Roofing '86

National Roofing Contractors Association

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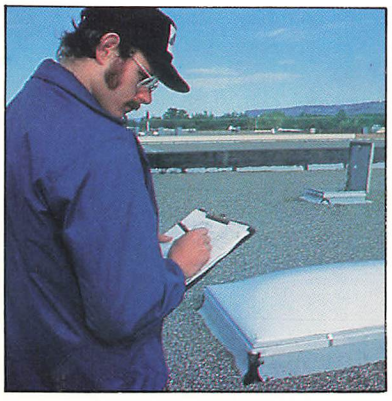

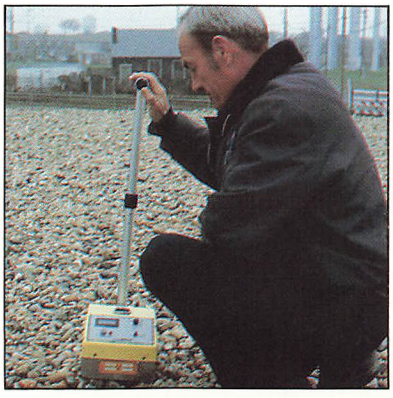

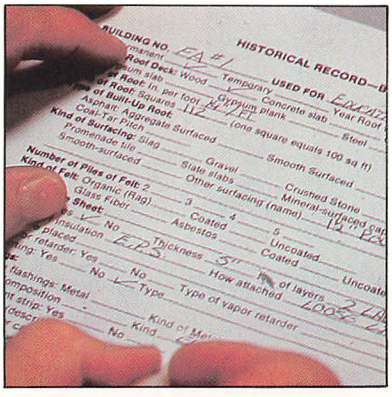

Holiday Inn/CROWNE PLAZA, Atlanta, Georgia. Southeastern States Roofing (Orlando, FL).

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Dickinson Center and Cass School, Livonia, Michigan. Single Ply International (Livonia, MI). Marquette Building, Detroit, Michigan. WBC Roofing (Detroit, MI).

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Check #35 on Reader Service Card

Roofing '86 outlines proper roof care

At some point in every roof's life it will fail. If it has been built according to accepted roofing principles and regularly inspected and repaired, however, it may not fail for decades. Unfortunately, most building owners, designers and maintenance supervisors don't realize the importance of proper roof care. *Roofing '86* was prepared by the National Roofing Contractors Association to give you the knowledge you need to keep your commercial or industrial roof in working condition.

The procedures described in the following articles are valid for all three of the most popular types of roofing in use today—built-up, single-ply and modified bitumen. Built-up roofing (BUR) is the most common, having been used for more than 100 years. The traditional BUR assembly is custom-built at the jobsite. It is composed of a structural deck, thermal insulation and a membrane that is built of several alternating layers of bitumen and felt. The bitumen—asphalt or coal tar—is the membrane component that actually makes the system waterproof. It is also the adhesive that binds the system together.

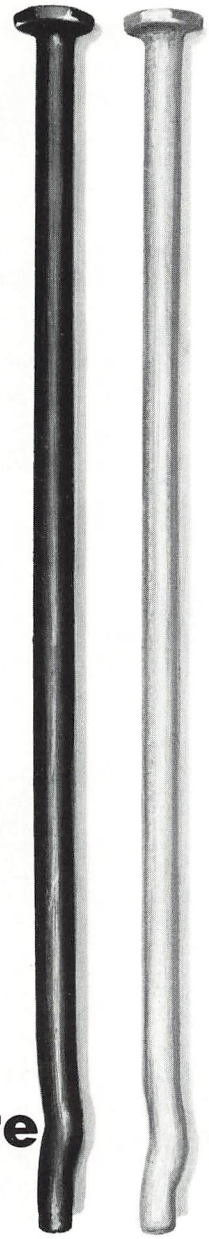
Single-ply systems have been gaining in popularity in recent years, and NRCA's own research has revealed that more single-ply systems are being installed than BUR systems. What attracts many to single-plies is the systems' simplicity; only one layer of a watertight, weatherable membrane, sealed at the seams and edges, is needed to protect a building. The single-ply sheeting may be made from rubber or plastic. The most common single-ply system uses a membrane made of EPDM, a synthetic rubber.

Modified bitumens are a combination of modern single-ply technology and time-tested materials. The membranes are composed of a polyester or fiber glass felt sandwiched between two layers of polymer-modified bitumen. The roofing comes in a roll and may be installed in a single layer.

More detailed discussions of the various types of roofing available may be found in the NRCA publication *Roofing '85*, which is available at a cost of $3 from the Communications Dept., NRCA, 8600 W. Bryn Mawr Ave., Chicago, Ill. 60631.

Martin Eastman

Martin Eastman, editor



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Check #3 on Reader Service Card

Owners want answers to protect investment

A roof is a large investment, and an untimely roof failure can quickly drain a building owner's resources. Because of the high stakes involved, owners are anxious to protect their investments with proper maintenance and repairs. But recent changes in roofing products and practices have left designers, owners and maintenance supervisors wondering when or how often the roof should be inspected, repaired or replaced. The following questions and answers address some of the roofing consumers' most common concerns.

Q How will I know when roof maintenance is no longer possible and I must reroof my building?

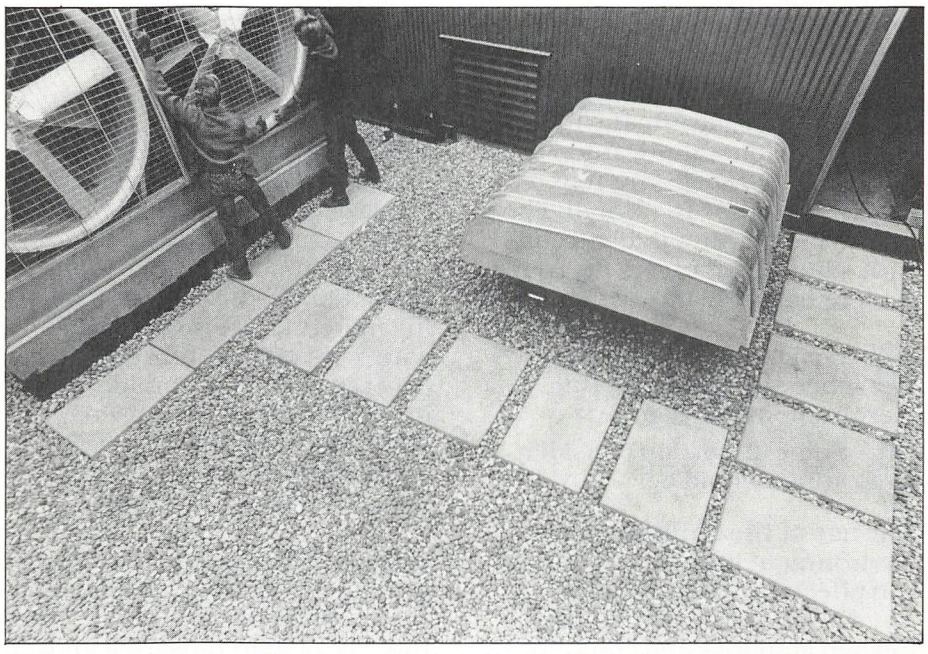
A There are a number of signs that will tell you that the condition of the roof has deteriorated to the point that repairing it will no longer be cost-effective and reroofing is necessary.

One sign is an increase in the cost of roof maintenance. If the cost of annual maintenance begins to exceed 10 percent of the cost of roof replacement, it is time to consider reroofing. When roof leaks persist despite maintenance and repair efforts it is also time to think about a new roof.

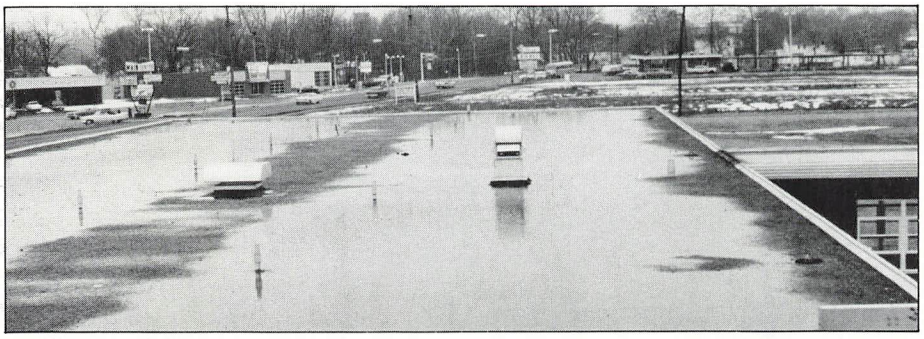
It is also not possible to repair a roof system that has been severely weakened by moisture or the elements. A built-up roofing membrane that has lost more than 50 percent of its design tensile strength or a single-ply membrane that has lost more than 50 percent of its design elongating properties will need to be replaced.

Reroofing may also be necessary if the presence of moisture in the roof assembly has caused the roof insulation to lose more than 50 percent of its thermal efficiency.

Moisture may enter a roof assembly through a leak in the membrane or it may condense in the insulation if there is no moisture vapor retarder to keep moisture inside the building from moving into the roof system. Once inside the roof, the moisture may deteriorate the insulation or it may saturate the entire system. In either case, the result will be a substantial increase in



Walkway pads such as these manufactured by the Diversitech Corp. may be necessary to protect roofs from foot traffic.



If large ponds such as this remain on the roof longer than 24 hours after a rain, it may indicate the need for reroofing to correct the condition.

the cost of energy for heating and cooling.

Some insulations are not adversely affected by moisture or water, however, and will regain some of their thermal efficiency over a period of years once leakage has been corrected. When this is the case, some contractors may recommend the installation of vents to speed the drying process once repairs have been made.

The presence of large ponds of water on the roof may also indicate the need for reroofing. These ponds have a tendency to grow over the years as the weight of the ponded water deflects the structural roof deck causing a larger and larger depression. Deep ponds that cover a large area of the roof evaporate slowly, giving the water plenty of time to deteriorate the roof surface and find a way to seep into the roof assembly. Generally, water should evaporate from a roof within 24 hours of a rainfall. The weight of the water is also a concern when it endangers the roof deck's structural integrity.

Q What must be considered when selecting a roofing membrane and system?

A Some important considerations would be:

The use of the building. The environment inside a building can affect the roof assembly as much as the forces of nature. Certain activities and conditions will subject the membrane to greater-than-normal moisture levels or temperature extremes. For example, roofs over swimming pools or laundries would need to be built to withstand the high humidity these activities generate, while membranes installed above freezers or cold-storage buildings would require protection from water vapor entering the system from the outside and condensing in the roof assembly.

The use of the roof. The maintenance of mechanical equipment located on the roof may require workers to walk across the roof frequently. Tools or small parts accidently walked on or pressed into the roof surface may also puncture the membrane. A roof on which a great deal of mechanical equipment is located would have to be designed to resist this abuse.

The requirements of the HVAC system. Maintaining a certain range of temperatures in the building may depend on the use of high-performance roof insulation. Some of these insulating materials are incompatible with some roof membranes. It is necessary, once the building's insulation needs have been determined, to find the right combination of materials to achieve the desired results.

The budget constraints of the project. Some systems are less costly than others, depending on the type of materials used and the method of attachment to the roof deck.

The location of the building. If the building is located in the center of the city, is several stories high and has a roof that is difficult to reach, a roofing system must be selected that can be easily transported to the rooftop.

The building's location will also determine how much wind, sunlight, ultraviolet radiation, heat, cold, rain, snow and chemical contaminants the roof will be called on to withstand during the course of its lifetime. While most systems are designed to perform in a wide range of climates, some products are particularly well-suited for certain harsh conditions.

The type of structural roof deck. The weight of different systems may vary a great deal. A system held in place with stones or cement paver blocks may add more than 10 pounds to each square foot of roof area. Decks such as concrete with greater structural strength may be able to withstand the extra pounds. However, decks with less strength such as wood or metal may require a lighter membrane that is adhered to the substrate with mastics or mechanical fasteners.

The number of penetrations. It is easier to install a roof with many penetrations requiring multiple flashing details if a material is used that is available in narrow sheets. For large roofs with few penetrations, it may be desirable to use a wide sheet to reduce the number of field seams necessary.

Q Must the old roof always be removed before the new roof is installed?

A Very often it is less expensive to leave the old roof in place and install the new roof over it, saving the cost of removing the old roofing system and hauling it away. Furthermore, whatever's left of the old roof's insulation value will be added to the new roof if it is left in place. The old roof can also help protect

the building from the elements during the installation of the new system.

This procedure does have its drawbacks, however. The selection of the new roof's components will be limited to products that are compatible with the old roof's materials. Also, if the old roof contains small amounts of moisture, some venting of the old roofing system may be required to relieve moisture vapor pressure.

If a large amount of water is present in the old roof, it will have to be removed before the new system is installed. It is also not possible to apply a new roof over an old roof if any of the following conditions apply:

- the existing roof insulation has rotted or disintegrated, or has been saturated and permanently damaged by free-standing water;
- the roofing membrane has deteriorated to the point that it is too fragile to withstand the foot traffic necessary to install the new membrane;
- the structural roof deck cannot accommodate the combined weight of the old and new roofs; or
- the structural roof deck has deteriorated and requires extensive repairs or replacement.

Q Should some slope be built into the roof?

A NRCA and most roofing membrane manufacturers recommend some roof slope to allow water to run off the roof surface and into drains. Getting the water off the roof quickly is a good idea because it reduces the load on the structural deck, it reduces the possibility of ice damage to the roofing membrane, it hinders vegetation growth on the roof, and it doesn't give the water time to seep into small holes in the membrane. If the present roof doesn't have enough slope and ponds excessively, it is possible to add slope during reroofing to improve drainage. To do this, the contractor installs tapered insulation boards under the membrane.

Almost all BUR membrane manufacturers insist on roof slope. They will take no responsibility for the performance of their products if they are installed without slope. On the other hand, most single-ply membrane manufacturers recommend roof slope in their literature, but will still issue warranties even if roofs pond water.

In the real world of roofing, practically all roofs pond some water somewhere, even those designed to slope. However, with some slope built into the system the roofs may not pond as severely.

This information was provided by Prospect Industries, Inc., a firm specializing in roof contracting and insulation manufacturing and installation based in MacLean, Va.

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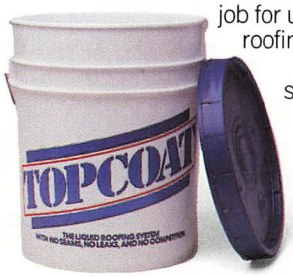

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Check #18 on Reader Service Card

The roof survey: getting back to basics

by Michael Dhunjishah, P.E.

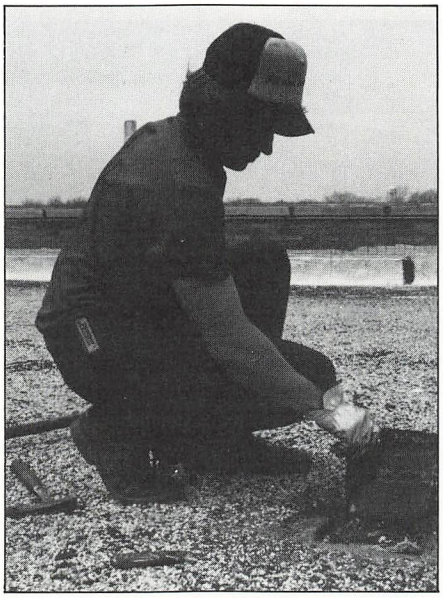
The last decade has seen the introduction of sophisticated equipment to evaluate and analyze roof conditions. Most of the roofing being analyzed, however, is still conventional BUR. And when it comes to evaluating conventional roofing, the newer approaches cannot replace the basics—a systematic and visual survey based on knowledge and experience.

The systematic approach to roof surveys involves preparation, field work, evaluation, reporting and possibly follow-up work. For a visual condition survey to be useful, the documentation, results and evaluation must be reported in a form that will permit the building owner to take the appropriate actions based on his financial and other constraints. Advanced, nondestructive techniques that measure infrared radiation, nuclear movement or capacitance can be used if necessary, but in my opinion, they should be used only to augment the visual survey.

Basic, systematic visual surveys aren't only for built-up systems, however. More and more single-ply systems are requiring inspection and repair as the number of installations increases and existing systems age. Although this article describes procedures for evaluating built-up roofs, the same general approach can be applied to single-ply systems. The growing variety of single-ply systems makes one additional evaluation necessary, however. When surveying a single-ply roof, it should be determined if the system applied fits the installation's structural and environmental constraints.

Establish purpose first

Prior to starting a roof condition survey, it is necessary to establish its purpose. There are four main reasons why surveys are undertaken:



An investigator cuts a small sample out of the roof to analyze its condition.

Maintenance. This type of survey determines what maintenance procedures are needed to maximize the service life of the existing roof. These surveys are generally carried out for the owner or property manager.

Existing condition determination. This survey evaluates a roof's present condition and probable service life. Roof problems are examined, and the costs and procedures of the options available to maximize service life are determined. These surveys are generally carried out for the present owner or property manager or for prospective owners.

Leak investigation. This survey is conducted to determine the cause of a roof's leaks and the best way to fix the damage.

Lawsuit investigation. This type of survey provides an independent expert's opinion about the condition of a roof and the possible cause of its problems. The information is usually requested by two or more parties who cannot agree on a remedy for the roof's ailments.

Regardless of the type of survey, the approach is generally the same, even though the degree of documentation and reporting may vary.

Gathering the information

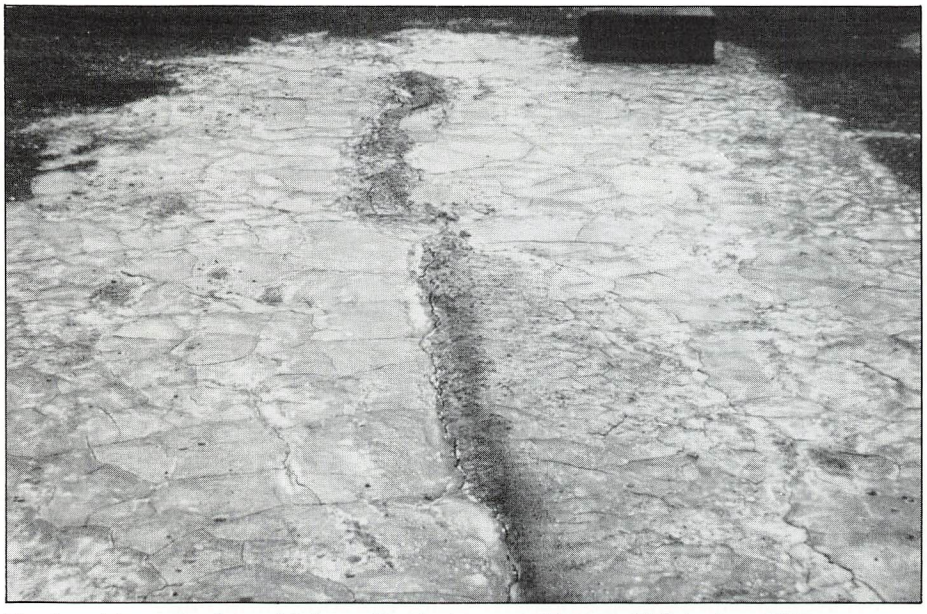
Once the purpose of the survey is established, the next step is to obtain as much information about the roof as possible. The best way to start is with a review of the roof plans, details and specifications. In most instances, however, these are not available. Nevertheless, some information such as the roof's age, and the number and dimensions of the roof's different levels should be available. Other useful information includes the locations of the roof's current leaks and its leak history as well as other past or present roof problems.

Often, the surveyor will be able to obtain a chronological history of the roof by reviewing repair invoices. Much information can also be gleaned from the maintenance workers that are responsible for getting roof problems fixed. The building's occupants can be valuable sources of background information as well.

There are four main reasons why surveys are undertaken.

The roof investigator uses several tools and pieces of equipment to evaluate the roof's condition. Generally, he will bring with him:

- a ladder;
- a camera and film;
- measuring devices;
- a lumber crayon and marking paint to designate problem areas;
- a clipboard and paper, including a checklist of items to be observed;
- some roof cut tools, including a knife, heavy-duty plastic bags, tape, a test cut template, a whisk broom, a hatchet, a brick mason's hammer and a rag; and
- a flashlight to look at the roof from below.



Roof problems such as ridging, alligatoring, cracking and blistering will be documented in the investigator's report.

Field work begins indoors

The actual survey begins inside the building. First, the investigator tries to update and fill the gaps in the previously gathered information by interviewing the owner, maintenance personnel or occupants. Then, the problem areas are examined. During the inspection, evidence of roof leaks, water stains, structural damage, and leaking drain lines or other mechanical units will be documented on the checklist and the problem areas marked on the roof plan. Sometimes this documentation is augmented with photographs.

This interior survey should proceed systematically and should include as much of the interior area below the roof as possible. The deck will also be inspected during this survey. A close examination of the deck may reveal the actual construction of the roof. This information can be used to verify that the roof was constructed according to the plan.

C.W. Griffin in his *Manual of Built-Up Roof Systems* (McGraw-Hill Book Co., New York, 1982) presents a fairly comprehensive list of items that need to be evaluated. For the following types of decks Griffin suggests:

Steel should be examined for rusting, differential deflection at side or end laps and excessive deformation. Welds should be sound and rooftop components should have their own structural angle supports.

Wood should be checked for rotting, warping, shrinkage, excessive joint gaps and proper attachment.

Structural concrete should not have cracks over 1/8-inch wide, and deflection should not be excessive.

Examining the underside of the roof may be the only way to discover this type of deteriorated condition.

Precast concrete should not have excessive joint gaps or differential deflection at adjacent units.

Poured gypsum should be examined for excessive deflection of subpurlin bulb tees, cracking and evidence of excess moisture.

Corrugated steel supporting lightweight insulating concrete should have venting slots in the deck's underside or side laps. There should be no effluorescence on the metal. The deck surface should be checked carefully during the topside inspection.

Structural wood fiber should be checked for excessive deflection, differential deflection between adjacent units and excessive joint gaps.

Up on the roof

Once topside, the investigator will walk over the roof to form a general impression of its condition, making mental notes of any visible problems and problem areas. A systematic examination may proceed after an overview of the roof has been gained. During the systematic examination, such things as roof dimensions; the location, type and size of each rooftop unit and penetration; the type of perimeter; and any other pertinent information will be documented and verified.

A systematic examination will yield information about each roof area and component, and include a record of any signs of damage, misuse or improper installation. The investigator's observations should include:

The roof surface's general appearance. The investigator will note if the roof is well-maintained or if material is being stored there and debris allowed to collect. The quantity and adequacy of repairs and the amount of traffic and mechanical damage to which the roof has been subjected will also be observed.

The membrane and surfacing. Bare areas, ridges, splits, blisters, curled felt edges, alligatoring and other damage will all be documented as well as inadequate amounts of aggregate and excessive dirt in the aggregate. The quality of the roof's construction will also be evaluated. This can be gauged from evidence of correct design; good or poor workmanship; the use of proper materials; adequate attachment of the membrane to the insulation and the insulation to the deck; adequate decking; deterioration of the roof assembly or decking; and the presence of moisture within the system.

Evidence of ponded water. The depth of any ponded water will be measured and the length of time it has been present on the roof will be recorded. If there is

no water on the roof, other evidence of ponding such as a buildup of dirt, algae and dark areas or growing vegetation will be noted.

Flashings. If their positions correlate with interior leak locations, this will be noted. Base flashings around the perimeter and rooftop will be checked to see if they were properly constructed and mechanically fastened to prevent slippage. Evidence of deterioration, damage, disbonding or wrinkling, partially filled pitch pans or otherwise improperly flashed penetrations will also be recorded. The investigator must also determine if the counterflashing was sealed and secured in a way that allows for contraction and expansion.

Other roof accessories and drains should also be examined to determine if they were properly installed and are performing adequately.

Test cuts check quality

While you will learn much about a roof through a surface inspection, it has been my experience that roof test cuts should be made, if at all possible. To glean the most information from the samples, they should be taken from locations that represent both typical and atypical conditions.

The location of each sample should be documented as it is taken as well as the type of substrate it is attached to and the method of attachment. The amount, type and condition of insulation and the sample's pliability should also be recorded along with any other pertinent data noted during the cut.

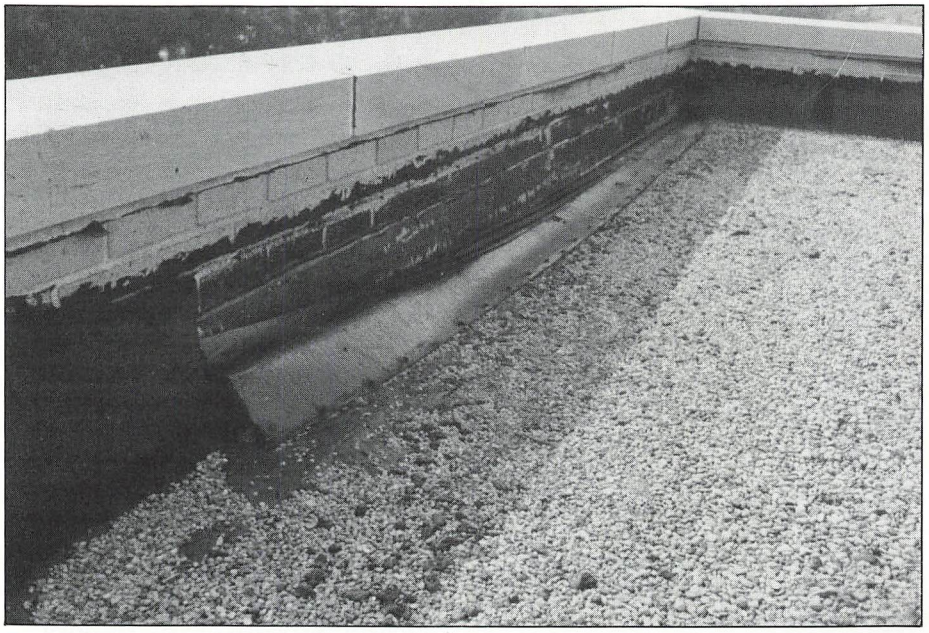
The newer approaches cannot replace the basics—a systematic and visual survey based on knowledge and experience.

Once all the cuts have been removed, they will be sent to a laboratory where they can be frozen, dissected and examined. Information such as the membrane's adhesion, the general amounts of interply bitumen that were applied, how the interplies cooled and the type of felt used can be gleaned from this technique.

An analysis of the test cuts can also yield quantitative information, if needed. A laboratory can deduce a roof's interply bitumen content, amount of flood coat or number of plies from a test cut evaluation. While this quantitative information may be necessary for documentation in case of a lawsuit, I find that the qualitative analysis yields the invaluable data that is needed to evaluate a roof's condition and history.

Report presents evaluation

For the investigator to evaluate the information he has gathered, he must keep in mind the reason the survey was undertaken and what the client wants or needs. As he reviews the field-work documentation, he will look at the

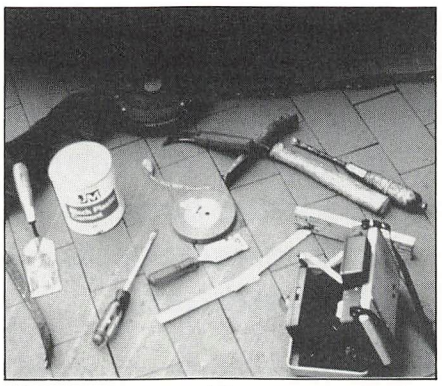


Poorly flashed parapet walls are a prime source of leaks in a roof system.

roof's general condition, the quality of its construction, the condition of the flashings and penetrations and the adequacy of its drainage.

Once the investigator has evaluated the roof's design, materials, installation methods and maintenance, he is ready to make a set of recommendations tailored to the client's needs. Generally, it is possible to give the client a set of options. However, each of the options should be presented in enough detail to allow a decision suited to the client's constraints to be made. The client should also be able to determine the amount of risk involved with each option.

Three courses of action are usually possible with most existing roofs. The client can choose to reroof, undertake major repairs or repair the specific problems. In most instances, finances will be the most important consideration.



These are some of the common tools an investigator will use to examine and document a roof's condition.

Information in a properly presented report is arranged to allow the client to weigh the available alternatives and reach the decision that best suits his needs.

Regardless of its format, a report should contain the following items:

- the purpose of the evaluation;
- background information, listing the sources of roof data; the building's location, construction, age and size; and the roof's composition, area, levels and problems;
- the scope of services, including the review of plans and specifications, interviews with building personnel, visual examinations, roof cuts and analyses that were needed to conduct the evaluation;
- the evaluation, describing the roof's condition and giving an estimate of remaining service life along with the criteria that was used to arrive at conclusions (summary of major findings);

- the investigator's recommendations, including a summary of the client input that affected the recommendations; the options available, stating the advantages and disadvantages of each; the recommended option, if applicable; and cost estimates;
- any recommended additional work such as additional evaluations; non-destructive surveys; preparation of plans, details and specifications for corrective work; preroofing conferences; and inspections during repairs or reroofing that will be needed; and
- an appendix that includes the detailed findings, an analysis of any roof cuts made; a roof plan; and numbered photos with captions.

Once topside, the investigator will walk over the roof to form a general impression of its condition.

Systematic survey remains the key

After the condition of the roof is assessed, additional tests using non-destructive detection devices may be desirable. These tests can pinpoint moisture that is not readily detectable by visual examination. However, the usefulness of non-destructive tests is limited by the operator's expertise, the type of roof system being tested and the interpretation of the results. The advent of sophisticated non-destructive moisture detection equipment may seem like a roofing problem panacea, but a systematic survey in conjunction with the use of all available data and roofing knowledge still remains the key to determining the causes of roof problems.

Simply repairing the symptom without knowing the cause leads to a temporary solution at best!

Michael Dhunjishah is the senior engineer of Law Engineering Testing Co. in Houston, Texas.

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Technology harnessed to seek out moisture

The condition is not always easily recognizable. Like periodic physical examinations, a moisture survey spots potential roof problems at an early stage before damage becomes severe. At worst, a moisture survey is the first step for diagnosing a terminal roof.

To ensure long roof life, a good, preventive maintenance program should include a detailed history of the roof (what system is being used, how many plies it has, how was it attached), yearly on-site inspections and test cuts.

And now, contractors can add one more aspect to roof inspections: non-destructive moisture detection surveys. Three popular techniques for non-destructive surveying are infrared scanning (thermography), and nuclear and electrical surveying. The methods are labeled "non-destructive" because they do not puncture or in any way damage the roof system.

Use of any of the moisture detection instruments can help roofing contractors get a jump on moisture.

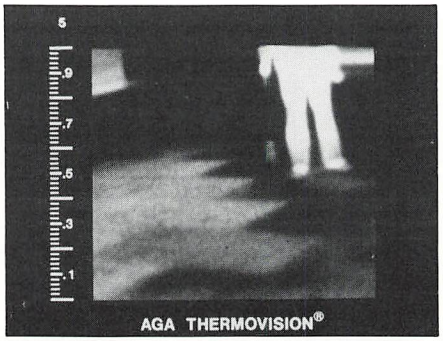
A roof that looks dry could actually have wet insulation. Detected in the early stages, small problems can be corrected before excessive damage occurs and repair costs become prohibitive.

Financial priorities can be established and budgets devised to incorporate costs over a period of time, benefiting both the building owner and roofing contractor.

"From the roofer's standpoint, he can quote a job close to the bone with our [infrared] report," says Peter Jacobsohn of Energy Conservation Consultants, Inc., (ECC) of Bloomington, Minn.

He adds that moisture detection can prevent the roofing contractor from taking off good insulation or a good roofing system by enabling him to zero in on the affected areas. By studying the survey results, the contractor will know exactly where to take core samples.

"Wet insulation actively conducts heat, adding significantly to the building owner's energy bills," says Paul Grover, Infraspection Institute, Shelburne, Vt. "Water can structurally damage the roof deck, and unless all the wet insulation is located and removed, roof repairs or a new single-ply membrane system can fail prematurely."



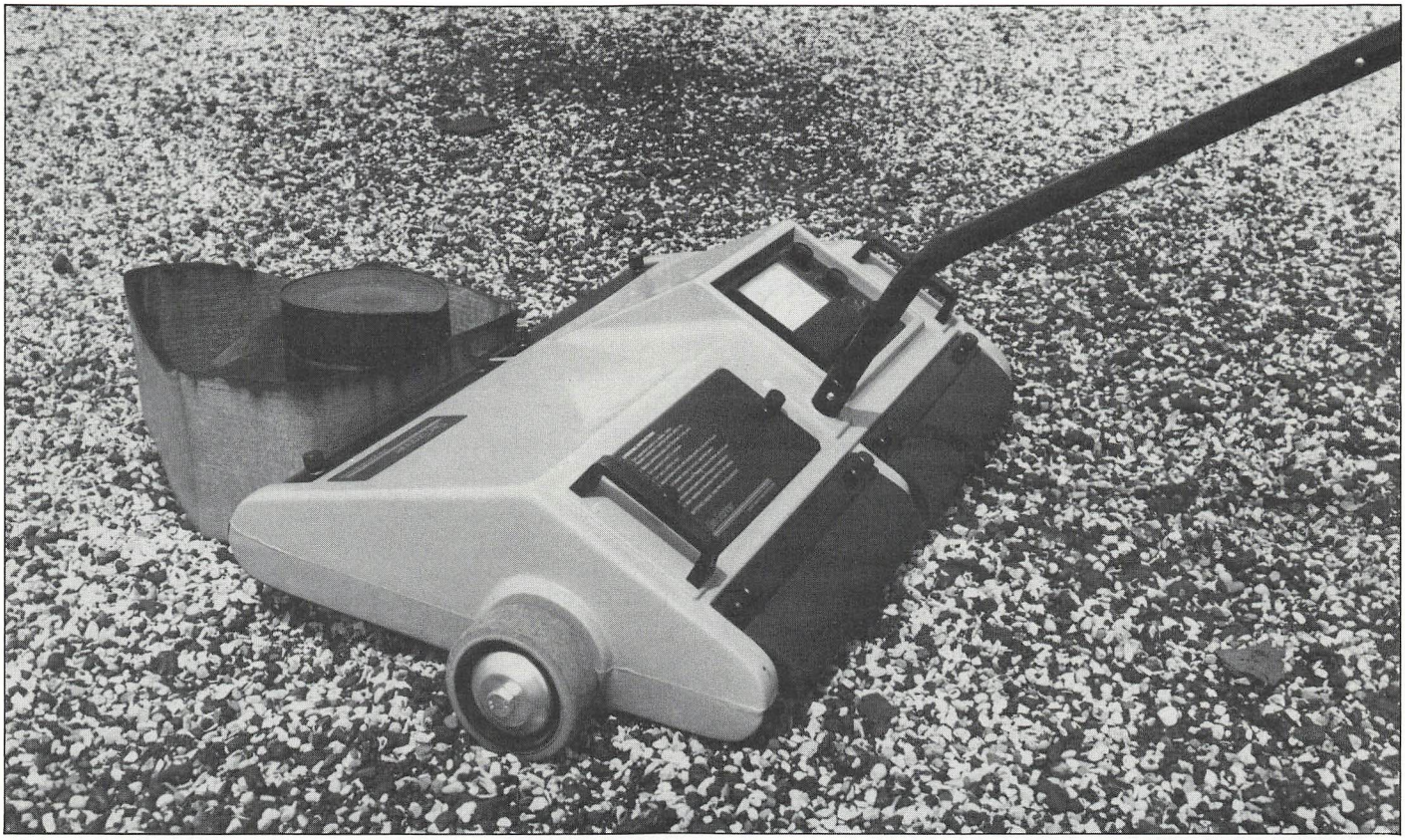
By graphically portraying information received from an infrared camera, a roof thermogram reveals a roof's condition.

Several options are available to roofing contractors who want to use non-destructive surveys.

Deep heating

Infrared heat detection scanning or thermography was first employed by the military to detect far-off enemy aircraft. It was also used by fire departments nationwide to rescue victims.

"Infrared can see energy-wasting moisture in the insulation of a roof by measuring electromagnetic energy," Jacobsohn says.



This type of electrical capacitance meter measures roof moisture while saving the investigator's back.

A thermogram, the photograph taken by an infrared scanning camera, is the key component in the scanning procedure. The thermogram indicates energy loss from wet insulation.

The best time for conducting infrared scans is during the evening hours when "reflected solar radiation, which distorts surface-temperature readings," is not a factor, according to C.W. Griffen in his book, *Manual of Built-Up Roof Systems.*

"The radiative subcooling of roof surfaces on clear nights—with little or no cloud cover to absorb and reradiate escaping infrared radiation beamed out into space—provides the biggest contrast between wet and dry roof area temperatures," Griffen maintains.

"When the temperature difference between the wet and dry areas is the greatest, the contrast between the dark and light (wet and dry) images is the most obvious in the photograph.

"Judged from extensive experience, a clear cool night after a clear sunny day—several hours after sunset to several hours before sunrise—is the best time to run a thermographic moisture-detection survey," Griffen states in his book.

Neutron dance

The nuclear moisture detection technique operates on the principle of neutron moderation.

"Fast neutrons emitted by a radioactive source are slowed by hydrogen in the roof," according to Troxler Electronic Laboratories, Inc., Research Triangle Park, N.C. Troxler is a manufacturer of a nuclear roof moisture gauge.

"Slowed neutrons are detected and counts displayed are proportional to moisture (hydrogen) content," Troxler says.

Often, a grid pattern is laid out on the roof area for a nuclear survey. A typical grid size is 10 feet by 10 feet. Nuclear moisture counts are taken at each grid intersection.

Radioactive materials are used in the nuclear devices and a special U.S. Nuclear Regulatory Commission license is required to operate the detector.

On impulse

An electrical roof moisture detector picks up the electrical impulses reflected through roof waterproofing. This method can also use grid markings. Unlike the nuclear method, where readings are taken only at specific locations, the electrical device sweeps across a wider area, emitting a continuous readout on moisture content.

"With its inevitable impurities, water is a good conductor, and electrical resistance in nonconductive insulating materials varies inversely with their moisture content," Griffen states.

Pros and cons

Infrared, nuclear and electrical moisture detectors can be very useful to roofing contractors and building owners as diagnostic tools for determining the location of invisible problems.

The best time for conducting infrared scans is during the evening hours.

A major advantage to infrared is that the process scans a larger area and does not necessitate gridding. The cost of infrared equipment can be a drawback, though; prices range from $40,000 to $60,000. Also, the best time to conduct the surveys is at night—not always convenient or safe for the operators. And the test data must be interpreted by experienced infrared technicians to determine the margin of error.

Nuclear equipment is available in the more affordable price range of $3,000 to $4,000. Testing can be conducted at any time. This method does require a grid layout for measurements and works best on smaller areas, when taking samples of only one section at a time.

Nuclear detection requires an operator's license because of the radioactive material present in the device. Like the infrared method, data from the survey must be interpreted by experts. This is because "Hydrogen atoms abound in hydrocarbon bituminous roofing materials," Griffen says. This additional source of hydrogen atoms complicates the correlation of hydrogen atom count with the quantity of water.

"In more or less uniform cross sections, however, a datum level of hydrogen atoms can be established for dry areas and the excess count assumed to indicate water," Griffen adds.

Using a hand-held infrared camera, an investigator assesses the amount of moisture present in a roof system.

Electrical detectors are also closer in line with the small business owner's budget: $400 for a hand-held model and $4,000 for a scanner designed for larger roof areas. With minimal instruction, a member of a roofing crew can operate the battery-powered machine and read the results immediately.

An electric detector can be used at any time of day. Gridding can be done, but is not necessary. The electrical device must be used in dry conditions only; all ponded water should be swept clear before the surveying.

The method is also limited to certain roof systems that do not contain metal trace elements. Rubber roofs also pose problems.

"A system like EPDM [ethylene propylene diene monomer, a popular elastomeric roof system] is conductive enough to act like a metal," says Dick Fricklas, director of the Roofing Industry Educational Institute. "It could short-circuit the equipment."

Roofing contractor Cy Tilsen of Tilsen Roofing Co., Madison, Wis., has worked with building owners who use infrared scanning services. The results of the thermographic surveys are then turned over to Tilsen Roofing for confirmation.

"It's a useful tool, but the results need to be verified by taking core samples of the roof," Tilsen says.

He explains that there are many "variables" with the method; in particular, the expertise of the equipment operator and those who interpret the results of the scan.

"Human error has to be factored into thermography," Tilsen claims.

Cliff Johnson of Empire Roofing & Insulation Co., Tulsa, Okla., uses an electric capacitance meter to check for moisture on roofs rather than infrared scanning machines. "Infrared has too many limitations," Johnson says. "It doesn't have the ability to tell you if you have moisture between the felts."

An investigator places a hand-held electrical capacitance meter on a roof surface to measure roof moisture.

The electric capacitance meter can measure moisture in four stages or varying degrees of wetness. The meter can detect moisture in one ply or pour coating (stage one), two or more plies (stage two), insulation (stage three), and totally saturated (stage four).

"We use the meter because it can measure the moisture between layers of felt before the water gets into the insulation," Johnson reports.

He cautioned that when using thermography, a contractor should test each area indicated as wet on the thermogram to make sure the "wet" reading "is not actually heat buildup from inside the building."

The wet reading could be the result of "hot lights, a boiler system or a parapet that absorbs heat during the day and emits heat at night," Johnson says.

Bill Stender, maintenance manager for G.D. Searle Co. in Skokie, Ill., hired ECC to conduct an infrared survey of two built-up roofs.

"With nuclear, a section in the middle of the grid could be wet and we wouldn't know," Stender says. "Infrared gave us the whole picture." Stender recommends infrared surveys. "Thermography told us where the insulation was wet and how badly it was in need of repair," he says.

Mike Promen of Clark Roofing Co., Broadview, Ill., uses an electrical moisture detection device. After analyzing all three methods, he came to his own conclusions.

"Infrared is expensive, you have to use it at night, it's humidity sensitive and must be read by experts," Promen said. "Nuclear must also be read by experts, it's radioactive, gives a very slow reading, and reads only where it is placed."

The problem with the latter is that the reading picks up "anomalies." "An anomaly, such as too much asphalt, could interfere with an accurate reading," Promen says.

With his handheld and larger size electric capacitance meters, Promen and an assistant can survey a roof in 20 minutes to an hour, depending on the size of the area, he claims.

"You don't have to grid or hire special personnel to operate and interpret the equipment," Promen says.

Fricklas also has an opinion on the three options. "All can give satisfactory results, all have limitations and all must be verified by a physical means," he said. "Verification is the critical step." Fricklas recommends that roofing contractors should be familiar with all three types.

Like the infrared method, data from a nuclear survey must be interpreted by experts.

"Contractors should know what [the surveys] can and cannot do if called in to do a repair job after a building owner had a survey conducted," he said.

Full-service contractors

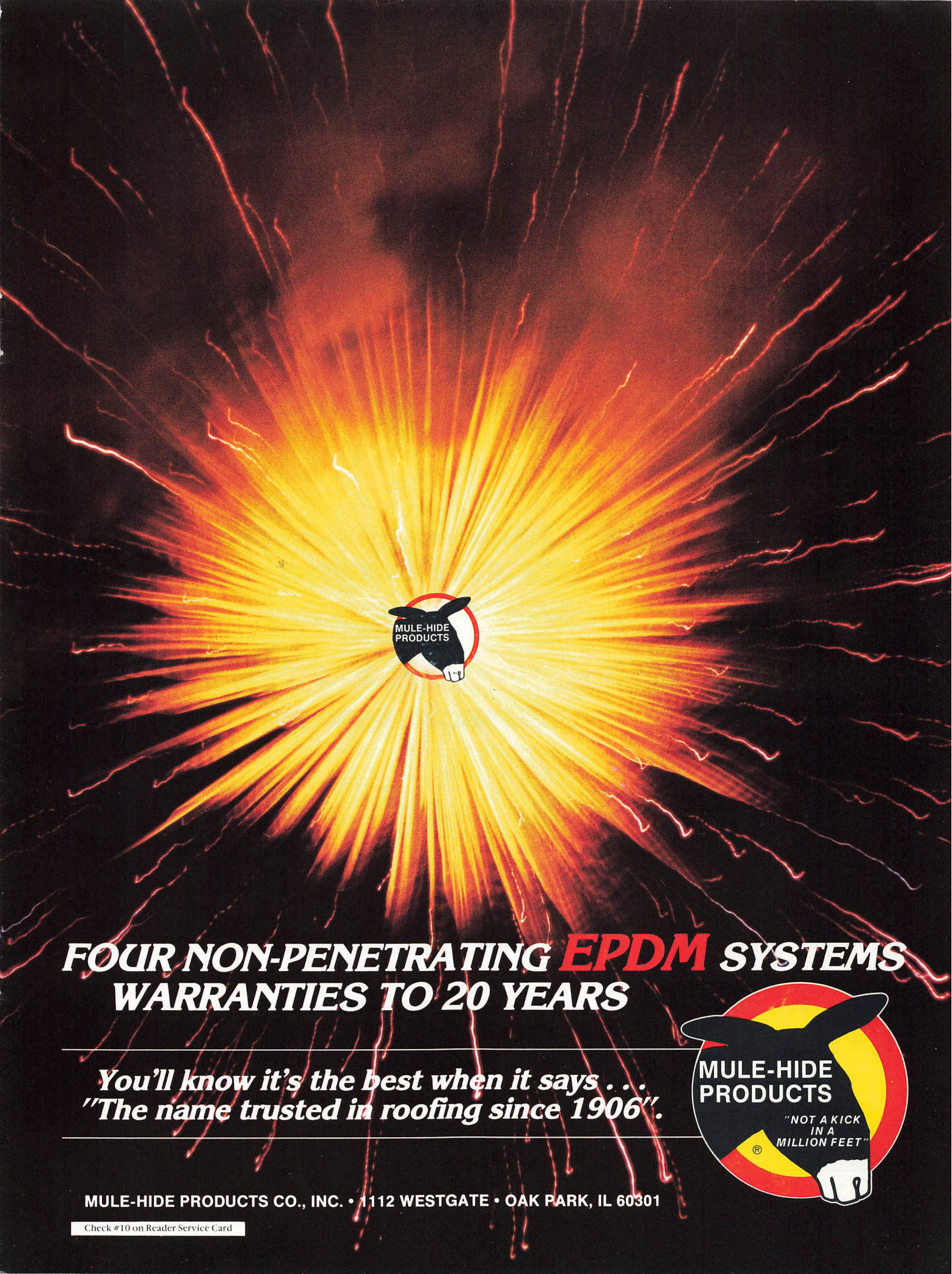
Some believe that nondestructive moisture detection is a good addition to the roofing contractors' preventive maintenance plan.

"It's an impressive tool," Promen said. "Until recently, you had to tear off at least the top layer of the roof" if wetness was suspected, he says.

In any event, all roofing contractors and others interested in roofing surveys should study each method, its benefits and limitations, before purchasing equipment or hiring a service.

Whether the selection is infrared, nuclear or electrical, the last word is verification—preferably by core sample test cuts.

"Core sampling is messy and time-consuming, but if the survey is not verified, you're not converting good data to good information," Fricklas said.



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Maintenance programs help keep roofs in shape

The adage "an ounce of prevention is worth a pound of cure" is particularly apt in the roofing business. Building owners are discovering that money spent on preventive roof maintenance can help them postpone or avoid costly roof replacements, even if the roof has just been installed. One way some owners have found to make sure roof maintenance is performed on a regular basis is by contracting with a roofing professional for regular roof inspections and minor repairs. Roofing contractors have also found these preventive maintenance programs valuable for maintaining a lifeline to clients with yearly and long-range roofing needs.

"Preventive maintenance is regularly scheduled inspections and timely corrective actions on problems discovered," explains John Bradford, a Montana contractor who has developed very successful maintenance programs for his clients. "We're talking about how to manage roofs, rather than be victimized by them."

Bradford emphasizes the importance of careful recordkeeping to a successful maintenance effort. He says the following initial questions should be answered as the contractor develops a file of historical documents for a building: Who was the architect? Who was the general contractor? Who was the roofing contractor? When was construction completed? Where are the original plans and specifications located? What was the design load of the roof structure? What was the specification of the original roof system? What is the specification of the current roof system? What type of roof deck was used? What kind of roof insulation was used and what is the thermal value? Is there a current guaranty on the roof system? What is the history of repairs and reroofing? What is the access to the roof?

Bradford emphasizes the importance of careful recordkeeping to a successful maintenance effort.

California contractor Gaylord Blue answers many of these questions during an initial roof survey. "We walk on the roof, noting general conditions," said Blue. "Then we take aerial photos, measure the roof and have a roof plan drawn up of the building, indicating the location of equipment on it. Next, we take photos of the problem areas. Then we make roof cuts and identify what kind of roof the owners have, and determine, if we can, how many roofs are on the building."

Other maintenance program paperwork includes a small-scale roof plan, inspection forms, a calendar of inspection dates, a work order system, surveys, contracts, and promotional brochures.

"Probably the most used document in each master file is the small-scale roof plan," Bradford comments. "It's used to indicate the location of problems, and is included in reroofing specifications. The drawings should be of a size that can be reproduced on a standard office copying machine."

According to Blue, administering maintenance programs for several clients requires the contractor to index each job by month of inspection, by owner and by job name. "These files should show the scope of the work and the pre-agreed charges," he said.

Bradford's records are computerized. "We have a program that allows us to identify the point at

which additional maintenance is not economically feasible," he reports. At that point, Bradford will recommend reroofing.

Passing inspection

Bradford emphasizes the importance of regular inspections. He recommends that the contractor administering the maintenance program choose the intervals between inspections. Once these intervals have been set, however, the contractor must strictly adhere to them. The program fails if the contractor misses these dates, he warns.

The contractor determines the proper intervals between inspections by considering the type of roof system, the environment, the number of penetrations and the amount of abuse the roof has suffered in the past, according to Virginia contractor John Van Wagoner. "Most preventive maintenance programs can be classified as annual or biannual," he says. His company's preventive maintenance contracts range from one to five years, depending on these factors.

Bradford recommends that the contractor administering the maintenance program choose the intervals between inspections.

Monte Upshaw, a California contractor, says some roofs may require frequent inspections. Rooftops that support a lot of mechanical equipment such as air conditioners may need biannual or quarterly surveys, he said. A roof on which there is little equipment, and that is located in a wide open space away from trees and leaf debris, may need to be inspected only once every 18 to 24 months.

Van Wagoner reports that some programs offer inspection services only; the building owner receives a written report that includes the repairs needed, but they are performed by another party. Other contractors offer repair-only agreements and

develop relationships with inspectors so that they are recommended for jobs.

Bradford says maintenance programs should be administered by companies familiar with roofing materials and practices. He claims that even though it may be common for organizations with large roof areas such as school districts to leave roof care to their maintenance crews, these workers generally look at the roof only when there's a problem. "Usually these people have no specific experience in roofing or there's one man who is in charge of mowing the lawn, repairing broken windows, etc., with no spare time to inform himself about roof maintenance," he said.

Upshaw says some roofs may require frequent inspections.

Programs make economic sense

Bradford believes that preventive maintenance programs are particularly valuable for large public institutions. "It's more cost-effective to extend the life of a roof on a $20 million project than to replace it. If you give a one-year extension on the roof's life, the owners are saving one-twentieth the cost of a new roof," he explained.

The Montana contractor brings preventive maintenance down to dollars and sense. "Consider a 40,000-square-foot area that originally cost $2.50 per square foot. The total cost was $100,000. If the roof lasts as long as the architect, the material manufacturer, and the roofing contractor designed it to last—a nominal 20 years—the cost per year would be $5,000.

"However, if no one looked at it for 10 years, then it failed and had to be replaced, the per-year cost would be $10,000. To put it another way, there would be a net loss of use of $50,000 if the roof lasts only one-half as long as it was designed for," he says.

"Preventive maintenance of roofs just has to be the most cost-effective program a building owner can have," he summarizes.

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Check #6 on Reader Service Card

A glossary of maintenance and reroofing terms

At times it may seem as if your roofing contractor is speaking a foreign language. Like any other profession, roofing has its own jargon to describe its materials, techniques and problems. Knowing a few basic terms may keep you from calling the police the next time your contractor tells you there's some flashing creep on your roof.

Alligatoring—the cracking of the surface bitumen on a built-up roof, producing a pattern similar to an alligator's hide; the cracks may or may not extend through the surfacing bitumen.

Bitumen—a semisolid mixture of organically derived hydrocarbons. Two types of bitumen are used in roofing—asphalt and coal tar.

Blister—a spongy, raised portion of the roof membrane, ranging from barely detectable rises to 1-inch-diameter bubbles. Blisters result when gases (air or water vapor) trapped in the roof system expand and push up the membrane.

Built-up roofing—often abbreviated as BUR. It is a roof membrane consisting of two to four plies of fiber glass or organic felts alternating with layers of bitumen and generally surfaced with gravel or a bitumen flood coat.

Creep—permanent deformation of the roof system caused by movement of the membrane. Creep occurs most often when the bitumen has been softened by warm rooftop temperatures.

Dead level—a perfectly flat roof surface.

Deck—the structural surface to which the roofing, waterproofing and insulation materials are attached.

Elastomeric—the term used to describe elastic, rubber-like materials. It is usually applied to synthetic rubber single-ply products such as EPDM.

EPDM—ethylene propylene diene terpolymer, a synthetic rubber that is manufactured in sheets and used as the waterproofing membrane in some single-ply installations.

Felt—usually made from organic fibers or fiber glass. Felts are saturated with bitumen and applied in alternating layers on a built-up roof.

Flashing—used to seal the edges of the roof membrane at walls, expansion joints, drains, gravel stops and other interrupted areas of the roof to prevent water leakage.

Membrane—a flexible or semiflexible roof covering that seals out water.

Pitch pocket—a flanged, open-bottomed metal accessory placed around columns, pipes or equipment supports, which penetrate the roof. The pocket is filled with hot bitumen and/or flashing cement to seal the joint. The use of pitch pockets is not recommended by NRCA.

Ply—a layer of felt in a built-up roof system; usually BUR contains three or four plies.

Pond—a roof area that is slow to drain.

Reroofing—the application of a roofing membrane or system over a previously roofed building.

Ridging—upward displacement of the roof membrane, usually occurring over joints or base sheet edges.

Roll roofing—smooth surfaced or mineral surfaced coated felts.

Roof assembly—a collection of interacting roof components, including the deck, insulation and the waterproofing membrane.

Single-ply—one of a collection of recently developed roofing materials that is installed in a single layer.

Slope—the tilt of a roof. It is expressed as the number of inches a roof rises per foot of horizontal run. The Asphalt Roofing Manufacturers Association ranks slope as:

level slope— up to 1/2 inch per foot
low slope— 1/2 inch per foot to 1 1/2 inches per foot.
steep slope— more than 1 1/2 inches per foot

Substrate—the surface that the roofing or waterproofing is installed on—the structural deck or insulation.

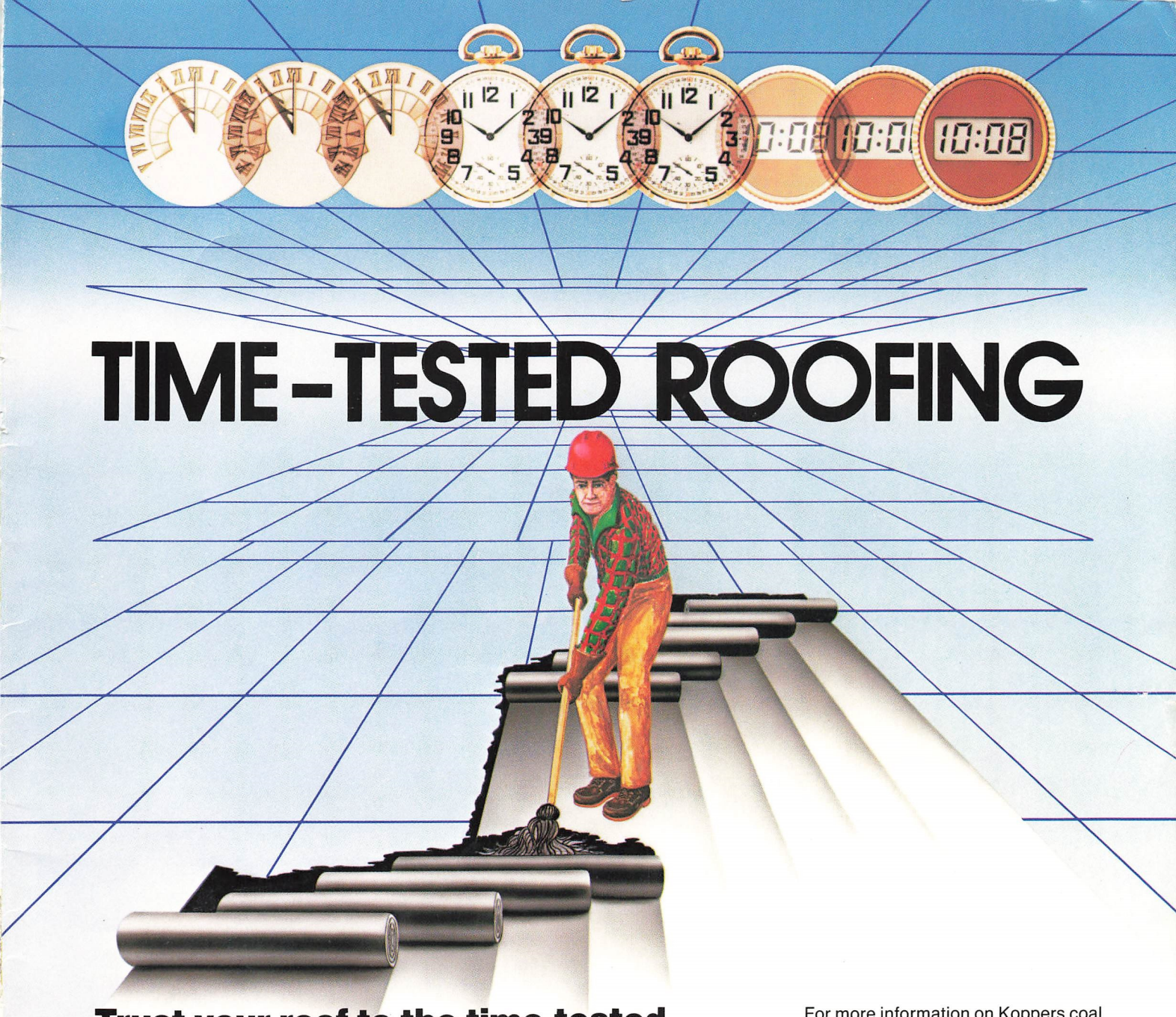
Test cut—a sample of a roof membrane, usually measuring 4 inches by 40 inches, that is cut from a roof system to determine its condition.

Thermal shock—stress produced by sudden roof temperature changes.

Underwriters laboratories (UL)—an organization that classifies roof materials by their fire resistance and wind uplift characteristics.

Vapor retarder—material designed to restrict the passage of water vapor through a roof.

Vent—an opening designed to allow water vapor to escape from the building or the roof assembly. It is usually covered with a metal cap to prevent moisture from re-entering.



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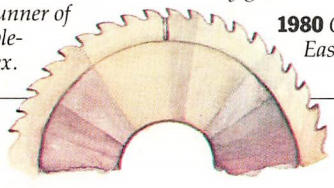
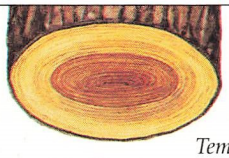
1893 *A new forest products supply company was formed in East Texas by T. L. L. Temple. It was the forerunner of Temple-Eastex.*

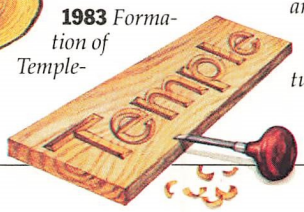


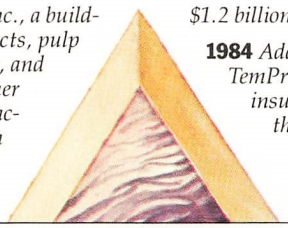
1958 *Expansion into the manufacturing of fiberboard products after 60 years of steady growth.*



1980 *Opening of the Temple-Eastex rigid foam insulation plant in Diboll, Texas.*

1983 *Formation of Temple-Inland, Inc., a building products, pulp and paper, and container manufacturer with $1.2 billion in sales.*





1984 *Addition of TemPro roof insulation to the company's product line.*

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