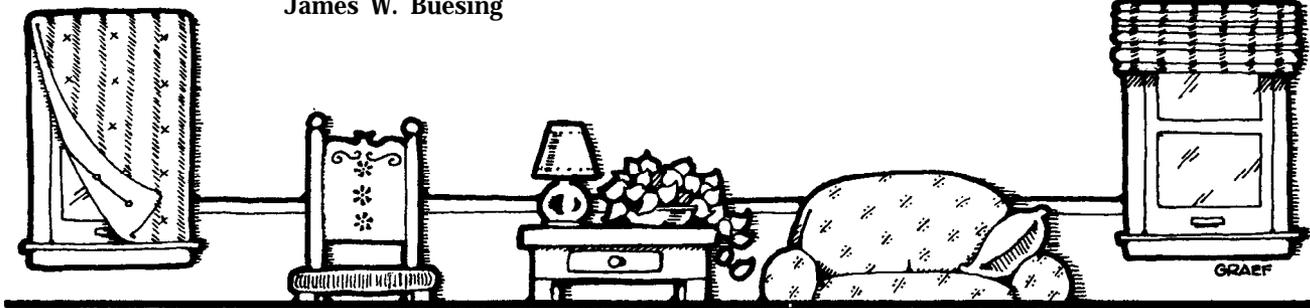


# Energy Conserving Window Treatments: Insulated Shades and Draperies

James W. Buesing



In the average Wisconsin home at least 10 percent of the exterior walls are windows. Even when carefully weatherstripped, caulked and equipped with a tight-fitting window, the winter heat loss through a window can account for 10 to 30 percent of your total heating bill. Additional layers of plastic or glass will help reduce heat loss by creating additional insulating pockets of air. You can further reduce window heat loss and increase comfort through the use of insulated window shades or draperies.

## What makes a shade or drapery an insulated shade or drapery?

To be effective, any insulated window treatment must include three features:

1. A method of *reducing heat loss*. (An average window will lose almost 10 times as much energy as the same area of wall or ceiling.)
2. A *tight seal* at each edge to prevent room air from circulating behind the shade or draperies and contacting the window surface.
3. A *vapor barrier* (sheet of plastic, vinyl, mylar, etc.), on the warm side to prevent moisture in the room's air from passing through the window treatment and condensing on the cold window.

## IMPROVE THE EXISTING WINDOW FIRST

### Caulk and weatherstrip

Research and experience have indicated many ways to save energy being lost through and around windows. The first step should always be to caulk and weatherstrip all cracks to reduce infiltration of cold air to an absolute minimum.

### Use interior storm windows

If a window has no storm, add at least one additional glazing (layer of glass or plastic). Even if the window has a storm or is an insulating double glass unit, adding one or two additional inexpensive glazings can be very cost effective (even on south-facing windows which capture the winter sun's heat unless a night insulation product is used). They have the additional benefits of

greatly increasing the comfort level and reducing condensation problems. Glazings may be either on the inside or outside. Conventional polyethylene storm window plastic is the most cost effective, but you may choose other plastics or glass for aesthetic reasons. Inexpensive plastic placed behind lightweight sheers may look better and still allow light and some visibility. New plastics, which may be shrunk by using the heat from a hair dryer, are inexpensive and very clear. They may be attached permanently for even greater savings. *Be sure any added glazings will still permit the window to be used as an emergency fire exit*

### Improve existing shades and draperies

Shades and draperies have been used for years to increase comfort by shielding people from cold glass surfaces. They also can reduce heat loss. You can significantly increase the effectiveness of conventional shades and draperies just by sealing first the bottom, second the center and sides, and finally the top. (If draperies are not hung near a sill or the floor, you will need to add an artificial sill or shelf. Use heat deflector if draperies hang over registers or radiators.) Zippers, Velcro®, magnetic fasteners, tacks, snaps or hooks could all be used to seal the drapery centers and sides. Valances work well to seal the top. Edge seal channels are now available to improve the fit of conventional shades. Be aware that improving the seal around existing window treatments will probably greatly increase nighttime condensation problems unless they are a vapor barrier.

## BUYING INSULATED WINDOW TREATMENTS

Many new insulating window products are now becoming available to the consumer. These can be seen at energy fairs or in recent issues of such magazines as Popular Science, Better Homes and Gardens, Woman's Day, Organic Gardening, New Shelter, or Alternative Sources of Energy. Ask your public library for other similar magazines. To find which products are carried locally, call the stores listed under "Draperies," "Window Shades" or "Energy Products" in the yellow pages of your phone book.

As with any new product, beware of unscrupulous claims. Remember that insulated window treatments *must* have a vapor barrier *and* a tight seal to be effective. Many so-called insulated draperies (foam backed, quilted, lined, etc.) are not effective because they do not contain a vapor barrier or sealing system. They will cause extensive condensation problems. Some insulated shades use conventional insulating materials, while others might use multiple layers of reflective foils to trap insulating air and bounce the heat back. Ask to talk with satisfied customers to determine which design is best for your application.

**Caution:** Sealed insulating double glass windows may crack if interior insulation is applied. This is most likely to occur 1) if insulation is left on during a sunny day, thereby creating a severe temperature difference between the inside and outside glass, and 2) when insulation is removed and the warm room air first hits the cold glass. The chance of a crack occurring can be reduced by adding one or more permanent glazings on either side of the insulating glazing unit.

Up and down shade designs seal more easily than drapery-like designs that pull to one side. A roller shade design can be used if the edges travel within a side track and a double roller is used at the top. Designs of this sort are available for about \$8-\$10 per square foot. (See figure 1.)

## COST, SAVINGS AND PAYBACK

It is very popular to analyze energy saving products in terms of their payback, that is, how long it will take before the money saved equals the money spent. Payback is also important when comparing various window options. It is *not*, however, the only means of comparison. Ease of installation, operation and cleaning, care, durability, aesthetics and increased comfort need to be considered also.

In the past, consumers have spent large amounts of money on decorative window treatments with no thought of any payback. Likewise, today's consumers must determine how much they feel they are paying for insulation and how much they are paying for aesthetics and convenience. If saving energy was the only concern, glass fiber insulation could be stapled over our windows.

To determine how much you will save from various window treatments, first calculate how much the window treatments will cost per square foot (see end of bulletin). Since every house has a different amount of window area, only by looking at the loss per square foot of window can a figure be given which is useful to everyone. While the figures given in this section are only approximations, they can be helpful in giving you an idea of the savings involved and the comparative value of different options.

For example, in the winter of 1983-84, it would have cost you about \$1.50 for the heat lost through *every square foot* of double glazed window (single window with storm or sealed double insulating glass) if you heated with oil

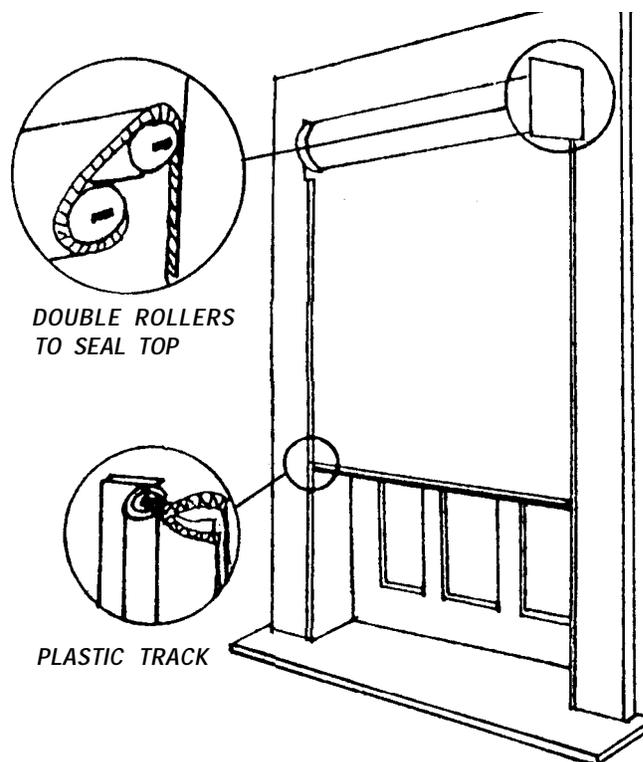


Figure 1. Typical Quilted Shade with Top and Side Seals

or LP gas. The cost is about \$1.20 if your home is heated with natural gas and about \$2.30 if your home is heated with resistant electric heat. (See end of bulletin for directions on how to calculate the current heat loss for your region.)

How much of that \$1.50 can you expect to save by adding something to the window? Rough estimates of projected savings can be seen in Table 1.

The R-values are a measure of resistance to heat flow. The higher the R, the better the insulating value. A bare, double glazed window has an R-value of 1.82, a standard insulated 3-1/2 inch wall has an R of 13.2 and 6 inches of fiberglass attic insulation has an R of 19.

Line 8 in Table 1 shows that an insulated R-3 shade will save 38 percent of the \$1.50 for heat lost, or 57¢ per square foot per year ( $.38 \times 1.50 = .57$ ). If you constructed your own insulated shade for a cost of \$4 per square foot, it would take seven years to pay back your original cost: original cost per square foot (\$4) divided by first year's savings per square foot (57¢) = simple payback ( $4.00 \div .57 = 7$  years).

Adding one glazing in the form of a simple outdoor plastic storm will result in a 35 percent savings (line 13 in Table 1), or 53¢ per square foot per year. Since the plastic may cost less than 10¢ per square foot, the payback period is about one month.

For most products the advertised R-value is the only indicator the consumer has of insulating value. Often companies list window treatments as a total of the double glazed window *plus* their product. Subtract 1.8 (R-value of double glazed window) to obtain the R-value of the product.

As shown in the table, the most savings occurs with the smallest addition of insulation. R-2 saves 14 percent more energy than R-1, but adding one more R for a total of R-3 saves only 3 percent more. As a rule-of-thumb, do not pay for large R-values unless the cost is not more than seven times the first year's savings. (Cost can be up to 15 times greater for durable insulating products which last up to 10 years.) An R-3 window treatment will save 57¢ the first year, so \$4 per square

foot (7x.57=\$4) installed is about the maximum you should pay for the insulation value of the product. Most window treatments will cost more than this, but remember, *not all the benefits have a dollar value.*

Generally, permanent architectural products such as storm windows are eligible for federal energy tax credits. Temporary devices, such as conventional shades and draperies, are not. This leaves some uncertainty about sealed window treatments. The Internal Revenue Service is currently studying this issue. Call the IRS toll-free at 1-800-452-9100 to ask about any federal tax credits which may apply. Do not rely on dealers' claims.

Escalating fuel costs will always help payback, so when in doubt, it will probably pay to invest.

**Table 1. SAVINGS IN TOTAL WINTER HEAT LOSS THROUGH WINDOWS<sup>a</sup>**

Added window treatment	Percent saved <sup>b</sup> when added window treatment is used with:		
	Single glass	Double glass	Triple glass
<b>Night only use (14 hours)<sup>c</sup></b>			
1. loose drapes <sup>d</sup>	4	2	1
Venetian blinds <sup>e</sup>	6	3	2
2. tightly fitted shade (1/4" edge gap) <sup>e</sup>	20	12	8
4. pinned and tacked draperies <sup>d</sup>	22	13	9
5. sealed shade <sup>d</sup>	25	15	11
6. R-1 insulating treatment <sup>f</sup>	32	21	16
7. R-2 insulating treatment <sup>f</sup>	42	35	25
8. R-3 insulating treatment <sup>f</sup>	46	38	31
9. R-4 insulating treatment <sup>f</sup>	49	41	35
10. R-5 insulating treatment <sup>f</sup>	51	44	39
11. R-7 insulating treatment <sup>f</sup>	53	48	43
12. R-13 insulating treatment <sup>f</sup>	56	52	50
<b>Day and night use</b>			
13. 1 added glazing (permanent) <sup>f</sup>	51	35	25
14. 2 added glazing (permanent) <sup>f</sup>	68	51	40

<sup>a</sup> Savings compared to total winter heat loss through bare window anywhere in U.S. Effects of sunlight and infiltration are not calculated.

<sup>b</sup> Percent saved through window only! Windows contribute 10-300/o to total fuel bills. Energy-saving treatments may reduce total heating bills by 5-15%.

<sup>c</sup> If window treatment is left in place continuously, day and night, multiply savings by 1.67

<sup>d</sup> Calculated from results listed in research report "Insulating Properties of Carpets and Draperies," University of Georgia, College of Agriculture Experiment Station, Athens, Georgia, November 1969.

<sup>e</sup> Calculated from results listed in research report "Window Shades and Energy Conservation," Illinois Institute of Technology, Chicago, Illinois, December 1974.

<sup>f</sup> Calculated using standard procedures outlined in American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) Handbook of Fundamentals, 1977. If advertised R-value includes window, subtract .88 for single glass, 1.82 for double or 2.76 for triple glass.

## INTERIOR STORMS VS. INSULATED NIGHT COVERINGS

Interior storms should always be the first consideration for any window. They reduce heat loss and infiltration 24 hours a day and still provide light and visibility. They do not require daily operation and are usually significantly cheaper than night insulation. They also help solve most normal condensation problems. Only in instances where the area of glass is so large as to cause great discomfort in the evening should insulated shades or shutters be considered.

## DO-IT-YOURSELF INSULATED ROMAN SHADES

The Roman shade design seems to be the most popular and practical for home construction. Designs can be adapted to most windows and patio doors. The shades are permanently sealed at the top when they are mounted. The bottom is sealed with weights or Velcro<sup>®</sup> fasteners. The most successful side seal uses a board fastened with spring hinges to the side trim. This board acts as a large clamp which seals the sides. These seals, along with a vapor barrier (polyethylene plastic) on the warm side, will prevent any condensation. Of course, there are other ways you can seal sides. Experiment to determine the best method for your window.

Kits are available from many fabric stores which allow you to just add the decorative material you wish to face the room. Many of these use magnets to seal the sides, but these are less effective on windows over 45" wide. To construct your own insulated shade, use bonded fiberfill or a similar product as the insulating material. A shade with a 1/2 inch layer of insulation will give an effective insulating value of approximately R-3. This amount has proven to work the best. Actual R-values will vary depending on materials, construction, mounting and seal.

### Construction of insulated Roman shades

- Measure the window and draw to scale on graph paper to determine the dimensions of pieces needed. Allow a few extra inches on all sides for sealing and attaching to window at top.
- Allow 1/8 inch more material for each row of tufts or stitching, as it draws the shade together. Add 1/2 inch for seam allowance on both sides and bottom.
- Wash the material before you cut it to allow for shrinkage. A cotton-polyester blend is best and a tighter weave is easier to sew because it is more stable.
- Put the front and back material (right sides together) on a table. Place the *bonded* fiberfill (best if bought off the roll) on top. Pin the three layers together and sew side and bottom seams 1/2 inch from edge. Turn shade right side out. (Plastic could be pinned to the bottom of the other three layers or installed as indicated in the next step.)
- Cut vapor barrier (out of polyethylene plastic or vinyl) the same size as the shade "pocket." Slide plastic into pocket between front fabric and fiberfill. Push plastic all the way to corners and pin in place. You can top-stitch around edges, although this may not be necessary since quilting tufts will hold the plastic in place.

- Tie quilting knots in 10 to 12 inch squares, tying rings on back side or leaving loops for draw-strings. Clear buttons may be added to the front to prevent the tie from pulling through.
- Attach shade directly to top of window trim with tacks or Velcro®, or staple shade to board which can then be mounted above the window.
- Attach heavy string to the bottom of the shade and thread through the loops to a screw-eye on one side. Pulling the strings will now cause the shade to "ac-cordian" fold toward the top.
- Attach spring-loaded hinges to boards at sides on window frame to form a clamp for sides of shade. Space must be left at bottom of clamp to ac-commodate fabric on the sill. Velcro® strips may be needed on the bottom if condensation occurs.
- Experiment by constructing a few small samples first.

### Care of insulated Roman shades

- Shades may be washed and tumble dried with no heat.
- Do not iron shades. Fiberfill begins to fuse at 105 degrees F.
- Use a steamer to remove wrinkles.

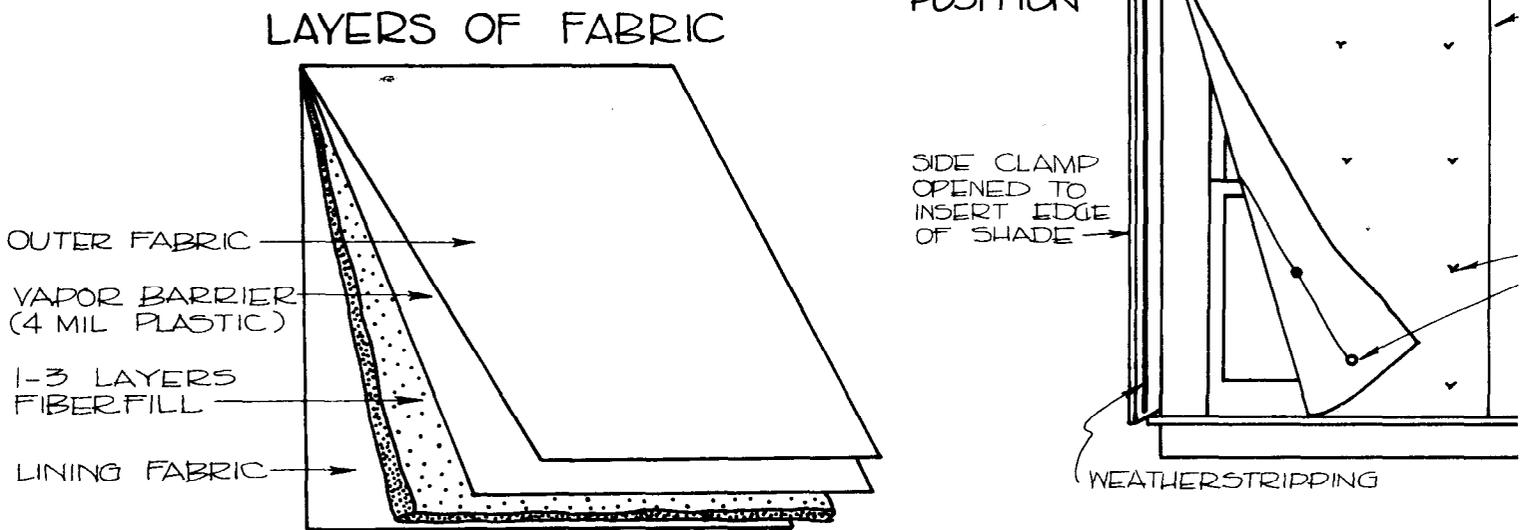


Figure 2

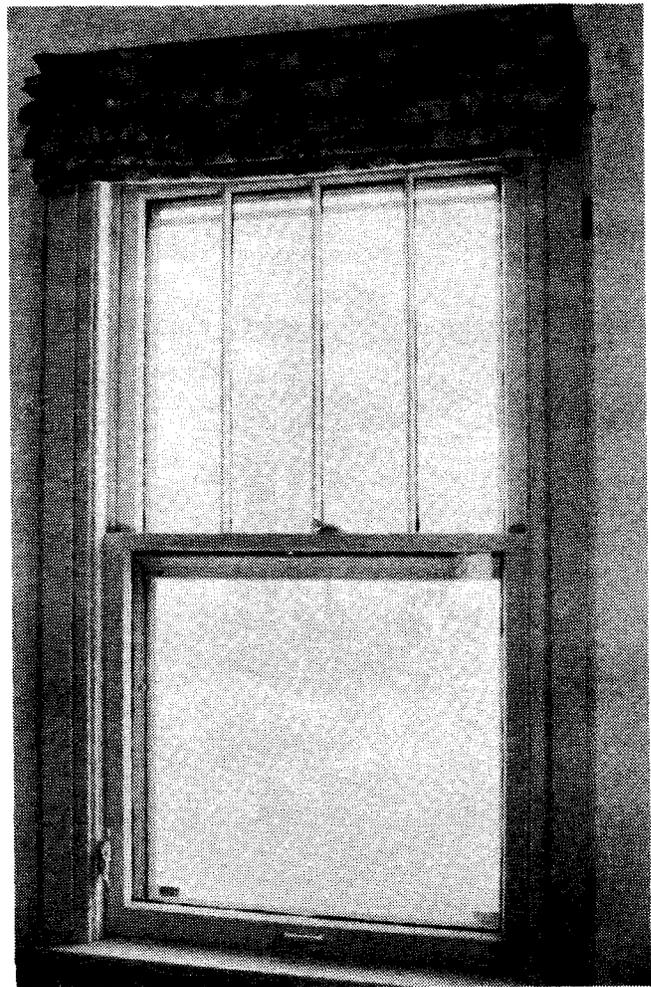
## HOW TO CALCULATE CURRENT HEAT LOSS THROUGH WINDOWS FOR YOUR REGION

The seasonal heat loss varies with the number of degrees the average daily temperature is below 65 degrees F. This number is called the heating degree days (DD) in your area and can be obtained by calling your fuel supplier, county Extension office or nearest weather office or airport.

For 8000 DD winter (Mid-Wisconsin) for a bare double glass window, not including sunshine or infiltration, your current cost of heat lost through your window can be found by multiplying your current fuel cost by the following multipliers:

- electricity cost per kwh x 31.06=cost of fuel lost per sq. ft. of window per year
- oil cost per gallon x 1.26=cost of fuel lost per sq. ft. of window per year
- LP gas cost per gallon x 1.76=cost of fuel lost per sq. ft. of window per year

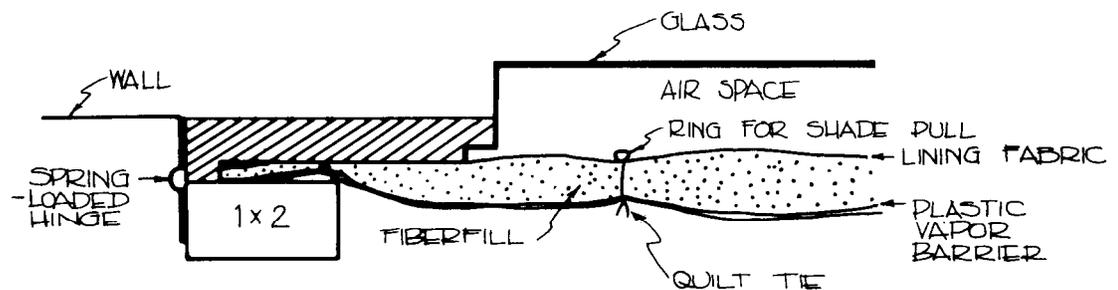
natural gas cost per 100 cubic ft. or therm x 1.63=cost of fuel lost per sq. ft. of window per year

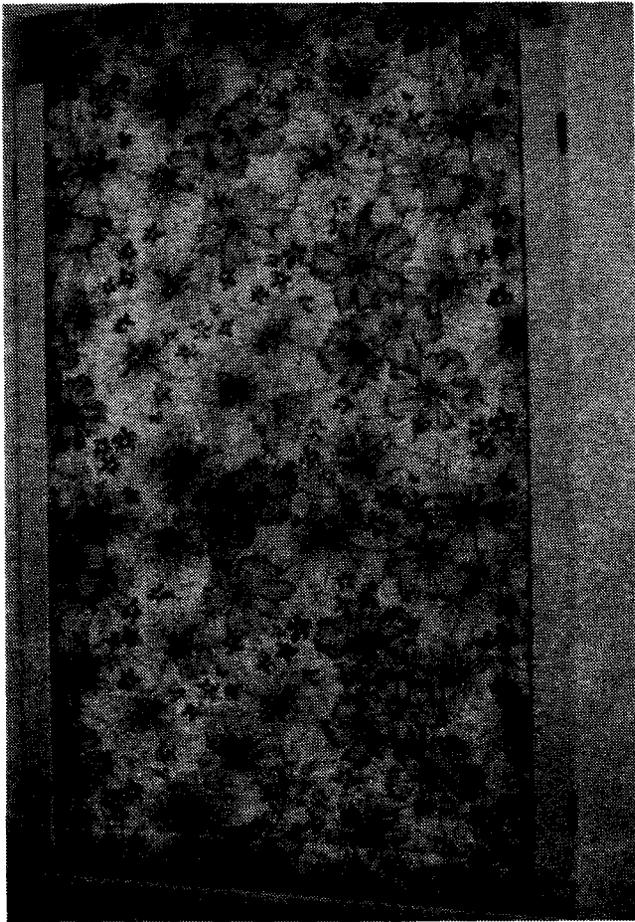


*This Roman shade opens "accordian-style" and may be raised to any height. This requires attaching rings on the back side. The shade is lightweight and can easily be drawn up by strings run through the rings.*

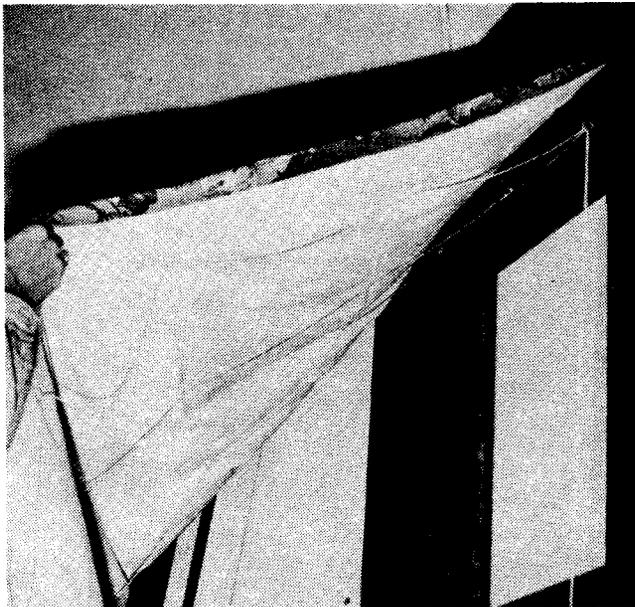
- SHADE TACKED TO TOP OF MOULDING
- CLOSED POSITION OF 1x2 SIDE CLAMP
- SPRING-LOADED HINGE
- QUILTING TIE: ATTACHES RING ON REVERSE SIDE FOR ROMAN SHADE PULL

### CROSS SECTION VIEW FROM THE TOP





A Roman shade in a closed position is shown above. A furring strip is attached to the moulding with a spring or regular hinge. (Space must be left at the bottom to accommodate fabric on the sill.) Seal the bottom with Velcro or a friction fit.



Rings are quilted to the shade at 10 to 12 inch intervals. A string pulled through the rings causes an accordion effect. The top rings must be near eye hooks which are attached toward the top of the shade. Strings run through the eye hooks to one side and form a cord for shade operation.

For example, if you have resistant electric heat at a cost of 5¢ (.05) per kwh, multiplying by 31.06 would result in an annual cost for heat lost out of 1 square foot of window of \$1.55 (\$.05 x 31.06=\$1.55).

For regions other than 8000 DD winter; calculate the cost of heat lost out of a double glass window by multiplying your cost of fuel per unit (kwh, gallons, or cubic feet) times your heating degree days divided by 1000, times the number given next to your heating type (furnace efficiencies are taken into consideration).

Fuel cost multiplier:

electricity (kwh)	38.82
LP gas (gallons)	2.20
oil (gallons)	1.57
natural gas (100 cu. ft. or therms)	2.03

For example: Oil, which costs \$1.25 per gallon in Missouri (5000 DD) would result in 98¢ lost per square foot of window per year:

$$(\$1.25 \times \frac{5000}{10,000} \times 1.57 = 98\text{¢})$$

For single and triple glass windows, multiply the cost of heat lost out of a double glass window by .65 to obtain the heat lost out of 1 square foot of a triple glass window and by 2.27 to obtain the heat lost out of 1 square foot of a single glass window.

## WINDOW TREATMENT CONSUMER CHECKLIST

Use the checklist to compare different window treatment options, either purchased commercially or constructed at home. If you are designing your own window treatment, use this checklist to determine the materials needed and their cost.

### Design components

- control mechanism
- storage
- seals
  - bottom
  - sides
  - center
  - top
- heat deflector
- vapor barrier
- insulation
- material
  - front
  - back
- fasteners
- framing or interior supports

### Rating

• ease of installation	1	2	3	4	5	6	7
• ease of operation	1	2	3	4	5	6	7
• durability	1	2	3	4	5	6	7
• care and cleaning	1	2	3	4	5	6	7
• aesthetics	1	2	3	4	5	6	7

# CALCULATION SHEET

Calculate according to formulas given. Bold italicized numbers refer to the figure you filled in on the line with that number.

Example

## Cost per square foot

1. height of window (opening size) in inches = \_\_\_\_\_ 1
2. width of window (opening size) in inches = \_\_\_\_\_ 2
3. square feet of window  $1 \times 2 + 144$  sq. in./sq. ft. = \_\_\_\_\_ 3
4. cost of window treatment for window (or extra amount you are paying to save energy) = \_\_\_\_\_ 4
5. cost of window treatment per square foot  $4 \div 3$  = \_\_\_\_\_ 5

## Cost of heat lost

6. cost of fuel per unit sold = \_\_\_\_\_ 6
7. fuel cost multiplier (see page 6) = \_\_\_\_\_ 7
8. heating degree days for your area (in Wisconsin use 8000 DD if you don't have your local figure) = \_\_\_\_\_ 8
9. cost of heat lost annually for 1 square foot of double glass window  $\frac{6 \times 7 \times 8}{10,000}$  = \_\_\_\_\_ 9
10. cost of heat lost annually if window is single glass  $9 \times 2.27$  = \_\_\_\_\_ 10
11. cost of heat lost annually if window is triple glass  $9 \times .65$  = \_\_\_\_\_ 11
12. cost of heat lost annually through entire window  $9$  or  $10$  or  $11 \times 3$  = \_\_\_\_\_ 12

## Savings and payback

13. savings in energy cost first year—percent from Table 1 = \_\_\_\_\_ 13
14. dollars saved first year through entire window  $\frac{12 \times 13}{100}$  = \_\_\_\_\_ 14
15. simple payback in years  $4 \div 14$  = \_\_\_\_\_ 15

= _____ 1	= <u>60"</u> 1
= _____ 2	= <u>30"</u> 2
= _____ 3	= <u>12.5 sq. ft.</u> 3
= _____ 4	= <u>\$50.00</u> 4
= _____ 5	= <u>\$ 4.00</u> 5
= _____ 6	oil/gal = <u>\$ 1.25</u> 6
= _____ 7	oil = <u>1.57</u> 7
= _____ 8	= <u>8000</u> 8
= _____ 9	$\frac{1.25 \times 1.57 \times 8000}{10,000}$ = <u>\$ 1.57</u> 9
= _____ 10	= _____ 10
= _____ 11	= _____ 11
= _____ 12	$\$ 1.57 \times 12.5 =$ <u>19.63</u> 12
= _____ 13	R-30w DOUBLE GLASS = <u>38</u> 13
= _____ 14	$\frac{38}{100} \times 19.63 =$ <u>\$ 7.46</u> 14
= _____ 15	$\$ 50.00 \div \$ 7.46 =$ <u>6.7 yrs.</u> 15

## FOR MORE INFORMATION

Insulated Roman Shade Designs:

Insulated Roman Shade plans or kits, available from Creative Energy Products, 1406 Williamson Street, Madison, WI 53703, (608) 256-7696.

Solar Age magazine, August 1980 issue.

Alternative Sources of Energy magazine, June 1980 issue.

### Other Window Designs and Products:

Contact your county Extension office for updating and information on energy conserving window treatments and on how to caulk and weatherstrip.

"Energy Saving Decorating," by Judy Lindahl, 1981. Order from 3211 N.E. Siskiyou, Portland, OR 97212 or check local fabric stores.

"Movable Insulation" by William K. Langdon, Rodale Press, 1980.

"Thermal Shutters and Shades" by William Shurcliff, Brickhouse Publishing Co., Andover, MA, 1980.

"Low Cost Energy-Efficient Shelter" by Eugene Eccli, Rodale Press, 1980.

New Shelter magazine, October 1980 issue.

Check your public library for recent window articles listed in Popular Science, Better Homes and Gardens, Alternative Sources of Energy and other similar magazines.

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*Design for the insulating roman shade was developed by the Center for Community Technology, 1121 University Ave., Madison, WI 53705, (608) 251-2207.*