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ABSTRACT

Instructional materials are provided for a small gas engine course. A list of objectives appears first, followed by a list of internal parts and skills/competencies related to those parts for engine work, ignition and electrical systems, fuel system, crankcase lubrication system, arc welding skills, and gas welding skills. Outlines are provided for the 10 units in this course. The topics covered include opportunities in the small gas engine field, shop safety and regulations, small gas engine nomenclature, tools used in small gas engine repair, principles of operation, ignition and electrical systems used in small gas engines, fuel systems, small gas engine cooling and lubricating systems, arc welding, and gas welding. (YLB)

SMALL GAS ENGINE Repair

DIVISION OF VOCATIONAL-TECHNICAL SCHOOLS

CONNECTICUT DEPARTMENT OF EDUCATION

1983-1984

SCHOOL_____

INSTRUCTOR_____

SHOP_____GRADE_____

CONNECTICUT STATE DEPARTMENT OF EDUCATION
Division of Vocational-Technical Schools
Hartford

0392Y

OBJECTIVES
SMALL GAS ENGINE COURSE

1. To develop an understanding for the importance of safe work habits.

2. To develop the ability to correctly use and care for all tools and equipment related to small gas engines.

3. To encourage professionalism and pride.

4. To develop the ability to logically apply a step by step procedure to all shop and classroom problems.

5. To develop entry level knowledge and skills to aid in gainful employment.

INTERNAL PARTS

Engine work

- Degrease block
- Remove head and gasket
- Remove ring ridge
- Remove piston assembly
- Remove rings
- Check ring grooves
- Check ring side clearance
- Check ring gap
- Check piston wrist pins
- Check connecting rod
- Check crank pin bearing
- Check piston
- Measure cylinder wall
- Deglaze cylinder
- Hone cylinder
- Cross hatch cylinder
- Check crankshaft end play
- Check crank drive end journal
- Check crank pin journal
- Check crank, magneto end journal
- Check camshaft end play
- Check camshaft journals
- Check camshaft lobes
- Check bearings
- Remove and replace oil seals
- Remove and replace plain bearing
- Remove valves
- Measure valves
- Reface valves
- Measure valve seats
- Reface valve seats
- Replace valve seats
- Check valve tappet clearance
- Adjust valve tappet clearance
- Check valve guides
- Replace valve guide bushings
- Check plunger bushings
- Wash block (free of all metal filings)

Ignition and Electrical Systems

- Check spark
- Gap spark plug
- Check primary and secondary coil windings
- Remove flywheel
- Check condensor
- Remove and replace points

Ignition and Electrical Systems (Continued)

- Check plunger
- Check and replace plunger bushing
- Check magnets
- Adjust breaker point gap
- Adjust armature air gap
- Check flywheel key
- Check magnetron
- Solid state system
- Retrofit solid state ignition systems
- Ignition time engine
- Check battery, specific gravity
- Clean battery terminals
- Clean battery cables
- Charge battery
- Check starter draw
- Check voltage drop in starting circuit
- Remove starter
- Test starter fields
- Check starter solenoid
- Check starter armature
- Test charging circuit
- Test generator armature
- Test voltage regulator
- Test alternator
- Test diodes
- Check rotor
- Check stator

Fuel System

- Remove and replace fuel filters
- Remove and clean gas tanks
- Remove and repair fuel pumps
- Remove and repair float carburetors
- Remove and repair diaphragm type carburetors
- Remove and repair suction lift carburetors
- Check governor
- Adjust governor
- Remove and repair governor
- Remove and service the oil-bath
- Type air cleaner
- Remove and service the oiled-filter air cleaner
- Remove and service the dry type air cleaner
- Remove and service the sediment bowel
- Adjust carburetor choke valve
- Adjust the high speed load valve
- Adjust the idle valve
- Adjust idle speed stop screw

Crankcase Lubrication System

- Drain oil
- Remove and service oil pump
- Remove and replace oil seals
- Remove and replace gaskets
- Check for leakage
- Replace crankcase oil

Arc Welding Skills

- Strike an arc
- Select proper electrode
- Select proper polarity
- Select proper amperage
- Weld preparation
- Run a flat bead
- Remove slag
- Butt weld
- Tee weld
- Multiple pass weld
- Padding
- Lap weld
- Test plate
- Horizontal weld
- Vertical weld
- Cutting

Gas Welding skills

- Install regulators
- Test for leaks
- Set heating pressure
- Set neutral flame
- Puddling
- Butt weld
- Tee weld
- Butt weld with filler rod
- Single V joint
- Track welding
- Metal preparation
- Forehand weld
- Backhand weld
- Brazing
- Cutting set up
- Cutting
- Piercing

UNIT I: Opportunities in the Small Gas Engine Field

A. Types of jobs available
   1. Sales
   2. Service
   3. Parts
   4. Dwnership
   5. Design and Enginering

B. General working conditions
   1. Hours
   2. Uniforms
   3. Salaries
   4. Ability to work with others

C. Training
   1. Math skills
   2. Power mechanics
   3. Metal working
   4. Welding
      a. Stick
      b. gas
   5. Public speaking
   6. English
   7. Factory sponsored schools

D. Uses of small gas engines
   1. Lawn mowers
   2. Garden tractors
   3. Chain saws
   4. Pumps
   5. Portable power equipment
   6. Agricultural uses
   7. Industrial uses
   8. Recreational uses
   9. Portable refrigeration units
   10. Marine field

UNIT II: Shop Safety and Regulations

A. Personal safety
   1. Safety glasses
   2. Shop coats
   3. Proper shoes
   4. Loose clothing

B. Shop safety
   1. Gasoline and oil storage
   2. Waste rag disposal
   3. Procedure if fire occurs in shop
   4. Safety with hand tools
   5. Safety with power tools
   6. Shop clean up procedures
   7. Good shop habits
   8. Safety concerning fellow workers

C. Classroom regulations
   1. Starting time
   2. Break time
   3. Lunch time
   4. Dismissal time
   5. Attendance requirements

D. Equipment usage safety
   1. Safety guards
   2. Safety checks on equipment
   3. Using proper specifications

E. Manual usage
   1. Usage of parts books
   2. Usage of specification charts
   3. Usage of repair assembly manuals

UNIT III: Small Gas Engine Nomenclature

A. Terms common to the small gas engine industry

1. Additive
2. Air cleaner
3. Air fuel ratio
4. Air gap
5. Air horn
6. Alternator
7. Anti-clockwise rotation
8. Atmospheric pressure
9. Atomize
10. Backfire
11. Backlash
12. Backpressure
13. B.H.P. break horse power
14. Before-dead-center
15. Blow-by
16. Bore (cylinder)
17. Boring bar
18. Boss
19. Breaker arm (contact)
20. Breaker point (contact)
21. Break-in
22. Burnish
23. Bushing
24. By-pass
25 Calibrate
26. Cam
27 Cam angle
28. Cam ground piston
29. Cam shaft
30. Carbon
31. Carburetor

32. Centrifugal force
33. Chamfer
34. Choke
35. Clutch
36. Combustion
37 Compression
38. Compression ratio
39. Condenser
40. Connecting rod
41. Counterbore
42. Counterweight
43. Crankshaft
44. Cycle
45. Cylinder block
46. Cylinder head
47. Cylinder sleeve
48. Dead center
49. Detonation
50. Diaphragm
51. Die
52. Direct drive
53. Displacement
54. Dog clutch
55. Dowell pins
56. Down-draft
57. Drive fit
58. Dwell
59. Dynomometer
60. Eccentric
61. End play
62. Engine displacement
63. Feeler gauge
64. Filter
65. Fin

66. Float
67. Floating piston pin
68. Float level
69. Flutter or bounce
70. Flywheel
71. Foot pound
72. Four-cycle engine
73. Gasket
74. Gear
75. Gear ratio
76. Generator
77. Glaze breaker
78. Governor
79. Growler
80. High-test gasoline
81. Hone
82. Horsepower
83. Idle
84. Ignition
85. Internal combustion
86. Jet
87. Journal
88. Key-keyway
89. Knock
90. Knurl
91. Lands
92. Lap
93. Liner
94. Linkage
95. Load
96. Lost motion
97. Magneto
98. Mesh
99. Micrometer

100. Miss
101. Mono-block
102. Muffler
103. Nozzle
104. Octane number
105. Oil pumping
106. Orifice
107. Out of round
108. Outside diameter (O.D.)
109. Overhead valve or valve-in-head engine
110. Pawl
111. Phillips screw or screwdriver
112. Piston
113. Piston collapse
114. Piston pin
115. Piston ring
116. Piston ring expander
117. Piston ring gap
118. Pitted
119. Poppet valve
120. Port
121. Preignition
122. Preloading
123. Press fit
124. Race
125. Ratio
126. Resistance (electrical)
127. Retard
128. Ridge
129. Ring gap
130. Ring gear
131. Rotary valve
132. SAE
133. SAE thread

134. Saybolt test
135. Scoring
136. Seat
137. Seizing
138. Shear
139. Shim
140. Shrink-fit
141. Skirt
142. Sleeve
143. Sludge
144. Solvent
145. Spark advance
146. Spark gap
147. Spark plug
148. Spline
149. Standard thread
150. Stroke
151. Stud
152 Tachometer
153. Tappet
154. Throw
155. Thrust
156. Timing gears
157. Tolerance
158. Top-dead-center
159. Torque
160. Torque wrench
161. Troubleshooting
162. Tune-up
163. Two-cycle engine
164. Vacuum
165. Valve
166. Valve clearance

167. Valve grinding
168. Valve overlap
169. Valve seat
170. Vanes
171. Venturi
172. Volumetric efficiency
173. Work
174. Wrist pin

UNIT IV: Tools Used in Small Gas Engine Repair

A. Repair tools

1. 3/8 socket set
2. Combination wrench set
3. Punch set
4. Screwdriver set
5. Torque wrench
6. Mallet set
7. Impact driver
8. Feeler gauges
9. Valve spring compressor
10. Briggs spark tester
11. Breaker plunger gauge
12. Plunger bushing counter bore reamer
13. Plunger bushing driver
14. Needle nose pliers
15. Compression tester
16. Cylinder hone
17. Parts cleaner
18. Plunger bushing finish reamer
19. Valve guide bushing counter bore reamer
20. Valve guide bushing driver
21. Valve guide bushing finish reamer
22. Flywheel puller
23. Ring compressor
24. Starter clutch wrench
25. Valve guide reject gauge
26. Flywheel holder
27. Reamer guide bushing
28. Service manuals

B. Measuring Tools
    1. Torque wrench
    2. Telescoping gauge
    3. Dial caliper
    4. Tachometer
    5. V.O.A. meter
    6. Micrometer set
    7. Coil Tester (condensor)

C. Tool care
    1. Tool racks
    2. Tool boxes
    3. Work benches
    4. Clean all tools

UNIT V: Principles of Operation

THEORY

A. Four stroke cycle engine - principles of operation
    1. Intake
    2. Compression
    3. Power
    4. Exhaust
B. Valve movement
    1. Valves
    2. Valve train
    3. Valve timing
C. Piston displacement
    1. Explanation
    2. Determining displacement
D. Two stroke cycle engine - principles of operation
    1. Intake
    2. Compression
    3. Power
    4. Exhaust

UNIT VI: Ignition and Electrical Systems Used in Small Gas Engines

A. Ignition system types
    1. Magneto ignition system
    2. Solid state ignition system
    3. Magnetron ignition system
    4. Battery ignition system

B. Magneto ignition system
    1. Points
    2. Plug
    3. Condensor
    4. Coil
    5. Flywheel magnet
    6. Flywheel key
    7. Spark plug

C. Solid state ignition system
    1. Coil
    2. Rectifier
    3. Capacitor
    4. Pulsation transformer
    5. Spark plug
    6. Flywheel magnet
    7. Flywheel key

D. Manetron ignition system
    1. Coil
    2. Magnetron ignition module
    3. Flywheel magnet
    4. Flywheel key (aluminum)

E. Battery components
    1. Plates
    2. Electrolyte solution
    3. Casing
    4. Caps

F. How the battery works
    1. Charging action
    2. Discharging action
    3. Specific gravity
    4. Differ in Temp (Causes)
G. Types of charging
    1. Trickle charge
    2. Slow charge
    3. Fast charge
    4. Booster charge
H. Basic electrical circuits
    1. Charging circuit
    2. Cranking circuit
I. Generator components
    1. Brushes
    2. Commutator
    3. Armature
    4. Pole shoes
    5. Field coils
    6. Bearings
    7. End frame assemblies
    8. Housing
    9. Alternator
J. Principles of generator operation
    1. Magnetic principles
    2. Brush and commutator action
K. Purpose of the starter
    1. Magnetic principles
    2. Function and construction of switches
        a. Solenoid
        b. Magnetic
    3. Function and construction of starter drives
        a. Bendix
        b. Gear reduction-type drives

UNIT VII: Fuel Systems

A. Carburetion
    1. Atmospheric pressure
    2. Venturi
    3. Air foil

B. Carburetor types
    1. Gravity fed
    2. Diaphragm - type carburetors
    3. Suction fed
    4. Pressurized fuel systems

C. Carburetor parts
    1. Vented tank
    2. Choke
    3. Idle valve
    4. Fuel pump
        a. Electric
        b. Vacuum
        c. Mechanical
    5. Jetts
    6. Float
    7. Venturi
    8. Diaphragm
    9. Reed valves
    10. Fuel filter
    11. Air filter
        a. Dry type
        b. Oil bath

D. Engine speed - Govenors
    1. Mechanical or centrifugal
    2. Pneumatic or air vane

UNIT VIII: Small Gas Engine Cooling and Lubricating Systems

A. Cooling systems
   1. Air cooled system
      a. Cylinder baffle
      b. Cooling fins
      c. Shroud
      d. FLywheel blower
      e. Intake screen
   2. Water cooled system (outboard engine)
      a. Water jacket
      b. Water pump
      c. Thermostat
      d. Pressure control valve
      e. Heat exchanger

B. Lubrication systems
   1. Four cycle engine oil system
      a. Oil dipper
      b. Oil slinger
      c. Oil ejection pump
   2. Two cycle engine oil system
      a. Fuel-oil-air mixture
   3. Oil Spec. and SAE standards

UNIT IX: ARC Welding

A. Safety

B. Arc welding components and their function

1. Current source
2. Ground cable
3. Electrode cable
4. Electrode
5. Electrode holder
6. Welding helmet
7. Welding gloves
8. Chipping hammer
9. Wire brush
10. Coveralls
11. Welder's cap

C. Terms used in Arc Welding

1. Arch
2. Fusion
3. Amperes
4. Volts
5. Current
6. Ground
7. AC
8. DC
9. Penetration
10. Undercutting
11. Crater
12. Spatter
13. Porosity
14. Slag inclusion
15. Arc Blow
16. Polarity
17. Welding position
18. Arc length
19. Speed of travel
20. Bead
21. Fillet
22. Single Bevel
23. Magnetic field
24. Tensile strength
25. Compressive strength
26. Electrode
27. Flux
28. Slag
29. Ultra violet
30. Infra red

D. Factors that determine weld quality

1. Amperage
2. Length of arc
3. Speed of travel
4. Position of the electrode

E. Factors that determine proper machine adjustment

1. Length of wleding cable
2. Thickness of metal
3. Diameter of electrode
4. Welding technique used by operator
5. Efficiency of the machine
6. Polarity of machine
7. Welding position

F. Reasons for removing slag

1. Permits better fusion
2. Prevents gas pockets

G. Selecting proper electrodes

1. Aws classification
2. Electrode diameter
3. Tensile strength
4. Compressive strength

UNIT X: Gas Welding

A. Safety

B. Industrial gases
   1. Oxygen
   2. Acetylene
   3. Propane
   4. Natural Gas
   5. Mapp
   6. Proplyene Based Gases

C. Oxy Fuel apparatus
   1. [illegible]linders
   2. [illegible]ulators
   [illegible]ose
   4. Welding torch
   5. Welding tip
   6. Heating tip

D. Welding procedures
   1. Preparing the metal
   2. Lighting the torch and adjusting the flame
   3. Starting the weld
   4. Forehand and backhand

E. Oxyfuel cutting operation
   1. Set up
   2. Tip selection
   3. Travel speed
   4. Quality cuts
   5. Piercing

F. Terms

1. Acetylene
2. Regulator
3. Aws
4. Bead
5. Bevel
6. Blowpipe
7. Braze weld
8. Carburizing
9. Cone
10. Filler rod
11. Flux
12. Mapp
13. Neutral flame
14. Oxidizing flame
15. Puddle
16. Stress relieving
17. Tensile strength
18. Tinning
19. Soldering