Ball Peen Hammer Test

HAAG ENGINEERING CO.

A HAAG Engineering Co. Publication

COMPANY PROFILE

Haag Engineering Co. is one of the oldest firms in this country specializing in the engineering analysis of failure and damage. Mechanical, civil, structural, chemical, electrical, aerospace, architectural, and meteorological specialties are represented on the Haag engineering staff. Services include determining cause and scope of damage, computing costs of repair, monitoring reconstruction, analyzing rework/restoration, performing laboratory and field testing, and testifying in litigated matters. Offices are located in Dallas, Houston, and Tampa.

Haag Engineering Co. serves a broad spectrum of clients including large and small private companies as well as corporations throughout the world, major insurance and adjusting companies, law firms and attorneys, and individuals.

Data developed by Haag Engineering Co. during laboratory testing programs and field studies have resulted in the publication and dissemination of information vital to persons involved in damage assessment, including a 20-year study of hail damage to cedar shingles and a 15-year study of hail damage to asphalt shingles. Other studies have been conducted on hail damage to various other types of manufactured roofing materials.

Ball Peen Hammer Test
Written by Tim Marshall, P.E. with
assistance from Scott Morrison, P.E.

Revised 2003

Compiled by Polly Lawler

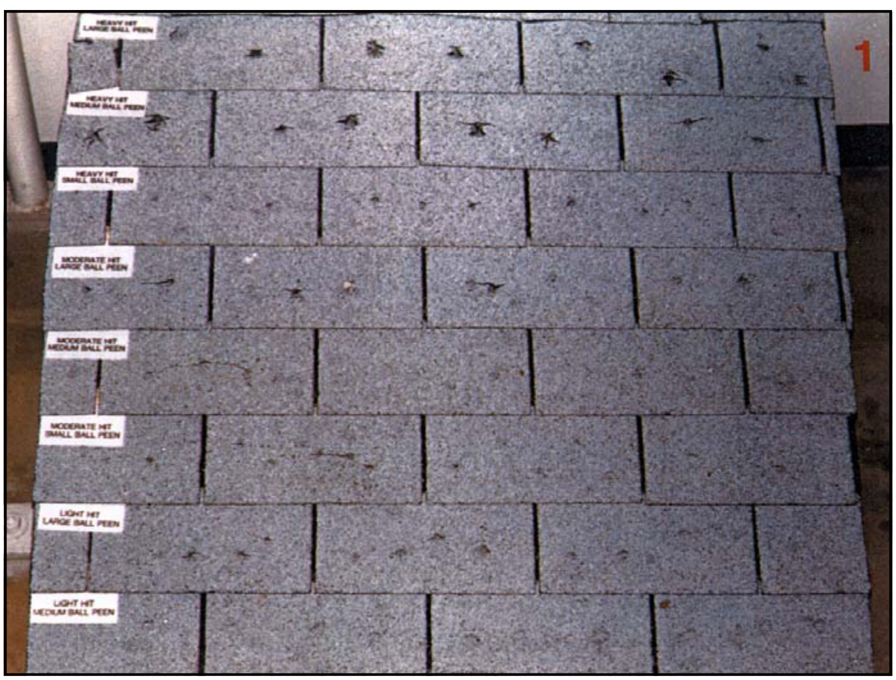
Haag Engineering Co. has conducted a study on the effects of striking ball peen hammers against red cedar and composition shingle roofing. The results of this study will assist roof inspectors in identifying roof damage uncharacteristic of that caused by hailstone impact. Haag Engineering Co. has been assessing hail damage to all types of roofing products for more than 60 years.

Testing

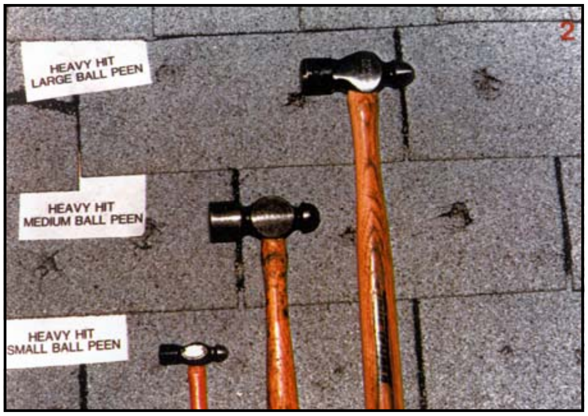
Test panels were constructed to simulate standard lightweight composition shingle and red cedar shingle roofs. Panels were constructed and new roofing applied according to recommendations by the Asphalt Roofing Manufacturers Association and the Cedar Shake and Shingle Bureau. Haag technicians selected three ball peen hammers (each a different size) to strike the test panels. Using each size of hammer, panels were struck with light impact (wrist action only), moderate impact (arm initially parallel to the roof), or heavy impact (arm above head). Results were documented by photographs and are summarized herein.

Composition Roof Panel

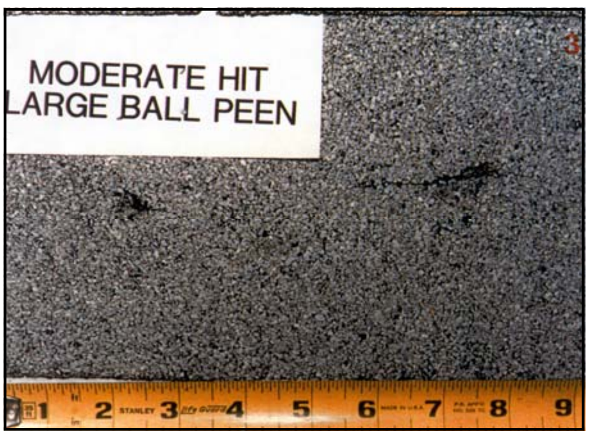
The composition roof test panel was four-feet square and sloped 4:12. Shingles were standard asphalt three-tab lightweight composition types covered with white-colored granules. Several hammer blows were struck on each tab using ball peen ends of the hammers. Refer to photographs 1 through 4.



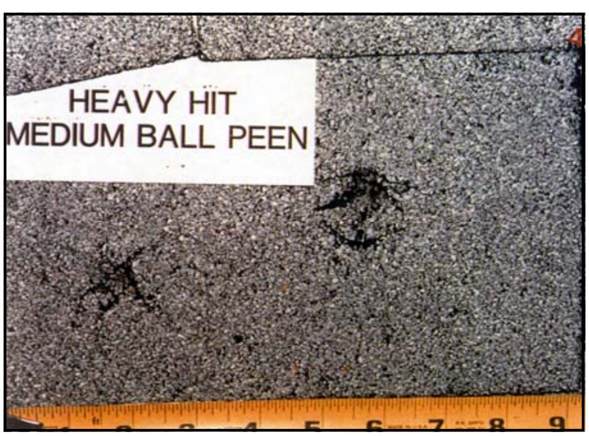
Photograph 1: Composition shingle roof panel



Photograph 2: Comparing ball peen hammer sizes



Photograph 3: Large ball peen, moderate hit



Photograph 4: Medium ball peen, heavy hit

Hammer impacts on the composition roof panel produced three distinct types of marks: rounded, star-like, or blemished.

1. *Round Marks* resulted from heavy blows of the hammers. Upslope portions of the impacted area were driven into the decking, whereas downslope portions were deformed downward. The marks appeared half-moon shaped with the deepest indentation on the upslope side. Granules were dislodged from along the impact perimeters. Granules were smeared or crushed to a powder along the upslope perimeter of the impacted area as well as within the area driven to the deck. Surfaces of the indentations were smooth. Collections of granules gathered on downslope rims of the indentations. Refer to photograph 5.

Photograph 5: Round Mark

2. *Star-Like Marks* occurred with heavy or moderate blows of the hammers. Cracks radiated outward from the impact point in a star-like pattern. The longest cracks were oriented near parallel to butts of tabs. Indentations recovered slightly in the relatively flexible tabs. Refer to photograph 6.

Photograph 6: Star-like mark

3. *Blemished Marks* resulted from light blows of the hammers. Marks were of similar size, shape, and depth. Granules were dislodged from around some of the impact perimeters.

Red Cedar Shingle Roof Panel

The red cedar shingle test panel also was four-feet square and sloped 4:12. Red cedar shingles were 18 inches long and approximately 1/2-inch thick at butts. Two or more blows were struck on each shingle using ball peen ends of the hammers. Hammer impacts on cedar shingles produced marks that were similar in size and shape. In all instances, interiors of the marks were noticeably shiny.

1. With *Heavy Blows*, the ball peen end of all three hammer sizes dented and split the shingles. Wood fibers were compressed most deeply in centers of the impact areas. Shingles split along the grain or were (in some cases) splintered coincident with dents. Refer to Photograph 7.

Photograph 7: Heavy hit, large ball peen

2. *Moderate Blows* dented the shingles but did not split the wood. However, bottom sides of the shingles exhibited splits that did not extend completely to the top (weathering) surface. Refer to Photograph 8.

Photograph 8: Moderate hit, heavy ball peen

3. *Light Blows* only dented the surfaces of the struck shingles and compressed the wood fibers at the area of impact. No splitting of the shingle occurred. Marks were similar in size and shape, and the wood inside each indentation was compacted similarly. Refer to photograph 9.

Photograph 9: Light hit, medium ball peen

DIFFERENCES BETWEEN HAIL AND BALL PEEN HAMMER-CAUSED DAMAGE

Naturally occurring hail has characteristics which results in damage distinctly different from hammer-caused damage.

1. *Geometry*– Hailstones vary in size, shape, and hardness. Thus, hail impact-caused marks on a roof have various sizes, shapes, and depths. Since hailstones range from irregular to spherical shapes, some hailstone-caused impact marks are irregular while others are rounded. Hailstone impacts do not crush or smear granules on composition shingles.

   Hammer inflicted damage results in impact marks of similar size and shape. Only much harder than ice materials such as metal inflicted dents in wood shingles where bases of dents appear shiny. Hard blows with a hammer crush and smear granules on composition shingles.
2. *Pattern*– The larger the hail, the fewer and farther apart hailstones fall and the farther apart the impact marks appear on a roof slope. Smaller sized hail tends to fall in greater quantities (and duration) than does larger hail. Thus, pea and marble size hailstones can be expected to strike almost every tab on a roof, whereas golfball size and larger hailstones strike (typically) several feet apart. The size distribution of hail is random. Thus, impact marks on the roof are random. Hail is not selective. Hail impact marks of varying sizes, shapes, and depths appear in metal vents, flashing,

and air conditioner cooling fins and in the same random patterns as on the rest of the roof.

Hammer-caused marks almost always are inflicted in distinct patterns. It has been our experience that hammer-inflicted damage typically appears at regular intervals, often one mark in the center of each composition shingle tab or wood shingle exposure. In many instances, no indentations are found in roof vents, chimney flashings, or air conditioner cooling fins. Shingles along rakes, eaves, ridges, and valleys also frequently are absent of indentations. Furthermore, some shingles may have several impact-damaged areas per tab or wood shingle, whereas a few feet away on the same roof slope, shingles are unscathed.

3. *Angle of Impact*– Hailstones usually are driven by the wind and strike the roof at a predominant angle from one direction. Thus, the windward roof slopes have a greater number and more severe impact marks than the leeward roof slopes. On roofs with steep pitches, windward-facing slopes can be heavily damaged while leeward slopes are virtually unmarked.

   Hammer-caused marks are the same size on all affected roof slopes. More importantly, the angle of hammer impact almost always occurs so that marks are deeper along upslope edges. Thus, on a two-sided gable, hammer impacts usually occur from two directions. On a four-sided hip roof, hammer impacts usually occur from four directions.

Summary of Ball Peen Hammer Results

Three types of marks occurred when shingles on the composition shingle roof panel were struck by the hammers: rounded, star-like and blemished. The sizes and shapes of the marks depended on the blow intensities, and shape and size of the ball-shaped peen.

Hammer-caused marks on the cedar shingle roof panel were of similar diameter (uniform in size), hemi-spherical in shape, smooth on the indentation surface, and with almost identical indentation angles. Splitting of the shingles and depths of the indentations were dependent on blow intensity. Similar test results have been achieved using claw and roofing hammers.

Additional information on hail effects to red cedar shingles can be obtained from Property Claims Services (800)888-4476, www.iso.com/products.

For more information on Haag's other publications, or to learn more about the variety of failure and damage consulting services and seminars offered by Haag Engineering Co., visit:

www.haagengineering.com

Offices

Dallas
2455 McIver Ln
Carrollton, TX 75006-6597
Fax 972-484-1821
800-527-0168

Houston
625 Sugar Land, TX 77478-2819
281-313-9700
Fax 281-313-9707
800-635-0116

Tampa
5706 Benjamin Center Dr. Ste. 114
Tampa, FL 33634-5262
813-901-0411
Fax 813-901-0311
800-218-8886

HAAG
ENGINEERING CO.

Failure and Damage Consultants Since 1924