

GALVALUME®

COATED STEEL



Construction
Roofing
Cladding and Siding
Pre-Engineered Buildings
Appliance and
Automotive Parts

GALVALUME® is a metallic coated carbon steel product that has proven its superior performance as a corrosion resistant building material in extended field testing in a diverse range of environments. The GALVALUME coating is an alloy composed of 55% aluminum and approximately 45% zinc by weight. It is applied on both sides of cold-rolled steel sheet using a precise continuous hot-dip process. The result is highly corrosion-resistant coated steel that combines the barrier protection and extended durability of aluminum with the galvanic protection of zinc. GALVALUME has gained wide acceptability throughout North America due to its versatility, ease of use, aesthetics and long-term performance.

GALVALUME®

Product Offering

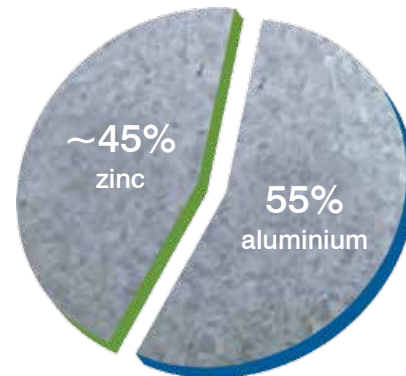
Cleveland-Cliffs offers two categories of GALVALUME products:

- **GALVALUME®** coated steel sheet for unpainted applications. This is usually supplied with chemical surface treatment and oiled with vanishing or slushing oil.
- **Prepainted GALVALUME®** steel sheet is an organic coated steel that is coil coated as specified, with a wide assortment of proven paint systems and attractive, long-lasting baked-on colors.

Advantages of GALVALUME® coating

GALVALUME offers the following advantages over galvanized steel:

- At least twice the corrosion resistance of traditional galvanized coatings of similar thickness under the same exposure conditions
- Excellent corrosion protection at cut edges
- A distinctive appearance, with a smooth, fine spangle and silvery metallic appearance
- Exceptional solar reflectance, resulting in lower energy load on buildings and improved interior comfort
- High temperature resistance



The GALVALUME coating is an alloy composed of 55% aluminium and approximately 45% zinc by weight.

Product Characteristics

PROVEN CORROSION RESISTANCE, LONG SERVICE LIFE EXPECTANCY

GALVALUME sheet steel is intended for uses requiring superior, long term corrosion resistance. GALVALUME performs outstandingly well in North American regions subject to acid rain and harsh winter conditions. The excellent corrosion resistance of GALVALUME has been proven by outdoor exposure tests and confirmed through extensive field evaluations of actual buildings.

Atmospheric tests using flat coupon samples were conducted over 36 years in the USA and 17 years in Canada. The tests covered a variety of environments ranging from rural to severe marine. Based on these tests, GALVALUME steel sheet can be expected to provide at least twice the service life of traditional zinc-coatings of similar coating thickness under the same exposure conditions.

While service life expectancy will vary depending on the environment of exposure and the type of installation, GALVALUME can generally be expected to provide at least 35 years of performance before requiring major maintenance, and is projected to have a service life between 40-60 years in industrial and rural environments, based on long term data from actual building installations.

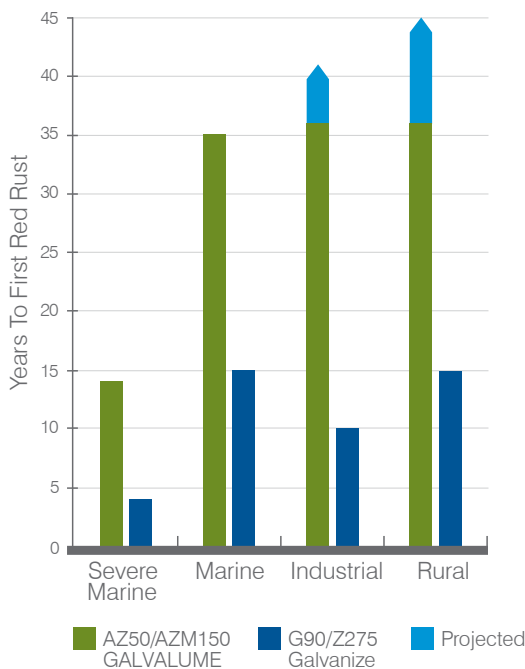
SUPERIOR CUT EDGE PROTECTION

The GALVALUME coating provides exceptional cut edge corrosion protection of the steel substrate by providing a long-term barrier against corrosive elements. The aluminum and zinc in the coating combine to prevent corrosion at exposed edges. The zinc component of the GALVALUME coating provides galvanic cut edge protection, while the aluminum component remains as a continuing barrier to corrosion.

GALVALUME provides galvanic protection of bare edges in all environments, whereas aluminum-coated (aluminized) steel edge protection is limited to marine environments.

While galvanized steel may exhibit less corrosion and red rust at cut edges compared with GALVALUME in the short term (<10 years depending on the environment), the zinc coating will deteriorate more rapidly at edges and on the surface of the steel component beyond this timeframe. This advantage over galvanized steel has been well documented from inspections of plain (bare, unpainted) and prepainted roof inspections on buildings up to 25 years old. The greater corrosion protection of GALVALUME will provide longer service life, especially in the more corrosive acid rain and coastal regions of North America.

SERVICE LIFE (YEARS TO FIRST RED RUST)



Source: Bethlehem Steel Flat Coupons Exposures of equal coating thickness.



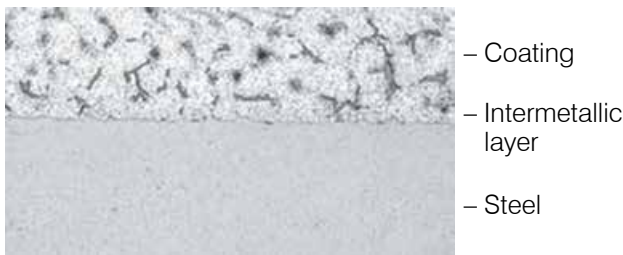
UNIQUE APPEARANCE AND MICROSTRUCTURE

Cleveland-Cliffs GALVALUME sheet steel has a distinctive silvery metallic appearance, with a smooth, uniformly distributed spangle. From an aesthetic perspective, the spangle and gentle sheen of unpainted GALVALUME offers a very desirable appearance. The spangle size will typically vary from very small to as large as 3/8 in. (9.5 mm) in diameter.

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The coating makeup is a duplex microstructure that results from the aluminum-rich phase solidifying first, as the coating cools, forming a network of dendrites. Interdendritic spaces are filled by the zinc-rich phase. The intermetallic layer is an Al-Fe-Zn-Si alloy that metallurgically bonds the coating to the steel substrate and further aids in corrosion resistance.

GALVALUME COATING METALLOGRAPHIC CROSS-SECTION (500X)



SOLAR REFLECTANCE/REFLECTIVITY

GALVALUME has undergone extensive testing by the Oak Ridge National Laboratory to determine its solar reflective performance. Test results have qualified GALVALUME as an approved roof product by the U.S. EPA – ENERGY STAR® Program, for both low-slope ($\leq 2:12$) and steep-slope ($>2:12$) applications.

On newly-manufactured GALVALUME, solar reflectance was rated above the minimum U.S. EPA requirement of 0.65. For weathered roofs over three years of age, the overall solar reflectance also exceeded the minimum U.S. EPA requirement of 0.50 for maintenance reflectivity.

HEAT RESISTANCE

GALVALUME steel compares very favourably with the more expensive aluminized steel for heat reflectivity, making it a practical alternative in automotive applications such as mufflers, tail pipes, heat shields and catalytic converters. Unlike galvanized steel, which begins to discolor at temperatures around 450°F (232°C), GALVALUME will not discolor in prolonged exposure to temperatures up to 600°F (538°C), and will continue to exhibit very good oxidation resistance up to 1250°F (677°C). Additionally, high temperature GALVALUME grades are available, which will not exhibit zinc embrittlement known to affect galvanized steel above temperatures of 572°F (300°C) over prolonged periods. As a result, GALVALUME is ideal for heat-sensitive range parts, toaster components and commercial grills, as well as gas heater parts, heat exchangers, chimneys and fireplaces.

FIRE RESISTANCE

GALVALUME is non-combustible and, consequently, does not burn, provide an ignition source or add fuel load that would enable a fire to spread or grow into a catastrophic event. When converted into building components, its noncombustibility and assembly fire ratings do not degrade throughout the entire lifecycle of a building. This provides a reduced fire risk to workers and occupants, minimizes the impact on municipal fire services, and results in less property damage and collateral damage to adjacent buildings if a fire should ever occur.

GALVALUME steel has an assigned flame spread rating of 0 and an assigned smoke developed classification of 0, which is the lowest in each respective rating category.

TABLE 1 – REFLECTIVITY AND EMISSIVITY VALUES FOR GALVALUME PRODUCTS

Product	Solar Reflectance (Initial)	Thermal Emissivity (E)	Solar Reflectance (3 Year)	Solar Reflectance Index (Initial)	Solar Reflectance Index (3 Year)
GALVALUME	0.78	0.08	0.58	75	34
Painted GALVALUME	INQUIRE (dependent on specified paint system)				

Customer Manufacturing

FORMABILITY

GALVALUME steel sheet can be readily roll formed, bent, stamped and fabricated. While not as formable as galvanized steel, the formability of GALVALUME is quite adequate for the majority of construction and manufacturing applications, and mainly becomes a factor when attempting to fabricate deep drawn parts or bending on a tight radius.

Additionally, Prepainted GALVALUME steel can also be roll formed without lubricants. The formability of Prepainted GALVALUME is dependent on the paint system that is specified. Additional details regarding the formability of Prepainted GALVALUME, as well as other typical properties and performance, are available in the Prepainted GALVALUME section.

GUIDELINES FOR WELDING GALVALUME

GALVALUME is routinely used in applications that require spot welding, seam welding or arc welding during fabrication. GALVALUME steel sheet can be welded similarly to other zinc coated sheet products. In general, the 55% aluminum-zinc coating is soft and less conductive when compared with uncoated steel, and therefore requires higher welding currents, welding times and electrode forces for resistance welding. The parameters used to weld GALVALUME are similar to those for galvanized steel.

SPOT WELDING

The electrodes used for resistance spot welding are made from copper alloy specified in the Auto/Steel Partnership (ASP) Randomized Lobe Test and Standard Procedure. The typical spot welding schedules for GALVALUME steel sheet products are shown in the table below.

TABLE 2 – TYPICAL SPOT WELDING SCHEDULE FOR GALVALUME

Material Thickness	Welding Current	Electrode Force	Welding Time Cycles	Electrode Face Diameter
Inches (mm)	(amperes)	Pounds (kN)	(1/60 second)	Inches (mm)
0.022 (0.56)	11,000	350 (1.56)	10	0.187 (4.75)
0.028 (0.71)	11,300	400 (1.78)	12	0.187 (4.75)
0.036 (0.91)	12,500	500 (2.23)	14	0.250 (6.35)
0.040 (1.01)	12,800	500 (2.23)	14	0.250 (6.35)
0.053 (1.34)	13,000	550 (2.45)	14	0.250 (6.35)
0.065 (1.64)	13,400	650 (2.89)	18	0.250 (6.35)

Note: Actual requirements will vary depending on the job conditions

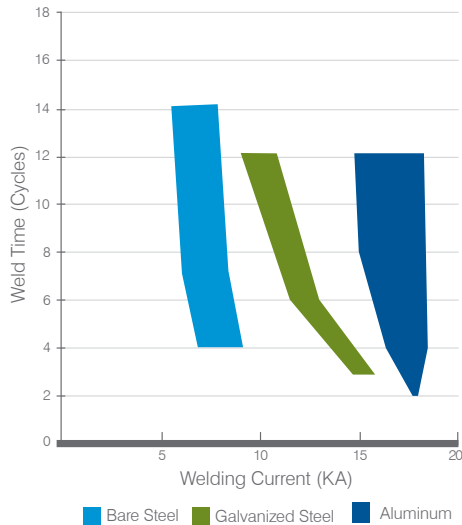
Electrode maintenance is also important in spot welding coated sheet products because the electrodes undergo gradual deterioration of the contact surfaces. This requires the electrodes to be “dressed” more frequently than with uncoated steel. In general, the electrode tips should be dressed periodically, depending on the sheet thickness and conditions of use. Additional factors influencing electrode life are tip alignment and sufficient water cooling of the electrode.

The peel test, which is commonly used as a measure of weld nugget size and weld soundness, can be used to test the quality of spot welds on GALVALUME sheet. Two coupons are welded together and then peeled apart. Under proper weld conditions, failure should occur around the weld, and not through the weld. The weld nugget diameter should approximate the diameter of the electrodes.

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A comparison of the welding lobes of GALVALUME versus other coated and uncoated sheet products are shown in the figure below. Note that the location and current range for GALVALUME is similar to galvanized steel.

WELDING LOBES FOR VARIOUS STEEL SHEETS AND ALUMINUM



SEAM WELDING

The conditions for seam welding GALVALUME steel sheet are similar to galvanized steels and require higher currents and closer control of welding schedules than for uncoated steel sheet. Intermittent current feed is preferred over continuous current and 0.5 in. (12.7 mm) radius faced electrodes can be used for all sheet thicknesses if desired. Scheduled for seam welding GALVALUME steel sheet are shown in the table below.

Seam welding wheels should be RWMA class 2 copper alloy. Knurled wheels are preferred because the knurled drive rollers continuously remove pick-up from the sheet coating and maintain a constant face width, thus eliminating the need for redressing. The electrode wheels in the weld area should be flushed with water during welding to provide adequate cooling.

TABLE 3 – SPECIFIED COMPOSITION

Material Thickness Inches (mm)	Electrode Face Type Inches (mm)	Electrode Thickness Inches (mm)	Electrode Force Pounds (kg)	Welding Current (amperes)	Weld Cycle Times		Welding Speed Inches m (min.)
					Heat	Cool	
0.017 (0.43)	0.5 (12.7) radius	0.375 (8.4)	700 (318)	14,500	2	2	60 (1.52)
0.022 (0.56)	0.5 (12.7) radius	0.375 (8.4)	850 (386)	16,000	3	2	60 (1.52)
0.034 (0.86)	0.25 (6.4) flat	0.5 (12.7)	1000 (454)	21,500	4	2	60 (1.52)
0.049 (1.24)	0.25 (6.4) flat	0.5 (12.7)	1100 (499)	22,000	4	2	60 (1.52)
0.049 (1.24)	0.25 (6.4) flat	0.5 (12.7)	1100 (499)	23,000	4	1	90 (2.29)
0.83 (2.10)	0.313 (8.0) flat	0.375 (8.4)	1600 (726)	27,000	10	6	30 (0.76)

Note: As with the spot welding schedules, actual requirements will vary depending on the job conditions.

ARC WELDING

Gas tungsten-arc (TIG) welding of GALVALUME sheet is not recommended because, as with galvanized steel sheet, fumes generated during welding tend to contaminate the tungsten electrode and cause instability of the arc.

Shielded metal-arc (MIG) welding is best accomplished using electrodes such as E6010, E6011 or E6012. A whipping technique is often used to burn off the coating ahead of the puddle weld.

For gas metal-arc (MIG) welding, a mild steel wire should be used with Ar/1% O₂ or Ar/O₂ shielding gas. Gas containing argon provides a more stable arc, resulting in better bead appearance and significantly less weld spatter. When a backup plate is used, the plate should be grooved under the weld to provide better penetration and venting of fumes from the underside of the weld.

WELD FUMES

The lower zinc content of GALVALUME sheet results in considerably less fuming (i.e., less zinc oxide) than with welding galvanized steel. The result is 95% less zinc oxide with spot welding under similar welding conditions. In arc welding, the total amount of evolved fumes per unit weld area for GALVALUME sheet is only 25% of the amount generated for galvanized steel. The decreased fuming of GALVALUME sheet represents a reduced fume hazard to welders, but still requires the use of fume hoods and/or forced air.

CORROSION RESISTANCE/PROTECTION OF WELDS

As is the case with other coated steel sheets, spot and seam welding may remove the coating from GALVALUME sheet exposing the base steel. These areas may be too large to be galvanically protected by the adjacent coating and should be covered with metal-sprayed zinc, aluminum-zinc, zinc-rich paint or organic coatings. Covering the arc welded area of exhaust systems is especially important because the damage to the coating is even more severe for this application.

SOLDERING

It is not practical to solder GALVALUME sheet in the field, therefore soldering is not recommended.

JOINING AND SEALING

Recommended fasteners to be used on GALVALUME steel sheet should have washers made of neoprene or a similar material. Fasteners containing lead or copper should not be used. Lead-headed nails and lead washers should also not be used on GALVALUME.

For sealing, neutral cure silicone sealants should be used. Sealants comprised of butyl rubber and styrene butadiene rubber are also acceptable. Sealants containing acetic acid or amines should not be used on GALVALUME steel. Check with your sealant supplier for brand name recommendations, as well as application, curing and clean up instructions.

Seams should always be mechanically fastened for strength. While the sealant does not require total adhesive strength, it must bond continuously to both surfaces. To ensure a complete sealant cure, the width of the sealant in lap should not exceed 1 in. (25 mm) when compressed. The steel thickness will dictate fastener spacing, but for flashing applications, 2 in. (approximately 45-50 mm) should be considered maximum.

PAINTING AFTER FABRICATION

The attractive silvery-matte finish of Cleveland-Cliffs GALVALUME is easy to paint after surface preparation similar to that for traditional galvanized steel. Experience indicates that no weathering is necessary. Surface preparation is critical when field painting or powder coating, since the GALVALUME coating is typically chemically treated (passivated). This typically involves first cleaning to remove dirt, oils and other contaminants, followed by rinsing, drying and applying a primer or pretreatment prior to the final paint coating. Paint manufacturer instructions related to surface preparation and painting of GALVALUME should be adhered to in order to ensure the best possible paint adhesion and resistance to corrosion.

HANDLING AND STORAGE

To preserve the surface, GALVALUME panels sheets or components should only be handled using clean, dry gloves. Do not slide sheets over rough surfaces or each other.

As with conventional galvanized steel, a discoloration known as “storage stain” may develop if moisture is permitted to remain between GALVALUME sheet cut lengths, coil wraps or nested fabricated components. This storage stain will appear as a dull black or dark grey discoloration. To avoid storage stain, bundles of GALVALUME steel sheets or products made from



GALVALUME steel in all finishes must be kept dry in transit. After transit, material should be covered and stored off the ground at a slight angle to prevent water or condensation from being trapped between adjacent sheet surfaces. If the bundles become wet, sheets should be separated, wiped with a clean cloth without delay and then placed so that air circulation completes the drying process. These procedures are recommended to avoid possible deterioration of the coating, which could result in a non-uniform appearance or premature corrosion.

INSTALLATION

During installation, at the end of each work day, it is essential that nails, rivets and debris be removed from areas like roofs, eaves troughs and valleys. As with galvanized and prepainted steel, corrosion of coating may occur when iron or copper-based materials are allowed to remain in contact with GALVALUME steel surfaces under moist conditions. Normal night/day condensation effects are sufficient to produce enough moisture to start the corrosion process.

Excessive foot traffic involving hard-soled shoes on bare GALVALUME roofs will cause the surface to become abraded, resulting in black burnish marks. While the dark areas are not defects and will not adversely affect product performance, they are visually apparent. Removal of the darkened area is not generally possible once the coating has become abraded. Provisions should be made for a properly designed and installed roof walkway system if regular foot traffic is planned.

For more technical information and guidelines for handling and installing GALVALUME steel sheet products, please refer to www.steelroofing.com.

Typical Customer Applications and Considerations

APPLICATIONS

Cleveland-Cliffs GALVALUME has many proven applications in commercial, industrial, institutional, agricultural and residential construction.

GALVALUME Applications	
Low-Slope Structural Roofing	Tubular Construction
High-Slope Architectural Roofing	Structural Steel Framing
Cladding and Siding	Solar Panel Frames
Quonset Buildings	Appliance Components
Pre-Engineered Steel Buildings	Automotive Parts
Building Accessories	Furniture
Gutters and Downspouts	Culvert and Drainage Pipe

Manufacturers and owners of steel building systems are demanding GALVALUME steel sheet due to its attractive appearance, superior corrosion resistance and heat reflectivity.

Prepainted GALVALUME steels are being used for roofing, siding and cladding applications. Prepainted GALVALUME sheet offers additional barrier protection from corrosion, as well as an attractive choice of colors. The proven strength qualities of steel sheet roofing and cladding – impact resistance, toughness, lightweight, wide spans – are retained when GALVALUME steel is used.

Cleveland-Cliffs GALVALUME is replacing galvanized steel in many residential and non-residential roofing applications. Its superior ability to resist the corrosive effects of standing water makes GALVALUME steel an improved roofing material when water ponding cannot be avoided. Similarly, GALVALUME sheet with a AZ70/AZM210 coating weight is listed in the CAN/CSA G401 (Corrugated Steel Pipe) standard as an acceptable coating for culvert applications and drainage systems involving long-term exposure to flowing and standing water and various soil conditions.

COMPATIBILITY WITH OTHER MATERIALS

All common and uncommon building or fabrication materials used presently with galvanized steel can be used with GALVALUME steel except for lead and copper, which, when in contact with GALVALUME, can result in accelerated corrosion of the coating in the contact area. Water run-off from copper should also be avoided, along with the use of lead-headed nails, lead washers or lead flashings. Cleveland-Cliffs also recommends

that GALVALUME not be used in contact with pressure treated lumber products that contain copper and other corrosive chemicals.

Bare and Prepainted GALVALUME steel sheets suffer rapid corrosion when in contact with mortar and concrete, especially during the curing phase. Exposure to these materials, and other highly alkaline materials and environments, should be avoided.

The rate of corrosion when GALVALUME is exposed to these materials increases with the severity of the environment.

GALVALUME and galvanized steel can be combined on the same building project, although it is not advisable for exterior applications, because galvanized steel will likely exhibit corrosion long before GALVALUME. As a design practice, when both materials are in contact, always use GALVALUME downstream from unpainted galvanized steel. Otherwise, accelerated drip corrosion of the galvanized steel can occur. Accelerated drip corrosion is premature corrosion of galvanized steel due to water run-off or dripping from a “less active” material onto a plain galvanized steel surface. Less active materials may include bare and Prepainted GALVALUME steel, prepainted galvanized steel, prepainted aluminum, glass, plastic, fiberglass panels and glazed tiles.

Additionally, when GALVALUME steel is used and underside condensation conditions are likely, zinc-coated or painted steel components should be used to avoid contact with any bare steel.

Typical materials that can be used in direct contact with GALVALUME steel	
Galvanized Steel (including Galvanneal and Eletrogalvanized)	Structural Steels; Purlins should be protected with an organic (paint) or metallic (zinc) coating
Aluminum	Nylon
Zinc	Rubber
Prepainted Galvanized Steel	Neoprene
Prepainted GALVALUME Steel	Prepainted Aluminum
Plastic	Glazed Tiles
Stainless Steel	Fiberglass Panels
Wood	Glass

ATTRIBUTES RELATED TO AGRICULTURAL APPLICATIONS

GALVALUME has been used extensively for many years as a material for roofing and cladding in the construction industry. GALVALUME is also the material of choice for a wide range of agricultural buildings. Both Plain and Prepainted GALVALUME are used for agricultural applications such as:

- Quonset/steel arch buildings
- equipment storage facilities
- barns for storing harvested crops and feed
- greenhouse, plant nursery and food processing facilities
- animal confinement buildings, excluding pig barns

Animal confinement buildings have been identified as very corrosive, due to the types of corrosive gases that are produced during the decomposition of animal waste and the high humidity conditions involved. In confinement buildings that house cattle, poultry or horses, GALVALUME can be used and will provide equal or better service life than galvanized steel with proper waste management, ventilation, insulation and building design.

There are a few applications for which GALVALUME (Plain or Prepainted) is not recommended and should not be used. These include bulk chemical fertilizer (potash) storage buildings, particularly in relatively humid regions, and pig barns. The environment in animal confinement buildings for pigs has been identified as severely corrosive for metals and is especially detrimental to GALVALUME.

If building products made from GALVALUME steel are intended to be used in unusually corrosive environments, please contact your Cleveland-Cliffs technical service representative for advice.

USE IN FOOD PROCESSING FACILITIES

In Canada, GALVALUME has been approved by the Canadian Food Inspection Agency (CFIA) as construction materials for use in food processing facilities. Several prepainted steel systems have also been evaluated against the CFIA and United States Dairy association (USDA) criteria for use as walls and ceilings of food processing plants and have been confirmed to meet all requirements. A list of these approved prepainted steel systems is available upon request from your Cleveland-Cliffs sales representative.

ENVIRONMENTAL SUSTAINABILITY

Steel is one of the most sustainable construction materials. Its strength and durability, coupled with its ability to be infinitely recycled without ever losing quality, make it truly compatible with long term sustainable development.

GALVALUME is durable and has up to a 60-year service life in certain environments, and therefore requires less maintenance, repair and replacement than other building products. The long service life of GALVALUME is endorsed by the Athena Institute and included in their Life Cycle Analysis (LCA) calculator.

Cleveland-Cliffs GALVALUME coated steel contributes to LEED (Leadership in Energy and Environmental Design) Green Building Rating System credits in a number of categories. GALVALUME coated steel contains pre-consumer and post-consumer recycled steel content. Additionally, aside from being fully recyclable, building panels and other construction components made from GALVALUME can often be salvaged and re-used.

GALVALUME roofing offers exceptional heat reflectivity properties, resulting in a lower energy load on buildings and improved interior comfort. An optimal choice for maximum energy savings, regardless of geographic location, is a Bare or Prepainted GALVALUME steel roof. GALVALUME's high reflectivity provides a benefit in summer by reducing the cooling load, and its low emissivity provides a benefit during winter by retaining heat and therefore reducing the winter heating load. As a result of its cool roofing properties, Bare and Prepainted GALVALUME steel can contribute to the LEED Urban Heat Island credit for low and steep slope roofing.

Warranties

Based on evidence of more than 30 years of exposure in the field, Cleveland-Cliffs warrants to the Buyer that GALVALUME steel sold for use as unpainted steel building products and exposed to normal atmospheric conditions, will not rupture, fail structurally, or perforate due to corrosion for a minimum of 20 years for AZ50/AZM150, 25 years for AZ55/AZM165 and 30 years for AZ60/AZM180.

Cleveland-Cliffs also warrants the AZ50/AZM150 GALVALUME product for 20 years and the AZ55/AZM165 GALVALUME product for 25 years when prepainted in accordance with prepaint industry standards.

The GALVALUME warranties by Cleveland-Cliffs are the result of proven performance in the field and extensive data from Research studies. The GALVALUME warranties are also available for buildings erected outside the United States and Canada. These warranties are subject to stipulations, limitations and conditions. Please contact a Cleveland-Cliffs Sales Representative if you require additional information.



Prepainted GALVALUME®

INTRODUCING THE BEST OF BOTH WORLDS: COLOR AND CORROSION RESISTANCE

The manufacture of Cleveland-Cliffs Prepainted GALVALUME steel starts with the GALVALUME substrate and its highly corrosion resistant 55% aluminum-45% zinc alloy coating. The coated steel then passes through one of many available modern continuous coil coating lines that carefully apply and factory-bake a broad range of paint systems.

Prepainted GALVALUME steel is made to rigid specifications, and quality-tested to meet the steel and GALVALUME coating requirements of ASTM A792/A792M. The paint system is applied to the paint manufacturers' specifications and tested in accordance with stringent standards recommended by the National Coil Coaters Association (NCCA).

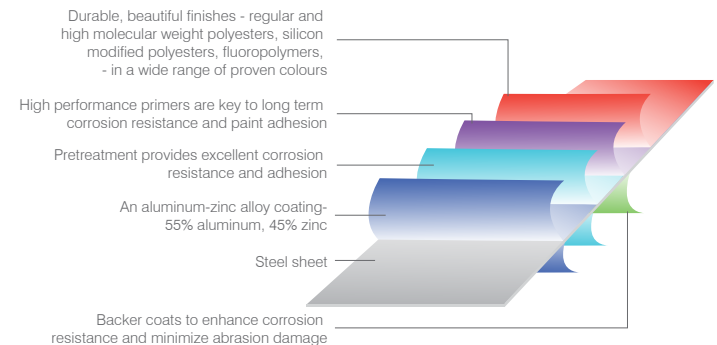
This combination of long-lasting GALVALUME sheet and modern high-performance paint systems results in durable, versatile, colorful and economical building products.

Architects, building designers, contractors and owners have turned to Prepainted GALVALUME steel because of design flexibility and long term durability, combined with a wide spectrum of colors, all of which enhance the appearance, life expectancy and value of buildings. Over 800 million sq. m. (80 billion sq. ft.) of Prepainted GALVALUME sheet covers buildings in all types of climates and environments in North America, Europe, Asia and Australia.

Prepainted GALVALUME comes with a factory applied, baked-on finish. Processing on a paint line includes

cleaning, followed by the application of a pretreatment, primer, and colorful finish coat, all in one continuous process. Typical paint systems include polyesters, silicon modified polyesters, polyurethanes and fluoropolymers (Kynar®/Hylar®). The unexposed side is typically pretreated and coated with a wash coat or backer coat. The following schematic of Prepainted GALVALUME sheet demonstrates these product features.

PREPAINED GALVALUME® SYSTEM



GALVALUME sheet, with its highly corrosion resistant 55% aluminum-zinc alloy coating, not only serves as the foundation for the paint system, but also provides long-term corrosion protection at edges, damaged sites, and tension bends. Building inspections have confirmed that GALVALUME's resistance to corrosion is at least twice that of galvanized steel of equivalent coating thickness.

Handling and Job Site Considerations

Building products made from Prepainted GALVALUME steel should be kept dry in transit and covered during storage at the job site. Bundles should be stored above ground, at a slight angle, to prevent water or condensation build up between adjacent sheets.

Please refer to *Prepainted GALVALUME® Sheet: A Guide To Best Practices* for advice regarding the following job site considerations:

- transit abrasion
- removing installation debris
- field cutting sheets
- compatibility with other building accessories
- insulation
- joining and sealing
- use of strippable films

To obtain a copy of this best practice guide, contact Cleveland-Cliffs or visit www.steelroofing.com.

Prepainted GALVALUME® Advantages

Creativity is enhanced when designing projects using a vast palette of colors, allowing buildings to stand out strikingly or to blend in and complement the surroundings.

Prepainted GALVALUME steel blends well with most other building materials. It is available in a variety of thicknesses and profiles, ranging from shallow corrugated to complex shapes, from standing seam to hidden fasteners, and from curved and foamfilled to flat-faced profiles.

This versatility allows it to be used to match or coordinate with textures and patterns produced by most other building materials, including exposed concrete, wood and glass curtain wall systems.

With the combination of field-tested paint systems and the superior corrosion resistance of GALVALUME coating, Prepainted GALVALUME steel has proven durability. Paint

systems have been developed and proven over the past 40 years across the entire spectrum of environmental conditions in North America, including the temperature extremes of the Prairies and corrosive acid rain, industrial and marine environments of the United States and Canada.

Prepainted GALVALUME steel is economical. It offers the economics of a lightweight structurally strong roll-formed product, allowing structures to be designed with efficient insulation packages and erected cost effectively any time of the year. Prepainted GALVALUME steel, with all its inherent advantages, is typically available at a similar price per square meter (same gauge) as prepainted galvanized steel. Creativity, versatility, durability, and economy – the proven reasons to choose Prepainted GALVALUME.

Maintenance

With a little care and attention during service, Prepainted GALVALUME sheet will provide extended service life. Although factory-applied, durable paint finishes for building panels will last many years, they should be cleaned thoroughly on a routine basis at least once a year. Applications where the paint finish is washed

by rain do not require this maintenance. For additional information on cleaning procedures and touching-up damaged paint areas, refer to *Prepainted GALVALUME® Sheet: A Guide To Best Practices*. To obtain a copy of this best practice guide, contact Cleveland-Cliffs or visit www.steelroofing.com.

Joining and Fastening

The table below provides specific recommendations regarding fasteners to be used with Prepainted GALVALUME sheet.

Rural Atmosphere	Moderate Industrial Atmosphere	Heavy Industrial or Marine Atmosphere
1. 300 Series stainless steel or 300 Series capped-stainless steel washer combination	1. 300 Series stainless steel or 300 Series capped-stainless steel washer combination	1. 300 Series stainless steel or 300 Series capped-stainless steel washer combination
2. Aluminum-zinc alloy cast or capped head used with neoprene-coated aluminum or Type 303 stainless washer	2. Aluminum-zinc alloy cast or capped head used with neoprene-coated aluminum or Type 303 stainless washer	2. Aluminum-zinc alloy cast or capped head used with neoprene-coated aluminum or Type 303 stainless washer
3. Nylon capped head over zinc coated carbon steel shank	3. Nylon capped head over zinc coated carbon steel shank	3. Nylon capped head over zinc coated carbon steel shank
4. 1.0 mil zinc coated steel, with additional organic or inorganic coating	4. 1.6 mil zinc coated steel, with additional organic or inorganic coating	4. 1.6 mil zinc coated steel, with additional organic or inorganic coating

Applications

Prepainted GALVALUME steel is ideal for a wide range of painted applications, especially when superior atmospheric corrosion resistance is required.

Applications such as pre-engineered buildings, architectural panels, roofing, siding, cladding and many other building components all benefit from Cleveland-Cliffs Prepainted GALVALUME steel.

Prepainted GALVALUME steel is available in a broad range of proven colors and a variety of proprietary and non-proprietary paint systems. Paint systems should be specified with assistance from Cleveland-Cliffs.

General Product Guide

Available Unpainted Products	GALVALUME® coated steel sheet
Industry Specifications	ASTM
Surface Treatment	Oiled (vanishing or slushing oil) Chemical treatment (passivated) and dry Chemical treatment (passivated) and oiled
Qualities	ASTM A792/792M <ul style="list-style-type: none"> • Commercial Steel (CS) • Forming Steel (FS) • Structural Steel (SS) - Grade 33 (230 MPa) to SS Grade 80 (550 MPa) • High Strength Low Alloy (HSLA) • Special Forming Steel • Helical Steel
Sizes Available	Thickness range: 0.0085 in. (0.22 mm) to 0.030 in. (0.76 mm) Width range: 24 in. (610 mm) to 49 in. (1245 mm)
Available Flatness	Standard ASTM ½ ASTM < ½ ASTM (inquire)
Standard Coating Weights	ASTM A792/792M AZ30, AZ50, AZ55, AZ60 and AZ70 (0.30, 0.50, 0.55, 0.60, and 0.70 oz/ft2 respectively) AZM100, AZM150, AZM165, AZM180, and AZM210 (100, 150, 165, 180, & 210 g/m2 respectively)
Coil I.D.	20 in. (508 mm) or 24 in. (610 mm)
Surface Quality	Ranges from standard to prepainted steel (critical) applications

A GUIDE TO COATING THICKNESS

GALVALUME AZ50 (AZM150) coating will provide at least twice the corrosion protection of galvanized coated steel with a G90 (Z275) zinc coating. The following chart shows the calculated coating thickness, based on nominal metallic coating weight per unit area and density. It is not a measured value, nor does it imply any type of specified limit.

MASS PER UNIT AREA AND CALCULATED THICKNESS

Coating Designation		Minimum Triple Spot Average (Total Both Sides)		Minimum Thickness (Per Side)	
Imperial	Metric	Imperial (oz/ft ²)	Metric (g/m ²)	Imperial (Mils)	Metric (Microns)
G90	Z275	0.9	275	0.77	19.7
AZ50	AZM150	0.5	150	0.80	20.4
AZ55	AZM165	0.55	165	0.88	22.5
AZ60	AZM180	0.6	180	0.96	24.5
AZ70	AZM210	0.7	210	1.12	28.6

Notes:

- (1) All calculated results have been rounded off to the last digit shown.
- (2) Calculated coating thickness results (total both sides) are based on the following relationships:
 Galvanized, 1 oz/ft² = 1.7 mils coating; 305 g/m² = 0.043 microns,
 GALVALUME, 1 oz/ft² = 3.2 mils coating; 305 g/m² = 0.083 microns



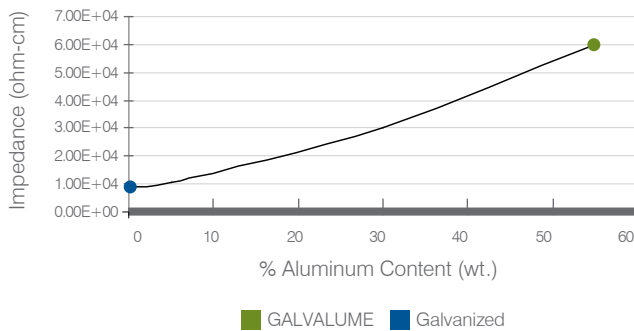
Frequently Asked Questions

Q: IS GALVALUME SUBSTRATE MORE PRONE TO RED RUST STAINING THAN ZINC-COATED (GALVANIZED) STEEL?

Steel can be protected from corrosion by providing galvanic and/or barrier protection. GALVALUME provides both methods of corrosion protection by providing zinc's galvanic protection and aluminum's long term barrier protection.

GALVALUME is a 55% aluminum-zinc alloy coating with higher electrochemical impedance than galvanized steel and therefore provides greater barrier protection.

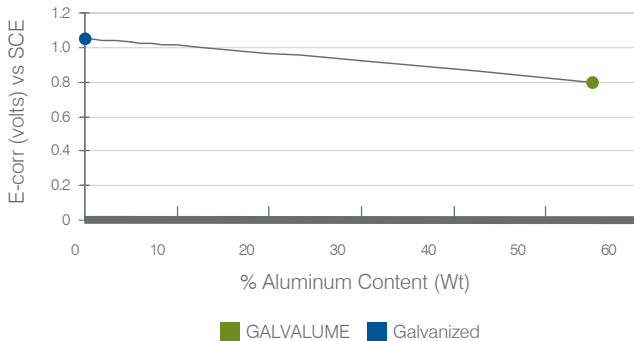
GALVALUME BARRIER PROTECTION VS GALVANIZED STEEL



Electrochemical Impedance of Various Aluminum/Zinc Alloy Metallic Coatings

Additionally, the galvanic protection level (corrosion potential) of GALVALUME is much lower than galvanized steel.

GALVALUME GALVANIC PROTECTION VS GALVANIZED STEEL



Corrosion Potential After 3 Years Atmospheric Exposure

However, like galvanized coatings, once the area ratio of exposed steel to metal coating thickness exceeds the critical protection level, corrosion of the base steel will occur.

The slower corrosion rate of GALVALUME will ensure that protection is maintained for a longer period than galvanized. The same corrosion protection against red rust offered by Plain GALVALUME is provided by Prepainted GALVALUME.

Q: DOES GALVALUME STEEL WEATHER IN A NON-UNIFORM MANNER COMPARED WITH GALVANIZED STEEL?

Metallic coatings weather by forming a thin oxide at the surface. The oxide will darken the appearance of the surface by absorbing incident light. The weathered appearance of metallic coatings will depend on the thickness, uniformity and type of oxide across the width and length of a steel sheet, as well as the exposure environment.

Passivation chemical treatments are applied to metallic coatings to retard the formation of oxides especially in wet nested conditions which accelerate corrosion. Without passivation, rapid oxidation will occur and form thick white and black corrosion products.

Passivation treatments are applied during the production of GALVALUME by flooding the strip with a solution of corrosion inhibiting chemicals followed by an air dry process. Although there are controls in place to achieve minimum and maximum levels, there are application limits that cannot precisely control the degree of passivation across the width, throughout a coil or from coil to coil.

Therefore the uniform appearance of weathered metallic coated steels (galvanized steel or GALVALUME) cannot be guaranteed. It is controlled by variables such as:

- the type of oxide that is formed;
- the thickness of the oxide;
- the application and performance of the passivation system;
- environmental conditions.

Q: DOES SPANGLE SIZE AFFECT THE APPEARANCE OF GALVALUME?

Unlike galvanized steel, GALVALUME has a spangle appearance which has made it attractive for many applications. The normal variation in spangle size can be visually apparent and therefore affect the overall appearance, but it does not affect the corrosion performance. It is technically beyond the capability of a continuous hot dip coating line to produce the same spangle size across the width and throughout the length of a coil, especially from coil-to-coil produced at different production dates. Although Cleveland-Cliffs uses current technology for process control in manufacturing GALVALUME, we cannot guarantee a uniform appearance of the coating.

Plain (bare) GALVALUME is specified because it offers the best combination of corrosion protection and value in comparison to other hot dip metallic coatings. For applications where uniform appearance is required, Prepainted GALVALUME should be specified.

Q: CAN PREPAINTED GALVALUME BE REPAINTED?

If maintenance repainting becomes necessary with the passing of time, Prepainted GALVALUME steel can be easily repainted with paints compatible with the original finish. Touch-up paints are also available that can be used to repair blemishes on prepainted steel components that have been scratched or damaged during handling and installation. These should be used sparingly and only on areas where paint has been removed, since misuse or over-use can spoil the overall appearance of a prepainted steel panel or component. For more detailed instructions regarding repainting and touch-up paints, please refer to *Prepainted GALVALUME® Sheet: A Guide To Best Practices*. To obtain a copy of this best practice guide, contact Cleveland-Cliffs or visit www.steelroofing.com.

About Cleveland-Cliffs Inc.

Cleveland-Cliffs is the largest flat-rolled steel producer in North America. Founded in 1847 as a mine operator, Cliffs also is the largest manufacturer of iron ore pellets in North America. The Company is vertically integrated from mined raw materials and direct reduced iron to primary steelmaking and downstream finishing, stamping, tooling, and tubing. The Company serves a diverse range of markets due to its comprehensive offering of flat-rolled steel products and is the largest steel supplier to the automotive industry in North America. Headquartered in Cleveland, Ohio, Cleveland-Cliffs employs approximately 25,000 people across its mining, steel and downstream manufacturing operations in the United States and Canada.



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