The CSI INTENT
Pikes Peak Chapter
The Construction Specifications Institute
October, 2016 Volume 48, No 2

This Month's Program:

The Future of Green is Clear—Wednesday, October 26

InPro Corporation

Presents

"The Future of Green is Clear"

An AIA accredited program.

See page 2 for program details

SPEAKER : Monty Crandon / Six Sigma Green Belt
Senior Regional Sales Director

Monty Crandon has been with Inpro for 10+ years. Most recently as the Sr. Regional Sales Director for the Western United States, and now in a new role as the Sr. Director of Specifications and In-Field Development. Monty brings an extensive amount of knowledge in all 6 divisions of Inpro (Door and Wall protection, Expansion Joints, Wayfinding, Solid Surface material, Window treatments and Elevator cab systems). In addition Monty has a broad understanding of the construction process and the challenges it brings along with solutions.

Date: Wednesday, October 26, 2016
Time: 11:30 a.m. to 1:00 p.m.

Southside Johnny's
528 S. Tejon Street
Colorado Springs, CO 80903

No cost to Pikes Peak Chapter members
Please RSVP to Greg Gulliksen at
(719) 473-7225 or
gog@csnaarchitects.com by noon on
Monday, October 24

528 SouthSide Johnny's

InPro Corporation
AIA CES Provider Number: H294
Program #: IPC1020
Credits: 1 LU

IDCEC CEU-103128 – 0.1 CEU HSW

USGBC – 910000119 – 1.0 CE Hour

Title: The Future of Green is Clear

Course Description

When it comes to building products in the ever-evolving field of sustainable design and construction, the industry is moving beyond simple tallies of things like recycled content and certified wood products. While still valuable measures, they are taking a back seat to declarations of the products' impact on planetary and human health. Said another way, the design community is now expecting a much more encompassing view of a product's sustainability.

Taking a cue from Europe, America is turning an analytical eye to the life cycle impacts of products through Environmental Product Declarations (EPDs). Concerns over chemicals used in the millions of products going into buildings are driving the creation of Health Product Declaration (HPDs) in order to inventory substances and potential impacts on human health.

As if to cement their place in the evolution of sustainability, the USGBC codified EPDs and HPDs as credit worthy in its recently ratified Version 4 rating systems. Endorsement of these Declarations by the world's leading sustainable building organization is testimony to the documents' status as the go-to "bibles" on product content and impacts. This course discusses how we got here, and what lies ahead.

Learning Objectives

- Explore the history and background of the EPA's Toxic Substance Control Act (TCSA), Red Lists, and the rise of the Transparency Movement.
- Be able to define the Environmental Product Declaration (EPD) creation process, and identify the EPD's key measurements.
- Be able to define the Health Product Declaration (HPD) creation process, identify the HPD's key measurements, and contrast the HPD to the EPD.
- Master how these Declarations are a key component of the Material & Resource credit structure in the U.S. Green Building Council's LEED® v4 rating system.

Fall always seems to fly! We're now mid-October, which means that we've got Halloween at the end of the month, followed three weeks later by Thanksgiving, Christmas right after that and then we're in a new year! And to top it off, we've got a very important election coming in less than a month!! As busy as this time of year is, I hope you will all make time to join us for our monthly Chapter meetings because we've got some great presentations coming up. This month we have Becky Parnell from InPro presenting "The Future of Green is Clear". With all the focus on sustainability in our industry, this should be a very interesting presentation.

I want to once again thank Bobbie Jo Kinsey from American Tile & Stone and Phil Koester and Richard Anderson from Triton Watertight Systems for their wonderful presentation last month on Triton's watertight shower systems. I was very impressed with the shower system and love the idea that everything ships together in one package, and who doesn't love the idea of the square drains! What I loved most though, was how interactive the presentation was. I loved all of the great questions and discussion we had throughout the presentation. For those of you that were not able to attend, or anyone that would like more information on the Triton Watertight Shower System, please make sure to view their YouTube video at https://www.youtube.com/watch?v=uHhGVMywJIA. Richard was nice enough to share a pdf version of their presentation with us, so if you'd like to have a copy please email me.

The board works very hard to put together programs that are of interest to you as members. As most of you know, Bruce Barr is our Programs Director and Shane David is our Academic Liaison (responsible for tabletop presentations). I cannot thank these gentlemen enough for all they do. We all know that membership in organizations like CSI continues to be flat or decreasing. I believe strongly that CSI offers so much to our members and hope you all do as well. It is so important that we hear your thoughts and ideas on how we can make this organization even better. Please take the time to chat with one of us at a meeting, shoot any of us an email, or better yet give us a call. All of our contact information is on our website.

My last thought to all of you this month is actually a question. Have you visited our new website? We are all so excited about the new website and all of the capabilities we now have online through the website. This month we are sending out the invitations via the website and you will be able to RSVP the same way. This will reduce the number of follow up emails you receive once you've registered for the meeting. If you haven't yet logged on and visited the new site, please do. You have the ability to update your personal information and add a picture if you'd like. If you have comments or concerns about our new website, please chat with Rob Hixon, this year's President Elect. Rob has worked with Shane David, Andy Baturevich and Manny Mungaray as a committee to get the new site up and going, and has a pretty good handle on how everything works. I would like to thank the committee for working so hard on this endeavor.

I look forward to seeing you all in a couple of weeks.

Joni Zimmerman, CSI Pikes Peak Chapter President

http://www.csisouthwestregion.org/news/

Be on the lookout for Spring CDT exam signups, which will open in January of 2017

See http://csinet.org/main/certification/CDT

September—November Anniversaries

Charlie Lengal	*17 years*	*Ben Pollock*	*5 years*

If you're organization would like to advertise upcoming events in *The Intent*, please contact Andy Baturevich at

abaturevich@hcdaengineering.com or 719-633-7784

Upcoming Program Dates

Folks, please make sure to mark your calendars for the following dates and join us for our Monthly Meetings!

Wednesday, November 30

Wednesday, December 14

CSI Pikes Peak Chapter would like to thank

Rob Haddock

for agreeing to include his award winning seven part article series on metal roofing in the *Intent* each month. The article series won the Carl G. Cash Award from ASTM D 08 Committee on roofing and waterproofing. Part 2 of the series is included at the end of this newsletter.

Pikes Peak Chapter

President:
Joni A. Zimmerman CSI, CDT
TK-Architecture, LLC
719-393-2987

President-Elect:
Rob Hixon, CSI
Stresscon
719.390.5041

Vice-President:
Manny Mungaray
GCC of America
720-579-6288

Secretary:
Luke Bleichrodt CSI
RW Specialties
303-880-5584

Treasurer:
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LGA Studios
719.635.0880

Past President:
Shane David, CSI, CDT
H+L Architecture
303.298.4808

Directors:

Charlie Lengal III,
QCP, CxA, CPD, CCCA
M-E Engineers, Inc.
719.536.0036

Bob Stanton, CSI, CDT
Stanton Construction Co.
719.471.7891

Ben Pollock, CSI
Webb Design
719.344.8350

Greg Gulliksen, CSI, CDT, AIA
CSNA Architects
719.473.7225

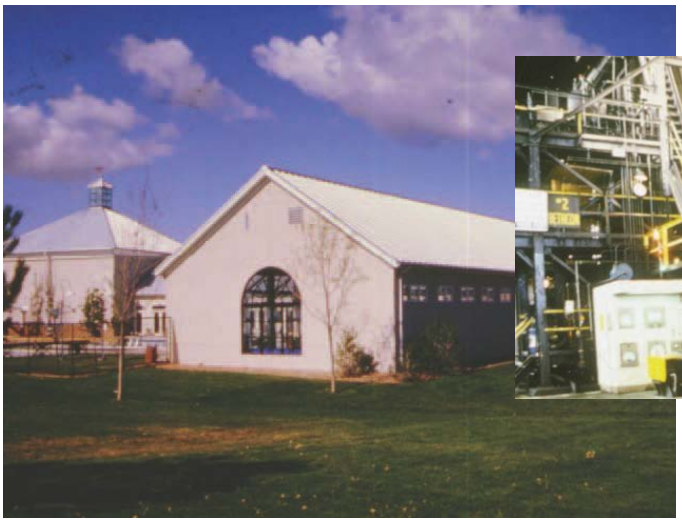
Bruce W. Barr, CSI, AIA, LEED AP
Art C. Klein Construction, Inc.
719.570.6060

WHITE PAPER

Part 2: Metal Roofing from A (Aluminum) to Z (Zinc)

Metallic Coatings for Carbon Steel

Carbon steel sheet is a popular domestic choice for metal roofing, primarily for economic reasons. However, carbon steel has corrosive characteristics, which means it must be protected by some other metallic coating that is less corrosive in behavior. Such a coating provides "barrier" protection for the steel. Because steel requires moisture and oxygen to corrode, the coating must create a thin, moisture-impermeable film so air and water cannot reach the steel substrate. This is what is meant by "barrier" protection. Some (zinc-rich) coatings also provide "sacrificial" protection. This is an electrochemical phenomenon that protects the base metal at the expense of the coating metal.



▲Advances in metallic coatings have expanded the applications for the use of steel in roofing (above). Coatings (right) are applied in a continuous hot-dip line at the producing mill.

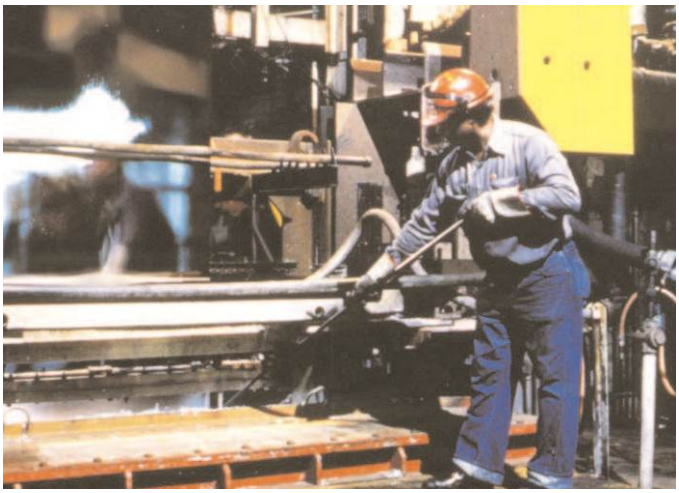
Continuous Hot-dip Process

These coatings are normally applied to the steel coil at the producing mill using a process called "continuous hot dip." The steel is first meticulously but automatically cleaned, degreased, rinsed and forcibly air dried. It is also "pickled" in an acid bath and preheated. At this point of the process, the mechanical properties of the material can be affected, if desired, by exacting control of heating and cooling processes. Finally the coil is passed through a bath of molten metal at temperatures that provide for a metallurgical bond between base steel and coating metal. The exact temperature (800 to 1,100°F) varies with the coating type because the materials have differing melting temperatures. The metallurgical bond between coating and base steel substrate causes monolithic behavior of the material during fabrication and service.

The coating thickness is controlled in most mills with "air knives"—sophisticated pneumatic squeegees that interface with the surface of the coil as it emerges from the bath of molten metal. The material is cooled (and coating solidifies) upon exit from the bath and entrance to the cooling tower. This process is also closely controlled to affect varying surface appearance characteristics. It is during this process that the "spangle" of zinc-rich coatings is sometimes altered (minimized). Finally, the material is water quenched, dried and recoiled at the end of the line.

Most often just prior to recoiling, a chemical, passivation or oil treatment (or combinations of these) is applied to extend the shelf life of the material, prevent storage staining or to prepare it for the next step of production—painting or fabrication. When oils are used, they are sometimes water-soluble oils that help to lubricate during the rollforming process and evaporate soon after.

The continuous hot-dip process takes place at line speeds of about 800 linear feet per minute, which can translate to as much as 4,800 square feet



▲As metal comes out of the zinc pot on the way to the cooling tower, the coating thickness is regulated by the use of “air knives,” or pneumatic squeegees.

per minute, making it a very cost effective method to apply metallic coatings.

Zinc Coatings

Perhaps the best-known coating for carbon steel sheet is commercially pure zinc, commonly known as galvanized. (It is worth mentioning here that galvanized iron, or G.I., though commonly designated on architectural plans, is a product that has been obsolete for decades.)

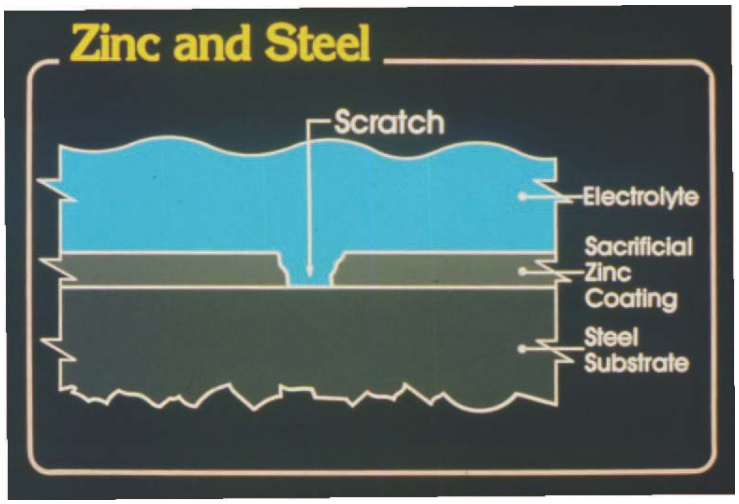
Common coating application rates for galvanized steel are 0.30, 0.60 and 0.90 ounces per square foot, designated as G-30, G-60 and G-90. Long ago, the target application rate for G-90 was 1.25 ounces with 0.90 serving as the minimum requirement. Sophistication of modern application equipment has enabled producers to hold much more consistent and uniform application thickness, so the target rate of 1.25 ounces has gone by the wayside. Target application weight now is much closer to the minimum and verified by testing using a single spot or triple spot sample according to ASTM procedures.

It is important users understand zinc application coating rates because they have a direct impact on the roof’s performance and longevity.

It is important users understand zinc application coating rates because they have a direct impact on the roof ’s performance and longevity. For example, with other factors being equal, G-30 will have one-third the life of G-90; consequently, it is not used for exterior claddings. G-60 is used only in cost-cutting applications and G-90 is the common choice for steel roofing in pre-painted applications.

The total coating thickness of both sides of G-90 is 1.51 mils. This means that at the target application rate, coating thickness on a single side is about 0.75 mil. Because of coating process tolerances, however, industry standards allow that the minimum on one side can be as low as 40 percent of the total, so the thickness (on one side) could be as low as 0.60 mil.

Because of the slim coating thickness, zinc and zinc-alloy coatings also rely upon the unique ability of zinc’s “galvanic protection” at scratches and cut edges. In the presence of electrolyte (water), zinc’s active (anodic) behavior retards oxidation of the steel substrate. For the same reason, zinc bars are attached to steel-hull ships and often inserted into domestic hot-water tanks: to retard the corrosion of the steel. Zinc coating is preferred by some manufacturers because of its excellent flexibility (malleability) in fabrication, especially when sharp



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BUILD LEGACIES METAL

radius bends are required in the fabricated product. Another advantage of galvanized steel is that it is solderable.

Galvalume has become the undisputed lead of coated-steel options in unpainted applications and at very low slopes (1/4:12 minimum, as dictated by the warranty.)

Although technically, any coating (including zinc) offers barrier protection, zinc is generally referred to as a "sacrificial" coating because its electrolytic behavior is somewhat unique. By design, the coating goes away over time, sacrificing itself to retard corrosion of the steel. Its life, then, is directly proportional to its thickness and the elements to which it is exposed. This "galvanic" activity is a desirable characteristic with respect to the corrosion behavior of steel, especially at surface scratches and cut edges, where the base steel will be exposed and unprotected by a "barrier."

In unpainted applications, galvanized has become outdated. It has been replaced by newer-technology coatings that significantly outperform it in such applications. It is still considered an acceptable coating and preferred by some when a premium organic finish (paint) is used. Although the paint is not impervious to moisture, it retards the galvanic process, prolonging the life of the galvanized substrate. Because the galvanic process is retarded, however, the corrosion performance at scratches, cut edges and severe outside radius bends is somewhat diminished.

▲Performance of G-90 in a semi-arid climate is demonstrated by this 40-year-old roof.

Galvanized steel is produced by many mills and is widely available. It is not typically warranted by the producing mills for corrosion performance. Because of galvanic behavior and the natural oxidation process, the zinc diminishes over time. When a substantial volume is gone, the base steel is exposed and the corrosion protection— barrier or sacrificial—is no longer afforded.

This service life is widely varied in different environments. Because the galvanic process occurs only when an electrolyte is present (when the surface is wet), galvanized steel does much better in dry climates and at steeper slopes that keep surface moisture well drained. Hence, the duration of wetness on the panels' surface has more to do with service life than rainfall intensity or frequency.

In dry, desert-like climates, where roofs seldom dew at night, I have seen bare G-90 that is 50- or 60-years old and still doing well. In more humid climates, this will not be so because roofs reach dewpoint almost every night, so the roof is wet for one-third of its life even before the first raindrop hits.

The aggression of the moisture also has much to do with the life of galvanized material. In salt-spray or acid-rain environments, the life will be drastically reduced. This is because such contaminants make for a much more effective electrolyte, accelerating the galvanic process. Once the coating is depleted, the steel roof need not be replaced, but it is a good candidate for a field-applied coating to extend its useful life. No known field-applied coating, however, will have the same life expectancy as the original metallic coating.

Zinc coatings are typified by a broad "spangle." This is the metal flake appearance in the finish of the coating. It is actually caused by trace lead or antimony content. The size of the spangle can be controlled or eliminated by the producing mill. In

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general, minimized spangle is preferred when the material is to be painted.

Spec references for galvanized include the following: Federal Spec QQS-775d; ASTM A924, "General Requirements for Steel Sheet Metallic Coated by the Hot-Dip Process," which was formerly ASTM A525; ASTM A653, which was formerly A526, 527 or 446 and is used with the number followed by steel grade, such as A653, Structural Quality Grade 50.

The same ASTM spec references are also used for Galvannealed, a product that is a special zinc-iron alloy coating. Other zinc coating treatments, sometimes tailored to specific field-painting applications, are known by their various trade names.

Aluminum Coating

The application of commercially pure aluminum to steel sheet is a process developed by Armco Steel Inc. many years ago. It is known by the trade names "Aluminized Type I" or "Aluminized Type II." Type I is used in the automotive industry but not in the exterior claddings industry. Type II is used in coating weight of 0.65 ounce (T-265), resulting with a mil thickness of 2.43 (total both sides). Although the coating weight is less than zinc (G-90), the resulting thickness is significantly greater because of the light weight of aluminum. It is also available in other coating weights.

Aluminum coating is a "barrier-type" protection and a better one than galvanized.

Although Aluminized does not have the sacrificial protection of zinc, scratch and cut edge performance is still reasonably good. Corrosion seems to progress very slowly from such areas, presumably because of the durability of the aluminum oxides that provide a protective layer.

Having a "matte" finish without spangle, Aluminized is a good choice for bare applications and will generally outperform many other popular coatings in salt or acid environments. However, the material has decreased in relative market share in the last three decades and is commercially available from only one domestic supplier. Check availability before specifying for roofing/cladding applications.

Aluminum does not react well with strong alkalis or graphite, so use caution when cement mortars are present, and do not mark the material with pencil.

Spec references include Federal Spec. S-4174 B; ASTM A463, Sheet Steel, Aluminum Coated (Type 1 and Type II); and ASTM A754, "Test Method for Coating Weight, Aluminum Coated."

Steel can be welded. Coated steel cannot.

Galvalume®

Although several aluminum/zinc (AlZn) formulations are used worldwide, the most popular AlZn alloy coating used domestically is known by its trademarked name, "Galvalume." This alloy is 55 percent aluminum, 43.4 percent zinc and 1.6 percent silicon (by weight). Measured by volume, the coating is about 80 percent aluminum. Developed by Bethlehem Steel, it was made commercially available in the late 1960s. It has since been licensed by BIEC International, Inc. (formerly Bethlehem International Engineering Corp.) to 56 producers worldwide, nine of which

▲Newer-generation metallic coatings have led metal roofing into very low-slope applications, which compete with traditional flat-roof alternatives.

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▲Cosmetic surface stains that detract from the appearance of unpainted Galvalume in steep applications can be minimized by using Acrylume or Galvalume Plus.

are North American companies—one Canadian, one Mexican and seven U.S. It is much more popular in North America and in the Far East and Pacific Rim than it is elsewhere on the globe. It is also known by other trade names outside the U.S.

The coating blends the barrier protection of aluminum and its oxide durability with the sacrificial properties of zinc, resulting in a synergistic alloy that has superior weathering properties when compared to galvanized, yet maintains the "galvanic" corrosion protection of zinc at scratches, cut edges and severe radius bends.

Galvalume is used in various application weights, including 0.50, 0.55 and 0.60 ounce per square foot (total both sides). These weights are designated AZ50, AZ55 and AZ60, respectively. The AZ55 coating is usually preferred in unpainted applications and warranted by most domestic producers for 25 years. Its thickness (both sides) is 1.76 mils. The warranty is generally an assurance that the panel will not perforate (in a "normal" environment) due to corrosion.

Field studies of actual performance for more than 30 years now indicate in friendly environments, the coating will almost triple its warranted life, hence the warranties offered by industry are a very conservative representation of its real expected service life.

Galvalume has become the undisputed leader of coated-steel options in unpainted applications and at very low slopes (1/4:12 minimum, as dictated by the warranty). It is also gaining popularity as a painted substrate and now accounts for a majority share of such applications. Because paint retards the galvanic process, its performance at scratches and cut edges will not be as good on painted applications as on unpainted applications.

While Galvalume inherits the strengths of both its alloy metals, it also inherits their respective weaknesses. Contact with strong acids and alkalis should be avoided. Animal waste and fertilizers can be particularly aggressive to this coating because of their ammonia con-tent even in a gaseous state, so it's use in animal confinements should be guarded. Hog and cattle waste is the worst; poultry waste, not as severe. When insulated and ventilated adequately, good vapor retarders may minimize the problem in this type of structure. On roofs that frequent pigeon and seagull exhaust, occasional power washing may be a prudent investment to prolong coating life.

Galvalume has a tendency to retain cosmetic stains, such as footprints, handprints, etc. Unlike galvanized, these stains are permanent and rarely weather away. For this reason, some producers offer a thin application (about 0.3 mil) of acrylic coating to afford temporary stain protection during handling

▲Exhaust flues that discharge gases from burning fossil fuels can cause a micro-acid rain environment neat the flue.

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and installation. The acrylic also eliminates the need for surface lubrication and weathers away in a few years. This option, dubbed ACRYLUME® or GALVALUME PLUS®, depending upon the producer, is used only for unpainted applications and is becoming more popular domestically. It has been used in Western Europe for quite some time.

Spec references include Federal Spec. Army CEGS-07413; Army CEGS-07415; Army CEGS-13120; Navy NFGS-13121; ASTM A924, "General Requirements for Steel Sheet Metallic Coated by the Hot-Dip Process;" and ASTM A792, "Sheet Steel, Aluminum-zinc Coated (GALVALUME)."

Other Coatings for Steel

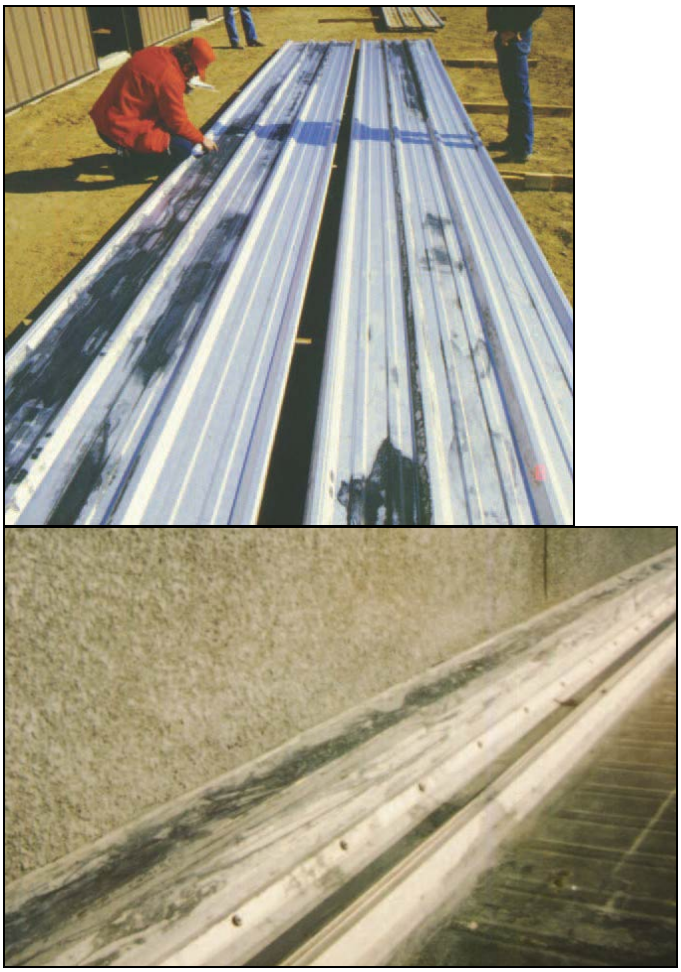
Other coatings for steel include Galfan®, which is about 95 percent zinc by volume—almost reciprocal of Galvalume, and terne, which is a solderable tin-lead alloy used over special copper-bearing steel in thin gauges. Terne has been around for more than a century. Its advantages are the cost efficiency of steel combined with the ductility of softer metals, as well as solderability.

These metals are only used in painted applications. Galfan is always prepainted and terne is most often post-painted using special paint though it can be prepainted by coil coating. Post-painted terne will require repainting at about six- to eight-year intervals. Newer terne coatings (Terne II by trade name) are tin-zinc rather than tin-lead alloys.

Copper flashings should not be used anywhere upstream or in electrolytic contact with the coated steel.

Limitations of Coated Steel Products

Precautionary measures when using metallic-coated steel are primarily chemical and metallurgical. Contact of these coatings with strong acids should be avoided. Heavy discharge of



(Top) Improper storage and/or transit of Galvalume panels can result in damage from trapped moisture.
(Bottom) Alkali in the mortar from this stucco wall induced corrosion of the Galvalume. The black stain is accelerated oxidation of the aluminum.

sulfurous and nitrous oxides from flues and the like will shorten coating life adjacent to those areas. When using aluminum or aluminum alloy, strong alkalis are also detrimental to the aluminum. For this reason, use of these products with wet cementitious mortars, such as reglet flashings, is precluded unless the metallic coating is first protected with a good, heavy coat of spray or brush-applied clear coating, such as acrylic, to protect it until the mortar cures. When work adjacent to Galvalume, Aluminized or aluminum involves cement mortar, the trades should be sequenced such

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(Top) Choose specialty preformed equipment curbs of all-welded aluminum construction with diverters at their uphill side.
(Bottom) This Galvalume curb was shop-welded, resulting in traces of red rust at the vertical edge of the curb after just one year.

that the masonry trades are complete prior to placement of metal panels. Cured mortar poses no threat.

There are also some mechanical precautions to be observed. Warranties on Galvalume will usually specify a minimum bend radius of “2T” in fabricated shapes. This means the radius of a bend must be at least double the thickness of the metal. This is because the material is stretched into tension on the outside of the radius and may develop micro-fractures if such a mini-mum were not observed. G-90 is a little more flexible and will tolerate a tighter radius. Aluminized (and aluminum sheet) are less tolerant and may require even greater bend radii. In most cases, the tooling of rollforming equipment anticipates these limitations, so there is no need for concern. There are exceptions, however. Sometimes panels or related flashings are brake-formed. Often, common leaf-brakes will violate the minimum bend restrictions of some coated-steel products. The result may be premature corrosion at tension bend lines.

Weldability

Contrary to many industry claims, the simple truth is that coated steel cannot be welded. Steel can be welded. Coated steel cannot. When coated steel is welded in some fabrication or manufacturing process, the first step is to completely remove all coating from the area to be welded. Having done that, it is no longer coated steel but bare steel, and the integrity of the metallic coating cannot be restored.

The weld must be protected from corrosion, however, so the fabricator often utilizes a brush-applied, air-dried paint of sorts (sometimes with zinc or aluminum particulate) for the needed corro-sion protection. This secondary-applied coating cannot hope to have the life or maintenance freedom of the original hot-dip metallic coating. It is my opinion the specification of such a process is a disservice to the end-customer who thinks he is buying a maintenance-free hot-dip-coated steel roof system.

Compatibility Issues

Zinc and aluminum are anodic metals and should be isolated from electrolytic contact with more noble or cathodic metals, most notably copper. For the contractor, this means copper flashings should not be used anywhere upstream or in electrolytic contact with the coated steel. Additionally, any rooftop equipment involving copper lines that will drip condensate or rainwater runoff onto the roof should be avoided at any cost.

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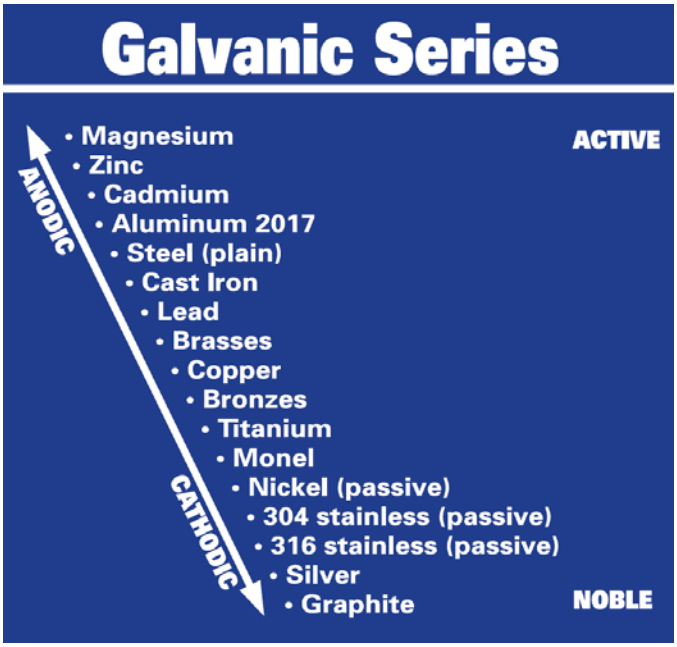
Drippage from a rooftop unit can cause corrosion as shown on this 1 ½-year-old roof. In another year and a half, the white zinc oxide trails will turn red with iron oxide.

Run-off from copper contains copper salts and will cause rapid galvanic corrosion of any of these coatings. It is not unusual to see a trail of red rust downslope of a roof-mounted air conditioner after a few years of service. Copper lines should be jacketed with insulation to prevent electrolytic runoff. Alternatively, the run-off can be collected in a condensate pan and directed to drains by use of PVC piping, isolating it from the roof panels.

Another common mistake is the use of graphite pencil to mark aluminum, Aluminized or Galvalume-coated steel. Graphite has a severe corrosive effect on aluminum and will cause etching of the surface. In the case of coated steel and a wet climate, heavy pencil marks can display trace red rust in as little as one year. Instead, use a felt-tip marker for layout lines and so forth.

A "galvanic scale" can be used as a tool for determining dissimilar metals, and the same is included in many reference materials. However, the user should be aware this scale does not tell the whole truth. Do not conclude that galvanic corrosion is imminent on the basis of the scale alone. For instance, lead is distant (cathodic) from zinc (anodic) on the scale, but zinc is soldered with lead alloy solder with no adverse effects whatsoever. Nickel steel is distant from zinc and aluminum, but stainless fasteners are not only used, but also preferred for these metals. Aluminum nails can be used in galvanized steel, but the reciprocal presents a problem. For more on "Compatibility of Fasteners" for metal roofing, see the MCA Tech Bulletin (www.MetalConstruction.org).

Metals' compatibility is more complex than a quick look at the galvanic scale. The best practice is to ask more questions if metals are found to be distant on the scale. Although coated-steel panels are a popular choice for coastal applications, users should be aware salt spray has a detrimental effect on all these coatings and they will not yield the kind of life mentioned earlier.



Adequate Drainage

None of these coatings will tolerate moisture that is trapped against their surface for prolonged periods of time. Zinc is markedly less tolerant of this than aluminum, but they all like to be freely drained and able to air-dry readily. Warranties will typically exclude subsurface corrosion resulting from this latter condition. Topside corrosion can also be induced from the same phenomena where water ponds on the panel or where leaves, pine straw or other debris retain moisture on the surface of the coating. Periodic inspection and routine cleaning if

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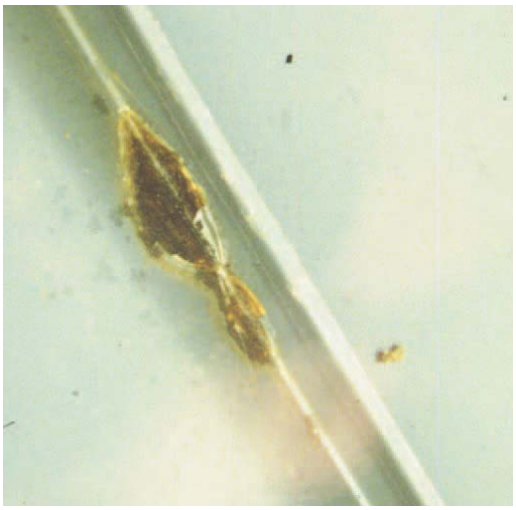
847.375.4718 | mca@metalconstruction.org | www.metalconstruction.org

necessary will go a long way toward avoidance of induced coating corrosion.

Coated steel is the most widely used of all metals for roof coverings in the U.S. by a ratio of about ten-to-one. These options have excellent strength-to-weight ratio; good formability and paintability characteristics; and are durable enough for engineered, structural applications over open framing. Other factors being equal, they can offer superior wind-uplift performance because of their strong mechanical properties. In many environments, they can have a service life of four decades or more and are a cost-compelling choice, as well.



The view down into a seam area shows corrosion that began on the inside and worked its way out.

Markings from a punch listing by the installer are beginning to show traces of red rust.

A heavy graphite pencil mark turns to white rust from zinc oxide after one-year of exposure in south Florida.

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Rob Haddock is president of the Colorado Springs, CO-based Metal Roof Advisory Group, Ltd. He is a consultant, technical writer, training curriculum author, inventor and educator. In 2012 he became a charter inductee of Modern Trade's "Metal Construction Hall of Fame" for his many contributions to the industry.

Photos courtesy of Metal Roof Advisory Group, Ltd., Colorado Springs, CO, unless otherwise noted.

Founded in 1983, the Metal Construction Association brings together the diverse metal construction industry for the purpose of expanding the use of all metals used in construction. MCA promotes the benefits of metal in construction through:

- Technical guidance
- Product certification
- Educational and awareness programs
- Advocating for the interests of our industry
- Recognition of industry-achievement awards
- Monitoring of industry issues, such as codes and standards
- Research to develop improved metal construction products
- Promotional and marketing support for the metal construction industry
- Publications to promote use of metal wall and roof products in construction

For more information, please visit the MCA Web site at www.metalconstruction.org

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