



Rehab It Right! Historic
Windows & Doors



Established in 1966, Utah Heritage Foundation was the first statewide preservation organization in the western

United States. Our mission is to preserve, protect and promote Utah's historic built environment through public awareness, advocacy, and active preservation. As a private non-profit, membership-based organization, Utah Heritage Foundation is supported mainly by private resources including memberships, gifts, grants, and special events. The foundation fulfills its mission through a variety of programs and activities which reach communities throughout Utah.

SPECIAL THANKS TO:

GEORGE S. AND DOLORES DORÉ ECCLES
F O U N D A T I O N

UHF's Historic Properties Committee

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HISTORIC WINDOWS AND DOORS

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Introduction

This document is intended to guide property owners, planning a successful rehabilitation project, towards sensitive preservation practices. It is meant to be a how-to resource and identifies issues common to a historic building's irreplaceable original windows and doors. It provides solutions for how these issues can be resolved without compromising the historic integrity of the building. It also presents techniques for approaching the evaluation and repair of existing windows and doors, and considerations for weatherization and replacement if necessary. Work to repair a deteriorated or damaged historic architectural feature is easier, more economical, and environmentally friendly than you might think.



Why Historic Windows Matter

Windows are significant elements of the overall design and appearance of any building façade and bring sheer architectural value as distinct elements of interior spaces as well. Their design, quality of materials, workmanship, and other aesthetic qualities are unique to a building and the era when it was built.

Nothing gives character and scale to older and historic buildings like original windows. They were custom built to fit their frames and specific design choices were made to coordinate their design and detailing to the architectural style and function of the building. Important characteristics include the pattern and size of the openings, proportions and profiles of the frame and sash, configuration of glass panes, muntin profiles, material, ornamentation and the fascinating mechanisms behind them. These variations in composition and construction reflect not only the evolution of architectural styles, but craftsmanship, building practices, regional preferences, and the economics of earlier times. Even the glass tells a story. Old glass may vary in type, texture and color, each indicating advances in related technology.

Just as historic windows define the architectural character of a building, they also make an enormous contribution to the historic significance and integrity of streetscapes, neighborhoods and the downtown. The continuity and rhythm of windows and openings along a street are just as important collectively as they are to the composition and character of the individual building. They impart considerable historic value as material evidence about the lives of past generations. Importantly, retaining historic features, especially windows, is vital to understanding the cultural heritage of a community.

Keeping historic windows in good repair while saving money also supports a community's efforts of environmental sustainability. Constructed of quality materials, including old-growth wood that is more durable than today's options, historic window components are designed to be easily repaired or parts



replaced if or when they reach the end of their useful life. They can be restored many times and function for the life of the building.

Preserving historic windows means the energy that went into making them will be conserved and the windows will not be sent to landfills, adding to the waste stream. Limited new construction materials are required, avoiding the energy, waste and pollution from manufacturing and for transportation and construction.

Windows Should Be Considered Significant To A Historic Building If They:

- 1) are original,
- 2) reflect the original design intent for the building,
- 3) reflect period or regional styles or building practices,
- 4) reflect changes to the building resulting from major periods or events, or
- 5) are examples of exceptional craftsmanship or design.

Preservation Brief 9: The Repair of Historic Wooden Windows, National Park Service

<https://www.nps.gov/tps/how-to-preserve/briefs/9-wooden-windows.htm>

Consider Repair Before Replace

In considering alternatives to replacing historic windows, one needs to keep in mind that the benefits can be summarized under three important factors: authenticity and integrity, sustainability, and energy efficiency.

Authenticity & Integrity

Windows are one of the most important elements defining the architectural character of a building. Typically, they comprise a considerable proportion of the historic fabric of a façade. Distinctive qualities in window size, shape, and proportion contribute greatly to the overall visual appeal. Other important features are the number of “lights” or panes dividing a window and the depth and profile of window components along with the shadow lines they create. The tendency to replace original windows becomes more prevalent due to limited understanding and ill-informed choices, they consequently become a more valuable feature that raises the desirability of a building to discriminating buyers.

“Historic integrity is the authenticity of a property’s historic identity as evidenced by the survival of physical characteristics that existed during the properties prehistoric or historic period.”

http://www.nps.gov/nr/publications/bulletins/nrb16a/nrb16a_II.htm

“Similarly, retaining and celebrating authenticity is one key element of an exemplary preservation program. No one should take lightly the option of discarding authentic historic materials – in this case, windows – without fully evaluating the consequences. Once authentic material is lost, it is lost forever. It does not matter how accurate the replacement window, it never reflects the nuances of the original.”

<http://www.dahp.wa.gov/sites/default/files/WhatReplacementWindowsCantReplace.pdf>



“The visual impact and appearance of new, replacement windows that do not match or replicate features can be dramatic. Even minor changes to the appearance of windows can alter the way a building looks. Original material is lost and thrown away. And some buildings may no longer be considered ‘historic’ in terms of integrity and eligibility for historic designation.”

<http://www.preservationnation.org/information-center/sustainable-communities>

“For so many reasons, the original windows of older and historic homes and buildings are what make them places that matter. Consider it this way: If you had a beautiful piece of art that was custom designed, crafted by hand, made from native old-growth wood, and imbued with clues to its age and crafting traditions, would you throw the authentic piece in the dumpster if a simulated plastic version suddenly became available? Seems ridiculous, right. However, this is precisely what people all over the country are doing when they rip out their historic wood windows and replace them with new windows.

<http://www.preservationnation.org/information-center/sustainable-communities>



Sustainability

Older buildings play a unique and valuable role in the development of sustainable communities. Repairing and retrofitting windows is a sustainable course of action that protects the character of a historic place and respects the environment. Importantly, any repair costs usually reflect an investment in local labor benefiting the local economy or indeed personal skills and understanding.

“Older and historic buildings comprise more than half of the existing buildings in the United States. Retention and adaptive reuse of these buildings preserves the materials, embodied energy, and human capital already expended in their construction. The recycling of buildings is one of the most beneficial “green” practices, and stresses the importance and value of historic preservation in the overall promotion of sustainability.”

http://www.ohp.parks.ca.gov/?page_id=24592

“A product with a “green” label must also be sustainable. Historic wood windows, constructed of old-growth lumber and superior craftsmanship, will last up to five times longer than replacement models, namely because the wood is durable and they are easily repaired. The same can’t be said for vinyl or new-growth wood replacement windows with plastic parts. Moreover, the insulating glass found in double-

glazed replacement windows will eventually fail and the whole window will have to be replaced.”

<http://napc.uga.edu/Popular%20Window%20Replacement%20Myths.pdf>

“Windows are a critical element of sustainability, but sustainability is not just about energy. It is about making environmentally responsible choices regarding historic windows that take into account the spectrum of associated costs and effects. The choice of whether to replace or restore requires embracing a more encompassing definition of sustainability. The answer is not as simplistic as some would have us believe.”

<http://www.sanantonio.gov/historic/Resources/Windows>



“The manufacture of polyvinyl chloride (PVC), is one of the most toxic production processes there is. Dioxin is formed when PVC is manufactured and when it is burned. Dioxin is a carcinogen and among the most toxic chemicals known. Fire fighting has become a serious problem at vinyl-encased homes. Fortunately, the windows are not toxic while they are being used, but they are toxic to produce and toxic to dispose of.”

<https://napcommissions.org/technical-assistance>

Energy Efficiency

Research shows that a larger percentage of energy loss occurs through uninsulated walls, floors, and roofs than through windows. Proper maintenance of an older window and the addition of a storm window and weather stripping can be just as energy efficient as a new window. In addition, replacing a historic window may not save you money in the long run.

“To me, the strangest problem is how many old-house owners have been persuaded to throw away all their fine old windows and replace them with plastic counterparts that will last only five to twenty years. A well-built old window can be maintained and repaired to last for centuries and can also be upgraded to meet current energy-saving goals with simple, low-cost treatments like exterior storms, interior air panels, or even ordinary roller shades.”

<http://www.oldhouseonline.com/category/articles/repairs-and-how-to/page/13/>

“After spending about \$12,000 dollars on properly installed, high-quality replacement windows (the average home has between twenty-four and thirty windows, replaced at an average of \$500-\$1,000 each), a typical household might save about \$50 a month on heating or cooling bills. However, if a house is actively heating or cooled for an average of six months a year, the savings amounts to only \$300 a year. At this rate, it would take forty years to even begin to recoup in energy savings the amount spent on the new windows.”

<http://www.preservationnation.org/information-center/sustainable-communities/buildings/weatherization>



“The Bottom Line. Retrofitting windows with high performance enhancements can result in substantial energy savings across a variety of climate zones. Selecting options that retain and retrofit existing windows are the most cost effective way to achieve these energy savings and to lower a home’s carbon footprint. Retrofits extend the life of existing windows, avoid production of new materials, reduce waste and preserve a home’s character.”

<http://www.preservationnation.org/information-center/sustainable-communities/green-lab/saving-windows-saving-money/#.VM6R5zo5DIU>

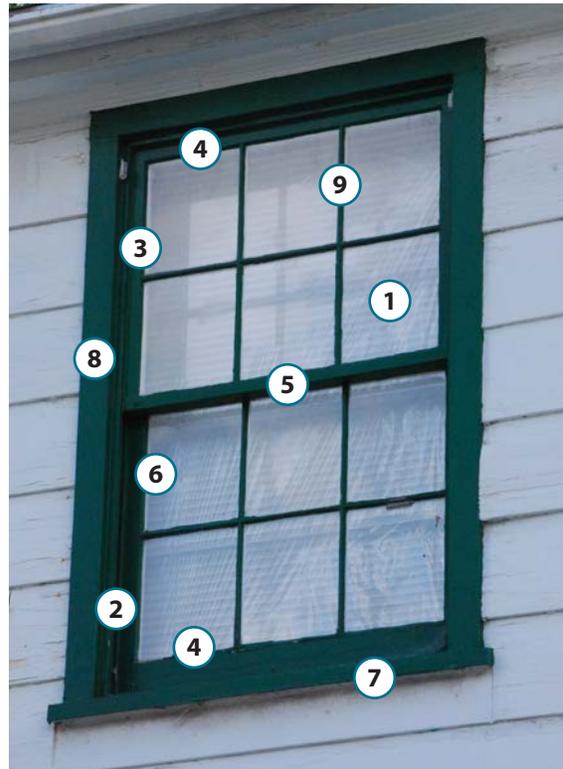
Common Issues with Older Windows

Decades of exposure to the extremes of Utah's climate coupled with a lack of regular maintenance can lead to problems with your historic building's windows. When regularly maintained, and repaired correctly if necessary, these significant features can last as long as the building.

The photograph to the right identifies the various components of a traditional double-hung window.

Parts of a Window

- 1. PANE:** A single piece of glass surrounded by wood, metal or other material.
- 2. JAMB:** Vertical parts of a window forming the sides of the frame.
- 3. SASH:** Framework inside the jamb that holds the glass.
- 4. RAIL:** Horizontal element of a sash.
- 5. MEETING RAIL:** The bottom rail of the upper sash and the top rail of the lower sash.
- 6. STILES:** Vertical members of a sash.
- 7. SILL:** A horizontal element at the bottom of a window that usually extends beyond the width of the opening and slopes away from the unit to drain water.
- 8. CASING:** Wooden trim that frames the inside or outside opening of a window unit.
- 9. MUNTIN:** A narrow molding holding individual panes of glass in a multi-paned true divided light sash, or applied in a simulated divided light sash.



Not shown in photo:

- FRAME:** A fixed frame that is set in the wall and supports the entire window unit.
- STOP:** A vertical element that holds the sash in the frame.
- PARTING BEAD:** A vertical strip that separates the upper and lower sashes in a double-hung window.
- MULLION:** A large vertical element between coupled or multiple window frames.



Water Infiltration

Window deterioration is mainly caused by water penetration which can gradually undermine both the overall appearance of the window and eventually structural soundness. The areas most affected by moisture, and therefore more vulnerable to decay are sills and crucial joints such as the lower corners of the upper and lower sashes, and joints between the sill and the window jamb - areas where water might remain longer.

Warning signs: Visual evidence of moisture penetration is paint failure on both interior and exterior surfaces, separation of sash and frame joints, standing water, degradation of wood surfaces, and eventually rot. Broken, loose or missing putty can also be a means of water infiltration. Traditional putty (linseed oil-based) is intended to be a gradual sacrificial medium. As it dries out and cracks over time, it can easily be removed without notable risk to the glass, and ultimately be replaced.

Condensation

In colder weather, condensation or even frost sometimes forms on the inside of windows. Warmer air contains more moisture than cooler air and condenses when it comes in contact with a colder surface.

Warning signs: Because windows are generally the coolest area in a building, excess moisture in the air is drawn there and condenses on glass panes, sills and other perimeter frame components. Water can collect on the horizontal parts of the window, gradually affecting glazing putty and paint, and cause peeling, blistering, loosening, disintegration, and rot. This may not necessarily be a sign that you have bad windows, but could be an indication of too much humidity in the building.





Building Movement

Settling and other structural movement in a wall over the course of many decades may deform a window opening. Keep in mind that some signs of settling may be so old that they have stabilized, leaving the misaligned window as an expression of age and character.

Warning signs: Sashes may shift leading to rattling glass panes, displaced or cracked glass, windows that fail to open and close properly, misaligned hardware, and deflection in the mullions. Windows that are difficult to operate because they are no longer square are considered “racked.” Racked windows can cause problems ranging from increased air and moisture infiltration due to exposed gaps between the frame and wall opening to damaged joints and broken meeting rails.

Air Infiltration

There is perhaps no greater concern with historic windows than the amount of air that is able to enter a building making the window feel drafty. The biggest culprits are where window frames meet the wall opening, around sashes and sash weight pockets.

Warning signs: The frame may fail to fit properly in the wall opening or the caulking material may be cracked, loose, or missing. Leakage occurs around the pane when glazing compounds and sealants are damaged or missing. Damaged, or partially missing weather stripping can also create a pathway for the seepage of outside air into the building. Poorly working or broken locks and latches can be a problem as well.



Energy audits provide the best way to identify air leaks in your building. An audit identifies a building’s problem areas and lays out how best to make improvements to increase energy efficiency.

Weathering

Fluctuations in temperature and weather will naturally cause window components to deteriorate, especially those that are not well protected. Some materials are susceptible to deterioration from the acids and salts contained in rainwater. Environmental pollutants can also have a negative effect on the physical condition of a window.

Warning signs: Without periodic maintenance, paint can crack, blister or flake off exposing the wood, wood can crack and may eventually rot, while metal framing, hinges and other hardware can gradually corrode or rust.



Paint

Painted windows must be painted on a regular basis in order to prolong their life span. Where the paint breaks down, wood frames are directly exposed to extremes of heat, cold, sunlight, pollution and moisture that will accelerate deterioration.

Warning signs: If painting has been carried out incorrectly working parts can become stuck. Windows may be painted shut if the sash and surrounding frame or casing are painted over. Paint-covered sash cords make a window more difficult to open and close, and they may become brittle and break. The buildup of paint layers overtime can also impede the smooth operation of sliding sashes.



Age

As you would expect, some window components will inherently deteriorate over time from normal wear and tear.

Warning signs: Eventually glazing putty will dry out and crack, sash cords and pulleys may break, paint will exhaust its effectiveness, and seals between frames and sashes or upper and lower sashes may fail.



Safety Note: In older homes, there is a good chance your building contains lead-based paint. Lead is hazardous to humans, particularly small children. Therefore, take proper precautions when dealing with abrasive/mechanical, chemical stripping or thermal removal methods. Before undertaking any repairs where paint will be disturbed, it is important to review and strictly follow established lead safety procedures. For more detailed information, download [Lead Paint Safety: A Field Guide for Painting, Home Maintenance, and Renovation Work](#).

Also see page 29 for additional information.

Thermal Methods of Removing Paint:

Recommended

- Electric heat plate/gun
- Infrared heat plate/gun
- Steamer

Not Recommended

- Blow torch
- High heat removal

Proper disposal of lead-based paint residue is required.

Maintenance and Repairs

While repairs to windows may be labor intensive, they are generally a relatively easy undertaking, and most homeowners have the skills to do them themselves. A simple round of maintenance and minor repairs on a regular basis can provide effective, trouble-free service for the life of your building. Historic windows are made of separate parts. Each component can be individually repaired or replaced in kind if necessary. Any repairs can be done incrementally and will be much cheaper and more durable than removing and replacing a window, while still retaining historic fabric, increasing the energy efficiency of the window, and reducing demolition waste.

First, take time to assess the working condition of each window. Carefully exam their physical condition both inside and outside. This assessment will help you identify priorities, investigate costs, and establish a plan of action. You may not need to do the same thing to all of the windows and save money.

It is better to approach the maintenance and repair of your historic windows as a long-term program. Their life span depends on how well you take care of them. The primary emphasis of this guide is on techniques for the repair of a typical double-hung wooden window and may be modified in obvious ways for other window types and styles.

The basics we will cover:

- Maintenance and Minor Repairs
- Weatherization
- Window Replacement



Tools Needed To Conduct Conditions Assessment:

1. Pocket knife to test the wood for soundness.
2. Scraper to check if metals are corroded or rusted.
3. Brush for paintwork.



In a Conditions Assessment, One Should Note the Following:

- window location,
- paint condition,
- condition of the frame and sill,
- sash condition (rails, stiles, joinery and muntins),
- glazing problems (glass, glazing compound and putty),
- existence or condition of weather stripping,
- hardware condition, and
- overall condition of window.

Preservation Brief 9: The Repair of Historic Wooden Windows, National Park Service

<https://www.nps.gov/tps/how-to-preserve/briefs/9-wooden-window.htm>

Painted Shut

It takes little more than one sloppy coat of paint to render a window frame inoperable. However, there is no need to replace an otherwise sound historic window that you can repair yourself. To unstick a painted window you will need a utility knife or “window zipper,” putty knife and rubber mallet.

HERE'S HOW

1. Take a utility knife and gently score the paint where the seams around the sash are, taking care not to damage the wood itself. Don't try to cut through the paint on the first pass. Keep this line straight by starting with a very light cut using less pressure and progressively cutting deeper and deeper. The idea is to have the paint break cleanly along the score mark. If you're using a window zipper, run the curved toothed edge along the seam, sawing through the paint build up in the joint.
2. Push your putty knife with the rubber mallet into the seam to gently brake the paint bond.
3. Do the same at the meeting rail (where the top and bottom sash meet when the window is closed.)
4. Try lightly pressing against the bottom sash stiles several times with your hands to help break the bond at the bottom rail and stool (indoor sill.)
5. Repeat these steps on the exterior of the window. Don't forget to brake the bond at the bottom of the sash where it meets the sill.
6. Slowly try to wiggle the window open from the inside.
7. If it still won't open, keep using the putty knife to remove any remaining paint.
8. If the sash stays stuck, soften the paint using appropriate methods and try again.



Follow These Procedures to Control Lead-Based Paint Hazards:

- Properly setup the work area. The work area should be isolated and protected by taped-down plastic sheeting applied to the floor, ground or other applicable surfaces to contain dust generated by the work.
- Protect yourself. Wear protective eye wear, disposable clothing and shoe covers, respiratory protection, a hat and gloves. Wash up after working.
- Control the spread of dust and debris. Always mist the area with water before disturbing any paint. Don't use dangerous work practices that may increase dust or fumes such as high speed power tools without HEPA dust containment systems, open-flame burning or heat guns at temperatures greater than 1,100 degrees Fahrenheit.
- Leave the work area clean at the end of every day. Thoroughly clean the work area at the end of the job as well.
- Control the waste. Use heavy plastic sheeting or bags to collect waste. Bag and seal all waste before removing it from the work area. Be aware of waste disposal rules.

The above information was obtained from the website of the Environmental Protection Agency (EPA.) Consult the resources at the end of this guide for additional information.

Removing a Window Sash



Historic window sashes were typically designed to be taken out of the frames for repair. Each sash, upper and lower, run along their own channels separated by what is called a parting bead. The lower sash is held in place against the parting bead with the interior stop. This stop may be a decorative trim piece. Sometimes the interior stop has visible screws. Other times it is tacked on with nails. In order to remove the sash, the interior stop and parting bead may only need to be removed from one side of the window. You can remove both if you want to clean them up more thoroughly.

HERE'S HOW

1. If the interior stop has been painted and is stuck, reach for your utility knife and gently break the paint seal.
2. Remove any screws holding it in place.
3. Use the putty knife or a thin pry bar to slip behind the stop. Carefully pry the stop from the side jamb a little at a time along its entire length easing nails out if you find any.
4. With one stop removed, pivot the bottom sash out of the window frame so it dangles from the two cords.
5. You may need to repeat these steps on the other side of the window if the sash doesn't budge.
6. Once the sash is out of the frame, you can detach the sash cords. The knotted end of the sash cord sits in a hole drilled in the side of the sash, perhaps secured with a nail that can be removed. Pull the cord out of the knot hole while supporting the sash. Tie a large slip knot near the pulley, pin with a nail, or clamp the cord to keep the weight from falling into the weight pocket and the cord accessible on the outside.
7. The upper sash can be removed in a similar manner as the lower sash. Be aware that the parting bead is thinner and more fragile than the interior stop. If it splits, you can easily cut a piece of wood the same size for replacement.
8. Now that you have removed the sashes you can rehab your window at your leisure. Temporary enclosure of the opening is required of course.
9. Replacing the sashes should roughly follow the reverse steps for removing them.

Replacing Broken Glass and Reglazing

Windows will undoubtedly crack or break sometimes, and before you call a professional to replace a broken glass pane you might consider doing it yourself.

Keep an eye out for discarded old wavy glass to maintain your window's historic character. This glass is of historical significance for its age, rarity and finish. It can be sourced from specialty companies, architectural salvage stores or yard sales. New window glass can be purchased to your specified dimensions at almost any hardware store. But be sure to replace old clear glass with new clear glass if you can't find historic glass to match. Reglaze using a good quality linseed oil-based glazing compound or putty. It does take practice so don't be put off by your first results. Give yourself some time to practice on a less visible sash and perfect your technique.



HERE'S HOW

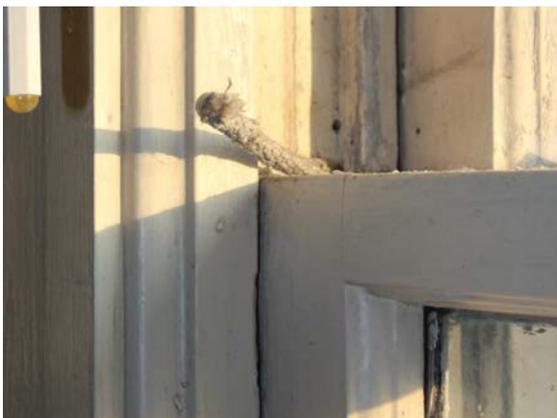
1. If only a few small pieces of broken glass remain of the pane you're going to replace, you can put on gloves and safety glasses and wiggle out the broken glass.
2. More often, though, carefully chip out the glazing compound against the glass and wood with a putty knife. Old putty may also be softened by cautiously applying heat.
3. Fill a spray bottle with water and mix 2 to 3 drops of dish soap into it. Spray the glass and keep it wet to help lubricate it and prevent scratches while working.
4. Underneath the putty are small metal objects (glazing points) pushed into the wood to hold the glass in place. These points should be removed.
5. When you have removed enough of the old putty and points you should be able to lift the glass from the sash.
6. If the glass still won't come out, remove the small bead of putty from the recess (rabbet) that holds the glass. This can be scored with your utility knife until the glass comes free.
7. With the glass pane out, use your scraper and sand the rabbet to remove any remaining putty and paint down to bare wood.
8. Make sure the sash is dry and clear of all dust and debris. Apply boiled linseed oil to the exposed wood and/or prime with an oil-based primer.
9. After the primer is dry, apply a thin bead of glazing compound into the rabbets where the glass sits. Press the glass pane evenly into place. The putty will squeeze out around it, but you can clean up the excess later.

Replacing Broken Glass and Reglazing (continued)

10. Once the glass is tight against the sash, wiggle-push the glazing points into the wood around the perimeter of the pane just far enough for them to be covered by the new putty. They are usually placed every 6-8 inches. Small panes up to 12 inches can use 1 or 2 points evenly spaced per side.
11. Then the final glazing compound can be applied to the edge to fully seal the glass pane. Take a handful of glazing compound and work it in your hands until it becomes pliable and warm. Starting at a corner and holding the ball of putty in one hand, tear off a golf ball sized piece and firmly press it in place using a putty knife.
12. Or work putty into a bead the same length as the section you're working on. Really push the bead in place with your fingers making sure to cover both the wood and glass.
13. When the groove is fully packed with putty, smooth it out (tool) with your putty knife. Place the putty knife in a corner and hold it at an angle steep enough to ensure that the edge of the putty falls just below the sight line of the interior wood. This will allow a small space to seal the putty to the glass with paint. Working from one corner to the other, apply slow consistent pressure to smooth the putty at a bevel while cutting off the excess putty. Go back and make nice clean 90° corners using the corner of the putty knife. You can keep tooling the putty or use your finger to smooth it until you are happy with the results.
14. Once the putty has formed a skin (1-2 weeks) seal it to the glass with top finish coats of paint that slightly overlap the glass.



Replacing a Broken Sash Cord



The reason your double hung window may not open or shut properly may be because there is a broken cord or two. Sashes are hung on cords which pass over pulleys and connect to weights concealed within the weight pockets cut into the window jambs. When the sashes are raised or lowered, the sash weights move up and down in the hollow channels allowing the windows to remain open without additional support (counterbalance system.)

Anytime the sash cord shows signs of wear or careless painting, replace it with the best product you can find that is specifically marked as sash cord. The new sash cord should be the same diameter as the old so it moves smoothly over the pulley. Even if only one cord is broken, consider replacing all four cords (double-hung window.) The others are likely to have a similar life expectancy and you already have the window apart.

HERE'S HOW

1. Once the window sash has been removed, you will see a small wood or metal cover sitting flush inside the bottom of the window jamb. This cover, usually secured with short screws, will give access to the weight pocket without having to remove the inside window trim.

2. The weights for both the upper and lower sashes should be visible; however, the one with the broken cord will be sitting at the bottom of the pocket. Pull the weight out and remove the broken cord, noting how the cord is knotted through the top of the weight. Also note which weight goes with each sash.
3. Next you will need to thread the new cord over the pulley and down into the pocket. Attach a small weight to a piece of string and feed it over the pulley and down into the frame until the weight is visible in the pocket.
4. Tie the end of the string to the new sash cord and gently pull the small weight until you can see the new cord in the pocket.
5. Securely tie the new sash cord to the existing weight. Pull the new sash cord until the weight is inside the frame and lifted to the top.
6. Lift the sash up into the window in the location where it will sit when fully closed. Cut the cord to an appropriate length beyond the circular knot hole in the side of the sash leaving sufficient length to tie a knot that will fit into the hole. You can gently add a nail or two (or screw) here to secure the new sash cord. Don't attach the weights so they bottom out on the sill or bump against the pulley when the sash is all the way open or closed.
7. Put the window sash back in place and check if the window moves properly before reassembling it.

Before You Replace the Sash Cord Consider:

- Removing the pulleys, stripping off all old paint, and lubricating the pulleys.
- Stripping the old paint from channels and sashes and repainting the sashes.
- Lightly sanding the channels and waxing with either beeswax or paraffin.
- Installing weather stripping.

Working with Stained Glass and Leaded Windows

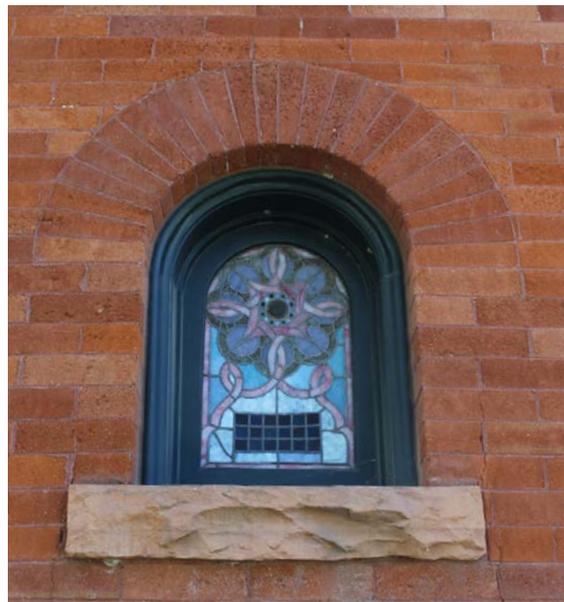
A leaded glass window is both an important architectural feature of a building and a unique work of art. Residential use includes windows, door panels and transoms. Like architecture, a window is a carefully selected combination of materials; mainly glass, lead (zinc or copper) and surface decoration each of which has its own preservation needs.

Leaded decorative windows are hand-crafted and may contain colored, textured, etched, or painted glass or a combination of these. As a material, colored glass is created by adding salts of metallic oxide during its fabrication. Thus, the color is part of the glass. Color can also be painted cold onto the glass or applied and then fused to the surface in a kiln.

The pieces of glass are held together by strips of grooved lead (H-shaped) called “came” and the panel is glazed into a ridged frame. The joints where the leading comes together are finished and secured by soldering on both sides of the panel. The entire window is weatherized by filling the spaces between the glass and lead came with lead-colored putty.

For properly designed and fabricated windows, deterioration takes place gradually over a very long period of time and preventative maintenance can lengthen their life. However, when regular maintenance has been deferred, a full restoration of a seriously damaged window can also preserve it for centuries.

Repairing stained or leaded glass yourself is possible, but it requires a high level of skill and working with toxic materials. Keeping in mind that minor cracks, sagging, and lead discoloration (dark patina) are considered part of the historic character of a window. These signs of age generally require no treatment.



All work on stained and leaded glass requires extreme care. The leading may be deteriorating and the glass may no longer be firmly held in place. It is advisable to consult a professional or experienced craftsman.

HERE'S WHAT YOU CAN DO

Inspection

A thorough inspection should be performed on a regular basis. There are a few things you should be aware of which may indicate that repair or restoration work is needed and to look for advice from an expert. An experienced specialist can identify the cause of any of the conditions listed below and recommend suitable treatment.

- Damaged, cracked or broken areas of glass
- Gaps in the panel or glass popping out of the comes allowing daylight to come through
- Loose or flaking painted areas (unstable)
- Leaking water or drafts
- Broken or loose wire ties
- Lead with a white powdery look (oxidation)
- Rattling panels
- Lead “fatigue” evident by tears or cracks in the lead comes (particularly near the solder joints)
- Sagging or bulging panels
- Loose or missing perimeter putty that holds the glass into the sash
- Stained or wet sills

Cleaning

Cleaning must be done carefully and correctly. Seek the advice of an expert if you suspect painted areas are unstable. They can give you advice on how to remove surface dirt without harming materials or compromising any decoration.

To maintain stained and leaded glass windows:

- Dust them occasionally with a soft dry cloth.
- If that seems to be leaving behind some grime, dampen the cloth with distilled water (soft water.) Individually clean each piece of glass before moving on to the next.
- The cloth should be rinsed often or replaced when dirty as potentially abrasive particles may stick to it.



- Use a cotton swab to clean around the edges of the glass and in the corners.
- After you finish cleaning a piece of glass dry it with another soft cloth.
- If you're still seeing a dirty residue, try cleaning using a pH neutral cleaning solution mixed with distilled water.
- Never use household detergents, abrasives, scouring powders or steel wool scrubbers.
- Repeat the process on the outside of the window if it is accessible.

Recommended Reading:

For more detailed information, download *Preservation Brief 33: The Preservation and Repair of Historic Stained and Leaded Glass*

<https://www.nps.gov/tps/how-to-preserve/briefs/33-stained-leaded-glass.htm>

Wood Repair

Modern wood can rarely match the quality and durability of the old growth wood typically used to construct historic windows. Since they are an irreplaceable historic resource, it is important to remember that because a portion of a window is deteriorated, replacement of the entire unit is rarely necessary. At the early stages of wood deterioration, it is possible to complete in-place treatments that retain as much of the valuable historic material as possible.

Deteriorated windows can usually be repaired by consolidating, patching, splicing or otherwise stabilizing. Some wood damage can be fixed simply with putty or epoxy products, others require more extensive repair. You can replace rotten areas with a new piece of wood. Try to match the type and age of the wood where possible, to ensure that the replacement section is likely to perform similarly to the original. This splice repair is called a “dutchman.” Replacement in kind of entire window components that are extensively damaged or missing requires some skill and might warrant an experienced craftsperson.

Wood decays when moisture builds up and cannot dry out. The sill is usually the area most prone to decay. Below are several techniques to consider for addressing varying levels of deterioration. Keep in mind that the source of the moisture must be determined and eliminated to avoid continued deterioration. Once the wood has been repaired, repainting is essential to extending the life of your repair and window.

Always follow the recommendations for use provided by the manufacturers of the products you intend to apply. Epoxy filler materials are considered to be among the most durable and long lasting materials available for more minor wood repair. They work best in areas where they are protected from moisture.



Routine Maintenance

Provide adequate protection of the window frame, sash, muntins, and other architectural elements on a cyclical basis. This will also enable you to identify and keep up with any emerging issues so that corrective measures can be taken to avoid a more major problem developing.

HERE'S HOW

1. Clean window. Approach any cleaning project with the “gentlest means possible.”
2. Scrape off loose paint.
3. Let the wood dry out.
4. Apply a fungicide or preservative to treat deteriorating areas (only on areas that will be painted).
5. Recondition wood and waterproof with several coats of boiled linseed oil. Allow each coat to dry for a day.
6. Fill nicks, gouges and minor cracks with glazing putty. Use a putty knife to tool the repair flush with the surrounding surface.
7. Once the putty has cured and a “skin” forms, paint surfaces to seal over the putty in the filled voids.



Consolidation of Weathered Wood

Deep cracks, called checks, can often occur in exterior woodwork. The purpose of filling these cracks is to create a smooth surface that will drain properly and hold paint. The weathered area is saturated with a penetrating liquid consolidant that strengthens and reconditions the wood. Once this has cured, the surface checks are then filled with an epoxy paste or filler. Each epoxy product typically consists of a resin and hardener which must be mixed prior to use.

HERE'S HOW

1. Remove any loose paint.
2. Clean out checks, removing dust and debris down to the base of the cracks. Scrape center of checks to expose bare wood making sure not to damage the wood.
3. Allow wood to dry.
4. Saturate the area with an epoxy primer or consolidant made specifically for wood. Use a large plastic syringe, narrow tipped squeeze bottle and/or brush to keep the primer in the cracks and crevices. Apply several times to allow liquid to penetrate deep into the wood.
5. Once the consolidant has cured, completely fill just the checks with epoxy paste filler and allow it to cure. Don't cover the entire surface of the wood. Strips of untreated wood allow the material to release moisture.
6. Sand or plane the epoxy filler even with surrounding wood.
7. Prime and paint the surface.

Minor Rot or Missing Wood Repair

When sections of the frame, sill or sash are disintegrating or missing another method is to remove any rot and fill in the missing part. It is recommended that you remove all rotted wood down to bright solid wood before applying an epoxy consolidant.

HERE'S HOW

1. The first thing you need to do is dig out any soft, mushy, crumbly or loose wood.
2. Have a clean area to work with. Gently wire brush the surface free of all debris. Wood should also be free of paint, grease and oil.
3. If the underlying wood is still wet allow it to dry out before you begin your repair.
4. Liberally apply (brush, pore or inject) epoxy consolidant into the void until the wood no longer absorbs anymore product.
5. After consolidant cures, firmly press the filler mixture into place with your hands or a putty knife. Press it deeply into the void to make sure any air pockets are filled and you have a solid patch. Build a mold to duplicate profiles or use a straight edge for larger areas.
6. The filler should slightly rise above the wood surface. Once hardened, the material can be planed, carved, sawed or shaped, and then sanded to match the original profile with ordinary wood-working tools.
7. If you repaired bottom rot on a window element, such as a sash stile end, drill several weep holes (1/16" diameter) through the epoxy repair and well into the solid wood above. This will allow moisture to seep through the repair instead of trapping it in the good wood above and causing further damage.
8. Apply a wood preservative to the surrounding wood surfaces, prime and paint the entire surface.
9. Re-drill any covered weep holes to ensure moisture can move down from above the repair.

Wood Splicing

When a localized area of a window component is so rotted or otherwise damaged that it cannot be stabilized, try a dutchman repair. The decayed area is cut out and replaced by splicing in a new wooden piece. It is best to select compatible replacement material with similar characteristics to the original. The splicing can be done using a waterproof epoxy as an adhesive.

This technique, however, requires more skill for successful repairs. Dutchman repairs should provide smooth continuous surfaces that match the planes and profiles of the wood components being replaced. This is especially important for proper drainage. It is possible for the more advanced do-it-yourselfer to take on a dutchman repair with the right tools.

HERE'S HOW

1. Strip the area around the repair of paint. Then remove any rot damaged wood mechanically or with a wood chisel.
2. Cut the patch from the new wood slightly larger than the damaged area that has been removed.
3. Lay the wood splice over the damaged area, and use a utility knife to score its outline on the wood surface below.
4. Dutchman's joints must be tight so any cuts into the wood should be smooth and straight. Make the cross-grain cut with a Japanese handsaw.
5. Use a sharp chisel and hammer to neatly remove the remainder of the decayed material and carve out a straight edge in the underlying bright sound wood to attach the new piece. The dutchman should fit snugly into the area you have chiseled.
6. Apply an appropriate fungicide to the surrounding surfaces of the void and allow to dry.
7. After test-fitting your patch, apply enough adhesive to fill minor gaps as it seeps out of the joints.
8. To enhance the bond, clamp the patch in place until the adhesive sets.



9. Finish the patch by removing excess material with a block plane, and sanding it smooth to blend with the old wood. Be careful not to damage or alter the profile or finish of the adjacent wood-work.
10. The patch is now ready for priming and painting.

Painting

The best way to preserve wood is to keep it as dry as possible, and protected by regularly applying a good paint coating system. It is also essential that any underlying moisture problems be corrected before repainting.

When you paint any material, the most important step is proper surface preparation to ensure adhesion and an appreciably longer life for the primer and subsequent paint. Original wood should be sound and any deteriorated wood treated or removed. The paint coating system should be of the best available quality you can afford.

Be aware of the considerable amount of time and labor involved to fully remove paint from large areas of a building. And always follow lead-safe work practices when scraping or otherwise removing paint.

HERE'S HOW

1. Old paint that is well adhered and in otherwise good condition can be lightly sanded and re-painted.
2. Complete paint removal may be necessary if it shows signs of failing (peeling, blistering, cracking or alligating to bare wood) or it is so thick that it interferes with the proper operation of the window. Use the gentlest methods possible. If applying heat, an infra-red stripper is best as it allows careful control of surface temperature.
3. Minor voids in the wood should be filled with putty compound.
4. The entire area should be sanded to smooth out any putty repairs and provide a better bond with the new paint. Also, feather the edges of the paint that is still adhering to the surface.
5. Thoroughly remove dirt, sawdust and other debris that may prevent the paint from adhering well.
6. Apply compatible paint coating system (primer and finish coats).

Recommended Reading:

For more detailed information, download *Preservation Brief 10: Exterior Paint Problems on Historic Woodwork*

<https://www.nps.gov/tps/how-to-preserve/briefs/10-paint-problems.htm>



Renovate Safely! This information is in no way a substitute for the lead safe work practices described and enforced by the Environmental Protection Agency (EPA). The information is intended as a resource for owners of property built before 1978 and for distribution by Utah Heritage Foundation. For more detailed information, download http://www2.epa.gov/sites/production/files/2013-11/documents/steps_0.pdf Also contact your local authorities.



When Selecting a Paint Consider These Factors:

- drying and recoating time
- coverage
- environmental factors, such as toxicity and flammability
- adhesion
- color and gloss durability
- moisture permeability
- expected service life
- compatibility with window putty
- tolerance to adverse weather conditions
- adhesion between contacting surfaces

Repairing Old and Historic Windows: A Manual For Architects And Homeowners, New York Landmarks Conservancy

Replacing an Original Window

Although the preservation of original or historic windows is preferable, and this Guide is intended to encourage that practice, there may be instances when a window should be replaced. Window replacement may be necessary when the window is so damaged that, even if repaired, very little original material would remain. Or when the original window has already been replaced with little regard for the design of the original window. This diminishes the overall historic character and authenticity of the building, as well as the surrounding neighborhood.

Historic windows also embody a level of craftsmanship and quality of materials that is difficult to find today. They are made of durable old growth wood which is denser and more resistant to fungi, insects, and rot than newly manufactured wooden windows. Under a limited warranty, newer thermal windows are not repairable. Once the double-glazing seals break, the ensuing cycle of replacement proves costly over time and adds more waste to our landfills.

However, if an entire window is too deteriorated to repair, replace it in the most historically sensitive manner while retaining as much of the original material as possible. Every effort should be made to replicate the original's unique qualities including:

- the shape of the opening and size
- type of window (double-hung, casement, hopper, pivot)
- dimensions of frame and sash
- depth of the window from the plane of the wall surface (window reveal)
- configuration of window panes (number and position of glass panes)
- muntin profile (true divided light)
- material
- characteristics of the glass
- associated features (decorative elements, arched tops, hoods, brick molds, millwork)



Ask Yourself Two Questions:

- How important are windows in terms of architectural significance and the character of my building? Usually windows play an important role, especially those at the front and on sides that are highly visible from the street.
- Are the windows really beyond repair? Often windows in disrepair look worse than they actually are and can be easily repaired and retrofitted for greater energy efficiency at a significantly lower cost than replacement.

Repair or Replace Old Windows: A Visual Look at the Impact, National Trust for Historic Preservation

<http://www.preservationnation.org/information-center/sustainable-communities/buildings/weatherization/windows>

There are three approaches to replacing an old window beyond repair: sash kits, insert windows and full window replacement.

1. Sash Kits: This cost-effective option is suitable for a window with a frame that's in good condition, but with a sash that is unrepairable. The kits are designed to replace just the sash without removing the casing and window frame. Your old window should be square or a new sash might not operate or seal properly.

They are relatively easy to install and can be done from the interior of the building. You can save on installation fees if you try to do it yourself.

2. Insert Window: Installing inserts is an option when window frames are sound and only slightly out of square.

Replacement inserts are self-contained units with their own jamb and sash, and fit inside the original window frames. You won't have to worry about tearing into walls or ruining existing moldings. Only the window stops and damaged sashes are removed.

These can be custom built to fit exactly into the existing frame. However, the size and proportion of window elements will never match the original window due to the new unit's position within the old frame. This is an important factor to consider when determining the appropriate level of intervention.

3. Full Window Replacement: To install these, you must remove every part of the existing window, inside and out, all the way back to the wall. The new window is placed into the rough opening that was occupied by the old window.

Full window replacement involves more labor. It will be messy, disruptive and a costly project that impacts other building materials as well.



Prior Approval: It is highly recommended that you consult with local authorities before purchasing any replacement windows. They may have guidelines and processes in place regulating any work to buildings which are historically designated or located within a designated historic district.

Weatherization

Weather Stripping

Weather stripping is an inexpensive way to improve the energy performance of your windows and should be an integral part of a general maintenance program. It is a strip or material that is added to fill in gaps and reduce air and water infiltration. It also has the added benefit of helping to keep dust, dirt, noise and bugs out of your building. Some air infiltration is healthy, but too much can lead to wasted energy. Both wood and metal sash units can be enhanced by weather stripping.

The type and manner of weather stripping installation is very important when applied to historic buildings. There are many types of weather stripping on the market and these materials vary in cost and durability. Choose a type that will withstand the friction, weather, temperature changes and wear and tear associated with its location. The material you choose should seal well and allow the window to function properly and will be influenced by the type of window.

The more work and money spent upfront the less you will have to worry about the weather stripping over the years. Some types of weather stripping are more complicated than others and may require modifications to the window. Leave those to a professional or craftsman.

WHERE TO START:

- Major gaps or cracks should be filled with wood filler
- Make sure surfaces are dry and free of dirt, oil, grease, loose paint, wood splinters, old weather stripping, adhesive, etc.
- Lightly sand if necessary
- Fill and sand old nail holes
- If old screw holes can't be reused, fill and sand those as well



We have briefly described the most common options below so that you will know just what to use for your situation. Follow the manufacturer's installation instructions for the best results.

Adhesive-backed Foam Tape: Foam tape is probably the most common, affordable and easiest weather stripping to install. It functions as a compression seal, meaning that when the window closes against it, the material compresses to block air infiltration. Many different types of foam are available in tape form such as synthetic, sponge rubber, vinyl and more. It comes in rolls of varying dimensions. The size and flexibility of the tape make it well suited for blocking irregular sized cracks. Closed cell foam tapes are more durable than the open cell varieties.

Foam stripping has a limited life span, so you will need to regularly check the condition of the material. If it stays compressed when the window is opened, then it is time to replace it.

WHERE TO INSTALL IT

Foam tape works best where the top or bottom of the window sash closes against the frame. This type of material is not suitable for applications where there is friction or abrasion.

HERE'S HOW

All you need to do is cut it to length, remove the paper backing to expose the sticky surface, and firmly press it into place. Avoid getting paint on the material because paint causes the foam to lose its resiliency.

Felt: Felt is one of the oldest types of weather stripping. It is sold in rolls, either plain or reinforced with a flexible metal strip. Felt is available in a variety of lengths, widths, thicknesses, qualities and colors. Although economical and easy to install, it may only last several years because of its porous composition, causing it to absorb moisture and deteriorate quickly. All wool felt is more durable, but more expensive. Reinforced felt has a slightly longer life.

WHERE TO INSTALL IT

Use in double-hung windows is limited to horizontal surfaces only. Felt may be fastened to the top, bottom, and meeting rails. This type of strip should not be used for movable parts subject to friction.

HERE'S HOW

Felt strips may be stapled, tacked or nailed in place. The material is also available with an adhesive backing. Felt seals best if the staples are positioned parallel to the length of the strip.

Tubular Gaskets: Available in rolls, tubular gaskets are made of flexible vinyl or rubber, with or without a spongy foam core. Windows press against them to form a seal. Gaskets are secured by stapling or tacking (generally supplied with the material) the full length flange into place. Some types of gaskets are even self-adhesive. They are more durable than the best foam or rubber tape, and effective even when gaps are large and uneven. The solid tubular stripping provides extra insulating qualities and holds its shape better than the hollow style.

WHERE TO INSTALL IT

Usually installed outside, it is best to fasten the material against the frame or sill, rather than the sash. Gaskets can be installed on the interior of the window as well, but they are not very attractive.

HERE'S HOW

When installing, abut the tubular section snugly against the window crack, maintain tension on the gasket, but do not stretch it, as you drive staples or nails through the flange. Staples should be installed parallel to the flange's length. Refer to the manufacturer's directions for spacing requirements. Gaskets should not be painted because paint causes them to stiffen and lose their flexibility.

Tension Seal: A tension seal is a durable plastic strip (vinyl) folded in a V-shape or a springy, usually copper, metal strip (V-shape or single). The shape of the material springs open to create tension between the sash and window frame. When the sashes are closed, both sides of the "V" are pushed together, forming an airtight seal. Most manufacturers package the material in rolls and include the brads (small nails) needed to attach the strips. The material is also available in long strips and strips that come with an adhesive backed surface.

Adhesive backed vinyl stripping is easier to install and costs less, but won't last as long. Although more expensive, metal styles create a highly effective seal that will last decades, they can cause windows to become difficult to operate. They also call for more work and removal of the window sashes to properly install them. Be cautious of versions made of aluminum which due to its softness, do not retain their spring action and will fail a shorter time after installation than other materials.

WHERE TO INSTALL IT

Install inside the vertical channels of a double-hung window and at the horizontal meeting rail where the two sashes meet when the window is closed. The V-strip should be installed on the front side of the lower rail of the upper sash to avoid getting caught on the window latch. On casement or sliding windows, install along the vertical side jamb where the sash closes. Now would also be a good time to check the condition of the latch. Not only does it increase security, it also creates a progressively tight seal between the sashes.

HERE'S HOW

Scrape the jambs of built up paint so you have a clean smooth surface to work with. If you want your jambs primed or painted you'll need to do this prior to installation as well. Cut to desired length, then peel off the adhesive backing at one end, and press strip in place, or install with finishing nails. Make sure the sash does not catch on the nails. A utility knife will cut the plastic, but you will need tinsnips for the metal. Metal strips require placing nails approximately every inch or so, and "springing" the strips by prying their unfastened edges to create a tighter fit against the sash. The weather stripping shouldn't interfere with the operation of the window so you need to work around the cord pulley and window pocket access door.

Caulking and Glazing Compounds

Caulking and glazing compounds are flexible materials used to bridge gaps where two dissimilar materials meet but don't move, and fill cracks and seams. Select a durable product suited to the materials and location to which you are applying it and be sure to read the instructions. Avoid the cheapest caulks because they generally do not hold up as well. In some instances caulks and sealants can be sanded and/or painted to minimize their visual appearance.

Tube caulk: Caulk can be found in a plastic or cardboard tube or cartridge. You slip the tube into a caulk gun to make it easier to apply.

WHERE TO INSTALL IT

The interior wood work needs to be tight with the wall surface; if it is not, use caulk (paintable) or spackling compound to seal all fixed joints of the window casing. Exterior locations include, joints between materials that expand and contract at different rates, and between the window frame and adjacent wall.

HERE'S HOW

1. For best results plan to caulk in cool, dry weather.
2. Carefully remove any old caulk and residue before applying new caulk.
3. If the joint is large and deep, fill the gap directly behind the joint with packing.
4. Review the instructions on the tube of caulk and load it into the caulking gun.
5. Snip the tip of the nozzle of the tube at a 45° angle. Cut near the narrow end for a narrow bead or further up for a wider bead.
6. There might be a seal at the base of the nozzle. Use a long nail to pierce the inner seal and plug the nozzle when finished.
7. Place nozzle against seam. Hold caulking gun at a 45° angle in the direction it will travel. Squeeze trigger with steady pressure to push caulking material out the nozzle.
8. Apply in a continuous stream that overlaps both sides of the crack and without stopping and starting.
9. To ensure a neat finish and a good seal, you may want to tool (shape and smooth) the caulking bead by running a wet finger along the bead. Use a plastic spoon or suitable tool for toxic materials. Refer to the manufacturer's instructions.
10. Allow the caulk to dry for the amount of time specified on the label before painting.



Rope caulk: If you prefer not to mess with a caulk gun, rope caulk may be a suitable alternative. Also called caulk cord, this material is probably the easiest type of sealant to use. Cords are stuck together in a roll and require no tools or special skills to apply.

WHERE TO INSTALL IT

Rope caulk is used mostly as a temporary seasonal sealant that can be applied to cracks around windows. It can be used both indoors and outside.

HERE'S HOW

A clay like material - just unravel the caulk and press into place. On cold days it's not as easy to separate the ropes and apply. Letting it warm a bit makes it more pliable. The caulk is easily removed once the weather warms and can be reused if handled carefully.

Glazing Compounds: Complete replacement or replacing deteriorated glazing compound or putty maintains the weather tight seal between the non-operable parts of the window sash. Window sashes that are difficult to remove can be reglazed in place. However, if you can remove the sash, it's easier to accomplish with the sash on a horizontal surface. It is recommended that you use a quality oil-based product. Most compounds are intended to be protected with paint.



WHERE TO INSTALL IT

Glazing compounds are used to secure and seal the joints where glass and wood meet (rails, stiles and muntins.)

HERE'S HOW

1. Remove loose deteriorated putty with a chisel or putty knife. Use great care and approach from the bottom to avoid breaking the glass, particularly if you have original, wavy glass. You can work around the compound that is adhering well and too difficult to get out.
2. Make sure the wood is dry and clear of all dust, dirt and debris. Clean all glass.
3. If you have play in the glass, make it tight by installing glazing points.
4. If the remaining putty has cracks, brush some boiled linseed oil onto the bead so it soaks into the cracks.
5. Mix a little boiled linseed oil and a bit of glazing putty to create a runny paste and fill any cracks.
6. Using a putty knife, fill remaining open cracks with straight putty.
7. Reglaze the sections of missing putty as described above.

Storm Windows



Storm windows have been used to control the comfort level of a building for well over one hundred years in America. Since there is a precedent for their use and the installation process is reversible, attaching storm windows to existing windows is regarded as a highly appropriate preservation practice. They also help protect the original window.

Adding storm windows is one of the most cost-effective ways to improve your window's energy efficiency. Studies have shown that a weatherized historic window, coupled with a storm window, can perform just as well as a more expensive new double-pane window.

Storm windows can be installed to either the exterior or interior of a window and provide an insulating layer of air. They can be either a temporary seasonal measure or more permanent additions that include operable sashes, screens and other features that enhance natural ventilation. Look for quality or you may end up paying for it later when the storm window fails to function properly.

Storm windows don't require any modifications to your existing windows and are easy to attach. The hardest part is taking good measurements to ensure a proper fit. A property owner who can install them will gain additional savings on their investment. Carefully follow the manufacturer's instructions. Don't forget to make sure adequate egress is still possible from interior spaces during an emergency.

Exterior Storm Windows: Aside from the energy savings, storm windows will cut down on air and sound infiltration, and provide an extra measure of protection for your historic windows. By keeping them protected from the elements, you minimize on the regular upkeep that is necessary to maintain older windows. Another advantage is that the primary window sash can be removed for maintenance or repair with the storm window in place. This eliminates the need to cover the window opening while working on your window.

Exterior storm windows typically attach to the blind stop, next to the exterior casing and sit on the sill. The goal is to have a tight seal with the window surround. Local craftspeople or contractors can custom-build them to replicate a traditional style, fit virtually any window opening and type, or try a national storm window manufacturer.

For a preservation sensitive approach consider the following:

1. The historic appearance and character of the building.
2. If historic storm windows exist, consider reusing or recreating them. Make sure that the bottom of the frame isn't completely sealed to the sill so moisture won't be trapped there.
3. Ideally, the material used for storm windows should match the material of the window they will cover. Small framed aluminum storm windows don't fit as well with the historic character of older windows.

4. Match the size and overall design of the historic windows. Align window components such as meeting rails with the overall configuration of the associated window. This will make their appearance as unobtrusive as possible.
5. If you decide to use metal storm windows, make sure that the frames are anodized or painted so raw or highly reflective metal is not visible.
6. Proportion the sash components similar to that of the primary sash.
7. Glass should be clear.
8. Steer clear of storm windows that significantly step outward from the existing plane of the molding.
9. Avoid damage to historic material.

Interior Window Units: Particularly suited to historic buildings, this energy-saving solution fits over the inside of your window so it won't impact its exterior appearance. There are many different types of interior window units available. The units can be made with wood, metal or vinyl frames, and may use glass, plastic panels or special plastic sheets. They can be attached to the inside of the window opening with a magnetic seal, compression fit framing, hooks and clips, tracks, or other small hardware. Units are available directly from the manufacturer or through local distributors.

Naturally, there are advantages and disadvantages to the various types of interior units. Important considerations when adding them include:

1. Generally easier to install than exterior models, especially on upper floors.
2. Since they are attached to the inside of the window, they will not weather.
3. Some attachment methods are conspicuous, while others can blend in with the window surround.
4. Some attachment methods can damage other window components.
5. They may cause condensation on the interior face of the sash if they are not tight.



6. Flexible plastics have a shorter life expectancy before needing to be replaced.
7. Plastic may scratch when cleaned.
8. Some window treatments give off fumes when burned and may be considered unsafe for use.

Window Insulation Kits: Another option for storm windows is a do-it-yourself kit. This kit simply consists of clear plastic film that shrinks tight when warmed, and double sided tape to attach it to the inside of the window frame. The only tools required are a knife or scissors and a hair dryer.

DIYer Insulating Panel: A simple frame is constructed to fit snugly into the window opening. The frame is covered with heat shrink plastic film. It can be applied on one side of the frame or both to enclose additional air space and increase performance. The film is then shrunk with a hair dryer and weather stripping attached around the edge. Checkout the following link for detailed instructions.

<http://www.midcoastgreencollaborative.org/storms.html>

Historic Doors and Doorways

Doorways are one of a building’s most important architectural features in defining its overall historic character. The significance of a historic doorway is derived from a number of design elements. This includes the shape of the opening, door design (glass panes, divisions, decorative details and panels), materials and method of construction, finishes, door surround, sidelights, fanlights, transoms, means of opening, hardware, and other associated elements. All of these contribute to the architectural interest of a historic doorway not typically found in modern construction.

Carefully integrated into a building’s design, original doorways often provide important clues to the age, style and craftsmanship of a building. Because they establish the character and scale of a facade, doorways generally shouldn’t be altered in their configu-



ration or design, particularly on primary facades. In addition, a pattern and rhythm of entrances can contribute to the historical significance of groups of buildings and streetscapes. Most residential buildings have a secondary entrance on the side or rear facade. This type of doorway is usually simpler in design than the main entrance.

Many external doors and their frames are made of high quality wood and fine joinery, and extremely durable with a service life equivalent to the life of the building, with minimal maintenance. Since doorways are subject to constant use and are exposed to the elements, they require a regular program of inspection and maintenance. Be sure to care for your doors as problems arise. Repair or limited replacement of damaged or missing parts are often all that is necessary to restore a doorway to good working condition. But if the wall is out of plumb or the building has major settlement issues, you may need to carry out more extensive work to fix a problem. Minor repairs and weatherization will keep doors functional and attractive for many years, and work in much the same way as for windows. To determine if work might be required check the following:

- condition of materials that comprise the doorway
- operation and tightness of hinges and hardware
- glazing condition
- paint condition
- air infiltration
- water drainage

Despite their deceptively simple appearance, traditional doors may be constructed of numerous parts and a bit complex. They typically feature frame-and-panel construction with stiles and rails connected by mortise and tenon joinery. Solid wooden doors are common, although doors with glass panes are also found. Loose joints, splits and damaged areas may require partial or complete disassembly to carry out necessary repairs. Doors can easily be removed for repairs to be handled by a specialist.



Common Issues with Doors:

- dirt, debris and paint build-up
- paint failure
- loose or missing glazing putty
- cracked or splintered surrounds, panels, or thresholds
- open joints
- worn, sagging, shrinking, swelling, or warping parts
- door sits crooked in its frame
- misaligned or binding door
- corroded, loose, or worn hardware
- water damage or deterioration
- door sills that no longer slope downward away from the building
- corroded metal doors
- absent or ineffective weather stripping

Parts of a Door

1. **LINTEL:** The horizontal structural element that supports the load over the door opening.
2. **FRAME:** The fixed outer portion of a door which is set into the wall to hold the door.
3. **JAMB:** The vertical sides of a frame to which a door is hung.
4. **PANEL:** The recessed portion of a door with a perimeter edge such as molding or some other decorative element.
5. **STILE:** The vertical framing element of a paneled door. The stile in which the lock is set is called the locking stile; the stile to which the hinges attach is called the hanging stile.
6. **RAIL:** The horizontal framing element of a paneled door. The uppermost rail is known as the top rail, the middle rail the lock rail, and the lowest rail the bottom rail.
7. **TRANSOM:** The small horizontal window or series of glass panes located above a door. The horizontal component that separates a transom from the door is called a transom bar.
8. **SIDELIGHT:** A fixed window, usually with a vertical emphasis, at the side of a door.



Not shown in photo:

FANLIGHT: A semicircular or arched shaped window with a radiating glass pane configuration. Commonly seen in Federal and Colonial Revival style buildings.

Maintenance

Cleaning: Dirt, grime and debris should be removed from surfaces following cleaning methods appropriate to the material.

Hardware: Preserve original handles, knobs, hinges and locks where possible. Regular cleaning of their internal parts, tightening of screws and lubrication will help them to work better for years to come.

Finish: Exterior paint can potentially last up to a decade before it starts to break down. This may vary with the orientation and exposure of the door. To prepare for re-painting, remove loose paint, sand the surface, wash with a mild detergent and rinse clean. Use a high quality paint system to repel water and resist wear following the manufacturer's instructions. Period doors often had a stained finish especially on Craftsman style buildings. It is recommended not to paint a door that was originally stained. Conversely, originally painted doors should not be stripped of paint and left natural or stained.



Minor Repairs

Glass: Colored, textured or beveled glass were frequently used for decorative effect. This glass is valuable and an important element in defining the historic character of a doorway. Therefore, consider retaining and preserving old glass with corner cracks or scratches on the surface. Remove loose glazing putty around any glass panes and reglaze. It also is important to check the back putty as it creates a seal that prevents condensation.



Paint Build-up: Remove paint build-up on doors and jambs which hinder the smooth operation of the door using a paint scraper. Cautiously use thermal or chemical removers to remove any excess paint that can't be easily scraped off.



Safety note:
All work should be done in a lead-safe manner.
Consult lead safe best practices.

Hinges: Doors that bind, sag or will not close properly are common problems. The solution could just be due to the condition of the hinges. Be aware that a wooden door can expand with the moisture in the air on a seasonal basis, and return to its original dimensions in dryer weather.

HERE'S HOW

1. Beginning at the top hinge, tighten the hinge screws in both the door and jamb as much as possible, and the problem might be solved. Use a screwdriver rather than a drill to avoid overtightening the screw and stripping the screw holes or damaging the screw heads.
2. If the screws don't tighten, usually the holes have been stripped. For stripped screw holes in the door stile, you may be able to correct the problem by replacing the screws with longer screws. Make sure the head of the new screw is the same size as the loose screw.
3. If the screw holes in the jamb are enlarged, you can drill out and plug the holes with short lengths of wood dowel glued into place. Allow the glue to dry before drilling pilot holes slightly smaller than the screws and re-installing the hinge.
4. If the screws are secure, the problem may be with the hinge mounts on the door frame. Open and close the door, looking to see where it sticks, and for uneven gaps between the jamb and the door. Resetting the hinges can correct these problems. Before unscrewing a hinge, swing the door open and push a wedge under it to hold it up firmly.
5. If the door binds on the hinge side, the hinges may be too deep. Add shims to either the top or bottom hinge between the hinge leaf and jamb.
 - Set a level against the hinge-side of the door to measure the sag and determine which hinge needs to be adjusted to straighten the door.
 - Loosen the screws on the door frame from the hinge that needs shimming.
6. Alternately, if there is not enough clearance between the knob edge and the jamb, the hinges are too shallow. Carefully, chisel out the mortise (recess in the wood for the hinge leaf) to set the hinge deeper.
 - Cut pieces of thin cardboard to match the shape of the hinge leaf. Mark the screw locations on the shims and cut horizontal slits to fit over the screws.
 - Slide a shim behind the loosened hinge leaf and over the screws.
 - With the shim in place, tighten the screws and close the door to check the fit. Continue to add shims under the hinge until the door is level again.



If the door continues to stick after shimming, you may need to remove some wood at the binding points. This may require removing the door. Carefully use a plane to remove just a little wood at a time. If the door binds at the sides, plane only on the hinge side.



Inappropriate Alterations:

- 1. Removal or shaving deteriorating elements.**
- 2. Capping or wrapping elements with another material.**
- 3. Moving or blocking-up original doors on a primary facade.**
- 4. Covering or removing a transom, sidelight or fanlight.**
- 5. Altering the size and shape of an original door and its opening.**
- 6. Modifying the original framing to fit a new door.**
- 7. Changing a double door entry to a single door with additional framing.**
- 8. Replacing a sound historic door.**
- 9. Removal of an original door surround.**
- 10. Installing a historically incompatible replacement door.**
- 11. Cutting new entrances on a primary façade.**
- 12. Adding elements for which there is no historic precedent.**

Door Surround: The part of the doorway that frames the door itself can vary from plain, undecorated lintels and sills, to elaborate designs (“high-style”) with a high level of ornamentation. Any damaged or missing sections of a surround should be repaired when possible or replaced in form and detailing. Unsound material should be stabilized. Restoring masonry moldings, profiles and ornamentation, however, is a skill that is best handled by a specialist.

Although many doorways survive intact, others have suffered from insensitive alterations. If a door surround is missing, it is recommended to restore the missing feature if it can be accurately reproduced through historical, physical or pictorial evidence. Another acceptable intervention is to replace the feature with a new design that is compatible with the remaining character-defining features of the historic building. Similar neighboring properties may provide insight as to what the missing feature might have looked like.

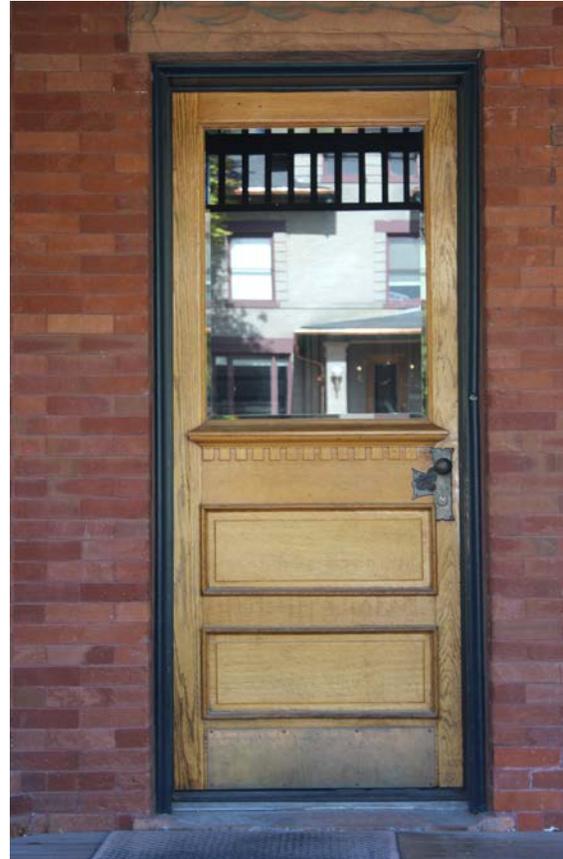


Wood: Wood deterioration is progressive, from sound wood to soft wood to small voids, then to total loss of wood fiber which destroys the integrity of the material. A simple means of testing for rot is to probe the area where the wood is damaged with a screwdriver, awl or ice pick. Soft wood that is easily penetrated and short splinters against the grain are signs of possible rot.

HERE'S HOW

1. If the door will be painted, epoxies are well suited for small, nonstructural areas that have deteriorated but are essentially sound. You can treat the area with a wood consolidant or primer, then use a bit of epoxy filler to rebuild the void or missing part. Use the surrounding wood shape as a guide.
2. If the damage is confined to an area that is less likely to affect the door's structural strength, consider a dutchman patch for the repair.
3. Wood replacement may be the next level of intervention when the damage involves a joint or threatens a door's structural integrity. To replace an entire part, such as a rail or stile, or splice in a new section, use a strong splice joint (scarf or half-lap) for a better bond. The connection can also be secured with a wooden dowel if desired. The replacement piece should have the same visual characteristics of the historic woodwork.

The preferred rehabilitation techniques outlined for windows are equally effective on doors and their surrounds. For additional information on how to make minor repairs see pages 29-39.

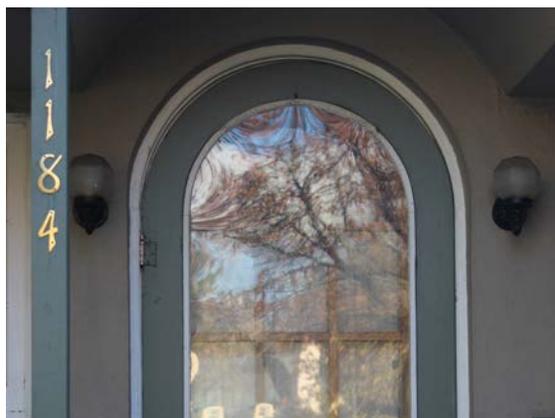


Weatherization

Weather stripping: Maintaining an airtight seal on your doors can eliminate drafts, keep your home comfortable, and help reduce heating and cooling bills. It can also attenuate noise. An original wooden door is likely to have good thermal properties because of the high quality old growth wood used to construct it. All four edges around a door can permit air to leak in and out of a building. If you see daylight around a door when it is closed or feel a draft, you may need to seal holes and gaps between the frame or trim and wall surfaces with caulk, and install or replace weather stripping.

HERE'S HOW

1. Weather stripping for doors is available in a variety of materials, each with its own level of effectiveness, durability and ease of installation. Select one that can withstand friction and won't impede proper function. The same type of weather stripping can generally be used to cover the sides and top of the door. But if the door sits crooked in the frame, weather stripping may hinder the smooth operation of the door.
2. A gap at the bottom of the door requires a different approach from the gaps on the sides and along the top. A "sweep" can be installed on the interior bottom of an in-swinging door to fill the space between the threshold and the bottom rail. You won't be able to use a sweep, however, if the floor, carpet or rug is even with or higher than the threshold. Altering the threshold may be an option as well.



Storm doors/Screen doors: Historically, detachable storm doors were often used to improve the thermal performance of a door. The storm doors were changed over to screen doors in the warm months. When replacing a traditional wooden storm door or screen that can't be repaired, use a design that duplicates the original door. Buildings in cold climates may benefit from the installation of new storm doors. They can add an airtight barrier, insulation, and protection from direct exposure to the elements. The tighter the fit of a storm door, the more effective it will be.

HERE'S HOW

1. Choose a design that either follows the same pattern as the existing door or choose a door with the largest amount of transparent area to enable the form and detail of the underlying door to be readily visible.
2. If the entrance door is built of wood, the frame of a storm or screen door should be of wood and finished to match the door.
3. Storms and screen doors that are not full view should be compatible with the architectural character of the building.
4. The installation should not damage any part of the historic door framing or jamb.

Door Replacement



Consider a replacement door only if the existing door is truly deteriorated beyond repair or already an inappropriate replacement. Keep in mind, that it is important to preserve the original door frame. This is key to retaining the size and shape of the historic door. Furthermore, replacement of an entire door and frame can be costly and is hardly ever necessary. Once historic doors are removed and discarded, they're probably lost forever.

HERE'S HOW

1. If you must replace a door, a replica of the original, if evidence exists to document its appearance, is the preferred approach. Similar to windows, replacement doors should match the original materials, type, shape, proportions, panel configuration, window pattern, profiles and details as the historic door. Historic doors can be reproduced by a local millwork shop or carpenter to provide an excellent match for the original.
2. Because replacement in kind may not always be feasible, a door may be replaced with a suitable contemporary product. It is always preferable that a new door match the historic door as closely as possible in design as well as material.
3. When the original design of the door is unknown, consider a simple design that reflects the style, period and use of the building. Today's "stock" doors are typically not appropriate to use in historic rehabilitation projects. They have fairly flat surfaces and often simulated divided lights, and therefore lack the proportions, crisp profiles and detail of a historic door. In general, very ornate doors are also incompatible with most styles of residences, unless their use is supported by historical evidence.
4. An economical and eco-friendly approach is to find and restore a historic salvaged door. Typically, doors were made by local mills, so if you shop locally there is a chance you might find a good fit for the style and period of your building. Check salvage yards, yard or estate sales, preservation oriented magazines or catalogues, or suppliers of old building materials.

Resources

Preservation Guidance

National Park Service. Technical Preservation Services.
<http://www.nps.gov/tps/how-to-preserve/briefs.htm>

The Secretary of the Interior's Standards
<http://www.nps.gov/tps/standards.htm>

National Trust for Historic Preservation
<http://www.preservationnation.org>

State Historic Preservation Office, Utah Financial Assistance
<http://heritage.utah.gov/history/historic-buildings>

Utah Heritage Foundation
<http://www.utahheritagefoundation.org/>

A Preservation Handbook for Historic Residential Properties & Districts in Salt Lake City
<http://www.slcgov.com/historic-preservation/historic-preservation-residential-design-guidelines>

Maintain, Repair & Improve

Traditional Windows: their care, repair and upgrading
<https://content.historicengland.org.uk/images-books/publications/traditional-windows-care-repair-upgrading/heag039-traditional-windows.pdf/>

Repair and Upgrade Windows and Doors
<http://www.nps.gov/tps/sustainability/energy-efficiency/weatherization/windows-doors.htm>

Repairing Windows in an Older Home
<https://historicengland.org.uk/advice/your-home/looking-after-your-home/repair/windows/>

Windows Preservation Standards Collaborative:
order online
<https://www.createspace.com/4364852>

Window Repair & Weatherization Guidebook
http://www.visitahc.org/files/pdf/AHC_Window-RepairGUIDEBOOK.pdf

Sash & Case Windows: A short guide for homeowners
<http://www.historic-scotland.gov.uk/sash-and-case-windows.pdf>

Sustainability Research
<http://www.nps.gov/tps/sustainability/research.htm>

Window Know-How: A Guide to Going Green
<http://www.preservationnation.org/magazine/2009/march-april/ma09window.html>

Windows
http://www.preservationnation.org/information-center/sustainable-communities/buildings/weatherization/windows/#.Vhw_LhJdHIV

How to Restore Sash Windows
<http://www.oldhouseonline.com/how-to-restore-sash-windows/>

Repairing Old Windows
<http://www.hereandthere.org/oldhouse/windows-repairing-steps.html>

How & When To Use Epoxy Fillers
<http://www.oldhouseonline.com/how-when-to-use-epoxy-fillers/>

The Effects of Energy Efficiency Treatments on Historic Windows

<https://www.kshs.org/preserve/pdfs/effectsenergyonhistoricwindows.pdf>

Weatherstripping

<http://energy.gov/energysaver/weatherstripping>

How To: Install Spring Bronze Weatherstripping

<http://thecraftsmanblog.com/how-to-install-spring-bronze-weatherstripping/>

Making Sash Windows Energy Efficient

<https://historicengland.org.uk/advice/your-home/saving-energy/older-houses/sash-windows/>

Window Replacement

The Right Thing

http://www.clearwindowrestoration.com/assets/files/wysiwyg/replacement_windows.pdf

Repair or Replace Old Windows

http://www.preservationnation.org/information-center/sustainable-communities/buildings/weatherization/windows/additional-resources/nthp_windows_repair_replace.pdf

What Replacement Windows Can't Replace: The Real Cost Of Removing Historic Windows

https://www.kshs.org/preserve/pdfs/sedovic_36_4.pdf

Saving Windows Saving Money

<http://www.preservationnation.org/information-center/sustainable-communities/green-lab/saving-windows-saving-money/#.VhxA0hJdHIU>

Replacement Windows That Meet the Standards

<http://www.nps.gov/tps/standards/applying-rehabilitation/successful-rehab/windows-replacement.htm>

Lead Paint

Learn About Lead

<http://www2.epa.gov/lead>

National Park Service Preservation Briefs 37: Appropriate Methods of Reducing Lead-Paint Hazards in Historic Housing

<http://www.nps.gov/tps/how-to-preserve/preserved-ocs/preservation-briefs/37Preserve-Brief-LeadPaint.pdf>

<http://www.hud.gov/offices/lead/training/LBPguide.pdf>

http://www2.epa.gov/sites/production/files/2013-11/documents/steps_0.pdf

Videos

Window Sash Glazing: John Leeke

<https://www.youtube.com/watch?v=3yiWBR7hh04>
How to Replace Window Sash Cords: This Old House <http://www.thisoldhouse.com/toh/video/0,,1631564,00.html>

Window Rehab Workshop Videos: Boston Building Resources <http://www.bostonbuildingresources.com/advice/?tag=window+sashes>

Historic Wooden Window Rehabilitation: Preservation Alliance of West Virginia

<https://www.youtube.com/watch?v=JdazwMjlk-s>

How to Reglaze Old Windows: The Craftsman Blog

<http://thecraftsmanblog.com/how-to-reglaze-old-windows/>