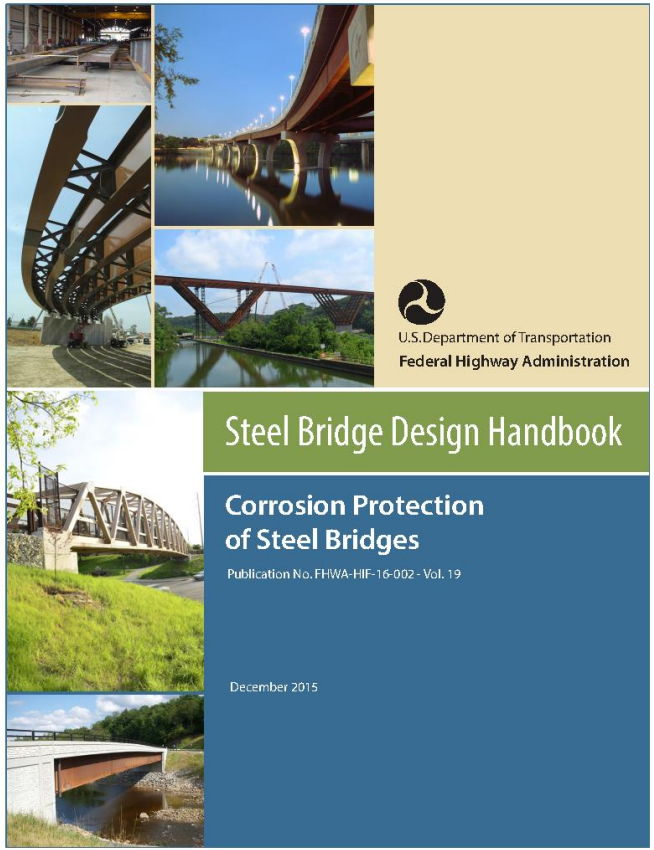
Modern Corrosion Protection Systems

Jeff Carlson

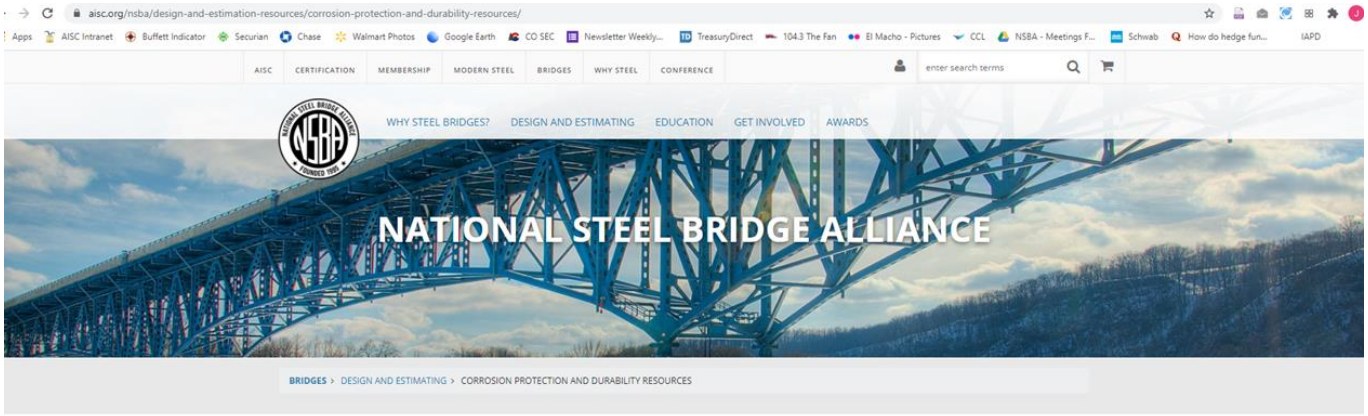
Smarter. Stronger. Steel.

Steel Bridge Design Handbook, Volume 19



NSBA Webpage

Go to: aisc.org/nsba/corrosionprotection



Corrosion Protection and Durability Resources

There are several proven ways to protect steel bridges from corrosion, and no single solution is best for all circumstances.

The first consideration when selecting one of these techniques is, of course, a bridge's anticipated exposure to corrosive elements over its lifetime. In addition, teams must consider initial and life-cycle costs, fabrication, productivity, and long-term performance and maintenance when choosing a corrosion protection approach for a given bridge.

General resources:

- **Volume 19 of The FHWA Steel Bridge Design Handbook** focuses on corrosion protection.
- **AASHTO's National Transportation Product Evaluation Program** (NTPEP) offers **a wealth of information** about various structural steel coatings.
- **The Society for Protective Coatings** (SSPC) issues and maintains many coating standards, including the **SSPC Good Painting Practice and Systems and Specifications Manuals**. Both the SSPC and the **National Association of Corrosion Engineers** (NACE) provide training and certification for coatings inspectors as well as coating contractors. These certifications help establish a quality threshold for the coatings industry.

Photo: Eads Bridge Over the Mississippi River, St. Louis, Missouri

Mitigation Strategies for Steel Bridges

What's Right For you?

- Uncoated Weathering Steel (UWS)
- Liquid Applied Coatings
- Thermal Spray Coatings (TSC, aka - Metallizing)
- Hot-Dip Galvanizing (HDG)
- A709-50CR (previously known as A1010)

Uncoated Weathering Steel (UWS)

Grade	Yield Strength (ksi)
36	36
50	50
50S	50
50W	50
HPS 50W	50
HPS 70W	70
HPS 100W	100
50CR	50
QST 50	50
QST 50S	50
QST 65	65
QST 70	70

From ASTM A709

- Grade designations ending in “W” are weathering grades.
  - They develop a stable patina that provides barrier corrosion protection
  - The patina controls the rate that oxygen can reach the bare steel underneath

Uncoated Weathering Steel (UWS)

Provides "barrier" protection

Well formed patina has a dark-chocolate, almost purple hue. Also has fine pinholes.

ASTM A709-50CR

- ~11% chrome
- Ferrite / tempered martensite (formally it's a martensitic stainless steel)
- Develops a brown colored patina like weathering steel

6yr. exposure McLean, VA (vertical)

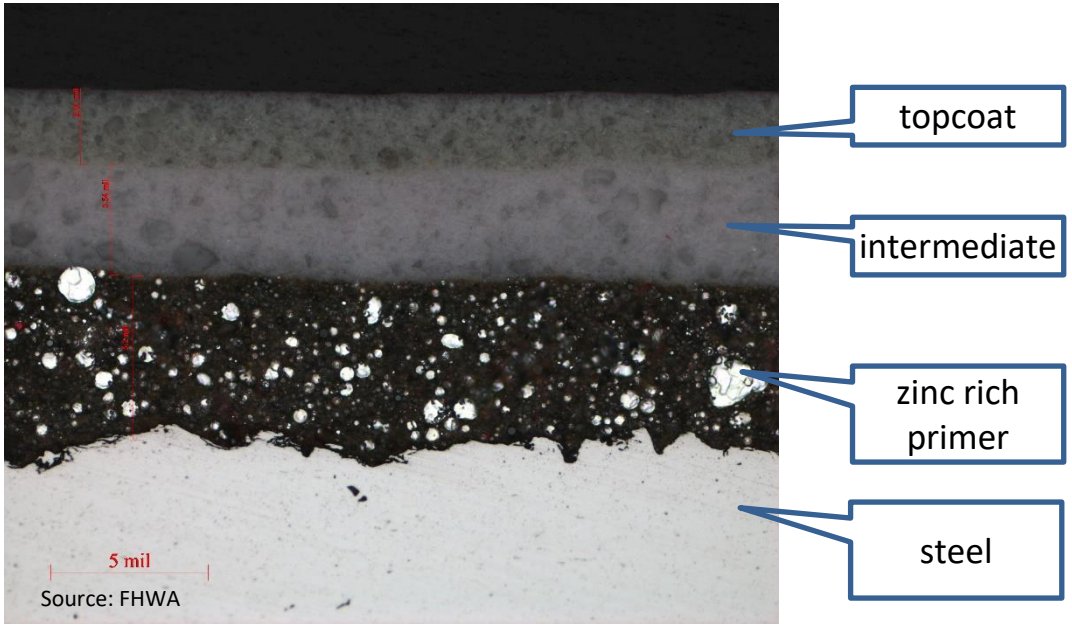
3 yr. exposure Hampton Roads, VA (horizontal)

9 mo. And 3 yr. (inset) exposure North Topsail, NC (vertical)

Modern Liquid Applied Coatings

Types & Definitions:

- IOZ – Inorganic Zinc Primer
- OZ – Organic Zinc Primer
- E – Epoxy (intermediate coat)
- U – Urethane (topcoat)



The Misperception Dilemma

Whittier Bridge - Massachusetts

This bridge utilized the old lead paint systems prior to implementation of current practices.

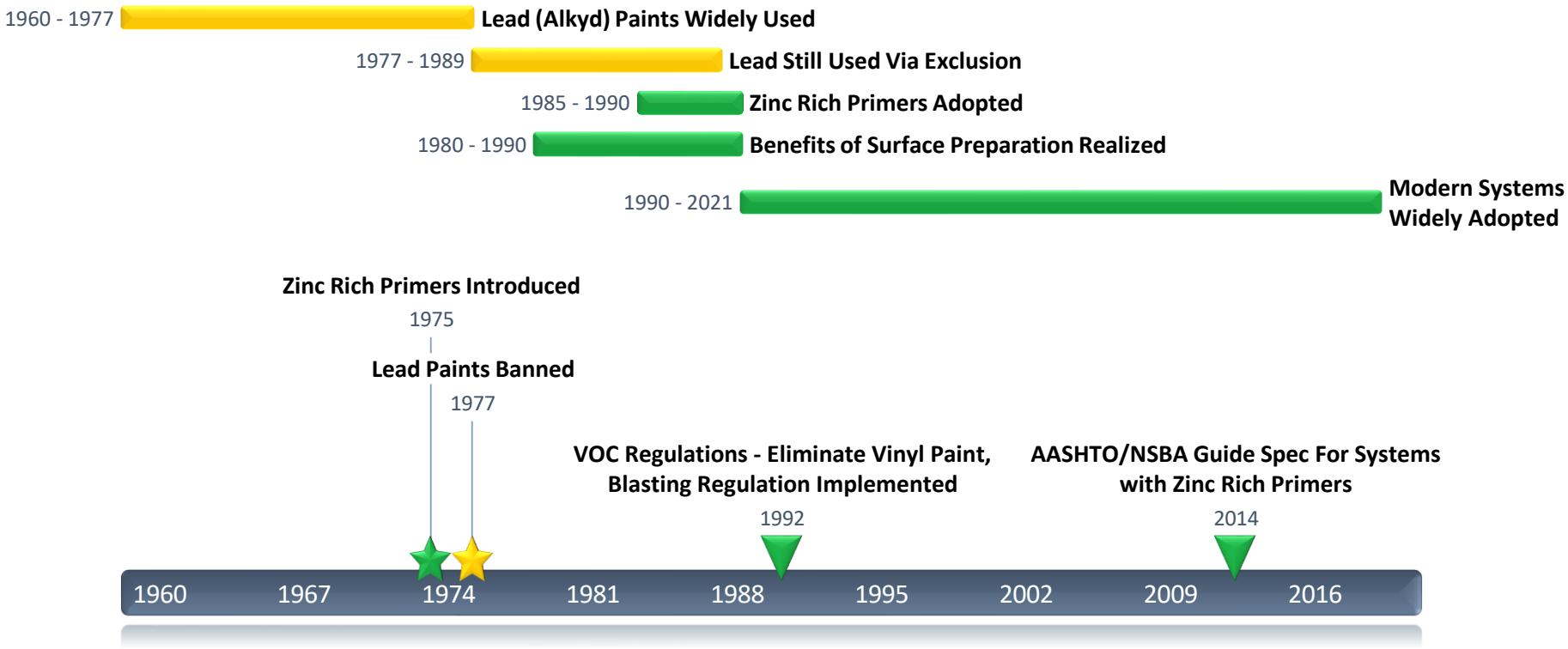
The Colorful History of Steel Bridge Paint Systems

1960 - 1977 **Lead (Alkyd) Paints Widely Used**

1990 - 2021 **Modern Systems Widely Adopted**

1960 1967 1974 1981 1988 1995 2002 2009 2016

The Colorful History of Steel Bridge Paint Systems



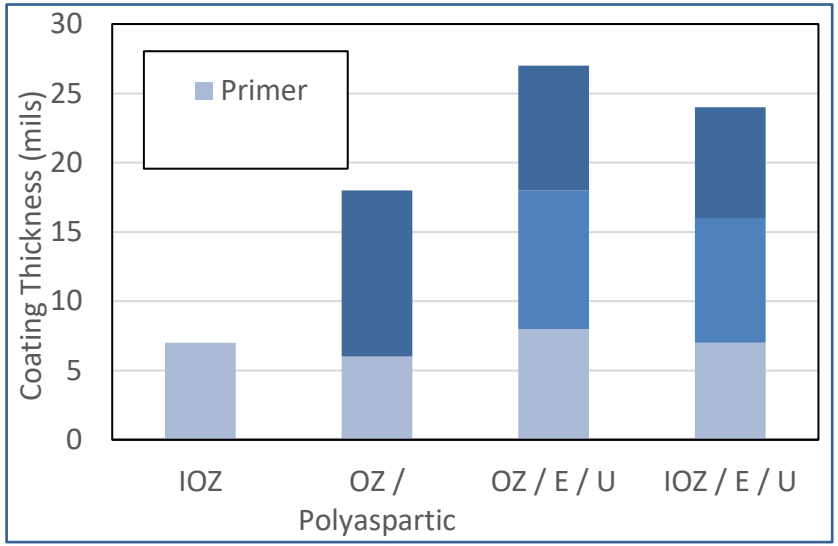
Old Liquid Applied Coatings

Liquid Applied Coatings

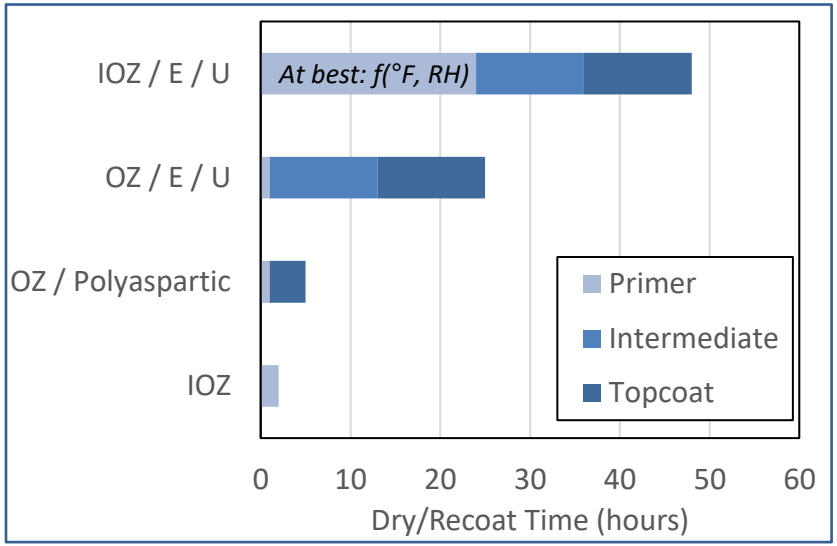
- Primarily “barrier” protection, however zinc-rich primer provides “cathodic” protection if exposed

Liquid Applied Coatings – Cost Implications

Consult With Local Fabricator



Source:
Random selection of qualified systems from http:\\data.ntpep.org\SSC (except for single-coat IOZ)



Source:
Medlock, R. (2020). "Two-Coat OZ/Polyaspartic Topcoat System for New Bridge Construction. Presentation delivered to Subcommittee AHD30(2), Annual Meeting of the Transportation Research Board.

Liquid Applied Coatings

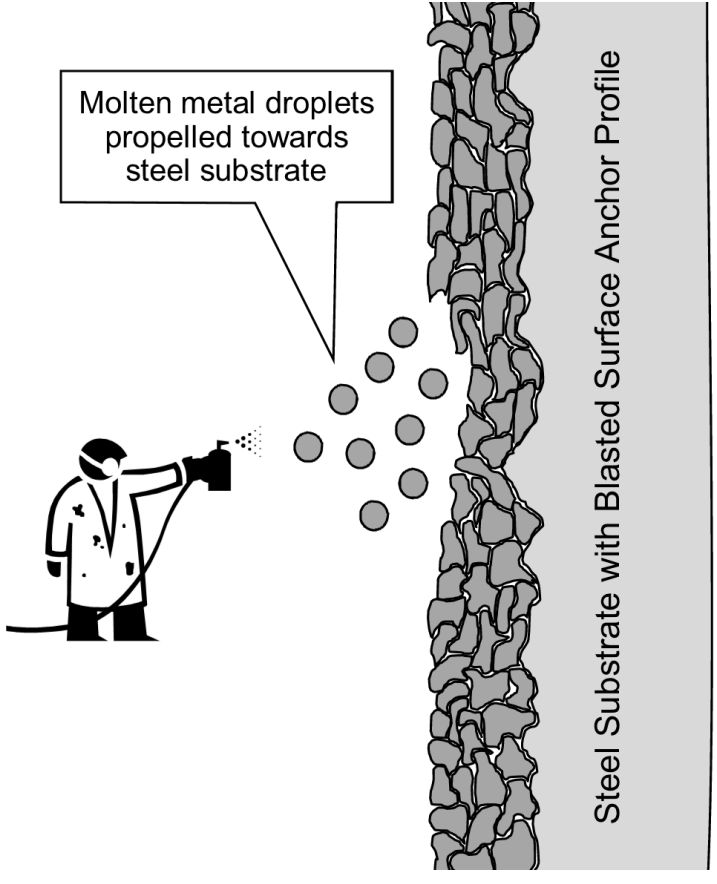
Workhorse systems

- 3-coat, OZ/Epoxy/Urethane
- 3-coat, IOZ/Epoxy/Urethane

Innovative systems

- IOZ only
- IOZ with acrylic topcoat
- 2-coat, OZ/polyaspartic

Thermal Spray Coatings (TSC) – aka Metallizing



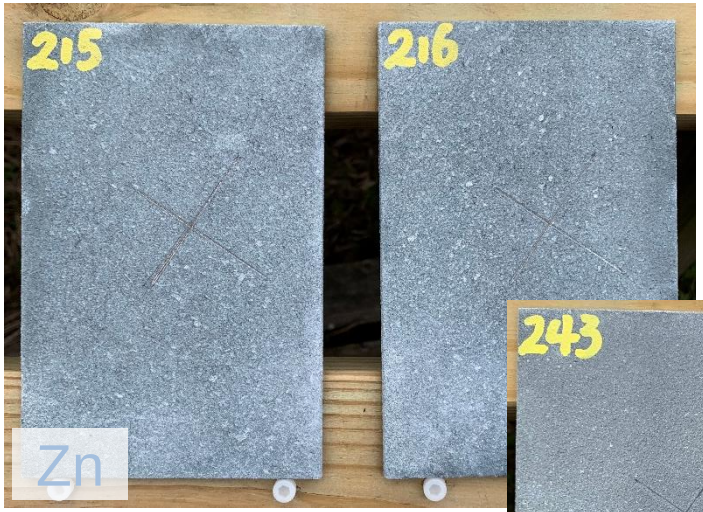
Common Alloys

Aluminum (Al)

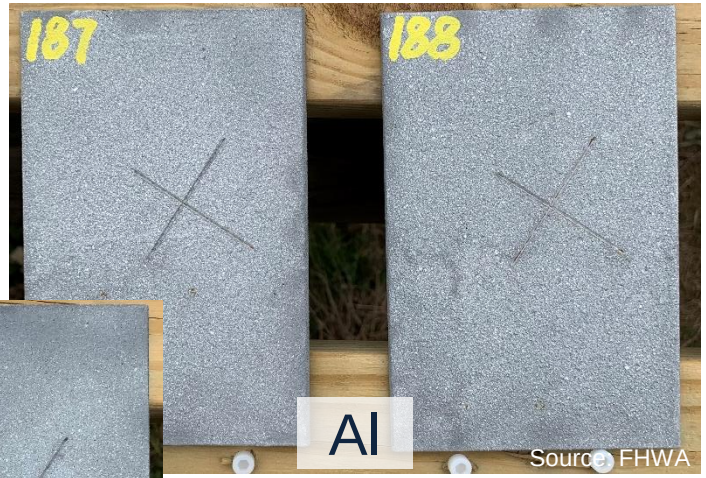
85/15 (Zn/Al) ---------- Most common

Zinc (Zn)

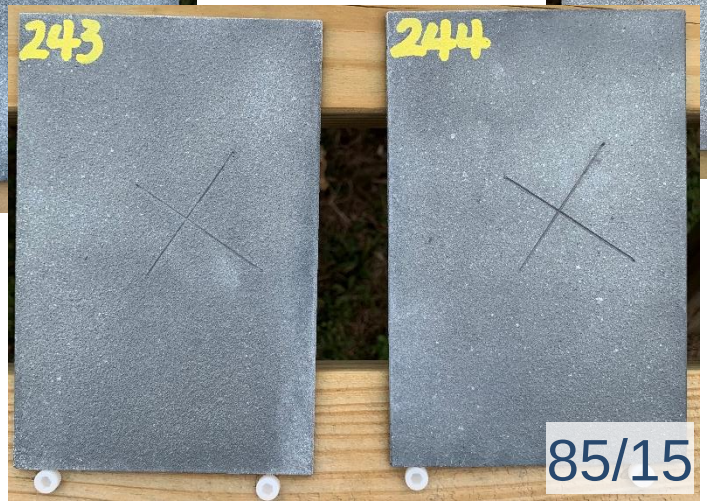
Thermal Spray Coatings (TSC)



Source: FHWA

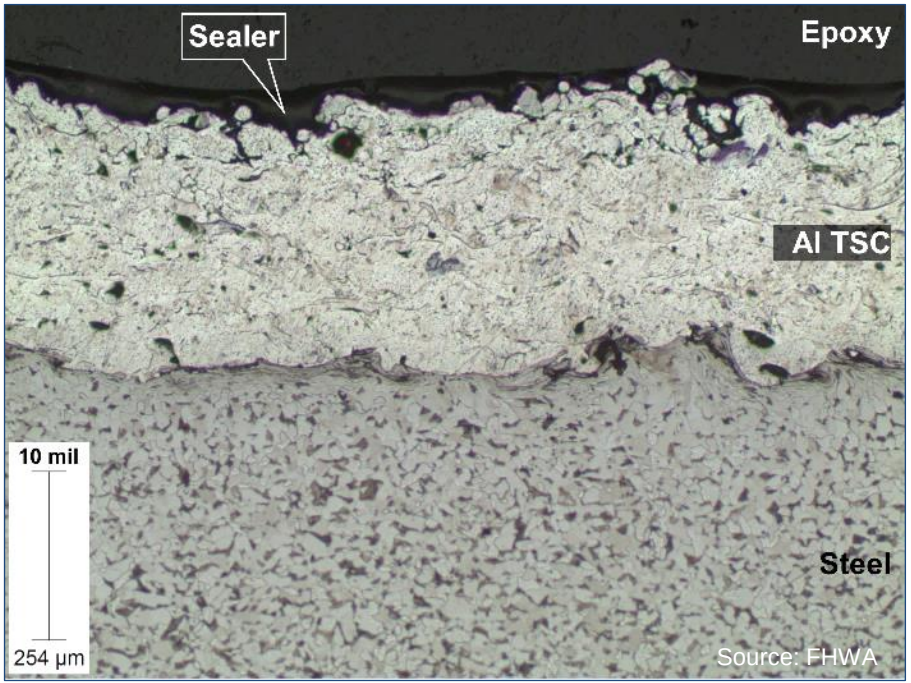


Source: FHWA



Source: FHWA

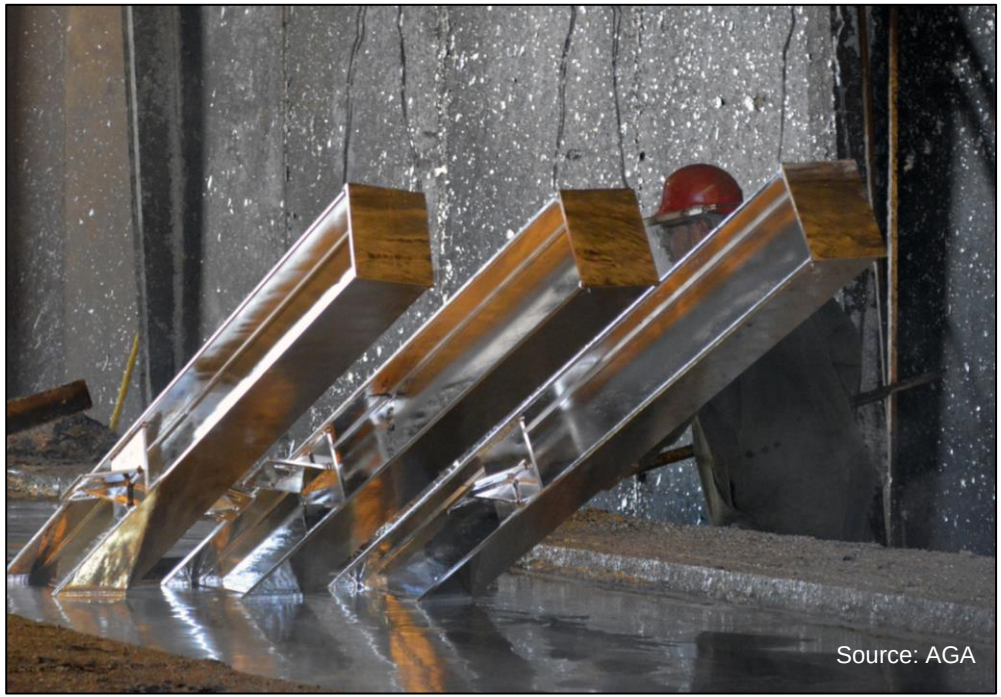
Thermal Spray Coatings (TSC)



Mostly “cathodic” protection

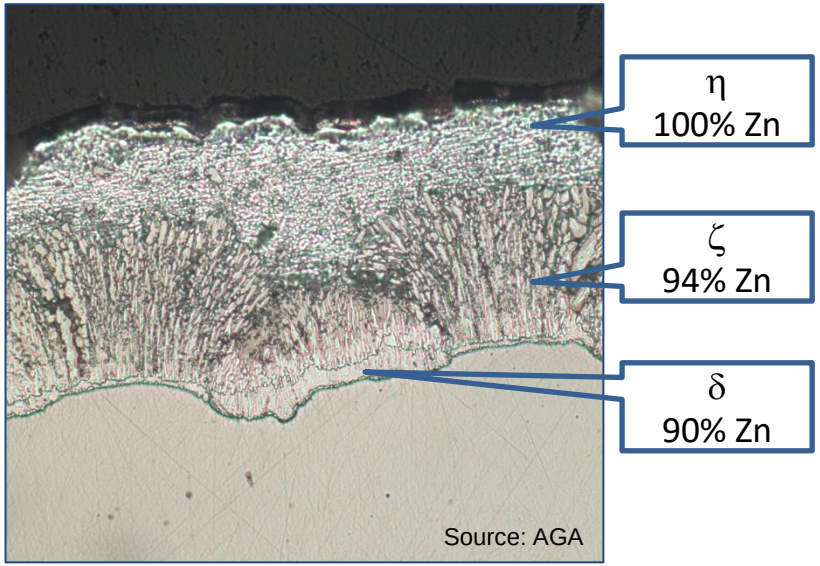
- TSC are porous – sealing is common, but not necessary
- Sealers are low-viscosity, liquid applied coatings meant to penetrate through pores
- Mechanical process, whereas HDG is chemical process

Hot-Dipped Galvanizing

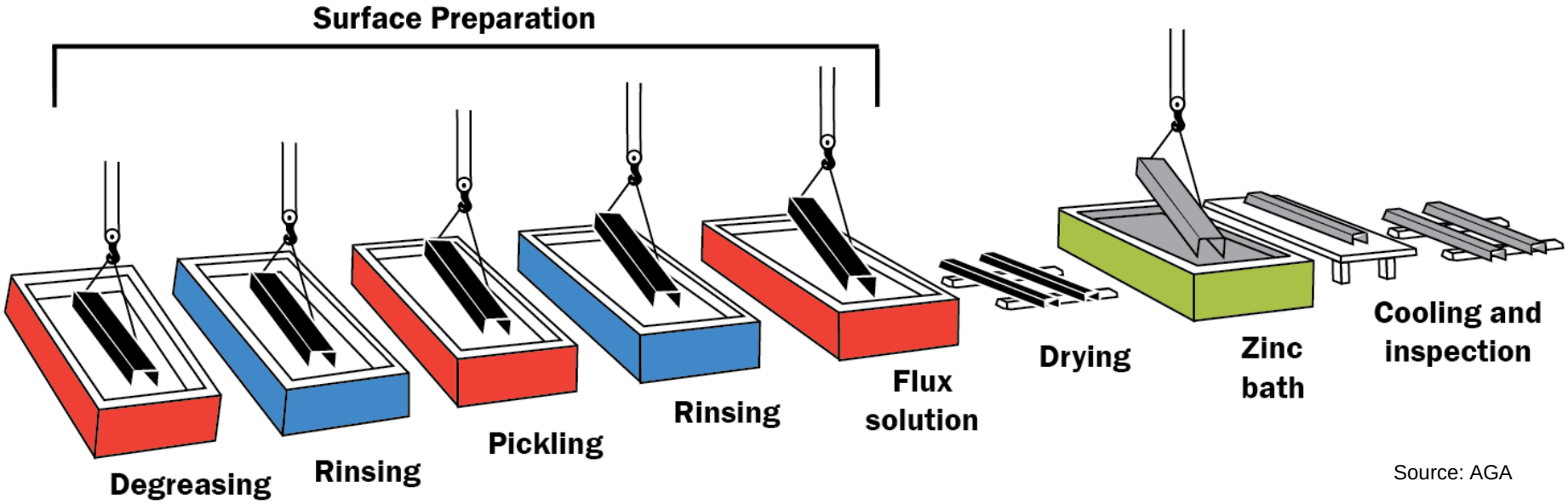


Both “barrier” and “cathodic” protection

- Dipping steel in ~830ºF zinc creates a metallurgical bond



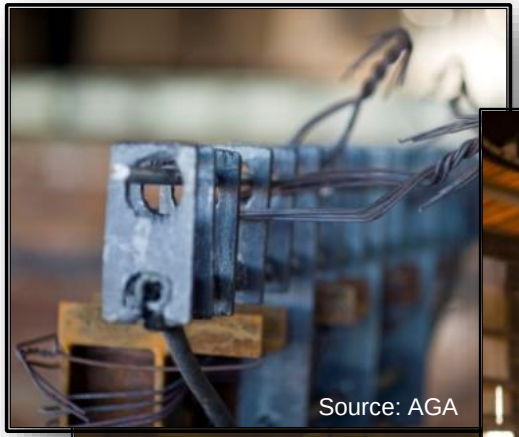
Hot-Dipped Galvanizing

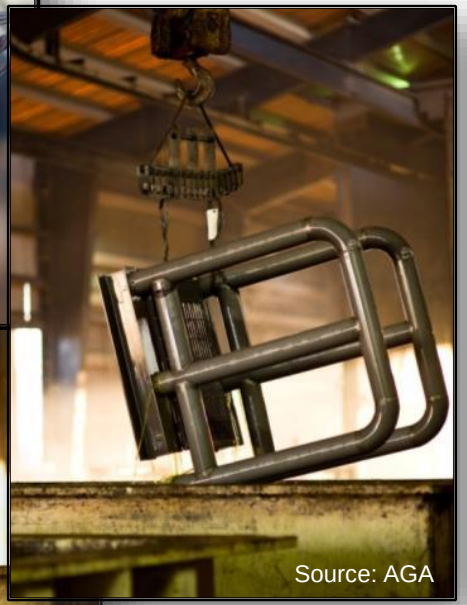


Source: AGA

Hot-Dipped Galvanizing – Surface Preparation

- Thorough cleaning is necessary as zinc will only react with clean steel
- Three cleaning solutions:
  - **Degreasing** – removes dirt, oils, organic residue
  - **Pickling** – removes mill scale and oxides
  - **Fluxing** – mild cleaning, protective layer
- Unclean areas will not grow zinc coating





Thank you

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