

Best Practice – Window Repair or Replacement

Date: Revised May 2020

Subject: Window Repair and Replacement

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

Discussion:

When assessing the windows of a dwelling unit, assessment staff should consider the following:

- DOE, DOE/LIHEAP, or LIHEAP only programs guidelines can have different allowable repair/replacement guidelines
- Replacement should be considered if window(s) are damaged beyond repair & allowing air infiltration through the window frame itself
- Components of the window which clearly allow for air infiltration such as sash locks, broken window pane(s), glazing, etc. should be addressed as infiltration measures.
- Solar heat gain of windows can often be addressed in a more cost effective fashion through the consideration of solar screens or window film installation.
- Windows can often be weatherized to reduce infiltration through the installation of window weather-stripping.
- Clear photographic & written documentation of the defective items or aspects of window(s) should be obtained and placed in the client file to justify repair/replacement actions.
- Visual appearance (aesthetics) or customer desires are not a valid reasons to authorize window replacement.

For LIHEAP Only units:

- Window Repair is allowable as part of either air infiltration costs or the \$500 miscellaneous repair costs as provided in the LIHEAP Priority List. Window repair air infiltration cost could include window weather-stripping, glass pane replacement, installation of new glazing, sash locks, frame repair, etc. Repair measures related to windows should be limited to preserving the integrity of an associated energy conservation measure or block moisture intrusion.
- Window Replacement is also an option as a Secondary Measure on the Priority List. If the window(s) are structurally unsound or unable to be repaired, then they may be replaced. Remember, prior to replacing the window, all the Major Measures on the Priority List need to have been evaluated and properly addressed and you must receive written Department approval for the replacement. Major Measuring skipping is not allowed.

For DOE units:

- Window Repair can be allowable as part of either air infiltration costs or as an incidental repair measure costs (IRM), however must be cost justified by the WA 8.9 (NEAT/MHEA) energy audit.
 - Air infiltration related repair measures such as window weather-stripping, glass pane replacement, installation of new glazing, sash locks, frame repair, etc. should be included in the air infiltration cost and must have a SIR of 1.0 or greater to allow for installation.
 - Incidental repair measures related to windows are only allowable to preserve the integrity of an associated energy conservation measure (ECM) and must meet the guidance outlined in WPN 19-5. IRM cost must be included in the whole house SIR calculation and the whole house SIR must have a SIR of 1.0 or greater.

- Window Replacement can potentially be allowed, as either as an energy conservation measure (ECM) or as an incidental repair measure (IRM), however must be cost justified by the WA 8.9 (NEAT/MHEA) energy audit. All window replacements must first be modeled and treated as ECM(s) if cost justified.
 - ECM replacement of a window is an energy conservation measure option provided within the NEAT/MHEA energy audit. If a window is properly modeled and ranks in the Recommended Measures Report with an SIR of 1.0 or greater, you may proceed with the replacement. Major factors for ranking window replacements in the energy audit are window type, window replacement efficiency ratings, frame type, glazing type, shading, leakiness, orientation, and installation cost. As a reminder, according to WPN 19-4 Attachment 9, window replacements have an expected measure lifetime of 20 years, so make sure your audit libraries have accurate lifetime expectancies, as that will impact SIR rankings.
 - IRM replacement of a window is only allowed to preserve the integrity of an associated ECM(s) and must meet the guidance outlaid in WPN 19-5. IRM cost must be included in the whole house SIR calculation and the whole house SIR must have a SIR of 1.0 or greater.

Note-Window replacement is **not allowed** as a Health & Safety or Air Sealing measure.

For DOE & LIHEAP leveraged units: Since DOE funds are involved, we must follow the DOE guidance above. DOE or LIHEAP funds can be used to pay for the repair or replacement.

Recommendation Summary: Utilizing either the Priority List or WA 8.9 energy audit, window repair/efficiency upgrades can often be addressed within the work scope, however each program has different guidelines and it is imperative to pay close attention to the details to ensure of program compliance. Please contact Department Training Staff to assist if you are experiencing difficulties determining allowable methods to address window concerns, have question related to the priority list for LIHEAP units, or need assistance in energy audit modeling of windows for DOE/DOE-LIHEAP leveraged units.

The remaining guidance is Window FAQs to aid in determining how to accurately address windows

FAQ's

- 1) We are in the process of completing the ENERGY AUDIT and trying to determine which window Retrofit Option to select, should we select the type of window "Retrofit Options" we want to install in the unit based on our judgement or should we select the "Evaluate All" selection? For example, after performing the assessment on a unit we feel the Low-E window replacement retrofit option should be considered for all windows and want to know should we select "Low-E" in the Retrofit Options, or should we run the audit utilizing the "Evaluate All" option.

All ENERGY AUDITS should first be ran from the "Evaluate All" standpoint as identified in the caption below. This is the only way to accurately allow the ENERGY AUDIT to consider all measures and provide a report identifying the most cost-effective measures based on their calculated energy-savings.

The screenshot displays the NEAT AUDIT software interface. The window title is "NEAT AUDIT -- NEAT AUDIT -- NEAT AUDIT -- NEAT AUDIT -- NEAT AUDIT -- NEAT AUDIT -- NEAT AUDIT". The main window contains a form for entering audit information. The "Audit Name" is "House with crawl space", "Client ID" is "00004 House with cra", "Client Name" is "Crawlspace, Joe", and "Alt. Client ID" is empty. The "Retrofit Options" dropdown menu is highlighted with a red circle and set to "Evaluate All". Other fields include "Window Code" (WD1), "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). A "Run Audit" button is visible on the right side of the form. The bottom of the window shows a "WINDOW" list with a table containing one entry: "1" out of "3" windows.

Utilizing the "Evaluate All" Retrofit Option allows the ENERGY AUDIT to determine if window replacement will be a cost-effective measure for the unit based on the calculated energy-savings. The ENERGY AUDIT may select another Retrofit Option, not recommend any of the Retrofit options, or it may recommend (rank) the window replacement based on what the audit calculates to be the most energy efficient solution based off the unit needs.

- If window related measures are recommended on the Suggested Measures Report utilizing the "Evaluate All" Retrofit Option, have an SIR equal to or greater than 1, and all other ranking measures with higher SIRs have been addressed then the window measure would be allowed without question.

Note: TAC Rule 6.416 (b) requires measures to be installed in order of highest SIR to lowest depending on funds available. If funding limits do not allow you to reach the window measure you could consider leveraging the unit with LIHEAP or other available funds. Measure skipping is not allowed.

2) **What are we supposed to do when the windows don't rank in the ENERGY AUDIT using the "Evaluate All" method but, are deteriorated beyond repair and leaking a significant amount of air? Is there any other option to allow for replacement?**

Yes. You could possibly still replace the window utilizing with Option #1 or Option #2 listed below.

Option #1

If window replacement is determined to be a necessary to meet program guidelines, but **not recommended in the Suggested Measures Report** after utilizing the "Evaluate All" option described above, there is a potential exception to the "Evaluate All" rule that could be utilized on a limited basis. Window conditions must be beyond repair, allow significant infiltration, and require replacement to meet a program guideline to consider this exception.

First print and retain a copy of the "Evaluate All" Suggested Measures Report for reference later in the process. To remodel this, you could go back into the audit and mandate the desired window Retrofit Option (example you could select "Replace with Low-e") for the window(s) requiring replacement. This is a user-defined action that "triggers" an exception to the SIR-based order of energy-saving measures and "mandates" that the ENERGY AUDIT consider the selected Retrofit Option first. After mandating the needed window Retrofit Options, rerun the audit and determine if this process is allowable or unallowable using the guidance below:

Note: Caution should be taken as mandating measures often has a negative effect on the SIR calculations of other measures. Often measures that previously ranked utilizing the "Evaluate All" method may not rank now because of the effect the mandated change has on the ENERGY AUDIT analysis and calculations.

- **Process Unallowable-** Review the "Evaluate All" vs. "Mandated" Suggested Measures Report from the ENERGY AUDIT and compare. If any of the original ranking measures from the "Evaluate All" audit report disappear or no longer rank this process is unallowable. The auditor should return the ENERGY AUDIT to its original "Evaluate All" standpoint and determine if the unit would meet the criteria of Option #2, be a deferral, or windows could be addressed utilizing alternate means.
- **Process Allowable-** Review the "Evaluate All" vs. "Mandated" Suggested Measures Report and compare. If all original measures are still listed on the energy audit report, the mandated window replacement has a SIR greater than 1, and all measures ranking above the window replacement are installed then addressing the window(s) replacement would be allowable if the following are retained in the client file:
 - Copy of the original ENERGY AUDIT to verify all original measures from the "Evaluate All" standpoint are addressed.
 - Clear photos of the window(s) condition along with robust written documentation to justify using the exception rule.

Note: TAC Rule 6.416 (b) requires measures to be installed in order of highest SIR to lowest depending on funds available. If funding limits do not allow you to reach the window measure you could consider leveraging the unit with LIHEAP or other available funds. Measure skipping is not allowed.

Option #2

Incidental Repair Measure- Window replacements are required to be modeled as an ECM before considering replacement as an IRM. If they do not rank as an ECM, the window replacement can only be allowed as an IRM to preserve the integrity of an associated ECM(s) and must meet the guidance outlaid in WPN 19-5. IRM cost must be included in the whole house SIR calculation and the whole house SIR must have a SIR of 1.0 or greater.

3) What are we supposed to do when windows simply just will not rank for replacement utilizing the ENERGY AUDIT or meet the requirement of WPN 19-5 to be considered an Incidental Repair Measure? What are our other options?

Window replacement that does not rank with an SIR equal to or greater than one 1 or meet the WPN 19-5 guidance to be an Incidental Repair Measure will not be an allowable program expenditure. Additionally, as stated earlier in this Best Practice they are not allowed to be replaced under H&S or air infiltration. Some common solutions noted from within the network that can be possibly charged to air infiltration are:

- Window elimination for severely deteriorated windows in which the subrecipient would remove the window from the building shell, install appropriate framing/wall coverings to conceal the opening and insulate the removal area. Special attention should be paid to the ingress/egress requirement for fire safety when considering this option.
- Window weather-stripping in which the subrecipient can install foam strips at the bottom of the window opening, door type weather-stripping along the operable portions. When performed correctly this can have a drastic reduction in infiltration.
- Glass pane replacement
- Caulking/Glazing. When caulking please do not caulk windows closed and special attention should be paid to the ingress/egress requirement for fire safety.

4) 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.

Tempered glass is allowable, as long as it ranks with the required SIR of 1 or greater 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.

5) 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.

If you take down burglar bars with no safety latch to allow egress from inside the house to the outside in every room, then these bars cannot be remounted if they do not meet current code. Inform the client during the assessment phase of weatherization that you will be required to take down burglar bars to allow for proper window installation, but you can only re-install the bars that meet code. If the client has existing burglar bars that meet code then the cost of remounting the 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.

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

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. All of these weatherization improvements were justified by the ENERGY AUDIT because the costs for the door/wall did not outweigh the SIR benefit of the new window (SGD) and the door/wall combination had a higher working efficiency value. If construction/carpentry costs are high in your part of Texas, this may not be a viable option to your agency.

7) Our solar screens are constructed of the 80% fabric which drastically reduce solar heat gain entry into the house. Installation and material are not that expensive. Why do they continue to not rank in the ENERGY AUDIT with an SIR great than 1?

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:** Review your material specifications file, 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.

8) How do we determine how leaky a window is?

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

NOTE: This document is on the Oak Ridge National Laboratory website at:

<https://weatherization.ornl.gov/wp-content/uploads/2018/05/WindowLeakiness.pdf>

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.

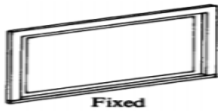
The guidance provided below is based primarily on the condition of the frame, sashes, and weather-stripping. Once a leakiness level is selected using the guidance below, it should be modified as follows to take into account the condition of the window panes and the presence of a storm window:

- **Condition of window panes**

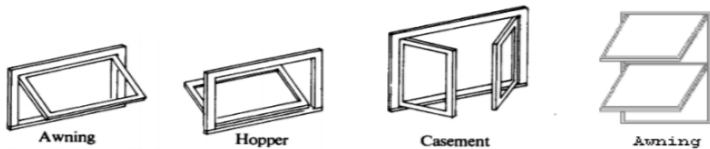
- No adjustment should be made if the window pane is cracked or if less than 2 sq. in. of glass is missing in the window (e.g., up to about a 1.5" diameter hole or a 1.5"x1.5" glass section).
- Degrade the leakiness one level if 2 to 9 sq. in. of glass is missing in the window (e.g., about a 1.5" to 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 weather-stripping. 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.*

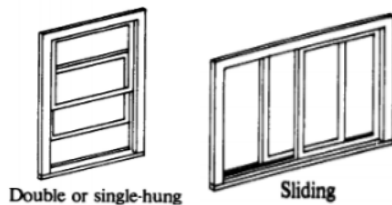


- **Very tight** — The sashes and window frame fit together snugly to form a complete seal when the window is closed. The sashes and frame are in excellent condition, or they can be in average condition if weather-stripping in good condition is also present. The cranking and locking mechanisms are typically 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. Weather-stripping 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. Weather-stripping 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. Weather-stripping 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 closed. The sashes and frame are in very poor condition and are likely warped or not square. Weather-stripping 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. Weather-stripping 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. Weather-stripping 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. Weather-stripping 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. Weather-stripping 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. Weather-stripping 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.”