Corrosion Report

This report is focused on the subject of controlling ALL THE FACTORS involved in preventing corrosion long term for 30 years plus. The only subject area not examined in depth is the selection of paint coatings.

By implementing all of the following techniques in a build or corrosion repair job, the end result will be a corrosion free job for 30 plus years. But all the techniques MUST be used in conjunction together to produce this result. One process skipped or done wrong will be the weak link that causes failure. Do it all right or don't even bother.

This Corrosion Report is best seen in the digital PDF version because then the hyperlinks will function. If you received this report in the paper version, naturally the links won't work so you can download the digital PDF version here **http://after-hours-welding.com/Corrosion-Report.pdf**

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Subjects discussed in this report.

And when you see this link, "Back to the top." It will take you back here to the top of the page.

If a paint job will last 30 years, then I would give it permission to fail. But how do you feel about paint coming off within 3-5 years? How do you feel about rust problems that continually come back no matter how frequently you paint the project? Acceptable or not?

Why does paint coating after paint coating not stop the rust from reappearing? Because the problem originates even before the first coat of primer or paint is applied. The problem is usually not the paint itself, it's typically what the paint is sticking to.

The problem is in the preparation, or to be more precise, actually in the lack of proper preparation. The problem starts with the steel manufactured and how it is delivered for sale to the fabricator that is going to build that new steel into some new item or project.

We would like to think that the first coat of paint applied to a newly built item, is applied directly to the steel. But in actuality, that is rarely the case. In most cases, the first coat of paint is applied to mill scale and not the steel itself.

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What is mill scale?

When steel is manufactured, there are two types of processing the new steel into the desired shape.

Cold roll and hot roll.

> *If out of curiosity you would like a visual of cold and hot rolling, this old time video is one of the best I've seen as it is educational in nature and not promotional as most of the modern videos. https://www.youtube.com/watch?v=aEatTMQsGtg At minute 1:14 you can see the outside layer of scale that forms on red hot steel, and watch it flake off. On red hot steel, the darker patches are mill scale. Same as you can watch the mill scale flake off metal being formed, mill scale can and does flake off years later after forming is complete.*
>
> *Notice when the steel is hot rolled, you can see the scale develop and some of it literally flake offs.* ***After minute 11:05, the rest of this video is about other subjects not related to scale*** *and you may or may not want to continue watching as it has no more bearing about paint not sticking well to steel.*

With hot roll the steel is heated red hot until it is soft, pliable and then rolled into the desired dimension. Steel heated red hot in an oxygen environment is constantly going through a oxygenation process on its exterior and scale is a coating produced on the outside of the red hot metal that is in contact with oxygen. The entire time the steel is red hot, the layer of mill scale is growing on the exterior because of its contact with oxygen.

With cold rolling the steel is not heated and not softened but still rolled to squeeze it into new dimensions. Cold steel needs much more pressure to roll it cold therefore the process is more expensive but its finish does not have mill scale on it.

Cold rolled steel, while it does not have mill scale on it, it typically **comes new with a film of oil on it that must be removed before painting**.

While mill scale is adhering to the steel, the scale itself won't rust. The problem is that the scale is just a coating on the steel and scale will and does flake off. The older it gets the more the scale will flake off of the steel as it exposes the unprotected steel.

When painting on steel coated with mill scale, the paint is not adhering to the steel. The paint is adhering to the scale and scale is not real good at holding paint. But even worse is when the scale ages and let's go of the steel **the scale flakes off of the steel and the paint on the scale comes up and off** with the scale **leaving unpainted steel now exposed**.

Now while this is bad, this is not the worst of it. Now you have some areas of steel where the scale has left the steel. Scale and steel have different resistances to voltage. Scale has a .3 difference in voltage (galvanic process) than the steel and this **causes ACCELERATED corrosion** in the exposed areas of the steel where the scale has left.

Take a piece of sheet metal that has no scale and don't paint it and leave it out in the rain. It may take ten years to rust through. Now take a piece of sheet metal with scale on it. When the scale begins flaking off with age, the newly exposed area of steel will rust 10 times faster due to the galvanic process going in. While there is scale on most of the sheet metal still, the newly exposed areas of steel where the scale has flaked off (taking your paint with it) will now rust through creating holes in the sheet metal in as little as one year.

Where the scale flaked off taking the paint with it, the remaining scale (galvanic process) forced the exposed steel to corrode at ten times the normal speed of steel corroding that has zero scale on it.

It does not matter how great of a paint you use if your painting over mill scale covered steel. The paint does nothing to make the scale permanently adhere to the steel. Scale lets go of the steel as it ages and as the scale lifts up and comes off, so does your coating of paint on that area of scale.

A. You can paint over hot rolled steel (coated in mill scale) but then don't expect the protective coating to have a long life span.
B. Instead of using hot rolled steel, cold rolled steel can be used instead. But its cost is about double. BEWARE: Cold roll does not have a profile for holding paint.
C.

D. Or hot rolled steel can be dipped in acid (pickling steel) to remove the scale. BEWARE: Pickling will not produce a profile for holding paint.
E. Or hot rolled steel can be abrasive blasted to remove the scale. NOTICE: This does create a nice profile for fantastic paint adhesion.

Choosing cold rolled steel will eliminate the problem of mill scale flaking off later as cold rolled has zero scale because it was not heated red hot in a oxygen environment while being formed. **HOWEVER cold rolled steel normally comes with a slimy film of oil on it** that will need to be carefully washed off before installing/ painting.

The scale will take your new paint off in a short amount of time in certain places where its adhesion is the weakest. Changing from hot rolled to cold rolled does not change fabricating labor costs. But it does change material purchase costs which would change delivered product prices. Do you want to pay more for cold rolled so there is no scale problem later?

Conclusion: Mill scale must be removed for long term corrosion prevention. Painting over it is a waste.

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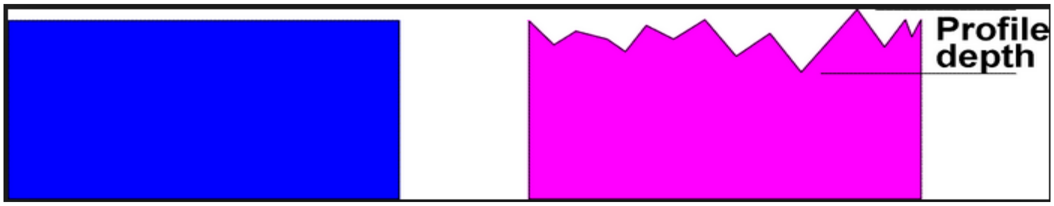
Anchor Pattern: But that leaves us with another factor to consider. **PROFILING THE METAL** to be painted.

While cold rolled does not have scale that will lift the paint off the metal later, the steel is perfectly flat and smooth from the high pressure rolling. Perfectly flat and smooth steel is ok at holding paint, but it's not great and it's certainly not tremendous at holding paint long term.

Industry's such as bridge building, high and tall municipality water tanks, petroleum manufacturing with lots of piping and huge tanks and giant ship building **do not** choose cold rolled steel. These industry's because of the high cost of repainting later, choose the method during construction that will hold paint for 30 plus years. These four industry's have scientific knowledge in how to make paint last for 30 years. They use hot rolled steel, and then sandblast the scale off the steel. **Removing the scale with sandblasting provides another enormous benefit. It creates a (PROFILE) anchor pattern for painting over that is tremendous at making paint adhere to the steel long term**.

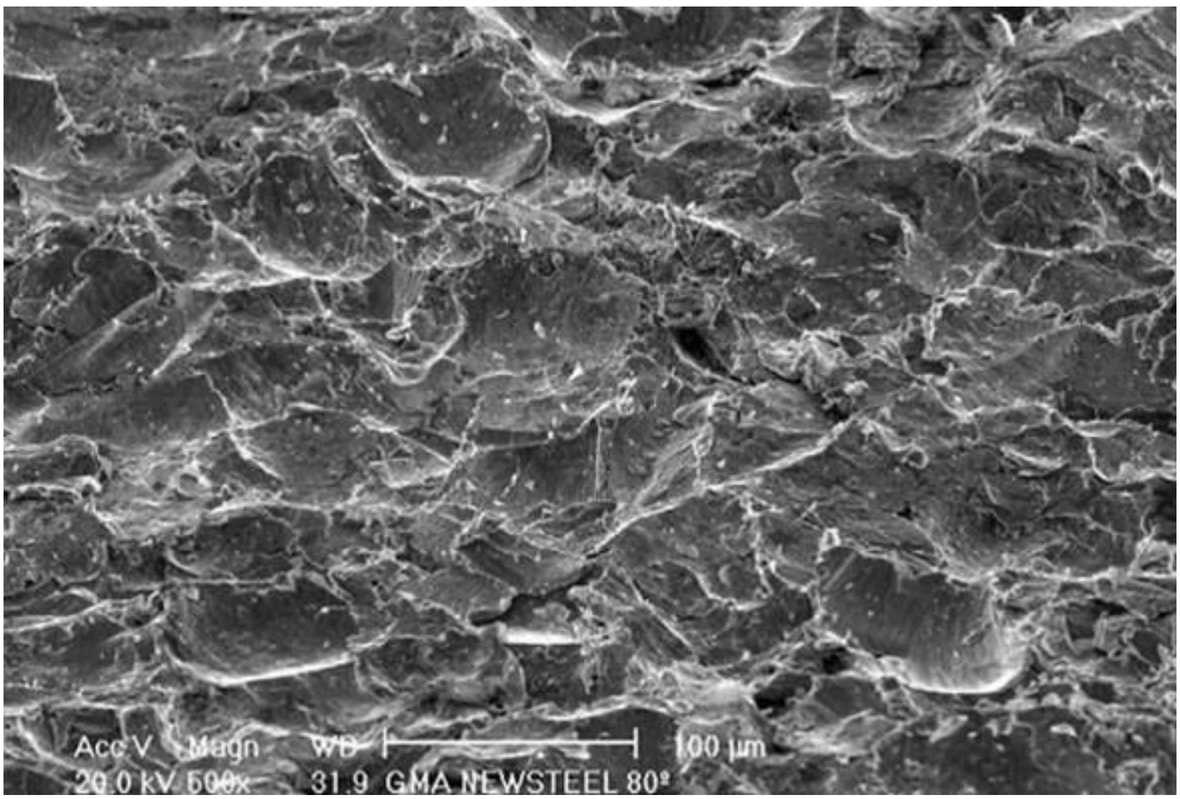
A profile or anchor pattern, is roughening the surface of the steel which creates 300-500% more surface area for the paint to adhere to. Only abrasive blasting does this perfectly.



It is called profiling, anchor pattern or roughened steel. All the same.

Blasting metal changes the flat smooth surface to peaks and valleys. This increases the surface area paint is able to adhere to. It removes the smooth surface and makes it rough. **Paint sticks to rough areas fabulously**.

Here is profiled steel as seen under a high power microscope.



Here is a brand new tank just built and never used yet. They have blasted it to create a profile to paint over for the longest lasting coating. https://www.youtube.com/watch?v=Gp4ut6TJYhY That is what freshly sandblasted steel looks like. They build/erect it first, then create the anchor pattern (sandblast it) (while removing scale) for paint to stick to. Then they paint over the freshly blasted steel.

Here is another new tank being built. Again you see after it is constructed and welded, then (at 3:13) the scale is sandblasted off and a profile is created before it's painted. They could have sandblasted it before the metal arrived at the job to be welded. Wouldn't it make sense to blast it on the ground instead of blasting it later when it's high in the air? But then the welds would have welding slag on them and they would not have a anchor pattern for holding paint. Then later (5-10 years) they would have paint failure at all the weld joints. But then it would have been high up in the air after it was lifted into place. They will do whatever it takes to make that paint last 30 plus years. So they will sandblast if after welding is complete, not before when the steel is on the ground and easy to reach.

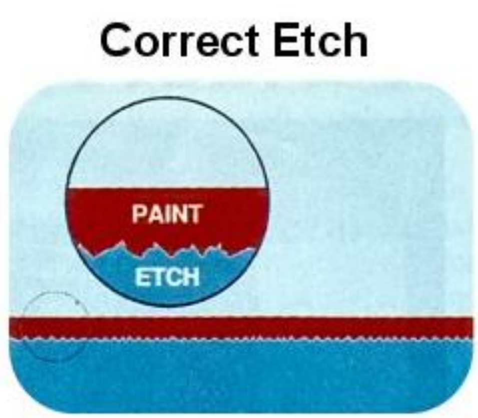
At 3:28 notice the white stripe painted the sharpest edge. This is called paint striping. More about it later. It is very important for long lasting paint.

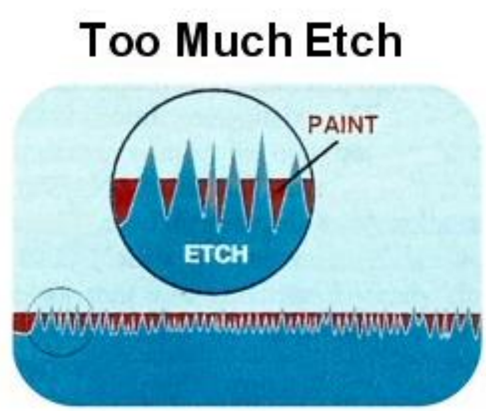
If you want a 20-30 year paint job then choose blasted (profiled) hot rolled over smooth cold rolled. The difference in quality is so large, that engineers for bridge builders, water tank builders, and ship builders will flat out refuse to paint over metal that has not been profiled. They know doing it right the first time is less expensive than doing it multiple times later.

Now in reference to profiling or anchor patterns.

There is a proper peak height to valley depth ratio. With blasting brand new metal this is easy to achieve with the right abrasive grit size selection. But that particular abrasive size grain is not very effective at removing multiple layers of paint or deep layers of rust.

In the case of rebuilding rusty metal stairs, water/fuel tanks, I am not blasting brand new metal so my grain size isn't perfect for achieving the proper ratio height difference between the peak and valley bottom.





The peaks I created are a little high and therefore can't be considered perfect. When a peak is tall and at the upper limit of the paint film, that area of the peak has very little paint on its point. Knowing that because I had to blast thick paint and rust layers off, and not new metal, I strongly recommend adding an additional layer of paint above and beyond paint manufactures recommendation, to compensate and raise the paint film layer above my high peaks. This is the proper process of rebuilding it verses building it new.

One additional layer of primer or paint, whichever is thicker, will probably change the life of the paint from 15 years to 30. You may ask the paint manufactures Professional rep which they recommend, an additional layer of primer or an additional layer of paint.

If you want a realistic 30 year plus life span on your metal project, then it means doing everything correctly so the entire recipe is congruent with success. Beware one weak link and the whole system can fail.

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FULL SEAM WELDING.

Stitch welding is applying enough weld to give it sufficient strength to safely do its job, but no more weld than that. Stitch welding leaves an open seam between the two pieces of metal where corrosion cannot be prevented.

Full Seam Welding is applying a weld bead around the entire edge on all the sides completely creating a seal between the two pieces of metal.

Here is some stairs we are rebuilding. Below the bottom of the stairs are angle irons stitch welded to the beam to support the stair treads and risers.


STANDARD

The un-welded seam area allowed moisture and oxygen to get between the two pieces of steel and feed the rusting process. We can't sandblast between the two pieces of metal and you cannot repaint between them either. With open seams between two pieces of steel there is no way to prevent nor stop the rusting process unless you alter the welding pattern later. (Which I do regularly)

Now we have sandblasted the paint and rust off the beam and angle iron. Now you can see clearly the rust hidden in the seams behind the angle.

Although we have sandblasted it, there is no way to remove or stop the rust between the joint of the two pieces. At some point someone caulked the seam in hopes to stop the rust but it never works. Blasting does not remove caulk so you can still see it there. As the rust grows, its size/thickness increases. It expands with tremendous pressure as Ice expands when it freezes. Now you have tremendous pressure building up between the beam and angle iron and it begins popping the welds free and pushing the angle away from the beam as it breaks/bursts the stitch welds free.

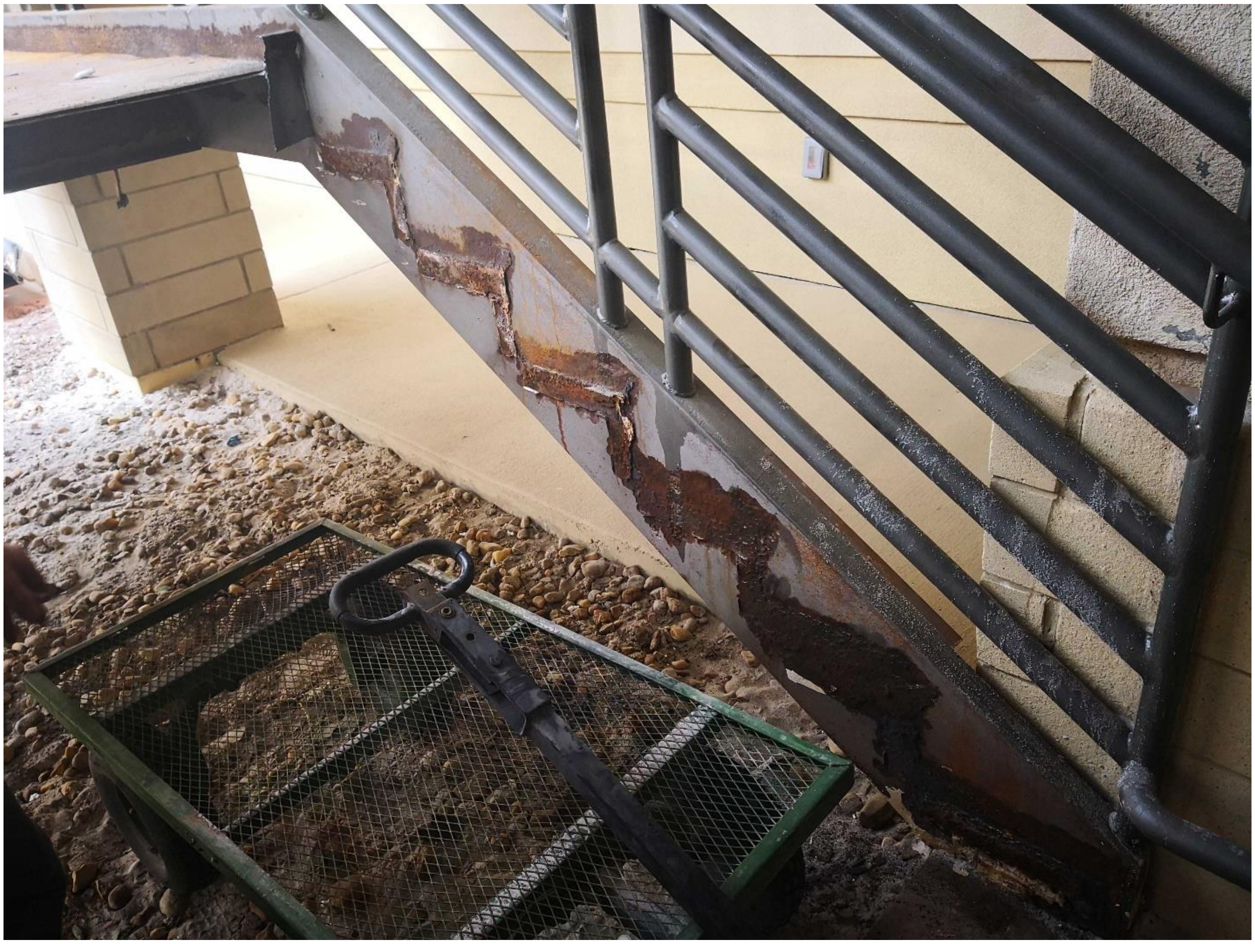
In the next picture, the expanding buildup of rust pushed the two pieces of metal apart from each other so much, we were able to sandblast between them and removed some (but not all) of the rust. Look close, you can see the rust still in there had expanded to over 3/8” of an inch thick.

Now the Structure is getting (dangerously) weaker along with rusting away. Above we blasted that angle and removed the rust out of the open area. But that won't stop the rust from coming back, neither will attempting to repaint it.

The long term fix is to remove the bad metal, replace it with new metal, and use full seam welding so there are no open joints where moisture can get between them again. Seal welds are used to preclude moisture and oxygen-laden air and water from entering that cavity. Then a correct paint job over top of it will prevent future rust.

Below we have removed the angle pieces off the beam and you can no see how much rust was behind them that could not be stopped because they were originally stitch welded and not full seam welded.

Notice the handrails. They were all full seam welded. Nowhere on the handrails was there rust issues. Nowhere where that full seam welding was done, was there rust issues. Everywhere stitch welding was done there was enormous rust issues.



In the picture above, you can now see all the rust that was hidden in the joints. Those angle irons we removed were so weak the stairs were definitely dangerous. Each angle had 4 stitch welds. Sometimes when we would cut one stitch free, the pressure behind them would burst the other three stiches free and the angle would just burst off and fall to the ground. Then when we learned how weak they were, before cutting the stitch welds free, we would hit them with a hammer. Some of them, the rust build up was creating so much pressure between them, when hit with a hammer they would just burst off the beam. The rust had the welds to 97% off their breaking limit, and a whack with a hammer would push them over the edge and they just broke off.

Stitch welding is not only an invitation to rust, it's a command to cause rust that later cannot be prevented or controlled. Stitch welding is a guarantee for causing corrosion and short life spans of the steel object. These stairs have their date stamped on them in many places. They are only 11 years old.

The cost to stitch weld on one angle iron may have been $30 when originally built. The cost to full seam weld that angle iron would have been $70.

The cost to later remove and rebuild it, with blasting, painting and new steel costs, is $600.

Bridges, water towers and ships will not allow stitch welding in the build. Everything is full seam welded these days. They have learned the hard way, it's significantly less expensive to pay more up front than to pay much MUCH more later.

In the cases where stitch welded metal is not dangerously weak and does not need replacing, after sandblasting is completed, we will repair the stitch welded design by full seam welding it. The full seam weld closes up and seals all joints and gaps so rust cannot grow inside the joint. Then when it is painted over later, you won't have rust growing inside and out of the joint.

ABOVE. A full seam welded joint so there is no gap/seam between the two different plates. Now any rust that does appear because of scratched off paint, is surface rust which can be dealt with and stopped. Full seam welding prevents rust in the joints. This is a necessary part of a 30 year corrosion free paint plan. We can take a stitch welded plate, finish the welds and turn it into full seam welded. But ignoring pieces that are stitch welded together will guarantee corrosion in the future.

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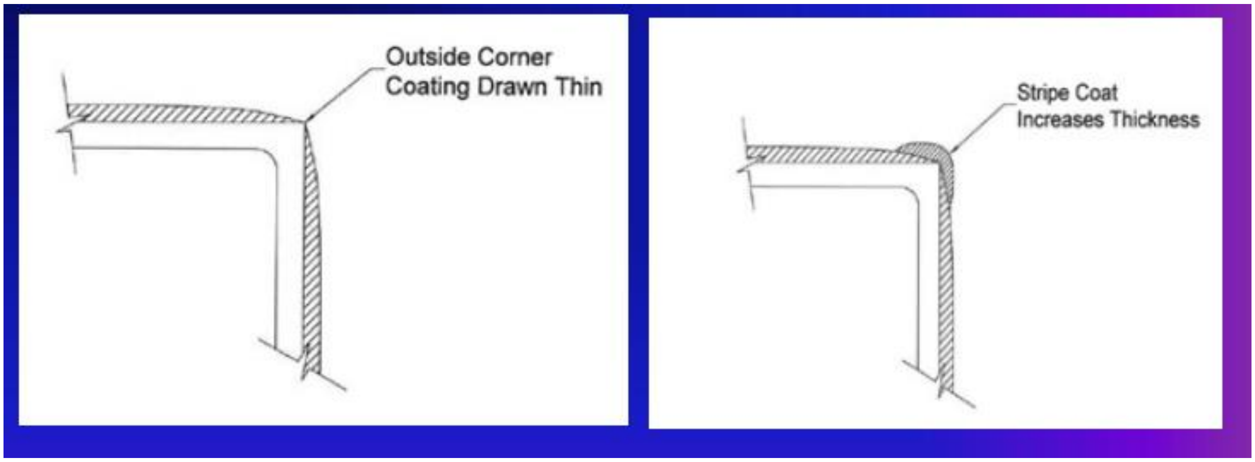
STRIPE PAINTING.

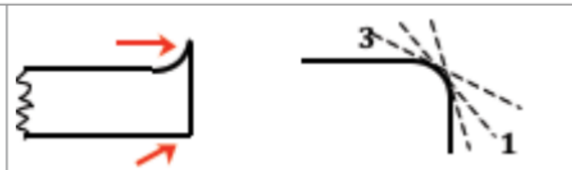
Not all application methods of coatings are equal.

Definition - What does Stripe Coating mean?

Most liquid coatings have a tendency to flow away from the edges and cause a reduction in the thickness of the dry paint film. The paint flows away due to the surface tension of the paint film and the shrinking of the film as it cures. This causes the paint film at the edges to become thinner than other parts of the component and exposes the areas to early attacks by corrosion.

Stripe coating is the application of an extra coat of paint to edges, welds, fasteners, and other irregular areas. The coating provides the areas with sufficient film build for necessary added protection against corrosion, and is usually done before applying the full coat to the entire surface.
https://www.corrosionpedia.com/definition/1714/stripe-coating



SHARP EDGE	Edges should be treated to a rounded radius of minimum 2mm, or subjected to three pass grinding or equivalent.	

In this video, notice corrosion is worst on the edges of the steel and in the joints and corners and not on flat walls. https://www.youtube.com/watch?v=IhdREkAhiRo

So in this video they are putting in a special effort to combat the known weak areas by addressing them specifically https://www.youtube.com/watch?v=OYk3J7_glE8 . Also notice, there are no stitch welds. Everything is full seam welded on every joint and every side.

This is what proper strip coating looks like. An extra layer of paint on every edge and every joint.

Surfaces are typically stripe coated because they contain “edges” and “crevices” to which a uniform coat of paint is difficult to apply. When applied to edges, surface tension and shrinkage of the coating during drying tends to draw the coating away from the edge resulting in a thinner applied film. Thinner coating films mean reduced corrosion protection and an increased susceptibility to damage. Crevices are typically a combination of "outside corners (edges)" with a crevice in between. While the same surface tension and shrinkage stresses apply along the edges, surface tension also inhibits "flow-out" of the coating down into the crevice. https://ktauniversity.com/importance-stripe-coating-extending-life/

Stripe coats are typically applied before primer, but if applied after primer, contrasting colors are used to show it's been done completely. A stripe coat that is the same color as the primer or top coat, can be very difficult to verify it's been done correctly.

Stripe coating is always done before the last topcoat.

While stripe painting adds an additional cost, what's the alternative? Giving your edges/seams permission to corrode? What is the cost of doing it right, versus doing it again? Doing it twice is always more expensive than doing it right the first time.

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Below are citations supporting the references I have made above.

https://en.wikipedia.org/wiki/Mill_scale Mill scale is formed on the outer surfaces of plates, sheets or profiles when they are being produced by rolling red hot iron or steel billets in rolling mills.[1] Mill scale is bluish-black in color. It is usually less than 0.1 mm (0.0039 in) thick, and initially adheres to the steel surface and protects it from atmospheric corrosion provided no break occurs in this coating.

Because it is electrochemically cathodic to steel, **any break in the mill scale coating will cause accelerated corrosion of steel exposed at the break**. Mill scale is thus a boon for a while until its coating breaks due to handling of the steel product or due to any other mechanical cause.

Mill scale becomes a nuisance when the steel is to be processed. **Any paint applied over it is wasted, since it will come off** with the scale as moisture-laden air gets under it. Thus mill scale can be removed from steel surfaces by flame cleaning, pickling, or abrasive blasting, which are all tedious operations that consume energy.

https://www.steelconstruction.info/Surface_preparation Surface preparation is the essential first stage treatment of a steel substrate before the application of any coating, and is generally accepted as being the most important factor affecting the total success of a corrosion protection system.

The performance of a coating is significantly influenced by its ability to adhere properly to the substrate material. **Residual mill scale on steel surfaces is an unsatisfactory base** to apply modern, high performance protective coatings and is therefore removed by abrasive blast cleaning. Other surface contaminants on the rolled steel surface, such as oil and grease are also undesirable and must be removed before the blast cleaning process.

https://www.sciencedirect.com/topics/engineering/millscale Surface preparation: Good surface preparation is essential to successful painting, the primary cause of many paint failures being the inadequacy of the initial material preparation.

It is particularly important before painting new steel that any millscale should be removed. Millscale is a thin layer of iron oxides that forms on the steel surface during hot rolling of the plates and sections. Not only does the non-uniform mill scale set up corrosion cells, as illustrated previously, but it may also come away from the surface removing any paint film applied over it.

https://protective.sherwin-williams.com/tools/surface-preparation-guide/ Sherwin Williams talks about **the need to remove mill scale before painting** so the paint adheres to the steel and not the temporary mill scale. Coating integrity and service life will be reduced because of improperly prepared surfaces. **As high as 80% of all coating failures can be directly attributed to inadequate surface preparation** that affects coating adhesion. Selection and implementation of the proper surface preparation ensures coating adhesion to the substrate and prolongs the service life of the coating system.

Industrial paint and protection magazine. Talks about **surface prep and removing mill scale**.
https://www.ippmagazine.com/surface-preparation/steel-surface-preparation/

Thomas coatings has a pdf on surface preparation before painting, and indicates **mill scale is to be removed**
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=14&cad=rja&uact=8&ved=2ahUKEwiNpKCllq_gAhVlqlkKHZL3BScQFjANegQIAhAC&url=https%3A%2F%2Fwww.thomasindcoatings.com%2Fsites%2Fdefault%2Ffiles%2FTIC-surf-prep-v5.pdf&usg=AOvVaw08a0D3RwbmSAz7iaTydWqY

Areas where signs of corrosion or mill scale are present must be abraded to clean metal. Smooth surfaces shall be abrasive blast cleaned **to create an anchor profile** to improve adhesion.
http://www.specifypaint.com/DT201arcom/SubstrSurfPre.asp?ID=int_id4&SubstrID=INT%205.1

Type of Abrasive	Mesh Size	Max. Height of Profile
Very fine sand	80	37 microns (1.5 mils)
Coarse sand	12	70 microns (2.8 mils)
Iron shot	14	90 microns (3.6 mils)
Typical non metallic "copper slag" 1.5-2.0mm grain size	-	75-100 microns (3-4 mils)
Iron grit No. G16	12	200 microns (8.0 mils)

Googles link to this pdf article. And it mentions you can't paint over "Hold Tight 102" rust inhibitor that's used in wet blasting.

Here it talks about mill scale not adhering permanently and when it lifts off, it takes the paint with it. And Mill scale has a .3 difference in voltage than the base steel and it causes galvanic corrosion to begin, which in itself will lift the paint off.
https://books.google.com/books?id=peIEMVOvOIQC&pg=PA151&lpg=PA151&dq=problems+of+painting+over+mill+scale&source=bl&ots=X5unyeZGYG&sig=ACfU3U0JbjrGQY6pmoXMw59XlpWJsPZzMA&hl=en

&sa=X&ved=2ahUKEwjqyIvvnq_gAhUQuVkKHU_xAEA4ChDoATAIegQIABAB#v=onepage&q=problems%20of%20painting%20over%20mill%20scale&f=false

Because mill scale is electro-chemically cathodic to steel, any break in the mill scale causes accelerated corrosion of steel exposed at the break. Therefore, coating over a steel without the mill scale removed, however tempting, is a futile exercise, as the presence of mill scale on the steel accelerates the corrosion of the underlying steel.

All mill scale needs to be removed to present a uniform and clean surface of the substrate steel for any application of any coating on the steel. Removal of mill scale is virtually impossible by hand. It is extremely tedious and time consuming using power tool cleaning methods. Neither of these two methods gives a good base to start. In addition, steel from the hot rolling mills has no surface profile, which is most important to the overall adhesion strength and integrity of the coating system. Abrasive blasting by a suitable media such as steel grits or garnets is the most effective method of removing the mill scale and provide a surface profile that gives the coating system its design requirements.

We have to differentiate between rust converters and surface tolerant coatings. Surface tolerant coatings are coatings that are used on hand-cleaned surfaces, old coatings, and surfaces cleaned by high-pressure water-jetting. Surface tolerant coatings can be applied over non-perfectly cleaned rusted surfaces. They do not contain acids, and were created on the basis of epoxy, polyurethane, and other resins, which can be used to treat dense rust with thickness less than 100 microns remaining on the steel surface. Surface tolerant coatings work based on their penetration through rust and inertisation of all rust components. Brush and airless application are the best methods for assuring the right substrate penetration. They form a protective thick film on rust constructions, are used under particular conditions in the atmosphere, water, and fuels. They might not however be very suitable for long term corrosion protection of the steel structures, say for years and decades.https://www.linkedin.com/pulse/mill-scale-rust-coating-101-shiwei-william-guan

Hot rolled structural steelwork leaves the last rolling pass at a temperature of 1000°C. As it cools, the surface reacts with oxygen in the atmosphere to produce mill scale. This is a complex oxide which appears as a blue-grey tenacious scale completely covering the surface. Mill scale is unstable and with time **water in the atmosphere penetrates fissures in the scale and rusting of the steel occurs**. The corrosion process progressively detaches the mill scale and produces a variable surface that is generally unsuitable for overcoating.

National Physical Laboratory www.npl.co.uk/upload/pdf/surface_coating.pdf . **Weldments on fabricated structural steelwork** represent a relatively small but important part of the structure and can produce variable surface profile and uneven surfaces or sharp projections that can cause premature failure of the coating. Although welded areas are inspected, **the requirements for weld quality do not**

<u>usually consider the requirements for coating</u>. Welds must be continuous and free from pin holes, sharp projections and excessive undercutting. Weld spatter and residual slags should also be removed. And this article goes further to explain that **<u>wet blasting</u> will leave a film of dust on the surface that needs to be washed off before painting,** and that if a rust inhibitor is used, it needs to be checked with the paint manufacture to determine is coating adhesion is adequate because usually it is not.

Surface Profile vs. Class of Blast: VIDEO https://www.youtube.com/watch?v=qHe9vwVWvU4

WHY IS SURFACE PREPARATION IMPORTANT? https://www.coatfab.com/abrasive_blasting.htm Profile or anchor pattern as preparation for paint adhesion.

<u>Surface preparation is the most important part of a coating system</u>, because it affects the performance of the coating more than any other variable. Given that the correct coating system is selected, if the surface preparation is poor, coating performance is usually going to be poor. If surface preparation is good, then the coating applied over it is likely to perform well.

Following completion of a bridge painting project, relatively small areas of damaged coating were prepared by “Power Tool Cleaning to Bare Metal” (SSPC-SP 11) and the organic zinc-epoxy-urethane system was reapplied. But after just a few weeks, failures in repair areas were observed and testing found poor adhesion of the zinc primer to the steel. The surface appeared to have been cleaned to bare metal, but little to no profile had been created, which likely caused the poor adhesion. https://ktauniversity.com/coating-failure-surface-prep/ . And this article goes on to explain how a high sandblasting surface profile in combination with a coating film thickness (*Nominal dry film thickness (**NDFT**) refers to the dry film thickness of the coat indicated in the specification.*) too thin caused rusting within just months of a new paint job.

And I have saved the best for last. This is the most complete library of information all in one place.

Planning of corrosion protection painting

https://www.teknos.com/industrial-coatings/

Corrosion protection painting requires a plan, which indicates the structure’s progress from raw material to the final structure ready for deployment (see chapter 3). The **specification planning for new and previously painted surfaces** is described in ISO 12944-8. Handbook for Corrosion Protection of Steel Surfaces by Painting . The 76-page manual provides comprehensive information on corrosion protection by painting for buyers, planners, and implementers of corrosion protection painting work alike, as well as for students in the field.

Only good planning will provide a corrosion protection solution that is both technically optimal and economically sound. **The entire process chain associated with the structure, from the raw material to a final structure ready for deployment, will be considered at the planning stage. Therefore, corrosion protection must be taken into consideration from the very start of designing a new structure**. A corrosion protection specification is issued, which comprises all information on all parameters influencing the durability of the coating, such as - designed function and service life of the structure

- corrosivity parameters of the environment and special corrosivity stresses for the structure

- design and shape of the structure

- surface cleaning and surface preparation

- paint materials

- site, time, and conditions for execution of the paint work

- supervision of paint work

- requirements for future maintenance

In the visual design of the structure, shapes promoting corrosion resistance are to be preferred. The surfaces being coated should be as smooth and plain as possible to **eliminate sharp edges**, which hamper the application of paint. Positioning of the elements should allow for keeping the structure clean and dry, and in a way that rain, splash and condensation **water has free passage off the surface**. **The weld joints must be designed to eliminate formation crevices and traps between components**, which cannot be coated. Interrupted welds (STITCH WELDING) are to be avoided. Unlike interrupted welds, a solid weld bead does not form crevices or traps in the structure, which are difficult to coat. (FULL SEAM WELDING)

Painting is a process where quality cannot be fully assessed merely based on the acceptance inspection of the outcome, i.e. the coating finish. Therefore, **careful planning of corrosion protection work as well as supervision and control during execution over all parameters that may have an effect on the final coating is imperative**. Purchasers increasingly request reference and certification information in writing, or other similar permanent form, i.e. quality control and assurance information on the quality of the painting **and on all relevant parameters**. In corrosion work, a number of different parameters have an effect on the painting quality. The process steps are divided into planning, execution and quality assurance, i.e. monitoring and inspection activities at various levels. Qualifications and commitment of personnel is emphasized in all process phases.

Paint system implemented
Quality assurance tests, e.g. film thickness, magnetic pull-off test, and other agreed tests and measurements
Performance of the coating, visual inspection
Patching
Application conditions
Application
Surface preparation
Quality degree of metal working
Appropriate design and structure
Qualified and target-oriented personnel
Planned paint system

The rust grade of an uncoated steel surface is determined based on ISO 8501. Unless otherwise agreed to the contrary, only surfaces of rust grades A, B, or C are acceptable. **The quality of metal working is inspected pursuant to standards, while validating that the welds and edges are finished to the agreed quality degree.** The applicators must have unobstructed access to the work object (ISO 12944-3) and surface illumination must comply with the paint work specification.

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Sparks generated by abrasive blasting are not able to ignite a fire.
https://www.blastone.com/us/resources-training/tips-of-the-trade/are-sparks-from-abrasive-blasting-explosive . I weld on fuel tanks regularly http://after-hours-welding.com/pages/welding/aluminum_fuel_tank_fabrication_and_repair.html . Since I’ve been doing it for ten plus years on dozens of them and I’m still alive, I believe it’s safe to call myself an expert. When we are ready to begin blasting on a gasoline tank, and we pull the trigger starting the process and the very first piece off abrasive comes out of our nozzle, that sand grain does NOT arrive faster than our stream of air propelling it.

If the sand grain or abrasive grain could arrive first, (**which it cannot**) then it could arrive into an area with a fume buildup of proper concentration and the spark generated could ignite the fumes. **However the sand grain cannot arrive first**. It's not possible. Something must be propelling that grain. In our case air is propelling that grain and the air is ALWAYS moving faster than the slower grain it is propelling along. IF THERE WERE FUMES, the moment our air blast stream gets there, **our huge volume (185 CFM) of air instantly pushes the fumes away from the area where the sand grain is to land upon next**. IF there had been fumes collected, **they are now purged away from the zone the abrasive is later landing upon**. Fumes CANNOT re-gather there since we are in a state of constant purge and our huge air supply will always keep any fumes pushed away from the small zone where we do generate sparks. Fumes may be nearby, but fumes cannot build up in our blast zone from our constant purge.

In the case of abrasive blasting, the air is always traveling much faster than the abrasive so our air always pushes away any buildup of fumes if there was even such a buildup. Or another way to say it is, our enormous influx of air is constantly diluting any possible fume build up so it cannot achieve a sufficient concentration for ignition. *On a slight side note: We have blasted at night in the dark. The abrasive hitting the steel makes for a most attractive spark/light show. In any given one second period, there may be 25 individual, see-able sparks. It is like a mini fireworks show*.

I loved this test. They poured gasoline on the metal piece to be blasted, they lit it on fire and continued pouring gas on it, they heated the metal up to above the boiling point where liquid gas was constantly forced to vaporize, when abrasive blasting was initiated, it put out the fire and could not reignite it even though it still had liquid gasoline on it boiling and vaporizing.
https://www.blastone.com/BlastOne/media/BlastOne/Tips%20of%20the%20Trade/Blasting-in-Inflammable-Atmospheres-Shell-Thornton-Full-Report.pdf

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