>
<td>Conduct</td>
</tr>
<tr>
<td>Company</td>
<td>Trade</td>
</tr>
<tr>
<td>Cooperative venture</td>
<td></td>
</tr>
<tr>
<td>Working together</td>
<td></td>
</tr>
<tr>
<td>Encouragement</td>
<td></td>
</tr>
<tr>
<td>Seek help of others (specialist)</td>
<td></td>
</tr>
<tr>
<td>Housekeeping</td>
<td></td>
</tr>
</tbody>
</table>

### MATH – NUMBER SYSTEMS

Set of Real numbers: Rationals
Uses of numbers: (Without calculation)
Ratio: Gear box
Fundamental Operations: (Calculation)
Basic Arithmetic Skills and Concepts
Reduction of fractions: Alignment spec
Use of computers and mechanical aids: Computers: Data
Basic Measurement Skills and Concepts
Instruments: Measurement: Geometry
Area, Angle (radiator)
Basic Logic
Deductive

### COMMUNICATIONS

#### PERFORMANCE MODES

- Speaking
- Reading
- Writing
- Listening
- Viewing
- Touching

#### EXAMPLES

- Customer Information
- Spec Charts
- Test results, Cost estimate
- Knock, rattle, squealing tire
- Featheredge, uneven wear
- Featheredge

#### SKILLS/CONCEPTS

- Terminology
- Logic
- Comprehension
- Terminology
- Penmanship
- Spelling
- Terminology
- Logic
- Auditory discrimination
- Logic
- Visual analysis
- Logic
- Symbols
- Consistency
<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Steering Unit</td>
<td>Remove, disassemble, clean and inspect</td>
<td>Wear safety glasses</td>
</tr>
<tr>
<td>Puller set</td>
<td>Replace defective parts, reassemble, adjust and replace in car</td>
<td>Double check all work</td>
</tr>
<tr>
<td>Bushing drivers</td>
<td></td>
<td>Foreign material may get in eyes</td>
</tr>
<tr>
<td>Bearing press</td>
<td></td>
<td>Life depends on good steering</td>
</tr>
<tr>
<td>Steering column</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Worn gear</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bearing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bushing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gaskets</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**DECISIONS**
- Determine how to remove and what is the problem
- Determine which parts are defective

**CUES**
- Loose steering gear
- Catch in steering
- Hard to steer

**ERRORS**
- Accidents
- Road failure
- Tire wear
### SCIENCE

<table>
<thead>
<tr>
<th>Simple machines used to gain mechanical advantage: Gears, levers</th>
<th>Work input, work output, friction, and efficiency in simple machines: Steering gear box</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motion resulting from two or more forces acting on a point in a body: Force vs. Resistance</td>
<td></td>
</tr>
</tbody>
</table>

The following principles of behavioral patterns should be included:

- **Professionalism**
- **Personality conflicts**
- **Communications**
- **Respect**
- **For others**
- **Tools and equipment, etc.**
- **Loyalty**
- **To peers**
- **Customers**
- **Company**
- **Cooperative venture**
- **Working together**
- **Encouragement**
- **Seek help of others (specialist)**
- **Housekeeping**

### MATH - NUMBER SYSTEMS

<table>
<thead>
<tr>
<th>Set of Real numbers</th>
<th>Rational Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses of numbers (Without calculation)</td>
<td>Ratios: Gear box</td>
</tr>
<tr>
<td>Fundamental Operations (Calculation)</td>
<td>Basic Arithmetic Skills and Concepts</td>
</tr>
<tr>
<td>Reduction of fractions: Alignment spec</td>
<td>Use of computing devices and mechanical aids</td>
</tr>
<tr>
<td>Instruments: Alignment rack</td>
<td>Computers: Dyno</td>
</tr>
<tr>
<td>Measurement: Geometric</td>
<td>Basic Measurement Skills and Concepts</td>
</tr>
<tr>
<td>Area: Angle (caster)</td>
<td>Basic Logic</td>
</tr>
<tr>
<td>Basic Angle (caster)</td>
<td>Deductive</td>
</tr>
<tr>
<td>Basic Measurement Skills and Concepts</td>
<td>Reading and interpreting tables, charts, and graphs</td>
</tr>
<tr>
<td>Computers: Dyno</td>
<td>Logs: Spec charts</td>
</tr>
<tr>
<td>Basic Arithmetic Skills and Concepts</td>
<td>Properties of the real number system</td>
</tr>
<tr>
<td>Properties of the real number system</td>
<td>Identity of zero (0)</td>
</tr>
</tbody>
</table>

### COMMUNICATIONS

#### PERFORMANCE MODES

- **Speaking**
- **Writing**
- **Listening**
- **Viewing**
- **Touching**

#### EXAMPLES

- **Customer Information**
- **Spec Charts**
- **Test results, Cost estimate**
- **Knock, rattle, squealing tire**
- **Featheredge, uneven wear**
- **Featheredge**

#### SKILLS/CONCEPTS

- **Terminology**
- **Logic**
- **Comprehension**
- **Terminology**
- **Penmanship**
- **Spelling**
- **Terminology**
- **Logic**
- **Auditory discrimination**
- **Logic**
- **Visual analysis**
- **Logic**
- **Symbols**
- **Consistency**
### Tool, Equipment, Materials, Objects Acted Upon
- Puller set
- Seal drivers
- Bushing drivers
- Pressure gauge
- Power steering pumps
- Power steering gear boxes

### Performance Knowledge
- Test, remove, disassemble and inspect
- Replace necessary parts, reassemble, adjust and test

### Safety - Hazard
- Wear safety glasses
- Beware of oil under pressure hazard
- May get dirt or oil in eyes
- Line may break under pressure

### Decisions
- Determine from test results what has failed
- Determine from inspection what parts to replace

### Cues
- Noise
- Eratic steering
- Loss of power steering

### Errors
- Liquid leaks
- Improper steering
- Loss of power
### SCIENCE

- Simple machines used to gain mechanical advantage: steering gear box
- Work input, work output, friction and efficiency in simple machines: pump
- Fluids under pressure: pump
- The following principles of behavioral patterns should be included:
  - Professionalism
  - Personality conflicts
  - Communications
  - Respect
  - For others
  - For tools and equipment, etc.
  - Loyalty
  - To peers
  - Customers
  - Cooperate venture
  - Working together
  - Encouragement
  - Seek help of others (specialist)
  - Housekeeping

### MATH - NUMBER SYSTEMS

- Set of real numbers: rational
- Uses of numbers (without calculation)
- Ratio: gear box
- Fundamental operations: calculation
- Basic arithmetic skills and concepts
- Reduction of fractions: alignment spec
- Use of computing devices and mechanical aids: computers
- Basic measurement skills and concepts
- Instruments: alignment rake
- Measurement: geometric
  - Area
  - Angle (caster)
- Basic logic
- Deductive
- Basic measurement skills and concepts
- Instruments: oil pressure gauge
- Measurement: geometric
  - Volume
  - Oil measurement: non-geometric
- Liquid
- Reading and interpreting tables, charts, and graphs
- Logs
- Basic arithmetic skills and concepts
- Properties of the real number system
- Identities of zero (vertical)

### COMMUNICATIONS

<table>
<thead>
<tr>
<th>PERFORMANCE MODES</th>
<th>EXAMPLES</th>
<th>SKILLS/CONCEPTS</th>
</tr>
</thead>
</table>
| Speaking          | Customer Information | Terminology
|                   | Spec Charts | Logic |
|                   | Test results, cost estimate | Comprehension
|                   | Knock, rattle, squealing tire, belt slip | Terminology
|                   | Knerrge, uneven wear, belt loose, fluid leaks | Penmanship
|                   | Belt tension | Spelling
| Reading           |                      | Terminology
| Writing           |                      | Logic
| Listening         |                      | Auditory discrimination
| Viewing           |                      | Logic
| Touching          |                      | Visual analysis

- Vertical
DUTY L. REPAIRING AND ALIGNING FRONT END ASSEMBLIES

1. Diagnose front end problems
2. Service front end components
### TASK STATEMENT

**L-1 DIAGNOSE FRONT END PROBLEMS**

### TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

- Alignment rack
- Wheel balancer
- Dynamometer
- Upper and lower control arms
- Ball joints
- Tie rod end and linkage
- Wheel bearings
- Spindles

### PERFORMANCE KNOWLEDGE

- Dyno test
- Visual inspection
- Performance test

### SAFETY – HAZARD

- Wear safety glasses
- Loose clothing and long hair
- Foreign material may get into eyes
- Loose clothing or long hair may catch in moving parts

### DECISIONS

- Determine results of Dyno test
- Determine from visual inspection if front end components are safe
- Test drive and check problems

### CUES

- Tire wear
- Shummy
- Too much play in steering

### ERRORS

- Accidents
- Tire wear
- Road failure
**SCIENCE**

| Simple machines used to gain mechanical advantage: Steering linkage. Work input, work output, friction and efficiency in simple machines: Steering box. Motion resulting from two or more forces acting on a point in a body: Force vs. Resistance. |

The following principles of behavioral patterns should be included:

- **Professionalism**
  - Personality conflicts
  - Communication
  - Respect
  - For tools and equipment, etc.
  - Loyalty
  - For peers
  - Customers
  - Co-op and association
  - Cooperative venture
  - Working together
  - Encouragement
  - Seek help of others (specialist)
  - Housekeeping

**MATH – NUMBER SYSTEMS**

- Set of Real numbers: Rationals
- Use of computing devices and mechanical aids: Computers, Dyno
- Basic logic: Deductive
- Basic measurement skills and concepts: Instruments, Alignment rack

**COMMUNICATIONS**

<table>
<thead>
<tr>
<th>PERFORMANCE MODES</th>
<th>EXAMPLES</th>
<th>SKILLS/CONCEPTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speaking</td>
<td>Customer Information</td>
<td>Terminology</td>
</tr>
<tr>
<td>Reading</td>
<td>Spec. Charts</td>
<td>Logic</td>
</tr>
<tr>
<td>Writing</td>
<td>Test results, Cost estimate</td>
<td>Comprehension</td>
</tr>
<tr>
<td>Listening</td>
<td>Knock, rattle, squealing tire</td>
<td>Terminology</td>
</tr>
<tr>
<td>Viewing</td>
<td>Featheredge, uneven wear</td>
<td>Penmanship</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EXAMPLES</th>
<th>SKILLS/CONCEPTS</th>
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</tr>
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<td>Spec. Charts</td>
<td>Logic</td>
</tr>
<tr>
<td>Test results, Cost estimate</td>
<td>Comprehension</td>
</tr>
<tr>
<td>Knock, rattle, squealing tire</td>
<td>Terminology</td>
</tr>
<tr>
<td>Featheredge, uneven wear</td>
<td>Penmanship</td>
</tr>
</tbody>
</table>

**SKILLS/CONCEPTS**

- Auditory discrimination
- Noise discrimination
- Visual analysis
- Recognition of symbols
### (TASK STATEMENT) L-2 SERVICE FRONT END COMPONENTS

<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alignment rack</td>
</tr>
<tr>
<td>Puller set</td>
</tr>
<tr>
<td>Special tool as required</td>
</tr>
<tr>
<td>Front end alignment</td>
</tr>
<tr>
<td>Upper and lower control arms</td>
</tr>
<tr>
<td>Ball joints</td>
</tr>
<tr>
<td>Tie rod ends and linkage</td>
</tr>
<tr>
<td>Wheel bearings</td>
</tr>
<tr>
<td>Bushings</td>
</tr>
<tr>
<td>Spindels</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repair detective parts</td>
<td>Wear safety glasses</td>
</tr>
<tr>
<td>Check tire wear patterns</td>
<td>Support car properly for type of repair you are doing</td>
</tr>
<tr>
<td>Remove &amp; replace detective parts</td>
<td>May get foreign object in eye</td>
</tr>
<tr>
<td>Align front end</td>
<td>Car may slip off jack and cause accident or damage to car</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DECISIONS</th>
<th>CUES</th>
<th>ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine what parts are defective</td>
<td>Tire wear</td>
<td>Accidents</td>
</tr>
<tr>
<td>Determine how to remove and replace detective parts</td>
<td>Shimmy</td>
<td>Tire wear</td>
</tr>
<tr>
<td>Determine from tire wear pattern what the problems are</td>
<td>Loose steering</td>
<td>Road failure</td>
</tr>
<tr>
<td>Determine if alignment is within specifications</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**L-2 SERVICE FRONT END COMPONENTS**

### SCIENCE

- Simple machines used to gain mechanical advantage: Steering linkage
- Work input, work output, friction and efficiency in simple machines: Steering box
- Motion resulting from two or more forces acting on a point in a body: Force vs. Resistance

The following principles of behavioral patterns should be included:

<table>
<thead>
<tr>
<th>Professionalism</th>
<th>Communications</th>
<th>Respect for others</th>
<th>Loyalty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Personality conflicts</td>
<td>-</td>
<td>for tools and equipment, etc.</td>
<td>to peers</td>
</tr>
<tr>
<td>Communications</td>
<td>-</td>
<td>Company</td>
<td>Customers</td>
</tr>
<tr>
<td>Cooperative venture</td>
<td>-</td>
<td>Working together</td>
<td>Encouragement</td>
</tr>
<tr>
<td>Working together</td>
<td>-</td>
<td>Seek help of others (specialist)</td>
<td>Husbanding</td>
</tr>
<tr>
<td>Dependability</td>
<td>-</td>
<td>On time</td>
<td>Regularity</td>
</tr>
<tr>
<td>Efficiency</td>
<td>-</td>
<td>Accuracy of repair</td>
<td>Image</td>
</tr>
<tr>
<td>Image</td>
<td>-</td>
<td>Personal appearance</td>
<td>Conduct</td>
</tr>
<tr>
<td>Conduct</td>
<td>-</td>
<td>Trade</td>
<td></td>
</tr>
</tbody>
</table>

### MATH – NUMBER SYSTEMS

- Set of Real numbers: Rational
- Use of computing devices and mechanical aids: Computers, Dyno
- Basic Logic: Deductive
- Basic Measurement: Skills and Concepts
  - Instruments: Alignment rack
- Basic logic: Deductive
  - Angle: Metric measure and conversion
  - Reading and interpreting: tables, charts, and graphs: Logs, Alignment charts

### COMMUNICATIONS

#### PERFORMANCE MODES

- Speaking
- Reading
- Writing
- Listening
- Viewing

#### EXAMPLES

- Customer Information
  - Spec. Charts
  - Test results, Cost estimate
- Knock, rattle, squealing tire
  - Featheredge, uneven wear

#### SKILLS/CONCEPTS

- Terminology
- Logic
- Comprehension
- Terminology
- Penmanship
- Spelling
- Reports
- Terminology
- Clarity of expression
- Auditory discrimination
- None discrimination
- Visual analysis
- Recognition of symbols
DUTY M. REPAIRING REAR AXLE AND DRIVE LINE

1. Diagnose rear axle and drive line problems
2. Service rear axle components
# M-1 Diagnose Rear Axle and Drive Line Problems

## Tools, Equipment, Materials, Objects Acted Upon
- Dynomometer
- Stethoscope
- Protractor and level
- Rear axle assembly
- Drive line components

## Performance Knowledge
- Dynomometer test
- Check noise with stethoscope
- Check drive line angle

## Safety - Hazard
- Wear safety glasses
- Watch for moving parts
- Foreign material in eye
- Clothing or long hair may catch in moving parts

## Decisions
- Determine Dyno test results
- Determine what is making noise with stethoscope
- Determine if drive line angles are within specifications

## Cues
- Rear end noise
- Vibration

## Errors
- Road failure
- Vibrations and noise
**ASK STATEMENT** M-1 DIAGNOSE REAR AXLE AND DRIVE LINE PROBLEMS

### SCIENCE

| Simple machines used to gain mechanical advantage | Gears |
| Work input, work output, friction and efficiency in simple machines | Applied force |
| Centripetal forces developed by bodies in rotation | Drive line |
| Effects of friction on work processes and product quality | Power loss due to friction |

The following principles of behavioral patterns should be included:

- Professionalism
- Communications
- Respect
- For others
- For tools and equipment, etc.
- Dignity
- To peers
- To customers
- To company
- Cooperative venture
- Working together
- Encouragement
- Seek help of others (specialist)
- Housekeeping

### MATH - NUMBER SYSTEMS

- Set
- Real numbers
- Rational
- Fundamental Operations (Calculation)
- Use of computing devices and mechanical aids
- Computers
- Data
- Basic Measurement Skills and Concepts
- Instruments
- Stethoscope, protractor level (angle)
- Basic Logic
- Deductive
- Basic Measurement Skills and Concepts
- Measurement: Non-geometric
- Speed (RPM, MPH, NV)

### COMMUNICATIONS

#### PERFORMANCE MODES

- Speaking
- Reading
- Writing
- Listening
- Viewing
- Touching

#### EXAMPLES

- Customer complaint
- Spec chart
- Test results, cost estimate
- Noise level, pitch
- Loose U joints
- Car vibration

#### SKILLS/CONCEPTS

- Terminology
- Logic
- Comprehension
- Terminology
- Penmanship
- Spelling
- Terminology
- Process report (instruction)
- Auditory discrimination
- Logic
- Visual analysis
- Detail and inference
- Symbols & codes
- Vibration
## M-2 Service Rear Axle Components

### Tools, Equipment, Materials, Objects Acted Upon

- S, I, K
- Special tools for type of rear axle servicing
- Micrometer
- U joint clamps
- Rear axle stand
- Rear axle assemblies
- Axle bearing
- U joints
- Slip joints
- Carrier bearing

### Performance Knowledge

- Disassemble, clean and inspect rear axle assemblies and drive line components
- Repair or replace and adjust defective parts
- Assemble, adjust and test rear axles and or drive line components

### Safety - Hazard

- Wear safety glasses
- Mounting of rear axle in stand
- May get foreign material in eye
- Loose mounting may cause accident or damage to rear axle assemblies

### Decisions

- Determine from inspection what parts are defective
- Determine from special manual how to replace and adjust replacement parts
- Determine from road test or dyno test if repairs meet manual specifications

### Cues

- Rear axle or drive line noise
- Vibration from drive line or rear axle

### Errors

- Road failure
- Vibration and or rear end noise
### (TASK STATEMENT) M-2 SERVICE REAR AXLE COMPONENTS

<table>
<thead>
<tr>
<th>SCIENCE</th>
<th>MATH – NUMBER-SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple machines used to gain mechanical advantage</td>
<td>Gears</td>
</tr>
<tr>
<td>Work input, work output, friction and efficiency in simple machines</td>
<td>Applied force</td>
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<tr>
<td>Centripetal forces developed by bodies in rotation</td>
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<td>Power loss due to friction</td>
</tr>
<tr>
<td>The following principles of behavioral patterns should be included</td>
<td></td>
</tr>
<tr>
<td><strong>Professionalism</strong></td>
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<tr>
<td>Personality conflicts</td>
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<tr>
<td>Loyalty</td>
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<td>Working together</td>
<td></td>
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<tr>
<td>Encouragement</td>
<td></td>
</tr>
<tr>
<td>Seek help of others (spec. assist)</td>
<td></td>
</tr>
<tr>
<td>Housekeeping</td>
<td></td>
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</tbody>
</table>

### COMMUNICATIONS

<table>
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<th>EXAMPLES</th>
<th>SKILLS/CONCEPTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speaking</td>
<td>Customer complaint</td>
<td>Terminology</td>
</tr>
<tr>
<td>Reading</td>
<td>Spec. chart</td>
<td>Logic</td>
</tr>
<tr>
<td>Writing</td>
<td>Test result, cost estimate</td>
<td>Comprehension</td>
</tr>
<tr>
<td>Listening</td>
<td>Noise level, pitch</td>
<td>Terminology</td>
</tr>
<tr>
<td>Viewing</td>
<td>Loose U joints</td>
<td>Penmanship</td>
</tr>
<tr>
<td>Touching</td>
<td>Car vibration</td>
<td>Spelling</td>
</tr>
</tbody>
</table>

| | | |
| | | |
DUTY N. REPAIRING TRANSMISSIONS (STANDARD)

1. Diagnose transmission problems (STD)

2. Service transmission components and repair
### Tools, Equipment, Materials, Objects Acted Upon
- Stethoscope
- Dynamometer or road test
- Transmission (STD)
- Shift linkage
- Clutch

### Performance Knowledge
- Dynamometer or road test
- Check noise with stethoscope
- Check shift linkage

### Safety - Hazard
- Wear safety glasses
- Beware of moving parts
- May get foreign material in eye
- Clothing or long hair may catch in moving parts

### Decisions
- Determine from dyno or road test what the problems are.
- Using stethoscope determine what gear or bearings are at fault.
- Determine if shift linkage meets manual spec.

### Cues
- Noise in transmission
- Hard shifting

### Errors
- Road failure
- Hard shifting
### SCIENCE

Simple machines used to gain mechanical advantage: Levers, work input, work output, friction and efficiencies in simple machines, applied force, power, output. Effects of friction on work processes and product quality: Power loss due to friction.

The following principles of behavioral patterns should be included:

- **Professionalism**
  - Dependability
  - On time
  - Accuracy of repair
  - Image

- **Personality conflicts**
  - Communications
  - Respect
  - For others
  - For tools and equipment, etc.
  - Quality
  - To peers
  - Customers
  - Company

- **Cooperative venture**
  - Working together
  - Encouragement
  - Seek help of others (specialist)
  - Housekeeping

### MATH -- NUMBER SYSTEMS

Set of Real numbers: Rationals
- Fundamental Operations (Calculations)
- Use of computing devices and mechanical aids
- Computers: Basic
- Arithmetic, skills, and concepts
  - Ratios (gears)
- Basic Measurement, skills, and concepts
  - Instruments: Stethoscope
  - Metric and English measure and conversion
  - Measurement: Geometric
  - Angle: Gears
  - Measurement: Non-geometric
  - Speed
  - Reading and interpreting tables, charts, and graphs
  - Logs: Transmission charts
- Basic Logic
- Deductive

### COMMUNICATIONS

#### PERFORMANCE MODES

- Speaking
- Reading
- Writing
- Listening
- Viewing
- Touching

#### EXAMPLES

- Customer complaint
- Spec Chart
- Test result, cost estimate
- Noise level: pitch, knocking sound
- Loose U joints
- Car vibration

#### SKILLS/CONCEPTS

- Terminology
- Logic
- Comprehension
- Progress report
- Terminology
- Penmanship
- Spelling
- Reports
- Terminology
- Auditory discrimination
- Visual analysis
- Detail and inference
- Recognition of symbols
- Vibration
## SERVICE AND REPAIR TRANSMISSION PROBLEMS

### TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON

- Clutch aligning tool
- Puller set
- Gear lube
- Clutch
- Transmission
- Clutch release bearing
- Linkage

### PERFORMANCE KNOWLEDGE

- Remove, disassemble, clean and inspect
- Adjust, repair or replace defective parts
- Assemble, adjust, test and install

### SAFETY – HAZARD

- Wear safety glasses
- Weigh of transmission
- Use of safety stands
- May get foreign material in eye
- Use transmission jack
- Car may slip off jack and cause accident or damage to car

### DECISIONS

- Determine from inspection what parts are defective
- Determine from service manual how to adjust, repair and replace parts
- Determine if repairs are complete; dyno or road test

### CUES

- Clutch slipping
- Noise in transmission
- Hard shifting
- Foreign material in gear case

### ERRORS

- Road failure
- Damage transmission or clutch and linkage parts
## SCIENCE

- Simple machines used to gain mechanical advantage: Gears
- Work input, work output, friction, and efficiency in simple machines: Applied force, power output
- Effects of friction on work processes and product quality: Power loss due to friction

The following principles of behavioral patterns should be included:

- Professionalism
  - Personality conflicts
  - Communications
  - Respect for tools and equipment, etc
  - Loyalty
  - To peers
  - Customers
  - Company
  - Cooperative venture
  - Encouragement
  - Seek help of others (specialist)
  - Housekeeping

## MATH - NUMBER SYSTEMS

- Set of Real numbers: Rationals
- Fundamental Operations (Calculation): Use of computing devices, and mechanical aids
- Computers, Dyno
- Basic Arithmetic Skills and Concepts: Ration (gears)
- Basic Measurement Skills and Concepts:
  - Instruments: Stethoscope
  - Metric and English measure and conversion
  - Measurement: Geometric
  - Angle, Gear helix
  - Measurement: Non-geometric
  - Speed
  - Reading and interpreting tables, charts, and graphs
  - Logs, Transmission charts
- Basic Logic
- Deductive
- Basic Measurement Skills and Concepts:
  - Instruments: Clutch aligning tool
  - Measurement: Non-geometric
  - Liquid, P intro. gear lube

## COMMUNICATIONS

### PERFORMANCE MODES

- Speaking
- Reading
- Writing
- Listening
- Viewing
- Tasting
- Smelling

### EXAMPLES

- Customer complaint
- Spec. Chart
- Test result, cost estimate
- Noise level: pitch, knocking sound
- Loose U joints
- Car vibration
- Burned clutch

### SKILLS/CONCEPTS

- Terminology
- Logic
- Comprehension
- Progress report
- Terminology
- Penmanship
- Spelling
- Reports
- Terminology
- Auditory discrimination
- Visual analysis
- Detail and inference
- Recognition of symbols
- Vibration
DUTY 0. REPAIRING TRANSMISSIONS (AUTOMATIC)

1. Diagnose transmission problems (AUTO)

2. Service transmission components
### 0-1 Diagnose Transmission Problems (Auto)

**Tools, Equipment, Materials, Objects Acted Upon**
- Dynamometer
- S 1 K
- Oil pressure gauge
- Automatic transmission
- Torque converter

**Performance Knowledge**
- Check automatic transmission fluid
- Administer pressure, temperature and dynamometer tests

**Safety - Hazard**
- Wear safety glasses
- Beware oil under pressure
- Use care in use of Dyno
- Foreign objects in eyes
- Oil could burn body
- Car under power and speed conditions

**Decisions**
- Determine if fluid is full or contaminated
- Determine if pressures are at specified levels
- Determine if clutches or bands are malfunctioning

**Cues**
- Brown or black (Discolored) fluid
- Low oil pressures
- Slipping shift points

**Errors**
- Misquote problem and price
- Road break down
**ASK STATEMENT** 0-1 DIAGNOSE TRANSMISSION PROBLEMS (AUTO)

<table>
<thead>
<tr>
<th>SCIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluids under pressure: Hydraulic transfer of pressure</td>
</tr>
<tr>
<td>Simple machines used to gain mechanical advantage: Planetary gears</td>
</tr>
<tr>
<td>Centrifugal forces developed by bodies in rotation: Used in torque converter</td>
</tr>
<tr>
<td>The following principles of behavioral patterns should be included:</td>
</tr>
<tr>
<td><strong>Professionalism</strong></td>
</tr>
<tr>
<td>Personality conflicts</td>
</tr>
<tr>
<td>Communications</td>
</tr>
<tr>
<td>Respect for others</td>
</tr>
<tr>
<td>Loyalty to peers, customers, company</td>
</tr>
<tr>
<td>Cooperative venture</td>
</tr>
<tr>
<td>Encouragement</td>
</tr>
<tr>
<td>Seek help of others (specialist)</td>
</tr>
<tr>
<td>Housekeeping</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>MATH – NUMBER SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Set of real numbers</td>
</tr>
<tr>
<td>Integers, Hydraulic pressures</td>
</tr>
<tr>
<td>Uses of Numbers (without calculation)</td>
</tr>
<tr>
<td>Counting, Band adjustment</td>
</tr>
<tr>
<td>Basic Measurement Skills and Concepts</td>
</tr>
<tr>
<td>Measurement: Non-geometric: Torque wrench</td>
</tr>
<tr>
<td>Pressure, Temperature</td>
</tr>
<tr>
<td>Basic Logic</td>
</tr>
<tr>
<td>Deductive</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMMUNICATIONS</th>
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<tbody>
<tr>
<td><strong>PERFORMANCE MODES</strong></td>
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<td>Viewing</td>
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<tr>
<td>Listening</td>
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<tr>
<td>Writing</td>
</tr>
<tr>
<td>Reading</td>
</tr>
<tr>
<td>Smelling</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>EXAMPLES</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Spec chart, Oil contamination</td>
</tr>
<tr>
<td>Knock, slipping, scraping, buzzing: low oil</td>
</tr>
<tr>
<td>Analysis report, cost estimate</td>
</tr>
<tr>
<td>Shop manual: Spec chart</td>
</tr>
<tr>
<td>Burned oil: odor</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>SKILLS/CONCEPTS</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual analysis</td>
</tr>
<tr>
<td>Detail and Inference</td>
</tr>
<tr>
<td>Color Discrimination</td>
</tr>
<tr>
<td>Recognition of symbols</td>
</tr>
<tr>
<td>Noise discriminations</td>
</tr>
<tr>
<td>Penmanship</td>
</tr>
<tr>
<td>Spelling</td>
</tr>
<tr>
<td>Reports (Recommendation)</td>
</tr>
<tr>
<td>Terminology</td>
</tr>
<tr>
<td>Process Report Instruction</td>
</tr>
<tr>
<td>Comprehension</td>
</tr>
<tr>
<td>Terminology</td>
</tr>
<tr>
<td>Odor</td>
</tr>
</tbody>
</table>
### Tools, Equipment, Materials, Objects Acted Upon

<table>
<thead>
<tr>
<th>S.T.K.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Special automatic transmission tools</td>
<td></td>
</tr>
<tr>
<td>Transmission clutch press</td>
<td></td>
</tr>
<tr>
<td>Automatic transmission torque converter</td>
<td></td>
</tr>
</tbody>
</table>

### Performance Knowledge

- R & R automatic transmission and torque converter
- Disassemble, clean and inspect parts
- Rebuild and reassemble transmission
- Flush or replace converter

### Safety – Hazard

- Wear safety glasses
- Flush cleaning solvents
- Secure transmission on trans. jack
- Support car on jack stands

### Decisions

- Determine the need to repair or replace parts (Clutch, bands, seals, etc.)
- Determine if the converter is reusable

### Cues

- Worn parts
- Plugged converter
- Cracked parts

### Errors

- Transmission will malfunction
- Car will break down
- May burn out transmission
### SCIENCE

- Fluids under pressure
- Hydraulic transfer of pressure
- Simple machines used to gain mechanical advantage
- Planetary gears
- Centrifugal forces developed by bodies in rotation
- Used in torque converter

The following principles of behavioral patterns should be included:

- Professionalism
- Respect
- Loyalty
- Cooperation
- Teamwork
- Encouragement
- Housekeeping

### MATH - NUMBER SYSTEMS

- Set of real numbers
- Integers
- Hydraulic pressures
- Uses of Numbers (without calculation)
- Counting, Band adjustment

- Basic Measurement Skills and Concepts
  - Measurement: Non-geometric
  - Torque wrench
  - Pressure
  - Temperature

- Basic Logic
- Deductive

- Basic Measurement Skills and Concepts
  - Measurement: Non-geometric
  - Liquid
  - Cleaning solution
  - Instrument: Dial Indicator
  - Measurement: Geometric
  - Linear

- Basic Arithmetic Skills and Concepts
  - Ratio and proportion

### COMMUNICATIONS

### PERFORMANCE MODES

- Viewing
- Reading
- Writing

### EXAMPLES

- Spec. chart, Instruments
- Wiring diagram, condition of wires
- Report analysis, cost estimate

### SKILLS/CONCEPTS

- Visual Analysis
- Detail inference
- Color Discrimination
- Comprehension
- Description of mechanism
- Terminology
- Process report instruction

- Penmanship
- Spelling
- Reports (recommendation)
- Clarity of expression
DUTY P. MAINTAINING AND REPAIRING ELECTRICAL SYSTEMS

1. Diagnose electrical systems problems

2. Service and repair electrical systems components
### Tools, Equipment, Materials, Objects Acted Upon

- Volt-amp meter
- Test light
- Ohm meter
- Generator
- Regulator
- Starter
- Solonoid
- Battery
- Headlights
- Tailights
- Turn signals
- Courtesy lights

### Performance Knowledge

- Test generating system per specifications
- Test starting circuit
- Test battery
- Check lights for operation

### Safety - Hazard

- Wear safety glasses
- Be careful of test equipment
- Beware of hot wires or cables
- Foreign material in eyes
- Wires entangled in moving parts
- Hot wires cause fires or burn hands

### Decisions

- Determine if charging circuit is functioning according to specifications.
- Determine if the cranking circuit is operating correctly (Amp draw) (cranking RPM)
- See if battery is at peak performance
- See if all lights work

### Cues

- Generator light on
- Starter inoperative
- Battery voltage low
- Lights inoperative

### Errors

- Car will not start
- Lights will not work
### SCIENCE

<table>
<thead>
<tr>
<th>Simple machines used to gain mechanical advantage</th>
<th>Pulleys on generator gears on starter</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnetic fields of force - Basis for electricity</td>
<td>Transfer of energy from one form to another - Mechanical to electrical - Electrical to mechanical</td>
</tr>
<tr>
<td>Resistance of materials to flow of electrical current</td>
<td>Wire size resistors</td>
</tr>
</tbody>
</table>

The following principles of behavioral patterns should be included:

- Professionalism
- Personality conflicts
- Communications
- Respect
- for others
- for tools and equipment, etc.
- Loyalty
- To peers
- Customers
- Company
- Cooperative venture
- Working together
- Encouragement
- Seek help of others (specialist)
- Housekeeping

### MATH – NUMBER SYSTEMS

- Use of computing devices and mechanical aids - Calculators - Electrical
- Basic Measurement Skills and Concepts
  - Given an Instrument of Measure, determine precision and/or accuracy with respect to relative error
  - Significant digits, and tolerance - Calculators
  - Instruments - Volt amp meter, continuity tester, Ohm meter, hydrometer
  - Measurement: Non-geometric - Volt, amp, Ohm
  - Reading and interpreting tables, charts, and graphs - Specification charts, wiring schematic
  - Use of Real numbers - Rationals
  - Basic Logic - Deductive

### COMMUNICATIONS

### PERFORMANCE MODES

- Reading
- Viewing
- Writing

### EXAMPLES

- Wired diagram, condition of wires
- Spec. chart, Instruments
- Report analysis, cost estimate

### SKILLS/CONCEPTS

- Comprehension
- Description of mechanism
- Terminology
- Process report instruction
- Visual analysis
- Detail and inference
- Recognition of symbols (Meters)
- Penmanship
- Spelling
- Reports (Recommendations)
- Terminology
- Clarity of expression
## Task Statement
P-2 Service and Repair Electrical System Components

### Tools, Equipment, Materials, Objects Acted Upon
- S.T.K.
  - Volt-Amp meter
  - Ohm meter
  - Hydrometer
  - Generator-regulator tester
  - Bearing puller
  - Battery lift strap
- Generator
- Regulator
- Starter
- Solonoid
- Battery
- Lights

### Performance Knowledge
- Repair generator
- Repair starter
- Repair or replace solonoid
- Charge or replace battery
- Repair lights

### Safety - Hazard
- Wear safety glasses
- Beware moving parts
- Beware hot wires
- Foreign material in eyes
- Test or run leads entangled in moving parts
- Hot wires cause fire or burns

### Decisions
- Determine if the generator can be repaired per specifications
- Determine if starter can be repaired

### Cues
- Parts cost may exceed price of rebuilt unit
- Specification charts
- Parts cost sheet

### Errors
- Car may not start
- May stop on highway
- Battery may not hold charge
ASK STATEMENT) P-2 SERVICE AND REPAIR ELECTRICAL SYSTEM COMPONENTS

<table>
<thead>
<tr>
<th>SCIENCE</th>
<th>MATH - NUMBER SYSTEMS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple machines used to gain mechanical advantage Pulleys on generator gears on starter Magnetic fields of force Basis for electricity Transfer of energy from one form to another Mechanical to electrical Electrical to mechanical Resistance of materials to flow of electrical current Wire size, resistors</td>
<td></td>
</tr>
<tr>
<td>Use of computing devices and mechanical aids Calculators Electrical Basic Measurement Skills and Concepts Given an Instrument of Measure, determine precision and/or accuracy with respect to relative error significant digits, and tolerance Calculators Instruments—Volt amp meter, continuity tester, Ohm meter, hydrometer Measurement: Non-geometric—Volt, amp, Ohm Reading and interpreting tables, charts, and graphs—Specification charts, wiring schematic Use of Real numbers Rationals Basic Logic Deductive Basic Measurement Skills and Concepts Instruments—Battery charger Rate—Rate of charge Measurement: Non-geometric Time</td>
<td></td>
</tr>
</tbody>
</table>

| COMMUNICATIONS |
| PERFORMANCE MODES | EXAMPLES | SKILLS/CONCEPTS |
| Viewing | Wiring Diagram Condition of wires Report analysis Cost estimate Spec Chart, Instruments | Visual analysis Memory Detail and inference Recognition of symbols (include meters) Penmanship Spelling Reports (recommendation) Terminology Clarity of expression |
| Writing | |
| Viewing | | Visual analysis Detail and inference Recognition of symbols (meters) |
DUTY Q. SERVICING AND REPAIRING A/C UNIT

1. Diagnose a/c unit problems

2. Service and repair a/c components
<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
<th>PERFORMANCE KNOWLEDGE</th>
<th>SAFETY – HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.T.K.</td>
<td>Run performance test</td>
<td></td>
</tr>
<tr>
<td>Charging station</td>
<td>Check clutch operation</td>
<td></td>
</tr>
<tr>
<td>Volt-amp meter</td>
<td>Check sight glass</td>
<td></td>
</tr>
<tr>
<td>Compressor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clutch</td>
<td></td>
<td></td>
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<tr>
<td>Dehydrator-Receiver (dr.)</td>
<td></td>
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<tr>
<td>Condensor</td>
<td></td>
<td></td>
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<tr>
<td>Evaporator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermostatic expansion valve (T.E.V.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lines &amp; fittings</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Decisions**

Determine performance results
See if outlet temperature is correct

**Cues**

Outlet temperature low
Foam in sight glass
Clutch or belt slipping
Oil around lines, seals, or fittings

**Errors**

No cooling
Wrong repairs made

**Safety – Hazard**

Wear safety glasses
Beware moving engine parts
Make sure test fittings are secure
Foreign material in eyes, especially freon
Test lines, clothing or hair may become entangled
May leak oil or freon
**ASK STATEMENT) Q-1 DIAGNOSE A/C UNIT PROBLEMS**

### SCIENCE

- Simple machines used to gain mechanical advantage: Pulleys on generator gears on starter
- Magnetic fields of force: Basis for electricity
- Transfer of energy from one form to another: Mechanical to electrical, Electrical to mechanical
- Resistance of materials to flow of electrical current: Wire size resisters

The following principles of behavioral patterns should be included:

<table>
<thead>
<tr>
<th>Professionalism</th>
<th>Dependability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Person conflict</td>
<td>On time</td>
</tr>
<tr>
<td>Communication</td>
<td>Regularity</td>
</tr>
<tr>
<td>Respect</td>
<td>Accuracy of repair</td>
</tr>
<tr>
<td>Loyalty</td>
<td>Image</td>
</tr>
<tr>
<td>For others</td>
<td>Personal appearance</td>
</tr>
<tr>
<td>For tools and equipment, etc.</td>
<td>Conduct</td>
</tr>
<tr>
<td>Loyalty</td>
<td>Trade</td>
</tr>
<tr>
<td>To peers</td>
<td></td>
</tr>
<tr>
<td>Customers</td>
<td></td>
</tr>
<tr>
<td>Company</td>
<td></td>
</tr>
<tr>
<td>Cooperative venture</td>
<td></td>
</tr>
<tr>
<td>Working together</td>
<td></td>
</tr>
<tr>
<td>Encouragement</td>
<td></td>
</tr>
<tr>
<td>Seek help of others (specialist)</td>
<td></td>
</tr>
<tr>
<td>Housekeeping</td>
<td></td>
</tr>
</tbody>
</table>

### MATH - NUMBER SYSTEMS

<table>
<thead>
<tr>
<th>Basic Measurement Skills and Concepts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instruments</td>
</tr>
<tr>
<td>Charging station</td>
</tr>
<tr>
<td>Thickness gauge</td>
</tr>
<tr>
<td>Reading and interpreting tables, charts, and graphs</td>
</tr>
<tr>
<td>Ambient temp chart</td>
</tr>
<tr>
<td>Measurement Non-geometric</td>
</tr>
<tr>
<td>Temperature</td>
</tr>
<tr>
<td>Pressure</td>
</tr>
<tr>
<td>Measurement Geometric</td>
</tr>
<tr>
<td>Integral</td>
</tr>
<tr>
<td>Set of real numbers</td>
</tr>
<tr>
<td>Rationals</td>
</tr>
</tbody>
</table>

### COMMUNICATIONS

**PERFORMANCE MODES**

- Viewing
- Touching
- Listening
- Reading
- Writing

**EXAMPLES**

- Oil loss, sight glass, broken lines
- Hot or cold
- Hiss of refrigerant leak
- Spec. chart, ambient temperature
- Analysis report, cost estimate

**SKILLS/CONCEPTS**

- Visual analysis
- Memory
- Detail and inference
- Color discrimination
- Recognition of symbols
- Temperature
- Noise discrimination
- Comprehension
- Terminology
- Process report (instruction)
- Clarity of expression
- Terminology
<table>
<thead>
<tr>
<th>TOOLS, EQUIPMENT, MATERIALS, OBJECTS ACTED UPON</th>
</tr>
</thead>
<tbody>
<tr>
<td>S.T.K., Special clutch tools, Compressor tools</td>
</tr>
<tr>
<td>R-12 Charging station, Test goggles, Leak tester</td>
</tr>
<tr>
<td>Clutch, Compressor, Condenser, Evaporator, Drier, T.E.V., Lines</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PERFORMANCE KNOWLEDGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test and repair clutch</td>
</tr>
<tr>
<td>Test and repair or replace compressor</td>
</tr>
<tr>
<td>Check and/or repair condenser</td>
</tr>
<tr>
<td>Repair or replace evaporator</td>
</tr>
<tr>
<td>Replace drier</td>
</tr>
<tr>
<td>Check or replace T.E.V.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SAFETY - HAZARD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wear safety goggles</td>
</tr>
<tr>
<td>Beware moving parts</td>
</tr>
<tr>
<td>Freon</td>
</tr>
<tr>
<td>Hoses, test connections may catch in moving parts</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>DECISIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine if more expedient to repair or replace</td>
</tr>
<tr>
<td>Determine if unit will now meet performance test</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CUES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost is more to repair than to replace</td>
</tr>
<tr>
<td>Sight glass clear</td>
</tr>
<tr>
<td>Outlet temperature correct</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ERRORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/C unit will not cool</td>
</tr>
<tr>
<td>Compressor tie up</td>
</tr>
<tr>
<td>SCIENCE</td>
</tr>
<tr>
<td>---------</td>
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<td>Simple machines used to gain mechanical advantage</td>
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<tr>
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<td>Communications</td>
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<td>Respect</td>
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<td>for tools and equipment, etc.</td>
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<td>Loyalty</td>
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<td>To peers</td>
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<td>Cooperative venture</td>
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<td>Working together</td>
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<td>Encouragement</td>
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<td>Seek help of others (specialist)</td>
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ABBREVIATIONS

A/C—Air Condition
Auto—Automatic
Dyno—Dynomometer
Ign.—Igniter
Lube—Lubrication
M.P.H.—Miles Per Hour
N.H.V.—Noise, Harsh, Vibration
P/M—Preventive Maintenance
Pts.—Parts
Qt.—Quart
R.P.M.—Revolutions Per Minute
R & R—Remove and Replace
Specs.—Specification
S.T.K.—Standard Tool Kit
1/8" drive socket set
1/2" drive socket set
Pliers 4
Screw drivers 6-3stg-3-Philip's
Hammer 16 oz.
Carbon Scraper
Std.—Standard
T.E.V.—Thermostatic Expansion Valve

Punches 5
Chisels 4
Thickness gauge 2 flat and round
End wrench 1/4" to 3/8"
Combination wrench 3/8" to 3/4"
Tool Box

√—check