New England DOTs Develop Program for Selecting Coating Systems

by Richard S. Haupt

Because of restrictions on the use and removal of lead-based paint, state transportation agency representatives from Vermont, New Hampshire, and Maine decided to work cooperatively to evaluate the effectiveness of protective coating systems. Lead-based coating systems that have been used for over 50 years to protect structural steel bridge members are now unacceptable due to excessive quantities of hazardous materials in their formulation. But lead-based paint provided predictable long-term performance of 20 years or more before recoating was required. With lead-based paints no longer is use, the benefit of predictable, proven long-term performance is creating a void that must be filled.

In selecting new coating types to replace lead-based paint, each state has been faced with answering the same difficult questions: which new systems will be the most effective, efficient, and enduring? and what techniques will be the most practical to qualify proprietary protective coating systems for the preservation of structural steel?

The harsh climatic conditions of New England complicate the evaluation process. These conditions increase the severity of exposure that coatings must resist. They include

- long periods of cold weather, including severe winters;
- rapid changes in humidity;
- significant changes in surface temperatures, ranging from a high of 140 F (60 C) to a low of -40 F (-40 C);
- rapid changes in ambient temperature from day to night with drops as dramatic as 60 F (33 C);
- extensive exposure to sunlight;
- exposure to high salt fog; and
- exposure to abrasion from road sand and salt.

Representatives from Vermont, New Hampshire, and Maine agreed to create a cost-effective procedure to evaluate and qualify proprietary protective coating systems. These representatives met in April 1992 with the Connecticut DOT to review their current procedures for selecting and approving proprietary protective coating systems.

As a result of this meeting, Vermont, New Hampshire, and Maine agreed to work with Connecticut to generate unified criteria to meet the 4 states' combined needs and objectives. Departments of transportation from Massachusetts and Rhode Island subsequently joined this endeavor. Thus, all 6 states created the New England Protective Coating Committee (NEPCOAT). NEPCOAT assumed the responsibility of developing unified criteria for evaluating coatings, as well as dealing with problems in the use of coatings to protect structural steel.

NEPCOAT criteria address performance requirements such as resistance to sunlight, needed on bridges like the Piscataqua River Bridge between New Hampshire and Maine.
Courtesy of Richard S. Haupt

Editor's note: The article below is based on a paper to be given at the Fourth World Congress on Coating Systems for Bridges and Steel Structures, organized by the University of Missouri-Rolla and scheduled for February 1-3, 1995 in St Louis, MO

NEPCOAT Plan

The initial objective of NEPCOAT was to develop criteria for protective coatings applied in the shop over

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new steel, and for coatings applied during field rehabilitation of existing steel cleaned to bare metal.

Based on existing research on the performance of new coatings and evaluation of their field histories, NEPCOAT concluded that the coating system most capable of providing effective performance to protect bare steel would initially be a three-coat system consisting of a zinc primer, an epoxy or urethane intermediate coat, and an aliphatic urethane topcoat.

There are single-coat and two-coat systems that may yield effective performance, but field experience in New England has demonstrated that long-term performance is best assured by a three-coat system. State transportation agencies have traditionally used similar three-coat system specifications. Long-term field exposure of these systems demonstrates their effectiveness.

Initially, NEPCOAT considered the classification of systems for overcoating lead-based paints to be a secondary priority. Overcoating systems must be compatible with the existing coatings. Because the composition of lead-based paints varies widely, each candidate for overcoating must be individually evaluated. NEPCOAT decided to develop a procedure for evaluating overcoating systems after it had developed a satisfactory system for evaluating coatings for bare steel.

NEPCOAT Qualification Requirements

For a coating system to be considered for acceptance on the NEPCOAT Qualified List, product manufacturers will be required to complete the following steps.

- They must submit selected samples of their coatings to one of the NEPCOAT authorized independent testing laboratories and have each system tested to evaluate its performance under specific laboratory testing procedures (described below).
- They must provide acceptable information for each coating on its product data sheet. If a manufacturer's standard data sheet does not identify appropriate information, a supplementary data sheet will be acceptable.
- They must provide certified evidence that the coating system selected for testing has demonstrated acceptable field performance.
- They must provide certified evidence that their coating formulations comply with federal regulations.
- They must provide certified evidence that the lead content of each coating is less than 0.01 percent (100 parts per million [ppm]) by weight.

NEPCOAT Requirements for Primers

To comply with contemporary health concerns, NEPCOAT has imposed special requirements to ensure that the composition of zinc-rich primers conforms with standards for high purity zinc pigments, defined under ASTM D 520, Type II, specification for Zinc Dust Pigment. Trace quantities of lead occur naturally within zinc. ASTM D 520 restricts the incidental lead content in zinc dust pigments to no more than 0.01 percent by weight or 100 ppm. Compliance with this standard ensures that admissible zinc-rich formulations do not exceed the limits for minimal lead content.

In addition, most structural steel connections for bridges are currently designed to conform with the American Association of State Highway and Transportation Officials (AASHTO) Class B slip coefficient specifications. If a manufacturer desires to have a primer considered acceptable for this condition, each coating must be tested to verify its compliance with AASHTO requirements. Compliance requires a minimum slip coefficient value of 0.5.

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Surface preparation requirements for coating steel commonly reference the Steel Structures Painting Council (SSPC) surface preparation specifications. To ensure consistency of surface preparation and improve the life expectancy of applied coatings, the NEPCOAT Criteria reference specific SSPC surface preparation requirements for shop and field applications. The composition of primers submitted for evaluation must be compatible with the surface preparation requirements referenced in NEPCOAT.

NEPCOAT Testing Requirements

The laboratory chosen by a coating manufacturer will be required to provide NEPCOAT with specific information pertaining to each coating being evaluated. To ensure consistency for testing, NEPCOAT requires each test panel to be fabricated from the same grade of steel, to have identical dimensions, and to meet the same surface preparation standard. Additionally, the laboratory must use identical colors for the topcoats; a standard procedure for measuring dry film thickness, an identifiable code number for each panel, a specific duration for curing (within designated temperatures and humidity), and a standard method for scribing the applied coatings.

Procedures for preparing photographic records of each test panel have been specified to ensure that appropriate evidence of their condition is documented before, during, and after the testing process.

There is a wide range of laboratory tests that could be performed to evaluate the effectiveness of protective coating systems. NEPCOAT examined this matter for 2 years and selected 6 tests with a supplementary option for the weathering resistance test. The results of these tests should provide sufficient information for identification of the coating systems that will perform best. NEPCOAT selected the following laboratory tests: salt fog resistance (ASTM B 117); weathering resistance (ASTM G 53 with supplemental option for ASTM G 26); relative humidity resistance (ASTM D 2247); abrasion resistance (ASTM D 4060); adhesion (ASTM D 4541); and infrared identification of vehicle solids (ASTM D 2621).

Recognizing that improved laboratory testing is a focus of industry research, NEPCOAT is willing to revise its test methods once performance results have been evaluated and more effective methods become available.

NEPCOAT faced a dilemma when selecting the weathering resistance

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test that would be the most accurate in determining the effectiveness of protective coatings for the New England region. After evaluating the consequences, NEPCOAT decided to use the fluorescent ultraviolet radiation/condensation test (ASTM G 53) for basic information. NEPCOAT also recommends but does not require that coating manufacturers use the xenon-arc weathering test (ASTM G 26) for information about how each coating system performs under more intense light exposure. The xenon-arc test may be a more realistic procedure for evaluating the performance of protective coating systems over structures exposed to increased intensity of sunlight (e.g., truss bridges).

Special Evaluation Project For Weathering Resistance Tests

As a result of NEPCOAT's consultations with experts involved in the xenon-arc testing process, a proprietary testing service volunteered to perform a special evaluation project with the following objectives.

- Provide baseline data from long-term outdoor exposure that may be used by NEPCOAT to validate results obtained from accelerated weathering resistance tests.
- Provide comparable data from accelerated weathering resistance tests, fluorescent ultraviolet radiation/condensation versus xenon-arc, currently specified under NEPCOAT Test No. 3. Evaluation of these data can be used to compare and correlate data from these laboratory tests with data from long-term outdoor exposure testing or results obtained from field exposures.

The evaluation project will be conducted for 3 years before the data can be fully evaluated.

All participants in the evaluation project will keep the results confidential until there is unanimous agreement to divulge them.

NEPCOAT Implementation

The NEPCOAT Criteria, issued June 15, 1994, were officially distributed to execute the committee's protocol for accepting protective coating systems. May 1, 1995, was specified as the date for receipt of the initial round of laboratory test reports. Once NEPCOAT has received the initial test results and performance information, the committee will evaluate all data and identify the coating systems that will be accepted for the NEPCOAT Qualified List.

A protocol was outlined for laboratory test reports to ensure they provide appropriate and consistent information. The current duration for laboratory testing is 5,000 hours (approximately 7 months). Testing laboratories need at least 10 months to

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perform testing and administrative functions necessary to compile a report for each coating system.

An upper level of performance for each laboratory test is not yet known. After initial test results are obtained, NEPCOAT will be able to adjust performance levels of its criteria to improve the overall performance of products admissible to the NEPCOAT Qualified List.

NEPCOAT Qualified List

Once a NEPCOAT Qualified List has been established, each transportation agency that adopts the NEPCOAT Criteria will be responsible for using it to meet its individual circumstances. For example, the NEPCOAT List will indicate coating systems that exhibit the highest levels of weathering resistance, but all NEPCOAT members will have the option of selecting specific systems appropriate for their specific needs. Each members has agreed to use only coatings on the Qualified List.

Similarly, the NEPCOAT Qualified List will identify primers that meet the Class B slip coefficient requirements, but each NEPCOAT member will be required to identify where the primers are needed on specific projects.

NEPCOAT Alliance

To develop partnerships with participants in the NEPCOAT process and others interested in what was being developed, representatives of regional and local FHWA units, testing laboratories, and selected paint manufacturers were invited to attend committee meetings scheduled to develop NEPCOAT Criteria.

During the development process, draft proposals of the NEPCOAT Criteria were distributed to technical representatives of paint manufacturers, testing laboratories, FHWA, and AASHTO. States neighboring New England, as well as others with problems comparable to those encountered by NEPCOAT, have expressed an interest in the NEPCOAT objective. Pennsylvania DOT was voted in as a member of NEPCOAT in December 1994, and the NEPCOAT committee has been renamed, the North East Protective Coating Committee.

The AASHTO Subcommittee on Materials is reviewing the NEPCOAT Criteria to determine if a similar strategy should be considered for establishing a national list of qualified proprietary paints.

Additional objectives of NEPCOAT are to develop criteria for evaluating independent testing laboratories for the NEPCOAT list of authorized independent laboratories; and to develop additional criteria related to climatic conditions in the New England region for the evaluation of existing coatings, coating removal, coating application, and qualification requirements for overcoating. The criteria being considered are:

- guidelines for evaluating the condition of existing protective coatings applied to structural steel;
- guidelines for shop application of protective coatings to structural steel;
- guidelines for abrasive blast cleaning and painting of structural steel;
- guidelines for containment, collection, and disposal of surface preparation debris from cleaning surfaces that contain hazardous materials;
- guidelines for field-applied maintenance overcoating; and
- guidelines and criteria for acceptance of coating systems to be used for maintenance overcoating applications.

For additional information on the NEPCOAT project, write or call Richard S. Haupt (Retired NEPCOAT Vice Chairman), 13 Laphams Mills Road, Peru, NY 12972; 518/563-4550; or Peter Barlow, NEPCOAT Chairman, ConnDOT, Maintenance Division, 44 Banner Drive, Milford, CT 06406; 203/878-6300; fax: 203/874-5293.

EPA Studies Paint Removal

The United States Environmental Protection Agency (EPA) Office of Research and Development in Cincinnati, OH, has released the results of 2 studies evaluating the cost effectiveness of paint removal techniques.

The first report is a comparative evaluation of a conventional abrasive blasting system and a dustless needle gun system. The second report discusses a study evaluating sodium bicarbonate blasting to strip paint from aircraft wheels.

The complete reports and project summaries were released in September 1994. Highlights from the project summaries follow.

Needle Gun System Cuts Dust

In "Removal and Containment of Lead-Based Paints Via Needle Scalers," Paul B. Kranz, James E. Stadelmaier, and Paul M. Randall report that the dustless needle gun system evaluated in the study reduced hazardous waste significantly compared to the conventional abrasive blasting system used.

The study was initiated in October 1992. The New York State Thruway Authority (NYSTA) and a manufacturer of dustless surface preparation equipment participated in the program.

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