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**IDENTIFIERS** Florida; \*Quinmester Program

**ABSTRACT**

This course outline provides students with an understanding of the observation of basic refrigeration system components, the techniques used in working with copper tubing, and practice demonstrations to show what they have learned. Course content includes specific block objectives, orientation, refrigeration components (evaporator, compressor, condensers, metering devices), refrigeration materials (tubing and fittings), servicing procedures, and a brief bibliography. A Quinmester post-test is followed by an appendix of post-test samples. (NH)

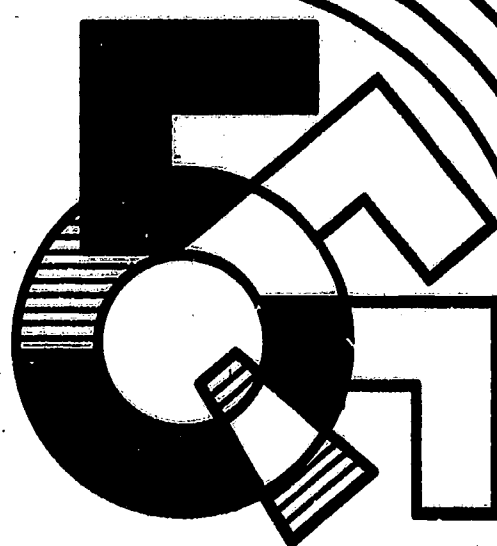
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**AUTHORIZED COURSE OF INSTRUCTION FOR THE**

**QUINMESTER PROGRAM**



**DADE COUNTY PUBLIC SCHOOLS**

U.S. DEPARTMENT OF HEALTH  
 EDUCATION & WELFARE  
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**Course Outline**  
**APPLIANCE REPAIR - ADVANCED - 9027**  
**(The Refrigeration System)**  
**Department 48 - Quin 9027.01**

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**DIVISION OF INSTRUCTION • 1973**

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Course Outline

APPLIANCE REPAIR - ADVANCED - 9027  
(The Refrigeration System)

Department 48 - Quin 9027.01

county office of  
VOCATIONAL AND ADULT EDUCATION

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**Dade County Public Schools**  
**Miami, Florida 33132**

**February, 1973**

**Published by the School Board of Dade County**

Course Description

<u>9027</u> State Category Number	<u>48</u> County Dept. Number	<u>9027.01</u> County Course Number	<u>The Refrigeration System</u> Course Title
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This quinmester course includes refrigeration components such as the evaporator, compressor and condenser, refrigeration tubing, including bending, swaging, flaring and soldering techniques. The course also includes basic evacuation and charging procedures. This is a two or three quinmester credit course.

Indicators of Success: Prior to entry into this course, the vocational student will display mastery of the skills indicated in Fundamentals of Refrigeration (9025.05) or Washing Machine: Circuitry and Trouble Analysis (9025.04).

Clock Hours: 90, 135

## PREFACE

The following pages contain the quinmester course outline entitled "The Refrigeration System." This quinmester course outline will provide the student with an understanding of the observation of the basic components of a refrigeration system and will also introduce the learner to the techniques used in working with copper tubing. In addition it will provide the student with an opportunity to demonstrate an understanding to practice what he has learned from the classroom instruction.

This course is taught in a two hour block for 90 clock hours or a three hour block for 135 hours. In each instance, the course consists of five instructional blocks; however, the three hour session permits the learner to cover each block in more detail and also provides added opportunity to practice and increase his skills.

This course is concluded by a post-test sample.

Manipulative instructional methods include demonstration and shop use of actual appliances, equipment and appliance components, as well as mock-ups and demonstration pieces and pits.

Related instruction is taught through lecture, books, instructional sheets and chalkboard presentations. Students are expected to keep notebooks and to complete daily related and manipulative assignments. Opportunity is provided for practicing newly learned techniques.

An adjunct to the listed instructional methods is provided through the instructor's utilization of audiovisual equipment and materials.

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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.

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with Suggested Hourly Breakdown

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Introduction . . . . .	1
Student Responsibilities . . . . .	1
Course Benefits . . . . .	1
<b>II. REFRIGERATION COMPONENTS (35 Hours)</b>	
Evaporator . . . . .	1
Compressor . . . . .	1
Condensers . . . . .	2
Metering Devices . . . . .	2
<b>III. REFRIGERATION MATERIALS (50 Hours)</b>	
Refrigeration Tubing . . . . .	2
Connecting Tubing . . . . .	2
Refrigeration Fittings . . . . .	2
Repairing Refrigeration Tubing . . . . .	2
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Evacuation Procedures . . . . .	2
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GOALS

The student must be able to:

1. Describe and discuss the opportunities in the field of refrigeration and the duties of an appliance refrigeration technician.
2. Identify and describe the basic parts, and explain the operation of a refrigeration system.
3. Properly work with copper tubing using all the various methods of connecting and repairing tubing.
4. Evacuate, charge and test a refrigeration system, and explain each step in detail.
5. Satisfactorily complete the quinmester post-test.

**SPECIFIC BLOCK OBJECTIVES**

**BLOCK I - ORIENTATION**

The student must be able to:

1. Describe the refrigeration cycle and be able to name the operating components.
2. List the career opportunities open to the refrigeration technician and state the duties and responsibilities of each position.

**BLOCK II - REFRIGERATION COMPONENTS**

The student must be able to:

1. Explain the purpose and function of the major components of a domestic refrigeration system, and describe how each is related to the other in working sequence to obtain a refrigerated space.

**BLOCK III - REFRIGERATION MATERIALS**

The student must be able to:

1. Define the various types and signs, and identify and select refrigeration tubing used in the major appliance trade.
2. Bend tubing in the approved manner using the proper tools.
3. Perform the different methods of connecting refrigeration tubing using the proper tools and special fittings obtainable in the refrigeration trade.
4. Repair refrigeration tubing that has been damaged using the different approved methods accepted in the refrigeration field.

**BLOCK IV - SERVICING PROCEDURES**

The student must be able to:

1. Evacuate, charge and test a refrigeration system, using the special tools and testing equipment available in the refrigeration trade.

**BLOCK V - QUINMESTER POST-TEST**

The student must be able to:

1. Satisfactorily complete the quinmester post-test.

Course Outline

APPLIANCE REPAIR - ADVANCED - 9027  
(The Refrigeration System)

Department 48 - Quin 9027.01

I. ORIENTATION

A. Introduction

1. Principles of Refrigeration
  - a. Refrigeration cycles
  - b. Refrigeration tools
  - c. Refrigeration components
2. Opportunities in Refrigeration Trade
  - a. Future opportunities
  - b. Different applications of refrigeration
3. Duties of Refrigeration Appliance Technician
  - a. Installing units
  - b. Replacing components
  - c. Diagnosing malfunctions

B. Student Responsibilities

1. Safety regulations
  - a. Identifying hazards
  - b. Work with others
  - c. Knowledge of tool use and care
2. Shop and School Regulations
  - a. Care of equipment and tools
  - b. Care of shop
  - c. Shop and school rules

C. Course Benefits

1. Career opportunities
2. Learning and improving basic skills
3. Implementing basic skills
4. Preparation for the next course

II. REFRIGERATION COMPONENTS

A. Evaporator

1. Types of evaporators
2. Applications of evaporators
3. Defrost methods

B. Compressor

1. Types of compressors
2. Functions of compressors
3. Parts of compressors
4. Lubrication of compressors

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- C. Condensers
  - 1. Types of condensers
  - 2. Functions of condensers
  - 3. Maintenance of condensers
- D. Metering Devices
  - 1. Types of metering devices
  - 2. Functions of metering devices
  - 3. Maintenance of metering devices

### III. REFRIGERATION MATERIALS

- A. Refrigeration Tubing
  - 1. Types and sizes
  - 2. Methods of cutting
  - 3. Methods of bending
- B. Connecting Tubing
  - 1. Flaring tubing
    - a. Why and when to flare
    - b. Types of flares
    - c. Tools used to flare
  - 2. Swaging tubing
    - a. Why and when to swage
    - b. Tools used to swage
  - 3. Constricting tubing
    - a. Why and when to constrict
    - b. Tools used to constrict
  - 4. Annealing tubing
    - a. Reason to anneal
    - b. Method of annealing
  - 5. Techniques of soldering
    - a. Why and when to solder
    - b. Types of solder
    - c. Methods of soldering
- C. Refrigeration Fittings
  - 1. Types and sizes of fittings
  - 2. When to use various fittings
  - 3. Methods of using fittings
- D. Repairing Refrigeration Tubing
  - 1. Soldering
  - 2. Brazing
  - 3. Epoxy Bonding

### IV. SERVICING PROCEDURES

- A. Evacuation Procedures
  - 1. Methods of evacuating
  - 2. Tools and equipment used in evacuation

3. Checking unit by evacuating
4. Checking for refrigerant leak by evacuating
5. Safety Regulations

B. Charging Procedures

1. Methods of charging
2. Tools and equipment used to charge system
3. Steps to follow when charging
4. Checking unit by charging
5. Safety regulations

C. Testing

1. Testing for compressor efficiency
2. Testing for refrigerant leaks
3. Testing electrical circuit
4. Diagnosing and repairing

V. QUINMESTER POST-TEST

## BIBLIOGRAPHY

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### Basic References:

1. Marsh, Warren A. and Olivio C. Thomas. Principles of Refrigeration. Albany, New York: Delmar, 1966  
374 pages
2. Althouse, Andrew D., et. al. Modern Refrigeration and Air Conditioning. Homewood, Illinois: Goodheart-Willoox Co., Inc., 1968 1120 pages
3. Edwin P. Anderson. Home Appliance Servicing. New York, N. Y.: Howard W. Sams and Company, Inc. 1967 600 pages
4. Tricomi, Ernest. How to Repair Major Appliances. New York: Howard W. Sams and Company, Inc. 1964 600 pages

### Supplementary References:

5. Domestic Refrigeration. Master Publications Inc., Los Angeles, California 80 pages

### Manufacturers Manuals:

6. Basic Electrical Refrigeration Controls. Booklet R-10 #821230, Whirlpool Corporation, La Porte, Indiana.
7. Use and Care of Test Instruments. Booklet G-5, #828439, Whirlpool Corporation, La Porte, Indiana.
8. Brazing-How and Why. Booklet G-9, #829003, Whirlpool Corporation, La Porte, Indiana.

### Audio Visual Aids:

#### Slides and Records:

1. Definitions #GTA-1. 35mm 34 slides. Color. 1970. Syracuse, New York. Carrier Air Conditioner Company.
2. Refrigeration Cycle #GTA-2. 30 slides. Color. 1970. Syracuse, New York. Carrier Air Conditioner Company.

Audio Visual Aids:

Filmstrips and Cassette Tapes:

3. Use and Care of Test Instruments. Whirlpool Corporation, La Porte, Indiana. Filmstrip: G-5 #828440. Cassette Tape G-5 #828459.
4. Brazing-How and Why. Whirlpool Corporation, La Porte, Indiana. Filmstrip: G-9 #829004, Cassette Tape G-9, #829005.
5. Basic Electrical Refrigeration Controls. Whirlpool Corporation, La Porte, Indiana. Filmstrip R-10 #821229.

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A P P E N D I X

Quinmester Post-Test Samples



QUINMESTER POST-TEST

Name \_\_\_\_\_ Date \_\_\_\_\_ Score \_\_\_\_\_

I. COMPLETIONS

1. The two principal types of refrigeration systems are \_\_\_\_\_ and \_\_\_\_\_.
2. In order to bend tubing, bending \_\_\_\_\_ are used.
3. The three classifications of compressors are \_\_\_\_\_ and \_\_\_\_\_.
4. The evaporator is on the \_\_\_\_\_ side of the system.
5. The condenser used on domestic refrigerators is \_\_\_\_\_ cooled.

## QUINMESTER POST-TEST

Name \_\_\_\_\_ Date \_\_\_\_\_ Score \_\_\_\_\_

### II. TRUE-FALSE:

- \_\_\_\_\_ 1. A capillary tube system has a critical charge of refrigerant.
- \_\_\_\_\_ 2. Any good grade of copper tubing is satisfactory for refrigeration work.
- \_\_\_\_\_ 3. Once a roll of refrigeration tubing is cut, there is no further reason to cap the end.
- \_\_\_\_\_ 4. Small tubing can be bent as sharply as needed.
- \_\_\_\_\_ 5. The double thickness flare provides greater strength against vibration.

## QUINMESTER POST-TEST

Name \_\_\_\_\_ Date \_\_\_\_\_ Score \_\_\_\_\_

### III. MULTIPLE CHOICE

1. Solder is classified as (a) only soft (b) only hard (c) both soft and hard.
2. A hard solder contains (a) a higher (b) a lower (c) the same percentage of tin as a soft solder.
3. The flux that is used for silver solder will also work satisfactorily for (a) 50-50 (b) 95-5 (c) neither solder.
4. A swaging tool bears the closest resemblance to a (a) reamer (b) flaring tool (c) tubing cutter.
5. A thread which is on the outside of a fitting is called a (a) female pipe thread (b) national pipe thread (c) male pipe thread.

## QUINMESTER POST-TEST

### IV. TRUE-FALSE

1. Old copper tubing can be softened by annealing.
2. Color of the surface to be silver brazed will indicate the temperature.
3. Refrigeration oils should be practically wax free.
4. The most desirable type of epoxy adhesive is the two part system.
5. Aluminum tubing can be soldered.

## ANSWER KEY TO QUINMESTER POST-TEST

### I. COMPLETIONS

1. absorption; mechanical
2. springs
3. reciprocating; rotary; centrifugal
4. low
5. air

### II. TRUE-FALSE

1. True
2. False
3. False
4. False
5. True

### III. MULTIPLE CHOICE

1. c
2. a
3. c
4. b
5. c

### IV. TRUE-FALSE

1. True
2. True
3. True
4. True
5. True