



United States Steel

Technical Bulletin Construction: **Storage Stain**

For further assistance on the use of steel building panels or related topics, contact U. S. Steel Construction Sales

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Storage Stain

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What is Storage Stain?

Metallic coated steel products, such as hot-dip galvanized and GALVALUME^{®1} Coated Sheet Steel, owe much of their excellent corrosion resistance properties to a protective oxide which is formed and replenished when their surfaces are exposed to freely circulating air. However, if the same surfaces are exposed to moisture for prolonged periods of time, in the absence of freely circulating air, white or black corrosion products begin to develop. Such conditions can occur when moisture is trapped between the laps of a coil of hot-dip galvanized or GALVALUME[®] Coated Sheet Steel. The same conditions can also occur when moisture is trapped between the stacks or bundles of improperly stored formed panels at a construction site. The ensuing white, black or intermediate gray corrosion products are commonly referred to as storage stain.

Figure 1 shows an example of a black storage stain on a roof panel. Figure 2 shows an example of white rust storage stain on a hot-dip galvanized coil. Staining can also occur when moisture permeates between a strippable film and the metal coating. This unique “worm tracking” pattern is a combination of black and white corrosion product as shown in Figure 3.

Once the storage stain is formed, it is very difficult to remove. It is not only aesthetically unappealing, it can also indicate permanent damage to the integrity of the products depending on the amount of time the product has been stored under the improper conditions. The only practical option is to prevent storage stain from occurring in the first place.

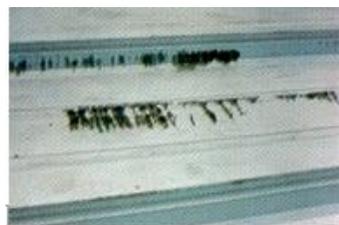


Figure 1. Black storage stain on a GALVALUME[®] roof panel.



Figure 2. White rust on the surface and sidewall of a galvanized coil.



Figure 3. Stain on a GALVALUME[®] roof panel under strippable coating.

Preventing of Storage Stain in Coils

To prevent storage stain, manufacturers of galvanized and GALVALUME[®] Coated Sheet Steel use two basic principles: prevent water from penetrating the laps of coils and reduce the corrosive effect of moisture should it penetrate the coil laps.

¹ GALVALUME[®] is an internationally registered trademark of BIEC International, Inc. and some of its licensed producers.

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Moisture is prevented from damaging the surfaces of coated steels in coil form by a variety of methods including:

1. Passivation Treatment

A chemical treatment is applied to the surface of coated steel products, which chemically reduces the reactivity of the coated surface with moisture. Such treatments significantly extend the storage life of coated steel products when they are stored under adverse conditions, but it cannot indefinitely prevent the occurrence of storage stain. In addition, the passivation treatments cannot always be used if the product is to be subsequently painted.

2. Oiling

The application of oil to the surface of coated products during manufacture prior to coiling is also effective in reducing moisture penetration. Two types of oils are used: slushing oils and vanishing oils. These oils generally also contain corrosion inhibitors, which can slow the effects of moisture during storage. They also provide lubrication during subsequent forming operations. Vanishing oils are often used for construction products since they are designed to evaporate during manufacturing.

3. Edge Sealers

These are more viscous oils or greases applied to the side-walls of steel products after coiling to prevent moisture from entering between the coil laps.

4. Packaging

Coils are wrapped in tear resistant, waterproof paper wrapping for transportation and storage. The papers often contain vapor phase corrosion inhibitors (VPI), which are volatile at ambient temperatures and are slowly released from the paper, and then penetrate the laps of the enclosed coil along with any water vapor that might also be present and reduce its corrosive effect.

5. Storage

If the temperature of a steel coil is lower than the dew point of the surrounding air, water from the surrounding air will condense on the surfaces of the coil. This is a condition known as "sweating". The mass of a steel coil is capable of condensing large quantities of water under such conditions. This water can penetrate the laps either by capillary action or by high humidity air penetrating the laps and subsequently condensing water on surfaces between coil laps.

Therefore, it is important to store coils of coated steel products in controlled environments so that the dew point of the ambient air is always below the temperature of the coils being stored.

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Storage and Handling of Formed Panels

Formed panels are normally stacked and bundled for shipment and storage. This also introduces conditions for storage stain if enough care is not taken in the packaging and storage of these bundles.

Paper wrapping should be used to protect the bundles of material from dirt and moisture. Plastic or other non-breathing material should not be used for wrapping bundles because these materials prevent air passage and tend to trap moisture in the bundle. The top wrapping sheet of each bundle should lap **over** the bottom paper, to prevent rainwater from entering the bundle (see Figure 4). All panel bundles should be accompanied by a tag or other listing that clearly describes each bundle's contents.

Each bundle should be inspected upon receipt, and any damage, corrosion or wet material must be noted on the delivery documents. Wet material should be dried according to the panel manufacturer's instructions. Panels and accessories should not be stored in a wet condition.

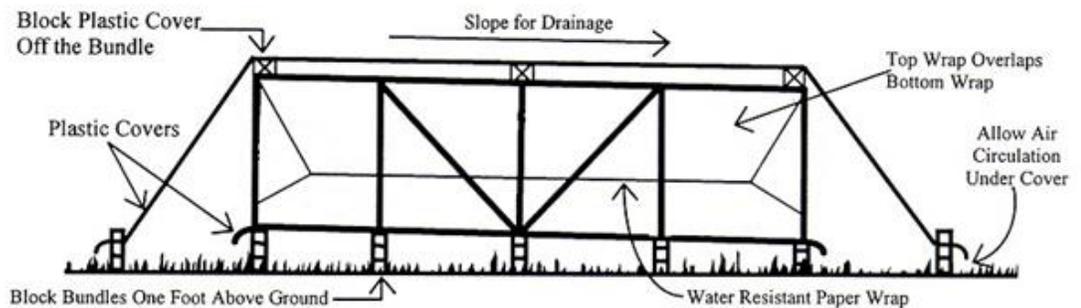


Figure 4. Proper Storage of Building Panel Bundles at Job Site

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Storage at the Job Site

It is recommended that panel bundles be stored under a roof whenever possible. If panel bundles are stored outside, the following list of requirements should be adhered to:

1. The storage area should be reasonably level and should be located to minimize handling of bundles during the construction process.
2. When storing on bare ground, place a plastic ground cover under the bundles to minimize condensation on the panels.
3. Store bundles at least 12 inches above ground level to allow air circulation beneath the bundle, and to prevent rising water from entering the bundle.
4. Elevate one end of the bundle slightly to permit runoff of moisture from the top of the bundle or from between nested panels. Water-resistant paper will not provide long-term resistance to moisture penetration from puddled water on top of the bundle. A waterproof cover should be placed over the bundles, with allowance for air circulation under the cover (see Figure 4).
5. Inspect stored bundles daily and repair any tears or punctures in the water-resistant wrapping with a compatible waterproof tape.
6. Re-cover opened bundles at the end of each day to prevent entry of moisture.

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Summary

1. Storage stains are white or black corrosion products formed while the hot dip galvanized or GALVALUME® Coated Sheet Steel is in a coil form or in a tight stack.
2. Long term exposure to water or moisture in an oxygen deprived environment can cause storage stain.
3. The most common sources of storage stain are when the steel is in a coil or a bundle of panels. Any time a portion of the steel is exposed to moisture and deprived of oxygen, storage stain can occur.
4. Storage stain should be prevented because it is very difficult to remove without affecting the appearance and/or the performance of the products.
5. Passivation treatments (chemical treatments) can be used to resist storage stain. However, the chemical treatment should not be used on the galvanized products that would be subsequently painted.
6. Oils may be applied to prevent water from reaching the metal surface, thus retarding the appearance of storage stain.
7. To prevent stain while the steel is in a coil, several steps can be taken:
 - Use a climate-controlled storage area
 - Wrap in VPI paper
 - Use edge sealers
 - Use First-In, First-Out inventory control
8. To prevent storage stain in a bundle of stacked panels, take the following steps:
 - If possible, store under a roof until use
 - Keep the bundle 1 foot off the ground
 - Slope the bundle
 - Cover the bundle
 - Keep a plastic sheet under the bundle
 - Allow air circulation around the bundle
 - Inspect the bundle daily for rips or tears
 - Re-cover partially used bundles
 - Use a conveniently located, level storage area

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