Robust Functional Paperless Paint

Prepared for:

National Shipbuilding Research Program

Surface Preparation and Coatings Panel (SPC)

Submitted by:

Ross Boyd, TruQC

Stephen Cogswell, BAE Systems Southeast Shipyards

December, 2013

Executive Summary

The National Shipbuilding Research Program (NSRP) Surface Preparation and Coating (SPC) Panel completed this project to modify a commercial off-the-shelf (COTS) product to partially meet the needs of US shipbuilders who perform surface preparation and coating activities on US Navy ships. The commercially available system has been developed for and successfully used by industrial coating contractors. Because there are technological (connectivity/security) challenges to integrating electronically with US Navy databases, the project focused on an intermediate goal of using the electronic system by the shipbuilder to electronically generate a PDF report which is essentially identical to the form delivered to the Navy today. While not all of the potential efficiencies of a truly paperless QA system are recognized with this step, NSRP shipyards can improve their internal efficiency with this intermediate step.

The project successfully modified COTS (Commercial off-the-shelf) technology to output QA data in accordance with the requirements of Naval Sea Systems Command Standard Item 009-32. An example of the product output is included as Appendix B to this report. Key aspects of the final production application included:

- Electronic generation of eight appendices required by NSI 009-32
- PDF generation for an appendix only if data had been entered into that report's section
- Auto-fill fields after a tap based on what was entered in that field previously
- Pre-populate a field, regardless of tap, based on what was entered previously
- Improved "Add from Device" workflow for over-the-air import of data from the DeFelsko Positector WiFi gage.

The project team identified varying degrees of technological (connectivity/security) challenges at each shipyard. Some shipyards will need to overcome internal IT issues before adopting the technology while others have fully integrated the technology into their production process.

Once the system was developed, the project team worked with Regional Maintenance Center QA representatives to identify a path forward to integrate the paperless capability into the Navy Maintenance process. Features which take advantage of the paperless technology in the QA process include:

- Electronic event notification
- Auto-flag out of spec conditions
- Automate Non-Conformance reporting and resolution
- Quality control reports for contractor process improvement

Acknowledgements

This project would not have been successful without the assistance of a number of people. A number of Navy and Industry representatives who have been involved with previous evolutions of paperless QA technology provided critical feedback to the project team. In particular, representatives from General Dynamics-NASSCO, Bath Iron Works, Marinette Marine Corporation, BAE Systems, HII-Ingalls Shipbuilding, Vigor Industrial and Naval Sea Systems Command provided time and technical expertise during the discovery and beta testing phases.

Table of Contents

Conclusions

1. There is still a strong desire for a paperless quality assurance system that can improve efficiency of surface preparation and coatings QA/QC during shipbuilding and ship repair. The need is not solely driven by the US Navy; shipyards desire a system for both military and commercial work.

2. A commercial off-the-shelf (COTS) system has been developed by this project which can meet the requirements for electronically collecting surface preparation and coatings QA data and delivering it in the format required by the Appendices of NAVSEA Standard Item (NSI) 009-32. The system is now commercially available and being used for Navy projects.

3. The COTS system still delivers the Navy a "paper" (or .pdf) product. More work is required to electronically transfer data to the Navy in a suitable manner.

4. NSRP shipyards are also using the system for commercial shipbuilding activities.

Recommendations

1. Perform pilot programs/demonstrations with Navy QA/QC agencies (RMC and SUPSHIP). Use the results of these demonstrations to modify and improve the product.

2. Develop and implement features which take advantage of the paperless technology in the QA process by:
   - Electronic event notification
   - Auto-flag out of spec conditions
   - Automate Non-Conformance reporting and resolution
   - Quality control reports for contractor process improvement
   - As-needed improvements to the data collection and reporting process

Background

Proper evaluation of coating quality requires a trained individual to observe and measure elements of the process at various stages of coating application. Such quality assurance procedures can be expensive, inefficient, and difficult to administer.

NAVSEA painting practices require acquisition, recording, and reporting of QA data collected during surface preparation and coating processes. This data is collected after various critical stages in the process are completed (e.g., initial surface cleaning, surface preparation prior to painting, application of each coat, and final inspection). Data is also collected throughout the process to document the environmental conditions during surface preparation and coating activities. The data collected can be quite voluminous. Each inspection point may generate several sheets of paper records; over the course of a project such records may occupy several hundred pages. In addition to the reduction of paperwork, there are several other sources of cost reduction and process improvement. Table 1 shows some of the benefits.

Table 1 - Benefits of Paperless QA System

Process Improvement	Cost Reduction
Increase transparency of inspection to the surface preparation and coating process	Minimize or eliminate delays associated with adjudication of out of spec items
Improve efficiency of inspection efforts	Reduce inspection cost
Transmit inspection data efficiently to decision-makers	Expedite decision making, reducing analysis cost and associated downtime
Archive inspection data for future use	Eliminate costs incurred to re-create history for assessments
Leverage inspection data to its fullest extent	More accessible information could be used for more efficient planning, facilitating process improvement, troubleshooting, etc.

In the mid-2000's, the National Surface Treatment (NST) Center developed a paperless QA software program. The system was originally called "QA Toolkit" and later re-named "Preservation Quality Assurance Data System [PQADS]"). The program was a client server based system that was fully functional and implemented at Mayport Naval Station by the SERMC team in 2006. However, completion funding for that program ceased. Fleet Forces Command assumed responsibility for the paperless paint QA program. In 2009, the Coating Quality Assurance Tool Kit (CQATK) was developed by MI Technical Solutions through Navy program funding. The CQATK system was developed to record the data and make it available to the Navy through the Maintenance Figure of Merit (MFOM). However after 3 years of effort it was determined the CQATK did not support the technical requirements invoked in NAVSEA Standard Items 009-04 and 009-32. While CQATK remains an option in NSI 009-32, the

Regional Maintenance Commands (RMCs) in Norfolk and Mayport have suspended the use of this system.

There is a continued need for an automated, hand-held device to gather, record, and assess the necessary QA data from surface preparation and coatings activities. A project sponsored by the DoD Corrosion Policy and Oversight office suggested that the Navy could save up to 2% of the cost of coating if they could implement an effective paperless QA system.[1] A recent NSRP project corroborated the magnitude of potential cost savings.[2] Of the thirteen specific process improvements which would help the Navy reduce cost without sacrificing quality, an effective paperless QA system was ranked highest in terms of potential cost savings. Paperless QA was one of the few process improvements that would benefit all shipyards.

The NSRP Surface Preparation and Coating panel has continued to monitor the state of electronic QA/QC tools that may be suitable for shipbuilding use. A commercially available system produced by TruQC was identified as a commercial off-the-shelf system that could be easily modified to produce the records required in NSI 009-32. The present project sought to develop the data entry and reporting tables which are consistent with US Navy reporting requirements.

[1] Corrosion Control Cost Reduction through Improved Quality Assurance Information Management, Project No: W07NS01

[2] FUTURE STATE FOR NAVY SHIP MAINTENANCE PAINTING, July 2013

Project Objectives and Methodologies

For over 7 years the US Navy and its shipbuilding industrial base have been working to reduce the burden of QA/QC through more efficient electronic data collection, review and storage. The NSRP funded this project to adopt a fully functional commercial off-the-shelf (COTS) software system and modify it to support US Navy preservation documentation in accordance with 009-04 (NAVSEA's Quality Management System) and 009-32. The COTS technology chosen is currently supporting commercial painting contractors, third party inspectors, and facility owners. This effort will reduce the cost of preservation documentation in shipbuilding and repair by reducing the man-hours spent conducting and documenting inspections and correcting transposition, administrative and mathematical errors in the documentation. It will keep the inspectors on the deck plates measuring and monitoring the quality product instead of at their desk shuffling paper.

The project was completed through a series of four related tasks, each described below:

Task 1 –Survey 009-32 Users. US Navy and NSRP shipyards were surveyed to assess any unique barriers to implementation of the COTS hardware/software. Presentation alternatives of the 009-32 data output were included in the survey as an opportunity for the users to improve the customer's QA Appendices.

Task 2 - Discovery Process. The COTS application developer worked with BAE Systems SSYI, Fincantieri MMC, General Dynamics-NASSCO, Bath Iron Works, HII-Ingalls Shipbuilding, Vigor Industrial and their sub-contractors to ascertain the needs of both new construction and repair yards. One on one meetings were held with deckplate inspectors and others involved with the QA/QC processes to identify the necessary functionality to meet NSI 009-32 requirements. The existing TruQC system generated documentation required by SSPC QP-1 (a Navy requirement). This project improved the software to populate the current NSI 009-32 appendix format.

Task 3 - Operational Testing and Measurement. Dedicated test platforms located at participating shipyards were utilized for consistency and validation testing. Various manufacturers' digital instruments were used to collect data and information that was used to populate and evaluate various software manufacturers programs for continuity, reliability, and functionality. During this process inspections were conducted in the traditional paper method and on the TruQC application for the purpose of developing an ROI.

Task 4 – Implementation. Project updates and information was presented to the NSI 009-32 users and other interested parties at all NSRP SPC panel meetings, Mega Rust, Coating Community (SSPC, NACE) meetings held during the project period. The project team interfaced with the Public Shipyards, NAVSEA 04 and NAVSEA 05 during the development of the information output.

NSRP Project Efforts

TruQC utilized their proprietary development template as a basis for customizing the existing system to meet the requirements of NSI 009-32. The process includes multiple phases as outlined below and discussed in this section of the report.

- Discovery
  - Information Gathering
  - Requirements Report
  - Wireframe Document
  - User Interface
- Development
  - Integration
  - Beta Testing
  - Production
- Implementation

The discovery phase of the project involved multiple iterations of information exchange between the programmers and end-users over the first six months of the project. Information from the discovery phase was integrated into a working prototype over the next three months of the project and the final three months was dedicated to beta testing and production of the final version of the software.

Discovery

Discovery is perhaps the most important phase of the application development process. During this phase, the processes currently being used in each shipyard are broken down to their most basic elements and organized into a logical manner for the application. The discovery process is an iterative effort that involves on-site visits as well as follow-up phone calls and emails. The following shipyards participated in the discovery process:

- BAE Southeast – Jacksonville, FL
- MMC – Fincantieri – Marinette, WI
- Bath Iron Works – Bath, ME
- NASSCO – San Diego, CA
- Vigor – Seattle, WA

<u>Information Gathering</u>

The information gathering process begins by collecting copies of paper forms currently being used. Appendix A contains a representative hand-completed Appendix form. A team consisting of the software programmers, hands-on end-users and their mangers review the forms to determine the types and number of answers for each required data point. This process is arduous but allows the project

team to develop a thorough understanding of the types and depth of data entry required for unique fields. The TruQC project manager documented the needs of each data entry point and mapped out any logic associated with this process.

In addition to the data requirements on the report, TruQC maps out the approval hierarchy in each shipyard. There may be different approval points for a complete report meeting Navy requirements. It is the intent of the app to make the report flow in a logical manner that reflects process management in the shipyard. The submission, approval and delivery process are structured to mimic the process already in place.

The final stage of information gathering is to map out the data storage and retrieval needs of the yard. Once a report has gone through the appropriate approval flow, the team needs to understand how it is currently stored and the ideal way in which one would be able to retrieve pertinent archived data.

Requirements Report

Once the information gathering process was complete, the system designer created a document that outlines the needs of each yard in a way that is as concise as possible. The Requirements Document is essentially a series of if-then statements that outline the QA/QC process in simple terms.

An interesting finding was that not all yards utilize the same reports in the same way nor manage or store the reports in similar fashion. Despite the fact that they are working to the same Navy requirement, each yard has unique jargon, procedures and idiosyncrasies. The project had to create a single system that would be understood by all involved and not require unique builds and development for each yard. The challenge was in understanding which lines could be bent or shifted and which could not be altered.

The requirement document was discussed with each participant yard a second time to ensure needs were understood. Ambiguous items were shown particular attention and revisited during this process.

Wireframe Document

Based on the feedback from the requirements report a wireframe document was developed to give a visual idea of how the app would appear and flow utilizing the feedback previous two processes. This is where interaction between developers and users became more intensive, as software is easier to understand in the context of their current procedure. The wireframe is a lower cost visual representation of the software that helps to flush out last minute “major” structure issues prior to User Interface development. Figure 1 shows an example of feedback during the wireframe phase of the discovery process. Three different wireframe “clickable prototypes” were delivered to the shipyard team before the development phase began.

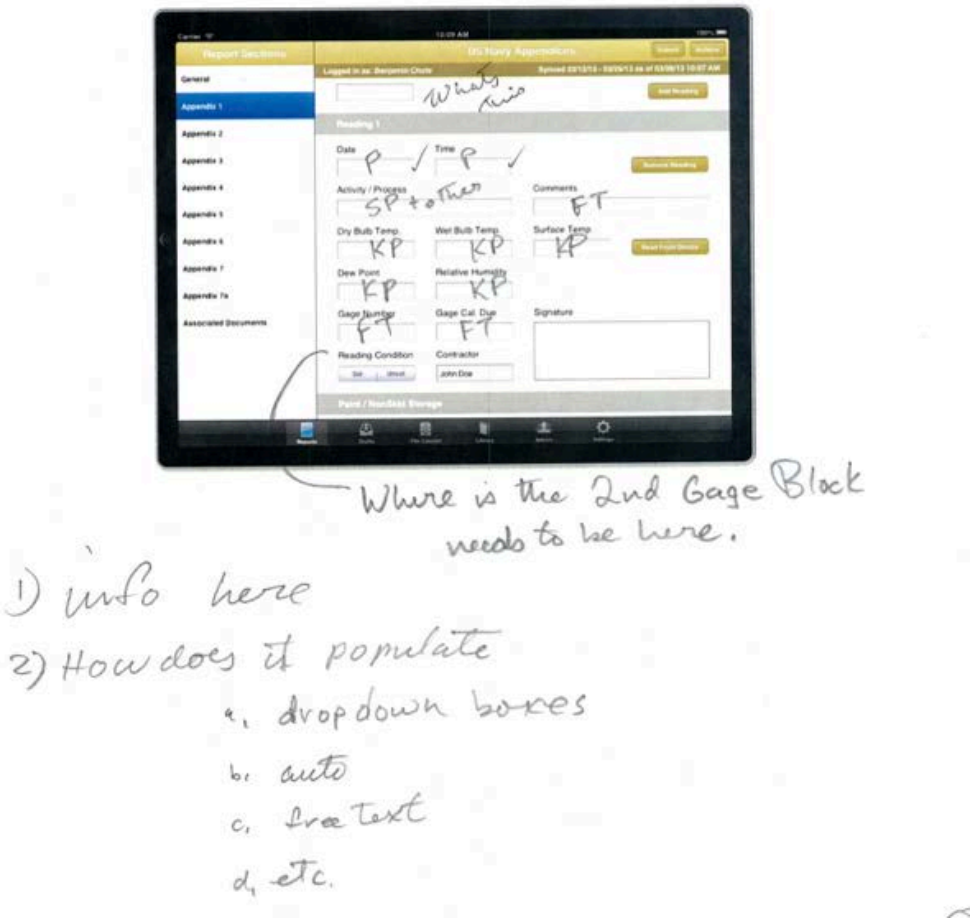

Figure 1 - Example of feedback provided at the wireframe stage.

User Interface

User-Interface development takes the information gathered from the previous steps and gives the end user an early version of the app that actually behaves in a way similar to the final product. There is no back end or storage functionality -- only a front end that can be viewed and reviewed to help in cleaning up any previously missed data points. In the case of the appendices and this project, multiple versions of the UI mock-up were developed to show progress and confirm the changes suggested made sense for the user.

Development

Development is without a doubt the most expensive and time-critical portion of the process. All suggestions, User Interface testing, discovery and process understanding is assembled to create a fully function build. In this case, full function includes the user interface created for the end-user compiled in a PDF format that appeared in a format that the US Navy inspectors were used to seeing. The report

would then need to go through a logical administrative process allowing for review, approval or rejection, and ultimately storage. TruQC has an iterative development cycle that allows for constant internal QC/QA testing of the software. The development process included three stages: Integration, Beta Testing, and Production.

Integration

Integration is similar to developing a rough draft of the software. At the end of the integration phase, the software has all the required functionality but has not been through aggressive vetting or testing. During integration, multiple releases were provided to development environment done every day. On-going demonstrations and communications helped to keep the user community engaged during the integration process.

The test community had access to these builds via TestFlight. TestFlight allows end-users to view the user interface and interact with it as opposed to a review process that involves story boards or long requirements documents. The end-user can go through each appendix line by line and provide the programmers with feedback throughout the process. Fifteen users actively interacted with the system on 41 different devices during the integration phase.

Ultimately, integrating Navy requirements into TruQC required the development of 49 new database tables (approximately 19% of TruQC's data model). Over 40,000 lines of code were written, 90% of which gets incorporated on the client-side application.

Over 200 unique data items are capture for the NSI 009-32 Appendices. Most data items will require multiple entries for a typical project (e.g., multiple thickness or humidity readings) while some are only recorded once. Table 2 shows how many data items are in each Appendix.

Table 2 - Number of Data Items by Report Section

Section	Number of Data Items
General	10
Appendix 1	34
Appendix 2	19
Appendix 3	30
Appendix 4	20
Appendix 5	15
Appendix 6	21
Appendix 7	42
Appendix 7a	21

Beta Testing

The Beta version is a more complete build which is distributed for field-testing. This is the final opportunity to identify and resolve issues with the software prior to a final production build being

delivered. During this process, the participating shipyards had access to the most current Beta build of the software. Several hundred reports were produced by users in the Beta Testing phase.

Key challenges during the Beta Testing phase were:

- Getting PDF just right
- Coordinating and aligning feedback among various yards
- Encouraging adoption of a new technology to provide user feedback

Production

Production is the final step in the development process. The production build has been completed, tested and approved by participant yards prior to being provided as part of the commercial product. Key aspects of the final production application included:

- Electronic generation of eight appendices required by NSI 009-32
- PDF generation for an appendix only if data had been entered into that report's section
- Auto-fill fields after a tap based on what was entered in that field previously
- Pre-populate a field, regardless of tap, based on what was entered previously
- Improved "Add from Device" workflow for over-the-air import of data from the DeFelsko Positector WiFi gage.

TruQC version 2.4 was released on October 15, 2013 with the ability to produce the Appendices in NSI 009-32. TruQC version 2.5 was released on December 9, 2013 with minor updated to the appendices and improvements in PDF rendering.

Figure 2 is a screenshot from the TruQC application showing how Appendix 1 would appear on the screen. Appendix B includes a complete set of sample forms generated as a PDF file using the TruQC application as modified through this project.

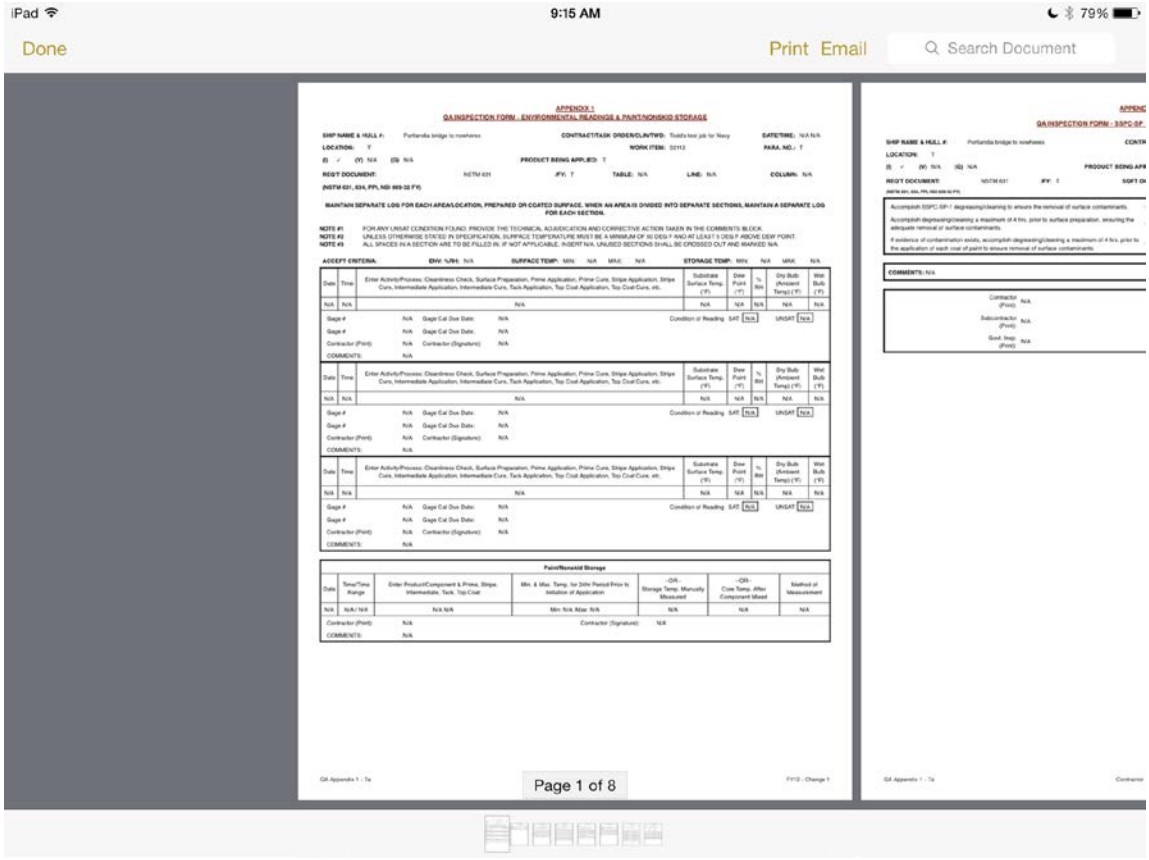

Figure 2 - Screenshot of Production Application.

Implementation

The system is currently being used by some NSRP shipyards for commercial work. The project team has met with the Southeast Regional Maintenance Center (SERMC) to develop a path forward for acceptance of the system by the Navy for maintenance work. A follow-on project has been funded by NSRP to focus on implementing features that take advantage of the paperless technology in the QA process by:

- Electronic event notification
- Auto-flag out of spec conditions
- Automate Non-Conformance reporting and resolution
- Quality control reports for contractor process improvement
- As-needed improvements to the data collection and reporting process

Appendix A

Representative Hand-Written NSI 009-32 Appendix

APPENDIX 1

QA INSPECTION FORM - ENVIRONMENTAL READINGS & PAINT/NONSKID STORAGE

SHIP NAME & HULL #: USS NIMITZ(CVN68) CONTRACT/TASK ORDER/CLIN/TWO: A5131 DATE/TIME: 31-Mar-13 1208

LOCATION: Hangar Bay No. 2 & AGE No. 2 Approach Area WORK ITEM: 084-21-031 PARA. NO.: 3.2

(I) N/A (V) X (C) N/A PRODUCT BEING APPLIED: N/A (Cleanliness Inspection)

REQ'T DOCUMENT: 009-32 (FY): 12 CH 1 TABLE: 2 LINE: 6 COLUMN: N/A
(NSTM 631, 634, PFI, NAVSEA 009-32 FY)

MAINTAIN SEPARATE LOG FOR EACH AREA/LOCATION, PREPARED OR COATED SURFACE. WHEN AN AREA IS DIVIDED INTO SEPARATE SECTIONS, MAINTAIN A SEPARATE LOG FOR EACH SECTION.

NOTE #1 FOR ANY UNSAT CONDITION FOUND, PROVIDE THE TECHNICAL ADJUDICATION AND CORRECTIVE ACTION TAKEN IN THE COMMENTS BLOCK.

NOTE #2 UNLESS OTHERWISE STATED IN SPECIFICATION, SURFACE TEMPERATURE MUST BE A MINIMUM OF 50 DEG F AND AT LEAST 5 DEG F ABOVE DEW POINT.

NOTE #3 ALL SPACES IN A SECTION ARE TO BE FILLED IN. IF NOT APPLICABLE, INSERT N/A. UNUSED SECTIONS SHALL BE CROSSED OUT AND MARKED N/A.

ACCEPT CRITERIA: ENV: % RH: N/A SURFACE TEMP: MIN: N/A MAX: N/A STORAGE TEMP: MIN: N/A MAX: N/A

Date	Time	Enter Activity/Process: Cleanliness Check, Surface Preparation, Prime Application, Prime Cure, Stripe Application, Stripe Cure, Intermediate Application, Intermediate Cure, Tack Application, Top Coat Application, Top Coat Cure, etc.	Substrate Surface Temp. (°F)	Dew Point (°F)	% RH	Dry Bulb (Ambient Temp) (°F)	Wet Bulb (°F)
31-Mar-13	1208	Cleanliness Inspection	69	49	53	69	N/A

Gage #: 9102747 Gage Cal Due Date: 12/30/2013 Condition of Reading SAT: ☑ UNSAT: ☐

Gage #: 7717-1 Gage Cal Due Date: 12/30/2013

Contractor (Print): Rod Joe Contractor (Signature): Rod Joe

COMMENTS: Environmental readings by QI Checkoff

Date	Time	Enter Activity/Process: Cleanliness Check, Surface Preparation, Prime Application, Prime Cure, Stripe Application, Stripe Cure, Intermediate Application, Intermediate Cure, Tack Application, Top Coat Application, Top Coat Cure, etc.	Substrate Surface Temp. (°F)	Dew Point (°F)	% RH	Dry Bulb (Ambient Temp) (°F)	Wet Bulb (°F)

Gage #: Gage Cal Due Date: Condition of Reading SAT: ☐ UNSAT: ☐

Gage #: Gage Cal Due Date:

Contractor (Print): Contractor (Signature):

COMMENTS:

Date	Time	Enter Activity/Process: Cleanliness Check, Surface Preparation, Prime Application, Prime Cure, Stripe Application, Stripe Cure, Intermediate Application, Intermediate Cure, Tack Application, Top Coat Application, Top Coat Cure, etc.	Substrate Surface Temp. (°F)	Dew Point (°F)	% RH	Dry Bulb (Ambient Temp) (°F)	Wet Bulb (°F)

Gage #: Gage Cal Due Date: Condition of Reading SAT: ☐ UNSAT: ☐

Gage #: Gage Cal Due Date:

Contractor (Print): Contractor (Signature):

COMMENTS:

Paint/Nonskid Storage

Date	Time/ Time Period	Enter Product/Component & Prime, Stripe, Intermediate, Tack, Top Coat	Min. & Max. Temp. for 24 hr Period Prior to Initiation of Application	-OR- Storage Temp. Manually Measured	-OR- Cure Temp. After Component Mixed	Method of Measurement
			MIN: MAX:			

Contractor (Print): Contractor (Signature):

COMMENTS:

Appendix B

Sample of TruQC generated NSI 009-32 Appendices

APPENDIX 1
QA INSPECTION FORM - ENVIRONMENTAL READINGS & PAINT/NONSKID STORAGE

SHIP NAME & HULL #: Portlandia bridge to nowheres **CONTRACT/TASK ORDER/CLIN/TWD:** Todd's test job for Navy **DATE/TIME:** N/A N/A

LOCATION: T **WORK ITEM:** 02112 **PARA. NO.:** T

(I) ✓ **(V)** N/A **(G)** N/A **PRODUCT BEING APPLIED:** T

REQ'T DOCUMENT: NSTM 631 **/FY:** T **TABLE:** N/A **LINE:** N/A **COLUMN:** N/A

(NSTM 631, 634, PPI, NSI 009-32 FY)

MAINTAIN SEPARATE LOG FOR EACH AREA/LOCATION, PREPARED OR COATED SURFACE. WHEN AN AREA IS DIVIDED INTO SEPARATE SECTIONS, MAINTAIN A SEPARATE LOG FOR EACH SECTION.

NOTE #1 FOR ANY UNSAT CONDITION FOUND, PROVIDE THE TECHNICAL ADJUDICATION AND CORRECTIVE ACTION TAKEN IN THE COMMENTS BLOCK.
NOTE #2 UNLESS OTHERWISE STATED IN SPECIFICATION, SURFACE TEMPERATURE MUST BE A MINIMUM OF 50 DEG F AND AT LEAST 5 DEG F ABOVE DEW POINT.
NOTE #3 ALL SPACES IN A SECTION ARE TO BE FILLED IN. IF NOT APPLICABLE, INSERT N/A. UNUSED SECTIONS SHALL BE CROSSED OUT AND MARKED N/A.

ACCEPT CRITERIA: **ENV: %RH:** N/A **SURFACE TEMP:** MIN: N/A MAX: N/A **STORAGE TEMP:** MIN: N/A MAX: N/A

Date	Time	Enter Activity/Process: Cleanliness Check, Surface Preparation, Prime Application, Prime Cure, Stripe Application, Stripe Cure, Intermediate Application, Intermediate Cure, Tack Application, Top Coat Application, Top Coat Cure, etc.	Substrate Surface Temp. (°F)	Dew Point (°F)	% RH	Dry Bulb (Ambient Temp) (°F)	Wet Bulb (°F)
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Gage # N/A Gage Cal Due Date: N/A Condition of Reading SAT: N/A UNSAT: N/A
Gage # N/A Gage Cal Due Date: N/A
Contractor (Print): N/A Contractor (Signature): N/A
COMMENTS: N/A

Date	Time	Enter Activity/Process: Cleanliness Check, Surface Preparation, Prime Application, Prime Cure, Stripe Application, Stripe Cure, Intermediate Application, Intermediate Cure, Tack Application, Top Coat Application, Top Coat Cure, etc.	Substrate Surface Temp. (°F)	Dew Point (°F)	% RH	Dry Bulb (Ambient Temp) (°F)	Wet Bulb (°F)
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Gage # N/A Gage Cal Due Date: N/A Condition of Reading SAT: N/A UNSAT: N/A
Gage # N/A Gage Cal Due Date: N/A
Contractor (Print): N/A Contractor (Signature): N/A
COMMENTS: N/A

Date	Time	Enter Activity/Process: Cleanliness Check, Surface Preparation, Prime Application, Prime Cure, Stripe Application, Stripe Cure, Intermediate Application, Intermediate Cure, Tack Application, Top Coat Application, Top Coat Cure, etc.	Substrate Surface Temp. (°F)	Dew Point (°F)	% RH	Dry Bulb (Ambient Temp) (°F)	Wet Bulb (°F)
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Gage # N/A Gage Cal Due Date: N/A Condition of Reading SAT: N/A UNSAT: N/A
Gage # N/A Gage Cal Due Date: N/A
Contractor (Print): N/A Contractor (Signature): N/A
COMMENTS: N/A

Paint/Nonskid Storage

Date	Time/Time Range	Enter Product/Component & Prime, Stripe, Intermediate, Tack, Top Coat	Min. & Max. Temp. for 24hr Period Prior to Initiation of Application	--OR-- Storage Temp. Manually Measured	--OR-- Core Temp. After Component Mixed	Method of Measurement
N/A	N/A / N/A	N/A N/A	Min: N/A /Max: N/A	N/A	N/A	N/A

Contractor (Print): N/A Contractor (Signature): N/A
COMMENTS: N/A

APPENDIX 2

QA INSPECTION FORM - SSPC-SP 1 CLEANLINESS CHECKPOINT

SHIP NAME & HULL #: Portlandia bridge to nowheres **CONTRACT/TASK ORDER/CLIN/TWD:** Todd's test job for Navy **DATE/TIME:** N/A N/A

LOCATION: T **WORK ITEM:** 02112 **PARA. NO.:** T

(I) ✓ **(V)** N/A **(G)** N/A **PRODUCT BEING APPLIED:** T

REQ'T DOCUMENT: NSTM 631 **/FY:** T **SQFT OF AREA PRESERVED:** N/A **PARTIAL AREA:** N/A **FINAL:** N/A

(NSTM 631, 634, PPI, NSI 009-32 FY)

Accomplish SSPC-SP-1 degreasing/cleaning to ensure the removal of surface contaminants.	Date/Time: N/A	SAT: N/A UNSAT: N/A
Accomplish degreasing/cleaning a maximum of 4 hrs. prior to surface preparation, ensuring the adequate removal of surface contaminants.	Date/Time: N/A	SAT: N/A UNSAT: N/A
If evidence of contamination exists, accomplish degreasing/cleaning a maximum of 4 hrs. prior to the application of each coat of paint to ensure removal of surface contaminants.	Date/Time: N/A	SAT: N/A UNSAT: N/A

COMMENTS: N/A

Contractor (Print):	N/A	Contractor (Signature):	N/A	Date/Time:	N/A
Subcontractor (Print):	N/A	Subcontractor (Signature):	N/A	Date/Time:	N/A
Govt. Insp. (Print):	N/A	Govt. Insp. (Signature):	N/A	Date/Time:	N/A

APPENDIX 3
QA INSPECTION FORM - SURFACE PROFILE / PREPARATION & CLEANLINESS LOG

SHIP NAME & HULL #: Portlandia bridge to nowheres **CONTRACT/TASK ORDER/CLIN/TWD:** Todd's test job for Navy **DATE/TIME:** N/A N/A

LOCATION: T **WORK ITEM:** 02112 **PARA. NO.:** T

(I) ✓ **(V)** N/A **(G)** N/A **PRODUCT BEING APPLIED:** T

REQ'T DOCUMENT: NSTM 631 **/FY:** T **SQFT OF AREA PRESERVED:** N/A **PARTIAL AREA:** N/A **FINAL:** N/A

(NSTM 631, 634, PPI, NSI 009-32 FY)

MAINTAIN SEPARATE LOG FOR EACH AREA/LOCATION, PREPARED OR PAINTED SURFACE. WHEN AN AREA IS DIVIDED INTO SEPARATE SECTIONS, MAINTAIN A SEPARATE LOG FOR EACH SECTION.

NOTE #1 FOR PAINTS: 1 PROFILE READING REQUIRED FOR EVERY 200 SQFT (3 INDIVIDUAL TAPES FOR METHOD C) FOR THE FIRST 1000 SQFT AREA (15 INDIVIDUAL TAPES TOTAL FOR METHOD C); 1 PROFILE READING REQUIRED FOR EACH ADDITIONAL 500 SQFT OR LESS AREA (3 INDIVIDUAL TAPES FOR METHOD C).

NOTE #2 FOR NONSKID: 1 PROFILE READINGS REQUIRED EVERY 100 SQFT (3 INDIVIDUAL TAPES FOR METHOD C) FOR THE FIRST 500 SQFT AREA (15 INDIVIDUAL TAPES TOTAL FOR METHOD C); IF READINGS ARE SATISFACTORY, 1 PROFILE READING PER 1000 SQFT REMAINING (3 INDIVIDUAL TAPES FOR METHOD C).

NOTE #3 FOR ANY UNSAT CONDITION FOUND, PROVIDE THE TECHNICAL ADJUDICATION AND CORRECTIVE ACTION TAKEN IN THE COMMENTS BLOCK

NOTE #4 IF SPACES ARE NOT APPLICABLE, INSERT N/A. UNUSED SECTIONS SHALL BE CROSSED OUT AND MARKED N/A.

ACCEPT CRITERIA: **PROFILE RANGE** N/A **MILS** **TO** N/A **MILS**

			Mils (Average of 3 tapes)
Reading: N/A mils	Reading: N/A mils	Reading: N/A mils	N/A mils
Reading: N/A mils	Reading: N/A mils	Reading: N/A mils	N/A mils
Reading: N/A mils	Reading: N/A mils	Reading: N/A mils	N/A mils
Reading: N/A mils	Reading: N/A mils	Reading: N/A mils	N/A mils
Reading: N/A mils	Reading: N/A mils	Reading: N/A mils	N/A mils
		TOTAL AVG:	N/A

COMMENTS: N/A

Abrasive Manufacturer: (if Applicable) N/A Type: (if Applicable) N/A Mesh Size: (if Applicable) N/A

TYPE OF SURFACE PREPARATION: N/A

GAGE # N/A GAGE CAL DUE DATE: N/A	(Base Metal Reading) (Type 1 gage) BMR N/A	SURFACE PROFILE INSP: SAT: N/A UNSAT: N/A	SURFACE PREP. INSP: SAT: N/A UNSAT: N/A	CLEANLINESS INSP: SAT: N/A UNSAT: N/A

Contractor (Print):	N/A	Contractor (Signature):	N/A	Date/Time:	N/A
Subcontractor (Print):	N/A	Subcontractor (Signature):	N/A	Date/Time:	N/A
Govt. Insp. (Print):	N/A	Govt. Insp. (Signature):	N/A	Date/Time:	N/A

APPENDIX 4
QA INSPECTION FORM - SURFACE CONDUCTIVITY / CHLORIDE LOG

SHIP NAME & HULL #: Portlandia bridge to nowheres **CONTRACT/TASK ORDER/CLIN/TWD:** Todd's test job for Navy **DATE/TIME:** N/A N/A

LOCATION: T **WORK ITEM:** 02112 **PARA. NO.:** T

(I) ✓ **(V)** N/A **(G)** N/A **PRODUCT BEING APPLIED:** T

REQ'T DOCUMENT: NSTM 631 **/FY:** T **SQFT OF AREA PRESERVED:** N/A **PARTIAL AREA:** N/A **FINAL:** N/A

(NSTM 631, 634, PPI, NSI 009-32 FY)

MAINTAIN SEPARATE LOG FOR EACH AREA/LOCATION, PREPARED OR PAINTED SURFACE. WHEN AN AREA IS DIVIDED INTO SEPARATE SECTIONS, MAINTAIN A SEPARATE LOG FOR EACH SECTION.

MAXIMUM READING (IMMERSED SURFACES): CONDUCTIVITY (30) μS/cm CHLORIDE (3) μg/cm²
MAXIMUM READING (NON-IMMERSED SURFACES): CONDUCTIVITY (70) μS/cm CHLORIDE (5) μg/cm²

1 READING REQUIRED FOR EVERY 200 SQFT FOR FIRST 1000 SQFT, THEN 1 READING FOR EACH ADDITIONAL 500 SQFT OR LESS

NOTE #1 FOR ANY UNSAT CONDITION FOUND, PROVIDE THE TECHNICAL ADJUDICATION AND CORRECTIVE ACTION TAKEN IN THE COMMENTS BLOCK.
NOTE #2 IF SPACES ARE NOT APPLICABLE, INSERT N/A. UNUSED SECTION SHALL BE CROSSED OUT AND MARKED N/A.

TEST LOCATIONS	Chloride (μg/cm²)	Conductivity (μS/cm)	SAT	UNSAT
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A	N/A

COMMENTS: N/A

GAGE # N/A GAGE CAL DUE DATE: N/A CONDITION OF CHECKPOINT: SAT: N/A UNSAT: N/A

Contractor (Print): N/A Contractor (Signature): N/A Date/Time: N/A

Subcontractor (Print): N/A Subcontractor (Signature): N/A Date/Time: N/A

Govt. Insp. (Print): N/A Govt. Insp. (Signature): N/A Date/Time: N/A

APPENDIX 5
QA INSPECTION FORM - SURFACE CLEANLINESS (DUST) TAPE

SHIP NAME & HULL #: Portlandia bridge to nowheres **CONTRACT/TASK ORDER/CLIN/TWD:** Todd's test job for Navy **DATE/TIME:** N/A N/A

LOCATION: T **WORK ITEM:** 02112 **PARA. NO.:** T

(I) ✓ **(V)** N/A **(G)** N/A **PRODUCT BEING APPLIED:** T

REQ'T DOCUMENT: NSTM 631 **/FY:** T **SPECIFIC FEATURES OF AREA TO BE TESTED:** N/A

(NSTM 631, 634, PPI, NSI 009-32 FY)

ADHESIVE TAPE TYPE(S) FOR DUST MEASUREMENT: N/A

MAINTAIN SEPARATE LOG FOR EACH AREA/LOCATION, PREPARED OR COATED SURFACE. WHEN AN AREA IS DIVIDED INTO SEPARATE SECTIONS, MAINTAIN A SEPARATE LOG FOR EACH SECTION.

NOTE #1 FOR UNDERWATER HULL, 1 PROFILE READING REQUIRED FOR EVERY 200 SQFT FOR THE FIRST 1000 SQFT AREA; IF READINGS ARE SATISFACTORY, 1 INDIVIDUAL READING REQUIRED FOR EACH ADDITIONAL 500 SQFT OR LESS AREA.

NOTE #2 FOR FLIGHT DECK NONSKID, 3 INDIVIDUAL READINGS REQUIRED EVERY 100 SQFT FOR THE FIRST 500 SQFT; IF READINGS ARE SATISFACTORY, 1 INDIVIDUAL READING PER 1000 SQFT REMAINING.

NOTE #3 FOR ANY UNSAT CONDITION FOUND, PROVIDE THE TECHNICAL ADJUDICATION AND CORRECTIVE ACTION TAKEN IN THE COMMENTS BLOCK.

NOTE #4 IF SPACES ARE NOT APPLICABLE, INSERT N/A. UNUSED SECTIONS SHALL BE CROSSED OUT AND MARKED N/A.

Spot Measurement	Dust Quantity Rating	Dust Size Class	Approximate Location
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A

Spot Measurement	Dust Quantity Rating	Dust Size Class	Approximate Location
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A

Spot Measurement	Dust Quantity Rating	Dust Size Class	Approximate Location
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A

Spot Measurement	Dust Quantity Rating	Dust Size Class	Approximate Location
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A

Spot Measurement	Dust Quantity Rating	Dust Size Class	Approximate Location
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A
N/A	N/A	N/A	N/A

CONDITION OF CHECKPOINT

SAT: N/A UNSAT: N/A

COMMENTS: N/A

Contractor (Print):	N/A	Contractor (Signature):	N/A	Date/Time:	N/A
Subcontractor (Print):	N/A	Subcontractor (Signature):	N/A	Date/Time:	N/A
Govt. Insp. (Print):	N/A	Govt. Insp. (Signature):	N/A	Date/Time:	N/A

APPENDIX 6
QA INSPECTION FORM - PAINT/NONSKID APPLICATION AND CONSUMPTION LOG

SHIP NAME & HULL #: Portlandia bridge to nowheres **CONTRACT/TASK ORDER/CLIN/TWD:** Todd's test job for Navy **DATE/TIME:** N/A N/A

LOCATION: T **WORK ITEM:** 02112 **PARA. NO.:** T

(I) ✓ **(V)** N/A **(G)** N/A **PRODUCT BEING APPLIED:** T

REQ'T DOCUMENT: NSTM 631 **/FY:** T **TABLE:** N/A **LINE:** N/A **COLUMN:** N/A

(NSTM 631, 634, PPI, NSI 009-32 FY)

MAINTAIN SEPARATE LOG FOR EACH AREA/LOCATION, PREPARED OR PAINTED SURFACE. WHEN AN AREA IS DIVIDED INTO SEPARATE SECTIONS, MAINTAIN A SEPARATE LOG FOR EACH SECTION.

		Prime Coat	Stripe Coat (if applicable)	Intermediate Coat (if applicable)	Stripe Coat (if applicable)	Topcoat	Other
Application Method: Plural Airless, Conventional Airless, Brush, Roller, Conventional Spray		N/A	N/A	N/A	N/A	N/A	N/A
Airless Pump Ratio (if Plural Component): Fixed: N/A Variable: N/A		N/A	N/A	N/A	N/A	N/A	N/A
If Using Inline Heater, Temp in °F (Fahrenheit)	Temp. Setting At Heater	N/A	N/A	N/A	N/A	N/A	N/A
	Temp. At Tip	N/A	N/A	N/A	N/A	N/A	N/A
Product Applied		N/A	N/A	N/A	N/A	N/A	N/A
Product Manufacturer		N/A	N/A	N/A	N/A	N/A	N/A
Color Applied		N/A	N/A	N/A	N/A	N/A	N/A
Base Portion Batch No # (Part A)		N/A	N/A	N/A	N/A	N/A	N/A
Expiration Date (Part A)		N/A	N/A	N/A	N/A	N/A	N/A
Hardener Portion Batch No # (Part B)		N/A	N/A	N/A	N/A	N/A	N/A
Expiration Date (Part B)		N/A	N/A	N/A	N/A	N/A	N/A
Gallons Used Per Coat		N/A	N/A	N/A	N/A	N/A	N/A
Square Feet Covered		N/A	N/A	N/A	N/A	N/A	N/A
Start (Date/Time)		N/A	N/A	N/A	N/A	N/A	N/A
Stop (Date/Time)		N/A	N/A	N/A	N/A	N/A	N/A

APPENDIX 7
QA INSPECTION FORM - DRY FILM THICKNESS MEASUREMENTS

SHIP NAME & HULL #: Portlandia bridge to nowheres **CONTRACT/TASK ORDER/CLIN/TWD:** Todd's test job for Navy **DATE/TIME:** N/A N/A

LOCATION: T **WORK ITEM:** 02112 **PARA. NO.:** T

(I) ✓ **(V)** N/A **(G)** N/A **PRODUCT BEING APPLIED:** T

REQ'T DOCUMENT: NSTM 631 **/FY:** T **SQFT OF AREA PRESERVED:** N/A **PARTIAL AREA:** N/A **FINAL:** N/A

(NSTM 631, 634, PPI, NSI 009-32 FY)

MAINTAIN SEPARATE LOG FOR EACH AREA/LOCATION, PREPARED OR PAINTED SURFACE. WHEN AN AREA IS DIVIDED INTO SEPARATE SECTIONS, MAINTAIN A SEPARATE LOG FOR EACH SECTION.

NOTE #1 FOR ANY UNSAT CONDITION FOUND, PROVIDE THE TECHNICAL ADJUDICATION AND CORRECTIVE ACTION TAKEN IN COMMENTS BLOCK.
NOTE #2 IF SPACES ARE NOT APPLICABLE, INSERT N/A. UNUSED SECTIONS SHALL BE CROSSED OUT AND MARKED N/A.

Select Type of Gage being used: Type 1 [N/A] Type 2 [N/A] Base Metal Reading (Type 1 gage): N/A

Gage # N/A Current Calibration Due Date: N/A Accuracy Adjustment (Type 1 gage): N/A

ACCEPTANCE CRITERIA

[N/A] **PRIMER COAT DRF** **N/A TO N/A MILS** [N/A] **TOPCOAT DRF** **N/A TO N/A MILS**

[N/A] **INTERMEDIATE COAT DRF** **N/A TO N/A MILS** [N/A] **TOTAL SYSTEM DRF** **N/A TO N/A MILS**

[N/A] **STRIPE COAT (for cleanliness & holiday QA)**

Note: Each Spot Measurement = The AVG of Three Gage Readings.		
SPOT MEASUREMENT	DFT (Miles) AVG of 3 Gage Readings	Approximate Location
1	N/A	N/A
2	N/A	N/A
3	N/A	N/A
4	N/A	N/A
5	N/A	N/A
Average:	N/A	

Note: Each Spot Measurement = The AVG of Three Gage Readings.		
SPOT MEASUREMENT	DFT (Miles) AVG of 3 Gage Readings	Approximate Location
1	N/A	N/A
2	N/A	N/A
3	N/A	N/A
4	N/A	N/A
5	N/A	N/A
Average:	N/A	

Note: Each Spot Measurement = The AVG of Three Gage Readings.		
SPOT MEASUREMENT	DFT (Miles) AVG of 3 Gage Readings	Approximate Location
1	N/A	N/A
2	N/A	N/A
3	N/A	N/A
4	N/A	N/A
5	N/A	N/A
Average:	N/A	

Note: Each Spot Measurement = The AVG of Three Gage Readings.		
SPOT MEASUREMENT	DFT (Miles) AVG of 3 Gage Readings	Approximate Location
1	N/A	N/A
2	N/A	N/A
3	N/A	N/A
4	N/A	N/A
5	N/A	N/A
Average:	N/A	

Note: Each Spot Measurement = The AVG of Three Gage Readings.		
SPOT MEASUREMENT	DFT (Miles) AVG of 3 Gage Readings	Approximate Location
1	N/A	N/A
2	N/A	N/A
3	N/A	N/A
4	N/A	N/A
5	N/A	N/A
Average:	N/A	

Note: Each Spot Measurement = The AVG of Three Gage Readings.		
SPOT MEASUREMENT	DFT (Miles) AVG of 3 Gage Readings	Approximate Location
1	N/A	N/A
2	N/A	N/A
3	N/A	N/A
4	N/A	N/A
5	N/A	N/A
Average:	N/A	

HOLIDAY INSP: SAT [N/A] UNSAT [N/A] DFT INSP: SAT [N/A] UNSAT [N/A] N/A (for stripe coat) [✓]

CLEANLINESS INSP: SAT [N/A] UNSAT [N/A] CHLORIDE/CONDUCTIVITY INSP: SAT [N/A] UNSAT [N/A] N/A (for stripe coat) [✓]

COMMENTS: N/A

Contractor (Print):	N/A	Contractor (Signature):	N/A	Date/Time:	N/A
Subcontractor (Print):	N/A	Subcontractor (Signature):	N/A	Date/Time:	N/A
Govt. Insp. (Print):	N/A	Govt. Insp. (Signature):	N/A	Date/Time:	N/A

APPENDIX 7A
QA INSPECTION FORM - WET FILM THICKNESS MEASUREMENTS

SHIP NAME & HULL #: Portlandia bridge to nowheres **CONTRACT/TASK ORDER/CLIN/TWD:** Todd's test job for Navy **DATE/TIME:** N/A N/A

LOCATION: T **WORK ITEM:** 02112 **PARA. NO.:** T

(I) ✓ **(V)** N/A **(G)** N/A **PRODUCT BEING APPLIED:** T

REQ'T DOCUMENT: NSTM 631 **/FY:** T **SQFT OF AREA PRESERVED:** N/A **PARTIAL AREA:** N/A **FINAL:** N/A

(NSTM 631, 634, PPI, NSI 009-32 FY)

MAINTAIN SEPARATE LOG FOR EACH AREA/LOCATION, PREPARED OR PAINTED SURFACE. WHEN AN AREA IS DIVIDED INTO SEPARATE SECTIONS, MAINTAIN A SEPARATE LOG FOR EACH SECTION.

NOTE #1 FOR ANY UNSAT CONDITION FOUND, PROVIDE THE TECHNICAL ADJUDICATION AND CORRECTIVE ACTION TAKEN IN COMMENTS BLOCK WHERE REQUIRED IN LIEU OF DFT.

NOTE #2 IF SPACES ARE NOT APPLICABLE, INSERT N/A. UNUSED SECTIONS SHALL BE CROSSED OUT AND MARKED N/A.

Indicate Coating System Sequence

N/A	Prime Coat	N/A	Intermediate Coat (if applicable)	N/A	Topcoat
N/A	Stripe Coat (if applicable)	N/A	Stripe Coat (if applicable)		Other Coat (specify) ()

METALLIC SURFACES

2 SPOT READINGS PER 1000 SQFT:
0 - 1000 SQFT = 2 SPOTS REQUIRED
1001 - 2000 SQFT = 4 SPOTS REQUIRED

NON-METALLIC SURFACES

0 - 100 SQFT = 5 SPOTS REQUIRED
101 - 200 SQFT = 10 SPOTS REQUIRED
201 - 1000 SQFT = 15 SPOTS REQUIRED
> 1000 SQFT = 5 SPOTS REQUIRED PER 1000 SQFT AREA

WFT Measurement Number	Location of Readings	WFT Measurement IAW ASTM D 4414
1	N/A	N/A
2	N/A	N/A
3	N/A	N/A
4	N/A	N/A
5	N/A	N/A
6	N/A	N/A
7	N/A	N/A
8	N/A	N/A
9	N/A	N/A
10	N/A	N/A
11	N/A	N/A
12	N/A	N/A
13	N/A	N/A
14	N/A	N/A
15	N/A	N/A
16	N/A	N/A
17	N/A	N/A
18	N/A	N/A
19	N/A	N/A
20	N/A	N/A

COMMENTS: N/A

Contractor (Print):	N/A	Contractor (Signature):	N/A	Date/Time:	N/A
Subcontractor (Print):	N/A	Subcontractor (Signature):	N/A	Date/Time:	N/A
Govt. Insp. (Print):	N/A	Govt. Insp. (Signature):	N/A	Date/Time:	N/A