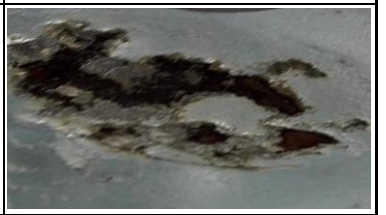
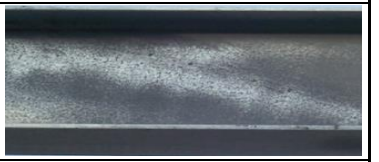
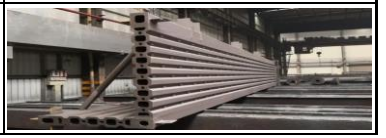
Inspection Guide and Hot Dip Galvanization Issues Analysis as per ASTM / AS / NZS / ISO

Nr.	Description	Cause	Effect & Remedy	Responsible Party	Action	Example
1	**Appearance of Sodium Dichromate** A small amount of sodium dichromate is generally added to the quench water bath for passivation	Although the recommended quantity of sodium dichromate is about 0, 15 to 0,3%, occasionally when topping up, more is added. This often results in a dark yellow to brown colour on the galvanized surface. The darker colour will provide enhanced initial corrosion protection.	Maintain concentration of sodium dichromate at about 0,15 to 0,3%.	Galvanizer	**Accepted**	
2	**Ash Deposits** Ash deposits are grey, no-metallic deposits consisting of zinc oxide that have been deposited no the hot dip galvanizing coating	Zinc oxide deposits take place when the component is dipped or when it is removed from the both.	The coating is normally intact underneath the ash deposits. Ash must be removed and the coating thickness verified for conformance to the specification requirements. Remove ash from all liquid conveyance pipes.	Galvanizer	**Depends upon the percentage and size of the ash deposit. Repair and cleaning is required. If the percentage of ash deposit is rather big, this will lead to rejection.**	
3	**Uncoted/Bare Spots** Although excluded from ISO 1461, bare spots of about 5mm (2,2 x 2,2mm), due to small localised flows, ore adequately protected by the sacrificial properties of zinc and will have very little effect on the service life of the coaling. Where necessary, such spots may be repaired using one of the specified repair methods. Gross uncoated areas ore a cause for rejection. See Coating Repair Procedures.	There are several causes of bare spots: **Over -drying**: If the time between fluxing and hot dip galvanizing is prolonged or the drying temperature is too high, the barrier protection provided by the flux may be lost. This is indicated by a rusty appearance on the un-galvanized article, which can result in coating discontinuities after hot dip galvanizing. **Excess** - aluminum: A condition sometimes referred to as black. Spats may occur if the aluminum content of a bath becomes too high. No trouble should be experienced if flux concentration is correct and the aluminum content of the both is maintained below approximately 0,007%. **Other causes**: Blowouts; flux deposits; stains and inclusions; mechanical damage; touch marks; uncoated surfaces caused by - surface contaminants, scale or sand; welds and weld spatter. Also see Nr. 6, 16, 19, 30, 33, 34, 35 and 37.		Galvanizer	**Depends upon the percentage and size of the bare spots. Repair is required. If the bare spot area is bigger than specified limit, this will lead to rejection.**	
4	**Steel Material Inspection** Inspection prior to hot dip galvanizing is extremely important.	Components should be checked for distortion caused during rolling or fabrication. Check for appropriate vent, fill and drainage holes: removal of weld slag and spatter; venting of overlapping surfaces; unsuitable joining materials; temporary identification markings; clearance for moving ports and potential distortion due to the process.	Insufficient inspection prior to hot dip galvanizing can be the cause of dispute.	Galvanizer	**Acceptance or Rejection**	
5	**Blasting Damage** Sweep blasting, dune correctly, substantially increases paint adhesion and final coating appearance hut done incorrectly can result in coating damage.	Incurred nozzle pressure; nozzle angle; sweeping distance; size of abrasive and recycling of grit.	A hot dip galvanized coating wil be partially or fully destroyed by excessive blasting.	Fabricator	**Rejected**	
6	**Blow Outs** Staining and coating defects around unsealed weld areas and vent holes. Similar to stains ceased by weeping. See SC 28.	Pre-treatment chemicals penetrating sealed overlap areas through the required vent holes and escaping during immersion in the molten zinc. This effect tends to damage the flux coating, causing localized uncoated areas.	Pre-heat item prior to immersion in zinc both to dry out overlap area as much as possible.	Galvanizer & Designer	**Acceptance with condiction. The blow outs often require repair.**	
7	**Clogged Holes** Zinc film clogging or partly bridging holes.	Molten zinc has a high surface tension and will not easily drain from holes under 8mm in diameter.	Makes holes as large as possible. Removal of molten zinc over the bath and utilization of vibrators will reduce the likelihood of clogging	Galvanizer	**Repair work is required.**	
8	**Clogged Threads** Threaded components or attachments have threads dogged with zinc.	Insufficient centrifuging or poor drainage of threaded attachments on withdrawal from the galvanizing bath.	The correct centrifuging equipment or post galvanizing thread cleaning by heating, wire brushing or oversize tapping of nuts, will generally remove clogging. If necessary specify delivery of bolts end nuts in nutted up farm.	Galvanizer	**Rejected, and fitting with nuts is required after the repair.**	
9	**Design structures with optimum dimension to fit bath size.**	Double dipping can sometimes be used to hot dip galvanize fabrications that are too long or wide far single immersion. If the fabrication exceeds the bath size, members in the fabrication may require touching up.	If the design of the steel workpiece fits to the galvanizing bath, touch up and repair can be avoided, the cost of hot dip galvanizing will reduced and the overall quality improved.	Designer & Fabricator	**Acceptance with condiction.If touch-up, cleaning, and double dipping is required.**	

Fabmann
The Sheet Metal Fabrication Specialist

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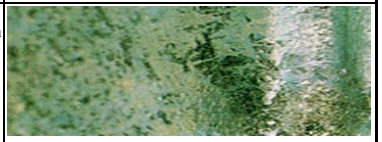
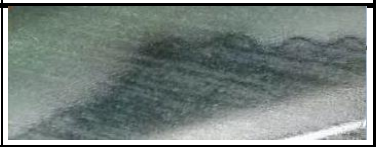
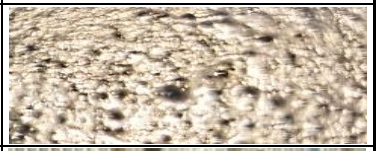
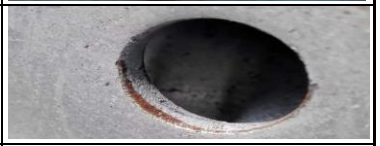
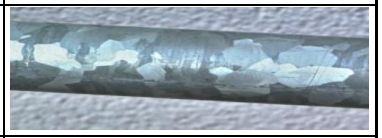
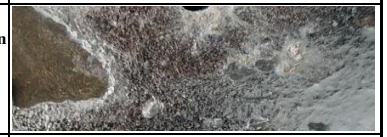
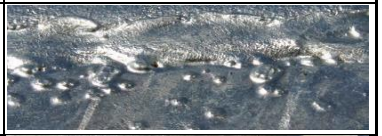
Nr.	Description	Cause	Effect & Remedy	Responsible Party	Action	Example
11	**Warping & Distortion** Distortion is the unwanted warping that occasionally becomes evidents after hot dip galvanizing. The hot dip galvanizing process occurs ala molten zinc temperature of 450° C. This is at the lower end of stress relieving temperature for treating steel	Thus, any inherent rolling or welding stresses in the fabrication, are likely to be released. This may result in a dimensional change, i.e. distortion.	Use symmetrical designs & sections of similar thickness; Stiffen unsupported thin wall sections; Use preformed members with the correct minimum bend radii & balanced or staggered welding techniques; Make use of temporary braces on thin walled sections such as troughs, cylinders and angle frames. Avoid quenching after galvanizing. Components can be straightened after hot dip galvanizing.	Designer & Fabricator	**Negoation is required by the buyer and galvanizer. This will also lead to repair.**	
12	**Drainage Spikes** Spikes and teardrops of zinc often appear along the edge of a component after hot dip galvanizing.	The edge mast likely to have these spikes is the last to leave the bath on withdrawal. This applies particularly to complex fabrications.	Drainage spikes are easily removed at the bath while still molten but with complex fabrications, the solidified spikes will be removed by fettling by the galvanizer prior to inspection.	Galvanizer	**Acceptance with condition, the drainage spikes needs to grinded.**	
13	**Dross** Dross particles are iron/zinc alloy crystals produced when hot dip galvanizing steel. These precipitate to the bottom of the bath and are removed by the galvanizer.	Gross dross deposit from the bottom of the zinc both, trapped in the corner of a fabrication. The dross incorporated in the coating prevents drainage of the zinc in the intermediate area and a buildup occurs.	Dross consists of the same iron/zinc alloy as the coating, it will provide the same corrosion protection as a normal hot dip galvanized coating.	Galvanizer	**Acceptance with condiction, the dross needs to be cleaned.**	
14	**Dull Grey or Mottled Zinc Coating** Dull grey or mottled coatings can appear as a dark grey circular pattern, a localized dull patch or, may extend over the entire surface of the component.	This appearance indicates the presence of extensive iron/zinc allay phase growth, mused by steels with high reactive levels of Silicon and Phosphorous in steels.	Although not as aesthetically pleasing as a coating with free zinc on the surface, a dull grey coating provides similar or hotter corrosion protection.	Galvanizer	**Acceptance**	
15	**Flaking or Declamination of Zinc Coating** No adhesion of zinc to steel surface. Thick, rough coating.	High phosphorous content (greater) than 0, 03% causes entire coating to delaminate from the steel.	Use a steel that has a phosphorous content of lower than 0, 03%.	Steel Raw Material Supplier & Fabricator & Designer	**Reject**	
16	**Flux Deposits, Stains and Inclusions** Flux deposit or stains from the galvanizing process may adhere to the steel or become included in the coating. Flux residues are black, brown, grey or yellowish non-metallic deposits consisting mainly of ammonium chloride.	Flux deposits or stains may occur as a result of excessive "dusting" with ammonium chloride on withdrawal from the molten zinc. Flux inclusions can occur when a surface flux blanket is applied to the zinc surface (wet galvanizing). Flux blankets are normally only used for specialized processes, e.g. galvanizing of tubes and fasteners.	Flux deposits or stains should be removed, and inspector needs to determine whether ammonium chloride conforms to the minimum requirements of the specification.	Galvanizer	**Acceptance with condition if flux deposit situation is not severe, and galvanizer needs to clean the flux deposits**	
17	**Discoloration of Paint Coating over HDG**	Inadequate repair of a damaged surface on the hot dip galvanized coating prior to the application of a paint coating.	Make use of the correct repair materials and application procedures when touching up cut or welded hot dip galvanized components.	Fabricator	**Rejection, rework is required.**	
18	**Coating Thickness on Fasteners for Hot Dip Galvanized Structures.**	No matter how the zinc coating is applied, the coating life is proportional to its thickness in a given environment. Often electroplated fasteners with insufficient coating thickness are incorrectly used in external environments.	Specify hot dip galvanized fasteners to ISO 1461, where required. Alternatively overcoat fastener with an approved zinc rich point or epoxy.	Fabricator	**Rejected, rework is required.**	
19	**Mechanical Damage** Mechanical handling or transports damage may occurs, particularly with extremely thick coatings, which is tend to be brittle in nature.	The use of chains, wire ropes, dragging or dropping of the component onto a hard surface, can cause mechanical damage. This is particularly relevant with thick brittle coatings.	Warning labels, highlighting a thick coating and possible damage if manhandled, should be attached by the galvanizer, before the component is transported. The use of nylon lifting slings is recommended.	Galvanizer	**Acceptance with condition, the damaged parts shall either be sorted out or repaired.**	

Nr.	Description	Cause	Effect & Remedy	Responsible Party	Action	Example
20	**Oxide Line** Light aluminium oxide film lines on hot dip galvanized surface.	Due to the shape and/ or drainage conditions of some components, the hoist crane has stopped and started upon withdrawal of the items from the molten zinc.	No effect on corrosion resistance. The overall appearance becomes uniform in time.	Galvanizer	**Acceptance**	
21	**Pimples or Blisters** Pimples or Blistering formed during Hot-dip galvanizing are usually associated with surface imperfections such as dross inclusions.	Dross pimples result from agitation of the dross layer at the bottom of the bath or from dragging material through the dross layer. They appear as small, hard lumps on an otherwise normal galvanized surface. Blisters may be formed by hydrogen, which is absorbed daring pickling and diffused at galvanizing temperatures.	The galvanizer should avoid disturbing the dross layer at the bottom of the bath by controlling immersion depths and dressing regularly. Since dross pimples represent minor disturbances in coating uniformity, they do not affect corrosion resistance.	Galvanizer	**Acceptance, clean if nessary**	
22	**Reactive & Non -Reactive Steel, Welded Together** Variations in coating thicknesses can arise when reactive and non - reactive steel welded togethers. Efforts to increase to coating thickness on the less reactive steel may result in an undesirably thick and brittle coating on the most reactive steel.	This difference in coating thickness, is brought about by a combination of a more reactive silicon killed steel, and/or high phosphorous resulting in a thicker coating and a less reactive aluminium killed steel, resulting in a coating thickness sometimes below that required in the specifications. Should the galvanizer be asked to re-galvanize in accordance with the specification, the resultant coating thickness on the reactive steel will be excessively thick, resulting in a brittle coating more susceptible to damage.	Select the same steel for fabricating a component. If need be, accept a concession request by the galvanizer when the thinner coating is possibly below specification.	Fabricator	**Negoation is required by the buyer and fabricator.**	
23	**Over Grinding of Zinc Coating** Unless otherwise agreed, the galvanizer will limit cleaning of the final coating by mechanical means to that required in the specifications.	Excessive cleaning of the coating, particularly the edges, by mechanical methods, can result in uncoated areas.	The affected areas usually only appear after the component is installed. Care should be exercised by the galvanizer to avoid over cleaning.	Galvanizer	**Reject, and repair is required for over grinded area**	
24	**Rolling Defects in Steel** These defects may be broadly classified as surface discontinuities in the steel that have been elongated dring rolling.	Steel may occasionally include laminations, laps, folds and nonmetallic impurities, which result in slivers rolled into the metal surface. Defects of this type are sometimes detected before or after pickling, but may only become apparent after hot dip galvanizing.	Surface flaws in the base material may be removed by local grinding after hot dip galvanizing followed by repair of the affected surface. Minor surface defects will not adversely influence coating life.	Steel Supplier	**Acceptance**	
25	**Rough zinc coating due to steel surface condition**	Rough surfaces, typical of coatings on corroded steel surfaces, can be hot dip galvanized satisfactorily. The coating will, however, reflect the texture of the substrate. Other causes of rough surfaces include uneven cold working, over pickling, a high galvanizing temperature and/ or extended immersion in the molten zinc.	he rougher surface will produce a thicker coating and result in a longer service life.	Steel Supplier	**Acceptance**	
26	**Rough and Thick Zinc Coating Due To Chemical Composition.**	Rough, heavy coatings refer to hot dip galvanized components showing markedly rough surfaces. This can include coatings that have a generally rough surface and, in some cases, groove type surface configurations, "tree bark effect" caused by variations in surface steel analysis.	The thicker coating produced will provide greater corrosion protection. Except when the coating tends to flake off or delaminate.	Steel Supplier	**Reject if the thick coating tends to flake or delaminate.**	
27	**Rough and Thick Coating Caused by Poor Centrifuging.**	Efficient centrifuging, will generally remove excess zinc and provide a smooth and attractive exterior.	Provided the steal/casting surface is reasonably smooth, correctly centrifuged articles will provide an acceptable finish.	Galvanizer	**Rejection**	
28	**Stains Caused By Weeping**	The salts from acid or flex that have penetrated porous welding or between contact surfaces during pickling can weep after hot dip galvanizing and water quenching, producing a stained area.	The stains can be easily removed by Should the component be destined for a corrosive area, the crevice should be sealed with a sealant after cleaning.	Designer & Fabricator	**Acceptable if repairable**	

Nr.	Description	Cause	Effect & Remedy	Responsible Party	Action	Example
29	**Zinc Coating Lumps**	Heavy walls and thick flanges used in the manufacture of piping can act as a heat sink when immersed in molten zinc. This effect considerably lengthens the immersion time. Occasionally the galvanizer will remove the pipes before all the zinc has melted from the inside of the pipe.	The galvanizer should ensure all zinc hen been removed from the side of the pipe by longer immersion times.	Galvanizer	**Acceptable if zinc coating lumps could be removed without damage the galvanized steel work.**	
30	**Touch Marks** The zinc in the galvanizing bath should have free access to all component surfaces or small unmated or damaged areas can results.	Articles entering the galvanizing baths should not be in tight contact with each other. Jigging wire should also be loosely attached to eliminate wire marks. Where a component has been resting on jigging or dipping equipment, an uncoated area an touch mark could appear.	Minimize contact between components and jig connections. (Loosen jigging wire). Small components can be centrifuged.	Galvanizer	**Reject**	
31	**Spangled Hot Dip Galvanization Coating** A typical hot dip galvanized surface is shown in the example. The surface is silver grey in color and not necessary but often as a spangled effects (Zinc Crystal) in a range of sizes.	Surface appearances may vary according to the chemical composition of the steel. Cooling rate has a direct effect on the surface brightness and spangle size. Easter cooling usually results in a brighter coating with a smaller spangle size.	Small additions of aluminium to the molten zinc, brightens the coating.	Galvanizer	**Acceptance**	
32	**Uneven Drainage** Uneven drainage results in an uneven or lumpy area on which zinc build op has occurred.	This condition can occur over the entire surface Grin isolated areas. Uneven drainage also includes drips en the ends of ports, runs near halos. The cause is withdrawal speed too high or low galvanizing temperature.	Although not particularly attractive, this condition dons not adversely affect coating performance. Protuberances and lumps, which interfere with mating surfaces are unacceptable.	Galvanizer	**Acceptance, Clean if necessary**	
33	**Uncoated Surface Due To Steel Contamination or Entrapped Air.**	CONVENTIONAL FIXING METHODS. result in localized un-galvanized areas in an otherwise continuous galvanized coating. Defects after galvanizing can vary in color from grey black to brown while no galvanized coating has been formed.	Ensure all paint or grease is removed prior to hot dip galvanizing. Make usual suitable marking pens for temporary identification. Correctly position adequately sized vent hubs.	Galvanizer	**Acceptance with condition if uncoated area is small, and repair work is required.**	
34	**Uncoated Spots Caused by Scale or Dirt**	Sand on cast iron or scale on the steel surface is generally caused by the process used to form or roll the product. A localized un-galvanized area in an otherwise continuous coating can occur if scale or sand from the moulding or rolling is not removed by acid pickling or abrasive blasting.	These ungalvanized areas may occur in a linear pattern on angles, channels or other rolled products. They can also appear on cast iron products.	Galvanizer	**Reject if the uncoatd spots are beyond specification**	
35	**Uncoated Area Around Welds**	A localized un-galvanized area near a weld can be caused by weld slug deposit, weld porosity or weld undercut. Oxide deposits and residues from welding are resistant to normal pickling adds and mint be removed before the work is pickled and hot dip galvanized.	Weld slag deposits should be removed by fabricators by means of abrasive blast cleaning. The deposit can also be removed by proper chipping or wire brushing. Shielded arc welding as opposed to slick welding is preferred for components which are to hot dip galvanized.	Fabricator	**Reject if uncoated spots are beyond specification. Repair work is certainly required.**	
36	**Repair Damaged Zinc Coating Caused By Welding or Non-Conventional Fixing Solution**	Conventional drilling and bolting after hot dip galvanizing is preferred. Should welding or noon-conventional method of fixing be used, resulting in damage to the coating, an approved repair method is necessary.	Coating repair can be done by spraying zinc rich painter epoxy, providing the product conforms to the requirements of the specification.	Designer & Fabricator	**Acceptance & Repair zinc coating is required.**	
37	**Weld Spatters** Weld spatter is oxidized, normally spherical expelled weld metal, that is fused or not onto the surrounding material during welding.	Weld spatter is caused by weld pool explosions when improper welding parameters are used, or if the material is dirty or contaminated.	Loosely adherent weld spatter should be removed prior to hot dip galvanizing. Although not acceptable in terms of the specification the presence of tightly adherent weld spatter after hot dip galvanizing will not affect the corrosion resistant properties of the coating.	Fabricator	**Acceptance with condition, and those loose weld spatters needs to be removed with zinc repair.**	
38	**White Rust** Wet storage stains and white rust as it is commonly called, is a white voluminous deposit that is occasionally found on the surface of freshly galvanized coating.	Wet storage stain (zinc hydroxide) is formed on freshly galvanized surfaces whirls are in close contact in presence of moisture. Freshly galvanized coatings react with the environment until such time as a stable zinc carbonate film is formed on the cooling surface.	Wet storage stain ceases when the cause is eliminated. If the coating thickness at the affected area is equal to, or greater than the minimum required in the specification, it is not a cause for rejection, other than for aesthetic reasons. The latter is subject to discussion with the end user. Customer is to exercise caution during transport and storage.	Galvanizer	**Acceptance, and cleaning is required.**	

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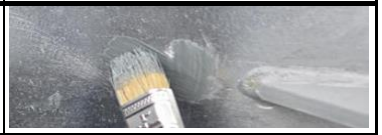
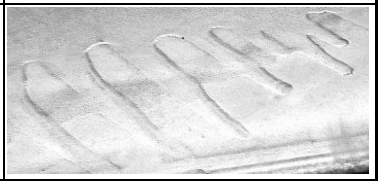
39	**Zinc spray repair is done to poor blasted or wire brushed surface**	In order for zinc metal spraying to adhere on application, the damaged galvanized surface mast be adequately blasted. As it is difficult not to over spray, excess zinc metal spray loosely adheres to the surrounding coating.	Prepare surface for repair by adequate blasting. Loosely applied zinc metal sprayed coating at the perimeter of the repair should be removed by wire brushing.	Galvanizer & Fabricator	**Acceptance with condition, rework is required.**	
40	**Zinc Splatter** Splashes or flakes of loosely adherent zinc, caused by moisture on the steel surface when hot dip galvanizing.	When hot dip galvanizing an unusually deep fabrication by double dipping, moisture and the surface of the steel contacts with the molten zinc causing splashes of zinc to loosely adhere to the already hot dip galvanized surface.	The loosely adherent zinc splashes are easily removed. An experienced galvanizer can ensure the coating overlap on double end dipped surface, is not visible.	Galvanizer	**Acceptance, and rework is required.**	
41	**Excess Aluinium in Galvanizing Bath:** These are the black spots occurs on the steel surface.	When the excess aluminium is in the galvanizing bath, it creates black marks or bare spots on the steel surface.	These effects can be repaired only if small areas are evident. If this condition occurs over the entire part then it must be rejected.	Galvanizer	**Rejected**	
42	**Runs** These are the localized thick areas of zinc that occurs on the surface of galvanized elements.	These effects causes when zinc freezes on the surface of the galvanized elements during the removal from the zinc bath.	Unless they affect the intended use of steel part, not necessary to remove. If runs are unavoidable due to the design of the product, but will interfere with the intended application, they can be buffed.	Galvanizer	**Acceptance with condition, need to buff if it affects assembly.**	
43	**Rust Bleeding** These appears as a brown or red stain that leaks from unsealed joints aftet hot dip galvanization.	This effect caused by pre-treatment chemicals that penetrate through unsealed joint.	It can be cleaned up by washing the joint after the crystals are hydrolysed.	Galvanizer	**Acceptance, need to clean the rust bleeding.**	
44	**Striations** These are the parallel ridges in the galvanized coaings.	Striations are characterized by raised parallel ridges in the galvanized coating, which can be caused by the chemical composition of the steel. Striations are related to the type of steel that was galvanized, and while the appearance is affected, the performance of the corrosion protection is not striations are acceptable.	Fish-boning, similar to striations, is an irregular pattern over the entire surface of the steel part, which is caused by differences in the surface chemistry of a large diameter steel piece and variations in the reaction rate between the steel and molten zinc. These surface conditions do not affect the corrosion performance and are acceptable.	Galvanizer	**Acceptance**	
45	**Puddling**	These are caused by poor drainage also the Design issues are the main cause of puddling and can only be eliminated by good design. With the exception of blowouts and bleeding, and where the galvanizedcoating is missing, most galvanizing defects have no effect on the coatings' durability.	These defects are unavoidable in the hot-dip galvanising of general items and are acceptable as long as they do not interfere with the assembly of the function of the item or present a safety hazard in handling service.	Galvanizer	**Acceptance, but need to repair first.**