ITEM 514 PAINTING OF STRUCTURAL STEEL

514.01 Description. This work consists of cleaning and painting all steel surfaces.

514.02 Materials. On existing steel, apply a three-coat paint system consisting of an organic zinc prime coat, an epoxy intermediate coat, and a urethane finish coat. The coating system shall conform to 708.02.

On new steel, apply a three-coat paint system consisting of an inorganic zinc prime coat, an epoxy intermediate coat, and a urethane finish coat. The prime coat shall conform to 708.01, and the intermediate and finish coats shall conform to 708.02. Supply the intermediate and finish coats from the same manufacturer. The Contractor may supply the prime coat from a manufacturer other than the manufacturer of the intermediate and finish coats.

For caulking, use a single pack moisture cured polyurethane based material, which will not shrink or sag, capable of filling voids greater than 1/8 inch (3mm) and up to 1 inch (25 mm) wide. Only material that is listed on ODOT's Qualified Product List website may be used.

514.03 Superintendent. In addition to the requirements of 105.06, the Superintendent must successfully complete a Bridge Painting pre-qualification course and training offered by ODOT. The course must have been completed within the past four years and an individual course certificate must have been received by the Superintendent. Present certificate to the Engineer prior to commencing work. No work is permitted unless the Superintendent provides a valid course certificate.

514.04 Quality Control. Quality control consists of designating quality control specialists to control the quality of work in each phase established by Quality Control Points (QCPs). Control quality by inspection, tests, and cooperation with inspection and testing performed by the Engineer and Inspector.

A. Quality Control Specialist. Identify the individuals dedicated to performing duties as the painting quality control specialists before starting work in the field. Provide a quality control specialist for each structure, but one quality control specialist must be provided for every three structures for which work is progressing concurrently on this contract.

Each quality control specialist must be either a NACE (National Association of Corrosion Engineers)certified coating inspector or a SSPC (The Society for Protective Coatings, SSPC) protective coating specialist or formally trained or retrained by a NACE certified coating inspector or a SSPC protective coating specialist. The training shall be adequate to ensure that the quality control specialist is able to use all the testing equipment and understands the requirements of this specification. Provide a copy of the NACE or SSPC certification or a copy of the trainer's NACE or SSPC certification and a letter or certificate signed and dated by the trainer to the Engineer. Ensure that the NACE or SSPC certification is current or retrain the quality control specialist every five years in accordance with the above requirements.

The quality control specialist must successfully complete a Bridge Painting prequalification course offered by ODOT. The training course must have been completed within the past four years and an individual course certificate must have been received by the quality control specialist.

Select only a quality control specialist who is approved by ODOT. ODOT's Engineer will publish a list of approved Quality Control Specialists. Present all required certificates, letters of certification, and valid identification to the Engineer prior to commencing work.

The Engineer will immediately remove the quality control specialist from the work and will disqualify this individual from future work if any quality control failure occurs. A quality control failure is defined as any of the following:

1. The dry film thickness has been approved by the quality control specialist and it is later found that over 20 percent of the spot measurements of any one member of a structure, such as a cross frame, web, flange, stiffener, or other parts of the structure are either under the minimum or over the maximum spot thickness.

2. The dry film thickness has been approved by the quality control specialist and it is later found that the thicknesses of any area of a structure as described in 514.20 are either under the minimum or over the maximum specification thickness.

3. Two separate occurrences when the surface preparation has been approved by the quality control specialist of any one member type, such as the cross frames, webs, flanges, stiffeners, or other parts of the structure and it is later found that the surfaces of those members were either not properly profiled or not properly cleaned as required by the Contract Documents. Occurrences are determined per structure.

4. Two separate occurrences of the quality control specialist performing production duties not allowed by the Contract Documents. Occurrences are determined per structure.

5. Two separate occurrences when the quality control specialist fails to perform any one of the duties assigned to the quality control specialist in the Contract Documents. Occurrences are determined per structure.

Suspend work if the quality control specialist is not available or has been removed. The Engineer or Inspector will immediately provide written notification to the Engineer of any quality control failure identified above. Resume work when a quality control specialist, qualified and approved as provided in 514.04, is available.

For work in the fabrication shop, each fabricator shall identify one or more full-time individuals who shall perform the duties of the painting quality control specialist.

The quality control specialist may not be used to perform production duties including supervision, blasting, painting, waste disposal, mixing, operating or repairing equipment, or other tasks not associated with duties of the quality control specialist while the Contractor is performing work toward the completion of a Quality Control Point (QCP).

Ensure that each quality control specialist is trained and equipped with Material Safety Data Sheets (MSDS), product data sheets, tools, and equipment necessary to provide quality control on all aspects of the work. Each quality control specialist shall have a thorough understanding of the plans for the work, including any pertinent addenda, change order, or other contract documents, and these Specifications. Duties each quality control specialist shall perform include:

1. Inspect equipment and abrasive at specified intervals.

2. Approve the work and provide documentation that the work has been approved immediately before each QCP.

3. Inspect the work with the Engineer or Inspector at each QCP.

4. Verify the Contractor or fabricator performed work according to the Contract Documents.

5. Cooperate with the inspection and testing performed by the Engineer and inspector.

6. Document test results and compare test results with the Engineer’s and inspector’s test results.

7. Notify Superintendent of nonconforming work.

8. Stop work when test equipment is not available and when necessary to ensure the work is performed according to the Contract.

The fabricator’s quality control specialists shall provide the Engineer with a letter that includes specified information or check point data documenting acceptance of the work and consisting of the following:

1. Checks on the abrasive to ensure that it has not been contaminated with oil.

2. The profile of the blasted surface.

3. The air and steel temperature and dew point before blast cleaning and painting and at 4-hour intervals during the blasting and painting operation.

4. Readings of the actual dry film thickness.

5. The lot and stock number of the paint and the date of manufacture.

6. Documentation that the paint mixer is functioning properly, that each spray operator has demonstrated the ability to paint, and that all spray equipment is used as per the manufacturer's recommendation.

B. Quality Control Points (QCP). QCPs are points in time when one phase of the work is complete and approved by the quality control specialist and ready for inspection by the Engineer or the inspector before commencing the next phase of the work. At a QCP, the quality control specialist shall provide quality control tests bearing his signature to the Engineer or Inspector. The Contractor or fabricator shall provide the Engineer and inspectors access to inspect all affected surfaces. If inspection identifies a deficiency, correct the deficiency according to the Contract Documents before starting the next phase of work. Discovery of defective work or material after a Quality Control Point is past or failure of the final product before final acceptance, shall not, in any way, prevent the City from rejecting the final product or obligate the City to final acceptance. **The Engineer will determine final acceptance according to 514.21, Final Inspection.**

Quality Control Points	Purpose	New Steel	Existing Steel
1. Solvent Cleaning	Remove asphalt cement, oil, grease, etc.	Yes	Yes
2. Grinding Flange Edges	Remove sharp corners	Yes	Yes
3. Abrasive Blasting	Blast surfaces to receive paint	Yes	Yes
4. Containment/Waste Disposal	Contain, collect, & dispose of abrasive blasting debris	No	Yes
5. Prime Coat Application	Check surface cleanliness, apply prime coat, check coating thickness	Yes	Yes
6. Remove Fins, Tears, & Slivers	Remove surface defects and slivers	Yes	Yes
7. Washing of Shop Primer	Remove all water soluble materials (salt, dirt, etc.)	Yes	No
8. Intermediate Coat Application	Check surface cleanliness, apply intermediate coat, check coating thickness	Yes	Yes
9. Caulking	Caulk areas not sealed by the intermediate coat	Yes	Yes
10. Finish Coat Application	Check surface cleanliness, apply intermediate coat, check coating thickness	Yes	Yes
11. Final Review	Acceptance and check total system thickness	Yes	Yes

514.05 Testing Equipment. For the project duration, provide the Engineer or inspectors with the test equipment listed below for the type of work at each work site

with ongoing work. With the exception of the recording thermometer, the fabricator shall provide its quality control specialists with the test equipment listed below. The Contractor and fabricator shall maintain all testing equipment in good working order, and provide documentation or certification of calibration from the manufacturer. When no test equipment is available, no work shall be performed.

A. Film and a camera with the following features:

1. Uses self developing color print film.
2. Lens with auto focus system.
3. Focuses from 2 feet (0.6 m) to infinity.
4. Built-in fill flash.

Or provide a digital camera with the following features:

1. 5.0 Megapixel or greater resolution.
2. Minimum 3X Optical zoom lens capability with automatic focus.
3. Minimum 512M Memory capability.
4. Built-in flash.
5. Photograph printer with docking capability compatible with the camera including supplies necessary to print. (i.e. Ink Cartridges, Photograph quality paper, and other consumables required for operation and photograph printing.)

B. One Spring micrometer and extra-coarse replica tape on the project at all times.

C. One SSPC-PA2 Type 2 (electronic) non-destructive coating thickness gage and two sets of National Institute of Standards & Technology calibration plates. The first set of calibration plates shall be 1.5 to 8 mils (38 to 200 μm), Model No. 1362b, and the second set shall be 10 to 25 mils (250 to 625 μm) , Model No. 1363b.

D. One Sling Psychrometer including Psychometric tables, (or comparable electronic or digital equipment for the measurement of dew point, accurate within 2 °F (1 °C) and within 1% relative humidity).

E. Two steel surface thermometers accurate within 2 °F (1 °C).

F. Flashlight 2-D cell.

G. SSPC Visual Standard for Abrasive Blast Cleaned Steel (SSPC-VIS 1).

H. One recording thermometer capable of recording the date, time, and temperature over a period of at least 12 hours.

514.06 Work Limitations. Apply the prime coat to new structural steel inside permanent buildings at the fabricator's facility. If inside permanent buildings, the fabricator may perform year-round abrasive blasting and painting. Perform abrasive blasting and painting in the field from April 1 to October 31. The City will not issue a time extension due to adverse weather during the month of April. The plans or other Contract Documents may require additional work limitations for specific bridges or projects.

A. Temperature. Except for inorganic zinc, apply paint when the steel, air, and paint temperature is 50 °F (10 °C) or higher and expected to remain higher than 50 °F (10°C) for the cure times listed below. Apply inorganic zinc when the steel, air, and paint is 40 °F (4 °C) or higher. Cure inorganic zinc according to the minimum curing time and temperatures specified in the paint manufacture's printed instructions.

	50 °F (10 °C)	**60 °F (16 °C)**	**70 °F (21 °C)**
Primer (Organic Zinc)	4 hrs	3 hrs	2 hrs
Intermediate	6 hrs	5 hrs	4 hrs
Finish	8 hrs	6 hrs	4 hrs

Monitor the temperatures listed above for cure times using the recording thermometer. The Contractor may use a heated enclosure or building. Supply heat continuously and uniformly to maintain the required minimum curing temperature within the enclosure or building until the coating has cured.

If combustion type heating units are used, vent the units away from the enclosure or building and do not allow exhaust fumes to enter the enclosure or building. Do not use open combustion in the enclosure or building.

The fabricator may use radiant heat when painting new structural steel inside permanent shop buildings. Locate radiant heaters at least 10 feet (3 m) above all surfaces to be painted. Vent exhaust fumes to prevent fumes from contacting surfaces to be painted.

B. Moisture. Do not apply paint:

1. If the steel surface temperature is less than 5 °F (3 °C) above the dew point.
2. If the steel surface is wet, damp, frosted, or ice-coated.
3. If the relative humidity is greater than 85 percent.
4. During periods of rain, fog, or mist unless the above moisture criteria is met.

If steel was abrasive blasted when the temperature of the steel was less than 5 °F (3 °C) above the dew point, reblast the steel when the steel temperature is at least 5 °F (3 °C) above the dew point.

514.07 Protection of Persons and Property. Collect, remove, and dispose of all rubbish, buckets, rags, or other discarded materials and leave the job site in a clean condition.

Except for deck bottoms and backwalls which have not been sealed or are not to have a sealer applied, protect all portions of the structure, that are not to be painted from damage or disfigurement by splashes, spatters, and smirches of paint.

If the Contractor causes any damage or injury to public or private property, the Contractor shall restore the property, to a condition similar or equal to the condition existing before the damage or injury.

514.08 Pollution Control. Comply with pollution control laws, rules, or regulations of Federal, State, or local agencies and requirements of this specification.

514.09 Safety Requirements and Precautions. Comply with the applicable safety requirements of the Ohio Industrial Commission and OSHA.

Provide Material Safety Data Sheets (MSDS) at the preconstruction meeting for all paints, thinners, and abrasives used on this project. Do not begin work until submitting the MSDS to the Engineer.

514.10 Inspection Access. In addition to the requirements of 105.10, furnish, erect, and move scaffolding and other appropriate equipment to allow the inspector and the Engineer the opportunity to closely observe all affected surfaces during all phases of the work and for at least 10 workdays after completely painting each structure to allow for the Final Inspection as per 514.21. Submit to the Engineer for information, complete details of the inspection access that complies with the applicable safety requirements of The Ohio Industrial Commission and OSHA. The details shall be reviewed, signed, stamped and dated by an Ohio registered Professional Engineer certifying that they meet these requirements. Maintain the in-place inspection access equipment employed during original painting activities or provide alternate inspection equipment such as platform lifts, bucket trucks, snooper trucks, or equivalent as approved by the Engineer. If scaffolding, or any hanger attached to the scaffolding, is supported by horizontal wire ropes, or if scaffolding is directly under the surface to be painted, comply with the following requirements:

A. If scaffolding is suspended 43 inches (1092 mm) or more below the surface to be painted, place two guardrails on all sides of the scaffolding. Place one guardrail at 42 inches (1067 mm) above the scaffolding and the other guardrail at 20 inches (508 mm) above the scaffolding.

B. If scaffolding is suspended at least 21 inches (533 mm) but less than 43 inches (1092 mm) below the surface to be painted, place one guardrail on all sides of the scaffolding at 20 inches (508 mm) above the scaffolding.

C. If 514.10.A and 514.10.B do not apply, place two guardrails on all sides of scaffolding. Place one guardrail at 42 inches (1067 mm) above the scaffolding and the other guardrail at 20 inches (508 mm) above scaffolding.

D. Provide scaffolding at least 24 inches (610 mm) wide if guardrail is used and 28 inches (711 mm) wide if guardrail is not used and scaffolding is suspended less than 21 inches (533 mm) below the surface to be painted. If using two or more parallel scaffolding to achieve the proper width, rigidly attach the scaffolding together to prevent differential movement.

E. Construct guardrail as a substantial barrier, securely fastened in place and free from protruding objects such as nails, screws, and bolts. Provide a properly located opening in the guardrail to allow the Engineer and inspector access onto the scaffolding.

F. Construct guardrails and uprights of metal pipe, steel angles, or wood. If using pipe railing, provide pipe with a nominal diameter of at least 1 ½ inches (38 mm). If using steel angle railing, provide 2 × 2 × 3/8-inch (50 × 50 × 9 mm) steel angles or other metal shapes of equal or greater strength. If using wood railing, provide 2 × 4-inch (50 × 100 mm) nominal stock. Space uprights no more than 8 feet (2.4 m) on center. If using wood uprights, provide 2 × 4-inch (50 × 100 mm) nominal stock.

G. If the surface to be inspected is more than 15 feet (4.57 m) above the ground or water, and the scaffolding is supported from the structure being painted, provide a safety harness (not a safety belt) and lifeline for the Engineer and inspector. The lifeline shall not allow a fall greater than 6 feet (1.8 m). Provide a method to attach the lifeline to the structure that is independent of the scaffolding, cables, and brackets supporting the scaffolding.

H. If scaffolding is more than 2.5 feet (762 mm) above the ground, provide an access ladder and equipment to attach the ladder onto the scaffolding capable of supporting 250 pounds (113 kg) with a safety factor of at least four. uniformly space rungs, steps, cleats, and treads no more than 12 inches (305 mm) on center. Extend at least one side rail at least 36 inches (914 mm) above the landing near the top of the ladder.

I. If the distance from the ladder to the access point on the scaffolding exceeds 12 inches (305 mm), provide an additional landing that is capable of supporting a minimum of 1000 pounds (454 kg) and at least 24 inches (610 mm) wide and 24 inches (610 mm) long. Size and shape the landing so that the distance from the landing to the point where the scaffolding is accessed does not exceed 12 inches (305 mm). Firmly attach the landing to the ladder; however, do not use the ladder to support the landing.

J. In addition to the scaffolding requirements above, comply with all Federal, State, and local laws, ordinances, regulations, orders, and decrees.

K. Furnish all necessary traffic control to allow inspection during and after all phases of the project.

514.11 Job Site Visual Standards. Before starting abrasive blasting, establish job site visual standards by preparing a test section, subsequent test sections, and by using photographs of approved test sections. Use job site visual standards and SSPC-VIS 1 standard for blasting. The Contractor or fabricator shall prepare an approximately 20 to 30-square foot (2 to 3 m2) test section from a representative area on the first structure to be painted. After the Engineer or Inspector and the Contractor or fabricator agree the test area was blast cleaned to the requirements of the Contract Documents, photograph the test section and check the steel surface for the proper profile. After the Engineer or Inspector approves the test section and the job site visual standards are documented by photographs and replica tape, the Contractor or fabricator may start abrasive blasting. The quality control specialists and Engineer or Inspector will use the job site visual standards (photographs), the Plan, Specification and requirements to determine acceptance of blast cleaning procedures. In all cases of dispute, the SSPC-VIS 1 standard shall govern. If the Contractor, Engineer, Inspector, or fabricator believe the initial test section does not establish the proper visual standard for a different structure another test section on the different structure may be performed.

514.12 Quality Control Point Photographic Verification and Documentation. The Engineer or Inspector will take a sufficient number of photographs to document the condition of the work at Quality Control Points 3, 4 and 11.

514.13 Surface Preparation.

A. Solvent Cleaning (QCP #1). Solvent clean by methods described in SSPC-SP 1, areas containing oil, grease, asphalt cement, diesel fuel deposits, other petroleum products and contaminants.

B. Grinding Flange Edges (QCP #2). Before abrasive blasting, round all exposed flange edges of all beams and girders to a radius of 1/8 ± 1/16 inch (3 ± 1.5 mm). This work has no weather and temperature restrictions.

C. Abrasive Blasting (QCP #3). Do not abrasive blast areas that contain asphalt cement, oil, grease, or diesel fuel deposits. Before abrasive blasting, completely remove all dirt, sand, bird nests, bird droppings, and other debris from the scuppers, bulb angles, and pier and abutment seats.

Abrasive blast all steel to be painted according to SSPC-SP 10 and as shown on the pictorial surface preparation standards for painting steel surfaces shown in SSPC-VIS 1. Maintain steel in a blast cleaned condition until it has received a prime coat of paint. The Contractor may commercial blast clean the back side of end cross frame assemblies that are 3 inches (75 mm) or closer to backwalls according to SSPC-SP 6.

Cover and protect galvanized and metalized steel (including corrugated steel bridge flooring), adjacent concrete already or specified to be coated or sealed, and other surfaces not intended to be painted, from damage caused by blasting and painting operations. Repair adjacent coatings damaged during the blasting operation. Backwalls and bottoms of decks not sealed nor specified to be sealed do not need to be covered and protected.

For field blasting, use a recyclable steel grit. For shop blasting, use an abrasive that produces an angular profile. All abrasives shall provide a profile from 1.5 to 3.5 mils (40 to 90 μm) as determined by replica tape according to ASTM D 4417, Method C. Clean the abrasive of paint, chips, rust, mill scale, and other foreign material after each use and before each reuse. Use equipment specifically designed for cleaning the abrasive.

Check abrasives used at the job site or fabrication shop for oil contamination at the beginning of each shift and at 4-hour intervals. Also check each load of abrasive delivered to the job site or fabrication shop for oil contamination before use. Check for oil by placing a small sample of abrasives and tap water into a jar. Reject the abrasive if an oil film is detected on the water surface.

To ensure that the compressed air is not contaminated, the quality control specialists shall blow air from the nozzle for 30 seconds onto a white cloth or blotter held in a rigid frame. If the cloth or blotter retains oil or other contaminants, suspend abrasive blasting until retests verify the problem was corrected. Perform this test at the start of each shift and at 4-hour intervals.

The Contractor may simultaneously abrasive blast and paint the same bridge provided the abrasive blasting debris and dust does not contact freshly painted surfaces and does not contaminate paint during the curing period. For shop blasting, the fabricator may simultaneously abrasive blast and paint if the two operations are separated by distance or containment that prevents paint contamination.

For surface preparation of new structural steel in the fabricator's shop, the quality control specialist shall take replica tape readings as follows:

1. For an automated blasting process, test the greater of 20 percent of the main members or one member per shift. These tests shall consist of taking five random readings per member.

2. For a manual blasting process, test each main member. The test of a main member consists of taking five readings at random locations.

3. For both an automated and manual blasting process, test 15 percent of all secondary members. The test of a secondary member consists of taking one random reading.

Remove abrasives and residue from all surfaces to be painted. Keep all structural steel that was blast cleaned in the field or the fabricator's shop dust free. Apply a prime coat to steel that was blast cleaned in the field within 12 hours of the beginning of the abrasive blasting operation. Apply a prime coat to structural steel that was blast cleaned in the fabricator's shop within 24 hours of the beginning of the abrasive blasting operation. If a prime coat is not applied within the times stated above, reblast the steel before applying the prime coat. Remove all dust or abrasives from adjacent work and from the finish coat.

Provide the Engineer and Inspector with field wash facilities and an adequate supply of running potable water, soap, and towels for washing face and hands during the surface preparation operation. Properly contain, test, and dispose of the wastewater. Locate a wash facility at each bridge site and in an area that will not be contaminated by the blasting debris.

D. Containment/Waste Disposal (QCP #4). Waste material generated by abrasive blasting operations in the field is a solid waste and may be a hazardous waste. Contain, collect, store, evaluate, and properly dispose of the waste material. Comply with all Federal, State, and local environmental protection laws, regulations, and ordinances including, but not limited to, air quality, waste containment, and waste removal. The Contractor is advised that various governmental bodies are involved with solid waste and hazardous waste disposal and the Contractor is responsible for complying with laws enforced by the various governmental bodies.

To prevent contamination of the pavement or soil, park all equipment on ground covers free of cuts, tears, and holes.

Clean equipment of spent abrasives or debris before bringing equipment to the project, moving equipment from one bridge site to another, and removing equipment from the project. Store debris cleaned from equipment with the debris from the structure that generated the debris.

Erect an enclosure to completely surround (around, under and over the top on truss type bridges) the blasting operations. The Contractor may use the ground as the bottom of the enclosure if the ground is completely covered with plastic or tarps.

Construct the enclosure of flexible materials such as tarpaulins (specifically designed for blasting containments), or construct the enclosure of rigid materials such as plywood. Maintain all materials free of tears, cuts, and holes. Overlap all seams a minimum of 6 inches (150 mm) and fasten the seams together at 12-inch (300 mm) centers or in a manner that ensures a seal that does not allow openings between the edges of the containment material. Extend the vertical sides of the enclosure completely up to the bottom of the deck on a steel beam bridge and use bulkheads between beams to enclose the blasting area.

Collect all debris from blasting operations, equipment, or filters, and all debris that fell to the ground. Store the debris in steel containers with lids that are locked at the end of each workday. The storage location shall be at the bridge site unless, the Engineer and Contractor agree on an alternate storage location. Test and evaluate the debris for disposal. The location of centralized cleaning stations for recyclable steel shall also be agreed by the Engineer and the Contractor.

Obtain the services of a testing laboratory to obtain directly from the project site and evaluate a composite representative sample of the abrasive blasting debris for each bridge site. The person taking the sample must be an employee of the testing laboratory.

Take composite sample in the presence of the Engineer or Inspector, comply with the requirements of U.S. EPA Publication SW 846 and take individual samples from all containers that are on the site at the time of the sampling. Blend individual samples of equal size together to comprise one composite sample. Take one individual sample from each drum and four randomly spaced individual samples from each container other than drums.

Take individual samples and place into clean glass or plastic containers.

Prepare a chain of custody record (Chain of Custody) for all composite samples. The Chain of Custody must include the name of the person taking the sample, the name of the testing laboratory for which the person works, the date and time the sample was taken, the bridge sampled, the Township and Municipality where the bridge is located, and the signatures and dates of all persons in possession of the sample in the Chain of Custody.

Sample the abrasive blasting debris within the first week of production blasting at each bridge. Cease all blasting and painting operations on the bridge from which waste was generated, if sampling is not performed within the first week of production blasting.

Test composite samples for lead, chromium, cadmium and arsenic according to the U.S. EPA Publication SW 846 Method 1311 (TCLP). Provide the Chain of Custody and test results to the Laboratory immediately after the test results are available. If the Laboratory determines the blasting debris is hazardous, as defined below, provide the Engineer with the names of the hauler and treatment facility. Perform all sampling and testing required by the hauler, treatment facility, or disposal facility.

The existing paint removed from bridges may contain lead, chromium, cadmium or arsenic. The Contractor is responsible for taking the proper safety precautions to ensure workers in this environment are properly protected.

1. Hazardous Waste. The blasting debris is hazardous if lead, chromium, cadmium or arsenic exceed any of the regulatory concentration limits shown below:

SW 846 Analyte	Regulatory Concentration Limit
Lead	5.0 mg/l
Chromium	5.0 mg/l
Arsenic	5.0 mg/l
Cadmium	1.0 mg/l

Label all the containers of hazardous blasting debris "HAZARDOUS". Secure the storage location by surrounding the site with a 5 foot (1.5 m) high chain link fence fabric supported by traffic sign drive posts 10 feet (3 m) apart. Drive the traffic signposts into the ground at least 2 feet (0.6 m) deep. Secure the fencing with padlocks at the end of each day. Post hazardous waste warning signs at obvious locations on the fenced enclosure.

The Engineer will obtain a generator number assigned to the State. After the Engineer obtains the generator number, arrange for the hauling, treating, and disposing of the hazardous waste. Use a firm licensed by EPA to haul and dispose of the hazardous waste. This firm is also responsible for providing the completed Uniform Hazardous Waste Manifest (EPA Form 8700-22, or current version).

In every case, properly dispose of all hazardous waste within 60 days after it is generated. If hazardous waste is not properly disposed of within 60 days, the City will consider the Contactor in breach of its Contract and the City will take the following actions:

a. Immediately suspend all abrasive blasting and painting of structural steel on the Project until hazardous waste is properly disposed.

b. Cease processing all pay estimates.

c. Forward a breach of contract notification to the Contractor's Surety.

The Contractor is responsible for fines or liens assessed by any governmental agency that has jurisdiction over the disposal of this hazardous waste material.

Decontaminate or dispose of all collection and containment equipment according to EPA guidelines.

The Contractor shall inform the City when all hazardous waste has been removed from the Project so the EPA Site ID Number (Hazardous Waste Generator Number) can be deactivated.

2. Non-Hazardous Solid Waste. For all waste that is determined to be a Non-Hazardous Solid Waste by the DRWE, the Contractor is required to:

a. Before disposing of any material, provide the Engineer with documentation that the disposal facility is licensed by the EPA to accept non-hazardous solid waste.

b. Haul and dispose of the waste to the documented, non-hazardous solid waste facility.

c. Obtain from the disposal facility and provide the Engineer with a receipt that documents disposal of waste material at the licensed disposal facility.

d. Properly dispose of all waste within 60 days after it is generated.

514.14 Washing Shop Primer (QCP #7). Wash shop primed structural steel after it is erected and the concrete deck is placed and within 30 days of applying the intermediate coat.

Wash the steel with potable water. Use equipment capable of delivering the water at a nozzle pressure of at least 1000 pounds per square inch (7 MPa) and at a rate of not less

than 4 gallons (15 L) per minute. The Contractor shall provide the Engineer with equipment specifications that verify both the delivery pressure and rate. Provide gauges on the equipment to verify the pressure during operation. Hold the nozzle a maximum of 12 inches (300 mm) from the surface being washed. The surface is clean when clear rinse water runs off the structure. After rinsing the surface, inspect for remaining dirt and rewash dirty areas until clean.

514.15 Handling. Deliver all paint and thinner in original unopened containers with labels intact. The Engineer or Inspector will accept containers with minor damage provided the container is not punctured. Thinner containers shall be a maximum of 5 gallons (19 L). Before use, provide the Engineer with shipping invoices for all painting materials used on the Project.

Supply containers of paint and thinner with labels clearly marked by the manufacturer to show paint identification, component, color, lot number, stock number, date of manufacture, and information and warnings as may be required by Federal and State laws.

Store paint at the temperature recommended by the manufacturer and in a storage facility that prevents theft. Provide thermometers capable of monitoring the maximum high and low temperatures inside the storage facility.

Before opening paint or thinner containers, check the labels to ensure the proper container is opened and the paint has not been stored beyond its shelf life. Do not use paint that exceeded its shelf life. Do not open containers of paint and thinner until required for use and then open the oldest paint of each kind first. Solvent used for cleaning equipment is exempt from the above requirements.

Do not use paint that has livered, gelled, or otherwise deteriorated during storage. Properly dispose of unused paint and paint containers.

514.16 Mixing and Thinning. Thoroughly mix all ingredients immediately before use with a high shear mixer (such as a Jiffy Mixer). Do not mix paint using paddle mixers, paint shakers, or an air stream bubbling under the paint surface. After mixing, carefully examine the paint for uniformity and to ensure that no unmixed pigments remain on the bottom of the container. Before use, strain the paint through strainers that remove skins or undesirable matter but not pigment.

Except for primer, mix paint as necessary during application to maintain a uniform composition. Continuously mix primer using an automated agitation system. Do not use hand-held mixers for primer paints.

Do not add thinner to the paint without the Engineer's or Inspector's approval, and only add thinner if necessary for proper application as recommended by the manufacturer's printed instructions. In the Engineer's or Inspector's presence, slowly add the amount of thinner recommended and supplied by the manufacturer to the paint during the mixing process. Do not mix other additives into the paint.

Add catalysts, curing agents, or hardeners that are in separate packages to the base paint only after thoroughly mixing the base paint. With constant agitation, slowly pour the proper volume of catalyst into the required volume of base. Do not pour off liquid that has separated from the pigment before mixing. Use the mixture within the pot life

specified by the manufacturer and dispose of unused portions at the end of each workday.

514.17 Coating Application.

A. General. Paint all structural steel, scuppers, expansion joints except top surface, steel railing, exposed steel piling, drain troughs, and other areas as shown on the plans. Paint galvanized or metalized surfaces if shown on the plans. Unless otherwise shown on the plans or specified below, apply paint by brush, spray, or a combination of brush and spray methods. If brush and spray are not practical to paint places of difficult access, the Contractor may use daubers, small diameter rollers, or sheepskins.

Use daubers, small diameter rollers, or sheepskins to paint the following areas:

1. Where cross-frame angles are located within 2 inches (50 mm) of the bottom flange.

2. Where end cross frames are within 6 inches (150 mm) of the backwall.

3. Where there is less than 6 inches (150 mm) between the bottom of the bottom flange and the beam seat.

B. Application Approval. The Engineer or Inspector may inspect the initial application of the prime, intermediate, and final coats. If the Engineer or Inspector discovers defects, adjust the method of application to eliminate the defects then continue applying the coat.

C. Additional Information Pertaining to Shop Applied Primer. Apply a prime coat to all structural steel surfaces including insides of holes, behind stiffener clips and contact surfaces of connection, and splice material that is to be fastened with bolts in the shop or field. Apply a mist coating from 0.5 to 1.5 mils (12.5 to 37.5 μm) on surfaces that are to be imbedded in concrete and on surfaces within 2 inches (50 mm) of field welds other than those attaching intermediate or end cross frames to beams or girders. Apply one coat of primer to pins, pin holes, and contact surfaces of bearing assemblies, except do not paint those containing self-lubricating bronze inserts. Once the prime coat is dry, apply erection marks, using a thinned paint of a type and color that is completely concealed by, and compatible, with the second coat.

Do not handle or remove structural steel coated with inorganic zinc primers from the shop until the paint has cured as specified by the paint manufacturer's printed instructions.

Reduce the thickness of thick films of inorganic zinc primer by screening, sanding, or sweep blasting. If the primer paint cured longer than 24 hours, apply a re-coating of primer paint according to the paint manufacturer's printed instructions. Abrasive blast and re-apply the primer to the affected area if "mud cracking" occurs. If "checking" occurs, abrasive blast and reapply the primer or remove the "checking" by screening and evaluate the area by adhesion testing.

D. Surface Cleanliness. All surfaces to be painted shall be free of dust, dirt, grease, oil, moisture, overspray, and other contaminants. If the surface is degraded or contaminated, restore the surface before applying paint. In order to prevent or minimize degradation or contamination of cleaned surfaces in the field, the prime coat of paint shall be applied within 12 hours of the beginning of the abrasive blasting operation as

required in surface preparation above, for steel which is cleaned and painted in the shop, the prime coat of paint shall be applied within 24 hours of the beginning of the blasting operation.

Schedule cleaning and painting when dust or other contaminants will not fall on wet, newly painted surfaces. Protect surfaces that do not receive paint or have already been painted from the effects of cleaning and painting operations. Before applying the next coat, remove overspray and bird droppings with a stiff bristle brush, wire screen, or a water wash with sufficient pressure to remove overspray and bird droppings without damaging the paint. Before applying the next coat, remove all abrasives and residue from painted surfaces with a vacuum system equipped with a brush type cleaning tool.

Remove all visible abrasives on the finish coat that came from adjacent work.

E. Brush Application. Apply the paint to produce a smooth coat. Work the paint into all crevices, corners, and around all bolt and rivet heads. Apply additional paint as necessary to produce the required coating thickness.

F. Spray Application (General). Apply paint using spray application as follows:

Keep spray equipment clean so that dirt, dried paint, solvents, and other foreign materials are not deposited in the paint film. Remove solvent left in the equipment before using the equipment.

Apply paint in a uniform layer with overlapping at the edges of the spray pattern. Paint the border of the spray pattern first, followed by painting the interior of the spray pattern. Complete painting a spray pattern before moving to the next spray pattern area. Within a spray pattern area, hold the gun perpendicular to the surface and at a distance that will ensure a wet layer of paint is deposited on the surface. Release the trigger of the gun at the end of each stroke. To ensure coverage, spray all bolts and rivet heads from at least two directions or apply the paint to bolts and rivet heads using a brush.

Each spray operator shall demonstrate to the Engineer or inspector the ability to apply the paint as specified before the operator sprays paint.

If mud cracking occurs, the affected area shall be cleaned to bare metal in accordance with surface preparation above and repainted. Fill all gaps and crevices 1/8 inch (3 mm) or less with primer.

Use spray equipment recommended by the paint manufacturer and suitable for use with the specified paint. Provide adequately sized traps or separators to remove oil and condensed water from the air. Periodically drain the traps during operations. To ensure that the traps or separators are working properly, test by blowing air from the spray gun for 30 seconds onto a white cloth or blotter held in a rigid frame. The Engineer or Inspector will verify the test results by inspecting the white cloth or blotter. If the cloth or blotter retains oil, water, or other contaminants, suspend painting until retests verify the problem was corrected. Perform this test at the start of each shift and at 4-hour intervals. This is not required for an airless sprayer.

Do not use spray application unless the operation is totally enclosed as required for abrasive blasting, to prevent overspray damage to the ground, public and private property, vegetation, streams, lakes, and other surfaces not to be painted.

G. Prime, Intermediate, and Finish Coat Application (QCP #5, #8, and #10). Apply paint as a continuous film of uniform thickness, free of all defects such as holidays, pin holes, mud cracking, checking, drips, runs, and sags. The Contractor is responsible for applying the manufacturer's paint as necessary to satisfy the above requirement. Repaint all thin spots or areas missed before the next coat of paint is applied.

Ensure that each coat of paint is properly cured before applying the next coat. Comply with the manufacturer's written instructions for the time interval between coats and apply the next coat when an additional coat will not cause detrimental film irregularities, such as lifting, wrinkling, or loss of adhesion of the undercoat. Do not exceed the following time intervals. If the prime coat is organic zinc, the maximum time between the prime and intermediate coats is 30 days. There is no maximum time between the prime and intermediate coats for an inorganic zinc primer. The maximum time interval between intermediate and finish coats is 13 days. These maximum recoat times include adverse weather days and the Engineer will not extend the times. If the next coating is not applied within the times stated above, remove the coatings and re-blast the steel according to SSPC-SP 10.

Stencil the Completion Date (month and year) of the finish coat and the letters of the applied paint system on the steel in 4 inch (100 mm) letters with black urethane paint. The appropriate letters for the paint systems are as follows:

System Comprised of:	Letters
Inorganic zinc prime coat, epoxy intermediate coat, and urethane finish coat	IZEU
Organic zinc prime coat, epoxy intermediate coat, and urethane finish coat	OZEU

Apply the date and paint system at four locations near the end of each outside beam on the outside web visible from the road or as directed by the Engineer.

514.18 Removing Fins, Tears, or Slivers (QCP #6). Use a grinder to remove all fins, tears, slivers, or any other burred or sharp edges that become evident after applying the prime coat. Retexture ground surfaces to produce a profile from 1.5 to 3.5 mils (40 to 90 μm) and reprime ground surfaces before applying the intermediate coat. The Contractor may begin removing fins, tears, and slivers after blasting and before priming. Temperature and weather restrictions do apply to removing fins, tears, and slivers, and to applying the prime coat.

514.19 Caulking (QCP #9). After the intermediate coat cures and before applying the finish coat, caulk gaps or crevices greater than 1/8 inch (3 mm).

514.20 Dry Film Thickness (QCP #5, #8, and #10). Determine prime coat thickness; prime and intermediate coat thickness; and prime, intermediate, and finish coat thickness using a Type 2 magnetic gage as follows:

Measure paint thickness at separate, evenly spaced, spot measurement locations over each 100-square feet (9 m^2) of area of structural steel. Locate five spot measurements on each of the following locations: top flanges; bottom flanges; webs; cross bracing; stiffeners; etc. At each spot location, take three gage readings of either the substrate or the paint. Move the probe 1 to 3 inches (25 to 75 mm) for each new gage reading.

Discard an unusually high or low gage reading that is not consistently repeated. The spot thickness measurement is the average of the three gage readings.

The average of five spot measurements for each location in the 100-square foot (9 m^2) area shall not be less than the specified thickness. No single spot measurement area shall be less than 80 percent of the specified minimum thickness nor greater than 150 percent of the maximum specified thickness when organic zinc is applied and 120 percent of the maximum specified thickness when inorganic zinc is applied. Any one of three readings which are averaged to produce each spot measurement, may under run or overrun by a greater amount. Take five spot measurements per location for each 100-square foot (9 m^2) area as follows:

A. For all shop painted steel, regardless of size, randomly select and then measure one 100-square foot (9 m2) area within each 300 square foot (27 m^2) unit of surface area that is painted.

B. For structures not exceeding 300 square feet (27 m^2) in area, measure each 100-square foot (9 m^2) area.

C. For structures not exceeding 1000 square feet (90 m^2) in area, randomly select and then measure three 100-square foot (9 m^2) areas.

D. For structures exceeding 1000 square feet (90 m^2) in area, measure the first 1000 square feet (90 m^2) as stated in section C and for each additional 1000 square feet (90 m^2), or increment thereof, randomly select and then measure one 100-square foot (9 m^2) area.

E. If the dry film thickness for any 100-square foot (9 m^2) area (sections C and D) is not in compliance with the requirements of this subsection, then measure each 100-square foot (9 m^2) area.

F. Measure other areas or revise the number of spot measurements as shown on the plans.

Each coat of paint shall have the following thickness measured above the peaks:

	Min. Spec. Thickness	**Max. Spec. Thickness**	**Min. Spot Thickness**	**Max. Spot Thickness (Inorganic Zn)**	**Max. Spot Thickness (Organic Zn)**
Prime	3.0 mils (75 μm)	5.0 mils (125 μm)	2.4 mils (60 μm)	6.0 mils (150 μm)	7.5 mils (188 μm)
Intermediate	5.0 mils (125 μm)	7.0 mils (175 μm)	4.0 mils (100 μm)	10.5 mils (263 μm)	10.5 mils (263 μm)
Subtotal	8.0 mils (200 μm)	12.0 mils (300 μm)	6.4 mils (160 μm)	16.5 mils (413 μm)	18.0 mils (450 μm)
Finish	2.0 mils (50 μm)	4.0 mils (100 μm)	1.6 mils (40 μm)	6.0 mils (150 μm)	6.0 mils (150 μm)
Total	10.0 mils (250 μm)	16.0 mils (400 μm)	8.0 mils (200 μm)	22.5 mils (563 μm)	24.0 mils (600 μm)

Remove paint with a film thickness greater than the maximum specified thickness unless:

A. The paint does not exhibit defects such as runs, sags, bubbles, or mud cracking, etc.

B. The manufacturer provides a written statement to the Engineer that the excessive thickness is not detrimental.

For any spot or average of five spots at any location of a 100-square foot (9 m^2) area that exceeds the maximum spot thickness, either remove and replace the coating according to 514.22 or prove to the Engineer that the excess thickness will not be detrimental to the coating system. In order to prove to the Engineer that the excess thickness will not be detrimental to the coating system, the Contractor must provide the Engineer with the following information.

Certified test data proving that the excessive thickness will adequately bond to the steel when subjected to thermal expansion and contraction. The thermal expansion and contraction test shall take place over five cycles of a temperature ranges from -20° to 120 °F (-49° to 49°C). After the thermal contraction and expansion cycles have taken place, the tested system shall be subjected to pull off tests and the results compared to the results of pull off tests that have been performed on a paint system with the proper thicknesses.

Perform the adhesion tests per ASTM D 4541 Type IV. Document the preparation methods for the panels, including profile and level of cleanliness. Document the application methods, conditions and if any thinner, (percentage), was used. Test the panels according to the following:

1. Lightly sand the coating surface and aluminum dolly, and apply a quick set adhesive. Document the type of adhesive.

2. Allow adhesive to cure overnight.

3. Scribe the coating and adhesive around the dolly before testing.

4. Make a minimum of 4 trials to failure, and report the 4 trials. Reject trial if fracture occurs at the primer-substrate interface or pressure at failure is less than 400 pounds per square inch (2.8 MPa).

a. Describe the test specimen as substrate A, upon which successive coating layers B, C, D, etc. have been applied including the adhesive Y which secures the dolly Z to the topcoat.

b. Designate cohesive failures by the layers within which they occur as B, C, etc., and the percent of each.

c. Designate adhesive failures by the interfaces at which they occur as A/B, B/C, C/D, etc, and the percent of each.

In addition to the certified test results, the Contractor shall provide the Engineer a written statement from the paint manufacturer stating that the excessive thickness is not detrimental.

If the Engineer does not approve the excessive coating thicknesses or the Contractor elects not to provide the required written statement from the paint manufacturer and the certified test results when required, the Contractor shall remove and replace the coating. The removal and replacement of the coating shall be done as specified in 514.19.

514.21 Final Inspection.

A. The Engineer will select locations for coating removal for inspection of surface preparation and dry film thickness. For all structures in which the supporting members are rolled beams or girders, remove a minimum of one location per 150 linear feet (46 m) of beam line for webs and flanges and 5% of all cross frame assemblies and other secondary structural members shall be selected for destructive testing. For all other bridge types with structural steel, remove one location for every 1,200 square feet (108 m^2) of steel surface for destructive testing. Do not perform destructive testing on areas that have been painted with an inorganic zinc prime coat.

B. At the selected areas, the Engineer will perform total dry film thickness testing using a type 2 magnetic gage. If the dry film thickness for that spot does not meet the requirements of 514.18, additional measurements will be taken to determine the extent of the deficient coatings.

C. At the selected areas, where an organic zinc prime coat has been applied, remove at least 9 square inches (58 cm^2) of the new coatings by methods that will not damage the surface of the steel. Approved removal methods are scraping, sanding, or the use of solvents. Do not use power tools. Perform removal while in the presence of the Engineer. The Engineer will document and photograph the selected areas after removal of the new coatings. If work is found not to be in conformance with the specifications and pertinent contract documents, additional locations may be selected for testing.

D. Make repairs of areas where the coatings were removed and other areas that were determined to be deficient. Make repairs as per 514.22. If the final destructive testing according to 514.21.C, reveals greater than 15% of the areas inspected are not in complete conformance with the specifications and pertinent contract documents, the City will require that surface preparation and painting of the structural steel be completely redone to meet the requirements of the Contract Documents at no additional cost to the City.

E. Final Acceptance shall be based upon the results of the surface preparation observations and dry film thickness measurements obtained from the final inspection. Final Acceptance will also take into consideration acceptable progressive project documentation and progressive field measurements in determining the final acceptability of the Bridge Paint System.

Inspection access to the test locations to perform the required final inspection measurements shall conform to the requirements of 514.10.

514.22 Repair Procedures. Remove paint and correct defects or damaged areas, including areas damaged by welding, and in areas that do not comply with the requirements of this specification. Correct defects and damaged areas using the same paint as originally applied except the Engineer may approve using organic zinc to repair inorganic zinc in the field. Retexture the steel to a near white condition and a profile between 1.5 to 3.5 mils (40 to 90 μm). Measure the profile immediately before applying the prime coat to ensure the profile is not destroyed during the feathering procedure. See 514.13C.

Feather the existing paint to expose a minimum of 1/2 inch (13 mm) of each coat.

During the reapplication of the paint, apply paint as follows:

A. Apply the prime coat only to the surface of the bare steel and the existing prime coat exposed by feathering. Do not apply the prime coat to the adjacent intermediate coat.

B. Apply the intermediate coat only to the new prime coat and the existing intermediate coat exposed by feathering. Do not apply the intermediate coat to the adjacent finish coat.

C. Apply the finish coat only to the new intermediate coat and the existing finish coat that was feathered or lightly sanded. Do not apply the finish coat beyond areas that were feathered or lightly sanded.

At the perimeter of the repair area, apply the prime and intermediate coats using a brush. Apply the finish coat using either brush or spray.

The Contractor may need to apply several applications to obtain the proper thickness for each coat.

During the application of the prime coat, the paint shall be continuously mixed.

Perform all surface preparation and painting according to this specification. Instead of abrasive blasting, the Engineer may allow alternate methods of preparing the surface.

Blend repair areas with the adjacent coating and provide a finished surface in the patched areas that is smooth and has an even profile with the adjacent surface.

Submit, in writing, the method of correcting areas with runs to the Engineer for approval.

514.23 Method of Measurement. The City will measure Surface Preparation of Existing Structural Steel and Field Painting of Existing Structural Steel Prime Coat by the number of square feet (square meters) of structural steel painted or on a lump sum basis. The City will measure Field Painting Structural Steel, Intermediate Coat and Field. Painting Structural Steel, Finish Coat by the number of square feet (square meters) or pounds (kilograms) of structural steel painted, or on a lump sum basis.

The City will determine the number of pounds (kilograms) of new structural steel painted by the accepted pay weight of the new structural steel.

For steel beam and steel girder bridges, the City will determine the surface area by taking a nominal measurement of the beams (i.e., two times the beam depth plus three times the flange width). In addition to this nominal measurement, the City will add a percentage to account for incidentals such as cross frames, bearing assemblies, stiffeners, expansion joints, scuppers, etc. It is not necessary for the Engineer or Inspector to field measure every detail of the bridge to verify quantities. If there is a quantity dispute, exact field measurements of all painted surfaces and calculations will govern over the above percentage to account for incidentals.

For extremely complex bridges, such as trusses, the City will pay for painting on a lump sum basis.

The City will measure grinding fins, tears, slivers on existing structural steel by the number of man hours expended by the workers actually doing the grinding and will include the time when the workers are performing grinding and repairing prime coat and not limited to only the actual grinding duration (i.e., the City will include all hours of the

workers when assigned to grinding regardless of actual grinding time). The City will not measure grinding fins, tears, and slivers on new steel but will consider it incidental to unit price for the new steel.

514.24 Basis of Payment. The City will pay for accepted quantities at the Contract prices as follows:

The City may consider paint as eligible for payment for material on-hand as specified in 109.10, however, only paint that the Contractor can prove to the Engineer will be used during the construction season is eligible for payment. The Contractor shall provide the Engineer calculations indicating the total square feet (square meter) of steel to be painted during the construction season. The Contractor shall also provide calculations showing the total number of gallons (liters) required.

If the Contractor causes damage or injury to public or private property, the City will not pay for restoring the property to its original condition.

The City will not pay for repairing adjacent coatings damaged during the blasting operation.

The City will not pay for removing and replacing an area of coating because a spot or maximum average thickness exceeds the maximum spot thickness.

The City will not pay for additional testing required by any hauler, treatment facility, disposal facility or landfill.

The City will pay for caulking under Field Painting Structural Steel, Intermediate Coat.

The City will pay for final inspection access, test area preparation and test area repair at each selected area under Final Inspection Repair. The City will not pay for accessing, inspecting, and repairing areas that are not found to be in conformance with the specifications and pertinent contract documents.

All other requirements of this specification are considered incidental to the work.

Item	Unit	Description
514	Square Foot (Square Meter) Lump Sum	Surface Preparation of Existing Structural Steel
514	Square Foot (Square Meter) Lump Sum	Field Painting of Existing Structural Steel, Prime Coat
514	Square Foot (Square Meter) Lump Sum, Pound (Kilogram)	Field Painting Structural Steel, Intermediate Coat
514	Square Foot (Square Meter) Lump Sum, Pound (Kilogram)	Field Painting Structural Steel, Finish Coat
514	Man Hour	Grinding Fins, Tears, Slivers on Existing Structural Steel
514	Each	Final Inspection Repair