

Field Metalizing of a Steel Beam Bridge

HARDWICK VERMONT - VT RTE. 16 BR. 1

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Accelerated Innovation Deployment Demonstration Project – AID Grant Application

Purpose of Grant?

- Investigate alternative protective coatings for steel bridges.

Why Hardwick VT 16 Br. 1?

- No Right-of-Way required or Utility adjustments.
- Two lanes of unrestricted traffic easily maintained.
- Existing steel framing plan in good condition.
- Abutments in good condition and well protected.
- Good adjacent staging area.

Hardwick, VT

VT 16 Br. 1

- Concrete deck
- 6 Rolled Beams (Painted)
- Constructed in 1950
- 82 ft. c – c bearing
- NBIS Ratings:

Deck	7
Superstructure	8
Substructure	7
Paint	6

Existing ROW (red line)
provided adequate
staging for metalizing
equipment.

FIELD METALIZING OF STEEL
BEAM BRIDGE



Looking North

Bridge provides a 3-12-12-3 Typical Section



Elevation View



Fascia Beam



Interior Steel Beams

- 3 Coat Paint System applied in 1995
- Operations applied subsequent green grease coating



Paint System Deterioration

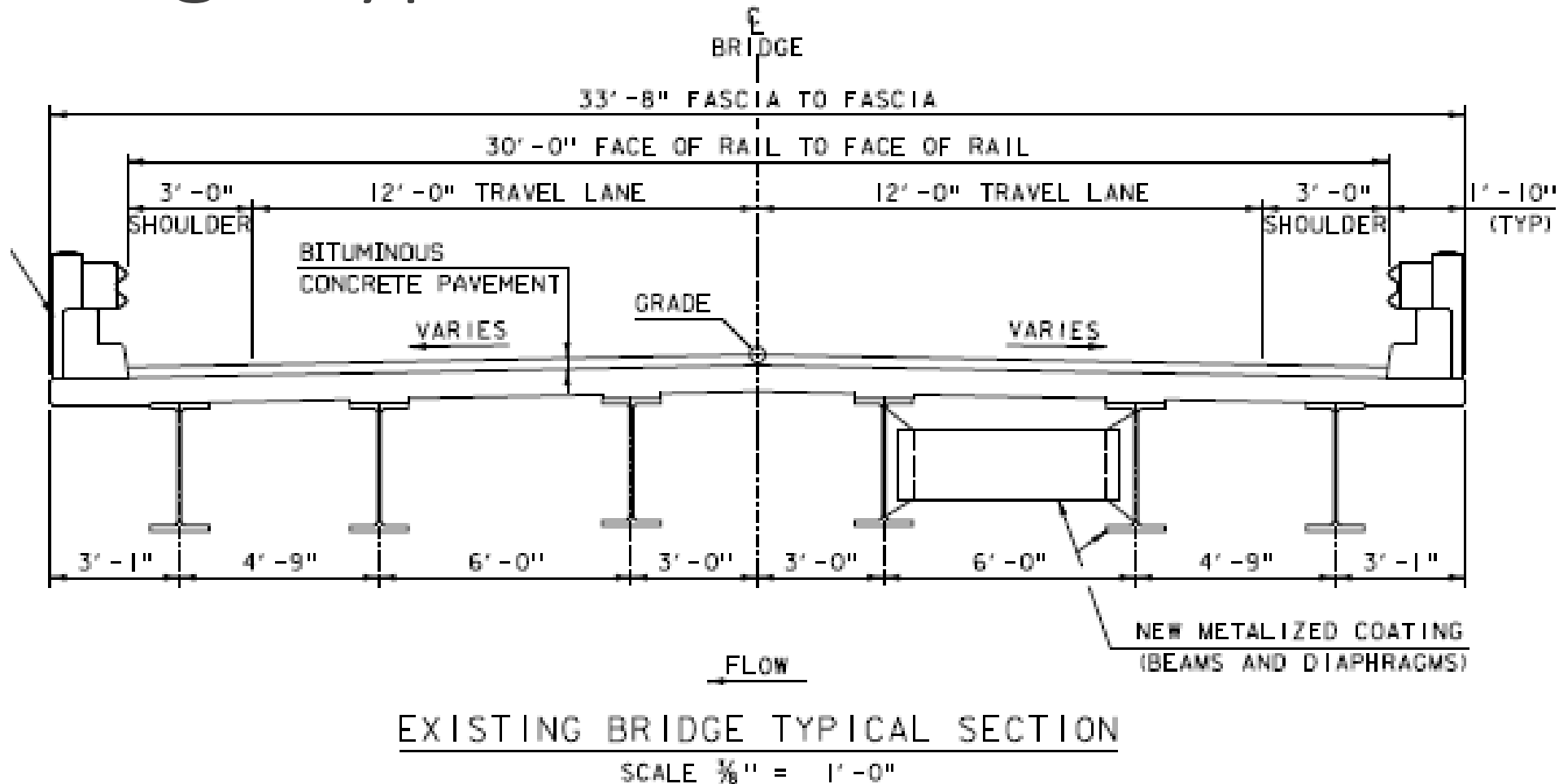
- Beam Ends and Bottom Flange
- No significant section loss to date



Loss of Paint System — Bottom Flange



Bridge Typical Section



Span – 82 ft.

6 – 36WF280 Rolled Beams

15 - MC 18 x42.7 Diaphragms

Total Weight of Structural Steel – 142,000 lbs.

Total Surface Area Coated: 5300 Sq. ft.

What is Metalizing?

Metalizing is the process of thermal spraying molten zinc on a prepared abrasively blasted surface. Metalizing creates an impermeable, non-porous, abrasion resistant and well-bonded, corrosion resistant coating for steel.

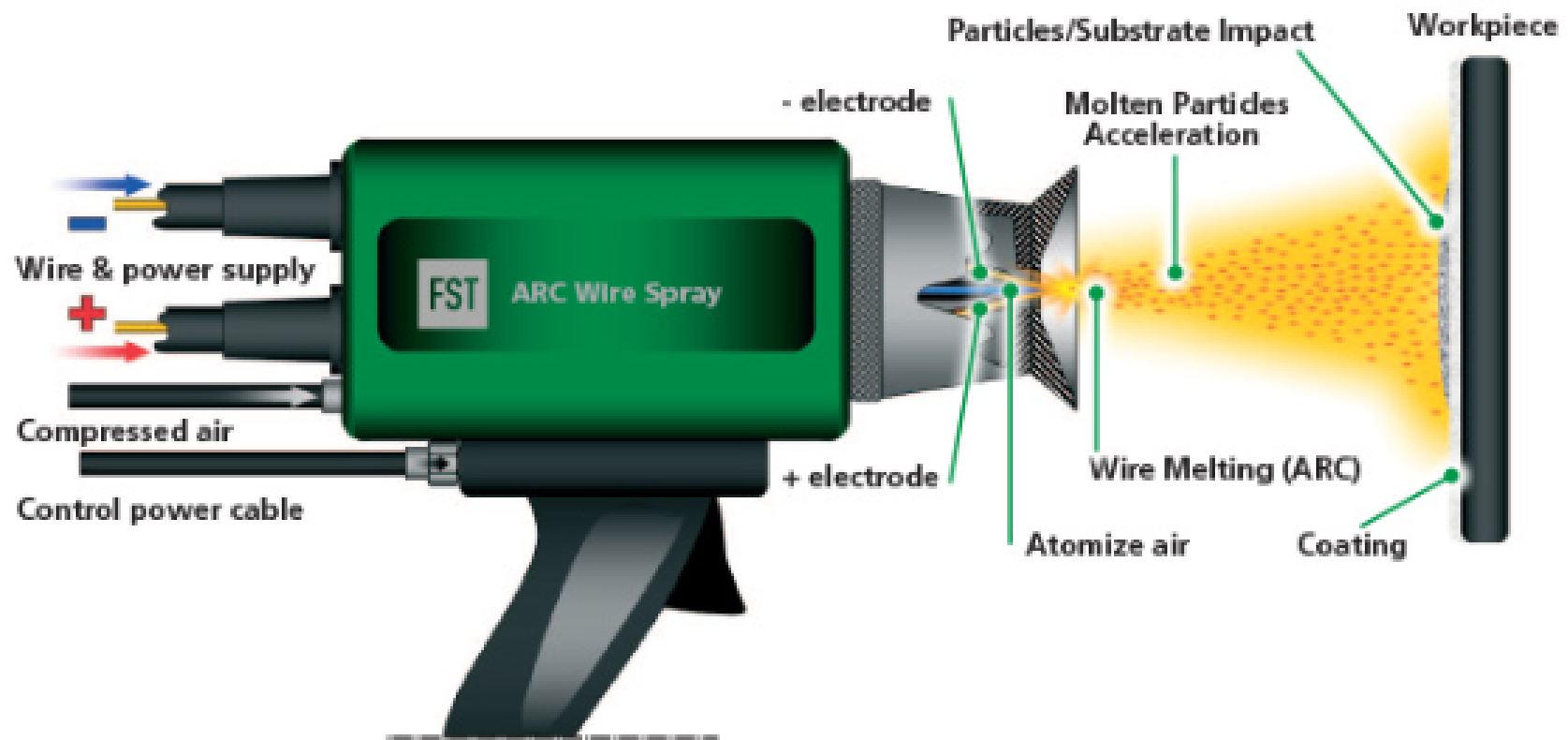
A sealer coat is then applied to the metalized surface.

Metalizing Compared to Painting

Advantages of metalizing compared to painting:

- One coat versus three for most paint systems
- There is no drying or cure time
- Service life of at least 2 times that of paint systems
- No volatile organic compound (VOC) emissions
- Wide range of application temperatures allowed
- Extends application season which is a benefit in Vermont

Metalizing Spray Gun



Hardwick - Design Plans and Specifications

Two Major Special Provision Items

1. Removal, Containment and Disposal of Lead Paint
2. Field Metalizing of Existing Structural Steel

These two items required many documents to be prepared and submitted by the contractor prior to any work.

Removal, Containment and Disposal of Lead Paint

Description

Removal, containment, temporary on-site storage, transportation and disposal of lead paint (Including grease coating).

Federal and State Environmental Regulations

Contractor submittals for:

- Personnel Qualifications
- Containment Plan
- Environmental Monitoring
- Quality Control Inspections
- Quality Assurance Observations
- Surface Cleaning – including the “grease coating”
- Hygiene Facilities and Site Emergencies

Field Metalizing of Existing Structural Steel

Description

Field surface preparation and field application of the thermal spray coating (TSC), also know as metalizing to existing steel bridges with final application of a clear seal coat.

Major Specifications

SSPC-QP 6, Contractor Metalizing Certification – few contractors certified

SSPC –SP 5, White Metal Blast Cleaning

SSPC-PA 18, Specification for Application of Thermal Spray Coating Systems to Steel Bridges.

Sequence of Work:

- Prepare surfaces
- Remediate Soluble Salts
- Apply Metalizing
- Apply Seal Coat

Field Metalizing of Existing Structural Steel

Contractor Prequalification

- Contractor shall have SSPC-QP6 certification
- Performed a minimum of three previous metalizing projects
- At least one within last two years

Quality Control Inspector

- SSPC PCI Level 2, or SSPC BCI Level 2, or NACE CIP Level 2
- 12 months cumulative experience over last three years with application or inspection of metalizing.
- 12 months cumulative experience over last three years with inspection of coatings on steel structures.

Field Metalizing of Existing Structural Steel

A major amount of time was spent reviewing the contractor submittals (and re-submittals) to ensure compliance with the contract specifications.

Contractor submittals for:

- Personnel Qualifications
- Quality Control Plan
- Inspection Access Plan
- Surface Preparation Plan
- Abrasives Identification
- Metalizing Plan
- Sealing Plan
- Progress Schedule
- Repair Procedure

Field Metalizing of Existing Structural Steel

Environmental Conditions

- Steel surface shall be at least 5 degrees F above dew point for entire application.
- Temperature, dew point and relative humidity monitored every 2 hours.
- Once blast cleaned there was a 4-hour window to apply at least one coat of metalizing. An additional 4 hours was available if humidity levels kept below 50%.

Surface Preparation

- Steel surfaces to be metalized shall be white metal blast cleaned to meet SSPC-SP 5 using dry abrasive blast cleaning methods. Surface profile depth of 3.5 to 5.5 mils.

Metalizing (99.9% zinc wire)

- Prepared surface shall be metalized within 4 hours of blast cleaning.
- Daily coupons prepared and metalizing (8-12 mils) for bend tests (2" x 8" x 0.05" coupons).
- Adhesion tests performed daily for every 500 sq. ft. metalized and must meet 700 psi.
- Metalizing shall be performed with electric arc thermal spray metalizing equipment per material supplier and SSPC specifications.
- Application shall be done with overlapping passes with a second set of overlapping passes at right angles to the first set.
- 1/8" diameter zinc wire used on the project.

Field Metalizing of Existing Structural Steel

Metalizing (Cont'd)

The total thickness of metalizing shall be 8-12 mils. Contractor was allowed to apply a 2-mil initial coat and return to apply metalizing to obtain the full thickness.

Sealer Coat

The sealer coat shall be applied within 8 hours of metalizing.

A stripe coat shall be applied to all corners, edges and irregular surfaces by brush. Sealer shall be applied by spray and supplemented with rolling or brushing.

Warranty

Specifications included a two-year warranty from the date of substantial completion.

Basis of Payment

The metalizing work was paid for as a lump sum price.

Work Platform hanging from bottom flange



Enclosure completed with one access door



Hangers for work platform



Equipment to collect the lead paint and filter the air in the enclosure



Air Filtration Ducts



FIELD METALIZING A STEEL BEAM BRIDGE

Metalizing equipment (notice spools of zinc wire)



Applying the metalizing



Streaking due to metalizing pattern and potentially variable sealer application



Hanger brackets need to be moved to complete the metalizing and sealer



Finished Product



Project Cost Estimated vs Actual

Estimate submitted with the Grant was developed from calls to painting contractors in the Northeast with factors applied given the lack of availability of qualified contractors to perform field metalizing.

	<u>Estimated</u>	<u>Actual</u>
Preliminary Engineering (20%)	\$125,000	\$47,624
Right of Way	\$0	\$0
Construction	\$615,000	\$464,840
Constr. Engr. (15%)	\$92,250	\$132,073
Contingency Items	<u>\$80,000</u>	<u>\$0</u>
Total	\$912,250	\$644,537

Overall project facts

Major item cost comparison based on low bid:

- Removal, Containment and Disposal of Lead Paint - \$212,192
- Field Metalizing of Existing Structural Steel - \$121,805
- Estimated cost for 3 coat paint system - \$115,000

The relatively low cost of the field metalizing for this project as compared to the estimated cost to paint was due mainly to the low bid contractor's desire to gain experience on a field metalizing of existing structural steel.

Future field metalizing projects are expected to be much higher in cost.

Overall project facts

- Duration of removal of the existing paint system and metalizing:
 - 21 workdays
- Removal of the existing grease coating was troublesome requiring hand scraping, application of solvent and hot water pressure wash with final solvent wipe to be sure grease was completely removed.
- Metalizing inside the enclosure is relatively difficult as compared to metalizing in the shop due to tight dark conditions.
- 10 Sq. ft. test panel conducted at the start of work every day.
- All adhesion tests, bend tests and coating thickness measurements consistently met the project specifications.
- The contractor used 1/8" zinc wire. Using 3/16" wire would increase the rate of production but may be more costly.

Overall project facts

- A considerable amount of the zinc wire simply rebounds off the substrate creating a dusty environment.
- There was relatively poor visibility inside the enclosure during the metalizing even with dust collectors and air scrubbers running.
- Perhaps the uneven final appearance was a result of this poor visibility or uneven application of the sealer.
- Different color sealers are available, and the final surface can be painted in areas where aesthetics is a concern.
- Overall weather conditions were good during the metalizing with no rain or damp humid weather to contend with.
- Construction engineering cost was higher than expected given the amount of review and resubmittals required to arrive at acceptable documents to perform the work.

Resident Engineer – Scott Wheatly (left)
KTA – Tator Metalizing Inspector – Steve Holdner (right)



Acknowledgements & References

Acknowledgements

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Ryan Foster – VTrans Structural Steel Shop Inspector

Steve Holdner - KTA-Tator Inspector

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References

American Galvanizers Association

<https://galvanizeit.org/corrosion/corrosion-protection/zinc-coatings/metallizing>

Thermal Spray Guns

<https://www.thermalspraygun.com/thermal-spray-guns/>