

Research Report

KTC-93-3

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The Removal of Lead-Based Paint  
from Steel Bridges

by

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in cooperation with  
Transportation Cabinet  
Commonwealth of Kentucky

and

Federal Highway Administration  
U.S. Department of Transportation

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January 1993



COMMONWEALTH OF KENTUCKY  
TRANSPORTATION CABINET  
FRANKFORT, KENTUCKY 40622

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August 22, 1994

Mr. Paul E. Toussaint  
Division Administrator  
Federal Highway Administration  
330 West Broadway  
Frankfort, KY 40601

SUBJECT: IMPLEMENTATION STATEMENT  
Research Study KYHPR 91-138  
"Removal of Lead-Based Paint from Steel Bridges"

Dear Mr. Toussaint:

Under this study, Kentucky Transportation Center (KTC) researchers and Study Advisory Committee members identified the best current technology for removing lead-based paint from steel bridges while conforming to state and Federal regulations related to environmental and human health issues. That was determined by a comprehensive review of technical literature related to maintenance painting of bridges and by a survey concerning paint removal that was sent to 26 state highway agencies.

At the direction and guidance of the Study Advisory Committee, KTC researchers prepared 3 contract documents including an experimental special provision for maintenance painting, a price contract for hazardous waste transport and disposal, and a contract for consulting services for environmental monitoring, waste management and paint inspection. Those study deliverables will assist the Transportation Cabinet in maintenance painting of bridges in conformance with provisions of applicable regulatory agencies.

Sincerely,

A handwritten signature in cursive script, appearing to read "J.M. Yowell".

J.M. Yowell, P.E.  
State Highway Engineer

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16. Abstract <p>The purpose of this study was to assist the Department of Highways in conducting bridge-painting operations involving removal of existing lead-based paint. Pertinent state and Federal regulations affecting generation of hazardous wastes, limiting environmental pollution and protecting public and worker safety were obtained and reviewed. State highway agencies were surveyed relative to how they conducted maintenance bridge painting involving lead-based paints and comply with applicable regulations. Information from the painting industry related to safe removal of lead-based paints was also reviewed.</p> <p>Based upon the reviews of applicable regulations, operations of other state highway agencies and painting industry practices, the best demonstrated available technology to use in removing lead-based paints from bridges was identified. The key technologies incorporated the use of: 1) containment enclosures over the open abrasive blasting, 2) recyclable abrasives and 3) closed material-handling systems to move abrasive-blasting wastes.</p> <p>The Study Advisory Committee determined that the Best Demonstrated Available Technology would be applied to all bridge maintenance painting operations involving the full removal of lead-based paints. The Committee decided that the Department of Highways would limit painting contractors' work to painting-related activities. The Department employ a consultant to monitor activities related to the generation of hazardous wastes. The consultant would also inspect the contractor's painting work. The Department would also employ a contractor to transport, treat and dispose hazardous wastes generated by abrasive blasting.</p> <p>Three documents were prepared to facilitate this work including: 1) an experimental special provision for bridge maintenance painting, 2) a invitation-to-bid for hazardous waste transport and disposal, and 3) a consultant services contract for environmental monitoring, waste management and inspection of contractor painting operations.</p>			
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## EXECUTIVE SUMMARY

In the past, maintenance painting of steel bridges involved removal of old, existing paint by open abrasive blasting. However, the existing paint on most bridges requiring re-painting contains lead that is now considered a hazardous material. Federal, state and possibly local laws and regulations severely limit environmental and human contact with lead wastes. That includes debris generated by abrasive-blasting operations conducted during maintenance painting operations. Additionally, environmental regulations restrict actions to dispose of that debris. As a result of those actions, the Kentucky Transportation Cabinet required a viable, cost-effective approach to maintenance painting operations that would also comply with environmental and health regulations.

The objective of this study was to assist the Kentucky Transportation Cabinet in meeting that goal by: 1) determining applicable Federal and state laws and regulations, 2) formulating guidelines that stipulate levels of waste containment for specific bridge environments, 3) preparing specifications providing for compliance with applicable laws and regulations, 4) determining waste containment and disposal procedures employed by other state highway agencies, 5) providing recommendations for innovative procedures for containing or disposing of lead-based paint debris and 6) identifying permitting and record-keeping steps necessary to comply with laws and regulations.

Lead is a toxic metal that serves no beneficial purpose in humans. It may effect humans by high (acute) exposures over short periods and by low (chronic) exposures over long periods. The hazardous level of lead in the body of adults occurs at blood lead levels slightly below 50 $\mu$ g/d. The hazardous level in children is believed to be one fifth of that value for adults. In adults, lead causes a variety of disorders. Concern for children rests primarily with brain damage.

Lead is absorbed into the body primarily by inhalation and ingestion. In maintenance painting operations, airborne leaded particulates are generated by abrasive blasting. When not contained, those may be carried about the job site and environs. Workers and persons near a job site may breath air contaminated with leaded particulate. Those particulates are also deposited on workers' bodies, clothes, and eating utensils. They also may contaminate nearby soils, water, residences, schools and offices. Bridge workers and the public may unknowing ingest lead by using poor hygiene practices. That is especially true of children who are most susceptible to lead damage.

Hazardous materials are those that increase mortality, cause illness or pose a threat to human health when improperly handled. The U.S. Environmental Protection Agency has designated specific materials as hazardous. Those materials are classified as hazardous in specific concentrations and for specific threats. Lead is classified as toxic under conditions where, in a buried state, it could leach into the groundwater.

The hazards posed by abrasive blasting of lead-based paints must be dealt with effectively. Costs associated with those actions must be weighed against problems arising from contamination. Punitive actions imposed by regulatory agencies include expensive

remediation measures and the possibility of legal actions including civil suits, fines and, in extreme cases, criminal penalties.

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Regulations affecting the generation of hazardous wastes and safeguarding public and worker health are issued by government agencies charged with promulgation and enforcement of Federal and state legislation impacting those subjects. The primary legislation affecting environmental and public health issues was enacted by Congress. Legislation impacting maintenance painting operations include:

1. Clean Air Act,
2. Federal Water Pollution Act,
3. Resource Conservation and Recovery Act,
4. Comprehensive Environmental Response Compensation and Liability Act,
5. Hazardous and Solid Waste Amendment,
6. Superfund Amendment and Reauthorization Act and
7. Third Third Land Disposal Restriction Act.

Since the Federal laws were enacted, the Kentucky Legislature passed statutes providing for state government to assume to responsibility for regulation promulgation and enforcement.

The primary Federal agencies responsible for issuing regulations impacting generation of hazardous wastes and safeguarding public and worker health are the U.S. Environmental Protection Agency (EPA), U.S. Occupational and Safety Health Administration (OSHA), and the National Institute for Occupational Safety and Health (NIOSH). The primary Kentucky state agencies having related authority are the Natural Resources and Environmental Protection Cabinet (NREPC), the Kentucky Occupational Safety and Health Program (KOSH), the Department of Health Services and the Fish and Game Department.

Currently, regulations exist which limit discharges of lead into the environment. Limitations have been established (primarily by the EPA) for air, water and soil. Additional regulatory thresholds exist for the discharge of airborne dust typically produced during open abrasive blasting operations using consumable abrasives. Regulations cover the testing of wastes to determine whether they are hazardous. Additional regulations govern the collection, storage, transport and disposal of all hazardous wastes generated by maintenance painting operations. State regulations are enumerated in the report.

Worker safety is a major concern on maintenance painting operations incorporating abrasive blasting of lead paints. Currently, OSHA regulations involving worker safety related to lead exposure are evolving. Those regulations impose limits on worker exposure to lead. Those limits may be achieved by: 1) engineering controls on the environs, 2) instituting safe working practices, 3) using personal respirators and 4) instituting a worker training program. Medical surveillance (blood testing) is another effective measure of limiting worker health risks.

Several paint removal methods are available. Open abrasive blasting remains the best method. The use of recyclable abrasives has been incorporated into that method to lessen the quantity of wastes generated. Areas of a bridge being cleaned by open abrasive blasting must be enclosed to contain the hazardous debris and dust for collection and disposal.

Containment enclosures are commonly placed around the portion of a bridge subject to abrasive blasting. All containment enclosures employ flexible or rigid materials either loosely attached to the structure such as free-hanging tarps or screens draped over a truss or firmly attached enclosures incorporating scaffolding, skeleton framework of wood and/or steel and rigid or flexible impermeable siding. The most efficient method of containment employs impermeable walls with negative pressure. A fan system creates a lower pressure inside the enclosure relative to the outside environment. When a leak occurs, air will be drawn into the enclosure minimizing the chances for waste discharges.

The bridge owner is considered the hazardous waste generator regardless of whether a painting contractor generates the wastes by abrasive blasting. The waste generator is responsible for all accidental waste discharges and must be responsible for his/her hazardous wastes forever. Therefore, it is critical that the bridge owner be confident that contractors and consultants he/she employs properly address all applicable regulations affecting the generation and disposal of hazardous wastes.

The lead in paint may not constitute a hazardous waste when removed from a bridge. However, it is likely that lead will pose a hazard to humans near or on the structure. Proper steps should be taken during abrasive blasting operations to insure compliance with all regulations concerning waste discharges and worker and public health.

Specific tests should be performed on bridge paint to determine whether it contains lead. Once abrasive blasting operations are initiated, samples should be obtained of the abrasive-blasting debris and tested to determine whether the wastes are hazardous. A specific test protocol should be followed to insure that sufficient tests are performed and that the laboratory test results are definitive. Samples are tested using the Toxicity Characteristic Leaching Procedure or TCLP test to determine whether the wastes are hazardous.

When the wastes are determined to be hazardous, the generator should institute practices to prevent the hazardous wastes from being discharged into the atmosphere. Bridge locations where abrasive blasting operations are conducted should be enclosed. Hazardous wastes generated should be collected and stored on site for eventual transport and disposal. Regulations governing the amount of hazardous wastes that may be stored on site and the duration of storage are based on the quantity of wastes generated per calendar month.

Typically, bridge maintenance painting operations would generate sufficient wastes to classify the bridge owner as a full quantity hazardous waste generator. A full quantity generator should obtain an EPA Identification number for each specific waste generation

site. He may not store hazardous wastes on site for more than 90 calendar days. The hazardous waste may either be treated on site to render them non-hazardous or more commonly transported to a treatment-storage-disposal (TSD) facility for eventual disposal. Hazardous wastes may only be transported off site by a permitted hazardous waste hauler. Each waste shipment should be manifest to provide assurance that it has been properly disposed.

On-site treatment is not practical in Kentucky due to permitting requirements for temporary treatment facilities. Commonly, wastes are transported to TSD facilities. Hazardous wastes containing lead should be treated to render them non-hazardous (i.e. non-leachable) by the TCLP test. That is usually performed by treatment facilities that are often sited near disposal facilities. The disposal facilities are typically landfills. Treated wastes should be re-tested to determine whether they remain hazardous. If they are non-hazardous, they should be disposed. Otherwise, they should be re-treated. Wastes testing non-hazardous may be disposed in a Subtitle D (industrial waste) landfill.

The generator should retain manifest records of waste disposal for a 3-year period. Medical records of personnel working at the job site should be stored for 20 years. The records of disposed wastes are especially important since the generator is responsible for disposed wastes forever.

Several alternatives to full paint removal employing the use of containment enclosures exist. The most viable alternative is to overcoat old, existing paint systems with new paints. Minimal surface preparation is used in overcoating. Special "surface tolerant" paints capable of functioning over minimally prepared surfaces are commonly used for overcoating projects.

One alternative is to dismantle bridge steelwork for shop or ground-level re-painting. Painting may be deferred until more economical paint removal and waste disposal methods are developed. Another option is to dismantle a bridge and scrap the steel.

In 1991, Kentucky Transportation Center (KTC) personnel conducted a survey of state highway agencies to determine how they performed maintenance painting operations entailing full paint removal with containment. Responses were obtained from 17 state highway agencies. That information was compiled in Tables 1-7. Additionally, applicable state regulatory agencies were contacted and regulations affecting maintenance painting operations were obtained.

The Study Advisory Committee members and KTC researchers determined the Best Demonstrated Available Technology for maintenance painting operations involving full paint removal with containment. That technology included: 1) containment enclosures using impermeable walls having negative pressure, 2) totally enclosed waste handling systems and 3) recyclable abrasives.

SAC members had KTC personnel prepare three documents concerning maintenance painting operations. Those documents were 1) a Special Provision for maintenance



painting operations, 2) a contract for hazardous waste transport and disposal and 3) contract provisions for consultant environmental monitoring, waste management and paint inspection services. Those are contained in Appendices I-III.

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The work performed during this study has met the study objectives. The Kentucky Transportation Cabinet has been provided with the most effective methods for conducting maintenance painting operations involving full paint removal with containment. The Cabinet has also been furnished with specifications and contracts to enable the necessary work to be conducted properly.

# METRIC (SI\*) CONVERSION FACTORS

## APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
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### LENGTH

in	inches	2.54	millimetres	mm
ft	feet	0.3048	metres	m
yd	yards	0.914	metres	m
mi	miles	1.61	kilometres	km

### AREA

in <sup>2</sup>	square inches	645.2	millimetres squared	mm <sup>2</sup>
ft <sup>2</sup>	square feet	0.0929	metres squared	m <sup>2</sup>
yd <sup>2</sup>	square yards	0.836	metres squared	m <sup>2</sup>
mi <sup>2</sup>	square miles	2.59	kilometres squared	km <sup>2</sup>
ac	acres	0.395	hectares	ha

### MASS (weight)

oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg

### VOLUME

fl oz	fluid ounces	29.57	millilitres	mL
gal	gallons	3.785	litres	L
ft <sup>3</sup>	cubic feet	0.0328	metres cubed	m <sup>3</sup>
yd <sup>3</sup>	cubic yards	0.0765	metres cubed	m <sup>3</sup>

NOTE: Volumes greater than 1000 L shall be shown in m<sup>3</sup>.

### TEMPERATURE (exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
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\* SI is the symbol for the International System of Measurements

## APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
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### LENGTH

mm	millimetres	0.039	inches	in
m	metres	3.28	feet	ft
m	metres	1.09	yards	yd
km	kilometres	0.621	miles	mi

### AREA

mm <sup>2</sup>	millimetres squared	0.0016	square inches	in <sup>2</sup>
m <sup>2</sup>	metres squared	10.764	square feet	ft <sup>2</sup>
km <sup>2</sup>	kilometres squared	0.39	square miles	mi <sup>2</sup>
ha	hectares (10 000 m <sup>2</sup> )	2.53	acres	ac

### MASS (weight)

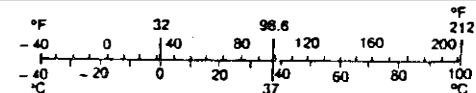
g	grams	0.0353	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams (1 000 kg)	1.103	short tons	T

### VOLUME

mL	millilitres	0.034	fluid ounces	fl oz
L	litres	0.264	gallons	gal
m <sup>3</sup>	metres cubed	35.315	cubic feet	ft <sup>3</sup>
m <sup>3</sup>	metres cubed	1.308	cubic yards	yd <sup>3</sup>

### TEMPERATURE (exact)

°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F
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These factors conform to the requirement of FHWA Order 5190.1A.

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## INTRODUCTION

### Overview

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For the past 15 to 20 years, bridge maintenance painting operations have incorporated open abrasive blasting to clean steel before re-painting. Abrasive blasting removes worn paint, rust, and other contaminants from the steel surface. It also provides a rough surface profile required for proper adhesion of new paint.

Abrasive blasting operations on bridge steel traditionally have employed consumable abrasive grits such as silica sand or mill slags. The grit is carried in a stream of compressed air. The air/grit mixture travels through a hose. Upon exiting a blast nozzle, it is thrown against the surface of a steel work piece. The grit impacts existing paint and corrosion products causing them (and the grit) to fracture into small pieces and detach from the surface of the bridge steel. The grit also removes mill scale and creates a rough profile on the surface that is beneficial for re-painting.

Conventional abrasive blasting generates large quantities of wastes consisting of spent abrasives, corrosion products and paint debris in the form of granular fines and dust. For many years, open abrasive blasting was employed. The wastes generated were not contained. As a result, debris and dust generated were allowed to fall and disperse haphazardly near the job site. When the debris deposited on bridge steel, it was promptly removed by blasting with compressed air. Such operations often generated large piles of wastes near the base of a bridge. Commonly, that debris remained at a job site after painting operations ended (Figure 1).

In recent years, environmental regulations were enacted prohibiting those procedures and imposing strict controls on the removal of common structural paints. Those regulations have been applied to bridge-painting operations because most bridge paints removed by abrasive blasting contain lead that is now controlled as a hazardous material. Levels of lead in the existing bridge paints are usually so high that any wastes generated by blast cleaning are considered hazardous. As a result, bridge painting operations involving existing lead-based paints should be confined. All wastes generated by abrasive blasting should be contained, collected and disposed of according to strict regulations (1-5).

In addition to environmental controls, health and safety issues have arisen regarding maintenance painting operations. That has resulted in the enactment of additional regulations related to worker health and public safety. Those regulations further influence maintenance painting operations, especially ones involving removal of existing lead-based paints.

Health, safety, and environmental regulations are forcing painting contractors and state highway agencies to adopt new painting practices. That is a difficult undertaking for an industry that has grown accustomed to performing unconfined blast-cleaning operations for decades. Regulations are issued primarily by federal and state Occupational Safety and Health Agencies (OSHAs) and Environmental Protection Agencies (EPAs). Some urban and municipal agencies, typically in larger cities, have also issued similar regulations.

Industry compliance has been historically linked to the level of enforcement by the regulatory agencies. While many regulations have been enacted recently affecting the paint industry, other existing regulations have simply been enforced more rigorously in recent years.

The unexpected enforcement of new and existing regulations affecting the removal of lead-based paints has caught many state highway agencies unaware and somewhat unprepared to deal with them. The painting industry did not keep pace and is now in a "catch-up" mode trying to evolve new technologies that will meet the difficult requirements imposed by those regulations. A further complication is that states and localities have differing regulations or interpret and enforce similar regulations differently. That creates a situation where a national, industry-wide consensus for action cannot be achieved. Compliance with regulations affecting removal of lead paints from bridges should be addressed at a state level, and in some cases, also at a local level.

The generation of new health, safety and environmental laws and regulations is proceeding at a rapid pace. Several issues discussed in this report may be affected by new regulations that were not enacted or were unforeseen during the progress of this study. The only two axioms that can be provided that will remain applicable over time are the admonitions that: 1) many additional laws and regulations impacting health, safety, and the environment will be invoked in the future and 2) those will be more restrictive than current regulations and more expensive to address.

### Commercial Uses of Lead

Lead is the most widely used nonferrous metal. It is a common element that is found in a concentration of 12µg/g of the earth's crust. Lead is a bluish-gray metal having the properties of softness, malleability, high density, low melting point and, most notably, corrosion resistance (6).

Lead has been smelted and employed by humans for 6,000 years. It has been used to make tools, tableware and vessels, arts and crafts (7). Today, 76% of all lead is used in the manufacture of automobile batteries. It is also employed in ammunition, metal products such as brass, solder, pipes, power and communication cable coverings, lead sheeting for flashing material in construction and sound proofing, radiation shielding and in plastics and paint pigments. Commercial lead comes from ores or recycled scrap. In 1986, the U.S. production of lead from primary sources (ore) was 808 million pounds and from secondary sources (scrap) it was 1,356 million pounds (8).

Lead pigments have been used in structural paints for over 100 years. Lead-based paints have been employed extensively on highway bridges. Other structures such as water towers, football stadiums, water treatment plants, and radio towers also have been protected using lead-based paints. A 1991 survey revealed that about 35-40% of all steel structures are currently coated with lead-based paints (9). The most common lead-based paints employ red lead, basic lead silicochromate, basic lead chromate, basic lead sulfate, and basic lead carbonate. The most commonly used "lead-based paints" are red lead, blue

lead, lead suboxide, basic lead silicochromate, and zinc yellow (10).

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## Study Objectives

This study was initiated to assist the Kentucky Transportation Cabinet in complying with all applicable health, safety and environmental regulations related to the removal of lead-based paints on bridges. The study had six major objectives:

- 1) to determine the applicable federal and state laws and regulations related to lead paint debris generated during maintenance painting operations,
- 2) to formulate guidelines that stipulate levels of waste containment for specific bridge environments and disposal procedures for those wastes,
- 3) to prepare draft specifications that would provide for compliance with applicable laws and regulations,
- 4) to determine applicable waste containment and disposal procedures employed by other state highway agencies,
- 5) to provide recommendations for adopting innovative procedures for containing or disposing of lead-based paint debris that would provide a cost savings over practices currently employed or to meet more restrictive regulations anticipated as the result of new or pending legislation and
- 6) to identify the various permitting and record-keeping steps necessary for the Transportation Cabinet to comply with federal and state laws and regulations.

## **HEALTH HAZARDS POSED BY LEAD**

### Toxicity of Lead

The detrimental effects of lead on the human body have been known for over 2,000 years. Current exposure levels average almost 100 times more than typical exposure levels in pre-metallurgical times. Lead poses health hazards at work places, in homes and at schools (11).

Industrial lead paint removal operations and leaded gasolines have been major sources of air, water, and land pollution for years. Homes 20 years or older still contain lead paint on interior walls. The drinking water in many homes flows through lead pipes. Urban playgrounds and residential areas often have high levels of lead contamination in the surrounding soil. Many municipal landfills leach lead and other hazardous chemicals to underground aquifers that supply drinking water.

Occupational exposures to lead include secondary lead production from old auto batteries and scrap metal, casting lead-containing alloys in foundries, soldering with lead at high temperatures, adding lead stearate as a stabilizer in PVC plastic, batch mixing with lead compounds for the production of crystal glass, production of and spraying with paints containing lead pigments and desiccators, and abrasive blasting of lead alloys and paints during maintenance painting (12).



Lead is a toxic element that serves no beneficial purpose in the body. It is harmful or fatal when ingested or absorbed (Figure 1). It can damage the brain causing seizures, comas, and death. Lead poisoning may occur at high or acute exposure concentrations or at low or chronic exposure concentrations over an extended period. In high concentrations, it may kill in a few days. Lead may cause either temporary or permanent bodily damage. Permanent damage may occur before any symptoms are evident (13).

In adults, acute lead poisoning often occurs at blood levels above 80  $\mu\text{g}/\text{dl}$ . Symptoms include loss of appetite, nausea, stomach disorders, breathing problems, sleeping difficulties, fatigue, moodiness, joint or muscle aches, anemia, and decreased sexual drive. Health effects of acute lead exposure include damage to the nervous system, including wrist or foot drop (extensor muscle paralysis), tremors, and convulsions or seizures. Uncontrolled occupational exposures of acute lead poisoning has resulted in fatalities.

Chronic lead poisoning occurs after lead has collected in the body over time. Lead is a poison that accumulates in the blood, bones, and organs, including the kidneys, brain, and liver. That accumulation or "body burden" of lead may remain in bones for decades and be slowly released over time causing toxic effects. The effect may be evident long after exposure has ceased. A physiological event such as an illness or pregnancy may release lead stored in bones into the bloodstream. The chronic effects of slow releases of lead include impaired hemoglobin synthesis, alteration in the central and peripheral nervous systems, hypertension, effects on male and female reproductive systems, and damage to developing fetuses. Health effects may occur at blood lead levels below 50  $\mu\text{g}/\text{dl}$ . Chronic lead poisoning typically occurs in occupational settings (14).

Children are more susceptible than adults to the effects of lead because of their rapidly developing central nervous systems. Growing evidence indicates that at levels slightly above 10  $\mu\text{g}/\text{dl}$ , lead exposure may cause disabilities in children (15). Disabilities include "hearing impairment, irritability, delayed physical and neuro-behavioral development, inattentiveness, inability to follow instructions, and decreased test scores for reading, spelling, and IQ (16)." Many lead-induced injuries to the central nervous system of children are considered irreversible. Elementary-school children having a higher body burden of lead are "more easily distracted, less independent and organized, more hyperactive and impulsive, less persistent, more easily frustrated, and showing poorer overall functioning, compared with children in lower lead groups (17)." The most common sources for lead poisoning in children are lead paint on toys, peeling paint on poorly maintained old structures and soil around homes and playgrounds due to fallout from leaded gasolines (18).

The level of environmental lead pollution in the U.S. may be better understood when a comparison in body lead levels is made with human populations living in remote mountainous areas in East Asia. Asian children have blood-lead levels of 3  $\mu\text{g}/100\text{ml}$ . That is substantially lower than the average for the U.S. population of 15 to 20  $\mu\text{g}/100\text{ml}$ . In the last several decades, U.S. blood lead levels have declined primarily due to the elimination of lead additives in gasolines. Government enforcement of environmental regulations and public awareness of lead hazards have also yielded reductions in lead

contamination (19).

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## Human Uptake of Lead

Lead is absorbed into the body after being ingested or inhaled. Once in the body, it travels through the bloodstream to the soft tissues including the brain and kidneys. It is then deposited in the bones where it has an estimated half-life of 20 years (20). Inorganic lead compounds are absorbed only minimally in the gastrointestinal tract of adults. However, the gastrointestinal tract of children is permeable to lead.

The daily oral intake of lead in America averages about 100 µg compared to below 30 µg in some European countries. Lead may contaminate food sources in several ways including from naturally occurring concentrations of lead in soil and water. Man-made causes of lead food contamination may result from runoff at mining operation sites and pollution from smelting operations. Direct sources of food and water lead poisoning include lead-containing pesticides and lead-soldered tin cans, and lead-soldered water pipes in residential homes. In the work place, improper personal hygiene may lead to ingestion of lead. If workers eat, smoke, or chew gum or tobacco products in lead-contaminated areas, they risk ingestion of lead (21).

Inhalation of lead-containing dust or fumes usually occurs in an occupational setting around paint-removal or smelting operations. Abrasive blasting of structural steel generates large quantities of air-borne contaminants. Resulting fines of any size may be absorbed or ingested by human in various ways. From an inhalation standpoint, particles less than 10 microns in diameter are a major concern since they may be trapped in the lungs (22).

Lead is only minimally absorbed by the skin. On lead-removal projects, that is not a significant problem. Organo-leads that were once very prevalent in U.S. gasolines may pass through the skin, but apparently do so only in limited quantities when diluted in gasoline (23).

## **LEAD CONTAMINATION FROM PAINT REMOVAL**

### Environmental Pollution

Uncontained open abrasive blasting of lead-based paints probably poses the greatest potential for environmental contamination of all methods for paint removal. It may release large quantities of lead-based paint dust or particles that may become air-borne or fall from heights eventually depositing on the ground or in water. Dust particles smaller than 10 microns are not visible and, in the atmosphere, they behave more like gases than solids. They may remain airborne for long periods and may be carried over long distance by winds.

Air pollution concerns are: 1) inhalation of lead compounds and 2) the deposition of lead particles in areas exposed to an abrasive plume. Environmental pollution and toxicity

problems are most serious in urban areas.

Deposition of leaded particulates that fall in water are controlled by several factors: 1) particulate size, 2) water turbulence, and 3) the chemical form of the lead in a particle. Most paint debris sinks immediately upon contact with water. However, smaller particles may float creating a scum on the water surface. That form of pollution is the most objectionable aspect of lead paint removal over waterways. Those particles will continue to float until they overcome water surface tension or water turbulence increases. Paint debris that sinks to the bottom of a body of water may not pose an environmental threat. Lead-based bridge paints, unlike other more toxic lead forms, are believed to be the most insoluble of all the lead compounds (24). However, a recent University of Tennessee report indicates that lead paint debris may dissolve in waterways and subsequently constitute a significant hazard (25).

The disposition of leaded particulates which cause soil contamination varies greatly adjacent to a lead paint removal site: 1) they may remain in place at or near the soil surface; (the average background lead concentration in soils in the United States is about 16 ppm); 2) some particles may be re-suspended by wind and transported away from the job site; 3) particles may enter bodies of water as a result of surface run-off; 4) some particles may be tracked into buildings by people or pets; and 5) some plants will absorb lead from soils. Lead particles may remain in soil for several thousand years and may present a hazard in areas around previous lead-based paint removal projects (26).

### Public Exposure

In recent years, the public has become increasingly concerned about maintenance painting operations for pollution and health reasons. Many cases of lead contamination and other pollution hazards have been reported by the media. Unexplained illness symptoms and a rise in the incidence of cancer deaths has alarmed the public about all forms of environmental pollution. Health, safety, and environmental regulations enacted to reduce or remove those risks are the result of public opinion. Any paint removal operations that may potentially affect the health of the public are obviously going to be subject to intense public scrutiny.

When conducting abrasive blasting operations, urban areas pose the highest risks since they provide the most opportunities for human exposure, especially to children and because they contain the highest concentration of structures that may become contaminated by airborne debris. Unconfined abrasive blasting generates dust clouds that may be carried over a wide area. Even if lead-free paint is removed, the resulting dust may deposit on houses, businesses, and schools posing a nuisance and, possibly, a health hazard when existent in particle sizes less than 10  $\mu\text{m}$  in diameter (typically measure in a PM 10-type air monitor). Dust that small becomes airborne easily and may become lodged in the lungs. Most state EPAs have "clean air" regulations limiting such exposures.

Abrasive blasting operations that remove lead-based paints compound the dust nuisance

with additional health risks provided by lead. The ground in some urban areas (particularly roadways) contains significant lead contents. That was caused by: leaded gasolines, industries that use lead in their processes and past paint removal operations. An important goal of maintenance painting operations is not to add to the lead background in the soil lead (or to avoid blame for pollution created by others). Large monetary losses have been incurred by some painting contractors and government agencies due to improper containment of abrasive blasting operations on structures in urban areas.

Dust generated by abrasive blasting is not as objectionable in rural areas as in urban areas. Lead contamination may not pose a significant health risk to the public. In rural areas, hazards posed by abrasive blasting of lead-based paints on bridges are usually limited to environmental pollution and worker safety concerns. Little information exists on the effects of lead on farm animals, vegetation, and wild life (27).

### Worker Safety

Industrial hygiene may be the most important health issue involving abrasive blasting operations of lead-based paints (28-30). Workers at or near a job site should take special precautions to avoid inhaling or ingesting lead particles. In confined environments such as the holds of ships, or in enclosures employed to contain abrasive blasting operations on bridges, the concentrations of airborne lead particles are thousands of times greater than those found in unconfined, open abrasive blasting. Microscopic particles of lead paint dust also pose a health hazard associated with operations that occur during painting including: clean up, moving, and rigging. Worker clothing may retain lead paint dust and eventually contaminate additional enclosed areas, especially workers' homes, placing their families at risk (31).

### Preventive Measures

The hazards posed by abrasive blasting of lead-based paints should be dealt with effectively. Costs associated with those actions should be weighed against problems arising from contamination. Punitive actions imposed by regulatory agencies include expensive remediation measures and the possibility of legal actions including civil suits, fines and, in extreme cases, criminal penalties (32). Those severe penalties suggest that efforts to prevent contamination of lead paint debris should be effective with emphasis on preventing contamination and injury and on providing for proper handling and disposal of all generated wastes.

The need to limit dust and lead-containing debris exposure is more crucial in urban areas since the potential for problems is greater than in other locations. Abrasive blasting operations are more likely to be scrutinized closely by regulatory agencies in urban areas.

### Lead as a Hazardous Waste

Congress defined the term "hazardous waste" in Section 1004(5) of the Resource

Conservation and Recovery Act (RCRA) as "a solid waste or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may:

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- 1) Cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness or
- 2) Pose a substantial present or potential hazard to human health or the environment when improperly treated stored, transported, or disposed of, or otherwise managed."

By that definition, if a waste is not solid, it is not a hazardous waste. The EPA further defines a solid waste as hazardous when it is not excluded from regulation and if it meets the following criteria:

- 1) It exhibits the characteristics of a hazardous waste,
- 2) Has been named as a hazardous waste and listed as such in the regulations,
- 3) Is a mixture containing a listed hazardous waste and a nonhazardous solid waste, and
- 4) Is a waste derived from the treatment, storage, or disposal of a listed hazardous waste (33).

The EPA classifies hazardous wastes as listed or characteristic. Listed wastes are related to specific or non-specific sources typically associated with manufacturing. Characteristic wastes are not specifically associated with any manufacturing process. RCRA lists specific wastes by a number denoting whether the waste is listed or characteristic -characteristic wastes having a "D" prefix, and specific hazard (i.e. ignitable - D004, corrosive - D002, reactive -D003, or EP-toxic - (D0004-D0017). "EP" signifies the term "Extraction Procedure". Lead is listed as an EP-toxic waste. Its specific RCRA waste number is D008.

## **GOVERNMENT REGULATION OF THE REMOVAL OF LEAD-BASED PAINT FROM BRIDGES**

### Federal Legislation

Since the 1970's, Congress has addressed work-related and -generated health hazards by enacting several related pieces of legislation or "Acts." Those Acts are laws under which programs are implemented and enforced by regulatory agencies such as the U.S. Environmental Protection Agency (EPA). Those agencies are responsible for fulfilling the requirements of an Act by promulgating regulations. Regulations are legal mechanisms that define how a law's broad policy directives are to be implemented. Further clarification of regulations are issued through agency guidance documents and policies.

They are issued by a regulatory agency primarily to elaborate and provide direction for implementing regulations.

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Congressional legislation (Acts) yields regulations promulgated by the agencies charged with enforcing them. The initial versions of those regulations is provided in the **Federal Register** that is published daily. The regulations are eventually revised after public review. The revised regulations are summarized annually and published in the **Code of Federal Regulations** (CFR). Those regulations are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC (34).

Some of the Acts currently affecting maintenance painting operations are:

1. Clean Air Act,
2. Federal Water Pollution Act,
3. Resource Conservation and Recovery Act,
4. Comprehensive Environmental Response Compensation and Liability Act,
5. Hazardous and Solid Waste Amendment,
6. Superfund Amendment and Reauthorization Act and
7. Third Third Land Disposal Restriction Act.

Several of those Acts were amended since their initial enactment. Some of those amendments are much broader in scope and more far-reaching in impact than the initial Acts.

**Clean Air Act** - The Clean Air Act standards put forth by the EPA are meant to limit the emission of pollutants into the atmosphere. Under that Act, the EPA established National Ambient Air Quality Standards (NAAQS) which cover such substances as lead, ozone, carbon monoxide, nitrous oxides, sulfur oxides, hydrocarbons, and particulates (35).

**Federal Water Pollution Control Act** - The Federal Water Pollution Control Act has been amended three times since it was enacted: the Federal Water Pollution Control Act Amendments of 1972, the Clean Water Act (CWA) of 1977, and the Clean Water Act Amendments of 1987. Current regulations are designed to reduce pollution of streams, lakes, and rivers from organic wastes, hazardous substances, heat, and sediment. The 1987 act addresses point sources such as lead removal activities on industrial structures next to waterways (36).

**Resource Conservation and Recovery Act** - The Resource Conservation and Recovery Act (RCRA) directed the EPA to develop and implement a program to protect human health and the environment from improper hazardous waste and management practices. Several programs exist under RCRA that deal with this problem. One program termed "Subtitle C," deals specifically with hazardous wastes. The program is designed to control the management of hazardous wastes from generation to final disposal -- "from cradle to grave" (37). The ultimate responsibility for implementing those controls is

placed on the hazardous waste generator.

~~Under the current RCRA Act, a waste generator (i.e. a facility owner or generator) should determine whether a waste is hazardous. Wastes are considered hazardous by RCRA at specific concentrations. The hazardous waste listing for wastes containing lead specifies them to be hazardous when leaching tests in an acid solution (to be discussed below) result in leachable concentrations greater than 5 mg/l (5 ppm).~~

Comprehensive Environmental Response Compensation and Liability Act - The Comprehensive Environmental Response Compensation and Liability Act (CERCLA), commonly called the "Superfund," was created for the same purpose as RCRA. Both were enacted to protect human health and the environment from the dangers of hazardous waste. However, RCRA does not address the cleanup of existing sites containing hazardous waste, nor does it address hazardous waste releases or spills.

CERCLA was created in 1980 to respond to those situations. It was enacted to address the thousands of potentially dangerous hazardous waste sites then existent throughout the country. A prime example of a superfund site was the "Valley of the Drums" in Bullitt County, KY where 17,000 leaking drums of hazardous wastes were discovered in 1967.

CERCLA provided new cleanup authority to the federal government. A \$1.6 billion trust fund was created to pay for government cleanup and liability for that work was imposed on those responsible. This fund consisted primarily of tax assessments on oil and designated chemicals. The Act authorized a 5-year program by the federal government to perform the following primary tasks:

1. Identify hazardous waste sites where releases have already occurred or that might occur,
2. take appropriate action to remedy those releases, and
3. ensure that parties responsible for the releases pay for the cleanup actions.

Under CERCLA, the EPA will respond to any release of hazardous substances, pollutants, or contaminants that may present an imminent danger to the public health and welfare. Lead is included as a hazardous substance that is regulated under the CAA, CWA, and RCRA. A CERCLA response would probably be triggered if lead dust was released from a work site and contaminate a given area. A spill of hazardous, lead-containing debris during transport also might cause a response (38).

Hazardous and Solid Waste Amendment - RCRA has been amended several times since it was enacted. The most significant amendment is the Hazardous and Solid Waste Amendment (HSWA) that was enacted in 1984. It expanded the requirements of RCRA since it dealt with landfill design criteria and waste regulations, surface impoundments, land disposal restrictions and record-keeping requirements. It requires that the generation of hazardous waste be minimized, and where minimization cannot be achieved, hazardous waste management is to be conducted in such a way that it is

protective to human health and the environment.

~~The amendment requires that the EPA establish "...levels or methods of treatment, if any, which substantially diminish the toxicity of the waste or substantially reduce the likelihood of migration of hazardous constituents from the waste so the short-term and long-term threats to human health and the environment are minimized." In regards to land disposal restrictions (LDRs), HSWA defines land disposal "...to include, but not limited to, any placement of such hazardous waste in a landfill, surface impoundment, waste pile, injection well, land treatment facility, salt-dome formation, or underground mine or cave (39)." HSWA is also significant because it established timetables for the implementation of its provisions (40,41).~~

Superfund Amendment and Reauthorization Act - The Superfund Amendment and Reauthorization Act (SARA) of 1986 extended the time frame of CERCLA for five more years. The original program underestimated the number of abandoned hazardous waste sites in the U.S and how complex and time-consuming the cleanup efforts would be. SARA increased the program funding from \$1.8 billion to \$8.5 billion and established new standards and schedules for site cleanup (42).

Third Third Land Disposal Restriction Act - An important provision to HSWA known as the Third Third Land Disposal Act or "Land-Ban" became effective on August 8, 1990. This act refers to the last third of the remaining soft-hammer provisions for hazardous wastes. It effectively banned the landfilling of any hazardous waste. The Land Ban set treatment standards and conditions under which waste may be properly disposed. It requires that hazardous wastes be treated until they fall below established regulatory limits (43).

#### Kentucky Legislation and Regulations Related to Lead

In enacting environmental and worker-safety legislation, Congress intended for states to eventually assume responsibility for enforcement of regulations. States were allowed to formulate comparable legislation as long as it was as strict as the federal regulations they supplanted. Over 40 states have enacted legislation and have established state agencies charged with regulation promulgation and enforcement (44). In instances where states have not assumed an enforcement role, or where state enforcement is considered inefficient, federal regulatory agencies including the EPA and OSHA may intervene.

The Kentucky Legislature has enacted legislation addressing the assumption of regulatory enforcement for environmental and worker safety issues. Legislation has been enacted establishing regulatory agencies and authorizing those agencies to issue and enforce regulations. Legislation has also been enacted which now supplants federal regulations with statutory laws. That legislation is incorporated in the Kentucky Revised Statutes (KRS). The KRS are available from Banks-Baldwin Publishing Company of Cleveland, OH and the Michie Company, Charlotte, NC.

Based on those statutes, state regulatory agencies are empowered to prepare regulations



that specify how the specific statutes are to be enforced. Those regulations are termed Kentucky Administrative Regulations (KARs). Those regulations may determine issues that are influenced, rules governing proper procedures to address those issues, permitting fees for conducting specific operations, and penalties for violations. Kentucky regulatory agencies also interpret and enforce those regulations. Most KARs reference federal regulations CFRs as the KARs relate to the state's assumption of regulatory duties originally promulgated by federal regulatory agencies. KARs are available from the Kentucky Legislative Research Commission, Frankfort, KY.

## **FEDERAL AND STATE REGULATORY AGENCIES**

There are many state and federal agencies that regulate how lead paint removal projects are planned, undertaken, and completed. All aspects of these operations are regulated in some way because they affect the health and well-being of workers, the public, and the environment.

### **U.S. Environmental Protection Agency**

The U.S. Environmental Protection Agency (EPA), created in 1970, has the primary responsibility of monitoring the environment for health effects. Its regulations cover air, water, and soil contaminants that may harm human health or the environment. The EPA is charged with enforcing regulations that exist under CERCLA (45).

### **Natural Resources and Environmental Protection Cabinet**

In Kentucky, the Natural Resource Environmental Protection Cabinet (NREPC) is charged with protecting the environment. The NREPC was created and empowered by KRS 224 "Environmental Protection." It is comprised of divisions that oversee environmental issues including the following ones which may directly impact maintenance painting projects involving the removal of lead-based paints:

1. Division of Water
2. Division of Air Quality
3. Division of Waste Management
4. Division of Environmental Services

Each of those divisions has regulations which pertain to lead-abatement projects. The titles of most of those divisions explain their area of regulatory authority. The Division of Environmental Services is primarily a service organization that supports the other divisions. In the future, its risk-assessment group will be issuing regulations related to underground storage tanks and Superfund sites.

As noted, state EPAs such as the NREPC are also charged with enforcing the environmental regulations they issue. Historically, some state EPAs have been reluctant to enforce environmental regulations on other state agencies. However, that trend has changed recently and most state EPAs, including the NREPC, are now insistent that all

parties subject to regulations comply with them.

## ~~U.S. Occupational Safety and Health Administration~~

The U.S. Occupational Safety and Health Administration (OSHA) is the primary federal agency concerned with worker safety and health issues. That agency was created in 1971 when the Occupational Safety and Health Act was enacted by Congress. It was created in the U.S. Department of Labor to discharge the responsibilities assigned under the Act. The Act gives the Secretary of Labor the following powers: "1) to promulgate, modify, and revoke safety and health standards, 2) to conduct inspections and investigations, 3) to issue citations and to propose penalties, 4) to require employers to keep records of safety and health data, 5) to petition the courts to restrain imminent danger situations, and 6) to approve or reject state plans for programs under the Act (46)."

## Kentucky Occupational Safety and Health Program

The Kentucky Occupational Safety and Health Program (KOSH) is an agency established under the Kentucky Labor Cabinet by KRS 338 "Occupational safety and health of employees." The KOSH Standards Board meets biannually to adopt new standards or to revise existing ones. It has adopted, by reference, the OSHA General Industry and Construction Standards. The regulations (803 KAR 2:400 through 2:423 for the Construction Industry and 803 KAR 2:015, 2:018, 2:019 and 2:300-2:320 for the General Industry) and the empowerment of KOSH to enforce those are based on specific statutes (KRS 338.051 and 338.061).

## Department of Health Services

The Department of Health Services is an agency established under the Human Resources Cabinet. It functions "after the fact" to identify health problems that affect the public. The Department of Health Services actively measures children of low-income families for lead poisoning under 401 KRS 211.900 "Lead poisoning prevention." The Department of Health Services would investigate any public concerns or reported cases of lead poisoning arising from abrasive blasting operations in urban areas.

## Fish and Game Department

The Fish and Game Department is under the Tourism Cabinet. When wildlife are impacted by toxic discharges (e.g. fish kills), the Fish and Game Department determines the wildlife impact (i.e. number of dead fish) and issues a fine to the offending party. Regulation of toxic effects on wildlife is established under KRS 150 "Fish and wildlife resources." Hazards to aquatic wildlife might result from water pollution due to particulate discharge from unconfined abrasive blasting. However, during the 15 to 20 years that unconfined abrasive blasting was employed over waterways, there were no related instances of fish kills.

## National Institute for Occupational Safety and Health

The National Institute for Occupational Safety and Health (NIOSH) is part of the U.S. Department of Health and Human Services (DHHS). It was created by the OSHA Act and currently is located in Cincinnati, OH. NIOSH provides advice and consultation to OSHA, state agencies, industry and labor on occupational safety and health problems in general. It is the principle federal agency engaged in research to eliminate on-the-job hazards. Its responsibilities include identification of occupational safety and health hazards and recommendation of changes in the regulations limiting them. It also provides OSHA with recommendations for PEL values and provides external support for research by other institutions (47). NIOSH may be requested by an employee to intervene with on-site testing when the employee believes he/she is at risk from a potential work hazard.

## **IMPACT OF GOVERNMENT REGULATIONS ON BRIDGE MAINTENANCE PAINTING OPERATIONS**

### **Compliance with Laws and Regulations**

In every instance, waste generators (facility owners) and contractors bear the responsibility of compliance with all laws and regulations. Ignorance of those laws and regulations is not a viable defense against the assessment of fines and other penalties. Additionally, generators of hazardous wastes are responsible for those wastes after they leave the generator's possession.

### **Limitations of Waste Discharge**

Government laws and regulations no longer permit unrestricted pollution of the environment. Waste generators should limit discharges of hazardous wastes as they are generated and insure that the wastes generated are contained and eventually treated and disposed of or recycled to prevent them from posing continuing hazards. While contractors may be employed to perform specific services related to waste generation or disposal, the generator still bears ultimate responsibility for all hazardous wastes generated. That responsibility extends to the welfare of a contractor's workers involved with the generator's wastes.

**Air** - The EPA has established National Air Quality Standards (NAAQS) for certain pollutants, including lead. The maximum allowable level for airborne lead is  $1.5\mu\text{g}/\text{m}^3$  averaged over a calendar quarter (i.e. three months). Those standards are rarely enforced for bridge maintenance because they were intended for permanent operations, such as lead smelters. For bridge maintenance, there is a relative lack of monitoring data and most bridge blast-cleaning jobs are finished in less than 90 days. This may change in the near future. The EPA has already announced intention to lower the exposure limit to  $0.75\mu\text{g}/\text{m}^3$  and to reduce the time frame for averaging to 30 days. That change would impact bridge painting activities that usually exceed those limits when high levels of airborne-lead discharges occur.

The EPA established national primary and secondary air quality standards for PM-10

dust. The primary standard is more restrictive. It protects public health and considers 24-hour exposure. The secondary standard protects the public from adverse effects of a pollutant and covers an 8-hour exposure. The primary standard for PM-10 discharges is  $50 \mu\text{g}/\text{m}^3$  averaged over a calendar year. For any 24-hour period, the maximum average concentration is  $150 \mu\text{g}/\text{m}^3$  (Figure 2). Open abrasive blasting operations often exceed this 24-hour standard (48).

The NREPC regulations related to air quality are 401 KAR 53:010 "Ambient Air Quality Standards," 401 KAR 63:010 "Fugitive Emissions" and 401 KAR 63.022 "New or modified sources emitting toxic air pollutants." The air quality standards for lead and particulate matter set under 401 KAR 53:010 are identical with those set by the EPA. Regulation 401 KAR 63:010 prohibits actions that release dust into the atmosphere. Regulation 401 KAR 63:022 sets limits for air quality and total emissions of toxic air pollutants.

Water - The EPA previously established the drinking water limit for lead at  $50 \mu\text{g}/\text{l}$  (49, 50). The regulated limit for lead leaching from a landfill is based on a model composed of 95 percent municipal solid waste and 5 percent commercial waste. The EPA estimates that a dilution attention factor (DAF) of 100 will reduce the leachable lead content by an order of two magnitudes before it reaches the nearest well. Therefore, the leachate from a landfill may have a lead content no greater than  $5 \mu\text{g}/\text{l}$  (approximately 5 ppm) according to the TCLP test (discussed below). Lead in wastes disposed in a landfill cannot have a leachable lead content of greater than that amount (51, 52). Recently, the EPA reduced the allowable lead content in drinking water to  $15 \mu\text{g}/\text{l}$  (53).

The NREPC regulates water quality under 401 KAR 5:031 "Surface water standards." That regulation considers water hardness in providing limits for allowable lead (and zinc) contamination. For waterways that are drinking water sources, the EPA limit applies. Specific waterways are classified for designated uses under 401 KAR 5:026 "Classification of waters." Attendant definitions are provided under 401 KAR 5:029 "General provisions."

Soil - No EPA regulations directly address lead contamination of soil resulting from lead-paint removal projects. Some state or local governments may have regulations that provide limits to soil contamination. The only guidance on lead-contaminated soil is provided by the EPA Office of Solid Waste and Emergency Response (OSWER). That agency established cleanup (remediation) levels for superfund sites. It set the remediation level for lead at 500 to 1,000 ppm when the current or predicted use of land is residential. Those levels refer to total lead content and were based on guidelines from a 1985 Center for Disease Control (CDC) statement on childhood lead poisoning. "The CDC recommendation states that lead in soil and dust appears to be responsible for blood levels in children increasing above background levels when the concentration in the soil or dust exceeds 500 to 1,000 ppm. Site-specific conditions may warrant the use of soil cleanup levels below the 500 ppm level or somewhat above the 1,000 ppm level (54)."

Collection and Disposal of Hazardous Wastes Generated by Maintenance Painting

Plans to deal with expected wastes should precede field work to prevent delays in the onset of painting operations and potential problems related to waste discharges. Removal of old existing paint by abrasive blasting is one of the first steps in conventional bridge maintenance painting. A generator's direct efforts to comply with environmental regulations obviously should begin then. Work to collect and dispose of abrasive blasting debris should accompany paint removal operations and continue after those wastes have been removed from the job site. Due to scheduling, that work may continue after a painting contractor has abandoned the job site.

### Lead-testing Regulations

In 1961, the Consumer Product Safety Commission banned the use of consumer paints containing more than .06% lead (55). Industry adopted this as the regulatory threshold for determining whether to implement measures to protect public and worker health against a lead hazard on paint removal projects. If desired, preliminary tests to determine the lead content of paint samples obtained from a bridge are conducted according to Methods 6010 and 7000 in EPA Manual SW 846 (56). The tests will determine total lead in the paint.

Samples of wastes generated during abrasive blasting should be obtained according to 401 KAR 31:100 "Appendix on representative sampling methods." Wastes are determined to be hazardous if they contain one of 400-plus listed wastes in accordance with 401 KAR 31:040 "Lists of Hazardous Wastes" or have one or more of the EPA characteristic hazards (i.e. ignitability, corrosivity, flammability, or toxicity) according to 401 KAR 31:030 "Characteristics of Hazardous Wastes." Testing of abrasive blasting debris to determine whether it is hazardous is performed according to Method 1311 the Toxicity Characteristic Leaching Procedure (TCLP) according to EPA SW 846, Method 1311 (57). The TCLP test is described in 401 KAR 31:110 "Appendix on toxicity characteristics leaching procedure."

### On-site Storage, Handling, Transport and Disposal of Hazardous Wastes

Procedures for on-site storage of hazardous wastes are specified in 401 KAR 32:010 "General provisions for generators." Duration of on-site accumulation, packaging for transporting, labeling, and vehicle placarding are regulated under 401 KAR 32:030 "Pretransport requirements." Certain requirements related to worker safety that are not addressed by KOSH are specified in 401 KAR 32:030 "Pretransport requirements", 401 KAR 35.020 "General facilities standards", 401 KAR 35.030 Preparedness and prevention", and 401 KAR 35.040 "Contingency plan and emergency procedures."

Certain hazardous waste generators should manifest wastes for transport to treatment-storage-disposal (TSD) facilities in accordance with 401 KRS 32:020 "Manifest system." Manifesting in-state should be performed according to 401 KAR 32:100 "Appendix on hazardous waste manifest and instructions."

Preparation of hazardous wastes for shipment to a TSD facility should be according to

401 KAR 32:030 "Pretransport requirements." In-state facilities are permitted according to 401 KAR 35:020 "General facility standards"; 401 KAR 35:030 "Preparedness and prevention" and ~~401 KAR 040 "Contingency plan and emergency procedures."~~

A hazardous waste generator should maintain records related to hazardous waste generation and on-site accumulation, transport and disposal according to 401 KAR 32:040 "Recordkeeping and reporting."

### Worker Safety - Construction vs General Industry Requirements

During this study, worker lead contamination from abrasive blasting became the major industrial-health problem in the U.S. OSHA requirements for workers involved with lead paint are contained in Title 29 "Labor" of the Code of Federal Regulations. Two parts of that section address the protection of workers in the construction industry and in manufacturing:

**29 CFR 1926 Safety and Health Regulations for Construction.** This part is commonly known as the "Construction Industry Standards," and

**29 CFR 1910 Occupational Safety and Health Standards.** This part is commonly referred to as the "General Industry Standards." Specific requirements for worker protection from lead are found in 29 CFR 1910.1025 "Lead." This section is typically termed the "Lead Standard (58)."

The Construction Industry Standards are generally applied to the maintenance painting industry at bridges, water towers, and other field job sites (59). However, federal regulations will be amended to replace the Construction Standards with a more stringent standard in 1993 (60, 61). The initial replacement for the current Construction Standard will be an interim standard. It will probably be based upon the current General Industry Standards. Due to the inadequacies of the current Construction Industry Standards and to the likelihood of its imminent revision, further discussion will be limited to the Lead Standard of the General Industry Standards.

**Permissible Exposure Limit** - The lead standard section of the General Industry Standard provides a "permissible exposure limit" (PEL) for implementing worker-protection practices against airborne lead in a work environments. This limit is set at 50  $\mu\text{g}/\text{m}^3$  averaged over an 8 hour period. The employer is responsible for assuring that unprotected employees are not exposed to lead concentrations greater than this level (62).

When that regulatory threshold is exceeded, an employer is responsible for instituting controls to insure worker protection. The employer should enact controls to limit worker exposure. In hierarchy of enactment, those are 1) engineering controls, 2) work practice controls, 3) respiratory protection, and 4) a compliance program. In some cases, a combination of controls should be employed (63).

**Engineering Controls** - Abrasive blasting operations generate large amounts of dust. The

dust particles consist of abrasive blasting material, paint chips, and residual soils. Ventilation is an important engineering control for limiting worker exposure to dusts, especially those contaminated with toxic materials. When the operation is contained, airborne particulate levels may increase drastically making proper ventilation very important. Engineering controls for a proper ventilation system should maintain a minimum air velocity (50 feet/min. -vertical, 100 feet/min. - vertical) through the enclosure to move airborne dust away from workers. Besides improving vision, a properly directed airflow system will drop the airborne-lead concentration to a safe level that will not exceed the threshold limit of the workers' respiratory equipment (64).

To comply with OSHA standards, the vented air must be exhausted through a filtration system. Dust collectors should be designed so particulates may be filtered from the ventilation air when it is exhausted. That is necessary to prevent contamination of other areas. The most efficient system uses a cartridge-type dust collector that removes 99.95% of all particulates 0.5 microns or larger (65).

Other engineering controls use paint-removal methods that lessen or eliminate dust and lead paint particulate generation. Some typical methods are discussed below. If those methods prove economically impractical, other methods of limiting working exposure should be employed.

**Work Practice Controls** - The second hierarchy of controls to limit worker exposure is to revise work practices. That often involves changing work-related actions by either eliminating unsafe practices or minimizing worker exposures to hazards. Typical work practice controls related to abrasive blasting include 1) minimizing the generation of dust within contained areas and 2) prohibit eating and smoking in the work area, providing suitable cleaning facilities and reduced work periods in locations where high airborne concentrations of lead exist.

Several practices may be introduced to prevent the generation of airborne dust at the job site, especially in contained areas. A common practice that should be avoided is the use of compressed-air blasting to remove dust from blast-cleaned steel. That generates large amounts of fine dust in a closed area such as a containment enclosure. That practice may be supplanted by collecting surface dust by vacuuming with a unit equipped with a high-efficiency particulate (HEPA) filter. A job site should be kept as clean as possible of lead particulates. Collected dust inside of contained areas has the potential to become airborne and spread lead contamination over a larger area. Wet cleaning or vacuuming with a HEPA-equipped unit is the recommended housekeeping method for dust suppression (66).

An employer may need to provide workers with hygiene facilities located a safe distance away from any airborne-lead contamination. That includes a changing area where work clothes are kept separate from street clothes, shower facilities, clean restrooms for workers to wash before eating, and a clean dining area. Work clothes should be removed before entering any designated smoking or dining facilities. Employers are mandated to place warning signs at and around the job site to remind workers to keep food, cigarettes,

or beverages out of work areas.

~~Blasters, painters, and other workers at the job site in contact with wastes or exposed~~ to dust should be supplied with clean work clothes daily. Clothing should include disposable or reusable overalls. Separate storage bins are needed to store soiled clothing (also disposable clothing) at the end of each day. Workers should not attempt to clean dust from their work clothes. That would increase the chances of lead-dust inhalation for the employee and other workers. Also, workers should be required to shower and change clothes at the job site. Separate laundry facilities that are equipped to handle lead-contaminated clothing should be used by the employer (67).

**Respiratory Protection** - When the PEL is exceeded, the employer is required to provide respiratory protection. Respirators and air-supplied helmets are rated to provide specific protection factors. Measurements need to be made of airborne lead concentrations in specific work environments at the job site to determine which types of respiratory protection are necessary. Inside containment enclosures, abrasive blasters, painters, and inspectors may need to wear continuous air-supplied blast helmets having full faceplates that cover the head and neck (Figure 3). That type of respirator is designed to protect workers from rebounding abrasive particles as well as high concentrations of lead bearing dust. The supplied air is generated by a compressor located outside a containment enclosure. It should provide workers with a "Class D" air supply which consists of: 20% oxygen, less than 1000 parts per million (ppm) carbon dioxide, less than 20 ppm carbon monoxide, and less than 0.13 ml/l of oil and particulates (68).

Other employees outside of containment may be exposed to airborne leaded particulates at or above the PEL. They may need to wear half-mask powered air-purifying respirators (PAPR) having HEPA filters.

All respiratory devices should be fitted to workers that will wear them. The respirators should be periodically cleaned and properly stored to prevent damage.

Initial employee monitoring is necessary to insure that the PEL is not exceeded by the respiratory device supplied to any worker. That requires attaching a portable battery operated pump to the belt. A hose connects the pump to a filter that is positioned in the worker's breathing zone, but outside any respiratory protective device. The unit samples air by pulling it at a known flowrate through the filter that traps airborne particles (69). A similar technique may be employed in which the filter is located within the respirator or air-supplied helmet to measure the degree of protection afforded the worker.

**Compliance Program** - According to OSHA Hazard Communication Standard 1910.1200, termed the "Right-To-Know-Law," it is an employer's responsibility to initiate a training program for all workers at job sites where the PEL is exceeded. They should be informed of the hazards of lead, proper hygiene practices, proper work procedures, use of respiratory protection equipment, and the precautions to take when working near lead. Employees should be trained well in advance of working on a lead paint removal project.



In addition to worker training, employers should develop and make available a written hazard communication program. According to the OSHA General Industry Standards, ~~the purpose of that program is to "ensure that the hazards of all chemicals produced are~~ evaluated, and that information concerning their hazards is transmitted to affected employers and employees within the manufacturing sector. This transmittal of information is to be accomplished by means of comprehensive hazard communication programs, which are to include container labeling and other forms of warning, material safety data sheets and employee training (70)."

A final precaution involves regular medical monitoring of workers. The employer is responsible to initiate a medical surveillance program for workers who are exposed to lead above the PEL for more than 30 days. Included in this program is blood sampling and testing for indicators of lead contamination. Common blood tests include total lead content, zinc protoporphyrin (ZPP), and free erythrocyte protoporphyrin (FEP) tests. The total blood test is usually not as sensitive an indicator of potential worker health problems as the other tests. The general industry standard requires specific actions including worker removal from the job site when one blood test exceed 60 µg/dl or when the average of three tests exceed 50 µg/dl (71).

## **MODERN PAINT-REMOVAL AND CLEANING OPERATIONS**

### **Maintenance Painting Operations**

Health and environmental regulations have changed bridge-cleaning and painting practices. In urban areas, contractors should limit waste discharges (e.g. dust) into the atmosphere even when those are not hazardous. Provisions should be made to safeguard worker health. Specific procedures for waste disposal should be followed, regardless of whether those wastes are hazardous. Potential liabilities and insurance costs are also major concerns. All of those considerations have increased both maintenance painting costs and the complexity of maintenance painting project management.

### **Paint Removal Methods**

During lead paint-removal projects, the environment should be protected against discharges of hazardous materials consisting of dust and abrasive wastes. Many contracts or specifications call for contractors to prevent any abrasive debris from contaminating the environment. Such levels of environmental protection may only be approximated, and then, only at high cost. A certain fraction of dust generated will inevitably escape. The following is a list of existing paint-removal methods used by the painting industry today:

1. open abrasive blast cleaning,
2. open abrasive blast cleaning with recyclable abrasives,
3. vacuum blast cleaning with recyclable abrasives,
4. air abrasive wet blast cleaning,
5. high-pressure water jetting with and without abrasives,

6. hand and power tool cleaning,
7. chemical stripping,
8. innovative cleaning methods, and
9. combinations of removal methods.

Several reviews have been made of alternate paint-removal technologies, including some which were touted as the "optimum" solution to the hazards normally experienced in removal of lead paints (72-74). A brief review of those methods is provided as follows.

**Open Abrasive Blast Cleaning** - Open abrasive blasting involves the use of a system that air-transportes abrasives drawn from a holding tank through hoses to nozzles. The nozzles are directed toward work pieces by blast-cleaning personnel. It is the method of choice of contractors due to familiarity, productivity, and ease of operation. Abrasive blasting provides the best removal of tightly adherent paint, mill scale, or rust. It cleans in small cracks and crevices better than other paint-removal methods. It also allows abrasive blasters to move at a consistent pace.

That method has several disadvantages. Full-containment enclosures are required to prevent discharges of dust and hazardous debris. Disposable abrasives are often friable and, when used, contribute to the build-up of dust presenting vision problems in containment enclosures. Usually large quantities of spent abrasives are generated which may result in increased transportation and disposal costs when the wastes test hazardous. More effort and funds may be expended in building and moving a containment enclosure than in performing the actual work. Also, hazardous wastes may concentrate inside a containment enclosure exposing workers to a potentially dangerous environment.

**Open Abrasive Blast Cleaning with Recyclable Abrasives** - Waste minimization is an important consideration for the painting industry due to recently enacted hazardous waste legislation. The Third Third Land Disposal Restrictions (LDR) Act of 1990 put severe restrictions on the handling and disposal of hazardous wastes. One result has been a significant increase in those costs. The most effective method for reducing waste-debris generation is to use recyclable abrasives. Steel or iron grit, which may be reused up to 200 times, are the most commonly used recyclable abrasives. The recycling process separates mill scale, rust, and paint chips from the abrasive before it is reused.

Use of recyclable abrasives entails high equipment costs, primarily for a system necessary to separate wastes and clean the abrasive for reuse. Recyclable abrasives are also expensive and a high percentage should be reclaimed after each use. Recycled abrasive should be 99% contaminant-free before reuse to prevent undesirable build-up of fine lead particles in the containment enclosure. Use of open abrasive blasting with recyclable abrasives requires use of containment enclosures with all the attendant disadvantages.

**Vacuum Blast Cleaning with Recyclable Abrasives** - Vacuum blast cleaning employs a shrouded outlet or nozzle that focuses an air stream carrying recyclable abrasive against

a portion of a work piece. That portion is covered by the end of the nozzle. The nozzle acts as an enclosure to contain the rebounding abrasive and paint debris. A vacuum outlet located near the end of the nozzle collects the ricocheting material and routes it to a central waste collection system for waste separation and recycling. Since the blast-cleaning operation is enclosed, containment is not necessary. Also, workers may use half-face respirators rather than air-supplied helmets.

Properly shaped nozzles should be used to seal against structural details of irregular shapes. A nozzle should be held tightly against the surface so no abrasives or dust escape. This is difficult on irregular surfaces and often results in low productivity and operator fatigue. Typically, vacuum cleaning systems are expensive.

**Air Abrasive Wet Blast Cleaning** - Air abrasive wet blast cleaning injects water into an air stream that propels the abrasives. The wetted abrasives do not create the dust problems associated with conventional abrasive blasting. Full containment may not be required. Use of this method may allow workers to use half-face respirators rather than air-supplied helmets. Water in the blast stream is effective in removing surface contaminants such as chlorides.

The productivity of that method is lower than conventional abrasive blasting. Waste water generated by blast cleaning should be captured and treated to remove any lead before being disposed. The water may cause flash rusting. That may be remedied by use of corrosion inhibitors in the blasting water supply. However, corrosion inhibitors may cause compatibility problems with certain paints.

**High Pressure Water Jetting** - This method employs water pressurized up to 20,000 psi for high-pressure systems and between 20,000 to 40,000 psi for ultra-high pressure water jetting. High water pressure may remove paint and loose rust. The systems should use abrasives to remove mill scale and tight rust. When only water is used, only old paint and corrosion products are generated as wastes. Full containment may not be required. Use of this method may allow workers to use half-face respirators rather than air-supplied helmets.

The ultra-high pressure methods are the most expensive. Some operational disadvantages enumerated for air abrasive wet blasting apply to this method.

**Hand and Power Tool Cleaning** - Hand and power tool cleaning methods are noted for being low to moderately inexpensive for equipment investment. No additional abrasive wastes are generated during cleaning operations. When those tools have vacuum-equipped shrouds, no containment is necessary. Worker respiratory protection may be limited to half-face respirators.

Those methods are labor intensive with low productivity. Moderate containment methods such as wind screens or tarps having ground covers may be needed for tools without vacuum systems.

Chemical Stripping - Chemical stripping involves the use of chemical compounds consisting of acids, bases, or solvents placed over existing paint. The compound is allowed to penetrate and soften the existing paint that is removed later, typically by scraping. The wastes are easily collected and no containment is necessary. Workers may not need respiratory protection.

Chemical stripping is not very effective in removing tight rust/mill scale or cleaning irregular surfaces. The production rate is low. Also, this method may create large volumes of waste water depending upon the amount of water used for flushing.

Innovative Cleaning Methods - There are other innovative methods of cleaning. Those methods include sponge jetting, laser jet cleaning, induction heating, and blasting with water soluble abrasives and dry ice. Those methods offer potential benefits of negligible spent abrasive wastes and low dust generation, obviating the need for containment. Since those methods have not been applied on bridges in this country, except, perhaps for a few experimental applications, they will not be described further.

Combinations of Removal Methods - Contractors may apply combinations of removal methods to benefit from specific features characteristic of each different method and to offset limitations of a particular method (75). That approach may be used to reduce the amount of waste generated, eliminate containment requirements, reduce the possibility for hazardous waste discharge and reduce overall costs. As an example, a contractor may use chemical stripping to remove lead-based paint from a bridge located near a school. That method would be selected because it is not prone to dust generation. After that, a painting contractor may use open abrasive blasting to impart a profile to the uncoated bridge steel.

### Containment Enclosures

When open abrasive blast cleaning or other unconfined paint-removal methods are employed, some method should be used to prevent environmental pollution. The most practical method consists of enclosing a work area to prevent airborne debris from escaping.

The term "containment enclosure" broadly describes work enclosures placed over structures to prevent discharges of wastes generated during paint removal (Figure 4). Containment enclosures differ in size, cost, complexity, function and containment efficiency. They are usually custom designed to match the bridge members to which they are attached. It is difficult to devise standard designs since each project provides unique requirements. Those requirements are due to existing conditions such as bridge layout and environs, work force size in paint removal operations and containment efficiency specifications (typically set by the facility owner).

All containment enclosures employ flexible or rigid materials either loosely attached to the structure such as free-hanging tarps or screens draped over a truss or firmly attached enclosures incorporating scaffolding, skeleton framework of wood and/or steel and rigid

or flexible impermeable siding (76).

~~Wind Screens - Most free-hanging containment enclosures employ tarps or screens that are suspended from the structure to form walls. The most commonly used wall materials are "wind screens." Wind screens are flexible sheets of loosely woven mesh materials. Openings in the mesh allow light and some air to come through to reduce the "sail effect" or wind load. Wind screens are usually categorized by percent of light transmission (i.e. opacity). Typical wind screens have 85 percent light transmission.~~

The screens are typically reinforced with strips of strong belting placed at intervals along the mesh and around the border. The belts are commonly fitted with grommets that allow adjacent sheets to be joined. Cables also may be strung outside the suspended screens to serve as reinforcement.

The wind screen mesh openings are sufficiently small to prevent discharge of large particulate matter and some dust. However, wind screens will allow some dust to escape (77).

Ground Cloths and Water Booms - Early containment applications (and some current ones) frequently incorporated free-hanging enclosures having wind screen walls. Those descended from the bridge to the ground which was covered with ground cloths or to a barge where ground cloths were strung and water booms employed in adjacent waters.

Ground cloths are typically tarps or plastic sheets placed on the ground to collect debris that falls from a bridge. Typically, ground cloths are extended beyond the base of the bridge to provide for collection of materials that fall outside the enclosure. Cloths also may be placed on water using floats. Water booms are long narrow tubes that are connected end-to-end across the waterway. The booms float on the water and trap or block floating debris and prevent it from drifting away from the job site.

Ground cloths and water booms represent early technology where containment enclosures and debris collection methods were primitive and often inefficient (78). They are inexpensive, but they also have poor collection efficiency.

Negative Pressure Enclosures - The most effective type of containment is termed "total enclosure with negative air pressure." It offers the possibility of containing 95 percent of the abrasive dust and debris when proper control technology is used (79). That method employs a rigid-framed enclosure having rigid or flexible walls of impermeable materials (80). Use of impermeable walls insures that no dust may escape through the walls (unlike wind screens) and that the container may be pressurized (negatively).

To maintain negative pressure inside the enclosure, air must be drawn into the container and exhausted in a manner that the ambient pressure inside an enclosure is less than the atmospheric pressure. In theory, any potential leaks at seams are negated by the pressure differential that pulls air into the enclosure. When the enclosure is properly designed, the air flow inside the enclosure will reduce the concentration of dust and

thereby protect workers in the enclosure. Outside air is drawn into the enclosure through specially designed openings. Exhaust air must be filtered through dust collectors to prevent discharge of dust to the atmosphere (81).

**Factors Affecting Enclosure Design** - The design of a containment enclosure primarily depends on the type of structure being painted, its size and location. With vertical structures such as water towers, it is more economical to enclose the whole structure. Flexible materials such as wind screens and cables are used for that type of structure. For horizontal structures such as bridges, small, rigid containment units enclosing individual bridge members are best (82).

A bridge containment enclosure should be sufficiently large to contain an area that a crew may clean, inspect, prime and move within a 24-hour period. The support deck (i.e. containment floor) should be close to the work area. That reduces the containment enclosure size, thereby decreasing wind loads. Structures that require large enclosures, such as water towers, typically employ containment units that may be quickly lowered in case of wind gusts (83).

During lead paint removal projects, the environment should be protected against discharges of dust and abrasive wastes. Many contracts or specifications call for contractors to prevent any abrasive debris from contaminating the environment. High levels of environmental protection may be achieved, but only at high expense. Inevitably, a certain fraction of dust will escape.

Selection of specific containment enclosure type and specification of containment efficiency has been the subject of controversy. The Steel Structures Painting Council (SSPC) recently prepared a guide for selection of enclosure design. In that document, containment enclosure designs are categorized in five classes with Class 1 (rigid or flexible) providing the highest containment efficiency and Class 5 (rigid or flexible) the least containment efficiency. While no quantitative values for containment efficiencies are provided, that guide is an important aid for those preparing specifications (84). Typically, containment enclosures employing wind screens and water booms are stated to have collection efficiencies of 50 percent of the wastes generated. Total containment enclosures using impermeable walls with negative pressure can have containment efficiencies as high as 90 to 95 percent.

#### Collection and Disposal of Hazardous Wastes Generated by Maintenance Painting

Plans to deal with expected hazardous wastes should precede field work to prevent delays in the onset of painting operations and potential problems related to waste discharges. Abrasive blasting begins early in bridge maintenance painting operations. Therefore, to be timely, a generator's efforts to comply with environmental regulations should begin before the onset of field work. Steps to collect and dispose of abrasive blasting debris should accompany paint removal operations and continue after all wastes have been removed from a job site. Due to scheduling, that work may continue after a painting contractor has abandoned the job site. Activities described below may be performed by

the generator, a paint contractor or the generator's agent (e.g. a consultant). However, most the actions described for on-site work will be attributed to the generator.

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#### Responsibility for Generated Wastes

The party responsible for waste generation and its proper disposal is the generator. In Kentucky and most other states, the state agency responsible for bridge maintenance (e.g. the Kentucky Transportation Cabinet) is the generator. In some states, the paint contractor is considered a "co-generator" and assumes some responsibility for waste generation. Usually, a paint contractor's only liabilities are contractual. As the generator, a state highway agency is primarily responsible under both statutory and common laws for all wastes generated.

A generator must determine whether his wastes are hazardous. The generator is also responsible for insuring that all wastes are properly handled at each stage of the operation, i.e., generation, shipping, treatment and/or disposal. The regulations for dealing with solid wastes enacted under RCRA deal with the issue of waste disposal as a "cradle-to-grave" operation. The responsibilities of the generator, transporter, and TSD facility have been addressed. Ultimately, the generator has an endless responsibility for all hazardous wastes he/she generates (85, 86).

#### Lead Testing of Existing Paint and Abrasive Blasting Wastes

Lead in existing bridge paint is always hazardous to the public and workers due to its toxicity. Before performing maintenance painting operations, it is desirable to conduct tests on paint samples obtained from a bridge to determine whether its existing paint contains lead. Although the color orange is traditionally associated with lead-containing primers, lead may be present in red- and white-colored primers or other colors in intermediate and top coats. Preliminary testing is not necessary if the generator acknowledges that the existing paint contains sufficient lead to warrant regulatory controls.

Only one sample is needed to determine whether an existing bridge paint contains lead. The sample should accurately represent all layers of paint on a bridge. The sample should be extracted down to the metal substrate to insure all layers of paint are analyzed. The sample should be "thumb-nail" sized. The sample should be tested for total lead according to previously cited EPA specifications.

Preliminary testing of paint for lead cannot be used to determine whether the waste resulting from its removal will be hazardous. In part, that will depend upon the method of paint removal. Though the preliminary test may not be used to classify waste debris as hazardous, it should alert the generator that special precautions should be taken in removing, handling, and storing of waste paint removal debris before hazardous waste testing.

Shortly after abrasive blasting operations are started, samples should be extracted from waste storage. They are sent to a laboratory for TCLP testing to determine whether the

wastes are hazardous. Wastes exceeding the TCLP regulatory threshold are classified as hazardous (87).

The TCLP test is a chemical leaching procedure. A waste sample is agitated for a fixed period in an acetic acid solution having a pH of 5.0. Then, the liquid leachate is extracted and the amount of hazardous material extracted into the solution is measured quantitatively. For EP-toxic materials such as lead, leachable lead concentration is of concern.

The regulatory threshold for a waste being classified as hazardous due to its leachable lead content is 5.0 ppm in the TCLP extract. However, paints may contain other EP-toxic metals (e.g. barium, cadmium, chromium, and mercury). Therefore, the TCLP samples should also be analyzed for the other EP-toxic metals (i.e. arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver). While testing for all EP-toxic metals may exceed requirements for abrasive wastes containing lead-based paints, it prevents unexpected problems and may sufficiently address test requirements of most TSD facilities (88).

Proper hazardous waste analyses require that at least four samples be submitted for testing. Each sample should weigh about 100 grams (approximately 0.3 lbs). If the average of the four test results is less than the regulatory threshold, the waste may still be classified hazardous due to the statistical effect of the confidence interval (51). Additional samples may be submitted for testing to determine whether a waste may yet be classified non-hazardous. If all four test results exceed the regulatory threshold, subsequent samples will probably also test hazardous (89).

A generator may declare his/her wastes hazardous before conducting TCLP tests. However, that will not defer the responsibility for conducting the four mandatory TCLP tests. Once a generator has declared his/her wastes hazardous, he/she may not rescind that declaration despite subsequent test results to the contrary. He/she must still employ all procedures specified by the applicable state EPA for handling, transport and disposal of hazardous wastes.

#### Hazardous Waste Management Collection, Handling, Transport and Disposal

Traditionally, wastes from abrasive blasting have been used for landfilling, construction aggregate or, more commonly, abandoned at a job site. Those practices are no longer permissible. Lead-containing abrasive wastes must be properly collected from each job site and taken to a TSD facility to be treated and disposed. That may cost between \$250 to \$300 per ton.

In Kentucky, a generator is allowed to collect hazardous wastes in a 55-gallon drum at the point of waste generation. He/she also may transport it to a designated on-site storage facility (satellite accumulation).

Abrasive blasting debris containing lead should be confined at the point of generation to



prevent environmental pollution and public exposure beyond regulatory limits. The hazardous wastes also should be collected at the point of generation and containerized ~~for on-site storage and eventual transport. Good practices for the collection, handling, transport and disposal of hazardous wastes resulting from maintenance painting operations are contained in a recent Steel Structures Painting Council Guide (91).~~

When a generator uses on-site storage (accumulation) of hazardous wastes, he/she must meet requirements including providing training to inform workers about hazardous wastes, contingency planning and emergency procedures, and inspections of the waste storage area.

Procedures for on-site storage depend upon the classification of a generator. Generators are classified by the amount of hazardous wastes they expect to generate per calendar month. If the amount exceeds 1,000 kg (2,200 lbs) per calendar month the generator is classified as a full quantity generator. When the amount is between 1,000 kg and 100 kg (2,200 lbs and 220 lbs) per calendar month, a generator is classified as a small quantity generator if he/she stores less than 6,000 kg (13,200 lbs) of hazardous wastes on site. When the amount generated is less than 100 kg (220 lbs) per calendar month, the generator is classified as a limited quantity (conditionally exempt) generator when storing less than 1,000 kg (2,200 lbs) of hazardous wastes on-site (92).

Full and small quantity generators must register with the NREPC Division of Waste Management to obtain an EPA ID number. The number is site-specific and must be renewed annually (if necessary). Limited quantity generators normally do not apply for an EPA ID number (93).

Full quantity generators may accumulate and store hazardous wastes for 90 days after initially filling and storing a waste container. The wastes must be transported to a TSD facility or the generator may request a 90 calendar-day storage extension. Small quantity hazardous waste generators may collect and store up to 6,000 kg of wastes for up to 270 days. Limited quantity generators may store wastes as long as desired when the maximum limitations are not exceeded.

For proper on-site storage and shipment, hazardous wastes should be placed in DOT-standard containers. On-site accumulation of hazardous wastes in piles is not permitted regardless of whether ground cloths are used. It is probably desirable to use the same storage containers for shipment. The containers should be labelled and marked to identify the type and quantity of material stored and the hazards associated with that waste. Markings also should include the name and address of the generator and the manifest (shipment) number.

Shortly after a hazardous waste determination is made, a generator should arrange to ship and dispose hazardous wastes generated at the job site (67). Conveyance of hazardous wastes on public roads must be performed by a licensed (regulated) hazardous waste transporter. This includes short hauls from the point of waste generation to an on-site storage location. A hazardous waste transporter should deliver the entire

quantity of wastes he/she received to the designated TSD facility on the shipping document (manifest). If unable to deliver those wastes, he/she should contact the generator for further instructions. Before releasing the waste to a TSD facility, the transporter is responsible for proper disbursing of the manifest forms (94).

In Kentucky, hazardous waste transporters are registered by the NREPC Division of Waste Management. When the waste is shipped to an in-state TSD facility, the transporter also should be permitted by the Kentucky Transportation Cabinet. The transporter may complete the manifest forms for a generator. The generator should be prepared to furnish the transporter with placards to place on his/her vehicle to identify the wastes being transported. It would be desirable to require that a hazardous waste transporter show proof of insurance to cover remediation of spillages.

A manifest is a shipping document used to track and check the progress of a hazardous waste to its final TSD destination. It should accompany a waste shipment wherever it travels. Each handler of a waste should sign the manifest and keep one copy. Once the waste reaches its final destination (i.e. TSD facility), the TSD facility returns the final copy of the manifest to the generator to confirm its arrival.

Full and small quantity generators should manifest hazardous wastes for shipment. In Kentucky, limited quantity generators are not required to manifest hazardous waste shipments (in-state). However, the wastes should be disposed by a permitted hazardous waste facility or other NREPC-authorized recycling or disposal facility.

The EPA has prepared a national standard manifest form that has specific information requirements including the state EPA ID permit number for hazardous waste generation at the job site. However, some state EPAs have additional information requirements that require different manifest forms. When a generator sends hazardous wastes out-of-state, he/she should use the manifest form authorized by the state where the receiving TSD facility is located. The generator retains the top copy of the manifest which is signed by the hazardous waste transporter receiving the wastes. The (final) transporter will provide the TSD facility owner with the remaining copies of the manifest. The facility owner will sign those and give one copy to the transporter. He/she will return one copy to the generator and keep the remaining copy for his records (95).

#### Abrasive Re-use for Construction

An important RCRA provision allows the reuse of a waste material generated in one operation for another purpose when the waste material may be directly employed. The material generated in the initial operation is not classified as a waste and does not fall under waste treatment regulations. Operations that reuse abrasive blast material do not have to be tested for leachable lead content. A key RCRA factor is that the waste be processed where it is generated or put into a container or vehicle specifically intended for input into a processing facility. The processing should begin within 90 or 180 calendar days of the time the waste is generated, or a hazardous waste permit may be required (96).

Several states have proposed or evaluated and tested methods for reusing spent abrasive lead waste from bridge sites. A pilot program in North Carolina used the spent silica abrasives as an asphalt subgrade for highway road construction. It used state asphalt plants to expedite the environmental approvals and right of way needed for transportation. The asphalt mixture stabilizes and encapsulates the lead from the paint chips. Lime is added for additional stabilization. Although the reuse of spent abrasive appears to be a viable approach to Land Ban compliance, NCDOT officials note that in some instances, structure replacement is more feasible than repainting, especially where deck replacement is required (97).

Two other states are also involved in using spent abrasive waste mixed with paint chips in construction materials. In California, a construction firm has been mixing the lead containing abrasives in asphalt and other materials for use in construction since early 1990. In Pennsylvania, research in making clay bricks out of spent abrasive waste has been ongoing. Tests indicate that lead abrasives improve the properties of the bricks while encapsulating and preventing leaching of the lead. Also, several companies have been successful in mixing lead abrasives with cement kiln dust. The resulting material may be taken to a non-hazardous landfill or used in some construction applications (98).

Another on-site approach uses pre- and post-blast treatment for abrasive waste. When blasting, a small percentage of steel grit is added to the abrasive material before use to insure that the resulting waste is non-hazardous via TCLP tests. This waste is then treated a second time with Portland cement or some other proven stabilizer to produce a permanently stabilized product (99). A commercial firm now offers a non-metallic formulation that is also added to the abrasive material. The resulting wastes will test non-hazardous.

### Treatment-Storage-Disposal Facilities

The RCRA-mandated "cradle to grave" management of hazardous wastes ends at Treatment-Storage-Disposal facilities. A treatment facility chemically stabilizes or otherwise treats a hazardous material rendering it non-hazardous. A storage facility temporarily holds a hazardous waste shipment before sending it to another TSD facility. A disposal facility is the final depository for the treated non-hazardous wastes. Commonly, those wastes are disposed by landfilling (100).

Hazardous Waste Treatment - Treatment refers to "any method, technique, or process designed to change the physical, chemical, or biological characteristics or composition of any hazardous waste so as to neutralize such waste, or so as to recover energy or material resources from the waste, or so as to render such waste non-hazardous or less hazardous; safer to transport, store or dispose of; or amenable for recovery, amenable for storage, or reduced in volume (101)."

As a result of the Third-Third Land Disposal Restrictions Act, a generator is responsible for treating hazardous wastes to make them non-hazardous. For abrasive blasting debris contaminated with lead, a treatment would make the lead component non-leachable

(102).

~~When TCLP test results for leachable lead fall below 5 ppm treatment threshold, the abrasive blasting wastes may be disposed in a non-hazardous Subtitle-D (industrial waste) landfill. That is correct provided no other toxic metals are present in "hazardous concentrations." Hazardous waste treatment is necessary only when the TCLP test results for lead exceed 5 ppm. A waste should be re-tested using the TCLP test after being treated. When the treated waste tests below 5 ppm for lead, it is no longer toxic and the waste may be disposed in a industrial landfill.~~

When a waste fails the TCLP-based treatment criterion, the generator may opt to have the waste tested using the EP-TOX test (103). A waste subsequently passing the treatment criterion for that test (i.e. leachable lead < 5 ppm), may disposed in a Subtitle-C hazardous waste landfill. Otherwise, the generator may choose to have the wastes re-treated and re-tested using the TCLP-test treatment criterion with the end-objective of disposal in a Subtitle D landfill. Wastes failing both the EP-TOX and TCLP test treatment criteria should be re-treated (104).

A generator should adopt a treatment strategy when his/her wastes test hazardous. He/she has treatment options for rendering wastes non-hazardous. Many of those methods are experimental or are considered unacceptable by state or local officials. The current Code of Federal Regulations (CFRs) contains 29 different generic technologies that could be used for treatment (105). The generator also should decide the treatment location. Hazardous wastes may be accumulated on site to collect a sufficient quantity for cost-effective waste transportation to an off-site treatment facility. If on-site treatment of waste is desired, a waste analysis plan must be filed with the regional EPA office or the state within 30 days before treatment. On-site treatment must be performed within 90 calendar days of waste generation (106).

Generators that treat or process hazardous waste must obtain a license or permit through the NREPC Division of Waste Management. That is a long and costly process. NREPC officials have stated that each maintenance painting site would need to be permitted making that approach unacceptable in Kentucky. On-site treatment procedures usually add materials to abrasive blasting wastes to stabilize and make them non-hazardous. Additives include Portland cement, kiln dust, lime, and steel grit. Those treatments are considered effective because they render the lead content in the waste insoluble in the leaching solution. Use of such treatment would allow the generator to avoid preparing manifest documents and dealing with hazardous waste handling and disposal. For these reasons, those processes are considered "Best Demonstrated Available Technology" (BDAT) according to the EPA's Third Third final rule (107).

Off-site treatment of hazardous wastes are conducted at permanent treatment facilities. They provide large-scale processing equipment, facilities dedicated to treatment and readily available support staff. Chemical stabilization methods similar to those performed on site are conducted at off-site treatment facilities but at a higher cost. Other off-site treatment methods include kilning or incineration of abrasive wastes. Both

methods are emerging technologies that have involved laboratory testing and some pilot-scale testing. Off-site treatment facilities that would use these and other methods are ~~more likely to be constructed when more viable treatment techniques are developed,~~ when a large steady stream of abrasive debris is produced, and when regulations are better defined and enforced. A representative of a Midwest TSD facility recently provided an estimate of treatment and disposal in an adjacent Subtitle D landfill to be between \$150 to \$170/ton.

**Hazardous Waste Storage** - A storage facility may hold waste for 90 calendar days (or 10 days when a transporter) at the end of which the hazardous waste must be treated, disposed or stored elsewhere. When a transporter takes hazardous wastes off site and re-packs them for shipment elsewhere, the facility where the re-packing is performed is considered a storage facility (108).

**Hazardous Waste Disposal** - Wastes from lead removal job sites may be directly disposed by landfilling when its leachable lead content measures below 5 ppm. Because of the Land Ban, hazardous materials cannot be disposed on the land. As a consequence of the TCLP rule, 90% of all abrasive waste will probably be classified as hazardous waste. A recent SSPC survey revealed that hazardous waste disposal costs range between \$250 to \$400/ton compared to a maximum of \$250/ton before 1989. These increased disposal costs due to RCRA regulations emphasize the need to reduce the amount of generated waste at the source (109).

In most states, lead wastes that test non-hazardous do not require the expensive handling and processing. In Illinois, Maine, Pennsylvania, and a few other states, non-hazardous wastes from blasting operations are classified as industrial wastes. Those states require a certain amount of manifesting and record keeping for industrial waste. Some disposal sites will readily accept waste having any measurable amount of lead due to the potential liability it may cause (110).

Landfilling is the most prevalent method for disposal of treated abrasive blasting wastes. Landfills where treated abrasives may be disposed are classified as RCRA Subtitle D industrial landfills and RCRA Subtitle C hazardous waste landfills.

Both types of landfills incorporate geotextiles and compacted clay liners to limit diffusion of leachate caused by rain from entering the groundwater. The design requirements for Subtitle C landfills are more exacting than those for Subtitle D landfills. Also, maintenance of Subtitle C landfills includes provision for collection and treatment of leachate that forms due to rain. Under Subtitle C, landfill wastes are placed into separate cells walled in by clay that prevents various wastes from interacting. A representative of a Midwest TSD facility provided estimates for waste disposal under Subtitle C landfill between \$250 to \$270/ton compared to \$30/ton for an adjacent Subtitle D landfill.

A disposal facility must be permitted in the state in which it is located. Currently, there are no permitted Subtitle C landfills in Kentucky that accept commercial wastes (111).

Hazardous Waste Recycling - A possible method for disposal of hazardous waste involves separating the hazardous portion of the wastes and employing them for a useful purpose (i.e. recycling). Lead in paint chips may possibly be extracted from the abrasive wastes and reclaimed (112). However, during the progress of this study, no suitable recycler was identified.

### Recordkeeping and Reporting

A generator must maintain records related to hazardous waste generation and on-site accumulation, transport and disposal. The generator must prepare exception reports to the NREPC Division of Waste Management if he/she does not receive the TSD facility copy of the manifest within 45 days of transport. The generator must prepare and annual report containing information on all site-specific hazardous waste shipments made during a calendar year. The generator must keep manifest records for three years. Medical records of workers, the generator's or painting contractors must be kept for 20 years.

A TSD facility may be the final repository for the generator's hazardous wastes. Therefore, a generator should be selective in choosing that facility. When the wastes are transported to an out of state facility, the generator should review that facility's compliance history. The compliance histories of in-state TSD facilities are available from the NREPC Division of Waste Management. The generator also should consider the resident state's permitting, insurance, and closure-funding requirements for that type of facility.

A generator is responsible for remediation of all accidental spillages and leaks that occur at the point of generation, at the on-site storage facility, during transport and at the TSD facility. The generator's responsibility for his/her hazardous wastes continue forever. Even when a hazardous waste is recycled, the generator is responsible for remediation of collateral contamination caused by the recycling facility. From a liability standpoint, that responsibility is based on the percentage of traceable wastes that may be attributed to the generator. Spillages of hazardous wastes greater than 1 pound require CERCLA notification and prompt remediation. A previously contaminated area must be re-tested after remediation to show that no further hazardous wastes exist above permissible regulatory limits (113).

### Maintenance Alternatives

There are several alternatives to complete paint removal with containment. The most economically viable option is to topcoat old, existing lead-based paints. To accomplish that effectively, surface-tolerant paints are employed. Those paints are suitable for coating surfaces that cannot be extensively cleaned. Typically, the existing paint surfaces are washed and mechanically cleaned to remove loose paint and corrosion products. Thereafter, the surface-tolerant paint is placed upon the existing paint and other prepared surfaces. This method reduces problems with waste generation and worker exposure. Overcoating systems may provide service lives more than 20 years. The use

of overcoating may eliminate the need for complete paint during the remaining service life of the bridge. Then, ownership of the lead-based paint is transferred to the buyer of the scrap steel. That eliminates the need for a state highway agency to dispose of a hazardous waste.

A highway agency may choose to defer maintenance painting activities until the costs may decrease. However, that has limitations in that it is difficult to determine whether future maintenance painting costs involving complete removal with containment will decrease or increase. Also, while painting operations are deferred, candidate bridges experience corrosion damage. At some point, they may require additional renovation to alleviate that damage.

Another alternative is to dismantle a bridge and take it to a shop for re-painting and rehabilitation or re-paint it on the ground. In Kentucky, bridges have been realigned and steel re-used. Steel members may be easily cleaned with containment when removed from a bridge. The shop option is more expensive, especially since there are no fabrication shops in Kentucky.

The other alternative is to demolish a bridge and scrap the steel. That may be a viable option when a bridge is structurally deficient or functionally obsolete. When the Department of Highways implements a bridge management system, it should consider employing a paint management system to track the age, type and condition of bridge paints. That would allow for bridge painting decisions to be coordinated with plans to demolish or rehabilitate a bridge.

#### Bridge Maintenance Painting Costs Incorporating Containment

The costs of bridge maintenance painting vary due to a variety of factors including size and condition of an existing structure and specification provisions imposed. Cost data provided by the FHWA in 1988 indicated abrasive blasting costs (to a near-white appearance) ranged between \$3.50 to \$4.50 per square foot (114). Containment/waste collection costs ranged from \$1.50 to \$3.50 per square foot while waste transportation and disposal costs ranged from \$2.00 to \$3.00 per square foot. That provides a range of total costs from \$7.00 to \$11.00 per square foot. More recent information indicates total costs ranging from \$4.52 to \$12.84 per square foot (115). The latter data does not include costs for large bridges which are expected to be somewhat higher. It is likely that costs for total containment with negative pressure and recyclable abrasives will also be more expensive. The reduction in waste debris achieved by the use of recyclable abrasives will somewhat offset the costs associated with their use.

### **SURVEY OF STATE HIGHWAY AGENCIES EMPLOYING CONTAINMENT DURING ABRASIVE BLASTING OPERATIONS**

At the onset of this study, the decision was made to survey state highway agencies using containment during abrasive blasting operations. A survey form was prepared and sent to 26 state highway agencies. Seventeen agencies responded and provided specifications

either that had been employed or were being prepared for use. The specifications provided by the responding highway agencies are summarized in Tables 1-7. The topics summarized are "Hazardous Waste Testing" (Table 1), "Containment" (Table 2), "Waste Management" (Table 3), "Abrasives" (Table 4), "Environmental Monitoring" (Table 5), "Worker Hygiene" (Table 6) and "Maintenance Paint" (Table 7).

Some specifications provided could be termed "first-generation." They were used by highway agencies for several years. Agencies submitting some specifications acknowledged they were dated and stated they were being revised at the time of our survey. Though they were somewhat outmoded, they had provided the operational experiences that led to the development of improved specifications.

First-generation specifications typically required the use of wind screens and water booms for containment. Typically, first-generation specifications placed all responsibility for proper on-site waste handling, transportation and disposal on painting contractors. Usually, those specifications only provided general admonitions to contractors not to violate applicable environmental regulations. Some of those specifications referred to the use of the EP Tox test which the EPA had recently supplanted with the TCLP test for hazardous waste determination. Additionally, the provisions did not furnish much guidance for environmental monitoring or worker protection. First generation specifications also did not address the issue of waste minimization by use of recyclable abrasives.

## **DOCUMENT PREPARATION**

Better technology and the experience gained in early containment projects conducted by other highway agencies provided the opportunity for developing improved "second-generation" specifications. Most of the specifications obtained during the survey process contained more current provisions. Those were reviewed and considered for adoption by the Kentucky Department of Highways.

In preparing a state-of-the-art specification for abrasive blasting with containment, the decision was made to employ the "Best Demonstrated Available Technology" (BDAT). That technology provides the best assurance of preventing hazardous waste discharges during paint-removal operations in an economically feasible manner. Assessment of BDAT technology was provided primarily by the Steel Structures Painting Council that provided effective guidance and leadership concerning issues related to wastes generated during painting operations. Another significant source of information was NCHRP Report No. 265 "Removal of Lead-Based Bridge Paints." However, that report was published in 1983 and it was slightly dated at the time of this study. Transportation Cabinet personnel estimated that painting projects could be performed in Kentucky at a unit cost of about \$10 per square foot. They were willing to accept that cost to benefit from the high waste collection efficiency offered by the "Best Demonstrated Available Technology." Lower waste collection efficiencies offered by other schemes were considered unacceptable.



Based on initial data-gathering efforts, KTC personnel determined that BDAT for paint removal operations on bridges primarily consisted of 1) containment enclosures with negative pressure, 2) totally enclosed waste handling systems and 3) recyclable abrasives. That provided the least probability of waste discharges, hazardous waste exposure to workers outside of containment and a minimization of generated wastes.

KTC researchers conducted preliminary reviews of current paint-removal technology and federal and state hazardous-waste and worker-safety regulations. Then, a series of meetings was held with the Study Advisory Committee (SAC) for this study. The SAC members were Department of Highways officials from pertinent divisions within the Department of Highways involved with specification preparation, painting operations or waste handling and a representative from the Federal Highway Administration. During those meetings, potential specifications were reviewed and revised to address the operational requirements of the Department of Highways.

SAC members had KTC personnel prepare three documents concerning maintenance painting operations. Those documents were 1) a Special Provision for maintenance painting operations, 2) a contract for hazardous waste transport and disposal and 3) contract provisions for consultant environmental monitoring, waste management and paint inspection services.

The Study Advisory Committee members decided that all painting operations involving abrasive blasting of lead-based paints would require full containment. The Department of Highways would apply for a hazardous waste generator's permit at each of those sites. That would obviate the need to perform initial paint tests to determine the total lead content. Additionally, all regulatory procedures related to the generation and disposal of hazardous wastes would be obeyed.

#### Special Provision for Maintenance Painting

The maintenance painting Special Provision was based on specifications furnished by other state highway agencies (primarily one provided by the Ohio Department of Transportation), information gathered by KTC personnel and Department of Highways operational requirements (Appendix 1).

SAC members decided to limit painting contractors' responsibilities to painting-related activities. Responsibilities for environmental monitoring and waste transport and disposal were delegated to third parties. Another important decision was to employ only BDAT containment technology for paint projects entailing full removal of existing paint regardless of project location (i.e. urban or rural).

The resulting Special Provision, Kentucky Transportation Cabinet, Department of Highways, Special Provision No. 89(91), Maintenance Painting of Steel Bridges (Experimental) is contained in Appendix 1. That document contains concise requirements for paint contractors to insure that they will properly address environmental pollution and worker and public safety issues. In that manner, the Special Provision alerts

painting contractors that regulations will be rigorously enforced. Concurrently, it provides them guidance as what steps will be necessary to address those regulations. ~~When deemed applicable, the Special Provision refers to specific administrative regulations issued by the NREPC and KOSH.~~

The Special Provision requires painting contractors to furnish the Department of Highways with specific documents including a contingency plan, personnel training plan and containment enclosure plans and calculations for approval before starting a project.

Painting contractors must be knowledgeable of all applicable laws and regulations related to generating hazardous wastes. Painting contractors are held liable for any related problems due to their errors or omissions and may be ordered to suspend work by the Department or its designated agent (i.e. a consultant). Additionally, the Special Provision requires painting contractors to maintain all documents related to environmental or health issues at job sites.

The special provision advises painting contractors that the Department will employ a qualified consultant to monitor abrasive blasting and waste handling operations and will also inspect routine painting operations. Consultant's authority and tasks are covered in the Special Provision. Those are cited in the following discussion on the consultant contract.

The Special Provision requires that the containment system be fully enclosed, provide negative pressure, provide filtration at all forced air outlets and employ impermeable walls (flexible or rigid). Provision is made for proper ventilation within the containment enclosure. Performance limits are established on allowable waste (lead particle discharge) outside the enclosure. The waste collection in and out of enclosures must be done by closed systems. The enclosure must be kept in place while painting zinc-rich primers on over-stream bridges.

The Special Provision mandates the use of abrasives that must be recyclable a minimum of 30 times at painting contractors' standard abrasive blasting pressures. Abrasive type is not specified. The recycling system must clean used abrasives of dust to specified limits. The paint contractor cannot bring to or take from a job site abrasives that fail the TCLP test. The consultant will monitor a painting contractor's abrasives and recycling procedures to ensure conformance with the Special Provision.

The painting contractor is held responsible for on-site handling, containerizing, and temporary on-site storage of all waste debris generated during abrasive blasting operations. All wastes are to be treated as hazardous. The wastes are to be promptly placed in containers that will be used for waste transport. The temporary on-site storage site will be properly secured and signed to inform the public of its use. Different wastes are to be stored separately. The painting contractor will release stored wastes to the Department's selected waste disposal contractor at the direction of the Consultant. Provisions are provided for painting contractors leaving job sites before final transport of wastes from the on-site storage areas.

Painting contractors are also required to provide special clothing and respirators for their personnel and Department of Highways inspectors. Painting contractors must have workers tested for blood-lead levels before, during and after paint-removal operations. Prior to implementation of the Special Provision, it was submitted to NREPC personnel for review. Their comments were received and the document was revised as necessary. After that, it was formally adopted by the Department of Highways.

#### Contract for Hazardous Waste Transport and Disposal

After preparing the Special Provision for maintenance painting, KTC personnel and SAC members prepared an invitation-for-bid for hazardous waste transport and disposal (Appendix 2). That document was based on prior Department of Highways contract documents to dispose of miscellaneous hazardous wastes at Department of Highways garages and a request for proposal for hazardous waste management services by the state of Wisconsin (116, 117).

The contract is for characterization (chemical testing) of waste materials, furnishing of waste-disposal containers, manifest preparation, collection of filled waste containers from on-site storage areas, transport of wastes to TSD facilities and disposal of the wastes (and containers or liners) conforming to EPA and other applicable state regulations.

The contractor's personnel are to be qualified to perform their specific duties. The hazardous waste transporter was to be licensed in the states through which the wastes were transported. They are to employ safe practices to load and transport hazardous wastes from the on-site storage areas. The contract requires the contractor acquire specific permits and to maintain specific records. The contractor must have \$5,000,000 in environmental impairment insurance. Additionally, the contractor may not hold the Transportation Cabinet responsible for actions of the contractor or his/her employees.

The contractor must furnish bids for providing various sized waste storage containers including, labpacks, 30- and 55-gallon drums and roll-offs (with liners). Labpacks are used to store up to 10 lbs of miscellaneous wastes. Typically, labpacks are directly buried in a RCRA subtitle C landfill. Thirty-gallon drums are to be employed where the on-site storage area is difficult to access. Fifty-five gallon drums are most commonly used on small- and medium-sized jobs where a limited amount of wastes is to be generated or where wastes are generated over an extended period. Roll-offs are large units meant to store a significant amount of wastes. Typically, a roll-off is employed for a large project where several abrasive-blasting operations were occurring concurrently. Roll-offs have interior liners that are disposable.

The contract requires that bids be received for delivering for specific containers and transporting them to TSD facilities. The wastes and the containers (or liners in the case of roll-offs) are to be disposed of after treatment. The bids are to be in cost per container type per mile for container delivery and transport and for disposal of wastes in the various containers based on whether the wastes are treated and disposed in subtitle C or D landfills. Bidders must specify locations of the applicable TSD facilities.

## Contract Provisions for Consultant Environmental Monitoring, Waste Management and Paint Inspection Services

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The contract provisions for consultant services related to supervision and inspection of the painting contractors containment and painting operations and management of waste disposal operations were based on Kentucky Transportation Cabinet guidelines entitled, "In-Depth Inspection Consultant Provisions - Rev. 2/22/88."

The contract provisions split the consultant's work into two stages, a design stage and an inspection (construction) stage. The division was necessary primarily to determine costs for the inspection stage. It was expected that a consultant could readily estimate his/her costs for the design stage where the scope of work was limited to the contract provision specifications and his estimate of that work. However, his/her work in the inspection stage depended on the level of effort of the painting contractor. For large projects, that could not be determined until the paint contractor had been selected (i.e. after the design stage work was completed and the painting contract was let). Additionally, the Department of Highways had an option to extend the consultant's work under special circumstances (e.g. remediation).

The design stage consultant work could be negotiated as a fixed cost and the construction stage work based on unit costs for specific services with an upset limit on total expenditures set by the Department of Highways.

The design stage work provides for: 1) preliminary meetings with Department of Highways' Officials, 2) initial site inspections and 3) preparation of documents (plans) for letting the painting contract. Review of contractor bids will be performed by the Department.

The inspection stage work provides for: 1) preliminary meetings with the painting contractor, 2) preparation of environmental monitoring and waste management plans, 3) on-site environmental monitoring, 4) management of waste disposal and 5) inspections of cleaning and painting operations.

The consultant must be familiar with all applicable federal, state and local laws and regulations related to worker safety, generation of hazardous wastes and waste disposal procedures. The consultant is required to provide his/her workers who will monitor abrasive blasting operations training and medical surveillance (e.g. blood monitoring) to insure their safety.

**Design Stage Work** - In the design stage, the consultant will perform an inspection of the projected job site to determine potential sites for right-of-way storage. The consultant will take pertinent measurements of the structure and locate adjacent features such as waterways and buildings that must be accommodated for during painting operations. The consultant will perform preliminary background monitoring tests for lead in the soil and air. The consultant will prepare a preliminary environmental report summarizing the results of the site inspection.

The consultant will prepare documents necessary for the letting of the painting contract. That will include: 1) scope of work, 2) sizes and dimensions of steelwork, 3) locations of features that will affect the work, 3) major dimensions of the structure(s), 4) locations of adjacent features that will affect the work and 5) locations where special work must be performed. The consultant also will prepare plan and elevation drawings of the structure(s) and cost estimates for the work.

Inspection Stage Work - For the inspection stage, the consultant will act as the Department of Highways' site manager for the painting contract. The consultant will perform the specific duties to monitor the painting contractor's operations related to: 1) abrasive-blasting, 2) structural containment, 3) on-site hazardous waste handling and storage operations and 4) bridge painting. The consultant also will manage all hazardous waste processing at the job site and act as the Department of Highways' agent in transactions with the Department's waste disposal contractor.

The consultant will meet with the paint contractor to discuss plans for the painting project. He/she will review the painting contractor's containment plans to determine their adequacy. That review will be performed by licensed structural and ventilation engineers. The consultant also will review the contractor's contingency plan and personnel training plan.

The consultant will prepare a detailed air monitoring plan describing how his/her personnel will conduct air monitoring operations at the job site. That plan will be based on the consultant's initial site inspections.

The consultant will have specific authority during a contractor's painting operations. Those include the authority to stop a contractor's operations if they pose potential environmental or public health hazards. When a contractor's personnel are found to be performing unsafe practices, the consultant may warn the contractor and subsequently stop work if violations persist. A contractor's failure to comply with Special Provision 89(91) will be sufficient justification for the consultant to stop a contractor's operations. The consultant must allow a contractor to resume work after the contractor has remedied a problem situation. The consultant will promptly inform, in writing, both the Department and the contractor when problems occur.

The consultant will conduct soil tests during a contractor's abrasive-blasting operations when excessive waste discharges are observed. The same soil testing procedures employed during the inspection stage will be repeated in the same general locations once the abrasive-blasting operations are completed. When the lead content in the soil has increased significantly, Department of Highways' officials may require a contractor to perform remediation of affected areas. The consultant would perform follow-up soil tests to determine whether the areas have been suitably cleaned.

The consultant will conduct daily air monitoring of the job site and environs while the contractor's abrasive-blasting operations are in progress. When particulate or lead discharge exceed regulatory limits, the consultant will notify both the Department of

Highways and the contractor. The consultant will perform air monitoring daily inside the containment enclosure and after major changes have been made to a containment enclosure. Besides the containment enclosure, the consultant will inspect the ventilation system, the material handling system, the dust collectors and the abrasive recycling system. Those will be inspected daily or after a containment enclosure is re-staged.

The consultant will sample the wastes generated during the abrasive-blasting operations. Four samples will be obtained during the first 20 percent of abrasive blasting and one sample for each 20 percent thereafter. Samples of miscellaneous wastes such as filters and clothing also will be submitted for testing. The initial four samples will be submitted to laboratory and TCLP tested for the eight heavy metals listed as EP-Toxic by the EPA. Follow-up TCLP tests will only be conducted for lead. The consultant will inform the Department of Highways of the test results. Within 30 calendar days the Department will provide the consultant with a hazardous waste identification number for the job site.

When directed by the Department of Highways, the consultant will perform water quality tests. Those tests will not be required unless large waste discharges are observed from a containment enclosure.

The consultant will inspect the abrasives and the recycling system employed by a painting contractor to insure their conformance to the specifications. Used abrasives will not be allowed when they test hazardous by the TCLP test. The abrasive also must be free from oil contamination. The recycled abrasive must be tested daily to determine whether it is sufficiently free (99 percent clean) of fines.

The consultant will monitor a painting contractor's handling, containerizing and on-site storage of all waste debris generated at the job site. He/she will insure that all wastes are collected and containerized daily and that different wastes are containerized separately. The consultant also will label the waste containers. The consultant will inspect the on-site storage area daily and verify that it is locked.

The consultant will review the need for containers and promptly order them from the Department of Highways waste contractor. The consultant will take a daily inventory of waste containers in the storage site and determine whether additional containers are required or whether the waste contractor should be contacted concerning transport of filled containers for eventual treatment and disposal. The consultant will inform the painting contractor when the waste contractor is scheduled to pickup stored wastes.

The consultant will maintain records and prepare reports related to waste storage and disposal. The consultant will be certain that all wastes have been transported and disposed of properly. The consultant will prepare an exception report when the final TSD facility does not furnish a manifest within 35 calendar days of shipment.

The consultant will inspect a painting contractor's painting operations according to specific Department of Highways' Standard Specifications and guidance manuals. The consultant will have specific equipment for monitoring surface preparation and paint

applications. The consultant also will collect paint samples for conformance testing by the Department of Highways' Division of Materials.

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The consultant will conduct paint inspections at specific quality control points. Those would be after abrasive blasting (surface profile and cleanliness and applications of each coat of paint coating thickness). The number of tests would be based upon the surface area painted. Areas that tested below specification limits would be reworked by the painting contractor.

The consultant would maintain pertinent records at the job site. Those would include: 1) employee health monitoring, 2) employee training records, 3) time sheets, 4) the environmental monitoring plan, 5) the painting contractor's contingency and personnel training plans, 6) test results and waste analyses, 7) hazardous waste manifests, 8) written communications, 9) diaries, report forms and logs of measurements, 10) photographs, 11) applicable Department of Highways' specifications and contract-related documents, and 12) local, state and federal environmental and worker-safety regulations.

The consultant will take photographs of the work area and systems during various stages of the project. Additionally, all problem situations that apply will be photographed.

The consultant will inform the Department of Highways when the work is complete. When the wastes have not been completely removed, the consultant will employ a caretaker. The caretaker will inspect the storage site daily and will be present when the waste contractor arrives to transport the remaining wastes. The consultant will inform the Department of Highways when he/she believes that any remediation work is necessary.

The consultant's personnel must have at least one year of experience at their assigned position. The consultant will provide the Department of Highways with resumes for all his/her personnel. The consultant will have an administrator at the project during a painting contractor's normal daytime working hours.

Within 30 calendar days of official completion of the work at the job site, the consultant will make a presentation and provide an Environmental Monitoring/Hazardous Waste Report to Department of Highways' officials at a project review meeting. In the presentation, the consultant will review the progress of work, monitoring of the abrasive-blasting operations, test results and waste analyses, on-site waste handling and storage, waste transportation and disposal and any problems including their resolution. The report will include a title page, title sheet, table of contents, introduction, narrative of the painting contractor's abrasive-blasting operations, review of the air monitoring plan and results, hazardous waste analyses and disposal, any environmental problems experienced, conclusions and recommendations for future work, and appendices. The consultant also will turn over all project-related documents to Department of Highways' officials.

## CONCLUSIONS

The study produced three contract documents that will serve as the basis for initial performance of maintenance painting projects involving complete paint removal with containment. Those documents provide a BDAT approach to waste generation and final disposal. Those documents will insure that proper actions will be performed by Department of Highways' personnel and representatives in complying with regulations and obtaining necessary permits. They represent a high commitment to reducing waste generation, seeking the least likelihood for environmental pollution, providing ample worker protection and insuring proper treatment disposal of all generated wastes.

Besides providing strict compliance to applicable government regulations, the specifications promote proactive efforts that anticipate and decrease the chances of environmental and worker-safety problems. However, those documents are considered preliminary and experimental. It is expected that they will be revised as the Department of Highways gains additional experience in conducting painting projects involving complete paint removal and containment. Further changes may be warranted as regulations impacting those projects also evolve.

Complete paint removal and containment provided a major disadvantage that became obvious to the Study Advisory Committee members during document preparation and review. The cost of painting bridges using the specified technology will be expensive. Estimates should be about \$10 or more per square foot of steel painted including waste disposal and consultant costs. That is 2 to 3 times more expensive than when uncontained abrasive-blasting was permitted. The regulatory penalties for that approach are now prohibitive. A significant hidden cost is the high expenditure of manpower within the Department of Highways. That manpower is necessary to prepare contracts, negotiate contracts and review documents, neglecting the many records that must be maintained, some for as long as 20 years! Additional concerns exist regarding obligations and ownership of wastes disposed by landfilling.

Considering the large backlog of Kentucky bridges requiring maintenance painting, the imposition of additional costs for adherence to complex environmental and worker-safety regulations are unbearable. Some improvements may be achieved as painting contractors adopt better paint-removal technology and become more accustomed to bidding on maintenance-painting projects requiring containment. However, the employment of containment will not extend the service lives of maintenance paints over painting operations that employed unconfined abrasive blasting.

The number of painting projects before the imposition of containment were not sufficient to impact the backlog of bridges needing painting. Painting is primarily employed to prevent undue corrosion in steel bridges. That goal becomes obscured when recanting the litany of actions that must be performed to address environmental and worker-safety regulations when paint removal is employed before painting. A viable option is to perform minimal cleaning and surface preparation and overcoat the existing paint with new paint. There are several bridges in the Pittsburgh area that were overcoated almost



15 years ago. They are in excellent condition and will not require repainting for another 5 to 10 years. It is unlikely that painting operations employing complete paint removal and containment will last longer than 30 years.

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The initial costs for overcoating are one-third to one-fifth that of complete paint removal with containment. Based on that potential cost savings, overcoating should to be given prominent consideration for a bulk of the maintenance painting projects conducted by the Kentucky Department of Highways. However, some bridges may contain existing paint conditions that make the application of overcoating impractical. In those cases, the use of complete paint removal with containment is unavoidable. The best procedures and painting practices should be employed in those situations to insure conformance with government regulations and a good paint job to provide a durable protective coating.

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## FIGURES

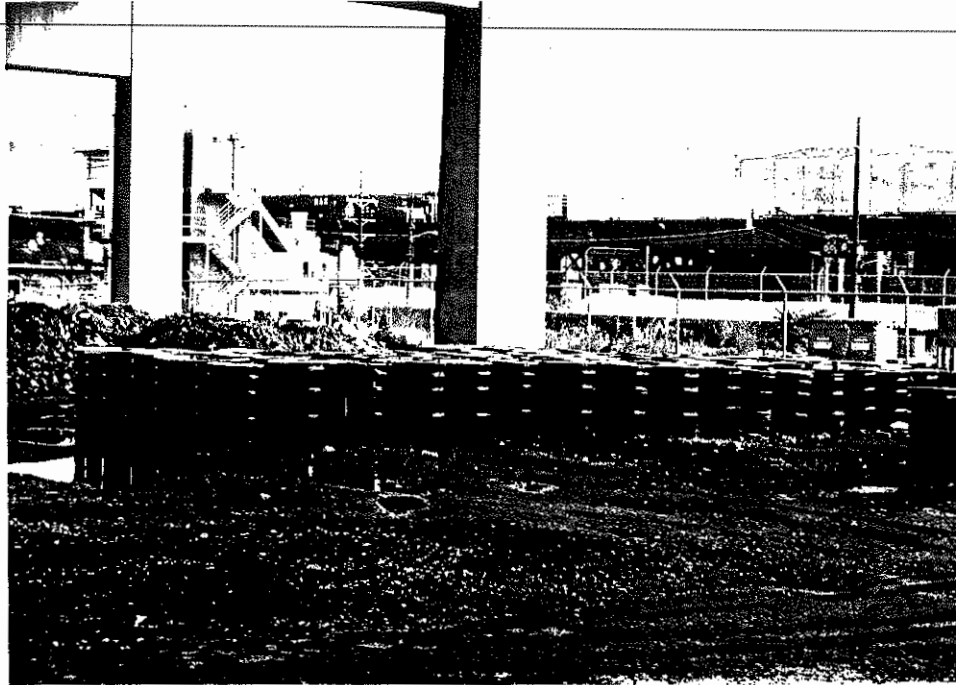


Figure 1. Uncontained Abrasive-blasting Debris Deposited under a Bridge during Maintenance Painting Operations.



Figure 2. Total Suspended Particulate Monitor Mounted atop a Portable Shelter.



Figure 3. Worker inside a Containment Enclosure Wearing an Air-Supplied Helment.

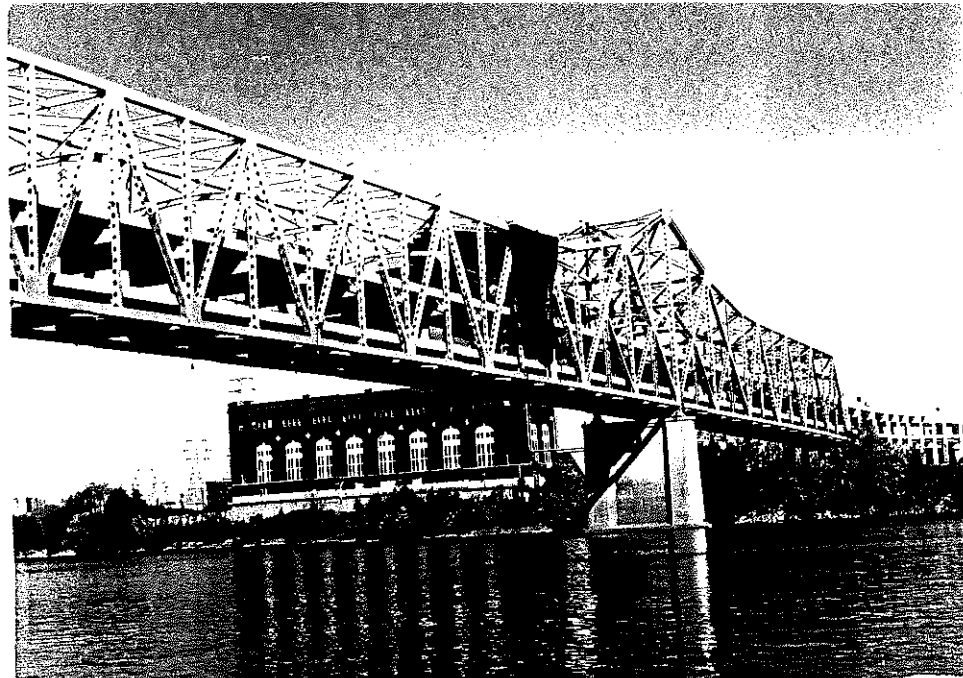


Figure 4. A Containment Enclosure Employing Wind Screens on the I 75 Bridge over the Ohio River at Covington.

Table 1. Hazardous Waste Testing

State	Preliminary Testing for Lead or Chromate Presence	Soil Pre/Post Testing	Water Testing for Lead and Zinc
California			
Illinois			
Indiana			
Louisiana			
Maryland	It shall be the contractor's responsibility to accomplish an initial determination for the presence of lead on the project, and to accomplish exposure monitoring in compliance with state regulations.		
Massachusetts			
Michigan	All spent material will now predictably be classified as hazardous due to the severity of the TCLP testing method.		
Minnesota	The state will sample materials collected on tarps and paved areas and deliver 4 samples from each bridge to the contractor. The Contractor will be required to have the samples analyzed for EP Toxicity (Lead Only).		
New Jersey			
New York			
North Carolina		Yes	Water tested for lead after spills
Ohio			
Oklahoma	Waste material shall be classified as hazardous if it contains more than 5 ppm of leachable lead, as determined by the EPA's EP toxicity test.		
Oregon	Same as above.	Random soil samples will be taken directly under the structure and at 50-foot intervals in both directions for up to 200 feet from the ends of the structure. Background levels shall be determined prior to the start of the project. Subsequent sampling and testing may take place.	
Pennsylvania			
Virginia			
West Virginia			

Table 1. Hazardous Waste Testing (continued)

State	TCLP Testing of Waste Abrasive	Testing of Spent or Recycled Abrasive	Lab TCLP Pretesting of Abrasives
California			
Illinois			
Indiana		If the bridge is designated as coated with lead-based paint, this spent material shall be sampled and tested by the state highway department using the EP toxicity test.	
Louisiana	Waste generated by the contractor's operations shall be deemed hazardous if the lead concentration exceeds five parts per million as determined by the EPA tests as stated in the Resource Conservation and Recovery Act.		
Maryland		The contractor shall take representative samples of the accumulated residues at each bridge to be analyzed for EP toxicity.	
Massachusetts		The contractor shall hire a certified testing laboratory to test spent materials.	
Michigan	Preliminary testing of spent material by the TCLP test has resulted in all waste debris being declared hazardous.	All recycled and/or spent material has been pre-determined to be hazardous by the TCLP test.	
Minnesota			
New Jersey			
New York			
North Carolina			
Ohio			
Oklahoma			
Oregon			
Pennsylvania			
Virginia		The state will sample and test the spent material.	
West Virginia		The spent material shall be sampled and tested by the state in accordance with current DNR methods to determine if it is hazardous.	

Table 2. Containment

State	Require Contractor to Maintain Containment	Specify Containment Ventilation	Degree of Containment Within Different Localities
California			
Illinois	Yes.		
Indiana			
Louisiana			
Maryland	Yes.		
Massachusetts			
Michigan			<p>1: Grade Crossing Bridges. The contractor shall drape tarpaulins from the fascias on both sides of the portion of the bridge being blast cleaned down to ground level. The spent material shall be collected daily by weeping ground cloths and paved areas.</p> <p>2: Bridge over Waterways. Same conditions for containment as number 1 with the addition of using floating booms stretched out 200 feet downstream and/or downwind, and possibly the use of a barge or platform to catch waste debris.</p> <p>3: Bridge near Business or Residential Areas. The contractor shall enclose all portions of the bridge during all blast operations.</p>
Minnesota			
New Jersey	The contractor shall set forth in detail the specific pollution control system which proposes for the complete capture, containment collection and disposal of the waste generated by the work.		
New York			
North Carolina		The contractor is required to use a dust collection system that would maintain a negative pressure of 0.03 inches of water column inside containment structures.	
Ohio			
Oklahoma			
Oregon	The contractor shall provide all practical and feasible means to prevent the creation of any nuisance condition in the vicinity of the structure during the life of the project.	<p>1. Full or partial enclosure of materials stockpiles in cases where application of oil, water, or chemicals are not sufficient to prevent particulate matter from becoming airborne. 2. Installation and use of hoods, fans, and fabric filters to enclose and vent the handling of dusty materials. 3. Adequate containment during sandblasting or other similar operations.</p>	<p>Class A: Urbanized area within 100 feet of residence or business with heavy vehicular and pedestrian traffic. Complete containment with negative pressure or other means to contain dust is required.</p> <p>Class B: Same as above except that dust is not considered to have a critical impact on residence or business. Complete containment with no negative air pressure is required.</p> <p>Class C: Urbanized area not in close proximity to residence or business with vehicular or pedestrian traffic. Partial containment is required.</p> <p>Class D: Rural with minimal environmental impact. Minimal containment required.</p>
Pennsylvania			
Virginia	The contractor shall use the most effective method possible for collection and containment operations.		
West Virginia	The contractor is responsible for collection and containment of waste material.		



Table 2. Containment (continued)

State	Specify Payment for Containment	Require Professional Review of Containment
California		
Illinois		All details of the pollution control plan shall be submitted to the state engineer in the form of drawings and specifications and must be approved prior to start of work.
Indiana		
Louisiana		The contractor is required to submit working drawings of his blast containment system, which will include a detailed description of containment methods and air filtration systems as well as details of attachment of his system to the structure, to the state engineer for approval.
Maryland	Payment shall be included in the contract prices bid on the several cleaning items.	The contractor's containment design shall be reviewed by an appointed state PE who will perform a bridge load analysis. It shall be the contractors responsibility to ensure the feasibility and workability of the containment system.
Massachusetts	Compensation for this work will be at the contract lump sum price. For purposes of estimating partial payments for work performed during several pay periods, the lump sum price for containment will equal 25 percent of total.	The contractor shall submit his intended method of containing the residue to the state engineer.
Michigan	Lump sum basis.	
Minnesota		
New Jersey		The contractor shall submit to the engineer a pollution control plan including a description of the system(s) to contain, collect, dispose of, and otherwise fully protect the environment from all rust, paint particles, blasting medium and contaminants associated with the work.
New York		
North Carolina	The cost of containment and delivery of blast cleaning debris shall be included in the lump sum price bid for pollution control.	The contractor is required to submit a containment plan including a dust collection system that would maintain a negative pressure inside the containment structure while blasting is being conducted.
Ohio		
Oklahoma		The contractor shall submit a containment plan to the bridge engineer for approval prior to commencement of work.
Oregon		
Pennsylvania		
Virginia	Payment will be on a lump sum basis per bridge which includes containment operations, monitoring regulations, and for furnishing all materials, labor, tools, equipment and incidentals necessary to complete the work.	Prior to removal operations, the contractor shall submit to the state engineer a detailed environment control system plan for complete capture, containment, and collection of waste generated by the work.
West Virginia	Payment will be on a lump sum basis for the bridge to be painted and cleaned.	The proposed method for containing, collecting, storing and securing the spent material shall be submitted to and approved by the state engineer.

Table 2. Containment (continued)

State	Specify Containment Design Factors
California	
Illinois	<p>The contractor has the option to utilize one of the two following methods or a combination thereof when removing the old paint system:</p> <ol style="list-style-type: none"> <li>1. Blast cleaning with full containment inside a complete enclosure. A negative pressure system is utilized. The contractor shall cover the ground or the inside of the working platform with sheets or tarpaulins.</li> <li>2. Vacuum blasting equipment capable of recycling abrasive material.</li> </ol>
Indiana	<p>Paint particles containing lead shall not be allowed to come in contact with the ground surface surrounding and under the bridge. They shall be contained by the use of plastic sheets, tarps, or other approved procedures.</p>
Louisiana	<p>Three methods of containment, partial enclosure, full enclosure, and full negative pressure enclosure, are recommended. Partial enclosure shall consist of scaffolding and curtains and/or drapes extending from the bridge to the ground. Floating booms and/or floating paint skimmers shall be used for bridges over waterways. Full enclosure shall consist of fully contained blast enclosures to limit the escape of nuisance dust to within the limits of the highway right-of-way and prevent the escape of other blast residue. Full negative pressure blast enclosure shall maintain a negative pressure within the enclosure sufficient to effectively minimize the escape of airborne nuisance dust or other blast residue and to visibly draw the containment drapes into the enclosure.</p>
Maryland	<p>The contractor is required to meet all state regulations using the best available technology for each bridge site.</p>
Massachusetts	<p>All work shall be sufficiently shielded, for public protection, by use of substantial canvas, or polyethylene drop cloths, which will effectively prevent the residue from being dissipated into the surrounding environment. The shields shall be weighted, or otherwise fastened at the bottom to prevent displacement by wind or other air movements.</p>
Michigan	<p>Several methods of blast cleaning are at the disposal of the contractor for waste material containment. Wet abrasive blasting is recommended whenever total containment is required because it totally eliminates dusting during the blast cleaning. This method would contain all spent materials, airborne particles, mist, and water within the highway right-of-way. It calls for completely enclosing those portions of the bridge being blast cleaned with tarpaulins or other approved sheet material.</p>
Minnesota	<p>Emphasis shall be placed on containment of waste materials rather than placing reliance on safeguards such as booms, straw dams, skimmers, or absorbent mats. These shall be considered backup systems for bridges over waterways. Tarpaulins shall be utilized to provide complete coverage of the ground area not containing a paved surface.</p>
New Jersey	
New York	<p>All paint removal work is bound by containment requirements. No waste is permitted to enter any waterway or be left upon the ground. Reduced waste volume is preferred to save valuable landfill space and to lessen disposal cost. Power tool cleaning and vacuum blasting with a closed-system recycling machine are recommended methods to achieve these goals. Covers shall be used to protect the ground from waste material. Collectors and floating booms shall be deployed to protect waterways.</p>
North Carolina	
Ohio	<p>The enclosure shall be dustproof and wind resistant and shall be designed and erected to contain, as well as facilitate, the collection of debris resulting from the surface preparation.</p>
Oklahoma	
Oregon	
Pennsylvania	<p>These factors include combinations of tarps to surround the sides of the bridge, tarps laid on the stream banks, tarps suspended under the bridge by scaffolding, barges in the river, or booms up and down stream of the bridge to catch floating debris or any combination thereof.</p>
Virginia	<p>The contractor shall use the most effective method possible for collection and containment operations. Such operations may include but not be limited to: Ground and Water Covers; Containment Booms; Rigid and Flexible Blast Enclosures; Drapes; Vacuum Blasters; Water Curtains; Wet Abrasive Blasting; High Pressure Water and Abrasive Blasting; Air Water, Abrasive Blasting; Centrifugal Blasters; Negative Pressure Blasters; Wet Scrubbers; Cyclones.</p>
West Virginia	<p>The contractor shall contain spent material by one or more of the following methods: 1. enclosing the portion of the bridge being cleaned; 2. vacuum blasting; or 3. other measures approved by the state engineer.</p>



Table 3. Waste Management

State	Specify Site Pickup of Hazardous Waste	Specify On-site Storage	Specify Storage Containers
California			
Illinois			
Indiana		Spent material and waste debris will be stored in a suitable location at the bridge site.	Waste materials shall be stored in approved containers or piles covered with waterproof coverings.
Louisiana		At the end of each work day, the contractor is required to haul the waste material to an approved temporary storage site obtained by the contractor and approved by the state engineer.	
Maryland	Hazardous waste must be removed under manifest by a licensed hazardous waste transporter to a permitted disposal facility.	At the end of each work day, the contractor shall haul the waste material contained and collected to an approved temporary storage site.	
Massachusetts	Only a licensed hazardous material carrier is allowed to remove hazardous waste from the job site or nearby temporary storage area.		
Michigan		The waste containers shall be approved by the state engineer, covered with waterproof lids, labeled, and stored in an environmentally safe and secure area.	
Minnesota		The spent sand and paint chips shall be stored by the contractor at a location close to each bridge site.	
New Jersey			
New York	Only a registered hazardous waste hauler using correct manifesting procedures and vehicles displaying current certification of compliance can remove hazardous waste from the work site.	All containers shall be stored in a place and manner acceptable to the state engineer.	No container shall be filled in excess of 200 pounds of paint material. All containers or rolloffs shall be clean, dry, weatherproof, watertight, and acceptable to the disposal facility.
North Carolina			Waste debris will be collected at the end of each day in 35 cubic feet plastic lined bulk bags.
Ohio		The debris, abrasive blast residue and paint chips removed, shall be stored in leakproof bulk storage containers near the site.	Bulk storage containers shall be leakproof and shall conform to federal regulations.
Oklahoma			
Oregon		Collected debris must be stored at a site approved for temporary storage.	Debris to be contained must be collected at the end of each day, placed in 55 gallon drums or other approved manner.
Pennsylvania	Only a licensed hazardous waste transporter can transport hazardous material from the work site.	Waste material must be stored at a temporary storage facility. The storage area must be secure, preferably owned by the state and fenced to prevent tampering with the debris before final storage.	Waste material shall be placed in a U.S. DOT approved bulk storage container after it has arrived at a temporary storage area. These containers may include 55 gallon drums, portable tanks, tank cars, cargo tanks and hopper or drum type vehicles that are free from leaks with discharge openings closed during transportation.
Virginia	The contractor shall store, pack, label and ship hazardous waste to a licensed treatment facility for disposal.	The storage site shall not be located within a floodplain, drainage area, or where water will pond. The site shall have a berm around it to ensure spill control.	Material shall be transported to storage site in a closed leakproof container with waterproof coverings.
West Virginia	The contractor is responsible for locating a hazardous waste disposal facility, transporting it there, and disposing of it.	The storage site for spent material shall not be located within a floodplain, drainage area, or where water will pond. The site shall have a berm around the perimeter to ensure spill control.	Waste material shall be transported to a storage site in a closed container that will permit no leakage of material.

Table 3. Waste Management (continued)

State	Specify Maximum On-site Storage Period	Consider Waste to be Hazardous ?	On-site Treatment	Who Handles Waste ?
California				
Illinois				
Indiana		Hazardous waste consideration will be determined by the EP toxicity test.		If the spent material is classified as a hazardous waste by the EP toxicity test, it shall be disposed of by the contractor at a licensed hazardous waste disposal facility.
Louisiana	Hazardous waste material shall remain at the temporary storage site for no more than 30 days.			
Maryland	In no case shall the waste remain at the temporary storage site longer than 90 days.			
Massachusetts		The residue is expected to contain a quantity of lead and, therefore is considered hazardous waste.		
Michigan				
Minnesota		The state highway department expects the EP Toxicity test results to show that the bridge waste materials are non-hazardous. The contractor should base his bid on this assumption.		The contractor shall contain waste materials and provide for their disposal in accordance with Minnesota pollution control laws and regulations.
New Jersey				
New York	All waste resulting from paint removal operations shall be in transit to the disposal site no later than 45 calendar days subsequent to generation, or two weeks following demobilization of the site, whichever occurs first.	The state highway department will treat all lead paint chips and blast cleaning materials as hazardous waste.	If a closed-system recycling machine is used, blast media will be recycled.	All waste material collected shall become the property of the contractor who is responsible for on-site storage.
North Carolina				The contractor handles all waste debris generated at the work site.
Ohio				
Oklahoma				
Oregon				
Pennsylvania	After laboratory analysis conclusively proves that waste is hazardous, the material cannot be stored for more than 90 days from the time of that determination.	The paint being removed is likely to contain mostly lead and chromium. The DER is more concerned about the chemical constituents of the abrasive material used to remove the paint.	No on site treatment.	The contractor is responsible for containing waste within the legal right-of-way and recovering waste products generated by cleaning, blasting and painting operations.
Virginia				
West Virginia	Hazardous Waste shall not be stored by the contractor over 90 days after it has been identified as hazardous.			

Table 3. Waste Management (continued)

State	Specify Frequency of Site Cleanup and How it is Done	Who Maintains Documents for Cleanup Operation?
California		
Illinois	The contractor shall thoroughly clean the interior of the blast enclosure at the end of each work day and properly dispose of all waste.	
Indiana	The spent material shall be collected daily by sweeping or vacuuming grounds cloths and paved areas and stored in a suitable waste disposable container.	
Louisiana		It shall be the contractor's responsibility to meet all applicable environmental regulations and to obtain the required permits. A copy of these permits must be submitted to the engineer.
Maryland	At the end of each working day the contractor shall haul the waste material contained and collected to an approved temporary storage site.	The contractor maintains documentation for each work project.
Massachusetts	The cleaning residue shall be collected daily and stored in covered containers on the job site or as near as possible.	The state engineer maintains all documents dealing with waste collection, containment, and disposal.
Michigan	All spent materials, slurry, blasting water and other debris shall be collected daily in a suitable waste disposal container located at the site.	
Minnesota	Paint chips and spent sand shall be removed from the tarps and any paved areas on a daily basis.	
New Jersey	The contractor shall remove all waste materials (contained and errant waste) to storage at least once a day or more frequently if required or directed.	The contractor shall obtain and maintain all permits that are required for the handling and disposal of all the debris and material collected during the course of the work.
New York	All waste materials that collect on a bridge deck, or on a highway pavement and paved shoulder under a structure or on covers shall be removed at least once a day or more if directed by the state engineer. No waste shall remain on the bridge deck, pavement or containment covers overnight.	All documentation preparation shall be the responsibility of the contractor. All labeling, marking (except date mark), and placarding of waste containers shall be the responsibility of the contractor under the supervision of the state engineer.
North Carolina		
Ohio		
Oklahoma		The contractor shall be required to obtain any blast cleaning permits that may be required.
Oregon		
Pennsylvania	The contractor shall remove waste materials from the project site at the end of each work day, or more frequently as directed by the PADOT inspector. After the containment devices have been cleaned, the material shall be transferred to a temporary storage area.	All documentation required will be maintained by the contractor for the life of the project. After the waste is accepted and disposed of, the district shall retain the associated paper work for a period of 20 years.
Virginia		The contractor shall obtain a temporary generator number to handle waste and shall provide a copy of the shipping manifest signed and dated by the waste treatment facility.
West Virginia		The contractor shall obtain any and all necessary documents, permits, and manifests required for transporting and disposal of waste.

Table 3. Waste Management (continued)

State	Specify Means of Hazardous Waste Transport / Disposal	Payment for Waste Disposal or Specifications	Generator of Waste
California			
Illinois			
Indiana		Disposal of hazardous waste material shall be paid for on a force account basis. The disposal of all other spent materials collected shall be paid for on a lump sum basis.	
Louisiana		Payment for disposal of waste will be made on a lump sum basis.	
Maryland		Hauling and disposal to an approved industrial waste site or hazardous waste site will be measured and paid for at the contract unit prices bid per ton of waste for the pertinent "hauling and disposal of waste items."	The contractor is designated as "generator" of all waste associated with the work and shall be responsible for containing, collecting and disposing of all waste.
Massachusetts			
Michigan	The state engineer shall authorize the disposal of hazardous waste debris. The contractor shall dispose of the waste at a licensed hazardous waste disposal facility.	Lump sum basis.	The state highway department is considered to be the generator of any hazardous waste produced by blast cleaning lead-based paint from bridges.
Minnesota			
New Jersey		Painting and blast cleaning of bridges and pollution control shall be paid for on a lump sum basis.	
New York	All material shall only be hauled by a currently registered waste hauler. The contractor shall supply the state engineer with letter from a legally permitted disposal facility, stating that the facility will accept the waste material.	The unit price bid per square foot shall include the cost of all labor, materials, and equipment necessary to complete the work, including all paint waste collecting, packaging, storing, and transportation costs.	
North Carolina	The contractor shall deliver and unload the bulk bags to the state asphalt plant in Creswell, N.C. at such times scheduled through the engineer at least 10 days in advance of the anticipated shipment. Such bags shall be delivered at the plant, and placed on new wooden pallets.	Payment for waste disposal shall be on a lump sum basis.	
Ohio		This work will be paid for at the contract lump sum price for containment and collection of surface preparation debris, at the site designated. The price shall include all materials, containers, equipment, labor and work incidental thereto.	
Oklahoma			
Oregon		Payment made for containment and disposal work will be made at the contract lump sum amount.	
Pennsylvania	A licensed transporter removes the hazardous waste material from the storage site. The transporter must locate a hazardous waste landfill.	Measurement and payment of solid waste handling and disposal is on a lump sum basis.	Both PennDOT and the contractor are considered generators of the hazardous waste.
Virginia		Disposal of waste will be paid for at the contract lump sum price which shall include transportation, storing, and disposal and for furnishing all materials, labor, tools, and equipment.	
West Virginia		Disposal of hazardous and non-hazardous waste shall be paid for on a per ton basis for spent material.	It is understood that the state is the generator and the contractor is to act in its behalf.



Table 4. Abrasives

State	Specify Abrasive Type	Specify Recycling	Restrictions on Silicas
California			
Illinois	The abrasive used for blast cleaning shall be an approved recyclable low dusting abrasive and shall have a gradation such that the abrasive will produce a uniform profile.		
Indiana			
Louisiana			The contractor may use a silica-free abrasive to reduce the amount of nuisance dust or debris if approved by the state engineer. The silica-free abrasive must be tested for contaminants which may effect coating application and performance.
Maryland			No mention of silica restriction.
Massachusetts			
Michigan	A low dusting abrasive.		
Minnesota			
New Jersey			
New York	The recommended abrasive type shall be compatible with the requirements of the vacuum blast cleaning system.	Vacuum blasting with a closed system recycling machine is recommended as a waste volume reduction method. This system shall be required to remove 95% of the existing paint coatings and should contain a minimum of 99% of the removed paint within the system. The maximum permissible quantity of collected paint which will be allowed under this method is 200 pounds per month per site. For lead-based paint systems, this would be equal to approximately 3600 square feet of area.	
North Carolina			The blasting media shall be a silica sand which is free of contaminants.
Ohio			
Oklahoma			
Oregon			
Pennsylvania	Low dust abrasives and grit.	Not specified.	White silica sand is not allowed.
Virginia		The contractor shall recycle abrasives on Type B bridges which contain hazardous waste debris in order to reduce the least amount of waste practicable.	
West Virginia	The following abrasive types are to be used on bridges with coatings that may generate a hazardous waste: 1. Aluminum Oxide; 2. Silicon Carbide 3. Zirconium Aluminum Oxide; 4. Steel Grit or Shot;	The contractor shall recycle abrasives in order to create the least amount of waste practical.	

Table 5. Environmental Monitoring / Public Safety

State	Monitoring Standards	Who Performs Environmental Monitoring	Standards for Independent Monitoring	Monitoring Requirements for Different Localities	Minimize Work Site Noise
California					
Illinois					
Indiana					
Louisiana					
Maryland					
Massachusetts					
Michigan					
Minnesota					
New Jersey		The state engineer may request the contractor (or outside consultant) to conduct air, water, or soil quality testing to determine the quantity of pollution escaping from the project area.			
New York					
North Carolina					Equipment noise is a major consideration in urban environments. Equipment shall be positioned so as to minimize the noise to adjacent property owners and traffic.
Ohio					
Oklahoma					
Oregon					
Pennsylvania		The project inspector shall ensure that the contract special provisions for environmental controls are properly implemented.			
Virginia					
West Virginia					

Table 6. Worker Hygiene

State	Worker Lead Exposure Monitoring Requirement	Worker Safety Training Requirements	Documentation of Safety
California	The employer shall monitor employee lead exposures. Monitoring for the initial determination may be limited to a representative sample of the exposed employees who the employer reasonably believes are exposed to the greatest concentrations of airborne lead in the workplace.		
Illinois			
Indiana			
Louisiana			
Maryland	The work area must be tested for lead exposure at the start of the job, every 6 months, every quarter, when job change may result in new or additional exposure, and if worker complains of symptoms related to lead exposure. Whenever exposure monitoring is performed, the employee must be provided with written notice of results.	The contractor is required to provide a safety training program for employees on an annual basis.	The contractor is required to develop a written compliance program and review it every six months.
Massachusetts			
Michigan			
Minnesota			
New Jersey			
New York			
North Carolina			
Ohio			
Oklahoma			
Oregon			
Pennsylvania			
Virginia			
West Virginia			



Table 6. Worker Hygiene (continued)

State	Specifications Covering Safety Equipment	Specifications Covering Air Monitoring of Worker Areas	Specifications Covering Respirator Usage
California			The contractor shall provide appropriate respirators for several different airborne concentrations of Lead. The lowest concentration level requires a quarter or half mask, air-purifying respirator approved for lead dust, fume, or mist. The highest concentration level would require a combination breathing apparatus consisting of supplied air, positive pressure full facemask respirator with auxiliary self-contained compressed air supply. The employer shall perform quantitative face fit tests at the time of initial fitting and at least semi-annually thereafter for each employee wearing negative pressure respirators.
Illinois			
Indiana			
Louisiana			
Maryland	The contractor is required to provide medically approved personnel with Powered Air Purifying Respirators with high efficiency filters.	The contractor must conduct air sampling at the start of any operation which may involve workers in lead exposure.	Workers performing welding, oxy-acetylene cutting or spray painting must wear either a powered air purifying respirator, or an air supplied respirator. Workers actually performing sandblasting must wear a continuous flow, airline, abrasive blasting respirator for protection from silica. All respirators must be approved by NIOSH.
Massachusetts			
Michigan			
Minnesota			
New Jersey			
New York			
North Carolina			
Ohio			
Oklahoma			
Oregon			
Pennsylvania			
Virginia			
West Virginia			



Table 6. Worker Hygiene (continued)

State	Specify Worker Clothing Provided	Are Cleanup Areas Provided for Workers?	Are Noise Levels Considered?
California	The employer shall provide at no cost to the employee coveralls or similar full body work clothing; gloves, hats, and shoes or disposable shoe coverlets; and face shields, vented goggles, or other appropriate protective equipment. Clothing shall be provided in a clean and dry condition at least weekly, and daily to workers in high lead exposure areas.	The contractor shall provide adequate change rooms with separate storage facilities, an adequate number of shower facilities and lavatories, and lunchroom facilities. The contractor shall enforce workplace standards that deal with lead exposure.	
Illinois			
Indiana			
Louisiana			
Maryland	The contractor shall provide "full body protection clothing" in a clean and dry condition at least weekly, and daily to employees whose exposure levels without regard to a respirator are over 200 ug/m3 of lead as an 8-hour time weighted average. The contractor shall provide for the cleaning, laundering, or disposal of protective clothing and equipment.	The contractor shall provide change areas and storage, wash and lavatory facilities, and a clean area for eating and drinking. The contractor shall make sure that workers do not leave work areas in contaminated clothes and that they wash prior to eating or drinking and at end of each shift. (Maryland Lead and Construction Standard)	
Massachusetts	The contractor shall provide coveralls, work gloves, waterless hand cleaner, and a canister type respirator with replaceable filter.		
Michigan			
Minnesota			
New Jersey			
New York			
North Carolina			
Ohio			
Oklahoma			
Oregon			
Pennsylvania			
Virginia			
West Virginia			

Table 6. Worker Hygiene (continued)

State	Are Warning Signs Posted?	Are Air Supplies Monitored for Carbon Monoxide?	Blood Lead Level Monitoring (Pre/Post Work)
California	<p>The contractor shall post the following signs in each area where the PEL limits are exceeded:      WARNING                      POISON                      NO SMOKING OR EATING                      LEAD WORK AREA</p> <p>The employer shall assure that signs are illuminated and cleaned as necessary so that the legend is clearly visible.</p>		<p>The employer shall provide the required medical surveillance including multiple physician review without cost to employees and at a reasonable time and place. He shall make available blood lead and zinc protoporphyrin sampling and analysis to each employee.</p>
Illinois			
Indiana			
Louisiana			
Maryland	<p>The contractor should post warning signs.                      (Maryland Lead in Construction Standard)</p>		<p>The contractor shall institute a medical surveillance program to monitor worker lead exposure. Biological monitoring shall include blood lead, ZPP (zinc protoporphyrin) and FEP (free erythrocyte protoporphyrin) level tests. These tests shall be conducted prior to work assignment, every two months for the first 6 months of exposure, every one to two months for workers with high blood lead levels, and at the termination of employment. Written notification of results shall be given to each worker.                      (Maryland Lead in Construction Standard)</p>
Massachusetts			
Michigan			
Minnesota			
New Jersey			
New York			
North Carolina			
Ohio			
Oklahoma			
Oregon			
Pennsylvania			
Virginia			
West Virginia			

Table 7. Paint Maintenance

State	Specify Usage of Lead Paints	Restrictions on Zinc Based Paints	Restrictions on Volatile Organic Compounds	Restrictive Use of Toxic Solvents	Is Containment Required During Painting?	Is Environmental Monitoring Required during Painting?
California						
Illinois						
Indiana						
Louisiana	The use of red lead and basic lead silico-chromate coatings has been terminated.	No restrictions.				
Maryland						
Massachusetts	A basic lead silico chromate system is used.					
Michigan						
Minnesota						
New Jersey	The sections covering lead paint usage have been deleted from state bridge paint specifications.	Inorganic zinc and organic zinc coating systems are used. The inorganic zinc coat utilizes an inorganic zinc-rich primer while the organic zinc coat utilizes an organic zinc-rich primer. Both coating systems require a high-build epoxy intermediate coat and a urethane finish coat.				
New York						
North Carolina						
Ohio		No restrictions listed.				
Oklahoma						
Oregon					Yes	
Pennsylvania	Not allowed.	No restrictions listed. Structures constructed after 1981 have an inorganic zinc paint system.				
Virginia		No restrictions listed.				
West Virginia						

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**APPENDIX I**  
Kentucky Transportation Cabinet Special Provision 89(91)  
Maintenance Painting of Bridges (Experimental)

**KENTUCKY TRANSPORTATION CABINET  
DEPARTMENT OF HIGHWAYS  
SPECIAL PROVISION NO.89(91)**

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**MAINTENANCE PAINTING OF STEEL BRIDGES  
(EXPERIMENTAL)**

This Special Provision shall apply when indicated on the plans or in the proposal. Section references herein are to the Department's *Standard Specifications for Road and Bridge Construction*.

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In addition to the provisions for cleaning and painting included in Section 727 of the Department's Standard Specifications, all maintenance painting operations on steel bridges that require containment shall conform to this Special Provision. The Contractor shall be responsible for collection, containerization, and temporary on-site storage of wastes generated during the painting process. The Department will be responsible for waste disposal. The standards for environmental compliance will be determined based

on the provisions of KRS 224 *Environmental Protection* and all regulations promulgated pursuant thereto. The Contract and Special Provisions do not relieve the Contractor from compliance with those provisions.

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Existing Section 727.16 is deleted and new Sections 727.16 through 727.24 are added to Section 727 of the Standard Specifications as follows.

**727.16 Definitions and Abbreviations**

CFR - Code of Federal Regulations, Office of the Federal Register, General Services Administration, Washington, District of Columbia.

KAR - Kentucky Administrative Regulations, Legislative Research Commission, Commonwealth of Kentucky, Frankfort, Kentucky.

KOSH - Kentucky Occupational Safety and Health Program, Labor Cabinet, Commonwealth of Kentucky, Frankfort, Kentucky.

KRS - Kentucky Revised Statutes, Legislative Research Commission, Commonwealth of Kentucky, Frankfort, Kentucky.

NIOSH - National Institute of Occupational Safety and Health, US Department of Health and Human Services, Cincinnati, Ohio.

NREPC - Natural Resources and Environmental Protection Cabinet, Commonwealth of Kentucky, Frankfort, Kentucky.

TCLP Test - US Environmental Protection Agency (USEPA) Toxicity Characteristic Leaching Procedure Test (Method 1311 in *SW 846, Test Methods for Evaluating Solid Wastes*).

**727.17 Mandatory Contractor-Furnished Documents**

(1) General

The Contractor shall furnish the Engineer with the documentation described in Subsections (2), (3), and (4) below at least 30 calendar days prior to the onset of blast-cleaning work. No blast-cleaning work shall be commenced before the Engineer reviews those documents, recommends necessary modifications, and receives acceptable revised documents from the Contractor. The Contractor shall retain and apply, as necessary, all specified documents until the project is completed. Documents required by this Special Provision shall be submitted to the Department at the end of the Contractor's field work on the project.

(2) Contingency Plan



The Contractor shall submit a written Contingency Plan prepared in accordance with Kentucky Administrative Regulations 401 KAR34:040 *Contingency plan and emergency procedures (IS)*. The Engineer will review the Contingency Plan for completeness and will notify the Contractor of necessary modifications. After any necessary modifications are acceptably made, it will be adopted as the Department's Contingency Plan. At a minimum, the Contingency Plan shall address potential releases of lead paint debris due to failure of the containment, spillage, and possible flooding of the waste storage area. The Contractor shall also provide contingency plans for any other hazardous materials the Contractor employs or stores at the job site. The Contractor shall not store any hazardous materials at the job site that are not directly related to work at the job site. The Engineer or his designated representative will provide the Contractor with a list of agencies that must be furnished copies of the plan.

(3) Personnel Training Plan

The Contractor shall submit a written Personnel Training Plan for Worker Safety and Waste Handling to the Engineer prepared in accordance with 29 CFR Part 1910 as adopted by 803 KAR 2:300 through 2:320, *Kentucky Occupational Safety and Health Standards for General Industry*, § 1910.1025, *Lead* and KAR 35.020 *General Facilities Standards (IS)* § 7. Portions of Contractor's Personnel Training Plan for Worker Safety and Waste Handling not specifically related to lead shall be in accordance with the Supplement to 29 CFR Part 1926 as adopted by 803 KAR 2:016, 803 KAR 2:200, and 803 KAR 2:400 through 2:423 *Kentucky Occupational Safety and Health Standards for Construction* (with latest amendments). The Engineer will review the Personnel Training Plan for completeness and notify the Contractor of necessary modifications. After any necessary modifications are acceptably made, it will be adopted as the Department's Personnel Training Plan for Worker Safety and Waste Handling.

(4) Containment Enclosure Plans and Calculations

The Contractor shall submit all containment enclosure plans and calculations. The Contractor shall not proceed with installation of the containment enclosure(s) until the Contractor receives written authorization from the Engineer. As a minimum, the Contractor shall submit: a) drawings of the blast containment enclosure(s) in various stagings along the bridge(s), b) a comprehensive description of containment methods as well as details of containment enclosure attachment to the bridge(s), c) ducting and ventilation calculations, d) applied dead and wind loads, and e) structural calculations. The Contractor shall revise all plans and equipment that do not meet the requirements of the Department.

**727.18 Contractor Compliance with Environmental and Health Regulations**

(1) Governing Regulations

The existing paint to be removed in this project contains lead which is classified



as a hazardous (toxic) waste. The Contractor shall be knowledgeable of and comply with all lead-related environmental and health regulations governing the Contractor's operations. ~~Regulations current at the time the work is performed and all requirements herein shall be met.~~

(2) Liabilities and Obligations

The Contractor shall be solely responsible for compliance with all applicable environmental and health regulations to the satisfaction of the applicable government regulatory agencies and the Department. The Department assumes no obligations or liabilities for work stoppages due to enforcement actions by government regulatory agencies or to related delays that the Department deems necessary.

(3) Regulation of Contractor Operations by the Department

If the Engineer deems that violations have occurred related to environmental or health regulations, the Engineer may suspend blast-cleaning and/or painting operations. The Engineer may also request that any government regulatory agency the Engineer deems appropriate inspect the Contractor's operations or review documentation the Contractor maintains at the job site.

(4) Hold Harmless Clause

The Contractor shall agree to hold the Department and all of its employees, representatives, and agents harmless with respect to liabilities and claims which arise from the acts or omissions of the Contractor's officers, employees, or agents.

(5) Contractor Document Maintenance

The Contractor shall maintain copies of all documents related to environmental or health issues on file at the job site and shall make them available for review by any government regulatory agency on request.

**727.19 Consultant Monitoring and Inspection**

(1) Monitoring and Inspection of Contractor Blast-Cleaning, Hazardous Waste Handling, and Painting Operations

The Department will employ a qualified Consultant to monitor the Contractor's blast-cleaning and hazardous waste handling operations and to conduct field inspections of the Contractor's painting operations. The Consultant will be responsible for special field sampling, environmental monitoring, and subsequent laboratory tests of field samples. The Consultant will have the option of employing qualified testing laboratories to analyze field samples the Consultant furnishes.

(2) Consultant's Authority

- a. The Consultant will act as the Engineer's designated field representative and will have specific authority as stipulated in this Special Provision. The Contractor shall cooperate with the Consultant as stipulated in Sections 105.06 and 105.11 of the Department's Standard Specifications. Disputes between the Consultant and the Contractor will be resolved by the Engineer.
- b. The Consultant will review the Contractor's Contingency Plan, Personnel Training Plan, and Containment Enclosure Plans and advise the Engineer as to their acceptability.
- c. The Consultant will provide written reports to the Contractor, in a timely manner, notifying the Contractor of environmental test results and/or the Contractor's compliance in meeting this Special Provision. Due to possible time constraints in preparing written notifications, the Consultant may verbally inform the Contractor of compliance problems and necessary remedial action(s) followed by prompt written notification to both the Contractor and the Engineer.
- d. Tests and monitoring operations performed by the Consultant and their relation to the Contractor and the Contractor's operations are indicated in Subsections (3) to (8) below. The Consultant's monitoring of waste handling and related Contractor operations are indicated in Subsection (9) below. The Consultant's inspection painting work related to Contractor operations are indicated in Subsection (10) below.
- e. The Consultant is authorized to temporarily suspend the Contractor's blast cleaning or painting operations if those operations pose potential environmental or public health hazards. The Consultant must inform the Contractor of the cause(s) for a stoppage and allow the Contractor to resume work once he has satisfactorily remedied the situation. Within 24 hours of that action, the Consultant must provide the Engineer and Contractor with a written report justifying that action.
- f. The Consultant shall routinely monitor the Contractor's personnel concerning unsafe working practices. When such actions are observed, the Consultant shall promptly inform the Contractor of those practices. Continuance of unsafe practices by the Contractor's personnel will be sufficient justification for the Consultant to suspend the Contractor's operations.

### (3) Soil Testing

- a. The Consultant will conduct preliminary soil tests prior to the onset of painting operations. Soil samples shall be taken at 50-foot intervals under the bridge and will extend 100 feet beyond the abutments. For over-stream bridges, at least two sediment sites will be sampled near the banks of the waterway. A minimum of ten sample sites will be selected at the job site.
- b. At least five surface soil samples will be taken at each sampling site. Tests will be performed on each sample for total lead content (ppm) in accordance with USEPA SW 846 *Test Methods for Evaluating Solid Wastes*, Method 3050. The mean and standard deviation of the soil lead contents will be determined from all tests.
- c. The Department may authorize additional soil tests during blast-cleaning operations if excessive waste discharge is observed at the job site.
- d. After the project is completed, the Consultant will conduct soil sampling and tests of samples taken from the same general sites.
- e. If the mean value of the post-project soil tests provides an increase in total lead

content greater than 2 standard deviations of the mean value of the initial test results, the Contractor shall provide hazard remediation (waste clean-up) of the soil. That work shall be deemed satisfactory when the mean value of follow-up soil tests from sample sites selected by the Consultant indicates the soil lead content has decreased to within 2 standard deviations of the mean value of the initial test results.

(4) Air Monitoring Plan

a. The Consultant will prepare a written Air Monitoring Plan and submit it to the Engineer for approval. The Consultant will conduct air monitoring operations at the job site in accordance with the approved Air Monitoring Plan.

b. In part, the Air Monitoring Plan will be based on a site visit by the Consultant. At that time, the Consultant will measure the prevailing wind speed and direction during a typical work day, observe the placement of the bridge(s) in relation to boat docks, car lots, houses, offices, restaurants, schools, nurseries, miscellaneous dwellings, roads, sidewalks and paths, playgrounds, waterways, farming operations, and other prominent natural or man-made features that could be impacted by airborne wastes generated by blast-cleaning operations. The Consultant will also obtain information from local sources concerning typical weather patterns.

c. The Contractor shall meet with the Consultant to review the Contractor's plans for the painting project. They shall review the plans for the containment enclosure(s), staging on the bridge(s), and anticipated work scheduling. This meeting shall occur not later than 60 calendar days prior to onset of blast-cleaning operations specified by the Contractor.

d. The Air Monitoring Plan submitted by the Consultant will be based on the site inspection, the Contractor/Consultant review, and the Consultant's professional judgement. The Air Monitoring Plan will include plan drawings of the project environs, the job site, and the containment enclosure(s). Drawing(s) of the environs will locate the job site area and surrounding areas of public access which will be identified as to buildings (type, typical inhabitation, and use), and pertinent areas frequented by people (e.g. playgrounds, pedestrian travel ways, or boat docks) and the principle wind direction and its average (or maximum) velocity. Drawing(s) of the job site will indicate positions of the Contractor's equipment and containment enclosure stagings as blast-cleaning work progresses along the bridge(s). Containment enclosure drawings will show the containment enclosure(s) in typical stagings, indicating anticipated air flows, seams or joints, entrances, and ducts. Those drawings will show the placement of air monitoring devices relative to the environs, job site, and containment enclosure(s) and will identify them by type.

e. The Air Monitoring Plan will describe the Consultant's routine test procedures, manpower assigned to air monitoring, standard report forms, anticipated flow of documentation, and equipment employed at the job site.

(5) Air Monitoring of Contractor Operations at the Job Site

a. The Consultant will monitor air quality at the job site, at the environs, and in the containment enclosure measuring total lead-in-air.

b. The Consultant will employ air samplers with air flow rates in the range of 2 to 10 liters/minute. The sampler filters will be analyzed in accordance with NIOSH *Manual of Analytical Methods*, Method 7082 by a laboratory analyst who is Precision Analyst-Technique qualified by NIOSH for lead analyses. The Consultant will obtain the test results and verbally transmit them to the Contractor within 24 hours of the completion of field sampling.

c. The Consultant will operate the samplers during work days while blast-cleaning operations are in progress. The Consultant will take air-quality samples on a daily (8-hour) basis at the job site and in the containment enclosure. Air quality monitoring downwind and at other critical locations in the environs will be conducted on a 40-hour work week basis or longer if blast-cleaning operations exceed 40 hours. Additionally, the Consultant will take 8-hour readings of samplers at the job site and environs on 2 precipitation-free days preceding blast-cleaning operations. Those readings will be made to determine baseline ambient lead levels.

d. Test results for airborne lead particles that exceed permissible limits, as provided in Sections 727.20(2) and 727.20(5)a. of this specification, will be reported to both the Contractor and the Engineer. The Contractor shall promptly determine the cause of those high readings and apply remedial procedures. The Contractor shall explain the problem (and remedial action) in writing to the Engineer. The Engineer will review the situation with the Consultant to determine whether the Contractor's remedial procedures are satisfactory. The Engineer will also determine whether hazard remediation (clean-up) or health-related work is necessary. The Engineer will provide the Contractor in writing with any additional requirements the Engineer deems necessary. The Engineer may elect to halt work until the Contractor institutes those requirements. The Contractor shall bear the expense for those items and any suspension of work.

e. The Consultant will monitor airflow rates and pressure differentials in and about the containment enclosure(s). Performance tests will be conducted on all major ventilation devices such as fans and compressors. Those tests will be performed prior to the onset of blast-cleaning work. Ventilation testing of containment enclosure(s) will be performed each day prior to initiating blast-cleaning operations. Further tests will be performed after any major changes to the containment enclosure(s). Variances with ventilation requirements for the containment enclosure(s) shall be promptly remedied by the Contractor.

f. The Consultant will maintain records of all test results at the job site and will provide both the Contractor and the Engineer with the results on a weekly basis.

#### (6) Waste Testing

The Consultant will perform TCLP tests of waste paint debris during the initial blast-cleaning operations. Those tests will be conducted to confirm whether the waste paint debris, other site-generated debris, and recycled abrasives are to be disposed as hazardous wastes (i.e. the lead content in the TCLP leachate of the waste paint debris exceeds 5 milligrams per liter).

#### (7) Water Quality Testing

The Consultant will perform water quality tests at over-stream bridges if directed by the Engineer due to observed discharge or leakage of waste. Random water sampling will be performed under the structure during routine blast-cleaning operations. Those samples will be tested for total recoverable lead (ppb) or total zinc (ppb) in accordance with 40 CFR 136 *Guidelines Establishing Test Procedures for the Analysis of Pollutants* to be compared with the appropriate standard in 401 KAR 5:031 *Surface Water Standards*.

(8) Additional or Special Tests

The Department reserves the right to perform any additional or special tests deemed necessary.

(9) Contractor Handling and Temporary Storage of Wastes Generated at the Job Site

The Consultant shall monitor the Contractor's handling and storage of all wastes generated at the job site. The Consultant will enforce the applicable provisions in Sections 727.20 and 727.22. Any violations of those Sections by the Contractor's personnel will be promptly reported in writing to both the Contractor and the Engineer. The Contractor shall promptly remedy the situation. Also, the Contractor shall explain in writing to the Engineer what remedial actions were taken and what steps would be instituted to prevent its recurrence.

(10) Paint Operation Monitoring

The Consultant will be the Engineer's representative for all paint-related matters. The Consultant will monitor and inspect all Contractor paint operations in accordance with the Department's *Standard Specifications for Road and Bridge Construction*, Sections 727.01 through 727.15. The Consultant will reject all work that is unacceptable under those specifications. The Department will monitor the Consultant's and the Contractor's work for compliance with control requirements. The Department will issue a final inspection report.

**727.20 Containment**

(1) Containment Enclosure Design

a. Containment systems shall be designed to meet criteria set forth in this section. The containment system(s) shall: a) be fully enclosed; b) utilize negative pressure (mechanical ventilation); c) provide filtration at all forced air outlets; and d) employ impermeable walls (rigid or flexible).

b. All designs shall be made by licensed structural and ventilation engineers. The designs should take into consideration project traffic control requirements and structural requirements that allow for the weight of materials collected. Air flow inside containment enclosure(s) shall be engineered to provide for the movement and eventual collection of air-suspended particulate created by blast-cleaning operations.

(2) Containment Performance

~~Containment enclosures shall be subject to performance specifications that limit potential lead-exposure rates. Occasional visible fugitive dust emissions shall be allowed outside a containment enclosure as the work progresses to new portions of a bridge. However, once the structure is tightened at a given location, no further visible emissions shall be permitted. Generally, blast-cleaning operations shall cease between stagings of the containment enclosure. The maximum permitted exposure level for ambient lead permitted at the job site, outside the containment enclosure, as determined by NIOSH Method 7082 shall not exceed 50 micrograms per cubic meter over an 8-hour time-weighted average. Ambient air lead monitoring in areas of public access outside the designated job site area over a 40-hour working period, shall not exceed a time-weighted average greater than that for baseline ambient conditions (see Section 727.19(5)c.) or 15.0 micrograms per cubic meter as determined by NIOSH Method 7082. The time-weighted average for that monitoring shall not be greater than that for baseline ambient conditions (see Section 727.19(5)c.) or 1.5 micrograms per cubic meter for a calendar quarter (90 calendar days).~~

(3) Spent Blast-Cleaning Debris Collection

Spent blast-cleaning debris may be collected inside containment enclosure(s) by vacuuming or be allowed to funnel down ducts in the base of the enclosure(s) into sealed recyclable material storage containers. Such designs shall be completely closed systems that employ dust collectors to remove fines prior to deposition in the recyclable material storage containers. Fines from dust collectors shall be stored and analyzed as a hazardous waste separately from the waste paint debris. Waste paint debris separated from recycled abrasives shall be directly placed in waste storage containers and sealed. The transfer of waste paint debris from hoppers or collection containers to waste storage containers shall be effected using closed systems that prevent the discharge of airborne dust.

(4) Over-Stream Debris Discharge

In no case shall waste debris be discharged directly into adjacent bodies of water. If excessive fugitive dust discharge occurs over water, the Contractor shall revise the operations as necessary to eliminate the discharge.

(5) Containment Enclosure Ventilation and Airborne Lead Requirements

a. Containment enclosure(s) shall meet minimum ventilation and worker lead-exposure requirements and shall comply with the Department's *Standard Specifications for Road and Bridge Construction*, Subsection 107.01.01.

b. The containment enclosure(s) shall meet the following performance standards during blast-cleaning operations: a) a continuous negative pressure throughout an enclosure of 0.05-inch water column (W.C.) relative to ambient conditions for rigid impermeable wall enclosures, a continuous negative pressure throughout an enclosure

of 0.03-inch W.C. relative to ambient conditions for a combination of rigid and flexible impermeable wall enclosures, or a continuous negative pressure throughout an enclosure monitored by the concave nature of the walls for flexible impermeable wall enclosures;

b) for horizontal configured enclosures employing horizontal air movement - a minimum horizontal velocity past each of the workers within the enclosure of 100 feet per minute; c) for vertically configured enclosures employing vertical air movement - a minimum vertical velocity past each worker in the enclosure of 50 feet per minute; and d) for other enclosures employing localized capture system near the point of dust generation - a minimum velocity of air past each worker in the enclosure greater than 100 feet per minute.

c. The Contractor shall implement the appropriate actions to protect workers inside the containment enclosure from airborne lead in accordance with 29 CFR Part 1910 as adopted by 803 KAR 2:300 through 2:320, *Kentucky Occupational Safety and Health Standards for General Industry*, § 1910.1025, *Lead*. The concentration of airborne lead in the containment enclosure will be determined by the Consultant.

(6) Containment Staging when Employing Zinc-Rich Primer

If zinc-rich primer is used on an over-stream bridge, the containment enclosure shall remain in place until the primer is applied.

**727.21 Abrasive Recycling**

(1) Abrasive Requirements

a. The Contractor shall employ dry blast cleaning using a recyclable abrasive. It shall be of the low-dusting, non-siliceous type, and shall not be contaminated with oil. The abrasive selected by the Contractor shall provide the desired anchor pattern in the substrate of the blast-cleaned steel. The abrasive shall be recyclable for a minimum of 30 applications at the Contractor's standard blast pressure. The abrasive supplier shall provide data sheets on any non-metallic abrasive to ensure that it meets these specifications and is compatible with the TCLP test.

b. The Consultant shall monitor performance of the abrasive and may mandate that the Contractor change operating procedures or abrasives if the resulting dust or abrasive consumption are excessive.

(2) Recycling System Requirements

a. The Contractor shall employ a recycling system that separates fines and paint chips from the recyclable abrasive. That process must be a contiguous part of the blast-cleaning operation (i.e. the abrasive recycled from the waste paint debris *must* be used to blast clean the bridge).

b. The Consultant shall take samples from the recycling system during operation and conduct tests to ensure that 99 percent, by weight, of the recycled abrasives will not pass a 70 mesh screen. If that limit is exceeded, the Contractor must modify the recycling system operation in a manner that cleans the recycled abrasive to that level.

c. If the Contractor uses recycled abrasive previously employed on a non-Department project, the Consultant shall perform TCLP tests on the abrasive at the expense of the Contractor. ~~If the used abrasive tests hazardous, it will be rejected. At the end of the project, the Consultant shall perform TCLP tests on the remaining abrasive. If the remaining abrasive is determined to be hazardous, it shall be cleaned to a non-hazardous level as indicated by TCLP testing prior to its removal from the job site by the Contractor. Otherwise, it must be disposed as a hazardous waste.~~

## **727.22 Handling, Temporary Storage, and Disposal of Waste Debris**

### **(1) General**

The Contractor shall be responsible for on-site handling, containerizing, and temporary on-site storage of all waste debris generated during blast-cleaning and painting operations. All spent paint debris generated at the job site shall be treated as hazardous wastes by the Contractor's personnel regardless of TCLP test results. All waste debris generated by the Contractor shall be collected and containerized daily in a manner that prevents environmental pollution [See Subsection 727.22(4)b.].

### **(2) Contractor Waste Containerization**

Contractor-generated debris shall be promptly placed in sealable steel containers furnished by the Department or its designated waste disposal contractor. Temporary non-containerized storage of any potentially hazardous waste materials will not be permitted by the Department outside the containment enclosure(s). The Contractor shall firmly secure container lids between filling operations and prior to transport. The Contractor shall fill only waste storage containers that are in good condition and that are free of serious physical damage or corrosion.

### **(3) Waste Storage Site Requirements**

a. The containers shall be stored at a site selected by the Department that is on well-drained ground which is not subject to flooding. All waste storage containers shall be placed on pallets or dunnage to prevent corrosion.

b. The storage site shall be adequately protected from vandalism or unauthorized access by the public. Open storage areas shall be enclosed by a wire fence with a lockable gate. Prominent warning signs shall be displayed around the perimeter indicating it is a hazardous material storage site. While on the job site, the Contractor shall be the only party to possess keys to locks on the storage-site entrance(s). The Contractor shall be responsible for access to the storage site during that time.

c. If the site is also used for equipment storage, the waste storage containers shall be segregated within the site. That shall be accomplished by placing all waste storage containers in an assigned area within the secured site and surrounding that area with a temporary fence.

### **(4) Waste Separation/Container Labelling**



a. Waste paint debris and debris from other sources such as disposable clothes or dust-collector discharge shall be stored in separate containers. Waste-storage containers shall be labelled as to the date of initial waste deposit. They shall also be marked as to the material stored (e.g. lead-based paint debris), its origin, initial date of collection, tare and (estimated) filled container weights, and the potential hazard of the enclosed waste (toxicity). The container identification numbers shall be keyed to samples taken by the Consultant for hazardous waste (TCLP) testing.

b. The Contractor shall dispose only waste materials generated during the project (i.e. any lead-contaminated wastes) in waste storage containers furnished by the Department. The Contractor must arrange for disposal of all wastes generated from the routine operation of the Contractor's equipment (e.g. waste oil, spent cleaning solvents, brushes, etc.). The Contractor will not be permitted to incinerate, bury, dump into the stream, or abandon wastes at the job site.

(5) Waste Reporting

The Consultant shall provide both the Contractor and the Engineer with a weekly report of wastes stored including: a) the identification numbers of containers presently in storage; b) the date that each waste storage container was filled; c) the type and weight of wastes in each specific container (and TCLP test results); d) the identification numbers of containers removed by the Department's waste disposal contractor; and e) the anticipated number of waste storage containers to be filled during the next week. The Consultant will meet with the Contractor on a weekly basis and discuss the need for additional waste storage containers.

(6) Waste Collection

The Consultant will notify the Contractor when the Department's Waste Disposal Contractor will come to the job site to remove full waste storage containers. The Consultant will be present at that time. The Contractor shall *not* release any filled waste-storage containers from the storage site without authorization of the Consultant.

(7) Contractor Project Completion Prior to Final Waste Collection

If the Contractor completes the project prior to final collection of hazardous wastes from the storage site, the Contractor shall leave the storage site intact with all wastes properly containerized and the fence gate locked. The Contractor shall provide the Engineer with keys to the gate. Once the wastes are collected, the Contractor will be notified. The Contractor will be allowed to dismantle and reclaim the storage site fence.

**727.23 Contractor Employee Safety, Training, and Medical Surveillance Provisions for Employees**

(1) Safety and Training Requirements

a. The Contractor shall furnish the Department's and the Consultant's personnel

with clothing, footwear, and protective respiratory devices for working in the containment enclosure(s). The Contractor shall also allow the Department's and the Consultant's personnel to use the changing and eating facilities the Contractor provides for the Contractor's employees.

b. The Contractor shall conduct all employee training work for the project in accordance with the approved Personnel Training Plan for Worker Safety and Waste Handling. All employee training and Contractor work at the job site shall be performed in accordance with 29 CFR Part 1910 as adopted by 803 KAR 2:300 through 2:320, *Kentucky Occupational Safety and Health Standards for General Industry*, § 1910.1025, *Lead* and KAR 35.020 *General Facilities Standards* (IS) § 7. The Contractor shall offer to provide training to the Department's and the Consultant's personnel involved with the project.

(2) Medical Surveillance of Employees

a. The Contractor shall have baseline blood lead tests performed on all employees working at the job site. Specific blood analyses shall be performed: a) total lead; b) zinc protoporphyrin (ZPP); and c) free erythrocyte protoporphyrin (FEP). Initial blood tests shall be performed at least 7 calendar days before employees commence work at the job site. Repeat testing shall be performed on employees at 60 calendar-day intervals. The employees shall also be tested 7 calendar days after work on the project ends.

b. If the entrance lead blood level of a Contractor employee exceeds 40 micrograms per 100 grams of whole blood, the Contractor shall not employ that individual where the "action level" (airborne concentration of lead without regard to air filters) exceeds 30 micrograms per cubic meter measured over an 8-hour period.

**727.24 Basis of Payment**

(1) Cleaning and Painting Structural Steel

a. This work will be paid for at the lump sum contract price for Clean and Paint Structural Steel, or a designated section of a structure, which payment shall be full compensation for furnishing and erecting signs and other devices required for the maintenance, protection, and control of traffic; for all necessary cleaning and painting; and for furnishing all materials, equipment, tools, tackles, scaffolding, and incidentals necessary for the satisfactory completion of the work. Partial payments will be based on Department estimates per section as the work progresses. When the structure is not divided into sections, the entire structure shall be considered as one section for pay purposes.

b. For purposes of partial payments, percentages of the lump sum contract price will be allocated to the various phases of the work as set out herein depending on the number of coats specified:

1. *Two-Coat System.* When the specified number of paint coats consists of a prime coat and finish coat, 40 percent of the lump sum contract price will be allocated to the satisfactory cleaning and acceptable spot painting, 30 percent will be allocated to the acceptable application of the prime coat of paint, and the remaining 30 percent will

be allocated to the acceptable application of the finish coat of paint.

2. *Three-Coat System.* When the specified number of paint coats consists of a prime coat, an intermediate coat, and a finish coat, 10 percent of the lump sum contract price will be allocated to the satisfactory cleaning and spot painting. Forty percent will be allocated to the acceptable application of the prime coat, 25 percent will be allocated to the acceptable application of the intermediate coat, and the remaining 25 percent will be allocated to the acceptable application of the finish coat.

(2) Environmental Controls

Partial payments will be made based on the Contractor's progress on major portions of the project. Those payments and progress milestones are: 1) 10 percent when containment is approved and erected, 2) 60 percent when cleaning of the steel is complete, 3) 20 percent when painting is complete, and 4) 10 percent when equipment is removed and clean up is complete. Final payment will not be made until acceptable soil test results are documented, all containment equipment and working materials are removed, and any spillage is cleaned up or disposed of in accordance with NREPC regulations.

Payment will be made under:

Code	Pay Item	Pay Unit
8434	Clean and Paint Structural Steel	Lump Sum
_____	Environmental Controls	Lump Sum

APPROVED \_\_\_\_\_

Date

State Highway Engineer

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**APPENDIX II**  
Kentucky Transportation Cabinet Invitation for Bid  
Hazardous Waste Transport, Treatment and Disposal

**INVITATION FOR BID  
SPECIAL CONDITIONS**

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**I. PURPOSE**

The purpose of this Invitation For Bid is to establish a firm Price Contract to provide waste characterization, removal, treatment, and disposal services for paint debris and attendant dry waste materials generated during recyclable abrasive blast-cleaning operations to remove paint from bridges at various job sites throughout the State of Kentucky. The waste materials generated at those job sites may contain, or be contaminated with lead, and therefore, may be characterized as hazardous (EP Toxic-D008) wastes. The contract will be a price contract for providing waste-storage containers to job sites designated by the Department, testing of sample wastes furnished by the Department, and subsequently removing, treating, and disposing of wastes generated in forthcoming maintenance-painting operations (and if applicable the subject containers). The price contract will be effective for 1 year from the date of award with a yearly option to renew for a 4-year period.

**II. DEFINITIONS AND ABBREVIATIONS**

EP Tox - US Environmental Protection Agency (USEPA) Extraction Procedure Toxicity Test (Method 1310 in SW 846, Test Methods for Evaluating Solid Wastes).

KAR - Kentucky Administrative Regulations, Legislative Research Commission, Commonwealth of Kentucky, Frankfort, Kentucky.

KOSH - Kentucky Occupational Safety and Health Program, Labor Cabinet, Commonwealth of Kentucky, Frankfort, Kentucky.

KRS - Kentucky Revised Statutes, Legislative Research Commission, Commonwealth of Kentucky, Frankfort, Kentucky.

NREPC - Natural Resources and Environmental Protection Cabinet, Commonwealth of Kentucky, Frankfort, Kentucky.

TCLP Test - US Environmental Protection Agency (USEPA) Toxicity Characteristic Leaching Procedure Test (Method 1311 in SW 846, Test Methods for Evaluating Solid Wastes).

**III. SCOPE OF WORK**

(1) Service Requirements: The Contractor(s) shall characterize waste materials, furnish waste-disposal containers to designated job (waste-generation) sites, prepare manifest, collect filled waste-disposal containers from those job sites, transport them from

job sites to the place of treatment or disposal, and dispose of them in a manner conforming to the rules, regulations, and procedures prescribed by the USEPA or the ~~authorized state regulatory agency where the disposal site is located.~~

(2) Waste Characterization

a. The Contractor shall conduct adequate tests to characterize the lead-contaminated paint debris generated at a job site and to determine whether the Contractor's facilities can accept the wastes for treatment and/or disposal. Those tests shall be performed at the expense of the Contractor using samples furnished by the Department. Those tests shall be performed within 14 calendar days of receipt of the samples. The Contractor shall perform waste-stream profiles sufficient to meet transportation and facility or state waste acceptance requirements. The Contractor (or his test firm) shall notify the Department of: 1) the test results, 2) whether the wastes can be accepted by the Contractor's treatment and/or disposal facilities, and 3) the methods of treatment and disposal the Contractor shall employ.

b. Attendant miscellaneous, lead-contaminated dry wastes (spent air filters, clothes, rags, etc) shall also require disposal. If the Contractor's treatment/disposal site requires testing of all wastes furnished, the Contractor must note that fact in the bid submittal package and specify the extent (and costs) of testing necessary for attendant miscellaneous dry wastes.

c. The Contractor shall state in his bid submittal package whether waste characterization testing can be waived after a sufficient number (state the amount) of tests have been performed to adequately profile the paint debris waste-stream. Testing costs shall be specified on a per job-site basis. That waiver does not include "fingerprinting" that the Contractor's waste treatment and disposal facilities may require to accept a shipment of wastes from the job site.

(3) Furnishing of Waste Containers

a. The Contractor shall furnish the required number and types of containers specified by the Department to the designated job sites on the specified delivery dates. If additional container deliveries are required, the Contractor shall provide those within 7 calendar days of notification. If the specified containers are not available, the Contractor shall furnish alternate containers at no cost penalty compared to those initially requested. In such instances, the Contractor shall not charge the Department for collecting partially unfilled containers.

b. The Contractor shall furnish storage containers acceptable for use by the NREPC. All containers the Contractor shall furnish must be in good condition -- free from corrosion or mechanical damage. The Contractor shall replace any rejected containers within 24 hours. All containers shall be furnished with sealable lids. Roll-offs shall be furnished with disposable liners. The Contractor shall quote the container sizes noted in Attachment A.

(4) Manifest Preparation

a. The Department will provide the Contractor in writing with the Kentucky EPA ID Number (if necessary) for each job site. That identification number will be provided at least 30 calendar days prior to the NREPC-mandated date for removal of filled waste-

disposal containers from the job site. When providing the EPA ID number, the Department will indicate the NREPC-mandated date for collection of wastes from the job site. If intermittent waste collection is required, the Department will stipulate the number and types of containers and wastes to be collected (and the number and types of additional empty containers to be delivered).

b. The Contractor shall prepare proper manifesting and any other necessary documents and/or permits for transporting, treating, and disposing of the wastes. In the bid submittal, the Contractor shall indicate whether the 30 calendar-day lead time provided in Subsection III(4)a. of this Invitation For Bid is sufficient for obtaining all necessary analysis, documentation or permitting, and transporting to the waste treatment/disposal facility. If not, the Contractor shall indicate the number of calendar days required.

c. The Contractor shall provide necessary copies of all documents and permits to the relevant parties and one copy to the Department at the job site upon waste collection. The Engineer or his designated representative will not release those wastes without being furnished proper documentation at the time of waste collection. The Contractor shall be responsible for the proper routing of all documents once the wastes have been collected and transported from the job site. The Contractor shall also provide the Department with final copies of the manifest and other necessary documents indicating the wastes have been properly treated and disposed.

(5) Waste-Storage Container Collection and Transportation

a. The Contractor shall furnish the labor and vehicles necessary to collect the wastes generated at all job sites within the 30-day time limit noted in Subsection III(4)a. of this Invitation For Bid and transport those wastes to either 1) an approved transfer facility, 2) a treatment facility, or 3) a disposal facility. If the Contractor does not perform the waste collection and transportation, he shall provide his transporter's and at least one alternate transporter's: 1) name, 2) address, 3) NREPC copy of "Certificate of Registration", 4) a copy of the Kentucky Transportation Cabinet "Hazardous Material Permit", and 5) any other license(s) needed for transport within any necessary state. The Contractor shall provide that information in his bid package. Some sites may have intermittent waste generation. In those instances, the Contractor shall collect the wastes as stipulated by the Department within the applicable regulatory time limits for temporary job-site waste storage as noted in Subsection III(4)a.

b. The Contractor shall notify the Department in writing of the date and time for waste-disposal container collection at the job site. That notification must be received 7 calendar days prior to the collection date. All collections must be during normal working hours (8:00 am to 4:30 pm) Monday-Friday.

c. The Engineer or his delegated representative will be present at the job site to provide access to the waste storage site. The wastes will not be released unless the Contractor or his transporter provide proper manifest documents. The Engineer or his delegated representative may inspect the waste-transporting vehicle to determine if it is properly signed and marked. If the vehicle is deficient, the wastes will not be released from storage and the Department will not be liable for travel charges.

d. The Contractor's personnel shall remove the filled waste-disposal containers from the storage site and load them on their vehicle. The Engineer or his delegated

representative will inspect the load prior to leaving the job site, and will inspect all containers to ensure they are properly filled, sealed, and securely loaded. The Engineer, or his delegated representative will review the manifest form for proper preparation. The Engineer or his designated representative will also confirm the number of containers and weights collected. The weight of waste blast-cleaning debris entered on the manifest shall be made from a volumetric/density computation. The weight of any ancillary wastes shall be determined by direct weighing. The Contractor or his transporter shall provide a portable 500-lb capacity scale for weighing ancillary wastes.

e. The Contractor shall indicate in his bid submittal package whether a small amount of attendant miscellaneous wastes can be stored in plastic bags in drums or roll-offs and accepted for direct disposal without waste characterization or treatment. If that is acceptable, the Contractor shall also indicate the quantity of wastes allowed under that provision.

f. The Contractor shall provide a per-mile cost for waste collection and container delivery. That cost should be broken down by mile and types of waste-disposal containers collected or empty containers delivered as noted in Attachment A.

#### (6) Waste Treatment and Disposal

a. In his bid submittal package, the Contractor shall provide: 1) facility name, 2) owner, 3) address(es), 4) EPA I.D. number and 5) a copy of the certificate from the permit application of the primary or interim storage, treatment, and disposal facilities and 6) an indication of EPA permit status. The Contractor must also provide similar information for any alternate disposal facilities.

b. In his bid submittal package, the Contractor shall provide a complete record of any EPA or related state agency citations for the Contractor's treatment and disposal facilities over the past 5 years. The Contractor must explain: 1) the reasons those citations were issued, 2) remedial actions taken, and 3) documents from the citing agency indicating that the situation has been resolved.

c. The Contractor shall specify in his bid submittal package, the method(s) he intends to employ for treatment of the waste paint debris and the subsequent method(s) of disposal. The Contractor shall provide historical evidence that his proposed treatment method is suitable for lead-based paint debris from blast-cleaning operations employing recyclable abrasives. Waste treatment and disposal shall be in accordance with current EPA regulations in the states where the treatment and disposal facilities are located. If treatment and disposal options exist for a specific shipment of hazardous wastes, the Contractor shall employ the methods that result in the lowest cost to the Department.

#### IV. CONTRACTOR REQUIREMENTS

(1) Contractor's Personnel: The Contractor and any subcontractors shall have qualified personnel test, classify, prepare the manifest and load the hazardous wastes. All of the Contractor's personnel shall be knowledgeable and comply with (1 NREPC standards for handling and transporting the hazardous wastes described in this Invitation for Bid and (2 KOSH requirements for personnel safety while performing their assignment.



(2) Safety/Legal Requirements

- a. All material, equipment and supplies provided to the Department must comply ~~fully with the applicable standards of 401 KAR Chapters 31-38, all applicable KOSH standards and the laws applicable in the states through which wastes are transported, treated, stored and disposed.~~
- b. The Contractor and any subcontractors shall implement engineering controls or work practices which ensure no contamination of work area or exposure to other employees or persons. For sampling or otherwise handling the Department's waste materials, all waste materials must be assumed to be toxic and all necessary safety precautions and equipment must be utilized.
- c. The Contractor and any subcontractors shall assume full and complete responsibility for the competency, judgement, and actions of their employees, at all times, and the Department will not assume and will be under no obligation whatsoever for the same.
- d. The Contractor shall be liable for injury to any person at the site for which the contractor is responsible. If applicable, the Contractor must provide warning devices and signs which shall be prominently displayed and in full compliance with safety regulations. No eating, drinking, or use of tobacco will be allowed at the Department's temporary waste storage sites.
- e. The standards for environmental compliance will be determined based on the provisions of KRS 224 Environmental Protection and all regulations promulgated pursuant thereto. The terms of the contract do not relieve the Contractor from compliance with those provisions.

(3) Workmanship: All packing and handling of the hazardous wastes shall be done in conformance with the applicable standards of 401 KAR, chapters 31-38. All packed hazardous wastes shall be transported from Department's job sites immediately after completing the packing and preparation of the manifest. The Engineer or his delegated representative may stop the packing and/or moving of the hazardous wastes if it is not being done in accordance with the contract.

(4) Record-keeping and Record Retention

- a. The Contractor shall establish and maintain adequate records of all expenditures incurred under the contract in accordance with generally accepted accounting principles as promulgated by the American Institute of Certified Public Accountants.
- b. Duly authorized representatives of the State shall have the right to audit, review, examine, copy and transcribe any pertinent records or documents relating to any contract resulting from this Invitation For Bid. The Contractor shall retain all documents associated with this contract (including copies of all required hazardous waste records and reports) for a period of not less than four (4) years after final payment is made.

(5) Permits: The Contractor shall act in accordance with all state and federal laws and shall secure permits and licenses required for any transport of the hazardous wastes. The Contractor shall provide the Engineer or his designated representative any generating site identification application forms and instructions required by disposal site environmental protection authorities. The Contractor shall provide copies of applicable permits and license(s) required by law prior to award of contract.

(6) Certificate of Disposal: The bid shall state the specific location(s) and the method(s) of disposal for hazardous wastes. The Contractor shall ensure that a notarized certification is sent to the Engineer or his delegated representative by the operators of the disposal site verifying the hazardous wastes were accepted and disposed of in accordance with EPA regulations at the stated waste management facility.

(7) Time and Frequency of Performance: Contractor shall perform on-call hazardous waste removal and subsequent treatment and disposal for hazardous wastes generated at each of the in-state job sites designated by the Department during the life of the contract.

## **V. INSURANCE**

The Bidder selected shall provide Certificates of Insurance for commercial insurance coverages required or in effect for the term of the contract. In addition to insurance coverages specified in the State's standard bidding contracts, the Contractor shall maintain environmental impairment insurance with \$5,000,000 combined liability single limits per occurrence or claims made.

## **VI. ASSIGNMENT OF LIABILITY**

(1) Certificate of Assurance: The successful Bidder (Contractor) must provide a Certificate of Assurance that the Department is not responsible for any accidents or spillage during transportation of the hazardous wastes. That responsibility belongs solely to the Contractor.

(2) Hold Harmless: The Contractor shall agree to hold the Department and all of its employees, representatives, and agents harmless with respect to liabilities and claims which arise from the acts or omissions of the Contractor's officers, employees, or agents.

## **VII. BIDDER'S SUBMITTAL PACKAGE**

To respond to this Invitation For Bid, the Bidder shall provide a bid submittal package. In that package, the Bidder shall provide all information or responses requested in the Invitation For Bid. The bid submittal package shall have a similar organization to this Invitation For Bid with equivalent section titles and numbers.

**ATTACHMENT A: COST SCHEDULE FOR CONTAINMENT DELIVERY,  
WASTE TRANSPORTATION, TREATMENT AND DISPOSAL**

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A. Container Delivery (from Bidder's container storage site to any location in Kentucky specified by the Department). The Bidder shall identify his primary container storage site in his bid submittal package. If various storage yards are employed for the different container types, those will also be identified. The prices quoted will be per container per mile.

1. Labpacks (10 lbs)
2. 30 gallon steel drums (DOT Std.)
3. 55 gallon steel drums (DOT Std.)
4. Roll-offs with liners (state Bidder's standard capacity)

B. Waste Transportation (from any job site in the state of Kentucky specified by the Department). This shall include transportation of all wastes, disposable containers, and liners to the treatment sites and also to the site(s) of final disposal. Those charges shall be quoted per container per mile. The Bidder shall state the methods of and locations for treatment and disposal. If alternate treatment and disposal options exist [e.g. stabilization treatment followed by landfilling at an EPA Class "D" site, or no treatment (if EP Tox < 5 ppm) and direct disposal at an EPA Class "C" hazardous waste site], those options shall be quoted separately and the appropriate sites and their locations should be identified along with attendant transportation costs on a per container basis. Containers and/or liners shall also be disposed of and if special sites are required for handling and disposing of them, those sites shall be identified along with attendant hazardous waste transportation costs per container.

1. Labpacks (10 lbs)
2. 30 gallon steel drums (DOT Std.)
3. 55 gallon steel drums (DOT Std.)
4. Roll-offs with liners (state Bidder's standard roll-off capacity)

C. Treatment and Disposal (at the Bidder's treatment and disposal facilities). The Bidder shall state the per container cost for treatment and disposal. Costs will be specified per container including costs for processing and disposing of the containers or liners where applicable. If alternate treatment and disposal options exist [e.g. stabilization treatment followed by landfilling at an EPA Class "D" site, or no treatment (if EP Tox < 5 ppm) and direct disposal at an EPA Class "C" hazardous waste site], those options should be quoted separately and the appropriate sites and their locations should be identified along with attendant costs.

1. Labpacks (10 lbs)
2. 30 gallon steel drums (DOT Std.)
3. 55 gallon steel drums (DOT Std.)
4. Roll-offs with liners (state Bidder's standard roll-off capacity)

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**APPENDIX III**  
Kentucky Transportation Cabinet Contract Provisions for  
Consultant Environmental Monitoring, Waste  
Mangement, and Paint Inspection Services

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DIVISION OF MAINTENANCE  
BRIDGE BRANCH

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CONTRACT PROVISIONS FOR  
CONSULTANT ENVIRONMENTAL MONITORING, WASTE  
MANAGEMENT, AND PAINT INSPECTION SERVICES

These provisions provide for: 1) environmental monitoring, 2) waste management, and 3) paint inspection services related to contractor blasting-cleaning and painting operations on existing steel bridges.

Those services are required to: 1) provide for the safety of the public, 2) prevent discharge of hazardous wastes into the environment, 3) ensure that proper procedures are followed in storage, transportation, and disposal of hazardous wastes, and 4) verify the suitability of the Contractor's painting operations. Other applicable documents shall be the Department's *Standard Specifications for Road and Bridge Construction*, Special Provision No. 89 (91) *Maintenance Painting of Steel Bridges (Experimental)*, Division of Construction *Guidance Manual*, Division of Materials *Guidance Manual*, and the "General Provisions" contained in the *Professional Services Procurement Manual* as amended by this Special Provision.

**Provision I**

**Definitions and Abbreviations** - The following definitions and abbreviations apply where used in this Special Provision.

CFR - Code of Federal Regulations, Office of the Federal Register, General Services Administration, Washington, District of Columbia.

Contract Administrator - The Department's representative for supervision of the work. Under the Inspection Stage work, that representative will be the Engineer.

Generator - Owner of hazardous wastes resulting from blast cleaning operations on bridges coated with lead-based paints (i.e. the Department).

KAR - Kentucky Administrative Regulations, Legislative Research Commission, Commonwealth of Kentucky, Frankfort, Kentucky.

KOSH - Kentucky Occupational Safety and Health Program, Labor Cabinet, Commonwealth of Kentucky, Frankfort, Kentucky.

KRS - Kentucky Revised Statutes, Legislative Research Commission, Commonwealth of Kentucky, Frankfort, Kentucky.

NIOSH - National Institute of Occupational Safety and Health, US Department of Health and Human Services, Cincinnati, Ohio.

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NIST - National Institute of Standards and Technology (Formerly the National Bureau of Standards), Gaithersburg, Maryland.

NREPC - Natural Resources and Environmental Protection Cabinet, Commonwealth of Kentucky, Frankfort, Kentucky.

SSPC - Steel Structures Painting Council, Pittsburgh, Pennsylvania.

TCLP Test - US Environmental Protection Agency (USEPA) Toxicity Characteristic Leaching Procedure Test (Method 1311 in *SW 846, Test Methods for Evaluating Solid Wastes*).

## **Provision II**

**Stages of Consultant Work** - Consultant work related to a specific painting project or series of painting projects shall be broken down into two stages: a) a Design Stage and an Inspection Stage. The stages of Consultant work will be negotiated separately by the Department of Highways (hereinafter referred to as the Department). Implementation of the Inspection Stage and the Consultant's continued work for the Department will depend on a) whether the painting contract is let or awarded, and b) the Department's review of the Consultant's documents prepared during the Design Stage. The Department has the option to employ others for the Inspection Stage.

(1) Design Stage - The Design Stage provides for: 1) preliminary meetings with Department of Highways officials, 2) initial site inspection(s) and testing, and 3) preparation of documents (plans) for letting the painting contract. Review of painting contractor bids will be performed by the Department.

(2) Inspection Stage - The Inspection Stage provides for: 1) preliminary meeting(s) with the painting contractor (hereinafter referred to as the Contractor), 2) preparation of Environmental Monitoring and Waste Management Plans, 3) on-site environmental monitoring, 4) management of waste disposal, and 5) inspections of cleaning and painting of bridge(s) contracted to be painted.

(3) Options for Contract Extension - For the Inspection Stage, options for a contract extension exist as stated in the advertised "Announcement of Need for Professional Services."

a. The Department may require the Consultant to perform additional work in the event that the bridge site(s) requires hazard remediation (waste clean-up) work due to hazardous waste discharge by the painting contractor.

b. The Department may require the Consultant to perform additional work in the event of personal or property damage claims related to hazardous waste



discharge in connection with the project.

c. The Department may require the Consultant to perform additional work in the event of a citation against the Department by state or federal environmental protection agencies related to handling, transport, treatment, and/or disposal of hazardous wastes generated at the bridge site(s).

### **Provision III**

**Contract Administration** - At the initial meeting, the Department will assign a Contract Administrator (hereinafter referred to as the Administrator) to oversee the Consultant's work. The Administrator shall be responsible for the daily supervision of the contract. The Administrator will: 1) attend meetings, 2) visit the job site, 3) respond to all questions, 4) review all reports, 5) review all pay estimates, and 6) generally supervise the contract. All questions and inquiries should be directed to the Administrator. The Administrator will supervise the total program of the Contractor's maintenance painting operations and Consultant's environmental monitoring, waste management, and paint inspection operations.

### **Provision IV**

**Meetings** - After the consultant contract is completed and approved, a series of meetings will be held between the Department and Consultant at the State Office Building in Frankfort, KY or at another location selected by the Department. The Department will meet with the Consultant as outlined below:

(1) Design Stage Meetings

a. **Scope of Work Meeting** - The Department and the Consultant will have a preliminary meeting. The anticipated scope of work, time schedules, and type of contract will be presented and discussed. The Department will furnish to the Consultant copies of existing data such as plans, structural calculations, and prior maintenance records as appropriate. The Consultant shall identify any private laboratory to be employed to test field samples.

b. **Pre-Letting Meeting** - The Consultant shall meet with the Department to present: 1) a Preliminary Site Environment Presentation and Report, 2) an estimate of the amount of hazardous waste to be generated, 3) a set of plans and specifications, and 4) a cost estimate for the project (i.e. the Contractor's work). The Consultant shall discuss any problems anticipated in performing the work. The specifications may be modified as jointly agreed upon by the Department and Consultant.

(2) Inspection Stage Meetings

a. **Scope of Work Meeting** - The Department and the Consultant will have a preliminary meeting. The anticipated scope of work, time schedules, and type of contract will be presented by the Consultant and discussed. The Department will

identify the Contractor for the project(s). The Department will also identify the firm that will transport and dispose of hazardous wastes (hereinafter referred to as the Waste Contractor).

b. Pre-Inspection Meeting - The Consultant shall meet with the Department to present a draft Air Monitoring Plan identifying equipment, personnel, sampling schedule, test procedures, and test firms (private laboratories). The Consultant shall also provide a draft Waste Handling Plan identifying equipment, personnel, and sampling procedures. The Consultant shall also provide a Gantt-type chart showing the anticipated schedule for Contractor's blast cleaning and paint activities and the Consultant's associated activities. The Consultant shall provide a list of all employees to be used at the job site, their functions, biographical data indicating relevant education, work experience, and employment history with the Consultant. The Consultant shall provide the local address and telephone number of the Consultant's Project Supervisor. The Consultant shall discuss any problems anticipated in performing the work.

c. Contract Extension Meetings - The Consultant shall meet with the Department to negotiate any contract extensions necessitated by events noted in Provision II(3), subsections a. through c. The Contract Extension Meetings will have the dual purpose of specifying additional consultant work and negotiating contract fees. The Consultant shall provide unit prices and tentative schedules for all work specified.

d. Project Review Meeting - After official termination of the Consultant's work at the job site, the Consultant shall meet with the Department. At that meeting, the Consultant shall provide preliminary draft(s) of an Environmental Monitoring/Hazardous Waste Report(s) and make a presentation on the work performed. The Administrator shall review the draft report(s) and provide comments that shall be incorporated in the final report(s).

(3) Additional meetings - Additional meetings may be required if deemed necessary by either the Project Administrator or the Consultant.

### **Provision V**

**Minutes of Meetings** - The Consultant shall submit the minutes of each meeting to the Administrator within 7 calendar days. The Administrator shall review the minutes and advise the Consultant of any necessary additions and corrections. Within 7 calendar days of the receipt of those comments, the Consultant shall revise the minutes and return them to the Administrator.

### **Provision VI**

**Safety** - The Consultant shall conduct work at the job site in accordance with the rules and regulations of KOSH. As this project involves exposure to a hazardous (toxic) material, lead, the Consultant's work specifically related to that material shall be conducted in accordance with 29 CFR Part 1910 As Adopted by 803 KAR 2:300 through 2:320, *Kentucky Occupational Safety and Health Standards for General Industry*, §

1910.1025, *Lead* and KAR 35.020 *General facilities standards* (IS) § 7. The Consultant's work not specifically related to lead shall be conducted in accordance with the Supplement to 29 CFR Part 1926 As Adopted by 803 KAR 2:016, 803 KAR 2:200, and 803 KAR 2:400 through 2:423 *Kentucky Occupational Safety and Health Standards for Construction* (with latest amendments).

(1) Safety Training of Employees

a. As mandated in Subsection 727.23(1)b. of *Special Provision No. 89 (91) Maintenance Painting of Steel Bridges (Experimental)* [hereinafter referred to as Special Provision 89(91)], the Contractor will conduct employee training for the project in accordance with an approved Personnel Training Plan for Worker Safety and Waste Handling. The Contractor will offer to provide training to the Consultant's personnel involved with the project. The Consultant's personnel should attend that training to learn about site-specific precautions and Contractor-specific safety equipment and facilities. The Consultant may elect to perform in-house safety training for his employees instead of availing of the Contractor's training. In that case, a representative of the Consultant shall attend the Contractor's training to acquire safety information particular to the specific job site(s).

b. The Contractor will furnish the Consultant's personnel with clothing, footwear, and protective respiratory devices for working in containment enclosure(s). The Consultant's personnel will be allowed to use changing and eating facilities provided for the Contractor's employees.

(2) Medical Surveillance of Employees

a. The Consultant shall have baseline blood lead tests performed on all his/her employees working at the job site. Specific blood analyses shall be performed for: 1) total lead; 2) zinc protoporphyrin (ZPP); and 3) free erythrocyte protoporphyrin (FEP). Initial blood tests shall be performed at least 7 calendar days before employees commence work at the job site. Repeat testing shall be performed on employees at 60 calendar-day intervals. The Consultant's employees shall also be tested within 7 calendar days after work on the project ends.

b. If the entrance lead blood level of an employee exceeds 40 micrograms per 100 grams of whole blood, the Consultant shall not employ that individual where the "action level" (airborne concentration of lead without regard to air filters) exceeds 30 micrograms per cubic meter measured over an 8-hour period.

(3) Hold Harmless Clause

The Consultant shall agree to hold the Department and all of its employees, representatives, and agents harmless with respect to liabilities and claims which arise from the acts or omissions of the Consultant's officers, employees, or agents.

## **Provision VII**

**Consultant Design Stage Work** - The Consultant's work for the Design Stage should be sufficiently complete to provide all information and documentation specified by the Department in the Scope of Work Meeting.

(1) Document Review - The Consultant shall review all applicable Department specifications, guidance manuals, and special provisions. In addition, the Consultant shall review the applicable bridge plans furnished by the Department.

(2) Site Inspection(s)

a. The Consultant shall conduct at least one inspection at the proposed job site.

b. The Consultant shall measure the prevailing wind speed and direction during a typical work day and determine the location of the bridge(s) in relation to boat docks, car lots, houses, offices, restaurants, schools, nurseries, miscellaneous dwellings, roads, sidewalks and paths, playgrounds, waterways, farming operations, and other prominent natural or man-made features that could be affected by airborne wastes generated by blast cleaning operations. The Consultant shall also obtain information from local sources concerning typical weather patterns.

c. The Consultant shall determine a suitable location along the right-of-way for temporary storage of hazardous wastes. The site should be on well-drained ground which is not subject to flooding. The Consultant should check to verify that the proposed storage site is located on the right-of-way at least 30 feet from the edge of the roadway. The Consultant should confer with the Administrator to determine an acceptable site if the 30-foot roadway clearance is impractical.

d. The Consultant shall compare the bridge plans furnished by the Department with the structure(s) in place. The Consultant shall conduct bridge inspections and determine any additional specifications necessary for proper painting of the particular structure (s).

(3) Soil Testing

a. The Consultant shall conduct preliminary soil tests. Soil samples shall be taken at 50-foot intervals under the bridge and extend to 100 feet beyond the abutments. For over-stream bridges, at least two sediment sites shall be sampled near the banks of the waterway. A minimum of ten sample sites shall be selected at the job site.

b. At least 5 surface soil samples, each with a volume of 1 cubic inch, shall be extracted at each sample site. Samples shall be taken at the surface of the soil to a depth of one inch from a 1-foot-square area. The Consultant shall maintain a diary recording where the samples were taken relative to the bridge.

c. The 5 individual samples taken from each site shall be mixed and containerized for delivery to the test laboratory. The sample containers shall be ~~marked to identify where each sample was taken relative to the bridge.~~ Tests shall be performed on each sample for total lead content (ppm) in accordance with US EPA SW 846 *Test Methods for Evaluating Solid Wastes*, Method 3050. Mean and standard deviation values of the lead content shall be determined from all the tests.

(4) Air Quality Monitoring

a. The Consultant shall monitor air quality on the bridge site(s) measuring total lead in air. Air quality shall be determined by taking 8-hour readings of air samplers at the job site and environs on 2 precipitation-free days. Those readings shall be made to determine baseline ambient lead levels.

b. The Consultant shall employ air samplers with air flow rates in the range of 2 to 10 liters/minute. The sampler filters shall be analyzed in accordance with NIOSH *Manual of Analytical Methods*, Method 7082 by a laboratory analyst who is Precision-Analyst-Technique qualified by NIOSH for lead analyses.

c. During air quality monitoring, the Consultant shall maintain a daily diary recording: a) weather conditions (i.e. temperatures, ambient conditions, wind velocity, and direction), and b) locations of air-monitoring equipment.

(5) Laboratory Testing

a. The Consultant may employ a qualified private testing laboratory (hereinafter referred to as the Laboratory) to perform tests on field samples. The Laboratory must be approved by the Department.

b. Prior to testing, the Laboratory shall provide the Consultant with a copy of the Laboratory's quality assurance/quality control program. The Laboratory shall provide certified test results. Testing of hazardous wastes shall be performed in accordance with USEPA SW 846, *Test Methods for Evaluating Solid Wastes*.

(6) Preliminary Site Environmental Presentation and Report

a. The Consultant shall prepare a Preliminary Site Environmental Report. The report shall contain the findings of the site inspections as specified in Subsection (2) of this provision. The report shall also discuss sampling locations and procedures used in Subsections (3) and (4). The report will identify the test laboratory employed to analyze the samples and discuss the test results. The report will contain scaled plan drawings locating: 1) the bridge(s), 2) any waterway(s), and 3) all facilities in the environs (with their identification) that might be affected by the painting operations.

b. A presentation will be prepared outlining the material contained in the Preliminary Site Environmental Report. That presentation will be made at the Pre-Letting Meeting.

(7) Letting Plans, Specifications and Estimates

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a. The Consultant shall prepare a set of plans showing the bridge(s) in sufficient detail to permit potential painting contractors to accurately bid on the work. At a minimum, those plans shall indicate: 1) scope of working including location, description of structure(s), and description of general tasks to be performed; 2) sizes and dimensions of all major steelwork including framing; 3) major dimensions of the structure(s); 4) locations of adjacent features such as exit and entrance ramps that will affect the work; and 5) locations where special work must be performed. Plan and elevation views shall be provided. The Consultant shall furnish the Department with copies of all plans at the Pre-Letting Meeting for review. The Consultant shall provide the Department with one mylar copy of each sheet of the approved plans. The Consultant shall retain the original plans until the project is completed. Those shall be turned over to the Department at the project review meeting.

b. The Consultant shall prepare cost estimate(s) for the proposed painting contract. The cost estimate(s) shall be based on either tonnage of steel or steel surface area. In addition to the estimated total project cost, the cost estimate(s) shall be broken down by span and by major elements in each span (i.e. beams, cross bracing, bents, etc.). The cost estimate(s) shall be broken down by task including: 1) mobilization, 2) containment erection, 3) surface preparation (blast-cleaning), 4) on-site waste handling, 5) painting, and 6) site clean-up and demobilization. The Consultant shall also list unit costs used for estimating purposes. The Consultant shall review the cost estimate at the pre-letting meeting.

c. The letting documents and specifications may be modified as jointly agreed upon by the Department and Consultant.

### **Provision VIII**

**Consultant Inspection Stage Work** - For the Inspection Stage, the Consultant shall act as the Administrator's site manager for the painting contract. The Consultant shall perform the duties specified below to monitor the Contractor's operations related to: 1) blast-cleaning, 2) structural containment, 3) on-site hazardous waste handling and storage operations, and 4) bridge painting. The Consultant shall also manage all hazardous waste processing at the job site and act as the Department's agent in transactions with the Department's Waste Contractor.

(1) **Meeting with the Contractor** - The Consultant shall meet with the Contractor to discuss the plans for the painting project. That meeting shall occur prior to the Pre-Inspection Meeting and at least 60 calendar days prior to the onset of blast cleaning operations as scheduled by the Contractor. The Consultant and Contractor shall review the plans for: 1) the containment enclosure(s), 2) staging work on the bridge(s), and 3) anticipated work scheduling.

(2) Analysis of Containment Plans - The Consultant shall analyze the containment enclosure plans and calculations to ensure that the enclosure(s) conform to Section 727.20 of Special Provision 89(91). ~~Review of the Contractor's structural and ventilation designs shall be made by licensed structural and ventilation engineers. The structural engineers employed shall be pre-qualified by the Department. Structural review should include evaluations of bridge members to which the containment enclosure attachments are made and should also allow for the weight of materials collected in a containment enclosure. The containment enclosure design review must also take into consideration project traffic control requirements.~~

(3) Air Monitoring Plan

a. The Consultant shall prepare a draft Air Monitoring Plan and submit it to the Department for approval at the Pre-Inspection Meeting. The Consultant shall modify the Air Monitoring Plan based on comments provided by the Department. The Consultant shall conduct air monitoring operations at the job site in accordance with the approved Air Monitoring Plan.

b. The Air Monitoring Plan prepared by the Consultant shall be based on: 1) the site inspection, 2) the Preliminary Site Environmental Review, 3) the Contractor/Consultant meeting, and 4) the Consultant's professional judgement.

c. The Air Monitoring Plan shall include drawings of: 1) the project environs, 2) the job site, and 3) the containment enclosure(s). Plan drawing(s) of the environs shall display the job site and surrounding areas of public access. Those areas shall be identified as to: 1) buildings (type, typical inhabitation and use); 2) pertinent areas frequented by people (e.g. playgrounds, pedestrian travel ways, or boat docks); and 3) the principle wind direction and its average (or maximum) velocity. Drawing(s) of the job site shall indicate positions of the Contractor's equipment and containment enclosure stagings as blast cleaning work progresses along the bridge(s). Drawings prepared for the Preliminary Site Environmental Presentation may be modified as necessary and employed for this purpose. Containment enclosure drawings shall show the typical stagings of the containment enclosure(s) in plan and elevation views, indicating anticipated air flows, seams or joints, entrances, and ducts. The drawings shall show the placement of air monitoring devices relative to the environs, job site, and containment enclosure(s) and shall identify them by type.

d. The Air Monitoring Plan shall describe: 1) the Consultant's routine sampling and testing frequency and procedures, 2) personnel assigned to air monitoring, 3) standard report forms, 4) anticipated flow of documentation, and 5) the Consultant's equipment.

e. The Consultant shall provide the Administrator with a copy of the Air Monitoring Plan 14 calendar days prior to the date the Contractor has designated to begin blast cleaning operations. The Consultant shall revise the Air Monitoring Plan as directed by the Department.

(4) Consultant's Authority

- a. ~~The Consultant shall act as the Administrator's designated representative and shall have specific authority as set forth in Subsection 727.19(2) of Special Provision 89(91).~~
- b. In accordance with Section 727.17 of Special Provision 89(91), the Contractor will provide the Administrator with the Contractor's: 1) Contingency Plan, 2) Personnel Training Plan, and 3) Containment Enclosure Plans. The Consultant shall review those documents and, within 14 calendar days of their receipt, recommend to the Administrator whether they are acceptable. The Consultant shall also provide the Contractor with a list of agencies to which the Contractor shall submit copies of the Contingency Plan.
- c. The Consultant shall provide written reports to the Administrator and Contractor in a timely manner notifying them of environmental test results and/or the Contractor's compliance with Special Provision 89(91). The Consultant may verbally inform the Contractor of compliance problems and necessary remedial action(s) followed by prompt written notification to the Administrator and Contractor.
- d. Tests and monitoring operations performed by the Consultant are indicated in Provisions VIII(3) to (10). The Consultant's monitoring and management of hazardous wastes are indicated in Provisions VIII(11) to (16). The Consultant's paint inspection work are indicated in Provision VIII(17). The Consultant's attendant job site duties are indicated in Provisions VIII(18) to (20).
- e. The Consultant is authorized to temporarily suspend the Contractor's blast cleaning or painting operations if those operations pose potential environmental or public health hazards. The Consultant must inform the Contractor of the cause(s) for a stoppage and allow the Contractor to resume work once he has satisfactorily remedied the situation. Within 24 hours of that action, the Consultant must provide the Administrator and Contractor with a written report justifying that action. The Department will deem the Contractor's failure to comply with the terms of Special Provision 89(91) to be sufficient justification for suspension of the Contractor's operations.
- f. The Consultant shall routinely monitor the Contractor's personnel concerning unsafe working practices. When such actions are observed, the Consultant shall promptly inform the Contractor of those practices. Continuance of unsafe practices by the Contractor's personnel will be sufficient justification for the Consultant to suspend the Contractor's operations.

(5) Soil Testing

- a. Soil tests performed during the Inspection Stage shall be conducted in accordance with Provisions VII(3)a. through c.
- b. The Administrator may authorize the Consultant to perform soil tests during blast cleaning operations if excessive waste discharge is observed at the job site.



c. Within 7 calendar days after blast cleaning operations are terminated, the Consultant shall conduct final tests of samples taken from the same general sites ~~sampled for Provision VII(3)a.~~

d. Within 14 calendar days of receiving test results for the final samples, the Consultant shall provide the Administrator with a written report containing the preliminary and final soil test results. In that report, the Consultant shall indicate whether the mean value of the lead content in the soil for the final tests was greater than the mean value of the preliminary tests plus 2 standard deviations. If that is the case, the Consultant shall state whether the increase is attributable to acts of the Contractor. That assertion will be based upon: 1) a review of the Consultant's diaries, 2) air monitoring test results, and 3) other pertinent information available.

e. The Administrator may direct the Contractor to perform hazard remediation (waste clean-up) of soil around the bridge. After any hazard remediation work is performed, the Consultant shall perform follow-up soil tests of those areas as specified by the Administrator. The Consultant shall determine whether the remediation work is acceptable based on Section 727.19(3) of Special Provision 89(91).

f. The Consultant shall furnish the Administrator with a written report on follow-up tests within 14 calendar days of taking field samples.

(6) Environmental Monitoring of Contractor Operations at the Job Site

a. The Consultant shall monitor air quality on the job site, in the environs, and in the containment enclosure measuring total lead-in-air.

b. Air quality tests performed during the Inspection Stage shall be conducted in accordance with Provisions VII(4)a. through c. The Consultant shall obtain the test results and verbally transmit them to the Contractor within 24 hours of the completion of field sampling.

c. The Consultant shall operate the air samplers during work days while blast cleaning operations are in progress. The Consultant shall take air-quality measurements on a daily (8-hour) basis at the job site and in the containment enclosure. Air quality monitoring downwind and at other critical locations in the environs shall be conducted on a 40-hour work week basis or longer if blast cleaning operations exceed 40 hours.

d. The Consultant shall promptly notify the Administrator and Contractor if test results for airborne lead particles exceed permissible limits as provided in Sections 727.20(2) and 727.20(5)c. of Special Provision 89(91). The Contractor is to promptly determine the cause of such test results and apply remedial procedures.

e. The Consultant shall monitor: 1) airflow rates (velocities), 2) air densities, and 3) pressure differentials in and about the containment enclosure(s). The Consultant shall conduct performance tests on all major ventilation devices such as fans and air compressors. Those tests shall be performed prior to the onset of blast cleaning work. Ventilation testing of containment enclosure(s) shall be performed daily prior to blast cleaning operations. Additional tests shall be

performed after major changes are made to the containment enclosure(s). The Consultant shall promptly notify the Administrator and Contractor of non-conformance with Special Provision 89(91). ~~The Consultant shall conduct the necessary tests upon subsequent ventilation system modifications by the Contractor.~~

f. The Consultant shall inspect: 1) the Contractor's containment enclosure(s), 2) ventilation system(s), 3) material handling system(s), 4) dust collection system(s), and 5) abrasive recycling systems daily or after a containment enclosure is re-staged to verify that all systems are properly in place and operational. The Consultant shall notify the Contractor of any deficiencies in those systems and shall re-inspect them after modification to confirm that any problems are remedied.

g. The Consultant shall maintain a daily diary recording the following items:

1. All information in the Department's standard project diary,
2. Locations of air-monitoring equipment,
3. Samples taken,
4. Tests performed or results received (and analyses of same),
5. Actions taken (if any),
6. Waste disposal activities, and
7. Problems encountered (if any).

h. The Consultant shall maintain logs of all test results related to hazardous waste activities.

i. The Consultant shall provide the Administrator and Contractor with written summaries of test results on a weekly basis.

(7) Waste Analyses

a. The Consultant shall perform sampling of waste paint debris during the initial portion (first 20 percent) of the blast cleaning operations. All samples of waste paint debris shall be obtained from material that has been placed in waste storage containers after abrasive recycling operations. At a minimum, the Consultant shall obtain four samples, each weighing 3 lbs. The samples shall be packaged for over-night shipping to the Laboratory. Each sample container shall be marked to identify the waste storage container from which the sample was taken, when the sample was obtained, and the general bridge location from which the waste paint debris was generated. Regardless of test results from the initial portion of the blast cleaning operations, a minimum of one sample shall be taken of waste paint debris from each additional 20 percent increment of blast cleaning work. Samples shall also be taken of miscellaneous wastes such as filters and clothing that are considered to be contaminated with waste paint debris. Additional samples of the waste paint debris and other potentially hazardous wastes shall be furnished to the Waste Contractor.

b. The Laboratory shall perform one TCLP test for each of the four initial waste paint debris samples furnished by the Consultant. For those samples, the

Laboratory shall test for the 8 heavy metals listed as EP-toxic by the USEPA (i.e. arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver). ~~Samples of other wastes or additional waste paint samples furnished by the Consultant shall be tested only for lead (and chromium if previous TCLP test values exceed 5 mg/l). The Consultant shall require the Laboratory to provide certified test results to the Consultant within 3 calendar days of the receipt of those specimens.~~

c. The Consultant shall analyze the TCLP test results and determine whether the waste paint debris, other site-generated wastes, and recycled abrasives are to be transported and disposed of as hazardous wastes (i.e. the lead content in the TCLP leachate of the waste paint debris exceeds 5 mg/l). The Consultant shall notify the Administrator within 14 calendar days of initial sampling whether the wastes are to be considered hazardous. Within 30 calendar days of receipt of that notification, the Department will provide the Consultant with a hazardous waste identification number for the job site.

d. If TCLP results from waste paint debris vary considerably, EPA regulations may require additional sampling and TCLP testing<sup>1</sup>. The Consultant shall be reimbursed on a unit cost basis for TCLP sampling and testing requirements due to variability of results that exceed those specified in VIII(7)a and b.

e. Within 14 calendar days of the onset of waste paint debris storage, the Consultant shall obtain the Waste Contractor's mandatory sampling and testing requirements. The Consultant shall furnish the Waste Contractor with the necessary samples (or test results) within 30 calendar days of the deadline for transporting temporarily stored wastes from the job site. The Waste Contractor may elect to accept the TCLP test results provided by the Consultant. The Consultant shall be reimbursed on a unit cost basis for TCLP sampling and/or testing requirements of the Waste Contractor that exceed those specified in Provisions VIII(7)a and b.

## (8) Water Quality Testing

a. When directed by the Administrator, the Consultant shall perform water quality tests at over-stream bridges. The Consultant may be directed to perform random water sampling under the structure during both blast cleaning and zinc painting operations. The sampling frequency shall be established by the Administrator. Water samples shall be tested for total recoverable lead (ppb) or zinc (ppb) in accordance with 40 CFR 136 *Guidelines Establishing Test Procedures for the Analysis of Pollutants* to be compared with the appropriate standard in 401 KAR 5:031 *Surface Water Standards*.

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<sup>1</sup> To determine the number of TCLP tests required due to variation in test results, refer to the article, "The Criticality of Sampling and Quality Control for Hazardous Waste Testing," by G. Tinklenberg and L. Smith in the April 1990 issue of the *Journal of Protective Coatings and Linings*.

b. If the Consultant observes large-scale, continuous waste discharge into the water as a result of the Contractor's blast cleaning operations, the Consultant shall promptly notify the Contractor and immediately thereafter sample and test water at the location of discharge. Within 5 calendar days, the Consultant shall notify the Administrator and Contractor in writing of the test results.

(9) Additional or Special Tests - The Department may have the Consultant perform additional or special tests as deemed necessary. If additional tests are required, the Department will reimburse the Consultant based on unit prices in accordance with the terms and conditions previously agreed.

(10) Abrasive and Recycling System Testing

a. The Consultant shall inspect the abrasive used by the Contractor to confirm it is of the low-dusting, non-siliceous type. The Consultant shall review analyses of any non-metallic abrasive provided by the abrasive supplier to verify that the abrasive is compatible with the TCLP test.

b. If the Contractor employs previously recycled abrasive, the Consultant shall perform four TCLP tests (for lead only) on the abrasive at the expense of the Contractor. If the used abrasive tests hazardous, it will be rejected. At the end of the project, the Consultant shall perform four TCLP tests (for lead only) on the remaining abrasive used on the project. If the remaining abrasive is determined to be hazardous, it shall be cleaned to a non-hazardous level as indicated by TCLP testing prior to its removal from the job site by the Contractor. Otherwise, it must be disposed as a hazardous waste.

c. All abrasives, new or used, shall be checked for oil contamination before use. A small sample of abrasive shall be added to ordinary tap water. Any detection of an oil film on the surface of the water shall be cause for rejection. This test shall be conducted on each lot of abrasives delivered to the job site.

d. The Consultant shall daily sample the recycled abrasives and conduct tests to ensure that 99 percent, by weight, will not pass a 70 mesh screen. If that limit is exceeded, the Consultant shall require the Contractor to modify the recycling system operation to clean the recycled abrasive above that level.

e. If the Contractor employs a non-metallic abrasive, the Consultant shall monitor the recycling performance to ensure that the abrasive is recycled at least 30 times on average at the Contractor's standard blast pressure. Abrasives that do not meet that criteria shall be prohibited from further use at the job site.

(11) Waste Handling, Storage, and Disposal

a. The Department is considered the Generator of any hazardous wastes created as a direct result of the Contractor's blast cleaning and painting operations on the project. The Consultant shall act as the Department's on-site representative and shall manage all waste-related operations. The Consultant shall have signatory authority for all hazardous waste documentation that must be prepared at the job site.

b. The Consultant shall monitor the Contractor's handling, containerizing, and temporary on-site storage of all waste debris generated during blast cleaning and painting operations at the job site. ~~The Consultant shall confirm that all waste debris generated is collected daily and containerized before the Contractor's personnel leaves the job site.~~

c. The Consultant shall conduct a preliminary inspection of the waste storage area to determine whether it meets requirements.

d. The Consultant shall inspect the waste storage site at the end of each work day to verify that the waste storage containers are properly stored. The containers should have their lids sealed. The containers should have no signs of corrosion or spillage. The containers should be resting on pallets or dunnage. If the site is also used for equipment storage, the Consultant shall verify that all waste storage containers are in an assigned area within the secured site and are surrounded by a temporary fence. After completing a daily inspection, the Consultant shall verify that the entrance is locked.

(12) Ordering Waste Storage Containers

a. The Consultant shall review the terms of the Waste Contractor's price contract with the Department for hazardous waste disposal. During their joint meeting, the Consultant and Contractor shall estimate time frames for various phases of the project. The Consultant shall contact the Waste Contractor and order the delivery of sufficient containers to accommodate all waste debris that the Contractor will generate in a minimum of 7 days of blast cleaning. As a preliminary estimate, waste paint debris from 55 square feet of blast cleaning can be considered to have a volume of one gallon (0.13 cubic feet).

b. The Consultant should attempt to order the most cost-effective waste containers in keeping with NREPC temporary waste storage regulations for hazardous wastes and the anticipated rate of generation of wastes by the Contractor. A variety of containers (i.e. roll-offs, drums, and/or labpacks) shall be ordered to minimize shipment of partially filled containers. If the waste storage site is not readily accessible by vehicles or hand dollies, 30-gallon drums shall be employed.

c. At the end of each workday, the Consultant shall inventory the filled and empty waste storage containers. The Consultant shall be in contact with the Contractor on a continuous basis to monitor the need for additional waste storage containers. Based on the inventories and the estimated time frame for blast cleaning work, the Consultant shall place timely orders for additional containers with the Waste Contractor. In addition, the Consultant shall notify the Waste Contractor in writing of the need to transport filled waste storage containers for treatment and/or disposal within 14 calendar days of the 90-calendar day temporary storage limit.

(13) Waste Containerization/Labelling

a. ~~The Consultant shall monitor the Contractor's handling and storage of all~~ wastes generated at the job site. The Consultant shall verify the Contractor's compliance with the applicable provisions in Sections 727.20 and 727.22 of Special Provision 89(91). The Consultant shall promptly notify the Administrator of any problems related to waste handling or disposal.

b. Waste paint debris and debris from other sources such as disposable clothes or dust collector discharge shall be stored in separate waste storage containers. The Consultant shall ensure that the Contractor's personnel completely fill each waste storage container before using additional containers to store the same waste material.

c. The Consultant shall apply suitable labels and markings on each of the waste storage containers in accordance with 401 KAR 32.030 Section 2 *Labeling* and 401 KAR 32.030 Section 3 *Marking*. Each container shall be labelled with a discrete identification number. Samples taken by the Consultant for hazardous waste testing shall be keyed to those container identification numbers. The Consultant shall determine the weights of all containerized hazardous wastes. The Consultant may perform bulk density tests on the waste paint debris to provide a basis for weight estimates of filled waste storage containers.

d. The Consultant shall monitor the Contractor's disposal of wastes. The Contractor shall dispose only waste materials generated during the project (i.e. any lead-contaminated wastes) in waste storage containers furnished by the Department. The Contractor must arrange separately for disposal of all wastes generated from the routine operation of equipment (e.g. waste oil, spent cleaning solvents, brushes, etc.). The Contractor will not be permitted to incinerate, bury, dump into a stream, or abandon any wastes at the job site.

(14) Waste Collection and Transportation

a. The Consultant shall notify the Contractor when the Waste Contractor will arrive at the job site to remove filled waste storage containers.

b. The Consultant shall be present during the time the Waste Contractor is at the job site. The Consultant shall identify the waste storage containers to be transported. The Contractor will not release any filled waste-storage containers from the waste storage site without the Consultant's authorization.

c. Prior to allowing the Waste Contractor to transport the waste storage containers from the job site, the Consultant shall: 1) inspect the Waste Contractor's National Uniform Manifest Forms to verify they are properly prepared and sign them as the Department's representative, 2) retain the originally signed copy of the manifest form, 3) inspect the waste storage containers to verify their lids are sealed, 4) inspect the Waste Contractor's vehicle(s) to verify that they are properly placarded in accordance with 401 KAR 32.030 Section 4 *Placarding*, and 5) oversee the loading and securing of the waste containers on the Waste Contractor's vehicle(s).

(15) Waste Reporting

a. ~~The Consultant shall keep records and prepare reports in accordance with 401 KAR 32.040 *Recordkeeping and reporting* including annual reports in accordance with Section 2 of that regulation entitled *Annual Reporting*.~~

b. The Consultant shall provide the Contractor and the Administrator with weekly reports on stored wastes including: 1) the identification numbers of containers presently in storage; 2) the date that hazardous waste was initially placed in each waste storage container; 3) the type and weight of wastes in each specific container (and TCLP test results); 4) the identification numbers of containers removed by the Waste Contractor; and 5) the estimated number of empty waste storage containers required during the following week.

c. The Consultant must verify that all hazardous wastes have been transported and disposed of properly. If the Consultant does not receive a copy of the manifest with the handwritten signature of the Waste Contractor's treatment or disposal facility within 35 calendar days of the shipment, the Consultant shall contact the Waste Contractor to determine the status of the hazardous waste. The Consultant shall also submit an Exception Report to the NREPC in accordance with 401 KAR 32.040 Section 3 *Exception Reporting*. The Consultant shall provide the Administrator with copies of any Exception Reports.

d. The Consultant's work shall not end until the final disposition of all hazardous wastes have been determined. Within 60 days of the completion of the final shipment of hazardous wastes, the Consultant shall provide the Department with written notification of the final disposition of all wastes generated at the job site.

(16) Completion of Painting Operations Prior to Final Waste Collection - If the Contractor's painting operations are completed prior to final shipment of hazardous wastes, the Contractor will leave the waste storage site intact with all wastes properly containerized and the entrance locked. The Contractor will provide the Administrator with keys to the entrance lock. Once the remaining wastes are shipped, the Consultant shall notify the Contractor to dismantle and remove the storage site enclosure, as required by the contract.

(17) Painting Operations Monitoring and Inspection

a. The Consultant shall monitor and inspect the Contractor's paint operations in accordance with the Department's: 1) *Standard Specifications for Road and Bridge Construction*, Sections 727.01 to 727.15, 2) *Division of Construction Guidance Manual*, Chapter 63-08 (Structures), Sections 63-08.1400 to 63-08.1470, 3) *Division of Materials Guidance Manual*, Chapter 64-02 (General Information) Section 64-02.0200, 4) the Department's *Sampling Manual*, and 5) as provided herein. The Consultant shall reject all work that is unacceptable under these specifications. The Department will monitor the Consultant's and Contractor's work for compliance with control requirements. The Department will issue a final inspection report.

b. The Consultant shall furnish and employ the following items to inspect the Contractor's work:

1. One Polaroid camera with a flash attachment and color film.
2. One spring micrometer and replica tape.
3. One nondestructive dry film thickness gage, preferably *Positector 2000*, and calibrated plates per NIST calibration in accordance with ASTM D-1186.
4. One sling psychrometer including U.S. Weather Bureau psychrometric Tables.
5. Two steel surface thermometers.
6. Flashlight, 2-D cell type.
7. SSPC *Visual Standard for Abrasive Blast Cleaned Steel SSPC-Vis 1-89*<sup>2</sup>.
8. One *Tooke* Scratch Gage.
9. Kentucky Transportation Cabinet forms TC 63-14 "Daily Inspectors Report for Bridge Painting" and TC 63-28, "Daily Inspector's Report."

c. The Consultant shall inspect all materials and containers furnished by the Contractor to verify conformance to the Department's Standard Specifications. Any materials rejected shall be removed from the job site before the work is begun.

d. The Consultant shall inspect all blast cleaning and painting equipment utilized by the Contractor to verify conformance to the Department's Standard Specifications and Guidance Manuals. The Consultant shall collect and forward to the Department's Central Laboratory all material samples, certifications, or similar items required by the specifications or various manuals. The Consultant shall observe daily blotter tests conducted by the Contractor on every compressor prior to the start of work.

e. The Consultant shall perform inspections of the Contractor's operations at specific Quality Control Points. Quality Control Points are progress milestones that occur when one phase of work is complete and ready for inspection prior to continuing with the next operational step. At those points, the Contractor will provide access to inspect all surfaces. If inspection indicates a deficiency, that

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<sup>2</sup> This document may be purchased from the Steel Structures Painting Council, 4400 Fifth Avenue, Pittsburgh, PA 15213.



phase of the work shall be corrected prior to beginning the next phase of work. Quality Control Points are as follows:

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Quality Control Point Inspection Function

1. Abrasive blasting - Visually inspect to insure proper cleanliness and test to ensure correct surface profile
2. Prime coat - Check dry film thickness application.
3. Intermediate coat - Check dry film thickness application.
4. Finish coat - Check dry film thickness application.

f. At each Quality Control Point, the Consultant shall perform the appropriate inspections or tests. Surface profile monitoring shall be performed using replica tape and a spring micrometer in accordance with ASTM D-4417. Dry film thickness tests shall be performed for each coat and cumulatively using a nondestructive dry film thickness gage in accordance with ASTM D-1400 or the Tooke Scratch Gage in accordance with ASTM D-1438. The test frequency for each of those measurements shall be as follows: Five separate spot measurements shall be conducted spaced evenly over each 100-square foot area to be measured. Those measurements shall be taken on flanges, webs, cross bracing, stiffeners, etc. Three spot readings shall be taken for each measurement of either the substrate or the paint. The readings shall be taken about 6 inches apart. Unusually high or low readings that cannot be repeated consistently shall be discarded. The average (mean) of the three readings shall be recorded as the spot measurement. The average of the 5 spot measurements for each 100-square foot area shall not exceed the limits in the Department's Standard Specifications or the manufacturer's data sheets. No single spot measurement for surface profile dry film thickness in any 100-square foot area shall exceed the specified limits. Any one of the three readings which are averaged to produce each spot measurement, may deviate from the specified limits by 20 percent.

g. The five spot measurements of the 100-square foot area shall be made as follows:

1. For structures not exceeding 300 square feet in area, each 100- square foot area shall be measured.
2. For structures not exceeding 1,000 square feet in area, three 100- square foot areas shall be randomly selected and measured.
3. For structures exceeding 1,000 square feet in area, for the first 1,000 square feet in area, three 100-square foot areas shall be randomly

selected and measured and for each additional 1,000 square feet, or increment thereof, one 100-square foot area shall be randomly selected and measured.

4. If the spot measurements for any 100-square foot area tested in accordance with Provisions VIII(17)g.2. and VIII(17)g.3. are not in compliance with Provision VIII(17)f., then each 100-square foot area shall be measured.
5. The Department may specify other area sizes or numbers of spot measurements as deemed appropriate for the size and shape of the structure to be measured.

h. If the spot measurements specified in Provisions VIII(17)g.1 to 5 are outside the specified limits, the Consultant shall advise the Contractor that the designated spot measurement area(s) must be reworked. The Consultant shall determine what steps are required and promptly notify the Administrator and Contractor in writing.

i. The Consultant shall keep daily records of all field paint-related activities by preparing the Transportation Cabinet forms TC 63-14 and TC 63-28 (See Provision VIII(17)b.).

j. The Consultant shall *not* interfere with the Contractor's handling of paint damage claims by the public. However, if the Consultant considers the Contractor's precautions to prevent such damage to be inadequate, the Consultant shall promptly notify the Administrator and Contractor in writing.

(18) Job Site Documentation and Record Keeping

a. The Consultant shall maintain files of all pertinent documents at the job site during the Consultant's normal daytime working hours. Those documents shall include: 1) employee medical surveillance records, 2) employee training records, 3) employee time sheets, 4) the Environmental Monitoring Plan, 5) the Contractor's Contingency and Personnel Training Plans, 6) test results and waste analyses, 7) hazardous waste manifests (both the originally signed copies and copies returned from the waste treatment and/or disposal facility), 8) written communications including weekly reports, 9) daily information including diaries of project activities, Department report forms, and logs of measurements, 10) photographs, 11) applicable Department specifications and contract-related documents, and 12) local, state, and federal environmental and worker-safety regulations.

b. The Consultant shall photograph the bridge(s) and environs prior to the initiation of the Contractor's work. As Contractor's work progresses, the Consultant shall photograph: 1) typical stagings of the containment enclosure(s), 2) the material handling equipment, 3) the abrasive recycling equipment, 4) the environmental monitoring equipment, 5) tests being performed on the Contractor's ventilation equipment, 6) the hazardous waste storage site, and 7) the Contractor's

arrangement of equipment about the job site. The Consultant shall also photograph any visible problems. All photographs shall be marked as to the ~~subject matter and date of exposure.~~ The Consultant shall retain the photographs taken on the job site and thereafter, either incorporate them in the Environmental Monitoring/Hazardous Waste Report or provide them mounted on photopages in loose-leaf binders to the Department at the Project Review Meeting [See Provision X(1)].

(19) Payment of Contractor - The Consultant shall monitor the Contractor's work related to environmental controls and painting operations in accordance with Section 727.24 of Special Provision 89(91). The Consultant shall notify the Administrator of Contractor progress milestones for partial payment.

(20) Termination of Job Site Work

a. The Consultant shall notify the Administrator when the Contractor has completed painting and clean-up operations satisfactorily. The Administrator will inspect the project to ascertain whether the Contractor's work is complete. The Administrator will inform the Contractor if additional work is required.

b. If the Waste Contractor cannot transport the stored wastes when the Contractor terminates work at the job site, the Consultant shall assign a caretaker to inspect the waste storage site daily and to be present to process the final hazardous waste shipment. Once all hazardous wastes have been shipped, the Consultant shall lock the entrance and terminate work at the job site. The Consultant shall notify the Administrator in writing concerning termination of work at the job site.

c. If the Contractor has completed painting and clean-up operations, but environmental clean-up or other hazard remediation work appear necessary, the Consultant shall provide written notification to the Administrator. The Administrator will determine whether additional Consultant work is necessary. The Administrator may allow the Contractor to terminate work at the job site and retain the Consultant on a unit-cost basis (Provision II(3)a. through c. contract options). The Administrator will notify the Consultant of the scope of the additional work and the Department's reimbursement for that work based on the agreed upon unit prices.

## **Provision IX**

### **Consultant's Personnel**

(1) Personnel Qualifications - The Consultant's personnel shall have at least one year's experience in their assigned duties and shall be capable of operating the applicable equipment and instruments. The Consultant's personnel must be familiar with State hazardous waste and worker safety regulations.

(2) Project Supervision - The Consultant shall have a Project Supervisor at the job site during the Contractor's normal daytime working hours. The Project Supervisor shall be ~~the Consultant's official field contact with the Administrator and Contractor.~~ The Project Supervisor shall maintain all pertinent documents and records at the job site during working hours. He shall be thoroughly familiar with: 1) all relevant specifications and regulations, 2) the Contingency Plan, 3) the Personnel Training Plan, and 4) the Containment Enclosure Plans. In the event of a major hazardous waste emergency (e.g. a fire in the waste storage site), the Project Supervisor shall be present at the job site until the problem has been satisfactorily resolved. He shall monitor the Contractor's actions to verify compliance with the Contingency Plan. In addition to field administration and supervision, the Project Supervisor may perform routine environmental monitoring and paint inspection duties.

### **Provision X**

#### **Environmental Monitoring/Hazardous Waste Presentation and Report**

(1) Deliverables - Within 30 calendar days after official termination of the job site work, the Consultant shall make a presentation and provide a preliminary draft Environmental Monitoring/Hazardous Waste Report to the Department at the Project Review Meeting. If several bridges were inspected under the same contract, separate reports shall be provided within 30 days of termination of work at each site. At that meeting, the Consultant shall submit all project-related documents to the Department.

(2) Environmental Monitoring/Hazardous Waste Presentation - The Consultant's presentation shall concern the progress of work, monitoring of blast cleaning operations, test results and waste analyses, on-site waste handling and storage, waste transportation and disposal, and any problems that occurred including their resolution.

(3) Final Report Preparation - The final approved Environmental Monitoring/Hazardous Waste Report(s) shall be presented in an 8-1/2" x 11" bound document, with fold out sheets being permitted. The Consultant shall submit a preliminary draft of the report for initial review, a revised draft after receiving the Department's comments, and a final report upon receiving Department approval. The quantities of each of these reports shall be as follows:

- 3 copies of the preliminary draft;
- 1 copy of the revised draft; and,
- 3 copies of the final report.

If the subject bridge is jointly maintained with another state, then 6 copies of the final report are required. The cover of each report shall be appropriately stamped Preliminary Draft, Revised Draft, or Final Report. The final report shall include: 1) color photographs, 2) drawings, 3) sketches, and 4) narratives that describe the Consultant's work and events at the job site. The preliminary and revised drafts may use photocopies of the photographs. Color photocopies may be used for the final report. One copy of the

final report shall be submitted in a loose leaf binder to make it easier to remove and copy individual sheets. The material shall be formatted for presentation as follows:

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1. Cover shall show:
  - a. Title
  - b. Bridge, route and location
  - c. County
  - d. Bridge project numbers
  - e. Date of report (month and year final report submitted)
  - f. Name of contracting agency
  - g. Name of consultant
2. Title sheet containing the same information as cover, plus signature and title of the Consultant's Project Leader.
3. Table of contents.
4. Location map(s) with bridge project numbers.
5. Introduction, brief description of the structure and its environs, narrative with overall site pictures.
6. Narrative of the Contractor's blast cleaning operations including details of:
  - 1) containment enclosure design and staging,
  - 2) material handling, and
  - 3) abrasive recycling.
7. Review of the Air Monitoring Plan including brief summary of the test results.
8. Hazardous waste analyses, on-site waste handling and storage, waste transportation, waste treatment and/or disposal.
9. Environmental problems encountered with the Contractor's operations and their resolution.
10. Conclusions and Recommendations for conducting future environmental monitoring of blast cleaning operations on steel bridges involving lead-based paints.
11. Appendices
  - a. Description of field sampling including purpose, location, sampling procedures and sample numbers,
  - b. Copies of Laboratory certified test results,
  - c. Containment enclosure test procedures and results,
  - d. Plans (elevations, stream profiles, typical section and plan views),

- e. Copies of hazardous waste records and reports.

### **Provision XI**

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**Payment** - The Department shall make partial payments as the work progresses in accordance with the general provisions of Article X of the *Transportation Cabinet's Professional Services Procurement Manual*.

### **Provision XII**

#### **Submission of Hours and Costs**

(1) **Standard Procedures** - The submission of hours and costs shall conform to the Department of Highways forms and procedures, and to those procedures outlined herein. The fee proposal submittal must identify the firm's: 1) person-hour requirements to perform the environmental monitoring and paint inspection, 2) costs of testing, and 3) other direct costs. The person-hours shall be estimated for the following categories of work:

1. Person-hours to mobilize;
2. Person-hours to perform environmental monitoring and paint inspection;
3. Person-hours to prepare report; and
4. Person-hours for attending meetings.

(2) **Provisions for Temporary Suspension of Work** - If the Consultant's operations are temporarily suspended due to the Contractor's violations of environmental or worker health regulations, the Consultant shall be reimbursed for personnel and equipment on the job site at a pre-negotiated rate for short-term demobilization.

(3) **Laboratory Test Costs** - Laboratory test costs shall be reimbursed to the Consultant on a per-test basis once the Consultant provides written notification to the Administrator that certified test results have been received and are satisfactory. If an extensive series of similar tests are to be performed by the same laboratory, the Department will reimburse the Consultant on a lump-sum basis once the Consultant provides written notification that all scheduled test results have been received and are satisfactory.