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Report on a Shipyard Surface Preparation and Quality Program

U.S. DEPARTMENT OF THE NAVY
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Report on A Shipyard Surface Preparation & Quality Program

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A report prepared for the National Shipbuilding Research Program, Surface Preparation & Coating NSRP Panel SP-3, under Project 3-90-2

1.0 Project History

In 1991, the National Shipbuilding Research Program (NSRP) approved a project with the original intent of transferring the parameters of the Steel Structures Painting Council (SSPC) Painting Contractor Certification Program (PCCP) to U. S. Shipyards. The PCCP included requirements for quality improvement and quality assurance throughout a contracting organization, such as a third party invited by a shipyard to conduct work in ship repair or maintenance activities. Following extensive review of the purpose and content of the project by the National Shipbuilding Research Program SP3 Panel volunteer group, the direction of the project was altered. The feeling of the review group was that an effort which embodied the quality components of the original PCCP program, decoupled from the external review and certification aspects, was appropriate.

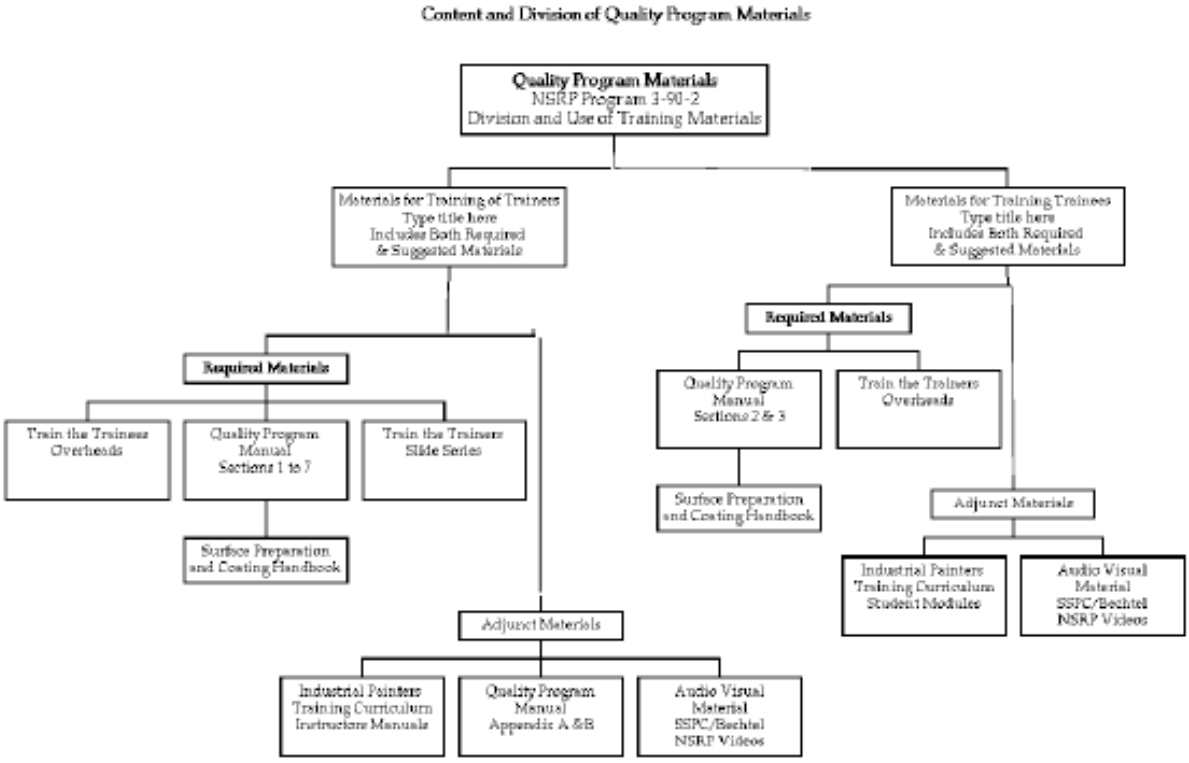
As the primary products of this research project, SSPC developed Quality Program Training Modules. These training modules were designed for use at shipyards that rarely employ external contractors and offer training and skill improvement to both trainers and Deckplate personnel. SSPC, in conjunction with Bath Iron Works (BIW) and representatives of the United States Navy's Inspector Group, conducted a series of training sessions offering the substance of this Quality Program to both Deckplate and managerial personnel.

2.0 Quality Program Description

The program devised in response to the panel suggestions addresses two audiences, trainers and trainees. There is one common goal for each audience, to inform shipyard surface preparation and coating personnel about the value of quality in their work. This goal is achieved through the use of different combinations of output material in training sessions.

Some of the output material was specifically designed for this project. Some material is suggested as an adjunct to complement the developed material. The program structure can be thought of in terms of two tiers. Tier 1 is intended for training of the trainers. Tier 2 uses the trainers to transfer concepts of quality to the deckplate level. Tier 1 and Tier 2 materials differ in terms of level of difficulty and length. Tier 2 materials are pitched at a level suited for deckplate personnel and are generally shorter in length.

FIGURE 1. .Diagram of Quality Program Content & Division



2.1 Quality Program Content RoadMap

To better understand the content of the quality program a diagram is provided, Figure 1 on page 2. This diagram describes the relationship between mterials developed for the project and materials used as adjuncts to the project output. The diagram also labels which items are required (or suggested) for each audience (Trainers or Trainees).

Specific items prepared for this project are decribed below.

The bulk of the quality training program materials were prepared from scratch. Though the original project efforts did yield such elements as the evaluation criteria that were retained in the training program materials, they underwent substantial revision to reflect the unique needs of the shipyards.

2.2 Written Materials Adapted for The Training Program

2.2.1 PCCP Contractor Guidance Materials

The sole elements from the PCCP contractor guidance materials included in the final program are shown in Appendix A on page 1-A, and Appendix B on page 1-B. These are the comprehensive lists of skill evaluation and organization procedure or process evaluation criteria. Even these materials underwent revision for conformity with the remainder of the Training program materials. In particular, these elements were significantly de-emphasized throughout the training program materials. The role these comprehensive lists of skills and organizational evaluation criteria now play is as follows: they provide a means for a shipyard to uniformly evaluate a sub-contractor to a surface preparation and coating project.

2.3 Written Materials Prepared for The Training Program

2.3.1 3-90-2 Shipyard Deckplate Skills List

The skills list actually used in the training program was a modified version of that previously developed in the project. It is shown in Section 6.1 on page 1 of the attached Quality Training Program Manual.

2.3.2 Additional Written Training Materials

The primary additional written materials developed for this training program were:

- A full training manual for the Quality Program - comprising seven sections with 2 Appendices the training manual is the core tool for use by Trainers in understanding the nature of the program, and how to implement the same.

The training manual sections were:

SECTION 1 - INTRODUCTORY COMMENTS

SECTION 2 - HOW QUALITY PROGRAMS CAN WORK

SECTION 3 - ELEMENTS OF QUALITY IN A SHIPYARD PAINTING DEPARTMENT

These sections provided clear examples of how a quality program can be implemented in a shipyard paint department. Concrete examples were shown of the use of quality measurement tools using realistic examples pertinent to surface preparation and coating work in a shipyard setting.

SECTION 4 - USING THE MANUAL

This section gave instructions to the Trainer on the proper use of the manual.

SECTION 5 - QUALITY EVALUATION & SUPERVISORS

This section contained the revised list of evaluation criteria for Supervisors to monitor their own work.

SECTION 6 - QUALITY EVALUATION & MECHANICS

This section contained the revised and much simplified list of evaluation criteria for evaluation of Deckplate personnel by Supervisors. These same criteria can be used by said personnel to conduct self-monitoring.

SECTION 7 - MODIFYING THE PROGRAM MANUAL

As stated earlier, the manual is not a static piece. There is flexibility within the curriculum to permit modification.

APPENDIX A - FULL LIST OF QUESTIONS

APPENDIX B - SUPERVISORS QUESTIONS WITH ANSWERS

Flexibility to amend the criteria used to evaluate worker skills was built into the manual from the outset.

2.4 Written Materials Suggested as Adjunct Training Program Texts

- The SSPC Applicator Training Bulletins
- The NSRP Surface Preparation & Coating Handbook
- The Bechtel Coating & Lining Inspection Manual
- The Joint SSPC/NACE/PDCA/ABC Industrial Painters Training Curriculum.

The general requirement for these written documents was that they all be pitched at a newspaper reading level.

2.5 Audio-Visual Training Materials

A variety of Audio-Visual Training Materials were pulled together for the training sessions. It was recognized that the target audience of the trainers might require substantial

visual reinforcement of points made in the written text. For this purpose both off -the-shelf and original materials were brought together.

2.5.1 Visual Training Materials 1 - Slide Presentation for Trainers

An original set of over one hundred slides was prepared which were used in the Training the Trainer Sessions. These slides lead the trainers through the key aspects of the Training Program Manual.

2.5.2 Visual Training Materials 2 - Overhead Presentation for Trainees

In addition a full set of Training Overheads was prepared for use by the trainers, in training the Trainees. These overheads were broken down into sets which matched the key evaluation criteria contained in the Deckplate skills list from Section 6.2 on page 2.

2.5.3 Additional Audio-Visual Training Materials

In addition to these materials the training program would employ the SSPC series of Video Tapes on Surface Preparation and Coating, developed in cooperation with Ameron Protective Coatings. The program includes direct reference to the NSRP Video Tapes previously issued by SNAME SP-3.

The top tier of the program output is intended for training of trainers. Items required to train trainers include all written texts developed for the project, all audio-visual aids developed for the project and (potentially) all adjunct materials

3.0 Devising the List of Deckplate Skills

As part of the project effort, a template sheet of skills and evaluation criteria, largely based on the PCCP program, was developed. The full list of these evaluation criteria and accompanying answers for Supervisors and Deckplate personnel are shown as part of the major appendices to this report - Appendix A on page 1 -A & Appendix B on page 1-B.

3.1 Quality Program Elements

The final product from this project as described in “Description of Final Training Materials” on page 10, is a quality program manual, accompanied by a variety of training materials. The road which lead to the conversion of this project from a simple implementation of the PCCP in US Shipyards to a broader, more valuable quality program left some original project efforts behind unused in the final product. With the cooperation of the NSRP SP-3 Panel, much of the original project effort proved useful in the finished product.

3.1.1 SSPC PCCP Elements

The primary PCCP elements having relevance to shipyard surface preparation and coating work were previously defined above. In addition, the shipyard representatives from NSRP SP-3 Panel were involved early in the process of defining the content of the skills evaluation checklists.

3.1.2 Shipyard Review and Input

The initial shipyard review and input to the project was based on reviewing the skills evaluation checklists and providing the project team with a “score-card” of acceptable Deckplate skills levels. These were developed by the project team to provide the first attempt at a common set of worker evaluation criteria. At this time the overall goal was to provide guidance to participating shipyards on the minimum qualifications required for implementation of a Qualification Program, along the lines of the PCCP. Only later with the input of the NSRP SP-3 Panel did the criteria and evaluation checklists become the quality program targeted to US Shipyards.

4.0 SNAME SP3 Panel Input

4.1 Suggested Revisions from SP3 Panel Review

The primary suggestion from the NSRP SP-3 Panel review of this project was to move it from a specialized, PCCP implementation oriented project to one with more general application. In addition the SP-3 Panel review team culled the list of PCCP elements for modification and inclusion in the final project. The culled list of PCCP elements is shown in “Elements of the PCCP Program Retained in 3-90-2” on page 2.

The input of the NSRP SP-3 Panel proved very valuable in crafting the final output from this project.

4.1.1 Specific Review Panel Suggestions

Specific suggestions from the review panel were incorporated in the later conduct of the project. Along with suggestions from the project team, these suggestions provided the scope of activity for the remainder of the project.

Key suggestions from the Review Panel included:

- Elimination of most references from the criteria listing and evaluation checklist to safety or managerial quality aspects of an organization.
- Development of a structured program to implement the quality aspects of the remaining material.
- Revision of the remaining evaluation criteria to “break” their link with their PCCP origins.

This last suggestion was merited because the original language of many evaluation criteria for Supervisors or Deckplate personnel were lifted directly from the PCCP admissions guidance manual. Thus some elements bore evidence of their heritage in the form of internal cross-references to existing PCCP admissions manual sub-sections or evaluation criteria. Other parts of the program documents still read in a manner more suited to implementation of PCCP, even if created as original works for this project.

4.1.2 Response of the Project Team

The project team responded to the requests of the SNAME Review Panel in the following fashion:

- Development of a quality program manual - customized for shipyard use, reflecting only shipyard paint department activities.
- Development of a revised set of evaluation criteria - all links to the PCCP would be broken, the evaluation criteria would be coupled to common shipyard paint department activities,. Emphasis would be placed on providing a series of evaluation criteria that matched the expectations of paint department supervisors for performance of Deckplate personnel.
- Greater emphasis would be placed on all quality aspects of the program documents.
- A curriculum for training the trainers would be created.
- A curriculum for trainers to train Deckplate workers would be created.
- The curricula would be put into action by undertaking a training the trainers session at a participating yard.
- The participating yard would conduct training of Deckplate personnel and report to the project team on:
  - The number of workers trained
  - The workers understanding & reception of the course materials;
  - Suggested improvements to the course materials.

Following the feedback from the participating yard revisions to the curricula would occur. The attachments to this final report are the results of this participating yard training feedback.

5.0 Implementation of The Training Program

Pilot implementation of the Training Program was implemented required considerable help and input from Bath Iron Works, the Participating Yard for this program.

5.1 Bath Iron Works Training Sessions for Trainers

On October 17th, 1994 a Train the Trainers Session was undertaken at Bath Iron Works in Bath, Maine. A total of twenty-five personnel attended the training sessions. The majority of the attendees were from various functions of the BIW Paint Department or Quality Assurance groups. A full list of attendees is given as an attachment to this report.

In addition to the BIW personnel, and in keeping with the philosophy of a Quality Program, the training sessions also included representatives from one of BIW's primary customers, the US Navy. Due to the implementation of a new contract at BIW there was strong interest in having both Supervisory and Deckplate personnel present during these sessions. This proved to be very beneficial in that the project team received on-site input not only from a Supervisory point of view, but also from the true target audience of the training to be dispensed by the trainers, the Deckplate personnel and the Mechanics. Note: all the Deckplate personnel present were to also perform a future role as trainers.

The duration of the training was a total of three days. All training was conducted in a traditional classroom setting.

5.1.1 Training the Trainers - Day by Day Actions

The training of the trainers uses the following structure.

The first day is devoted to a walk through of the Train the Trainers Slide Presentation. (Copies of all Visual Materials are available as an Aldus Persuasion file submitted to NSRP). The four goals are:

- Establish the purpose & philosophy of the training program for quality program implementation.
- Introduce to the trainers the classroom examples and quality measurement tools available for future administration and implementation of the quality program.
- Guide the trainers on the content and use of the implementation manual;
- Deliver a clear decision map for a quality program based on classical total quality management precepts.

The second day is devoted to displaying and describing the Training materials used by a Trainer to train Trainees. The materials covered include:

- The overheads for classroom presentation to trainees;
- The videos suggested for use as an accompaniment to the training program;
- The link between the overheads and discrete units of the evaluation checklists.

The third day focuses on integrating the Training Program elements together. The scope of activity is as follows:

- Providing an understanding of the link between the overheads for training trainees and the individual units of the industrial painters training curriculum (IPTC);
- Showing how the accompanying texts such as the Surface Preparation & Coating Manual may be used as an adjunct to training trainees;
- Showing how the accompanying texts such as the Bechtel Coating & Lining Inspection Manual may be used as an adjunct to training trainees;

- Discussing options for presentation of the training materials to trainees - such as:
  - Periodic review of key portions of the Industrial Painters Training Curriculum, IPTC, and the accompanying overheads
  - Routine use of quality measures for surface preparation & coating - such as dry film thickness measurements - or the proportion of non-conforming work;
  - Incorporation of problem solving processes into the quality program - that is to make the program inclusive inviting ideas for process improvement from a supervisor or Deckplate level;
  - Incorporation of the customer and customer expectations into the quality program - that is agreeing on a shared understanding of a project specification, providing a means to measure response to customer demands, and identifying a customer either internal or external.
  - A run-through of a quality program structure and process mapping, based on the earlier slide presentations for training the trainer.

5.2 Follow-up Training of Trainees by BIW

The general feedback from BIW on these training sessions has been positive. Despite the complications arising from significant internal restructuring and the implementation of the unique contracting agreement, BIW followed up with training of additional personnel at the Deckplate level. Currently a total of more than fifty personnel are trained in the Quality Program at BIW. More training of Deckplate Workers is planned.

6.0 Feedback on Training Program Materials

6.1 BIW Feedback on Training Materials

The primary feedback from BIW on the training materials fell into two categories:

- Further de-emphasis of managerial aspects of quality program manual, and;
- Editorial revision of training program visual aids (slides or overheads).

6.1.1 Suggested Revisions

The suggested revisions to the training materials have been incorporated into the final products which are attached hereto in “thumbnail” version. In addition these materials are made available as electronic files with full release of copyright to NSRP.

7.0 Final Training Program

7.1 Description of Final Training Materials

The final Training Materials are comprised of the Text, Audio-Visual, and Visual Aids outlined earlier in Section 5.0 on page 7, specific elements are defined in Section 2.2, “Written Materials Adapted for The Training Program,” on page 3; Section 2.3, “Written Materials Prepared for The Training Program,” on page 3, and Section 2.5, “Audio-Visual Training Materials,” on page 4.

The method of presentation of the text adjuncts for this program is as original text copies. One complete copy of each original publication cited in Section 2.2, “Written Materials Adapted for The Training Program,” on page 3 and Section 2.3, “Written Materials Prepared for The Training Program,” on page 3 are submitted under separate cover to the Program Managers.

The method of presentation of the original texts generated for this program by the project team is in two formats:

- As camera ready printed texts from 300 dpi laser writer print-outs
- As electronic copies using the FrameMaker™ file format for duplication and printing by a service bureau, the FrameMaker™ file format is completely cross-platform compatible.

The mode of presentation of the visual materials developed for this project is in two formats:

- As original full color overhead originals - for both overheads and 35mm slides;

- As Electronic documents in the aldus persuasion file format, both pc and Macintosh versions of the files are presented.

The mode of presentation of NSRP and SSPC videos is by reference only.

7.2 Suggested Implementation of Final Training Program

The results of the BIW training sessions suggest that the number of days required for training of trainers is approximately correct. The experience of BIW in training trainees suggests that the tool-box meeting model for follow-up training trainees is more appropriate than the imposition of classroom training alone. Classroom training of trainees should take place as an initial step to introduce key components of the program.

7.3 Distribution of Training Program Materials

To effect wider implementation of the Quality Program it is vital that the training materials be as widely available as possible. The core activities of the program may be accomplished using the Quality Training Manual, along with the slides and overheads developed for this program. These are freely distributable by NSRP as a matter of course.

The adjunct materials play a valuable role in setting the tone for the training program. They were essential to developing a sound training program at BIW. It is expected that such adjuncts will prove their value in any shipyard setting.

Of these adjuncts, the Surface Preparation and Coating Manual is an NSRP property, as is the NSRP Video tape series. All remaining adjuncts are properties of their respective publishers, including SSPC.

8.0 Suggestions for Future Activities and Additional Research

One potential improvement to the current program documents is to provide all relevant documents in machine readable electronic form. The software platform used to develop the written and visual texts for the program (FrameMaker™) provides this facility for creating on-line electronic documentation. The resulting electronic books contain links between significant sections of a text and related materials. This would permit a user to navigate the technical material at their own pace, it also greatly reduces the cost for future publication, while permitting easy updating of the text information to reflect new surface preparation technologies and quality program requirements.

July 10, 1995

Attachment 1 Implementation Manual

Report On A Shipyard Surface Preparation & Quality Program

Drs. Simon K. Boocock & Bernard R. Appleman,
Steel Structures Painting Council

A report prepared for the National Shipbuilding Research Program Under Project 3-90-2

Manual for Implementation of A Surface Preparation & Painting Quality Program

National Shipbuilding Research Program Project 3 - 90 - 2

Steel Structures Painting Council Project RO 32

A Self-Audited Program for Maintaining Quality

US Shipyard Surface Preparation and Painting Quality Program An Implementation Manual

SECTION 1 - INTRODUCTORY COMMENTS

1.1 Introduction

A quality program begins with a definition of quality. One simple definition of quality, applicable to all operations and activities is - “The execution of work with zero defects all the time.” Another definition might be meeting the customers’ requirements. Whichever definition you choose the goal of a quality program is to work toward this aim.

There are many examples of the use of quality management in the literature. Some of these examples are given as reference materials at the end of this manual. This manual is not another “total quality management” program. The focus is always on a unique operating group of a shipyard, the Surface Preparation & Painting Department. This manual can provide tools for assessing quality tailored to the tasks involved in coating and painting ships. Quality program elements in the manual can be made part of any existing quality management program by a shipyard.

The main question for surface preparation operators and coating applicators is, what is a good means for assessing quality in your operations? Quality will be measured using a yardstick of standards or specifications typically encountered in shipbuilding operations. These provide a quantitative measure of performance. Reference will also be made to other qualitative measures of quality surface preparation and coating work.

1.2 Purpose of Manual

The purpose of the manual is twofold. First, it provides information on the importance of quality to surface preparation and coating operations Second, it delivers a series of evaluation tools for conducting quality assessments. The tools for assessing quality are built around evaluation checklists. These checklists use criteria for figuring out the capability of workers, the quality of their work and that displayed by supervisory or management personnel.

SECTION 2 - USING THE MANUAL

2.1 Continuous Monitoring of Quality

2.1.1 How to Use this Manual in a Quality Program

A quality program assumes that there will be continuous monitoring of the quality of work performed by supervisory and deckplate personnel in all facets of their jobs. Sometimes similar criteria for assessing excellence apply to management, supervisory, and deckplate or operator personnel. A display of all criteria regardless of the type of worker could cause some confusion. To avoid confusion two distinct lists of evaluation criteria are shown, one for supervisory personnel, the other for deckplate personnel. Indeed, the overall team or crew quality depends on a coherent approach to work practices, and a shared understanding of goals and job targets.

To use this manual in a quality program the reader must remember an important idea: Quality is measurable. The criteria listings help give a base line reading on crew or team performance and job awareness. Though two lists are shown this does not imply that supervisors and mechanics or deckplate personnel work separately. With this manual and the criteria lists it is possible to begin a coordinated effort to first measure, then begin improvement of work quality.

Quality improvement procedures, QIPs, are described in this manual. The QIPs fall into two distinct classes: methods for measuring or analyzing quality, and; methods for analyzing quality measurements. The final decisions about how to change or improve an existing work practice will rest with the paint department management, with participation from the deckplate personnel where “quality teams” are in place.

2.2 Quality & Supervisory Personnel

2.2.1 Monitoring Crew Performance

It is assumed that supervisory personnel will monitor the performance of the deckplate crew. The supervisory personnel may judge crew performance against the list of skills, knowledge and evaluation criteria for surface preparation and painting operators.

2.2.2 Monitoring Supervisory Personnel

It is assumed that the supervisory personnel will also engage in a self-assessment of their own performance and capabilities. To achieve this end it is suggested that they use the criteria shown below. Some of the criteria listed involve paint department management or supervisors. Some quality criteria are relevant to both deckplate operators and supervisory or management personnel. Many criteria are directly relevant to deckplate personnel alone. For instance, this manual holds that both the operator and the supervisor should be aware of the requirements for quality surface preparation and painting operations. Conversely, the operator is affected by, but may not have an intimate knowledge of the backbone of a corporate safety program. Yet the operator knows about the safety program and uses safe working practices. To help in providing answers to these supervisory questions a list of suggested answers are also given in “Evaluation Criteria” on page 1 of Section 5.

2.3 “Deckplate” Personnel

By “deckplate” personnel this manual also refers to surface preparation and painting operators, in some locations the term used is mechanic. It is assumed that the deckplate personnel will be monitored by the supervisory personnel using the special skill listing for surface preparation and painting operators. This manual also assumes that the deckplate personnel would engage in their own self assessment for the purposes of gauging their own quality level.

To help identify key points of measure of evaluation for different personnel a simple organizational

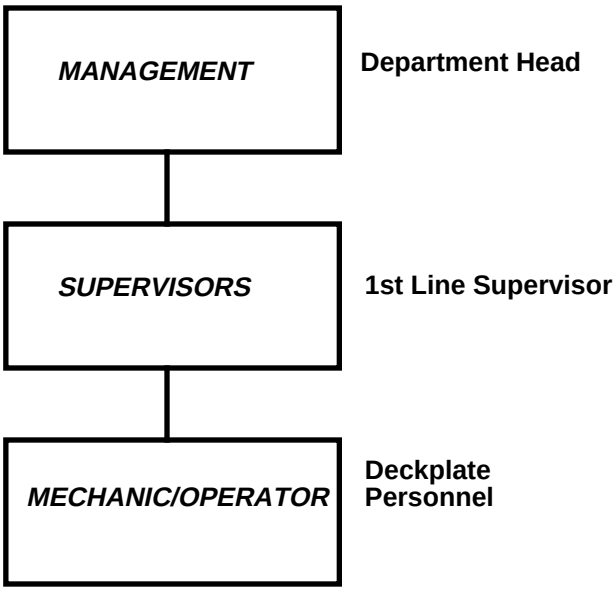
hierarchy is used to describe a paint department.

2.4 Monitoring Your Performance

When conducting self-assessment or self-monitoring there are some pitfalls to be avoided. Perhaps the most difficult task is to keep an adequate perspective on your own performance. An effective means of self-assessment is to allow peer review of your own grading. To give an example, Joe Supervisor completes his self-assessment using the criteria listing for guidance. To determine if he has maintained an unbiased viewpoint Joe then asks for input from other supervisory personnel who are familiar with his work and level of knowledge. To make things fair Joe is also providing an analysis of these same co-supervisors. Using such a team based approach makes it less likely that Joe will give an unfair high or low rating to his level of job knowledge. By the same token deckplate personnel can engage in the same activity.

To make certain that the task of rating others and yourself does not become too large it is suggested that these assessments of others and yourself involve groups no larger than four or five persons.

Figure 1: Simple Organization Structure of Paint Department



SECTION 3 - HOW QUALITY PROGRAMS WORK

3.1 Scope of Manual

The scope of this manual is to provide information required for starting and managing a Quality Program for Surface Preparation Operators and Painters by US Shipyards. The information will not match with an individual shipyard operation. The aim is to provide information that any shipyard can use for program application.

3.2 The Importance of Quality

Quality is important to a shipyard's customers. A customer's perception of quality is best defined by a shipyard delivering the product, a ship, on time and with no defects. Customers will have many ways of trying to decide if your product meets their needs. The most common way a customer defines a need is by issuing a set of specifications that govern the form or content of the finished product. The shipyard must meet these specification requirements to help match the customer's needs. The importance of quality to shipyard surface preparation and coating operations is best exemplified by a previous National Shipbuilding Research Program study. This concluded that though paints and coatings took up only 5% of the original work they were responsible for a much higher fraction of reworking or non-value added items. This implies that a quality gap exists. The "customer" was not receiving properly finished or painted parts, either at all, or at the right time.

Achieving quality will benefit any shipyard. You save money by getting things right the first time. Less money is wasted performing unneeded rework. Achieving quality will lessen the time required to deliver product and make an operation more efficient. Because of increased efficiency, the shipyard can become more competitive.

3.3 Steps to Quality

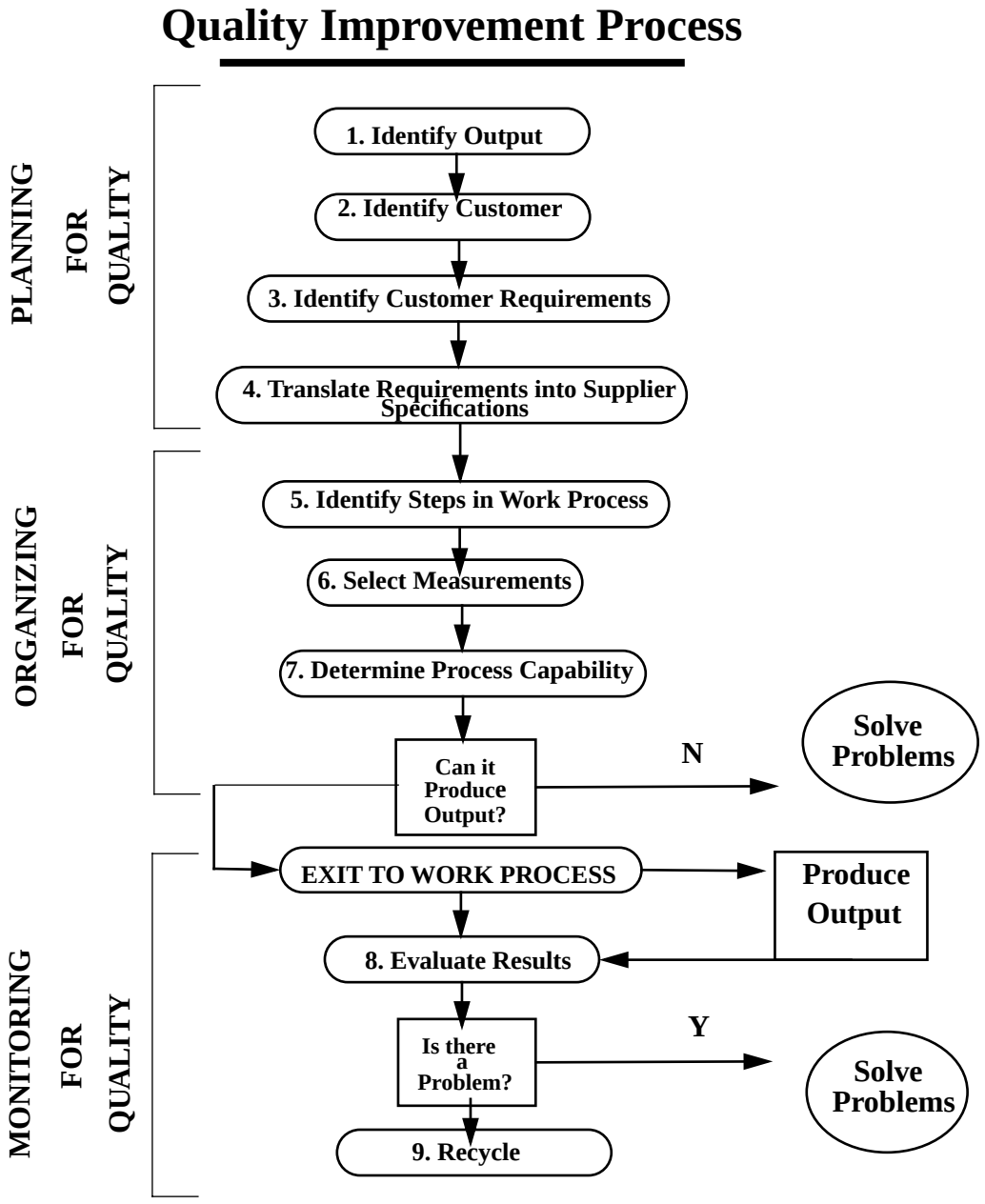
This manual uses lists of performance criteria to assess the quality of a shipyard's surface preparation and coating activities. This assumes that the yardsticks of excellence defined herein are sufficiently detailed to cover most eventualities at the supervisory and deckplate level. Integration of the performance requirements described in"Evaluation Criteria" on page 1 of Section 5 can be achieved by using a step -by-step process in which quality requirements are defined at the earliest possible opportunity in a work process.

3.3.1 Steps in A Quality Improvement Process

A simple flow chart is shown in Figure 1 to illustrate the points of action in a hypothetical quality process. The steps depicted fit those often suggested for working in a Quality Improvement Program.

Three phases of the process are broken out in Figure 1, they are planning for quality, organizing for quality, and monitoring for quality. Together, these three phases are the Quality Improvement Process (QIP).

Figure 1: Steps in A Quality Improvement Process



3.3.1.1 Planning for Quality

When planning for quality a first step is to conduct a review of the customer requirements such as written and verbal specifications. Achieving understanding of the specification requirements is a critical activity at this stage. Typical documents that may require review at this stage include:

- Surface Preparation Specifications -,e.g., quality of desired surface finish see “Surface Preparation Activities” on page 2 of Section 4;
- Painting Specifications - e.g., type of coating to be applied and film thickness requirements

see “Painting Activities” on page 5 of Section 4;
- Special Requirements - e.g. abrasive quality MIL-22262, or resultant weld quality MIL STD 148 C.

3.3.1.2 Organizing for Quality

Under organizing for quality it is appropriate to consider the steps involved in your work process, who does the work, how that work is done, and whether the work method is effective. For instance, all coating work has three main activities: surface preparation, paint application, and inspection. Each main activity is also made up of several smaller tasks. Application can involve mixing the paint and checking the operation of the spray equipment. For painting work, inspections may include film quality (no runs, no drips, no errors), and film thickness. Who is responsible for doing each task? Painting is typically done by the applicators from the paint department. Inspections of film quality may involve either the Quality and Paint Departments. How do you measure or inspect the work? For instance DFT readings are taken using magnetic gages to ensure specification conformance after application. Finally, does the work method produce the needed product. To cite an example, can a water based inorganic zinc preconstruction primer yield a uniform low film thickness required for good weldability? If not you must change the material or application method, or the welding process.

3.3.1.3 Monitoring for Quality

A primary requirement of monitoring for quality is that the yard define the means for ensuring specification conformance, which is how to analyze the products of the measurements. Taking the example of dry film thickness measurements, how many of these must be taken so you are assured of uniform film thickness. Some guidance on this matter is given in SSPC-PA 2, “Dry Film Thickness Measurement using Magnetic Gages” but the user should be aware that this specification cannot cover all requirements.

To cite again the example of maintaining close thickness control on the dry film thickness of a weldable primer. It may be that the criterion for acceptance under SSPC -PA 2, (80% of readings fall within the defined range of DFT values), is too lenient. Having 20% of your coated product fall outside this range may yield too many instances of poor weld porosity. Though the coating specification is met the companion military standards for weld quality are not met. The problem is that the two specification requirements are not in agreement. When instances like this occur, typically the requirements of the most severe specification governs the work process. Thus the cited SSPC specification could be invoked for its description of the film thickness measurement method, but a more stringent pass/fail criterion for the coated parts imposed, helping ensure conformance with the welding specifications.

3.3.1.4 Integrating Quality Steps into the Quality Program

Many activities required to fulfil the steps given in Figure 1 on page 2 are in force during normal shipyard operations. The specific structure of the quality process shown in Figure 1may not be typical of each individual shipyard. For simplicity the figure does not show all the responsibility paths and feedback loops from the various departments of the shipyard into the workflow of the Paint Department. Nonetheless, for the purpose of a quality program in surface preparation and coating, integrating the criteria defined later in this document in “Evaluation Criteria” on page 1 of Section 5 into each of the quality steps is readily accomplished.

3.4 Alternative Measures of Performance & Quality

The manual assumes that the developed list of criteria is sufficient to cover most skills or program elements needed to ensure a minimum level of quality. Earlier it was stated that the manual did not wish to impose requirements from “total quality management” programs, (TQM). Despite this statement it is recognized that many of the elements from such programs could be used as alternate means of improving or ensuring quality. In addition the philosophy embodied in many TQM programs is that an open work environment, with involvement from the full workforce, helps

improve the likelihood of success in the TQM program. This is also true for the targeted quality program described in this implementation manual.

3.5 Quality Measures from TQM Programs & The QIP

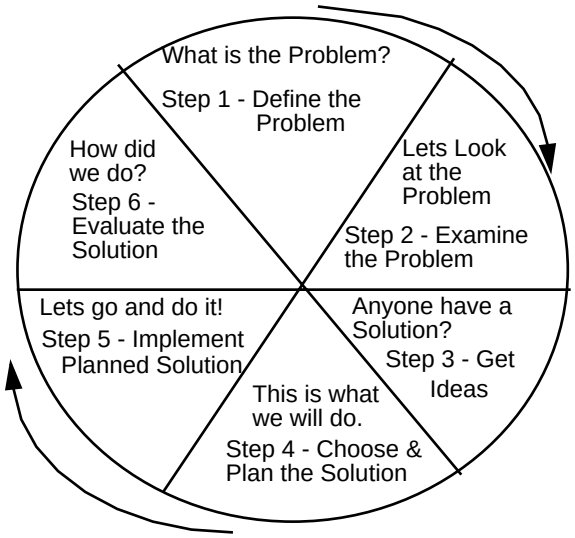
A TQM program can invoke many methods to help improve quality, one of the components found in a TQM program, a step by step quality program approach has already been described in “Figure 1: Steps in A Quality Improvement Process” on page 2 of Section 3. Other essential elements of such a quality program approach may include:

- A formal Problem Solving Process - PSP - based on group identification of problems and solutions;
- Training in Behavioral Skills & Meeting Utilization - Designed to help avoid unproductive PSP sessions;
- Identification of the Structure of a Working Process;
- The use of Measures of Quality - e.g. Charting of Defects their frequency of occurrence and type;
- The use of “Quality Teams” - a structure which can bring together management and deckplate to solve problems using PSP.

A significant presumption in almost all TQM programs is that the needs of the customer are paramount, “the customer is always right”. It is further assumed that these needs are expressed in both written and verbal form, i.e. not just in the form of a specification. Finally it is assumed that problems can be both identified, and the degree of problem resolution recognized by making quantitative measures of the work process. An example of such an approach is to measure the number of times a coating film thickness is on target. The causes of both high and low film thickness would then be identified, measures of the incidence with which each identified cause of poor film thickness adherence was involved would then be taken. Following the identification of the primary causes of film thickness problems, solutions to the problem would be identified then implemented. To close the loop, the new process would be subjected to renewed analysis to determine the need for additional solutions and the effectiveness of implemented solutions.

3.5.1 Problem Solving Processes

A problem solving process is a systematic way to simplify problem solving. The process is often shown as a wheel.



This process is shown as a wheel because you can generate new problems after putting a planned solution in action. Also, after putting a solution into action you may find you need to tweak it a little. This refinement also works within the Problem Solving Process.

Defining Problems
It is rare to go through the PSP wheel steps just once. It is normal to move cautiously through the different stages. Refinement of ideas is common, especially in the early stages - this may mean the group goes back a step before proceeding. Keeping all problem statements specific and measurable helps to define the scope of both the problem and suggested solutions. This greatly improves the success rate of the PSP.

Problem Statement - say, “1/3rd of our primer thickness readings are below specification;”

But - don’t say, “too few of our dft readings are on target.” (It is too vague of a statement).

Defining Goal
Another way to help during problem solving is to state how you want things to be under the problem statement. Like the problem, or current, statement, the goal - desired statement is best left terse, quantitative and reasonable. So below the statement about how many primer thickness readings are too low:

Desired State- say, “We want 80% of our DFT readings within specifications;”

But - don’t say, “We want all DFT readings to be correct.” (It will never happen).

Analyzing the Problem
During problem analysis you will try to identify the **causes** of the problem. To help remain focussed, keep an eye on the current problem, and desired goal statements. To help understand the problem better gather data about the problem. The key to success is a systematic approach. In the given example you may search for instances where odd DFT readings occurred because of high profile, incorrect gage calibration, applicator error, or other suspected, or reported, causes. This may involve the use of simple statistics as shown in Table 1 below.

For the sake of example let us say you found the attributable causes split as shown below.

Table 2: Analysis of Low DFT Readings

Attributable Cause	Frequency %
High Profile	45
Applicator Error	15
Gage Calibration Error	25
Other	15

This points to a problem cause that has certain probable solutions.

The next step in problem analysis is to make suggestions.

Generating Ideas
Never discount an idea while searching for solutions. Let the whole thing flow in a “brainstorming session.” The time to pick apart the suggestions comes later. For now let everyone have their say. To illustrate, let us say three solutions were suggested:

1. Change from abrasive blasting to power tool cleaning;
2. Lower the nozzle pressure during blasting, or;
3. Change to a different size of abrasive.

Selecting & Planning your Solution
This is an attempt to find the best idea from those suggested earlier. Often ideas are weeded out at this stage. This helps reduce instances of unintended consequences.

To illustrate let us look at our three suggested solutions:

1. Change from abrasive blasting to power tool cleaning;
2. Lower the nozzle pressure during blasting, or;
3. Change to a different size of abrasive.

Solution 1 is discussed, the opinion is offered that solution 1 will cost more money. Solution 1 is impractical. Solution 1 is discarded.

Solution 2 is discussed, the opinion is offered that solution 2 will reduce throughput of work items. Solution 2 will increase the cost of the vessel. Solution 2 is impractical and is discarded.

Solution 3 is discussed, the opinion is offered that solution 3 is feasible. Solution 3 will demand the shipyard keep a closer eye on factors like abrasive mix, this makes the work more difficult. Overall solution 3 is the best choice. The decision is made to adopt solution 3. A lower size abrasive mix will go into use immediately.

One last note on selection and planning. All the suggestions above meet three general criteria for good solutions, they are all:

A) Within shipyard control - that is the paint department or plate descaling facility can do this;
B) Effective - To a greater or lesser extent the suggestions can reduce the problem cause, high profile;
C) Meets Customer Needs - The solutions produce lower profiles, leading to better DFT readings, this is what the customer needs.

But, only solution 3 meets three other criteria:

D) Time - Will the solution take a long time to adopt?
E) Cost of Quality - Does the solution reduce the cost of non-conformance?
F) Acceptability - Is the suggested solution OK with the surface preparation group, can the organization adapt to the proposed change?

You can rate any solution against these six criteria. This is a strong way to screen out bad ideas.

Planning the Solution
The idea for a change requires “selling.”. A plan for making the solution happen will help others understand what you have in mind. Affected parties may include other shipyard departments (e.g., purchasing) as well your paint department coworkers. For example the plan to switch to a lower size abrasive may look like this:

1. Get table of abrasive sizes and associated profiles from manufacturer or industry standards body.
2. Determine price difference for lower size range abrasive.
3. Get schedule for blasting facility work mix change.
4. Find next window for changing abrasive mix size.
5. Find out how much abrasive to buy.
6. Procure abrasive.
7. Switch to lower size range abrasive mix at blasting facility.
8. Measure surface profile on steel before abrasive mix switch.
9. Measure surface profile on steel after abrasive mix switch.
10. Measure finished DFT of primer on steel cleaned with new abrasive mix.
11. Chart the new data on low DFT readings.
12. Analyze frequency of low DFT readings from data, compare to goal - > 80% good readings. (Note this may require the use of statistics).

It is vital that the plan involve a way to document the results of the proposed change. Also the work plan must account for contingencies. For example if the abrasive supplier you use is out of stock what will happen. Answer - select a temporary substitute supplier.

Solutions in Action
The planning done in the previous step will make plan implementation a smoother process.

Evaluation of the Solution - Did the Solution Solve the Problem?
The effectiveness of the solution is measured using the same statistical and data gathering methods that helped identify the problem.

Another part of Solution Evaluation is identifying any new problems which arise. For instance, the new smaller abrasive may create more dust, or have fewer reuse cycles than the large abrasive.

The solution and any new problems that arise are analyzed using the same Problem Solving Process described earlier.

3.5.1.1 Comparing Problem Solving and Quality Improvement Processes

On a simple level both a Quality Improvement Process (QIP) and Problem Solving Process (PSP) share some common features. Both are cyclical in nature, both are a never ending process. There are clear differences between the two. To summarize:

Quality Improvement Program - QIP
QIP is the entire process for continuously improving quality.
QIP is outlined in steps by Figure 2 earlier in this Section.

Problem Solving Process - PSP
PSP helps bridge any **gap** between what is made and what the customer has told you they want.
PSP is one part of a Quality Improvement Program. It can link different steps in the QIP Flowchart in Figure 2.

3.5.2 Behavioral Training & Interpersonal Skills

Because the problem solving process demands free expression of ideas, it will only work when a set of simple rules of conduct are observed. The general goal is to foster a supportive atmosphere where your team or department colleagues feel free to express themselves, **and** are given the opportunity to speak. The goal of learning the typical interpersonal skills is to avoid defensive/ attacking behavior. This occurs when one person has a personal stake in the problem, or feels they are being slighted.

The aim of the discussions involved in PSP or QIP is seeking ideas or common problems. Saying to others in a group that a problem is their fault does not get anyone closer to a solution. By way of contrast, disagreeing with an offered idea is constructive behavior. By disagreeing you help point to an unidentified problem with a suggested solution.

As mentioned in “Quality Measures from TQM Programs & The QIP” on page 4 of Section 3, teams play a role in this process. There is room for both QIP and PSP teams in this quality program. It is the role of a QIP or PSP team leader to identify when team members are not giving constructive comments. That team leader must keep the discussion on an even keel.

3.5.3 Organizing for Quality - Planning a Work Process

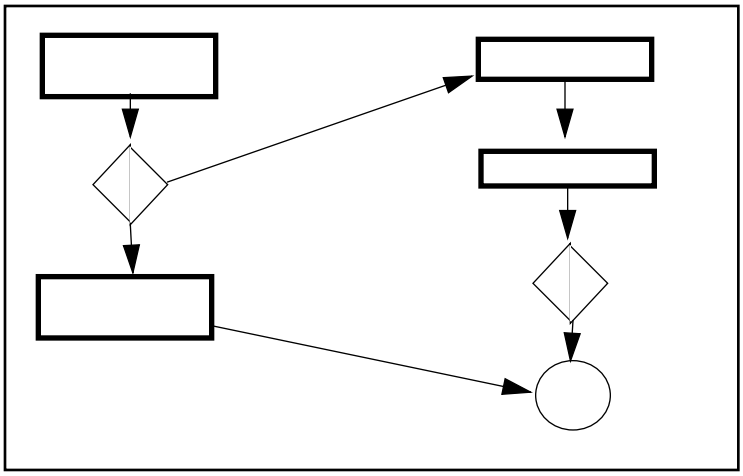
One of the requirements for a Quality Improvement Program is to diagram or draw up the work process. The work process is shown in graphical form as key tasks. This is defined in Figure 2 of this section as Step 5, “Identify Steps in the Work Process.” There are some popular options for diagramming a work process.

Tools to Plan Work - Listing the Tasks

A simple approach is to list all the tasks involved in a work process. Keep the list simple. One way to keep a list simple is breaking tasks out to smaller sub-tasks. For instance, instead of writing all quality assurance/control steps into a continuous work flow, segregate that task. This makes sense because the painting department will paint, the inspectors will inspect. There is a clear division of responsibility. A list of major tasks also is a useful first step for the diagramming of a work process.

Tools to Plan Work - Flowcharts

An example of a flow chart is shown below. Flowcharts show major tasks, critical or decision points, inputs, outputs and interrelationships for a work process. The type of task or point in the process is typified by the shape of the box in which the task/decision is written.

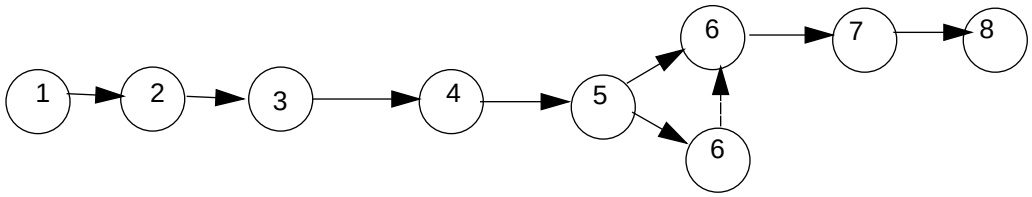


Rectangular boxes indicate specific tasks, your key task names go into these boxes. Diamonds show decision points, or intervals when a question is asked, your measuring methods go into the diamonds. If a problem arises the process shifts to a second stream of tasks that gives the work output. This stream of tasks is the contingency plan. If the decision point goes smoothly the process continues forward to the work output, shown as a circle.

Tools to Plan Work - PERT Charts

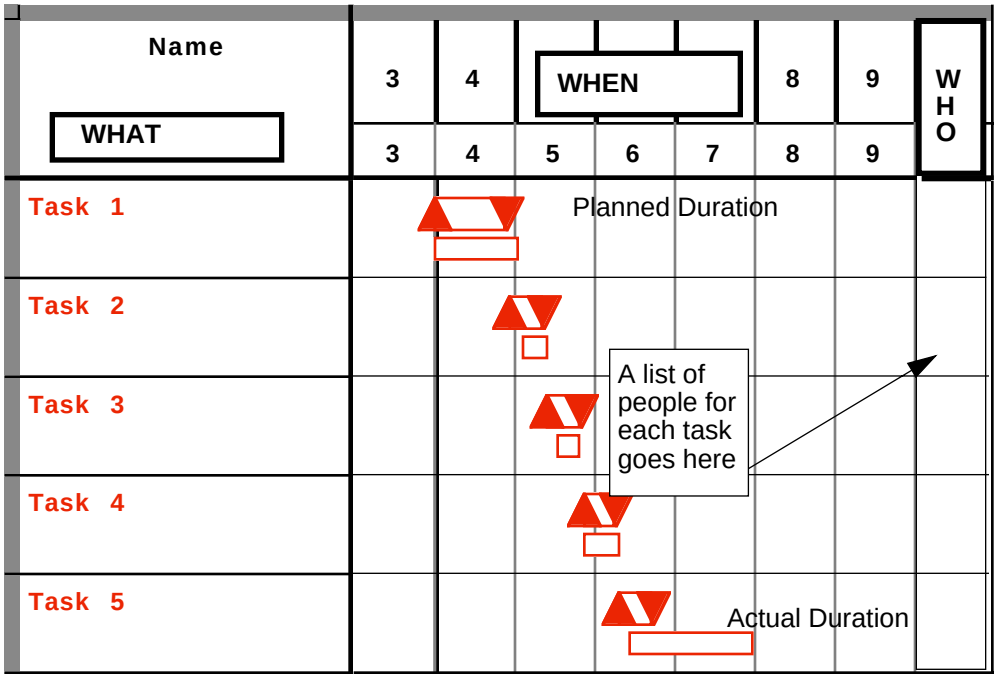
Program Evaluation and Review Technique charts were developed to improve the management of defense contracts. PERT charts are aimed at managing time and cost of a work process. PERT

tasks show the flow of individual steps in a work process and their dependency. That is step 3 cannot take place until steps 1 and 2 are done. It is common to put time estimates under the lines between dependent tasks in a PERT chart. The task name goes on the top of the line.



Tools to Plan Work - Gantt Charts

A Gantt Charts is a diagram which shows the schedule of events, responsibilities, and their duration. It is useful for breaking down a work process into smaller steps, assigning responsibility for steps to team members or departments, and setting realistic completion dates. The Gantt also lets you follow the work, providing two bars for each task, predicted and actual performance. A typical Gantt Chart is shown below.



3.6 Methods to Measure Quality

Quality is measurable. The question is how do you measure quality? What tools can be used to measure quality? There are two types of quality measuring tools:

1. Tools for gathering information, and;
2. Tools for analyzing information.

The tools you use will depend on whether information is gathered or analyzed. The choice of tool also depends on what is measured and when it is measured.

Here are some hints on the what, when, and how of quality measurement.

1. Choose what to measure wisely. Only measure the critical few items. To decide on which items are important a tool like a Pareto Chart is useful. See section 3.6.2 on page 11. The rule is choose the critical few things that need controlling.

2. Make a plan to collect the data.

3. Execute the plan **early** in the work process!

4. Make sure the item you measure is related to **customer requirements.**

3.6.1 Tools to Gather Information

Tools to gather information find use in two quality program activities:

A. Defining what causes problems - see section 3.5.1 on page 4, Problem Solving Processes, and;
B. Deciding if the work output measures up to specifications.

Some common tools to obtain information **during PSP** include:

Checksheets - Useful if you are recording information to **analyze a problem**, also used to collect information to **evaluate a solution**. A simple bar-gate checklist helps track in specification and out of specification work product. For instance, to follow how well surface preparation work progresses a chart like Table 3: may help.

Interviewing - Useful to collect information to help **analyze a problem**, also used to get information from non-group members about **potential solutions**.

Surveying - Useful to get information about **problem causes**, also used to **receive feedback** on **implemented solutions**

Some common tools to get information to **check on a work process** include:

Table 3: A Simple Checklist Example - Surface Preparation

Measure of Quality	Fails to Pass	Passes
Profile is Correct	~~///~~ /	~~///~~ ~~//~~
Meets Visual Standard	///	~~///~~ ~~//~~
Remains Rust Free before Painting		~~///~~ ~~//~~
Totals	~~////~~ ////	~~///~~ ~~///~~ ~~///~~ ~~///~~ /

Inspection Records

Most common inspection record sheets provide excellent sources of quality measurements. The data points in the inspection records are often numerical in nature. For example a record sheet may record the total DFT of the primer coat on a ship painting job.

The example in Table 4: on page 11 is greatly simplified to save space.

Modern Methods of Acquiring Data Using Data Loggers

Many modern inspection instruments come with the capacity to record information automatically. Often the digital information is transferred to a personal computer for later analysis. Examples of instruments that incorporate this technology include:

- Dry Film Thickness Measuring Devices;
- Environmental Condition Instruments, such as:
  - Relative Humidity Recorders;
  - Thermometers;
  - Emission Detectors, e.g., Particulate Matter, Solvent Emissions;
  - Anemometers, Air Movement Detectors.
- Profilometers;
- Bar-code scanners for logging in and logging out work pieces, materials, equipment.

Table 4: Simplified Example of an Inspection Record Sheet - DFT Readings

Material	Specified DFT Range/ mils	DFT as Measured per SSPC-PA 2/mils
Epoxy Primer	2.0 - 4.0	2.0
Epoxy Primer	2.0 - 4.0	3.0
Epoxy Primer	2.0 - 4.0	3.2
Epoxy Primer	2.0 - 4.0	3.5
Epoxy Primer	2.0 - 4.0	4.5
Epoxy Primer	2.0 - 4.0	1.6
Epoxy Primer	2.0 - 4.0	1.8
Epoxy Primer	2.0 - 4.0	1.0
Epoxy Primer	2.0 - 4.0	1.1
Epoxy Primer	2.0 - 4.0	0.8

3.6.2 Analysis & Evaluation of Results

Now we have raw data in hand, how can the data tell us what we want to know? The answer is that the raw data requires analysis. The best way to analyze data is in visual or diagrammatic form. A picture tells a thousand words, and is usually easier to understand than a lengthy table of results.

Common ways to display results include:

Checklists - The only non-charting method suggested, checklists can act as their own analysis tool. They summarize faults in a process by category. For example see Table 5: on page 12.

Histograms - A histogram or bar chart is a way to plot numerical information. For example taking the DFT readings from Table 4: on page 11 and plotting in a histogram gives the chart shown belowTable 5: on page 12.

Note the type of data - it is a set of quantitative readings - **hard numbers.**

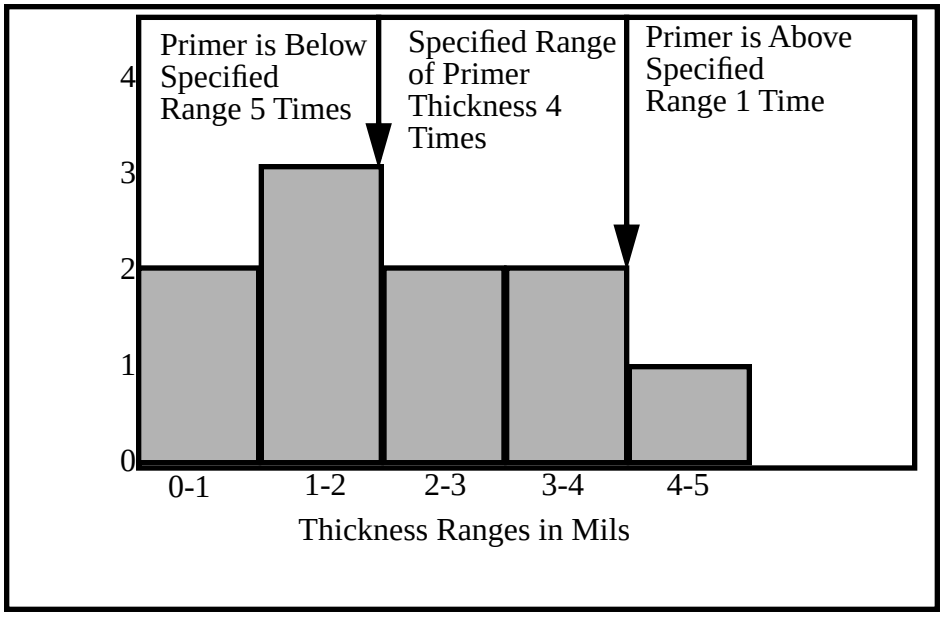
The data shows that only 40% of readings fall within the specified range. You can also use this type of graph to see if you meet SSPC-PA 2 requirements that 80% of your readings are within specified bounds.

Histograms point you to problem areas. Here the majority of your **out** of specification readings are on the low end. This is something that you can bring to the painter's attention. Perhaps by modifying spray techniques a closer adherence to specification is possible.

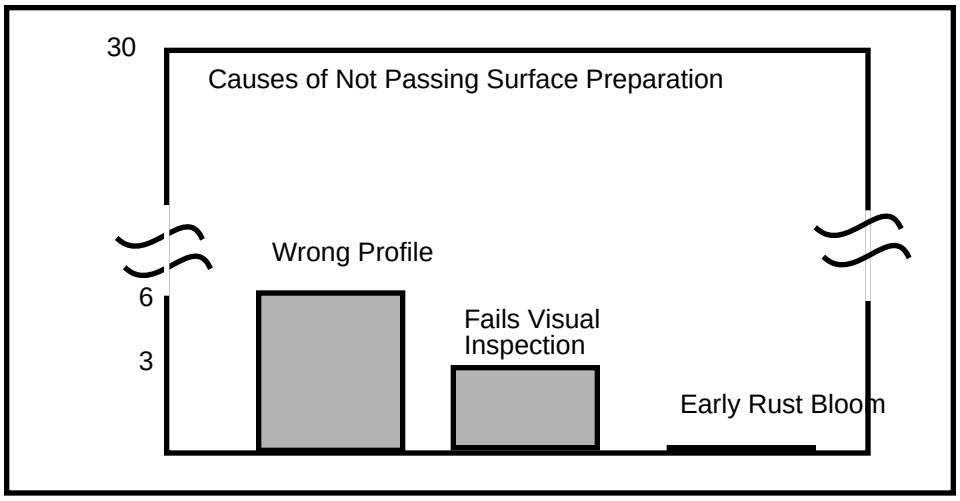
Table 5: A Simple Checklist Example - Surface Preparation Summarized

Measure of Quality	Fails to Pass	Pass to Fail Ratio
Profile is Correct	~~###~~ /	24:6
Meets Visual Standard	///	27:3
Remains Rust Free before Painting		30:0
Totals	~~####~~ ////	~~###~~ ~~###~~ ~~###~~ ~~###~~ /

Total Sample Run- 30



Pareto Charts - Another type of bar chart is the Pareto diagram. This has a large number of uses. Pareto will allow you to see the **frequency** of out of specification readings. An example is shown below based on the Surface Preparation data set in Table 5: on page 12.



The example shown is from a very small data set. In typical use Pareto charts show far more information about far more categories than this. Pareto charts are good for displaying **categorical information.**

Pareto charts use frequency of occurrence data.

Pareto charts are useful for sorting the sheep from the goats, they separate the vital few from the trivial many.

Pareto charts help a user to set priorities, here poor surface profile is a cause of problems.

Control Charts - Up until now we have displayed information about one product run. Control charts are particularly useful when you wish to follow the changes in a process. They permit discovery of how much variability in a process is due to **random variation**, and how much is due to **unique events** or **individual actions**.
A control chart is a run chart with statistically determined upper (Upper Control Limit - UCL) and possibly lower (Lower Control Limit - LCL) lines drawn either side of a **process average.** These limits are calculated by running a process using standard procedures. Samples are taken and the sample averages are “plugged” into the appropriate equations.
The equations which give the UCL and LCL numbers depend upon the type of control chart you wish to use. There are two families of control chart. A variables control chart plots data for samples expressed in terms of quantitative data - that which can be measured. This is the type of chart to use for plotting the results of DFT measurements. An attributes control chart is used to plot data of quantitative measurements, is/is not the sample defective.

We will begin to follow control charts using the data from Table 4: on page 11

Variables Control Chart - A common variable control chart will plot the Average ($\bar{X}$) or Range (R) of Data collected.

$\bar{X} = \frac{X1 + X2 + \ldots Xn}{n}$ Where *n* is the number of samples. $R = Xmax - Xmin$ Gives the range.

Plugging in the DFT readings from Table 4: on page 11 gives a value for ($\bar{X}$) of 2.25 mils from ten data points.
Likewise the data fromTable 4: on page 11 gives a value of 3.7 mils (4.5 - 0.8 mils) for our range (R)

The DFT readings may come from several observation periods. The readings from each period are sample sub-groups.

These can then be used to calculate the Average Range and Process Average (χ). Let us assume that there were another nine observation periods, these yield the following values of ($\bar{X}$): 2.25, 2.50; 1.80; 2.05; 1.65; 3.25; 4.5; 2.80; 2.20; and, 3.00 mils. The associated range values (R) for each data set are: 3.7, 2.9; 2.5; 2.8; 1.9; 4.1; 5.7; 3.2; 4.2; and,3.6 mils.

We can use these values to measure the Process Average using the following equation.

$\chi = \frac{\bar{X}1 + \bar{X}2 + \ldots \bar{X}k}{k}$ (*k*is the number of sample sub-groups) gives the Process Average (χ).

Based on our ten average values of ($\bar{X}$) the value for (χ) is 2.6 mils.

$\bar{R} = \frac{R1 + R2 + \ldots Rk}{k}$ (*k* is the number of sample sub-groups) gives the Average Range ($\bar{R}$).

Based on our ten range values of (R) the computed Average Range ($\bar{R}$). is 3.46 mils

These values of ($\bar{R}$). and (χ) can then provide the Upper Control Limit (UCL) and Lower Control Limit (LCL).

$UCL\bar{x} = \bar{X} + A_2\bar{R}$ Where A_2 is a factor which depends on the number of data points (n) in each sub-group (k).

Because we have ten data points in each sub-group our value for A_2 is 0.308.Thus the UCL is (2.6 +{0.308x3.46}), or 3.67 mils.

Likewise the LCL is calculated using the following equation:

$LCL\bar{x} = \chi - A_2\bar{R}$

Which yields a LCL value of 1.53 mils. The resulting control chart is shown as Figure 6: on page 16.

Calculating the UCLr and LCLr for a Range chart uses similar formulas but requires two factors, D_3 for the LCL, and D_4 for the UCL. Like A_2 these factors depend on the number of observations in each sub-group.

Attributes Control Chart - There are four classes in the family of attributes control charts.

1. **The p Chart** = Proportion of Defective Readings

$p = \frac{(n)\text{number of rejects in subgroups}}{(\bar{n})\text{number inspected in subgroup}}$ and $\bar{p} = \frac{\text{total number of rejects}}{\text{total number inspected}}$

Giving the following expressions for the UCL_p and LCL_p

$UCLp = \bar{p} + \frac{3\sqrt{\bar{p}(1-\bar{p})}}{\sqrt{n}}$ and $LCLp = \bar{p} - \frac{3\sqrt{\bar{p}-(1-\bar{p})}}{\sqrt{n}}$

2. **The np Chart** = Number of Defective Readings

$UCLnp = n\bar{p} + 3\sqrt{n\bar{p}(1-\bar{p})}$ and $LCLnp = n\bar{p} - 3\sqrt{n\bar{p}(1-\bar{p})}$

3. **The c Chart** = Number of nonconformities with a constant sample size

$$\bar{c} = \frac{\text{total nonconformities}}{\text{number of subgroups}}$$

which value then is used in these equations to compute the UCL_c and LCL_c boundaries.

$$UCLc = \bar{c} + 3\sqrt{\bar{c}} \quad \text{and} \quad LCLc = \bar{c} - 3\sqrt{\bar{c}}$$

4. **The u Chart** = Number of nonconformities with a varying sample size

$$\bar{u} = \frac{\text{total nonconformities}}{\text{total units inspected}}$$

which value is then plugged into the following equations for the Upper and Lower Control Limits

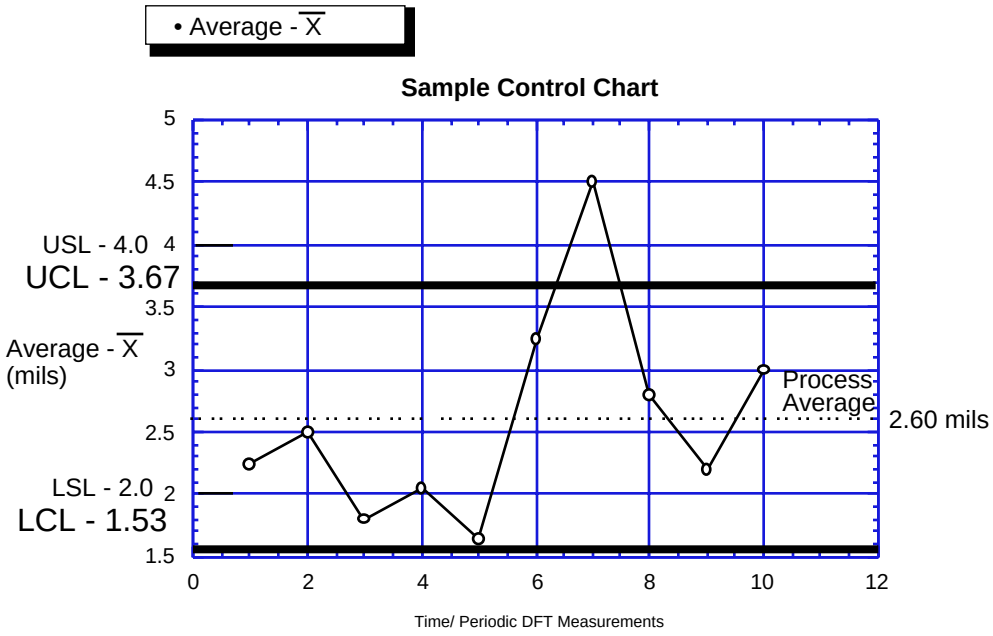
$$UCLu = \bar{u} + \frac{3\sqrt{\bar{u}}}{\sqrt{n}} \quad \text{and} \quad LCLu = \bar{u} - \frac{3\sqrt{\bar{u}}}{\sqrt{n}}$$

Standard quality control texts such as “The Memory Jogger” from GOAL/QPC (508)-685-3900 can help when it is time to calculate the control limit. The control limits are recalculated after each process improvement.

Control Limits and Specification Limits - A control chart will always display the UCL and LCL lines. It may show for comparison purposes the upper and lower bounds of a process required by a specification - Upper Specification Limit and Lower Specification Limit. **Note: These two sets of limits are not identical.** The control limits show what a process can deliver. The specification limits show what is required by the customer. Using both types of limit bars in a control chart allows a user to see if the process can meet the specification and determine if the process is under control. **Indeed the process may be <u>in control</u> but <u>out of specification</u> range <u>at the same time.</u>** You can address this type of situation by either changing the specification to match process ability or by improving the process to bring the specification and control limits into closer agreement with one another.

Dry Film Thickness Example - Let us take an example where a paint application process is followed using a **Variables Control Chart**. In our example the process begins under control, and is at the bottom of the specification limits. Using a starting point similar to that of the earlier example on primer thickness we see more cases in which the primer is below the low side of the specification range (< LSL) than above the high side of the specification limits (> USL). For the purpose of illustration the process is out of control only once, above the UCL.
When all points stay within the control limits the process is considered in control. In the example used there is a possibility of staying within the control limits, yet be below the specification.

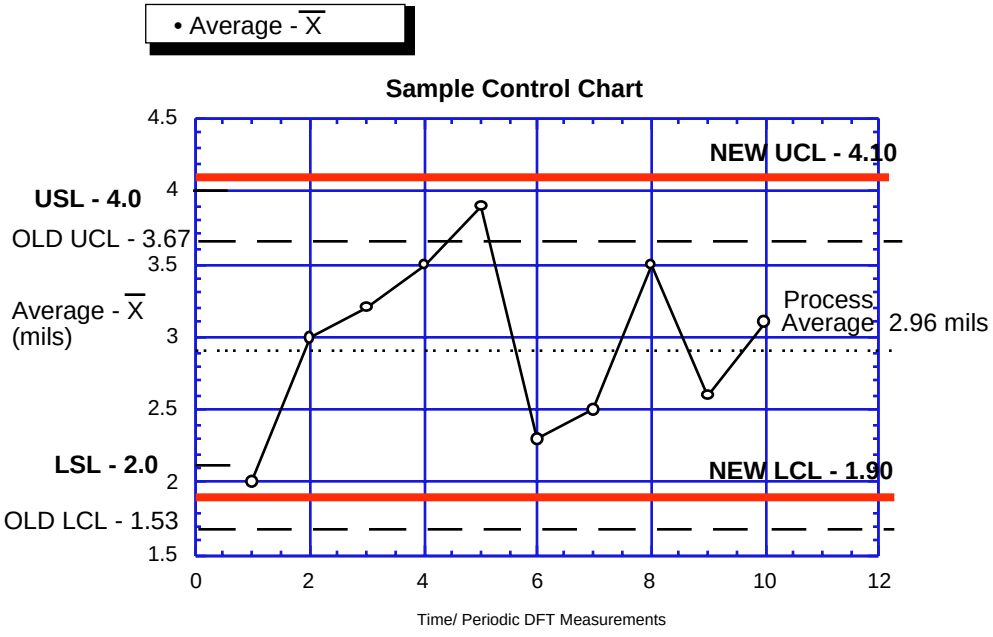
Figure 6: Initial Condition Variable Control Chart



Because the customer demands that the specification limits are met you make a change in your application process to try and bring the UCL and LCL closer to the USL and LSL.

Control Chart After Altering Process
The process is refined through several cycles, the following **Variable Control Chart** may result.

Figure 7: Revised Control Chart



Note the UCL and LCL are recalculated after a process change, but the USL and LSL are held constant. In this example the Average Range is artificially held constant but the Process Average is raised to 2.96 mils.

In the example chart above the desired outcome resulted, you met the customer's specification. Your Lower Control Limit and Lower Specification Limit are now in closer agreement. In addition, though the Upper Control Limit is different from the Upper Specification Limit it is within a tenth of a mil of the required Dry Film Thickness Range. Thus the application process now has a higher chance to comply with the specification and the application process is always in control.

To summarize:

Control charts tell you when to take action.

Control charts also **tell you when to leave things alone.**

3.6.2.1 Summary of Work Process Analysis

For good work process analysis you must have satisfied all the requirements for planning data gathering described in section 3.6.1 on page 10. In addition evaluation phase must satisfy these criteria.

1. Do you have a plan to display the data?

2. Was the collection and data analysis run early in the work process?

3. Is the aim related to customer requirements?

3.6.3 Other Quality Related Tools - Job Costs & Resources

Quality programs are good for reducing waste, re-work and unwanted rejection of work product. One of the primary goals of a quality program is also to keep costs in line. Tools exist for tracking excessive hours spent on a task. There are also tools to make sure costs of quality are positive for the company.

To track excessive resource use one tool is the **Gantt chart**, this will tell you if the tasks finish on time. It is known for a task to run long without using more labor or material than was planned, say when a delay occurs. Otherwise, a task overrun implies wasted resource, or poor projection of resource need.

Another task tracking tool is a **Time Chart**. Time charts track the number of hours spent on a project or task. You can choose to track all hours spent on a task, or only get a report on the total number of overtime hours. Either way the data gives a clear idea of the true cost of that task. Time charts also help in predicting or bidding future work.

Cost-Benefit Analysis Charts - These allow a group to estimate the real cost and benefits for an improved process. A cost benefit analysis is really a simplified spread sheet. In one column the group places an estimate of the cost to implement an improved process. In the other column the group puts estimates of benefits arising from the suggested change.

For example, if the cost to change to a new abrasive mix is $35,000, including material, switching old abrasive stocks and remeasuring work mixes, and the cost of any lost production. How does that figure compare to the cost of staying put. It is important to use realistic numbers for the benefit. The benefit is normally analyzed over a multi-year period. By reducing rejects due to poor profile we save money on reject material, the cost of reworking the item, and the cost of reduced delivery

to the paint department of in specification prepared steel. For the sake of argument let us assume that these costs amount to $100,000 in the first year, this justifies an immediate process switch. Note, even if the cost of switching is half that of staying put, the switch is still a bargain.

3.6.4 Team Measures from TQM

TQM programs emphasize the importance of teams. The primary distinction between the TQM approach and that of conventional US management practices is that the workforce at the deckplate level is actively encouraged to participate in the decision making process. This clearly implies the involvement of deckplate personnel in the Problem Solving Process. More important it also encompasses deckplate involvement in all phases of ship design and construction. The work force is empowered to provide input to a design at an early stage. Everyone is part of the same team, and there may be several teams in different areas of the shipyard which provide input to a larger equally representative team.

3.6.5 Summary of Quality Measurement

In summary, quality measurements and their use in a quality program provide a department or team with powerful tools to understand, modify, and improve a work process. By improving a work process, the overall quality of an operation also improves.

Quality measurement can work within the type of quality program defined in this manual. Quality measurement is particularly well suited to Quality Improvement Programs.

3.7 Putting it All Together

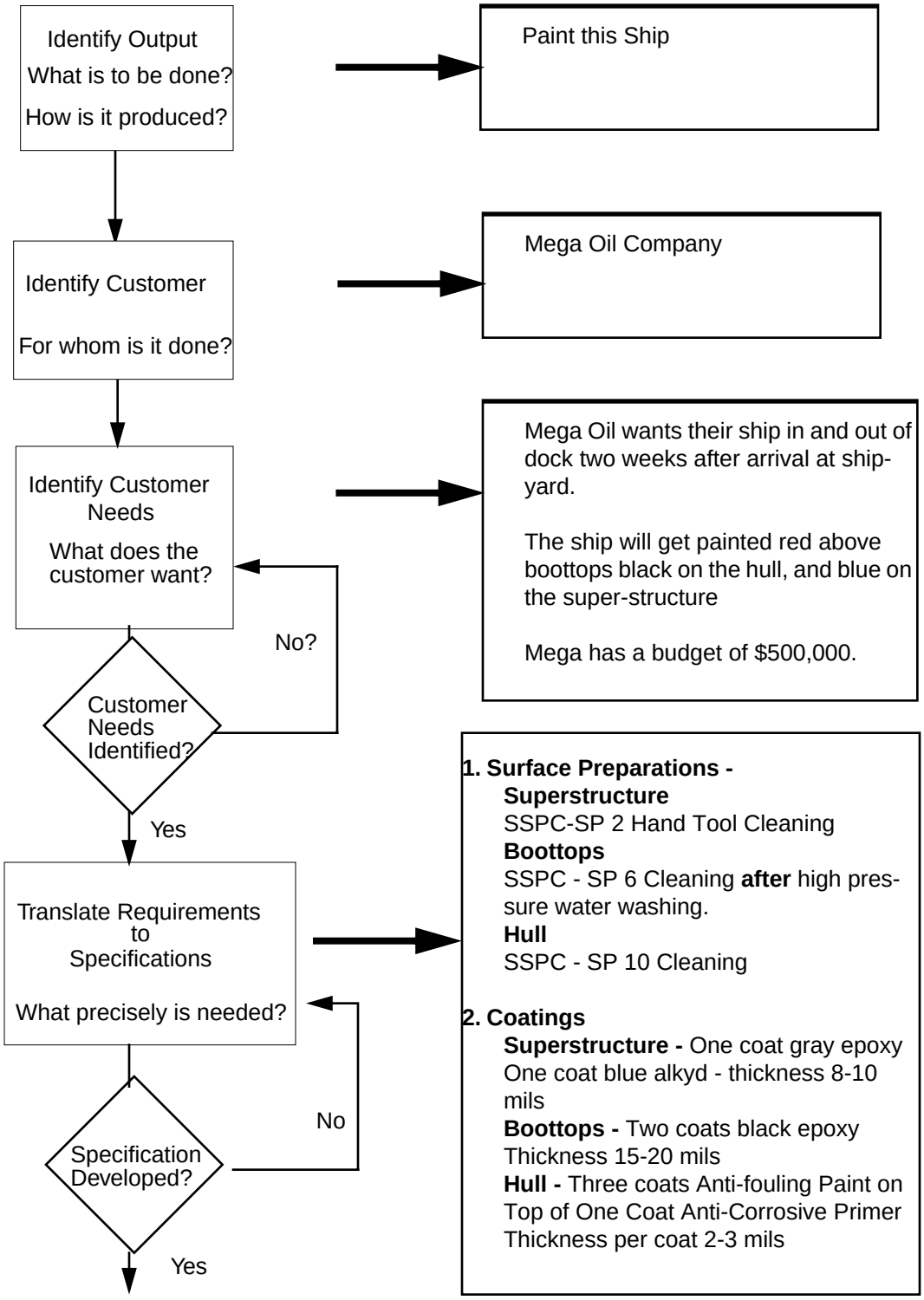
How can all the tools and techniques suggested in this section work in a quality program?

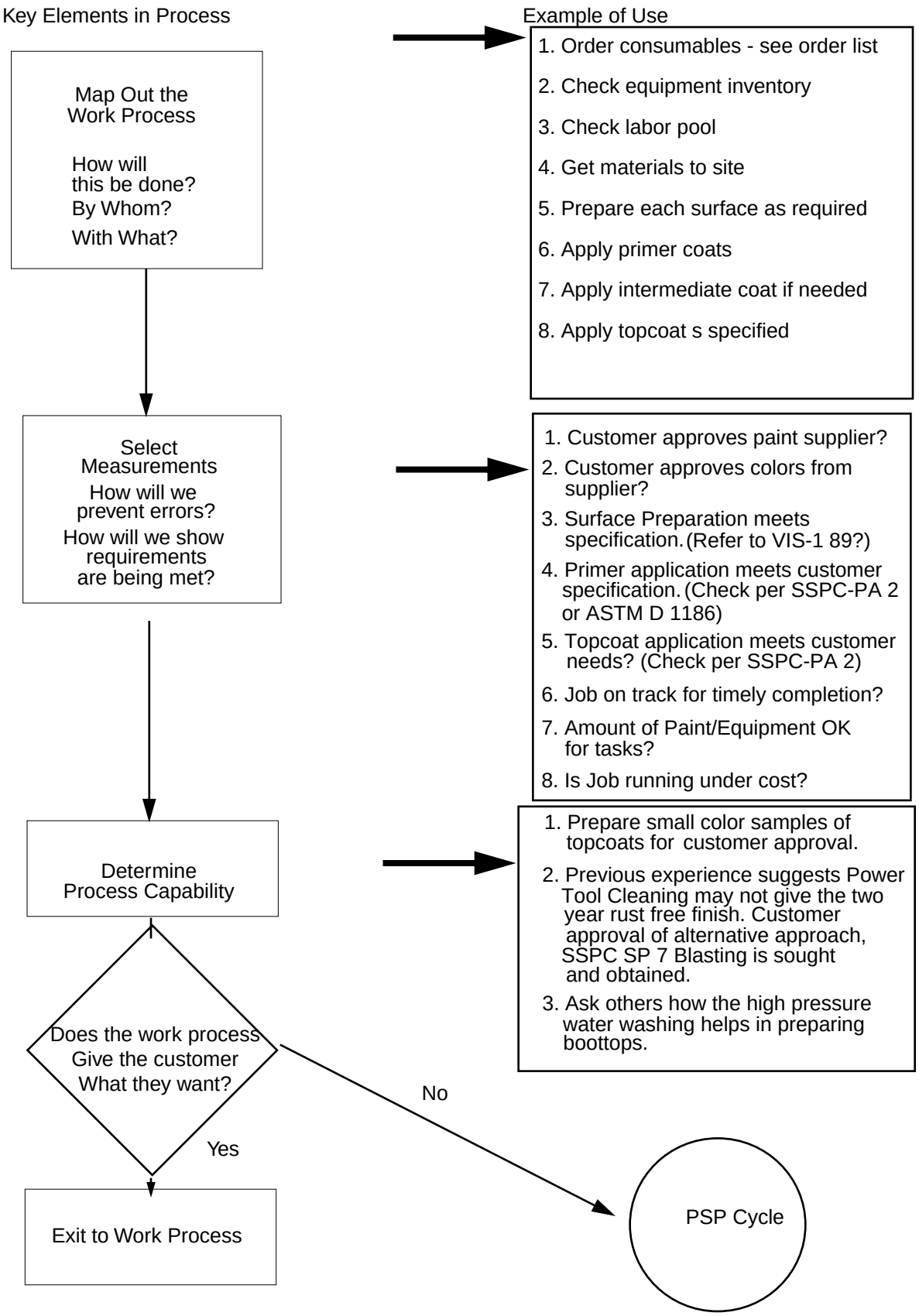
To answer that, a modified flowchart is provided on the following pages. It shows a hypothetical surface preparation and coating task in flowchart form. Measurement points are shown along the way, and points where a Problem Solving Process might help are marked. The job shown is painting a ship. Many steps are simplified for space requirements.

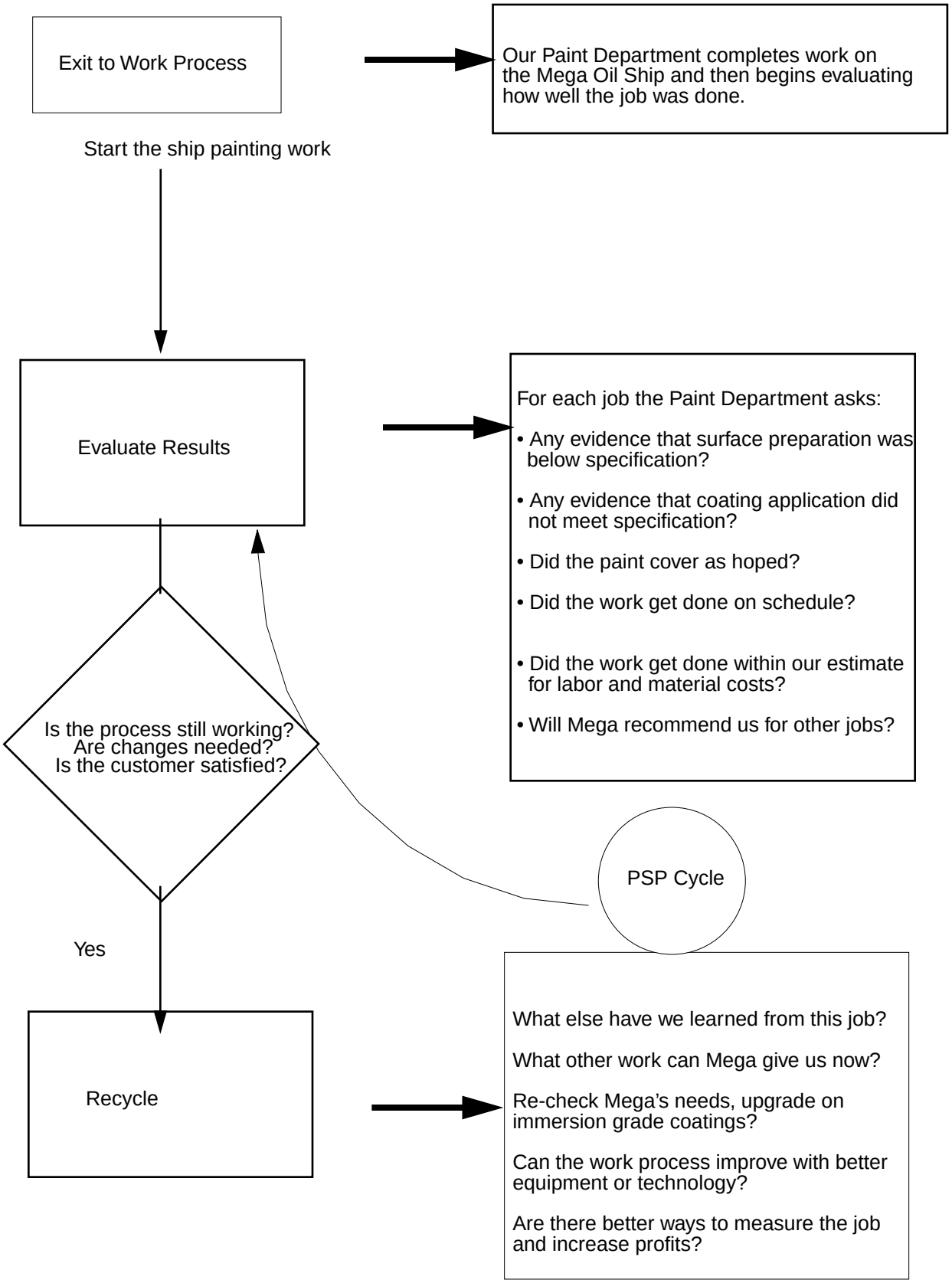
Modified Process Flowchart

Key Steps in Flow

Example of Process in "Action"




Key Elements in Process
Example of Use
Map Out the Work Process
How will this be done?
By Whom?
With What?
1. Order consumables - see order list
2. Check equipment inventory
3. Check labor pool
4. Get materials to site
5. Prepare each surface as required
6. Apply primer coats
7. Apply intermediate coat if needed
8. Apply topcoat s specified
Select Measurements
How will we prevent errors?
How will we show requirements are being met?
1. Customer approves paint supplier?
2. Customer approves colors from supplier?
3. Surface Preparation meets specification. (Refer to VIS-1 89?)
4. Primer application meets customer specification. (Check per SSPC-PA 2 or ASTM D 1186)
5. Topcoat application meets customer needs? (Check per SSPC-PA 2)
6. Job on track for timely completion?
7. Amount of Paint/Equipment OK for tasks?
8. Is Job running under cost?
Determine Process Capability
1. Prepare small color samples of topcoats for customer approval.
2. Previous experience suggests Power Tool Cleaning may not give the two year rust free finish. Customer approval of alternative approach, SSPC SP 7 Blasting is sought and obtained.
3. Ask others how the high pressure water washing helps in preparing boottops.
Does the work process Give the customer What they want?
No
Yes
Exit to Work Process
PSP Cycle


Exit to Work Process
Our Paint Department completes work on the Mega Oil Ship and then begins evaluating how well the job was done.
Start the ship painting work
Evaluate Results
For each job the Paint Department asks:
• Any evidence that surface preparation was below specification?
• Any evidence that coating application did not meet specification?
• Did the paint cover as hoped?
• Did the work get done on schedule?
• Did the work get done within our estimate for labor and material costs?
• Will Mega recommend us for other jobs?
Is the process still working?
Are changes needed?
Is the customer satisfied?
PSP Cycle
Yes
Recycle
What else have we learned from this job?
What other work can Mega give us now?
Re-check Mega's needs, upgrade on immersion grade coatings?
Can the work process improve with better equipment or technology?
Are there better ways to measure the job and increase profits?

SECTION 4 - ELEMENTS OF QUALITY IN A SHIPYARD PAINTING DEPARTMENT

4.1 Quality & Surface Preparation or Painting

The primary focus of this manual is the quality with which the activities of surface preparation and painting or coating are conducted in shipyard operations. There are many ways to measure and monitor quality of any activity. This manual takes the tack of imposing relevant criteria to each primary phase of ship surface preparation and coating. As an initial point of departure a listing of standards used for each activity is given. The importance of these standards is that they can provide a “safety net” of minimum acceptable performance, or means to assess such a minimum performance level. This is in keeping with an underlying assumption - quality can be measured.

4.1.1 Identify Customer Requirements

Under ideal circumstances the customer will use the standards below to help describe their needs for surface preparation and coating. It would also be nice if all customer specifications were identical in format or content. More often than not, each new job will present something different to understand in a specification.

It is vital to obtain, read, and understand the specification provided by the customer. This is an essential step toward defining the customer’s expectations. One customers specification will invoke different requirements from another. Each specification may refer to a different set of standards. Some customer orders may have tests or measures for accepting the work which are not a part of any published standard. Be critical when reading customer requirements. Not all customers are sophisticated, you may find limits or measures for the quality of the work that cannot be met. For example, the customer might state that all coating thickness will be within 0.5 mil, or set a simple upper ceiling, e.g., primer thickness will be 3 mils. Common experience tells the painter that such limits cannot be met. Bring this type of problem to the attention of the customer. This will help clarify customer needs.

4.1.2 Clarifying Customer Needs

Once you have an initial understanding of customer requirements, clarify any problems raised by the specifications These problems might be similar to the example above where a requested control on film thickness, either high or low, is not practical. More often than not, problems of this type mean the customer has misunderstood what can be done. Other unclear areas of a specification may include broad statements like: “Prepare (or coat) the structure according to manufacturers requirements.” Going to the coating technical data sheet shows several grades of surface preparation are allowed. Which of these grades of surface preparation is the customer asking for?

Ask the customer to clarify any unclear areas in a specification before beginning the work. If possible try to have the customer agree to a common published industry standard for defining the quality of work.

Sometimes discussions of this type reveal that the customer had quite different needs from those implied by the written job order. Perhaps the request above was a ceiling on film thickness, not an impossible narrow limit. Learn what the customer expects you to achieve. Try to let the customer know what can be done. Reach agreement on what will be done.

4.1.3 Impractical Demands

Often quality programs suggest that all problems are solved if you and the customer understand what the work will produce. The truth is **most** but not **all** problems can be solved in this manner. It is possible that the paint department dutifully reads, learns, and clarifies the specification with the customer, yet still finds fault with the customer requirements. To put it bluntly, a customer can wilfully make narrow, impossible demands. For example, if the customer will not budge from requiring spark testing of all tank linings with a requirement of zero-defects you may have no option but to either refuse the work, or accept that the work will all run at a loss.

4.2 Surface Preparation Activities

Surface preparation is the most important factor in coating performance. It involves removal of contaminants from a surface to be painted. Contaminants may include oil and grease, oxide products like mill scale or rust, and chemical contaminants like salt. The conditions of service for a ship are severe and require a high quality protective coating system. Coatings will protect the surface longer if the necessary quality of surface preparation is met.

Surface Preparation quality is defined by degrees of cleanliness. Various standard setting bodies define acceptable levels of quality for surface finishes using both written and photographic standards or adjuncts to written specifications. A list of those standards produced by individual standards organizations is shown below:

4.2.1 Written Standards

Written standards comprise the largest group of specifications that govern the acceptable quality of a finished surface.

4.2.1.1 Steel Structures Painting Council

SSPC-SP 1, “Solvent Cleaning”
SSPC-SP 2, “Hand Tool Cleaning”
SSPC-SP 3, “Power Tool Cleaning”
SSPC-SP 5, “White Metal Blast Cleaning”
SSPC-SP 6, “Commercial Blast Cleaning”
SSPC-SP 7, “Brush-Off Blast Cleaning”
SSPC-SP 10, “Near-White Metal Blast Cleaning”
SSPC-SP 11, “Power Tool Cleaning to Bare Metal”

4.2.1.2 National Association of Corrosion Engineers

NACE standards TM-01-70 and TM-01-75
NACE Surface Preparation Grade 1 (White)
NACE Surface Preparation Grade 2 (Near-White)
NACE Surface Preparation Grade 3 (Commercial)
NACE Surface Preparation Grade 4 (Brush-Off)

4.2.1.3 U.S. Government Specifications

Federal Specification TT-490, “Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings,”
U. S. Department of the Navy, Naval Sea Systems Command: Chapter 631, “Preservation of Ships in Service (Surface Preparation Painting) NAVSEA-S9086-VD-STM-000C/H-631,”

4.2.1.4 International Standards Organization

ISO 8501-1: l988/SIS SS 05 59 00 - This is a combined written and visual standard often cited by overseas owners.

Each of the written standards from these organizations may differ in format, style and content. To produce a quality item of work the operator must be aware of the level of finish defined in each standard. To help accomplish this aim, each standard organization has produced visual comparators or visual standards. These visual aids define only those surface finishes which are often encountered. Examples of each organizations visual standards are given below:

4.2.2 Visual Standards

Visual standards can be used as reference documents or with agreement of contractor and supplier as part of the specification. Visual standards are useful reference materials, they can help speed customer acceptance of the paint departments work.

For the most efficient use of visual standards do the following:

a - Hold a contractor customer review of the visual standards. However good these documents are, they cannot define all conditions. The customer must understand what to actually expect. Because achieved preparation quality may look different from a photograph it does not mean the surface fails to pass. Create an understanding with the customer that it is the written word of a specification which rules. The visual standards can help show an acceptable surface created with one set of operating conditions. Abrasive size, type, hardness, shape and blasting pressures can change the look of a finished surface.

b - Have the customer define what is acceptable from your process. If the customer expects more than the process can deliver, you have to clarify that there is no deficiency in your finish grade. This can be done by preparing standards for the job on-site. The standards provided by SSPC do contain definitions of surfaces meeting the same high level of quality, prepared using various media, all having quite different appearances. This can help get your point across that you are meeting cleanliness standards, not matching a single photograph.

4.2.2.1 Steel Structures Painting Council

SSPC-Vis 1-89, “Visual Standard for Abrasive Blast Cleaned Steel”
SSPC-Vis 3-93 “Visual Standard for Power Tool Cleaning”

4.2.2.2 National Association of Corrosion Engineers

NACE standards TM-01-70 and TM-01-75

4.2.2.3 International Standards Organization

ISO 8501-1: l988/SIS SS 05 59 00

Each of the three above visual standards is unique. To ensure a quality operation an operator, inspector, or supervisor must be aware of the defined finish depicted in each standard.

The NACE standards use small pieces of blast cleaned steel to show normal finishes typical of NACE Grades 1 (White), 2 (Near White), 3 (Commercial), and 4 (Brush-Off) of cleaning. The metal coupons show surfaces cleaned with mineral abrasives, (TM-01-70), and metallic abrasives, (TM-01-75). The coupons are part of the standards for the cleaning specifications. The NACE visual comparators match the finish defined in both NACE and SSPC written standards for abrasive blast cleaning for new steel surfaces only.

The ISO standards use transparency photographs. The photographs are an accompaniment to the written word. It is the written word which defines the finished condition. Currently the ISO standards do not match those of either SSPC or NACE for abrasive blast cleaned surfaces. The ISO standards do have photographs depicting finishes achieved using hand or power tool cleaning and flame cleaning.

The SSPC visual standards are photographs which depict all the levels of abrasive blast cleaning defined in the SSPC specifications. The SSPC visual standards accompany the SSPC specifications. SSPC-Vis 1-89 is strongly recommended for use in all surface preparation operations. The main photographs in SSPC-Vis 1-89 were produced by cleaning steel with sand. Additional photographs are included which show the different appearance of steel surfaces when cleaned with abrasives other than sand.

The SSPC and ISO visual standards depict finish conditions achieved by cleaning four original types of surface. The four original surfaces are:

Rust Grade A - Steel surface completely covered with adherent mill scale; little or no rust visible.

Rust Grade B - Steel surface covered with both mill scale and rust.

Rust Grade C - Steel surface completely covered with rust; little or no pitting visible.

Rust Grade D - Steel surface completely covered with rust; pitting visible.

Only the SSPC standards follow the original surface through the various levels of blast cleaning. The ISO standard uses the same photographs for commercial, near-white and white metal cleaning regardless of the original condition.

4.3 TYPICAL SURFACE PREPARATION EQUIPMENT

(See Tables 1 and 2)

Understanding the qualitative differences between different levels of surface cleaning is only one part of the knowledge required of a surface preparation operator. To correctly execute the job of surface preparation the operator must be aware of the principals of operation and be familiar with the use and maintenance of the various items of equipment required to achieve a desired level of cleaning.

4.3.0.1 Typical Process Equipment for Surface Preparation

Hot water pressure wash (e.g. Wheeler or Chemex for tank cleaning)
Steam cleaning equipment
Organic Solvent Cleaning Equipment - Vapor Degreasing Tank
High Pressure water blasting equipment
Abrasive blasting equipment (nozzle, wipe hose, abrasive supply hoses and pressure pots)
Impact tools, pneumatic or electric:
- Needle scaler (needle gun)
- Triple scaler
- Impact hammer with chisels (Chipping gun)
- Rotary wire finger stripper (Roto-stripper)
- Rotary scaling and chipping tool with cutter bundles

Deck scaling machines & Portable Centrifugal Wheel Blasting Equipment
Grinding tools, pneumatic or electric:
- Orbital (Oscillating) sander
- Disc (orbit or circular) sander
- Belt sander
- Vertical grinders/sanders
- Horizontal grinders
- Electric or pneumatic drill

Hand tool:
Wire brush
Beryllium-Copper non-sparking chisel/chipper
- Chipping hammer
- Deck scrapers

The above list is not all inclusive, considerable ingenuity has been applied to the development of tools and equipment which can perform certain unique tasks. Each tool or piece of equipment may have quite different use, maintenance, or operation criteria. Insufficient space exists to give a thorough description of each piece of equipment, instead it is required that the operator be familiar with the instructions for such use that are given by the manufacturer. The operator should also be aware of the capabilities of each machine or class of equipment to produce individual grades of surface cleaning.

Table 1: ACCESSORIES FOR GRINDING TOOLS

Mounted abrasive wheels (cylindrical-flat, cylindrical-radius end, cone, ball, square edge, rounded end taper, flat end taper, etc.)
Wire and knot wire wheel brush
Wire and knot wire cup brush
Flap and nonwoven abrasive wheels
Aluminum oxide grinding wheel

Table 2: Small Tools & Their Major Uses

SMALL TOOL DESCRIPTION	MAJOR USES
A. VERTICAL GRINDERS	Motor sides on top of unit with working wheel below. Examples include orbital and disc sanders. Accessories include: sanding pads, abrasive discs, cup wire wheels. Used for light to heavy duty sanding. Major manufacturers include: Cleco, Chi-Pneu and Ingersoll- Rand.
B. HORIZONTAL GRINDERS	Motor sides in side arm. Is used with wheel vertical to drive axle or with a right angle drive to power a disk or wheel in the horizontal. Accessories include: radial wheels, wire brushes, cone wheels, flap wheels, composite abrasive wheels. Used for light to heavy grinding, particularly if metal removal is necessary. Major manufacturers include: Cleco, Chi-Pneu and Ingersoll-Rand.
C. SCALERS	Includes piston (Piston hammer) and needle/chisel hammers. Piston scalers use the piston to directly hammer the surface. In needle and chisel scalers, the piston impacts on the needles or chisel. Used for general scaling, paint and rust removal. Major manufacturers include: Cleco, Chi-Pneu and Ingersoll-Rand.
D. CHIPPING HAMMER	Similar to scalers. Most useful for chipping and peening. Major manufacturers include: Cleco, Chi-Pneu and Ingersoll-Rand.
E. DECK SCALING MACHINE	Large rotary scaler, self propelled. Used to remove large areas of deck coverings. Major manufacturer: Tenent Co., Desco.

4.4 Painting Activities

Quality is also important to painting operations. Like surface preparation activities there are many existing standards and documents which can provide a “safety net” of minimum quality if adhered to by the operator. Examples of these standards are given below:

4.4.1 Steel Structures Painting Council

Paint Application Specifications:

SSPC - PA COM	Commentary on Paint Application;
SSPC - PA 1	Shop Field & Maintenance Painting;
SSPC - PA 2	Measurement of Dry Film Thickness with Magnetic Gages;
SSPC - PA Guide 3	A guide to Safety in Paint Application;
SSPC - PA Guide 4	Guide to Maintenance Repainting with Oil Base or Alkyd Painting System;
SSPC - PA Guide 5	Guide to Maintenance Painting Operations.

4.4.2 ASTM Standards

D 1186	Measurement of Dry Film Thickness with Magnetic Gages
D 1400	Measurement of Dry Film Thickness on Non-Ferrous Surfaces;
D 1005	Measurement of Dry Film Thickness using a Micrometer.

You should note that all the cited ASTM specifications and the SSPC - PA 2 specification deal exclusively with the measurement of the quality of the finished product.The finish quality is only assessed based on the quantity of paint applied. This is a quantitative measure of quality.

The operator should be aware that there are many other factors which determine the quality of applied paint, they are largely concerned with the appearance of the finished product These requirements are often expressed in rather loose terms such as, the coating film shall be smooth and free of all visible defects. No runs, no sags, no drips and no holidays shall be permitted.

Some of these qualitative criteria for determining product quality are discussed in the SSPC specifications or guides SSPC - PA COM, SSPC - PA 1, SSPC - PA Guide 4, and SSPC - PA Guide 5. These criteria are affected by the ability of the painter to mix, and apply the coating product in accordance with written instructions from the manufacturer. The finish quality will also be dictated by the ability of the painter to understand and operate a wide variety of application equipment ranging from conventional spray equipment through airless spray, to High Volume Low Pressure equipment.

4.5 Paint Application Equipment

The Operator should be aware of the principals of operation and be able to use the following items of paint application equipment:

4.5.1 TYPICAL APPLICATION EQUIPMENT

Air atomizing spray gun, associated hoses and pressure pots Airless spray gun, associated hoses and pump
Air-Assisted Airless Spray
Plural Component Spray Equipment
High volume, low pressure spray guns
All the above can be used with batch tanks and proportioning equipment.
Powder coating guns, electrostatic and non-electrostatic
Wire metallizing gun, acetylene or electric arc (if wire metallizing is a paint shop function at the particular shipyard)
Brushes and Rollers

4.5.2 PAINT MIXING EQUIPMENT

Paint mixing equipment (paint shakers [to five gallons], propeller mixers [Jiffy mixers]) in both electric and pneumatic types
Scales for proportioning small amounts of two component paints

4.6 Ambient Condition Assessment

A frequent cause of coating failure is the application of coating materials under poor weather conditions. Luckily this is simple to avoid. An operator can conduct various simple tests to determine if ambient weather conditions are suitable for surface preparation or coating work. The operator should be familiar with the principals of operation, use and maintenance of the following items:

Thermometers - Surface/Substrate Type;
Thermometers - Air Ambient Type;
Humidity Gage;
Dew Point Gages - Sling Psychrometers.

Housekeeping & Clean-Up Activities

This factor of the operation is often inadvertently ignored because it does not neatly fit into the framework of an inspection program for surface preparation and coating. Maintaining a clean working environment will contribute to maintaining quality by:

- Assisting in Environmental Compliance
- Improving Safety;
- Reducing Waste:
- Keeping Work Flow on Schedule.

The operator should be familiar with the use and maintenance of the following items of equipment that are used to keep a work zone clear:

4.7 CLEAN-UP EQUIPMENT

Vacuum cleaners, including both utility wet/dry and toxic removal vacuums with high efficiency particulate air (HEPA) filter types for lead, asbestos and chromate containing debris)
Brooms, brushes (floor and hand)
Cleaning rags, etc.
Hazardous and non-hazardous labeled debris containers
Hazardous or flammable spill control supplies (absorbent matting, granular oil/paint/solvent absorbent)

4.8 SAFETY

The operator should always have in place signs warning others that hazardous work is in progress. In the commercial painting industry an important factor in assessing the quality of a surface preparation and coating operation is the attention given to safety. This is important, for it is well recognized that surface preparation and coating work can present certain hazards. In a typical shipyard, the responsibility for training personnel in safe working practices falls squarely on a dedicated safety department. They put in place the controls which dramatically reduce the level of exposure of a worker to a hazard.

It is also recognized that some shipyard painting operations are conducted by outside contractors or service organizations. Should a shipyard wish to assess the quality of an outside third-party painting contractor's safety program, some suggested questions and criteria are given in Appendices A and B of this manual.

In addition a number of practices have been instituted, either by law, or through the common apprehension by shipyards of the cost benefits of maintaining a safe and healthy working environment. Some of the more common, believed useful to a quality program are briefly described below.

4.8.1 Right-to-Know

As a result of federal legislation, each workplace must now have procedures for maintaining records upon each material used in that corporation. A mechanism must be in place by which the management of the corporation disseminates information on these materials and processes to the workforce. The intent is that everyone in the company from top management to deckplate personnel be informed about the potential hazards represented by the materials used in their business. This requirement is generally referred to as the "right-to-know" laws. Typical of the information to be transferred to workers is:

- Material Safety Data Sheets - these must be present at the work site, the worker must know how to interpret the safety information given on the MSDS, the MSDS must be kept available for inspection during the work process. The MSDS must be kept on file for a set period for reference, even if the described material is no longer used.

- Understanding of Work Related Hazards - the workforce must have engaged upon a course of training in which the hazards associated with their work are described. In addition training should be given on the meaning and interpretation of certain "universal" insignia used to represent the potential for hazard in a material by the manufacturer. In the case of the shipbuilding industry it is likely that all the classes of hazard may be encountered at one yard or another by surface preparation and coating operators. Examples of typical hazards include:

    - Fire - Flammability
    - Chemical - Corrosive, Explosive, Ignitable, or Poisonous Hazards;
    - Radiation Hazards;
    - Ingestion Hazard - Oral, Inhalation or Skin Ingestion pathways must be described and understood.

- Understanding of Appropriate Safety Precautions - see personal protection programs below,

4.8.2 Safety Precautions I - Personal Protection Programs

The worker must be trained in and understand the capability of the various types of personal protective equipment. Examples of such equipment include general use items such as goggles, steel toed safety boots, safety helmets and the like. Other specific use products are likely to be needed to assure personal protection, these may include fitted respirators, chemically resistant bodywear, e.g. gloves, Tyvek suits, and ear protectors. Of these product classes, perhaps the most broad and widely used is the respirator. All personnel must be aware of the capabilities of the various different kinds of respirator, be they full-face, half-face, or quarter-face in size, air-fed or supplied air, recommended for use in protecting against organic vapors, radionucleides, common or nuisance dusts or specific chemical components. Workers must have an understanding of the correct type of respirator to wear while using a particular class of material. Finally, workers must be trained in the maintenance, and upkeep of their personnel protective equipment. For the specific instance of respirator use, workers must have attended a course which provides information on

qualitative fit-testing of respirators. Typically, the shipyard will have a safety coordinator whose job includes training the users of respirators in care, use, fit-testing and maintenance. The safety coordinator could have put all respirator users through a quantitative fit-testing program, explained to users the concepts of protection factors afforded by different respirators, and underscored the loss of protection afforded by a poorly sealing respirator such as caused by seal interfering facial hair.

4.8.3 Safety Precaution II - Personal Hygiene

The workforce must be given training on the importance of work related personal hygiene. Many hazardous materials most commonly find their way into the human body through inadvertent ingestion, typically by mouth. Such ingestion can be reduced or eliminated by maintaining and using a personal hygiene program. Typical components of that program may include:

- Available washing facilities or showering facilities;
- Transfer of knowledge of the dangers posed by smoking or eating after handling hazardous materials;
- A policy of washing/showering after each work shift;
- A policy of always washing or showering before meals or smoke breaks.

Other components of a personal hygiene program will vary dependent on the nature and severity of the application

4.8.4 Safety Precautions III - Confined Space Work

Much surface preparation and coating work required on a ship is conducted in tightly enclosed spaces. OSHA has instituted several policies which describe safe working practices in confined spaces. For instance, it may be that an oxygen deficient atmosphere is present in a previously enclosed ballast or hold area. In such instances it is important that the worker never enter the space without first having the atmosphere checked for oxygen content by the correct shipyard department.

4.8.5 Safety Precautions IV - Scaffolding & Erection

Many surface preparation and coating operations on ships involve the use of scaffolding. Operators must work closely with appropriate trades to ensure safe scaffolding practices. In addition, work on raised platforms will entail an understanding on the part of the operator of fall protection requirements.

4.9 MISCELLANEOUS

Hazardous work area signs to mark work zone

Spray and drip cloths

SECTION 5 - QUALITY EVALUATION & SUPERVISORS

5.1 Evaluation Criteria

The questions or criteria listed in both the supervisory personnel and deckplate or operator evaluation checklists are scored on the following basis: These criteria and the associated evaluation scales were developed for the trial sessions of the implementation program.

- Supervisory Personnel - Compare answers with suggested examples, score conformance on a scale of 1 to 4 using a scheme similar to that suggested below for deckplate personnel.
- Deckplate Personnel - Score Knowledge or skill level against suggested criteria on a 1 to 4 scale. Suggested minimum scores are given in tables below the deckplate criteria listing. A suggested scoring basis is given in the charts below. They are taken from the training materials developed for implementing the quality program.

Scoring for Criteria Lists

- The suggested scoring for the criteria lists is that using a simple 1 through four scale.
  - PAINTER SKILLS EVALUATION CHECKLIST RATING SCALE
  - Rating & Interpretation
    - 1 No skill/knowledge related to the item
    - 2 Unsatisfactory -painter's knowledge or skill is less than minimum acceptable level
    - 3 Satisfactory -painter's knowledge or skill is at minimum acceptable level
    - 4 Superior - painter's knowledge or skill exceeds minimum acceptable level

Scoring for Criteria Lists

- PAINTER SKILLS EVALUATION CHECKLIST RATING SCALE
- Determining Adequate Score - SUGGESTED RATING SCHEME
  - Use Criteria Sheets for Each Skill 1 through 20
  - Suggested Meaning of Terms
    - No Skill or Knowledge - A New Trainee
    - Unsatisfactory - Understands Half or Less of Criteria Sheet Requirements
    - Satisfactory - Understands Two-Thirds or more of Criteria Sheet Requirements
    - Superior - Understands All Criteria Sheet Requirements - Candidate Trainer
- Each Yard Can Develop Their Own Scheme!

5.2 Supervisory Personnel

The list of criteria given below was developed in cooperation with the Society of Naval Architects and Marine Engineers Panel SP 3 on Surface Preparation & Coating. In total there are some forty-four criteria in the application process. Of these only eleven are considered critical items in connection with US Shipyards. The critical items are always preceded by the notation **CRITICAL ITEM.**

5.2.1 Importance of the Critical Items

Why are the items below considered critical? To help guide the manual user through this process

each critical item is accompanied by a brief discussion of the item's impact on surface preparation and coating quality.

5.2.2 What About the Non-Critical Items?

Just because an item is not considered critical does not mean it has no importance. The non-critical supervisory checklist items can have greater or lesser importance in different shipyard settings. It is highly recommended that all the checklist items see use in a quality program self-assessment. At minimum the shipyard should use all eleven critical items.

5.2.3 THE CRITICAL ITEMS

(Noted in **BOLD CAPS** on the full Evaluation Checklist)

These eleven critical items are listed in numerical order in this chapter. A cross reference table is given at the end of this section to their relative position in the full Evaluation Checklist - Appendix A.

Item No. Supervisory Personnel must have:

1. A System for Monitoring Proficiency of Blast Cleaning and Application Personnel.

The term system means a collection of tools, techniques and methods to measure a work process. Remember the main assumption - quality is measured. How the measurement is done is governed by the system.

A minimal system for monitoring proficiency is defined below. Note that for supervisory personnel there is a heavy emphasis on document keeping or analysis. This is typical of all quality monitoring systems. Documents will define the steps in a work process, the level of acceptable quality in a work process, and how to measure, analyze and modify work processes.

With a defined work process, and a coherent system for monitoring proficiency, a quality program will have a sound basis.

2. An Up-to-date Library of Technical Standards Appropriate for the Work Process.

These are the most general of work process documents. Many relevant technical standards were described in Written Standards on page 2 of Section 4, and Visual Standards on page 2 of Section 4. It is important to have referenced technical standards so you and your customer can agree on expected job performance.

3. A Written Record of Job Specifications and Revisions.

In a quality program, documenting the work process is critical. A ledger of job specifications and any agreed changes is essential. This allows you to see the work goal and follow any changes agreed on during the contract. Job specifications include both technical standards and any customer needs stated in the contract or procurement documents.

An efficient quality program hinges on document control.

4. A Procedure for Communicating Specifications.

It is vital that two types of "conversations" take place in any quality program. The first conversation is between the customer and shipyard. Both parties must agree on what will be done, this is best done by referring to the specifications. A second conversation also occurs between the supervisory personnel and mechanics. Supervisory personnel must interpret the scope of the job specifications in terms of the process mechanics will implement. To simplify this task a process for communicating specifications is required.

When specifications and job standards are communicated between customer and

shipyard, and from supervisory personnel to mechanics all parties share a common understanding of what the customer wants. By definition, supplying what the customer wants means you are achieving a quality work process.

5. A System for Filing Inspection Reports - Record Keeping.

It is important to keep a continuous record of inspections. This is the shipyard's proof of past work. The inspection reports files are an essential part of the document trail.

6. Procedures for Calibrating Inspection Equipment.

Having good inspection equipment on hand with calibration standards does no good if the equipment isn't calibrated in the right way. Specifications and manufacturer's instruction sheets describe how to do calibrations. With procedures for calibrating inspection equipment the customer and shipyard have another guarantee that all work is checked in the right way.

7. Procedures to Stop Non-Conforming Work.

One purpose of specifications and inspection is to draw a minimum level of performance. On occasions when work does not meet quality expectations there has to be a method for stopping the non-conforming work. With a procedure to stop non-conforming work errors or re-work are reduced, fewer delays in schedule occur. The best procedures catch non-conforming work early in the process.

8. Procedures for Verifying Proper Coating Application.

Proper coating application is the goal of all painting work. Verifying proper coating application means that the applicator knows all coating material is mixed and applied correctly, it also means the inspector finds all applied films have uniform thickness within the specified range. Verifying proper application is one of the ways to catch non-conforming work early.

9. Procedures To Ensure That Each Major Operation (Surface Preparation, Primer, Intermediate, & Topcoat Application) is Inspected.

10. Inspection Equipment Maintenance and Calibration Standards.

It is important to keep all inspection equipment in good working order and properly calibrated. This gives the shipyard and its customer the guarantee that the tools of inspection are able to give correct answers.

11. Availability of Standard Operating Procedures

Standard operating procedures, SOPs, are common in many shipyards.

The strength of SOPs is that they identify repetitive tasks often done in surface preparation, coating application, and inspection. A set of SOPs act as "super-specifications" they give a shorthand way of referring to larger groups of several related tasks. Supervisory personnel will need copies of the SOPs in their reference files.

5.2.4 Evaluation Checklist for Supervisory Personnel

The full evaluation checklist for supervisory personnel is reproduced in Appendix A of this manual. Below are listed suggested responses to the critical items on that checklist.

5.2.4.1 Supervisors Checklist - How to Respond to the Critical Items

Answering the supervisors checklist will show if you have the framework of good process and document control required for implementing a quality program. The answers given below are only suggestions. Actual wording will vary from shipyard to shipyard. The numbering sequence corresponds to the full list of checks that a supervisor or shipyard could make on their operation.

1. PROFICIENCY MONITORING OF APPLICATION PERSONNEL.

Is there a system for monitoring the proficiency of application personnel?

The Project Supervisor (or Paint Department Foreman) is responsible for monitoring proficiency of the application personnel. Application & Surface Preparation defects are noted in daily inspection reports/logs. Surface preparation and coating operators are routinely graded against a standardized evaluation checklist. of required skills and job knowledge

2. TECHNICAL STANDARDS APPROPRIATE FOR QUALITY PAINTING WORK.

What current standards can be found at the company's home office?

The following is a list of typical standards found at ABC Shipbuilding Company's home office:

A. Commonly used manufacturers' current product catalogs
B. SSPC Manuals - Volumes 1 and 2, Current editions
C. Copies of current NACE standards on Surface Preparation
D. Federal Specification TT-490, “Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings,”
E. U. S. Department of the Navy, Naval Sea Systems Command: Chapter 631, “Preservation of Ships in Service (Surface Preparation Painting) NAVSEA-S9086-VD-STM-000C/H-631
F. Copy of Federal Standard 595 - Standard Colors
G. UL - Fire Resistance Directory
H. ASTM Volumes 06.01, 06.02, 06.03, and 06.04.

3. WRITTEN RECORDS OF JOB SPECIFICATIONS AND REVISIONS.

A copy of project contract documents, specifications, field orders, field changes, specification revisions or addenda, work orders, schedules and pertinent documents are maintained at both the contract office and the paint department office. Attached to each item is a sheet showing the distribution of the item (with name and date).

4. PROCEDURES FOR COMMUNICATING SPECIFICATIONS.

A distribution sheet showing the name, date, and signature of each recipient is attached to each specification and procedure and is signed by both paint department and quality control personnel upon receipt and review of all project specifications, procedures, and revisions. A copy of these sheets is maintained at both the quality control and paint department office.

5. SYSTEM FOR FILING INSPECTION REPORTS.

Daily Painting Inspection Reports (see Attachment 7) are maintained and signed off by the designated lead inspector. Individual record books are also maintained by each inspector and foreman. Copies of these reports are maintained on file at both the paint department and quality control office of ABC Shipbuilding Company. The original Daily Report is sent to the Owner/Client's designated Project Engineer.

6. PROCEDURES FOR CALIBRATION OF INSPECTION EQUIPMENT.

The designated lead inspector is responsible for the control of all testing, inspection and measuring equipment. This shall consist of inventory records and the issuing, reclaiming, and storing of equipment. All equipment is given a unique serial number, calibrated, and maintained prior to, during, and after use as appropriate.

The designated lead inspector fills out and maintains a calibration equipment report, maintains files of all equipment calibration certificates, and verifies that equipment is tagged with calibration status.

All equipment is calibrated in accordance with manufacturer's recommendations and in compliance with standard industry practice and the project specifications.

7. PROCEDURES TO STOP NON-CONFORMING WORK.

The designated inspector has the written authority to stop work found to be non-conforming (both during hold point inspections and general inspections) and the responsibility to inform the operating supervisor of non-conforming work. Lines of authority are noted in the company organization chart. Non-conformance and corrective action required and taken are documented by the inspector on the Daily Painting Inspection Report and in the individual daily record book. Examples are available for review.

8. PROCEDURES FOR VERIFYING PROPER COATING APPLICATION.

The ABC Shipbuilding Company coating inspector reviews coating mixing and application procedures prior to start of application and periodically during the project. This confirms that the applicator understands and is following the correct procedures. Applicators are provided with wet film gauges (wft) and a system to use the same. Foremen periodically measure dry film thickness and other quality control parameters during the project. Thickness measurements, ambient conditions and other quality control parameters are recorded daily.

9. PROCEDURES TO ENSURE THAT EACH MAJOR OPERATION (SURFACE PREPARATION, PRIMER, INTERMEDIATE, AND TOPCOAT APPLICATION) IS INSPECTED.

To ensure that surface preparation and coating application are conducted in accordance

with the project specification and industry standards, inspections are conducted at pre-arranged times tied to major activities in the coating project. The inspector is responsible for witnessing, verifying, inspecting, and documenting the work at these times. Work shall not proceed until the inspector has verified acceptance of the work.

a) Pre-surface preparation inspection
b) Measurement of ambient conditions
c) Evaluation of compressed air
d) Determination of surface preparation, cleanliness and profile
e) Observation of coating mixing
f) Determination of dry film and wet film thicknesses
g) Evaluation of surface cleanliness between coats
h) Pinhole and holiday testing (where applicable)
i) Evaluation of adhesion and cure

Documentation of inspection activities are recorded in the daily field book and on the Daily Painting Inspection Reports.

10. DEMONSTRATION THAT INSPECTION EQUIPMENT AND CALIBRATION STANDARDS ARE AVAILABLE.

ABC Shipbuilding Company inspectors are equipped with the following inspection tools and calibration standards:

a) Sling or Electric Powered Psychrometer
b) Surface Temperature Thermometer
c) Testex Press-O-Film Replica Tape and Spring Micrometer
d) Wet Film Thickness (WFT) Gage
e) Mikrotest or PosiTector Dry Film Thickness (DFT) Gage
f) US Weather Bureau Tables
g) NIST (NBS) Calibration Plates
h) SSPC Visual Standards (SSPC VIS 1-89)
i) Cross-Cut Guide for ASTM D 3359 Adhesion Testing
j) Elcometer Pull-Off Adhesion Meter and Accessories for ASTM D 4541 testing
k) Other specialized gages as required.

Calibration of the inspection equipment is performed in accordance with both project specifications and instrument manufacturers' instructions. All calibration records are maintained on file at the paint department and quality control offices of ABC Shipbuilding Company.

11. AVAILABILITY OF STANDARD OPERATING PROCEDURES

The paint department keeps copies of standard operating procedures on hand for all procedures described above. In addition any custom procedures developed during or for an individual job are also recorded and filed in the paint department office.

5.2.5 General Structure & Intent of The Full Evaluation Checklist

The full evaluation checklist contains several categories of criteria for judging if an organization has an effective quality program.

The full set of categories are as follows:

A brief description of environmental compliance requirements is given in 5.2.5.6 on page 12.

Each category contains several individual criteria. The importance of these criteria varies from shipyard to shipyard. Below is a discussion of why these criteria are important.

5.2.5.1 Management Procedures

The criteria in this section fall into three broad categories: Company Policy; Organization & Personnel, and: Administrative & Management Procedures.

Company Policy
There are two criteria in this sub-category. The first asks if you have a company mission statement that shows corporate commitment to quality in the work process. This is important because without backing from management there is no chance of any quality program flourishing. The second criterion is having procedures for disseminating company policy through the organization. In any business having a means to broadcast information is useful. In the case of a shipyard with a policy to use a quality program this is essential. If the deckplate personnel and mechanics are made partners in a quality program that program has a higher chance of succeeding. One way to do this is by informing deckplate personnel about company policy.

Organization & Personnel
There are three criteria in this sub-category.
The criteria ask if you have a defined organizational structure. It is important to know who works where in a company. This makes communicating and assigning responsibility easier. This can be answered on one of two levels: either by referring to a large corporate structure, and how the Paint Department fits into the picture, or; by only describing how the Paint Department itself is built.
In addition the criteria ask you to name the key personnel in each area/department of the organization and what they do. Again your response can only refer to the Paint Department. Knowing who is in the Paint Department, and what they do, gives mechanics a clear picture of where to turn with questions.
Finally you are asked the training and capabilities of key personnel. This is important because it shows the commitment of the shipyard Paint Department to keeping its workers at the forefront of the technology.

Administrative & Management Procedures
Four criteria are listed in this sub-category. The first three are only relevant to the larger structure of the shipyard. They have indirect relevance to the Paint Department. Nonetheless, without the

suggested controls on financial record keeping, estimating and job accounting procedures, and methods to review job specifications or bid documents the Paint Department will not function well and quality will suffer. What these three criteria hinge on is the idea that with good accounting a Paint Department will correctly report the true cost of a task. With that correct report the shipyard bid estimators are able to make accurate projections of work load requirements in the Paint Department. This means the Paint Department has an easier task to assign workers to a new painting job. Finally, if all work records are correct then bidding future work becomes easier. The estimators will identify the true cost for a job, resulting in a more competitive bid.

The last item in this sub-category is to have a means for learning about environmental, health, and safety regulations. From the Paint Department point of view this information will come from the responsible safety or environmental specialists elsewhere in the company. What is critical for the Paint Department is that they have a method for getting the information from those specialists, then making the mechanics alert to what it means. At the Paint Department level this translates to such obvious actions as having the MSDS records current, keeping mechanics aware that some work materials require special handling, and arranging instruction on how to handle such special materials.

5.2.5.2 Technical Capabilities

The technical capabilities section has four sub-categories: Personnel Qualifications; Technical Resources; Procedures, and; Equipment, Facilities & Experience.

Personnel Qualifications

This sub-category has one simple intention. It is a check that the workers in the Paint Department are qualified to do the work. To check this three simple questions are asked. Do you have training programs to keep workers up to speed on new methods ar safety requirements? Do you make sure your workers keep their skills up to a set level - proficiency monitoring? Can you document that your workers were trained to use the equipment on site? All three go to the basic need of any quality program - documentation of process, skills, and execution.

Technical Resources

Two kinds of resource are suggested for the Paint Department, industry technical contacts and in-house technical standards.

Procedures

The procedures section is quite lengthy. It covers five related criteria. All the criteria involve documentation of standards, keeping them current, communicating standards to mechanics, clarifying ambiguous or conflicting specifications, and keeping records of the job specifications and revisions. Documentation is critical to any quality program. Having documentation shows that the Paint Department’s quality program is not just words or good intentions. It records the quality program in action.

Equipment Facilities & Experience

In this sub-category the Paint Department lists their physical resources and relevant examples of past work. What have you done, how well was it done, with what was it done. This is really customer relations and marketing. Showing successful past experience gives your customer a better understanding of the quality shown by the Paint Department. Listing equipment shows how much and what type of work the Paint Department will handle. Describing maintenance records gives the customer a clear picture of the care taken to keep equipment in working order.

In a shipyard setting these types of criteria for equipment, facilities and experience can change from the simple example given in three ways. First, the number of types of equipment found in a shipyard is much larger. Second, the quantity of each type of equipment and accessory is much higher than the given simple example. Third, and most important, because so many equipment

and material items are in inventory another set of criteria will arise. The control and inventory of material and equipment is a vital part of any shipyard surface preparation and painting quality program. It is important that all equipment have the capacity to perform the tasks set by the customer.

5.2.5.3 Quality Control

The Department under which quality control is done will differ from shipyard to shipyard. Some yards integrate quality control within their Paint Department, other yards maintain a totally separate QC or Inspection Department. Whichever instance applies to your yard the criteria for quality control are important. These criteria are divided into two broad areas, personnel qualifications and inspection procedures and recording systems.

Personnel Qualifications
Much like the need to demonstrate that applicators know how to paint, one must show the inspectors know how to inspect.
By providing the resumes, company requirements for training and skills, and any in-house programs for continuing education, you document that the inspectors know how to inspect.
Please note that all references to Level I or Level II inspectors in the given examples are arbitrary standards. Some organizations like NACE International provide the training under which paint inspectors become Level I or Level II certified. Level I and Level II are industry consensus standards for appropriate paint inspector skills and knowledge, this is why they are cited in the given example. **There is no suggestion that all your inspectors must meet such requirements.** Alternative approaches to define the skills required of a shipyard paint inspector are appropriate, so long as they deliver an individual with the skills required for the job.

Inspection Procedures & Recording Systems
There are seven interlocking criteria under this sub-category. Inspection procedures in a quality program demand good documentation. Several of the criteria restate and underscore documentation needs implied by criteria for inspection procedures. All the criteria in this sub-category are also in the list of **CRITICAL ITEMS.** Their importance was discussed earlier in THE CRITICAL ITEMS on page 3 of Section 5.

5.2.5.4 Safety

The importance of safety cannot be overstated. The three main goals of any safety program are: compliance with OSHA regulations, ensuring the well being of the worker, and reduction of lost-time accidents. If safety is important, why do none of the eleven criteria in this sub-category rank as **CRITICAL ITEMS**? The answer lies in the way a shipyard is organized and the intent of this manual. A shipyard will almost always have a completely separate safety department. This manual is written to allow a **shipyard paint department** to implement its own quality program. Thus, the criteria cited in this sub-category **are** important, yet none appear as **CRITICAL ITEMS**. The safety criteria are divided into two general areas: Safety Procedures & Record-Keeping Systems, and; Resource Materials.

Safety Procedures & Record Keeping Systems
A recurrent theme of a quality program is that you have a systematic way to perform work, (procedures) and documents that prove the work followed the plan, (record keeping systems). Safety is no different. Of those criteria cited in this sub-category the following directly involve the paint department.
Safety procedures for specialized equipment, and;
Provision and maintenance of personal protective equipment.
The paint department will interact with the safety department for the other safety criteria listed.

Resource Materials
This sub-category contains four criteria. One can apply the criteria directly to a paint department, or to the shipyard safety department. Different performance levels apply to the paint and safety departments. Moreover, the paint department will try and meet goals for safety resource

procurement, distribution, and documentation set by the safety department. The safety department will almost certainly have two high priority goals. First, to make sure the shipyard as a whole meets OSHA regulations. Second, to reduce lost-time accidents.

5.2.5.5 Standard Operating Procedures

Planning the work and working the plan is central to any quality program. One way to simplify planning the work is through “Standard Operating Procedures.” The importance of SOPs was discussed earlier under THE CRITICAL ITEMS on page 3 of Section 5.

5.2.5.6 Environmental Compliance

Environmental regulations affect the way surface preparation and coating application is done. Most shipyards have a group or department that provides guidance on compliance with environmental regulations. A detailed discussion of all environmental regulations is beyond the scope of this manual. Complying with environmental regulations can affect surface preparation and coating through changes to processes that provide environmental compliance, and; by imposing requirements on the handling of waste materials.
As with safety, and for the same reasons, the criteria involving environmental compliance are not listed as critical items. These criteria are Compliance Procedures and Waste Handling.

Compliance Procedures
The paint department will interact with the shipyard environmental group to provide clear and practical environmental compliance procedures. Paint department supervisors should:

- Have written compliance procedures describing emissions control;
- Have copies of SOPs which reflect environmental compliance;
- Possess an understanding of the impact on product finish quality and productivity of process changes to achieve environmental compliance;
- Convey to deckplate personnel information about environmental compliance as it affects the work process.

Waste Handling
The paint department produces several types of waste products during surface preparation. Paint department supervisors should:

- Have written procedures for handling of wastes from surface preparation and coating application;
- Convey to deckplate personnel information about correct liquid and solid waste handling procedures.

Table 3: Cross Reference of Critical Items from Section 5 to Appendix A

Section 5 Numbering	Appendix A Numbering
1	II - A.2
2	II - B.2
3	II - C.1
4	II - C.4
5	III - B.1
6	III - B.6
7	III - B.3
8	III - B.4
9	III - B.5
10	III - B.2
11	V - A.1

[1]SECTION 6 - QUALITY EVALUATION & MECHANICS

6.1 The Evaluation Checklist for Deckplate Personnel

The evaluation checklist shown on the following pages is intended for in house assessment of surface preparation and painting operator competence and quality of operation. It is assumed that the same operator may be responsible for conducting a wide range of tasks. In yards where the surface preparation and paint application functions are not combined the list must be customized to meet the requirements of each individual operator. To aid in yard customizing of the criteria listing and suggested scores for meeting skill or knowledge requirements the category covered by each question is described, both at the beginning of each question and as a side note in each table. Furthermore, the score sheets are subdivided by operator skill or knowledge area. Four skill or knowledge areas are identified:

- Safety - applied to both surface preparation and painting operations;
- Surface Preparation Skills and Knowledge;
- Painting Skills and Knowledge;
- Quality Assurance Skills and Awareness.

Sometimes the same question is shown being scored on different score sheets, this is deliberate. In certain cases the question posed impacts both quality assurance and either painting or surface preparation. To cite one example, you will see question 15 regarding correction of defects appears on all score sheets except that for safety. This is because in correcting an applied paint defect there are three operations that must be performed:

- Quality Assurance - Identifying or recognizing a defect exists;
- Surface Preparation - to ready the prior defect area for repair;
- Painting - choice and application of the correct repair material.

The only set of criteria not fitting this model are those concerned with environmental compliance.

The checklist below cannot address all skills required in each individual yard, it can provide a benchmark for assessing the quality of your personnel, relative to one another and relative to other yards either foreign or domestic.

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1. The questions shown in this section were developed with the input of the SNAME SP3 Panel Members.

6.2 Questions and Criteria for Deckplate Personnel

Ambient Condition Assessment

1. Operator can check ambient conditions prior to start of work, using appropriate instruments.

(a) Can accurately read air temperature using psychrometer or thermometer;

(b) Can determine humidity by reading hygrometer or hygrograph (if available) or determine from sling psychrometer;

(c) Can properly use and accurately read standard surface temperature thermometer or digital thermometer;

(d) Can use sling psychrometer (including charts) or digital psychrometer.

Preliminary Surface Cleaning

2. Operator can recognize surface contaminants such as oil, grease, salts and soil and remove in accordance with SP-1 and other methods.

(a) Visually inspect likely sites for:

- oil and grease contamination;
- moisture, especially when ambient dew-point is within 5° F of the substrate temperature;
- abrasive dusts and miscellaneous soil.

(b) Can remove soluble salts as directed using wet blasting methods with and without abrasives.

Safety

(c) Places NO SMOKING and NO HOT WORK signs during solvent cleaning.

(d) Wears appropriate personal protective equipment, e.g. gloves, respirator, eye protection, ear plugs, safety shoes etc.

3. Operator can recognize and remove surface imperfections using power tools without damaging substrate, and can correct fabrication conditions which interfere with paint adhesion.

(a) Can identify and correct, using the proper tools for the job:

- weld spatter
- sharp edges
- slivers, gouges, cuts in surface
- excessive surface roughness

4. Operator can properly mask or protect adjacent work areas prior to start of paint application.

(a) Can demonstrate proper use of materials and techniques to minimize overspray to areas adjacent to work piece.

Surface Preparation Methods

5. Operator can use hand tools for removal of non-adherent detrimental foreign matter from substrate in accordance with SP-2.

(a) Use

- Using proper tools for the job, can demonstrate the techniques of SP-2 in removal of loose mill scale, loose rust, loose paint and other non-adhering materials.

(b) Safety

- Wears Personal Protective Equipment as needed for application, e.g. gloves, eye protection, dust mask or respirator.

6. Operator can use power tools for removal of non adherent detrimental foreign matter in accordance with SP-3.

(a) Use

- Using proper tools for the job, can demonstrate the techniques of SP-3 in removal of loose mill scale, loose rust, loose paint and other non adhering materials.

- Demonstrates knowledge of correct choice of media for each surface preparation specification.

(b) Safety

- Wears personal protective equipment appropriate for application, e.g. gloves, eye protection, ear plugs, dust mask or respirator.

- For air powered tools has hoses clear and untangled, avoiding tripping hazard.
- For electric powered tools has electric cords clear and untangled, avoiding a tripping hazard. Has correctly grounded tools.

- Uses non-sparking media if appropriate, e.g. in presence of near other painting activities.

(c) Maintenance

- Has a maintenance schedule for replacing abrasive media or working components in power tools.

7. Operator can use power tools to clean substrate to bare metal in accordance with SP-11.

(a) Use

- Using proper tools for the job, can safely demonstrate the techniques of SP-11 in cleaning substrate to bare metal while assuring proper surface profile.

(b) Safety

- Wears personal protective equipment appropriate for application, e.g. gloves, eye protection, ear plugs, dust mask or respirator.

- For air powered tools has hoses clear and untangled, avoiding tripping hazard.
- For electric powered tools has electric cords clear and untangled, avoiding a tripping hazard. Has correctly grounded tools.

- Uses non-sparking media if appropriate, e.g. in presence of near other painting activities.

(c) Maintenance

- Has a maintenance schedule for replacing abrasive media or working components in power tools.

8. Operator can set up and properly use abrasive blasting equipment.

(a) Can identify basic parts and explain function of each.

- Air compressor (provides air at appropriate pressure and volume)
- Blasting machine (container which holds abrasive; valve at bottom controls amount of abrasive fed into blast hose)
- Blast Hose (carries air/abrasive mix from blast pot to nozzle)
- Air Hose (carries air from compressor to blast pot)
- Nozzle (concentrates air/abrasive mix onto work area)

(b) Set-up

- Oil and water traps on compressor monitored to assure air cleanliness
- Compressor located as close to blast pot as possible
- Air hose largest ID as possible
- Blotter test conducted and properly interpreted
- Blast hose largest ID as possible
- Blast hose as short in length as possible
- Abrasive metering valve adjusted
- Abrasive cleanliness test conducted
- Nozzle length as long as possible
- Nozzle grounded to prevent static electricity discharge
- Nozzle pressure checked using hypodermic needle gauge
- Hose runs as straight as possible
- Nozzle Diameter measured

(c) Use

- Correct nozzle-to-surface distance used for job conditions (e.g., 6" for removal of tight mill scale, 18" for removal of old paint)
- Correct angle of attack used for job conditions (e.g., 60° - 70° for general cleaning, 80° - 90° for tight rust and mill scale; slight downward angle to direct dust away from operator)

- Straight passes used; no “arcing”
- Size of area to be blasted not more than can be primed the same day
- Profile height checked using Keane-Tator or other comparator

(d) Safety

- Protective clothing, respirator, ear, and eye protection devices worn
- Adequate ventilation assured
- Blast nozzle pointed only at surface to be cleaned, and deadman valve used
- Safety belts and lines used
- Maintains correct pressure within operational limits off equipment.
- Checks hoses for wear to avoid hose rupture.
- Grounding of Hoses and Fittings in Place

(e) Quality Assurance

- Can check abrasive for oil and other contaminants as outlined in SSPC publication 91-12 and SSPC-AB 1

Surface Preparation Visual Inspection

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9. Operator can prepare a surface using Vis-1-89 or other visual surface preparation standards.

(a) From a given initial rust grade or surface condition, can clean steel to the Vis-1-89 standard required in the job specification.

Application Techniques

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10. Operator can properly use, clean and store brushes and rollers.

(a) Brush

- Unattached bristles shaken loose and stray bristles snapped off
- Brush dipped into paint covering no more than 1/3 of bristle length; excess paint removed by tapping brush against side of can
- Light touch using tips of bristles
- Work from dry to wet surface
- Second coat applied at right angles to first coat
- Proper clean-up and storage

(b) Roller

- For thick-bodied coatings, roller dipped directly into paint container; for thin-bodied coatings, roller dipped into roller tray.
- When using new roller, first load rolled onto scrap paper to eliminate air bubbles in fibers
- Roll paint out in a V or W shape, then roll to fill in the square area. Finish with light vertical strokes in the direction producing the smoothest finish.
- Use moderate pressure
- Second coat applied at right angle to first
- Clean-up and storage (Clean paint tray and fill partially with solvent. Work roller out on newspaper until most paint removed. Dip roller in solvent and roll on tray ramp to work in;

roll out on newspaper until all solvent removed. Repeat twice more. Stand roller on one end until dry. Properly dispose of paper used in cleaning.)

(c) Mitt

- Uses appropriate mitts for solvent borne or water borne paints, e.g. lambs wool for solvent borne, lambs wool or synthetic for water borne paints.
- Always uses a mitt liner compatible with paint to be applied, e.g. non-swelling rubber liner.
- Can achieve a smooth mitt applied finish on cylindrical or complex surfaces, e.g. handrails or lattice work steel.

(d) Safety

- Wears appropriate personal protective gear, e.g. respirator, safety goggles, gloves, non-sparking boots etc.

Spray Methods - Only for conventional spray methods is the full list of criteria shown. Other spray application methods follow the same layout as that listed below for conventional spray. Specific criteria differences for individual spray methods are shown in the accompanying handouts which form part of the training package.

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11. Operator can use conventional spray equipment safely and efficiently.

(a) Can identify basic parts and explain function of each.

- Air compressor (supplies air at proper pressure and volume to assure proper operation of spray gun)
- Paint tank (holds material)
- Air Hose (carries compressed air to gun)
- Fluid Hose (carries material from paint tank to spray gun)
- Spray Gun (applies material to work surface) - (See attached drawing.)
- air cap (directs compressed air into paint stream, atomizing it and directing it onto the work surface)
- tip or fluid nozzle (regulates paint flow and directs it into compressed air stream)
- fluid needle (starts or stops fluid flow through fluid nozzle; fluid needle and fluid nozzle must be same size)
- trigger (operates air valve and fluid needle)
- fluid adjustment screw (controls fluid needle and adjusts volume of paint reaching fluid tip)
- air valve (controls rate of air flow through gun to nozzle)
- side port control (regulates supply of air to air nozzle; determines size and shape of spray pattern)
- gun body and handle
- air inlet (connects air hose to bottom of handle)
- fluid inlet (connects fluid needle to fluid hose)

(b) Set-up

- Oil and water extractors monitored to assure air cleanliness
- Air pressure regulator on paint tank adjusted to assure proper flow of paint to spray gun
- Paint tank agitator (if needed) working properly
- Air hose as short as possible; ID at least 3/8" from compressor to paint tank, 5/16" from paint tank to gun
- Spray pattern checked and adjusted
- Field demonstration of set-up and shut-down procedures, including cleaning (see

attachment)

(c) Use

- Maintain uniform distance from work surface (6" to 12"), holding gun at right angle to work surface, and consistent rate of speed
- Each stroke overlaps previous stroke by 50%
- Trigger at beginning and end of each stroke
- Recognize and correct film defects caused by improper application techniques and equipment difficulties

(d) Safety

- Protective clothing and gloves worn
- Good personal hygiene - wash before eating or drinking and after working
- Proper respiratory protection worn
- Spray units grounded to prevent static electricity; work piece grounded when spraying flammable material
- Proper ventilation assured in all work areas

12. Operator can use airless spray equipment safely and efficiently.

13. Operator can use air-assisted airless spray safely and efficiently.

14. Operator can use HVLP spray safely and efficiently.

Application Inspection

15. Operator can recognize and correct paint film defects, such as runs and sags, overspray, blistering, mudcracking, etc.

(a) Can identify and correct defects as described in SSPC 91-12, Chapter 12.

16. Operator can properly mix and thin one- and two-component paints using hand and mechanical techniques, following recommendations on product data sheet.

(a) Safety

- Appropriate protective apparel (rubber gloves, eye protection, etc.)worn

(b) Use

- Can demonstrate familiarity and proficiency in techniques of PA-1.

17. Operator can check film thickness using wet film thickness gauge and adjust application technique as necessary to assure compliance with specification and product data sheet.

(a) Can properly use and accurately read standard WFT gauge.

18. Operator can check dry film thickness using Positector or other devices.

(a) Can calibrate and use Positector, Elcometer, Microtest or other DFT gauge, following manufacturer's instructions.

19. Operator can use wet sponge holiday detector to check for paint film defects.

(a) Following manufacturer's instructions, can accurately detect holidays in coating.

Scaffolding & Rigging

20. Operator can safely erect and use stationary and portable support systems used in shipyard work.

(a) Scaffolding

- All sections inspected before use for wear;
- Supporting members plumb and securely braced;
- Scaffold anchored to structure when possible;
- Guard rails on all open sides if scaffold 10' or higher;
- Planking fastened properly and kept free of debris;
- Casters (if any) locked when unit is stationary.

(b) Portable Support Systems (mobile hydraulic lift devices)

- Equipment inspected completely before use;
- Wheels chocked and outriggers fully extended before operating unit;
- Obstructions noted before extending boom;
- 10' distance from power lines maintained.

(c) Rigging

- Cables inspected before use;
- Appropriate electrical connection and grounding;
- Wiring checked in power supply to hoisting unit;
- If outrigger in use, proper number of counterweights used and locked in place;
- Guard rail and toe boards in place;
- Braced to prevent swaying;
- Safety lines used

21. Operator can demonstrate familiarity with shipyard's respirator program, have general knowledge of respirator types and conditions for use, and can fit test, check and clean.

(a) Can demonstrate fit test;

(b) Identify and examine critical parts for wear;

(c) Can demonstrate techniques for cleaning and disinfecting.

22. Operator knows yard procedures for environmental compliance

(a) Disposes of all wastes in marked containers;

6.3 Scoring for Criteria Lists

The suggested scoring for the criteria lists is that using a simple 1 through 4 scale. The qualitative basis for achieving each level of score is as follows:

PAINTER SKILLS EVALUATION CHECKLIST RATING SCALE

Rating Interpretation

1 No skill/knowledge related to the item

2 Unsatisfactory - painter's knowledge or skill is less than minimum acceptable level

3 Satisfactory - painter's knowledge or skill is at minimum acceptable level

4 Superior - painter's knowledge or skill exceeds minimum acceptable level

On the next pages you will find a suggested "perfect" score card for a deckplate surface preparation an painting operator.

6.3.1 Suggested Scoring for The Individual Deckplate Criteria

Evaluation Checklist for Surface Preparation & Painting Operators

Table 4: Safety & Environmental Questions

Question	Minimum Acceptable Score	Actual Score	Category
2 (c)	3		Solvent Cleaning
2 (d)	3		
5 (b)	3		SP 2 Cleaning
6 (b)	3		SP 3 Cleaning
7 (b)	3		SP 11 Cleaning
8 (d)	3		Abrasive Blasting
10 (d)	3		Manual Applications
11 (d)	3		Conventional Spray
12 (d)	3		Airless Spray
13 (d)	3		Air-Assisted Airless
14 (d)	3		HVLP Spray
16 (a)	3		Mixing/Thinning
20 (a)	3		Scaffolding
20 (b)	3		
20 (c)	3		
21 (a)	3		Personal Protection
21 (b)	3		
21 (c)	3		
22 (a)	3		
Total	57		

Table 5: Surface Preparation Questions

Question	Minimum Acceptable Score	Actual Score	Category
2 (a)	3		SP 1 Cleaning
2 (b)	3		
3 (a)	3		Surface Imperfections
4 (a)	3		Masking
5 (a)	3		SP 2 Cleaning
6 (a)	3		SP 3 Cleaning
6 (c)	3		
7 (a)	3		SP 11 Cleaning
7 (c)	3		
8 (a)	3		Abrasive Blasting
8 (b)	3		
8 (c)	3		
9 (a)	3		Vis 1-89
15 (a)	3		Correction of Defects
Total	42		

Table 6: Paint Application Questions

Question	Minimum Acceptable Score	Actual Score	Category
10 (a)	3		Manual Application
10 (b)	3		
10 (c)	3		
11 (a)	3		Conventional Spray
11 (b)	3		
11 (c)	3		
12 (a)	3		Airless Spray
12 (b)	3		
12 (c)	3		
13 (a)	3		Air-Assisted Airless
13 (b)	3		
13 (c)	3		
14 (a)	3		HVLP Spray
14 (b)	3		
14 (c)	3		
15 (a)	3		Defect Correction
16 (b)	3		Paint Mixing
Total	51		

Table 7: Quality Assurance Questions

Question	Minimum Acceptable Score	Actual Score	Category
1 (a)	3		Ambient Conditions
1 (b)	3		
1 (c)	3		
1 (d)	3		
8 (e)	3		Abrasive Quality
9 (a)	3		Finish Quality
15 (a)	3		Defect Recognition
16 (a)	3		Paint Viscosity
17 (a)	3		Wet Film Thickness
18 (a)	3		Dry Film Thickness
19 (a)	3		Holiday Detection
Total	33		

SECTION 7 - MODIFYING THE PROGRAM MANUAL

7.1 Modifying the Checklists

The checklists and answers given above are by no means comprehensive, nor can they respond to all the variety of nuances exhibited by a unique operation like a shipyard. An individual shipyard may have developed unique specialty skills in areas other than those covered in the above criteria listing(s). Examples are given below of such unique areas of surface preparation and coating skill which may be encountered in a shipyard setting.

7.1.1 Assessing Performance Against the Checklist

In a quality program it is expected that the shipyard will implement a process wherein the skill evaluation and assessment would be conducted on a frequent basis. The actual frequency with which you conduct such skill assessments will be dependent upon:

- Resource availability, and;
- Commitment to the quality program.

7.1.2 Follow-up & Additional Training

One of the benefits of conducting a self-assessment is that it affords an opportunity to uncover individual, team, or corporate weaknesses. These do not constitute a failure by the program participants, rather it is an opportunity for follow-up and training.

In the case of supervisory personnel, further insight into the area of certification programs and self-assessment or self-accreditation can be gleaned from a bibliography attached to this manual.

For the case of deckplate personnel follow-up and training activities can involve tutoring sessions in critical skill areas. These sessions may be directed by other deckplate personnel who have demonstrated their skills. Supervisory personnel may be used for this purpose or a formal program of training, such as the industrial painters curriculum of SSPC may be engaged upon.

7.2 Skill Identification

Earlier it was stated that this listing of criteria could not hope to address all skills pertinent to every shipyard. Specific skills required by an individual shipyard can be added to the criteria lists for either the supervisory or deckplate personnel. Some areas not directly covered in this version of the manual are listed below as “Special Skills.”

7.3 Special Skills

Special skills are needed in a variety of shipyard surface preparation and painting operations. These vary widely from yard to yard. Some examples include these items listed below. When possible a suggested reference source is given for the unique application or skill category. Information from that reference can form the basis for the development of rating criteria for your unique application.

7.3.1 Surface Preparation

Cleaning of Masonry Surfaces
Cleaning & Preparing Non-Ferrous Metals
Cleaning & Preparing Composite Materials
Cleaning of Welds and Heat Affected Zones

Suggested reference material includes - Chapter 631 of the Navy Manual on Fleet Preservation, latest revision.

7.3.2 Surface Preparation Techniques

Vacuum Abrasive Blasting
Portable Centrifugal Wheel Blasting Equipment
Vacuum Power Tool Cleaning
Wet Abrasive Blasting
High Pressure Water Jetting

Suggested reference materials include “Surface Preparation the State -of-the-Art” Proceedings from the 1985 SSPC national Conference; A Survey of Surface Preparation Methods Applications - Draft report to David Taylor Research Center by SSPC under Purchase Order N 6153391M0508, “Guidance Document for Selection of Appropriate Paint Removal Techniques.”

7.3.3 Removing Hazardous Paint Materials

Suggested references include: Chapter 631 of the Navy Manual on Fleet Preservation, latest revision; SSPC Guides 6I (CON) & 7I (DIS) on Containment and Disposal of Hazardous Paint Materials; Industrial Lead Paint Removal Handbook, SSPC Publication number 91-18.

7.3.4 Specialized Coating Application

Thermal Metal Spray
Thermal Polymer Spray
Application of Plural Component Materials
Peroxide Catalyzed Polymers
Elastomeric Materials
Deck Surfacing Compounds
Anti-Skid Coatings
Using Batch Coating Containers

7.3.5 Working in Confined Spaces

Suggested reference OSHA guidelines on confined space entry.

7.4 References for Supervisory Personnel

“Contractors’ Participation in SSPC,” Bernard R. Appleman, Journal of Protective Coatings and Linings, p. 1, July, 1986.

“Pre-qualification of Contractors: One Giant Step Toward Increasing the Service Life of Coatings,” John C. Hauck and Eric S. Kline, JPCL, pp. 26-33, July, 1986.

“SSPC Considers Certification of Contractors,” JPCL, p. 4, September, 1986.

“Progress Report: SSPC Contractor Certification Program,” Harold E. Hower, JPCL, pp. 46-51, May, 1987.

“SSPC Expected to Adopt Painter Certification Program,” Painting & Wallcovering Contractor, p. 8, May-June 1987.

“Contractor Certification,” JPCL, p. 7, January, 1988.

“Quality Control: A Necessary Factor in SSPC Contractor Certification,” Frank Windler, JPCL, pp. 44-50, April, 1988.

“Contractor Certification,” JPCL, pp. 9-10, January, 1989.

“Contractor Certification Set to Begin,” JPCL, p. 3, March, 1989.

“Ballot on Contractor Certification Standard Reveals Misconceptions,” JPCL, pp. 5-8, April, 1989.

“Auditing Firm Selected for Contractor Certification Program,” JPCL, p. 83,
July, 1989.

SSPC-QP 1, “Standard Procedure for Evaluating Qualifications of Painting Contractors, Field Application to Complex Structures,” September 1, 1989.

`“SSPC Announces Implementation of Contractor Certification Program,” JPCL, p. 5, December, 1989.

“First Contractor Certified in PCCP,” JPCL, p. 10, February, 1990.

“Quality Control and Contractor Certification: A Program at the Steel Painting Council,” Charles H. Holes, The Construction Specifier, pp. 3-5, May, 1990.

“SSPC Contractor Certification Reviewed,” JPCL, p. 90-91, October, 1990.

PCCP News, Painting Contractor Certification Program, Vol. 1, 1990, Vol 2, No. 1, 1991, Vol. 2, No. 2, 1991, Vol. 3, No. 1, 1992.

“The Collected SSPC Applicator Training Bulletins From JPCL 1988-1992,”
Lloyd Smith, SSPC-92-03

Symbolic & Numerical Cross-Reference Tags

General Index

APPENDIX A - FULL LIST OF QUESTIONS

FOR

SUPERVISORY PERSONNEL

Note: This section is intended for use by shipyards in assessing the capabilities of outside third-party service providers. Use in assessing the capability of a shipyard paint department is entirely at the discretion of each individual shipyard.

I. MANAGEMENT PROCEDURES

I - A Company Policy

I - A.1 Mission Statement.
Describe in writing why the company is in business, and make specific statements regarding quality control and safety.

I - A.2 Procedures for disseminating company policies within the organization.

Show how management communicates company policy to workers.

I - B Organization and Personnel

I - B.1 Organizational Chart.
This diagram clearly shows lines of authority and responsibility for major activities of the company.

I - B.2 Names, titles, duties and job descriptions of key personnel (management, technical, quality control, safety).
Include all key positions in company, job descriptions, and specific duties.

I - B.3 Management training courses and career advancement programs attended by staff.
List training programs conducted by the company, or by other organizations, that management personnel have attended. Include records of employee attendance.

I - C Administrative and Management Procedures

I - C.1 Financial record keeping method.
Supply CPA audit statement. Provide evidence that job costs are accounted for and routinely recorded.

I - C.2 Estimating, scheduling, and job cost accounting procedures.
Demonstrate that procedures are consistent and industry-recognized. Evidence should be available in files.

I - C.3 Methods used to review job specifications and other bid documentation.
Demonstrate how management coordinates bidding process, and how jobs are monitored and reviewed.

I - C.4 Procedures for learning about and meeting current federal, state, and local environmental, health, and safety

I - C.4.A Securing Regulation Information

I - C.4.B Dissemination Procedures

List specific persons in company who secure and study regulations. Explain how they secure information, and how that information is disseminated to responsible company personnel.

II. TECHNICAL CAPABILITIES

II - A Personnel Qualifications

II - A.1 Availability of training programs.
Show that training programs are provided for employees when needed.

CRITICAL ITEM

II - A.2 PROFICIENCY MONITORING OF APPLICATION PERSONNEL.
Show how performance is monitored.

II - A.3 Qualifications of applicators.
Document that personnel are trained and qualified to use required equipment.

II - B Technical Resources

II - B.1 Industry associations.
List memberships in industry organizations that relate to the type of work performed (SSPC, SNAME, ASTM, AGC).

CRITICAL ITEM

II - B.2 TECHNICAL STANDARDS APPROPRIATE FOR CERTIFICATION CATEGORY.
Show that current standards and reference books are utilized.

II - C PROCEDURES
Describe procedures used to convert job specifications into a field work order or job plan.

CRITICAL ITEM

II - C.1 WRITTEN RECORDS OF JOB SPECIFICATIONS AND REVISIONS.
Verify that specifications and revisions for jobs are kept, and that the most current information is at hand.

II - C.2 Procedures for receipt of specifications and revisions.
Verify that procedure covers distribution and communication to field operations and quality control.

II - C.3 Procedures for clarifying ambiguous specifications.
Show how company clarifies ambiguous specifications, and how clarifications are communicated.

CRITICAL ITEM

II - C.4 PROCEDURES FOR COMMUNICATING SPECIFICATIONS.
Describe how company makes certain that quality control and production have current and complete files of field procedures.

II - C.5 Provisions to assure that specifications are kept current.
Show provisions to assure that specifications are kept current.

II - D Equipment, Facilities, and Experience

II - D.1 Materials your company has applied and inventory control methods.
Submit two parts:
A) A list of commonly applied specification or proprietary coating materials complete with manufacturers validation that your personnel are capable of using the material;
B) A brief description of how coating material inventory control is conducted in the painting department.

II - D.2 All current and recently completed industrial painting jobs (previous 12 months) and work experience. Include:

- Facility name, address, and principal contact
- Description of work performed
- Materials applied
- Equipment used
- Types and number of personnel employed
- Special safety or environmental requirements

List should demonstrate your company's ability to perform work at the category of certification sought.

II - D.3 List of equipment owned or leased
List equipment used, its capacity, your inventory system for accessories and system for matching equipment to individual surface preparation or painting tasks

II - D.4 Description of maintenance and repair procedures.
Demonstrate how equipment maintenance is performed, and have maintenance records available.

III. QUALITY CONTROL

III - A Personnel Qualifications

III - A.1 Quality Control Personnel

Send resumes of quality control personnel, including experience and any formal training courses taken to qualify them.

Define requirements for a quality control inspector.

Describe your company's program for training and qualifying coatings inspectors.

III - B Inspection Procedures and Recording Systems

CRITICAL ITEM

III - B.1 SYSTEM FOR FILING INSPECTION REPORTS.

Verify that inspection reports are maintained and kept with other job information.

CRITICAL ITEM

III - B.2 DEMONSTRATION THAT INSPECTION EQUIPMENT AND CALIBRATION STANDARDS ARE AVAILABLE.

Present inspection equipment and calibration standards used by quality control personnel.

CRITICAL ITEM

III - B.3 PROCEDURES TO STOP NON-CONFORMING WORK.

Present evidence that quality control inspectors have authority to stop work which is found to be non-conforming.

CRITICAL ITEM

III - B.4 PROCEDURES FOR VERIFYING PROPER COATING

Show how your company ensures that proper coating procedures are disseminated and followed.

CRITICAL ITEM

III - B.5 PROCEDURES TO ENSURE THAT EACH MAJOR OPERATION (SURFACE PREPARATION, PRIMER, INTERMEDIATE, TOP COAT APPLICATION) IS INSPECTED.

Provide evidence that inspections are made.

CRITICAL ITEM

III - B.6 PROCEDURES FOR CALIBRATION OF INSPECTION

Describe in writing the calibration of inspection instruments.

IV. SAFETY

IV - A Safety Procedures and Record-Keeping Systems

IV - A.1 Documentation of safety &health related activity.
Show that safety and health activities (education training, routine job site safety & health inspections by a competent person, safety meetings, and distribution of safety materials) are documented throughout the company.

IV - A.2 Documentation of pre-job safety meetings.
Submit meeting records including pre-job hazard evaluation and hazard control implementation plan.

IV - A.3 Documentation of accident reports.
Submit actual report showing how accidents are investigated and plans to avoid recurrence.

IV - A.4 Procedure for determining efficiency of safety measures.
Show how company monitors safety performance.

IV - A.5 Safety procedures for specialized equipment.
Verify the safe operation of equipment.

IV - A.6 Provision and maintenance of personal protective equipment.
Show how such equipment is issued and how it is maintained.

IV - A.7 Availability of first-aid trained employees.
Identify individuals, their training, and their presence on the job.

IV - A.8 Procedures for enforcement of safety rules.
Document enforcement of written safety and health program.

IV - B Resource Materials

IV - B.1 Available safety resource materials.
Provide listing of safety books and materials used.

IV - B.2 Sources of information on safety requirements.
Show sources of information, including magazines.

IV - B.3 Procedures for acquiring safety information and materials.
Describe how your company gathers information on safety issues.

IV - B.4 Availability of safety information mentioned in Item 40.
Verify availability.

V. STANDARD OPERATING PROCEDURES

V - A SOPs Are Available

V - A.1 Availability of Standard Operating Procedures
Are Standard Operating Procedures kept by the Paint Department.

APPENDIX B - SUPERVISORS QUESTIONS WITH ANSWERS

I MANAGEMENT PROCEDURES

I - A Company Policy

Example: A.Company Policy

I - A.1 Mission Statement.

Does the mission statement include statements on quality control and safety?

Example: Mission -It is the policy and goal of ABC Shipbuilding Company to provide painting, protective coatings, and related services to industry, government agencies, and our customers in accordance with their requirements and specifications, for ship construction or repair.

Example: Quality -The management of ABC Shipbuilding Company hereby acknowledges its total support of the Quality Assurance and Quality Programs described, and requires that these programs be implemented by all personnel directly or indirectly involved in painting operations.

Example: Safety -ABC Shipbuilding Company has established a detailed safety program that is implemented and enforced by each project superintendent on all ABC Shipbuilding Company work sites. Safety is of the greatest importance to the proper execution of all projects, and is given the highest priority.

I - A.2 Description of procedures for disseminating company policies within organization.

Does the company utilize a procedure for disseminating policy?

Example: Company policies are first introduced to management personnel upon hiring, and during initial indoctrination. Policies are also introduced during quarterly management safety/ quality assurance seminars. As new policies are adopted, management personnel are also informed via interoffice memos.

I - B Organization and Personnel

I - B.1 Organizational Chart.

Does the organizational chart clearly show lines of authority and responsibility for major activities of your department?

Example: The organizational chart for the Paint Department of ABC Shipbuilding Company is shown in Attachment 1. The lines of authority and responsibility for major coating activities in the company are clearly shown.

I - B.2 List of names, titles, duties, and job descriptions for key personnel.

Do job descriptions accurately define key positions in management, operations, quality control and safety?

Example: Job descriptions for the Production Operations Manager, Chief Engineer, QA/QC Manager, and Safety Officer are given in Attachment 2. NOTE: Change titles as appropriate.

Do assigned personnel meet job descriptions?

Example: Resumes of the personnel assigned to these jobs are in Attachment 3. As can be seen, the incumbent personnel meet the job descriptions.

I - B.3 Management training courses and career advancement programs attended by staff.

Are supervisory and management training programs for employee training and advancement available?

Example: ABC Shipbuilding Company encourages its management personnel to continue their education through training courses. In the past five years, management personnel have attended courses given by:

American Management Association (AMA)
Community College
Corrosion Control Consultants & Lab
University of Akron
Society of Naval Architects & Marine Engineers SP-3 Panel Surface Preparation & Coatings
Proof-Management, Inc.
KTA-Tator, Inc.
S. G. Pinney & Associates, Inc.
National Association of Corrosion Engineers / NACE International
American National Standards Institute

Do personnel utilize these programs?

Example: Mr. Jones, Manager of the Coatings Section of ABC Shipbuilding, Inc. has a degree in Management from the University of Houston. He has attended various seminars given by the AMA, and the University of Akron, and has recently attended a seminar given by Proof-Management, Inc. on bidding painting contracts. He has also attended the KTA training course. The Assistant Manager to Mr. Jones, Mr. Smith, has 25 years of experience in the coatings industry, and has a degree in Production Management from the University of Pittsburgh. He has attended courses in Painting Production Management sponsored by Carboline and Wisconsin Protective Coatings. He is a NACE Level III Coatings Inspector and qualifies as an ANSI Level III inspector. He has delivered papers on coating-related topics at SSPC, SNAME & NACE local and national meetings.

I - C Administrative and Management Procedures

I - C.1 Financial record keeping method.

Is a job cost accounting system available?

Example: ABC Shipbuilding Company utilizes computerized accounting software including payroll, accounts payable, accounts receivable, and job costing. The purchasing agent utilizes a purchase order number system which contains the project code number. With the numbering system, accurate project costs are compiled on a daily basis. When accounts payable invoices are received, the job number, vendor name, amount, and payment

terms are entered into the computer.

This information is consolidated weekly into a job cost program which includes all labor costs, insurance, taxes, materials, rentals, and all other cost data.

I - C.2 Estimating, scheduling, and job cost accounting procedures.

How are bids prepared?

Example: When bids are prepared upon receipt of an inquiry or a bid notice, the specifications and scope of work are reviewed. If drawings are made available, a quantity take-off is prepared of the surfaces scheduled to receive coatings. An on board visit may be required in the case of an existing marine vessel in order to establish the scope and limits of work. A quantity take-off is then prepared from owner provided marine architect renderings and from a visual perspective.

In either case, areas of work are recapped in the form of total square footage by coating system or by surfaces to be coated. These quantities are then used to estimate material requirements. Labor is determined by using the square footage and any special job conditions which would affect the cost of performance. Equipment is also factored in as required for surface preparation, scaffolding, environmental controls, etc. Labor costs are calculated with local labor rates, applicable insurance, and tax rates. All costs are recapped and a reasonable markup is applied to the project.

Upon award of a project, the owner or his representative will indicate required completion dates. From this information, a job plan is prepared utilizing the man hours from the estimate and required completion dates to derive project manpower loading. Prior to the project start, a project budget is prepared which estimates monthly costs. Actual job costs are compiled and updated on a weekly basis and include labor costs, all accounts payable applicable to the project, and all other associated costs.

These procedures are followed for all bids.

I - C.3 Methods used to review job specifications and other bid documentation.

How does management coordinate the bidding process?

Example: ABC Shipbuilding Company management coordinates the bidding process by reviewing specifications received with the project estimator. Items of significance are highlighted. After the estimate recap is complete and costs are applied by the project estimator, management reviews the estimate and makes any necessary changes.

If awarded a contract, job performance is monitored on a weekly basis by reviewing job costs against the project budget during a meeting of management. A typical job cost summary is appended (Attachment 4).

I - C.4 Procedures for learning about and meeting current federal, state, and local environmental, health, and safety regulations.

Does a program exist to routinely disseminate and implement regulations and requirements?

Example: ABC Shipbuilding Company is cognizant of the changes in environmental, health, safety, and other governmental regulations in the painting industry. It is the responsibility of Mr. White, the Safety Officer, to stay abreast of these changes and ensure prompt

dissemination to all employees. ABC Shipbuilding Company subscribes to the Federal Register and has access to the Center for Hazardous Material Research (CHMR), located in the state university. ABC Shipbuilding Company also ascribes to the Safety programs propounded by the Painting and Decorating Contractors of America (PDCA) and has the PDCA Hazardous Waste Handbook, Safety and Loss Control Manual, and various other publications on file at the home office. Finally ABC Shipbuilding maintains a copy of l Naval Sea Systems Command: Chapter 631, “Preservation of Ships in Service (Surface Preparation Painting) NAVSEA-S9086-VD-STM-000C/H-631, “which contains substantial safety information pertaining to marine coating and surface preparation activities.

As new contracts and/or specifications are received, Mr. White, the Safety Officer, has the responsibility to review these documents for new regulations and to disseminate regulatory information to company personnel.

Mr. White compiles an environmental “package” for each job. In that package, Mr. White includes copies of all pertinent bid regulations as they apply to the job. Mr. White meets with the Project Superintendent/General Foreman and reviews all such project conditions or requirements.

II Technical Capabilities

II - A Personnel Qualifications

II - A.1 Availability of training programs.

Does the company encourage employees to receive sufficient training?

Example: The project lead inspector has at least two years of experience in the coatings industry, and has attended the KTA-Tator, Inc., SGPAI, CCC&L, or equivalent Coatings Inspection Training Course (Level I).

The Project Manager/Superintendent has previous experience and a thorough knowledge of the project specification, surface preparation requirements, and the materials being applied. All personnel are aware of the procedures and restrictions implemented by various governing agencies and are familiar with the company quality control procedures.

All new site QC inspectors are trained in the appropriate procedures prior to job start-up.

CRITICAL ITEM

II - A.2 PROFICIENCY MONITORING OF APPLICATION PERSONNEL.

Is there a system for monitoring the proficiency of application personnel?

Example: The Project Supervisor (or Paint Department Foreman) is responsible for monitoring proficiency of the application personnel. Application & Surface Preparation defects are noted in daily inspection reports/logs. Surface preparation and coating operators are routinely graded against a standardized evaluation checklist of required skills and job knowledge

II - A.3 Qualifications of applicators.

Is there evidence that production personnel are trained and qualified to use required equipment?

Example: All applicators are tested, trained, and qualified on their ability to apply the types of coatings specified. Evidence of this training and a painter qualification record is maintained in the employee's personnel file and is available for examination. The qualification record includes a summary of the applicator's field experience and his experience with generic types of coatings. The applicator is field tested on an ASTM test panel (see Attachment 5) and evaluated by the company's project lead inspector. A periodic re-evaluation is conducted whenever a new coating is encountered. In addition, blast cleaning personnel are required to demonstrate their proficiency on ASTM test plates.

II - B Technical Resources

II - B.1 Industry Associations.

Is the company affiliated with technical societies appropriate to the type of work performed?

Example: ABC Shipbuilding Company maintains affiliations with the following industry organizations:

American Society for Testing & Materials (ASTM)
NACE International (National Association of Corrosion Engineers)
Society of Naval Architects and Marine Engineers (SNAME)
Steel Structures Painting Council (SSPC)

CRITICAL ITEM

II - B.2 TECHNICAL STANDARDS APPROPRIATE FOR QUALITY PAINTING WORK.

What current standards can be found at the company's home office?

Example: The following is a list of typical standards found at ABC Shipbuilding Company's home office:

A. Commonly used manufacturers' current product catalogs
B. SSPC Manuals - Volumes 1 and 2, Current editions
C. Copies of current NACE standards on Surface Preparation
D. Federal Specification TT-490, “Cleaning Methods and Pretreatment of Ferrous Surfaces for Organic Coatings”
E. U. S. Department of the Navy, Naval Sea Systems Command: Chapter 631, “Preservation of Ships in Service (Surface Preparation Painting)” NAVSEA-S9086-VD-STM-000C/H-631
F. Copy of Federal Standard 595 - Standard Colors
G. Journal of Protective Coatings and Linings - June 1984 to Present and Cumulative Index
H. ASTM Volumes 06.01, 06.02, 06.03, and 06.04.

II - C Procedures

CRITICAL ITEM

II - C.1 WRITTEN RECORDS OF JOB SPECIFICATIONS AND REVISIONS.

Does the company keep a written record of job specifications and revisions?

Example: A copy of project contract documents, specifications, field orders, field changes, specification revisions or addenda, work orders, schedules and pertinent documents are maintained at both the contract office and the paint department office. Attached to each item is a sheet showing the distribution of the item (with name and date).

II - C.2 Procedures For Receipt Of Specifications And Revisions.

Is there a procedure for receipt, distribution, and communication of job specifications and their revisions to field operations and quality control?

Example: The ABC Shipbuilding Company Vice President of Operations distributes and communicates to shop/field operations and quality control all project specifications, procedures and updated revisions. Attached to each item is a sheet showing the distribution of the item (name, date, and signature of receipt).

II - C.3 Procedures for clarifying ambiguous specifications.

Is there a process for amplifying, explaining, or clarifying incomplete or ambiguous specifications?

Example: A pre-job meeting is conducted between the company's Vice President of Operations, Project Manager/ Superintendent, and the company's project lead inspector to review the project specifications. During this meeting, ambiguous areas within the specifications are discussed and clarified in writing. All communications or notations beyond what is written in the specifications are documented in writing.

CRITICAL ITEM

II - C.4 PROCEDURES FOR COMMUNICATING SPECIFICATIONS.

Are specifications and job procedures communicated to quality control and production supervisors?

Example: A distribution sheet showing the name, date, and signature of each recipient is attached to each specification and procedure and is signed by both paint department and quality control personnel upon receipt and review of all project specifications, procedures, and revisions. A copy of these sheets is maintained at both the quality control and paint department office.

II - C.5 Communication of job procedures to quality control and production supervisors.

Are there provisions to assure that specifications are kept current in the field?

Example: During quarterly meetings between the home office and key field personnel, project specifications and procedures are reviewed to ensure that work is being performed in

accordance with current specifications and procedures. In addition, if any changes have occurred in the job specification or requirements, these changes are immediately transmitted to the proper site personnel by use of the attached Specification Change Verification Form (Attachment 6). A copy of this form is signed by the site Project Manager, returned to the home office and placed in the job file.

II - D Equipment, Facilities and Experience

II - D.1 MATERIALS THAT YOUR COMPANY HAS APPLIED AND PRODUCTION QUANTITIES.

A) What kinds of materials does your company have experience applying?

Example: Good Paint Co., “Our Best Preconstruction Primer,” inorganic zinc, 100,000 gal. per year
Top Rate Paint Co., “Premium Intermediate,” MIL-24441Epoxy, 50,000 gal. per year
Quality Paint Co., “Hard Coat Finish,” Haze Gray Silicone Alkyd, 80,000 gal. per year

B) What kind of inventory control procedures are used by the painting department?

Example: All coating materials are logged by batch number upon receipt. Only continuous batch numbers are used on a given job. Matching of intermediate and topcoat is made by referring to the master batch numbers at key points during construction.

II - D.2 CURRENT AND RECENTLY COMPLETED INDUSTRIAL PAINTING JOBS (PREVIOUS 12 MONTHS) AND WORK EXPERIENCE.

Can you provide a complete list of all industrial painting jobs (of reasonable duration) in the last 12 months?

Example: Vessel:LCC Tanker 1
Owner Address: Major Oil, Inc., Houston, TX
Contact: John D. Oilman
Work Scope: Remove old AF Coating and Replace same on hull sections of LCC Tanker 1. Repair and recut assorted bilge tanks.
Materials: Good Paint #20-1255 epoxy primer
Applied: Good Paint # 51-338 epoxy lining
Good Paint # 77 Tough Shield IV AF Coating
Equip. Used: 750 Air Compressors; No. 600 Canned Sand Unit; Hopper; 3/4 ton pick up truck; Job trailer; climbers; scaffolding; airless pumps
Types & no. of personnel employed: foreman; 2 blasters; 2 spray painters; 1 helper
Special Safety & Environmental requirements:- standard program for handling and use of AF coatings in effect.
OSHA Safety procedures followed

II - D.3 LIST OF EQUIPMENT OWNED OR LEASED.

List equipment used, its capacity, your inventory system for accessories and system for matching equipment to individual surface preparation or painting tasks.

Example: Compressors, Water-blasters, Forklift, Generator, Trucks, Sandblast Equipment, Stages, Spray Equipment and Accessories.

Example: All equipment is inventoried based on three factors. Type of equipment or accessory, capacity of equipment, and number of samples available for use.

Example: Equipment is matched against manufacturer listed surface preparation or application requirements.

II - D.4 DESCRIPTION OF MAINTENANCE AND REPAIR PROCEDURES.

What record is kept of equipment maintenance?

Example: Mr. Martin, the ABC Shipbuilding Company Equipment Manager for Surface Preparation & Coating, maintains a log of repairs and maintenance performed on all major equipment including:

Compressors
JLGs
Sandblast units
Spider staging and other climbing equipment
Spray units -- conventional and airless
Water-blasters

Vehicle maintenance is performed at an outside garage. Copies of Vehicle Maintenance Records are kept by the office manager.

III Quality Control

III - A Personnel Qualifications
III - A.1 QUALITY CONTROL PERSONNEL.

Is there a qualified supervisor for the quality control program?

Example: The ABC Shipbuilding Company quality control program has a quality control supervisor, Mr. Black, who is knowledgeable in quality control procedures. Mr. Black has been employed in the coatings industry for 15 years. He has been a quality control supervisor for 8 years. Mr. Black has received formal training in quality control from KTA-Tator, Inc., and SGPAI.

Are the qualifications of the coating inspectors properly defined?

All ABC Shipbuilding Company inspectors are minimally qualified as Level I inspectors as defined in ANSI N45.26 - 1978, “Qualifications of Inspection, Examination, and Testing Personnel for Nuclear Power Plants.”Level I personnel have a minimum of two years of experience in equivalent inspection, examination, or testing activities; or are high school graduates with at least six months of related experience in equivalent inspection, examination, or testing activities. All have attended Level I formal quality control training from either NACE, KTA-Tator, SGPAI or CCC&L.

Is there a program available for training and qualifying coatings inspectors, and is it utilized?

Training and qualification programs for ABC Shipbuilding Company inspectors are conducted on an as-needed basis. Training is normally done in-house by our quality control manager, Mr. Black in accordance with ANSI N45.26 - 1978. Training is also available by outside agencies such as KTA-Tator, SGPAI, CCC&L or NACE.

Are coatings inspectors properly trained and experienced?

All ABC Shipbuilding Company coating inspectors have received formal, 3 day, Level I training, in the use of instruments and other essential aspects of inspection (standards, record keeping, communication, etc.). This training is provided either in house by Mr. Black, the ABC QC Supervisor. or by an qualified outside agency. Additionally, they have at least two years of experience in coatings application.

III - B Inspection Procedures and Reporting Systems

CRITICAL ITEM

III - B.1 SYSTEM FOR FILING INSPECTION REPORTS.

Are inspection reports and other required records for compliance with specifications maintained?

Example: Daily Painting Inspection Reports (see Attachment 7) are maintained and signed off by the designated lead inspector (Level III) Individual record books are also maintained by each inspector and foreman. Copies of these reports are maintained on file at both the paint department and quality control office of ABC Shipbuilding Company. The original Daily Report is sent to the Owner/Client's designated Project Engineer.

CRITICAL ITEM

III - B.2 DEMONSTRATION THAT INSPECTION EQUIPMENT AND CALIBRATION STANDARDS ARE AVAILABLE.

Do the inspectors have the necessary inspection equipment and calibration standards available?

Example: ABC Shipbuilding Company inspectors are equipped with the following inspection tools and calibration standards:

a) Sling or Electric Powered Psychrometer
b) Surface Temperature Thermometer
c) Testex Press-O-Film Replica Tape and Spring Micrometer
d) Wet Film Thickness (WFT) Gage
e) Mikrotest or PosiTector Dry Film Thickness (DFT) Gage
f) US Weather Bureau Tables
g) NIST (NBS) Calibration Plates
h) SSPC Visual Standards (SSPC VIS 1-89)
i) Cross-Cut Guide for ASTM D 3359 Adhesion Testing
j) Elcometer Pull-Off Adhesion Meter and Accessories for ASTM D 4541 testing

The inspectors are equipped with other specialized gages as needed.

Calibration of the inspection equipment is performed in accordance with both project specifications and instrument manufacturers' instructions. All calibration records are maintained on file at the paint department and quality control offices of ABC Shipbuilding Company.

CRITICAL ITEM

III - B.3 PROCEDURES TO STOP NON-CONFORMING WORK.

Does the contractor's quality control inspector have the authority to stop work found to be non-conforming?

Example: The designated inspector has the written authority to stop work found to be non-conforming (both during hold point inspections and general inspections) and the responsibility to inform the operating supervisor of non-conforming work. Lines of authority are noted in the company organization chart. Non-conformance and corrective action required and taken are documented by the inspector on the Daily Painting Inspection Report and in the individual daily record book. Examples are available for review.

CRITICAL ITEM

III - B.4 PROCEDURES FOR VERIFYING PROPER COATING APPLICATION.

Is a check made to ensure that proper coating procedures are disseminated and followed?

Example: The ABC Shipbuilding Company coating inspector reviews coating mixing and application procedures prior to start of application and periodically during the project. This confirms that the applicator understands and is following the correct procedures. Applicators are provided with wet film gauges (wft) and foreman take periodic dry film thickness and other quality control checks during the project. Information on thickness measurements, ambient conditions and other quality control checks are recorded daily.

CRITICAL ITEM

III - B.5 PROCEDURES TO ENSURE THAT EACH MAJOR OPERATION (SURFACE PREPARATION, PRIMER, INTERMEDIATE, AND TOPCOAT APPLICATION) IS INSPECTED.

Are inspections conducted during each major operation?

Example: To ensure that surface preparation and coating application are conducted in accordance with the project specification and industry standards, hold point inspections are conducted. The inspector is responsible for witnessing, verifying, inspecting, and documenting the work at the established hold points. Work shall not proceed until the inspector has verified acceptance of these hold points.

a) Pre-surface preparation inspection
b) Measurement of ambient conditions
c) Evaluation of compressed air
d) Determination of surface preparation, cleanliness and profile
e) Observation of coating mixing
f) Determination of dry film and wet film thicknesses
g) Evaluation of surface cleanliness between coats

h) Pinhole and holiday testing (where applicable)
i) Evaluation of adhesion and cure

Documentation of inspection activities are recorded in the daily field book and on the Daily Painting Inspection Reports.

CRITICAL ITEM

III - B.6 PROCEDURES FOR CALIBRATION OF INSPECTION EQUIPMENT.

Do procedures exist for calibrating inspection equipment?

Example: The designated lead inspector (Level I) is responsible for the control of all testing, inspection and measuring equipment. This shall consist of inventory records and the issuing, reclaiming, and storing of equipment. All equipment is given a unique serial number, calibrated, and maintained prior to, during, and after use as appropriate.

The designated lead inspector fills out and maintains a calibration equipment report, maintains files of all equipment calibration certificates, and verifies that equipment is tagged with calibration status.

All equipment is calibrated in accordance with manufacturer's recommendations and in compliance with standard industry practice and the project specifications.

IV SAFETY

IV - A Safety Procedures and Record-Keeping Systems

IV - A.1 DOCUMENTATION OF SAFETY-RELATED ACTIVITY.

Are safety activities, including safety education, job site inspections, safety meetings, and distribution of materials documented at all levels of the organization?

Example: The Project Manager/Superintendent meets on a quarterly basis with the Vice President of Operations to discuss safety concerns and procedures. Documented records of these meetings, including sign-off sheets, are maintained at the ABC Shipbuilding Company home office and on file at the project site office.

Periodically, department correspondence is sent out to the Project Manager/Superintendent (see Attachment 8). This correspondence is kept on file at the project site office.

Periodic employee safety & health training is conducted by knowledgeable persons. A pre-job safety hazard evaluation and weekly tool box safety meetings, unless otherwise stated in the project specification, are conducted at the project site by the Project Manager/Superintendent. Regular site safety and health inspections are conducted by the Project Manager/Superintendent to insure hazard controls remain in place. Copies of these evaluations, meeting minutes, and site inspections are maintained on file at the project site office (see Attachment 9).

A chemical hazard list is available to all employees of ABC Shipbuilding Company on site and posted in the change trailer and at the project site office (see Attachment 10). Records of “Employee

Right to Know" training are also on file at the project site office as well as the home office.

IV - A.2 DOCUMENTATION OF PRE-JOB SAFETY MEETINGS.

Are formal pre-job planning and indoctrination meetings held?

Example: Pre-job planning and safety indoctrination meetings are held prior to the start-up of job operations. A pre-job safety hazard evaluation report is made and a hazard control plan implemented as a result. Documentation of all such meetings and reports is maintained on file both at the home office and the project site office.

IV - A.3 DOCUMENTATION OF ACCIDENT REPORTS.

Are accidents properly investigated and documented?

Example: The Project Manager and Corporate Safety Officer investigate all accidents. The Project Manager/Superintendent submit actual accident reports to the owner/client. Reports include what happened, how it happened, root cause and follow-up actions needed to prevent recurrence. Reports of accidents are maintained on file at both the home office and the project site office (see Attachment 11). Superintendents/Supervisors are required to complete necessary corrective action within a week of the accident.

IV - A.4 PROCEDURE FOR DETERMINING EFFICIENCY OF SAFETY MEASURES.

Is there a system for monitoring the efficiency of the safety and loss control policies of the company?

Example: The senior management of ABC Shipbuilding Company reviews monthly, or as needed, the efficiency of safety and loss control policies. The Company's Safety & Health Program, Experience Modification Rates, total case and lost work days as well as Superintendent/Supervisor safety performance are reviewed at least annually. The Field Safety and Loss Prevention Program established by ABC Shipbuilding Company is used as a guideline (see Attachment 12).

IV - A.5 SAFETY PROCEDURES FOR SPECIALIZED EQUIPMENT.

Are written procedures for safe operation of specialized equipment communicated?

Example: The Project Manager/Superintendent is responsible for verification of the safe operation of all equipment, including specialized equipment. The safe operation of all equipment is reviewed during the weekly safety meetings as well as in field training.

When needed, operating manuals for specialized equipment will be issued to all field personnel. The Project Manager/Superintendent is responsible for initiating and maintaining a Job site Checklist (see Attachment 13). This checklist covers all safety aspects of the project as well as equipment safety. A copy of this checklist is kept on file in the project site office.

IV - A.6 PROVISION AND MAINTENANCE OF PERSONAL PROTECTIVE EQUIPMENT.

Is personal protective equipment issued and means of maintenance provided?

Example: The Project Manager/Superintendent is responsible for purchasing, issuing, and maintaining personal protective equipment. All items, such as respirators and cartridges, are NIOSH/MSHA approved. When it's determined in pre-job safety planning by the

Company's Safety Officer that respirators are required, the ABC Shipbuilding Company's Respirator Program is put into practice (see Attachment 14) based on specific job requirements.

IV - A.7 AVAILABILITY OF FIRST-AID TRAINED EMPLOYEES.

Are first-aid trained employees present on all project sites?

Example: The Project Manager/Superintendent, Field Foreman, and at least one individual in each painting crew are properly trained and certified in CPR. These personnel also attend an approved Red Cross training seminar. Documentation of class attendance and copies of certifications are maintained at both the home office and at the project site office. Each project site office is equipped with physician approved first-aid supplies. Emergency medical procedures are posted at project site.

IV - A.8 PROCEDURES FOR ENFORCEMENT OF SAFETY RULES.

How are safety rules enforced?

Example: The Project Manager/Superintendent and Field Foreman are responsible for the enforcement of the Company's Safety Program which is based on applicable portions of 29CFR1926 (OSHA Construction Industry Standards).

The following safety policies are distributed to each employee and posted in the project site office and the change trailers:

Hard hat and safety glasses will be worn at all times while employees are in designated work areas. Failure to comply will result in the following:

First Offense -	Verbal Warning
Second Offense -	Written Warning
Third Offense -	Time Off Without Pay
Fourth Offense -	Termination

Where respirators and hearing protection are required, employees will at all times wear respirators or use hearing protection. Failure to comply will result in the following:

First Offense -	Written Warning
Second Offense -	Time Off Without Pay
Third Offense -	Termination

IV - B Resource Materials

IV - B.1 AVAILABLE SAFETY RESOURCE MATERIALS.

What safety resource materials are readily available?

Example: ASA Safety Handbook
OSHA Safety and Health Standards for the Construction Industry (29 CFR 1926/1910), OSHA 2207, Current Edition
SSPC Painting Manual (Vol. I), Current Edition
Naval Sea Systems Command: Chapter 631, “Preservation of Ships in Service (Surface Preparation Painting) NAVSEA-S9086-VD-STM-000C/H-631, “

IV - B.2 SOURCES OF INFORMATION ON SAFETY REQUIREMENTS.

What other sources of information about safety does your company use?

Example: State University of My State - Center for Hazardous Material Research (CHMR) OSHA Client Safety Programs

IV - B.3 PROCEDURES FOR ACQUIRING SAFETY INFORMATION AND MATERIALS.
How does your company gather material on safety issues?

Example: ABC Shipbuilding Company maintains revised editions of OSHA Publication 2207, OSHA Safety and Health Standards (29 CFR 1926/1910);

Our Safety Manager, Mr. Smith, and other personnel regularly attend industry seminars and tutorials offered by the SSPC, PDCA, OSHA Training Institute, AGC, local Safety Councils or other industry groups in Safety matters;

Our Safety Manager, Mr. Smith, regularly reviews industry journals (e.g. Applicator Training Bulletins and safety articles in the JPCL) and other industry newsletters and equipment manufacturers bulletins for information on new and current safety procedures.

All relevant Material Safety Data Sheets (MSDS) are reviewed prior to job start up.

IV - B.4 AVAILABILITY OF SAFETY INFORMATION MENTIONED IN
ITEM 40.

Example: How accessible are the safety resource materials mentioned in Item 40?

All safety information is kept on file in a central location in the ABC Shipbuilding Company home office, and is available to all personnel to review.

V STANDARD OPERATING PROCEDURES

V - A SOPS IN USE

V - A.1 AVAILABILITY OF STANDARD OPERATING PROCEDURES

Are copies of standard operating procedures available?

Example: The paint department keeps copies of standard operating procedures on hand for all procedures described above. In addition any custom procedures developed during or for an individual job are also recorded and filed in the paint department office.

July 10, 1995

Attachment 2 Slides for Train the Trainer Sessions

Report On A Shipyard Surface Preparation & Quality Program

Drs. Simon K. Boocock & Bernard R. Appleman,
Steel Structures Painting Council

A report prepared for the National Shipbuilding Research Program Under Project 3-90-2

Introduction

- Sponsored by the National Shipbuilding Research Program
  - Technical Support from the Society of Naval Architects & Marine Engineers
    - Created by the SSPC

Stages of a Quality Program

- Phase I - Planning for Quality
- Phase II - Organizing for Quality
- Phase III - Monitoring for Quality

Goals of A Quality Program

- Meeting the Customer Requirements
  - Standards & Specifications
- Reducing Waste
- Improving Production Efficiency

Planning for Quality

- Identify Output
- Identify Customer
- Identify Customer Requirements
- Translate Requirements Into Supplier Specifications

Meeting Customer Requirements

- Phase I - Planning for Quality
- objectives and use of engineering standards & coating specs
- components and types of specs
- sources of performance data for qualifying coatings
- development of coating specification

Engineering Standard for Painting

- objectives and use
- components

Components of an Engineering Standard

- scope
  - items not addressed
- surface preparation standards and methods
- materials selection
  - qualified products list
- quality control requirements
  - miscellaneous information

Objectives of Painting System Specifications

- legal document
- working document
- requires thorough planning
- practical document
- overall intent - communicate project instructions

Questions Answered by a Proper Coating Specification

- What surfaces are to be coated?
- What coating system will be used?
- What is the contractor to supply?
- Who will supply coating materials?
- How will coating materials be delivered?

Questions Answered by a Proper Coating Specification (cont'd.)

- What surface preparation is required?
- What are Weather condition restrictions?
- How is coating applied?
- What are the thickness and drying requirements?
- What inspection is required?

Components of Painting System Specifications

- general requirements
- special (paint) requirements

General Requirements

- scope of work
- description/location of project
- supervision by contractor
- safety
- use of premises; removal of debris/cleaning
- working conditions

General Requirements (cont'd.)

- protection of surrounding properties and facilities
- traffic control
- ventilation and lighting
- delivery schedule

Special Paint Requirements

- references
- materials
- labor & equipment
- surface preparation

Special Paint Requirements (cont'd.)

- coating materials
- coating application
- inspection
- first anniversary inspection

Classifications of Coating Specifications

- qualified products list
- product name
- product name or approved equal
- coating formula
- performance

Developing Specific Requirements

- reference documents
- contractor's responsibilities
- surface preparation requirements
- generic coating systems and approved suppliers
- abrasive type and approved suppliers
- coating application procedures
- inspection/documentation requirements

Organize for Quality

- Identify Steps in Work Process
- Select Measurements
- Determine Process Capability

Identify Steps in Work Process

- Simple Task Descriptions
- Include Alternatives & Contingency Plans
- Include Problem Resolution
- Decide on Work Methods

Identifying Coating Application Alternatives

- limits on spray due to local ordinance
- limits on brush/roll due to formulation

Identifying Surface Preparation Alternatives

- cleanliness
- roughness (profile)
- abrasive

Fixed Facility-Applied System

- advantages
  - greater control over environment
  - accessibility improved
  - high degree of surface preparation
  - thorough inspection opportunity

Fixed Facility-Applied System

- disadvantages
  - faying surfaces (slip and creep)
  - shipping/erection damage
  - application skill level in shop
  - limited shop floor space hurries production
  - other

Shop Prime/Ship Topcoat

- combines advantages of total field and total shop painting
- limitations
  - on-board touch-up of primer
  - on-board welding damage
  - confusion over responsibility for touch-up

Steel Fabrication Shop Operations

- standard practices
- equipment for blast cleaning
- equipment for coating application

Standard Practices

- surface preparation
- solvent cleaning
- grinding
- coating application

Equipment for Blast Cleaning

- centrifugal blast cleaning
- blast room/open nozzle blast cleaning
- abrasive media

Equipment for Coating Application

- airless spray
- plural component spray
- conventional (air atomizing) spray
- brush/roller

Decide on Measurements

- inspection of welds
- inspection of grinding procedures
  - welds
  - weld spatter
  - sharp edges

Decide on Measurments (cont'd.)

- determination of ambient conditions
- inspection of abrasive material - MIL-22262
  - oil
  - chloride/sulfate
- inspection of surface preparation
  - surface cleanliness - visual standards
  - surface profile - profilometer or replica tape

SSPC Surface Preparation Specs

- SSPC-SP 1, "Solvent Cleaning"
- SSPC-SP 2, "Hand Tool Cleaning"
- SSPC-SP 3, "Power Tool Cleaning"
- SSPC-SP 11, "Power Tool Cleaning to Bare Metal minimum 1.0 mil profile
- SSPC-Vis 1 89

Inspection Instruments and Procedures (cont'd.)

- coating mixing, thinning, and application
  - receipt inspection of materials
  - record of manufacturer product number, batch number, shelf life
  - mixing
  - induction time

Inspection Instruments and Procedures (cont'd.)

- coating mixing, thinning, and application
  - thinning
  - pot life
  - application technique

Inspection Instruments & Procedures

- coating thickness
  - wet film thickness
- non-destructive dry film thickness
  - type I
  - type II
- destructive dry film thickness

SSPC-PA 2, "Standard Method for Measurement of Dry Paint Thickness Using Magnetic Gages"

- Provides a clear quantitative reading
  - Often misunderstood
- Measures paint film over a magnetic mean

Inspection Instruments and Procedures (cont'd.)

- determination of cure
- holiday detection
  - low voltage
  - high voltage

Inspection Instruments and Procedures (cont'd.)

- adhesion testing
  - shear (knife) adhesion
  - tensile adhesion

Sequence of Operations and Scheduling of Painting Activities

- computerized scheduling
  - sample wall chart
- sequence work with other trades
  - sequence blast cleaning and coating operations

Monitoring for Quality

- Evaluation of Results
- Analysis of Quality Measurements
- Examination of New Problems

Surface Preparation Problems

- Surface Profile
- Level of Cleanliness
- Rust-Back

Coatings Problems

- during application
  - low film build
  - poor mixing
  - viscosity
  - bubbles, blisters

Coatings Problems (cont'd.)

- during application
  - non-drying/hardening
  - non-flowing/leveling
  - color

Coatings Problems (cont'd.)

- after application
  - premature corrosion
  - blistering
  - peeling/disbonding

Periodic Monitoring & Inspection

- establish rules for coordination
  - preliminary checks
  - inspection before repair and surface preparation
  - inspection during and after paint application
- final inspections
  - anticipate things that can go wrong

Anticipate Problems

- spec disagreements
  - non-uniformity of color/appearance
- interruptions from outside factors
  - weather variability
  - equipment malfunctions
- under estimation
- environmental, health, safety problems

Coating Failures

- definition and consequences of coating failure
- types and causes of failure
- methods for analyzing failure
- responsibilities of various parties to avoid or rectify failure

Consequences of Coating Failure

- substrate repair or replacement
- field repair of shop system
- down time
- product contamination
- aesthetics

Recognizing and Reporting Coating Failure

- determining whether failure occurred
- isolated failure
- aesthetics
- catastrophic failure compromising structural integrity
- who informs the owner of a failure
- action to take (if any)

Causes of Failure

- batch deficiencies
- specification error
- contractor error
- inaccurately defined service environment

Determine the Causes of Failure

- data collection and documentation
- field investigation
- analysis

Data Collection & Documentation

- obtain copy of the spec
- obtain construction sequence
- obtain structure history
- obtain painting history
- determine what equipment was used

Data Collection & Documentation (cont'd.)

- determine if problems were encountered
- review inspection documents

Specific Causes of Failure

- unsuitable coating material
- incompatibility
- surface preparation/application deficiencies
- design deficiencies

Unsuitable Coating Material

- unsuitable for service environment
- improperly formulated
- review manufacturer's product data thoroughly
- perform accelerated weathering

Incompatibility

- generic types inaccurately specified
- combining two or more manufacturers in a system

Types of Coating Failures

- bleeding
- blistering
  - osmotic
  - electro osmotic
- flaking
- scaling

Types of Failure (cont'd.)

- intercoat delamination
- peeling
- pinholing

Causes of Delamination

- underlying coat insoluble
- moisture
- chalking
- expansion/contraction of dissimilar coatings

Causes of Peeling

- surface contamination
- smooth substrate
- excessive coating thickness

Causes of Pinholing

- improper solvent balance
- improper spray atomization/application
- surface defects
- porous undercoat (e.g.,inorganic zinc)

Types of Coating Failures (cont'd.)

- pinpoint rusting
- undercutting
- blushing
- cratering
- holidays

Causes of Wrinkling

- excessive thickness
- improper drier mixture

Types of Failures (cont'd.)

- wrinkling
- chalking
- erosion
- discoloration

Causes of Discoloration

- light sensitive resin (UV)
- excessive heat
- reaction of vehicle with service environment
- sulfide staining

Types of Failure (cont'd.)

- checking
- cracking
- alligatoring
- mudcracking

Causes of Checking

- uneven coating stresses
- reaction of binder to oxygen/moisture in air

Causes of Cracking

- coating stress
- substrate expansion/contraction
- excessive coating thickness

Causes of Alligatoring

- inflexible coating over soft coating
- substrate/coating surface temperature differences

Causes of Mudcracking

- highly pigmented coating applied at excessive thicknesses
- rapid drying
- improper curing
- example: inorganic zinc

Quality Program Tools

- Quality Improvement Process
- Problem Solving Process

Quality Program Tools

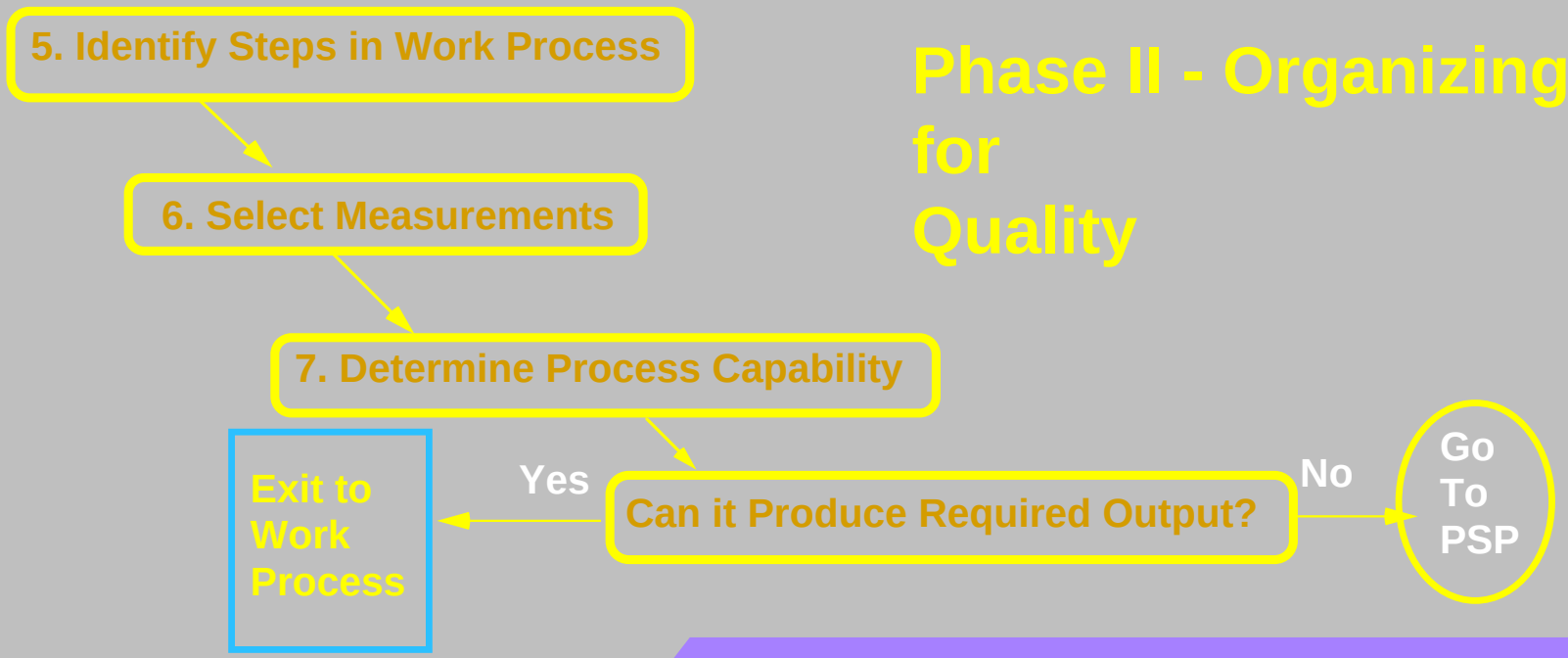
- **Quality Improvement Process**
- Problem Solving Process

Quality Improvement Process

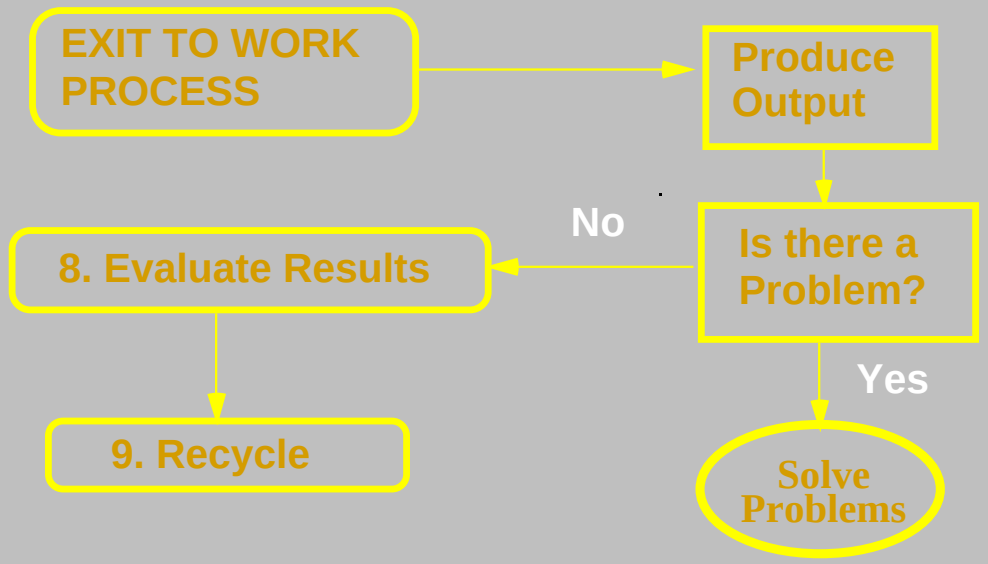
Phase I - Planning for Quality

1. Identify Output
2. Identify Customer
3. Identify Customer Requirements
4. Translate Requirements into Supplier Specifications

Quality Improvement Process (Ctd.)



Quality Improvement Process (Ctd.)

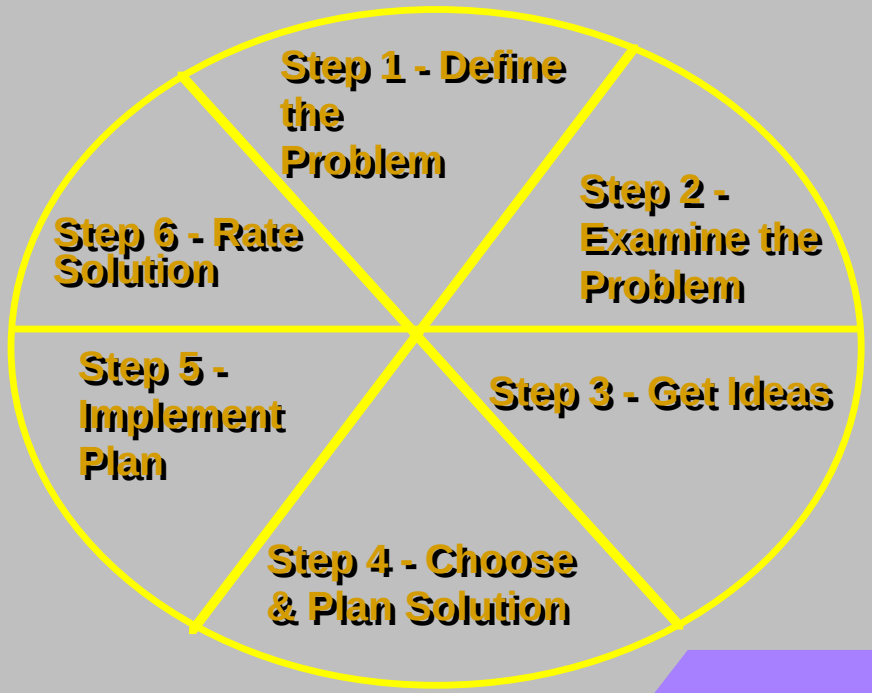


Phase III - Monitoring for Quality

Quality Program Tools

- Quality Improvement Process
- Problem Solving Process

Problem Solving Wheel



Quality Measurements - DFT Errors

Attributable Cause	Frequency %
High Profile	45
Applicator Error	15
Gage Calibration Error	25
Other	15

Quality Measurements - Surface Preparation

Measure of Quality	Fails to Pass	Passes
Profile is Correct	//// /	
Meets Visual Standard	///	
Remains Rust Free before Painting		
Totals	//// ////	//// //// //// //// /

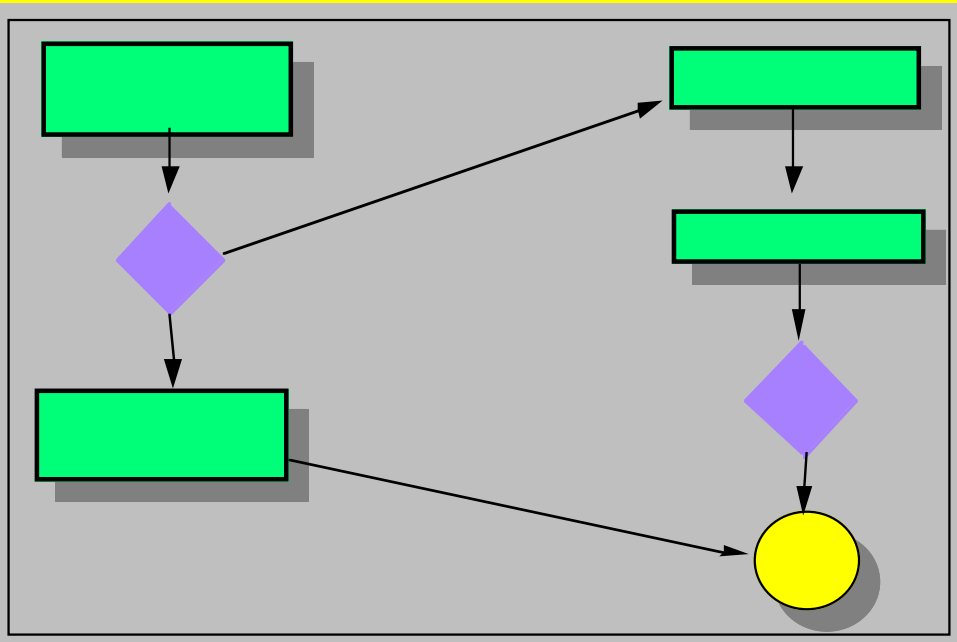
Quality Measurements - DFT Measurements

Material Specified	DFT Range/mils	DFT SSPC-PA 2/mils
Epoxy Primer	2.0 - 4.0	2.0
Epoxy Primer	2.0 - 4.0	3.0
Epoxy Primer	2.0 - 4.0	3.2
Epoxy Primer	2.0 - 4.0	3.5

Quality Measurements - Summary Checklist

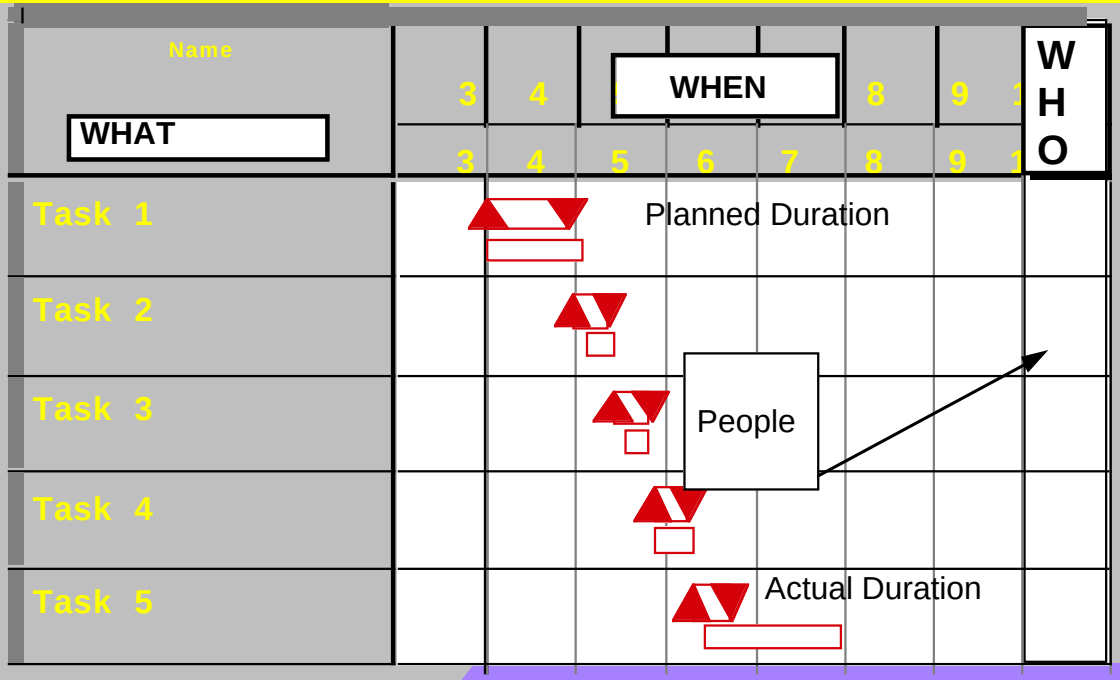
Measure of Quality	Fails to Pass	Pass to Fail Ratio
Profile is Correct	//// /	24:6
Meets Visual Standard	///	27:3
Remains Rust Free before Painting		30:0
Totals	//// ///	//// //// //// //// /

Quality Tools - Planning



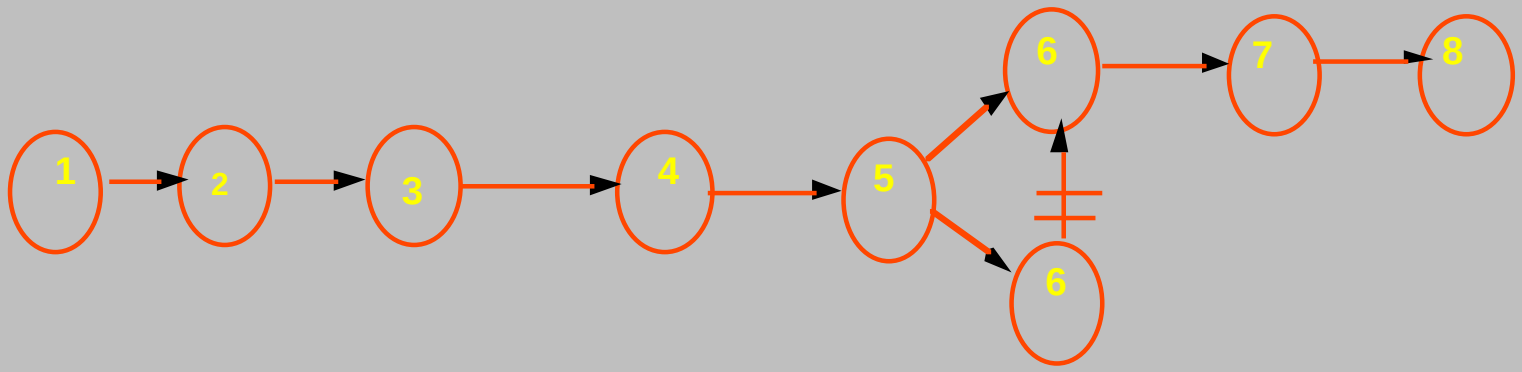
Planning Tools - Flowchart

Quality Tools - Planning



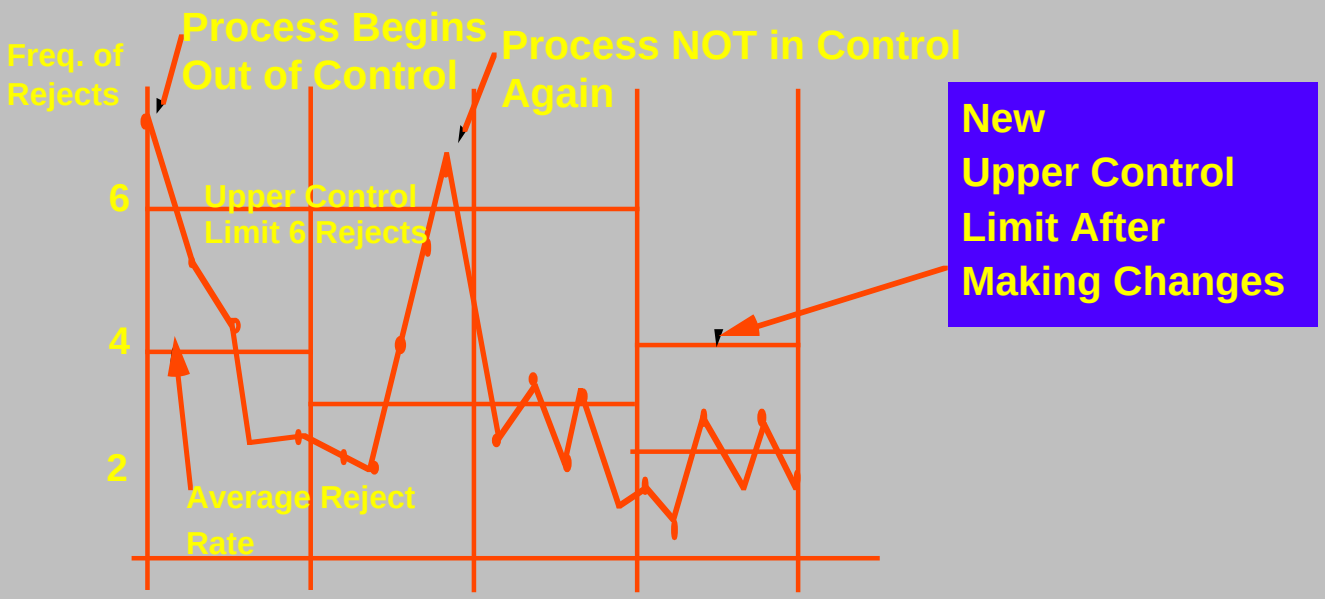
Planning Tools - Gannt Charts

Quality Tools - Planning

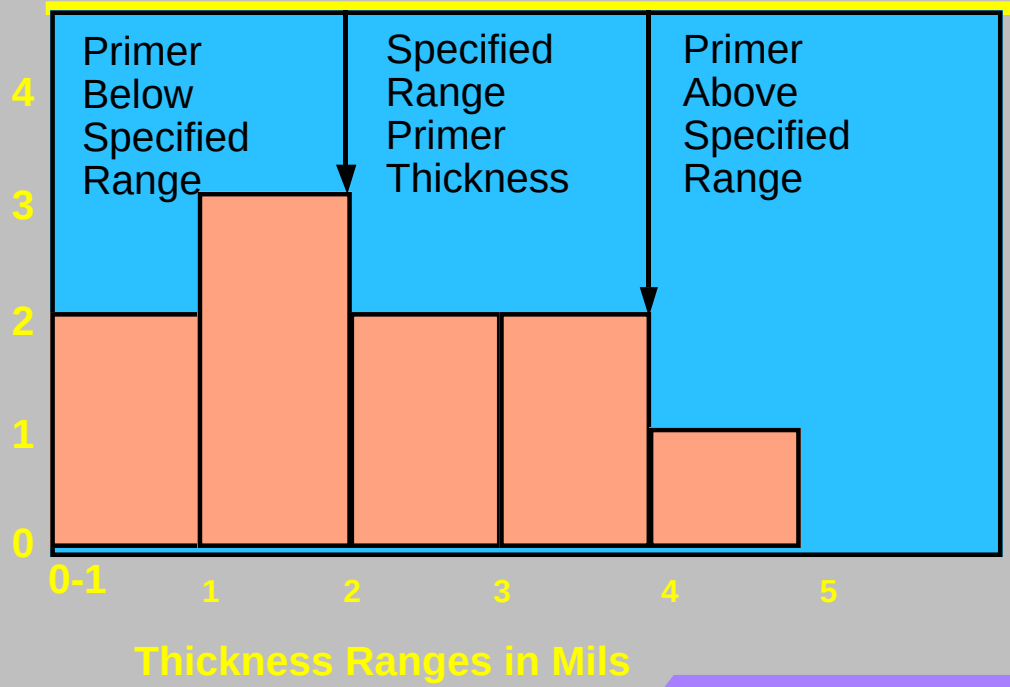


Planning Tools - PERT Charts

Quality Tools - Measurements

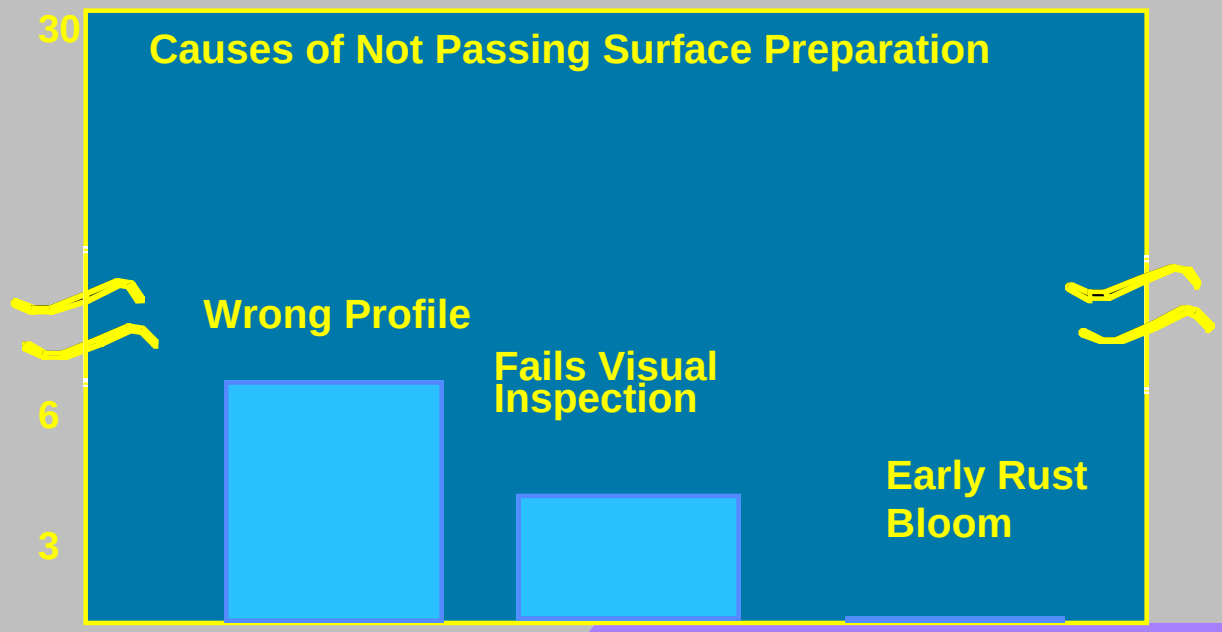


Quality Tools - Measurements



Quality Measurements - Histogram

Quality Tools - Measurement



Quality Measurements - Pareto

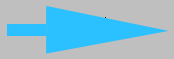
Quality Process-Step1

Identify Output → **Paint this Ship**

What is to be done?
How is it produced?

Quality Process-Step 2

Identify Customer



Mega Oil Company

For whom is it done?

Quality Process-Step 3

Identify Customer Needs

What Does the Customer Want?

Mega Oil wants their ship in and out of dock by sunrise two weeks from today.

The ship will get painted red above boottops black on the hull, and blue on the super-structure

Mega has a budget of $ 500,000.

Mega wants a two year warantee against corrosion

Quality Program-Step 4

Translate Requirements into Specifications

What precisely is needed ?

Surface Preparations
SSPC-SP 2 Superstructure

SSPC-SP 6 Boottop

Coating Systems
Colors
Thicknesses
Materials

Quality Program-Step 5

Map Out the Work Process

1. Order consumables - see order list
2. Check Equipment Inventory
3. Check Labor Pool
4. Get Materials to Site
5. Prepare each surface as required
6. Apply primer coats
7. Apply Intermediate Coat if needed
8. Apply Topcoat Specified

How will this be done?

By Whom?

With What?

Quality Program-Step 6

Determine Process Capability

Does the Work Process give the Customer What They Want?

Prepare small color samples of topcoats for customer approval.

Previous experience suggests Power Tool Cleaning may not give the two year rust free finish. Customer approval of alternative approach, SSPC SP 7 Blasting is sought and obtained.

Ask others how the high pressure water washing helps in preparing boottops.

Quality Program-Step 7

Select Measurements

Customer approves paint supplier?

Customer approves colors from supplier?

Surface Preparation meets specification (Refer to VIS-1 89?)

Primer application meets customer specification (Check per SSPC-PA 2 or ASTM D 1186)

Quality Program-Step 7.1

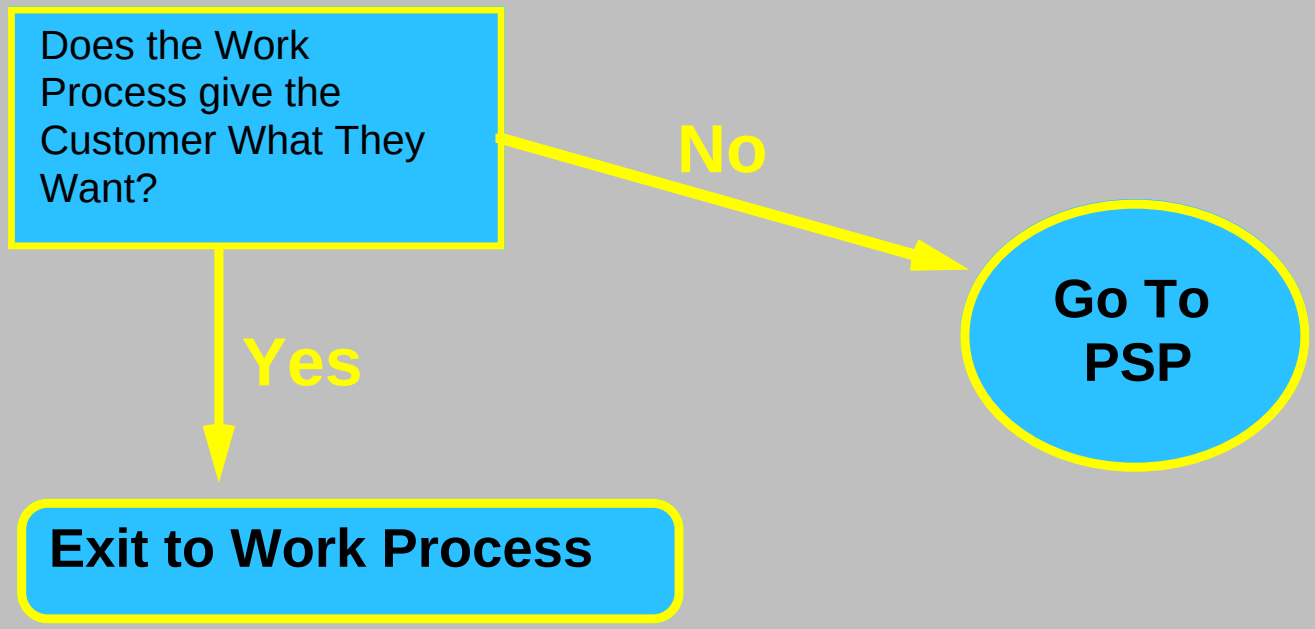
Select Measurements

Topcoat application meets customer needs?
(Check per SSPC-PA 2)

Job on track for Sunrise 2 weeks from today?
Check Gannt Chart

Amount of Paint/Equipment OK for tasks?

Quality Program-Step 7.2



Quality Program-Step 8

Evaluate Results

For each job the Paint Department asks:

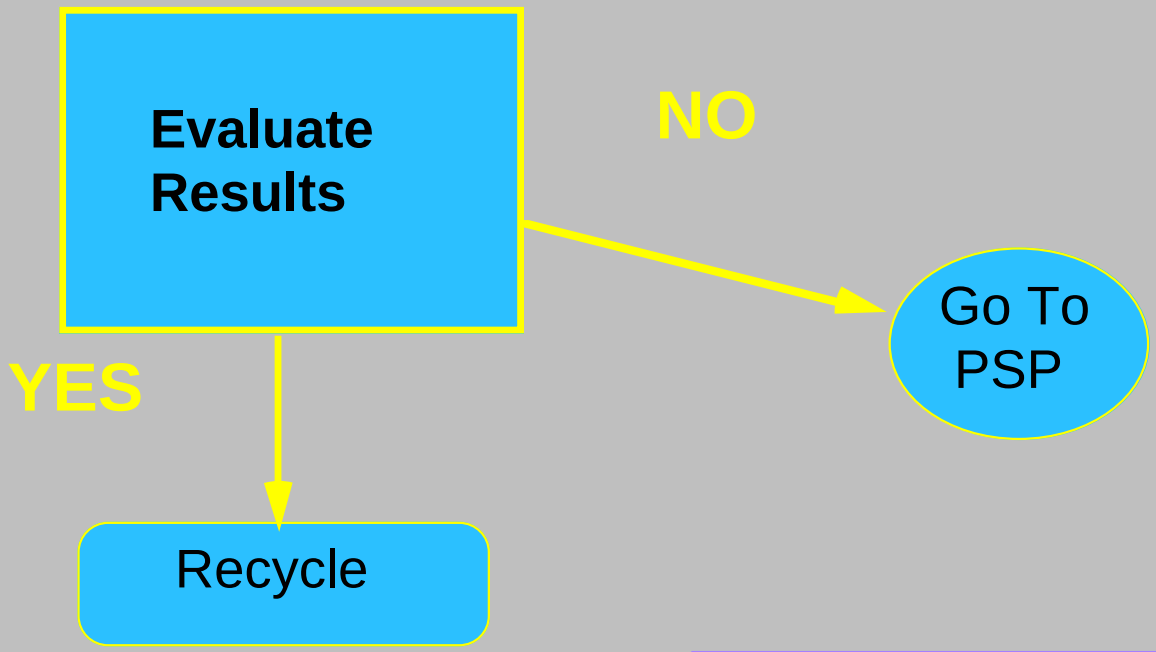
- **Any evidence that surface preparation was below specification?**
- **Any evidence that coating application did not meet specification?**
- **Did the paint cover as hoped?**

Quality Program-Step 8.1

Evaluate Results

- **Did the work get done within schedule - quickly enough?**
- **Did the work get done within our estimate for labor and material costs?**
- **Will Mega recommend us for other jobs?**

Quality Program-Step 9



July 10, 1995

Attachment 3 Trainers Overheads for Training Sessions

Report On A Shipyard Surface Preparation & Quality Program

Drs. Simon K. Boocock & Bernard R. Appleman,
Steel Structures Painting Council

A report prepared for the National Shipbuilding Research Program Under Project 3-90-2

The Evaluation Checklist for Deckplate Personnel

- Surface Preparation Skills and Knowledge;
- Painting Skills and Knowledge;
- Quality Assurance Skills and Awareness;
- Safety - applied to both surface preparation and painting operations;
- NOTE - SAFETY ISSUES ARE INCLUDED FOR INFORMATION ONLY - SAFETY TRAINING IS THE RESPONSIBILITY OF THE SAFETY DEPARTMENT AT SHIPYARDS.

Quality Assurance - Identifying or recognizing a defect exists;

- Surface Preparation - to ready the prior defect area for repair;
- Painting - choice and application of the correct repair material.

Use of Evaluation Checklists

- Suggested Use 1 - In conjunction with Industrial Painters Training Curriculum Modules as Module Visuals
- Suggested Use 2 - For Presentation in Overview of the NSRP Surface Preparation and Coating Handbook (hereinafter called the manual).
- Method of Use Suggestion 1 - Several Continous Sessions of Training
- Method of Use Suggestion 2 - To Accompany Short Module by Module Training Sessions
    - Note - Criteria Modules are Identified by Numbers 1 through 20

Questions and Criteria for Deckplate Personnel

- 1. Mechanics can check ambient conditions prior to start of work, using appropriate instruments.
- (a) Can accurately read air temperature using psychrometer or thermometer;
- (b) Can determine humidity by reading hygrometer or hygrograph (if available) or determine from sling psychrometer;
- (c) Can properly use and accurately read standard surface temperature thermometer or digital thermometer;
- (d) Can use sling psychrometer (including charts) or digital psychrometer.

2. Mechanics and SP-1 Cleaning methods.

- Specification Compliance
- (a) Visually inspect likely sites for:
  - oil and grease contamination;
  - moisture, especially when air temperature and dew-point approach the 5°F difference threshhold;
  - abrasive dusts and misc. soil.
- (b) Can remove soluble salts as directed using wet blasting methods with and without abrasives.

2. Mechanics and SP-1 Cleaning methods.

- Safety
  - (c) Notes that no smoking and or no welding signs present during solvent cleaning.
  - (d) Wears appropriate personal protective equipment, e.g. gloves, organic vapor respirator, safety goggles, rubberized shoes etc.
  - NOTE - SAFETY ISSUES ARE INCLUDED FOR INFORMATION ONLY - SAFETY TRAINING IS THE RESPONSIBILITY OF THE SAFETY DEPARTMENT AT SHIPYARDS.

3. Mechanics and Surface Imperfections

- (a)Can identify and correct, using the proper tools for the job:
  - weld spatter
  - sharp edges
  - slivers, gouges, cuts in surface
  - excessive surface roughness

4. Mechanics and Masking

- (a) Can demonstrate proper use of materials and techniques to minimize overspray to areas adjacent to work piece.

5. Mechanics and SP-2 Cleaning.

- (a) Use
  - - Using proper tools for the job, can demonstrate the techniques of SP-2 in removal of loose mill scale, loose rust,loose paint and other non-adhering materials.
- (b) Safety
  - - Wears Personal Protective Equipment as needed for application, e.g. gloves, eye protection, dust mask or respirator.
  - NOTE - SAFETY ISSUES ARE INCLUDED FOR INFORMATION ONLY - SAFETY TRAINING IS THE RESPONSIBILITY OF THE SAFETY DEPARTMENT AT SHIPYARDS.

6. Mechanics and SP-3 Cleaning.

- (a) Use
- -Using proper tools for the job, can demonstrate the techniques of SP-3 in removal of loose mill scale, loose rust,loose paint and other non-adhering materials.
- -Demonstrates knowledge of correct chce of media for each surface preparation specification.

6. Mechanics and SP-3 Cleaning.

- (b) Safety
- - Wears personal protective equipment appropriate for application, e.g. gloves, eye protection, ear plugs, dust mask or respirator.
- - For air powered tools has hoses clear and untangled, avoiding tripping hazard.
- - For electric powered tools has electric cords clear and untangled, avoiding a tripping hazard. Has correctly grounded tools.
- -Uses non-sparking media if appropriate, e.g. in presence of near other painting activites.
- NOTE - SAFETY ISSUES ARE INCLUDED FOR INFORMATION ONLY - SAFETY TRAINING IS THE RESPONSIBILITY OF THE SAFETY DEPARTMENT AT SHIPYARDS.

6. Mechanics and SP-3 Cleaning.

- (c) Maintenance
- - Has a maintenance schedule for replacing abrasive media or working components in power tools.
- (c) Maintenance
- - Has a maintenance schedule for replacing abrasive media or working components in power tools.

7. Mechanics and SP-11 Cleaning.

- (a) Use
- - Using proper tools for the job, can safely demonstrate the techniques of SP-11 in cleaning substrate to bare metal whileassuring proper surface profile.

7. Mechanics and SP-11 Cleaning.

- (b) Safety
- - Wears personal protective equipment appropriate for application, e.g. gloves, eye protection, ear plugs, dust mask or respirator.
- - For air powered tools has hoses clear and untangled, avoiding tripping hazard.
- - For electric powered tools has electric cords clear and untangled, avoiding a tripping hazard.Has correctly grounded tools.
- -Uses non-sparking media if appropriate, e.g. in presence of near other painting activites.
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7. Mechanics and SP-11 Cleaning.

- (c) Maintenance
- - Has a maintenance schedule for replacing abrasive media or working components in power tools.

8. Mechanics and Abrasive Blasting Equipment.

- basic set-up
- breathing apparatus and other safety equipment
- blotter test and abrasive cleanliness
- adjust abrasive metering valve and check nozzle pressure
- techniques for efficient operation
- achieving and measuring surface profile for compliance with specification using replica tape and/or Keane-Tator Profile Comparator

8. Mechanics and Abrasive Blasting Equipment.

- (a) Can identify basic parts and explain function of each.
  - - Air compressor (provides air at appropriate pressure and volume)
  - - Blasting machine (container which holds abrasive; valve at bottom controls amount of abrasive fed into blast hose)
- - Blast Hose (carries air/abrasive mix from blast pot to nozzle)
- - Air Hose (carries air from compressor to blast pot)
- - Nozzle (concentrates air/abrasive mix onto work area)

8. Mechanics and Abrasive Blasting Equipment.

- (b) Set-up
  - - Oil and water traps on compressor monitored to assure air cleanliness
  - - Compressor located as close to blast pot as possible
  - - Air hose largest ID as possible
  - - Blotter test conducted and properly interpreted

8. Mechanics and Abrasive Blasting Equipment.

- (b) Set-up
  - - Blast hose largest ID as possible
  - - Blast hose as short in length as possible
  - - Abrasive metering valve adjusted
  - - Abrasive cleanliness test conducted

8. Mechanics and Abrasive Blasting Equipment.

- (b) Set-up
  - - Nozzle length as long as possible
  - - Nozzle grounded to prevent static electricity discharge
  - - Nozzle pressure checked using hypodermic needle gauge
  - - Hose runs as straight as possible

8. Mechanics and Abrasive Blasting Equipment.

- (c) Use
- - Correct nozzle-to-surface distance used for job conditions (e.g.,6" for removal of tight mill scale, 18" for removal of old paint)
- - Correct angle of attack used for job conditions (e.g., 60° - 70°for general cleaning, 80° - 90° for tight rust and mill scale; slight downward angle to direct dust away from operator)
- - Straight passes used; no "arcing"
- - Size of area to be blasted not more than can be primed the same day
- - Profile height checked using Keane-Tator or other comparator

8. Mechanics and Abrasive Blasting Equipment.

- (d) Safety
  - - Protective clothing, respirator, ear, and eye protection devices worn
  - - Adequate ventilation assured
  - - Blast nozzle pointed only at surface to be cleaned, and deadman valve used
  - - Safety belts and lines used
  - - Maintains correct pressure within operational limits off equipment.
  - - Checks hoses for wear to avoid hose rupture.
  - - Grounding of Hoses and Fittings in Place
- NOTE - SAFETY TRAINING IS THE RESPONSIBILITY OF THE SAFETY DEPARTMENT AT SHIPYARDS.

8. Mechanics and Abrasive Blasting Equipment.

- (e) Quality Assurance
  - - Can check abrasive for oil and other contaminants
    SSPC publication 91-12 and SSPC-AB 1

9. Mechanics and visual surface preparation standards.

- (a) From a given initial rust grade or surface condition, can clean steel to the Vis-1-89 standard required in the job specification.

10. Mechanics and Brush or Roller Application.

- (a) Brush
  - - Unattached bristles shaken loose and stray bristles snapped off
  - - Brush dipped into paint covering no more than 1/3 of bristlelength; excess paint removed by tapping brush against side of can
  - - Light touch using tips of bristles
    - - Work from dry to wet surface
  - - Second coat applied at right angles to first coat
  - - Proper clean-up and storage

10. Mechanics and Brush or Roller Application.

- (b) Roller
- - For thick-bodied coatings, roller dipped directly into paint container; for thin-bodied coatings, roller dipped into roller tray.
- - When using new roller, first load rolled onto scrap paper to eliminate air bubbles in fibers
- - Roll paint out in a V or W shape, then roll to fill in the square area. Finish with light vertical strokes in the direction producing the smoothest finish.
- - Use moderate pressure
- - Second coat applied at right angle to first
- - Clean-up and storage (Clean paint tray and fill partially with solvent. Work roller out on newspaper until most paint removed. Dip roller in solvent and roll on tray ramp to work in; roll out on newspaper until all solvent removed.
- Repeat twice more. Stand roller on one end until dry. Properly dispose of paper used in cleaning.)

10. Mechanics and Mitt Application

- (c) Mitt
  - - Uses appropriate mitts for solvent borne or water borne paints, e.g. lambswool for solvent borne, lambswool or synthetic for water borne paints.
  - - Always uses a mitt liner compatible with paint to be applied, e.g. non-swelling rubber liner.
  - - Can achieve a smooth mitt applied finish on cylindrical or complex surfaces, e.g. handrails or lattice work steel.

10. Mechanics Brush, Roll & Mitt Application

- (d) Safety
  - - Wears appropriate personal protective gear, e.g. respirator, safety goggles, gloves, non-sparking boots etc.
  - NOTE - SAFETY ISSUES ARE INCLUDED FOR INFORMATION ONLY - SAFETY TRAINING IS THE RESPONSIBILITY OF THE SAFETY DEPARTMENT AT SHIPYARDS.

11. Mechanics and Conventional Spray Equipment

- basic set up
- adjusting air and paint pressure
- selecting proper tip and other devices
- safety precautions
- proper spraying techniques
- proper shut-down and cleaning techniques

11. Mechanics and Conventional Spray Equipment

- (a)Can identify basic parts and explain function of each.
  - - Air compressor (supplies air at proper pressure and volume to assure proper operation of spray gun)
  - - Paint tank (holds material)
  - - Air Hose (carries compressed air to gun)

11. Mechanics and Conventional Spray Equipment

- (a)Can identify basic parts and explain function of each.
  - - Fluid Hose (carries material from paint tank to spray gun)
  - - Spray Gun (applies material to work surface) - (See drawing in manual.)
  - - air cap (directs compressed air into paint stream, atomizing it and directing it onto the work surface)
  - - tip or fluid nozzle (regulates paint flow and directs it into compressed air stream)
  - -fluid needle (starts or stops fluid flow through fluid nozzle; fluid needle and fluid nozzle must be same size)

11. Mechanics and Conventional Spray Equipment

- (a) Can identify basic parts and explain function of each.
  - - trigger (operates air valve and fluid needle)
  - - fluid adjustment screw (controls fluid needle and adjusts volume of paint reaching fluid tip)
  - - air valve (controls rate of air flow through gun to nozzle)
  - - side port control (regulates supply of air to air nozzle; determines size and shape of spray pattern)
  - - gun body and handle
  - - air inlet (connects air hose to bottom of handle)
  - - fluid inlet (connects fluid needle to fluid hose)

11. Mechanics and Conventional Spray Equipment

- (b) Set-up
  - - Oil and water extractors monitored to assure air cleanliness
  - - Air pressure regulator on paint tank adjusted to assure proper flow of paint to spray gun
  - - Paint tank agitator (if needed) working properly
  - - Air hose as short as possible; ID at least 3/8" from compressor to paint tank, 5/16" from paint tank to gun
  - - Spray pattern checked and adjusted
  - - Field demonstration of set-up and shut-down procedures, including cleaning (see drawing in manual).

11. Mechanics and Conventional Spray Equipment

- (c) Use
  - - Maintain uniform distance from work surface (6" to 12") ,holding gun at right angle to work surface, and consistent rate of speed
  - - Each stroke overlaps previous stroke by 50%
  - - Trigger at beginning and end of each stroke
  - - Recognize and correct film defects caused by improper application techniques and equipment difficulties

11. Mechanics and Conventional Spray Equipment

- (d) Safety
  - - Protective clothing and gloves worn
  - - Good personal hygiene - wash before eating or drinking and after working
  - - Proper respiratory protection worn
  - - Spray units grounded to prevent static electricity; work piece grounded when spraying flammable material
  - - Proper ventilation assured in all work areas
  - NOTE - SAFETY ISSUES ARE INCLUDED FOR INFORMATION ONLY - SAFETY TRAINING IS THE RESPONSIBILITY OF THE SAFETY DEPARTMENT AT SHIPYARDS.

12. Mechanics and Airless Spray Equipment

- basic set up
- adjusting paint pump pressure
- selecting the proper tip
- safety precautions
- proper spraying technique
- proper shut down and cleaning techniques

12. Mechanics and Airless Spray Equipment

- (a) Can identify basic parts and explain function of each.
  - - Paint pump (draws paint from container)
  - - Paint Hose (carries paint from pump to gun)
  - - Spray gun (directs paint to work surface)

12. Mechanics and Airless Spray Equipment

- (b) Set up
  - - Correct hose selected; for high viscosity paints, 3/8"-1/2" ID required; less viscous can be smaller.
  - - Tip screen appropriate to tip size selected
  - - Appropriate tip selected (for largest pattern and smallest orifice practical for paint viscosity and desired production rate)
  - - Spray pattern tested and adjusted
  - - Field demonstration of set-up and shut-down procedures, including cleaning (see drawing in manual).

12. Mechanics and Airless Spray Equipment

- (c) Use
  - - Maintain uniform distance from work surface (12" to 15"), holding gun at right angle to work surface, and consistent rate of speed
  - - Each stroke overlaps previous stroke by 50%
  - - Trigger at beginning and end of each stroke
  - - Recognize and correct film defects caused by improper application techniques and equipment difficulties

12. Mechanics and Airless Spray Equipment

- (d) Safety
  - - Protective clothing and gloves worn
  - - Good personal hygiene - wash before eating or drinking and after working
  - - Proper respiratory protection worn
  - - Spray units grounded to prevent static electricity; work piece grounded when spraying flammable material
  - - Proper ventilation assured in all work areas
  - - Avoids and is aware of injection hazard from fluid tip

13. Mechanics and Air-assisted Airless Spray

- basic set up
- adjusting paint pump pressure
- selecting the proper tip
- safety precautions
- proper spraying technique
- proper shut down and cleaning techniques

13. Mechanics and Air-assisted Airless Spray

- (a) Can identify basic parts and explain function of each.
  - - Paint pump (draws paint from container)
  - - Paint Hose (carries paint from pump to gun)
  - - Spray gun (directs paint to work surface)

13. Mechanics and Air-assisted Airless Spray

- (b) Set up
  - - Correct hose selected; for high viscosity paints, 3/8"-1/2" ID required; less viscous can be smaller.
  - - Tip screen appropriate to tip size selected
  - - Appropriate tip selected (for largest pattern and smallest orifice practical for paint viscosity and desired production rate)
  - - Spray pattern tested and adjusted
  - - Field demonstration of set-up and shut-down procedures, including cleaning (see drawing in manual).

13. Mechanics and Air-assisted Airless Spray

- (c) Use
  - - Maintain uniform distance from work surface (12" to 15"), holding gun at right angle to work surface, and consistent rate of speed
  - - Each stroke overlaps previous stroke by 50%
  - - Trigger at beginning and end of each stroke
  - - Recognize and correct film defects caused by improper application techniques and equipment difficulties

13. Mechanics and Air-assisted Airless Spray

- (d) Safety
  - - Protective clothing and gloves worn
  - - Good personal hygiene - wash before eating or drinking and after working
  - - Proper respiratory protection worn
  - - Spray units grounded to prevent static electricity; work piece grounded when spraying flammable material
  - - Proper ventilation assured in all work areas
  - - Avoids and is aware of injection hazard from fluid tip
  - NOTE - SAFETY ISSUES ARE INCLUDED FOR INFORMATION ONLY - SAFETY TRAINING IS THE RESPONSIBILITY OF THE SAFETY DEPARTMENT AT SHIPYARDS.

14. Mechanics and HVLP Spray.

- basic set up
- adjusting paint pump pressure
- selecting the proper tip
- safety precautions
- proper spraying technique
- proper shut down and cleaning techniques

14. Mechanics and HVLP Spray.

- (a) Can identify basic parts and explain function of each.
  - - Paint pump (draws paint from container)
  - - Paint Hose (carries paint from pump to gun)
  - - Spray gun (directs paint to work surface)

14. Mechanics and HVLP Spray.

- (b) Set up
  - - Correct hose selected; for high viscosity paints, 3/8"-1/2" IDrequired; less viscous can be smaller.
  - - Tip screen appropriate to tip size selected
  - - Appropriate tip selected (for largest pattern and smallest orifice practical for paint viscosity and desired production rate)
  - - Spray pattern tested and adjusted
  - - Field demonstration of set-up and shut-down procedures,including cleaning (see drawing in manual).

14. Mechanics and HVLP Spray.

- (c) Use
  - - Maintain uniform distance from work surface (12" to 15") ,holding gun at right angle to work surface, and consistent rate of speed
  - - Each stroke overlaps previous stroke by 50%
  - - Trigger at beginning and end of each stroke
  - - Recognize and correct film defects caused by improper application techniques and equipment difficulties

14. Mechanics and HVLP Spray.

- (d) Safety
  - - Protective clothing and gloves worn
  - - Good personal hygiene - wash before eating or drinking and after working
  - - Proper respiratory protection worn
  - - Spray units grounded to prevent static electricity; work piece grounded when spraying flammable material
  - - Proper ventilation assured in all work areas
  - - Avoids and is aware of injection hazard from fluid tip
  - NOTE - SAFETY ISSUES ARE INCLUDED FOR INFORMATION ONLY - SAFETY TRAINING IS THE RESPONSIBILITY OF THE SAFETY DEPARTMENT AT SHIPYARDS.

15.Mechanics and Paint Film Defects.

- (a) Can identify and correct defects as described in SSPC 91-12,Chapter 12.

16. Mechanics and Paint Mixing

- (a) Safety
  - - Appropriate protective apparel (rubber gloves, eye protection,etc.)worn
- (b) Use
  - - Can demonstrate familiarity and proficiency in techniques of PA-1.

17. Mechanics and Wet Film Thickness Gauge.

- (a) Can properly use and accurately read standard WFT gauge.
- (b) Can adjust application technique to meet required WFT

18. Mechanics and DFT Measurement

- (a) Can calibrate and use Positector, Elcometer, Microtest or other DFTgauge, following manufacturer's instructions.

19. Wet Sponge Holiday Detector to check for Paint Film Defects.

- (a) Following manufacturer's instructions, can accurately detect holidays in coating.

20. Mechanics and Respirators.

- (a) Can demonstrate fit test;
- (b) Identify and examine critical parts for wear;
- (c) Can demonstrate techniques for cleaning and disinfecting.

Scoring for Criteria Lists

- The suggested scoring for the criteria lists is that using a simple 1 through four scale.
  - PAINTER SKILLS EVALUATION CHECKLIST RATING SCALE
  - Rating & Interpretation
    - 1 No skill/knowledge related to the item
    - 2 Unsatisfactory -painter's knowledge or skill is less than minimum acceptable level
    - 3 Satisfactory -painter's knowledge or skill is at minimum acceptable level
    - 4 Superior - painter's knowledge or skill exceeds minimum acceptable level

Scoring for Criteria Lists

- PAINTER SKILLS EVALUATION CHECKLIST RATING SCALE
- Determining Adequate Score - SUGGESTED RATING SCHEME
  - Use Criteria Sheets for Each Skill 1 through 20
  - Suggested Meaning of Terms
    - No Skill or Knowledge - A New Trainee
    - Unsatisfactory - Understands Half or Less of Criteria Sheet Requirements
    - Satisfactory - Understands Over Half but not all Criteria Sheet Requirements
    - Superior - Understands All Criteria Sheet Requirements - Candidate Trainer
- Each Yard Can Develop Their Own Scheme!

Non-Mandatory Information for Use with Outside Contractors

- The Following Overheads Only Apply if Rigging is A Responsibility of Deckplate Personnel/Mechanics

20. Mechanics and Scaffolding

- (a) Scaffolding
  - All sections inspected before use for wear;
  - Supporting members plumb and securely braced;
  - Scaffold anchored to structure when possible;
  - Guard rails on all open sides if scaffold 10' or higher;
  - Planking fastened properly and kept free of debris;
  - Casters (if any) locked when unit is stationary.

20. Mechanics and Scaffolding

- (b) Portable Support Systems (mobile hydraulic lift devices)
  - Equipment inspected completely before use;
  - Wheels chocked and outriggers fully extended before operating unit;
  - Obstructions noted before extending boom;
  - 10' distance from power lines maintained.

20. Mechanics and Scaffolding

- (c) Rigging
  - Cables inspected before use;
  - Appropriate electrical connection and grounding ;
  - Wiring checked in power supply to hoisting unit;
  - If outrigger in use, proper number of counterweights used and locked in place;
  - Guard rail and toe boards in place;
  - Braced to prevent swaying;
  - Safety lines used

For more information contact:
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