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ABSTRACT

This course outline provides major appliance repair students with a fundamental knowledge of waterheaters and dishwashers, and is intended to guide their performance of duties as technicians. Covering the complete electrical and mechanical functions of heaters and dishwashers, the course outline includes goals, specific block objectives, orientation, basic plumbing techniques (pipes, tubing, fittings, soldering), water heaters, dishwashers (types, operations, installation, components, service procedures), overhaul and repair of waterheaters and dishwashers, post-test, and a bibliography. The appendix contains post-test samples. (NH)

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AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

V-90

DADE COUNTY PUBLIC SCHOOLS

Course Outline
APPLIANCE REPAIR - BEGINNING - 9023
(Waterheaters and Dishwashers)
Department 48 - Quin 9023.04

DIVISION OF INSTRUCTION • 1973

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DADE COUNTY PUBLIC SCHOOLS
1450 NORTHEAST SECOND AVENUE
MIAMI, FLORIDA 33132

Course Outline

APPLIANCE REPAIR - BEGINNING - 9023
(Waterheaters and Dishwashers)

Department 48 - Quin 9023.04

county office of
VOCATIONAL AND ADULT EDUCATION

THE SCHOOL BOARD OF DADE COUNTY

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Dr. E. L. Whigham, Superintendent of Schools
Dade County Public Schools
Miami, Florida 33132

February, 1973

Published by the School Board of Dade County

Course Description

9023	48	9023.04	Waterheaters and Dishwashers
State Category Number	County Dept. Number	County Course Number	Course Title

This quinmester course includes installation of waterheaters, (gas and electric) waterheater malfunctions and repairs, operation and troubleshooting repairs to dishwashers. Shop related jobs will also be included. This is a one or two quinmester credit course.

Indicators of Success: Prior to entry into this course, the vocational student will display mastery of the skill indicated in Electrical Components and Appliance Circuitry (9023.03)

Clock Hours: 45, 90

PREFACE

The following quinmester course number 9023.04 is presented to provide the "Major Appliance Repair" student with a fundamental knowledge of waterheaters and dishwashers. It is intended to guide the student in the performance of the duties of a waterheater and dishwasher technician.

It covers the complete electrical and mechanical functions of all heaters and dishwashers. It provides for detailed safety instructions in the manipulative method of lesson work.

The student keeps a detailed notebook for all related lessons. The course utilizes audiovisual aids as well as related and manipulative skills and techniques.

This course is taught as a one hour block (45 clock hours) or a two hour block (90 clock hours). In each instance, the course outline consists of six individual blocks. However, the two hour class permits the student to cover each block in more detail and also allows for additional time to practice and increase his skills.

This outline was developed through the cooperative efforts of the instructional and supervisory personnel, the Quinmester Advisory Committee, and the Vocational Curriculum Materials Service, and has been approved by the Dade County Vocational Curriculum Committee.

TABLE OF CONTENTS
with Suggested Hourly Breakdown

GOALS

The student must be able to:

1. List and identify the different components.
2. Describe the various narts and functions of waterheaters and dishwashers.
3. Identify electrical circuits and describe their purpose in detail.
4. Demonstrate skills by repairing and replacing components.
5. Demonstrate proper techniques while diagnosing and servicing waterheaters and dishwashers.
6. Work well with others and prepare for the world of work as a competent waterheater and dishwasher technician.
7. Satisfactorily complete the quinmester post-test.

SPECIFIC BLOCK OBJECTIVES

BLOCK I - ORIENTATION

The student must be able to:

1. Orally state the principles of basic electricity and its applications to the Major Appliance Service field.
2. Work in a safe and responsible manner by himself and around others, demonstrating his knowledge and understanding of all school and shop safety rules.

BLOCK II - BASIC PLUMBING TECHNIQUES

The student must be able to:

1. Identify, select, and describe the purposes of the various types of pipe and tubing used in waterheaters and dishwashers.
2. Measure, cut and thread pipes for application in waterheaters and dishwashers, using a variety of accepted methods.
3. Bend copper tubing, without kinking, using free-hand and bending springs.
4. Use the proper fittings to join pipes, and tubing, so as to result in water-tight joints.
5. Prepare work for soldering, and employ the appropriate soldering technique when joining pipes and fittings with hard, medium, or soft solder.

BLOCK III - WATERHEATERS

The student must be able to:

1. Explain and describe the principles and methods of operation of gas and electric waterheaters.
2. Install, post-check, and demonstrate gas and electric waterheaters.
3. Diagnose, trace, and isolate equipment malfunctions using appropriate testing instruments and techniques.

BLOCK IV - DISHWASHERS

The student must be able to:

1. Explain and discribe the principles and methods of operation of dishwashers.
2. Install, post-check, and demonstrate portable and built-in dishwashers.
3. Diagnose, trace, and isolate dishwasher equipment malfunctions using appropriate testing equipment and techniques.

BLOCK V - OVERHAUL AND REPAIR OF WATERHEATERS AND DISHWASHERS

The student must be able to:

1. Remove and replace, in an orderly procedure, electrical and mechanical dishwasher components in order to make operative a formerly inoperative appliance.
2. Disassemble a rebuildable dishwasher component, identify worn or defective parts, replace them and reassemble the component to an operable condition.

BLOCK VI - QUINMESTER POST-TEST

The student must be able to:

1. Satisfactorily complete the quinmester post-test.

Course Outline

APPLIANCE REPAIR - BEGINNING - 9023
(Waterheaters and Dishwashers)

Department 48 - Quin 9023.04

I. ORIENTATION

A. Introduction
1. Types of water heating appliances
a. Hot water heaters
b. Dishwashers
2. Past, present, and future water heating appliances
a. Early water heating appliances
b. Present water heating appliances
c. Sonic water heating
d. Atomic energy as a water heating source

B. Student Responsibilities
1. Safety rules and regulations
a. Engage in no horseplay
b. Always wear goggles where required
c. Work safely with others
d. Take nothing for granted
e. Know the safety precautions
f. Obey the instructors orders
2. Shop rules
a. Clean all water spills immediately
b. Obey all rules and regulations
c. Take care of equipment and tools
d. Avoid all hazardous operations

C. Course Benefits
1. Career opportunities
a. Installer
b. Field technician
c. Shop technician
d. Service manager
e. Factory representative
2. Learning and improving basic techniques and skills
a. Proper use of testing meters
b. Preper use of tools
c. Identification of tools
d. Interpretation of electrical schematics

II. BASIC PLUMBING TECHNIQUES

A. Pipes and Tubing
1. Types
a. Rigid
(1) Galvanized pipe
(2) Gas pipe
(3) Brass pipe
(4) Copper pipe

b. Flexible
(1) Copper tubing
(2) Brass flex-line

2. Cutting, threading, and bending
a. Selecting the proper diameter pipe
b. Measuring and cutting
(1) Using a hacksaw
(2) Using a pipe or tubing cutter
c. Threading pipes
(1) Selecting the proper "die"
(2) Cutting the thread
d. Bending soft tubing
(1) Using bending springs
(2) Free-hand shallow bends
(3) Annealing copper tubing

B. Pipe Fittings
1. Types
a. Rigid pipe fittings
(1) Elbows and tees
(2) Unions and couplings
(3) Bushings, caps, and plugs
b. Soft pipe fittings
(1) Compression fittings
(2) Flared fittings
(3) Swaged fittings
2. Joining pipe to threaded fittings
a. Preparing pipe threads with compound and packing
b. Connecting the pipe to the fitting
c. Using a "pipe" wrench to secure the joint
3. Joining soft tubing to compression type fittings
a. Preparing tubing for a compression fitting
b. Using a flaring block and yoke on tubing
c. Connecting pipes to the fittings
4. Swaging soft tubing
a. Preparing the tubing for swaging
b. Using a flaring block and swaging punch
5. Checking for leaks
a. Methods of checking for water leaks
b. Methods of checking for gas leaks
c. Methods of checking to avoid

C. Sweat Soldering
1. Types of solder
a. Soft solder (low heat, approximately 350° F.)
b. Medium soft solder (medium heat, approximately 600° F.)
c. Hard solder (high heat, approximately 1200° F.)
2. Soldering flux
a. Acid
b. Rosin
c. Silver flux

3. The soldering torch
   a. The propane torch
   b. The acetylene torch
   c. Torch tips and flame spreaders
   d. Igniting the torch
4. Techniques of sweat soldering
   a. Cleaning the work
   b. Applying the flux
   c. Joining the tubing to the fitting or swaged tube
   d. Applying the flame to the joint
   e. Feeding the solder to the joint
   f. Cleaning the finished joint
   g. Checking for leaks

III. WATER HEATERS

A. Types
   1. Gas waterheaters
      a. Principles of operation
      b. Gas heaters
         (1) Main burner
         (2) Pilot
         (3) Safety circuits
   2. Electric waterheaters
      a. Principles of operation
      b. Electric heater elements
         (1) Single element
         (2) Dual elements
         (3) Safety circuits
   3. Methods of operation

B. Installation
   1. Installing the waterheater
      a. Connecting to plumbing
      b. Electrical connections
         (1) 120 volt service
         (2) 240 volt service
   2. Post-check and demonstration
      a. Checking for leaks
         (1) Water leaks
         (2) Gas leaks (for gas type heaters)
      b. Checking for normal operation
      c. Demonstrating method of igniting pilot light
      d. Explaining operation of circuit breakers

C. Service Procedures
   1. Diagnosing trouble
      a. Interpreting symptoms
      b. Isolating a suspected area

2. Trouble analysis and testing
   a. Checking a circuit
      (1) Using a testlamp
      (2) Using a meter
   b. Locating the defective component or circuit
3. Servicing the gas burner unit
   a. Checking the main burner
   b. Checking the pilot assembly

IV. DISHWASHERS

A. Types
   1. Dual function pump dishwasher
      a. In recirculation
      b. In drain
   2. Dual pump dishwasher
      a. In recirculation
      b. In drain
   3. Loading
      a. Top loading
         (1) Portable
         (2) Convertible
      b. Front loading
         (1) Under the counter
         (2) Portable
         (3) Convertible

B. Operations
   1. Principles of operation
   2. Cycles of operation
      a. Fill
      b. Pre-rinse
      c. Wash
      d. Drain
      e. Dry
   3. Methods of operation
      a. Single pump type
      b. Dual pump type

C. Installation
   1. Installing the dishwasher
      a. Connecting to plumbing
      b. Electrical connections
   2. Demonstration
      a. Explaining the cycles
      b. Proper loading
      c. Avoiding stains
   3. Post-check
      a. Checking for water leaks
      b. Checking for normal operation

D. Dishwasher Components
   1. Operating components
      a. Pumps
      b. Motors
      c. The fill valve
      d. Water heat booster
      e. Spray arms
   2. Control components
      a. Timers
      b. Cycle selectors
      c. Solenoids
      d. Relays

E. Service Procedures
   1. Diagnosing trouble
      a. Interpreting symptoms
      b. Isolating a suspected area
   2. Trouble analysis and testing
      a. Checking circuits
         (1) Using a testlamp
         (2) Using a meter
      b. Locating the defective component or circuit
      c. Using a wiring diagram in circuit tracing

V. OVERHAUL AND REPAIR OF WATERHEATERS AND DISHWASHERS

A. Removing and Replacing Components
   1. Electrical components
      a. Heaters
      b. Solenoids
      c. Electric motors
      d. Relays
      e. Timers and switches
      f. Thermostats
   2. Mechanical components
      a. Pumps
      b. Valves
      c. Spray arms
      d. Gaskets and seals

B. Repairing Components
   1. Rebuilding a valve
   2. Rebuilding a pump
   3. Replacing a motor start switch
   4. Aligning a door or lid
   5. Adjusting the soap cups

C. Gas Burner Assemblies
   1. Removing and replacing the burner assembly
   2. Disassembling and reassembling the burner assembly
   3. Cleaning and replacing pilot orifices

VI. QUINMESTER POST-TEST

BIBLIOGRAPHY
(Waterheaters and Dishwashers)

Basic References:

1. Olivio, Thomas C. and Marsh, Waver R. Principles of Refrigeration. Albany, New York: Delmar Publishing Company, 1964. Pp 358.

2. Marcus, Abraham. Basic Electricity. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., Pp 142, 163, 175, 184.

Manufacturers' Manuals:

3. Use and Care of Test Instruments. Booklet G-5, #828439, La Porte, Indiana: Whirlpool Corporation.

4. How to Read A.S.A. Wiring Diagrams. Booklet G-3, #Y32.2, La Porte, Indiana: Whirlpool Corporation.

Audio Visual Aids:

Filmstrips and Cassettes:

1. Use and Care of Test Instruments. Filmstrip G-5, Whirlpool Corporation. #828440

2. Use and Care of Test Instruments. Cassette Tape Whirlpool Corporation. #828459

A P P E N D I X

Quinmester Post-Test Samples

QUINMESTER POST-TEST

Name_____ Date_____ Score_____

I. TRUE-FALSE

_____ 1. All dishwashers are alike.

_____ 2. To sweat solder we use silver solder.

_____ 3. All waterheaters operate on 220 volts.

_____ 4. Some dishwasher waterheaters operate on 110 volts.

_____ 5. A no drain complaint might be a bad pump.

_____ 6. Most dishwashers have a water safety switch.

_____ 7. All waterheaters have pressure safety valves.

_____ 8. All waterheaters have adjustable thermostats.

_____ 9. You may install a waste line before the trap.

_____ 10. A dishwasher is connected to a cold water line.

_____ 11. A timer controls the cycle of a waterheater.

_____ 12. A gas hot water heater requires a vent.

_____ 13. Most gas heaters have a manual pilot light.

_____ 14. All hot water heaters have a cold water inlet.

_____ 15. Some dishwashers sterilize what they wash.

QUINMESTER POST-TEST

Name_____ Date_____ Score_____

II. COMPLETIONS

1. A _____ controls the cycles of a dishwasher.
2. A _____ switches the motor from start to run on many dishwashers.
3. A water _____ switch controls the amount of water.
4. A motor _____ _____ saves the motor from over-heating.
5. A 50-50 solder requires _____ degress temperature for it to melt.
6. Soft solder will not flow if there is any _____ in the pipe or tubing.
7. All electrical appliances should be properly _____ for safety.
8. Special _____ are used to wash dishes.
9. Most boiler safety valves blow at a pressure of _____ pounds.
10. A defective hotwater heater element would give no _____.
11. A higher temperature set on the boiler would give _____ water.
12. Most dishwashers have a _____arm for washing.

QUINMESTER POST-TEST

Name_____ Date_____ Score_____

III. MULTIPLE CHOICE

1. A portable dishwasher is used because (a) it cleans faster, (b) it's cheaper to buy, (c) it uses less electricity, (d) it can be easily moved.

2. An undercounter dishwasher is usually (a) a top loader, (b) portable, (c) connected direct to plumbing, (d) none of these.

3. A gas hot water heater must have a (a) burner safety switch, (b) 220 volt element, (c) 30 amp fuse, (d) 110 volt supply.

4. The amount of time it takes to fill a dishwasher is controlled by the (a) pump, (b) water valve, (c) pressure switch, (d) water pressure.

5. If a hot water reaches a temperature of 212 degrees (a) the fuse would blow, (b) the safety valve would blow, (c) the heater would melt, (d) none of these.

6. Most of today's dishwashers can wash and (a) scrub the dishes, (b) sanitize and dry, (c) warm the dishes, (d) all of these.

7. All dishwashers require at least a (a) 1/2" water line, (b) 3/4" water line, (c) 3/8" water line, (d) 7/16" water line.

8. An electric hot water heater does not have to be (a) grounded, (b) soldered, (c) vented, (d) painted.

9. A gas hot water heater runs with (a) 220 volts, (b) 110 volts, (c) gas only, (d) electric only.

10. When a dishwasher timer motor is defective it (a) won't wash, (b) won't drain, (c) won't fill, (d) won't turn.

11. Temperature on a gas hot water heater is controlled by (a) a relay, (b) a timer, (c) solenoid, (d) thermostat.

12. A kinked drain hose would most likely result in (a) water continues to fill, (b) motor will not run, (c) heater will not heat, (d) water will not go out.

13. Most dishwasher inlet valves are (a) thermo valves, (b) single inlet valves, (c) free-flow valves, (d) three-coil non-thermo valves.

14. A broken impeller could stop the (a) pump, (b) timer, (c) valve, (d) switch.

15. Hot water heaters should be drained periodically because (a) of heat, (b) of rust, (c) of gas, (d) none of these.

ANSWER KEY TO QUINMESTER POST-TEST

I. TRUE-FALSE

1. False
2. False
3. False
4. True
5. True
6. True
7. True
8. True
9. False
10. False
11. False
12. True
13. True
14. True
15. True

II. COMPLETIONS

1. timer
2. relay
3. pressure switch
4. overload protector
5. 250°
6. water
7. grounded
8. detergent
9. 125 lb.
10. heat
11. hotter
12. swirl or spray

III. MULTIPLE CHOICE

1. d
2. c
3. a
4. d
5. b
6. d
7. c
8. c
9. c
10. d
11. d
12. d
13. b
14. a
15. b