

Do Hail-Caused Dents “Damage” Steel Roof Panels?

1st Edition



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Overview

Following a hail storm, adjusters, engineers, and roofing consultants are often brought in to inspect roofing systems. In instances involving galvanized steel roof panels, the term “damage” is often used (or misused) to describe conditions following a hail event. In reality, the consultant can tell you what happened to the roof and any impact the hail had on the material either visually or physically, but the word “damage” can be interpreted in many ways.

Merriam-Webster¹ defines damage as “Loss or harm resulting from injury to person, property, or reputation”. Further drilling down, they define loss as “destruction or ruin”. A legal evaluation of the meaning of these words is outside the scope of this paper. This paper is not intended to define “damage” or interpret insurance policy or contract language on what constitutes “damage”. Instead, this paper evaluates the conditions resulting from hail impact from an engineering perspective.

Evaluating Hail Impact to Steel Roof Panels

When evaluating hail impact to steel roof panels, there are three possible outcomes or conditions, which are as follows:

1. Hail did not cause any denting to the roof panels (i.e. small hail with low impact energy – hail not large enough to dent the steel).
2. Hail caused dents to the roof panels (i.e. hail large enough in size possessing sufficient impact energy great enough to change the appearance of the roof panels), with the hail caused dents resulting in no micro-fractures or loss of coatings.
3. Hail caused punctures or tears to the roof panels or hail was large enough to cause distortion and/or disengagement of the lap seams, either of which allow water to immediately penetrate the roof assembly. Or hail large enough to disrupt the factory applied coatings.

While outcomes #1 and #3 are more straightforward and may be more obvious with respect to an engineering conclusion or opinion, outcome #2 results in the most difficult condition to assess and requires greater material understanding and investigation by qualified individuals to confirm if the roof panels would require replacement.

In evaluating the roof panels to determine which category they fall into, we must first discuss how galvanized or Galvalume® coated steel roof panels are manufactured and the tests performed to meet material impact requirements.

¹<https://www.merriam-webster.com>

Galvanized Steel Roof Panels – Manufacturing & Impact Testing Requirements

Galvanized or Galvalume® steel roof panels start as steel coils that are dipped in a zinc-based coating. This process is known as “Continuous Sheet Galvanizing” or “Coil to Coil Galvanizing”. After the galvanizing process, the steel is coiled up and shipped to manufacturers for forming, or coaters for an application of a colored coating. Some contractors will purchase coils of the galvanized or painted steel for on-site manufacturing. An illustration of the steel coil coating process is depicted below.

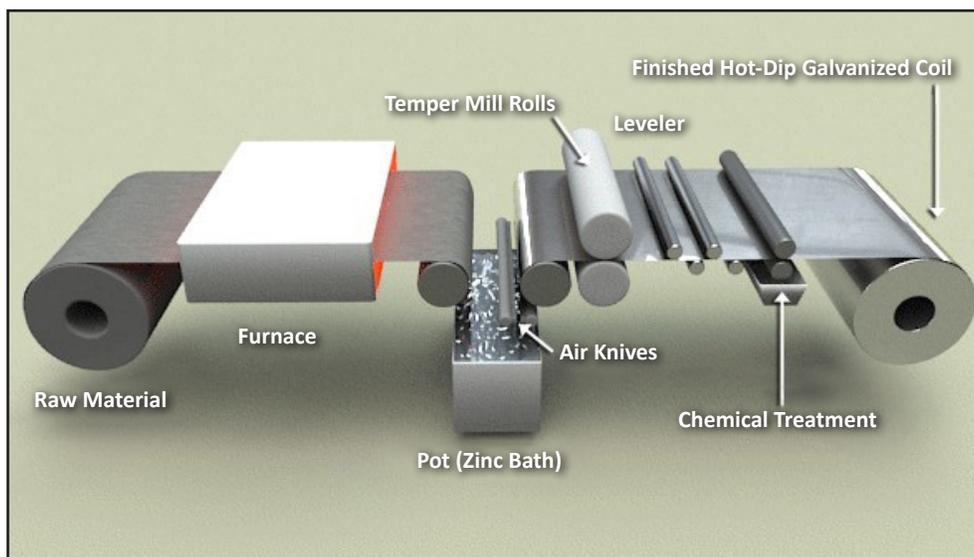


Figure 1 – Steel Coating Process. Illustration by Steel Dynamics.
<http://www.steeldynamics.com/The-Techs/Products/Process-Overview.aspx>

Continuously galvanized and painted steel coils are roll-formed and sheared to make desired profile and length roof panel. Roof panels come in numerous shapes and sizes. Some of these commercially manufactured steel roof panels pass a series of rigorous tests which allows them to meet impact test requirements of UL 2218.

The Underwriters Laboratories (UL) test—UL 2218, *Standard for Impact Resistance of Prepared Roof Covering Materials*, is a recognized standard for impacts against any steep-sloped roof covering. Roof coverings passing this test are given a classification of 1 through 4. The UL 2218 test standard uses steel balls ranging from 1.25 inches to 2.0 inches in diameter. The steel balls are dropped from heights of 12 feet, for the 1.25-inch ball, to 20 feet, for the 2-inch ball. Although this apparatus tests for impact resistance, not hail resistance, the impact of the steel ball simulates the impact energy of same-size, free-falling hailstones. The test assembly is struck with steel balls twice in the same target location.

To meet the acceptance criteria of UL 2218, the roof covering material exposed surface, back surface, and underneath layers must show no evidence of tearing, fracturing, cracking, splitting, rupture, crazing, or other evidence of opening through any prepared roof covering layer.

Dents in the steel panels with no evidence of tearing, fracturing, cracking, splitting, rupture, crazing, or other evidence of opening of the roof covering layer is considered to pass the test at each size steel ball. **Size and depth of dents are not criteria for failure of the test.** UL 2218 provides the following:

7.4 Cosmetic damage in and of itself shall not be determined to be a failure. Cosmetic damage such as denting, damage not extending through the cross-sectional area of a roof covering material layer, cracking of any paint finish, etc. shall not be determined to be a failure.

In short, roof panels can pass the UL 2218 standard with large dents at the impact areas. Most commercially available roofing panels pass the UL 2218 test and are typically rated as Class 4, which means they withstand impact energy from a 2-inch steel ball falling 20 feet (twice in the same location) with no damage to the panels.

What We Can Learn From Impact Testing

It is from this type of testing that we know steel roofing can withstand substantial deformation before the material is altered to such an extent that it allows any water penetration or shortens the service life of the roofing system. However, when hailstones possess the necessary impact energy, they can rupture (tear) the panels or cause disengagement of panel seams that result in immediate leaks.

What We Can Learn From Manufacturers' Warranty Statements

As stated previously, factory-coated steel coil is roll-formed into its final shape. In the case of standing seam roofing, the finished sheet steel is then folded/rolled at the seams to connect them together. Roll forming and seam folding can result in "micro-fractures" in the protective paint coatings. Manufacturers understand this condition and state in their warranties that "micro-fractures" are to be expected and are not detrimental to the performance of the coating. The warranty statement by MBCI (a prominent manufacturer of steel roofing panels) presents the following:

Microscopic crazing of the film on formed radii is considered normal and is not to be construed as film cracking.

Conclusion

From an engineering perspective, hail-caused dents in steel roof panels that **do not** disengage seams, compromise surface finishes, or alter the ability of the panel to shed water **would fall** under condition #2 and would be considered and reported only as physical alterations. Because micro-fractures are expected by manufacturers to exist in steel sheet roofing materials, it cannot be stated that the roof must be replaced simply because the hail impact caused micro-fractures. Accordingly, these condition #2 dents to roof panels would not typically drive an engineer to recommend replacement as the original design and use of the material has not changed. A more detailed analysis would need to be conducted if the hail impact resulted in changes to the panels in addition to micro-fractures, but not immediate leaks.

Testing and experience have shown that tears and punctures to steel roof panels can occur with hail starting around 2-1/2 inches in diameter. The design of the roof panel (thickness, profile, support conditions, etc.) plays a role in the severity of denting and the potential for disruptions at seams. For this reason, field inspections are necessary to evaluate the roofing system following a hail storm that causes dents in the roof panels.

As to the insurance policy and legal definitions of “damage”, we’ll leave that to Merriam-Webster and the lawyers.

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References

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