10.50 BRIDGE PAINTING

Testing for lead and chromium (scrape sample) is required for any proposed painting and/or demolition work. The following information about bridge painting is written for the bulk of our work - those projects involving "nonhazardous" paint wastes.

Note:

A. Nonhazardous paint waste as used herein is referenced strictly from RCRA disposal regulations and the waste's successful passing of the TCLP test.
B. No matter what information is available going into a project, one must proceed cautiously, always being protective of human health and the environment. It is essential to sample and analyze wastes for proof.

Background

During the past several decades Iowa DOT has used:

- Lead based paint was one of the first paint systems used to protect steel from corrosion and weathering. Its usage in Iowa continued until the mid 1970s. By and large, lead paint systems functioned very well and were used in practically all painting applications, from bridges to sign trusses, from light poles to fire hydrants. Experience indicates this paint will produce hazardous waste.
- Solvent based Zinc paint
  A. Zinc Chromate
     In the early 1970s it became apparent there were worker health and safety, and environmental problems associated with lead based paints. During the time between mid 1970s to late 1970s, Iowa DOT began using zinc chromate paint as a primer along with a vinyl top coat. Experience now indicates the Zinc Chromate pigment will produce worker health and safety problems and hazardous wastes.
  B. Zinc Silicate
     Beginning in the late 1970s zinc silicate was specified as a primer for shop and field applied paint. This system along with a vinyl top coat was used until early 1993. At that time, the top coat was changed from a solvent-based vinyl to waterborne acrylic. Experience indicates zinc silicate paint will not produce a hazardous waste when removed. However, there is evidence that low levels of lead are present in airborne dust generated during abrasive blasting.
  C. Aluminum Epoxy
     Aluminum epoxy is a high solids, two component paint which became favored to paint steel truss sections in the mid to late 1970s. It is still typically the paint of choice for steel truss bridges, but today it is called "High Solids Epoxy Mastic." There have been no reported RCRA waste disposal problems associated with its removal. However, air quality and worker health and safety are always a concern when abrasive blasting is used for removal.

10.51 METHODS OF PAINT REMOVAL

Open Abrasive Blast Cleaning

Open blasting uses compressed air to propel abrasive particles against the surface to be cleaned. The system creates high levels of dust which, if not contained, can become airborne causing fugitive dust and respirable dust. All open abrasive blast systems must therefore be contained both for waste collection and dust emissions.

A. Open Blasting using Expendable Abrasive

1. The abrasive used for this method is used once and becomes waste to be disposed. Typically, one of several low cost readily available materials such as sand, furnace slag, aluminum oxide, or garnet is the abrasive of choice.

   Expendable abrasive - open blasting is usually the method of choice for contractors because of familiarity, productivity, and ease of operation. Contractors also consider it the most economical due to readily available equipment and low abrasive costs. However, from an environmental and worker health position, the system is more expensive because of the need to fully contain the operation, increased worker risk to health problems, and significantly large volumes of waste to be disposed.

2. There is a variation of expendable abrasive - open blasting which has been used successfully for minimal touch up and removal of minor amounts of overspray. This variation uses "corn cobs" for abrasive, controlled abrasive usage, and very small diameter blast nozzles. (Refer to *Construction Manual 10.53* for further discussion.)

B. Open Blasting using Recyclable Abrasive

In this system the abrasive is accumulated after usage, cleaned, and reused more than one time. Recyclable abrasive must be hard and durable. Thus metallic material is typically used.

When recycling abrasive, special equipment is required to collect, classify, separate, and convey collected waste residue. Also, since the abrasive is harder, contractors must pay close attention to abrasive gradation to keep a cleaned surface profile within acceptable ranges. A contractor must also closely monitor the separation process. It is very important to "completely" remove all fine material from abrasives. If the abrasive is improperly or incompletely cleaned, dust concentrations within the containment can be adversely affected.

Several methods are available in the industry to filter discharged air from the system. The Iowa DOT will **NOT** approve a system that uses water for blasting or water filters to remove particulates. This is because the water then becomes another different waste for disposal.

As with all open blasting operations, the recycled abrasive method must also be fully contained. Costs associated with recyclable abrasive include additional equipment and increased initial abrasive costs. This is offset by increased cleaned surface area per unit of abrasive (some times up to 100 cycles) and reduced volume of waste produced.

Closed Abrasive Blast - (Vacuum Blasting)

Compressed air is used to propel abrasive particles against the surface to be cleaned. The blast nozzle is fitted into a localized containment assembly, which is attached to a vacuum. Dust, abrasive, and paint debris are vacuumed simultaneously with the blasting operation. Debris is separated for disposal and the abrasive is returned for reuse. Typically, hard metallic abrasives are used for this system.

As with Open Abrasive blasting, Iowa DOT will **NOT** approve a system that uses water or water filters.

The most limiting factors of vacuum blasting are its reduced production rate and operational problems cleaning edges and irregular surfaces. NOTE: To be completely effective, the whole nozzle assembly must be sealed against a surface. This is the only way to maintain proper suction for the vacuum operation.

Vacuum blasting equipment is expensive, however, both worker exposure to dust and environmental emissions are substantially reduced if the operations are conducted properly. Thus *Supplemental Specification for "Environmental Protection for Removal of Nonhazardous Paint"* allows vacuum blasting to be conducted without requiring full containment.

Hand and Power Tool Cleaning

Standard Specification 2508.01, A, 3, b, 2 identifies cleaning by methods other than abrasive blasting. In these cases SSPC - SP 2, SP 3, or SP 11 will typically be noted as acceptable surface preparation standards. (Steel Structures Painting Council "SSPC" is an organization whose purpose is to develop industry standards for painting. The above noted standards, i.e., SP 2, SP 3, etc. are visual standards used to evaluate cleanliness of steel surfaces.)

A. Hand Tool Cleaning

Hand tool cleaning involves manual operated impact, scraping, sanding, and brushing tools. Typical equipment would be slag hammers, chipping hammers, putty knives, paint scrapers, and wire brushes. Hand tool cleaning will produce little dust, however, only loose material is removed while intact rust, sound paint, and mill scale remain.

B. Power Tool Cleaning

Power tool cleaning uses electric and/or air operated impact, grinding, or brushing tools. Usually power chippers, needle guns, descalers, power wire brushes, and grinding wheels comprise equipment for this. Power tool cleaning produces some dust and can generate airborne debris.

Because airborne dust and debris are generated, workers must have respiratory and dress protection. However, protection for power tool work is considerably less stringent than required for abrasive blasting where the operator and helpers would be required to wear air supplied blasting hoods and some type of encapsulating suits.

10.52 CONTAINMENT

As currently specified, methods that do not involve open abrasive blasting (i.e., hand tool cleaning and power tool cleaning) do not require total enclosure because minimal fugitive dust is generated. However, because paint residue and other foreign material is generated by the process, some form of debris containment is required.

This can be as simple as a tarp (or diaper) placed under the working area. All material falls onto the tarp, is picked up at the end of each day, and is placed into a waste container for "proper" disposal. Removed paint or other debris shall not be allowed to remain at the site following a cleaning operation. It must be picked up, containerized, and disposed of in accordance with the contract documents.

THERE ARE NO EXCEPTIONS!

Design Considerations

Designing containment and ventilation systems that protect the environment without unduly endangering the health of workers pose a challenge to the painting contractor. A containment system includes:

- Some type or form of structure (i.e., walls, ceiling, floor)
- A ventilation system consisting of forced (or natural flow) air input
- A mechanical (or natural flow) exhaust passage and exhaust dust collection equipment

Unfortunately, the containment structure built to protect the environment can expose workers inside to extremely high levels of airborne particulate. Thus various containment and ventilation components must be uniquely combined with consideration to containment design, structure location, method of surface preparation, worker protection requirements, and constraints on emissions.

Containment, for the purposes of our specification, is primarily to protect the environment (i.e., keep fugitive dust below regulated levels, capture and accumulate waste, and facilitate recovery and collection of waste material). To accomplish "containment" the structure must be virtually air tight, unless some type of mechanical exhaust system is used.

With all of that said, one could realistically question:

- How can this be accomplished?
- If the containment is air tight, how does it remain so once pressurized during blasting?

The answers to these questions identify the importance and need for some type of exhaust system. As capacity and capability of the exhaust system's efficiency increases, the importance of "totally sealed" containment decreases. For example: If the exhaust system is capable of evacuating more air than is pumped in during blasting, the difference is allowed for containment.

Often "negative air" is a term used to describe air exhausting systems. For our purposes, this term will be used to signify that the exhaust system is withdrawing at least as much air as:

- Is being supplied by the blasting nozzle(s) and
- The combined effects of all leakage in the containment. Obviously in situations described above, **"NO NOTICEABLE DUST"** can escape the containment.

While the exhaust system capacity is important, it is only as effective as the system's filtering ability. All exhausted air must be filtered to remove suspended dust and particulate. Typically, a dust collection system (i.e., bag house) is attached to the discharge or exhaust equipment.

Rules-of-Thumb:
Good field checks on the effectiveness of any containment are to:

- Watch for signs of dust escaping the containment and/or dust being discharged from exhaust system.
- Containments with proper air handling systems should appear concave along the walls during blast operations. They should **NEVER** appear to bulge during blasting.
- Containments with proper air handling systems should not be so dusty inside that visibility is severely limited.

10.53 TOUCH-UP WORK

Painting specifications for new steel structures require field touch-up. It is envisioned this work will include "small" areas which become damaged because of shipping, handling, or areas having field installed shear lugs. Also this can include areas which have concrete “slobber” remaining after a deck pour. Because Iowa DOT is using shop applied silicate zinc and galvanized bolts, major field painting should not be necessary.

For those areas requiring field touch-up, uncontrolled open sand blasting shall not be permitted. The project engineer shall contact the Office of Construction in situations where preparation involves more than "very minor" work.

Preparation for Rusted Areas
One approved method to clean rusted touch-up areas involves modified open blasting equipment using very controlled nozzle sizes, reduced operating pressures, and controlled sand consumption. The equipment which has been approved uses a maximum 6 mm (¼ inch) nozzle and a maximum 14.5 kPa (100 psi) operating pressure. For conceptual purposes, this equipment would be the type available at a local auto parts store for home and hobbyist usage.

The project engineer can approve use of this system after a field demonstration. The whole purpose is to clean only the rusted areas while removing virtually no paint. Before and during the demonstration, check to be sure:

- The nozzle size is correct
- The equipment provides a controlled removal operation
- "Little to no" noticeable fugitive dust is produced
- "VERY LITTLE" paint is removed during the process of blasting

NOTE: This system is "only" approved for usage on new structural steel, painted with the zinc system.

Cleaning Concrete "Slobbers"
The contractor needs to make every effort to eliminate form leakage before concrete placement. If leakage occurs during a pour, the contractor should water wash those areas before the concrete has set. Adherence to the above recommendations should make concrete "slobber" nonexistent. However, if leakage does occur, the project engineer may approve the following method for removing the concrete:

Open blasting using "sand" and normal equipment shall never be approved without adding environmental containment. However, using normal open blasting equipment and ground corn cobs is an approved system to remove concrete from structural steel without special environmental containment. Again, the project engineer should require a field demonstration of the system prior to approving.

Blasting efforts shall be halted:

- After removing the majority of concrete from steel, but
- Prior to removing any paint

Once the concrete has been removed satisfactorily, a coat of paint shall be applied to the cleaned area. The paint shall be the same as that used for the shop applied coat.

10.54 PAINT WASTE DISPOSAL

TCLP Testing

All waste generated during removal operations **SHALL BE** sampled and analyzed by the contractor. The waste sample shall be submitted to a laboratory for a TCLP heavy metals analysis. (Refer to *Supplemental Specification for "Environmental Protection for Removal of Nonhazardous Paint*.") This analysis is for eight environmentally regulated metals typically found in paint and abrasive wastes.

Hazardous Waste Designation

Paint debris is classified as hazardous due to the characteristic of toxicity, if after testing by Toxic Characteristic Leaching Procedure (TCLP), the leachate contains any of the elements in the concentrations equal to or greater than those listed below.

METAL	Regulated Level (mg/L)*
Arsenic	5.0
Barium	100.0
Cadmium	1.0
Chromium	5.0
Lead	5.0
Mercury	0.2
Selenium	1.0
Silver	5.0

***** Wastes with analytical results less than those listed are considered nonhazardous. The Office of Construction will issue a memo to all field construction offices if any changes to these levels occur.

NOTE: Other elements, chemicals, and characteristics can cause a material to be hazardous as defined in *40 CFR 261*. It is for this reason Standard Specification 2508.01, A, 4, h requires that no foreign material or other painting related waste be mixed with paint waste generated during the cleaning process.

Standard Specification 2508.01, A, 4, f, 7 states "Maintain wastes on site and do not dispose of them until the Engineer has reviewed analytical data and approved of the disposal method". If any analysis indicates the presence of metals in levels close to (or above) those listed, contact the Office of Construction **BEFORE** approving transportation of the waste.

In a policy letter dated August 10, 1995, the U.S. EPA noted both the owner of the structure AND the paint removal contractor are considered generators of the waste. The contractor is responsible for signing waste disposal approval and shipment documentation which includes the waste profile and manifest. The contractor's signature is as co-generator and not "on behalf of the DOT".

The contractor is responsible to transport removed paint and abrasive waste to an approved Subtitle D landfill and provide the Engineer with copies of delivery tickets and landfill invoices.

A **Notice for Transfer of Non-hazardous Paint Waste** form is included as Appendix 10-5. This form may be used as a means to document the Engineer's approval for shipment and as additional tracking of the waste shipments.

The contractor is responsible to containerize and dispose of "other" project wastes generated at the site. Examples of "other" wastes can include empty (or partially filled) paint and solvent containers, rags, cleaners, bag-house filters, oil filters and oil, dunnage, brushes and rollers, etc. Most of these wastes require some type of special handling and disposal, but those issues are the contractor's responsibility. Dumping or burying at the site is also not allowed. Project inspectors should be sure all materials have been removed and the site is properly cleaned up at the conclusion of a contract.

10.55 PAINTING ISSUES

Contingency Plan

Iowa DOT Specifications for environmental protection require the contractor to provide a written plan for clean-up of spills. "Spills" as used in the specifications is a broad term intended to cover almost any "what-if" situation. The plan should be reviewed by the project engineer for reasonableness, constructability, and compliance with the specifications. Questions and comments from this review need to be returned to the contractor for further clarification and a revised plan submitted.

A contingency plan needs to provide enough detail that the end user contractor's site personnel and project inspector(s) can clearly understand what preventative measures will be used, what special clean-up/containment measures are going to be on site, and what procedures will be followed should a spill happen. This plan does not need to be detailed to "Nth" degree and can in fact, be some type of "boiler plate" language provided it covers the following general areas:

- Has the contractor developed a procedure of what they will do to eliminate potential spills? For example, how will:
  - Tarps be secured to the structure, ground, and/or possibly to a Hi-lift or scaffold?
  - Work be conducted adjacent to traffic to minimize potential hazards and yet maintain containment?
- How will contractor pick up, transfer, store, and dispose of wastes generated at the project? "Wastes" generated at the project include more than just abrasive wastes. For example, how will the contractor:
  - Handle waste rags, paint brushes and rollers, paint that is mixed and cannot be used, i.e., exceeds the pot-life, and spent solvent used to clean painting equipment?
  - Pick up, transfer, and store removed paint residue and any abrasive?
  - Collect and dispose of empty paint and solvent containers?

- How will the contractor contain and clean up any spills of paint thinner or paint? Another part could be special preventative measures which will be used to prevent such accidents from occurring.
- If any part of the project is over water, how does the contractor intend to contain and clean up spills of diesel fuels, hydraulic fluids, paint, thinners, or abrasive waste from the water. A part of this should list containment materials that are on site, how they will be deployed, and disposed of should a spill occur.
- How does the contractor intend to "clean" equipment and reusable materials before demobilizing?
- How does the contractor intend to conduct the required air monitoring, what type of air monitoring equipment will be used, where is the equipment located during sampling, and how often will sampling occur?

Equipment Inspection

Iowa DNR and U.S. EPA regulations mandate that paint wastes (hazardous and nonhazardous) generated at a site shall remain at that site until shipped to an appropriate disposal facility. Project inspectors need to inspect equipment and materials for cleanliness as the contractor mobilizes to a project and again as they demobilize. Equipment and materials which are not "clean":

- coming onto the project shall be rejected and not allowed on site until they are "clean."
- as the contractor demobilizes shall be cleaned, the waste added to that generated on the project, and the waste disposed of with other wastes from the project.

Inspectors should conduct a visual inspection of items such as blast pots, grit handling and recycling equipment, dust collectors, abrasives, containment structures, and tarps. While there are standard sampling procedures used to evaluate "clean," a visual inspection documenting good housekeeping practices is all that is required. Note: Items which are not "clean" are either rejected and "cleaned" some place else before they enter the project, or cleaned before demobilizing. Situations where a contractor attempts to bring dirty equipment onto a project should be reported to the Office of Construction.

RESERVED FOR FUTURE USE