

Best Practice – Window Repair or Replacement

Date: Revised March 2018
Subject: Window Repair and Replacement

Problem or Question: What is the process for justifying the replacement of windows in homes being weatherized?

Discussion: Considerable advancements in weatherization science and application techniques have occurred over the last 6 years. Home insulation and house-sealing against air infiltration is universally acknowledged as the best, lowest cost way of achieving energy savings and building efficiency. In the majority of homes to be weatherized in Texas, replacing single-pane windows with double-pane low-e windows is simply not as cost effective.

For DOE units: The measures justified to install regarding windows are determined by the energy audit, which must be run properly, with accurate information input in the audit, accurate pricing for the measures to be considered, material specifications to meet the current program/code requirements (U-value, SHGC, etc), proper individual SIR ranking and cumulative SIR ranking.

- If the window(s) rank for replacement in an accurate energy audit, then replace the windows.
- If the energy audit suggests installing window film or solar screens, install those.
- If air is leaking around the windows and the energy audit ranks lots of air infiltration dollars, but nothing regarding the windows, then use some of those air infiltration dollars to air seal around the windows.
- If the window replacement measure does not have an SIR ranking with a 1.0 or greater then we should not and canNOT replace the window, unless the window is unserviceable and/or there are other extenuating circumstances outlined in this best practice (BP).

For LIHEAP Only units: Repairing of windows are allowable as part of either air infiltration costs or the \$500 miscellaneous repair costs as provided in the LIHEAP Priority List. Repairing will include glass panes, parting stops, sill replacement, L brackets, glazing, sash locks, replacement rail (double hung wood window) etc. Additionally, now **window replacements are now allowed under measure #13 on the Priority List**. Windows that are structurally unsound or unable to be repaired may be replaced. Photo documentation must be maintained in the client file. Subrecipients must show that they have properly and fully addressed the previous 12 measures on the Priority List prior to addressing the potential window replacement.

For DOE & LIHEAP leveraged units: With DOE funds involved, follow the DOE guidance as stated above. If/when the window replacement properly ranks in a properly run energy audit, either DOE or LIHEAP funds can be used to pay for the replacement.

Experience with the energy audit in Texas has demonstrated that properly evaluated and correctly entered windows can and do rank in the energy audit. Major factors for ranking window replacements in the energy audit are: age, leakiness, window frame type, exposure to sunlight (shading percentages), orientation on the house (west, east, south, north), and price charged by your contractor to install the replacement windows. If your audits are recommending windows replacement often, or not at all, then it is recommended your team take a close look at how the window data is entered into the energy audit by using this best practice. Feel free to contact Department program staff to assist and guide your efforts to properly enter windows data into the energy audit.

When assessing the windows of a dwelling unit, Subrecipients shall consider the following:

- Consultation with the client as to which windows are leaking the most. This can be verified utilizing the Blower Door.

- Components of the window which clearly allow for air infiltration, such as sash locks, stops, broken window pane, and glazing, can be addressed as infiltration measures.
- Clear photographic documentation of the defective items or aspects of the window must be maintained with the client file.
- The visual appearance (aesthetics) and existing R- value of the window are not valid reasons to authorize window replacement as a repair measure.

Recommendation Summary: Properly assess air infiltration into client’s homes through windows and window frames and prioritize what measures are most needed to reduce infiltration into the client’s homes. For LIHEAP, work your way through the Priority List and if you reach #13 and the window needs to be replaced, follow the guidance and proceed. For DOE funded houses, once properly assessed, properly enter windows data into the energy audit in accordance with this best practice and following FAQs. The energy audit will only “rank” windows when the savings generated by the new windows exceeds the cost, i.e. installed windows measures have SIRs of 1 or greater.

The remaining guidance is FAQ questions and additional information regarding Energy audit information.

FAQ's

1) Question: When we are inside the audit and are selecting what type of measures (options) we want the ENERGY AUDIT to consider, should we only select the type of options we want to install based on the situation or should we select the “evaluate all” selection? For example, should we only select the type of windows we want to install, such as low-e, or should we run the audit with all window-types being eligible?

Discussion: The only way to ensure the ENERGY AUDIT considers all measures is to make sure that all measures are eligible when you run the ENERGY AUDIT. Select “evaluate all” whenever it is an option so that the ENERGY AUDIT will evaluate and select the most economical and effective package of measures for the dwelling unit. See the below screenshot for an “evaluate all” selection example.

The screenshot shows the NEAT AUDIT software interface. The main window title is "NEAT AUDIT -- NEAT AUDIT -- NEAT AUDIT -- NEAT AUDIT -- NEAT AUDIT -- NEAT AUDIT". The "Audit Name" is "House with crawl space". The "Client ID" is "00004 House with cra" and the "Client Name" is "Crawlspace, Joe". The "Alt. Client ID" is empty. The interface has several tabs: "Audit Information", "Status", "Shell", "Heating (1)", "Cooling (2)", "Ducts/Infiltration", "Baseloads", "Health & Safety", "Itemized Costs (3)", "Utility Bills (0)", "Photos (0)", and "Measures (10)". Below these tabs are sub-tabs for "Walls (4)", "Windows (3)", "Doors (2)", "Unfinished Attics (1)", "Finished Attics (0)", and "Foundations (1)". The "Window Code" form is active, showing "Window Code" as "WD1" and "Retrofit Options" as "Evaluate All". Other fields include "Window Type" (Slider), "Frame Type" (Wood or Vinyl), "Glazing Type" (Single with Metal Storm), "Interior Shading" (None), "Exterior Shading (%)" (0), "Leakiness" (Medium), "Average Size" (Width 24, Height 48), "Number on this Wall" (4), and "Wall Code" (WL1-N). There are also fields for "Additional Cost" (Weatherization, Replacement, Low E, Storm) and a "Run Audit" button. The "Last Run On" is "2/10/2011" at "10:36 AM".

There is an exception, however, to the general rule of “Evaluate all.” Generally you should not be making window replacements mandatory unless there is something physically wrong with them requiring repair (following your state’s guidance on all this). Normally you should choose “Evaluate All” in the Retrofit Option field on the Window form. This allows the energy audit to decide if a window retrofit is cost effective (Measure SIR > 1.0), and if it is it will be recommended. However, in the case of a window that must be replaced because it is no longer serviceable (rotted wood, significantly warped frame, functionality problems, significant damage, etc.), then we need to first decide if that specific window can rank with an SIR greater than 1 **or** if we must replace the window as a repair measure.

We need to first allow the ENERGY AUDIT to determine if the window will rank on its own merit (this is accomplished by selecting evaluate all and running the audit). The ENERGY AUDIT may select another measure, not recommend any measure, or it may recommend (rank) the window replacement on its own merit.

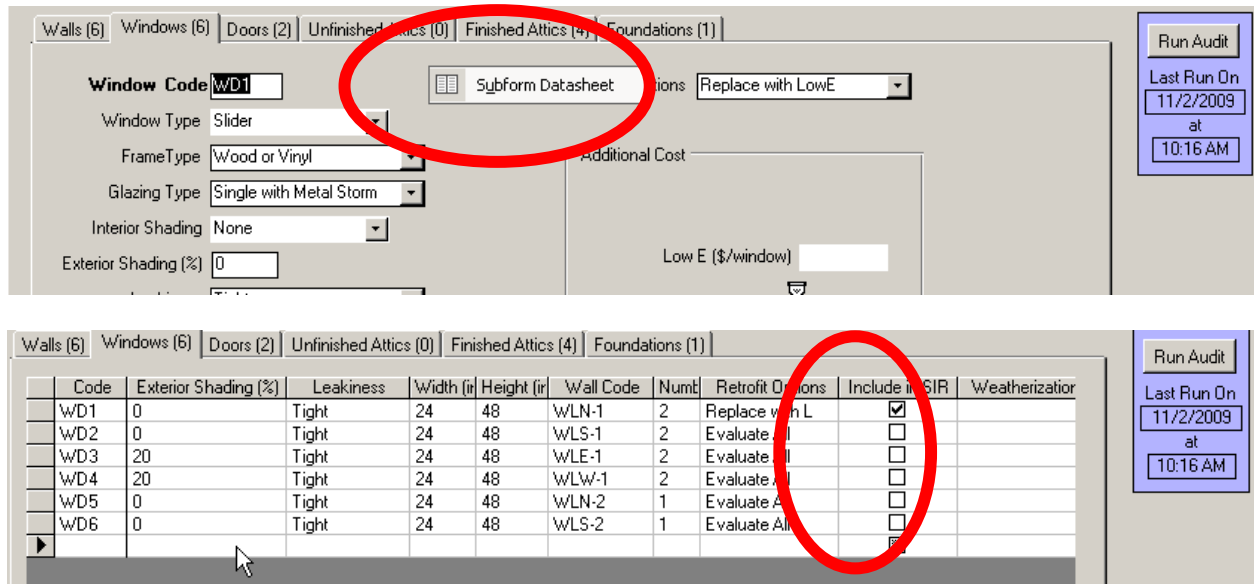
If the non-serviceable window does not rank on its own merit, and you still need to replace it because it is non-serviceable, you can specify (mandate) a window replacement. If you specify the measure to be considered, (for example if you select “replace with low-e”) then this user-defined action “triggers” the exception (to the SIR-based ordering of measures) and “mandates” that the ENERGY AUDIT to consider this particular measure first. Now, for example, the mandated “Replace with low-e” window measure will be considered before any other measures. This action will affect the SIR of other measures. In this case some measures that would have ranked, may now not rank because of the effect of mandated change on all the ENERGY AUDIT logarithmic permutations and calculations.

Some auditors ask, "If I am only replacing existing windows with low-e windows why can't I just check low-e windows instead of "Evaluate all"? The primary reason that you should check "Evaluate all" is to enable the ENERGY AUDIT to make the most cost-effective and most energy-saving recommendations for weatherization measures. The secondary reason you should check "Evaluate all" versus "Replace with low-e" is based on how the ENERGY AUDIT program evaluates, determines interactions, and prioritizes measures in the software. It does this to provide the auditor with a list of authorized measures in order of their priority of installation. The second order effect of "mandating" a measure, such as when you select "Replace with low-e," is that you pull that measure to the top of the measures list and reshuffle all the ones below. Because you introduced different variables by mandating a measure, the ENERGY AUDIT must now re-compare all the measures to each other (and reevaluate each measure) to recalculate how effective that measure is at saving energy at this point in time. Selecting "Evaluate all" enables the ENERGY AUDIT to do its job, which is finding the most cost-effective and energy-saving weatherization measures to install in a given home.



Weather damaged window in need of replacement.

IMPORTANT: To "mandate" a non-serviceable window to be treated as repair and be included in the whole house SIR, then, in the audit, check "replace" or "replace with low-e" instead of "evaluate all" in the retrofit options. NOTE: there is a minor glitch in the ENERGY AUDIT program which causes the SIR box to disappear when one of the "replace" options are chosen. Despite the fact the SIR box disappears, it is nonetheless very important to include the measure in the whole-house SIR. Therefore you should go into the "subform datasheet" by right-clicking in the gray area background near the measure box. Clicking in the gray background will result in a small "subform datasheet" option button popping up (as seen in the below screenshot of the ENERGY AUDIT). After you select this button, a larger spreadsheet subform datasheet will pop up. On the spreadsheet you should find all the windows including the non-serviceable window measure you are working on; check the "include in SIR" by that measure so that the measure is treated as a repair and not treated as a Health and Safety measure by the ENERGY AUDIT.



Recommendation Summary: Select “evaluate all” whenever it is an option in the ENERGY AUDIT and there are no overriding considerations calling for a “mandated” window replacement, as discussed above.

2) **Question:** What are we supposed to do when the windows don’t rank for replacement? What are our other options?

Answer: Windows that do not rank with an SIR of one (1) or greater on the “Shell” page may not be entered into the ENERGY AUDIT as an infiltration measure under the “Ducts and Infiltration” page for consideration of replacement.

- Should the window, which did not rank for replacement on the ENERGY AUDIT with a SIR of one (1) or greater be deteriorated to a point at which the building envelope is compromised and entered correctly in the Energy Audit with all contributory items, the window may be considered as a repair measure to ensure the protection of the building envelope. In order for the window to be considered for replacement as a repair measure, Subrecipients must clearly document the deterioration of the window with a narrative description and photographic documentation indicating that the window is broken or deteriorated beyond repair. If you have any questions as to what type of window situations should be addressed by repair or replacement measures, then it is recommended that you consult with Department program staff and provide him/her the documentation and photos of the window(s) in question.
- Glass panes can be entered as air infiltration or repair measures depending on the situation. (Examples: A crack between glass and pane-framing window can be addressed with clear caulk and, consequently, would be an air infiltration measure and entered in this area of the ENERGY AUDIT. On the other hand, a totally broken glass pane would be a repair measure and entered into the ENERGY AUDIT as a repair). A detailed house assessment with annotations about the window condition would be proper documentation of this, to include photos.

3) **Question:** Some city codes require tempered glass; in that case is it permissible to put in tempered glass windows into a home if it “ranks” in the ENERGY AUDIT with an SIR greater than or equal to 1? Our city requires tempered glass in some circumstances.

Answer: Tempered glass is allowable, as long as it ranks with the required SIR of 1 and the value includes the total installed cost. It is not permissible to rank the window without the tempered glass price and then put the difference in as a “repair” or a health and safety cost.

4) **Question:** How should we deal with “burglar bars”? The bars often have to be removed to install windows and some of the bars we deal with have no inside quick-release safety latch to allow escape in case of fire, which is unsafe, and against the current IRC code.

Answer: If you take down burglar bars with no safety latch to allow egress from inside the house to the outside in every room, then you cannot remount these bars ingress/egress is only required from the bedrooms. Instead, you should tell the client during the assessment phase of weatherization that the bars are not safe because they may not be able to escape a fire and that you will not be able to remount them. You can take down burglar bars to install a window, but you can only re-install those bars that have a safety latch in every room. If the client has existing burglar bars (with safety latches) the cost of remounting safe burglar bars should be included in the price for the windows and the window must rank with this cost included. You may add the cost of the burglar bar re-installation in the “additional cost // weatherization (\$/window)” category of the windows section of the ENERGY AUDIT. Make sure the “include in SIR” box is checked on the ENERGY AUDIT screen and/or the “subform datasheet.”

- 5) **Question:** How should we enter sliding glass doors in the ENERGY AUDIT? Do we have any options available to make these energy-hogs more efficient?

Answer: The sliding glass door should be classified as a window slider in the ENERGY AUDIT, but otherwise entered as a window in the program.

Some agencies have had success eliminating the energy-wasting sliding glass door altogether. They have replaced the glass door with a single exterior door and put in a wall where the other have of the sliding glass door was. One agency was even successful putting in a window in that new wall. All of these weatherization improvements were justified by the ENERGY AUDIT because the additional costs for the new window/door did not outweigh the SIR benefit of energy efficiency of the new window/door. If construction/carpentry costs are high in your part of Texas, this may not be a viable option to your agency.

- 6) **Question:** Our solar screens are the 80% ability to defeat solar heat gain entry into the house. Installation and material is not that expensive. Why do they continue to not rank in the ENERGY AUDIT with an SIR great than 1?

Answer: Use the louvered screen in the ENERGY AUDIT options to represent solar screens that can reduce solar heat gain by 75% or more. When the ENERGY AUDIT program was written only louvered window coverings could achieve such energy savings. The ENERGY AUDIT updates will adjust for this advancement in weatherization materials. Note: in your agency files, have actual documentation from the solar screen manufacturing detailing the ability of their product to defeat solar heat gain. If this is not at least 75% or greater you cannot select louvered screen in the ENERGY AUDIT to represent lower-grade solar screens.

Appendix A – Window Leakiness Guidelines

Guidelines on how to determine the degree of leakiness associated with windows based on the type of window. The degree of leakiness must be inputted on all windows in the "Leakiness" field found under the Windows tab of the energy audit .

NOTE: This document is on the WAPTAC.ORG website which is maintained by Department of Energy at: <http://www.waptac.org/Weatherization-Assistant/Weatherization-Assistant-Support-Material.aspx>

In the Weatherization Assistant, there is a data field under the “Windows” tab of both the energy audit called “Leakiness” that allows the user to describe the air leakage characteristics of each window entered. The ENERGY AUDIT and use this input to calculate the energy savings due to reduced air infiltration for window replacements, storms windows, and window weatherization (the ENERGY AUDIT only). For each window retrofit measure, the ENERGY AUDIT add the energy savings due to reduced air infiltration to other energy savings associated with the measure to obtain the total energy savings.

Five options are allowed under the “Leakiness” data field: very tight, tight, medium, loose, and very loose. Guidance on the applicability of these options to various window types is described below. In addition, the leakiness of a typical window that is frequently encountered in homes served by the Weatherization Assistance Program across the country is identified.

The guidance provided below is based primarily on the condition of the frame, sashes, and weatherstripping. Once a leakiness level is selected using the guidance below, it should be modified as follows to take into account the condition of the window panes and the presence of a storm window:

- **Condition of window panes**
 - No adjustment should be made if the window pane is cracked or if less than 2 sq. in. of glass is missing in the window (e.g., up to about a 1.5" diameter hole or a 1.5"x1.5" glass section).
 - Degrade the leakiness one level if 2 to 9 sq. in. of glass is missing in the window (e.g., about a 1.5" to 3.5" diameter hole or a 1.5"x1.5" to 3"x3" glass section).
 - Degrade the leakiness two levels if 9 to 25 sq. in. of glass is missing in the window (e.g., about a 3.5" to 5.5" diameter hole or a 3"x3" to 5"x5" glass section).
 - Specify the window to be Very Loose if more than 25 sq. in. of glass is missing in the window (e.g., a hole bigger than about a 5.5" diameter or a 5"x5" square).
- **Presence of storm window** — Upgrade the leakiness one level if a storm window in average or better condition is installed.

Fixed Window — Fixed windows are sealed in their frames and cannot be opened. Fixed windows can include most skylights (windows in the ceiling), decorative windows in doors, and large picture windows. *The leakiness of a typical fixed window is very tight.*

Awning Window (including hopper and casement windows) — Awning windows have one or two sashes that are hinged at the side and almost always project outwards. They usually have a cranking mechanism to open and close the sashes, and the sashes close by pressing against the frame. They also usually have a locking/latching mechanism that seals the window by forcing the sash against the frame and any installed weatherstripping. On awning windows with two sashes, a vertical framing bar is often present in the middle of the window that houses the locking mechanism. *The leakiness of a typical single-sash awning, hopper, or casement window is Tight, while the leakiness of a typical multiple-sash awning, hopper, or casement window is Medium.*

- **Very tight** —The sashes and window frame fit together snugly to form a complete seal when the window is closed. The sashes and frame are in excellent condition, or they can be in average condition if weatherstripping in good condition is also present. The cranking and locking mechanisms are typically operable and assist in securely pulling the sashes and window frame together. Typical of a new window.
- **Tight** (typical of a window with a single sash) — No visible gaps are observed between the sashes or between the sashes and the window frame when the window is closed. The sashes and frame are in average condition. Weatherstripping can be absent or deteriorated. The cranking and locking mechanisms are typically operable and assist in securely pulling the sashes and window frame together.
- **Medium** (typical of a window with multiple sashes) — Small gaps up to 1/8 in. are observable between the sashes and/or between the sashes and the window frame when the window is closed, even with the aid of a locking mechanism. The sashes and frame are in average to poor condition. Weatherstripping is usually absent or deteriorated.
- **Loose** — Gaps up to 1/4 in. are observable between the sashes at their interface when the window is closed as much as the cranking and locking mechanism allow, and/or gaps up to 1/2 in. are observable between the sashes and the window frame when the window is closed. The sashes and frame are in poor condition, and may be warped or not square. Weatherstripping is absent or ineffective.
- **Very loose** — Gaps 1/4 in. or greater are observable between the sashes at their interface when the window is closed, and/or gaps 1/2 in. or more are observable between the sashes and the window frame when the window is closes. The sashes and frame are in very poor condition and are likely warped or not square. Weatherstripping is absent or ineffective. The locking mechanism may not be able to be engaged.
 - If an auditor selects “very loose windows” then the audit/file needs to have documentation including photographic documentation. In general you can tell if a window is “very loose” by

placing your hand near it when the blower door is running or by using a smoke-puffer to see the stream of air entering the home when the blower door is on. In general, if you feel air coming from inside (probably about 5-20 Cfms or more) the frame then it is “loose” or “very loose.”

Slider Windows and Sliding Glass Door — Windows with sashes that move up and down are vertical slider windows. In double-hung units, both sashes can slide vertically past one another. Only the bottom sash slides up and down in a single-hung window.

- **Very tight** — The moveable sashes and window frame fit together tightly as designed when the window is closed such that no gaps are present. The sashes and frame are in excellent condition. Each moveable sash is secure and tight in its track. The moveable sashes are able to be closed such that the window locking mechanism can be fully engaged. Weatherstripping is present and in good condition. Typical of a new window.
- **Tight** (typical of an original double or single hung vertical slider window installed in a home built in the 1970s or later) — No visible gaps are observed between the sashes or between the moveable sashes and the window frame when the window is closed. The sashes and frame are in average condition. Each moveable sash is secure in its track although some play may be present. The moveable sashes are able to be closed such that the window locking mechanism can be engaged, although perhaps not fully. Weatherstripping is present and in good to fair condition.
- **Medium** (typical of an original double or single hung vertical slider window installed in a home built in the 1960s or earlier, a horizontal slider window or sliding glass door) — Small gaps up to 1/8 in. are observable between the sashes at their interface and/or between the moveable sashes and the window frame when the window is closed. The sashes and frame are in average condition. Each moveable sash is operable in its track although some play is likely. The moveable sashes may not sit perfectly horizontal or vertical when closed. The locking mechanism may not be able to be engaged. Weatherstripping is absent or deteriorated.
- **Loose** — Gaps up to 1/4 in. are observable between the sashes at their interface when the window is closed, and/or gaps up to 1/2 in. are observable between the moveable sashes and the window frame. The sashes and frame are in poor condition. Each moveable sash may be loose in its track. The moveable sashes likely do not sit horizontal or vertical when closed. The locking mechanism may not be able to be engaged. Weatherstripping is absent or ineffective.
- **Very loose** — Gaps 1/4 in. or greater are observable between the sashes at their interface when the window is closed, and/or gaps 1/2 in. or more are observable between the moveable sashes and the window frame. The sashes and frame are in poor condition. Each moveable sash may no longer fit in its track. The moveable sashes likely do not sit horizontal or vertical when closed. There may be considerable movement (rattling) between sashes. The locking mechanism is likely to be inoperative. Weatherstripping is absent or ineffective.
 - If an auditor selects “very loose windows” then the audit/file needs to have documentation including photographic documentation. In general you can tell if a window is “very loose” by placing your hand near it when the blower door is running or by using a smoke-puffer to see the stream of air entering the home when the blower door is on. In general, if you feel air coming from inside (probably about 5-20 Cfms or more) the frame then it is “loose” or “very loose.”

Jalousie windows — A jalousie window is made up of multiple horizontally-mounted glass louvers or slats. The glass louvers are usually 3” to 5” wide and are mounted in a metal panel. A crank typically rotates the glass louvers outward like a shutter when open. The glass louvers overlap each other slightly when closed. *The leakiness of a typical jalousie window is Loose.*

- **Very tight** — Generally not applicable to jalousie windows.
- **Tight** — Generally not applicable to jalousie windows.

- Medium — A tight glass-to-glass seal is visually obtained at the overlap of all the glass louvers when the window is closed. The cranking mechanism is in good working order. All window panes are securely attached to the cranking mechanism. Typical of a new window.
- Loose (typical) — Small gaps up to 1/8 in. are observable between the glass louvers when the window is closed. One or two of the glass louvers may not be securely attached to the cranking mechanism. The cranking mechanism may not be able to fully rotate the glass louvers to their fully closed position.
- Very loose — Gaps 1/8 in. or greater are observable between the glass louvers when the window is closed. Multiple glass louvers may not be securely attached to the cranking mechanism. The cranking mechanism is likely not able to fully rotate the glass louvers to their fully closed position.
 - If an auditor selects “very loose windows” then the audit/file needs to have documentation including photographic documentation. In general you can tell if a window is “very loose” by placing your hand near it when the blower door is running or by using a smoke-puffer to see the stream of air entering the home when the blower door is on. In general, if you feel air coming from inside (probably about 5-20 CFMs or more) the frame then it is “loose” or “very loose.”