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ABSTRACT

Presented is a guide for developing lessons for a home weatherization course that promotes the use of retrofit technology to conserve energy in residential housing. The course is intended to cover processes and causes of building heat loss, and home retrofitting procedures. Each lesson description contains a list of points the instructor should emphasize and recommended visual aids. Although these lessons are designed for a course for supervisors of work crews engaged in home weatherization, these learning activities are also appropriate for trades programs at the secondary or postsecondary levels. (WB)

U.S. DEPARTMENT OF COMMERCE
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HOME WEATHERIZATION INSTRUCTOR'S GUIDE

U.S. Department of Energy
Washington, D.C.

August 1978

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Project RetroTech

Home Weatherization Instructor's Guide

U.S. Department of Energy
Assistant Secretary for Conservation and Solar Applications
Office of Weatherization Assistance Programs
Washington, D.C. 20461

August 1978

(Reprint of Federal Energy Administration Conservation Paper Number 28A)

Other PROJECT RETROTECH booklets:

DOE/CS-0040/2 Home Weatherization Job Book
DOE/CS-0040/3 Home Weatherization Manual
DOE/CS-0040/4 Home Weatherization Charts

Foreword

Project Retro-Tech has evolved from efforts by the Department of Energy (DOE) to fill a need expressed by various consumer groups. On the one hand, State and local agencies that use Federal and State funds to weatherize the homes of fixed- and low-income people have pointed out a need for a source of technical know-how to improve the effectiveness of their weatherizing measures, either in terms of higher fuel savings or reduced installation cost.

On the other hand, many consumer groups have pointed out the difficulty in locating qualified technicians who specialize in weatherizing homes. Firms that sell either insulation or storm windows and doors are not always properly staffed with trained specialists who can make an overall assessment of thermal deficiencies and recommend optimum corrective action. Misapplication or lack of attention to any key element in the total weatherization process can negate the fuel and cost savings resulting from the installation of insulation and storm windows.

The shortage of skilled and trained technicians who specialize in weatherizing homes will be further aggravated during the next few years as homeowners turn to retrofit measures for relief from the higher cost of energy.

The expanding requirements for a large cadre of skilled technicians who have been trained in techniques for weatherizing the homes of all income levels of the population will place additional burdens on the vocational-technical schools at the secondary, post-secondary, and adult education levels. The Home Weatherization Course developed by DOE is designed to assist the vocational-technical schools to meet this challenge.

The DOE Weatherization Manual, however, is only one of a series of training materials being developed by DOE, Department of Housing and Urban Development (HUD), and private industry groups. These additional training materials, when they become available, will enable the vocational-technical schools to expand the content of the initial Home Weatherization Course. In addition, they will be able to add other courses to train the specialists needed to fill the many new jobs resulting from the increased emphasis on home weatherization.

Preface

This booklet was prepared as a guide to instructors in developing lesson plans for a Home Weatherization Course that promotes the use of known *RETRO*fit *TECH*nology to improve thermal characteristics and conserve energy in residential housing.

Although the suggested lesson plans contained in this booklet have been designed for a special course for supervisors of workcrews actually engaged in home weatherization, the concepts embodied in the individual lessons can also be incorporated into the curriculum of construction trades programs at vocational-technical schools at the secondary, post-secondary, or adult education levels.

DOE welcomes your ideas and comments about the Home Weatherization Course. In addition, we would appreciate information from you regarding your use of the training materials, either for special groups or for vocational students pursuing a career in the construction trades. Your comments, along with any suggestions for improving the training materials should be mailed to:

Director
Office of Weatherization Assistance
Department of Energy
Washington, DC 20461

Contents

General Lesson Plan for Course on Home Weatherization

A. Course Objectives:

1. The DOE Weatherization Manual and Job Book are based on known technology for retrofitting residential housing. The principal objective of the course on Home Weatherization is to train community service groups to use available technology when retrofitting residential housing under government-assisted weatherization programs. Retrofit measures can be an effective means for improving thermal characteristics of housing and reducing energy use.

2. A secondary objective of the course is to improve the vocational and avocational opportunities of young people and adults enrolled in both the accredited and nonaccredited construction trades programs by preparing students for the new business and employment opportunities resulting from increased emphasis on home weatherization.

B. Instructional Objectives

1. *Estimation*: Given the physical dimensions and construction features of a detached residential structure, a student will prepare for the homeowner a written analysis (job book), containing the following:
   a. Identification of gross thermal deficiencies of the structure that result in heat losses by infiltration and conduction;
   b. Comparison of current heating requirements with the potential fuel and cost savings;
   c. Job writeup, from which the material specifications and bill of materials will be prepared;
   d. Bill of materials for the feasible remedies, including costs and payback period.

2. *Installation:* Given the job writeup (job book) for a detached residential structure, the student will describe and/or demonstrate to others the proper methods for installing the specified materials. In addition, the student will describe and/or demonstrate the method for conducting a post-evaluation at the end of a heating season to determine the actual energy saved by a retrofit program.

C. Equipment Required

The following equipment is required for the classroom lectures and/or demonstrations:

1—Projection screen

1—Overhead projector

1—Set of transparencies (prepare from charts contained in supplement to this guide)

1—Set of 35 mm slides—optional (may be obtained on loan from the FEA Regional Office)

1—Sample of common forms of insulation and other weatherizing materials.

D. Student Materials

1. FEA Home Weatherization Manual
2. FEA Home Weatherization Job Book

E. Lessons: Lesson plans are included in this booklet on the following topics:

No.	Topic	Suggested Class Time (hr:min)
1	Overview of Course	0:30
2	Introduction to Heat Loss	:30
3	Heat Loss By Conduction	1:00
4	Heat Loss By Infiltration	:30
	Home Weatherization In Four Steps	
5A	Step 1 — Inspection	:30
5B	Step 2 — Calculation	:30
5C	Step 3 — Evaluation	1:00
5D	Step 4 — Installation	3:00
6	Job Book Example by Students	:30
	Total Suggested Class Time	8:00

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F. Instructional Strategies

1. Course for Work-Crew Supervisors
   In cooperation with the State Energy Office, State Board of Education, and other appropriate State offices, technical-vocational schools are encouraged to offer this 8-12 hour training course to work-crew supervisors, foremen, or estimators who are engaged in government-assisted programs for weatherizing the homes of fixed-and low-income people.

2. Post-Secondary and/or Secondary Vocational Technical Program
   For students who are pursuing a career in residential construction and/or retrofitting field, the vocational-technical schools are encouraged to modify their vocational programs by incorporating one or more of the lesson units into such related courses as carpentry, residential construction/rehabilitation, and heating, ventilating, and air-conditioning.

3. Adult Education Program
   For adults who wish to enhance their vocational or avocational opportunities, the vocational-technical schools are encouraged to conduct noncredit courses in home weatherization based on training materials developed by FEA and others.

G. Format of Lesson Plans

The lesson plans starting on the facing page contain "points of emphasis" to be covered by the instructor during the classroom lecture. Adjacent to each emphasis point is a page reference in the student's manual and the chart number of the visual aid to be used to reinforce the emphasis point.

The visual aids, either transparencies for overhead projection or 35mm slides, should be prepared locally from a set of 8" x 10½" charts contained in a separate package that accompanies this instructor's guide. Each chart is numbered to coincide with the appropriate point of emphasis.

For the convenience of the instructor when reviewing a lesson plan, each chart appears in miniature at the bottom of the appropriate page of the instructor's guide.

Lesson Plan 1. Overview of Course

Points of Emphasis	Manual Page	Chart No.
1. **Objective(s) of Course:** a. Learn to use simplified techniques for utilizing known technology when retrofitting residential structures to improve thermal characteristics and reduce energy use. b. (other) _____ _____ _____ (Lesson continued on next page)		C-1

Chart C-1

HOME WEATHERIZATION COURSE

Chart C-2

INSTRUCTIONAL OBJECTIVES

ESTIMATION

Student will prepare written analysis containing:

(1) Identification of deficiencies
(2) Comparison of requirements/savings
(3) Job specifications
(4) Bill of materials

INSTALLATION

Student will:

(1) Supervise application
(2) Conduct post-evaluation

Lesson Plan 1.
Overview of Course

	Points of Emphasis	Manual Page	Chart No.
	(Continued from previous page)		
2.	**Instructional Objectives**		
	Estimation: Given the physical dimensions and construction features of a detached residential structure, a student will prepare for the homeowner a written analysis (job book), containing the following:		C-2
	(a) Identification of gross thermal deficiencies of the structure that result in heat losses by infiltration and conduction;		
	(b) Comparison of current heating requirements with the potential fuel savings;		
	(c) Job writeup, from which the material specifications and bill of materials will be prepared;		
	(d) Bill of materials for the feasible remedies, including costs and payback period.		
	Installation: Given a job write-up (job book) for a detached residential structure, the student will describe and/or demonstrate to others the proper methods for installing the specified materials. In addition, the student will describe and/or demonstrate the method for conducting a post-evaluation at the end of a heating season to determine the actual energy saved by a retrofit program.		
	(Lesson continued on next page)		

Lesson Plan 1. Overview of Course

	Points of Emphasis	Manual Page	Chart No.
	(Continued from previous page)		
3.	**Course Content:**		
	(a) Introduction to Heat Loss		C-3
	(b) Building Heat Loss by Conduction		
	(c) Building Heat Loss by Infiltration		
	(d) Four Steps to Home Weatherization		
	Optional:		
	(e) Laboratory Exercises _____		
	(f) Field Exercises _____		
	End of lesson no. 1		

Chart C-3

LESSONS

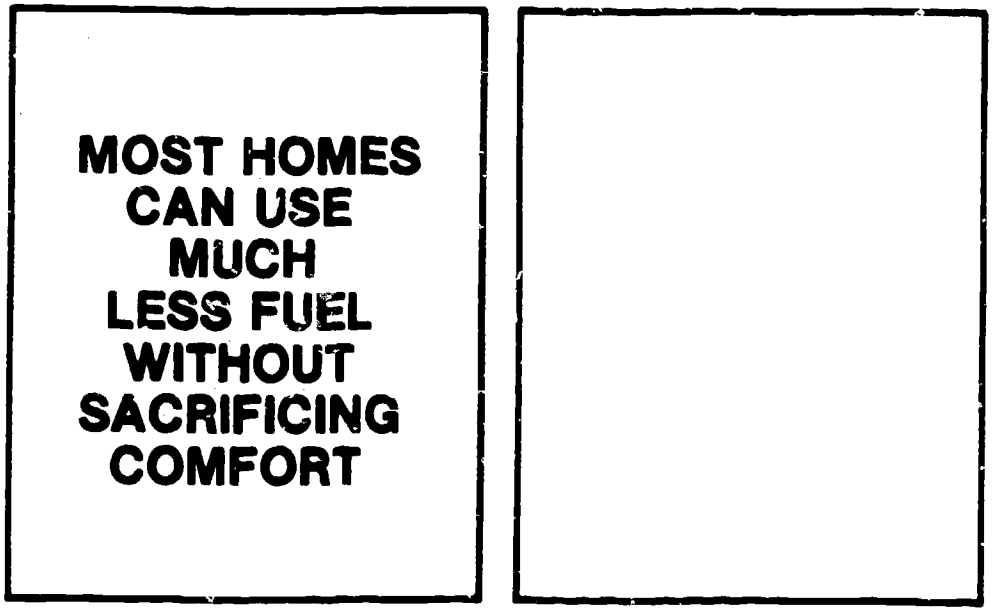
A. INTRODUCTION TO HEAT LOSS
B. BUILDING HEAT LOSS BY CONDUCTION
C. BUILDING HEAT LOSS BY INFILTRATION
D. 4 STEPS TO HOME WEATHERIZATION

Lesson Plan 2.
Introduction
to Heat Loss

	Points of Emphasis	Manual Page	Chart No.
1.	Most homes can use much less fuel without sacrificing comfort. Fuel can be saved by improving building.	1	C-4
2.	Heat always tends to flow from a high-temperature area to a low-temperature area.	1	

(Lesson continued on next page)

Chart C-4



Lesson Plan 2. Introduction to Heat Loss

	Points of Emphasis	Manual Page	Chart No.
	(Continued from previous page)		
3.	Heat that escapes must be replaced.	2	C-5
4.	When less heat escapes, less fuel is required.	2	C-6
	(Lesson continued on next page)		

Chart C-5

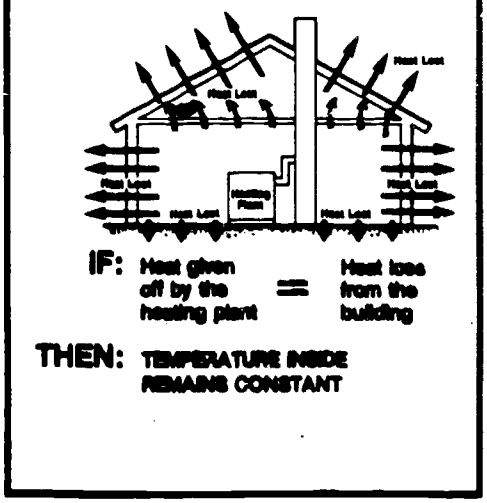
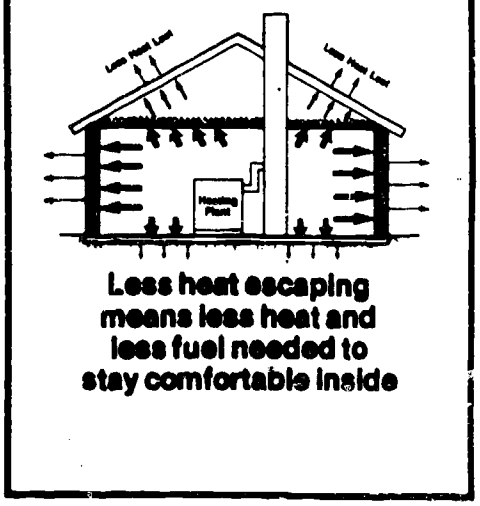


Chart C-6



Lesson Plan 2.
Introduction
to Heat Loss

	Points of Emphasis	Manual Page	Chart No.
	(Continued from previous page)		
5.	"Btu" as a unit of measure is very small.	4	C-7
6.	Heating unit concept will simplify calculations.	3	C-8
	1 heating unit represents about 100,000 Btu.		
	(Lesson continued on next page)		

Chart C-7

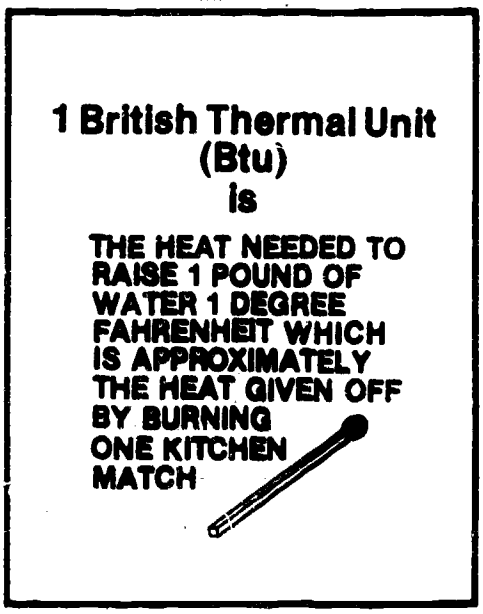
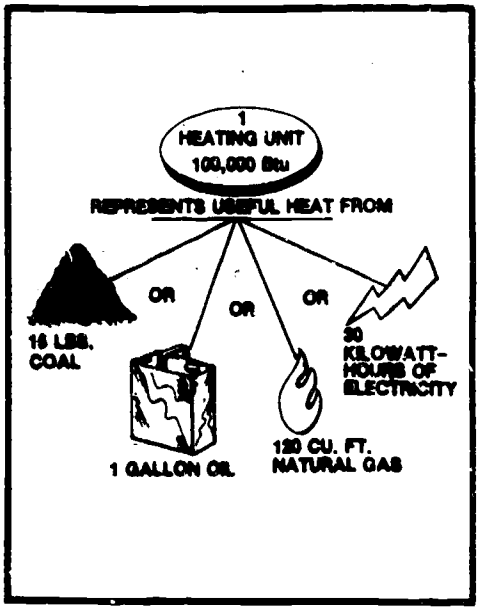


Chart C-8



Lesson Plan 2. Introduction to Heat Loss

	Points of Emphasis	Manual Page	Chart No.
	(Continued from previous page)		
7.	Heating requirements are calculated on seasonal basis to determine total fuel use.	3	
8.	District heating factor concept allows for climatic differences between areas.	3	C-9 C-10
	(Lesson continued on next page)		

Chart C-9

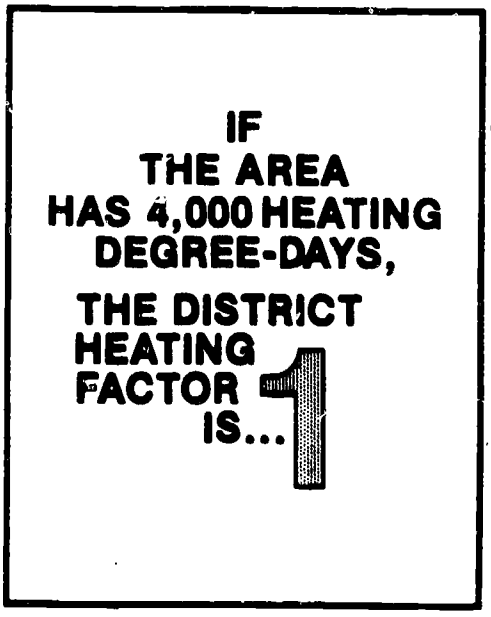
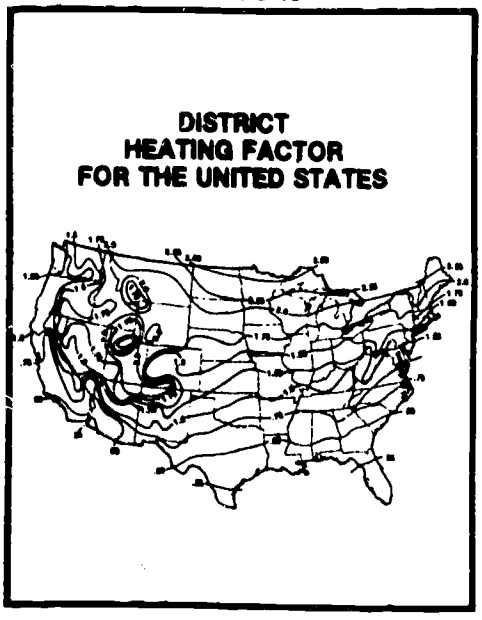


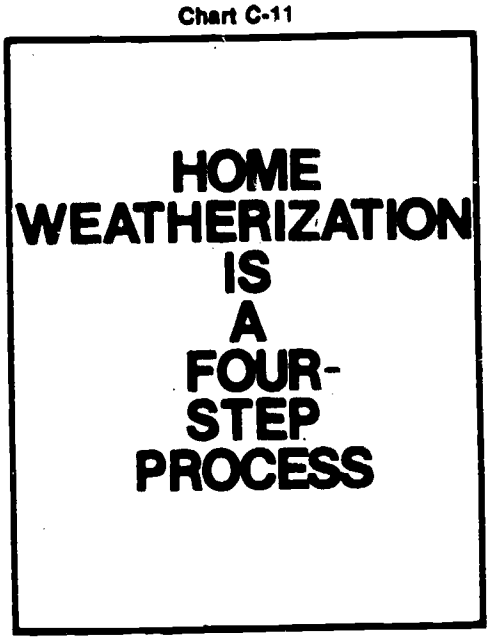
Chart C-10



Lesson Plan 2.
Introduction
to Heat Loss

	Points of Emphasis	Manual Page	Chart No.
	(Continued from previous page)		
9.	**Home Weatherization is a Four-Step Process:**	3	C-11
	(a) **Step 1: Inspection of the building** Inspect the building to determine its construction characteristics.	3	C-12
	(b) **Step 2: Calculation of heat losses** Calculate the heat losses from the house.	3	C-12
	(Lesson continued on next page)		

Chart C-11



Lesson Plan 2. Introduction to Heat Loss

	Points of Emphasis	Manual Page	Chart No.
	(Continued from previous page)		
	(c) **Step 3: Evaluation of the data** Evaluate the building characteristics and heat losses to determine what measures should be taken.	3	C-12
	(d) **Step 4: Installation of materials** Install the weatherizing materials.	3	C-12
10.	Job Book has been designed for recording this information on each separate building to be weatherized.		C-13
	End of Lesson No. 2		

Chart C-12

FOUR - STEP PROCESS

1. **INSPECTION OF THE BUILDING**
2. **CALCULATION OF HEAT LOSSES**
3. **EVALUATION OF THE DATA**
4. **INSTALLATION OF THE MATERIALS**

Chart C-13

Project RetroTech

Home Weatherization Job Book for:

Lesson Plan 3. Building Heat Loss by Conduction

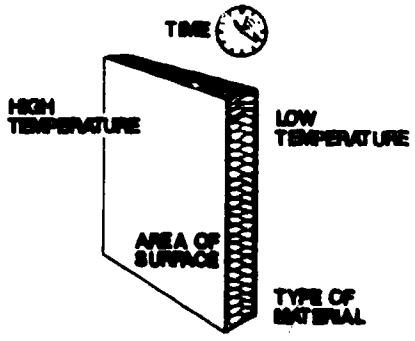
	Points of Emphasis	Manual Page	Chart No.
1.	Heat loss by conduction means heat removed by flow through the exterior materials.	4	C-14
2.	Rate of heat loss depends on. - Area of surface - Length of time - Type of material - Temperature difference across the surface.	4	C-15
3.	Materials that have low rate of heat flow are thermal insulators.	4	C-15
	(Lesson continued on next page)		

Chart C-14

CONDUCTION IS HEAT LOST THROUGH THE EXTERIOR SURFACES

Chart C-15

DETERMINANTS OF HEAT LOSS



Lesson Plan 3. Building Heat Loss by Conduction

	Points of Emphasis	Manual Page	Chart No.
	(Continued from previous page)		
4.	Types of insulation material commonly used in building construction are:	4	
	(a) **Loose fill**	4	
	- Glass or rockwool, wood fiber, plastics - Low cost - Use on horizontal surfaces - Will settle		(Show sample of each)
	(b) **Blanket or batt**	4	(Show sample of each)
	- Glass or rockwool, wood fiber - Low cost - Most common - Common thickness 3-1/2" to 6" - Common widths 16" & 24" - Blankets comes in rolls - Batts come in shorter lengths - Both come with, or without, vapor barrier.		
	(c) **Rigid insulation**	4	(Show sample of each)
	- Fiber boards, foamed plasters - Higher cost - Generally not used for home weatherization.		
5.	Insulating value of material is measured by its Resistance, or R value. The higher the R value, the better the insulation.	6	
	(Lesson continued on next page)		

Lesson Plan 3.
Building
Heat Loss by
Conduction

	Points of Emphasis	Manual Page	Chart No.
	(Continued from previous page)		
6.	From the table of R Values in the manual, compare the values of some common materials found in house construction:	6	C-16
	(a) Air film and spaces	6	C-17
	(b) Masonry	6	C-17
	(Lesson continued on next page)		

Chart C-16

Table 1:
Insulation Value of Common Materials

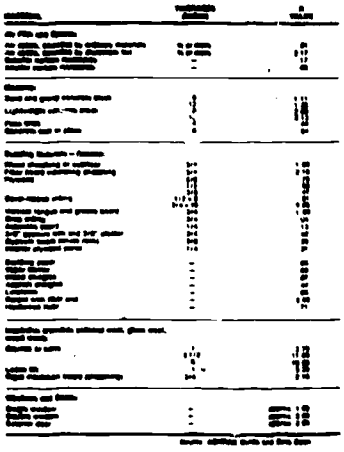
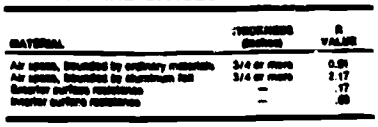


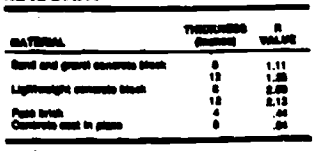
Chart C-17

R VALUES OF SOME COMMON MATERIALS

AIR FILM AND SPACES



MASONRY



Lesson Plan 3. Building Heat Loss by Conduction

Points of Emphasis	Manual Page	Chart No.
(Continued from previous page)		
(c) Building materials — general	6	C-18
(d) Insulation materials	6	C-19
(e) Windows and doors	6	C-19
(Lesson continued on next page)		

Chart C-18

R VALUES OF SOME COMMON MATERIALS

BUILDING MATERIALS

MATERIAL	THICKNESS (inches)	R VALUE
Wood shiplap or siding	3/4	1.00
Plywood sheathing	3/4	2.10
Plywood	3/8	.78
	1/2	1.00
	3/8	.47
Board-lapped siding	1/2x8	.81
	3/4x10	1.05
Vertical tongue and groove	3/4	1.00
Drop siding	3/4	.96
Asbestos board	1/8	.15
3/8" gypsum, cloth and 3/8" plaster	3/4	.32
Gypsum board	3/8	.32
Plaster plywood panelling	1/4	.25
Building paper	-	.06
Vapor barrier	-	.06
Wood shingles	-	.87
Asphalt shingles	-	.44
Linoleum	-	.08
Carpet with fiber pad	-	1.23
Hardwood floor	-	.71

Chart C-19

R VALUES OF SOME COMMON MATERIALS

INSULATION MATERIALS

MATERIAL	THICKNESS (inches)	R VALUE
Blanket or batts	1	3.70
	3-1/2	11.00
	6	19.0
Loose fill	1	3.33
Rigid foam board (sheathing)	3/4	2.10

WINDOWS AND DOORS

TO DISPLAY CALCULATIONS, USE THE FOLLOWING APPROXIMATE R VALUES.

MATERIALS	R VALUE
Single window	1.00
Double window	2.00
Exterior door	2.00

Lesson Plan 3.
Building
Heat Loss by
Conduction

	Points of Emphasis	Manual Page	Chart No.
	(Continued from previous page)		
7.	R value of materials can be added together to obtain an overall resistance, or R value of a building section.		
	(a) Typical overall R for wall section.	4	C-20
	(b) Typical overall R for ceiling.	5	C-21
	(Lesson continued on next page)		

Chart C-20

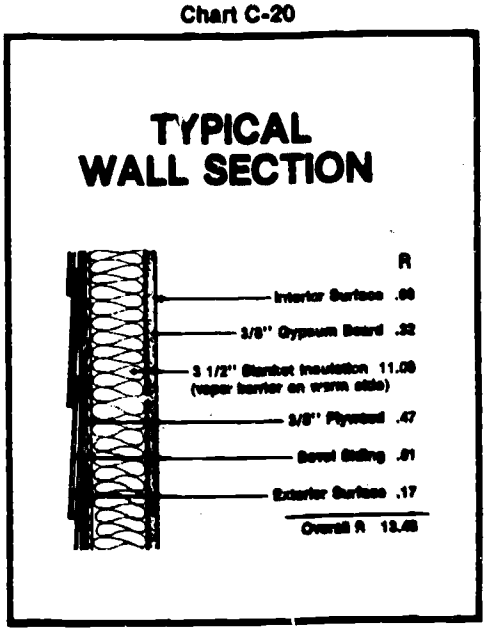
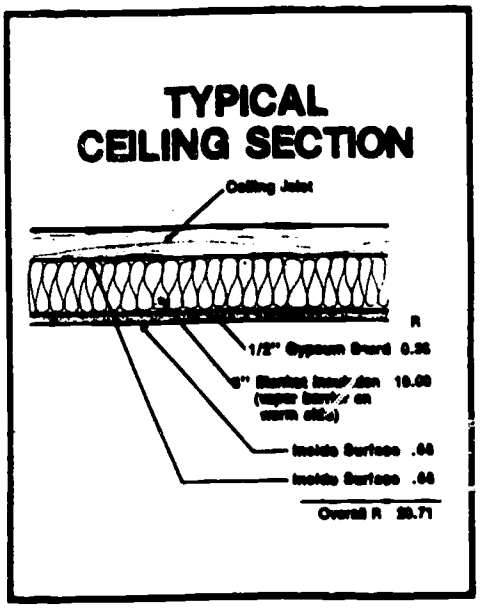


Chart C-21



Lesson Plan 3. Building Heat Loss by Conduction

	Points of Emphasis	Manual Page	Chart No.
	(Continued from previous page)		
	(c) Typical overall R for roof.	5	C-22
	(d) Typical overall R for floor.	5	C-23
8.	Vapor barrier: Moisture in air exerts pressure. Moisture flows from high pressure side to low pressure side.	5	C-24
	As moisture flows from inside to outside, the temperature drops. When the dew point is reached, the moisture condenses and causes wetting of insulation and framing.		
	(Lesson continued on next page)		

Chart C-22

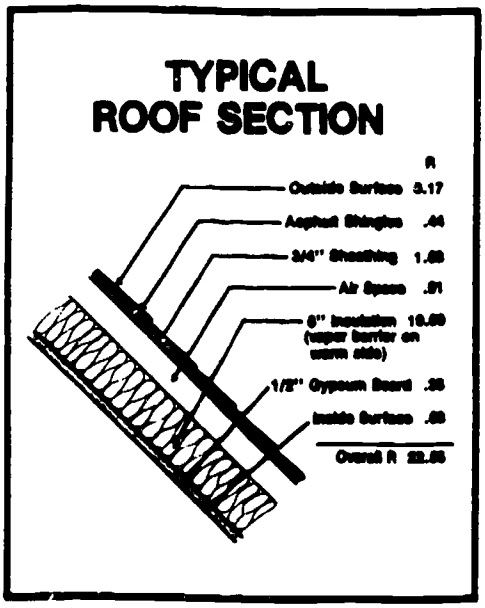
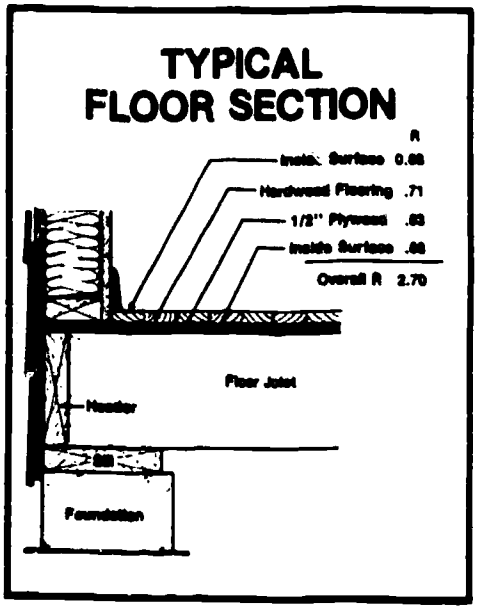


Chart C-23



Lesson Plan 3.
Building
Heat Loss by
Conduction

Points of Emphasis	Manual Page	Chart No.
(Continded from previous page) Since a vapor barrier will reduce the flow of moisture before it reaches the insulation, place the vapor barrier on the inside (warm side). (a) Polyethylene film and aluminum foil are excellent; kraft paper is average. (b) Seal with pressure joint. Remove moisture that escapes through vapor barrier by venting to the outside. End of lesson no. 3 (Lesson no. 4 starts on next page)		

Chart C-24

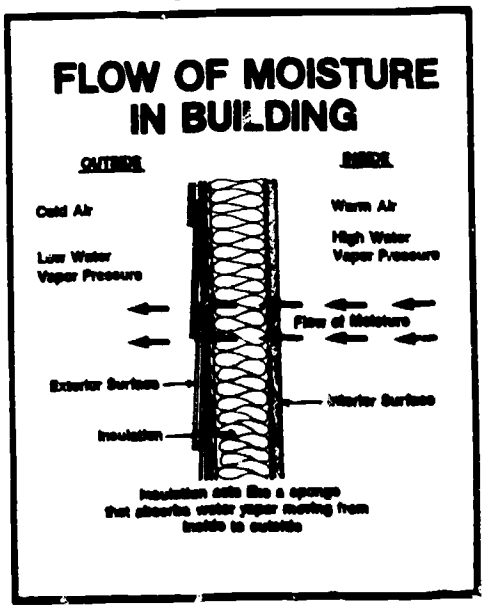
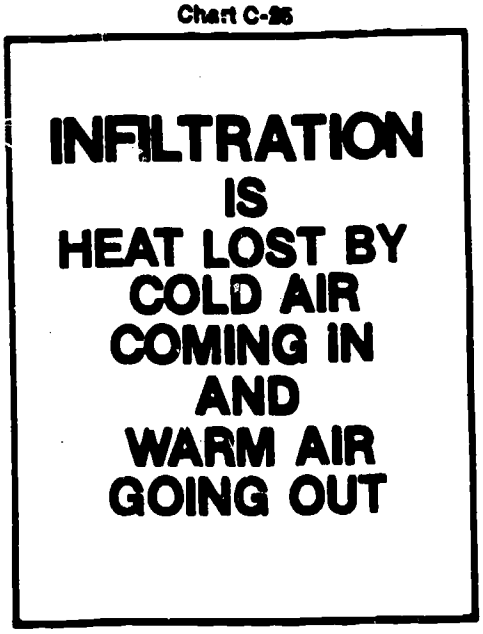


Chart C-25



Lesson Plan 3. Building Heat Loss by Conduction

	Points of Emphasis	Manual Page	Chart No.
1.	Heat is lost by cold air coming in and warm air going out. This leakage or infiltration is caused by two factors:	7	C-25
	(a) Infiltration by wind occurs when wind flows in on one side and warm air flows out on the leeward side.	7	C-26
	(b) Infiltration by "Chimney Effect" occurs when inside air is warmer than outside air. The building acts like a chimney: heated air, which tends to rise, leaks out of cracks and is replaced by cold air, which is sucked in at lower levels.	7	C-27
	(Lesson continued on next page)		

Chart C-26

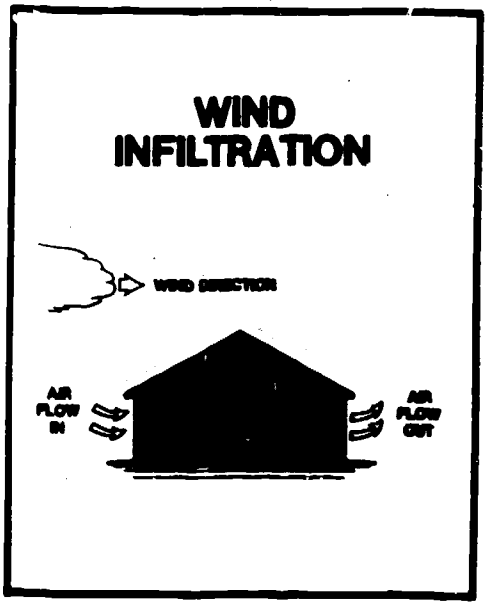
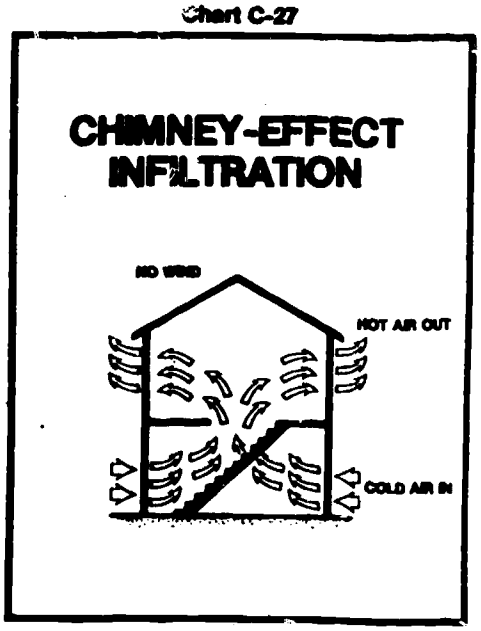


Chart C-27

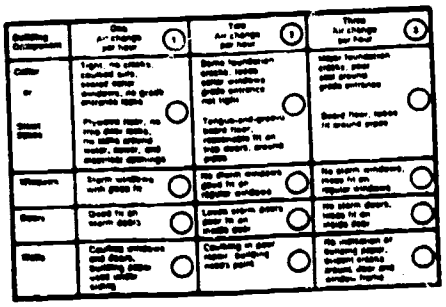


Lesson Plan 4.
Building
Heat Loss by
Infiltration

	Points of Emphasis	Manual Page	Chart No.
	(Continued from previous page)		
2.	Each cubic foot of air that must be heated requires 0.02 Btu for every 1°F increase.	7	
3.	Infiltration check list describes the typical conditions that result in infiltration rates of one, two and three air changes per hour.	10	C-30
	End of lesson no. 4		
	(Lesson no. 5A starts on next page)		

Chart C-28

DETERMINATION OF INFILTRATION LOSS



Lesson Plan 5a. Home Weatherization in Four Steps
Step 1: Inspection

	Points of Emphasis	Manual Page	Chart No.
1.	(Refresher from Introduction Section) **Home Weatherization is a Four-Step Process:** (a) **Step 1 — Inspect** the building to determine its construction characteristics. (b) **Step 2 — Calculate** the heat losses from the building. (c) **Step 3 — Evaluate** the building characteristics and heat losses to determine what measures should be taken. (d) **Step 4 — Install** the weatherizing materials.	3	
2.	The job book is designed to enable a work-crew supervisor (or job estimator) to follow this four-step process in a systematic manner. Perhaps, the best way to become familiar with the job book is to simulate the process by working out an example of a building to be weatherized. The charts that you will see have been marked up to show the information that an estimator will obtain when he inspects the building to determine the construction characteristics. (Lesson continued on next page)		

	Points of Emphasis	Manual Page	Chart No.
	(Continued from previous page)		
3.	Step 1 — Inspect the building to determine the construction characteristics.	9	C-29
	(a) *Visual inspection* of building should consist of the 10 steps listed on chart.	9	C-30
	(Lesson continued on next page)		

Lesson Plan 5a. Home Weatherization in Four Steps

Step 1: Inspection

Chart C-29

FOUR - STEP PROCESS

1. INSPECTION OF THE BUILDING

Chart C-30

10 STEPS IN BUILDING INSPECTION

1. Talk to the occupant
2. Take overall building dimensions (length, width, sidewall height)
3. Measure windows (height, width)
4. Measure doors (height, width)
5. Check condition of exterior (look for cracks, lack of paint, caulking)
6. Check wall construction
7. Check ceiling, roof
8. Check floor construction
9. Inspect foundation for cracks
10. Check for infiltration, feel for drafts, open outside door quickly (resistance means a tight fit)

Lesson Plan 5a.
Home Weatherization in Four Steps
Step 1: Inspection

Points of Emphasis	Manual Page	Chart No.
(Continued from previous page)		
(NOTE: In place of Chart C-30, the following 35mm color slides may be used to give the students a visual impression of the construction features of the building in the example to be worked out by the class. If these slides are not available from the State Department of Education, they may be obtained on a loan basis from the Regional Office of the Federal Energy Administration.)		
(1) Front view		S-1
(2) Right side view (showing carport)		S-2
(3) Rear view		S-3
(4) Left side view		S-4
(5) Take overall dimensions		S-5
(6) Measure windows		S-6
(7) Measure doors		S-7
(8) Speak to occupant		S-8
(9) Check condition of exterior		S-9
(10) Check wall construction		S-10
(11) Check ceilings, roof, floors		S-11
(12) Inspect foundation		S-12
(13) Look for cracks and crevices		S-13
(14) Check for infiltration		S-14
(Turn off slide projector)	(End of slides)	

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Lesson Plan 5a. Home Weatherization in Four Steps
Step 1: Inspection

Points of Emphasis	Manual Page	Chart No.
(Continued from previous page)		
(b) **Fill in the Job Book:** During the inspection, fill in the sections of the Job Book marked "Fill in At The Site." (NOTE: The student will be able to follow the instructions by referring to the example which follows page 12 of the Home Weatherization Manual).	9	
(1) Page 1: Name and Address		C-31
(2) Page 2: Description of building		C-32
(3) Page 3: Dwelling & heating information		C-33
(4) Page 4: Infiltration table		C-34
(5) Page 5: Table of floor materials		C-35
(6) Page 6: Table of ceiling/roof materials		C-36
(7) Page 9: Table of wall materials		C-37
(8) Page 11: Directions to house location		C-38
End of lesson 5A		

Lesson Plan 5a. Home Weatherization in Four Steps

Step 1: Inspection

Chart C-31

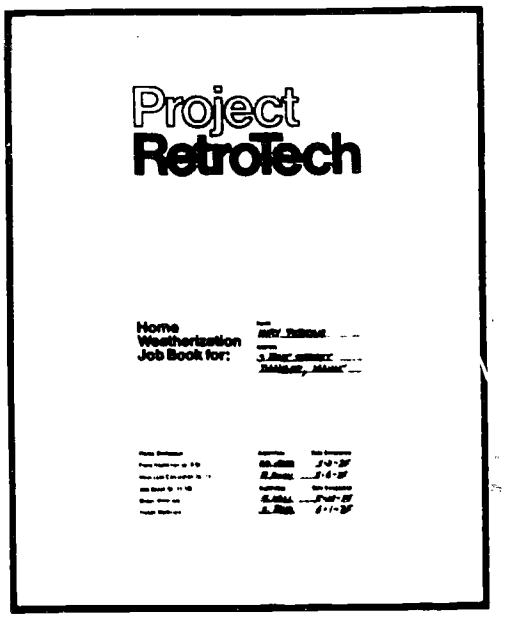


Chart C-32

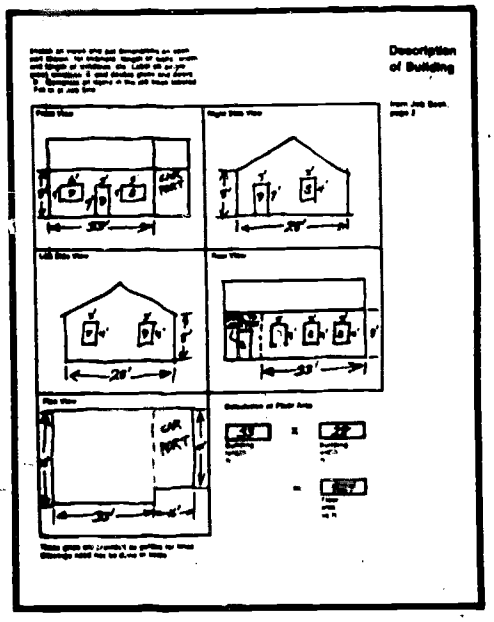


Chart C-33

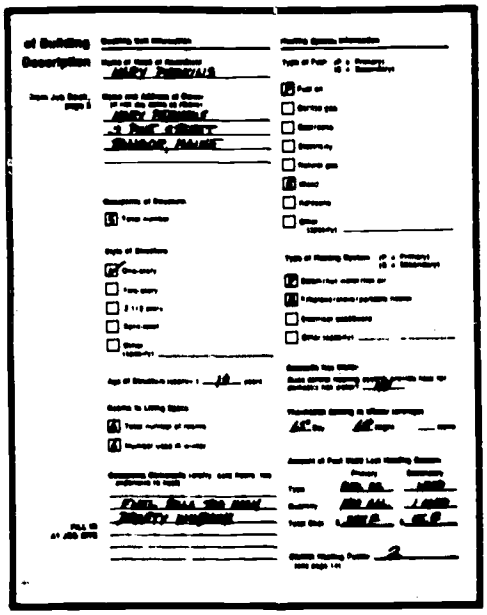


Chart C-34

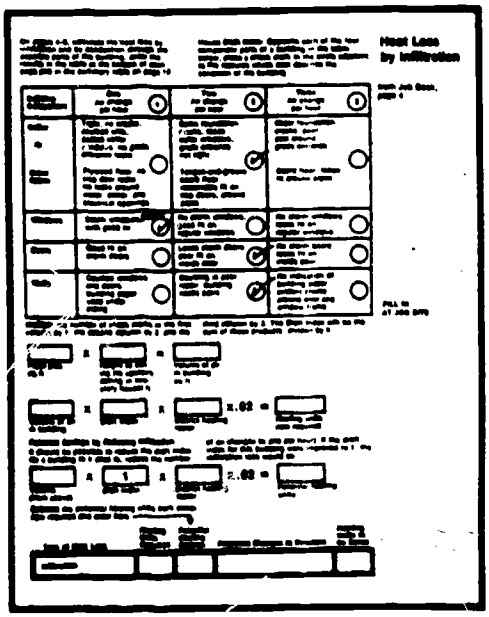


Chart C-35

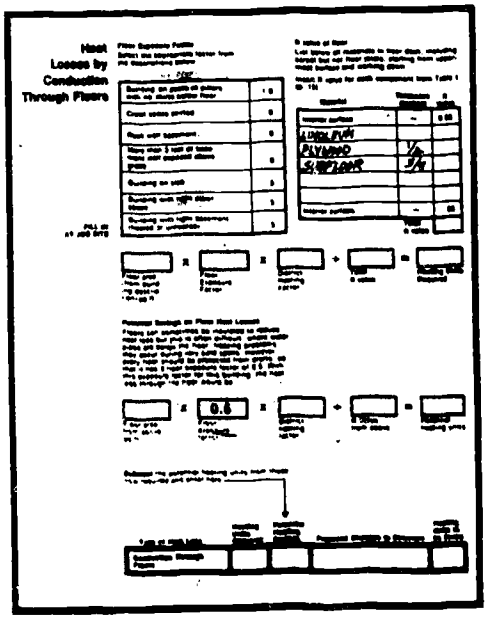
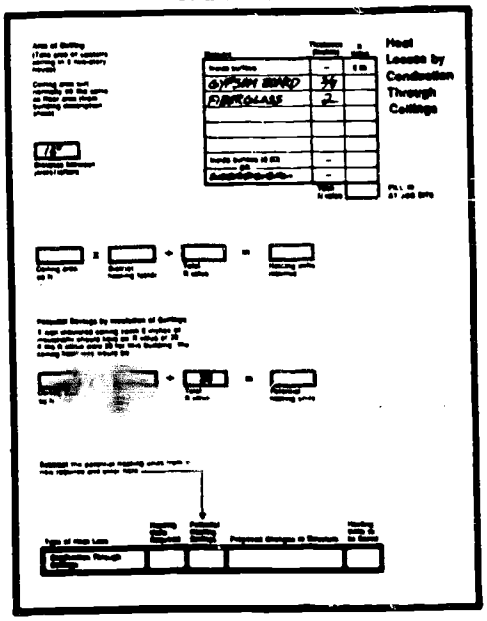


Chart C-36



Lesson Plan 5a.
Home Weatherization in Four Steps
Step 1:
Inspection

Chart C-37

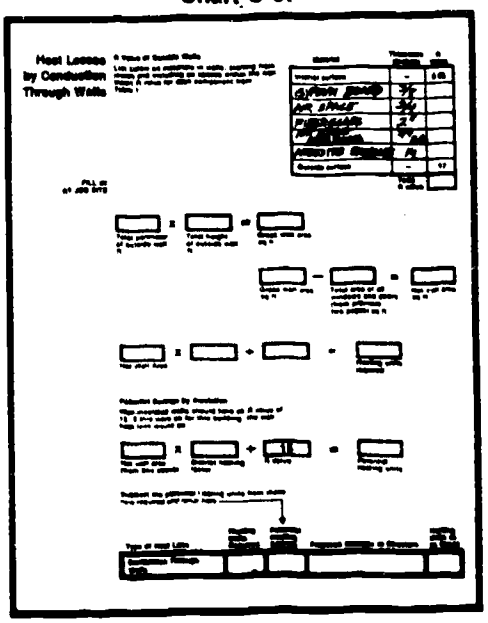
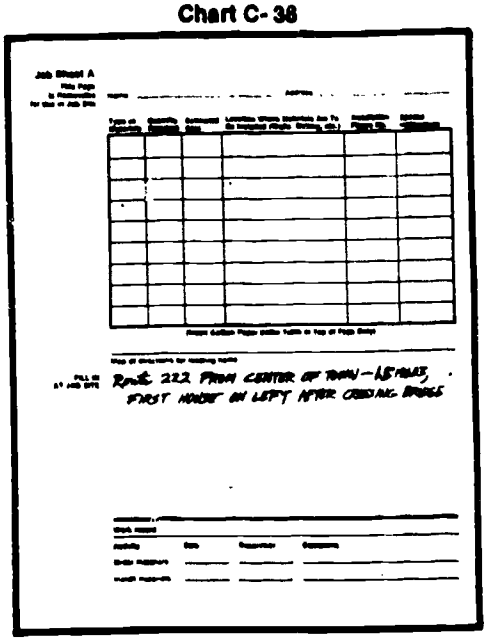


Chart C-38



Lesson Plan 5b. Home Weatherization in Four Steps
Step 2: Calculation

	Points of Emphasis	Manual Page	Chart No.
1.	**Step 2 — Calculate** the heat losses expected during a complete heating season (these simple calculations do not have to be done at the job site). (NOTE: The Job Book pages shown on charts C-40 thru C-49 are to be completed during class time by the instructor and students. Copies of the *completed* charts are included in this guide and in the manual.) (Lesson continued on next page)	11	C-39

Chart C-39

FOUR-STEP PROCESS

1. **INSPECTION OF THE BUILDING**
2. **CALCULATION OF HEAT LOSSES**

Lesson Plan 5b. Home Weatherization in Four Steps
Step 2: Calculation

Points of Emphasis	Manual Page	Chart No.
(Continued from previous page)		
(a) **Job Book page 4: Heat losses by infiltration**		C-40
(1) Enter floor area and ceiling height from page 2. Calculate volume of building.		
(2) Estimate the draft index based on the checkmarks in table. (1 air change) x (1) (2 air changes) x (3) 7 ÷ 4 = 1.75 Round to 1.8		
(3) Enter district heating factor from page 3.		
(4) Multiply these factors by 0.02 Btu/cu.ft./1°F to determine required heating units.		
(5) In a similar manner, determine potential heating units based on draft index = 1.		
(6) Subtract to determine potential heating savings, and enter on bottom line.		
(Lesson continued on page 32)		

Lesson Plan 5b. Home Weatherization in Four Steps

Step 2: Calculation

from Job Book, page 4

On pages 4-9, calculate the heat loss by infiltration and by conduction through the separate parts of the building; enter the results in the table at the bottom of each page and in the summary table on page 10.

House Draft Index: Opposite each of the four component parts of a building in the table below, place a check mark in the circle adjacent to the features which best describe the condition of the building.

Building Component	One Air change per hour (1)	Two Air change per hour (2)	Three Air change per hour (3)
Cellar or Crawl Space	Tight, no cracks, caulked sills, sealed cellar windows, no grade entrance leaks Plywood floor, no trap door leaks, no leaks around water, sewer, and electrical openings ○	Some foundation cracks, loose cellar windows, grade entrance not tight Tongue-and-groove board floor, reasonable fit on trap doors, around pipes ✓	Major foundation cracks, poor seal around grade entrance Board floor, loose fit around pipes ○
Windows	Storm windows with good fit ✓	No storm windows, good fit on regular windows ○	No storm windows, loose fit on regular windows ○
Doors	Good fit on storm doors ○	Loose storm doors, poor fit on inside door ✓	No storm doors, loose fit on inside door ○
Walls	Caulked windows and doors, building paper used under siding ○	Caulking in poor repair, building needs paint ✓	No indication of building paper, evident cracks around door and window frame ○

Multiply the number of check marks in the first column by 1, the second column by 2, and the third column by 3. The Draft Index will be the sum of these products, divided by 4.

924 (Floor area sq.ft.) x 8 (Height to ceiling (to upstairs ceiling in two-story house) ft.) = 7392 (Volume of air in building cu.ft.)

7392 (Volume of air in building) x 1.8 (Draft index) x 2 (District heating factor) x.02 = 532 (Heating units now required)

Potential Savings by Reducing Infiltration

It should be possible to reduce the draft index for a building to 1 (that is, reduce the number of air changes to one per hour). If the draft index for this building were improved to 1, the infiltration loss would be:

7392 (Volume (from above)) x 1 (Draft index) x 2 (District heating factor) x.02 = 296 (Potential heating units)

Subtract the potential heating units from those now required and enter here →

Type of Heat Loss	Heating Units Required	Potential Heating Savings	Proposed Changes to Structure	Heating Units to be Saved
Infiltration	532	236	CAULK & WEATHERSTRIP ALL WINDOWS & DOORS	

Chart C-40 (Form To Be Completed During Lesson)

Points of Emphasis	Manual Page	Chart No.
(Continued from page 30)		
(b) **Job Book page 5: Heat Losses by Conduction Through Floors**		C-41
(1) Enter floor area from page 2		
(2) Select appropriate floor exposure factor.		
(3) From Table 1 on page 15, obtain the R value for each material in the floor. Add these R values to obtain composite R value for floor. Round off value to nearest tenth of unit.		
(4) Enter district heating factor from page 3.		
(5) Use these factors to determine the required heating units and enter on bottom line.		
(6) In a similar manner determine potential heating units based on floor exposure factor = 0.5.		
(7) Subtract to determine potential heating savings, and enter on bottom line.		
(Lesson continued on page 34)		

Lesson Plan 5b. Home Weatherization in Four Steps
Step 2: Calculation

Lesson Plan 5b. Home Weatherization in Four Steps

Step 2: Calculation

from Job Book, page 5

Floor Exposure Factor
Select the appropriate factor from the descriptions below:

Building on posts or pillars with no skirts below floor	1.0
Crawl space skirted	.8
Rock wall basement	.8
More than 2 feet of basement wall exposed above grade	.8
Building on slab	.5
Building with tight crawl space	.5
Building with tight basement (heated or unheated)	.5

R value of floor
List below all materials in floor deck, including carpet but not floor joists, starting from uppermost surface and working down.

Insert R value for each component from Table 1 (p. 15)

Material	Thickness (inches)	R Value
Interior surface	—	0.68
LINOLEUM		.08
PLYWOOD	½	.65
SUBFLOOR	5/8	1.00
Interior surface	—	.68
	Total R value	3.1

924 (Floor area (from building description) sq.ft.) x 0.8 (Floor Exposure Factor) x 2 (District Heating Factor) + 3.1 (Total R value) = 477 (Heating Units Required)

Potential Savings on Floor Heat Losses
Floors can sometimes be insulated to reduce heat loss but this is often difficult; where water pipes are below the floor, freezing problems may occur during very cold spells. However, every floor should be protected from drafts, so that it has a floor exposure factor of 0.5. With this exposure factor for this building, the heat loss through the floor would be:

924 (Floor area from above sq.ft.) x 0.5 (Floor exposure factor) x 2 (District heating factor) + 3.1 (R Value from above) = 299 (Potential heating units)

Subtract the potential heating units from those now required and enter here

Type of Heat Loss	Heating Units Required	Potential Heating Savings	Proposed Changes to Structure	Heating Units to be Saved
Conduction Through Floors	477	178	CAULK BASEMENT BANK WALL	

Chart C-41 (Form To Be Completed During Lesson)

Points of Emphasis	Manual Page	Chart No.
(Continued from page 32)		
(c) **Job Book page 6: Heat Losses by Conduction Through Ceilings**		C-42
(1) Insert ceiling area (normally same as floor area on page 2).		
(2) From Table 1 on page 15 of Job Book, obtain R value for each material in the ceiling (or roof, where appropriate). Add these R values to obtain composite R value for ceiling (or roof). Round off value to nearest tenth of unit.		
(3) Enter district heating factor from page 3.		
(4) Use these factors to determine the required heating units and enter on bottom line.		
(5) In a similar manner, determine potential heating units based on an R value of well-insulated ceiling equal to 20.		
(6) Subtract to determine potential heating savings, and enter on bottom line.		
(Lesson continued on page 36)		

Lesson Plan 5b. Home Weatherization in Four Steps
Step 2: Calculation

Lesson Plan 5b. Home Weatherization in Four Steps

Step 2: Calculation

from Job Book, page 6

Area of Ceiling
(Take area of upstairs ceiling in a two-story house)

Ceiling area will normally be the same as floor area (from building description sheet)

16" — Distance between joists/rafters:

Material	Thickness (Inches)	R Value
Inside surface	—	0.68
GYPSUM BOARD	3/8	.32
FIBERGLASS	2	7.40
Inside surface (0.68)	—	.68
— OR —		
Outside surface (0.17)	—	
	Total R value	9.1

924 (Ceiling area sq.ft.) x 2 (District heating factor) + 9.1 (Total R value) = 203 (Heating units required)

Potential Savings by Insulation of Ceilings

A well-insulated ceiling (with 6 inches of insulation) should have an R value of 20. If the R value were 20 for this building, the ceiling heat loss would be:

924 (Ceiling area sq.ft.) x 2 (District heating factor) + 20 (Total R value) = 93 (Potential heating units)

Subtract the potential heating units from those now required and enter here →

Type of Heat Loss	Heating Units Required	Potential Heating Savings	Proposed Changes to Structure	Heating Units to be Saved
Conduction Through Ceilings	203	110	ADD 4" INSULATION	

Chart C-42 (Form To Be Completed During Lesson)

Lesson Plan 5b. Home Weatherization in Four Steps
Step 2: Calculation

Points of Emphasis	Menual Page	Chart No.
(Continued from page 34)		
(d) **Job Book page 7: Conduction Through Single-Glass Windows**		C-43
(1) Use sketches on page 2 to fill in table to determine total area of single-glass windows.		
(2) Enter district heating factor from page 3.		
(3) Use these factors to determine the required heating units (based on R = 1), and enter on bottom line.		
(4) Determine the potential heating savings as instructed, and enter on bottom line.		
(Lesson continued on page 38)		

Lesson Plan 5b. Home Weatherization in Four Steps

Step 2: Calculation

from Job Book, page 7

Area of Single Glass Windows:
(Assuming R = 1 for single glass)

If none, enter 0 — and go to next sheet on double windows and doors

Width	x	Height	x	Number	=	Area
5		4		1		20
3		4		4		48
				Total sq.ft.		68

68 (Total sq.ft.) x 2 (District heating factor) = 136 (Heating Units Required)

Potential Saving by Double Glazing

Double glazing or adding storm windows will cut the heat loss by half, so divide heating units by two, and enter here

Type of Heat Loss	Heating Units Required	Potential Heating Savings	Proposed Changes to Structure	Heating Units to be Saved
Conduction Through Single-Glass Windows	136	68	ADD PLASTIC STORM WINDOWS	

Chart C-43 (Form To Be Completed During Lesson)

Lesson Plan 5b. Home Weatherization in Four Steps
Step 2: Calculation

Points of Emphasis	Manual Page	Chart No.
(Continued from page 36)		
(e) Job Book page 8: Heat Losses by Conduction Through Double-Glass or Plastic Covered Windows and Through Doors		C-44
(1) Use sketches on page 2 to fill in table to determine total area of outside doors and double-glass windows.		
(2) Enter district heating factor from page 3.		
(3) Use these factors to determine required heating units based on R = 2, and enter on bottom line.		
(4) Potential heating savings will be "0" unless you triple glaze. Enter appropriate figure on bottom line.		
(Lesson continued on page 40)		

Lesson Plan 5b. Home Weatherization in Four Steps

Step 2: Calculation

from Job Book, page 8

Area of Double Glass and Doors

(Assuming R = 2 for these units)

Width	x Height	x Number	= Area
3	7	2	42
6	4	1	24
3	4	2	24
	Total sq.ft.		90

90	x	2	+	2	=	90
Total sq.ft.		District heating factor		R Value		Heating units required

Potential Savings

Triple glazing of windows can be done but is not usually practical. If no change were made in the windows, the potential saving would be 0 heating units and should be entered here.

(If windows were triple glazed, the R value would be approximately 3, and the potential savings would be one-third of the "Heating Units Required.")

Type of Heat Loss	Heating Units Required	Potential Heating Savings	Proposed Changes to Structure	Heating Units to be Saved
Conduction through Doors & Double-Glass Windows	90	0	NONE	

Chart C-44 (Form To Be Completed During Lesson)

Lesson Plan 5b. Home Weatherization in Four Steps
Step 2: Calculation

Points of Emphasis	Manual Page	Chart No.
(Continued from page 38)		
(f) **Job Book page 9: Heat Losses by Conduction Through Walls**		C-45
(1) Enter perimeter and height of outside walls from page 2. Multiply to obtain gross wall area. Subtract sum of areas of windows and doors from pages 7 and 8 to determine net wall area.		
(2) Insert district heating factor from page 3.		
(3) From Table 1 on page 15 of the job book, obtain R value for each material in walls. Add these R values to obtain composite value for the walls. Round off to nearest tenth of unit.		
(4) Use these factors to determine the required heating units, and enter on bottom line.		
(5) In a similar manner, determine potential heating units based on an R value of well-insulated walls equal to 15.		
(6) Subtract to determine potential heating savings, and enter on bottom line.		
End of Lesson No. 5B (Lesson No. 5C starts on page 42)		

Lesson Plan 5b. Home Weatherization in Four Steps

Step 2: Calculation

from Job Book, , page 9

R Value of Outside Walls

List below all materials in walls, starting from inside and including air spaces within the wall. Insert R value for each component from Table 1.

Material	Thickness (inches)	R Value
Interior surface	—	0.68
GYPSUM BOARD	3/8	.32
AIR SPACE	3/4	.91
FIBERGLASS	3	9.40
AIR SPACE	3/4	.91
SHEATHING	5/8	1.00
ASBESTOS SHINGLES	1/4	.13
Outside surface	—	.17
	Total R value	11.5

122 (Total perimeter of outside wall ft.) x 8 (Total height of outside wall ft.) = 976 (Gross wall area sq.ft)

976 (Gross wall area sq.ft) − 158 (Total area of all windows and doors (from previous two pages) sq.ft.) = 818 (Net wall area sq.ft.)

818 (Net wall area) x 2 (District heating factor) + 11.5 (Total R Value) = 142 (Heating units required)

Potential Savings by Insulation

Well-insulated walls should have an R value of 15. If this were so for this building, the wall heat loss would be:

818 (Net wall area (from box above)) x 2 (District heating factor) + 15 (R value) = 109 (Potential heating units)

Subtract the potential heating units from those now required and enter here →

Type of Heat Loss	Heating Units Required	Potential Heating Savings	Proposed Changes to Structure	Heating Units to be Saved
Conduction Through Walls	142	39	NONE - WALLS CLOSED	

Chart C-45 (Form To Be Completed During Lesson)

Lesson Plan 5c. Home Weatherization in Four Steps
Step 3: Evaluation

	Points of Emphasis	Manual Page	Chart No.
1.	**Step 3 — Evaluation of the Data**	12	C-46
	(a) Fill out the summary table on page 10 by entering the heating units required and the potential heating savings from the corresponding tables at the bottom of pages 4 through 9.		
	(b) Review the 12-point checklist on pages 11 and 12 of the manual to determine the most logical and practical weatherizing measures.	11-12	C-47

(Lesson continued on page 44)

Chart C-46

FOUR-STEP PROCESS

1. **INSPECTION OF THE BUILDING**
2. **CALCULATION OF HEAT LOSSES**
3. **EVALUATION OF THE DATA**

Lesson Plan 5c. Home Weatherization in Four Steps

Step 3: Evaluation

from Job Book, page 10

Use the instructions on page 11 of the Home Weatherization Manual to assess which potential savings can be obtained most successfully.

Fill out the following Summary Table by entering the "Heating Units Required" and the "Potential Heating Savings" from the corresponding tables at the bottom of pages 4-9. Then, write in the "Proposed Changes" and "Heating Units to be Saved" by such changes.

Heat Requirement Estimates (Annual Heating Units Needed)

Type of Heat Loss		Heating Units Required	Potential Heating Savings	Proposed Changes to Structure	Heating Units to be Saved
Infiltration	From Page 4	532	236	CAULK & WEATHERSTIP ALL DOORS & WINDOWS	236
Conduction Through Floors	Page 5	477	178	CAULK BASEMENT BANK WALL	178
Conduction Through Ceilings	Page 6	203	110	ADD 4" INSULATION	110
Conduction Through Single-Glass Windows	Page 7	136	68	ADD PLASTIC STORM WINDOWS	68
Conduction Through Doors & Double-Glass Windows	Page 8	90	0	NONE	0
Conduction Through Walls	Page 9	142	33	NONE - WALLS CLOSED	0
	Total	1580	625		592

Use the space below to calculate the quantities and cost of materials needed to make the proposed changes to the building.

INSULATION
CEILING - 924 sq. ft. - ORDER 1000 sq. ft.
PLASTIC STORM WINDOWS - 5' WIDE PLASTIC
4 x 3 = 12
1 x 5 = 5
17' - ORDER 20' + TAPE
BANKING - 4' WIDE PLASTIC: 33' + 28' + 33' = 94'
ORDER 100' + TAPE
WEATHERSTRIP - 2 DOORS: 7x3' 17' EACH x 2 = 34 ORDER 35'
CAULK - AROUND 8 WINDOWS + 2 DOORS = 122' + BASEMENT
ORDER 6 TUBES

Fill in job sheet on opposite page.

Chart C-47 (Form To Be Completed During Lesson)

Points of Emphasis	Manual Page	Chart No.
(Continued from page 42)		
(c) Enter these proposed changes and heating units to be saved in the summary table on page 10, and add up the three columns of figures.		C-47
(d) Use the lower half of page 10 to calculate the quantities and cost of materials needed to make the proposed changes to structure that you have specified in the summary table.		
(e) Fill out job sheet A on page 11 (insert carbon paper under table at top of page).		C-48
(1) Enter the type, quantity, cost and location for each item to be ordered. Enter installation diagram number from manual, as well as any special instructions regarding tools or methods.		
(2) Remove job sheet A from job book by tearing along perforated line at left edge of page.		
(Lesson continued on page 46)		

Lesson Plan 5c. Home Weatherization in Four Steps
Step 3: Evaluation

Lesson Plan 5c. Home Weatherization in Four Steps

Step 3: Evaluation

from Job Book, page 11

Name MARY PERKINS Address 3 PINE ST., BANGOR, ME.

Type of Materials	Quantity Required	Estimated Cost	Location Where Materials Are To Be Installed (Walls, Ceiling, etc.)	Installation Figure No.	Special Instructions
4 MIL. 16" O/C VB	1000 SQ FT	70.00	CEILING	14	TAKE SHEARS & STEPLADDER
POLYSTYRENE 4 MIL-9" WIDE	100 FT	16.00	BANKING	11	
POLY. 4 MIL 5" WIDE	20 FT	4.00	WINDOWS	8	NEED KNIFE & STAPLER
MASKING TAPE 2" WIDE	3 ROLLS	6.00	BANKING & WINDOWS	8,11	
CAULKING COMPOUND	6 TUBES	6.00	WINDOW & DOOR FRAMES	10	NEED CAULKING GUN
WEATHER STRIP VINYL TYPE	35'	3.00	DOORS	16,17	NEED HAMMER

(Insert Carbon Paper Under Table at Top of Page Only)

Map or directions for locating home:

ROUTE 222 FROM CENTER OF TOWN 1.5 MILES
FIRST HOUSE ON LEFT AFTER CROSSING BRIDGE

Work record

Activity	Date	Supervisor	Comments
Order materials	5-10-75	E. HALL	All materials ordered
Install materials	6-1-75	S. Paul	Doors not weatherstripped

Chart C-48 (Form To Be Completed During Lesson)

Points of Emphasis	Manual Page	Chart No.
(Continued from page 44)		
(f) Fill out lower half of job sheet on page 13		C-49
(1) Determine estimated total cost of materials used.		
(2) Enter fuel factor based on information from page 3.		
(3) Enter heating units saved based on the actual changes to structure.		
(4) Enter price of fuel from page 3.		
(5) Calculate payoff time. It should be less than three seasons. If it is not, check back to the most expensive changes to determine if they are really worth the expense.		

Lesson Plan 5c.
Home Weatherization in Four Steps
Step 3:
Evaluation

Lesson Plan 5c. Home Weatherization in Four Steps

Step 3: Evaluation

from Job Book, page 13

Type of Materials	Quantity Required	Estimated Cost	Location Where Materials Are To Be Installed (Walls, Ceiling, etc.)	Installation Figure No.	Special Instructions
4" INSUL, 16" B% VB	1000 sq.ft.	70.00	CEILING	14	TAKE STAPLERS & STEPLADDER
POLY 4 MIL - 9' WIDE	100 ft.	16.00	BANKING	11	
POLY 4 MIL 5' WIDE	20 ft.	4.00	WINDOWS	8	NEED KNIFE & STAPLER
MASKING TAPE 2" WIDE	3 ROLLS	6.00	BANKING & WINDOWS	8,11	
CAULKING COMPOUND	6 TUBES	6.00	WINDOW & DOOR FRAMES	10	NEED CAULKING GUN
WEATHER STRIP VINYL TUBING	35'	3.00	DOORS	16,17	NEED HAMMER

Total Cost 105.00

Pay-off Time

This is the number of seasons for fuel savings to pay off the cost of weatherization.

GOOD INVESTMENT!

$$\frac{\text{105.00 (Total cost, from job sheet above)}}{\text{1 (Fuel factor)} \times \text{592 (Total heating units saved, from page 10)} \times \text{.40 (Price of fuel per gal, cu.ft:, kWh, cord)}} = \text{.44 ("Pay-off" time, heating seasons)}$$

Fuel factor: Fuel oil = 1; Natural gas = 120; Electricity = 30; Wood = .01

Chart C-49 (Form To Be Completed During Lesson)

Lesson Plan 5d. Home Weatherization in Four Steps
Step 4: Installation

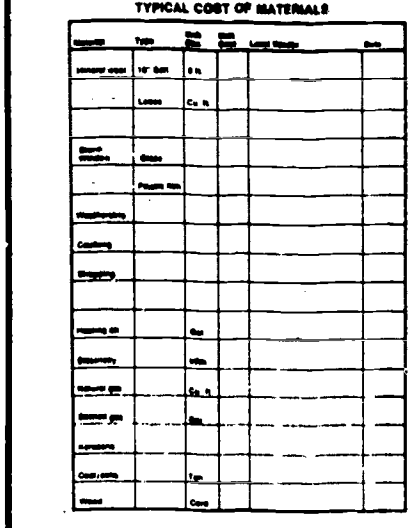
	Points of Emphasis	Manual Page	Chart No.
	(Continued from page 46)		
2.	Final step in the weatherization process is installation of materials. Some members of class may be well versed in this activity. Everyone will benefit by pooling our knowledge of the techniques that have proven to be most effective. Method we will use to cover the highlights of this subject will be: (NOTE: refer to following page for suggested methods for Lesson 5D). End of Lesson 5C (Lesson 5D starts on next page)	13	C-50

Chart C-50

FOUR-STEP PROCESS

1. INSPECTION OF THE BUILDING
2. CALCULATION OF HEAT LOSSES
3. EVALUATION OF THE DATA
4. INSTALLATION OF THE MATERIALS

Chart C-51



Lesson Plan 5d. Home Weatherization in Four Steps Step 4: Installation

Note To Instructor

1. This subject, installation of materials, does not lend itself as well to the lecture method of instruction that was used in the previous lessons. The following methods involving either laboratory exercises or classroom demonstrations are suggested for consideration by the instructor in preparing a lesson plan:

   (a) **Laboratory Exercises (preferred method)**
   The laboratory exercises that begin on the following page represent the most effective method for teaching this subject to a class of students who have had some training and/or experience in carpentry.

   (b) **Classroom Demonstration (alternative method)**
   If shop facilities are not available, the teacher may wish to conduct demontrations in a classroom of the installation activities covered in the laboratory exercises.

   (c) **Classroom Lecture (optional)**
   An optional lesson plan on installation, which utilizes approximately 60 35mm slides, has been prepared for use when classroom facilities are not suitable for either laboratory exercises or classroom demonstrations. Several sets have been distributed to the State Energy Office in each State for use in the vocational-technical schools. In addition, a set is available on loan from the Regional Office of the Federal Energy Administration.

2. **Laboratory Exercises on Installing Insulation**

   (a) **Objective:** to give the students a hands-on experience in installing the common forms of insulation materials.

   (b) **Equipment and Materials Required:**
   Wall frame mockup
   Insulation (blanket or batt)

(Lesson continued on next page)

Note To Instructor

(Continued from previous page)

(b) **Equipment and Materials Required (continued)**
Stapler
Shears

(c) **Suggested Procedure**
Demonstrate to class the proper methods for installing insulation in ceilings, floors, crawl spaces and masonry walls. Discuss vapor barriers and ventilating attics.

Have students (or teams) practice installing insulation on the wall frame mockups. (If small staples are used, the insulation can be carefully removed and reused).

3. **Laboratory Exercise on Installing Weatherstripping**

(a) **Objective:** to give the students a hands-on experience in installing weatherstripping and other weatherizing materials.

(b) **Equipment and Materials Required**
Door and frame mockup
Weatherstripping materials (several types)
Caulking gun and tube
Shears
Knife
Hammer
Stapler

(c) **Suggested Procedure**
Discuss the selection of materials. Demonstrate to class the proper method for installing the materials.

Have the students (or teams) practice installing the weatherizing materials to the mockups.

(Lesson continued on next page)

Lesson Plan 5d. Home Weatherization in Four Steps
Step 4: Installation

Lesson Plan 5d. Home Weatherization in Four Steps
Step 4: Installation

Note To Instructor

4. **Laboratory Exercise on Installing Plastic Storm Windows**

(a) **Objective:** to give the students a hands-on experience in installing plastic storm window.

(b) **Equipment and Materials Required:**
Window frame mockup
Plastic sheeting
Fastening materials:
Wood strapping and nails
Masking tape and staples
Tools:
Shears, knife, hammer, saw, and stapler

(c) **Suggested Procedure**
Discuss the procedure, demonstrate to class and have students (or teams) practice installing plastic on window frame mock-up.

5. **Field Assignment to Obtain Costs of Materials**

Instructor should encourage students to phone or visit local suppliers to obtain current costs of common materials used in the weatherizing process. A table for recording this information is provided in the student's manual on page 27 (chart C-51).

End of Lesson 5D

Note To Instructor

1. **Purpose of Lesson**

   This lesson will enable the intructor to evaluate the degree to which the instructional Objectives have been achieved.

2. **Evaluation of Instructional Objective No. 1: Estimation**

   (a) **Objective:** Given the physical dimensions and construction features of a detached residential structure, a student will prepare a written analysis (job book) containing the following:

   (1) Identification of gross thermal deficiencies of the structure which result in heat losses by infiltration and conduction;

   (2) Comparison of current heating requirements with the potential savings;

   (3) Job writeup, from which material specifications and bill of materials will be prepared; and

   (4) Bill of materials for the feasible remedies, including costs and payback period.

   (b) **Procedure**
   A preferred and an alternate procedure are suggested. The preferred procedure is a ***field exercise*** that involves the inspection-calculation-evaluation steps of the four-step weatherizing process covered in lesson plans 5A, 5B and 5C. The alternate procedure is a ***classroom exercise*** that involves the calculation-evaluation steps only.

   (c) **Field Exercise**
   (1) Inspection: Arrange for class to visit a nearby home that has simple construction characteristics (one-story and simple floor plan).

(Lesson continued on next page)

Lesson Plan 6.
Job Book
Example by
Students

Lesson Plan 6. Job Book Example by Students

Note To Instructor

(Continued from previous page)

(c) **Field Exercise (continued)**

Working independently or in assigned teams, each student will record the physical dimensions and construction features called for in the job book on pages 2, 4, 5, 6, 9, and 11. (To insure uniformity, the teacher will provide the student with the dwelling and heating system information called for on page 3.)

(2) Calculation-evaluation: After returning to the classroom, the data obtained by students will be discussed by the class to resolve differences. Then, each student will independently perform the calculations and evaluation called for in steps 2 and 3, and record the answers in the job book.

At the conclusion of the exercise, the answers will be compared and the differences discussed. (If appropriate, the job books will be collected by the instructor for grading and/or evaluation purposes.)

(d) **Classroom Exercise**

(1) Inspection: If a field trip is not practical, this step will be omitted. The instructor will prepare an example of a single-family home having simple features. Students will be given the physical dimensions and construction features called for in the job book on pages 2, 3, 4, 5, 6, 9, and 11.

(2) Calculation-evaluation: Each student will independently perform the calculations and evaluation called for in Steps 2 and 3 of the four-step weatherization process, and record the answers in the job book.

At the conclusion of the exercise, the answers will be compared and the differences discussed. (If appropriate, the job books will be collected by the instuctor for grading and/or evaluation purposes.)

(Lesson continued on next page)

Lesson Plan 6.
Job Book
Example by
Students

Note To Instructor

(Continued from previous page)

3. **Evaluation of Instructional Objective No. 2: Installation**

(a) **Objective:** Give a job writeup (job book) for a detached residential structure, the student will describe and/or demonstrate to others the proper methods for installing the specified materials.

(b) **Procedure:** Due to the wide variety of possible instructional situations, no standard procedure will be given here.

An ideal procedure would be for the instructor to make arrangements through a community service agency that is involved in weatherizing homes, to have the class install the weatherizing materials purchased by that agency.

If this is not practical or feasible, the instructor is encouraged to design an evaluation procedure based on the method of instruction employed in lesson 5D.

End of Lesson No. 6

Publications on Home Weatherization

Making the Most of Your Energy Dollars in Home Heating and Cooling, National Bureau of Standards, U.S. Department of Commerce, June 1975. Adapted from the methodology developed in the NBS Economic Analysis (also listed), this 16-page booklet presents a simplified technique for determining retrofit options and comparing costs and savings. Accuracy is sacrificed due to substitution of assumptions for actual data; however, the booklet can provide a fair estimate of the potential savings of retrofitting. Very little information is provided on installation techniques. Available from Superintendent of Documents, U. S. Government Printing Office, Washington, D.C. 20402. Price 70 cents. Stock Number 003-003-01446-0.

In The Bank . . . Or Up the Chimney? Department of Housing and Urban Development, April 1975. This 72-page sophisticated booklet is an effective homeowner's guide to energy-saving home improvements. It is probably the most detailed and easy-to-use guide designed for the individual homeowner interested in retrofitting his home. The booklet takes the homeowner on a step-by-step inspection tour of the house, determines the possible retrofit options, calculates the costs and savings of each, and then provides detailed instruction for either contractor or do-it-yourself installation. Well-written, well-researched, and up-to-date. Available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Stock Number 023-000-00411-9.

Retrofitting Homes for Energy Conservation: A Business Guide, National Association of Home Builders Research Foundation, Inc., March 1975. A 65-page study designed for business firms and other entrepreneurs considering entry into the field of home retrofitting. Specific areas covered include the emerging demand and need for the service, marketing considerations, unique aspects of the retrofit business, management of a retrofit work crew, development of retrofit packages, and a detailed technique for calculating retrofit needs and potential savings. Available from Office of Buildings Porgrams, Washington, D.C. 20461.

Retrofitting Existing Homes for Energy Conservation: An Economic Analysis, National Bureau of Standards, U.S. Department of Commerce, December 1974. This 70-page technical study examines the economic aspects of energy conservation techniques suitable for retrofitting into existing housing. Its objective is to determine that combination of techniques that will maximize net dollar savings in life-cycle operating costs for heating and cooling in existing homes, subject to specific climate conditions, fuel costs, and retrofitting costs. Thermal engineering data are combined with the economic analysis in a computer-assisted model to estimate optional combinations of retrofit actions. Available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Stock Number 003-003-01360-9.

Save Energy: Save Money! Institute on Energy Conservation and the Poor, Office of Economic Opportunity, December 1974. This 40-page booklet describes a wide variety of low-cost, do-it-yourself energy-saving techniques. The descriptions of installation techniques are less detailed than most of the other publications. Much more emphasis is given to exotic techniques (solar window heaters, intra-room vents, insulation curtains) than any other book. Available from the Office of Economic Opportunity, Washington, D.C. 20506.

How to Save Money by Insulating Your Home, National Mineral Wool Association, Inc., September 1974. This 16-page 4" x 9" pamphlet is a clearly written and well-illustrated guide to home insulation techniques for do-it-yourselfers. Covers loose fill and roll or batt insulation, vapor barriers, attic/crawlspace ventilation, and weatherstripping and caulking. Available from Office of Weatherization Assistance, DOE Washington, D.C. 20461.
Weatherization for Low-Income, FEA, Washington, D.C. 20461.