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ABSTRACT

Providing the student with an understanding of the basic refrigeration fundamentals, the course introduces the various types of tools and equipment used in this trade. The course consists of 90 clock hours and is organized into six instructional blocks. The student will gain an understanding of trade terminology, heat and temperature, transfer of heat, refrigeration components and the principle of the basic refrigeration cycle. The course will also provide an understanding of the tools necessary to function in this field and includes flaring, bending, swaging, and soldering of refrigeration tubing. Manipulative instructional methods include demonstration and shop use of actual appliances, equipment, and appliance components, as well as mock-ups and demonstration pieces and kits. A bibliography lists basic and supplementary references and audiovisual aids and an appendix provides a sample post-test. (MW)

AUTHORIZED COURSE OF INSTRUCTION FOR THE QUINMESTER PROGRAM

DADE COUNTY PUBLIC SCHOOLS

Course Outline
AIR CONDITIONING AND HEATING MECHANICS 1 - 9013
APPLIANCE REPAIR 2 - 9025
(Fundamentals of Refrigeration)
Department 48 - Quin 9013.01 and 9025.05

DIVISION OF INSTRUCTION • 1973

D A D E C O U N T Y P U B L I C S C H O O L S

1 4 5 0 N O R T H E A S T S E C O N D A V E N U E

M I A M I, F L O R I D A 33132

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county office of

VOCATIONAL AND ADULT EDUCATION

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

March, 1973

Published by the School Board of Dade County

Course Description

9013 9025	48	9013.01 9025.05	Fundamentals of Refrigeration
State Category Number	County Dept. Number	County Course Number	Course Title

This quinmester course provides the student with an introduction to refrigeration and an understanding of trade terminology, heat and temperature, transfer of heat, refrigeration components and the principle of the basic refrigeration cycle. It will also provide an understanding of the tools necessary to function in this field and will include flaring, bending, swaging and soldering of refrigeration tubing. This is a two or three quinmester credit course.

Clock Hours: 90, 135

PREFACE

The following quinmester course outline will provide the students with an understanding of the basic refrigeration fundamentals and will also introduce them to the various types of tools and equipment used in this trade. In addition, it will provide him with an opportunity to demonstrate the knowledge and skills he has learned in the classroom.

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 six instructional blocks, however, the three hour session permits the student to cover each block in more detail and also provides added opportunity to practice and increase his skills.

Manipulative instructional methods include demonstration and shop use of actual appliances, equipment and appliance components, as well as mock-ups and demonstration pieces and kits. 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 instructors utilization of audiovisual equipment and materials.

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. Demonstrate proficiency in the job skills he will be expected to perform as a technician.

2. Practice, in daily use, all shop safety methods and practices.

3. Use with knowledge and understanding all hand tools and testing equipment used by a technician.

4. Explain the cycles of refrigeration using the proper trade terminology.

5. Relate the principles of heat and pressure to refrigeration principles.

6. Identify the different refrigerants used in the refrigeration trade.

7. Work with copper tubing as used in the refrigeration trade.

SPECIFIC BLOCK OBJECTIVES

BLOCK I - ORIENTATION

The student must be able to:

1. Describe some of the processes used to refrigerate in the past, and discuss their operating principles, relating and comparing those processes to the ones used today in the refrigeration field.
2. Identify and list the different applications of refrigeration equipment he will learn in the refrigeration trade.
3. List and explain the primary duties of a refrigeration technician and the career opportunities open to him.
4. Work in a safe and responsible manner by himself and around others, thereby demonstrating his knowledge and understanding of all school and shop regulations.

BLOCK II - FUNDAMENTALS OF REFRIGERATION

The student must be able to:

1. Demonstrate an understanding of the technical terminology used in the refrigeration trade by being able to define the terms of the trade.
2. Discuss the relationship of heat and pressure as related to the refrigeration system.
3. Discuss the various refrigeration systems and their applications in the refrigeration trade using the proper technical names of the components.
4. Define the operation in detail of the refrigeration cycle using the necessary diagrams and technical trade terminology.
5. Discuss in detail the basic principles of refrigeration.

BLOCK III - REFRIGERATION SERVICE TOOLS

The student must be able to:

1. Name and describe the function of all hand tools used in the refrigeration trade and be able to use them in a safe and correct manner.
2. Select and describe the use of the proper testing equipment to check the refrigeration system.
3. Name and describe the functions and reasons for using special purpose tools.

BLOCK IV - REFRIGERANTS AND DRIERS

The student must be able to:

1. Define the word refrigerant and list the various types of refrigerants discussing the requirements for refrigerants in a refrigeration cycle.
2. Store and fill refrigeration cylinders in a safe and proper manner.

3. Write and practice the safety regulations to be observed when hand handling refrigerants.
4. Define the word drier and discuss the construction and placement of this component in a refrigeration system.

BLOCK V - REFRIGERATION MATERIALS

The student must be able to:

1. Identify and select various types and sizes of refrigeration tubing used in the refrigeration trade.
2. Bend tubing using the proper tools.
3. Perform the different methods of connecting refrigeration tubing using the various fittings obtainable in the refrigeration trade.
4. Repair tubing that has been damaged using the different approved methods as used in the trade.

BLOCK VI - QUINMESTER POST-TEST

The student must be able to:

1. Satisfactorily complete the quinmester post-test.

Course Outline

AIR CONDITIONING AND HEATING MECHANICS 1 - 9013
APPLIANCE REPAIR 2 - 9025
(Fundamentals of Refrigeration)

Department 48 - Quin 9013.01 and 9025.05

I. ORIENTATION

A. Introduction
   1. History of refrigeration
      a. Early experiments
      b. Modern uses of refrigeration
      c. Applications of refrigeration and air conditioning
   2. Duties of refrigeration technician
      a. Installing units
      b. Diagnosing and analyzing malfunctions
      c. Rebuilding, replacing and repairing components

B. Student Responsibilities
   1. Safety regulations
      a. Identifying and correcting hazards
      b. Working with others
      c. Obeying instructions and regulations
   2. Shop regulations
      a. Shop and school rules
      b. Care of tools and equipment
      c. Clean-up assignments

C. Course Benefits
   1. Learning and improving basic skills
      a. Identify tools and equipment
      b. Using tools and equipment properly
   2. Career opportunities
      a. Shop technician
      b. Outside service technician
      c. Supervisor
      d. Manager
      e. Business owner

II. FUNDAMENTALS OF REFRIGERATION

A. Trade Terminology
   1. Vocabulary of refrigeration terms
   2. Technical component names
   3. Technical control names

B. Heat Energy and Pressures
   1. Sensible heat
   2. Latent heat
   3. Relationship of pressure to heat

C. Temperature Scales
   1. Fahrenheit scales
   2. Centigrade scales
   3. Converting scales
   4. Humidity measurement
   5. Temperature measurements
   6. Temperature recorders

Refrigeration Components
   1. Evaporator
   2. Compressor
   3. Condenser
   4. Metering devices

E. Refrigeration Cycles and Systems
   1. Mechanical system
   2. Absorption system
   3. Nonmechanical systems

III. REFRIGERATION SERVICE TOOLS

A. Basic Hand Tools
   1. Wrenches
   2. Sockets
   3. Files and reamers
   4. Brushes
   5. Tubing cutters
   6. Flaring tools
   7. Swaging tools

B. Basic Testing Equipment
   1. Volt-ohmmeter
   2. Wattmeter
   3. Ampere meter
   4. Capacitor analyzer
   5. Temperature recorders
   6. Test cords

C. Special Purpose Tools
   1. Refrigeration charging tools
   2. Gauge manifold
   3. Vacuum pump
   4. Charging cylinder
   5. Torches
   6. Refrigerant cylinder

IV. REFRIGERANTS AND DRIERS

A. Refrigerants
   1. Definition of a refrigerant
   2. Requirements for refrigerants
   3. Identifying refrigerants
   4. Classification of refrigerants

IV. REFRIGERANTS AND DRIERS (Contd.)

B. Refrigerant Storage
   1. Color code
   2. Cylinders, sizes, types

C. Safety Regulations
   1. Cylinder storage
   2. Filling cylinders
   3. Workers personal safety regulations

D. Driers
   1. Purpose of driers
   2. Properties of a desiccant
   3. Construction of a drier
   4. Location of driers

V. REFRIGERATION MATERIALS

A. Tubing
   1. Selecting proper type and size
   2. How to cut tubing

B. Bending Tubing
   1. Using springs
   2. Using tybe bending tool

C. Connecting Tubing
   1. Flaring tubing
      a. Why and when to flare
      b. Types of flares
      c. Tool to use for flaring
   2. Swaging tubing
      a. Why and when to swage tubing
      b. Tool to use for swaging
   3. Tube constrictor
      a. Why and when to constrict tubing
      b. Tool to constrict tubing
   4. Annealing tubing
      a. Reason for annealing
      b. Method of annealing
   5. Soldering tubing
      a. Soft soldering
      b. Silber brazing

D. Tubing Fittings
   1. Types of fittings
   2. When and where to use each type

E. Repairing Tubing
   1. Soldering and brazing
   2. Epoxy bonding

IV. QUINMESTER POST-TEST

BIBLIOGRAPHY
(Fundamentals of Refrigeration)

Basic References:

1. Althouse, Andrew D., and Others. Modern Refrigeration and Air Conditioning. Homewood, Illinois: The Goodheart-Willcox Company, Inc., 1968. Pp. 1120.

2. Lang, Paul V. Principles of Air Conditioning. Albany, New York: Delmar Publishing Co., 1966. Pp. 340.

3. Marsh, Warren R., and Olivio, C. Thomas. Principles of Regrigeration. Albany, New York: Delmar Publishing Company, 1966. Pp. 374.

4. Tricomi, Ernest. How To Repair Major Appliances. New York: Howard W. Sams and Co., 1964. Pp. 224.

Supplementary References:

5. Brown, Samuel P. Air Conditioning and Elements of Refrigeration. New York: McGraw-Hill Book Company, Inc., 1947. n.p.

6. Domestic Refrigeration. Los Angeles, California: Master Publications, n.d. Pp. 80.

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8. Jordon, Richard C., and Gayle B. Preister. Refrigeration and Air Conditioning. Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1956. Pp. 555.

9. Nelson, C. Westley. Commercial and Industrial Refrigeration. New York: McGraw-Hill Book Company, Inc., 1952. Pp. 467.

10. Trane Air Conditioning Manual. LaCrosse, Wisconsin: The Trane Company, 1962. Pp. 380.

Audiovisual Aids:

Slides and Records:

1. Definitions. GTR 1. 35 mm. 34 slides. Color. 1970. Carrier Air Conditioning Company.

2. Refrigeration Cycle. GTR 2. 30 slides. Color. 1970. Carrier Air Conditioning Company.

A P P E N D I X

Quinmester Post-Test Sample

Quinmester Post-Test

_____ Date _____ Score ____

True-False Test Items

Each of the following statements is either true or false. If the statement is true, draw a circle around the letter T following it, if the statement is false, draw a circle around the F. If a statement is false in part, it is entirely false.

1. Evaporation of moisture cannot cool water. T F

2. Food preservation was accomplished by using natural ice in the 18th century. T F

3. Comfort cooling is not necessary in today's modern living. T F

4. Refrigeration can be applied for uses other than food preservation. T F

5. There is no hazard involved in refrigeration work. T F

Trimmester Post-Test

_____ Date _____ Score ____

Completion Test Items

Complete each of the following statements by writing the missing word or words in the space provided.

1. A refrigeration technician could advance to _____.

2. The _____ wrench measures the degree of thightness of bolts.

3. In order to measure power a _____ meter is used.

4. To measure pressures on a refrigerating system a _____ _____ is connected to the system.

5. A refrigerant cylinder should be transported in an _____ position.

Quinmester Post-Test

Name _____ Date _____ Score ____

Multiple Choice Test Items

Each statement needs a word, figure or a phrase to make it correct. Only one of the choices listed is correct. Place the letter of the choice you make in the space provided at the left.

____ 1. A good refrigerant must:

a. Not mix with oil
b. Mix with oil
c. Be nontoxic
d. Be flammable

____ 2. Cold CO_2 cylinders are:

a. Green
b. Black
c. Orange
d. White

____ 3. A good desiccant will:

a. Control moisture
b. Dissolve in refrigerant
c. absorb oil
d. Restrict refrigerant

____ 4. Annealing is accomplished through the use of:

a. Refrigerants
b. Torch
c. Hammers
d. Tube bender

____ 5. The minimum safe bending radius for small tubing is:

a. 8x diameter
b. 6x diameter
c. 5x diameter
d. 3x diameter

____ 6. Tubing can be connected by:

a. Epoxy
b. Solder
c. Flux
d. Adhesive

__ 7. The meter used to measure current is:

a. Ohmmeter
b. Wattmeter
c. Ammeter
Voltmeter

__ 8. A charging cylinder is used to:

a. Add oil to system
b. Charge desiccant into system
c. Add refrigerant to system
d. Remove moisture from system

___ 9. A compound gauge measures:

a. Pressure only
b. Temperature only
c. Temperature and pressure
d. Inches of vacuum and pressure

____10. Safety regulations are necessary:

a. To protect equipment
b. To protect the worker
c. Both a and b
d. None of the above

ANSWER KEY TO QUINMESTER POST-TEST

True-False

1. F
2. T
3. F
4. T
5. F

Completion

1. Manager, store owner, supervisor
2. Torque
3. Watt
4. Gauge manifold
5. Upright

Multiple Choice

1. c
2. d
3. a
4. b
5. c
6. b
7. c
8. c
9. d
10. c