ALBERTA TRANSPORTATION

TECHNICAL STANDARDS BRANCH

B401 – MAY 2014

SPECIFICATION FOR PAINT FOR USE ON STRUCTURAL STEEL BRIDGE COMPONENTS

BACKGROUND

Paint systems considered for use on structural steel bridge components shall be tested in a laboratory to evaluate anticipated field performance. Testing of paint systems is an expensive process and the cost is borne solely by the paint manufacturer. To meet the needs expressed by both Industry and Government, a committee of Canadian Government Agencies has been formed to test paint systems for use on bridge structures. This unified approach allows for member agencies to maintain and update Product Lists and Industry to have the latest paint systems tested and qualified for use at a reasonable cost.

Alberta Transportation is a founding member of the Cooperative Paint Testing Program (CPTP) that was established in 2000 and updated in 2008. The 2008 test round was presented to the paint industry through a single committee member's open call process. Qualified manufacturers/suppliers interested in participating in the program were requested to submit systems for testing and performance evaluation. The CPTP committee also created a CPTP Coordinator position to act as a direct point of contact between the manufacturers, testing laboratory and committee members. It is estimated that CPTP testing rounds will occur every 2 years or as required by Agency or Industry demand.

The CPTP is the primary and most cost effective mechanism for having paint systems qualified for the Alberta Transportation Approved Bridge Coating Systems (Paint) List. Alberta Transportation recognizes that between CPTP test years, new paint systems/technologies may be developed and manufacturers may request that their product be added to the Department's List. In this case, the paint Manufacturer shall have his product tested in accordance with this Specification for consideration for addition to the List. The Manufacturer/Supplier shall be responsible for all costs to complete the requirements of this Specification.

1.0 GENERAL

1.1 INTRODUCTION

This Specification covers the supply of liquid paint for use on structural steel bridge components. The contractor shall supply the paint and may be required by the special provisions to be a licensed applicator. Testing of the paint shall be carried out by an approved private laboratory. The costs and arrangements for testing are the responsibility of the paint supplier.

1.1.1 Need for Bridge Categories

The failure mechanisms for paint are affected by varying bridge site conditions such as humidity, temperature, presence of salt, exposure to ultraviolet radiation; rock chips and direct salt spray. Individual bridges will be classified into categories according to certain site conditions. Each proposed paint system will be tested for resistance to the major failure mechanisms. The evaluation of paints for each bridge category will be based on the typical site conditions that significantly influence failure for that category of bridge. Thus, a paint system may be approved in some bridge categories and not in others.

1.1.2 Acceptance of Test Data

Test results will only be accepted from private laboratories that are approved by Alberta Transportation for this type of work. The test procedures include a cyclic durability test that is not commonly available in many testing laboratories. In addition to this special equipment, the integrity of the testing laboratory must be above reproach. The Department reserves the right to reject data from non-approved testing labs. The supplier should consult with the Department prior to initiating any private testing.

1.2 TYPES OF PAINT

This Specification is intended to approve paints on the basis of performance and life-cycle economics, both of which are dependent on stressors that vary from one bridge to another. All paints that conform to volatile organic content (VOC) requirements established by Environment Canada, and are without hazardous chemicals, including lead, are eligible to compete in this testing against other paints for usage on various types of bridges that have different primary failure mechanisms, which will influence the decision making process for paint approval.

1.3 SUPPORTING DOCUMENTS

The most current versions of following documents will be used in conjunction with Specification B401:

ASTM D3960	Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D1475	Standard Test Method For Density of Liquid Coatings, Inks, and Related Products
ASTM D562	Standard Test Method for Consistency of Paints Measuring Krebs Unit (KU) Viscosity Using a Stormer-Type Viscometer

ASTM D2196	Standard Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield type) Viscometer
ASTM D4400	Standard Test Method for Sag Resistance of Paints Using a Multinotch Applicator
ASTM D5894	Cyclic Salt Fog/Freezer
ASTM D714	Test Method for Evaluating Degree of Blistering of Paints
ASTM D610	Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces
ASTM D2244	Test Method for Calculation of Color Differences from Instrumentally Measured Color Coordinates
ASTM D4541	Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D523 (60 degrees)	Test Method for Specular Gloss
ASTM D3170-91	Test Method for Chipping Resistance of Coatings
SAE J400	Chip Resistance

2.0 PROCEDURE FOR APPROVAL

2.1 OVERVIEW

Approval will be based on a combination of laboratory testing and field performance. The onus for obtaining approval is on the manufacturer or supplier to arrange for private testing in accordance with this Specification to demonstrate the durability of his paint to various deterioration mechanisms and to demonstrate successful field application and compliance with other requirements for VOC, user friendliness, etc. During the testing process the test data belongs to the manufacturer/supplier. If, at the conclusion of testing, the manufacturer/supplier chooses to submit the data to the Department for evaluation, the test results become the property of the Department and can be published or disseminated at the discretion of the Department.

2.1.1 Selection of Testing Laboratory

The approved testing laboratories are:

2.1.1.1 Charter Coating Service (2000) Ltd.
4603 13 St. NE #6, Calgary, AB T2E 6P1
Phone: 403/250-3027

2.1.1.2 KTA-Tator, Inc., Attn: Lab Manager
115 Technology Drive, Pittsburg, PA, USA 15275
Phone: 1-800-245-6379

2.1.2 Encapsulation or Replacement

The manufacturer shall instruct the laboratory on whether the paint is to be tested as an alkyd encapsulation product or as replacement paint to be applied on commercially sandblasted steel.

2.1.3 Field Performance

Paint application is more difficult in the field than in the laboratory. Some application problems may not be detected in this test program. Manufacturers shall submit a list of major paint jobs with names and phone numbers of applicators with field experience. Successful new paints without a record of field performance will be allowed limited approval status so as to acquire this record under somewhat controlled conditions. Test panels will be placed on a test structure and the performance recorded through the CPTP.

2.2 MANUFACTURER'S SUBMISSION TO LABORATORY

2.2.1 Description of Paint System

The manufacturer shall provide the name of the complete paint system as well as generic descriptions and product names for all individual layers. The Manufacturer shall also supply MSDS sheets and Product Data sheets for each component and complete the *Data Form and Application Record* provided at the end of this Specification.

2.2.2 Painting of Test Panels

The Manufacturer shall supply the Laboratory with the number of prepared panels in accordance with this specification. The manufacturer shall also provide the testing laboratory all pertinent instructions concerning the application, coverage rates, thinning, special equipment, wet film thicknesses, drying times, etc. used in preparing the panels.

2.2.3 Witnessing of Sample Application

The Manufacturer shall advise the Department’s representative one week in advance of panel preparation. The Department shall be granted full access to witness the application of the panels prior to submission to the testing laboratory.

3.0 TESTING PROCEDURES

3.1 PRELIMINARY REQUIREMENTS

3.1.1 Hazardous Chemicals

The manufacturer shall supply the testing laboratory with documentation of the paint ingredients prior to testing. No lead, chromium, cadmium or hazardous chemicals will be allowed.

3.1.2 Volatile Organic Content

The maximum allowable VOC shall be based on Environment Canada's AIM coating requirements for industrial coatings, currently 340 g/litre. The VOC content shall be measured in accordance with ASTM D3960. The VOC content shall be representative of the content at the spray nozzle.

3.1.3 Colour

Successive layers of paint shall be contrasting colours. The topcoat shall be US Federal Specification 595b Colour 16440 Grey.

3.1.4 Identification of Paints

3.1.4.1 Instrumentation

A minimum 32 scans shall be taken with a Fourier transform infrared spectrometer between 2.5 and 15 micrometers wavelength. The intention is to take spectra of the vehicle portion of the coatings without the pigment.

3.1.4.2 Single Component Materials

A representative sample of the single component material shall be centrifuged to remove pigment and a spectrum taken using the KBr sandwich technique as per the Instrumentation section above.

3.1.4.3 Plural Component Materials

Each of the separate components shall have an IR spectrum done as per the single component materials above. A sample of the mixed material shall be mixed in the correct ratio, spun down to remove pigment. A KBr pellet may be prepared from the cured product or the product may be cured directly onto an IR card. In either case after curing the spectrum shall be taken as per the Instrumentation section above.

3.2 TEST PANELS

Test panels shall be prepared by the testing laboratory. Panels shall be fabricated from A36 or equivalent steel. Edges and corners of the panels shall be rounded. Sizes and numbers of panels are described in Section 3.2.2.3.

There will be two types of test panels for the testing of either lead-based alkyd encapsulation paints or paints to be applied on commercially blasted steel surfaces. The DFT of each layer of the applied system shall be within 50% of the

manufacturer's specifications in order for the test data to be accepted.

3.2.1 Commercially Blasted Panels

Panels shall be prepared for coating by abrasive blasting to SSPC SP5, with a sharp surface profile of 1.5 to 2.5 mils at the time of coating.

Each coat shall be sprayed at the recommended thickness, and cured at 25 degrees Celsius, and 50% RH. Systems shall be cured fully cured for 30 days. All panels shall have their backs sealed with two coats of high quality epoxy and the edges of the panels shall be sealed by dipping in epoxy or applying a vinyl tape so that it laps onto the face of the panel 5 mm.

Panels identified for cyclic testing shall be marked with a single scribe line at 45 degrees to the long axis of the panel. Length shall be 5 cm. Scribe shall be centered horizontally on the panel and in the lower third of the panel. Scribing tool shall be as described in ASTM D1654-92 (ANSI B94.50 Style E). Scribing tool shall be used as per D1654-92.

3.2.2 Encapsulation Panels

The panels will be the same as commercially blasted ones except that the M-50 Alkyd System shall be applied and weathered as follows:

- 4 hours exposure to UV-B ultraviolet at 60^{o}C followed by 4 hours condensation at 40^{o}C for a total of 500 hours test in UV-CON.

3.2.3 Number of Panels

The number of panels required is as follows:

Size of Panels	Number of Panels	For Test	Required By:	Edge Treatment
3 x 6 x 0.0625 inches	6	Cyclic QUV/Salt Fog	Testing Laboratory	Round edges prior to cleaning, abrasive blasting and coating.
4 x 8 x 0.0625 inches	6	Freeze/Thaw Testing	Testing Laboratory	
4 x 8 x 0.0625 inches	4	Chip Resistance testing	Testing Laboratory	
4 x 8 x 0.0625 inches	4	Retained Samples	CPTP Coordinator	
6 x 12 x 0.125 inches	6	Field Testing	CPTP Coordinator	

3.3 CYCLIC TESTING

Cyclic tests will be used to evaluate the paint durability and resistance to different failure mechanisms.

A cycle shall total 504 hours (3 weeks) consisting of:

- 240 hours of QUV/condensation exposure
- 240 hours of cyclic salt fog/dry testing
- 24 hours for evaluation

A total of eight cycles shall be completed per system for a total of 4032 hours of testing.

3.3.1 QUV/Condensation Cycle

The QUV/condensation cycle shall consist of 4 hours of UV exposure at 60°C using UVA-340 lamps and 4 hours of condensation at 50°C.

3.3.2 Salt Fog/Dry Chamber Cycle

The fog/dry chamber cycle shall consist of a 1-hour of salt fog at ambient temperature and 1-hour dry off at 35°C. The fog electrolyte shall be a solution of 0.05wt% NaCl and 0.35wt% $(NH_4)_2SO_4$.

3.4 FREEZE THAW/STABILITY TESTING

The freeze/thaw stability testing shall consist of a 30 day freeze/thaw/immersion cycle. Each 24 hour cycle shall consist of 16 hrs at approximately -30 degrees Celsius, followed by four hours thawing at 50 degrees Celsius, followed by four hours of immersion in tap water at 25 degrees Celsius.

3.5 GLOSS RETENTION

Gloss retention shall be measured for the cyclic testing panels prior to exposure, and after each of the six cycles. Gloss shall be measured as per ASTM D523. If the gloss of a panel is such that an angle other than 60 degrees is more appropriate, the angle used shall be reported with the reading.

3.6 COLOUR RETENTION

Colour shall be measured on the cyclic testing panels initially and after each of the six cyclic testing cycles. It shall be measured as per ASTM D2244, using D_{65} light source, 45 degree geometry and a 2 degree observer. Results shall be reported in the L*a*b* system of colour coordinates.

3.7 ADHESION

Adhesion shall be done on the freeze thaw testing specimens initially and at the end of the test. Initial adhesion is to be done on two of the “spare” panels not exposed to testing. A total of six readings are to be done on the two spare panels. Final adhesion is to be done on the exposed panels and reported as individual readings. A total of two readings on each of the three panels shall be taken.

Adhesion shall also be done on the cyclic testing panels after the sixth cycle. One

reading shall be done on each panel. Adhesion readings are to be done according to ASTM D4451 using a self aligning tester. The same machine shall be used for all adhesion tests. Results shall be reported in MPa.

3.8 BLISTERING

Blistering shall be measured on the Cyclic testing Panels initially and after each cycle. On each panel, the 2/3 above the score and the 1/3 below the score shall be evaluated separately. It shall be measured as per ASTM D713 on each of the three panels exposed. Data shall be reported on size and frequency for each panel individually on the spreadsheet provided by Alberta Transportation.

3.9 UNDERCUTTING AT SCORE

Undercutting at the score lines on the cyclic testing panels shall be measured on each of the three panels of each system. The 5 cm score line on each panel shall be divided into five, 1cm segments and the maximum distance of undercut shall be measured for each segment. The 15 values for each system shall be reported on the form provided by Alberta Transportation.

3.10 RUST BREAKTHROUGH

Rust breakthrough shall be measured on the top 2/3 of the panels in the Cyclic Testing. Scores shall be assigned using ASTM D610. Each of the three panels of a given system shall be rated. Scores shall be reported on the form provided by Alberta Transportation.

3.11 CHIP RESISTANCE

Test is performed at -20 Celsius panel temperature, in triplicate. Evaluation is according to SAE J400 then results per Method I – Exact Counting Procedure are fit into a 0 to 100 Matrix. Note: The score for a panel is the sum of the scores for each of the four size ranges of chip times the number of chips for that range. The calculated score for the test overall is an average of the three scores for each chip size. The calculated score is subtracted from 100 to invert the scale.

3.12 PHOTOGRAPHIC RECORDS

Pictures shall be reported as electronic, jpg files on CD or DVD for each cycle of tests as indicated. When photographed, each panel shall be identified with a label (see illustration below) showing the panel identification number, the test, the hours of exposure for that test if applicable and the date. The label should not block any part of the panel.

3.12.1 Cyclic testing

The QUV/condensation cycle shall consist of 4 hours of UV exposure at 60°C using UVA-340 lamps and 4 hours of condensation. Photographs shall be taken of each panel of each system:

- Prior to exposure
- After each cycle.

Photographs shall include the entire panel and a printed label with the following information:

- Test Name
- Cycle Number
- Hours of exposure
- Date
- Unique System and Panel Identification Numbers

Sample label:

May 23, 2008
Cycle X, Y Hours of Exposure
SYSTEM 1234, PANEL A

3.12.2 Freeze/Thaw Testing

Before and after pictures shall be taken of each panel of each system. Labels shall carry the same information as above, reflecting the different test and identification data.

3.12.3 Adhesion Testing of the Freeze Thaw Panels

Pictures of the finished adhesion tests showing the panel, the upturned dollies, and the label shall be taken. The label shall carry the information as outlined above.

3.12.4 Chip Resistance

Pictures of chip resistance shall be taken before and after the test. The label shall carry the information as outlined above.

4.0 EVALUATION OF DATA

Data will be scored on the following criteria:

ASTM D5894/Cyclic Salt Fog/Freezer					
ASTM D714 Blistering on Scorelines:		**Scoring**	**Min. Possible.**	**Min. Acceptable**	**Max. Possible**
Frequency	Zero	10	1	5	10
	Few	8			
	Medium	5			
	Medium Dense	3			
	Dense	1			
Size	Zero	10	1	5	10
	Size #8	8			
	Size #6	6			
	Size #4	5			
	Size #2	1			
ASTM D714 Blistering in other areas:		**Scoring**	**Min. Possible.**	**Min. Acceptable**	**Max. Possible**
Frequency	Zero	10	1	8	10
	Few	8			
	Medium	5			
	Medium Dense	3			
	Dense	1			
Size	Zero	10	1	8	10
	Size #8	8			
	Size #6	6			
	Size #4	5			
	Size #2	1			
ASTM D610 Unscored Area: Rust Breakthrough:	**Percent Failed**	**Scoring**	**Min. Possible**	**Min. Acceptable**	**Max. Possible**
Estimated percent failed	None	10	0	7	10
	0.01%	9			
	0.03%	8			
	0.1%	7			
	0.3%	6			
	1%	5			
	3%	4			
	16.7%	3			
	33%	2			
	50%	1			
	>50%	0			

ASTM D5894/Cyclic Salt Fog/QUV (six- 504 hour cycles)					
ASTM D4541 Pull-Off Adhesion, MPa:					
	MPa	**Scoring**	**Min. Possible**	**Min. Acceptable**	**Max. Possible**
Equipment used shall be self-aligning (Note Whatever Instrument employed shall be used throughout the testing.)	<2	0	1	2.5 for inorganic zinc primer, 4.0 for Organic Zinc Primer	10
	2	1			
	3.5	2			
	3	3			
	3.5	4			
	4	5			
	4.5	6			
	5	7			
	5.5	8			
	6	9			
	>6	10			

ASTM D2244, Colour Change, Lab scale, 2º observer, D_{65} Illuminate, Delta E:					
	0-2	10	1	5	10
	2.1-4	8			
	4.1-5	5			
	5.1-7	3			
	>7	1			

Freeze Thaw Stability Adhesion After Exposure (30 - 24 hour cycles)					
ASTM D4541 Pull-Off Adhesion, MPa:					
	MPa	**Scoring**	**Min. Possible**	**Min. Acceptable**	**Max. Possible**
Equipment used shall be self-aligning (Note Whatever Instrument employed shall be used throughout the testing.)	<2	0	1	2.5 for inorganic zinc primer, 4.0 for Organic Zinc Primer	10
	2	1			
	3.5	2			
	3	3			
	3.5	4			
	4	5			
	4.5	6			
	5	7			
	5.5	8			
	6	9			
	>6	10			

ASTM D523, Gloss 60 Degree					
	% Loss	**Scoring**	**Min. Possible**	**Min. Acceptable**	**Max. Possible**
If a gloss angle different from 60 degrees is necessary, it should be noted.	0	10	0	5	10
	10	9			
	20	8			
	30	7			
	40	6			
	50	5			
	60	4			
	70	3			
	>70	0			

ASTM D3170 Test for Chip Resistance of Surface Coatings					
Test is evaluated according to SAE J400 then results are fit into a 0 to 100 Matrix.	**Chip Size**	**Maximum Number of Chips**	**Min. Possible Score**	**Min. Acceptable Score**	**Max. Possible Score**
Note: The score for a panel is the sum of the scores for each of the four size ranges of chip times the number of chips for that range. The score for the test overall is an average of the three scores for each chip size. The calculated score is subtracted from 100 to invert the scale.	A	50	0	5	10
	B	25			
	C	12.5			
	D	7.5			

4.1 EVALUATION OF DATA BY ALBERTA TRANSPORTATION

The laboratory shall supply an official copy of test data to Alberta Transportation when so instructed by the manufacturer. Test data will be evaluated based on the bridge categories established Alberta Transportation.

5.0 SUBMISSION OF TEST RESULTS TO ALBERA TRANSPORTATION

Certified copies of test results should be submitted to:

Alberta Transportation
Technical Standards Branch
2nd Floor, 4999 - 98 Avenue
Edmonton, Alberta T6B 2X3.
Attention: Dave Besuyen, Bridge Materials Engineer
Telephone: (780) 415-1037 ; Fax: (780) 422-5426

Test results shall include a complete description of the applied system, all test results, mode of application (encapsulation or replacement), date of completion of testing, mill certificates of test panels, names of responsible people conducting the tests, etc.

Test result shall also be supplied in electronic format. Scores shall be reported on the form provided by Alberta Transportation. Electronic templates will be available from Alberta Transportation upon request.

6.0 QUALITY CONTROL

Quality control of approved paints is the responsibility of the manufacturer. The Department has an interest in seeing that the manufacturer has a proper quality control program in place.

6.1 ISO 9000 Requirements

Certification within the framework of the ISO 9000 will be a requirement for all manufacturers of paint for supply to Alberta Transportation. The manufacturer shall show evidence of current certification of ISO 9002 (ANSI/ASQC Q92) or ISO 9001 (ANSI/ASQC Q91) for the manufacturing facility that will provide paint to Alberta Transportation. Other paints will remain on the approved status list as subject to other provisions in this specification.

6.2 Approvals

Approval is valid for 7 years from the date of approval. Any subsequent change in the product will require a re-testing for re-approval at the Supplier's/Manufacturer's expense.

A paint system will be subject to removal from the Alberta Transportation Approved List for:

1. Field Failure: A coating system that prematurely fails or exhibits other problems, either through application, normal service life or field testing.

2. Change of formulation: If a formulation changes, the entire paint system is considered to be changed and shall undergo re-testing.

3. Change of Name or Formulation Number: Unless provided with prior and written notification of a name or formulation number change for an existing tested formulation, that paint system will be considered to be a changed formulation and the entire system shall undergo testing to be re-approved.

4. Non Compliance of Environmental Regulations: Paint systems shall comply with Environment Canada's VOC Regulations.

5. Non compliance of requalification requirements. It is the responsibility of the Manufacturer to ensure its paint product(s) are retested prior to the paint product's listing expiring.

Physical Data Form and Application Record									
Contact Information:									
Manufacturer:				**Contact Name:**					
Contact Number:				**Email:**					
System Component Identification:	**Primer**			**Midcoat**			**Topcoat**		
System Component Formulation Number									
Test: Liquid Coating									
Primer:									
	Part A			Part B			Mixed After Induction		
Density 25 Degrees ASTM D1475		g/l			g/l			g/l	
Viscosity 25 degrees ASTM D562		KU			KU			KU	
Viscosity 25 degrees ASTM D2196		cpoise			cpoise			cpoise	
VOC ASTM D3960		g/l			g/l			g/l	
VOC thinned 10%		g/l			g/l			g/l	
Midcoat:									
	Part A			Part B			Mixed After Induction		
Density 25 Degrees ASTM D1475		g/l			g/l			g/l	
Viscosity 25 degrees ASTM D562		KU			KU			KU	
Viscosity 25 degrees ASTM D2196		cpoise			cpoise			cpoise	
VOC ASTM D3960		g/l			g/l			g/l	
VOC thinned 10%		g/l			g/l			g/l	
Topcoat:									
	Part A			Part B			Mixed After Induction		
Density 25 Degrees ASTM D1475		g/l			g/l			g/l	
Viscosity 25 degrees ASTM D562		KU			KU			KU	
Viscosity 25 degrees ASTM D2196		cpoise			cpoise			cpoise	
VOC ASTM D3960		g/l			g/l			g/l	
VOC thinned 10%		g/l			g/l			g/l	
Mixed Paint:									
	Primer			**Midcoat**			**Topcoat**		
Temperature (degrees Celsius)	**10**	**20**	**30**	**10**	**20**	**30**	**10**	**20**	**30**
Induction Time (Min)									
Dry to Touch (Hours)									
Dry to Overcoat (Hours)									
Dry to Handle (Hours)									
Max Overcoat Time (days)									
Application Data:									
	Primer			**Midcoat**			**Topcoat**		
Thinning %									
Application Temperature									
Date and Time									
Wet Film Thickness (mils)									
Cure Temp and Humidity									
Sag Resistance ASTM D4400									
Cured Panels:									
	Primer			**Midcoat**			**Topcoat**		
Dry Film Thickness in mils (10 readings, cumulative with each coat)									
Average									
Standard Deviation									
Maximum thickness									
Minimum Thickness									
Number of Readings									