

ArcelorMittal Dofasco



Galvalume™

The Steel Product of
Choice for Superior
Corrosion Resistance





Galvalume™: A superior building material

ArcelorMittal 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.

Product Offering

ArcelorMittal offers three 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.
- **Galvalume Plus™** coated steel enhanced with a clear, organic coating, applied to both sides of the sheet. This improved product is oil-free, stain resistant, does not finger print or smudge and can be roll formed without additional lubricants.
- **Prepainted Galvalume™** steel sheet is an organic coated steel that is coil coated as specified, from a wide assortment of proven paint systems and attractive, long lasting baked-on colors.

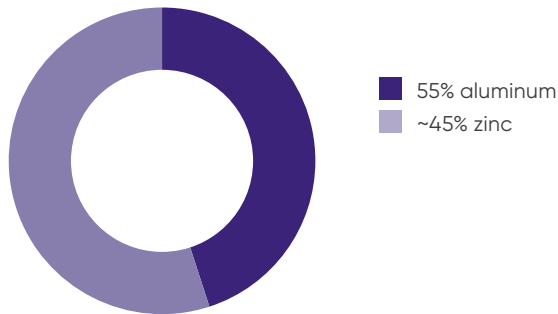
ArcelorMittal produces Galvalume™ coated steel sheet in Canada and is the exclusive producer for the country.

Advantages

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% aluminum and approximately 45% zinc by weight



Product Characteristics

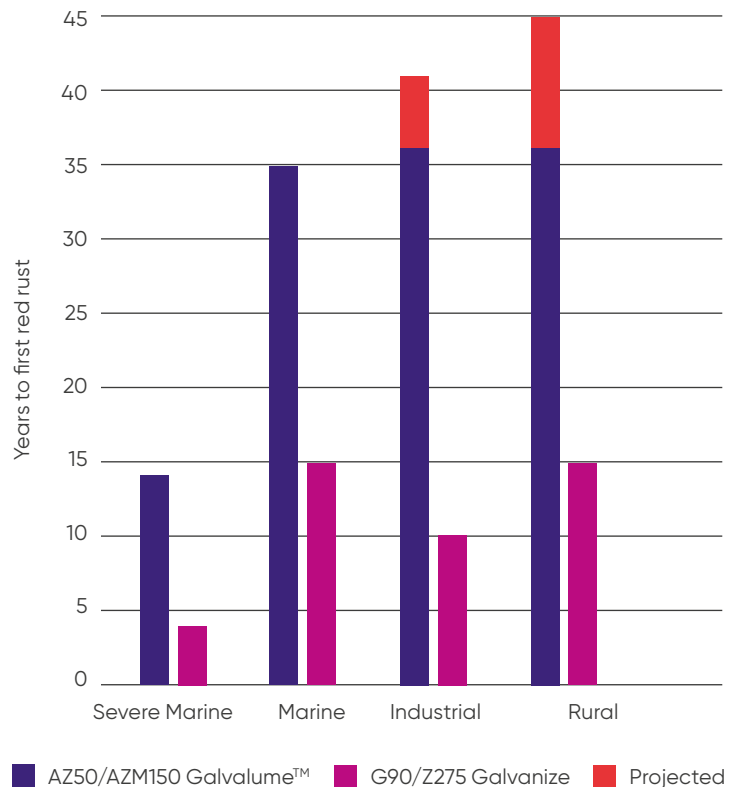
Proven corrosion resistance, long service life expectancy

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 40 years in the USA and 20 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.

Service Life (years to first red rust)



Source: Bethlehem Steel Flat Coupons Exposures of equal coating thickness

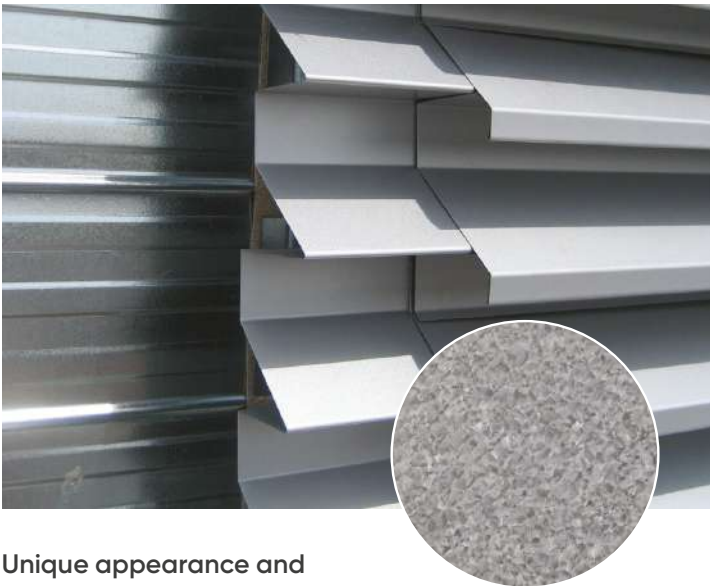
Superior cut edge protection

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.

Unique appearance

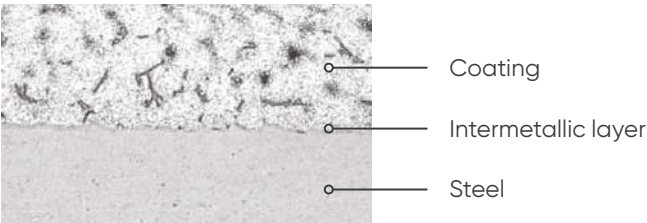


Unique appearance and microstructure

ArcelorMittal 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" (9.5mm) in diameter.

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

ArcelorMittal 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 (316°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 that is 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.

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)
AM Galvalume™	0.78	0.08	0.58	75	34
AM Galvalume Plus™	0.71	0.08	0.55	62	28
Prepainted 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, acrylic coated Galvalume Plus™ exhibits enhanced formability and corrosion resistance without the need for oils or lubricants. 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™ (and Galvalume Plus™)

Galvalume™ and Galvalume Plus™ are used in applications that require spot welding, seam welding or arc welding during fabrication. Galvalume™ steel sheet can be welded similar 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 and Galvalume Plus 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.

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.

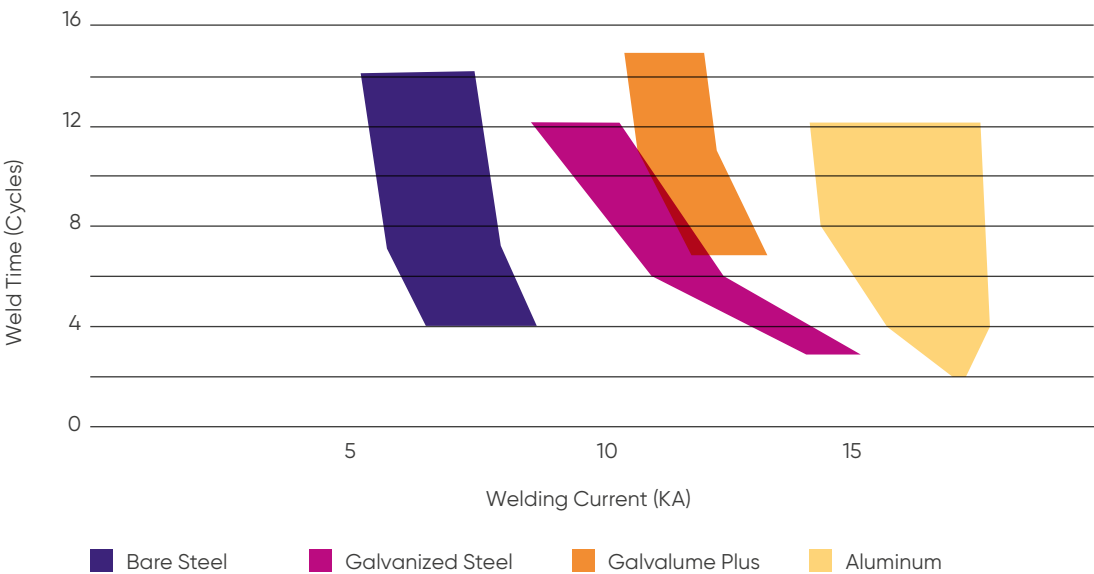
The peel test, which is commonly used as a measure of weld nugget size and weld soundness, can be used to test the quality of spot welds on Galvalume™ sheet. Two coupons are welded together and then peeled apart. Under proper weld conditions, failure should occur around the weld, and not through the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

Typical Spot Welding Schedule for Galvalume™

Material Thickness Inches (mm)	Welding Current (amperes)	Electrode Force Pounds (kN)	Welding Time Cycles (1/60 second)	Electrode Face Diameter 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

Welding Lobes for Various Steel Sheets and Aluminum



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

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 inch (12.7mm) 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.

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.

Typical Seam Welding Schedule for Galvalume™

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
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: Actual requirements will vary depending on the job conditions



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" (25mm) when compressed. The steel thickness will dictate fastener spacing, but for flashing applications, 2" (approximately 45–50mm) should be considered maximum.

Painting after fabrication

The attractive silvery-matte finish of ArcelorMittal 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 cleaning to remove dirt, oils and other contaminants, rinsing, drying and application of a primer or pretreatment prior to applying 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, handling of Galvalume™ panels, sheets or components should only be carried out 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.

ArcelorMittal strongly recommends the use of Galvalume Plus™ for customers having any issues or concerns associated with handling and storage of unpainted Galvalume™. This product provides excellent resistance to transit and field storage staining and effectively resists fingerprinting and smudging.

Installation

During installation, at the end of each work day, it is essential that nails, rivets, debris, etc. be removed from roofs, eaves troughs, valleys, etc. 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

ArcelorMittal Galvalume has many proven applications in Commercial, Industrial, Institutional, Agricultural, and Residential Construction.

Galvalume Applications	
Low-slope structural roofing	Construction tubular
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
Rain ware (gutters and downspouts)	Culvert and drainage pipe

Manufacturers and owners of steel building systems are demanding Galvalume™ steel sheet due to its attractive appearance, its superior corrosion resistance and heat reflectivity. Because it does not need to be oiled and is easier to handle, acrylic coated Galvalume Plus™ has become the preferred material for unpainted roofing, together with such accessories as ridge caps, roof ducts and rain ware.

Both Galvalume Plus™ and 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.

ArcelorMittal 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. ArcelorMittal also recommends that Galvalume™ not be used in contact with pressure treated lumber products that contain copper and other corrosive chemicals.

Bare and painted 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, e.g. 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 ArcelorMittal Technical Service Representative for advice.



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 40 years of exposure in the field, ArcelorMittal warrants to the Buyer that Galvalume™ and Galvalume Plus™ 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 40 years for AZ50/AZM150, 45 years for AZ55/AZM165 and 50 years for AZ60/AZM180.

ArcelorMittal also warrants the AZ50/AZM150 Galvalume™ product for 50 years and the AZ55/AZM165 Galvalume™ product for 55 years when prepainted in accordance with prepaint industry standards.

The Galvalume™ warranties by ArcelorMittal are the result of proven performance in the field and extensive data from R&D 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 an ArcelorMittal Sales Representative if you require additional information.

Use in food processing facilities

In Canada, Galvalume™ and Galvalume Plus™ have 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 ArcelorMittal Dofasco 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.

ArcelorMittal 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.

An Environmental Product Declaration (EPD) for roll formed panels using Galvalume™ has been completed and is available from ArcelorMittal in North America.



 ArcelorMittal

Galvalume™ & Galvalume Plus™

ArcelorMittal Dofasco G.P. provides this warranty to:

hereafter referred to as the "Buyer" ArcelorMittal Dofasco ("Dofasco") warrants to the Buyer that Dofasco's Galvalume Product when sold by Dofasco for approved Uses will not rupture or fail structurally, and will be free from Corrosion for a period after shipment from Dofasco's mill defined in Table 1, subject to the following provisions:

Galvalume™ and Galvalume Plus™

Table 1

Coating Weight	Period
AZM150 (AZ50)	40 years
AZM165 (AZ55)	45 years
AZM180 (AZ60)	50 years

Date

The Buyer (Name/Title)

ArcelorMittal Dofasco (Name/Title)

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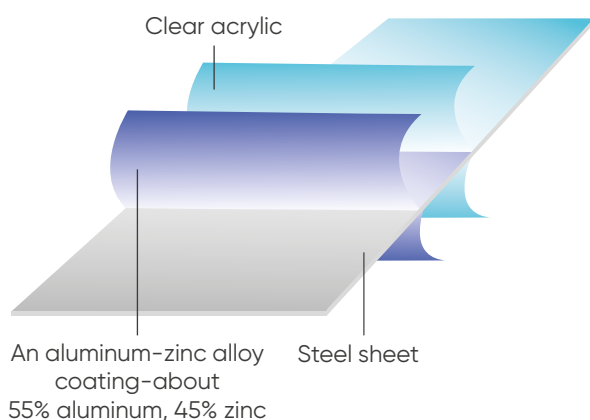
Galvalume Plus™

The proven solution for your unpainted roofing and siding

Galvalume Plus™ is a dry Galvalume™ steel product with a thin, clear organic coating applied on both sides of the steel as a final protective layer over the aluminum-zinc coating. Galvalume Plus™ provides a bright, attractive appearance and enhances the traditional look of Galvalume™. Because the resin coating is transparent, the standard surface appearance of the Galvalume™ substrate is unchanged.

As the final step in our continuous hot-dip Galvalume™ coating process, the clear, water-based organic coating is applied to both sides of the sheet using state-of-the-art in-line reverse roll coaters. The use of reverse roll coaters provides precise application of the organic film, assuring a uniform film thickness of approximately 0.04 mils (1 micron). The coated sheet then passes through an in-line drying oven where it is thermally cured. The transparent coating is flexible, provides excellent resistance to storage stains and has lubricating properties that provide superior roll forming characteristics. It is designed to run through roll forming operations without further lubrication and replaces the need for conventional passivation treatment and vanishing oil.

Galvalume Plus System



Galvalume Plus™ Advantages

The application of an organic coating eliminates the need for ArcelorMittal to apply conventional chemical treatment and vanishing oil. This enhancement offers our customers and users the following benefits:

Reduced costs

- Eliminates the need for roll forming lubricants, since the product is designed to be roll formed dry
- Lower maintenance costs – reduced coating build-up and reduced tool wear will extend die life
- Improved productivity – extended die life results in longer production runs
- Enhanced scheduling flexibility – eliminates the need for die clean-up prior to roll forming prepainted product
- Reduced energy costs for building owners – the bright appearance provides excellent solar reflectivity

Storage, handling and installation benefits

- Excellent resistance to staining during transit and field storage
- Reduces smudging and streaks associated with rolling oils
- Effectively resists fingerprinting and footprinting during installation

Improved safety

- Finished product is delivered to the job site dry, providing a safer, oil-free surface for workers

Applications

Galvalume Plus™ was developed for unpainted applications. The advantages of the resin coating adds to the list of reasons why Galvalume™ is the material of choice for unpainted roofing, siding, construction tubular, and other applications. Galvalume Plus™ offers strength, superior corrosion resistance, and an attractive bright appearance that provides excellent heat reflectivity. If color is specified, or if a silvery metallic appearance is desired over the long term, ArcelorMittal prepainted Galvalume™ should be used. ArcelorMittal's Galvalume™ coated steel sheet is available for applications in construction, transportation, appliances, and other manufactured products.

Availability

ArcelorMittal offers a full range of widths, thicknesses, coating weights, and steel grades. See the "General Product Guide" section of this document for specific details.

Prepainted Galvalume

Introducing the best of both worlds: color and corrosion resistance

The manufacture of ArcelorMittal 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.

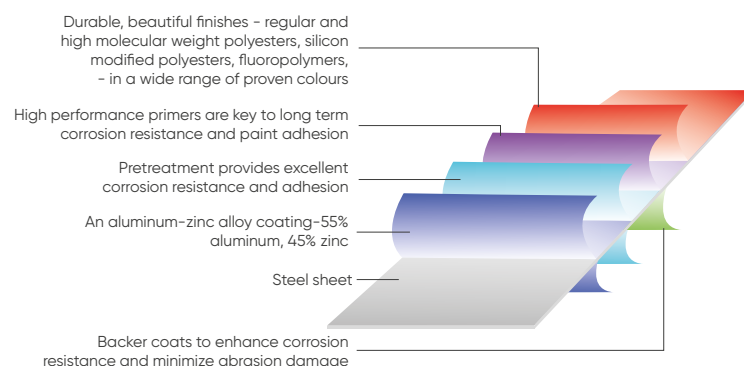
Prepainted Galvalume™ steel is made to rigid specifications, and quality tested to meet the steel and Galvalume™ coating requirements of ASTM A792/A792M. The paint system is applied to the paint manufacturers' specifications and tested in accordance with stringent standards recommended by the National 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 square meters (8.6 billion square feet) 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.

Prepainted 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 Pre-painted 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 ArcelorMittal or visit www.steelroofing.com.

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 Pre-painted Galvalume™ Sheet: A Guide To Best Practices. To obtain a copy of this best practice guide, contact ArcelorMittal or visit www.steelroofing.com.

Joining and fastening

The table below provides specific recommendations regarding fasteners to be used with prepainted Galvalume™ sheet.



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 foam-filled 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, on top of 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™.

Guidelines for Selection of Fasteners for Use With Prepainted Galvalume™ Steel Sheet

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



Prepainted Galvalume Steel Selection Guide

Paint Systems*	Silicon Modified Polyester	Very High Durability Polyester	PVDF 2-coat	Polyurethane
Benefits	Excellent Weathering	Excellent Weathering and Paint Flexibility	Very stable colors in hot and sunny climates	Good Weathering and Excellent Paint Flexibility
Weathering resistance	+++	+++	+++	++
Corrosion resistance (paint film barrier effect)	++	++	++	++
Hardness	+++	++	+	+++
Adhesion	++	+++	+++	+++
Flexibility (forming ability)	+	++	++	+++

*Paint systems currently offered by ArcelorMittal Dofasco/Baycoat

Galvalume™ Products - General Product Guide

Available Unpainted Products Galvalume™ coated steel sheet Galvalume Plus™	Available Prepainted Products Prepainted Galvalume™ Sheet
Industry Specifications ASTM, CSA	Paint System Options: • Silicon-modified polyester (SMP) • Polyesters • Fluoropolymer (PVDF) • Polyurethane (PU)
Surface Treatment Oiled (vanishing or slushing oil) Chemical treatment (passivated) and dry Chemical treatment (passivated) and oiled	
Qualities ASTM A792/792M • 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	Standard Coating Weights ASTM A792/792M AZ30, AZ50, AZ55, AZ60 and AZ70 (0.30, 0.50, 0.55, 0.60, and 0.70 oz/ft ² respectively) AZM100, AZM150, AZM165, AZM180 (100, 150, 165, & 180 g/m ² respectively) A non-standard coating designated AZ01 (AZM001) is also available, with no minimum coating weight specified.
Sizes Available Thickness range: 0.010" (0.25mm) to 0.091" (2.31mm) Width range: 24" (610mm) to 60.5" (1537mm)	Coil I.D. 20" (508mm) or 24" (610mm)
Available Flatness Standard ASTM ½ ASTM <½ ASTM (inquire)	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

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

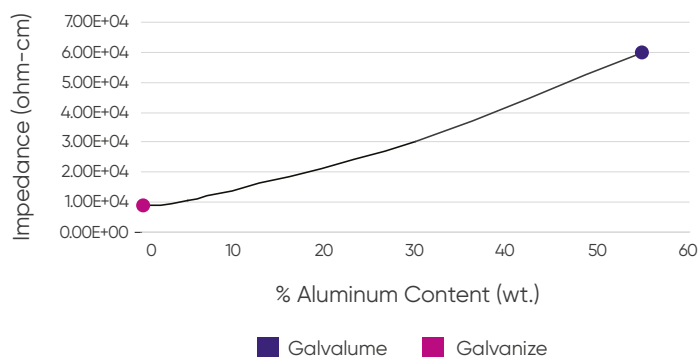
Frequently asked questions

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.

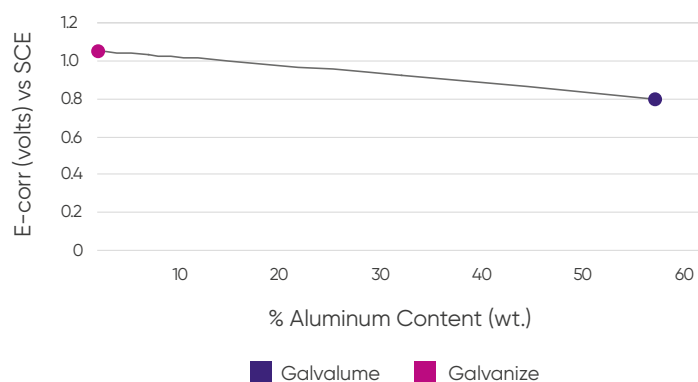
Galvalume Barrier Protection vs Galvanized Steel



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 Plus™ look different than regular Galvalume?



Galvalume Plus™ has the same attractive spangled appearance that has made the Galvalume™ coating the product of choice for many applications. The difference will be in the improved surface cleanliness of Galvalume Plus™ after roll forming and installation due to the protective coating and absence of roll forming lubricants.

The normal variation in surface appearance of bare Galvalume™ will not be masked by the organic coating. For critical appearance applications where uniform visual appearance is required, prepainted Galvalume™ should be specified.

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 ArcelorMittal 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 regular Galvalume™ and Galvalume Plus™ be used on the same building?

Even though both products have the same spangle appearance, the weathering performance of Galvalume Plus™ is superior. Therefore the two products should not be mixed on the same building. To minimize risk, the manufacturer and their distributors must take the necessary steps to keep inventory of the two products separate. The following are some suggested guidelines:

- Use the existing inventory of regular Galvalume™ for current projects until the inventory is depleted before processing new orders with Galvalume Plus™;
- Ensure that all coils have the appropriate ArcelorMittal (AM) tag that can be used to identify Galvalume Plus™ and keep the inventory of the two products physically separate. Maintaining a record of the tag/serial number is also required for warranty purposes;
- Do not stack coils or sheets of the two products together to avoid oil contamination of Galvalume Plus™;
- Identify all processed sheet bundles (flat or formed) with a clearly visible marking system that can be used to easily identify and distinguish the two products;
- Communicate the importance of not mixing inventory to all personnel involved in purchasing, operations, packaging, shipping and installation, including distributors.

Q: Are their applications where Galvalume Plus™ should not be used?

Similar to bare Galvalume™, Galvalume Plus™ is not compatible with lead or copper and should not be used in direct contact with, or subjected to, fallout or water run-off from these metals. Galvalume Plus™ can be used in contact with galvanized steel with complete safety.

Animal confinement buildings that house pigs have been identified as severely corrosive for metals and are also detrimental to Galvalume™. For this reason, Galvalume Plus™ or prepainted Galvalume™ should not be used for this application.

Galvalume Plus™ is not designed for high temperature/heat shielding applications, since exposure to these conditions would rapidly deteriorate the acrylic coating.

Q: Can lubricants be used with Galvalume Plus™?

Lubricants should not be used with Galvalume Plus™. Vanishing oils and other lubricating oils may chemically dissolve the acrylic film, which will affect visual appearance and lead to non-uniform weathering. If it is deemed necessary to use lubricants, suppliers should be consulted to ensure the lubricant is compatible with the acrylic coating. Additionally, a solvent rub test using a typical industry standard (e.g., ASTM D5402) should be conducted before and after the lubricating oils are applied to ensure the acrylic film has not deteriorated.

Galvalume Plus™ is designed to be roll formed dry, not only because oils can deteriorate the acrylic coating, but also because the addition of lubricating oils will result in a very slippery surface, and could adversely affect the safety of workers during roof panel installation.

Q: Will Galvalume Plus™ weather uniformly?

The organic coating applied to Galvalume™ will replace the chemical passivation system and the need for lubricating oils during forming. The technology is superior to conventional passivation systems. Therefore, it is expected that less variation in weathered appearance will occur with Galvalume Plus™ than regular passivated and oiled Galvalume™.

However, the organic coating will not mask normal variation in the surface appearance of Galvalume™ and a uniform weathering rate of Galvalume™ cannot be guaranteed. Therefore, for critical appearance applications where uniform visual appearance is required, prepainted Galvalume should be specified.

Q: Will Galvalume Plus™ provide better corrosion protection than regular passivated Galvalume™?

Accelerated corrosion tests and exposure in actual field conditions have demonstrated a significant improvement in resistance to surface corrosion staining of Galvalume Plus™ when compared to regular passivated Galvalume™. The benefit will be realized in potential storage stain conditions prior to installation. However, caution must be maintained to keep coils or bundled sheets dry at all times.

Q: Can Galvalume Plus™ be post painted/field painted?

Yes, Galvalume Plus™ can be painted in the field. For best results, consult with paint suppliers for their recommendation regarding surface preparation and choice of paint system. Additionally, a spot test for paint adhesion should be conducted using a standard industry test method (e.g., ASTM D3359). Suggested guidelines for painting Galvalume Plus™:

- Ensure surface is clean and dry
- Ensure that a lubricant has not been used in the roll forming or stamping operation
- Use two coats of high quality, water-based acrylic paint
- For enhanced corrosion protection, a water based acrylic primer may be considered for industrial or harsh environments.



Q: Can Galvalume Plus™ be fastened, joined or sealed similar to unpainted Galvalume?

Yes, the methods of fastening and joining Galvalume Plus™ are applicable to those for Galvalume™ and will likely not require any changes. When the use of a sealant or joining compound for the purpose of adhesive bonding is required, the product supplier should be consulted to ensure that the sealant is compatible with the Galvalume Plus™ acrylic coating.

Q: Does Galvalume Plus™ turn yellow from weathering?

Over time, the clear organic coating will disappear from weathering leaving the natural appearance of the Galvalume™ coating. The organic resin does not discolor or yellow during exposure as verified by ArcelorMittal during actual building inspections, outdoor exposure testing, and accelerated weathering and corrosion testing. A slight darkening and gloss reduction can be expected as with any metallic coating during weathering.

Q: Will the organic coating of Galvalume Plus™ extend the life expectancy of the Galvalume™ coating?

Galvalume Plus™ is comprised of a thin acrylic coating that will dissipate over time due to natural weathering. The acrylic coating provides superior resistance to staining during transit and field storage compared with conventional passivation systems, but it does not significantly impact the life expectancy of the Galvalume™ coating. The expected service life (time to red rust) of Galvalume™ would be extended by a measure of

months, rather than years, by specifying Galvalume Plus™. For this reason, the warranties for Galvalume™ and Galvalume Plus™ are the same.

Q: Is prepainted Galvalume™ more prone to paint blistering along cut edges than prepainted galvanized steel?

From the conception of prepainted Galvalume™ (early 1980s), extensive research has been conducted to investigate and evaluate pretreatments and primers suitable for Galvalume™. Screening and testing has been conducted not only throughout North America but also worldwide due to the global interest by pretreatment suppliers, paint companies and steel companies in utilizing the benefits of Galvalume™ as a prepainted substrate. The result has been approved pretreatments, primers and well-defined process controls to optimize corrosion performance along cut edges. The benefit has been superior long term corrosion performance along cut edges, damaged sites and tension bends as compared to G90/Z275 galvanized substrate.

The improved performance has been validated by actual building inspections conducted in United States and Canada. The results have demonstrated that prepainted Galvalume™ will exhibit less paint blistering and red rust on cut edges and outperform prepainted galvanized steel with similar coating thickness by at least four times in buildings >15 years old.

The improved performance is realized due to the combined galvanic protection and barrier protection properties of Galvalume™. The Galvalume™ coating provides a long lasting physical barrier for protection of the steel and support for the paint system. In contrast, the more active galvanized (zinc) coating is consumed through its galvanic protection of steel until it is depleted. This action is initiated at cut edges or damaged sites and continues at a linear (uniform) rate to a point when the steel substrate is left unprotected and red rusting occurs.

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 *Pre-painted Galvalume™ Sheet-A Guide To Best Practices*. To obtain a copy of this best practice guide, contact ArcelorMittal or visit www.steelroofing.com.

Smarter steels for people and planet

ArcelorMittal is one of the world's largest steel and mining companies. Guided by a philosophy to produce safe, sustainable steel, it is a leading supplier of quality steel products in all major markets including automotive, construction, energy, household appliances and packaging. ArcelorMittal is present in more than 60 countries and has an industrial footprint in more than 20 countries.

With a strong presence in North America, Europe, South America and South Africa, and an emerging presence in China, ArcelorMittal delivers a large scale of products, solutions and services to customers with the same quality focus in all regions. ArcelorMittal is a leader in steel technology, both in the breadth and depth of our product portfolio, and in our ability to supply a range of grades throughout the world. ArcelorMittal is a supplier of choice for all markets, a testament of our commitment to working collaboratively with our customers to engineer advanced steel grades to meet their needs.



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