

Appendix 11: Specification for Internal Tank and Pressure Vessel Coating



Encana Oil & Gas (USA) Inc.

Specification for Internal Tank and Pressure Vessel Coating

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SARP APPROVAL SIGN-OFF SHEET

SARP #: ECA-USA-COAT-S-001

SARP Name: Specification for Internal Tank Coating

Description: This specification contains the minimum technical requirements of Encana for application of a spray-applied protective coating to the interior shell and floor of liquid storage tanks and pressure vessels.

**The undersigned endorse the implementation of the SARP referenced above
for applicable USA Division activities**

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PREFACE

The Encana Specifications & Recommended Practices (SARPs) are an essential tool of Management for controlling and assuring the safety, reliability, operability, and economic viability of production equipment and pipelines.

The [Specifications](#) contain elements that are mandatory requirements as a result of Legislation, Regulation, Codes and/or Guidelines, whereas [Recommended Practices](#) contain proven non-mandatory techniques or methodologies; both aspects of which must be considered by the parties engaged in the design, procurement, construction, and maintenance of equipment and pipelines in which Encana has an interest.

The specifications may not be departed from in practice without official approval via the waiver process. The Recommended Practices are subject to interpretation in their application, but where deviations are considered the party responsible must:

1. Complete the Encana Risk Assessment Worksheet and Mitigation Documentation Form.
2. Ensure that deviations are reviewed and approved by a qualified company representative and/or a Professional Engineer where applicable.
3. Report any deviations from the recommended practice that cause increased risk, including financial risk, to the Standards, Engineering, and Technology Team (SET) via the formal waiver process for the purpose of quality assurance and intra-company communication.

The responsibility for design, build, and maintenance of equipment and pipelines resides within the Business Units, while SET makes itself available for advice to the Business Units when required and provides current information to users of the SARPs. SET will continue to update the SARPs to ensure that they express regulated minimum standards and to mitigate the problem of differing interpretation of Legislation, Regulation, Codes and/or Guidelines by different users. SET will alert the users to changes in these publications through the issuance of revisions to the SARPs.

The above approach will address the specific needs of stakeholders without compromising Regulatory requirements or essential corporate values.

These SARPs will be posted on the Encana SET web site, and it will be the responsibility of the users of these SARPs to use the most current revision.

REVISION SUMMARY

Rev	Clause Affected	Description of Change
2	Title change Various clauses	Updated title to include all fixed equipment coating Text updated to include pressure vessels Added API 650 to Codes and Standards Added SP0302-2007 to Codes and Standards Added Section 4.1.3 Added additional painting system Updated Figure 1 flow chart

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1.0 INTRODUCTION

1.1 Scope

This specification contains the minimum technical requirements of Encana Oil & Gas (USA) Inc. (Encana) for application of a spray-applied protective coating to the interior shell and floor of liquid storage tanks and pressure vessels. These tanks and pressure vessels are located at various Encana field locations (Here after all references to tanks shall refer to tanks and pressure vessels). Tank dimensions and volumes shall be indicated to the Contractor on the request for quotation.

The storage tanks **and pressure vessels** will be placed into liquid hydrocarbon or water storage services at various service temperatures. The actual service conditions however shall be determined on a project basis and specified to the Contractor by the Owner on the request for quotation.

During operation of the storage tanks **and pressure vessels** after internal coating, will have various amounts of water and solids, such as sand, asphaltene or paraffin, may enter the tanks and accumulate on the tank floor or be in contact with the lower tank shell areas.

The area of the tank shell and floor to be coated **or internal surface area of a pressure vessel** shall be indicated to the Contractor by the Owner on the request for quotation.

This standard addresses only the technical requirements for the coating application procedure and does not address or identify worker exposure or safety aspects involved with this coating application procedure. The Contractor shall address these based on their own safety procedures and through discussion and contact with the Owner's Safety Representative and the manufacturer of the coating product specified.

The requirements of this Specification are intended for new Encana projects, but may be applied retroactively if required by Business Unit management. Encana employees and contractors have 90 days from approved for use date to implement this Specification.

Key terms used in this Specification are defined in [Appendix A](#).

Sources used, in addition to codes and standards, in the development of this Specification are listed in [Appendix B](#).

1.2 Roles and Responsibilities

Table 1: Roles and Responsibilities

Role	Responsibilities
All Business Units	Follow Standard
Individual Business Units	Design, build and maintain equipment
Project/Facilities Engineers	Design facilities
SET Team	Provide technical advice and support
Coordinator	<ul style="list-style-type: none"> Act as first contact for all information related to Standard Manage all SARP-related processes: <ul style="list-style-type: none"> SARP numbering, formatting and publishing SARP approvals SARP waivers SARP proposals
Owner	<ul style="list-style-type: none"> Maintain SARPs Respond to requests for waivers
Reviewer	<ul style="list-style-type: none"> Review SARPs for code compliance Provide industry perspective on subject matter

2.0 GENERAL REQUIREMENTS

2.1 Codes and Standards

References to be used in conjunction with this specification are the most recent edition of the following:

American Petroleum Institute (API)

API 650 Welded Tanks for Oil Storage

ASTM International

ASTM D4285 Standard Test Method for Indicating Oil and Water in Compressed Air

ASTM E337 Standard Test Method for Measuring Humidity with a Psychrometer

Steel Structure Painting Council (SSPC)

SSPC-PA1 Shop, Field and Maintenance Painting

SSPC-PA2 Measurement of Dry Paint Thickness with Magnetic Gauges

SSPC-SP1 Solvent Cleaning

SSPC-SP10 Near-White Metal Blast Cleaning (NACE No. 2)

SSPC-VIS 1 Visual Standard for Abrasive Blast Cleaned Steel

SSPC-Guide15 Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates

NACE International (NACE)

SP0178 Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to be lined for Immersion Service

SP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
RP0287	Field Measurement of Abrasive Blast Cleaned Surfaces Using a Replica Tape
RP0288	Inspection of Linings on Steel and Concrete
SP0302	Selection and Application of a Coating System to Interior Surfaces of New and Used Rail Tank Cars for Molten Sulfur Service

Manufacturer

Materials Safety Data Sheet (MSDS)
Product Data Sheet
Handling and Application Procedures

2.2 Conflicts

- 2.2.1 Where there are conflicts between Encana's drawings, data sheets specifications or requisition and the specified code or governmental requirements, such conflicts shall be referred to Encana in writing for resolution.
- 2.2.2 If the above referenced standards conflict, the more stringent shall apply. If the above referenced standards conflict with this Specification, the requirements of this Specification shall apply. In all cases, applicable Governmental Regulations shall be fulfilled.
- 2.2.3 The Contractor shall comply with changes and/or additions incorporated in the most recent issue or edition of codes, regulations and other references issued up to the time of award of contract.
- 2.2.4 Where there are revisions to codes, regulations or other references listed in the contents of this Specification, the current revisions shall apply to new construction.
- 2.2.5 Where there is conflict between the contents of this Specification and detailed engineering drawings, the Owner shall be called upon to make a final and binding decision.
- 2.2.6 In case of conflict, Imperial units shall over rule metric (S.I.) units. In case of conflict, the Owner shall be called upon to make a final and binding decision.
- 2.2.7 In case of conflict between county, state and federal, the most stringent regulations shall apply.
- 2.2.8 Contractor shall obtain the Company's written approval for all deviations, exceptions and substitutions to this specification including those, which are permitted subject to the approval of the Encana.

2.3 Coating General Requirements

- 2.3.1 The Manufacturer's coating product data sheet and application recommendations are an integral part of this specification and the coating

application shall be in compliance with the Manufacturer's recommendations.

In the event of differences between the Manufacturer's recommendation and this specification, this specification shall prevail. In the event of any discrepancies, the Owner shall be called upon to make a final and binding decision.

- 2.3.2 Prior to coating application all tanks shall be inspected by the Contractor to ensure compliance with NACE SP0178 as detailed in [Section 7](#) and [Table 3](#).
- 2.3.3 Applied coating that fails the tests outlined in [Section 7](#) and/or Table 3 and is deemed not repairable by the Owner shall be removed and replaced by the Contractor's at no cost to the Owner.
- 2.3.4 The Contractor shall prepare an Inspection and Test Plan (I&TP) for all aspects of the coating application and submit a copy to the Owner prior to the commencement of work for review.
- 2.3.5 A pre-job meeting shall be conducted with the Contractor to review the quality program I&TP and the production schedule. Coating Inspection requirements shall be based on NACE RP0288.
- 2.3.6 The Contractor shall be responsible for supply of all personnel and equipment necessary for the implementation of the coating project inclusive of the I&TP requirements. The Contractor's designated quality control supervisor shall be responsible for quality and shall have suitable experience and be proficient in the use of inspection equipment. Where requested by the Owner, the quality control supervisor shall provide documentation that demonstrates suitable qualifications and experience.
- 2.3.7 The requirement for the coating of the underside of storage tank roofs shall be considered on a project basis since coating application may not be practical for large diameter tank roofs where interior tank roof girders and other supports are installed. The presence of the support girders prevents effective coating application of the roof plate over the tops of the girders. In cases where tank roof coating is deemed necessary by the Owner, a special coating application procedure shall be proposed by the Contractor based on a best effort basis.

Note: Where new tanks are being designed for known corrosive service fluid applications and where coatings are specified, consideration shall be given to minimizing the amount of interior structural steel support to the roof, use of self-supporting tank roof designs or the use of exterior roof rafters placed over the roof plate shall be considered.

3.0 COATING MATERIALS

Only the coating materials listed in [Table 3](#) shall be applied. Proposal for alternate equivalent coating products from the manufacturers listed in [Table 3](#) may be considered by the Owner. Approval of any alternate coating materials shall be obtained from the Owner and the Manufacturer before acceptance.

4.0 SURFACE CLEANING AND WASHING (PRIOR TO ABRASIVE BLASTING)

4.1 Cleaning Details for New Tanks & Pressure Vessels

- 4.1.1 For visual representation of surface preparation and coating application see [Figure 1](#) and [Figure 2](#) in [Appendix C](#).
- 4.1.2 The steel surface to be coated shall be cleaned of residual contaminants including chlorides in compliance with the procedures given in NACE SP0302 and SSPC-SP1. Following an initial low pressure washing of the tank, the application of a suitable surface cleaning chemical solution that is approved by the Owner and the Manufacturer shall be applied in accordance with the cleaning product directions for use.
- 4.1.3 Test for chlorides per section 7.2.1. If tank passes, then no further power washing is required. If tank fails chloride test, then proceed to Section 4.1.4.
- 4.1.4 Following application of the cleaner solution specified in [Section 4.1.2](#), 100% of the tank surfaces to be coated shall be high pressure water washed, using a washing pressure of 4000 psi or higher. The wash water shall be potable quality water (drinking water quality). The high pressure water washing shall fully remove the cleaning solution and render the steel surface free of traces of hydrocarbons and salt contaminants (see [Section 7.2](#)) and render a pH in the range of 6.0 to 8.0. The pH test shall be in accordance with the procedure specified in NACE SP0302, Section 6.

4.2 Cleaning Details for Used Tanks & Pressure Vessels

- 4.2.1 For visual representation of surface preparation and coating application see [Figure 1](#) and [Figure 2](#) in [Appendix C](#).
- 4.2.2 Where specified by the Owner, for storage tanks that have been in service prior to coating application, the steel surface to be coated shall be cleaned of residual contaminants including chlorides in compliance with the procedures given in NACE SP0302 and SSPC-SP1. Following an initial low pressure washing of the tank, the application of a suitable surface cleaning chemical solution that is approved by the Owner and the Manufacturer shall be applied in accordance with the cleaning product directions for use.
- 4.2.3 Following application of the cleaner solution specified in [Section 4.1.2](#), 100% of the tank surfaces to be coated shall be high pressure water washed, using a washing pressure of 4000 psi or higher. The wash water shall be potable quality water (drinking water quality). The high pressure water washing shall fully remove the cleaning solution and render the steel surface free of traces of hydrocarbons and salt contaminants (see [Section 7.2](#)) and render a pH in the range of 6.0 to 8.0. The pH test shall be in accordance with the procedure specified in NACE SP 0302, [Section 6](#).

- 4.2.4 In the event that scale deposits or contaminants remain on tank surfaces, abrasive blasting may be required to fully clean and prepare the tank for coating. After abrasive blasting has removed heavy scale and deposit, repeat wash and rinse as detailed in [Section 4.2.2](#) and [Section 4.2.3](#) above. If abrasive blasting is not required to remove heavy scale and deposit, proceed to Section 5 for surface profile preparation.

NOTE: Surface abrasive blasting steps outlined in [Section 5](#) must still be completed prior to coating.

- 4.2.5 For inspection and testing refer to [Table 3](#) and [Section 7](#).

5.0 SURFACE PREPARATION (ABRASIVE BLASTING)

5.1 Preparation Details

- 5.1.1 For visual representation of surface preparation and coating application see [Figure 1](#) and [Figure 2](#) in [Appendix C](#).
- 5.1.2 Prior to abrasive blasting, any accumulations of grease, oil, or other contaminants shall be solvent cleaned in accordance with SSPC-SP1. Residual chlorides and sulfates contaminants shall be removed by pressure washing and/or abrasive blasting to provide test result readings as specified in [Table 4](#). The maximum level of residual chloride contamination shall be 2 micrograms/cm² (µg/cm²) and the maximum level of residual sulfate contamination shall be 10 micrograms/cm² (µg/cm²).
- 5.1.3 Prior to commencement of work, documented details of the blasting abrasive type to be used shall be provided to the Owner for review and acceptance.
- 5.1.4 Suitable drying/dehumidification/oil filter equipment shall be installed on the compressed air supply provided by the Contractor and shall provide a continuous supply of clean, oil free and dry compressed air used for abrasive blasting.
- 5.1.5 All piping and appurtenances on the vessel or tank shall be sealed off or protected before starting abrasive blasting operations.
- 5.1.6 Abrasive blast media shall be maintained dry with a neutral pH, and containing no contaminants that may be injurious to the life expectancy of the applied coating. The abrasive blast media shall be sharp and hard so as to produce an angular profile. If requested by the Owner, a laboratory analysis of the abrasive blast media shall be provided prior to commencement of work. The blast media will be deemed unacceptable if the analyzed chloride level exceeds 5.0 ppm.
- 5.1.7 The final surface preparation immediately prior to the application of coating must conform to SSPC-SP10 (NACE No. 2), Near-White Metal Blast Cleaning. The surface is to be evaluated based on comparison to SSPC-VIS 1: Visual Standard for Abrasive Blast Cleaned Steel.

- 5.1.8 The surface profile of the prepared surface shall be in the range of 2.50 to 5.25 mils.
- 5.1.9 The Contractor shall provide any necessary tank or pressure vessel enclosures or other heating or dehumidification equipment required to ensure that the internal environment during abrasive blasting of the tank or pressure vessel is maintained at a relative humidity below 85%, and the steel shell and floor temperatures shall be maintained at a minimum of 5°F above the dew point temperature measured and determined inside the tank. ASTM E337 shall be used as the test method for measuring humidity.
- 5.1.10 On completion of abrasive blasting and removal of the spent abrasive, and prior to the coating application, all surfaces to be coated shall be thoroughly cleaned, including vacuum cleaning, to ensure all residual dust and/or abrasive is effectively removed.
- 5.1.11 Prepared surfaces shall be coated as soon as possible after surface preparation and no later than 8 hours after acceptance inspection. Any deterioration of surface condition due to any cause shall be re-blasted cleaned.
- 5.1.12 Any defective steel conditions revealed by the abrasive blast cleaning process shall be reported to the Owner and shall be repaired by the Owner before completion of abrasive blast cleaning.
- 5.1.13 All solid waste which contains, or at any time contained oil, grease, solvents or other petroleum products falls within the scope of the oil and hazardous substances control, cleanup and disposal procedures of the Encana Environmental Plan.
- 5.1.14 Prior to commencement of the coating application, the tank or vessel to be internally coated shall be inspected and accepted by the Contractor to ensure that all surfaces and other features can be coated as per the requirements of this specification stated in [Section 7](#) or [Table 4](#). Areas that do not meet these requirements shall be reported to the Owner or the Inspector and be repaired prior to commencement of the coating application.

6.0 COATING APPLICATION

6.1 Coating Details

For visual representation of surface preparation and coating application see [Figure 1](#) and [Figure 2](#) in [Appendix C](#).

- 6.1.1 The Contractor shall provide mixing, thinning, application and curing of the coating in strict accordance with the documented procedures of the Manufacturer. Any addition of thinner to the coating product and the rate of thinner addition where approved shall be in strict accordance with the Manufacturer's instructions.

- 6.1.2 Coatings with solids content greater than 90% by volume shall not be thinned and shall be applied with plural component spray equipment.
- 6.1.3 Coating containers shall arrive on site in unopened, undamaged, original containers, with legible product designation and batch number. All coating material received on site shall be stored in a manner that protects the coating from physical damage and deterioration due to moisture or ambient temperature conditions. Splitting of multi-component kits shall not be allowed. Full kits must be mixed as per the Manufacturer's recommendations.
- 6.1.4 During the application of the coating and curing, the Contractor shall maintain the metal temperature at a minimum of 5°F above the dew point temperature of the air inside the tank. In addition, the metal temperature shall not be lower or higher than the coating Manufacturer's recommended curing temperature at any point during the coating application and curing cycles. Should substrate temperatures and humidity be outside the recommended range, the Contractor shall provide suitable heating equipment and fuel and/or dehumidification equipment to ensure the temperature and humidity are maintained at the specified level.
- 6.1.5 Welds shall normally be stripe-coated by brush application prior to spray application of the primer coating. Where stripe coating is applied by spray application, it shall be approved by the Manufacturer and performed in accordance with their documented stripe coating procedure. For stripe-coat application only, the coating material may be additionally thinned, as recommended by the coating Manufacturer. For brushing/stripping welds, only sufficient coating material shall be applied to produce a slight color change of the steel substrate and the coating material shall not be applied excessively. Visible brush marks shall not be present on stripe coats and normally indicate that excessive coating thickness is applied.
- 6.1.6 Where pitted areas exist on the tank floor or shell, the primer coat shall be back-rolled to achieve coverage of pitted areas. If corrosion pits are considered by the Owner to be too severe for successful coating, than the Contractor shall propose a grouting procedure to fill pits, using a compatible epoxy based grout product that is approved by the coating Manufacturer and the Owner. Pressure vessel repairs must be done in accordance to ASME standards.
- 6.1.7 Raised face flanges attached to atmospheric tanks should be internally coated where size allows (i.e. >4), so that coating extends over the raised face uniformly and smoothly with a thickness range of 4.0 to 6.0 mils. Prior to coating, the flange shall have a small radius installed by grinding at the flange face bore to remove the sharp 90 degree corner.
- 6.1.8 Each coat shall be applied in accordance with the specified dry film thickness value and be free of runs, sags, blisters, misses and debris prior to the application of subsequent coat. The Owner or the Inspector shall determine acceptability of coating prior to application of subsequent

coating. Coating repairs shall be completed by the Contractor and accepted by the Owner prior to the next coat application.

- 6.1.9 The duration of the dry and cure time periods between coats shall be in strict accordance with the Manufacturer's recommendation.
- 6.1.10 The final dry film thickness of the coating shall be as specified in [Table 3](#) or as specified by the Manufacturer's product application instructions.
- 6.1.11 The coating shall be applied smooth and uniform, free of runs and sags, and shall be 100% holiday free.

7.0 INSPECTION AND TESTING

7.1 General Inspection and Testing Details

- 7.1.1 The Owner and Inspector shall have the right to access and inspect any phase of the coating application, witness the Contractor's inspection and to perform tests to evaluate the coating application. The Contractor is responsible for performing all quality assurance testing specified herein and the implementation of the approved coating application Inspection and Test Plan (I&TP).
- 7.1.2 [Table 4](#) provides a summary of the minimum inspection and testing requirements. The inspection program shall be based on NACE RP0288.

7.2 Surface Cleaning and Washing (Prior to Abrasive Blasting) Inspection and Testing Details

- 7.2.1 Upon completion of surface cleaning and washing (prior to abrasive blasting), a minimum of four tests on the tank shell and two tests on the tank floor shall be performed by the Contractor to determine the chloride residual on the metal surface and the pH. The maximum level of chloride contamination shall be 2 micrograms/cm² (µg/cm²) and the maximum level of sulfate contamination shall be 10 micrograms/cm² (µg/cm²) when tested in accordance with SSPC-Guide 15.
- 7.2.2 The pH acceptable range shall be 6.0 to 8.0 when tested as specified in NACE SP0302.
- 7.2.3 After surface cleaning and washing is complete, the tank shall be placed on **HOLD** and the Owner notified. The Owner shall be given the opportunity to inspect the tank. The **HOLD** shall be removed at the Owner's discretion.

7.3 Surface Preparation (Abrasive Blasting) Inspection and Testing Details

- 7.3.1 Prior to and once every four hours during operation, the cleanliness of the compressed air being supplied shall be checked in accordance with ASTM D4285. A clean, white cotton rag collector shall be positioned in the main compressed air supply stream downstream of the required moisture and oil traps. A one minute or longer sample of air shall be delivered onto the collector. Following this, the collector shall be visually

inspected and if moisture or oil is evident, this shall be reason to reject the compressed air supply.

- 7.3.2 For the abrasive blasting surface preparation, the metal temperature, relative humidity and dew point shall be measured once every eight hours at the start of each shift, documented and shall be in accordance with [Section 5.1.9](#) of this specification, NACE RP0288 and the Manufacturers recommendations.
- 7.3.3 Surface profile measurements shall be taken on the shell and floor of the tank at a frequency of once per four hours during abrasive blast cleaning, using profile tape in accordance with [Table 4](#) of this specification and NACE RP0287.
- 7.3.4 Upon completion of surface preparation (abrasive blasting), all surfaces shall be visually inspected using visual comparator SSPC-VIS 1, optical magnifying device and ultraviolet light to check for the presence of any residual contaminants, including hydrocarbon residues left on the metal surface.
-
- 7.3.5 The pH acceptable range shall be 6.0 to 8.0 when tested as specified in NACE SP0302.
- 7.3.6 After surface preparation (abrasive blasting) is complete, the tank shall be placed on **HOLD** and the Owner notified. The Owner shall be given the opportunity to inspect the tank. The **HOLD** shall be removed at the Owner's discretion.

7.4 Coating Application Inspection and Testing Details

- 7.4.1 Prior to coating application, all tanks shall be inspected by the Contractor to ensure compliance with NACE SP0178. All weld splatter, slag, sharp edges, sharp corners and other changes of profile that does not comply with the requirements of the NACE SP0178 shall be profiled by grinding. Weld surface condition, as a minimum, shall meet Weld Condition D, described in SP0178, [Appendix C](#).

Where weld surface conditions do not meet this requirement, the contractor shall notify the Owner or Inspector for remedial action.

- 7.4.2 Prior to and once every four hours during operation, the cleanliness of the compressed air being supplied shall be checked in accordance with ASTM D4285. A clean, white cotton rag collector shall be positioned in the main compressed air supply stream downstream of the required moisture and oil traps. A one minute or longer sample of air shall be delivered onto the collector. Following this, the collector shall be visually inspected and if moisture or oil is evident this shall be reason to reject the compressed air supply.
- 7.4.3 Following the curing of each coat, the dry film thickness of the coating shall be measured using a calibrated dry film coating gauge in

accordance with SSPC-PA2. Thickness measurements shall be performed on vessel and tank surfaces and on flange faces.

- 7.4.4 For coating application and coating curing the metal temperature, relative humidity, dew point and curing times shall be measured once every eight hours at the start of each shift, documented and shall be in accordance with [Section 6.1.5](#) of this specification, NACE RP0288, and with the Manufacturers recommendations.
- 7.4.5 The coating shall be visually inspected for any presence of discontinuities, voids, air entrapment, runs and sags. Any of these shall be cause for rejection and shall be repaired and re-tested by the Contractor at no cost to the Owner and require final acceptance by the Owner.
- 7.4.6 The entire surface of the coating shall be 100% holiday inspected in accordance with NACE SP0188.
- 7.4.7 After coating application, coating thickness and holiday inspection is complete, the tank shall be placed on **HOLD** and the Owner notified. The Owner shall be given the opportunity to inspect the tank. The **HOLD** shall be removed at the Owner's discretion.

8.0 REQUIREMENTS – COATING REPAIRS

8.1 Repair Details

- 8.1.1 The materials that were used for the internal coating shall be used for repairs.
- 8.1.2 Remove the defect or defective coating and feather back to tightly adherent coating by abrading the areas with coarse sandpaper, power sander or a file.
- 8.1.3 If more than 25 square inches of bare steel is exposed after defect removal, prepare the entire surface by abrasive blasting.
- 8.1.4 Abrade the surrounding coating for a distance of 1.5 inches from the edge of the defect to provide inter-coat adhesion. Feather the edges of the existing coating.
- 8.1.5 Prior to patching, remove all loose particles and dust with dry compressed air or a clean dry cloth. Solvent cleaning may be required using a Manufacturer approved cleaner.
- 8.1.6 Recoat or repair the prepared surface(s) to the specified dry film thickness, with the repair coating overlapping a minimum of at least 1 inch onto the surrounding intact coating.
- 8.1.7 The repair shall be holiday tested and 100% holiday free in accordance with NACE SP0188.

- 8.1.8 Where the repair area exceeds 25% of the total coated surface, the tank shall be abrasively blasted and re-coated in accordance with the requirements of this standard.

9.0 CONTRACTOR'S RESPONSIBILITY

The Contractor shall furnish all labor, tools, equipment, fuels and materials required for the performance of the work outlined in this specification.

This includes the following:

- Transportation of personnel and equipment to and from the job location;
- Handling and proper storage of coating materials and equipment in accordance with the Manufacturer's recommendations;
- Compressed air equipment quality and pressure at the nozzle and size of nozzle;
- Abrasive type, mesh size and results of qualitative test for soluble salts;
- Surface profile confirmed with replica tape and confirmation of surface cleanliness;
- Recording of time between blast and start of coating application;
- Coating product name and batch numbers of coating and thinner;
- Coating temperature prior to application, induction time, coating ratio and percentage of thinner used;
- Application method and equipment used to apply coating;
- Application of primer coat;
- Application of top coat;
- Coating film thickness;
- Recording of time duration between coats;
- Complete cure of the coating including the provision of insulated tarpaulins, indirect fired heaters, fuel to cure the coating (the method of supplying heat shall be approved by the Owner), cure time and temperature and cure test performed (type and method);
- Dehumidification equipment, if required;
- Inspection and testing;
- Holiday test results, type of tester used, voltage setting, number of holidays found, location and cause of holiday;
- Repairs and holiday repair procedure;
- Written job completion report submitted to the Owner within thirty days of the completion of the job that summarizes work performed and inspection test results.

APPENDIX A: DEFINITIONS

Table 2: Definitions

Term	Definition
Owner	The term Owner shall mean Encana Oil & Gas (USA) Inc. or their designated agent or representative for the coating application project to which this specification is applicable.
Applicator	The term Applicator shall mean the company responsible for the actual application of the coating.
Inspector	The term Inspector shall mean the individual or company who represents the Owner to ensure quality control of the work and adherence to this specification.
Manufacturer	The term Manufacturer shall mean the company responsible for the chemical formulation and characteristics, the manufacturing and the handling and application procedures for the specified coating product being applied to this specification.
Recommended Practices	<p>Non-mandatory documents that describe techniques or methodologies that, through experience and research, have proven to reliably lead to a desired result. Recommended Practices do not require official approval but where deviations are considered the party responsible must:</p> <ol style="list-style-type: none"> 1. Complete the Encana Risk Assessment Worksheet and Mitigation Documentation Form. 2. Ensure that deviations are reviewed and approved by a qualified company representative and/or a Professional Engineer where applicable. 3. Report any deviations from the recommended practice that cause increased risk, including financial risk, to the Standards, Engineering, and Technology Team (SET) via the formal waiver process for the purpose of quality assurance and intra-company communication.
Specifications	<p>Mandatory documents that specify, in a complete, precise, verifiable manner, the requirements, design, behavior, or other characteristics of a system, component, product, result, or service and, often, the procedures for determining whether these provisions have been satisfied. These documents will refer to appropriate guidelines, codes, and legislation/regulation and only repeat such information as a point of clarification/interpretation. They may at times exceed the requirements of these publications to provide best life cycle economics, not necessarily capital savings. If any deviation from these documents is desired, the waiver or proposal process must be followed.</p>

APPENDIX B: REFERENCES

The following sources were used in the development of this Specification:

American Petroleum Institute (API)

API 650 Welded Tanks for Oil Storage

ASTM International

ASTM D4285 Standard Test Method for Indicating Oil and Water in Compressed Air

ASTM E337 Standard Test Method for Measuring Humidity with a Psychrometer

Steel Structure Painting Council (SSPC)

SSPC-PA1 Shop, Field and Maintenance Painting

SSPC-PA2 Measurement of Dry Paint Thickness with Magnetic Gauges

SSPC-SP1 Solvent Cleaning

SSPC-SP10 Near-White Metal Blast Cleaning (NACE No. 2)

SSPC-VIS 1 Visual Standard for Abrasive Blast Cleaned Steel

SSPC-Guide15 Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates

NACE International (NACE)

SP0178 Design, Fabrication, and Surface Finish Practices for Tanks and Vessels to be lined for Immersion Service

SP0188 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

RP0287 Field Measurement of Abrasive Blast Cleaned Surfaces Using a Replica Tape

RP0288 Inspection of Linings on Steel and Concrete

SP0302 Selection and Application of a Coating System to Interior Surfaces of New and Used Rail Tank Cars for Molten Sulfur Service

APPENDIX C: COATING DETAILS

Table 3: Coating Material List

Mfg. [2], [6]	Coating System	Total Dry Fill Thickness (mils) [4]	# of Coats [4]	Air & Substrate Temp. Min/Max (°F)	Drying Times @ 77 °F		Coating System Service Applications [3]
					Recoat [5] Min/Max	Cure [5]	
Sherwin Williams	Dura-Plate UHS	20 to 24	2	50/110	16 hr / 14 day	4 day	-Use for oil and fuel immersion -Optional low temp hardener -Good for potable water -Acceptable w/ cathodic protection systems -Max Service Temp: Crude Oil ≤ 150 °F Fuel ≤ 120 °F; Water ≤ 150 °F
Sherwin Williams	Nova-Plate UHS	20 to 24	2	50/110	12 hr / 21 day	5 day	-Oil tanks and refined fuel storage liner -Acceptable under thermal insulation -Chemical holding tanks -Good in immersion service - Max Service Temps: Crude Oil ≤ 220 °F Fuel ≤ 120 °F; Water ≤ 275 °F
Sherwin Williams	Fast Clad ER	18 to 22	1	40/110	35 min / 14 day	12 hr	-Use for oil and fuel immersion -Chemical holding tanks -Rebuild pitted surfaces -Acceptable w/ cathodic protection systems
Sherwin Williams	Envirolastic AR200 HD [6]	60 to 250 [1]	1	-20/120	12 sec / 16 hr	24 hr	-Water service Only -NOT for use w/ hydrocarbons -Max Service Temp: Water ≤ 120°F
Sherwin Williams	ExpressCote HCR FF	20 to 50	1	50/120	5 hr / 7 day	24 hr	-For ethanol storage and chemical tanks -Acceptable w/ cathodic protection systems - Max Service Temps: Crude Oil ≤ 220 °F Fuel ≤ 120 °F; Water ≤ 190 °F
Sherwin Williams	Phenicon HS/FF	10-12	2	35/120	18 hr / 30 days	7 days	Refined Products, brine Water, Crude Oil, Ethanol. Low Temperature application not recommended for Ethanol service - Max Service Temps: Crude Oil ≤ 250 °F Fuel ≤ 120 °F; Water ≤ 120 °F
Specialty Polymer Coatings	SP-9888	25 to 30	1	59/122	3.5 hr / 12 hr	6.5 hr	-Excellent immersion chemical, solvent and water resistance -For use up to 300 °F
International Devco	Bar-Rust 236 with Devmat 111 Topcoat	236:5 to 10 111:10 to 30	236: 1 111: 1	236: Call mfg 111: min 50	236: 210min / 5d 111: 10hr / 72hr	236: 2day 111: 7day	236: -Universal coating -Use w/ fresh or salt water, fuel and solvent -Optional low temp cure (0°F) 111: -Resistant to solvents like ethanol and aromatics like gasoline, xylene and ether -Rebuild pitted surfaces -Designed for use on tank bottoms -Excellent wetting of glass mat chopped glass fiber
International Devco	Devchem 253 HS	12 to 16	1	min 50	7 hr / 2.5 day	7 day	-Industrial/chemical storage -For use in high corrosion environments, crude oil pipes and separation tanks -DO NOT apply over primer -NOT for inorganic acids
International Devco	Devmat 100	15 to 40	1	Call mfg	10 hr / 16 hr	7 day	-For petroleum tank bottom and chemical holding tanks -Good flexibility

- For non-immersion applications, minimum coating thickness is 30 mils.
- Table 3 references manufactures coating data sheets. In the event of a conflict between Table 3 and the manufactures specifications, the manufactures applications specifications shall apply. Please refer to all manufactures specifications prior to commencement of coating application.
- Allowable service temperatures vary between coating systems. Ensure service fluid operational temperatures fall within manufacture's recommendations.
- Table 3 provides referenced manufactures specifications for typical number of coats applied in a system and specified thickness. As a general rule, coat the floor and lower wall section to the upper end of the allowable thickness.
- The Recoat and Cure times listed in Table 3 are approximate times based on best practices and manufacture's literature. The cure time will vary from these values based on the product involved, the steel substrate temperature, air flow, air circulation within the tank and ambient temperature and relative humidity. Therefore, cure times shall be verified on a project basis based on manufacture's recommendations and ambient conditions.
- The coating systems listed in Table 3 are NOT EXCLUSIVE. Other coating systems can be used based on operational needs with approval from Owner. Manufacture's coating application procedures and recommendations must be adhered to for all coating systems.

Table 4: Inspection and Test Requirements Summary

Section	Requirement	Frequency	Test Protocol	Hold Point
2.3 7.4	NACE SP0178	100% of internals	Fabrication requirements: Coating Applicator to verify pre-job.	yes
4.1 4.2 5.1 8.1	Oil and grease cleaned	100% of internals	SSPC-SP1	no
5.1 7.3	SSPC-SP10 Cleanliness No hydrocarbon contaminants	100% of surface	SSPC-VIS1 Visual comparators, magnifying glass, black light	yes
5.1 7.2 7.3	Salt Contamination of steel: Chloride $\leq 2 \mu\text{g}/\text{cm}^2$ Sulfate $\leq 10 \mu\text{g}/\text{cm}^2$	Minimum 2 tests on floor and shell	SCAT or equivalent SSPC Guide 15	yes
5.1 7.3	Surface profile 2.50 to 5.25 mils	1 per 4 hours during abrasive blasting	NACE RP0287 Profile Replica Tape (Testex or equivalent)	yes
5.1 6.1 7.3 7.4	Relative humidity <85% and steel temperature maintained a minimum of 5°F above dew point	1 per 8 hour shift	ASTM E 337 Determine using standard psychrometer procedure and thermometer and record	no
5.1 7.3 7.4 8.1	Compressor air checked for cleanliness	1 per 4 hours of abrasive blasting or coating application	ASTM D 4285 – one minute air sample blown onto a clean, white rag collector, no evidence of moisture or oil on collector	no
6.1 7.4 8.1	Coating thickness in accordance with Table 2	Measured on each coat and final thickness	SSPC-PA-2	yes
6.1 7.4 8.1	100% holiday free coating	100% of coated surface	NACE SP0188	yes

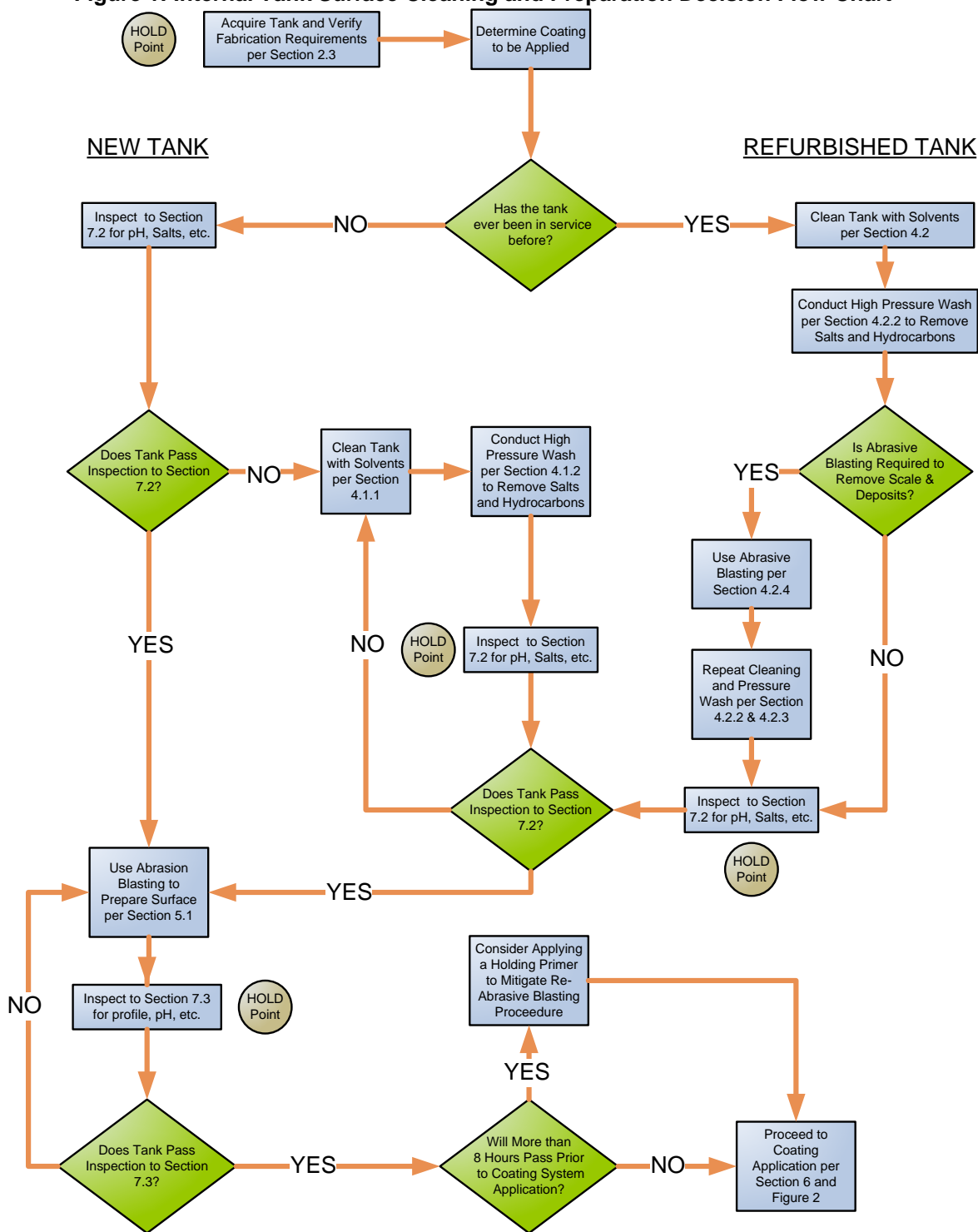
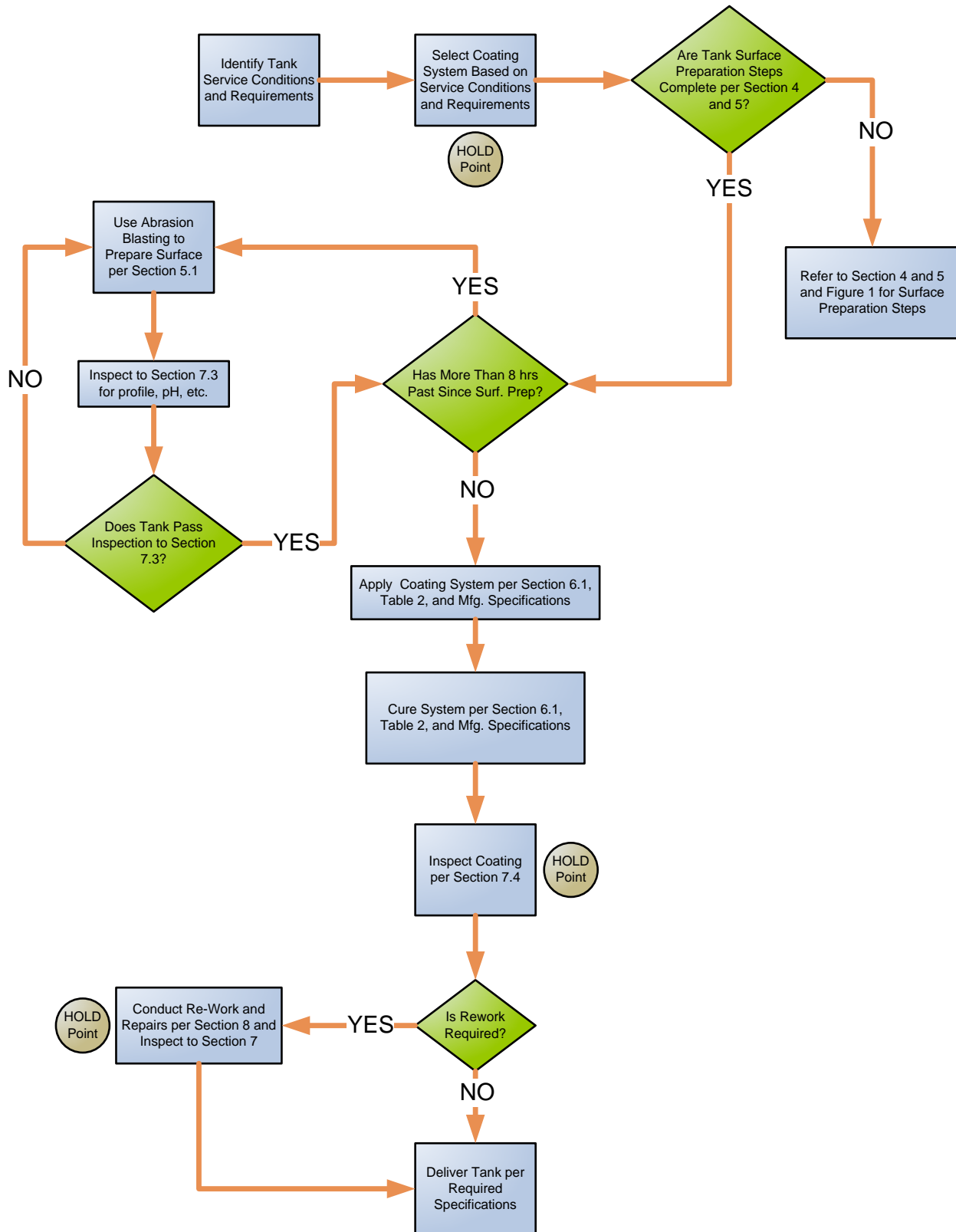
Figure 1: Internal Tank Surface Cleaning and Preparation Decision Flow Chart

Figure 2: Coating Application Decision Flow Chart



Encana Oil & Gas (USA) Inc.

Specification for Painting of New Equipment

Document Description

Document Type	Specification		
Document Number	ECA-USA-COAT-S-004		
Predecessor	N/A		
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0	Issued for Approval	05/18/11	FAM	Andrew Torres	Gerald Hunt
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SARP APPROVAL SIGN-OFF SHEET

SARP #: ECA-USA-COAT-S-004

SARP Name: Specification for Painting of New Equipment

Description: This specification describes the minimum requirements for surface preparation and application of selected painting materials for the protection of above-ground structural and miscellaneous steelwork, piping, vessels, tanks and equipment.

**The undersigned endorse the implementation of the SARP referenced above
for applicable USA Division activities**

A handwritten signature in blue ink, appearing to read "Byron B. Gale".

Byron Gale, Vice President
Environmental, Health, Safety & Security

Date: July 8, 2011

A handwritten signature in blue ink, appearing to read "D. Henke".

Darrin Henke, Vice President
South Rockies Business Unit

Date: 7/11/2011

A handwritten signature in blue ink, appearing to read "Paul Sander".

Paul Sander, Vice President
Mid-Continent Business Unit

Date: 7/26/2011

A handwritten signature in blue ink, appearing to read "John Schopp".

John Schopp, Vice President
North Rockies Business Unit

Date: 7/22/2011

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PREFACE

The Encana Specifications & Recommended Practices (SARPs) are an essential tool of Management for controlling and assuring the safety, reliability, operability, and economic viability of production equipment and pipelines.

The [Specifications](#) contain elements that are mandatory requirements as a result of Legislation, Regulation, Codes and/or Guidelines, whereas [Recommended Practices](#) contain proven non-mandatory techniques or methodologies; both aspects of which must be considered by the parties engaged in the design, procurement, construction, and maintenance of equipment and pipelines in which Encana has an interest.

The Specifications may not be departed from in practice without official approval via the waiver process. The Recommended Practices are subject to interpretation in their application, but where deviations are considered the party responsible must:

1. Complete the Encana Risk Assessment Worksheet and Mitigation Documentation Form.
2. Ensure that deviations are reviewed and approved by a qualified company representative and/or a Professional Engineer where applicable.
3. Report any deviations from the recommended practice that cause increased risk, including financial risk, to the Standards, Engineering, and Technology Team (SET) via the formal waiver process for the purpose of quality assurance and intra-company communication.

The responsibility for design, build, and maintenance of equipment and pipelines resides within the Business Units, while SET makes itself available for advice to the Business Units when required and provides current information to users of the SARPs. SET will continue to update the SARPs to ensure that they express regulated minimum standards and to mitigate the problem of differing interpretation of Legislation, Regulation, Codes and/or Guidelines by different users. SET will alert the users to changes in these publications through the issuance of revisions to the SARPs.

The above approach will address the specific needs of stakeholders without compromising Regulatory requirements or essential corporate values.

These SARPs will be posted on the Encana SET web site, and it will be the responsibility of the users of these SARPs to use the most current revision.

REVISION SUMMARY

Rev	Clause Affected	Description of Change

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1.0 INTRODUCTION

This specification describes the minimum requirements for surface preparation and application of selected painting materials for the protection of above-ground structural and miscellaneous steelwork, piping, vessels, tanks and equipment.

This specification applies to both indoor and outdoor work, regardless of location.

This specification applies to the painting of new equipment only. Any painting of existing assets shall be done in accordance with In-Field Coating Application and Repair ECA-USA-COAT-S-003 (*document under development*).

This specification does not cover coating of underground piping. Coating of underground piping (including transition areas) needs to be done in accordance with the In-Field Coating Application and Repair ECA-USA-COAT-S-003 (*document under development*) and/or Shop-Applied External Coating for Below Ground Pipe ECA-USA-COAT-S-002.

1.1 Scope

Unless otherwise specified, the Encana color schedule shall be followed for **all** painting, and any deviation from the colors in this specification must be approved in writing by Encana. For each project, the final paint colors used (specific brand and color) need to be verified by the BU or facility where work is taking place.

Mechanical, electrical and instrumentation commodities may be supplied in the Vendor's Standard Finish (VSF) and color unless otherwise specified in the purchase contract.

The target audience for this document is Encana facility engineers, project engineers, Encana procurement, manufacturers and fabrication shops.

The requirements of this Specification are intended for new Encana projects, but may be applied retroactively if required by Business Unit management. Encana employees and contractors have 90 days from approved for use date to implement this Specification.

Key terms used in this Specification are defined in [Appendix A](#).

Sources used, in addition to codes and standards, in the development of this Specification are listed in [Appendix B](#).

1.2 Roles and Responsibilities

Table 1: Roles and Responsibilities

Role	Responsibilities
All Business Units	Follow SARPs
Individual Business Units	Design, build and maintain equipment and pipelines
Project/Facilities Engineers	Design facilities
SET Team	Provide technical advice and support
Coordinator	<ul style="list-style-type: none"> Act as first contact for all information related to SARPs Manage all SARP-related processes: <ul style="list-style-type: none"> SARP numbering, formatting and publishing SARP approvals SARP waivers SARP proposals
Owner	<ul style="list-style-type: none"> Maintain SARPs Respond to requests for waivers
Reviewer	<ul style="list-style-type: none"> Review SARPs for code compliance Provide industry perspective on subject matter

2.0 GENERAL REQUIREMENTS

2.1 Codes and Standards

All references listed below shall be the latest edition up to award of contract unless otherwise stated in the contract documents.

2.1.1 The following Steel Structures Painting Council (SSPC) requirements apply:

- Steel Structures Painting Manual, Volume 1 "Good Painting Practice"
- Steel Structures Painting Manual, Volume 2 "Systems and Specifications"
- SSPC AB-1, Abrasive Spec No. 1 Mineral and Slag Abrasives
- SSPC VIS-1, Visual Standard for Abrasive Blast Cleaned Steel
- SSPC PA-2, Measurement of Dry Paint Thickness with Magnetic Gauges

2.1.2 The following Steel Structures Painting Council – Surface Preparation Specifications apply:

- SSPC SP1, Solvent Cleaning
- SSPC SP2, Hand Tool Cleaning
- SSPC SP3, Power Tool Cleaning
- SSPC SP5, White Metal Blast Cleaning

- SSPC SP6, Commercial Blast Cleaning
- SSPC SP7, Brush-off Blast Cleaning
- SSPC SP8, Pickling
- SSPC SP10, Near-White Blast Cleaning (NACE No. 2)
- SSPC SP11, Power Tool Cleaning (with resultant profile)

NOTE: See [Appendix C](#) for complete descriptions.

2.1.3 The following American Society for Testing Materials (ASTM) requirements apply:

- ASTM A 123, Standard Specification for Zinc (Hot-Galvanized) Coatings on Productions Fabricated from Rolled, Pressed and Forged Steel Shapes, Plates, Bars and Strip.
- ASTM A 143, Standard Recommended Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
- ASTM A 153, Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- ASTM E 337, Standard Test Method for Temperature, Relative Humidity and Dew Point Measurement.
- ASTM A 384, Standard Recommended Practice for Safeguarding Against Warpage and Distortion during Hot-Dip Galvanizing of Steel Assemblies.
- ASTM D 4285, Standard Test Method for Indicating Oil or Water Compressed Air.
- ASTM D 4752, Standard Test Method for Measuring MEK Resistance of Ethyl Silicate (inorganic) Zinc Rich Primers by Solvent Rub.

2.1.4 The following National Association of Corrosion Engineers (NACE-International) requirements apply:

- SP 0178-2007, Fabrication Details, Surface Finish Requirements and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service.
- RP 0287-2002, Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces using Replica Tape.
- SP 0188-2006, Discontinuity Holiday Testing of Protective Coatings.

2.1.5 The following US Federal Standard Colors requirement applies: Standard 595 B, US Standard Colors (replaces CGSB – Standard 1-GP-12C).

2.1.6 All work shall conform to the latest federal and local regulatory requirements; including those of worker safety and environmental protection.

2.2 Conflicts

2.2.1 Where there are conflicts between Encana's drawings, data sheets specifications or requisition and the specified code or governmental requirements, such conflicts shall be referred to Encana in writing for resolution.

- 2.2.2 If the above referenced standards conflict, the more stringent shall apply. If the above referenced standards conflict with this specification, the requirements of this specification shall apply. In all cases, applicable Governmental Regulations shall be fulfilled.
- 2.2.3 The Contractor shall comply with changes and/or additions incorporated in the most recent issue or edition of codes, regulations and other references issued up to the time of award of contract.
- 2.2.4 Where there are revisions to codes, regulations or other references listed in the contents of this specification, the current revisions shall apply to new construction.
- 2.2.5 Where there is conflict between the contents of this specification and detailed engineering drawings, the Owner shall be called upon to make a final and binding decision.
- 2.2.6 In case of conflict, Imperial units shall over rule metric (S.I.) units.
- 2.2.7 In case of conflict between county, state and federal, the most stringent regulations shall apply.
- 2.2.8 Contractor shall obtain Encana's written approval for all deviations, exceptions and substitutions to this specification including those which are permitted subject to the approval of the Encana.

3.0 BEFORE STARTING

3.1 General

- 3.1.1 The painting system shall be selected from [Appendix D](#), Schedule of Painting Systems, by the Encana Project Coordinator in consultation with the Encana Facilities Integrity Group.
- 3.1.2 Please note there are specific painting systems for **CO₂ projects** specified in [Appendix D](#). Due to the unique nature of CO₂ injection, conventional painting systems are not adequate because of temperature changes, pipe sweating, etc.
- 3.1.3 Refer to ECA SARP ECA-USA-TANK-S-001 (Above Ground Shop Fabricated Steel Tanks) for guidance on tank internal linings and tank external bottoms.
- 3.1.4 The Contractor shall have a fully implemented quality assurance program which is subject to approval by Encana.
- 3.1.5 Prior to the start of any work, the Contractor shall furnish for Encana approval, procedures to cover the work.
- 3.1.6 Preference shall be given to firms with craft persons who are certified through a comprehensive training program.

- 3.1.7 Surfaces that are not to be coated must be protected from damage, overspray or other contamination.
- 3.1.8 Waste (including spent blast material) generated by the Contractor on Encana property shall be disposed of by the Contractor in a manner conforming to the appropriate regulations.
- 3.1.9 The color schedule included in [Appendix F](#) is provided for convenience only. Due to differences between the pigments used in coatings and those used in printer inks, there may be slight discrepancies between the attached color schedule and US Federal Standard 595B. While the color schedule will be adequate in most situations, in cases of dispute, the US Federal Standard 595B shall take precedence.
- 3.1.10 No portion of the work shall be sub-contracted without written permission from Encana.

3.2 Surfaces NOT to be Primed or Coated

- 3.2.1 The following surfaces are **not** to be primed or coated unless otherwise specified:
 - Aluminum or stainless steel (unless safety or aesthetics are a project concern)
 - Insulation, lagging or jacketing
 - Galvanized steel (unless safety or aesthetics are a project concern)
 - Concrete, cementations materials, masonry, stucco or ceramics
 - Factory finished equipment, including but not restricted to, instrument cases, electrical panels, meters, compressors, pumps or control valves
 - Gauge glasses, valve stems or nameplates
 - Pre-finished metal with an approved finish and color acceptable to the Owner
 - Interior surfaces of equipment
 - Non-metallic surfaces
 - Steel to be embedded or covered in concrete or grout
 - UT data points identified on vessels and piping
- 3.2.2 Masking or compounds used to protect non-primed or coated surfaces must be removed prior to completion of the job.
- 3.2.3 Contamination as a result of overspray or breaches in masking must be cleaned by an appropriate method to restore the contaminated area to its previously uncontaminated state.

4.0 COLOR SELECTION

Paint color selection is the most common (and generally the cheapest) design measure used to mitigate visual contrast between the equipment and its surroundings. When selecting a paint color it is important to consider the following:

- Consider the overall dominant color in the landscape.
- Select a color that is one or two shades darker than the predominant background color.
- Paint all long term facilities in the same area the same color.

When selecting a paint color, it is important to also keep in mind anything else associated with the equipment (i.e. signs or electrical boxes) and how it will contrast with the surroundings as well.

When equipment is placed on BLM land, these steps must be followed and the paint color selected from the Standard Environmental Color Chart. A copy of the chart can be found in [Appendix H](#) or the original chart can be found on the BLM website: <http://www.blm.gov/nstc/VRM/colorcht.html>.

When equipment is being placed on Encana owned, or other non-BLM property, these steps above should be followed and the paint color should be selected from either the BLM Standard Environmental Color Chart or Encana Official Colors Chart in [Appendix G](#).

5.0 SURFACE PREPARATION

5.1 General

Appropriate SSPC surface preparation specifications for each application system in the coating systems summary shall be as shown in [Appendix D](#). For details of the required surface preparation specifications, see [Appendix C](#).

5.2 Steel Substrates

- 5.2.1 Steel substrates shall be prepared as specified. Where abrasive cleaning is specified, compliance shall be confirmed using the SSPC VIS-1 visual standards as a reference. Anchor profile depth and sharpness shall be in accordance with the coating manufacturer's recommendations as a minimum.
- 5.2.2 Prior to the surface preparation of steel substrates, objectionable defects such as weld faults, surface gouges and laminations shall be repaired. Exposed edges and corners shall be rounded for proper paint adhesion and to avoid incidental cuts to personnel and tears to clothing.

5.3 Abrasives

- 5.3.1 Special care shall be taken in selecting blast cleaning abrasives which shall be properly graded to obtain the specified surface profile. If mineral and slag abrasives are used, they shall conform to the Steel Structures Painting Council specification SSPC AB1.

- 5.3.2 All abrasives shall be free of deleterious contaminants. The use of reclaimed blast cleaning abrasives is not permitted except in systems specifically designed for abrasive recycle such as centrifugal cleaning machines.
- 5.3.3 Where compressed air is the preferred abrasive delivery method, the air shall be clean, dry and oil-free as measured by ASTM D-4285 standard.
- 5.3.4 Prior to abrasive cleaning of steel substrates, dirt or water soluble salts shall be removed by washing and rinsing with clean water. Oil, grease or other solvent soluble foreign material shall be removed in accordance with SSPC-SP1 Solvent Cleaning.
- 5.3.5 Objectionable defects such as visible burrs, slivers, scabs, laps and weld spatter that remain after abrasive cleaning shall be removed. Repaired steel shall have the anchor profile depth, density and degree of cleanliness restored as originally specified.
- 5.3.6 Interior surfaces or previously painted surfaces shall be suitably sealed or shielded to protect from blast media.

5.4 Inspection of Surface Preparation

Surface preparation shall be subject to inspection by Encana's inspector before a prime coat or self priming top coat is applied.

5.5 Prime Coat After Surface Preparation

The prime coat should be applied as soon as practical the same day as surface preparation is complete. In the case of abrasive blasted surfaces, the primer must be applied before any visible rusting occurs but in no case greater than 8 hours after completion of the blast. Where the time frame has been exceeded or rusting is evident, non-conforming areas must be re-prepared to meet the original specification. Subject to approval by Encana's inspector, de-humidification equipment may be used to extend the maximum time beyond 8 hours one day.

5.6 Surface Temperature and Relative Humidity

Surfaces shall not be blasted when the surface temp is below 50°F (10°C), within 5°F (2°C) of the dew point of the surrounding air or if the relative humidity exceeds 85%.

5.7 Spent Blast Material

All spent blast material shall be removed from site and disposed of by the Contractor.

6.0 PRIMER AND COATING APPLICATION REQUIREMENTS

6.1 General

Appropriate specifications for each application in the coating systems summary shall be as shown in [Appendix D](#). The brand of product to be applied shall be decided by Project Engineer in consultation with the Corporate Coating Specialist.

6.2 Material Safety Data Sheets

The Applicator shall provide copies of all Material Safety Data Sheets (MSDS) to Encana's site location. Copies of MSDS for all hazardous coating materials, to which the Applicator's personnel may be exposed, shall be kept at the site and posted or available for review by all the Applicator's personnel and Encana's inspector.

6.3 Priming and Coating Materials

- 6.3.1 Priming and coating materials shall be delivered to the Applicator in the manufacturer's unopened, undamaged, original containers which bear a legible product designation, batch number and date of manufacture or shelf life expiry date. All such materials shall be properly received, handled and stored in order to protect them from physical damage and deterioration due to extremes of moisture or temperature.
- 6.3.2 Priming and coating materials shall be applied within their recommended shelf life.
- 6.3.3 Containers of primers and coatings or their respective components shall be opened for immediate use only. Splitting of multi-plural component kits shall not be allowed.
- 6.3.4 Priming and coating materials shall be mixed, thinned, applied and cured in accordance with the manufacturer's written recommendations.

6.4 Test Wet Film Thickness

During the application process, the Contractor shall test the wet film thickness of each coat (except inorganic ethyl silicate zinc rich primer) with a wet film thickness gauge. Readings should be frequent enough to ensure an even application that will result in the desired thickness when dry.

6.5 Spray Application Preferred

The preferred method of application is by spray. Where necessary, brush application is acceptable for areas less than 5.4ft² (0.5m²) or where there is limited access for spray equipment.

6.6 Overcoat or Re-Coat Times

Overcoat or re-coat times as appropriate, shall be as specified in the manufacturer's published application instructions.

6.7 Welding Cutback

Where required, a cutback for welding shall be provided during priming or coating as follows:

Table 2: Welding Cutback Requirement

Primer Type	Cutback Length
Inorganic zinc rich/ethyl silicate primer	1 inch (25 mm)
All other coatings	2.5 inches (60 mm)

NOTE: Where zinc primed carbon steel is to be joined to stainless steel, the zinc primer shall be removed at least 12 inches back from the weld and re-primed with non-zinc coating compatible with the finish coat.

6.8 Austenitic Stainless Steel

Austenitic stainless steel surfaces shall be protected from overspray of zinc rich primers.

6.9 Primed or Coated Steel

Where necessary, primed or coated steel shall be solvent-cleaned to remove loose deposits, oil, grease and other contaminants. This is in accordance with SSPC-SP1 using solvents that will not have a deleterious effect on the primer or existing coating. Dirt and salts shall be removed with clean water by brush or power washing.

6.10 Moisture and Temperature Requirement

Priming or coating materials shall not be applied when there is moisture on the surface, the surface temperature is below 50°F (10°C), or the surface temperature is less than 5°F (2°C) above the dew point. Consult with manufacturer when surface temperatures are below 50°F for recommendations of low temperature application.

6.11 Multi-Coat System

Each coat of a multi-coat system shall be of a contrasting color, including the primer and substrate.

6.12 Base Color for Fabricated Equipment

The base color for fabricated equipment (e.g. vessels, piping, exchangers, etc.) shall be taupe color #16555 US Federal Standards. Banding with an appropriate color listed in [Appendix F](#) shall be provided at regular intervals along piping runs. Color bands shall be appropriately positioned to afford ready identification of the line contents but in no case be greater than 10ft (2.5m) apart. A color band shall be provided on each side of a wall penetration and immediately after each branch and elbow.

6.13 Color Banding

Color banding shall be accomplished by painted bands or colored tape. Clip on bands may be used in areas where paint or tape are impractical. Color banding shall display direction of flow where practical. Color bands shall be a minimum of 1 inch (25mm) wide and be substantially neat and clean.

6.14 Sealing Interior or Previously Painted Surfaces

Interior surfaces or previously painted surfaces shall be suitably sealed or shielded to protect from overspray.

6.15 Painting Damaged Surfaces

- 6.15.1 Before top coating, primed surfaces shall be examined for damage, contaminated areas and degree of cure. Affected areas shall be hand or power tool cleaned in accordance with SP2 or SP3 specifications to provide a surface suitable for adhesion of the top coat. Where necessary, water or solvent cleaning in accordance with SP1 shall be conducted.
- 6.15.2 After the re-preparation of damaged areas, touch-up of the primer shall be performed in accordance with the original specifications and allowed to cure suitably prior to application of top coat. When re-coat time of ethyl silicate zinc rich primer is questioned, the primer shall exhibit no effect after 50 Methyl Ethyl Keytone (MEK) double rubs in accordance with ASTM D4752 in addition to the re-coat time/temperature schedule specified by the coating manufacturer.
- 6.15.3 Where shop applied coating have been damaged in transit or where damage has occurred to field coats, all damaged and loosely adhering coating shall be removed and the surface thoroughly cleaned. Edges of the breaks shall be feathered so that a smooth tie-in of the new coating to the old coating can be made.

6.16 Re-work

Re-work, where required, shall be performed in accordance with this specification and the paint manufacturer's recommendations unless otherwise justified by means of a properly executed specification waiver.

6.17 Curing

Coated equipment will not be accepted by Encana until coatings are cured properly.

7.0 COMPLETION

7.1 Inspection and Testing

- 7.1.1 Encana reserves the right to perform inspection at any time during work covered by this specification. The Contractor shall provide access during normal working hours to all areas of the office, shop or site pertaining to the work. Off hour access, if required, shall be provided by mutual arrangement between Encana and the Contractor.
- 7.1.2 Where Encana's inspector is not in full time attendance at the work site, the Contractor shall provide a minimum of twenty-four (24) hours notice for required compliance confirmation milestones or other acceptance hold points.
- 7.1.3 The Contractor shall supply specialty assistance (e.g., manlift, safety harness, proprietary inspection tools, etc.) as required, to enable Encana's inspector to confirm compliance with the project requirements.

- 7.1.4 Acceptance criteria for blast cleaned surfaces shall conform to the appropriate level of cleanliness when compared to the SSPC VIS-1 Visual Standard for Abrasive Blast Cleaned Steel.
- 7.1.5 At each location where the work is carried out, the Contractor shall have the following:
- Surface profile replica tape and micrometer
 - Sling or electric psychrometer and psychrometric tables
 - Surface temperature gauge
 - SSPC VIS-1 Visual Standard for Abrasive Blast Cleaned Steel
 - Wet film thickness gauge
 - Magnetic dry film thickness gauge
 - Certified Thickness Calibration Standards
 - Surface Contamination Analysis Test (SCAT) Kit
 - pH Indicator Paper
 - Methyl Ethyl Keytone (MEK) solvent and cheesecloth
 - White blotting paper
 - Holiday Testing Equipment
 - Destructive film thickness gauge
 - Portable adhesion tester
- 7.1.6 The ambient temperature, dew point and relative humidity shall be determined with a psychrometer per ASTM E337 immediately prior to coating application. The Applicator shall maintain a daily log recording these conditions, including the finish time for each application. Ambient measurements shall be taken at the beginning of each shift and every four hours thereafter. If a sudden weather change occurs, additional readings may be required.
- 7.1.7 The anchor profile depth, sharpness and density of blast cleaned steel shall be verified using replica tape and a micrometer gauge following NACE RP 0287-91.
- 7.1.8 Compressed air cleanliness shall be tested prior to coating application by directing air onto white blotter paper, following ASTM D4285.
- 7.1.9 Previously painted surfaces, or surfaces exposed to chemical fallout, shall be determined to have a neutral pH by testing with pH indicator paper prior to painting. If contamination of surfaces by chlorides or sulfates is questioned, the surface shall be tested with a SCAT Kit.
- No painting shall be performed until the surface is cleaned to a chloride level <10ppm.**
- 7.1.10 The dry film thickness for the cured coating shall be measured and recorded for its specified range using a calibrated type 1A (magnetic pull-off) or type 2 (fixed probe) gauge in accordance with SSPC-PA2. Encana reserves the right to determine questionable film thickness with a

destructive film thickness gauge. Required repairs as a result of such tests shall be the responsibility of the Contractor.

- 7.1.11 The cured coating shall be visually inspected for film defects. Runs, sags, embedded debris, voids, overspray, mud cracking, inadequate cure or lack of adhesion require repair or re-work. The coating system shall be free of visible voids. Encana reserves the right to test questionable adhesion with a destructive pull off adhesion tester. Ethyl silicate zinc rich primers shall exhibit a minimum pull of 200psi over steel substrates. Epoxy based primers shall exhibit a minimum pull of 500psi over steel substrates.

7.2 Documentation

- 7.2.1 Regardless of the size or location of the work, the Contractor shall, at Encana's request, furnish documentation relative to the surface preparation, priming and coating. Documentation may include, but not be limited to the following:

- Ambient conditions encountered during the work
- Abrasive type, mesh size, results of quality tests (e.g. soluble salts, turgidity, etc.)
- Compressed air quality and pressure including acknowledgment of traps and filters
- Surface preparation methods and acceptance criteria
- Confirmation of required surface cleanliness
- Recorded values for surface profile including archived profile tape
- Recorded time between end of surface preparation and start of priming or coating
- Name identification, batch numbers and shelf life of primers and coatings used
- Mixing and thinning of primers and coatings (e.g. mixing temperature, induction time, thinning ratio, viscosity, etc.)
- Application method
- Wet and Dry Film Thickness (DFT)
- Recorded time between primer and topcoat(s)
- Non-conformance reports and final disposition reports

- 7.2.2 Copies of documentation generated on the projects shall be forwarded to Encana at the time of final acceptance of the project.

7.3 Shipping and Storage

- 7.3.1 Primed or coated steel and equipment shall be protected from damage during lifting, handling and shipping. All items shall receive a final touch-up and inspection after loading to ensure incidental damage is repaired and the items are correctly supported and tied down. Where chains are used, protection shall be provided to avoid damage to the coating.

- 7.3.2 Primed or coated items shall be protected during storage, supported off the ground and so positioned as to minimize moisture retention, soiling, contamination and deterioration of the coating film.
- 7.3.3 To accommodate field touch-up of shipping damage, the vendor shall supply a minimum of one (1) liter of the base color for each paint type used.

7.4 Guarantee

The Contractor shall provide a guarantee against improper surface preparation, improper application or other forms of poor workmanship. This guarantee shall remain in effect for the lesser of twelve (12) months from when the equipment is placed in regular operation or eighteen (18) months from completion of painting. The Contractor shall repair any defects noted during the guarantee period at his own expense.

APPENDIX A: DEFINITIONS

Table 3: Definitions

Term	Definition
Contractor	Any firm, person or authorized subcontractor who is engaged in the work.
Recommended Practices	<p>Non-mandatory documents that describe techniques or methodologies that, through experience and research, have proven to reliably lead to a desired result. Recommended Practices do not require official approval but where deviations are considered the party responsible must:</p> <ol style="list-style-type: none"> 1. Complete the Encana Risk Assessment Worksheet and Mitigation Documentation Form. 2. Ensure that deviations are reviewed and approved by a qualified company representative and/or a Professional Engineer where applicable. <p>Report any deviations from the recommended practice that cause increased risk, including financial risk, to the Standards, Engineering, and Technology Team (SET) via the formal waiver process for the purpose of quality assurance and intra-company communication.</p>
Specifications	<p>Mandatory documents that specify, in a complete, precise, verifiable manner, the requirements, design, behavior or other characteristics of a system, component, product, result or service and, often, the procedures for determining whether these provisions have been satisfied. These documents will refer to appropriate guidelines, codes and legislation/regulation and only repeat such information as a point of clarification/interpretation. They may at times exceed the requirements of these publications to provide best life cycle economics, not necessarily capital savings. If any deviation from these documents is desired, the waiver or proposal process must be followed.</p>

APPENDIX B: REFERENCES

The following sources were used in the development of this Specification:

American Society for Testing Materials (ASTM)

- ASTM A 123, Standard Specification for zinc (Hot-Galvanized) Coatings on Productions Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars and Strip.
- ASTM A 143, Standard Recommended Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
- ASTM A 153, Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- ASTM A 384, Standard Recommended Practice for Safeguarding Against Warpage and Distortion during Hot-Dip Galvanizing of Steel Assemblies.
- ASTM D 4285, Standard Test Method for Indicating Oil or Water Compressed Air.
- ASTM D 4752, Standard Test Method for Measuring MEK Resistance of Ethyl Silicate (inorganic) Zinc Rich Primers by Solvent Rub.
- ASTM E 337, Standard Test Method for Temperature, Relative Humidity and Dew Point Measurement.

Bureau of Land Management Website

- Best Management Practices – Visual Resource Management BMPs Part Four: Choice of Color

Encana SARPs

- ECA-USA-COAT-S-003 Engineering Coating Specification (*document in progress as of May 2011*)
- ECA-USA-TANK-S-001 Above Ground Shop Fabricated Steel Tanks

National Association of Corrosion Engineers (NACE-International)

- SP 0178-2007, Fabrication Details, Surface Finish Requirements and Proper Design Considerations for Tanks and Vessels to be Lined for Immersion Service.
- SP 0188-2006, Discontinuity Holiday Testing of Protective Coatings.
- RP 0287-2002, Field Measurement of Surface Profile of Abrasive Blast Cleaned Steel Surfaces using Replica Tape.

Steel Structures Painting Council (SSPC)

- Steel Structures Painting Manual, Volume 1 "Good Painting Practice"
- Steel Structures Painting Manual, Volume 2 "Systems and Specifications"
- SSPC AB-1, Abrasive Spec No. 1 Mineral and Slag Abrasives
- SSPC PA-2, Measurement of Dry Paint Thickness with Magnetic Gauges

- SSPC VIS-1, Visual Standard for Abrasive Blast Cleaned Steel

Steel Structures Painting Council – Surface Preparation Specifications

- SSPC SP1, Solvent Cleaning
- SSPC SP2, Hand Tool Cleaning
- SSPC SP3, Power Tool Cleaning
- SSPC SP5, White Metal Blast Cleaning
- SSPC SP6, Commercial Blast Cleaning
- SSPC SP7, Brush-off Blast Cleaning
- SSPC SP8, Pickling
- SSPC SP10, Near-White Blast Cleaning
- SSPC SP11, Power Tool Cleaning to Bare Metal

NOTE: See [Appendix C](#) for complete descriptions.

US Federal Standard Colors

- Standard 595 B, US Standard Colors (replaces CGSB - Standard 1-GP-12C)

APPENDIX C: SSPC SURFACE PREPARATION SPECIFICATIONS

Table 4: SSPC Surface Preparation Specifications

Specification	Subject	Purpose
SSPC SP1	Solvent Cleaning	Removal of oil, grease, dirt, soil, salts and contaminants by cleaning with solvent, vapor, alkali, emulsion or steam.
SSPC SP2	Hand Tool Cleaning	Removal of loose rust, loose mill scale and loose paint to the degree specified, by hand chipping, scraping, sanding or wire brushing.
SSPC SP3	Power Tool Cleaning	Removal of loose rust, loose mill scale and loose paint to the degree specified, by power tool chipping, descaling, sanding, wire brushing or grinding.
SSPC SP5	White Metal Blast Cleaning	Removal of all visible rust, mill scale, paint, oil, foreign matter and staining by blast cleaning by wheel or nozzle (dry or wet) using sand, grit or shot.
SSPC SP6	Commercial Blast Cleaning	Blast cleaned surface shall be free of all visible oil, mill scale, rust, corrosion products, paint and foreign material. Random staining shall be limited to no more than 33% of surface area.
SSPC SP7	Brush-off Blast Cleaning	Blast cleaning of all except tightly adhering residues of mill scale, rust and coatings, exposing numerous evenly distributed flecks of underlying metal.
SSPC SP8	Pickling	Complete removal of rust and mill scale by acid pickling, duplex pickling or electrolytic pickling.
SSPC SP10	Near-White Blast Cleaning	Blast cleaned surface shall be free of all visible oil, mill scale, rust, corrosion products, paint and foreign material. Random staining shall be limited to no more than 5% of metal surface.
SSPC SP11	Power Tool Cleaning to Bare Metal	Complete removal of all rust, scale and paint by power tools with resultant surface profile.

NOTE: All surfaces and equipment that are not to be prepared must be protected from damage or contamination.

APPENDIX D: SCHEDULE OF PAINTING SYSTEMS

All systems listed below are high performance coating systems that should be used for all new construction and major site maintenance with an expected ten (10) to fifteen (15) year life cycle or greater. The required painting system shall be selected by the Encana Project Coordinator in consultation with the Encana Facilities Integrity Group.

Any deviations from these systems require a signed specification waiver to be approved by a competent Project Engineer in cooperation with the Corporate Coating Specialist.

NOTE: Dry Film Thickness (DFT) – Topcoat DFT is based on factory coloring. Tinted products may require additional thickness to achieve satisfactory appearance.

Table 5: Schedule of Painting Systems

System #	Description of Surfaces	Surface Prep SSPC (See Appendix C)	Primer Total DFT (mils)	Topcoat Total DFT (mils)	Remarks
Aboveground Non-Insulated Equipment					
1	CO₂ PROJECT Aboveground Equipment operating at less than 200°F (93°C), including vessels, tanks, non-buried piping and fittings structural steel, pipe supports, piles and caps and CPT wellheads	Solvent cleaning to SP-1 with SP-10 blast	Immersion Grade Epoxy 4.0 – 8.0 mils	Aliphatic Urethane 2.0 – 3.0 mils	<ul style="list-style-type: none"> Proven Products = Primer Devoe Bar Rust 231, Topcoat Devthane 389, 349QC or 379 Primer: Tnemec Series N69 Topcoat: Tnemec Series 73 Sherwin Williams = Primer Macropoxy 646, Topcoat Sherthane, Acrolon 218HS, Hi Solids Polyurethane (Low VOC options available) Urethane needed for UV protection See Note 5
2	CO₂ PROJECT Field Touch-Ups for above System #1	Solvent cleaning to SP-1 with SP-2 or SP-3	Epoxy Primer 4.0 – 6.0 mils	Aliphatic Urethane 2.0 – 3.0 mils	<ul style="list-style-type: none"> Proven Products = Primer Devoe Bar Rust 235, Topcoat Devthane 389, 349QC or 379 Primer: Tnemec Series N69 Topcoat: Tnemec Series 73 Sherwin Williams = Primer Recoatable Epoxy, Topcoat Sherthane, Acrolon 218HS, Hi Solids Polyurethane Urethane needed for UV protection See Note 5
3	Non-insulated carbon steel piping, tanks & equipment from 214°F to 428°F (101°C to 220°C)	SP10	Epoxy-Phenolic Amine-Cured 4.0 - 6.0 mils	Epoxy-Phenolic Amine-Cured 4.0 - 6.0 mils	<ul style="list-style-type: none"> Available in limited colors depending on manufacturer (red, light grey, silver, black). Spray application only Surface profile 2.0 to 3.0 mils

System #	Description of Surfaces	Surface Prep SSPC (See Appendix C)	Primer Total DFT (mils)	Topcoat Total DFT (mils)	Remarks
4	Non-insulated carbon steel piping, tanks & equipment from 425°F to 750°F (220°C to 398°C)	SP10	Inorganic Zinc Rich 2.0 – 3.0 mils	Silicone Aluminum as per Manufacturer	<ul style="list-style-type: none"> Surface prep as per manufacturer's instructions Spray application only Hold finish coat to 2.0 mils DFT to avoid blistering
5	Non-insulated carbon steel piping, tanks and equipment up to 212°F (100°C)	SP6	Epoxy Primer 4.0 – 6.0 mils (Note 6)	Hi Build Urethane 2.0 – 4.0 mils (Note 3)	<ul style="list-style-type: none"> Surface profile 1.5 – 2.5 mils Use light colored primer under white topcoats Pressurized storage tanks to be white, all others to be Taupe Spray application only
6	Insulated and non-insulated stainless steel piping, tanks and equipment from 100°F to 1000°F (38°C to 538°C) RATIONALE: For aesthetic color change or mitigation of chloride cracking potential	SP1	Modified Silicone Primer 1.0 mils	Silicone Aluminum 1.0 mils	<ul style="list-style-type: none"> Guidelines only: Follow preferred manufacturer's recommendations for the specific application Spray application only
7	Structural Steelwork	SP6 (Note 4)	Organic Zinc Rich (Note 2) 1.5 – 2.5 mils	High Build Epoxy 4.0 mils	<ul style="list-style-type: none"> Surface profile 1.5 – 2.5 mils Single top coat required Spray application only
8	Structural Steelwork	SP6 (Note 4)	--	Inorganic Zinc Rich Epoxy 3.0 – 5.0 mils	<ul style="list-style-type: none"> Surface profile 1.0 – 2.5 mils Single coat only required Spray application only Contrasting color preferred
9	Miscellaneous Steelwork (Note 1)	SP8	--	Hot Dip Galvanizing	<ul style="list-style-type: none"> See Appendix E

System #	Description of Surfaces	Surface Prep SSPC (See Appendix C)	Primer Total DFT (mils)	Topcoat Total DFT (mils)	Remarks
10	Galvanized Steel requiring color finish system	SP1	Epoxy 2.0 mils	Hi-gloss Urethane (2 Coats) 2.0 – 4.0 mils	<ul style="list-style-type: none">Existing surface profile satisfactoryEtching of new surfaces may be required for good adhesionTo provide safety colors or aesthetics on galvanized steelSpray preferred, limited brushing acceptable where necessary
			RATIONALE: Epoxy sealer ensures good adhesion		
11	Wood	Sanded	Acrylic Latex Primer	Acrylic Latex Finish	<ul style="list-style-type: none">Interior or exterior useThin primer coat to manufacturer's recommendations (20% maximum)Spray or brush
12	Vendors Standard Finish "Purchased" electrical mechanical equipment and instruments	SP2 or SP3 minimum	Vendor's Standard 1.5 mils minimum	Vendor's Standard 1.5 mils minimum	<ul style="list-style-type: none">Existing surface profile satisfactoryPreferred color is TaupeMay be top coated with a utility system finish
Aboveground Insulated Equipment					
13	CO₂ PROJECT Insulated Equipment operating at less than 200°F (93°C), located outdoors or subject to saturated insulation All carbon and low alloy steel surfaces	SP-10	Immersion Grade Epoxy 4.0 – 8.0 mils	Aliphatic Urethane 2.0 – 3.0 mils Only required if exposed and uninsulated	<ul style="list-style-type: none">Proven Products = Primer Devoe Bar Rust 231, Topcoat Devthane 389, 349QC or 379 Primer: Tnemec Series N69 Topcoat: Tnemec Series 73Sherwin Williams = Phenicon Flake Filled Epoxy = 2coats at 3.5 – 4.5 milsRefer to NACE RPO198 for recommended systemsSee Note 5

System #	Description of Surfaces	Surface Prep SSPC (See Appendix C)	Primer Total DFT (mils)	Topcoat Total DFT (mils)	Remarks
14	CO₂ PROJECT Insulated Equipment operating at less than 302°F (150°C) located outdoors or subject to saturated insulation All carbon and low alloy steel surfaces	SP-10	Immersion Grade Epoxy 10.0 – 12.0 mils Requires 2 coats to achieve proper thickness	High Build Aliphatic Urethane 2.0 – 3.0 mils Only required if exposed and uninsulated	<ul style="list-style-type: none"> Proven Products = Primer Devco Devchem 253, Topcoat Devthane 359 Primer: Tnemec Series N61 Topcoat: Tnemec Series 73 Sherwin Williams = Phenicon Flake Filled Epoxy = 2coats at 3.5 – 4.5 mils Refer to NACE RPO198 for recommended systems See Note 5
15	Insulated carbon steel piping, tanks and equipment from -148°F to 75°F (-100°C to 24°C)	SP2 or SP3	Mastic as per ECA insulation spec X-1	--	<ul style="list-style-type: none"> Existing surface profile satisfactory
16	Insulated carbon steel piping, tanks and equipment from 77°F to 212°F (25°C to 100°C)	SP10	Immersion Grade Epoxy 4.0 – 8.0 mils	--	<ul style="list-style-type: none"> Surface profile 1.5 – 2.5 mils Single coat only required
17	Urethane type insulated carbon steel piping, tanks and equipment from 77°F to 212°F (25°C to 100°C) RATIONALE: Potential external corrosion due to formic acid if insulation becomes wet	SP10	Immersion Grade Epoxy 4.0 – 8.0 mils	Flame retardant elastomer (2 Coats)	<ul style="list-style-type: none"> Inhibits UV damage and retards flame spread of exposed foam Spray application only Apply second coat at right angle to previous coat for full coverage
18	Insulated carbon steel piping, tanks and equipment from 212°F to 248°F (101°C to 120°C)	SP10	Epoxy-Phenolic Amine-Cured 4.0 – 6.0 mils	Epoxy-Phenolic Amine-Cured 4.0 – 6.0 mils	<ul style="list-style-type: none"> Available in limited colors depending on manufacturer (red, light grey, silver, black) Spray application only Surface profile 2.0 – 3.0 mils

System #	Description of Surfaces	Surface Prep SSPC (See Appendix C)	Primer Total DFT (mils)	Topcoat Total DFT (mils)	Remarks
19	Insulated and non-insulated stainless steel piping, tanks and equipment from (100°F to 1000°F (38°C to 538°C)) RATIONALE: For aesthetic color change or mitigation of chloride cracking potential	SP1	Modified Silicone Primer 1.0 mils	Silicone Aluminum 1.0 mils	<ul style="list-style-type: none"> Guidelines only: Follow preferred manufacturer's recommendations for the specific application Spray application only

NOTES:

- Miscellaneous Steelwork, handrail, toe plate, ladders, gates, grating, stair tread and small intricate shapes may be hot-dip galvanized.
- Inorganic zinc rich primer may be substituted where curing can be assured under application conditions.
- Storage Tanks – to ensure satisfactory appearance on large plate surfaces, multiple coats may be required.
- Jagged profile is required. If wheel abrader is used, a 15% to 25% addition of new angular material is required to avoid a rounded/peened profile.
- Separate painting systems are required for CO₂ projects due to the unique nature of CO₂ injection (i.e., pipe sweating and temperature conditions).
- Non-insulated carbon steel piping and equipment below 120°F (49°C) may be externally blasted to SP6 and coated with a direct to metal polyurethane system, 5.0 – 6.0 mils required thickness.

APPENDIX E: GALVANIZING

- All materials to be galvanized shall be zinc coated in accordance with ASTM A123 or A153 following the recommended practice of ASTM A385. Galvanized materials which have become warped, distorted or embrittled shall be rejected. Touch-up and repair of galvanized surfaces shall be in accordance with ASTM A780 after removing any weld spatter or flux residue. Solvent clean to remove any oil or grease, power disk grind to brighten metal and apply an approved zinc rich coating.
- Welded connections requiring galvanizing shall be completely sealed by welding prior to galvanizing and the fabrication shall be blast cleaned.
- Remove any foreign materials from surfaces to be galvanized.
- Safeguard against embrittlement in accordance with ASTM A143.
- Protect against warpage and distortion in accordance with ASTM A384.
- Potential warpage problems that may require a modification in design shall be brought to the attention of the purchaser by the Contractor before proceeding with fabrication.
- All members and assemblies warped in galvanizing shall be straightened in the shop.
- When fabrication is performed after galvanizing, the damaged galvanizing shall be repaired with zinc repair primer as specified in Line 1 above.
- Special care shall be taken to eliminate any contact between galvanized and stainless steel components.

APPENDIX F: COLOR SCHEDULE

All colors must be free of lead, chromium and other hazardous heavy metal compounds. Unless otherwise approved by the Project Engineer, the manufacturer's standard finish for equipment shall be supplied in the color Taupe 16555.

Table 6: Color Schedule

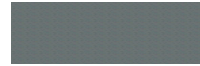
Item	Color	US Federal Standard 595B
1.0 Base Color	Taupe	16555
2.0 Structural Steelwork	Taupe	16555
NOTE: If the selected system is the high performance inorganic zinc rich finish topcoat, the manufacturer's standard color will be acceptable (green or grey preferred).		
3.0 Miscellaneous Steelwork		
• Floor Grating	Black	17038
• Equipment guard posts	Light Yellow	13591
• Guard rails, kick plates, ladders & cages	Taupe or Black (per project requirement)	16555 or 17038
• Stair treads (plate)	Taupe or Black	16555 or 17038
• Stair treads (grating)	Black	17038
• Stair treads (all)	Black	17038
4.0 Pipework		
NOTE: Colors may be achieved by banding pipe which has received a base color of Taupe 16555 . Bands may be painted or applied by use of colored tape. Snap on bands may be utilized where paint or tape are unsuitable.		
4.1 Water		
• Fire Water and Hydrants	Red	11310
• Produced Water	Medium Blue	15182
• Rain Water	Dark Blue	15052
• Treated Water	Light Green	14533
4.2 Gas		
• Fuel Gas	Purple	17155

Item	Color	US Federal Standard 595B
• Intermediate Process Gas	Medium Orange	11400
• Sales Gas	Light Orange	12243
• Sour Gas	Dark Yellow	13538
• Sweet Gas	Medium Orange	11400
4.3 Liquids		
• Clean Oil	Medium Brown	10115
• Condensate	Light Yellow	13591
• Emulsion – 2 Phase	Light Brown	10371
• Emulsion – 3 Phase	Dark Brown	10055
• Intermediate Process Oil	Medium Yellow	13655
• LPG Mixture	White	17886
• Propane	Pale Green	14672
• Butane	Blue-Green	35275
4.4 Utilities		
• Building Heating Lines	Medium Grey	16187
• Drains	Black	17038
• Flare Lines	Black	17038
• Instrument Air	Light Grey	26314
• Instrument Gas	Light Grey	26314
• Lean Amine	Green	14120
• Lean Glycol (Including Dowtherm R [1G])	Light Blue	15450
• Refrigerant Piping	Medium Blue	15182
• Relief Lines	Black	17038
• Rich Amine	Olive Green	14151
• Rich Glycol	Dark Blue	15052
• Utility Air	Medium Grey	16187

Item	Color	US Federal Standard 595B
• Vents	Black	17038
5.0 Equipment		
• Packaged Equipment	Taupe	16555
• Air Receiver	Taupe	16555
• Compressor	Taupe	16555
• Emergency Generator	Taupe	16555
• Filter	Taupe/Vendor's Standard Finish	16555
• Pump	Taupe/Vendor's Standard Finish	16555
6.0 Storage Tanks		
• Fiberglass	Vendor's Standard Finish	
• Carbon Steel (ambient)	Taupe	16555
• Carbon Steel (urethane fire retardant)	Black	17038
• Carbon Steel (pressurized)	White	17886
7.0 Vessels	Taupe	16555
8.0 Miscellaneous		
• Concrete Floors	Light Grey	26314
• Rotating Coupling Guards	Light Orange	12243
• Electrical Conduit	Natural/Galvanized	17178
• Electrical Panels	Taupe/Vendor's Standard Finish	16555
• Fired Exterior Stacks	Aluminum	17178
• Flare Stacks	Aluminum	17178
• Flywheels	Light Orange	12243
• Guards	Light Orange	12243
• Overhead Crane	Dark Yellow with Black Bands	13538/17038
• Pipe Supports	Taupe	16555
• Skids and Decks	Taupe	16555

APPENDIX G: COLOR CHART

Light Grey

26314

Medium Grey

16187

Taupe

16555

Light Blue

15450

Medium Blue

15182

Dark Blue

15052

Purple

17155

Light Green

14533

Medium Green

14223

Green

14120

Pale Green

14672

Blue Green

35275

Olive Green

14151

Light Yellow

13591

Medium Yellow

13655

Dark Yellow

13538

Light Orange

12243

Medium Orange

11400

Red

11310

Light Brown

10371

Medium Brown

10115

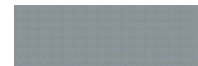
Dark Brown

10055

Black

17038

White

17886Aluminum/
Galvanized**17178**

Encana Official Colors



APPENDIX H: BLM STANDARD ENVIRONMENTAL COLOR CHART

The colors shown below are a replication of the BLM Standard Color Chart. The most current version of the chart can be accessed online here: <http://www.blm.gov/nstc/VRM/colorcht.html>, or a paper copy of the chart can be obtained from:

State Landscape Architect
Bureau of Land Management
5353 Yellowstone Road
P.O. Box 1828
Cheyenne, WY 82003
(307) 775-6232

Table 7: BLM Standard Environmental Color Chart

 Sand Beige (1Y 6/3)	 Desert Brown (10YR 6/3)
 Catalpa Canyon (2.5Y 6/1)	 Slate Gray (5Y 6/1)
 Sudan Brown (2.5Y 4/2)	 Brush Brown (10YR 5/3)
 Jungle Green (no Munsell Color)	 Shale Green (5Y 4/2)
 Yuma Green (5Y 3/1)	 Largo Red (2.5R 5/6)