

ART·TEC - Guy Marsden

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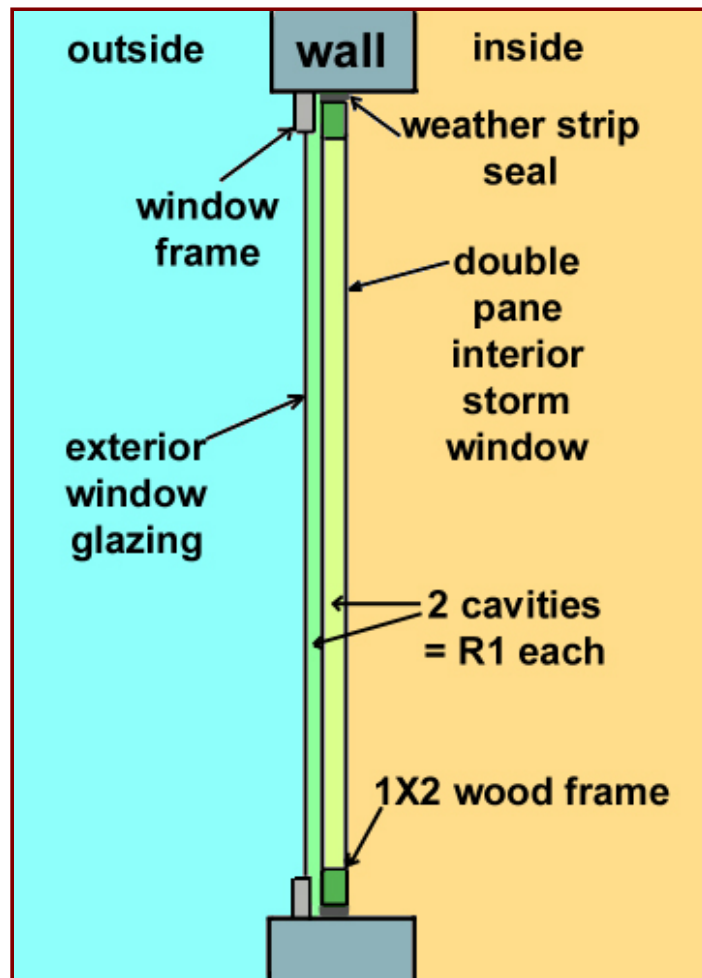


BUILDING INTERIOR WINDOW INSULATION PANELS

For more info:

Topher Belknap designed these windows, and is now making them to order for those who live near in Maine. He can also make kits to ship to you out of state. For more info call Topher: 207 882-7652
or email him at: topher@greenfret.com

Window Dressers in Rockland Maine is producing these affordable windows year round. They also organize "community builds" around the state, check their schedule for future events in the midcoast Maine region.



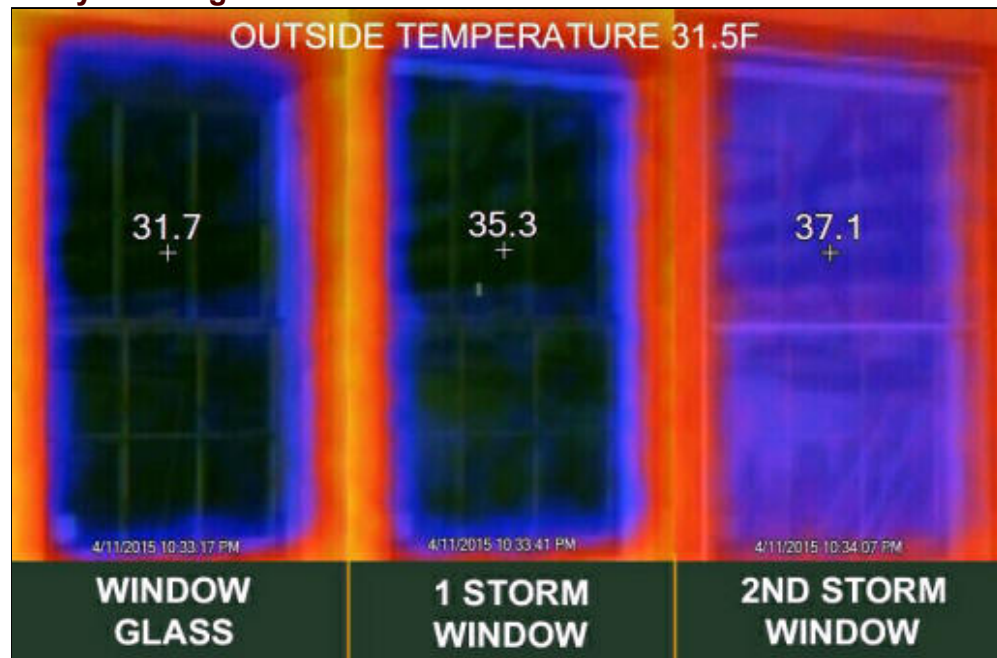
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About 30% of the heat loss in an average home is through the windows, if we can cut that in half or better it will represent a huge energy savings with a very short return on investment.

Topher Belknap is a fellow member of the Midcoast Green Collaborative here in Maine and he came up with a very simple design for double pane thermal window panels that simply push into the widow frame with foam insulation around the edges. Topher says that these panels will increase the R-value of your windows by around 2.3, this will triple the insulation factor of a single pane window, and it will block all air movement through it.

The panes are made of clear polyolefin shrink film. The simple wood frame can be constructed inexpensively from either natural or pre-primed lumber. The net cost of material per window is around \$1.25 per square foot and it takes 2 people about 40-45 minutes per window to make them up. (Commercial versions of these windows cost over \$9.00 per square foot!) These window panels serve 2 functions, improving insulation and stopping drafts. The projected savings for single pane windows in Maine is between \$4 and \$10 per square foot of window per heating season, depending on your windows. This assumes you are paying over \$3.50/gallon for oil. Drafty single pane windows will reap the most benefit from the new panels. In more moderate climates it may take longer to recoup the investment. You can use [this tool](#) to calculate your estimated energy savings.

You can even install two of these windows for additional benefit, here is a thermal study showing the results:



More details about this thermal study are on my blog.

Be advised that the panels are inexpensive in materials, but costly in time to make. Count on investing at least 40 minutes to actually build each window. An average home can have 10 to 20 windows.

Swap these panels out when you install and remove screen windows in the spring and fall. Removing the screens in the fall will allow 30% more solar gain so remember to remove them and clean the windows to get as much light as possible. Some panels can be left in place all year if desired if they are hard to get to or the window is never opened.

[Click here](#) to use a payback calculator for these windows. Generally you should make back the investment in the first heating season due to reduced heating costs.

Materials Sources:

Use links below to purchase in bulk

what	retail	cost	BULK	cost
1X4 clear pine lumber or pre-primed	Big box hardware store *	\$.95-1.20/ft.	Ask your lumber yard for a discount many will give you a break for more than 100 feet.	\$.60-.95/ft.
2.6 mil 2" clear packing tape and dispenser: \$11.49 	Staples® Clear View Packaging Tape, Clear, 1.89" x 54.7 yds, 6 Rolls will do hundreds of windows *	\$16.49	Staples® Clear View Packaging Tape, 54.7 yds 1.89mil 6 Rolls	\$16.49
			Uline 2" x 55 yards 3.1 Mil Clear Carton Sealing Tape by the case or 1/2 case	\$3.50/roll
Heat shrink film	 ACE kit includes film and double stick tape for 1 average window	\$10.99	Uline 40" x 3,500ft. 75ga Polyolefin Shrink Film Roll	\$211.00 +shipping for 40lbs!
			Clearmount 48" X 2600ft. roll 100	\$330 +shipping

			gauge Ultrafilm	
1/2" wide double stick tape	 ACE Hardware 1/2" wide double stick tape by the 18 ft roll (need 2 per average window)	\$6.50	Polyethylene Mounting Tape. From foamtapes.net 260ft rolls 1/2" wide. 12 rolls per carton (3120ft)	\$112.80
3/8" X 1/2" wide open cell foam weather strip	 17 ft. roll of OPEN CELL poly foam that is grey - not white!	\$3.00	Ether Foam Weatherstrip Tape * From Foamtapes.net 70ft rolls of 1/2" X 1/2" foam case of 12 rolls (840ft)	\$62.76
<u>SPECIAL OFFER KIT PACKAGE from Foamtapes.net</u> combines above 2 items in balanced footage that saves you around \$10.00. (this is enough for around 30 average sized windows) 7 rolls Ether Foam 1/2" X 1/2" weather strip (490ft) 5 rolls 1/2" wide double stick Mounting Tape (1080ft) Also includes: 4 Sets of Outlet Gaskets (for sealing air leakage through exterior walls) 1 Set = 1 Light switch + 3 Electrical Outlet gaskets				\$78.95

*** Materials notes:**

- If you buy the lumber from a big box store, you can get it as 1X2 (rather than 1X4 and ripping it in half yourself) and have them cut it all to the lengths you need for a nominal fee.
- Most hardware stores sell the shrink film in small rolls 40" and 80" wide and also packs that include double stick adhesive tape with a backing.
- Be sure to buy 1/2" wide double stick tape, 3/4" is hard to center on the wood frame.
- Make sure to buy the highest quality packing tape that is over 2mil thick, this will protect the frame better and will not yellow or age as badly as cheap tape.
- I highly recommend that you buy the Ether Foam weatherstrip since it has very good adhesive, and also is a full half inch thick. Most retail foam is only 3/8" thick and this is not enough to allow for error on most windows since almost ALL windows are not square. Ether Foam is also a higher quality foam that should last longer than store bought foam weather strip. If you do buy retail foam look for OPEN CELL foam that is gray colored, the light or white colored foam tape will not last because it degrades in UV exposure. Closed cell foam will not compress enough to fill gaps around out of square windows, DO NOT GET rubber based foam, it will not compress enough.

CUSTOM MADE WINDOWS AND SUPPLIES

Topher Belknap of Green Fret Consulting in Edgecomb, Maine who designed these windows, makes them to order and sells kits and materials.

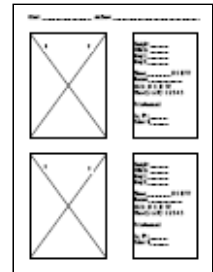
If you live in Northern New England and would rather not build these windows



yourself, then you should contact **Downeast Interior Storms**. This is a business that is set up to make these custom interior storm windows to order.

Construction overview: The basic steps are as follows:

1. Measure the inner dimensions of the window frames. I created a sheet that aids in the process download it click [here](#) or on the image at right. In older homes it is important to measure the diagonal dimension to see how out of square the window is. If the 2 diagonals are more than 1 inch different then the frame will need to be made out of square to match. Be sure there are no obstructions like blinds, curtain rods or screws in the frame.
2. Calculate how much wood is needed for all the windows. The panel frame dimensions need to be 1/2 inch smaller in each dimension to allow room for the foam weather strip, this also allows for out of square windows. Then just add the height to the width for each window. You will use 1 X 4 lumber and rip it in half to make each side of the frame, or just buy 1X2 lumber, but it can be more expensive. Allow an additional 10% for waste - or order an extra 8 foot length per 10 windows.
3. I created a spreadsheet to aid in pricing. Click the image at right to download it. Begin by calculating your cost per unit of materials such as pennies per square foot of shrink film, and enter that in the red section. Your costs may vary depending on your bulk purchase options. Then enter the specific window details and dimensions in the blue section. The sheet will calculate the total amount of linear feet of wood needed. The outer dimensions for the frame subtracting a half inch for the foam (brown section at the right), cost per square ft., and total cost for materials.
4. Order the wood. Surprisingly pre-primed wood (white primer painted) is cheaper than clear pine by over 45 cents per foot at my local lumber yard. Order 1 X 4 lumber of either type to match the trim of the windows.
5. **Assemble the wood frames.** I prefer a **butt joint** for it's simplicity and ease of assembly. Butt joints can be screwed or nailed together which makes for a strong joint - no glue required.
6. **Attach the film and weather stripping:**
 - o Apply double stick tape around the outer edge of the frame
 - o Cut a piece of window film about 8-10" over size
 - o stretch the window film onto the frame so that it sticks to the edge, and trim off the excess
 - o repeat the 3 steps above for the other side of the frame
 - o Take 2" clear packing tape and wrap the entire edge of the frame to secure and protect the edges
 - o Use a hair dryer to heat shrink the film on both sides



- Apply 1/2" open cell foam weather stripping around all edges.

Assembling the frames

This part takes about 15 minutes per window

The outer dimension of the wood frame should be 1/2" smaller than the opening of your window to allow the 1/2" weather strip to compress 1/4" on every side.

You can purchase 1X4 lumber with a white primer already applied from most lumber yards and big box hardware stores, you will need to rip this in half on a table saw to make best use of it. Or you can buy clear pine (unpainted) in 1X2. Lumber yards do not seem to sell 1X2 wood with a primed finish.

If you rip down primed 1X4 boards note that the cut edge should go on the outer edge of the frame where it will not be seen. With store bought clear 1X2 lumber this is not an issue unless you want to paint it, in which case you need not paint the outer edge. This makes it easier to handle while painting it.

If you lack carpentry skills or a chop saw, most big box hardware stores will cut 1X2 clear pine to length for you. Then simply assemble screws as below. Note that so-called one-by-two lumber is actually .75" X 1.5" when you purchase it.



If you bought 1X4 boards, begin by cutting them to length first and stacking them in matched pairs for each window. It is helpful to keep each pair matched throughout the process if you have many different sized windows. Then use a table saw to rip them exactly in half. Or rip the stock first and then cut to length if you wish.



I have learned that a butt joint is quicker to make than others styles, but be aware that in a butt joint one pair of boards will need to be shorter when you cut them. This should be the shortest side of the frame, so the length of these boards will be the width of the window minus 1/2" AND minus 2X the width of your boards.



Here's my simple trick for calculating the length of the shorter sides. Say your window opening is 23.5" wide. Pull out your tape measure from the end of the wood and then place 2 small scraps at the 23" mark (we are making the frame 1/2" smaller then the window), now mark your cut at the left edge of 2 scraps to account for the long sides of the frame (that you cut 1/2" smaller than the window opening).



The butt joint has the advantage of simplicity and strength and that you don't need glue so there is no delay while it dries. I use 2.5" drywall screws and pre-drill a clearance hole through the side first. I suggest that the screws go through the longest sides of the frame as it makes it simpler to assemble. Use 1 or 2 screws at each corner.

You can use a corner clamp (available at most hardware stores for under \$10) to hold the corner together while you drill and screw it together. Cordless drills make fast work of this assembly.



If you ripped down primed 1X4 boards note that the cut edge should go on the outer edge of the frame where it will not be seen. Be careful when handling the primed or painted wood as it will mar easily, you can select the "bad" sides for the outside face when you assemble the frame.

Now is a good time to label the frame. I suggest using a pencil or thin marker to label the top edge on the outside surface - this is the side that faces the window so you won't see the label. Try and be descriptive enough that next year you can easily figure out which panels go where. For instance "Second floor bedroom, south wall". The next owner of your home may not know what window "John's bedroom" is! The label will be protected by film and clear packing tape.

If you are really fussy you can paint the primed wood frames, but I don't see the value in this effort unless they will be highly visible. In most cases they will be hidden by drapes or visually unobtrusive. I have noticed that the primed wood from big box hardware stores is smoother and whiter than the wood found in most lumber yards. Sometimes it can be worth the extra money to get nice wood, so go to Lower's or Home Depot if appearance is a big concern.

Applying film and weather strip

This part takes 2 - 3 people about 30 minutes per window



Tools required for applying the film include (left to right): Packing tape dispenser, utility knife, scissors, tape measure, Adhesive transfer dispenser (optional) or double sticky tape and a hair dryer. Click [image at right](#) for a printable assembly sequence list you can refer to at a glance while you work.

WINDOW FILM ASSEMBLY SEQUENCE (starting with completed wood frame)	
1.	Label frame (on top outside edge)
2.	Apply double-stick tape (1" layer)
3.	Stretch on the film
4.	Trim off excess film
5.	Apply double-stick tape (2" layer)
6.	Stretch on the film
7.	Trim off excess film
8.	Apply 2" packing tape
9.	use hair dryer to stretch the film
10.	apply peel side
11.	Apply foam weather strip
Tools: Scissors, utility knife, cordless drill, hair dryer, tape measure, packing tape gun.	

A large work table is essential, it is good to have a large, clean, flat surface. 1 large 6ft. folding table works well. I also have used a 4X8 sheet of wood on 2 sawhorses.



I bought a 3700ft. roll of film so I could do a lot of panels for friends and neighbors. This huge 40lb roll is 20" wide, but the film unfolds to 40". If you use store bought sheets or rolls of film, be sure to keep the inner surface off the work table so it does not pick up dust and trap it between the 2 layers of the storm window.

Using double sided Mounting tape apply it firmly in one pass all the way around the frame. Peel off the backing just before applying the film..



The film on the roll is folded in half and separating the 2 layers is hard, the trick is to use 2 small pieces of blue masking tape right at the corner to pull the 2 layers of film apart. You may have the same issue with store bought rolls of film too.

Cut a piece of film so that you have 4 to 6" extra all around the frame. Smooth it out flat, then lay the frame on top centering it carefully. Now is the time to remove the backing from the double stick tape.



Begin at one end and carefully lift the film up and over the frame along one edge so that it sticks, rub the edge to ensure that it is well adhered. It helps to have one or more people holding the frame down while 2 people pull the film evenly.

Then do the opposite side being sure to pull it tight to take out any wrinkles. On the longer sides it is best to have 2 people doing this together so that you can tension the film to prevent wrinkles. I find it easier to start at one end, then pull the film tight to the other end before doing the longer sides. It is important to watch for wrinkles and try to pull them out before the film sticks. Pay attention when pulling the final side, you need to pull firmly to ensure the film is stretched tight. The film will only shrink about 1% (that adds up to only 1/2" across a 50" window).

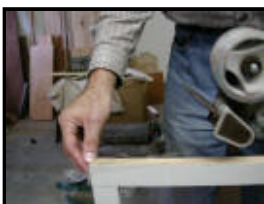


After each edge of the film is stuck, you will need to cut off the excess flush with the edge. By pulling the film upwards, you can slide a utility knife along the frame to cut the film off flush with the wood. A 45 degree angle works best as shown with the blade just resting flat on the wood. This takes practice to do well and requires a very sharp blade. The knife should just glide along

easily without encountering resistance.

Now repeat the steps above to apply more double stick tape all around the edge over the film you just applied and then apply the film to the opposite side.

Keep in mind that this film is both strong and resilient and also very fragile when exposed to sharp objects. Small tears can be repaired with clear packing tape, larger ones may require removing all the tape and film and re-applying it, so handle them carefully.



Next use the packing tape gun to wrap the entire edge of the frame to protect it from wear. I use high quality clear tape for it's strength and clarity (cheap tape will dry out and yellow with age). This tape protects the film at the edge of the frame during handling and insertion and removal from the windows. I have found that it is simplest to do each side separately. Start by pulling out a bit of tape and wrapping an inch or so over the edge being careful to center it on the frame.



Now pull the tape out to a few inches past the other end and lay it down so that the entire length centers on the frame. Cut off the tape and wrap it over the end. Now smooth the tape firmly down along the whole edge. Then begin at one end and fold the tape over and down the sides. You need to make a tight fold here or you will get bubbles in the tape. If bubbles get trapped you can puncture them with a knife then rub them out. Rub the tape down

firmly so it disappears.

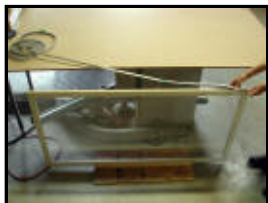


NOTE! Now is the time to install pull tabs made from clear packing tape. Use a short length of tape and stick it to the outer edge then fold it over and stick about 1" to the inside surface. Locate them where they will be easy to reach - typically a foot or so from the bottom. These panels will be VERY difficult to remove without a tab. (Note the picture shows the foam already applied, but do this step before applying the foam strip).

You can add a label onto the tape using a white address label that says "pull to remove" if you want to make it easier to find.



Use a hair dryer set on high to shrink the film. I have found that starting in the middle and working out to the edges works best to remove wrinkles. Keep the hair dryer moving at all times and be sure to heat every part of the film so you don't have loose spots or wrinkles. Don't use a heat gun - it will melt right through the film!



The open cell foam weather strip that I use is 1/2" by 1/2". I first measure it to length and cut it an inch or so long. *Note that I made a jig to hold the frame vertically on the floor. I glued 3 pieces of 1X lumber together. 2 wide ones and a narrow one with a layer of thick paper in the glue joint to space it out a bit. This forms a long U channel that holds the frame snugly allowing for the thickness of the film and tape. The channel is then glued to a*

larger board for stability.



Peeling the backing off the foam tape is tricky. This is annoying as it is hard to get it to start, but if you get your fingernail right up against a corner and pull the foam off the backing tape it will come off fairly easily. Now peel back a few inches and stick that down to the end of the frame with a slight overhang at the end.



Slowly pull the backing tape off as you guide the foam so that it sticks in the center of the edge of the frame. One person can lead by pulling out the backing tape as the other centers the foam and presses it down.



Apply foam to 2 opposite sides first. Then when you cut the foam off of the ends be sure not to undercut. You want the foam to hang over the end slightly so that the foam can overlap and stick to the foam and form a square edge.

I tried just wrapping the foam around the corners but it leaves a rounded gap that



looks unsightly and leaks air. The point here is to eliminate all drafts. Here's how it looks before you cut off the edge.

That's it! Repeat as needed for all the windows in your home. Then in the spring review your heating energy bill and SMILE!

If you found the information presented on my web site to be helpful you can send me a donation to show your appreciation for the many hours I have invested in preparing and refining these instructions. This is NOT tax deductible and will show as a consulting fee on your receipt.

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