Is it Worth It?
A Comparison of Energy Film® Versus M-D Shrink and Seal Window Insulation™

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ABSTRACT

This study investigated the effectiveness of two products designed to reduce heat loss though windows: M-D Shrink and Seal Window Insulation® and the costlier Energy Film. The study isolated a typical single pane wood-constructed window in a hot box with a consistent light source, thus controlling all factors except the window film products. A test was run without any window film then with each product.

The study concludes that M-D Shrink and Seal Window Insulation® is the most effective at reducing heat loss. Using the collected data, U values of the window, window with Energy Film, and window with M-D Shrink and Seal Window Insulation® were calculated. Our tests showed that the U value of the M-D Shrink and Seal film was approximately 10% lower than that of the Energy Film. This is nearly 13% lower than the U value of the untreated window

1. INTRODUCTION

The problem of heat flow through windows deserves attention because translucent components generally have the lowest R-value (highest U-factor) of all building envelope elements.[1] Energy Film¨ and M-D Shrink and Seal Window Insulation® are readily available and used by renters. However, Energy Film is the more expensive1 product making it somewhat less accessible.

Indoor window insulation kits are the least expensive and most prevalent product. M-D Shrink and Seal Window Insulation® claims to increase window R-value by up to 90%. The film insulation is installed on the inside of the window opening by placing double stick tape around the window frame, adhering the film and using a hair dryer to shrink the film into place. Energy Film is a brand product window film that claims to reduce heat loss through windows in winter up to 35%. Energy Film is a plasticlike material placed directly on the inside the window glass. The film is held in place by static-cling.

The purpose of this study is to compare the insulative value of two products available to low-to-middle income renters. The study was executed as part of University of Oregon's Environmental Control Systems Course and took place in Eugene, Oregon. Data was collected for each test in 1-minute intervals over 24 hours within a seven-day period. The method of constructing and using a hot box controlled for climate and situational factors. The same hot box, light source, window and data loggers were employed for each test.

2. HYPOTHESIS

Aftermarket window insulation products reduce the U-factor of conventional single-pane windows. Energy Film® more effectively reduces heat loss through windows than M-D Shrink and Seal Window Insulation™.

1 Stein, B. (2006). Mechanical and Electrical Equipment for Buildings. Hoboken, NJ.: Wiley

3. METHODOLOGY & EQUIPMENT

We tested heat transfer through a window under three conditions: the window alone, the window with shrink film insulation and the window with E-Film insulating film. We conducted our experiments in a hot box to control for outside variables, constructed of two layers of 1" thick rigid insulation, with an R-value of R-5 per inch of thickness, totaling R-10 throughout. Inside we positioned a wood framed, single pane window in relatively poor condition (typical of a window in a "loose" house), vertically dividing the chamber into two sides (see Figure 1). On one side we positioned a heat source: a light bulb that would remain on throughout the 24-hour testing period. Initially we used a 40w incandescent light bulb, but discovered that the bulb produced too much heat and failed to produce an even temperature on either the hot or the cold side of the hot box (see Figures 2-5).

We switched our heat source to an 11w compact fluorescent bulb, which produced a steady rise in temperature before a plateau. We suspected that this more gentle heat source would be more suitable for analysis. We included two HOBO data loggers on both the hot side and the cold side of the window in the hot box. On each side, one HOBO was positioned low in the chamber, the other high, in order to account for possible heat stratification.

We tested heat transfer through the window under three sets of circumstances. For our control test, we positioned the untreated window in the testing chamber and measured the temperature of each side of the chamber for 24 hours with the light bulb on. For our second test, we applied insulating shrink film to the frame of the window with a standard household electric hair dryer, according to manufacturer's directions. We reinserted the window into the chamber, and heated with the light bulb for 24 hours. For our third test we replaced the shrink film with E-Film, a plastic film that is applied directly to the glass of the window. Again, we heated the chamber with the light bulb for 24 hours. We conducted each test twice, for a total of six tests, each 24 hours long (see Figures 6-8).

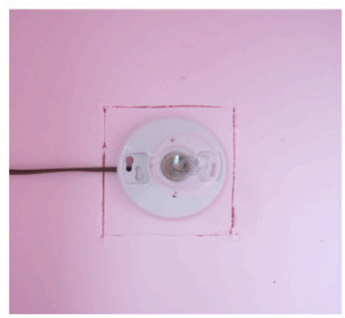
Figure 1: Testing Equipment

Hot Box Overall Assembly

Components in testing environment.

20" x 26" Single Pane
Wood Frame Window

Hobo Data Loggers -
4 total (2 on each side of
window)



11 watt CFC light bulb as
heat source

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4. <u>RESULTS</u>

Our results suggest that the shrink film and Energy Film® do act as an insulator for the interior (hot side) of the hot box. Comparatively the shrink film performed as a better insulator than the Energy Film® when the temperatures of the cold side were between 74° and 94° F, above this temperature however, the differences are negligible.

Based on these first three tests with the 40 watt bulb (see Figures 2-5) we extending our testing longer than 2 hours and switched to an 11 watt bulb.

Figure 6 is showing the result of the average temperature change from the hot to the cold side of the window under each insulation condition. We used this data to determine the U-factor each assembly (see Figure 7) and discussed our findings in the conclusion. The following graphs show the results of three preliminary tests:

Figure 2: Control Temperature (°F) 40 watt bulb 2 hour testing period
Hot (interior) vs. Cold (exterior)

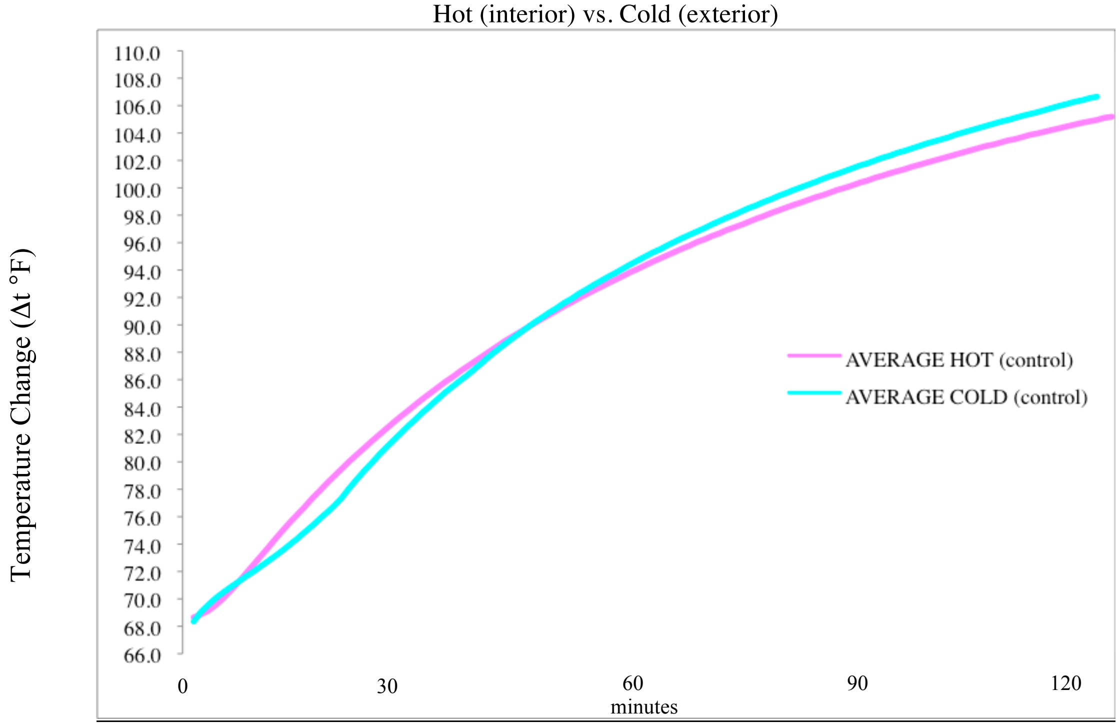

Figure 3: Shrink Film Temperature (°F) 40 watt bulb 2 hour testing period
Hot (interior) vs. Cold (exterior)

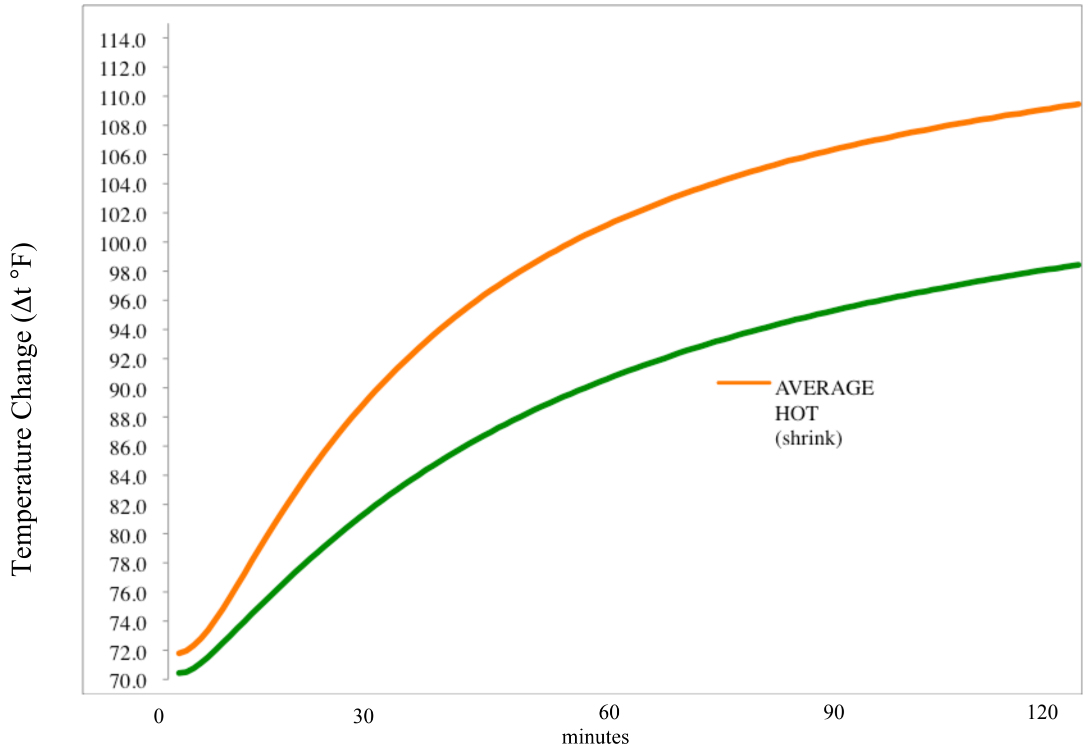

Figure 4: Energy Film® Temperature (°F) 40 watt bulb 2 hour testing period
Hot (interior) vs. Cold (exterior)

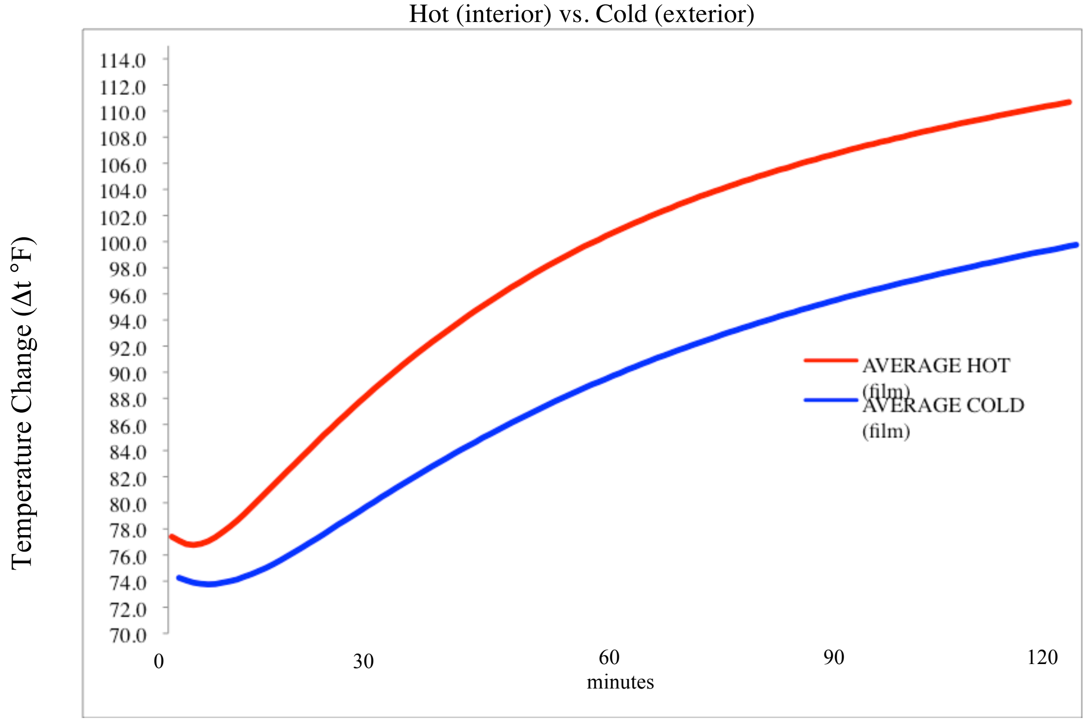

Figure 5: Energy Film® vs. Shrink Film Temperature (°F) Comparison 40 watt bulb 2 hour testing period
(Cold = exterior side)

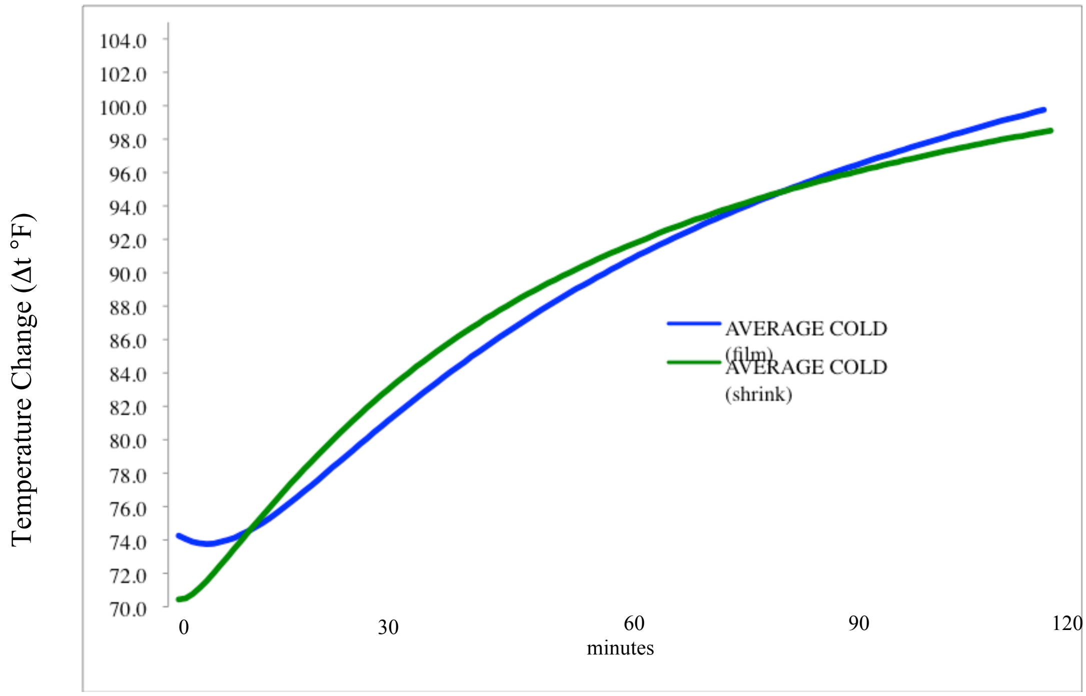

Figure 6: Energy Film® vs. Shrink Film vs. Control Temperature Change (Δt °F) Comparison – 11 watt CFC bulb 24-hour testing period

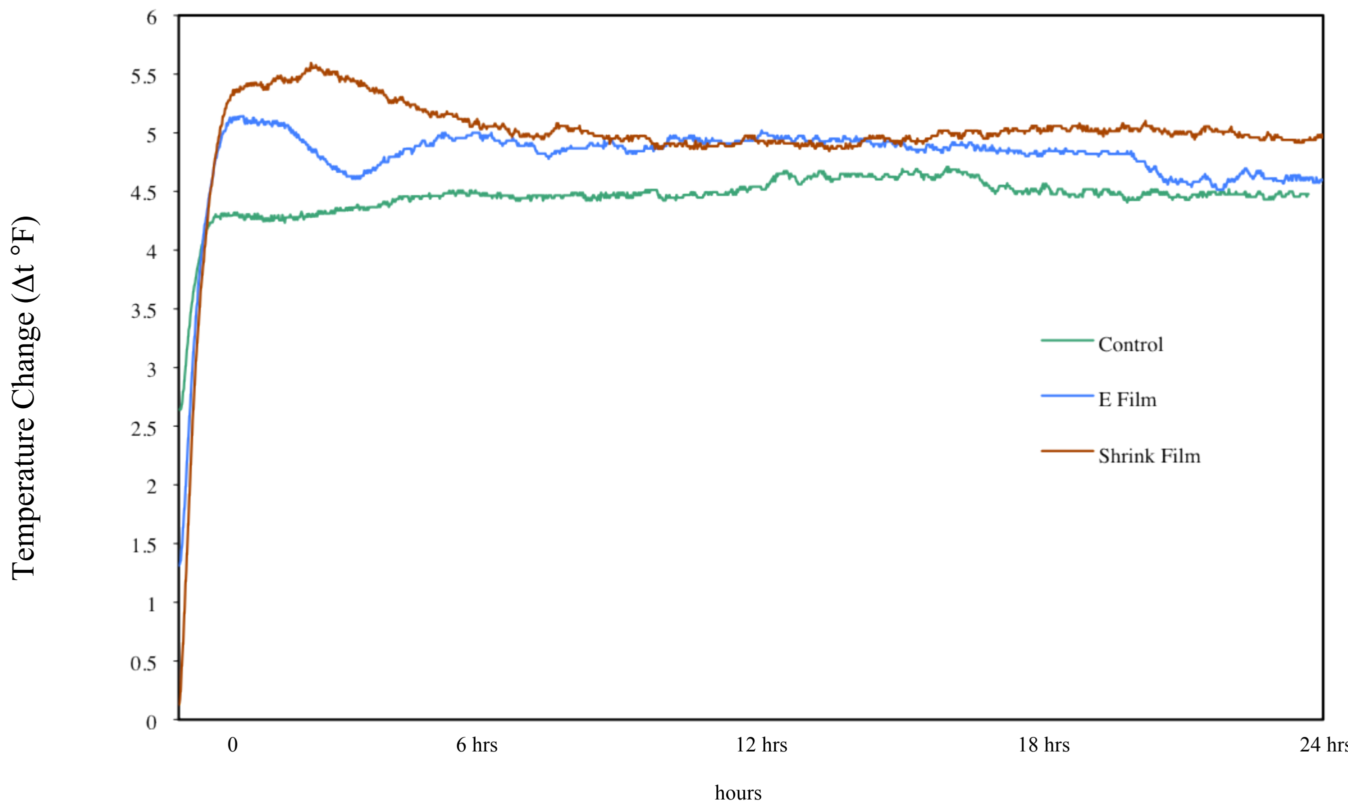

Figure 7: Results of Test 1 and Test 2 for all insulation conditions with 11 watt bulb over 24 hour period

	Test 1 Average Hot Temp	Test 1 Average Cold Temp	Test 1 ΔT	Test 2 Average Hot Temp	Test 2 Average Cold Temp	Test 2 ΔT
Shrink Film	82.567	77.495	5.072	81.187	76.22	4.967
E Film	82.406	78.197	4.209	82.538	77.676	4.862
Control	82.246	77.78	4.466	83.855	79.402	4.453

<u>Calculation to determine U-factor:</u>

Average ΔT

Control (4.466 + 4.453)/2 = 4.460

Energy Film (4.209 + 4.862)/2 = 4.535

Shrink Film (5.072 + 4.965)/2 = 5.019

for the Energy Film -----4.460/4.535 = 0.98 (heat difference Ratio)
then 0.98 * 0.98 (window control U-value) = 0.96 (U-Value for Energy Film)

for the Shrink Film ------4.460/5.019 = 0.890 (heat difference Ratio)
then 0.890 * 0.98 (window control U-value) = 0.87 (U-Value for Shrink Film)

5. CONCLUSION

This study investigated the issue of heat flow through windows by testing two readily available products used by renters: Energy Film® and M-D Shrink and Seal™ Window Insulation Kit. The two-part hypothesis stated that these products would decrease the U-factor of a conventional single paned window. Next, it proposed that the more costly Energy Film® would reduce heat loss greater than the M-D Shrink and Seal Window Insulation® film. The research findings indicate that, as proposed, both products decreased the U-factor of the window. However, contrary to the initial hypothesis a window with M-D Shrink and Seal Window Insulation® has a lower U-factor than a window with Energy Film®. A comparison of the U Factor shows that M-D Shrink and Seal Window Insulation® film U factor is .09 lower than the Energy Film®.

Comparing these results to product claims published on brand websites and on packaging yields interesting results. M-D Shrink and Seal Window Insulation® claims to increase window R-Value by up to 90%. The results show a 15% increase in R-value. Energy Film® claims that it will reduce heat loss through windows up to 35%. The results show a 6% reduction. Both products significantly fall short of the best results claimed by the brand manufacturers.

As stated in the introduction the purpose of this study was to compare the efficacy of two products available to low-to-middle income renters. Therefore it is appropriate to review study findings in light of product cost. The less expensive product, M-D Shrink and Seal Window Insulation®, at $.30 per square foot, performed significantly better than Energy Film® at $2.50 per square foot). Considering the cost difference of a $2.20 per square foot this information may be valuable to consumers.

The study methods were designed to be replicable. In this study each condition was tested twice. The results were then averaged. Repeating the tests again for each condition would increase reliability of the results. There are several other related factors that could be investigated. These include the lifecycle and durability of each product. Finally, the study could be expanded to include other window insulation products.

6. LESSONS LEARNED

Separate lessons were learned a various stages in the study. These include but are not limited to ensuring controlling potential variables and adapting methodology as needed.

Several methods and hypotheses were discuss and rejected prior to deciding upon the current study. It was necessary for the group to refine the purpose of this experiment. Once it was ascertained that the purpose was to test the ability of two products to reduce heat loss through windows, our group concluded on using a hot box. The group previously considered testing a window in one of the participant's homes.

While completing the tests some fine-tuning was required. Our initial light source was too hot. The group deemed that the extreme heat inside the light box might prevent the results from being applicable to typical conditions. The overarching theme at this stage of the experiment was flexibility. It was important to think critically about our initial results and design than adapt the methodology as necessary.

7. REFERENCES:

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