This combination progress record and course outline is designed for use by individuals teaching a course in automobile repair. Included among the topics addressed in the course are the following: shop safety, engines, fuel and exhaust systems, electrical systems, crankcase lubrication systems, cooling systems, power transmission systems, steering systems, brake systems, frame and suspension systems, air conditioning, emission controls, manual metal arcs, and automotive applications of gas welding. In addition to the theory outline, which includes space for recording information concerning the scheduling and presentation of the lesson material, this record book also contains a list of course objectives for grades 11 and 12 and a grid for use in recording the individual student's mastery of each specific skill taught in the course. (MN)
PROGRESS RECORD

AND

THEORY OUTLINE

AUTOMOBILE COURSE

DIVISION OF VOCATIONAL-TECHNICAL SCHOOLS

CONNECTICUT DEPARTMENT OF EDUCATION

1983-1984
PREFACE

This course outline is to be used with the trade analysis and it should be integrated with the progress record.

Although the course outline mentions safety only in a few areas, it is the responsibility of the instructor to examine the analysis as well as to draw on his own experience to be sure that the students are alerted to and practice the necessary safety procedures required for each job.
AUTOMOTIVE COURSE OBJECTIVES

GRADE 11 & 12

1. To maintain the ability and desire to work and live harmoniously together with mutual respect for the rights of others.

2. To apply each student's understanding of scientific and mechanical principles as well as manual skills to the repair of vehicles using production (real) jobs as a means to meet the specific course requirements.

3. To safely and correctly use and care for the basic automotive tools and diagnostic equipment.

4. To apply practical skills and related technical knowledge of the trade in sufficient degree to meet minimum job entry requirements in the automotive trade.

5. To approach each job and assignment with a logical step by step diagnostic procedure.

6. To practice good work habits of orderliness and care of property.

7. To practice safe work habits and to promote safety consciousness.

8. To be able to estimate job costs and part requirements.
<table>
<thead>
<tr>
<th>Division 1 - Engine</th>
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<tbody>
<tr>
<td>R &amp; R Engine</td>
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<tr>
<td>R &amp; R Cylinder head</td>
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<tr>
<td>R &amp; R Oil Pan</td>
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<tr>
<td>Ream cylinder ridge</td>
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<tr>
<td>R &amp; R Piston Assembly</td>
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<tr>
<td>Deglaze cylinder walls</td>
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<tr>
<td>R &amp; R Rod bearings</td>
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<tr>
<td>R &amp; R Main bearings</td>
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<tr>
<td>Replace rear main seal*</td>
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<tr>
<td>R &amp; R Cam bearings</td>
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<tr>
<td>R &amp; R Timing Gear Chain</td>
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<tr>
<td>R &amp; R Oil pump</td>
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<tr>
<td>R &amp; R Core plugs</td>
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<tr>
<td>R &amp; R Piston rings</td>
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<td>Reface and grind valves</td>
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<td>Task</td>
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<tr>
<td>Serv. Rocker arm shaft</td>
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<tr>
<td>Insp. &amp; Serv. Hydraulic lifters</td>
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<tr>
<td>Plastic Gauge bearings*</td>
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<tr>
<td>Check and Service Valve guides*</td>
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<tr>
<td>Test and Clean air filter</td>
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<tr>
<td>R &amp; R Fuel filter</td>
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<tr>
<td>Test fuel pump and system</td>
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<td>R &amp; R Fuel Pump</td>
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<td>Service carburetor</td>
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<tr>
<td>R &amp; R Gas tank</td>
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<td>R &amp; R Sending Unit</td>
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<td>Division II - Fuel and Exhaust System (Continued)</td>
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<tr>
<td>R &amp; R Dash Unit</td>
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<td>R &amp; R Heat riser valve</td>
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<td>R &amp; R Exhaust Pipe</td>
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<td>R &amp; R Muffler</td>
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<tr>
<td>R &amp; R Tail pipe</td>
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<tr>
<td>Serv. Thermo Cont. Air Cleaner*</td>
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<td>Serv. Vac. Oper. Heat riser valve*</td>
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<tr>
<td>Insp. Evap. Cont. system lines and filter*</td>
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<tr>
<td>Serv. Charcoal Cannister &amp; Filter*</td>
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<tr>
<td>Service Air Injector System*</td>
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<tr>
<td>Service Elec. Auto. Choke*</td>
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<tr>
<td>Serv. Cat. Converter System *</td>
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<td>Service EGR System*</td>
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<td>Service Decel Valve*</td>
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<tr>
<th></th>
<th>R &amp; R Fuel Injector</th>
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<th>R &amp; R Fuel Press Regulator</th>
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<td>Clean and Insp. Bat., top and posts</td>
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<td>Test specific gravity</td>
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<td>Load test battery</td>
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<td>Fill dry battery</td>
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<td>Test cranking circuits</td>
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<td>R &amp; R starter</td>
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<td>Service starter</td>
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<td>R &amp; R solenoid</td>
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<td>Service solenoid</td>
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<td>Test Prim. Ign. Circuits</td>
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<td>Renew primary wiring</td>
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<td>Test secondary</td>
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<td>Test Electronic</td>
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<td>Service Points</td>
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<td>Service Reluctor</td>
<td>(HEG) *</td>
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<td>Service Pick-up</td>
<td>coil assembly *</td>
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<td>Service vacuum</td>
<td>advance</td>
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<td>Service distributor</td>
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<td>Adjust Ignition</td>
<td>Timing</td>
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<td>Test Charging</td>
<td>Circuits</td>
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**DIVISION III - IGNITION & ELECTRICAL SYSTEM**

**Notes:**
- Certain items marked with an asterisk (*) indicate specific actions or components requiring attention.
- Adjust Ignition Timing and Test Charging Circuits are listed as additional tasks.

**Date:**
- 10/83
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<thead>
<tr>
<th>DIVISION III: ELECTRICAL SYSTEM (Continued)</th>
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<tbody>
<tr>
<td>R &amp; R Alternator</td>
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<td>Serv. Alternator</td>
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<td>Service diodes*</td>
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<td>Check &amp; adjust</td>
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<td>Alt. Reg.</td>
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<tr>
<td>R &amp; R Seal beam</td>
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<tr>
<td>Align headlights</td>
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<tr>
<td>R &amp; R Headlight S/W</td>
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<tr>
<td>R &amp; R Signal S/W</td>
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<tr>
<td>R &amp; R Stoplight S/W</td>
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<tr>
<td>Service Lighting circuits</td>
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<td>Service dash units and gauges</td>
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<td>Service Accessory circuits</td>
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<td>Serv. Dist. Spark Control System</td>
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<td>Serv. Electronic Choke System</td>
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<td>Electronic Control</td>
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<td>Ford Microprocessor</td>
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<td>Electronic Control Module</td>
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<td>Spark Control</td>
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<td>Computer Sensors</td>
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<tr>
<td>Test Oxygen Sensor</td>
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<td>Test Engine Speed Sensor</td>
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<td>Test Engine Temp. Sensor</td>
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<td>Test Engine Load Vac. Sensor</td>
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<td>Test Trottle Position Sensor</td>
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<tr>
<td>Test Intake Air Temp. Sensor</td>
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<tr>
<td>Test Intake Air Flow Sensor</td>
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<tr>
<td>Test Barometric/Manifold Pres. Sensor</td>
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<tr>
<td>Test Vehicle Speed Sensor</td>
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<td>Digital Volt Rh 0 &lt; 1-4 C 3 4 H H m &lt;- 0, Z 0-4 7, n 7 0-4 7</td>
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<tr>
<td>DIVISION IV - CRANKCASE LUBRICATION SYSTEM</td>
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<tr>
<td><strong>R &amp; R Oil Pump</strong></td>
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<tr>
<td>Check Engine Oil Pressure</td>
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<tr>
<td>Test and Prime Oil Pump</td>
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<tr>
<td>R &amp; R Full Flow Filter</td>
</tr>
<tr>
<td>R &amp; R Oil Filter Cart. (Bypass)</td>
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<tr>
<td>Perform Bearing Leakage Test</td>
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<tr>
<td>Prime Engine Lubricating System</td>
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<tr>
<td>Check Oil Returns in OHV Engine</td>
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<tr>
<td>Trace Oil Passages</td>
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<td>Check All Poss. Leak Pts. on Eng.</td>
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<tr>
<td>Check Oil Pump Gears (Plastigage)</td>
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<tr>
<td>Check Oil Pump (Rotor Type)</td>
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<tr>
<td>Test PCV System</td>
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<tr>
<td>R &amp; R Crankcase Breather &amp; Filters</td>
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<td>Test Item</td>
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<tr>
<td>Pressure Test</td>
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<tr>
<td>Test for Clogged Core</td>
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<tr>
<td>R &amp; R Thermostat</td>
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<tr>
<td>R &amp; R Hoses (Check for cracks)</td>
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<tr>
<td>Test Heater and Heat Valve</td>
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<tr>
<td>R &amp; R Belts (Check for cracks)</td>
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<tr>
<td>R &amp; R Water Pump</td>
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<tr>
<td>Check Bypass Valves</td>
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<tr>
<td>Check Trans. Cooler (Oil in water)</td>
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<tr>
<td>Check for Leaky Head Gasket</td>
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<td>R &amp; R Expansion Plugs</td>
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**DIVISION V - COOLING SYSTEM**
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<thead>
<tr>
<th>R &amp; R Vacc. Temp.</th>
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<tbody>
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<td>R &amp; R Coolant Recovery System</td>
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<tr>
<td>R &amp; R Transmission*</td>
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<td>R &amp; R Automatic Transmission</td>
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<td>R &amp; R Coolant transmission</td>
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<td>Draif &amp; refil</td>
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<tr>
<td>Check transmission and play</td>
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<tr>
<td>Check clutch shaft</td>
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<tr>
<td>Dis. &amp; adjust joint</td>
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<tr>
<td>Adjust auto.</td>
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<tr>
<td>Check transmission bands</td>
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<tr>
<td>Dis. &amp; assemble</td>
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**POWER TRANSMISSION SYSTEM (cont'd)**

**DIVISION**

**A**
<table>
<thead>
<tr>
<th>DIVISION VI - POWER TRANSMISSION SYSTEM (Cont'd)</th>
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<tbody>
<tr>
<td>R &amp; R Drive shaft</td>
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<tr>
<td>Dis. &amp; Assemble Sychn. Unit</td>
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<tr>
<td>Dis. &amp; Assemble Std. Transm.</td>
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<td>Dis. &amp; Assemble Auto. Transm.</td>
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<td>Adjust Standard Transm. Linkage</td>
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<td>Adjust Auto. Transm. Linkage</td>
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<td>Check Fork Travel</td>
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<td>Check Shift Dts. Std. Transm.</td>
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<td>Air Check Auto. Transm.</td>
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<td>R &amp; R Pilot Bearing</td>
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POWER TRANSMISSION SYSTEM (cont'd)
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<th>DIVISION VI(A) - TRANS AXLE ONLY</th>
<th>DIVISION VII - STEERING SYSTEM</th>
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<td>R &amp; R Axle</td>
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<td>R &amp; R Axle Bearing</td>
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<td>Replace Axle Seal</td>
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<td>Check fluid level</td>
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<td>Adj. Link Type Sr./Lr.</td>
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<td>Overhaul Std. Steer./Assem.</td>
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<td>Overhaul Power Steer./Assem.</td>
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<tr>
<td>Overhaul Link Steer./Assem.</td>
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<td>Overhaul Power Steering Pump</td>
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<td>R &amp; R Pitman Arm</td>
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<td>R &amp; R Drag Link</td>
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<td>R &amp; R Tie Rod</td>
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<td>R &amp; R Tie Rod End</td>
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<td>R &amp; R King Pin/Bush.</td>
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DIVISION VII - STEERING SYSTEM (Cont'd)
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<td><strong>R &amp; R Lower Cont. Arm Assem.</strong></td>
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<td><strong>R &amp; R Upper Ball Joint</strong></td>
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<td><strong>R &amp; R Torsion Bar</strong></td>
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<tr>
<td><strong>Adjust torsion bar</strong></td>
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<td><strong>Repack wheel bearings</strong></td>
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<tr>
<td><strong>Adjust wheel bearings</strong></td>
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<tr>
<td><strong>R &amp; R Shock Absorbers</strong></td>
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<tr>
<td><strong>R &amp; R Stabilizer Bar/Links</strong></td>
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<td><strong>R &amp; R Power Steering Press./Hose</strong></td>
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<tr>
<td><strong>Align Front End</strong></td>
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<tr>
<td><strong>Balance Wheels</strong></td>
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<tr>
<td>Repack Wheel Brgs.</td>
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<td>R &amp; R Wheel Brgs.</td>
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<tr>
<td>Adj. Wheel Bearings</td>
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<td>R &amp; R Brake Shoes</td>
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<tr>
<td>Inspect Wheel Cylinders</td>
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<td>R &amp; R Wheel Cylinders</td>
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<td>R &amp; R Control Arms</td>
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<td>R &amp; R Stabilizer Bar or Linkage</td>
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<td>R &amp; R Tie-Rod Ends</td>
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<td>R &amp; R Rear Coil Springs</td>
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<tr>
<td>R &amp; R Receiver</td>
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<tr>
<td>R &amp; R Compressor</td>
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<td>R &amp; R Compressor Clutch</td>
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<td>R &amp; R Compressor Seals</td>
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<tr>
<td>R &amp; R Comp. Valve Plate &amp; Hd. Gasket</td>
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<td>R &amp; R Compressor Hoses</td>
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<tr>
<td>Check &amp; Fill Compressor Oil</td>
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<tr>
<td>Purge Air Cond. System</td>
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<tr>
<td>Charge Air. Cond. System</td>
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<tr>
<td>Service and adjust controls</td>
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<td>Troubleshoot Auto Temp. Cont. System</td>
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<tr>
<td>System</td>
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<tr>
<td>Serv. Thermo Cont.</td>
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<td>Serv. Vac. Oper.</td>
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<td>Insp. Evap. Cont.</td>
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<td>Serv. Char. Cannister &amp; Filter*</td>
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<td>Serv. Elect. Auto. Choke*</td>
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<td>Serv. Cat. Convertor System*</td>
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<td>Serv. EGR System*</td>
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<td>Adj. Carb. w/ Limiter Caps*</td>
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<tr>
<td>Adj. Carb. w/Idle Lim. Needles*</td>
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<tr>
<td>Serv. Elect. Spark Cont. System*</td>
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<tr>
<td>Serv. Elect. Ignition System*</td>
</tr>
<tr>
<td>Remove PCV Valve*</td>
</tr>
<tr>
<td>Shake, Listen for Rattle</td>
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<tr>
<td>Remove Valve - Check for Vac.</td>
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<tr>
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<td>Check All Vapor Ls.</td>
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<td>R &amp; R Check Valve</td>
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<td>R &amp; R Platinum &amp; Palladium</td>
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<th>R &amp; R Welding Gauges</th>
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<td>Clean Torch Tips</td>
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<td>Adjust Regulators</td>
<td>R &amp; R Tips &amp; Cutting Torch</td>
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<tr>
<td>Adjust Flame</td>
<td>Braze Metal</td>
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<td>Weld Metal</td>
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<tr>
<td>Remove broken stud with torch</td>
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<tr>
<td>Heat Expand. Pipe</td>
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<tr>
<td>Read Arc Welding Chart</td>
<td></td>
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<tr>
<td>Select proper heat range for work</td>
<td></td>
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<tr>
<td>Match weld rod to operation</td>
<td></td>
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<tr>
<td>Weld 1/2&quot; metal stock</td>
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<tr>
<td>Weld 1/4&quot; metal stock</td>
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4. Control valves and servo-mechanisms
5. Transmission cooling

C. Maintenance and Adjustment Requirements
1. Fluid level requirements
   a. Check type used
   b. Check and add fluid
   c. Drain and refill

D. Linkage and Switch Adjustment
1. Neutral safety switch
2. Throttle linkage
3. Gear shift control linkage
4. Anti-stall dashpot clearance

E. Towing procedures and safety
VIII. THE STEERING SYSTEM

A. Introduction to Manual Steering Gears

1. Purpose of the steering gear
   a. As a link between the driver and the wheels
   b. As a device to produce mechanical advantage for steering effort

2. Identification of steering gears
   a. By manufacturer's trade name or symbol
   b. By physical construction
   c. By automobile application

3. The importance of steering gear adjustment to the alignment job
   a. Automobile asafety
   b. As a means of extending the service life of the steering gear

4. Mechanical service procedure
   a. Preliminary inspection of steering gear and linkage
   b. Interpreting specifications
   c. Proper methods of disconnecting steering gear from steering linkage
   d. Locating register marks for steering wheel and pitman arm
   e. Measuring steering gear preload
   f. Using manufacturer's special service tools
   g. Lubricating the steering gear

5. Basic power steering

IX. THE BRAKE SYSTEM

A. Braking principles

1. Define braking action
   a. Kinetic energy
   b. Heat
   c. Generation by friction
   d. Dissipation
   e. Transfer of energy
2. Define friction
   a. Conditions
   b. Static
   c. Moving

3. Factors controlling friction
   a. Area of contact
   b. Pressure
   c. Material
   d. Surface finish

4. Coefficient of friction
   a. Surface
   b. Force

5. Products of friction
   a. Heat
   b. Wear

6. Brake friction requirements
   a. Stopping distance
   b. Front of rear ratio
   c. Side to side balance

B. Hydraulic Principles
1. Pressure applied to liquids
   a. Noncompressable characteristic
   b. Pascal's principle for liquids under pressure

2. Multiplying force
   a. Relationship of force multiplication to cylinder areas
   b. Relationship of force multiplication to distance and speed

3. Application to the brake system
   a. Transmission of efforts
   b. Multiplication of force

C. Hydraulic System Components - Disc and Drum Type
1. Master cylinder
   a. Function
   b. Types
   c. Nomenclature
   d. Principle of operation
   e. Reconditioning
2. Brake Lines
   a. Function
   b. Types
   c. Service procedure
   d. Warning devices
   e. Proportioning valve

3. Wheel Cylinder
   a. Function
   b. Types
   c. Jomenclature
   d. Operating principle
   e. Reconditioning

4. Brake Fluid
   a. Function
   b. Requirements
   c. Replacement

5. Mechanical Components
   a. Brake pedal and linkage
   b. Function
   c. Types
   d. Mechanical advantage

6. Service Procedure
   a. Lubrication
   b. Adjustment

7. Brake Drums
   a. Function
   b. Types
   c. Internal

8. Materials and construction - drums
   a. Pressed steel
   b. Cast iron
   c. Cast iron with steel back
   d. Combination of pressed steel with centrifugally cast metal liner
   e. Cast aluminum with cast iron liner

9. Service Procedure - Drums
   a. Removal and replacement
   b. Inspection
   c. Reconditioning
10. Brake Shoes
   a. Function
   b. Types
   c. Pressed steel
   d. Service procedures
   e. Cleaning
   f. Inspection

11. Brake Linings - Brake Pads
   a. Function
   b. Types
   c. Woven
   d. Rigid molded

12. Methods of attaching
   a. Riveting
   b. Bonding

13. Brake Shoe and Lining Service
   a. Cleaning
   b. Inspection
   c. Fitting lined shoes to drum
   d. Purpose
   e. Contact requirements
   f. Methods of grinding

14. Braking Plate
   a. Function
   b. Types

15. Disc Brake Types
   a. Chrysler self-adjusting
      1) Description
      2) Application
   b. Caliper
      1) Description
      2) Application

X. THE FRAME AND SUSPENSION SYSTEM

A. Purpose of Wheel Alignment
   1. Safety
   2. Vehicle driving ease
   3. Prevention of abnormal tire wear
B. History and Evolution of the Suspension System

1. Invention of the wheel
2. Wagon or buggy system
3. "I" beam or solid axle
4. Independent suspension
   a. Parallel arm suspension
5. Spring design and application
   a. Leaf springs
   b. Coil springs
   c. Torsion bar suspension
   d. Air suspension
   e. Shock absorbers
   f. Wheels and tires

C. Suspension System Types

1. Front suspension systems
   a. "I" beam or solid axle
   b. Types of springs and shackles
2. Independent Suspension Systems
   a. King-pin type
   b. Ball-joint type
   c. Coil-spring supported
   d. Torsion-bar supported
   e. Anti-drive designs
   f. Anti-roll designs
3. Rear suspension systems
   a. Standard rear axle assembly
   b. Leaf-spring supported
   c. Coil-spring supported
   d. Independent rear suspension

D. Front Wheel Alignment Factors

1. Camber
   a. Definition
   b. Effect of camber on tire wear
   c. Application to the automobile
   d. Methods of adjustment
   e. Definition of a degree as a unit of measure
   f. Practical limits for specification
   g. Measuring devices and procedures
   h. Effect of camber on vehicle driving characteristics
2. Caster
   a. Definition
   b. Application to the automobile
   c. Effect of caster on vehicle driving characteristics
   d. Effect of caster on tire wear
   e. Methods of adjustment
   f. Practical limits for specifications
   g. Measuring devices and procedures

3. Toe-in
   a. Definition
   b. Application to the automobile
   c. Effect of toe on vehicle driving characteristics
   d. Effect of toe on tire wear
   e. Methods of adjustment
   f. Specifications
   g. Measuring devices and procedures

4. Toe-out on turns (Steering geometry)
   a. Definition
   b. Application to the automobile
   c. Effect of toe-out on turns on vehicle driving characteristics
   d. Effect of toe-out on turns on tire wear
   e. Correction procedures
   f. Practical limits for specifications
   g. Measuring devices and procedures

5. Steering Axis Inclination

6. Rear Wheel Alignment Factors
   a. Rear wheel camber
   b. Definition
   c. Application to the automobile
   d. Effect of camber on vehicle driving characteristics
   e. Effect of camber on tire wear
   f. Methods of adjustment or correction
   g. Standard rear axle
   h. Independent suspension
   i. Specifications and practical limits
   j. Measuring devices and procedures
7. Rear Wheel Toe
   a. Definition
   b. Application to the automobile
   c. Effect of rear wheel toe on vehicle driving characteristics
   d. Effect of rear wheel toe on tire wear
   e. Methods of adjustment or correction
   f. Tube axle
   g. Independent suspension
   h. Specifications and practical limits
   i. Measuring devices and procedures

8. Rear Wheel Track
   a. Definition
   b. Application to the automobile
   c. Effect of rear wheel tracking on vehicle driving characteristics
   d. Effect of rear wheel tracking on tire wear
   e. Methods of correction
   f. Tube axle-leaf spring
   g. Tube axle-coil spring
   h. Independent suspension
   i. Specifications and practical limits
   j. Measuring devices and procedures

9. Wheel Base Dimensions
   a. Front suspension members
   b. Rear suspension
   c. Standard rear axle
   d. Independent suspension

10. Specifications
    a. Information sources
    b. Practical limits

11. Measuring procedures

12. Correction procedures
    a. Check and adjust caster - camber - toe-in
    b. Check turning radius
    c. Check and adjust toe-in
    d. Check frame
E. Differentials - Rear Axle

1. Differential
   a. Types and identification
   b. Construction, function and lubrication
   c. Ratios - torque

2. Differential adjustments - methods
   a. Pinion depth bearing preload
   b. Tooth patterns - backlash
   c. Axle bearing adjustments

3. Trouble shooting differentials
   a. Road test
   b. Locate gear and bearing noises

XI. AIR CONDITIONING

A. Basic Air Conditioning Theory

1. Nature of heat
   a. Sensation of heat
   b. Degree of heat - absolute zero - 459.6°F
   c. Quantity of heat
   d. Radiant heat

2. Principle of heat transfer
   a. Measurement of heat - BTU's
   b. Conduction
   c. Convection
   d. Radiation

3. Change of state
   a. Evaporation
   b. Condensation
   c. Latent heat
   d. Latent heat of evaporation
   e. Latent heat of condensation

4. Refrigerants
   a. R 12
   b. R 22
   c. Safety precautions
5. Pressure
   a. Atmospheric pressure
   b. Relation of pressure and temperature

6. Vacuum theory

7. Basic principles of refrigeration theory
   a. Principle of operation
   b. Low pressure side and components
   c. High pressure side and components

8. Air Conditioning system components theory
   a. Dehydrator and receiver
   b. Thermostatic expansion valves
   c. Evaporator
   d. Compressor
   e. Condenser
   f. Refrigerant R-12
   g. Magnetic clutch
   h. Temperature control valves and devices
   i. Air conditioning hoses

9. Trouble-shooting, diagnosis and servicing
   a. No cooling
   b. Improper air flow
   c. Compressor noise
   d. Connecting and reading manifold gauges
   e. Charging air conditioning system
   f. Evacuating the system
   g. Purging the system
   h. Testing air conditioning system for leaks
      1) Propane leak detector
      2) Electronic leak detector
   i. Discharging air conditioning system
   j. Checking compressor oil levels

10. Performance Testing the system
    a. Connecting and reading manifold gauges
    b. Adjusting controls
XII. EMISSION CONTROLS

A. Introduction to Emission Controls
   1. Air Pollution - cause and effect
      a. HC, CO, NO_x, O_3, defined and explained
   2. Sources of emissions and pollution
      a. Nature
      b. Manmade
         1) Industry
         2) Home
         3) Vehicles
   3. Laws and regulations
      a. Federal
      b. State and local
   4. Sources of vehicle emissions
      a. Crankcase
      b. Fuel system
      c. Exhaust system

B. Emission Control Systems
   1. Crankcase emission controls
      a. Road draft tube
      b. PCV system
   2. Types of PCV Systems
      a. Open PCV system
      b. Open PCV system (California type)
      c. Closed PCV system
   3. Operation of PCV valve
      a. Starting mode
      b. Idle mode
      c. Moderate speed mode
      d. Heavy load mode
   4. PCV System Testing and Service
      a. Quick-check of PCV (tach. method)
      b. PCV ram type tester
      c. A.C. PCV system tester
      d. Replacing PCV valve
      e. Cleaning PCV system (filters, hoses)
      f. Inspection of PCV system
      g. Service and testing
C. Exhaust Gas Emission Control System

* 1. Fuel Feed System
   a. Carburetor designs
   * b. Idle limiters
   * c. Idle stop limiters
   d. Idle speed solenoids
   e. Deceleration throttle controls
   f. Vacuum breaks (choke)
   * g. Electric chokes
   h. Staged choke pulldown

2. Combustion Changer and Manifold
   a. Camshafts overlap
   b. Valves, ports and valve arrangements
   c. Intake manifold design
   d. Quench area
   e. Compression ratio modification and effect.
   f. Cooling system temperature
   g. Service and testing

* 3. Ignition System Controls
   a. Spark control conventional ignition system
   * b. Spark control electronic ignition system
   * c. Electronic ignition system
     1) Reason and results
     d. Temperature switches
     * e. Transmission switches
     f. Ported vacuum applications
     g. Speed sensors
     h. Solenoids
     i. Time relays
     j. Temperature relays
     k. Spark relay valves
     l. Solenoid control vacuum advance units
     m. Service and testing
D. Evaporative Emission Control System

* 1. Thermostatic Air Cleaners
   a. Principle and purpose
   b. Component parts
      1) Manifold shroud
      2) Flex connector
      3) Vacuum motor
      4) Heat control door
      5) Thermal vacuum valve
      6) Vacuum lines
   c. Testing and Service
      1) Inspect, clean or replace components
      2) Correct temperature of operation

2. Fuel Evaporative System
   a. Fuel tank
   b. Tank venting
   c. Liquid vapor separators
   d. Fuel line
   e. Carbon canister
   f. Carburetor bowl venting
   g. Service and testing
      1) Filters and lines
      2) Components

E. Air Injection System

* 1. System Components
   a. Air pump
   b. Air delivery and check valves
   c. Pressure relief valves
   d. Gulp valves
   e. Diverter valve
   f. Service and testing

F. Exhaust Gas Recirculation System

* 1. EGR Valve
   2. Coolant Temperature Switches
   3. Low and high temperature vacuum signal
   4. Service and testing
G. Catalytic Converters

1. Construction
   a. Pellet type
   b. Monolithic type

2. Chemical principle

3. Service and Testing

NOTE: The Emission Control Systems with an * have also been included in their appropriate job skill divisions.

XIII. MANUAL METAL ARC

A. Safety
   1. Personal
   2. Equipment
   3. Area

B. Manual Metal Arc Process
   1. Fusion (coalescence)
      a. Electric Arc
         1) Circuit
         2) Welding arc

C. Power Sources
   1. Alternating current (AC)
   2. Direct current (DC)
      a. DC reverse polarity
      b. DC straight polarity
   3. Types
      a. Motor generator sets; rectifiers; others
      b. Uses
   4. Associated equipment

D. Electrodes
   1. Identification
      a. Types
      b. Uses
      c. Polarity
      d. Positions
E. Base Materials

1. Types
   a. Ferrous
   b. Non-ferrous

2. Weldability
   a. Electrode types
   b. Procedures

F. Fundamentals

1. Current settings
   a. Amperage

2. Length of arc
   a. Voltage

3. Angle of Electrode

4. Rate of travel

XIV. GAS WELDING - AUTOMOTIVE APPLICATION

A. Safety

1. Personal
2. Equipment
3. Area

B. Fundamentals

1. Tip size
   a. Pressure
   b. Flames

2. Tip and flame distance

3. Torch angles

4. Rate of travel
   a. Filler wire deposit

5. Flux

C. Oxy-Acetylene Welding

1. Fusion created by heat of flame
   a. Types of flames
D. Brazing

1. Diffusion and alloying of filler material
   a. Filler-lower melting point than B/M
   b. Types of flames

E. Equipment

1. Regulators
   a. Types
2. Gases
3. Torches
   a. Types
4. Hoses
5. Fluxes
   a. Purpose
6. Filler
   a. Welding
   b. Brazing
7. Associated

F. Base Materials

1. Type B/M
   a. Flames adjustment
   b. Filler rod
   c. Flux