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National Park Service
Cultural Resources

Preservation Assistance Division

EXTERIOR WOODWORK

NUMBER 2

Paint Removal from Wood Siding

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TRUMAN HOME HARRY S TRUMAN NATIONAL HISTORIC SITE Independence, Missouri

Harry S Truman National Historic Site anchors one end of a local historic residential district in the city of Independence, located just east of Kansas City, Missouri. The Truman home was constructed in three major phases. The initial pre-Civil War construction is believed to have consisted of a simple two-story rectangular structure. Major additions in 1867 and 1884 enlarged the building to 15 rooms, totaling approximately 4000 square feet. Characteristic of the early Queen Anne style, the wood-sided exterior of the 2½ story frame home was embellished with over 200 wooden brackets, decorative jig-sawn porch frieze boards, and layered cornice mouldings.

The Truman property was willed to the United States upon the death of Mrs. Truman in 1982 and placed under the administration of the National Park Service. Immediate preservation problems such as metal roof replacement, rewiring, and grounds maintenance were accomplished prior to the official opening in May 1984, the centennial of Mr. Truman's birth. Given the nature of the problem, the Ser-

vice delayed the necessary removal of the deteriorated exterior paint and repainting until after the park's opening.

Problem

Examination of the exterior paint finishes in areas directly exposed to the elements revealed severe paint film failure, including cross-grain cracking, alligatoring, and peeling (see figure 1). Even in places shielded by porches and cornices, moderate paint film failure had occurred. A number of exposed areas, including soffits, fasciae, and siding, experienced near total paint failure due to recurrent moisture penetration from deteriorated roofs and built-in gutters. Windows were also in very poor condition; many exhibited loose glazing, broken glass and rotted sash. More than 20 coats of paint concealed deteriorated woodwork and cladding from direct examination. On much of the projecting mill work, the final layers of paint had been applied so heavily that stalactites in excess of one-quarter inch were apparent due to paint dripping.

On one section of the building, constant moisture penetration from a poorly detailed sleeping porch floor deck had caused total paint failure. Rain water had soaked the wall cavities of a ground floor

Special precautions should be taken when thermally removing paint from historic woodwork to prevent damage and to reduce fire and health risks.

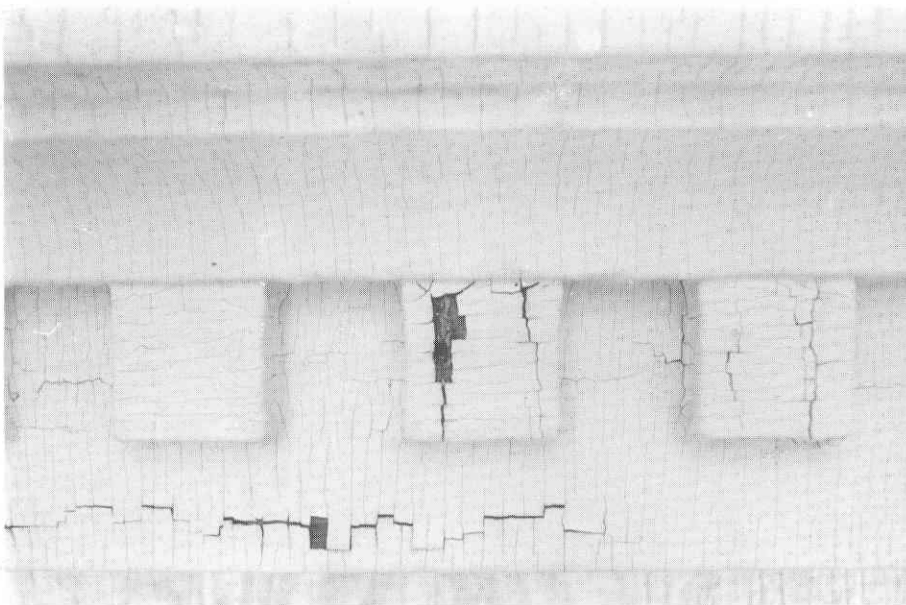


Figure 1. Detail of a cornice dentil shows the severe cracking and failure of paint finish. Photo: Alan O'Bright

bathroom causing the paint to peel off in hand-size sheets. It was clear the exterior finishes had lost most, if not all, of their elastic integrity. In order to achieve a sound surface for painting, the decision was made to remove a majority of the exterior paint finishes to bare wood in preparation for a three-coat paint application.

Solution

As part of the planning required before the selection of the paint removal method, a physical investigation was conducted of the exterior structure to determine the method of construction and condition (see figure 2). This is particularly critical whenever paint removal is planned. Decisions as to which paint removal methods will be used—especially methods involving heat—are in part guided by the potential flammability of the wall material and debris in the wall cavity and cornices. Sections of lapped siding were carefully removed and the underlying board sheathing cut with a hole saw to reveal the wall cavities. Fortunately, the bulk of the balloon-framed structure was found to be in good condition and the project team believed that potential fire risks could be minimized. With the exception of the 1884 addition, all wall cavities had been filled from foundation sill to soffit with soft brick and mortar. A majority of the house was

sheathed in white pine tongue-and-groove boards.

Three methods of paint removal were considered: hand scraping and sanding, chemical strippers, and thermal removal. Prior experiences with hand scraping and sanding on a large scale had shown this method to be very damaging to wood surfaces and the workmanship very difficult to control.

Chemical strippers are very messy and difficult to control on exterior vertical surfaces. After application, the volatile chemicals usually need to be covered with sheet plastic to keep them from rapidly evaporating.

The use of propane torches to remove the paint was not considered because of the high risk of starting a fire or at least of scorching the wood. Two thermal paint removal techniques, however, were evaluated—radiant heat plates and heat guns. The radiant heat plate gives a consistent heat flow, but heat intensity is less controllable. The plate housing also obstructs the laborer's view of the working surface, making it difficult to tell when the softened paint is ready to remove. If the paint is overheated, it can ignite and scorch the wood as the plate is withdrawn.

The heat gun was chosen because of the following advantages: the heat is controllable; the working surface is exposed to view, allowing better control; and all layers of paint can be softened and removed down to the original surface in one pass without mechanical damage to wood.

Although chemicals and hand scraping were rejected as the primary paint removal method, chemicals and scrapers were used



Figure 2. In assessing the safety of using thermal heat to remove paint from the siding, an investigation was performed to determine wall construction and condition. In this portion of the structure, there was no sheathing backing the siding but brick nogging extended from the foundation to the soffit. Photo: Alan O'Bright

in other areas such as porch ceilings, soffits, windows, and brackets, where the working surface was too complex, or where there was a risk of overheating unexplored cavities. The majority of the exterior walls, sheathed or filled with brick nogging, apparently caused the radiant heat to dissipate considerably before reaching wall cavities. Furthermore, the sheathing formed a barrier protecting the wall cavities from direct hot air blast through cracks and joints in the siding and trim. Nevertheless, strict fire precautions still were taken throughout the project.

Tools and Techniques

A heavy-duty heat gun was approved for the contractor's use (see figure 3). The metal encased unit featured variable heat control (500-750° F) through adjustable side vents, and a cool down switch, which extends the life of the replaceable heating elements. Since these elements can have a working life as short as 60 to 80 hours, extra elements were purchased and were available at the site for immediate replacement of those in the five heat guns used in the project.

Each unit operated on its own 20 ampere circuit to prevent constant tripping of breaker switches due to the high energy consumption of the heat guns (14 amps, 120 volts). Temporary weatherproof electrical outlets with ground fault interrupters were installed in the most advantageous locations to prevent voltage drop due to long extension cords.

Workers used alternative paint removal methods on some portions of the structure, including porch ceilings and cornices, because of the increased risk of overheating cavities in these locations. They exercised particular caution around windows and doors where siding butt-joined the trim. An additional concern was the potential for dust and other debris to overheat in the hollow areas behind the casing, such as in the sash weight boxes. For safety, siding paint was removed thermally no closer than 6 inches from window and door trim and alternate paint removal or feathering methods were employed for the remainder. The workers used chemical strippers around glass instead of heat guns to avoid heat stress fractures.

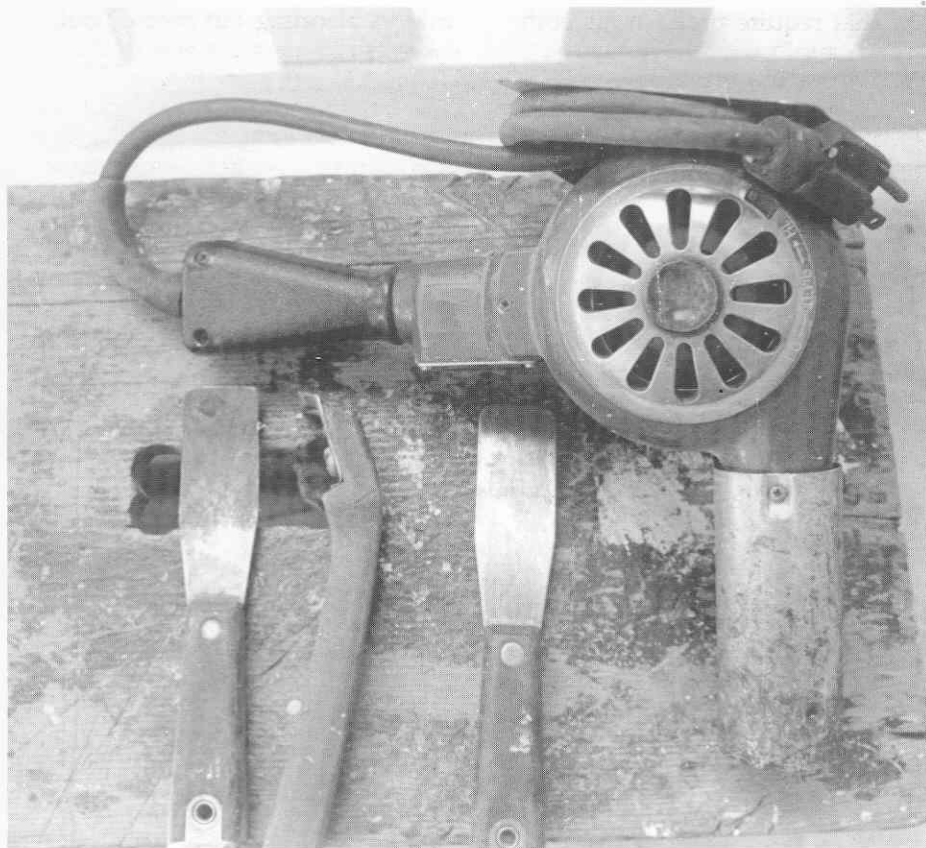


Figure 3. Heat guns, putty knives with corners rounded, and paint scrapers were used in paint removal. Photo: Michael Lee

Special care was taken in the removal of paint from decorative millwork. Scorching of decorative wood trim can occur easily, especially if the heat gun is trained on the same area too long in an attempt to remove all the irregular paint build-up. The heat gun was set at the lowest temperature and adjusted higher as necessary to compensate for the thickness and condition of the paint.

During paint removal the scraped paint tended to adhere to the putty knife, slowing the paint removal process. The workers tried several putty knives and scrapers, but none was successful in shedding the paint residue from the blade. Therefore, the knives had to be periodically cleaned of gummed paint with another putty knife. For siding, a 2 to 2½ inch-wide rigid putty knife worked best. Narrower blades were used for millwork and tight spots. To reduce chances of the workers gouging the wood with the putty knives, the edges of the blades were rounded using a grinder.

The workers used two techniques for thermal paint removal with equal success. In the first case, one

worker alternately heated and scraped the surface. Time was lost in this method because the heat gun had to be set down periodically in order for the worker to clean his putty knife. The second technique, developed by the contractor's site supervisor, was to fasten two heat guns together side by side using metal bars bolted to each gun base (see figure 4). In this way one worker heated the surface while another scraped in a continuous process. This method worked very well for expansive areas of siding and attained an average rate of 8 to 10 square feet per crew hour. On siding in tight areas where one worker operated a single heat gun, paint was removed at a rate of approximately 4 square feet per crew hour (see figure 5).

The siding was inspected for rot and cracks, and suspect sections were marked for repair or replacement. The marked sections were passed over in the paint removal process.

Fire Safety

Thermally removing paint using a heat gun does carry certain fire

risks that require precautions both in the planning as well as in the execution of the work. With an ignition temperature of approximately 200-250° F, the wood itself can ignite from the hot air blast, leading to potentially serious fire damage to the historic building.

In assessing the risk of the wood igniting, a number of factors need to be taken into account. The moisture level of the wood definitely affects the temperature at which the wood ignites. Wall studs behind the siding that are adjacent to high temperature heating pipes would be very dry compared to the siding. If the heat from the gun did not dissipate fast enough within the wall cavity, studs or deadening boards could begin to smolder in particularly hot spots or areas of very dried wood, even though the siding is not immediately affected. And where there is insulation in the wall, heat build-up would be greater, thereby increasing the fire risks. Even the daytime temperature and prevailing breezes need to be considered, since cooler temperatures and a mild breeze will help cool the siding faster. On the other hand, strong winds will make it more difficult to remove the paint, increasing fire risks in a variety of ways.

Another factor to be considered is the surface condition of the siding. Very rough edges are more susceptible to ignition than smooth surfaces. A more common problem that must be taken into account not

only in planning but throughout the work is the tendency of the laborers to get impatient or careless, directing the heat gun in one spot too long or adjusting the heat gun to a higher temperature.

In addition to the possibility of igniting the wood, there is the even greater risk of ignition of flammable debris commonly found in wall cavities and behind cornices. Debris such as bird and rat nests, builder's trash, accumulated dust and building material waste can all be more flammable than the wood siding. Examining selective areas of the wall cavity and cornices prior to selecting a paint removal method can help to establish the extent of potential fire risk from debris and building material.

Additional precautions need to be taken in the course of work. Both the work crew and park staff at the Truman home were thoroughly familiarized with the fire risks involved. Besides using scrapers or chemical strippers in the areas of highest risk, workers were instructed to avoid overheating the wood. This tends to occur at uneven wood surfaces, such as found in decorative trim or in cornices. Since workers tend to get overly confident and very casual as the job proceeds, someone on the crew should be assigned responsibility as the "fire-safety inspector."

Suitable fire-fighting equipment should be readily available. At the Truman home, carbon dioxide and water fire extinguishers were within

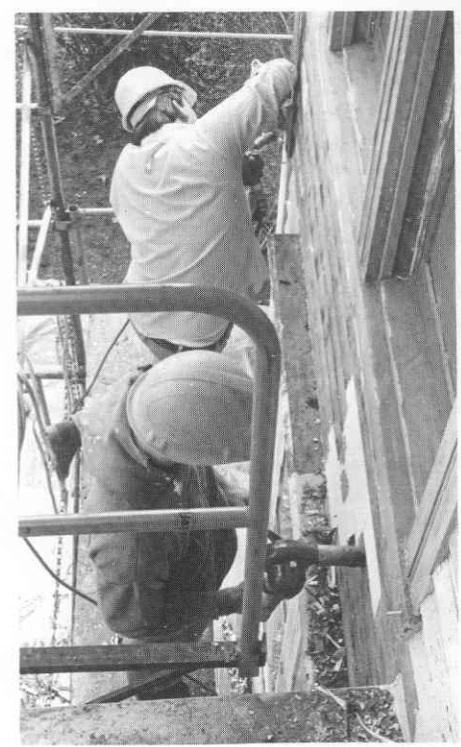


Figure 5. Using scaffolding, workers remove the paint with heat guns. Cracked or deteriorated siding was repaired or replaced. Photo: Alan O'Bright

immediate reach of every work station where a heat gun was being used. The contractor added glycol to the water extinguishers during cold weather work to prevent freezing. In addition, a long garden hose was kept near the work site during warm weather.

Since debris and wood will tend to smolder for a number of hours before breaking out into flames, the building should be equipped, if possible, with a temporary fire detection system in the attic eaves and adjacent to exterior walls. Furthermore, paint removal using heat guns should stop at least several hours prior to the site being vacated each evening, to increase chances of early detection of any smoldering fire. The area of the day's work must be carefully inspected. And finally, if there is a night watchman, extra diligence should be demanded during the weeks when paint removal is occurring.

Health and Safety Considerations

Since most of the pre-1950s paint used on house exteriors is

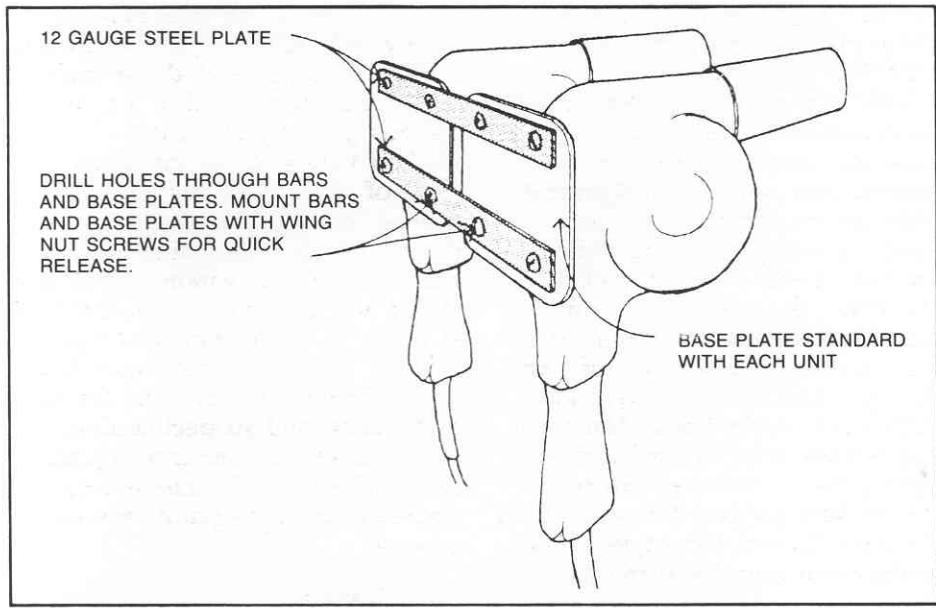


Figure 4. Method used to join two heat guns for simultaneous use. Drawing: Alan O'Bright

lead-based, additional special precautions are necessary in removing such paint. When thermally removing paint, workers should use respirators approved by the National Institute for Occupational Safety and Health (NIOSH) that have cartridges specially designed to filter lead. For projects as large as the Truman home, replacement filters available at the site are recommended to permit the necessary frequent changes of filters without interrupting the work schedule. Workers should wear separate clothing for paint stripping and provide for full leg and arm protection. An industrial vacuum cleaner placed outdoors permits periodic cleaning of clothes and the work area.

Additional time should be provided for workers to clean up properly before eating, and no eating should take place within the work area.

As at the Truman home, large plastic drop sheets should be used to collect the paint chips and prevent the lead-based paint from being deposited in the soil. Collected each day, paint chips need to be safely stored for disposition in accordance with the local and state health boards' guidelines for toxic waste.

To keep the inside of the building from being exposed to toxic vapors when removing exterior paint, it is necessary to close all doors and windows and to turn off intake fans. Workers should not be permitted to walk into the building wearing contaminated clothes. They must also wash their clothes separately from the rest of their laundry. As a final precaution, the work area should be closed to all but essential personnel, but in any event, caution must be exercised to prevent small children, pregnant women and people in ill health from entering the site.

Evaluation

Areas on the Truman home where paint was removed with the heat guns and then lightly sanded provided an excellent painting surface (see figure 6). By using workers experienced with thermal removal of paint, very few scraper tool marks were left that were noticeable. The new paint bonded well to the wood

surface and heightening the fire risks. The hot air blast from the heat gun will soften the paint by raising the latent oils. If a worker is impatient and either works too large an area or gets the paint too hot before it is scraped, the oils will be driven off and the paint will harden again. If this occurs, continued application of heat will not soften the paint again, instead it will eventually ignite.

Inexperienced laborers should be taught the mechanics of using heat guns on non-significant woodwork, perhaps even on another building, prior to work on a significant historic structure. Workers need to be familiar with different scraper sizes and the range of flexibility in scraper blades and putty knives. They should also know how to grind scrapers to match molding profiles in the wood work, know the appropriate angles in which scrapers should be set and used, and how to round the edges of knives and scrapers to avoid gouging the wood. Once rudimentary skills are learned, a worker should then begin on a simple, easily accessible portion of the structure to build confidence in this technique.

Regardless of the skill level of the workers, test patches should always be undertaken. Approved test patches thus serve as the standard of workmanship for the entire project and the basis for acceptance or rejection of the work. If after careful planning and examination of the test patches there is any doubt as to the ability of a structure or portions thereof to withstand thermal removal of paint, then alternative means should be considered.

Removal of paint using a heat gun is slower than utilizing a propane torch because the temperature of the gun is only half that of the torch flame which can reach as high as 1500° F. Use of an open flame is strongly discouraged because of the far greater fire risks involved as a result of the higher temperature. Such intense and concentrated heat not only compounds the existing fire risks already identified with the heat gun but also presents additional ones. For example, nails in the siding may conduct concentrated flame heat, thereby causing deadening boards, wall cavity debris or untreated cellulose insulation to ignite. In addition to the unacceptable fire risks with the propane torch, use of an open flame inevitably scorches the wood surface considerably—damage that is totally unnecessary.

Even with heat guns, however, scorching and tool mark damage may result. Patience is required; working too fast can be counter productive, causing damage to the

wood surface and heightening the fire risks. The hot air blast from the heat gun will soften the paint by raising the latent oils. If a worker is impatient and either works too large an area or gets the paint too hot before it is scraped, the oils will be driven off and the paint will harden again. If this occurs, continued application of heat will not soften the paint again, instead it will eventually ignite.

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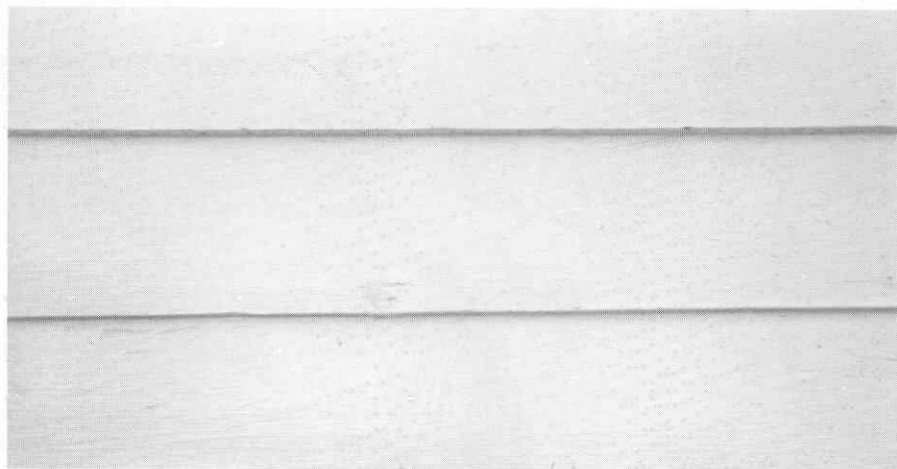


Figure 6. A typical section of the finish painted siding shows that little damage was done in removing the paint. Photo: Michael Lee

PROJECT DATA:

Building:

Harry S Truman National Historic Site
Independence, Missouri

Owner:

National Park Service
Harry S Truman National Historic Site
Independence, Missouri

Project Dates:

October 1984-November 1985

Project Staff:

Midwest Regional Office
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Contractor:

Campos Construction Company
Ernest Callaway
Contractor's Site Superintendent
Omaha, Nebraska

Project Costs:

For paint removal using heat guns on 5,800 square feet of siding and 1,000 square feet of porch deck, the labor costs averaged \$4.00 per square foot. For the 2450 square feet of decorative millwork, the labor costs averaged about \$5.50 per square foot. Total investment in paint removal equipment including heat guns, putty knives, extension cords, and lights was approximately \$950. In addition there were substantial costs for temporary electrical outlets and scaffolding. The total cost for paint removal by heat gun, scraping and sanding, and chemicals from all surfaces including siding, millwork, 74 window sash, 7 door openings, 200 brackets, porch ceiling, soffits, and fasciae was about \$57,000. The above figures do not include contractor's overhead and profit.

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PRESERVATION TECH NOTES are designed to provide practical information on practices and innovative techniques for successfully maintaining and preserving cultural resources. All techniques and practices described herein conform to established National Park Service policies, procedures, and standards. This Tech Note was prepared pursuant to the National Historic Preservation Act Amendments of 1980 which directs the Secretary of the Interior to develop and make available to government agencies and individuals information concerning professional methods and techniques for the preservation of historic properties.

Comments on the usefulness of this information are welcomed and should be addressed to PRESERVATION TECH NOTES, Preservation Assistance Division-424, National Park Service, P.O. Box 37127, Washington, D.C. 20013-7127.