BATCH GALVANIZED STEEL OR CONTINUOUSLY COATED ZM GRADE STEELS
A true comparison

Batch galvanizing of steel products to EN ISO 1461

A wide range of steel products can be assured of lifetime protection through hot dip galvanizing, which is done after all cutting, welding and forming has been completed.
This is batch hot dip galvanizing to EN ISO 1461:

- **Complete coverage** by a thick coating of zinc, with typical coating thicknesses of 55-200 microns or more.
- **Proven performance** through many decades of experience.
- ISO standards to provide conservative, **reliable predictions of performance**.
- Coating **performance improving with time** as a stable patina forms on the surface.
- Optimal potential for **reuse** and **full recycling**.

Complete coverage

Recognised ISO standards

Proven performance over decades

Galvanizing after manufacture ensures complete coverage and long-term protection

Precoated ZM steels are not an equal alternative to batch galvanizing to EN ISO 1461. Five key facts you need to know...

1. Accelerated corrosion tests in the laboratory overstate the relative performance of ZM coatings.
2. Corrosion exposure tests using external test sites can provide misleading information and long-term performance is not proven.
3. Exposed edges after cutting of ZM coated steel creates a long-term weakness in protection.
4. Bending and forming of ZM coatings during manufacturing creates damage and long-term weakness in protection.
5. More complex products are difficult to reuse and recycle.

For more information, read our 'The Importance of the Correct Specification of Metallic Coatings for Steel'

Limitations of manufacturing a steel product from pre-coated steel sheets

To lower costs, some manufacturers of steel products may be tempted to replace batch galvanizing with the use of steel sheets that are pre-coated with zinc alloys and then to manufacture the components afterwards – with all the consequences of:

- **Thinner coatings** that are typical of pre-coated sheets, with typical coating thicknesses of just 15-25 microns for construction applications.
- **Damage to the coating** when forming and welding during manufacture.
- **Uncoated areas at all cut edges** across the product.

The limitations of using pre-coated sheet steels are also applicable to the new ranges of ZM pre-coated steels that are now available alongside other types of pre-coated steel (Z and ZA steels). Despite the claims you may have seen, quite simply - use of ZM pre-coated steels is not an equivalent replacement for batch galvanizing after manufacture.

Key facts in detail

1 Accelerated corrosion tests in the laboratory overstate the relative performance of ZM coatings

This is because their small magnesium content has a major effect in the tests that is not seen in real service conditions.

- ISO standards make it clear that tests such as the **ISO 9227 Neutral Salt Spray test should not be used to compare different coating types** – so it is alarming that producers of ZM steels are doing exactly that to overstate the performance of their products.
- Even **small changes in test conditions give large changes in results** – producers of ZM steels choose the test that produces the greatest influence of the magnesium content of their products.
- Similar **misleading conclusions can be drawn** from short-term tests in soils.

Accelerated corrosion tests cannot be trusted

2 Corrosion exposure tests at external test sites can provide misleading information and long-term performance of ZM coatings is not proven

These exposure tests are carefully constructed and chosen to demonstrate a suggested improvement in performance for ZM coatings.

- Results of exposure tests are of limited duration – often reported for only 6 years – and include the period of time, typically 1-2 years, when a batch galvanized coating is still building its protective stable patina at its surface. Conversely, the ZM coating may have its highest performance in those first years. By calculating comparative performance over such a short period, **the real picture for long-term protection of the steel component is not seen**.
- Comparative exposure tests cited in promotional materials by ZM steel producers **do not appear to be compliant** with the most appropriate procedures for removal of corrosion products in the 'weight loss' methods that should be used for such tests. ISO 8407:2020 requires a special method for the removal of corrosion products of ZM coatings. Most reported **studies sponsored by ZM steel producers use an alternative method that is known not to remove all the corrosion products of ZM coatings – leading to understated corrosion losses**.
- Comparative tests in real exposures, eg in tunnel environments, that have used the correct method of removal of corrosion products of ZM coatings, shows **no significant difference in performance between galvanized steel and ZM coated steel**. So, coating thickness and completeness of protection will determine ultimate durability.
- Comparative tests in real exposures are often carried out with the cut edges of the test panels artificially coated with a paint– masking the effect of the cut edges on performance during the test.

Corrosion at cut edges of a precoated steel product

3 Exposed edges after cutting of ZM coated steel creates a long-term weakness in protection

The sacrificial (galvanic) action of zinc will provide some protection to steel exposed at a cut edge. But **do you really want to intentionally design a steel product in that way?** The surrounding coating will sacrifice itself to try to protect the cut edge – **depleting the coating over time**...and with a precoated ZM steel that coating has limited thickness.

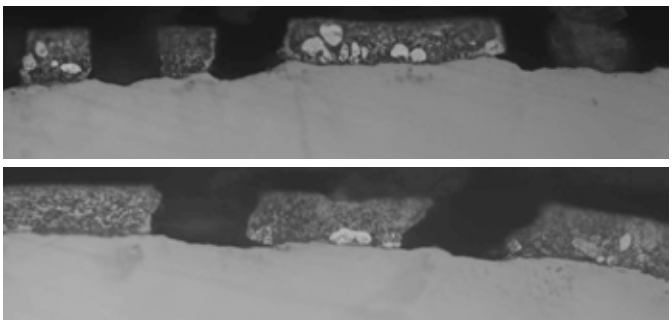
- Exposure performance studies when cut edges are not artificially coated for the test show significantly worse performance for ZM coated steels than when the edges are covered.
- Tests have shown the complete loss of up to 3mm of a ZM coating surrounding a cut edge that is exposed for only 3 years.

4 Bending and forming of ZM coatings during manufacturing creates damage and long-term weakness in protection

Although they are thin, **ZM coatings lack the formability of traditional continuous Z and ZA precoated steels.**

- The coating structure is inherently brittle, leading to local damage and thinning of the coating on corners.
- The effect of these deformations on long-term performance is unknown but cannot be ignored.

Effect of forming on ZM coated steels



ZM coating on steel product after 180° bending (without mandrel).

Source: CENIM, Spain

5 More complex products are more difficult to reuse and recycle

Optimal design for circularity should, in addition to extended durability and potential for reuse, ensure that all constituent materials, in particular critical raw materials that are in limited supply, are recoverable.

- Steel products made from precoated ZM steel sheets **cannot be recoated later in the same way.**
- Steel products made from precoated ZM steel sheets cannot be easily stripped and batch galvanized because the presence of aluminium and magnesium in the coating **creates technical difficulties in the stripping and galvanizing procedure.**
- When steel products made from precoated ZM steel sheets enter the steel recycling electric arc furnace at ultimate end of life, their **aluminium and magnesium content cannot be recovered, and they will be lost forever** to the steelmaking slags. Crucially, **both aluminium and magnesium are listed as EU critical raw materials** and should be conserved. Zinc, due to its plentiful supply and high levels of recycling, is not listed as an EU critical raw material.

Metals used in protective coatings protection – listed as EU Critical Raw Materials with significant supply risk and obligations for substitution and for recovery and recycling[1]	Metals used in protective coatings – deemed to be plentiful and with low supply risk[2]
Magnesium	Zinc

[1] REGULATION (EU) 2024/1252 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 April 2024 establishing a framework for ensuring a secure and sustainable supply of critical raw materials and amending Regulations (EU) No 168/2013, (EU) 2018/858, (EU) 2018/1724 and (EU) 2019/1020 *(Article 26 requires Member States to 'increase the technological maturity of recycling technologies for critical raw materials and promote circular design, materials efficiency and substitution of critical raw materials in products and applications, at least by including support actions to that effect under national research and innovation programmes')*

[2] European Commission, Study on the EU's list of Critical Raw Materials – Final Report (2020)

When designing for recycling and reuse - batch galvanized coatings are simply more consistent with the circular economy

- Batch galvanized steel products are most likely to have sufficient durability to be reused over more than one product life cycle.
- Batch galvanized steel products can, if needed, be stripped and regalvanized in an entirely circular process that is proven today and already in operation for some products.
- When batch galvanized products enter the steel recycling electric arc furnace at ultimate end of life, the remaining zinc can be recovered through the established zinc recycling loop and returned to primary zinc production. Many thousand of tonnes of zinc are already recovered this way.