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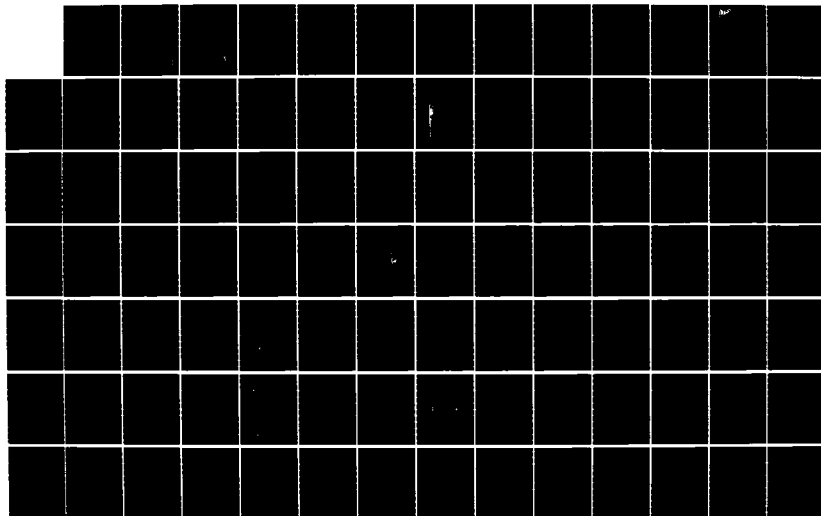
CORROSION-CONTROL (CC) PROGRAM SIMA (SHORE INTERMEDIATE 1/4
MAINTENANCE ACTIV. (U) INTEGRATED SYSTEMS ANALYSTS INC
NATIONAL CITY CA W ADKINS ET AL 30 NOV 85

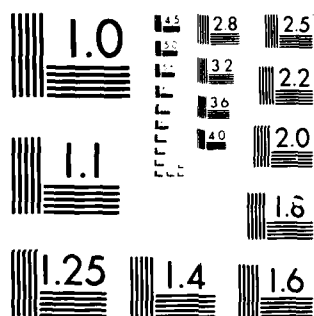
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ISA(MC)-107-VOL-3 N66001-85-C-0350

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MICROCOPY RESOLUTION TEST CHART
 NATIONAL BUREAU OF STANDARDS-1963-A

ISA(WC)-107
30 November 1985

1 AUGUST 1985 - 30 NOVEMBER 1985
FINAL REPORT

Corrosion-Control (CC) Program
SIMA Pilot CC Shop Service Test and Technical Support

Volume III
Appendix A7

Contract N66001-85-C-0350

Prepared for:

COMMANDER
NAVAL OCEAN SYSTEMS CENTER
SAN DIEGO, CALIFORNIA 92152

In support of:

Commander, Naval Surface Force, U.S. Pacific Fleet, Code 010/N41
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and

Commanding Officer, Shore Intermediate Maintenance Activity, San Diego
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by:

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REPORT DOCUMENTATION PAGE		1. REPORT NO. ISA(WC)-107	2.	3. Recipient's Accession No.
4. Title and Subtitle Corrosion-Control (CC) Program: SIMA Pilot CC-Shop Service Test and Technical Support				5. Report Date 30 Nov 85
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				13. Type of Report & Period Covered Formal 1 Aug - 30 Nov 85
15. Supplementary Notes				
16. Abstract (Limit 200 words) The objective of the SIMA Corrosion-Control Services Program was to develop a functional and production capability for SIMAs to deliver and support corrosion-control coating systems being used by the Navy in new construction ships and in the maintenance, repair and overhaul of ships in service. This report presents the results of the one-year Service Test of the SIMA San Diego Pilot Corrosion-Control Shop and the recommendations for establishing Corrosion-Control Production Shops at SIMAs. The one-year Service Test was completed on 30 November 1985. The establishment and operation of the Pilot Shop are summarized. For the Production Shop, recommendations are included for organization, manning, equipment, shop operation, shipboard operation, installation kits, planning and training to implement the establishment of a SIMA Production Shop.				
17. Document Analysis a. Descriptors Corrosion Paint Intermediate Maintenance Activity Aluminum Ships Corrosion Control Shop Metallizing Thermal Spray Process Instruction Powder Coating b. Identifiers/Open-Ended Terms c. COSATI Field/Group				
18. Availability Statement For sale by the Defense Technical Information Center.		19. Security Class (This Report) Unclassified	21. No. of Pages 860	
		20. Security Class (This Page) Unclassified	22. Price	

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APPENDIX A7-1

CC-SHOP TECHNICIAN TRAINING CURRICULUM in the SHOP-QUALIFICATION-IMPROVEMENT- PROGRAM (SQIP) FORMAT

CONTENTS

Preface

A7-1-2

		SHOP TECH		PAGE NO.
TITLE		CLASS (hr)	OJT (hr)	
UNIT	LESSON			A7-1-
I	MARINE CORROSION, CAUSES, PREVENTION AND CONTROL			
	1 Introduction and Corrosion Discussion	2	—	6
	2 Corrosion; Causes and Control	2	—	27
	3 Corrosion Evaluation and Control	2	—	39
	4 CC Systems 1 and 2: WSA	2	—	51
	5 CC Systems 3: Paints	3	14	83
	6 CC System 5: Non-Skid Deck Coating	1	—	119
	7 CC System 4: Powder Coating	3	—	134
	8 CC Systems 6-9: Fasteners and Preservation Materials	1	—	144
	9 CC Systems 10-15: Sealing and Coating Compounds	1	—	158
	10 Installation Kits	1	7	170
	11 Shop Modus Operandi*	(1)	—	
	12 Shop Organization and Management, Planning and Scheduling*	(1)	—	
	UNIT TOTAL	17 (2)	21	
II	WSA: EQUIPMENT AND APPLICATION PROCESS			
	1 Introduction to Corrosion for WSA Technicians	4	—	186
	2 CC Using WSA, Part I - Surface Preparation	4	20	195
	3 CC Using WSA, Part II - Wire Spraying	4	28	206
	4 CC Using WSA, Part III - PMS	4	8	213
	5 CC Using WSA - Certification Tests	2	6	218
	UNIT TOTAL	18	62	
III	ESP EQUIPMENT AND APPLICATION PROCESS			
	1 ESP-Coating Review and GEMA ESP Equipment	2	6	236
	2 NORDSON ESP Equipment	2	6	258
	3 ESP Spray Booth, Curing Oven and Containers	2	6	283
	UNIT TOTAL	6	18	
	COURSE TOTAL (141 hrs ≈ 18 days)	38 (2)	101	

* Will be developed for the SIMA(PH) CC-Shop Startup Training.

PREFACE

This Appendix contains the training curriculum recommended for training CC-Shop Technicians in the Shop Qualification Improvement Program (SQIP) format. The curriculum is divided into three units:

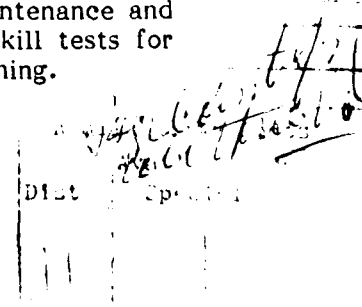
UNIT	TITLE	CLASS RM (hrs)	OJT (hrs)	TOTAL (hrs)
I	Marine Corrosion, Causes, Prevention and Control	16	21	37
II	Wire-Sprayed Aluminum (WSA): Equipment and Application Process	18	62	80
III	Electrostatic-Spray-Powder (ESP) Equipment and Application Process	6	18	24
TOTAL (≈ 18 days)		40	101	141

Formal operator training and certification testing is required for applying the NAVSEA-designated CC Systems One and Two (WSA coatings) per DoD-STD-2138(SH), Metal-Sprayed Coating Systems for Corrosion Protection Aboard Naval Ships. Operator training and certification is not required by NAVSEA for applying paint and non-skid deck coatings (NAVSEA-designated CC System No. Three and Five, respectively) and using the other corrosion prevention and control methods and materials (NAVSEA-designated CC Systems Four and Six through 15). This CC-Shop training curriculum, however, should provide the minimum training to adequately orient and provide basic knowledge and skills for apprentice CC-Shop technicians to:

- Diagnose basic marine CC problems.
- Apply corrosion prevention and control measures.

Unit I presents the basic marine corrosion phenomenology, corrosion prevention and control measures and on-the-job training (OJT) for paint coating application. Lessons 11 and 12 were not developed because the necessary subject matter was not available and was being developed during the Service Test. Lessons 11 and 12 will be developed for the SIMA, Pearl Harbor training.

Unit II covers the WSA equipments, application, quality-control processes and OJT training for basic apprentice skills in equipment operation and maintenance and flame spraying methodology. The flame-spray operator written and skill tests for DoD-STD-2138(SH) certification are given upon completion of Unit II training.



Unit III presents the basic theory and operation of ESP equipments, application and QC processes and OJT in the ESP Station of the CC Shop. Following is a summary of each Lesson of the recommended curriculum:

Unit I - Marine Corrosion, Causes, Prevention and Control

Lesson 1: Introduction and Corrosion Discussion - An introduction to the course; corrosion theory and a general overview of corrosion causes, identification, prevention and control; and the 15 NAVSEA-designated CC systems.

Lesson 2: Corrosion: Causes and Control - A continuation of Lesson 1 with emphasis on shipboard corrosion inspection, diagnosis and corrosion prevention and control.

Lesson 3: Corrosion Evaluation and Control - Corrosion inspection, degradation/failure modes, correction and prevention; an overview of the 3-M Maintenance Data System; corrosion inspection guide; corrosion problem summary sheets and corrosion prevention plan.

Lesson 4: CC Systems 1 and 2: Wire Sprayed Aluminum (WSA) - Properties; ship applications including items/spaces approved for WSA by the TYCOM and NAVSEA; equipment, industrial process and quality-control procedures for the application of WSA coatings.

Lesson 5: CC Systems 3: Paints - Properties; applications with emphasis for WSA coatings; safety; equipment; industrial process and quality control procedures for the application and curing/drying of paint coatings.

Lesson 6: CC System 5: Non-Skid Deck Coating - Purpose and application of non-skid deck coatings, surface preparation, coating preparation and application.

Lesson 7: CC System 4: Powder Coatings - Introduction to basic plastic composition; types of plastic properties; why powder coating is used, environmental concerns; shipboard items to be powder coated; and the ESP application equipment, safety and process instruction.

Lesson 8: CC Systems 6, 7, 8 and 9: Fasteners and Preservation Materials - Uses of ceramic coatings; water-displacing, clear CC compound; anti-seize and 304 stainless steel fasteners.

Lesson 9: CC Systems 10, 11, 12, 13, 14 and 15: Sealing and Coating Compounds - Properties and uses of sealing and coating compounds; polysulfide sealant; protection of electrical connectors; plastic dielectric barrier, vapor phase inhibitor and strippable coatings.

Lesson 10: Installation Kits - Description and information for making up proper installation kits for reinstallation of customer ship product items.

Lesson 11: Shop Modus Operandi - Information and specification for paper-efficient CC Shop operation. This lesson plan will be developed for the SIMA(PH) start-up crew training.

Lesson 12: Shop Organization and Management, Planning and Scheduling - Information and specification for CC Shop management, planning and scheduling of ship-to-shop and shop-to-shop production items. This lesson plan will be developed for the SIMA(PH) start-up crew training.

Unit II - WSA: Equipment and Application Process

Lesson 1: Introduction to Corrosion for WSA Technician - Introduction to Unit II, overview of corrosion theory and corrosion prevention and control, discussion of the 15 NAVSEA-designated CC systems highlighting the WSA coating system.

Lesson 2: CC Using WSA, Part I - Surface Preparation - Technical requirements for WSA coating system; description of industrial plant equipments for application of WSA coatings; surface preparation, masking and cleaning; cleaning material nomenclature and use.

Lesson 3: CC Using WSA, Part II - Wire Spraying - WSA equipment nomenclature and use; lighting off; spraying of items; shutting down; QA; safety, sealing procedures; component handling and re-assembly procedures.

Lesson 4: CC Using WSA, Part III - PMS for METCO 12E Wire Spray Gun - METCO 12E WSA Gun disassembly; daily, 16-hour, and 40-hour maintenance; and re-assembly.

Lesson 5: CC Using WSA, Certification Tests - Written examination and flame-spray skill tests for DoD-STD-2138(SH) certification.

Unit III - Electrostatic Powder Coating (ESP): Equipment and Application Process

Lesson 1: ESP-Coating Review and GEMA ESP Equipment - Review of CC System 4, ESP; basic plastic composition; differences between thermoset and thermoplastics; crosslinking; environmental concerns; why powder coating is used; shipboard items to be powder coated; and the powder coating process. GEMA ESP equipment nomenclature, startup, shutdown, changing of powder color; PMS, disassembly, cleaning and reassembly of manual gun; replacement of incorrect sleeve and cleaning ejector, troubleshooting and proper safety precautions.

Lesson 2: NORDSON ESP Equipment - NORDSON NPE-2M Gun specifications, nomenclature, theory of operation, disassembly, cleaning, (PMS) reassembly and use of troubleshooting guide. NPE-HR3 hopper feeder parts, functions, operation, maintenance and troubleshooting; necessary information for proper operation, maintenance, features, functions, troubleshooting PMS and CMS of NORDSON NPE-CC8 control console.

Lesson 3: ESP Spray Booth, Curing Oven and Containers - Description and explanation of safety, start-up operation, shutdown and PMS of ESP spray booth and curing oven.

This CC-Shop Training Curriculum was developed from the lessons learned during the SIMA Pilot CC-Shop Service Test. The lesson plan content and training aids were developed and refined through several deliveries of each lesson plan during the period of the one-year Service Test. The curriculum package will be used for the SIMA, Pearl Harbor start-up training and updated as required.

INSTRUCTOR PREPARATION

SIMA CC-SHOP
Lesson Plan

PAGE 1 OF 21

TITLE <u>Introduction and Corrosion discussion</u>		COURSE <u>CC-Shop Technician</u>		UNIT <u>1*</u>	LESSON NO. <u>1</u>
LEARNING OBJECTIVES				TRAINING AIDS/MATERIALS	
Trainees will be able to:				Materials:	
1. Understand objective, scope and completion requirements of the CC-Shop Technician course.				1. 35mm slides of shipboard corrosion aboard U.S. Navy ships.	
2. Draw and label a simple electrolytic cell.				Note: Instructor will need to develop slides from local sources, i.e., take color slides aboard in-port ships or make color slides from the colored corrosion figures in Reference 1 below.	
3. Identify and list four elements needed for corrosion to occur.					
4. Identify four types of corrosion found topside.				2. Transparencies T:1-1-1 through T:1-1-12.	
5. Understand and explain to peers the basic causes of marine corrosion and the basic corrosion-control (CC) methods.				3. Board, colored markers and eraser.	
				4. Dry eraser markers for transparencies.	
				5. Tape/slide 35mm carousel projector.	
				6. Overhead transparency projector.	
				References:	
				1. NAVSEA S9630-AB-MAN-010/FFG-7CI, <u>Manual, Corrosion-Control for FFG-7</u> , 30 November 1983	
				2. DoD-STD-2138(SH), <u>Metal Sprayed Coatings for Corrosion Protection Aboard Naval Ships</u> , 23 November 1981.	
				3. <u>Corrosion Basics</u> , NACE, 1984.	
				4. S. E. Coburn (editor), <u>Corrosion Source Book</u> , NACE, 1984.	
				5. C. G. Munger, <u>Corrosion Prevention by Protective Coatings</u> , NACE, 1984.	

* Marine Corrosion, Causes, Prevention and Control.

INSTRUCTOR PREPARATION

SIMA CC-SHOP
Lesson Plan

PAGE 2 OF 21

TITLE <u>Introduction and Corrosion discussion</u>		COURSE <u>CC-Shop Technician</u>		UNIT <u>1</u>	LESSON NO. <u>1</u>
LEARNING OBJECTIVES			TRAINING AIDS/MATERIALS		
			<u>Handouts:</u> 1. One copy of each transparency listed above. 2. Corrosion Discussion, Chapter 2 of Reference 1. 3. NAVSEA 0655-AA-JPA-010, <u>Job Performance Aid for Metal-Sprayed Coatings.</u>		

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

PAGE 3 OF 21

TITLE <u>Introduction and Corrosion discussion</u>		COURSE <u>CC-Shop Technician</u>		UNIT <u>1</u>	LESSON NO. <u>1</u>
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
I. COURSE INTRODUCTION A. <u>Purpose</u> To train SIMA CC-Shop technicians to man and operate all the CC-Shop stations knowledgeably and with proficiency. B. <u>Navy's CC Program Goals</u> 1. Reduce excessive S/F manhours. 2. Extend service life of shipboard components and areas. 3. Reduce/eliminate the attendant material, labor and schedule costs to repair/replace. C. <u>SIMA CC Shops are to Provide</u> • Technical assistance on the 15 NAVSEA CC Systems. • Ship-to-shop production services for WSA and ESP coating systems. • Makeup and issue installation kits (e.g., ceramic/316-SS fasteners, gasketing, insulation, anti-seize and sealants) for the proper reassembly and installation of items preserved by the CC Shop. • SIMA shop-to-shop CC services. • Portable WSA container system for ROH ships.		1. Write instructor's name, date, lesson number and title on board. 2. Describe CC Shop technician course training objectives and goals, SIMA CC-Shop services, scope and approach. 3. Distribute handouts. • Show class the FFG-7 Ship Class CC Manual and tell them that individual chapters will be passed out with related subject-matter lesson. • The Job Performance Aid (JPA) for Metal Spraying is the textbook for Unit II. • Show/discuss T:1-1-1.		1. Take notes. 2. Participate in class discussion. 3. Answer questions.	

TRAINING AID

SIMA CC-SHOP
Lesson Plan

1 TECH ADVICE ON THE CAUSES & PREVENTION
OF TOPSIDE CORROSION PROBLEMS & THE
APPLICATION OF THE 15 NAVSEA SYSTEMS

2 PRODUCTION FOR:

• WIRE-SPRAYED ALUMINUM

• POWDER COATING

• INSTALLATION KITS
FOR PRODUCTS
PRESERVED WITH
SYS 1, 2, & 4.

THE NAVSEA CC SYSTEM														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
WSA High Temp.														
WSA Low Temp.														
Exterior Topside Coating														
Powder Coatings														
Non-Skid Deck Coatings														
Ceramic Coatings														
Water Displacing Compounds														
Anti-Seize Compounds														
Improved Fasteners														
Seal & Coating Compounds														
Polysulfide Sealants														
Multi-Pin Conn. Prot.														
Plastic Dielectric Barrier														
Vapor Phase Inhibitor														
Strippable Coating														

CORROSION-CONTROL (CC) SERVICES

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

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TITLE	Introduction and Corrosion discussion	COURSE	CC-Shop Technician	UNIT	I	LESSON NO.	1
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
D. <u>Scope and Approach of CC-Shop Technician Course</u> <u>Unit I</u> Marine Corrosion, Causes, Prevention and Control. <u>Unit II</u> WSA: Equipment and Application. <u>Unit III</u> ESP Equipment and Processes. II. INTRODUCTION TO CORROSION DISCUSSION Corrosion is the process by which a material returns to its natural state. A. Rust is the result of steel reacting with the oxygen in air or water and forming iron oxide. B. Corrosion occurs in all metals but at different rates. C. Galvanic corrosion occurs when a current flows from the anode to the cathode through a metallic path. For corrosion to occur, four elements must be present at the same time. They are a/an: 1. <u>Anode</u> - A metal or local area of metal prone to corrosion that deteriorates in the process. 2. <u>Cathode</u> - A second metal or local area of metal that is less prone to corrosion and does not deteriorate. 3. <u>Metallic Path</u> - For electrical contact between the anode and cathode.				• Write on board. • Show slides of shipboard corrosion discussing type(s) of corrosion, causes and fixes. • Draw simple electrolytic cell on board; per Figure I-1-1.		• Copy electrolytic cell from board.	

TRAINING AID

SIMPLE ELECTROLYTIC CELL

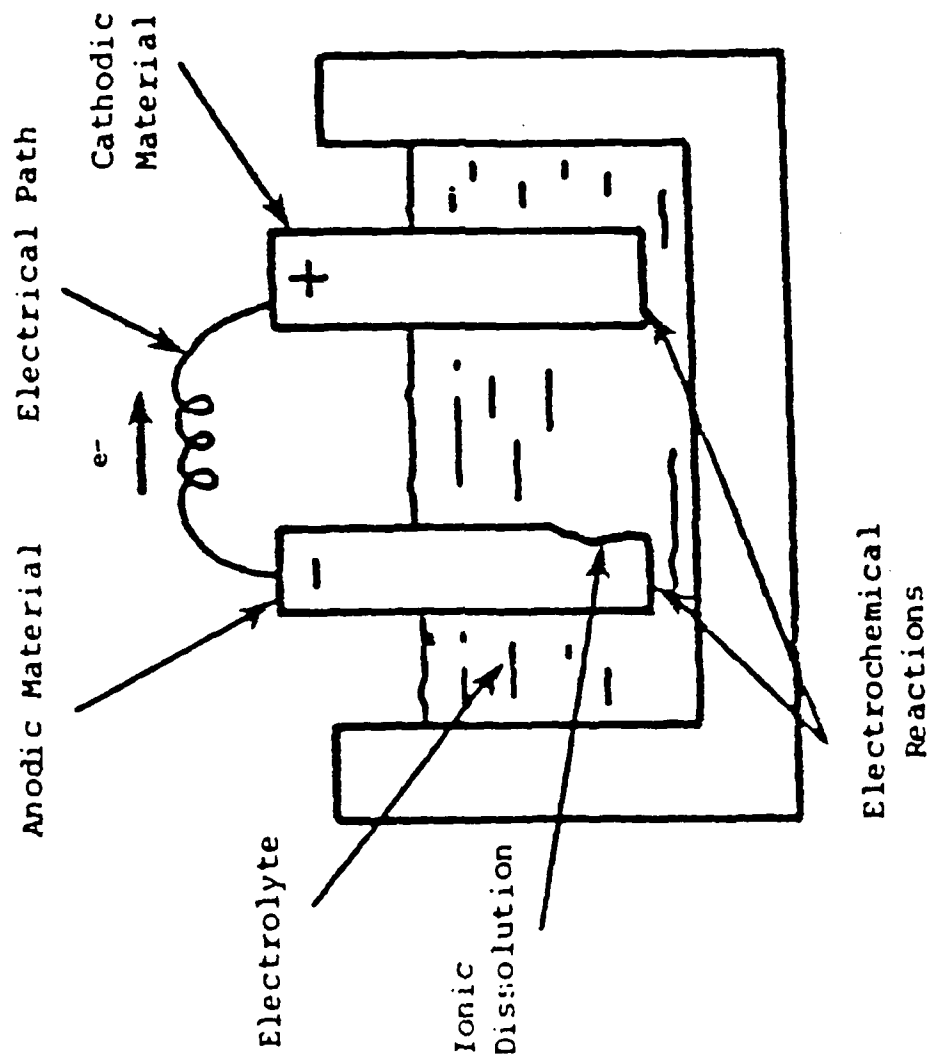
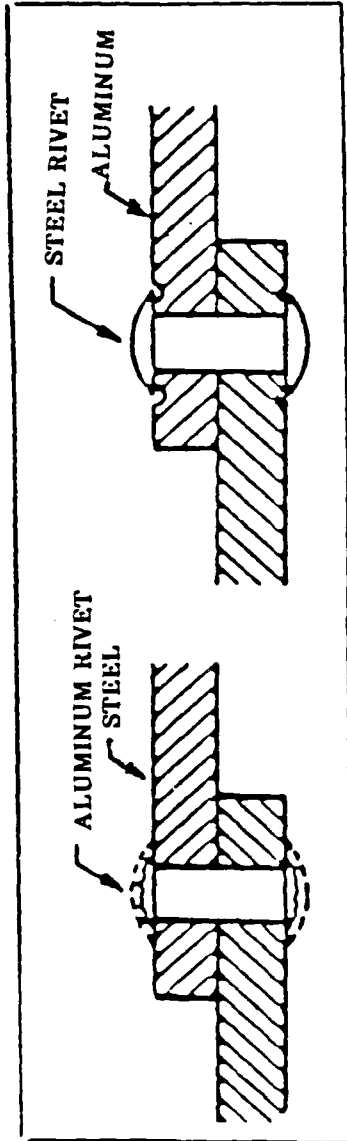


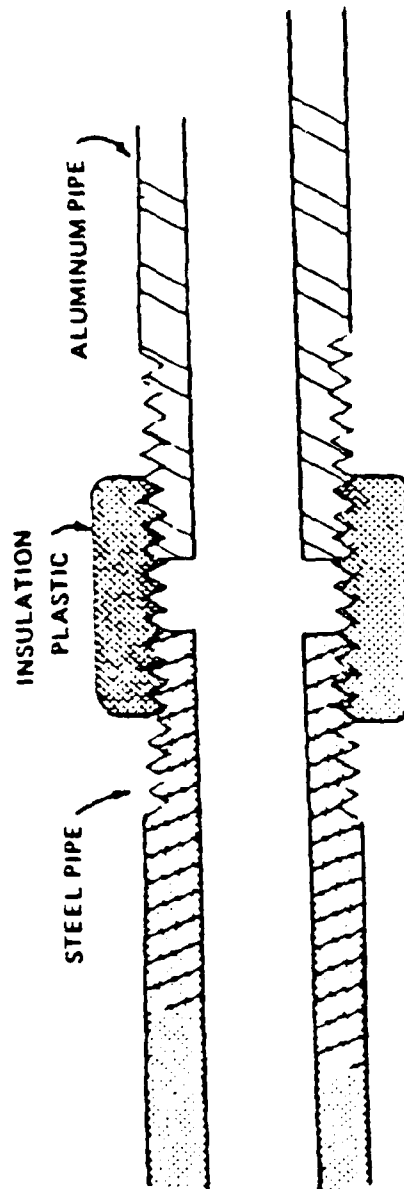
Fig 1-1-1

TRAINING AID



Galvanic couple between steel and aluminum.

TRAINING AID



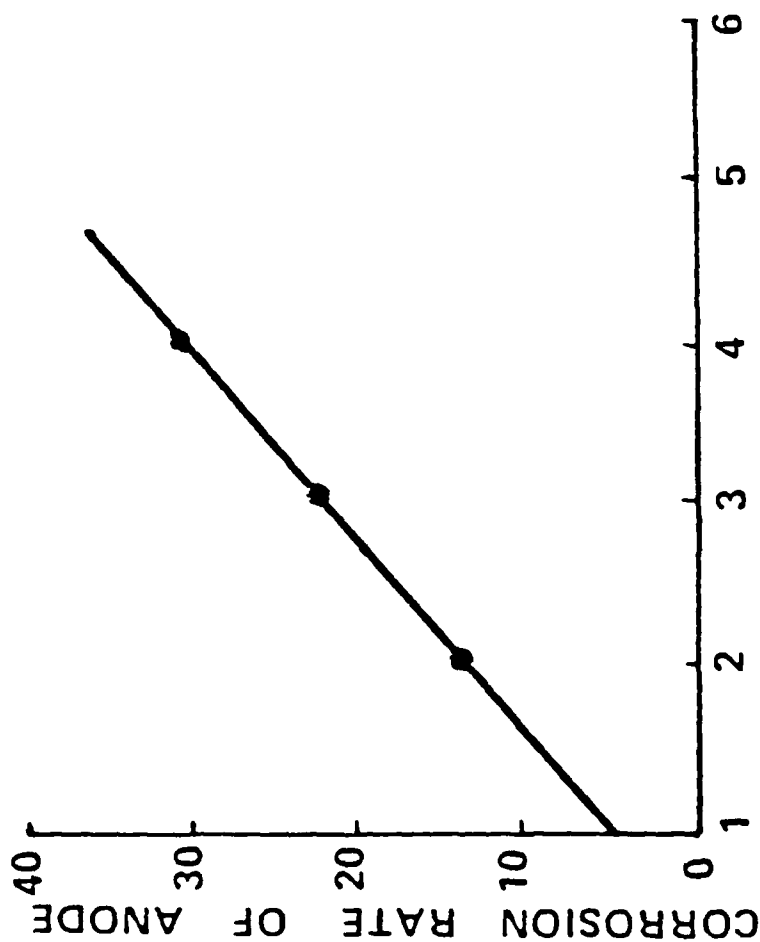
Prevention of galvanic corrosion of aluminum pipe by an insulating pipe coupling.

Table 2-1. ELECTROCHEMICAL POTENTIAL (GALVANIC SERIES)
OF METALS IN SEAWATER

Potential (volts) Ag/AgCl Reference Electrode	
-1.6 -1.4 -1.2 -1.0 -0.8 -0.6 -0.4 -0.2 0 +0.2 +0.4	
CORRODED END (ANODIC OR MOST ACTIVE METAL)	
■ Magnesium Anode (MIL-A-21412A)	
■ Zinc Anode (MIL-A-18001H)	
■ Aluminum (High Purity)	
■ Cadmium	
■ Tin (99.99+)	
■ Mild Steel (G 10200)	
■ Lead	
■ Copper (99.95+)	
■ Nickel (99.99+)	
■ Yellow Brass	
■ Bronze	
■ Copper-Nickel Alloys	
■ Inconel	
■ Stainless Steel	
■ Silver (99.99+)	
■ Titanium	
■ Gold	
■ Platinum	
PROTECTED END (CATHODIC OR LEAST ACTIVE METAL)	

T:j-1-4

TRAINING AID



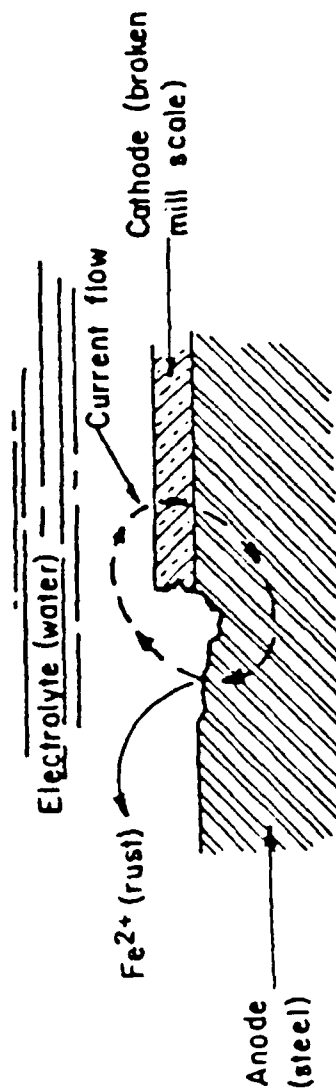
RATIO: $\frac{\text{AREA OF CATHODE}}{\text{AREA OF ANODE}}$

Area effect during galvanic corrosion.

TH-1-5

TRAINING AID

Fundamentals and Prevention of Metallic Corrosion



Mill scale is cathodic to steel, establishing a corrosion cell.

T:I-1-6

INSTRUCTOR PRESENTATION

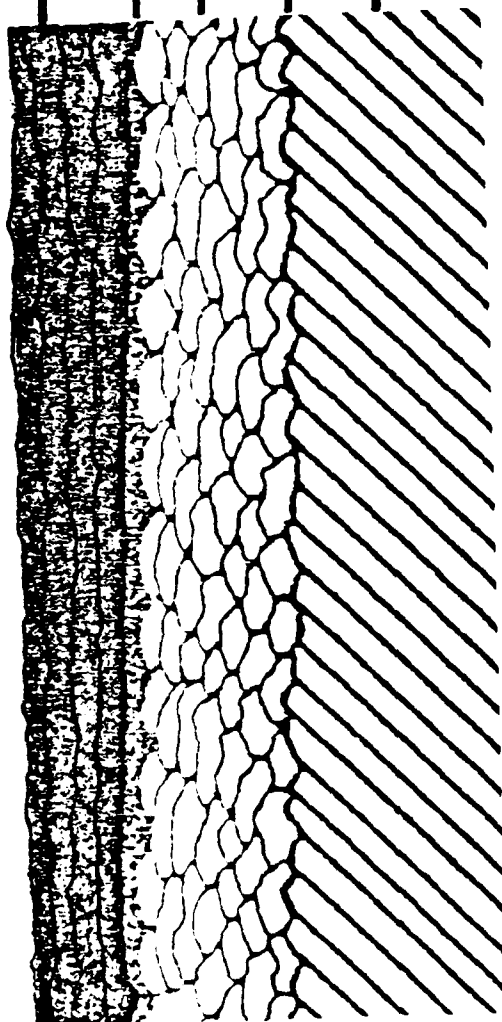
SIMA / C-SHOP
Lesson Plan

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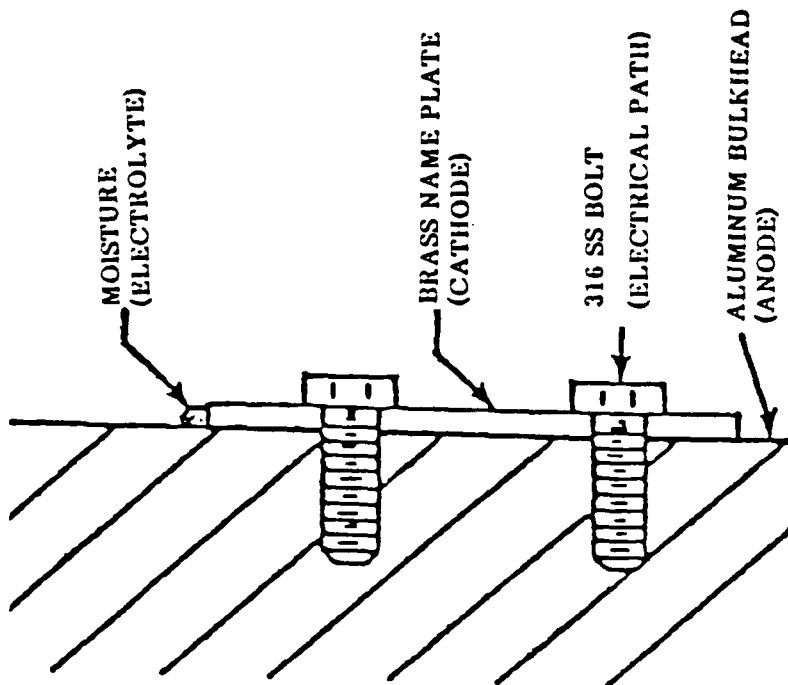
TITLE <u>Introduction and Corrosion discussion</u> COURSE <u>C-S-Shop Technician</u> UNIT <u>1</u> LESSON NO. <u>1</u>			
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
4. <u>Electrolyte</u> - A liquid solution capable of carrying an electrical current between the anode and cathode. D. <u>Galvanic Series</u> 1. Different metals and alloys have different tendencies to form galvanic corrosion cells. 2. The arrangement of metals and alloys ranked in order of susceptibility to corrosion is called the Galvanic Series. E. <u>Other Factors</u> Other factors that have an important effect on tendency of metals to corrode are: 1. Ratio of anode and cathode areas. 2. Surface films, e.g., mill scale on steel and oxide film on SS. 3. Applied or residual stresses; higher corrosion rate in tensile stress. 4. Concentration and type of ions in the solution. 5. Operating temperature. III. <u>CORROSION CONTROL METHODS</u> A. Corrosion control methods are based on the elimination or control of one of the previous stated factors. 1. The electrical path can be broken by a non-porous barrier film (such as paint or metal plating) between the metal surface and the electrolyte.	• T:I-1-2; ask trainees how to eliminate galvanic cell. • T:I-1-3. • T:I-1-4. • T:I-1-5. • T:I-1-6.	0 Break electrical path with insulation.	

TRAINING AID

- PAINT BARRIER &
- TOP-COATS
- SEALER
- SPRAYED METAL
- BLASTED SURFACE
- BASE MATERIAL



T:I-1-7



ACTIVE (ANODE: GREATER CORROSION RATE) TO PASSIVE (CATHODE: SMALLER CORROSION RATE)

ALUMINUM TO BRASS ALUMINUM TO 316 SS BRASS TO 316SS

T:-1-1-8

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

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TITLE Introduction and Corrosion discussion		COURSE CC-Shop Technician	UNIT 1	LESSON NO. 1
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
2. Galvanic corrosion can be reduced by using a more active metal on or near the base metal, e.g., WSA on steel or zinc anodes near bronze propellers. IV. TYPES OF CORROSION A. <u>General</u> Typical of the several types of corrosion to be observed topside are uniform or direct surface attack, galvanic corrosion, pitting and crevice corrosion. 1. Uniform attack also known as general surface attack is the simplest form. Occurs on the surface of metals where structure most uniform. (a) Rusting of iron. (b) Tarnishing of silver. 2. Galvanic corrosion occurs when dissimilar metals are in contact and joined with an electrolyte or conductive solution. (a) Size relationship of anode and cathode important. (b) Greatest damage occurs when area of attached metal is relatively small and current density high.		• Show/discuss T:1-1-7. • Show/discuss T:1-1-8.		

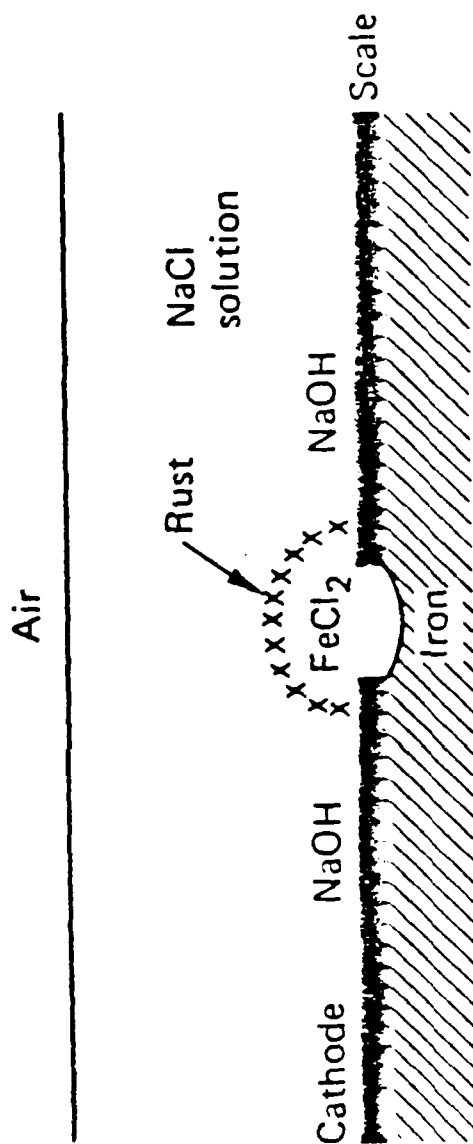
INSTRUCTOR PRESENTATION

SIMA CC-SHOP
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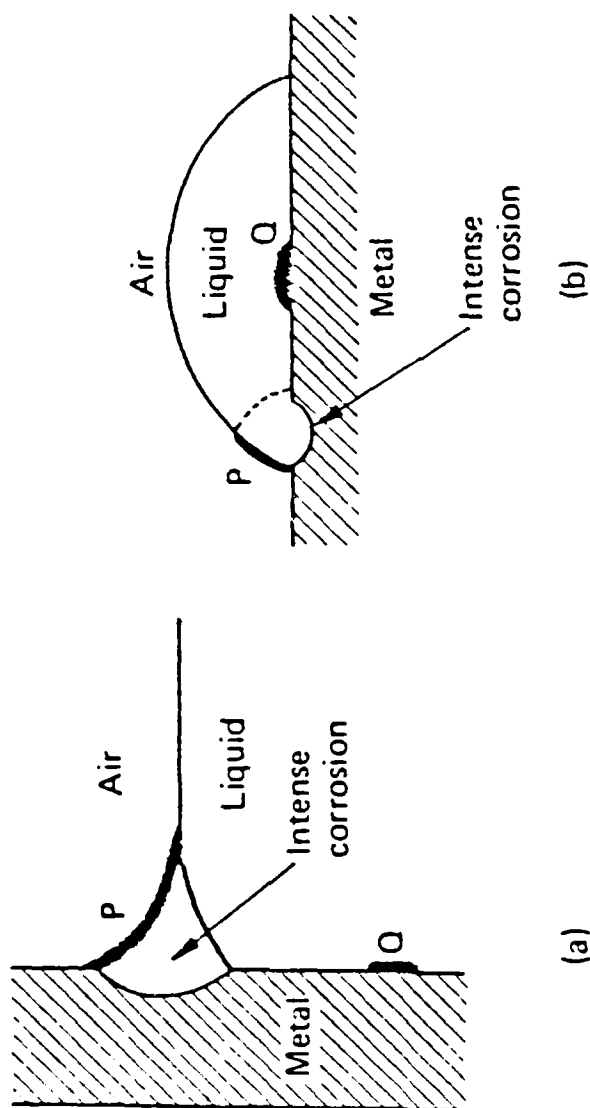
PAGE 16 OF 21

TITLE	Introduction and Corrosion discussion	COURSE	CC-Shop Technician	UNIT	1	LESSON NO.	1
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
(c) Fasteners are small compared to the materials joined, therefore, fasteners should be the same material of that to joined or of a metal lower on the Galvanic Series. 3. Pitting is a severe form of localized corrosion. The most susceptible are: (a) Steel (b) Stainless Steel (c) Aluminum caused by (d) Local galvanic cells caused by various metals in an alloy. (e) Incomplete films or coatings. (f) Damage to painted areas often occurs at the waterline where metal partly exposed to atmosphere and partly in water. Thin metal sheets are most vulnerable because the results can be full penetration of sheet and loss of structural integrity even though overall loss of metal may be small. 4. Crevice corrosion or concentration cell corrosion is due to physical irregularities on the metal surface. (a) A non-uniform electrolyte or environment can cause a difference in the concentration of ions or oxygen resulting in differences of potential on the surface of the same metal.				• Show/discuss T:I-1-9 and T:I-1-10. • Show transparencies T:I-1-11 and T:I-1-12.			

TRAINING AID

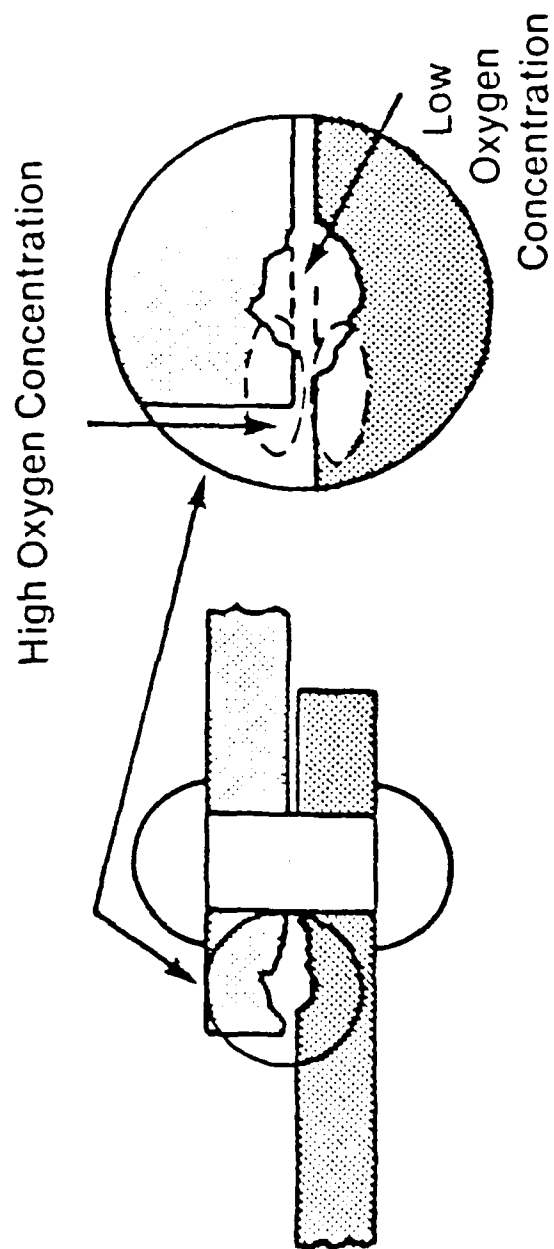


Corrosion at breaks in oxide scale on iron immersed in sodium chloride solution



Intense water-line corrosion of steel in liquid containing borderline concentration of inhibitor, (a) on partly immersed plate (b) below drop. At P, membranous rust appears at the water/air interface and fails to protect, whereas at Q, solid matter is built up at an incipient discontinuity and prevents corrosion from developing

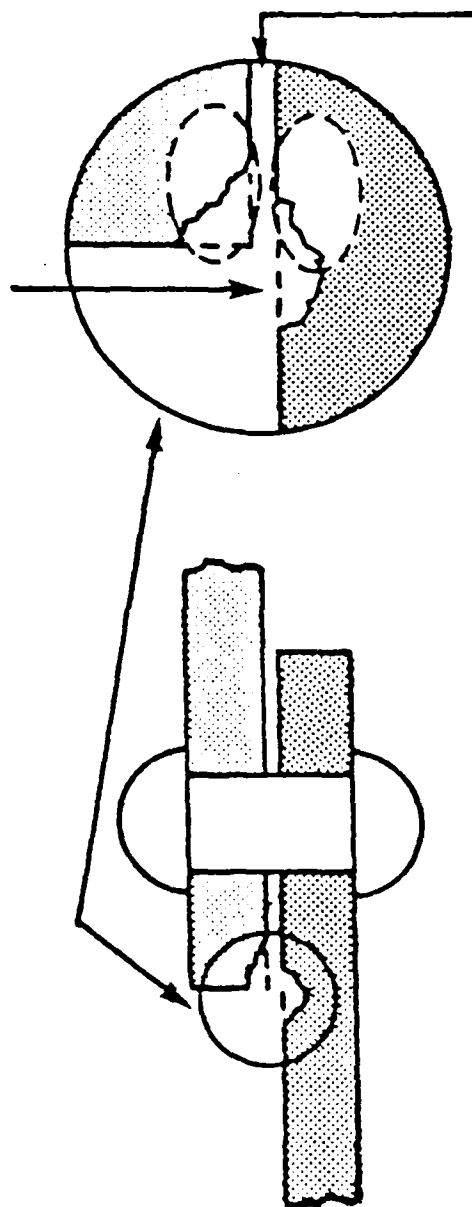
TRAINING AID



Schematic of oxygen concentration cell
formed in a crevice.

TRAINING AID

Low Metal Ion Concentration



High Metal Ion Concentration

Metal ion concentration cell.

INSTRUCTOR FOLLOW-THROUGH

SIMA CC-SHOP
Lesson Plan

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TITLE Introduction and Corrosion discussion	COURSE Cc-Shop Technician	UNIT 1	LESSON NO. 1
PRACTICAL APPLICATIONS	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
- Summarize Lesson. - Question students on key points; repeat and amplify the instruction as required.		- Answer questions and explain issues asked by the instructor. - Demonstrate knowledge of -CC services to be delivered by a SIMA CC Shop. -Electrolytic cell; anode being the active corroding metal. -Galvanic series and how to find the more active metal in a galvanic cell. -Types of corrosion.	

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TITLE <u>Corrosion; Causes and Control</u>		COURSE <u>CC-Shop Technician</u>	UNIT <u>1*</u>	LESSON NO. <u>2</u>
LEARNING OBJECTIVES		TRAINING AIDS/MATERIALS		
Trainees will be able to: - Understand factors influencing corrosion. - Identify common paint failures. - Determine causes and effects of marine corrosion on metal found onboard ship.		Materials: - Examples of corroded items of steel and aluminum, dissimilar metals (carbon and SS next to aluminum), weathered 304- and 316-SS fasteners and verdigris (green salts) on brass. Note: Examples of corroded items must be procured from local sources, such as discarded fasteners and components from ships. - Pocket magnet. 35mm color slides of representative topside shipboard corrosion issues/examples and common paint failures to be made locally. - Transparencies T:1-2-1 a/b. - One copy of the FFG-7 Ship-Class CC Manual for every two trainees to be used as class workbook. These CC manuals are not to be retained by trainees. 35mm slide projector. - Overhead projector. - Chalk/marker and board. References: - NAVSEA S9630-AG-MAN-010/FFG-7CL, Manual, Corrosion Control for FFG-7 Class, 30 November 1983. - NAVSEA 59086-VD-STM-000, Chapter 631, <u>Preservation of Ships in Service (NSTM-631)</u>. - Steel Structures Painting Manual, SSPC, Volumes I and II. (Referenced in Ship-Class CC Manuals).		

* Marine Corrosion, Causes, Prevention and Control.

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TITLE <u>Corrosion; Causes and Control</u> COURSE <u>Cc-Shop Technician</u> UNIT <u>1</u> LESSON NO. <u>2</u>			
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
L. FACTORS INFLUENCING CORROSION A. <u>Material Selection</u> Important factor in corrosion control, however, the most corrosion resistant materials not always selected. Compromises made because of 1. Cost 2. Strength 3. Weight 4. Durability 5. Shock resistance For example, aluminum alloys provide for lightweight materials but require a protective coating in a marine atmosphere. B. <u>Design Deficiencies</u> Careful consideration needed of life-cycle corrosion-control costs. Many corrosion-control problems due to trade off of corrosion control against: 1. Cost 2. Strength 3. Weight, etc.	• Write instructor's name, date, lesson number and title on board.	1. Take notes. 2. Participate in class activities and discussions.	
	• Show locally prepared 35mm colored slides. Point out examples of corrosion in the FFG-7 Class CC Manual. • T11-2-1 a/b.	• Examine examples found in FFG-7 Class CC Manual.	

TRAINING AID

SUMMARY OF DESIGN-RELATED FAILURE

COATING FAILURE	FAILURE APPEARANCE	CAUSE OF FAILURE	REMEDY
1. Edges	Corrosion linear with the edge and coating being undercut away from edge.	Surface tension of coating pulling liquid coating away from edge.	Precoat edges prior to coating flat surface. Overlap coating on flat surface over edge. Spray directly at an edge to build thicknesses.
2. Interior Corners	A void or blister under the coating at interior corners.	Excessive thickness, causing coating to shrink on curing.	Apply coating in thin, multiple coats, thoroughly drying or curing between coats.
3. Discontinuous Areas	Corrosion failure on edges of threads, bolt heads, rivets.	Many small surfaces to cover with a high ratio of sharp edges and corners to plain area. Surface tension of coating pulls coating away from points and edges.	Brush coat surfaces prior to full coating. Overlap brush coat with each coat. Multiple thin coats are better than one thick one.
4. Welds	Coating failure along welds, particularly hand welds; coating undercutting starting at weld.	Welding flux in undercuts along weld. Rough weld surface. Soap remaining from pressure testing of welds. Blue scale (similar to mill scale) remaining on weld.	Remove all blue scale or soap solution. Grind rough welds smooth. Blast weld at least 2"-3" on each side. Apply first coat by brush, working it into all rough weld areas.
5. Skip Welding	Discontinuous welds with skips from 6" to several feet between welds. Corrosion between overlapping metal undercuts coating.	Impossible to apply coating in crevice between metal surfaces.	Continuously weld all overlaps before applying coating in any corrosive environment.

TRAINING AID

SUMMARY OF DESIGN-RELATED FAILURE
(Continued)

COATING FAILURE	FAILURE APPEARANCE	CAUSE OF FAILURE	REMEDY
6. Back to Back Angles	Corrosion between back to back angles undercutting coating.	Impossible to apply coating in crevice between roof plates and between angles.	Use T bar or pipe for construction. As a stopgap, fill crevice with heavy, resinous caulking and overcoat with a compatible coating.
7. Storage Tank Roofs — Interior	Umbrella type roof — center pole and rafters. Coating failure between roof and rafter and between lapped roof plates.	Impossible to apply coating in crevice between roof plates and between roof plates and rafters.	Built weld or double weld roof plates. Precoat rafters and underside of roof.
8. Pipe Structures	Coating failure at welds or longitudinal with pipe.	Rough welds between pipe sections (see No. 4, "Welds"). Lack of sufficient overlap during coating application. Most application linear with pipe.	See No. 4, "Welds". Apply coating carefully, assuring 50% overlap on all passes.

INSTRUCTOR PRESENTATION

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TITLE <u>Corrosion: Causes and Control</u> COURSE <u>CC-Shop Technician</u> UNIT <u>1</u> LESSON NO. <u>2</u>			
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
Results of Design Deficiencies are: 1. Inadequate or poorly installed drainage (standing water). 2. Location of components and structures (creating inaccessible areas). 3. Combinations of dissimilar metals exposed to sea water and spray and instances of inadequate dielectric insulation between the two metals. 4. Selection of metal shapes that are functional for their purposes but create maintenance problems due to complex shape or form. 5. Fixtures or fittings not intended for marine environment. 6. Use of fastener systems made up of combinations of dissimilar metals and used to join dissimilar metals. 7. Use of absorbent materials, such as insulation, in exposed areas. 8. Location and lack of baffling on vent intakes leading to salt water and sea ingestion.		• Have students look up examples in FFG-7 Ship-Class CC Manuals. • Show corrosion examples and ask students why and how to prevent. • List common paint failures on board and explain.	• Look up examples in FFG-7 Ship-Class CC Manual. • Copy list of common paint failures from board.
II. COMMON PAINT FAILURES A. One of the most effective and important methods of corrosion control is prompt and complete removal of corrosion and proper application of paint coatings. The following is a list of common paint failures: 1. Alligatoring and Checking (a) Outer layer of paint is broken and undercoats are visible.			

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TITLE <u>Corrosion; Causes and Control</u> COURSE <u>CC-Shop Technician</u> UNIT <u>1</u> LESSON NO. <u>2</u>			
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
(b) May be caused by applying paint over soft undercoat, previous coats not dry. (c) Application of hard drying, inelastic paint over a more elastic paint. 2. <u>Cracking</u> (a) A break extends through to the surface painted. (b) Caused by paints that lack elasticity due to age, etc. and can no longer expand with moisture and temperature changes. 3. <u>Flaking, Scaling and Peeling</u> Characterized by detachment of pieces of paint (a) <u>Flaking</u> - small pieces less than 1/4 square inch, a result of cracking. (b) <u>Scaling</u> - pieces between 1/4 square inch and one square inch, also a result of cracking. (c) <u>Peeling</u> - pieces over one square inch, results from presence of moisture behind the film or incompatibility of paint film. (d) <u>Bleeding</u> - when color of previous coat is absorbed into top coat. Usually caused by dissolving of color ingredient of undercoat in vehicle of new coat. (e) <u>Blistering</u> - detached and raised unbroken areas from surface caused by gases or liquids forming beneath the surface.	Show common paint failures; discuss/explain causes and remedy.		

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TITLE <u>Corrosion; Causes and Control</u> COURSE <u>CC-Shop Technician</u> UNIT <u>1</u> LESSON NO. <u>2</u>			
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
(f) <u>Chalking</u> - presence of loose powder evolved from the paint films. (g) <u>Discoloration</u> - alteration of original color, such as yellowing, fading darkening and mottling. III. MAINTENANCE PERSONNEL MANNING LEVELS A. An indirect but significant factor in corrosion control is manpower. 1. The number of sailors available for upkeep of the topside areas has proven to be inadequate to maintain Navy standards, e-g., the 5-component paint schedule for the epoxy-alkyd system. 2. Improved coating systems like WSA and improved installation materials are now used to minimize S/F maintenance. IV. MARINE ENVIRONMENT A. Moisture is the greatest cause of corrosion. 1. Sea water is the only electrolyte commonly found in nature that contains a high concentration of salts. 2. Salt water accelerates corrosion. (a) Fresh water washdown best way to combat salt water corrosion topside. (b) Not always practical for Navy except possibly in port. 3. Other pollutants, such as combustion products from stack gases, increase the corrosive effects of the sea salts in the air.			

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TITLE <u>Corrosion; Causes and Control</u>		COURSE <u>CC-Shop Technician</u>		UNIT <u>1</u>	LESSON NO <u>2</u>
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
V. EFFECTS OF CORROSION ON METALS FOUND ABOARD SHIP A. <u>General</u> Numerous types of metals and non-metallic substances are used on U.S. Navy vessels. From a corrosion control view point, the most important are: 1. Steel 2. Stainless Steel 3. Brass 4. Aluminum B. <u>Steel</u> - Steel is used extensively throughout the ship. 1. Rust - the characteristic corrosion product of steel. (a) Appears on painted steel where paint coating is broken. (b) Must be removed completely. (c) Mechanical removal by abrasive blasting is the most effective method. C. <u>Stainless Steel</u> - Frequently referred to as corrosion-resistant steel (CRS) is found in some topside fittings, label plates and fasteners. 1. The distinctive characteristic of stainless steel is a 12% or greater content of chromium. 2. Chromium and nickel principle alloying elements.		• Show examples of corroded steel items and pass around to trainees.		• Examine items; pass on.	
		• Show examples of corroded steel and aluminum next to SS items. Show corroded 304-SS fastener. Pass around to trainees.		• Examine items; pass on.	

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TITLE Corrosion; Causes and Control		COURSE CC-Shop Technician		UNIT 1	LESSON NO. 2
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
3. Explain difference between types of SS and 316-SS and why 316-SS fasteners are the first choice. 4. Divided into magnetic and non-magnetic types. (a) Magnetic types are less resistant to corrosion. (b) Non-magnetic types are more corrosion-resistant, (commonly known as austenitic stainless steel and listed at the more noble end of the Galvanic Series). 316-SS is non-magnetic. (c) Pitting most common type of corrosion particularly in crevices. (d) Generally compatible with aluminum, especially where the aluminum surface is large compared to the stainless steel. D. <u>Brass</u> 1. Brass is a copper-base alloy used for: (a) Light assemblies (b) Fog applicator nozzles (c) Ships bell (d) Turnbuckles		Demonstrate magnet pick of carbon steel, monel, brass, 304-SS and 316-SS bolts.		Examine items; pass on.	

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TITLE Corrosion; Causes and Control		COURSE CC-Shop Technician	UNIT 1	LESSON NO. 2
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		
(c) Ports 2. Corrosion of brass is seen as a green coating called verdigris. E. <u>Aluminum</u> 1. Aluminum alloys are the primary metals used in superstructure and masts because of their strength-to-weight ratio. 2. The alloys most commonly used are: (a) 5080 (b) 5454 (c) 5456 3. Corrosion starts where there is any break in the paint surface. (a) White-gray product in early stages. (b) Powdery material will grow and the aluminum will appear etched or mottled in corroded area. 4. All corrosion must be removed before any preservation begins. Can be removed mechanically with: (a) Stainless steel brush (b) Abrasive paper		• Show examples of corroded aluminum items and pass around to trainees. • Examine items; pass on.		

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TITLE Corrosion; Causes and Control		COURSE CC-Shop Technician	UNIT 1	LESSON NO. 2
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
5. Do not use a carbon steel brush or steel wool because no matter how much care is taken; (a) Particles of dissimilar metal will become embedded in the aluminum and cause further corrosion; carbon steel is more corrosion prone than SS. 6. <u>Aluminum</u> (a) Is susceptible to damage by power-assisted scalers and chippers; aluminum is soft. (b) Cannot withstand heavy concentrations of acids or bases, such as paint removers and strong caustic cleaning solutions.				

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TITLE <u>Corrosion; Causes and Control</u> COURSE <u>Cc-Shop Technician</u> UNIT <u>1</u> LESSON NO. <u>2</u>			
PRACTICAL APPLICATIONS	TRAINING AID/ DEMONSTRATION		
- o Summarize Lesson. - o Question students on key points; repeat and amplify the instruction as required.	<table border="1"> <thead> <tr> <th>TRAINEE RESPONSE</th> </tr> </thead> <tbody> <tr> <td> • Answer questions and explain issues asked by the instructor. • Demonstrate knowledge of -design related coating failures and remedies. -common paint failures and remedies. -causes and prevention of corrosion of metals found aboard ship. </td> </tr> </tbody> </table>	TRAINEE RESPONSE	• Answer questions and explain issues asked by the instructor. • Demonstrate knowledge of -design related coating failures and remedies. -common paint failures and remedies. -causes and prevention of corrosion of metals found aboard ship.
TRAINEE RESPONSE			
• Answer questions and explain issues asked by the instructor. • Demonstrate knowledge of -design related coating failures and remedies. -common paint failures and remedies. -causes and prevention of corrosion of metals found aboard ship.			

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TITLE <u>Corrosion Evaluation and Control</u>	COURSE <u>CC-Shop Technician</u>	UNIT <u>4</u>	LESSON NO. <u>3</u>
LEARNING OBJECTIVES		TRAINING AIDS/MATERIALS	
Trainees will be able to understand and use: 1. Maintenance Data System (MDS). 2. A systematic inspection, correction and prevention procedure for topside corrosion control. 3. Corrosion inspection guide, corrosion problem summary sheets and corrosion prevention plan.		Materials 1. One copy of Reference 1 (FFG-7 CI CC Manual) for every two trainees. 2. Examples of each of the NAVSEA-designated CC Systems. 3. 35mm slides; Surface Preparation. Note: Slides must be procured from local sources. Slide subject matter should illustrate typical surface preparation methods used both onboard ship and at IMAs. 4. Transparencies T:I-3-1 through T:I-3-6. 5. Overhead projector. 6. 35mm slide projector. 7. Chalk or dry erase markers for board. References 1. NAVSEA S9630-AG-MAN-010/FFG-7CL, Manual, Corrosion Control for FFG-7 Class, 30 November 1983. 2. OPNAVINST 4790.1A, Ship's Maintenance and Material Management (3-M) Manual, 27 August 1984. 3. COMNAVSURFPACINST 4700.1A CH-3, COMNAVSURFPAC Maintenance Manual, 25 May 1983. Handouts 1. Paper copies of Transparencies T:I-3-1 through T:I-3-6. 2. Chapter Three and Appendix A of Reference 1.	

* Marine Corrosion, Causes, Prevention and Control.

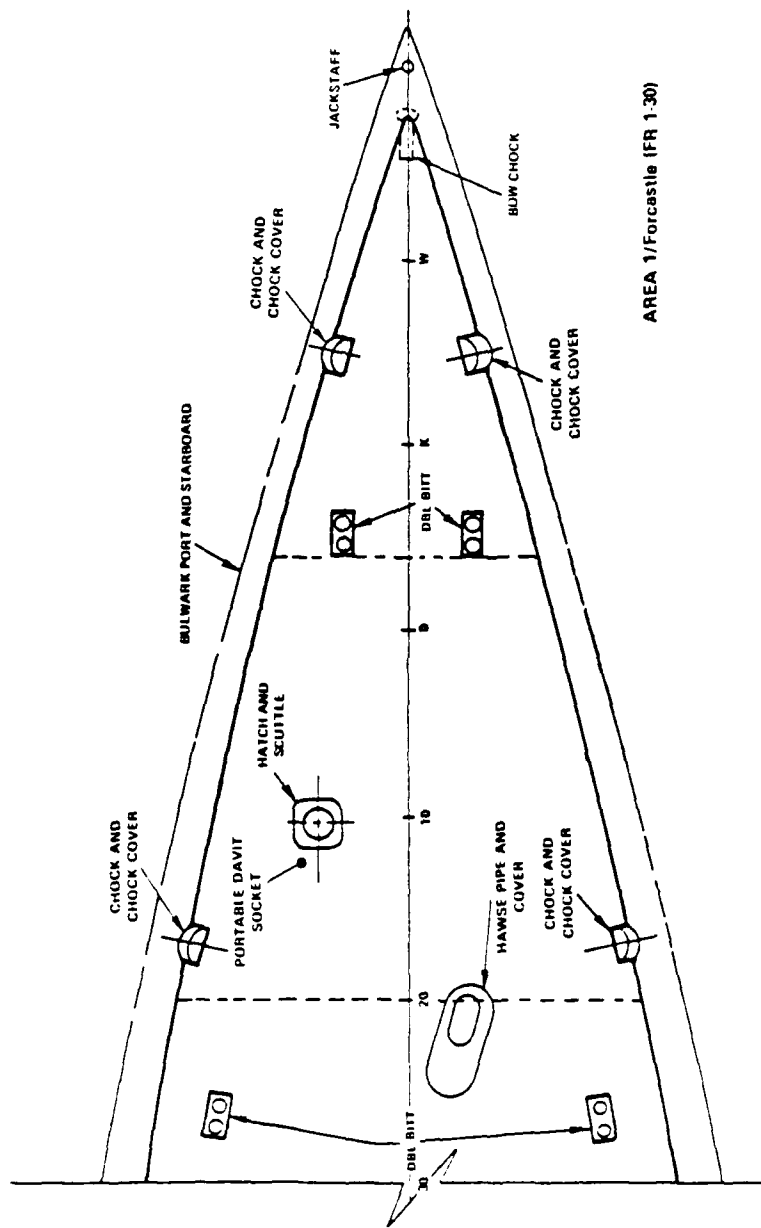
INSTRUCTOR PRESENTATION

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TITLE	Corrosion Evaluation and Control	COURSE	CC-Shop Technician	UNIT	1	LESSON NO.	3
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
EVALUATION AND TREATMENT OF CORROSION I. GENERAL A. In order to combat corrosion, there must be systematic: 1. inspection, 2. correction, and 3. prevention procedures. II. CORROSION HISTORY A. Controlling corrosion problems is highly dependent on reliable reporting of actual maintenance data from operating ships. 1. The Maintenance Data System (MDS) most important. (a) Primary means of sending reports from ship to NAVSEA tech codes. (b) Should be submitted every time a significant problem is identified, work accomplishment or maintenance deferred. III. INSPECTION GUIDE (Located in Each Ship-Class CC Manual) A. The Inspection Guide consists of drawings of sections of the topside structure. 1. Corrosion prone areas are highlighted. 2. Problem areas listed with their index numbers.				• Write instructor's name, date, lesson number and title on board.		1. Take notes. 2. Participate in class discussion and activities.	

TRAINING AID



AREA 1/Forecastle (FR 1-30)

INSTRUCTOR PRESENTATION

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TITLE Corrosion Evaluation and Control	COURSE CC-Shop Technician	UNIT 1	LESSON NO. 3	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
KEY POINTS/ACTIVITIES 3. Summary sheet provided with a corrective or preventive action guide. <u>b. Use of the Inspection Guide</u> - The supervisor responsible for a given area or piece of equipment. - Locates drawing required, - notes problem area(s) shown, - looks up problem summary sheets to determine exact nature of problem, - makes visual inspection of problem area(s) or equipment, - takes necessary treatment action. - When a new corrosion problem is found; - Locate the drawing that shows problem area(s) or equipment, - consult problem summary sheets and corrosion prevention plan for corrective and preventive action suggested. (For further explanation and information, refer to Chapter Three and Appendix A of your Ship-Class CC Manual). - If the corrosion problem is not covered in your Ship Class CC Manual, write up the problem and recommended fix (if you have one) on the NAVSEA (user) Technical Manual Deficiency/Evaluation Report (FMDEK). This blank form is the last page of your Ship Class CC Manual. Mail directly to the preprinted address (CO, NSWSES (Code 5700), Pt. Huenehue, CA 93043).		Show/discuss T:1-3-2 through T:1-3-5.			

S9630-AG-MAN-010/FFG-7CL

CORROSION PRONE AREAS	
AREA NUMBER/TITLE: AREA 1/Forecastle (FR 1-30)	
INDEX NUMBER	DESCRIPTION
0101	Hawse pipe cover
0102	Lifeline stanchion

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T-I-3-2

TRAINING AID

59610-A0-DAN-010/ETG-HLL

INOLEX NUMBER 0101

CORROSION PROBLEM SUMMARY SHEET

PROBLEM AREA OR COMPONENT: House pipe cover

TOPSIDE AREA OF OCCURRENCE: Area 01

TYPE OF CORROSION: Direct surface attack

TYPICAL EXTENT OF CORROSION: Light

FREQUENCY OF CORROSION: Low

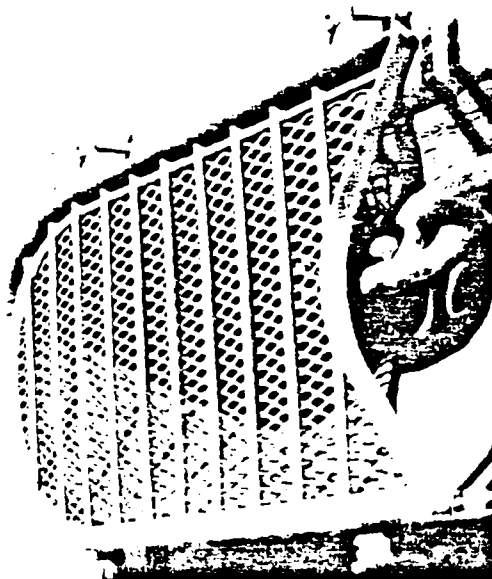
DESCRIPTION:

The house pipe cover is fabricated of expanded metal on a steel frame. The cover is exposed to occasional salt water immersion and frequent salt water spray. The expanded metal and supporting framework rusts and is difficult to maintain.

RECOMMENDED CORRECTIVE/PREVENTIVE ACTION:

Remove house pipe cover. Remove expanded metal from house pipe cover. Remove the drop bolt assemblies including staples. Install new CHS 316 alloy staples and drop bolt assemblies. Abrasive blast house pipe cover, the exposed surfaces of the house pipe, and six inches of adjacent deck to white metal finish. Prime bare blasted surface by applying Flame Sprayed Aluminum (FSA) and low temperature galvanneal expanded metal to the house pipe cover. Back weld expanded metal joints in accordance with Corrosion Prevention System (CPS) Two. Install new galvanized expanded metal to the house pipe cover, back weld expanded metal 1/2 inch every 6 inches around entire perimeter and on support angles. Preserve welded surface using FSA. Seal the FSA surfaces with low temperature sealer in accordance with CPS Two. Topcoat using epoxy polyamide paint in accordance with CPS Three U-1 or non-skid in accordance with CPS Five to match surrounding areas.

S96 10-AG-MAN-010; EFG-7CL



0101A. Hawse pipe cover and drop
bolt assemblies.

S9610-AG-MAN-010/FRG-7CL LIFE CYCLE CORROSION PREVENTION PLAN				INDEX NUMBER	0101
		DEPOT/IMA LEVEL (FULL INDUSTRIAL)	ORGANIZATIONAL LEVEL (SHIP)		
INITIAL INSTALLATION	Surface Preparation (Primary)	White metal finish (CPS 2)			
	(Alternative)				
	Metal Flame Spray	Flame Sprayed Aluminum (CPS 2)			
	Paint or Other (Primary)	*Topcoat of epoxy polyamide paint (CPS 3-M) *Install new bolt drop assembly.	Install new bolt drop assembly		
	(Alternative)	Topcoat with non-skid paint (CPS 5)			
SERVICE REQUIREMENTS				Inspect and repair as needed, semiannually	
SRA REQUIREMENTS		Inspect and repair as needed			
ROB REQUIREMENTS		Inspect and repair as needed			

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TITLE Corrosion Evaluation and Control		COURSE CC-Shop Technician	UNIT 1	LESSON NO 3
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
IV. CORROSION PREVENTION SYSTEMS A. There are fifteen (15) CC systems designated by NAVSEA to counter corrosion problems found aboard ship.				
SYSTEM NUMBER	METHOD			
1	WSA-High Temperature (1750F) + Heat-Resistant Aluminum Sealer and Topcoat (2-component paint schedule)			
2	WSA-Low Temperature (1750F) + Epoxy-Polyamide Sealer and Barrier Coats + Silicone-Alkyd Topcoats (5-component paint schedule)			
3	Coating Systems			
4	Electrostatically-Sprayed Powdered Coatings			
5	Non-Skid Deck Coating (Navy Approved)			
6	Ceramic Coatings (MIL-C-81751)			
7	Water-Displacing, Clear, Corrosion-Preventive Compound			
8	Thread Compound; Anti-Seize Compound (MIL-T-22361)			
9	Improved Fasteners			
10	Sealing and Coating Compound			
11	Polysulfide Sealant on Faying Surfaces			
12	Protection of Electrical Connectors			
13	Plastic Dielectric Barrier			
14	Vapor-Phase Inhibitor (VPI) (MIL-I-22110)			
15	Strippable Coatings			
		• Show/discuss T:1-3-6. • Define and discuss each system. • Show samples of each system.		

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<u>SYSTEM NUMBER</u>	<u>METHOD</u>
1	WSA-High Temperature (1750F) + Heat-Resistant Aluminum Sealer and Topcoat
2	WSA-Low Temperature (-1750F) + Epoxy Polyamide Sealer and Barrier Coats + Silicone Alkyd Topcoats
3	Coating Systems
4	Electrostatically-Sprayed Powdered Coatings
5	Non-Skid Deck Coating (Navy approved)
6	Ceramic Coatings (MIL-C-81751)
7	Water-Displacing, Clear, Corrosion-Preventive Compound
8	Thread Compound; Anti-Seize Compound (MIL-T-22361)
9	Improved Fasteners
10	Sealing and Coating Compound
11	Polysulfide Sealant on Paying Surfaces
12	Protection of Electrical Connectors
13	Plastic Dielectric Barrier
14	Vapor-Phase Inhibitor (VPI) (MIL-T-22110)
15	Strippable Coatings

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TITLE <u>Corrosion Evaluation and Control</u>		COURSE <u>CC-Shop Technician</u>	UNIT <u>1</u>	LESSON NO. <u>3</u>	
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
B. <u>Surface Preparation</u> 1. Surface preparation is most critical phase of coating process. 2. <u>Quality of surface preparation is the predominant factor in determining the effectiveness of the coatings applied.</u> (a) Surface must be free from contamination. (b) Surface must be roughened to the degree necessary to hold the coating applied (anchor tooth). 3. Grit blasting is the most effective method of surface preparation. (a) Hand chipping simplest but damages surface, not uniform, drives particles of contamination into surface. (b) Power tools adequate but also has problems. 4. Other considerations in surface preparation are: (a) Safety of personnel, (b) protection of surrounding area, (c) portability of equipment, and (d) environmental protection regulations related to air and/or water pollution.		• Show/discuss 35mm slides illustrating surface preparation methods.			

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TITLE <u>Corrosion Evaluation and Control</u>	COURSE <u>Cc-Shop Technician</u>	UNIT <u>1</u>	LESSON NO. <u>3</u>
PRACTICAL APPLICATIONS	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
- Summarize Lesson. - Question students on key points; repeat and amplify the instruction as required. - Have students demonstrate proper use of Appendix A, Topside Corrosion Inspection Guide, of the Ship Class CC Manual in the evaluation and treatment of corrosion.		- Answer questions and explain issues asked by the instructor. - Demonstrate knowledge and skill in using the Ship Class CC Manual Inspection Guide (Appendix A).	

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TITLE	CC Systems 1 and 2: WSA	COURSE	CC-Shop Technician	UNIT	1*	LESSON NO.	4
LEARNING OBJECTIVES				TRAINING AIDS/MATERIALS			
Trainees will be able to: 1. Discuss the similarities and differences of CC Systems 1 and 2. 2. Know which areas and items are approved for WSA by NAVSEA. 3. Know which system to use on approved areas and items. 4. Understand the processes and procedures for using CC Systems 1 and 2.				Materials: 1. Transparencies T:l-4-1 through T:l-4-10. 2. METCO 12E Wire Gun (one). 3. Overhead projector. 4. Chalk/marker, board and eraser. References: 1. NAVSEA S9630-AG-MAN-010/FFG-7CL, Manual, Corrosion Control for FFG-7 Class, 30 November 1983. 2. NAVSEA 59086-VD-STM-000, Chapter 631, Preservation of Ships in Service (NSTM631). 3. NAVSEA 59086-VD-STM-000, Chapter 634, Deck Coverings (NSTM634). Handouts: 1. DoD-STD-2138(SII), Metal Sprayed Coatings for Corrosion Protection Aboard Naval Ships, 23 November 1981. 2. SIMA(SD) Process Instruction, No. 7100-10-84 Rev 2, WSA for Corrosion Protection, NAVSEA CC Sys 1 and 2, September 1985. 3. NAVSEA 0655-AA-JPA-010, Job Performance Aid for Metal Sprayed Coating Systems, 30 May 1983. 4. Sections 4.3.1 and 4.3.2 of Reference 1 above. 5. Paper copy of transparencies used in this lesson.			

* Marine Corrosion, Causes, Prevention and Control.

INSTRUCTOR PRESENTATION

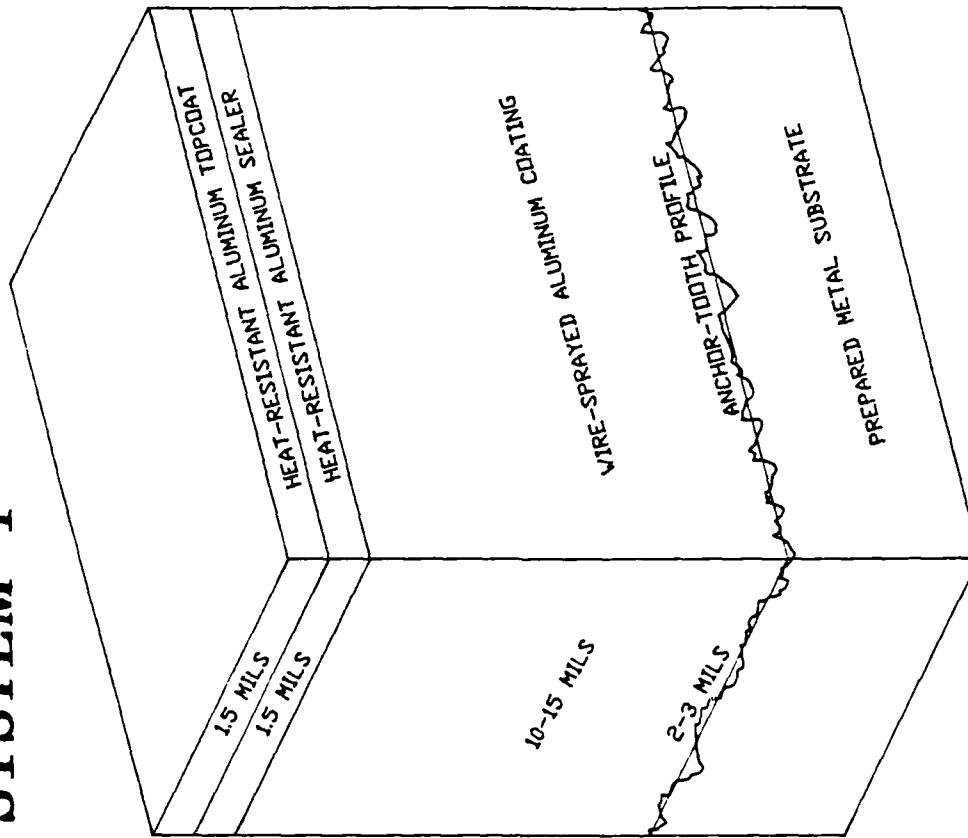
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TITLE CC Systems 1 and 2: WSA		COURSE CC-Shop Technician	UNIT 1	LESSON NO. 4
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		
L. SYSTEM DESCRIPTION A. Required for protection of steel where paints are not effective. WSA coating expected service life is seven (7) years in most applications. B. A coating of 99% pure aluminum is deposited on the surface to be protected by spraying in a molten state. - Coating is then sealed and topcoated with paint. - Resultant coatings system protects against corrosion. (a) The WSA provides a galvanic coating protection and, when sprayed to a "non-through-porosity thickness", barrier protection. (b) The WSA coating must be sealed and topcoated. 3. Two designated WSA systems are: - CC System 1: WSA with hi-temp sealer. - CC System 2: WSA with low-temp sealer/barrier/topcoat. C. Wire sprayed aluminum is applied by a hand-held flame spray gun. 1/8" or 3/16" 99% pure aluminum wire is drawn into the gun by a turbine, turned by compressed air. - The gun is supplied with controlled compressed oxygen and acetylene.		- Set up projector. - Write instructor's name, lesson number and title on board. - Handout copies of transparencies and copies of DoD-STD-2138(SII).		
		- Take notes. - Participate in class activities and discussion.		

TRAINING AID

NAVSEA CC SYSTEM 1

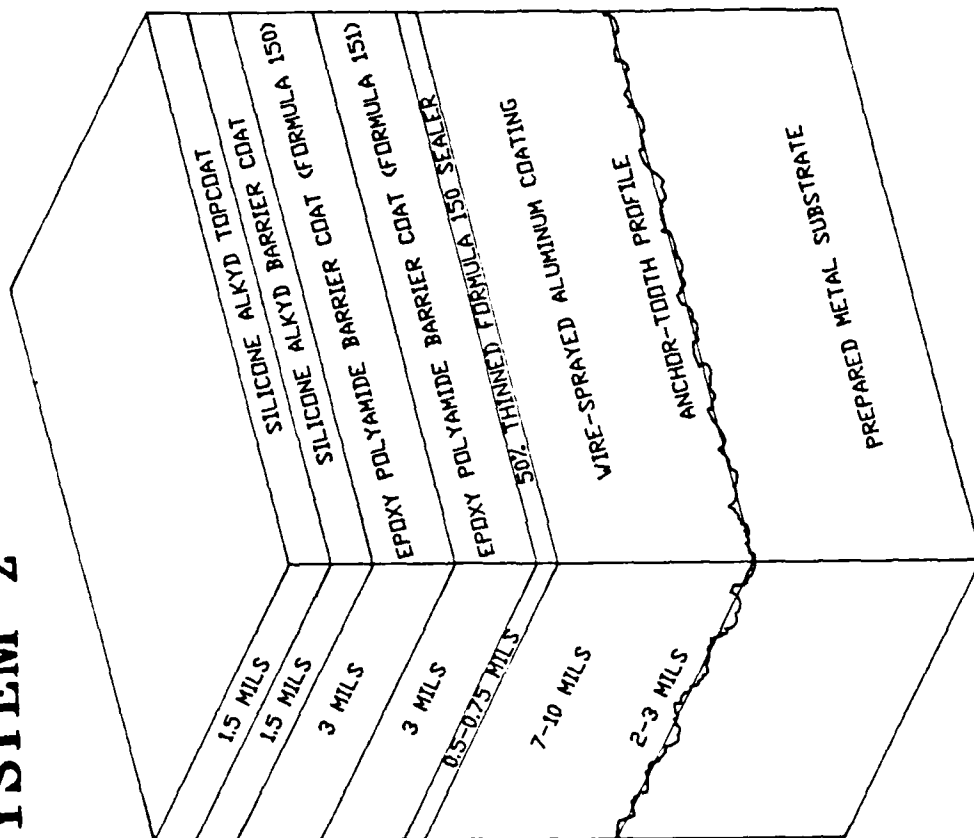


WIRE-SPRAYED ALUMINUM - HIGH TEMPERATURE

T:I-4-1

TRAINING AID

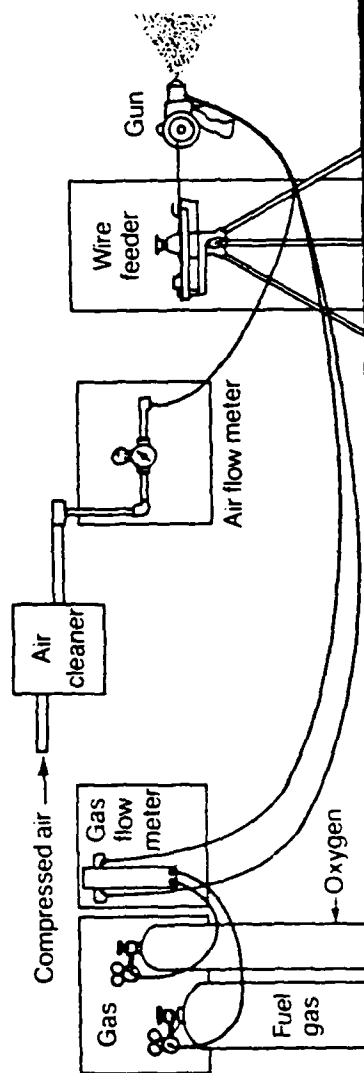
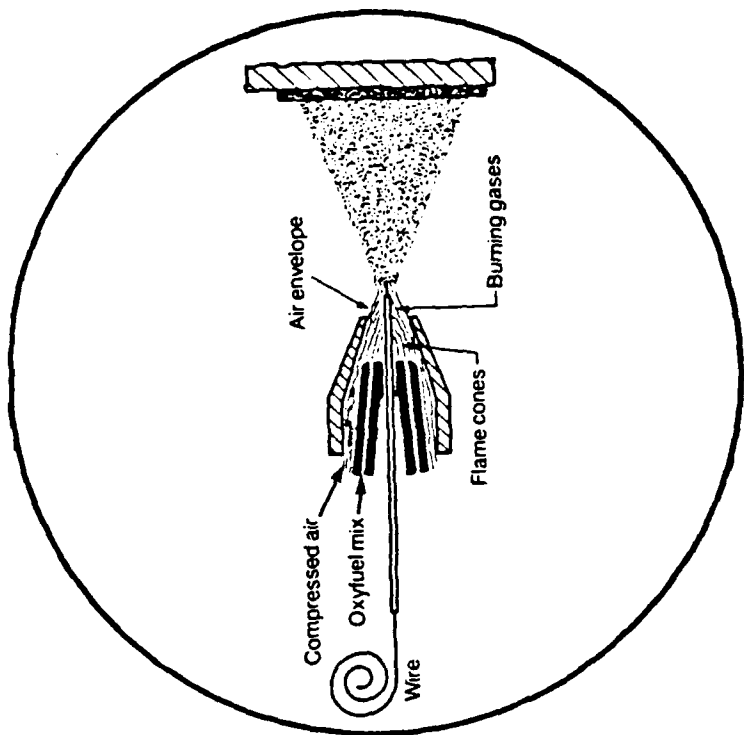
NAVSEA CC SYSTEM 2



WIRE-SPRAYED ALUMINUM - LOW TEMPERATURE

TRAINING AID

WIRE FLAME SPRAY



INSTRUCTOR PRESENTATION

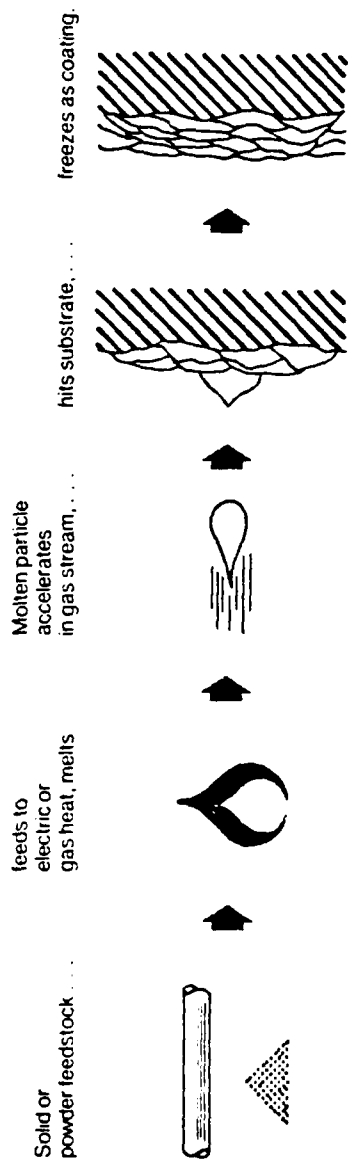
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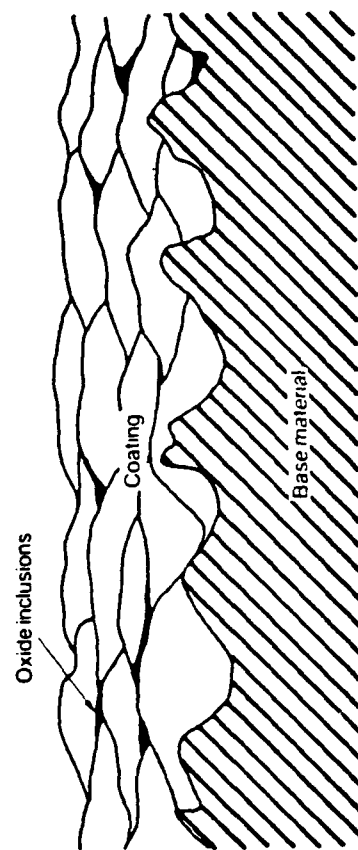
TITLE <u>CC Systems 1 and 2: WSA</u> COURSE <u>CC-Shop Technician</u> UNIT <u>1</u> LESSON NO. <u>4</u>			
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
3. The oxygen and acetylene combine in the gun and burn to form the flame necessary to melt the aluminum. 4. The molten aluminum is propelled to the surface by a stream of compressed air and solidifies into a protective coating upon contact. 5. Since the coating is porous, it must be sprayed to a non-through-porosity thickness (approximately 7 mils minimum) and sealed to fill the surface pores to minimize any open path through the aluminum to the surface of the item being protected. D. <u>For High-Temperature Applications:</u> 1. WSA is applied to a white-metal-blasted surface. 2. The WSA is applied 10- to 15-mils thick with crossing passes of 3- to 4-mils. 3. The WSA is then sealed/coated with two coats of heat-resistant aluminum paint (DoD-P-24555) 1.5 mils DFT per coat. 4. The first sealing coat must be applied within four (4) hours of spraying. 5. DoD-STD-2138(SII) is the governing document for WSA application.	<u>Note:</u> System described in more detail pages 24, 25 and 26. • Show/discuss T:I-4-4. • Show/discuss T:I-4-1.		

TRAINING AID

HOW THERMAL SPRAY COATING WORKS



A CLOSE-UP LOOK AT A THERMAL SPRAY COATING



INSTRUCTOR PRESENTATION

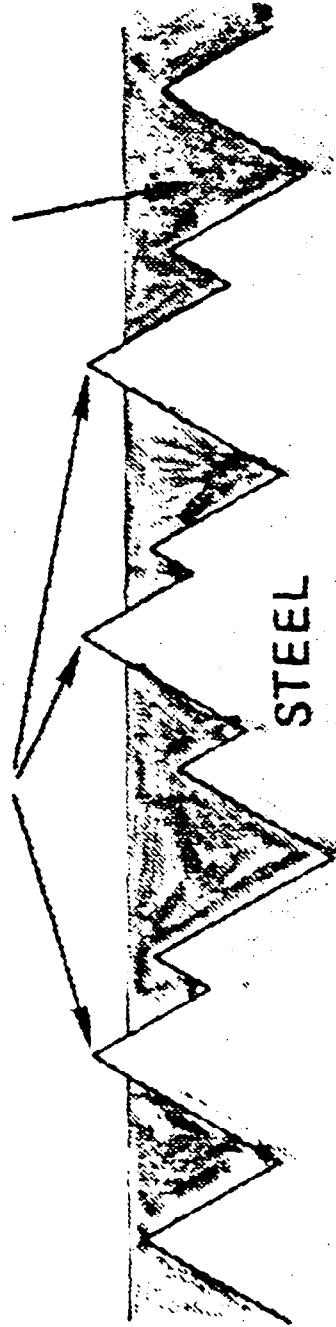
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TITLE	CC-Systems 1 and 2: WSA	COURSE	CC-Shop Technician	UNIT	1	LESSON NO.	4
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
E. <u>Significant Limitations</u> 1. Surface to be protected must be carefully prepared to a <u>white metal</u> standard. 2. Too thin a coating (less than 7 mils) will shorten the service life. 3. The aluminum will protect a steel surface over a long period of time; however, if a more noble metal such as copper or stainless steel is present (a) The aluminum will corrode rapidly, (b) the aluminum will fail prematurely. 4. The aluminum coating will not withstand heavy concentrations of chemicals, such as: (a) Strong cleaning solutions or, (b) acids.				• Show and pass around coupon with peeling WSA coating due to poor surface blasting. • Show/discuss T:1-4-5.		• Examine coupon.	
F. Wire sprayed aluminum is intended for selected application to external steel and aluminum alloy surfaces. 1. <u>Do not use WSA</u> on the following surfaces: • plastic, rubber, painted surfaces • internal surfaces of moving machinery (example: pump casings, valves, etc.) • brass, bronze, copper-nickel, or monel surfaces				• Show T:1-4-6. Discuss and explain reasons why components listed cannot be WSA coated.			

PINPOINT RUSTING

RUSTING WILL OCCUR HERE COATING



STEEL

TRAINING AID

DO NOT WIRE SPRAY

- (a) Plastic, rubber, painted surfaces.
- (b) Internal surfaces of moving machinery (example: pump casings, valves, etc.).
- (c) Brass, bronze, copper-nickel, or monel surfaces.
- (d) Stainless steels, 17-4PH, 15-4PH.
- (e) Surfaces subject to strong acids or bases (example: aircrafts catapult slides).
- (f) Threads of fasteners.
- (g) Valve stems.
- (h) Within 20 mm (3/4 inch) of surfaces to be welded.
- (i) Steel alloys with yield strength greater than 827.4 megapascals (MPa) (120,000 lb/in²).
- (j) Nonskid deck coatings (except as approved by NAVSEA for research and development evaluation).
- (k) Exterior underwater hull surfaces.
- (l) Sanitary tanks interior.

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TITLE <u>CC Systems 1 and 2: WSA</u>	COURSE <u>CC-Shop Technician</u>	UNIT <u>1</u>	LESSON NO. <u>4</u>
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
• stainless steels, 17-4PH, 15-4PH • surfaces subject to strong acids or bases (example: aircraft catapult slides) • threads of fasteners • valve stems • within 3/4 inch of surfaces to be welded • steel alloys with yield strength greater than 120,000 lb/in² • non-skid deck coatings • exterior underwater hull surfaces • sanitary tanks interior 2. DoD-STD-2138(SH) defines three categories for WSA applications. The component authorized in these three categories are: <u>Category 1. Machinery Space Components</u> Aluminum coating 10 to 15 mils thick: • low pressure air piping • steam valves, piping and traps (except steam turbine control valves) • auxiliary exhaust (such as stacks, mufflers and manifold) • air ejection valves	• Show/discuss T:1-4-7.		

TRAINING AID

DOD - STD - 2138(SH) APPROVED

Category L Machinery Space Components

Aluminum coating 10 to 15 mils thick:

- low pressure air piping
- steam valves, piping and traps (except steam turbine control valves)
- auxiliary exhaust (such as stacks, mufflers and manifold)
- air ejection valves

T:I-4-7

INSTRUCTOR PRESENTATION

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TITLE <u>CC-Systems 1 and 2: WSA</u> COURSE <u>CC-Shop Technician</u> UNIT <u>1</u> LESSON NO. <u>4</u>			
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
<u>Category II. Topside Weather Equipment</u> Aluminum coating 7 to 10 mils thick: • aircraft and cargo tie downs • aluminum helo decks • stanchions • scupper brackets • deck machinery casings and foundations • chocks, bitts and cleats • pipe hangers • capstans/gypsy heads (except wear area) • rigging fittings (blocks and hooks) • fire station hardware • lighting fixtures and brackets		• Show/discuss T:I-4-8 and T:I-4-9.	

TRAINING AID

D O D - S T D - 2 1 3 8 (S H) A P P R O V E D

Category II Topside Weather Equipment

Aluminum coating 7 to 10 mils thick:

- aircraft and cargo tie downs
- aluminum helo decks
- stanchions
- scupper brackets
- deck machinery casings and foundations
- chocks, bitts and cleats
- pipe hangers
- capstans/gypsy heads (except wear area)
- rigging fittings (blocks and hooks)
- fire station hardware
- lighting fixtures and brackets

TRAINING AID

D O D - S T D - 2 1 3 8 (S H) A P P R O V E D

Category III Interior Wet Spaces

Aluminum coating 7 to 10 mils thick:

- decks in wash rooms and water closets
- pump room deck and equipment support foundations
- turnstile
- fan room decks and equipment support foundations
- water heater room decks and equipment support foundations
- air conditioning room decks and equipment support foundations
- deck plate supports
- machinery foundations
- boiler air casings (skirts)

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TITLE CC Systems 1 and 2: WSA		COURSE CC-Shop Technician	UNIT 1	LESSON NO. 4
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
II. OVERVIEW OF THE WSA COATING SYSTEM PROCESS A. <u>Process Instruction</u> • SIMA Production Flow Chart is the "schematic diagram" of the industrial process. It shows all the necessary:		• Show/discuss T:I-4-10.		
• The production and quality control (QC) Process Instruction.		• Trainee will learn the functional flow of all the production and QC procedures in detail and given OJT in Unit II WSA Equipment and Application.		
B. <u>Major Production Phases</u> 1. Surface Preparation 2. Masking 3. Anchor-Tooth Blasting 4. Thermal Spraying 5. Sealing/Barrier/Topcoating		• Introduce with details to follow later in this lesson. Skill training in Unit II. • The WSA JPA (Handout #3) is your "textbook" for WSA application.	• Open SIMA(SD) Process Instruction to Figure 3, Production Flow Chart.	

TRAINING AID

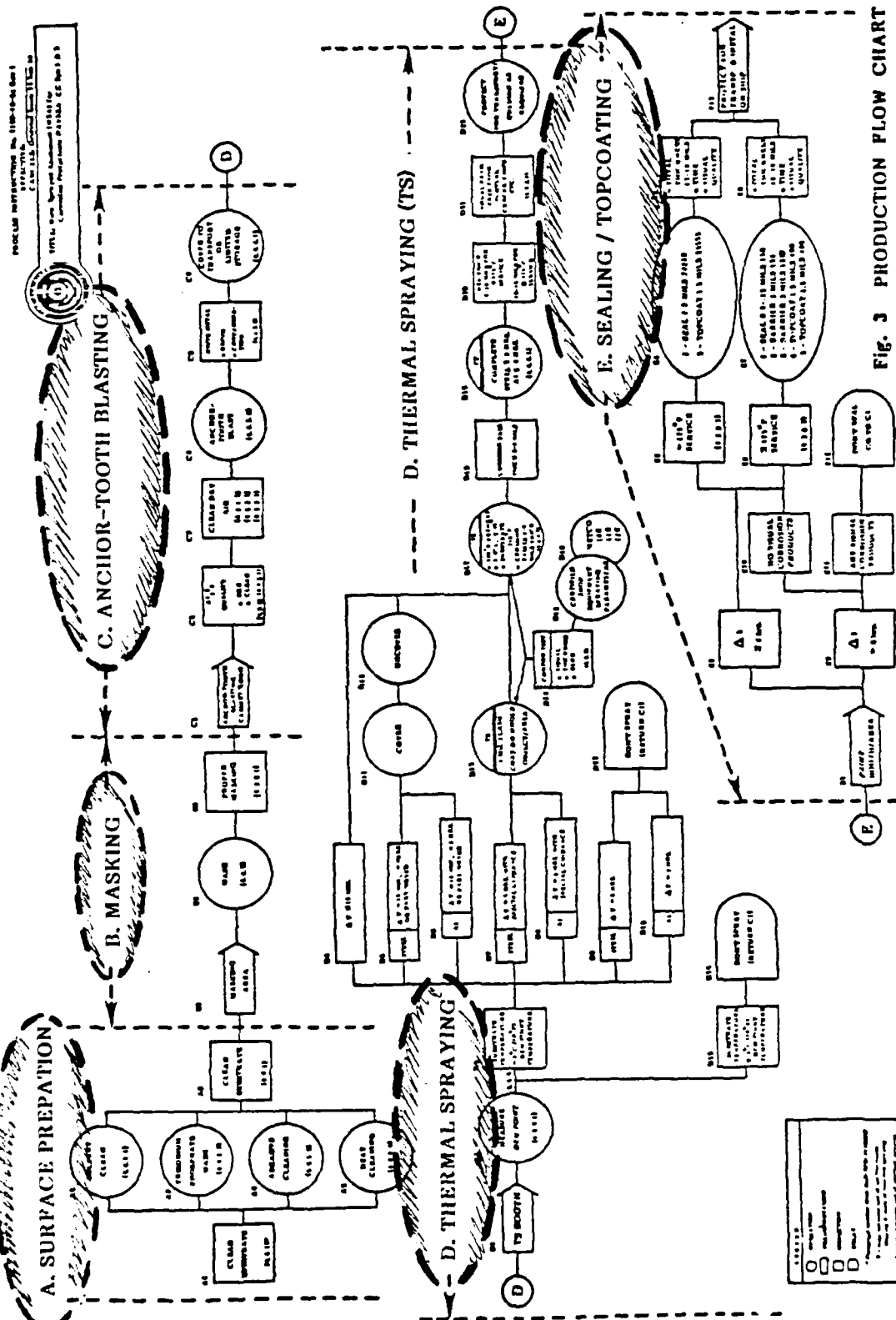


Fig. 3 PRODUCTION FLOW CHART

INSTRUCTOR PRESENTATION

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TITLE <u>CC Systems 1 and 2: WSA</u>	COURSE <u>CC-Shop Technician</u>	UNIT <u>1</u>	LESSON NO. <u>4</u>
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
III. SURFACE PREPARATION: DEGREASING AND ABRASIVE BLASTING A. The most effective and preferred method of removing scale, rust, etc. and preparing metal surfaces for coatings is abrasive or "grit blasting". 1. Equipment for "blasting" is normally available at the depot and IMA facilities. B. Abrasive blasting <u>does not</u> remove grease and oil. 1. Remove grease, oil and other contaminants from the item surface by solvent cleaning prior to blasting. (a) If excessive, a trisodium phosphate (TSP) solution may be used before solvent cleaning. (b) Solvent cleaning may be done by wiping, brushing or spraying with toluene or trichloroethane. (c) Precautions must be taken to protect parts that may be attacked by the solvents. (d) Surfaces cleaned with TSP should be rinsed with clean potable water and dried after solvent cleaning. 2. Surfaces that are not to be "blasted" must be heavily masked or plugged prior to blasting. 3. Interior of machinery, hydraulic equipment and other components must be protected to prevent contamination by the abrasive or removed rust particles.			

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TITLE CC Systems 1 and 2: WSA	COURSE CC-Shop Technician	UNIT 1	LESSON NO. 4
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
4. For WSA, the blasted surface must have a <u>white-metal</u> blasted surface with an anchor-tooth (not peened) surface profile of 2-3 mils. (a) White metal is defined (SSPC-SP5) as a grey white uniform metallic color, slightly roughened to form a suitable anchor pattern for coatings. (b) Various abrasives may be used for initial cleaning and removal of heavy deposits. (c) For anchor tooth blasting, the abrasives must meet DoD-STD-2138(SH) requirements which specifies 16-30 mesh aluminum oxide grit for steel or aluminum surfaces or a 25-40 mesh angular chilled iron grit for steel. (d) Carbon steel grit or shot must never be used on aluminum because particles of dissimilar metal will become imbedded in the aluminum and cause further corrosion. (e) Surface must be free from all grease, dirt, etc. (f) Surface profile must be validated (measured) with a profile tape and a dial micrometer. (g) Prepared surfaces must be handled with <u>clean</u> gloves, rags or slings. C. Apply WSA coating within specified times after blasting if there is no visible oxidation; an unprotected blasted surface will corrode rapidly 1. WSA must be started within four (4) hours after the anchor-tooth preparation and completed within six (6) hours for steel items.			

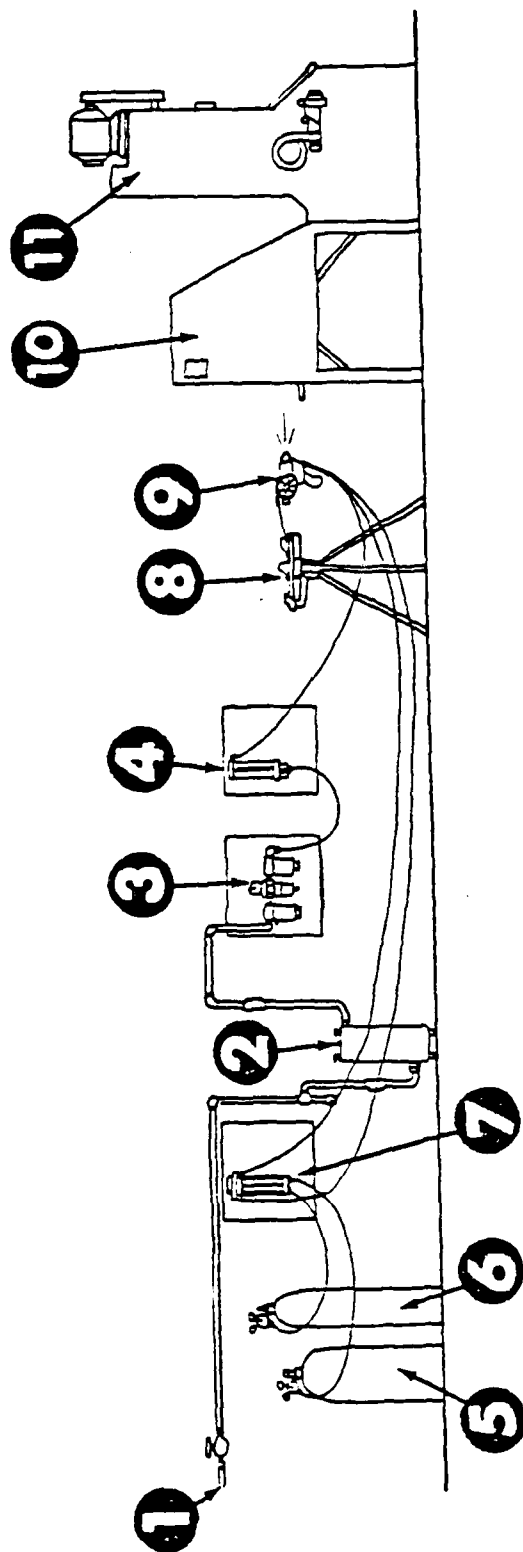
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TITLE	C/C Systems 1 and 2: WSA	COURSE	CC-Shop Technician	UNIT	I	LESSON NO.	4
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
2. WSA on aluminum must be started within two (2) hours after anchor-tooth preparation and completed within four (4) hours. 3. No WSA spraying will be conducted if the temperature is not at least ten (10°F) degrees above the dew point temperature. 4. If elapsed time between anchor tooth and WSA is more than 15 minutes but less than four (4) hours or the item is going to be moved to another location, the anchor tooth surface must be protected from: (a) moisture (b) contamination (c) fingerprints 5. Wrapping in clean paper usually will provide adequate protection up to four (4) hours. (a) For over four (4) hours, a flash coat of WSA (at least 1 mil thick) will protect the surface until final WSA applied. (b) If the period of time exceeds 6 hours for steel or 4 hours for aluminum, the surface must be reblasted. IV. DESCRIPTION OF WSA EQUIPMENTS Wire Flame Spray (10E-12E): Handheld gun producing combustion flame spray coating with metallizing wires. The gun can be mounted on a simple post for stationary work. Operation of the gun requires the following equipment:				• To be repeated in detail in Unit II training. • Discuss page 46 figure in JPA (Handout #3). T:1-4-11.			

TRAINING AID



COMPLETE FLAME SPRAY INSTALLATION

A flame spray installation consists of:

- (1) Compressed Air Line
- (2) Air Cleaner Unit
- (3) Air Control Unit
- (4) Air Flow Meter
- (5) Acetylene Gas Cylinder

- (6) Oxygen Gas Cylinder
- (7) Gas Flow Meter
- (8) Wire Control Unit
- (9) Flame Spray Gun
- (10) Flame Spray Booth
- (11) Wet Collector

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TITLE CC Systems 1 and 2: WSA		COURSE CC-Shop Technician	UNIT 1	LESSON NO. 4
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
1. <u>Compressed-air line</u> with dry air. 2. <u>Air Cleaner</u>: condenses water vapor and removes it. 3. <u>Air-Control Unit</u>: filters compressed air and controls pressure to gun. 4. <u>Air Flowmeter</u>: shows flow of air to help maintain exact spraying conditions. 5. <u>Acetylene Gas Cylinder and Regulator Gauge</u>: the fuel gas. 6. <u>Oxygen Gas Cylinder and Regulator Gauge</u>: the oxidizing gas. 7. <u>Gas Flowmeter</u>: indicates the flow of oxygen and fuel gas to gun. 8. <u>Wire Control Unit</u>: holds coiled wire and straightens it as it enters gun. 9. <u>Flame Spray Gun</u>: with three hoses, black for air, green for oxygen and red for fuel gas in conjunction with flow meter. 10. <u>Flame-Spray Booth</u>: to collect the overspray. 11. <u>Wet Collector</u>: a water wash to remove the overspray from the exhaust air. V. EQUIPMENT SET-UP 1. Inspect all hoses and fittings to insure there is no dirt, oil, grease or other obstructions.		• T:I-4-11		

INSTRUCTOR PRESENTATION

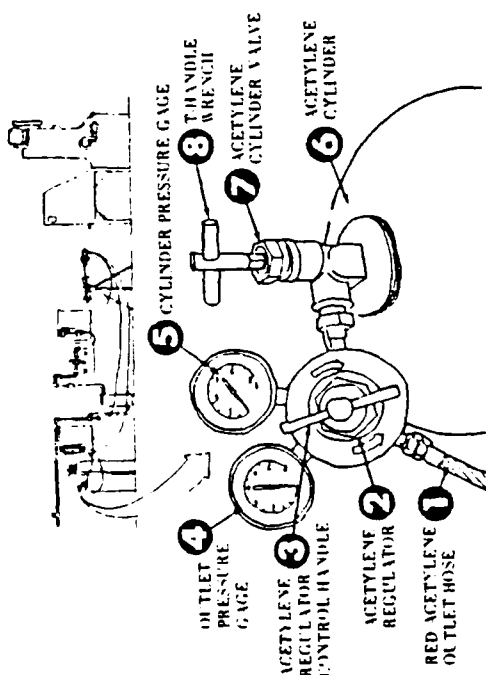
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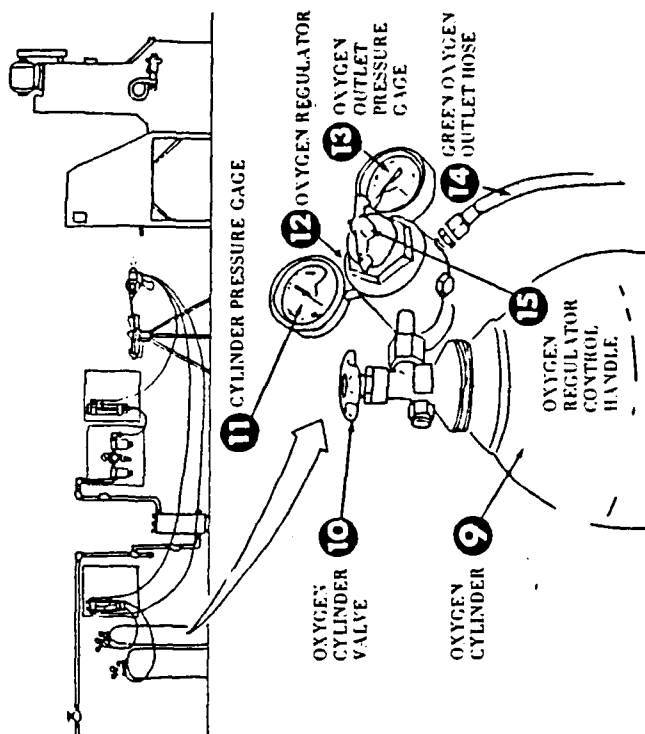
TITLE CC Systems 1 and 2: WSA		COURSE CC-Shop Technician	UNIT 1	LESSON NO. 4									
KEY POINTS/ACTIVITIES			TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE									
2. Connect hoses to gun: (a) Green hose is oxygen line and connects to the center fitting of the hose connection block. (b) Red hose is fuel line (for acetylene) and connects to the smaller fitting (next to the green hose). (c) Black hose is for the air. This connects to the remaining larger fitting on the gun. Tighten all fittings with a 6" adjustable open-end wrench. 3. Hook up pressure regulators to bottles. 4. Connect lines to regulators. 5. Open bottle valves and set pressures on regulators: <table><tr><td></td><td><u>10E Gun</u></td><td><u>12E Gun</u></td></tr><tr><td>(a) <u>Oxygen</u></td><td>60 psi</td><td>70 psi</td></tr><tr><td>(b) <u>Acetylene</u></td><td>15 psi</td><td>35 psi</td></tr></table> 6. Perform "drop test".				<u>10E Gun</u>	<u>12E Gun</u>	(a) <u>Oxygen</u>	60 psi	70 psi	(b) <u>Acetylene</u>	15 psi	35 psi	• T1-4-12	
	<u>10E Gun</u>	<u>12E Gun</u>											
(a) <u>Oxygen</u>	60 psi	70 psi											
(b) <u>Acetylene</u>	15 psi	35 psi											

TRAINING AID

← ACETYLENE



OXYGEN →



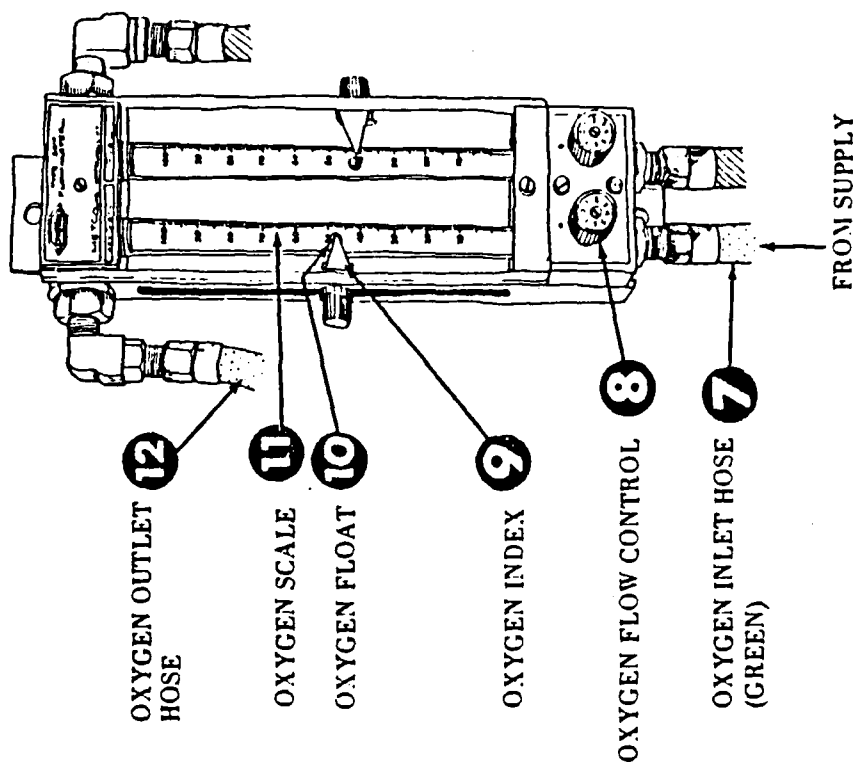
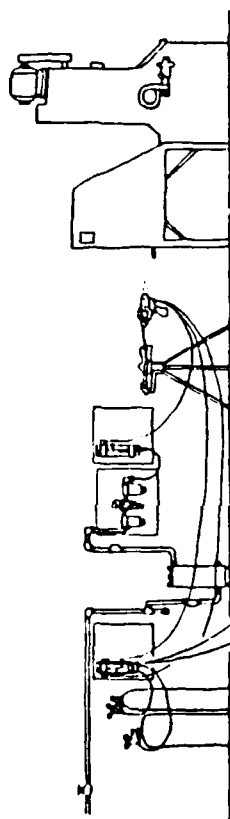
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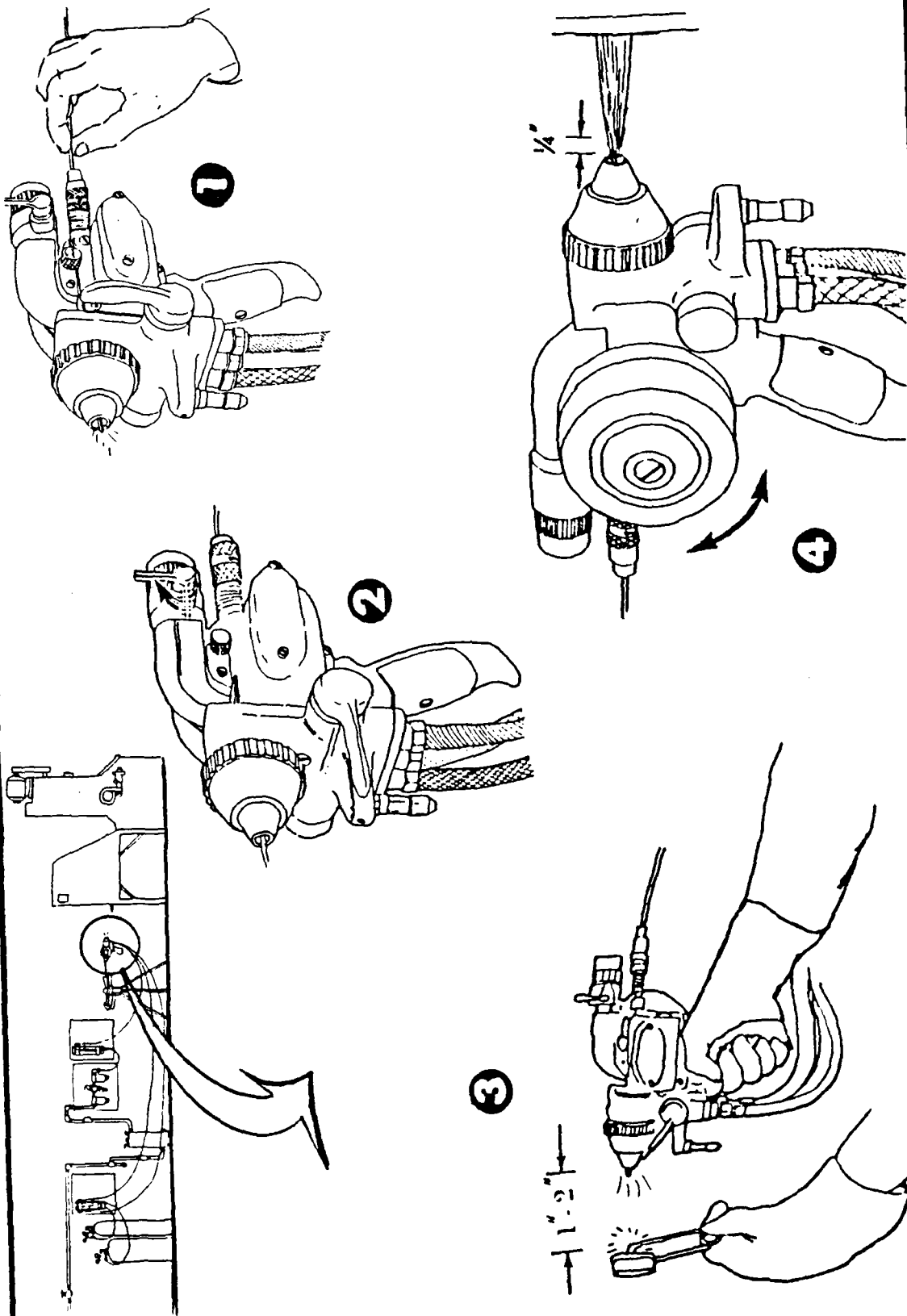
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TITLE CC Systems 1 and 2: WSA		COURSE CC-Shop Technician	UNIT 1	LESSON NO. 4												
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE													
7. Open gas head valve on gun to "full open" position and set flow rates: <table><thead><tr><th></th><th>10E Gun</th><th>12E Gun</th></tr></thead><tbody><tr><td>(a) <u>Oxygen</u></td><td>44 CFM</td><td>43 CFM</td></tr><tr><td>(b) <u>Acetylene</u></td><td>40 CFM</td><td>40 CFM</td></tr><tr><td>(c) <u>Air</u></td><td>53 CFM</td><td>52 CFM</td></tr></tbody></table>			10E Gun	12E Gun	(a) <u>Oxygen</u>	44 CFM	43 CFM	(b) <u>Acetylene</u>	40 CFM	40 CFM	(c) <u>Air</u>	53 CFM	52 CFM	T:1-4-13.		
	10E Gun	12E Gun														
(a) <u>Oxygen</u>	44 CFM	43 CFM														
(b) <u>Acetylene</u>	40 CFM	40 CFM														
(c) <u>Air</u>	53 CFM	52 CFM														
8. Close gas head valve and insert wire into gun through snubber assembly and gun until about 1/4" of wire is sticking out of nozzle. (<u>Never</u> light gun <u>without</u> wire sticking out). 9. Turn gas head valve to "full open" position for a few seconds, then shut down (about 45°) to the "light" position. Light with a striker, sparking about 1 to 2 inches to the front and side of the nozzle. As soon as gun lights, <u>immediately</u> open gas head valve to full open. 10. Adjust wire speed until about 1/4 inch of wire is sticking out of nozzle, turning wire grip valve on and rotating speed control ring.		T:1-4-14.														
VL GUN OPERATION (10E and 12E) 1. To prepare for spraying, turn wire grip valve to "off" position and using blue flame preheat part to be sprayed. 2. Turn wire grip valve back on and begin spraying, keeping gun at a 90° angle to the spray area and 5" to 8" from surface being sprayed.		- T:1-4-14. - Demonstrate correct spraying procedure with 12E Gun.														

TRAINING AID



TRAINING AID



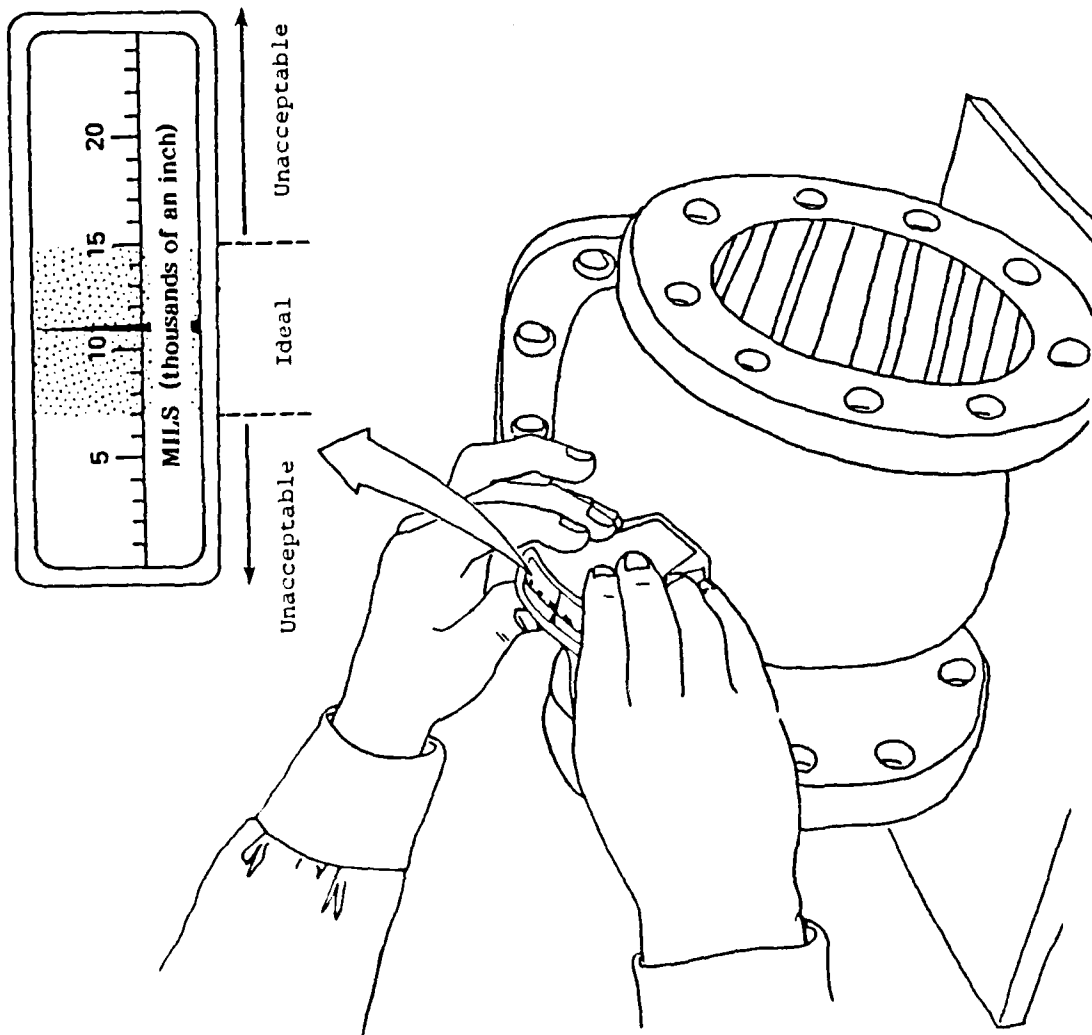
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TITLE	CC Systems 1 and 2: WSA	COURSE	CC-Shop Technician	UNIT	I	LESSON NO.	4
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
3. Use a "cross pattern" when spraying. Spray in either a horizontal or vertical pattern for the first coat, and then in the opposite direction for the second, to ensure uniform coverage.							
4. Measure thickness with elcometer to ensure compliance to specifications.							
VII HEALTH AND SAFETY PRECAUTIONS							
A. The following items are only a few of the health and safety precautions listed in NSTM Chapter 631/634. Refer to NSTM Chapter 631 Section 2 and NSTM Chapter 634 Section 3 for more complete coverage of health and safety precautions.							
1. When using cleaning solvents (toluene or trichloroethane) the following safety related items should be observed:							
(a) Shipping containers are marked to indicate dangerous or safety related items; these labels should be read prior to using the solvent and the stated precautions followed in their use.							
(b) Toluene vapor is flammable - keep away from heat, sparks and open flame.							
(c) Toluene and trichloroethane vapors are harmful and can be fatal - use only in adequate ventilation. Avoid prolonged breathing of vapor.							
(d) Avoid prolonged or repeated contact with skin.							
				T-1-4-15.			
				Detailed equipments operation, maintenance, troubleshooting and repair will be presented in Unit II training.			

TRAINING AID



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TITLE CC Systems 1 and 2: WSA	COURSE CC-Shop Technician	UNIT 1	LESSON NO. 4
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
2. Safety precautions for abrasive blasting are covered by NSTM 631 and include such items as avoiding explosion hazards, use of safety goggles, face shields, protective clothing and hearing protectors. 3. When using WSA equipment (a) All connections should be checked for tightness before the system is operated. (b) THE GUN IS A BURN HAZARD AND MUST BE HANDLED CAREFULLY. (c) Shaded safety goggles and ear plugs must be worn during spraying operations. (d) Adequate ventilation must be provided. (e) Spraying should never be done in the vicinity of combustible materials. (f) A fire watch must be provided. (g) Personnel in the area must also be protected. 4. When using spray-painting equipment: (a) Spray painters shall wear protective clothing that fit snugly at the ankles, neck and wrists. (b) Gloves and filter-type respirators must also be worn while spraying or mixing. (c) NEVER INHALE THE MIST FROM THE SPRAY GUN.			

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TITLE <u>CC Systems 1 and 2: WSA</u>		COURSE <u>CC-Shop Technician</u>		UNIT <u>I</u>	LESSON NO. <u>4</u>
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
5. Personnel mixing paints should: (a) Wear solvent-resistant synthetic rubber or plastic gloves and apron. (b) Keep sleeves rolled down. (c) Wear NIOSH-approved respiratory protection when air sampling data indicates vapor and solvent concentration exceeds limit values and/or cannot be controlled by ventilation.		• NSTM Ch 631/634 and DoD-STD-2138(SH) contain all the required safety information.			

INSTRUCTOR FOLLOW-UP-THROUGH

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TITLE <u>CC Systems 1 and 2: WSA</u>		COURSE <u>CC-Shop Technician</u>		UNIT <u>I</u>	LESSON NO. <u>4</u>
PRACTICAL APPLICATIONS	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE			
- Summarize Lesson. - Question students on key points; repeat and amplify the instruction as required.		- Answer questions and explain issues asked by the instructor. - Demonstrate knowledge through discussion of: -similarities/differences of CC Systems 1 and 2, -need for proper surface preparation, -WSA equipment and application process, -sealing/topcoating, and -quality control and end-item inspection.			

INSTRUCTOR PREPARATION

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TITLE <u>CC Systems 3: Paints</u>		COURSE <u>CC-Shop Technician</u>	UNIT <u>1</u>	LESSON NO. <u>5</u>
LEARNING OBJECTIVES		TRAINING AIDS/MATERIALS		
Trainees will know and understand - How to store, mix, prepare and use safely epoxy-polyamide paint and silicone alkyd paint. - The type, number and thickness of each coat to apply as determined by material and shipboard location.		Materials: - Examples: items coated in accordance with T:I-5-2. 35mm slides: mixing epoxy-polyamide paints, coating applications and spraying techniques. Note: Slides and examples must be procured from local sources. - Transparencies: T:I-5-1 through T:I-5-14 35mm slide projector. - Overhead projector. - Chalk/marker, board and eraser. References: - NAVSEA S9630-AG-MAN-010/FFG-7C1, Manual, Corrosion Control for FFG-7 Class, 30 November 1983. - NAVSEA 59086-VD-STM-000, Chapter 631, <u>Preservation of Ships in Service</u> (NSTM 631). - Steel Structures Painting Manual, Volumes I and II, Steel Structures Painting Council, June 1983. Handouts: - Copies of transparencies T:I-5-1 through T:I-5-14. - Section 4.3.3 and Appendix D with Figures 4-15 and 4-16 corrected to show a 50% thinned Formula 150 as the sealer coat. CC Shop: - Tour of the Painting Station in the CC Shop. 14 Hours OJT in the Painting Station.		

* Marine Corrosion, Causes, Prevention and Control

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Lesson Plan

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TITLE CC Systems 3: Paints		COURSE CC-Shop Technician	UNIT 1	LESSON NO. 5
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
L. SYSTEM III DESCRIPTION and PAINTS A. System Three consists of paint systems that are used in the recoating of topside areas. 1. The type, number and thickness of each coat is determined by: (a) material (b) location B. Epoxy-Polyamide Paint (MIL-P-24441) is the standard coating system used for topcoats. 1. Epoxy-Polyamide Paint is designed to provide a (a) high dielectric, (b) hard, (c) durable, (d) chemical resistant, and (e) non-porous coating. 2. Epoxy-Polyamide paint provides (a) a superior barrier and (b) exceptional service in wet areas.		- Set up projectors. - Write instructor's name, lesson number and title on board. -----	- Take notes. - Participate in class discussion and activities.	

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KEY POINTS/ACTIVITIES			TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
3. Epoxy-Polyamide paint differs from conventional paints in that each formula consists of two (2) components: (a) Polyamide - marked Component A (b) Epoxy - marked Component B (c) Both components <u>must</u> be mixed together. 4. The Epoxy System is applied in three (3) coats. However, epoxy coatings are moderately sensitive to light and are subject to: (a) mottling and (b) chalking 5. Silicone Alkyd paints are frequently used as the third (final) coat instead of epoxy. 6. Epoxy paint formulations suitable for priming barrier and exterior topcoats are:			- Continue discussion and expand. - Show T-1-5-1; explain, discuss and cite examples where used.	

TRAINING AID

Epoxy paint formulations suitable for priming and exterior top coats are:

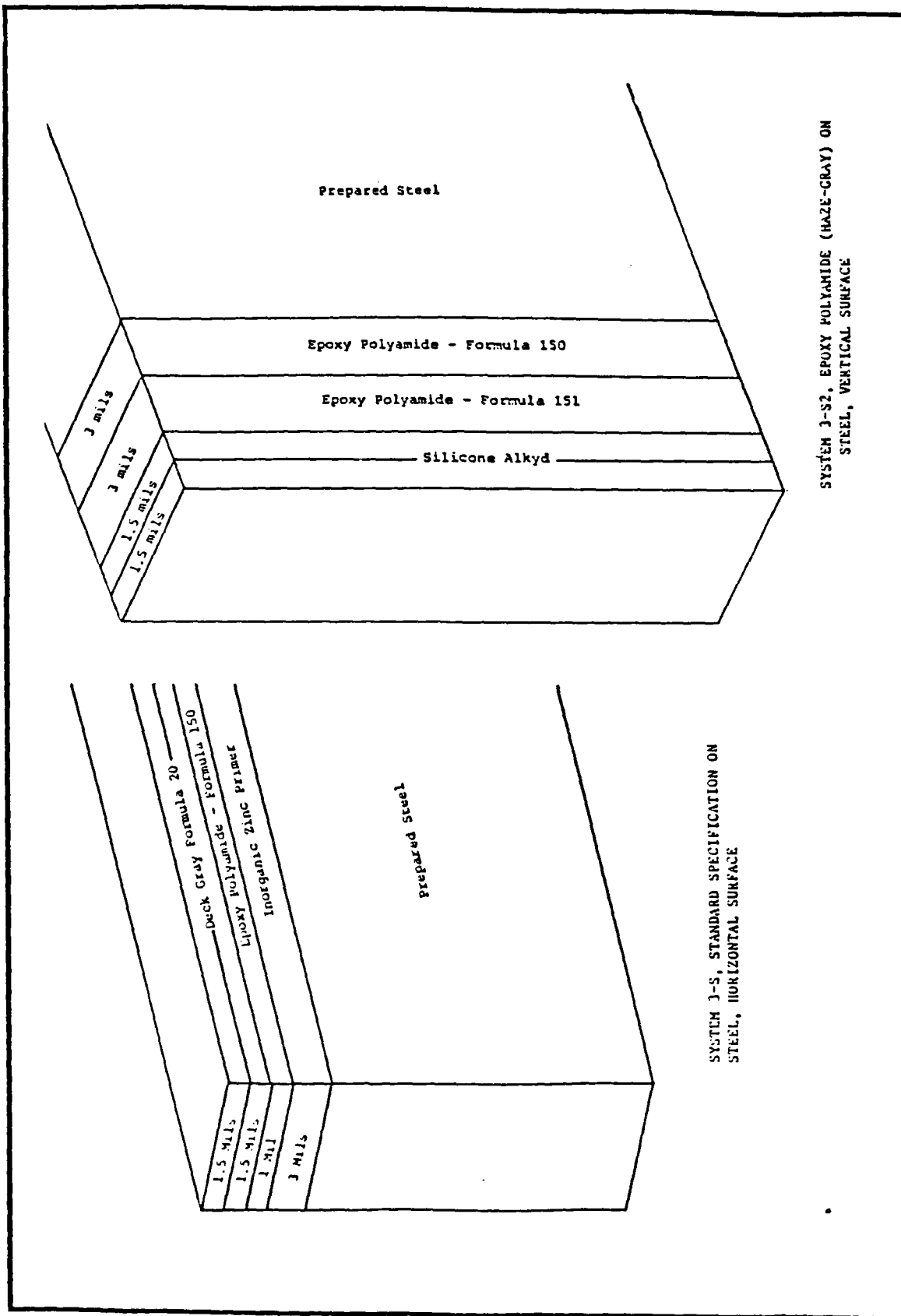
<u>FORMULA NUMBER</u>	<u>COLOR</u>	<u>TYPE</u>
150	Green	Primer
151	Haze Gray #27	Top Coat
152	White	Top Coat
153	Black	Top Coat
154	Very Dark Gray	Top Coat
155	Dark Gray	Top Coat
156	Red	Top Coat

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TITLE CC Systems 3: Paints		COURSE CC-Shop Technician	UNIT 1	LESSON NO. 5
KEY POINTS/ACTIVITIES			TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
<u>FORMULA NUMBER</u>	<u>COLOR</u>	<u>TYPE</u>	Continue discussion.	
150	Green	Primer		
151	Haze Gray #27	Top Coat		
152	White	Top Coat		
153	Black	Top Coat		
154	Very Dark Gray	Top Coat		
155	Dark Gray	Top Coat		
156	Red	Top Coat	Show/discuss T:1-5-2	
II. STANDARD COATINGS FOR TOPSIDE AREAS (VERTICAL and HORIZONTAL SURFACES): A. Primer Coats (1) Inorganic zinc coated steel (a) One (1) mist coat of 151 @ about one (1) mil dft on vertical surface. (b) One (1) mist coat of 150 of about one (1) mil dft on horizontal surfaces.				



INSTRUCTOR PRESENTATION

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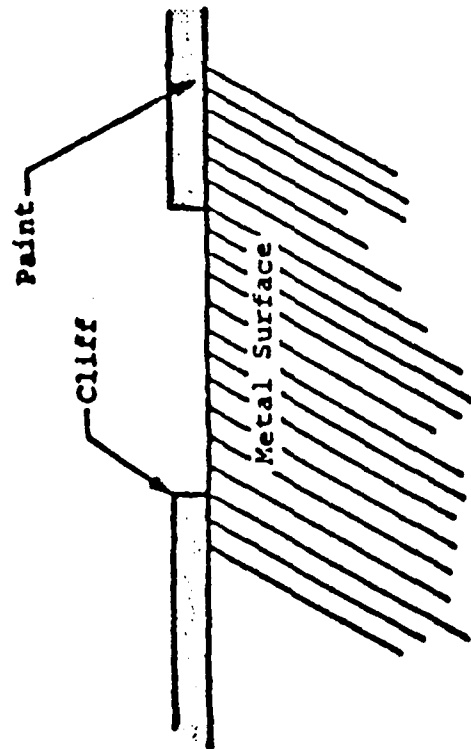
TITLE <u>CC Systems 3: Paints</u>		COURSE <u>CC-Shop Technician</u>		UNIT <u>I</u>	LESSON NO. <u>5</u>	
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE		
(2) Bare Steel (a) One (1) coat of 150 and one (1) coat of 151 to produce a minimum dft of five (5) mils total. (b) Paint should be applied to produce approximately three (3) mils per coat. (c) Do not apply paint in excess of four (4) mils dft per coat. B. Finish Coats (Final or Topcoat) (a) Vertical Surfaces - Two (2) coats of Silicone Alkyd, TT-E-490, at approximately 1.5 mils dft per coat. (b) Horizontal Surfaces - Two (2) coats, Deck Gray, Formula 20 of approximately 1.5 mils dft per coat.		• Show and pass around stepped samples painted in accordance with T:I-S-2.		• Examine and feel texture/thickness of the coating buildup.		
III. PROCEDURES A. Inspection - Review the common paint failures and causes presented in Lesson 2.		• Alligatoring and Checking • Cracking • Flaking • Scaling • Peeling • Bleeding • Blistering • Chalking • Discoloration		• Refer to handout and class notes on Common Paint Failures from Lesson 2.		
B. Preparation of surface prior to application of coatings						

INSTRUCTOR PRESENTATION

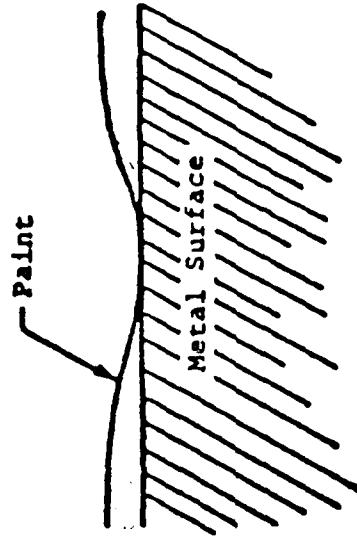
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TITLE CC Systems 3: Paints	COURSE CC-Shop Technician	UNIT 1	LESSON NO. 5
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
(1) Surface must be clean and free of all contamination. (a) oil (b) grease • (c) dirt (d) moisture (e) grit particles (2) Old paint should be removed back to where tight coat exists with no rust or blistering. (a) Intact paint in area to be recoated should be "feathered". (b) Feathering should be done by hand sanding. (3) For recoating WSA areas, the surface should be lightly blasted or mechanically cleaned to the first sound layer of paint or to the WSA layer. (4) Read and follow instructions on the paint containers exactly. C. Mixing Epoxy - Polyamide Paints (1) Epoxy - Polyamide coatings (a) are packaged in measured amounts,	• Show/discuss T:1-5-3. • Show/discuss slides: "Mixing Epoxy-Polyamide Paints."		



UNFEATHERED



FEATHERED

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TITLE <u>CC Systems 3: Paints</u>	COURSE <u>CC-Shop Technician</u>	UNIT <u>I</u>	LESSON NO. <u>5</u>
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
(b) must be mixed together in exact proportions to ensure the correct chemical reaction. (2) Mixing Ratios of Mil-P-24441 coatings are all 1:1 by volume. (a) Example: 5 gallons of component A to 5 gallons of component B. (b) The individual components of the various formulas are <u>not</u> interchangeable. (3) Each component must be thoroughly stirred prior to mixing the components together. (a) After mixing equal volumes of the two components, the combined mixture must again be thoroughly stirred until well blended. (b) Induction times must be adhered to (see Table 631-18 NAVSEA 59086-VD-SJM-000/CH631). (c) Induction time is defined as: that time immediately following mixing together of components A and B. (when the critical chemical reaction period of the components is initiated). (d) The reaction period is essential to insure complete curing of coating.	• Show/discuss T:l-5-4.		

MIL-P-24441 JOB SITE AMBIENT TEMPERATURE
AND INDUCTION TIME

Ambient Temperature °C (°F)	Induction Time (in hours)
1.6 to 10 (35 to 50)	2 at 21.1°C (70°F)
10.0 to 15.6 (50 to 60)	2
15.6 to 21.1 (60 to 70)	1 to 1-1/2
21.1 and above (70 and above)	1/2 to 1

INSTRUCTOR PRESENTATION

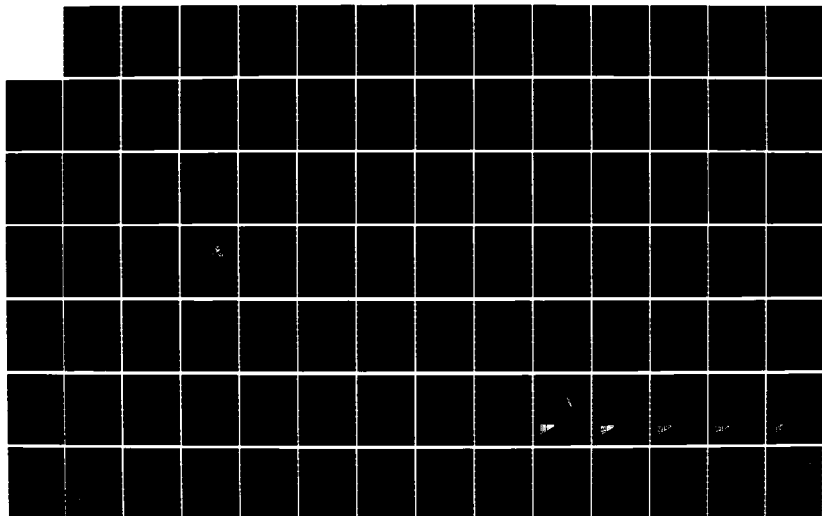
SIMA CC-SHOP
Lesson Plan

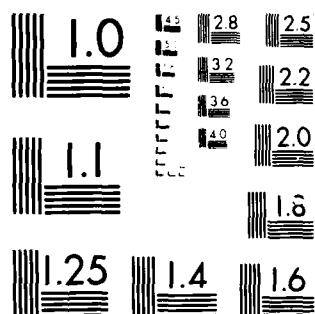
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TITLE CC Systems 3: Paints		COURSE CC-Shop Technician	UNIT 1	LESSON NO. 5	
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
D. Induction Time (MIL-P-24441) (1) The approximate temperature of the paint components in storage should be known (estimated) to judge the amount of induction time and pot life to be expected. (2) Job site application temperature will effect time required for paint to cure and must be considered in estimating: (a) cure time, and (b) the effect of batch size on these functions. (3) When these paints are to be applied at a job site with temperatures between 35° F and 50° F, it is essential that induction occurs in a warm (70° F) area to ensure that the coating will fully cure. When induction is completed, carry paint to job site.		• Show T-1-5-4 Explain and discuss.			
V. Epoxy-Polyamide Coating Application A. Epoxy-Polyamide Coatings may be applied by brushing, rolling, dip coating and spraying. B. Thinning if paint has thickened appreciably during cold temperature application or to improve application characteristics (1) Up to one (1) pint of ethylene glycol monoethyl (EGM) ether may be added for each gallon of mixed paint. (2) When applied at proper thickness (without thinning), these paints have no tendency to sag.		• Show/discuss slides: "Coating Applications and Spraying Techniques."			

AD-A163 672

CORROSION-CONTROL (CC) PROGRAM SIMA (SHORE INTERMEDIATE 2/4
MAINTENANCE ACTIV. (U) INTEGRATED SYSTEMS ANALYSTS INC
NATIONAL CITY CA W ADKINS ET AL. 30 NOV 85
UNCLASSIFIED ISA(MC)-107-VOL-3 N66001-85-C-0350 F/G 11/6 NL





MICROCOPY RESOLUTION TEST CHART
 NATIONAL BUREAU OF STANDARDS-1963-A

INSTRUCTOR PRESENTATION

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TITLE <u>CC Systems 3: Paints</u>		COURSE <u>CC-Shop Technician</u>	UNIT <u>1</u>	LESSON NO. <u>5</u>
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
C. Application Thickness (1) Unless otherwise specified apply each coat to produce: (a) approximately 3 mils DFT (or about 6-mils WFT). (b) <u>Do Not</u> exceed 4 mils DFT (or about 8-mils WFT). D. Normal Spray Application (1) Use normal spray guns and normal pot pressures specified in equipment manufacturer's instructions. (a) Spray gun should have a middle size (D) needle and nozzle assembly. (b) Both conventional and airless spray equipment are suitable for use. (2) When Non-Epoxy topcoats are applied over the epoxy (a) First coat of the topcoat must be applied before the final epoxy coat has hardened. (b) Epoxy should be slightly tacky when first coat of topcoat applied. (c) Tacky period generally occurs between four (4) to six (6) hours after epoxy has been applied. (d) Actual drying time depends on weather and temperature.	Show T-1-5-2 and discuss intercoat drying requirements.			

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KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
(3) If the epoxy is hard (usually eight (8) hours after application), (a) A tack or mist coat of one (1) to two (2) mils wet film thickness (WFT) must be applied, (b) dried to a slightly tacky state before applying first coat of top coat. (c) Tack coat should be same as preceding coat of epoxy or Formula 150. (4) If more than seven days elapse between preservation of the epoxy, (a) surface should be cleaned with <u>water</u> and <u>detergent</u> rinsed clean with fresh-water (b) Solvents should be used for grease and oil removal if required, (c) When dry, apply a tack coat (1 or 2 mils WFT) of the last coat applied (or Formula 150) to the hard epoxy coat. (d) Allow to dry four (4) hours before application of next full coat of the system (refer to Section 631-6.29 NAVSEA 59086-VD-STM-000/CH631 for more detailed information.)					
E. <u>Conventional Spray Painting Techniques</u> 1. <u>Before spray painting</u>, be sure the following steps are completed: (a) Mix paint thoroughly. (b) Strain paint through a wire screen or cloth to remove skin and coarse or foreign particles.					

INSTRUCTOR PRESENTATION

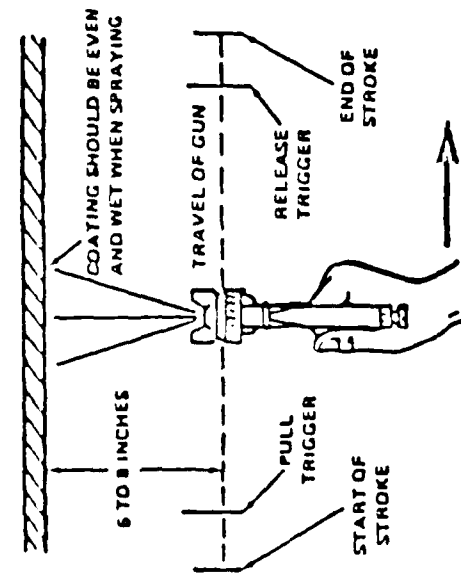
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TITLE <u>CC Systems 3: Paints</u>		COURSE <u>CC-Shop Technician</u>		UNIT <u>1</u>	LESSON NO. <u>5</u>
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
(c) Ensure that air filter is connected to the main air supply line to prevent moisture and oil particles from mixing with the paint. 2. <u>Spray Pattern Adjustment</u> (a) Make initial adjustments to air and liquid pressures. (b) Make final spray gun adjustments by observing spray pattern. 3. <u>Spray Gun Paint Application Steps:</u> (a) Hold gun 6 to 8 inches from the surface being painted. (b) Begin strokes before pulling the trigger. (c) Release trigger before ending the stroke. (d) Always keep the gun at a right angle to the surface being painted. (e) If you swing the gun in an arc, an uneven application and excessive overspray at the end of the stroke will result. (f) Spray to within 1 to 2 inches of the corners. (g) Hold the gun sideways to spray the corners so that both sides of the corner are sprayed at the same time.		• Show T-I-5-5 through T-I-5-11. Explain and discuss set up, operation and PMS. • Demonstrate set up, operation and PMS in the CC Shop of spray gun and related equipment.		• Selected trainees will go through set up, operation and PMS of spray gun and related equipment.	

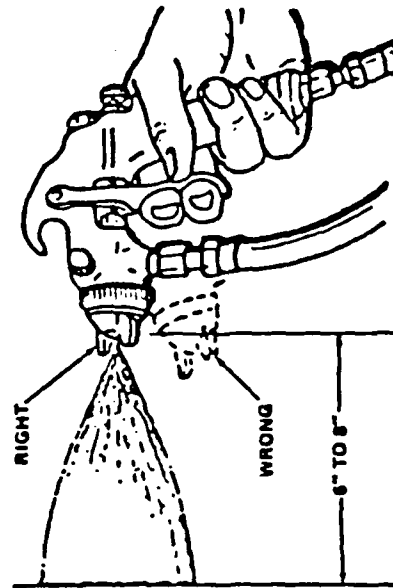
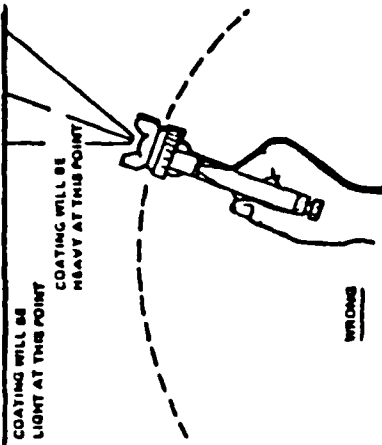
TRAINING AID

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CORRECT TRIGGERING

ARCING THE SPRAY GUN



HOLD GUN PERPENDICULAR TO SURFACE

T:1-5-5

NAVSEA S9086-VL-5 TM-000/CH-631

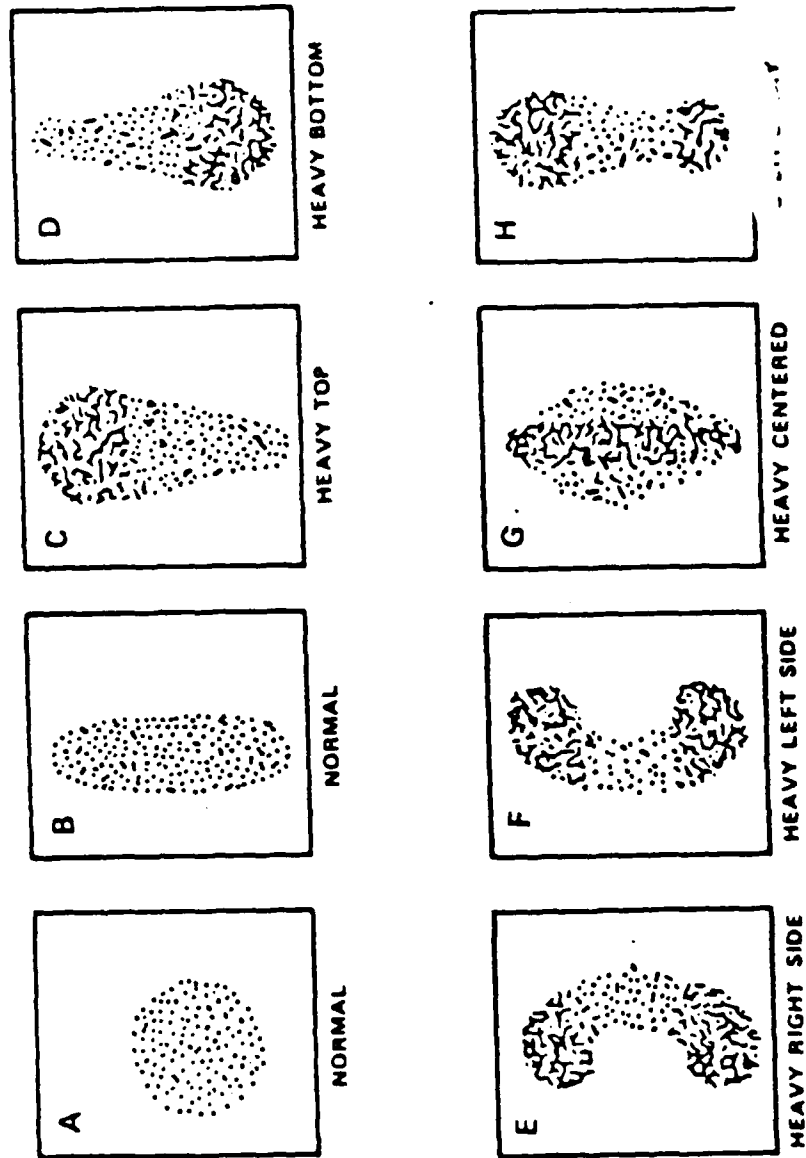
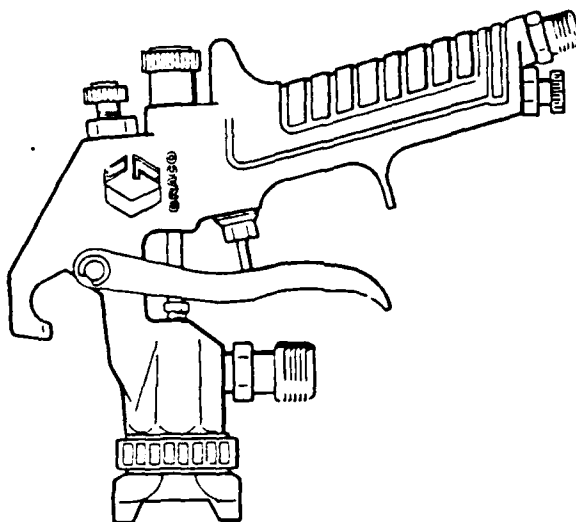


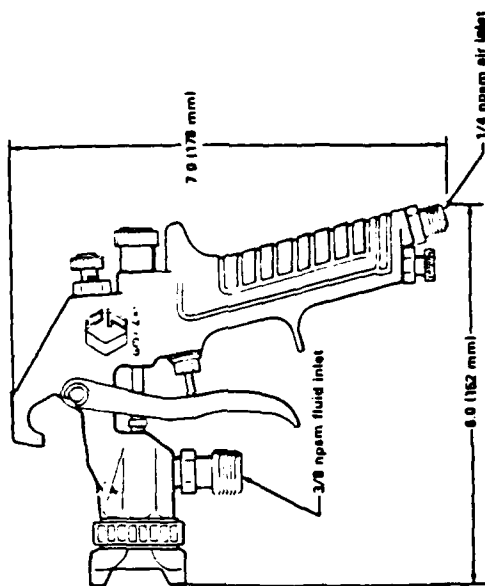
Figure 631-6. Spray Paint Patterns

MODEL 700N
AIR SPRAY GUN
STAINLESS STEEL FLUID PASSAGES
200 *psi* (14 *bar*) MAXIMUM WORKING PRESSURE



DIMENSIONAL DRAWING

Weight: 19 oz (535 g)



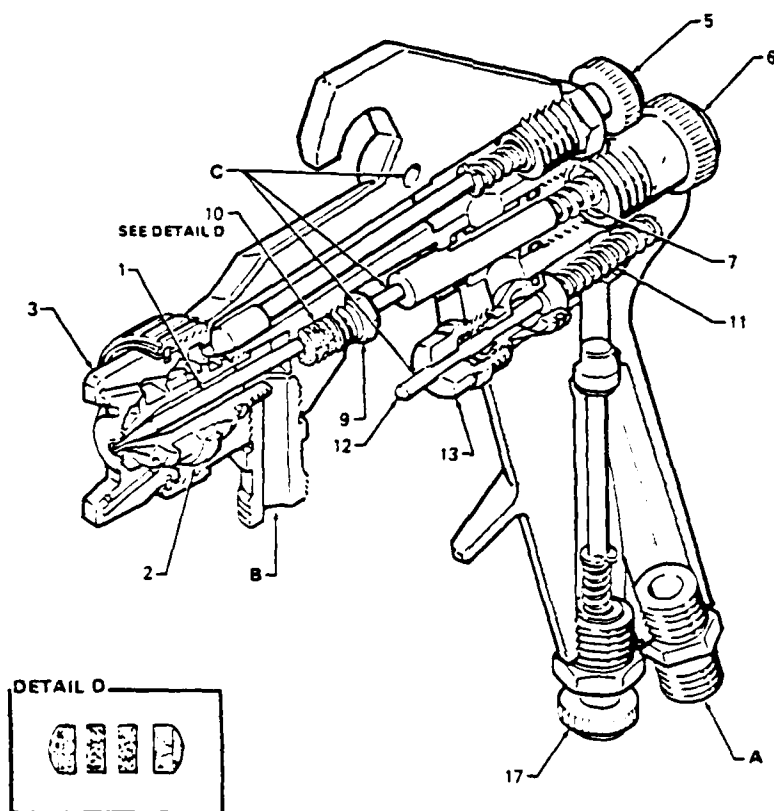


Fig 2

SERVICE

NOTE: If the gun has been completely disassembled for servicing, be sure the fluid adjusting valve spring (7) and the air valve spring (11) are reinstalled with their correct assembly. The spread valve spring is slightly larger in diameter and will not fit into the fluid adjusting valve cavity.

Air Valve Service

If there is air leakage at the air valve needle (12), remove trigger (14) and screw out valve assembly. Clean and inspect the needle (12), spring (11) and packing kit (13) for wear or damage. Replace if needed. Apply a few drops of lightweight machine oil to needle and reassemble valve.

Fluid Packing Replacement

If leakage occurs at the fluid needle packing nut (9), tighten the nut. If leakage cannot be stopped by tightening packing nut, then remove the fluid adjusting valve knob (6), spring (7) and needle (1). Unscrew the

packing nut (9) and remove the old packings (10). A small hooked tool can be used to remove packings from cavity. Clean and inspect all parts for wear or damage, replacing as needed.

Lubricate new packings with lightweight oil and insert packings into the cavity in the order shown in Detail D. Install the needle (1), spring (7) and adjusting knob (6) in the body. Slide the packing nut (9) onto the needle before inserting the needle in packing cavity.

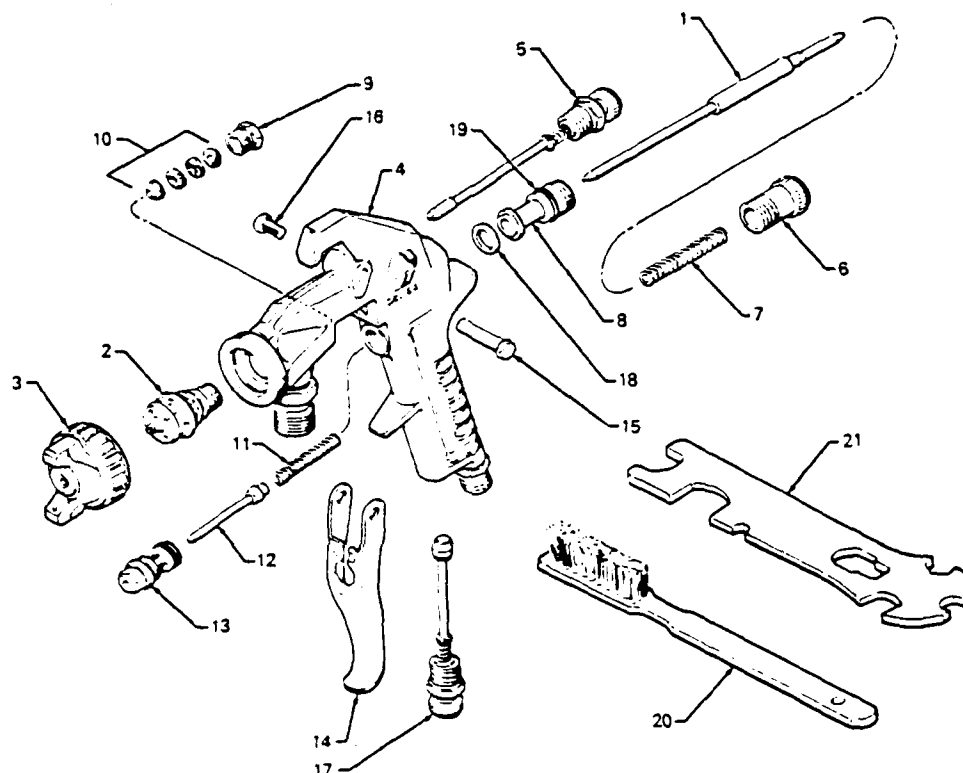
Turn the fluid adjusting valve in until it bottoms out, then back it out 6 full turns for proper spring adjustment.

With trigger released, screw the packing nut in until packing is fully compressed, then back the nut off until free needle movement is attained.

For best packing life, lubricate daily as explained on pages 3 and 4.

PARTS DRAWING

MODEL 700N Includes items 1-21



PARTS LIST

REF. PART NO.	DESCRIPTION	QTY	REF. PART NO.	DESCRIPTION	QTY.
1	NEEDLE, fluid (see chart, page 2)	1	14	106-730 TRIGGER	1
2	FLUID T.P. (see chart, page 2)	1	15	105-606 SCREW, pivot, trigger	1
3	AIR CAP (see chart, page 2)	1	16	105-605 SCREW, retaining, trigger	1
4	106-765 BODY, gun, includes inlet fittings	1	17	*106-729 VALVE, adj. air	1
5	106-719 VALVE, adj. spread	1	18	105-551 GASKET	1
6	105-553 KNOB, adj. fluid	1	19	*105-563 PACKING, spring	1
7	106-579 SPRING, compression, fluid needle	1	20	BRUSH	1
8	106-720 GUIDE, needle, fluid	1	21	WRENCH	1
9	106-718 NUT, packing, needle	1			
10	*106-385 KIT, packing, needle	1			
11	106-777 SPRING, compression, air valve	1			
12	*106-731 VALVE, air	1			
13	*106-732 KIT, packing, air valve	1			

Order parts by name and number. Always give the model number of the assembly for which you are ordering.

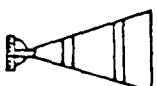
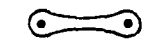
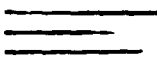
*Recommended "tool box" spare parts. Keep on hand to reduce down time.

TROUBLESHOOTING

WARNING

Always shut off air and fluid supply to gun and relieve pressures before servicing gun.

WHAT'S WRONG	WHY	WHAT TO DO
Fluid packing nut leaking	Loose needle packing nut (9) Worn packing (10)	Tighten. Replace.
Air leakage from front of gun	Air valve (12, 13) not seating properly	Clean, service.
Fluid leakage from front of gun	Needle (11) worn or damaged Worn needle/tip seat Needle packing (10) too tight	Replace Replace needle/tip set Lubricate and adjust

IMPROPER SPRAY PATTERN	WHY	WHAT TO DO
Fluttering or Spitting spray 	Insufficient fluid in cup or paint tank Dry or worn fluid needle packing or loose packing nut permits air to get into fluid passage (siphon feed) Loose fluid tip or damaged fluid tip taper seat Dirt between fluid tip, taper seat and body Loose or cracked coupler at fluid inlet Loose fluid tube in cup or tank	Fill cup or tank. Lubricate or replace packing (10), tighten packing nut (9). Tighten or replace needle/tip set. Clean. Tighten or replace gun body (4). Tighten.
	Material build up on air cap, partially clogged horn holes. Full air pressure from clean horn hole forces fan pattern toward clogged end Damaged tip or air cap holes	Clean with soft implement or submerge in suitable solvent and wipe clean. Replace damaged part.
	Material build up on the perimeter of fluid tip orifice, or partially clogged tip orifice	Remove obstruction. <i>Never</i> use a wire or hard instrument.
	Too high atomization air pressure Material too thin Not enough fluid pressure	Reduce air pressure or adjust air adjusting valve (17). Regulate material viscosity. Increase fluid pressure.
	Low atomization air pressure Too thick fluid Too much fluid	Raise air pressure. Fully open valve (17). Regulate material viscosity. Reduce fluid flow by turning valve on siphon feed guns. Reduce fluid pressure on pressure feed guns. Adjust fluid adjusting valve (6) until proper pattern is obtained.
Streaks 	Last coat or paint applied too wet Too much air pressure Insufficient air pressure Non uniform spray pattern	Apply drier finish with multiple strokes Use least air pressure necessary Increase air pressure Clean or replace air cap

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TITLE <u>CC Systems 3: Paints</u>	COURSE <u>CC-Shop Technician</u>	UNIT <u>1</u>	LESSON NO. <u>5</u>
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
4. <u>Speed of Application</u> depends on the : (a) Paint being sprayed. (b) Rate of paint flow, and (c) Surface to be covered. VL CONVENTIONAL HOT SPRAY PROCESS A. <u>Hot Spray is an industrial term for warming paint with special equipment prior to painting with conventional spray equipment.</u> 1. Most Navy paints when warmed do not exceed 120°F. B. <u>Benefits of the Hot Spray Process are:</u> 1. Elimination or reduction of gaps (holidays) in the film. 2. Smoother and less porous finishes with fewer dimpled areas (orange peels), sags or runs. 3. Reduction in paint waste from overspray or fogging (misting). 4. Elimination of need to add paint thinner to reduce paint to spraying consistency. 5. Reduction of atomizing air pressures. 6. Reduction in gun adjustments over a wide range of weather conditions because paint viscosities are controlled by maintaining a constant spraying temperature, thereby achieving more consistent results.	• For background information, not used in the CC-Shop.		

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TITLE <u>CC Systems 3: Paints</u>		COURSE <u>CC-Shop Technician</u>		UNIT <u>1</u>	LESSON NO. <u>24</u>	% <u> </u>
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
7. Application of heavier coats, thereby reducing the number of coats required for a multiple coat system, and total application time. 8. Reduction of cleanup time where paint is recirculated overnight. NOTE: Paragraphs 631-6.39 through 631-6.666 (NAVSEA S9086-VD-SYM-000/631) contain instructions for hot spray of vinyl paints. Do not use hot spray on other coatings without first obtaining guidance from a Navy paint technologist or NAVSEA. VII. IMPERFECT SPRAY PATTERNS A. <u>Causes of Imperfect Spray Patterns:</u> 1. Clogging of the gun's: (a) paint passages and/or (b) air passages. 2. Improper balancing of the air or fluid pressures. VIII. SUMMARY OF APPLICATION-RELATED FAILURES Summarize and discuss the application-related coating failures, failure appearance, course of failure and remedy cited in T:1-5-13 a/b/c.				• Show and discuss T:1-5-12. • Show and discuss T:1-5-13 a/b/c.		

NAVSEA S9086-VL-5 TM-000/CIH-631

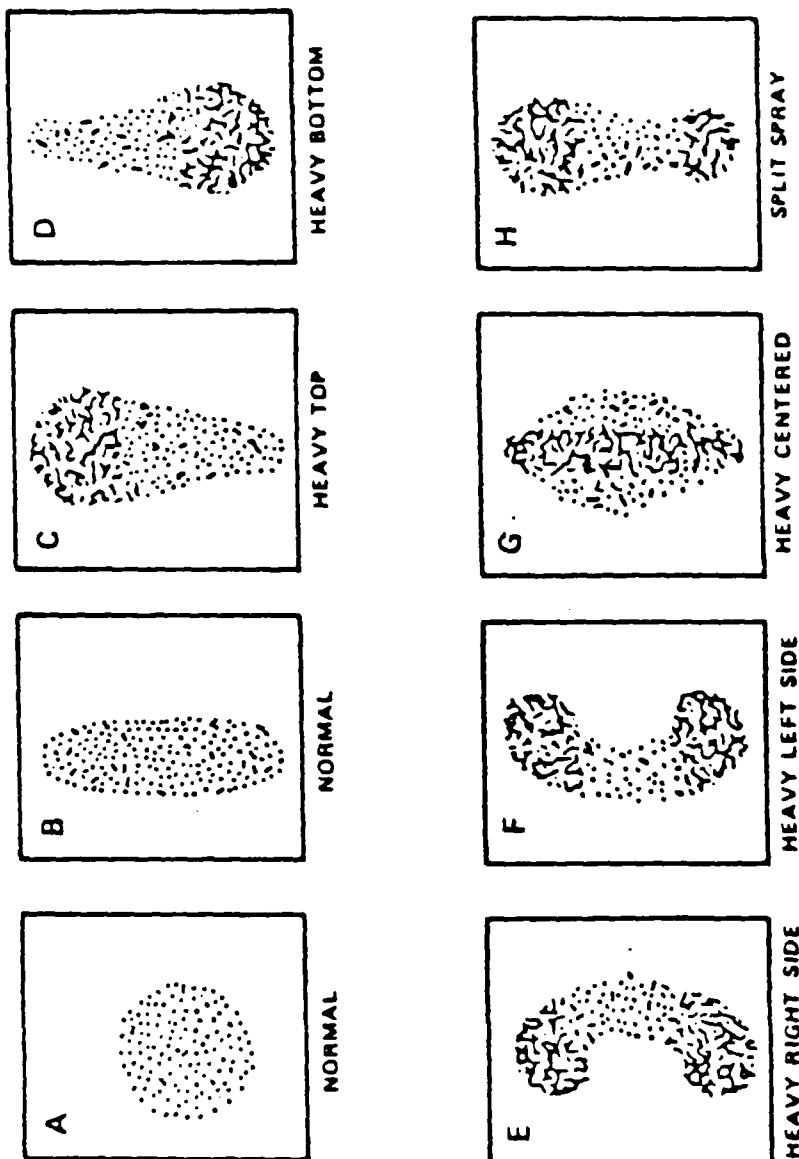


Figure 631-6. Spray Paint Patterns

TRAINING AID

SUMMARY OF APPLICATION-RELATED FAILURES

COATING FAILURE	FAILURE APPEARANCE	CAUSE OF FAILURE	REMEDY
1 Improper Mixing of Coating	Thin coating — non-uniform pigment distribution. May be areas of poor adhesion, uneven color, checking or cracking.	Most common cause is improper pigment-vehicle ratio, where settled pigment remains in the bottom of the can.	Thoroughly mix the liquid coating (preferably by mechanical means) to an even, smooth, homogeneous liquid with no color variation. Continue mixing as necessary during use.
2 Improper Thinning of Coating	Poor adhesion, pigment float or flooding (uneven color). Separation of pigment and vehicle after application — pinholing, blushing (coating turning white after application).	Thinner incompatible with resins or pigments. Improper drying — change in surface tension. Thinner evaporation too rapid, causing moisture to condense on liquid coating.	Use only manufacturer's recommended thinners, add slowly with thorough mixing
3 Poor Atmospheric Conditions for Coating Application	Poor adhesion and blistering from humid, damp conditions. Over-spray — powdery coating where drying is too rapid. Soft uncured film.	Condensation of moisture on the surface prior to application. Lack of proper cure due to too low or too high temperature during application.	Apply coatings at relative humidity of 80% or below and at least 3 °C (5 °F) above the dew point. Apply paint and coatings at 5 °C (40 °F) or above except for internally reactive materials which should be 25 °C (60 °F) or above.

T-1-5-13a

SUMMARY OF APPLICATION-RELATED FAILURES (Continued)

COATING FAILURE	FAILURE APPEARANCE	CAUSE OF FAILURE	REMEDY
4. Improper Coating Thickness	Areas of pinpoint corrosion between areas of solid coating where coating is thin. Checking, cracking, flaking where coating is overly thick.	Thin areas, spatter coating, holidays. Runs, puddles, excessive number of spray passes in areas where coating is difficult.	Careful application — even spray passes with each pass overlapped 50%. Use cross spray technique.
5. Overspray	Very rough coating surface. May appear like sand in the coating. Some dry coating, like dust, on the surface.	Improper spraying technique. Uneven spray passes with gun too far from the surface. Spray pressure too low, atomizing air pressure too high. Lacquer type coating most subject to overspray.	Apply coating with care and with even wet spray passes overlapped 50%. Use wire screen and sandpaper to obtain smooth surface before topcoating.
6. Pinholes	Small, visible holes in the coating ($\frac{1}{16}$ "). Holes generally appear in concentrations with a random distribution.	Improper spray technique. Spray gun too close to the surface with air bubbles being forced into the coating. Spray pot pressure too high with atomizing air pressure too low. Pinholes may exist in the substrate (concrete).	Apply coating with care with spray gun at the optimum distance from the surface. Make sure spray gun is properly adjusted. If pinholes already exist, apply coating by brush, working it into the surface.
7. Spatter Coat	Area of thin coating, usually at end of spray pass or around a complex section of structure. Small spots of coating which are non-continuous over substrate. In poor light, may seem continuous.	Discrete coating droplets which are not continuous over the surface. Inconsistent spray passes not overlapped 50%. Spray gun flipped at end of spray pass. Catalyst cured coatings most subject to spatter.	Apply coating with care. Use even, wet spray with each pass overlapped 50%. Use cross spray technique.

SUMMARY OF APPLICATION-RELATED FAILURES (Continued)

COATING FAILURE	FAILURE APPEARANCE	CAUSE OF FAILURE	REMEDY
8 Holidays	Bare areas of the surface which were uncoated by the painter. Most often in difficult areas to coat.	Poor, inconsistent application. Lack of care.	Apply coating in a careful, consistent manner, making certain that no areas remain uncoated.
9 Cratering	Bug eyes, fish eyes or craters randomly dispersed over coated area. May be more prevalent in thicker sections.	Improper solvent mixture, oil in atomizing air, surface contamination, particulate fall-out during application, high surface tension, silicone contamination.	Once cratering occurs, sand or roughen crater area. Apply another coat by brush, working coating into cratered area. Make sure contaminant is removed.
10 Bleeding	Staining of top coats.	Soluble resins or pigments in undercoat.	Seal with coating in which bleeding ingredient is insoluble.
11 Blushing	Haziness or whitening of film.	Condensation of moisture on coating due to rapid dripping of solvents.	Wait for improved humidity conditions. Reduce atomizing air pressure to a minimum.
12 Lifting	Wrinkling, swelling or blistering of film.	Attack or swelling of film by solvents in top coat.	Remove old coating and recoat.
13 Orange Peel	Overall bumpy pattern. Surface is smooth but irregular.	Spraying technique, drying characteristics of the film.	Apply a wet spray coat. Add a slower solvent.
14 Runs or Sags	Coating running in droplets down vertical surface causing curtain effect.	Excessive application.	Apply thinner coats. Check surface temperature. May be too cold for proper drying.

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

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TITLE <u>CC Systems 3: Paints</u> COURSE <u>CC-Shop Technician</u> UNIT <u>1</u> LESSON NO. <u>5</u>			
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
IX. SILICONE ALKYDS A. <u>Alkyd</u> is a <u>synthetic resin</u> modified with oils. - Oil is added because it increases: - Penetration of steel surface irregularities and pits. - Coating adhesion. - Alkyds are used above waterline and are unsuitable for use underwater service. <u>Commonly used</u> as both primers and topcoats on or in: - Ship interiors - Engine Rooms - Holds - Tank Hatches - Pipes - Deck Plates - Store Rooms - Pump Rooms			

INSTRUCTOR PRESENTATION

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Lesson Plan

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TITLE CC Systems 3: Paints	COURSE CC-Shop Technician	UNIT 1	LESSON NO. 5
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
4. When heat resistance is required, alkyd is modified with silicone. Silicone Alkyds have good heat resistance, very good moisture resistance and good chemical resistance. 5. Silicone Alkyds are basically used because of their superior gloss and color retention as compared to other alkyds. ALKYDS ADVANTAGES One-package coating Fair exterior durability Moderate cost Excellent flexibility Good adhesion to most surfaces, including poorly prepared surfaces Easy to apply Good gloss retention DISADVANTAGES Poor chemical and solvent resistance Fair weather resistance Poor heat resistance Poor immersion resistance	Show/discuss T:1-5-14.		

ALKYDS

ADVANTAGES

One-package coating
Fair exterior durability
Moderate cost
Excellent flexibility
Good adhesion to most surfaces, including poorly prepared surfaces
Easy to apply
Good gloss retention

DISADVANTAGES

Poor chemical and solvent resistance
Fair weather resistance
Poor heat resistance
Poor immersion resistance

EPOXY

ADVANTAGES

Excellent chemical and solvent resistance
Excellent water resistance
Very good exterior durability
Hard, slick film
Excellent adhesion
Excellent abrasion resistance
Good caustic resistance

DISADVANTAGES

Two-package coating—limited life
Curing temperature must be above 50 degrees F
Poor gloss retention
Film chalks on aging
Blasted surface desirable
Topcoating may require blasting depending on surface and cure time

INSTRUCTOR PRESENTATION

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TITLE <u>CC Systems 3: Paints</u>		COURSE <u>CC-Shop Technician</u>		UNIT <u>1</u>	LESSON NO. <u>5</u>
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
<u>ADVANTAGES</u> Excellent chemical and solvent resistance Excellent water resistance Very good exterior durability Hard, slick film Excellent adhesion Excellent abrasion resistance Good caustic resistance EPOXY <u>DISADVANTAGES</u> Two-package coating—limited life Curing temperature must be above 50 degrees F Poor gloss retention Film chalks on aging Blasted surface desirable Topcoating may require blasting depending on surface and cure time					
X. SAFETY PRACTICES FOR PAINTING OPERATIONS					
A. <u>Every operation</u> associated with painting exposes workers to health and safety hazards.					
1. It is the individual's responsibility to be aware of potential dangers and be knowledgeable in the use of safety equipment.					
2. Toxic materials can enter the body three ways:					
(a) inhalation					
(b) swallowing					
(c) absorption through the skin.					

INSTRUCTOR PRESENTATION

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Lesson Plan

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TITLE <u>Cc Systems 3: Paints</u> COURSE <u>Cc-Shop Technician</u> UNIT <u>1</u> LESSON NO. <u>5</u>	
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION
3. Safety (a) Respirators can control inhalation. (b) Proper personal habits can control swallowing. (c) Protective clothing and creams can control access through the skin. B. <u>In painting operations</u> personnel are exposed to: 1. Solvents, 2. Pigments, and 3. Resins. C. <u>Proper safety equipment</u> and practice will minimize exposure. 1. Protective clothing helps prevent direct skin contact with: (a) dusts (b) irritating chemicals. 2. Exposure can be controlled by use of: (a) protective creams (b) gloves	
TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE

INSTRUCTOR PRESENTATION

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TITLE CC Systems 3: Paints		COURSE CC-Shop Technician	UNIT 1	LESSON NO. 5
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
(c) respiratory equipment (d) face, eye and ear protection (e) proper safety practices such as washing immediately after working and before eating, drinking or smoking. 3. <u>Chemical contact can be minimized</u> around mixing vats by: (a) keeping face away from vats or open containers, (b) using face shields, (c) using low-speed mechanical stirrers to control splashing. 4. <u>All operations require eye protection.</u> 5. <u>All power equipment must be grounded and used correctly and operated per Manufacturer's Instructions.</u> 7. <u>Airless spray guns</u> should never be pointed at any part of the body. 8. <u>The size of a small job is no excuse</u> for not using all proper safety equipment and practices. D. <u>Paint Combustion</u> 1. Measured by "flash point".				

INSTRUCTOR PRESENTATION

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Lesson Plan

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TITLE <u>CC Systems 3: Paints</u>		COURSE <u>CC-Shop Technician</u>	UNIT <u>1</u>	LESSON NO. <u>5</u>
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
(a) The lowest temperature at which its solvent vapor will ignite when a flame or spark is present. (b) Paint should not be stored at temperatures near or above its flash point. X. TOUR OF PAINT STATION IN CC-SHOP • Explain Shop IPE, layout, production flow, quality control and safety. • Demonstrate - paint mixing - pot loading - spray-gun adjustment - spray procedures/techniques - measurements .. WFT measurements during spraying .. DFT measurements for QC checkpoints and QC records - securing and cleaning painting equipments. XI. 14 Hour OJT in Paint Spray Station of CC Shops.				

INSTRUCTOR FOLLOW-THROUGH

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TITLE <u>CC Systems 3: Paints</u>		COURSE <u>CC-Shop Technician</u>	UNIT <u>1</u>	LESSON NO. <u>5</u>
PRACTICAL APPLICATIONS	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
• Summarize Lesson. • Question students on key points; repeat and amplify the instruction as required.		• Answer questions and explain issues asked by the instructor.		

INSTRUCTOR PREPARATION

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Lesson Plan

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TITLE CC Systems 5: Non-skid Deck Coating	COURSE CC-Shop Technician	UNIT 1	LESSON NO. 6
LEARNING OBJECTIVES	TRAINING AIDS/MATERIALS		
Trainees will learn: - Purpose of non-skid deck coatings. - Types of non-skid coating applications for steel, aluminum and WSA surfaces. - Non-skid coating application procedures.	Materials: 3" x 5" sample panels coated with non-skid deck coatings to show as examples. 35mm slides of non-skid deck coatings: "Surface Preparation;" "Mixing and Application;" "Maintenance and Repair." - Transparencies T:1-6-1 through T:1-6-4 Note: Sample panels and 35mm slides must be procured from local sources. Slides may be developed by recording non-skid application onboard ship. Sample panels should be obtainable from local paint distributor. - Overhead projector. 35mm slide projector. - Chalk or dry-erase markers for board. References: - NAVSEA 59086-VD-STM-000 Chapter 631, <u>Preservation of Ships in Service</u> (NSTM 631). - NAVSEA 59086-VD-STM-000 Chapter 634, <u>Deck Coverings</u> (NSTM 634). - S9630-AG-MAN-010/FFG-7CL, <u>Manual, Corrosion Control for FFG-7 Class</u>, 30 November 1983. Handouts: - Section 4.3.5 (System 5: Non-Skid Deck Coatings), pages 4-49 to 4-60, Reference 3 above. - Copies of transparencies used in this lesson.		

• Marine Corrosion, Causes, Prevention and Control

INSTRUCTOR PRESENTATION

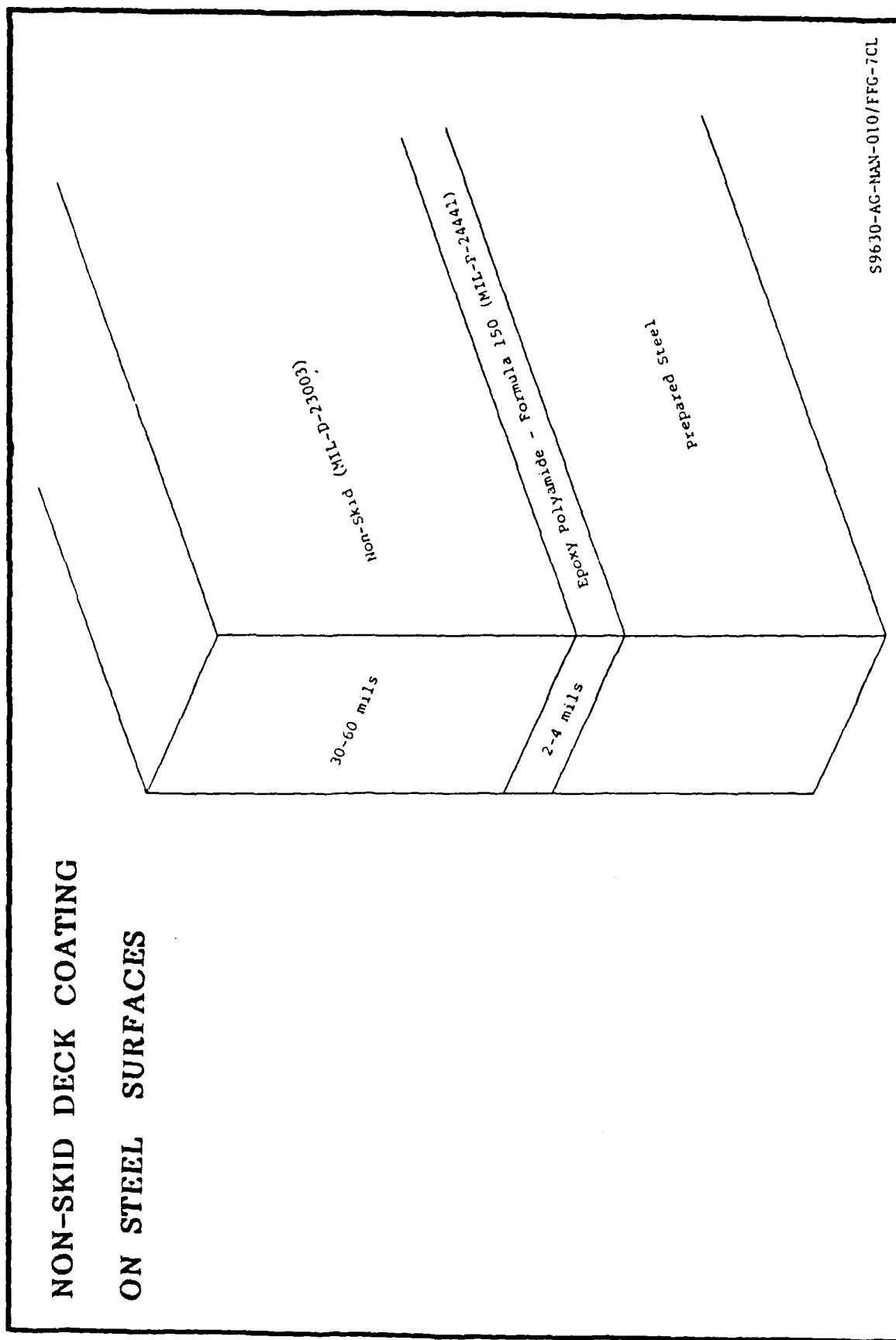
SIMA CC-SHOP
Lesson Plan

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TITLE CC Systems 5: Non-Skid Deck Coating		COURSE CC-Shop Technician		UNIT 1	LESSON NO. 6
KEY POINTS ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
I. GENERAL <u>System Five, Non-Skid Deck Coating (Navy approved)</u> is a general purpose, heavy-duty non-skid deck coating applied over a NAVSEA-approved primer. A. For Navy application MIL-D-23003 Type III non-skid deck coating is preferred. This Navy approved formula consists of: 1. Epoxy resins to give maximum (a) adhesion to steel (b) toughness, and (c) corrosion resistance 2. Aluminum aggregate for non-skid B. <u>Type III Non-Skid Deck Coating</u> is used to make decks safer for: 1. Personnel, 2. aircraft, and 3. rolling equipment. and at the same time be resistant to wear. C. <u>System 5 Non-Skid Deck Coatings for steel</u> must have a NAVSEA-approved primer. • Epoxy Primer, Formula 150, (MIL-P-24441) at 2-4 mils dft.		• Set up projector. • Write instructor's name, lesson number and title on board. ----- • Explain and discuss.		1. Take notes. 2. Participate in class discussion and activities.	

TRAINING AID

NON-SKID DECK COATING
ON STEEL SURFACES



INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

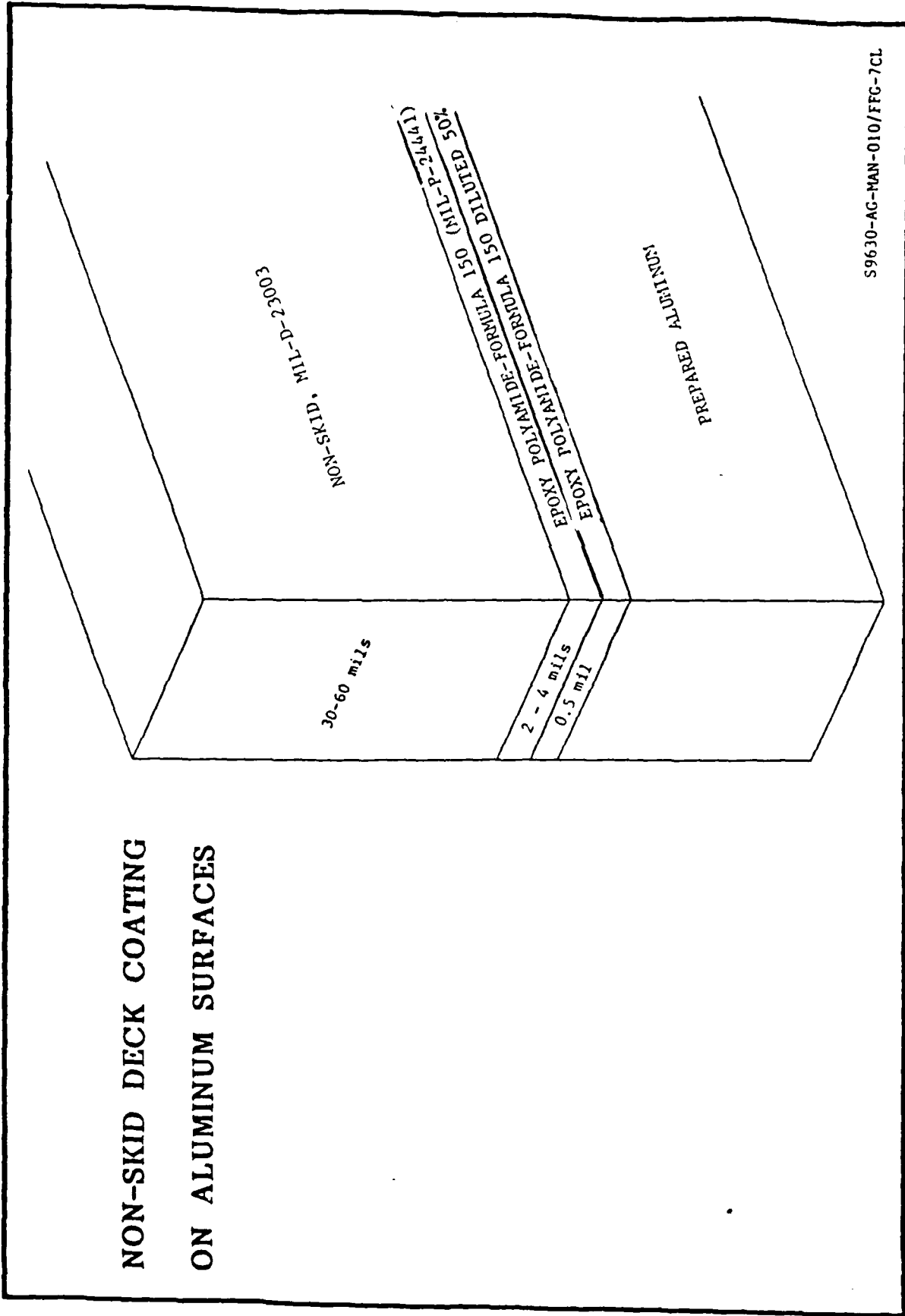
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TITLE CC Systems 5: Non-skid Deck Coating		COURSE CC-Shop Technician		UNIT 1	LESSON NO. 6
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
D. <u>Using System Five Non-Skid Deck Coating for aluminum</u>, the surface should be: 1. Primed with one (1) coat of MIL-P-2441 Formula 150, thinned 50%, at a thickness of 0.5-0.75 dft, followed by 2. One (1) coat of Formula 150 at a thickness of 2-4 mils dft, E. <u>The primer not only improves</u> adhesion of the non-skid but also prevents rapid failure of the non-skid topcoat if damaged. F. <u>Using System Five Non-Skid Deck Coating for WSA surfaces:</u> 1. Anchor-tooth pattern 2-3 mils, 2. WSA 7-10 mils, 3. Epoxy Polyamide - Formula 150, thinned 50%, 0.5-0.75 mils dft, 4. Epoxy Polyamide - Formula 150, 2-4 mils dft, and 5. Non-Skid Deck Coating, Type III.		• Show/discuss T:1-6-2.			
IL SYSTEM FIVE, NON-SKID DECK COATING (NAVY APPROVED) SURFACE PREPARATION A. <u>Surface must be clean, dry,</u> and free of all contamination and foreign matter. All of the following must be completely removed prior to system application: 1. Rust 2. mill scale		• Show/discuss locally prepared 35mm slides to demonstrate and reinforce the requirements and application procedures.			

TRAINING AID

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NON-SKID DECK COATING ON ALUMINUM SURFACES

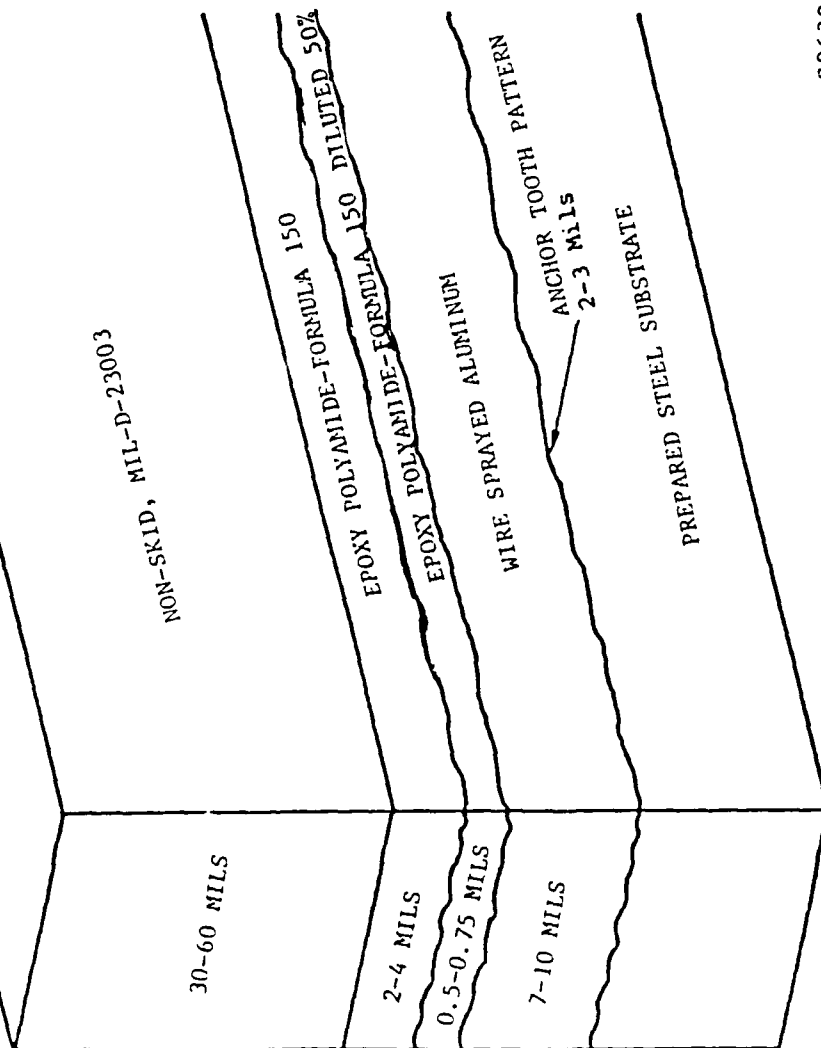


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T:1-6-2

TRAINING AID

NON-SKID DECK COATING ON WSA SURFACE WITH LOW - TEMPERATURE SEALER



S9630-AG-MAN-010/FFG-7CL

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TITLE CC System 5: Non-skid Deck Coating		COURSE	CC-Shop Technician	UNIT 1	LESSON NO. 6
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
3. paint 4. dirt 5. grease 6. oil, etc. B. <u>Grit Blasting is the preferred method of paint removal</u> and results in best surface adhesion. 1. Abrasive (grit) blasting does not remove grease and oil. Remove grease, oil and other contaminants from the item surface by solvent cleaning prior to blasting. (a) For excessive contamination, a trisodium phosphate (TSP) solution may be used before solvent cleaning. (b) Solvent cleaning may be done by wiping, brushing or spraying with toluene or trichloroethane. (c) Precautions must be taken to protect parts that may be attacked by the solvents. (d) Surfaces cleaned with TSP should be rinsed with clean potable water and dried after solvent cleaning. 2. Surface is to be cleaned of all paint and corrosion to a "near-white" metal surface. Surfaces that are not to be blasted must be heavily masked or plugged prior to blasting.					

INSTRUCTOR PRESENTATION

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TITLE <u>CC System 5: Non-skid Deck Coating</u> COURSE <u>CC-Shop Technician</u> UNIT <u>1</u> LESSON NO. <u>6</u>		
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
3. <u>Power sanders</u> may be used for small areas or repairs on damaged or worn spots or when/where "<u>grit blasting</u>" is not feasible. (a) #16 grit aluminum oxide sanding discs or abrasive cloth can produce a sufficiently clean surface. (b) Sanding must be done carefully and intensively. 4. <u>Other types of power-driven equipment</u> commonly available may be used. (a) wire brushes (b) sanding disks (c) grinders (d) chippers (e) scalers (f) needle guns (g) rotary descalers 5. <u>Air-powered and electrically-powered models</u> are readily found and offer: (a) less risk of contamination, (b) no grit removal problem,		

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TITLE CC System 5: Non-skid Deck Coating	COURSE CC-Shop Technician	UNIT 1	LESSON NO. 6
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
(c) less damage to sound coating in surrounding area, (d) less environmental pollution. Note: Portable pneumatic and electric-powered tools are probably responsible for more accidents and injuries than any other single category of shipboard equipment. III. MIXING AND APPLYING OF PRIMER COATING(S) A. After selecting the proper primer system (per NAVSEA S9086-VD-STM-000/Ch 631), mix according to manufacturer's directions and apply to surface. 1. Coverage should be approximately 1900 square feet per gallon, 2. at 0.5-0.75 mils dry film thickness (dft). B. Allow area to dry overnight before applying barrier coat. C. Block off and secure area to prevent any foot or rolling traffic. IV. APPLICATION OF NON-SKID (MIL-D-23003 TYPE III) DECK COATING A. <u>Test prepared surface for cleanliness.</u> 1. <u>Wipe with clean dry rags.</u>	• Ask student to enumerate the various surface-preparation methods and their attributes. • Continue 35mm slides. • Continue 35mm slides.		

INSTRUCTOR PRESENTATION

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Lesson Plan

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TITLE <u>CC System 5: Non-skid Deck Coating</u>		COURSE <u>CC-Shop Technician</u>	UNIT <u>I</u>	LESSON NO. <u>6</u>
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
2. <u>Remove all dirt and contamination</u> (a) oil, (b) grease, (c) dust, etc. 3. <u>Heavier accumulations, such as</u> (a) footprints (b) tiretracks (c) grease or oil films require detergent, or solvent washing. Repeat detergent or solvent wash until primed surface is clean. B. <u>Type III Non-Skid is a two-part coating consisting of a base material and a hardener. (Read manufacturer's instructions).</u> 1. <u>Open can of base material and stir thoroughly.</u> (a) Preferably with a mechanical mixer. (b) Make sure all settlement is lifted off bottom of the container and is uniformly incorporated in the material. 2. <u>Pour contents of can of hardener into base material.</u> (a) Scrape bottom and sides of hardener can to make sure the complete contents are emptied into pail of base material.	• Show slide of can of Type III non-skid deck coating and slide with label showing instructions. • Explain/discuss.			

INSTRUCTOR PRESENTATION

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TITLE CC System 5: Non-skid Deck Coating		COURSE CC-Shop Technician	UNIT 1	LESSON NO. 6
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
3. <u>Mix approximately 3-5 minutes or until mixed material assumes a uniform color and appearance.</u> 4. <u>Pot life is approximately 8 hours at 70°F.</u> (a) Pot life increases at lower temperatures, (b) Pot life decreases at higher temperatures, (c) Coating can be applied between 40°F and 90°F (air temperatures), (d) Below 50°F, curing time increases substantially. Note: Application when surface temperature is above 130°F or below 50°F is not recommended.		• Show slide of mixing procedures. • Explain/discuss.		
5. <u>Type III Non-Skid Deck Coating can be applied with roller or trowel</u> (a) Roller application • Use long handle roller cage with a <u>special smooth phenolic roller (NO CLOTH covering).</u> • Pour a "puddle" of Type III non-skid on the surface up to 18 inches in diameter. • Roll material in <u>one direction only</u>, in slow straight strokes, pulling material toward you. • Use moderate amount of pressure on roller handle. • <u>Do not over roll</u> too many times or press down heavily.		• Show slides of roller application. • Explain/discuss.		

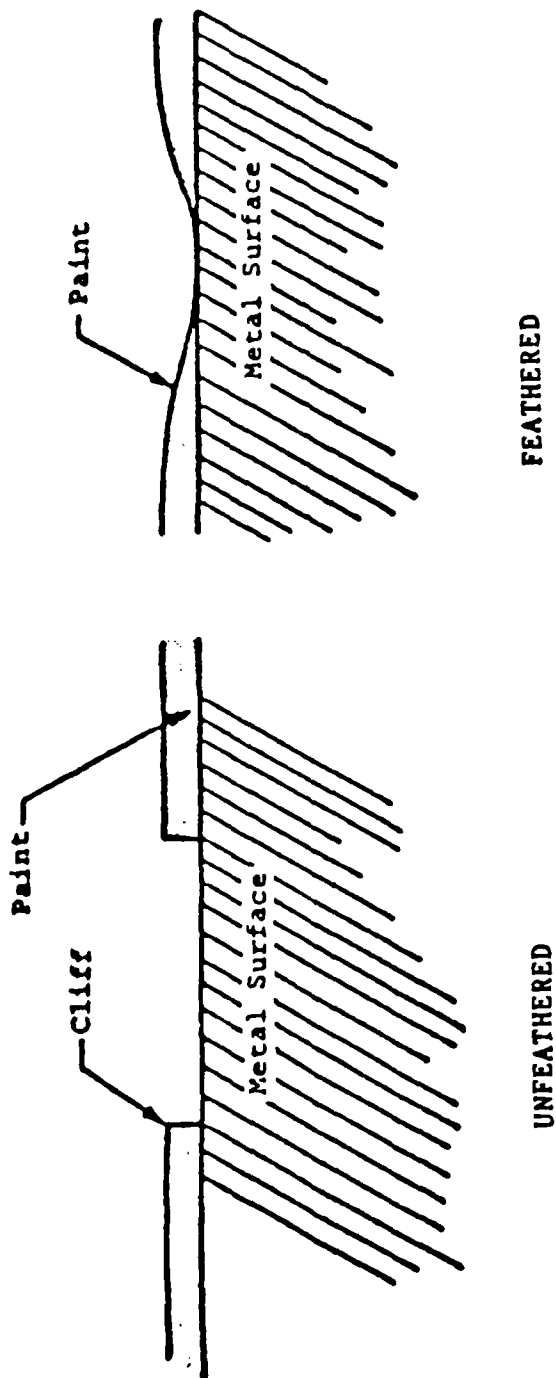
INSTRUCTOR PRESENTATION

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TITLE CC System 5: Non-skid Deck Coating		COURSE CC Shop Technician	UNIT 1	LESSON NO. 6
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
• Be careful material does not build up too thickly along welds. • Roll across welds, not along them. • Material applied too thickly will not cure properly. • On smooth surfaces, coverage should be 35 square feet per gallon. V. MAINTENANCE AND REPAIR A. For repair of areas requiring non-skid deck coating, the following guidelines shall be followed: 1. Determine whether the component has been WSA coated or not. 2. Mechanically clean the damaged area. (a) If the area has been coated with WSA, lightly roughen the surface with a stainless steel wire brush. (b) If the area has not been coated with WSA, clean the surface to near-white metal with a wheel abrader or needle gun. 3. Feather the edges of the area with a stainless-steel-wire brush.	• Show/discuss non-skid 3"x6" panel samples. • Show/discuss T:1-6-4.			

TRAINING AID



A7-1-131

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TITLE <u>C.C. System 5: Non-skid Deck Coating</u>		COURSE <u>C.C. Shop Technician</u>	UNIT <u>J</u>	LESSON NO. <u>6</u>
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
4. Clean the area with an approved solvent to remove all (a) moisture, (b) oil, and (c) dust. 5. Apply a sealer coat of Formula 150 Epoxy Polyamide thinned 50% at a thickness of 0.5-0.75 mils. 6. Apply a barrier coat of Formula 150 at a thickness of 2-4 mils. 7. Apply the non-skid coating within 24 hours at a thickness based on 33 sq.ft/gal. of non-skid.				

INSTRUCTOR FOLLOW-THROUGH

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TITLE <u>CC System 5: Non-skid Deck Coating</u>		COURSE <u>CC-Shop Technician</u>	UNIT <u>1</u>	LESSON NO. <u>6</u>
PRACTICAL APPLICATIONS	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
- Summarize Lesson. - Question students on key points; repeat and amplify the instruction as required.		- Answer questions and explain issues asked by the instructor. - Demonstrate knowledge by explaining/describing: - purpose of non-skid - surface preparation procedures - coating constituents and mixing procedures - application procedures - repair procedures.		

INSTRUCTOR PREPARATION

SIMA CC-SHOP
Lesson Plan

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TITLE	COC System 4: Powder Coatings	COURSE	CC-Shop Technician	UNIT	1*	LESSON NO.	7
LEARNING OBJECTIVES				TRAINING AIDS/MATERIALS			
Trainees will understand or be able to identify: 1. The differences between thermoplastic and thermoset plastics. 2. Crosslinking. 3. Why powder coating is used. 4. Environmental concerns utilizing powder coatings. 5. Shipboard items to be powder coated. 6. Powder coating process.				<u>Materials:</u> • Examples of powder-coated items. • Examples of thermoset and thermoplastic items. Note: Examples of powder coated and plastic must be procured from local sources. • Transparencies T:1-7-1 through T:1-7-3. • Overhead projector. • Chalk or dry erase markers for board. <u>References:</u> 1. NAVSEA S9630-AG-MAN-010/FFG-7CL, Manual, Corrosion Control for FFG-7 Class, 30 November 1983. 2. DoD-STD-XXXX, Powder Coating Systems for Corrosion Protection Aboard Naval Ships, SEA 05M11 draft circa August 1985. <u>Handouts:</u> 1. Section 4.3.4, Powder Coating (MIL-R-46896) from Reference 1. 2. Paper copies of T:1-7-1 through T:1-7-3.			

• Marine Corrosion, Causes, Prevention and Control.

INSTRUCTOR PRESENTATION

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TITLE <u>CC System 4: Powder Coatings</u> COURSE <u>CC-Shop Technician</u> UNIT <u>I</u> LESSON NO. <u>7</u>	
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION
I. GENERAL A. Powder Coating: the covering of a surface with a finish or protective layer of "resin" in a dry powder form that when heated will melt and flow into a smooth finish. B. Types of Powder Coating 1. Sprayed (a) preheated object (b) electrostatic (c) combination of "a" and "b". 2. Fluidized Bed (a) preheated object (b) electrostatic (c) combination of "a" and "b".	• Write instructor's name, number of lesson and title on board. 1. Take notes. 2. Participate in class discussion.

INSTRUCTOR PRESENTATION

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TITLE <u>CC System 4: Powder Coating</u> COURSE <u>CC-Shop Technician</u> UNIT <u>1</u> LESSON NO. <u>7</u>			
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
C. <u>Primary Concern</u> - Electrostatic sprayed powder coating - covers large variety of differently sized and shaped objects. D. <u>Application</u> - Electrostatic Sprayed Powder coating is applied: - Onto a clean, pretreated object: - white metal surface finish with a 1-2 mil anchor tooth. - priming required on some surfaces. - Preheated at or above curing temperature. - In powdered resin form. - With an electrostatic spray gun inside a filtered spray booth. E. <u>Curing</u> - Item is placed in a 200-450°F oven. - Powder melts and begins to cure: - If two coats are desired, the item is removed from oven during the partial cure (gel state), coated again and returned to oven. - Complete cure in oven occurs in 5-20 minutes. - Item may be handled immediately after cooling.		- Pass out examples of powder coated items to trainees. - Define "near-white" and "white" metal surface preparation.	Examine powder coated items and pass on.

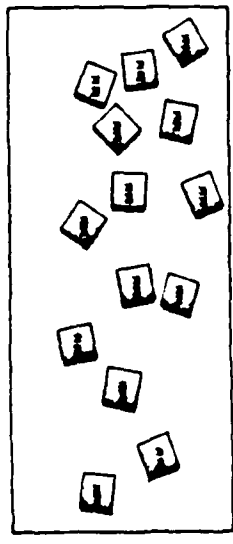
INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

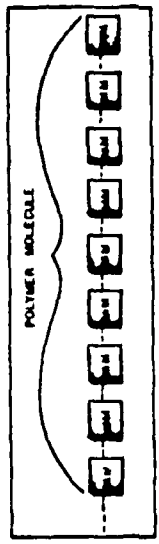
PAGE 4 OF 10

TITLE CC Systems 4: Powder Coatings		COURSE CC-Shop Technician	UNIT 1	LESSON NO. 7
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
II. TYPES OF POWDER The coating powders are plastics. A. <u>Basically, two types of coating powders</u> 1. Thermoplastics (a) Can be melted, formed, cooled and hardened separately. 2. Thermosetting (a) Heated, cured (set) into permanent state. (b) When reheated at high enough temperature will burn or char. B. <u>Thermosetting Resins in Particular</u> 1. They are the only type we will use because of their durability, flexural strength and chemical resistance. 2. Chemical difference between a thermoset resin and a typical plastic. (a) A plastic is made up of long molecules called polymers. (b) In cross-linking (curing), the polymers become chemically attached to each other. (c) Cross-linking is a chemical reaction that results in a permanent change.		• Show transparency T:l-7-1. • Explain and discuss. • Show transparency T:l-7-2.		

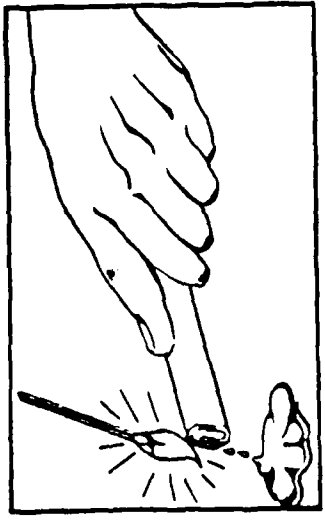
TRAINING AID



Monomer molecules
Monomer molecules are small molecules. They are not connected to each other.



Polymer molecule.
A polymer molecule is composed of hundreds to thousands of monomer molecules joined in a chain.

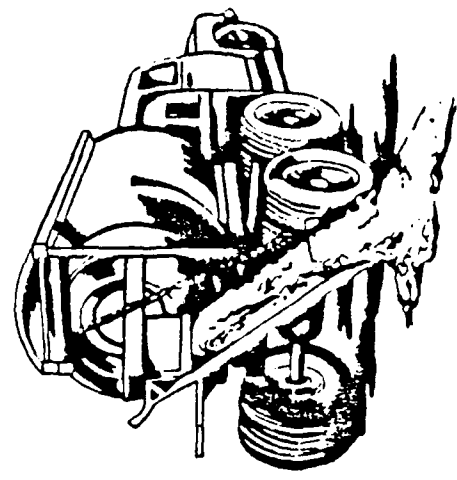


Thermoplastics act like candle wax when heated or cooled.

TWO TYPES OF PLASTICS

All Plastics are either

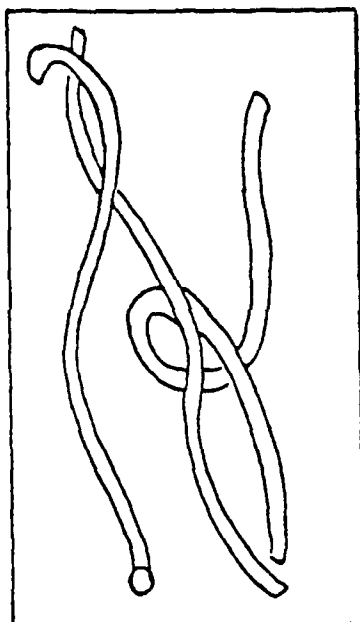
1. Thermoplastic (heat softening)
2. Thermosetting (heat curing)



Thermosetting plastics act like concrete when set.

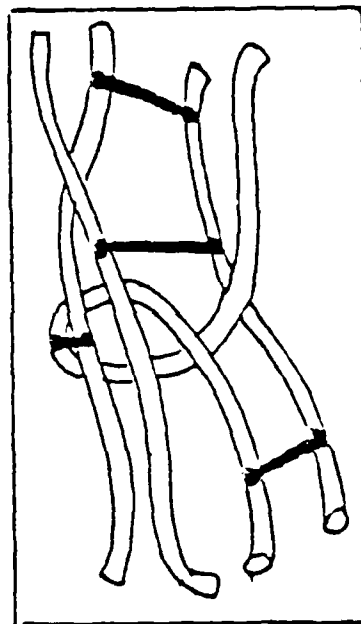
POLYMERS

Regular Plastic



Molecules Are Simply In Contact With Each Other.

Cross-Linked Plastic



Polymer Molecules Are Cross-Linked.

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TITLE <u>CC Systems 4: Powder Coatings</u>		COURSE <u>CC-Shop Technician</u>		UNIT <u>1</u>	LESSON NO. <u>7</u>	PAGE <u>7</u> OF <u>10</u>
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
3. Powdered resins are formulated to allow enough time between powder melting and polymer cross-linking so that a good, smooth coating results. C. <u>Thermosetting Powders</u> Powdered epoxy coatings are approved for interior and exterior application on steel surfaces above the upper limit of boot topping. There are several coatings which can be applied by this process, including polyvinyl chloride, polyethylene, polyester, epoxy, acrylic and nylon. Only the epoxy systems are authorized for shipboard CC applications by COMNAVSEASYS/COM. Current NAVSEA policy requires that only an epoxy meeting the standards of ASTM A775-81, and providing a total film thickness of 8-12 mils, shall be used for topside shipboard application. Chalking of the epoxy coating is to be prevented by the application of silicone alkyd paint. Polyesters are less affected by sunlight (ultraviolet light, in particular) retaining their color and gloss longer.						
III. WHY POWDER COAT INSTEAD OF PAINT? A. More durable. Powder coatings resist physical abrasion better than paint. Also, the powder coating will retain color and gloss longer. Saves maintenance time and money. B. A more complete barrier coating. Because there is no solvent evaporating from the coating during the cure, there are very few pores. C. EPA - 85% reduction of VOC. In other words, of all the solvent in your wet paint, only 15% may be released into the atmosphere. The 85% must be captured and safely disposed as hazardous waste.						

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TITLE	CC System 4: Powder Coatings	COURSE	CC-Shop Technician	UNIT	1	LESSON NO.	7
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE					
1. Solvent recovery systems are expensive. 2. Alternate paint systems have problems with poor curing or inadequate adhesion. D. <u>OSHA - Safety</u>. Coating powders are classified as a "nuisance dust" and are non-toxic. Proper respirators must be worn. E. <u>Clean-Up</u> 1. No hazardous waste. 2. No solvents to clean up spills. 3. Washes off skin and clothing with soap and water. IV. WHERE SHOULD POWDER COATING BE USED ON SHIP COMPONENTS? A. It may be used in low abrasion environments. WSA is to be used in high abrasion environments. B. Powder coatings supply corrosion protection as barrier coatings only. They supply no cathodic protection. C. Reference (a) lists proposed components for powder coating.	• Show/discuss T-1-7-3. •	• Copy list of approved application items from board.					

TRAINING AID

**Topside Shipboard Components Authorized by
NAVSEA to receive Powder Coatings***

1. Vent screens	5. Light shock mounts
2. Door screens	6. Switch cover plates
3. Ventilation discharge screens	7. Fog applicators
4. Light brackets	8. Battle helmets

*Powder Coating Systems for Corrosion Protection Aboard Naval Ships, DoD-STD-XXXX, SEA 05M1 Draft circa Oct 85.

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TITLE <u>CC System 4: Powder Coatings</u> COURSE <u>CC-Shop Technician</u> UNIT <u>1</u> LESSON NO. <u>7</u>			
PRACTICAL APPLICATIONS	TRAINING AID/ DEMONSTRATION		
- Summarize Lesson. - Question students on key points; repeat and amplify the instruction as required.	<table border="1"> <thead> <tr> <th>TRAINEE RESPONSE</th> </tr> </thead> <tbody> <tr> <td> - Answer questions and explain issues asked by the instructor. - Demonstrate knowledge of: -characteristics of powder coating. -surface preparation requirements. -industrial process requirements. -NAVSEA proposed items. </td> </tr> </tbody> </table>	TRAINEE RESPONSE	- Answer questions and explain issues asked by the instructor. - Demonstrate knowledge of: -characteristics of powder coating. -surface preparation requirements. -industrial process requirements. -NAVSEA proposed items.
TRAINEE RESPONSE			
- Answer questions and explain issues asked by the instructor. - Demonstrate knowledge of: -characteristics of powder coating. -surface preparation requirements. -industrial process requirements. -NAVSEA proposed items.			

INSTRUCTOR PREPARATION

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TITLE <u>CC Systems 6-9: Fasteners and Preservation Materials</u>		COURSE <u>CC-Shop Technician</u>		UNIT <u>1*</u>	LESSON NO. <u>8</u>
LEARNING OBJECTIVES		TRAINING AIDS/MATERIALS			
Trainees will understand: - CC Systems 6 through 9 description and purpose; - Safety and health precautions for the following 4 NAVSEA-designated systems: - CC System 6: Ceramic Coating (MIL-C-81751). - CC System 7: Water-Displacing Clear Corrosion-Preventive Compound (MIL-C-85054). - CC System 8: Anti-seize Thread Compound (MIL-T-22361). - CC System 9: Improved Fasteners. Trainees will be able to: - Apply Systems 7 through 9.		Materials: - CC System 6: Two sets of ceramic-coated fasteners (nut, bolt, washers). - CC System 7: One aerosol can of MIL-C-85054 and one small electrical box with wiring inside. - CC System 8: Tube of anti-seize compound MIL-T-22361 and paper towels. - CC System 9: Two sets of 316-SS fasteners. - Transparency T:I-8-1 a/b/c/d. - Overhead projector. - Chalk/marker, board and eraser. References: - NAVSEA S9630-AG-MAN-010/FFG-7CL, Manual, Corrosion Control for FFG-7 Class, 30 November 1983. Handouts - Paper copy of T:I-8-1 a/b/c/d. - Copy of Sections from Reference 1: - 4.3.6 on CC System 6 - 4.3.7 on CC System 7 - 4.3.8 on CC System 8 - 4.3.9 on CC System 9			

* Marine Corrosion, Causes, Prevention and Control.

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CC Systems 6-9: Fasteners and Preservation Materials		COURSE	CC-Shop Technician	UNIT	I	LESSON NO.	8
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
L SYSTEM 6 - CERAMIC COATINGS (MIL-C-81751) <u>General, System Description</u> System 6, ceramic coatings, provides protection to carbon steel substrates, such as nuts, bolts, fittings, etc. suitable for high- and ambient temperature applications. For example, this is the only coating authorized for B-16 hardened fasteners for ferrous 1200-psi steam valves. <u>A. Material and Ingredients</u> 1. An inorganic coating formula with binder solids of either: (a) inorganic compounds (b) ceramic oxides, or (c) glass frits (ground glass) 2. Compounded to form an acidic aqueous slurry (binder) (a) containing aluminum powder (filler) (b) particle size about 5-10 microns (c) chromate surround the aluminum particles to inhibit corrosion (d) phosphates are added to improve adhesion (e) sintered at 650°F for 30 minutes 3. This ceramic coating is normally applied to fasteners at a .75-1.0 mil thickness.				• Write instructor's name, lesson number and title on board. • Show and pass around samples.		Trainees will: 1. Take notes. 2. Participate in class discussion and activities. ----- • Visually examine and feel texture of coating.	

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TITLE CC Systems 6-9: Fasteners and Preservation Materials		COURSE CC-Shop Technician	UNIT 1	LESSON NO. 8
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
4. This System offers significant improvement over galvanized or cadmium-coated steel fasteners. B. Ceramic Coatings Procedures - This process is performed by a licensed commercial source. - Company must be qualified under MIL-C-81751. - Selective parts coated with this system are available in the Navy stock system. C. Maintenance and Repair - Ceramic coated fasteners are to be installed with anti-seize compound (see CC System 8) to protect the applied coatings. - Coating life expectancy is approximately three (3) years. - Repair of the coating is impractical for Ship's Force. - Damaged coatings require replacement of the component. - Replacement component must be identical in composition to damaged item. D. Safety and Health Precautions - Safe to handle the cured coating, however the uncured liquid coating materials are highly toxic if ingested.		Stress replacement.		

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TITLE <u>CC Systems 6-9: Fasteners and Preservation Materials</u> COURSE <u>CC-Shop Technician</u> UNIT <u>1</u> LESSON NO. <u>8</u>	KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
	II. SYSTEM 7 - WATER DISPLACING, CLEAR CORROSION-PREVENTIVE COMPOUND (MIL-C-85054) A. System Description (General) - This System is dry, clear, water-displacing corrosion-preventive compound. - System Seven will only prevent corrosion for a few weeks. - Used when servicing, such as opening/closing electrical boxes. - Application is by gas pressurized containers (aerosol spray cans), brushing or spraying. - System 7 material will displace light salt water moisture leaving a clear, corrosion-preventive film. - Intended for use: - On unpainted metal areas. - Where paint is damaged or cracked, such as around multi-pin electrical connectors, joints, seams and access panels. - Not intended for use on moving parts where a lubrication is required.	Show trainees aerosol can of compound; pass around class.	Examine, read label, <u>do not spray</u>. Pass on.

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CC Systems 6-9: Fasteners and Preservation Materials		COURSE CC-Shop Technician		UNIT 1		LESSON NO. 8	
TITLE		KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
II. SYSTEM 7 - WATER DISPLACING, CLEAR CORROSION-PREVENTIVE COMPOUND		A. <u>System Description (General)</u> - This System is dry, clear, water displacing corrosion-preventive compound. 1. System Seven will only prevent corrosion for a few weeks. (a) Used when servicing, such as where plugging/unplugging, is frequent. 2. Application is by gas pressurized containers (aerosol spray cans), brushing or spraying. 3. System 7 material will displace light salt water moisture leaving a clear, corrosion-preventive film. Intended for use: (a) on unpainted metal areas or, (b) where paint is damaged or cracked, such as around multi-pin electrical connectors, joints, seams and access panels. (c) Not intended for use on moving parts where a lubrication is required.		• Show trainees aerosol can of compound; pass around class.		• Examine, read label, <u>do not</u> spray. Pass on.	

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TITLE <u>CC Systems 6-9: Fasteners and Preservation Materials</u> COURSE <u>CC-Shop Technician</u> UNIT <u>1</u> LESSON NO. <u>8</u>			
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
4. The decomposition products may be corrosive, irritating or toxic in contact with flames or hot surfaces. 5. Store container in flammable liquids storeroom or locker. 6. Handle with care, protect from damage, keep away from all heat and heat sources. 7. Keep away from food. 8. <u>Read instructions and precautions on the can.</u> III. SYSTEM 8 - ANTI-SEIZE THREAD COMPOUND (MIL-T-22361) A. <u>General System Description</u> System 8 is a zinc dust-petrolatum anti-seize compound. 1. The compound is intended to prevent seizing during assembly or disassembly of threaded or unthreaded components. 2. The compound also acts to provide corrosion protection for the metal surfaces. B. <u>Application and Procedures</u> 1. Anti-seize compound is to be used on installation and reinstallation of all metallic fasteners. 2. Squeeze a small amount onto your fingers and apply liberally to all threads of the fastener.	• Stress importance of reading instructions on can and following them. • Pass tube of anti-seize around to trainees. • Demonstrate application and procedures for using anti-seize compound.	• Examine tube; squeeze small amount on fingertip and feel consistency of the material. Wipe fingers clean. • Selected trainees will use proper procedures and apply anti-seize compound to threads of fastener.	

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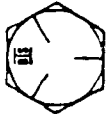
PAGE 7 OF 14

TITLE CC Systems 6-9: Fasteners and Preservation Materials	COURSE CC-Shop Technician	UNIT I	LESSON NO. 8
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
IV. SYSTEM 9 - IMPROVED FASTENERS A. <u>General System Description</u> <u>Improved Fasteners:</u> 316-SS and Ceramic Coated Fasteners. The CRES 316 alloy is 12-percent nickel, 18-percent chromium and 3-percent molybdenum. This alloy performs best in a marine environment and shall be used. Nickel-copper alloy has various compositions, principally nickel with 30-percent copper and small amounts of aluminum, titanium, iron or silicone. All have good to excellent corrosion resistance characteristics. <u>Standard bolt head markings</u> Bolt heads are generally stamped "316"; washers are unstamped. All unstamped nuts/washers must have a letter of certification from supplier that they are in fact 316-SS material. The term fasteners covers devices used to attach metal pieces and fittings together. 1. Examples: (a) bolts (b) nuts (c) studs (d) washers	• T-1-8-1 a/b/c/d • Show/discuss ASTM and SAE Standards for bolt head markings. Stress only SS Sections.	• Examine, compare and pass on.	

Identification Markings on Bolt Heads

ASTM and SAE Standards

Specifications, Proof Loads, Tensile Strengths.

Grade Marking	Specification	Material	Bolt and Screw Size, in.	Proof Load, psi	Tensile Strength min, psi
 M F G S Y M B O L	SAE—J429 Grade 1	Low or Medium Carbon Steel	½ thru 1½	33,000	60,000
	ASTM—A307		½ thru 4		60,000
	SAE—J429 Grade 2	Low or Medium Carbon Steel	½ thru ¾ Over ¾ thru 1½	55,000 33,000	74,000 60,000
	SAE—J429 Grade 5		½ thru 1 Over 1 thru 1½	85,000 74,000	120,000 105,000
	ASTM—A325 Type 1	Medium Carbon Steel Quenched and Tempered	½ thru 1 Over 1 thru 1½ Over 1½ thru 3	85,000 74,000 55,000	120,000 105,000 90,000
	ASTM—A325 Type 2		½ thru 1 Over 1 thru 1½	85,000 74,000	120,000 105,000
	ASTM—A325 Type 3	Weather Resistant Steel, Quenched and Tempered	1½ thru 1½ ½ thru 1	74,000 85,000	105,000 120,000

TRAINING AID

IDENTIFICATION MARKINGS ON BOLT HEADS (ASTM & SAE STANDARDS) cont'd

Grade Marking	Specification	Material	Bolt and Screw Size, in.	Proof Load, psi	Tensile Strength min, psi
	ASTM—A354 Grade BB	Low Alloy Steel, Quenched and Tempered	¼ thru 2½ Over 2½ thru 4	80,000 75,000	105,000 100,000
	ASTM—A354 Grade BC	Low Alloy Steel, Quenched and Tempered	¼ thru 2½ Over 2½ thru 4	105,000 95,000	125,000 115,000
	SAE—J429 Grade 8	Medium Carbon Alloy Steel, Quenched and Tempered	¼ thru 1½	120,000	150,000
	ASTM—A354 Grade BD	Alloy Steel, Quenched and Tempered			
	ASTM—A490	Alloy Steel, Quenched and Tempered	½ thru 1½	120,000	150,000

TRAINING AID

IDENTIFICATION
MARKINGS ON
BOLT HEADS
(ASTM & SAE
STANDARDS)

			Mechanical Properties				
Identification Grade Mark	Specification	Fastener Description	Material	Nominal Size Range (in.)	Proof Load (psi)	Yield Strength Min (psi)	Tensile Strength Min (psi)
	ASTM A320 Grade B8	Bolts, Screws, Studs for Low- Temperature Service	AISI 304	1/4 and larger		30,000	75,000
	ASTM A320 Grade B8C		AISI 347				
	ASTM A320 Grade B8T		AISI 321				
	ASTM A320 Grade B8F		AISI 303 or 303Se				
	ASTM A320 Grade B8M		AISI 316				
	ASTM A320 Grade B8		AISI 304				

contd

TRAINING AID

IDENTIFICATION MARKINGS ON BOLT HEADS (ASTM & SAE STANDARDS)

contd

Identification Grade Mark	Specification	Fastener Description	Material	Nominal Size Range (in.)	Mechanical Properties		
					Proof Load (psi)	Yield Strength Min (psi)	Tensile Strength Min (psi)
	ASTM A320 Grade B8C	Bolts, Screws, Studs for Low Temperature Service	AISI 347	1/4 thru 3/4 Over 3/4 thru 1 Over 1 thru 1-1/4 Over 1-1/4 thru 1-1/2	— — — —	100,000 80,000 65,000 50,000	125,000 115,000 105,000 100,000
	ASTM A320 Grade B8F		AISI 303 or 303Se				
	ASTM A320 Grade B8M		AISI 316				
	ASTM A320 Grade B8T		AISI 321				

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TITLE <u>CC Systems 6-9: Fasteners and Preservation Materials</u> COURSE <u>CC-Shop Technician</u> UNIT <u>1</u> LESSON NO. <u>8</u>		
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
2. Fasteners used in topside applications are subject to corrosion by: (a) direct attack (b) pitting (c) stress corrosion (d) galvanic action 3. The initial selection of fastening techniques and fastener material does not always optimize corrosion resistance, however, in many cases selection is decided on basis of: (a) availability (b) commonality, or (c) stress requirements B. <u>Applications</u> In all applications, all components of a fastening system must be compatible. 1. Common incompatibility (a) use of a steel washer with a stainless steel or nickel/copper bolt and nut.		

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TITLE <u>CC Systems 6-9: Fasteners and Preservation Materials</u> COURSE <u>CC-Shop Technician</u> UNIT <u>I</u> LESSON NO. <u>8</u>		
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
2. Most common fastening applications in exterior structural stress are: (a) steel to steel (b) steel to aluminum alloys, and (c) aluminum alloys to aluminum alloys. 3. For <u>steel-to-steel application</u> where high strength is required: (a) use low-alloy-steel fasteners (such as grade 5 or 8 MIL-S-001222G) with a ceramic coating. C. <u>Maintenance and Repair</u> 1. Onboard ship ceramic-coated fasteners must be painted when chipped. At SIMA, fasteners will be replaced. 2. Anti-Seize compound must be applied on: (a) installation, and/or (b) reinstallation of the fasteners		

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CC Systems 6-9: Fasteners and Preservation Materials		COURSE <u>CC-Shop Technician</u>	UNIT <u>1</u>	LESSON NO. <u>8</u>
PRACTICAL APPLICATIONS	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
- Summarize Lesson. - Question students on key points; repeat and amplify the instruction as required. - Have students demonstrate proper use and maintenance of anti-seize on fasteners.		- Answer questions and explain issues asked by the instructor. - Demonstrate knowledge of practical skills.		

INSTRUCTOR PREPARATION

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CC Systems 10-15: Sealing and Coating Compounds		COURSE <u>CC-Shop Technician</u>	UNIT <u>1*</u>	LESSON NO. <u>9</u>
LEARNING OBJECTIVES		TRAINING AIDS/MATERIALS		
Trainees will learn: - System descriptions and purposes/uses; - Application and maintenance procedures; and - Safety and health precautions. For CC System 10: Sealing and Coating Compound (MIL-S-81733, Type I) CC System 11: Polysulfide Sealant (MIL-S-81733, Type IV) CC System 12: Protection of Electrical Connectors CC System 13: Dielectric Barrier CC System 14: Vapor-Phase Inhibitor (MIL-I-22110) CC System 15: Strippable Coating (MIL-S-8802)		Materials (made up locally in the CC-Shop): - Display board or individual samples of CC Systems 10, 11, 12, 13 and 15. - CC System 10, Polysulfide Sealant, Type I (1/2-hour drying time) kit (base compound + accelerator). - CC System 11, Polysulfide Sealant, Type IV kit. - CC System 12, (a) heat shrinkable tubing; (b) vinyl tape and fast-drying sealant, (c) vinyl tape and putty and (d) heat gun, tools and connector with cable to demonstrate use. - CC System 13, ABS plastic sheet approximately 3" x 5" x 1/4" thick. - CC System 14, Vapor-Phase Inhibitor sample. - CC System 15, Strippable coating kit and electrical connector with cable to demonstrate use. - Transparency T-I-9-1. - Overhead projector. - Chalk/marker, board and eraser. Reference: - NAVSEA S9630-AG-MAN-010/FFG-7CI, Manual, Corrosion Control for FFG-7 Ship Class, Sections 4.3.10 to 4.3.15 and Appendix B.		

• Marine Corrosion, Causes, Prevention and Control

INSTRUCTOR PREPARATION

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TITLE <u>CC Systems 10-15: Sealing and Coating Compounds</u>		COURSE <u>CC-Shop Technician</u>	UNIT <u>1</u>	LESSON NO. <u>9</u>
LEARNING OBJECTIVES		TRAINING AIDS/MATERIALS		
Handouts:		1. Paper copy of T:I-9-1. 2. Copy of Sections 4.3.10 through 4.3.15 of Reference 1 above.		

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TITLE CC Systems 10-15: Sealing and Coating Compounds		COURSE CC-Shop Technician	UNIT 1	LESSON NO. 9
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
I. SYSTEMS 10-15 DESCRIPTIONS Systems 10 through 15 are sealing and coating compounds. These systems are used to help protect the metals from any moisture that may penetrate the barriers. A. The Systems are: (1) System 10: Sealing and Coating Compound (2) System 11: Polysulfide Sealant (3) System 12: Protection of Electrical Connectors (4) System 13: Dielectric Barrier (5) System 14: Vapor-Phase Inhibitor (MIL-1-22110) (6) System 15: Strippable Coatings		- Write instructor's name, lesson number and title on board. - Show/discuss T-1-9-1.	- Take notes. - Participate in class discussion and activities.	
II. SYSTEM TEN: SEALING AND COATING COMPOUND (MIL-S-81733, TYPE D) A. General This system is a sealing and coating compound. The polysulfide sealant has corrosion-inhibitive chromates added to help protect the metal against any moisture which may ultimately penetrate the barrier. It is a two-part system which cures at room temperature to form a resilient (rubber-like) coating that adheres well to steel, aluminum and other metals.		- Show/discuss the packaged material. - Show/discuss System 10 coated sample on metal box.	Examine, read label and pass on.	

TRAINING AID

**SEALING AND COATING COMPOUNDS
CC SYSTEMS 10, 11, 12, 13, 14 and 15**

System 10: Sealing and Coating Compound

System 11: Polysulfide Sealant

System 12: Protection of Electrical Connectors

System 13: Dielectric Barrier

System 14: Vapor Phase Inhibitor (MIL-1-22110)

System 15: Strippable Coatings

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TITLE	CC Systems 10-15: Sealing and Coating Compounds	COURSE	CC-Shop Technician	UNIT	1	LESSON NO.	9
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
B. <u>Applications</u> This polysulfide sealant shall be used to provide corrosion protection on fasteners and other small similar crevices.							
C. <u>Application Procedures</u> The sealant is applied in accordance with the manufacturer's specifications and NSTM 631.							
III. SYSTEM ELEVEN: POLYSULFIDE SEALANT (MIL-S-81733, TYPE IV)							
A. <u>General</u> This system is a corrosion-inhibitive sealing compound. The polysulfide sealant has soluble chromates to help protect the metal against any moisture which may ultimately penetrate the barrier. The sealant is intended for use only as a sealing compound at faying surfaces where metals are joined or fastened tightly together. This is a two-part system that will only cure in a joint in the absence of air. The curing process forms a resilient seal and will adhere well to steel, aluminum and other metals.				• Show/discuss the packaged material in a tube. • Show/discuss System 11 coated example on metal box.			
B. <u>Applications</u> Polysulfide sealant shall be applied at all faying surfaces, i.e., foundations.							
C. <u>Application Procedures</u> The sealant is applied in accordance with the manufacturer's specifications and NSTM 631.				• Read/discuss manufacturer's instructions on sample package.			

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

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TITLE		COURSE	UNIT	LESSON NO.	9
CC Systems 10-15: Sealing and Coating Compounds		CC-Shop Technician	1		
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
IV. SYSTEM TWELVE: PROTECTION OF ELECTRICAL CONNECTORS A. <u>General</u> These devices are for protecting topside electrical connections and are especially useful for multi-pin or cannon-plug connections on electronic equipment. The systems are (in order of preference) 1. heat-shrinkable tubing, 2. sealant with vinyl tape, and 3. vinyl tape with putty. <u>Note:</u> Variations and combinations of each may be used to suit the particular situation. <u>Note:</u> Each is easy to remove with either a knife or moderate heat and a knife. B. <u>Applications</u> Electrical connection protectors may be used at multi-pin or cannon-plug connectors in 1. interior communications or radio handsets, 2. fire-control devices and other electrical, 3. radar or radio components.		Note that there will be very minimal requirements for this treatment in the SIMA CC-Shop. However, CC-Shop personnel will provide technical assistance to S/F and other SIMA Shops, e.g., Shop 67 (Electrical Shop).			

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

PAGE 7 OF 12

TITLE	CC Systems 10-15: Sealing and Coating Compounds	COURSE	CC-Shop Technician	UNIT	I	LESSON NO.	9
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE			
C. <u>Application Procedures</u> The correct procedures for using the devices are as follows: 1. <u>Heat-Shrinkable Tubing (MIL-I-23053/15)</u> (a) Install the sleeve to cover the entire connector including the rotating cap. (b) After completely tightening the connector, heat the sleeve to not more than 250°F using a cool torch or electrical heat gun. (c) The sleeve will shrink to fit the connector and, at the same time, an adhesive in the sleeve will soften, thereby providing additional corrosion protection. Note: (If the connector must be disconnected frequently, as is done for radio and IMC handsets, do the above step for only the non-rotating parts. The caps should be treated with water-displacing, clear, corrosion-prevention compound at each reinstallation.) 2. <u>Sealant with Vinyl Tape</u> (a) This system consists of brushing on a fast-drying sealant over electrician vinyl tape (MIL-I-19166 or MIL-I-631). (b) The vinyl tape overlaps the connector approximately 3 inches and is sealed with two coats of the fast-drying polysulfide sealant (MIL-S-81733, Type I-1/2).		• Show materials and demonstrate use of heat-shrinkable tubing. • Show materials and demonstrate use on male connector with cable.		• Selected trainees explain process and apply heat-shrinkable tubing. • Selected trainees tape and seal a connector with cable.			

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

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TITLE	COURSE	UNIT	LESSON NO.
CC Systems 10-15: Sealing and Coating Compounds	CC-Shop Technician	1	9
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
(c) If the cable is unprotected, double wrap the connection (first with a silicone rubber tape and secondly with the standard vinyl insulation tape). It is also advisable to tie off the "bitter-end" of the electrical tape with a small plastic tie (to prevent tape separation) prior to sealing. 3. <u>Vinyl Tape and Putty</u> (a) This system uses a special insulation compound which is further covered by tape. (b) Tightly wrap the connection using a suitable insulation putty or caulking compound (include at least 3 inches of cable). (c) While wrapping, stretch the insulation tape to 1/2-inch thickness and apply at least four overlapping layers. (d) If the caulking compound is used, allow it to harden before the next step. Note:(For either the tape or caulk, cover with three layers of tightly drawn vinyl electric tape. As for the shrinkable tubing, modify as needed to suit the permanency of the connection.) V. SYSTEM THIRTEEN: PLASTIC DIELECTRIC BARRIER (ABS) A. <u>General</u> Plastic dielectric barriers are used to provide electrical insulation between identification plates and the base metal. This barrier prevents galvanic corrosion by breaking the electrical path. Acrylonitrile butadienestyrene (ABS) plastic is used 1/4-inch thick and 1/4-inch larger on all sides of the ID plate.	• Show materials and demonstrate use on male connector with cable. • Show materials and installation.	• Selected trainees tape and putty a connector with cable.	

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

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TITLE CC Systems 10-15: Sealing and Coating Compounds		COURSE CC-Shop Technician		UNIT 1	LESSON NO. 9
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
B. <u>Applications</u> ABS shall be used to electrically-insulated label plates from the base metal. C. <u>Application Procedures</u> 1. Screw label plate over ABS plastic with Type 316-SS fasteners. VL SYSTEM FOURTEEN: VAPOR PHASE INHIBITOR (MIL-I-22110) A. <u>General</u> System Fourteen, Vapor-Phase Inhibitor (VPI), is intended as a preservation for ferrous, aluminum, aluminum-base alloys and components in closed or low-air-flow spaces. When VPI material is exposed, it sublimates into a vapor which penetrates through the spaces to all exposed metallic surfaces. On contact with the surface, the vapors condense into a highly-protective, invisible molecular film which provides corrosion resistance. B. <u>Applications</u> As a rule, the application of vapor-phase inhibitors must be in confined areas with limited air flow such as: 1. tool boxes, 2. lockers, and 3. small containers.		• Show materials, explain and use procedures.			

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

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CC Systems 10-15: Sealing and Coating Compounds		COURSE		CC-Shop Technician		UNIT		1		LESSON NO.		9	
TITLE		KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE							
C. <u>Application Procedures</u> Vapor-Phase Inhibitor shall be applied in accordance with manufacturer's specifications.		VIL SYSTEM FIFTEEN: STRIPPABLE COATING (MIL-S-8802)											
A. <u>General</u> In this system, a synthetic rubber compound is used as a strippable coating for fasteners and similar components for corrosion protection when these components are exposed to marine environments. It is a two-part system which cures at room temperatures to form a resilient coating which adheres well to steel, aluminum and other metals.													
B. <u>Applications</u> Strippable coatings shall be used to protect fasteners on similar components subject to exposure upon disassembly that will be reinstalled at a later time.													
C. <u>Application Procedures</u> This system is packaged in a kit and should be applied following these general guidelines: 1. <u>The base compound should be thoroughly mixed</u> to obtain a uniform consistency before adding the accelerator. 2. The accelerator should also be mixed thoroughly in its container.													

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

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TITLE <u>CC Systems 10-15: Sealing and Coating Compounds</u>		COURSE <u>CC-Shop Technician</u>		UNIT <u>J</u>	LESSON NO. <u>9</u>
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE			
3. The accelerator is stirred into the base compound and thoroughly mixed. 4. It is important to scrape the sides and bottom of the container and the mixing paddle to be sure blending is uniform. 5. Surface to be protected must be cleaned with solvents just before applying the sealant to remove (a) dirt, (b) grease, and (c) other contamination. 6. Apply polysulfide compound using a spatula, brush or similar device as appropriate over clean painted surfaces. 7. Ensure complete coverage at a minimum thickness.					

INSTRUCTOR FOLLOW-UP-THROUGH

SIMA CC-SHOP
Lesson Plan

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TITLE <u>CC Systeme 10-15: Sealing and Coating Compounds</u>		COURSE <u>CC-Shop Technician</u>	UNIT <u>1</u>	LESSON NO <u>9</u>
PRACTICAL APPLICATIONS	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
- Summarize Lesson. - Question students on key points; repeat and amplify the instruction as required. - Have students demonstrate proper use and maintenance of NAVSEA CC Systems 10 through 15.		- Answer questions and explain issues asked by the instructor. - Demonstrate knowledge of practical skills.		

INSTRUCTOR PREPARATION

SIMA CC-SHOP
Lesson Plan

PAGE 1 OF 16

TITLE <u>Installation Kits</u>	COURSE <u>CC-Shop Technician</u>	UNIT <u>1*</u>	LESSON NO. <u>10</u>
LEARNING OBJECTIVES		TRAINING AIDS/MATERIALS	
Trainees will understand: 1. The definition and need for Installation Kits. 2. How to makeup and issue Installation Kits, including use of • Ship-Class CC Manuals. • Installation Kit Technical Data Sheets. 3. The supply support inventory and procurement needs and procedures for the Installation-Kit materials.		Materials: 1. Installation-Kit examples obtained from the Installation-Kit Station of the CC Shop made up for a • Boat Davit Controller Box (see T:I-10-10). • Fastener samples: 316-SS/304-SS/monel/ceramic-coated. 2. Transparencies T:I-10-1 through T:I-10-10. 3. Overhead projector. 4. Chalk/dry board and markers. Reference: 1. S9630-AG-MAN-010/FFG-7CL, Manual, Corrosion Control for FFG-7 Class, 30 November 1983. Handouts: 1. One paper copy of the transparencies used in this lesson. 2. Installation Kit Technical Data Sheet, FFG-7, Controller, Boat Davit.	

* Marine Corrosion, Causes, Prevention and Control

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

PAGE 2 OF 16

TITLE <u>Installation Kits</u>		COURSE <u>CC-Shop Technician</u>		UNIT <u>I</u>	LESSON NO. <u>10</u>
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
I. INTRODUCTION A. <u>Define Installation Kits</u> Installation Kits are a prepackage of items from NAVSEA CC Systems 6 through 15 as necessary for the proper installation of items preserved by the CC-Shop with WSA and powder coatings. B. <u>Need for Installation Kits</u> • Proper reassembly/reinstallation a must for long-lived service. • Eliminate/reduce corrosion potential from dissimilar metals, incorrect fasteners and coating compounds. C. <u>Trainee Knowledge at Completion of This Lesson</u> • Enumerate/discuss the Learning Objectives of this lesson. II. REVIEW NAVSEA CC-SYSTEMS 6 THROUGH 15 AND DISCUSSION OF USE IN INSTALLATION KITS • CC System 6: Ceramic Coatings (MIL-C-81751). • CC System 7: Water-Displacing, Clear, Corrosion Prevention Compound (MIL-C-85054). • CC System 8: Anti-Seize Thread Compound (MIL-T-22361).		• Write instructor's name, rate, lesson number and title on board.		• Take notes. • Participate in class discussion and activities.	

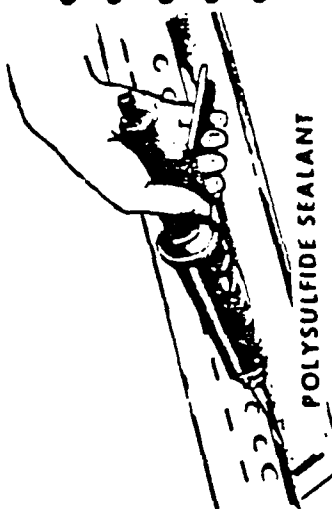
TRAINING AID

THE NAVSEA CC SYSTEM

1	WSA High Temp.
2	WSA Low Temp.
3	Exterior Topside Coating
4	Powder Coatings
5	Non-Skid Deck Coatings
6	Ceramic Coatings
7	Water Displacing Compounds
8	Anti-Seize Compounds
9	Improved Fasteners
10	Seal & Coating Compounds
11	Polyulfide Sealants
12	Multi-Pin Conn. Prot.
13	Plastic Dielectric Barrier
14	Vapor Phase Inhibitor
15	Strippable Coating

► Installation Kits (Sys 6 through 15)

Installation kits consist of selected items for Systems 6 through 15 for the proper installation of items pre-served with WSA and powder coatings.



- IMPROVED FASTENERS
- ANTI-SEIZE
- DIELECTRIC BARRIER
- PAINTS
- CERAMIC COATED FASTENERS
- STRIPPABLE COATING

TRAINING AID

THE NAVSEA
CC SYSTEM

1	WSA High Temp.	1
2	WSA Low Temp.	2
3	Exterior Topside Coating	3
4	Powder Coatings	4
5	Non-Skid Deck Coatings	5
6	Ceramic Coatings	6
7	Water Displacing Compound	7
8	Anti-Seize Compound	8
9	Improved Fasteners	9
10	Seal & Coating Compounds	10
11	Polyurethane Sealants	11
12	Multi-Pin Conn. Prot.	12
13	Plastic Dielectric Barrier	13
14	Vapor Phase Inhibitor	14
15	Stripable Coating	15

→ System Six: Ceramic Coatings (MIL-C-81751)

In this system, ceramic coatings provide corrosion and oxidation protection to carbon steel substrates such as nuts, bolts, fittings, etc. System Six is an inorganic coating formula consisting of an aqueous (water) binder solution with aluminum powder added as filler. The particle size is about 5 to 10 microns. The system contains phosphates which have been added to improve adhesion to the metal being coated. This coating is normally applied to fasteners at a 0.75- to 1.0-mil thickness. This system offers significant improvement over galvanized or cadmium-coated steel items.

→ System Seven: Water-Displacing, Clear, Corrosion-Preventive Compound

This system is a dry, clear, water-displacing, corrosion-preventive compound. System Seven will not prevent corrosion beyond a few weeks, but it is used where servicing, such as plugging/unplugging connections, is frequent. The compound may be applied from gas pressurized containers, by brushing or spraying. This material will displace light salt water moisture leaving a clear, corrosion-preventive film.

TRAINING AID

THE NAVSEA
CC SYSTEM

1	WSA High Temp.
2	WSA Low Temp.
3	Exterior Topside Coating
4	Powder Coatings
5	Non-Skid Deck Coatings
6	Ceramic Coatings
7	Water Displacing
8	Anti-Seize Compounds
9	Improved Fasteners
10	Seal & Coating Compounds
11	Polyurethane Sealants
12	Multi-Pin Conn. Prot.
13	Plastic Dielectric Barrier
14	Vapor Phase Inhibitor
15	Strippable Coating

→ System Eight: Anti-Seize Thread Compound (MIL-T-22361)

This system is a zinc dust-petrolatum anti-seize thread compound. The compound is intended to prevent seizing during the assembly or disassembly of threaded or unthreaded components made from aluminum alloys that are engaged with components made from similar or dissimilar metals. The compound also acts to provide corrosion protection for the metal surfaces.

→ System Nine: Improved Fasteners

The term "fasteners" covers devices such as bolts, nuts, studs and washers that are used to attach metal pieces and metal fittings together. Fasteners used in topside applications are subject to corrosion by direct attack, pitting, stress corrosion and galvanic action. The initial selection of fastening techniques and fastener material does not always optimize corrosion resistance, but in many cases is decided on the basis of availability, commonality, or stress requirements.

TRAINING AID

**THE NAVSEA
CC SYSTEM**

- 1
 - 2
 - 3
 - 4
 - 5
 - 6
 - 7
 - 8
 - 9
 - 10
 - 11
 - 12
 - 13
 - 14
 - 15
- WSA High Temp.
WSA Low Temp.
Exterior Topside Coating
Powder Coatings
Non-Skid Deck Coatings
Ceramic Coatings
Water Displacing Compounds
Anti-Seize Compounds
Improved Fasteners
Seal & Coating Compounds
Polysulfide Sealants
Multi-Pin Conn. Prot.
Plastic Dielectric Barrier
Vapor Phase Inhibitor
Strippable Coating

FASTENER MATERIALS FOR JOINING METALS		
Metals Being Joined	Fastener Material to be Used (in descending joined priority)	
	3/8" Dia. or Less	Greater than 3/8" Dia.
Steel and Steel	1. CRES 316 alloy 2. CRES 304 alloy 3. Other 18-8 CRES 4. Nickel-copper (monel)	*1. Steel with ceramic coating 2. CRES 316 alloy 3. CRES 304 alloy 4. Other 18-8 CRES alloys 5. Nickel-copper (monel)
Steel and Aluminum Alloys**	1. CRES 316 alloy 2. CRES 304 alloy 3. Other 18-8 CRES alloys	1. CRES 316 alloy 2. CRES 304 alloy 3. Other 18-8 CRES alloys
Aluminum Alloys and Aluminum	1. CRES 316 alloy 2. CRES 304 alloy 3. Other 18-8 CRES alloys	1. CRES 316 alloy 2. CRES 304 alloy 3. Other 18-8 CRES alloys
Nickel-copper and Nickel-copper (Monel) or steel	1. Nickel-copper (monel)	1. Nickel-copper (monel)

* Ceramic coating in accordance with system six.
** Aluminum alloy fasteners are not approved.

TRAINING AID

[illegible]

System Ten: Sealing and Coating Compound (MIL-S-81733, Type I)

This system is a sealing and coating compound. The polysulfide sealant has corrosion inhibitive chromates added to help protect the metal against any moisture which may ultimately penetrate the barrier. It is a two part system which cures at room temperature to form a resilient (rubber-like) coating that adheres well to steel, aluminum, and other metals. MIL-S-81733 is the applicable military specification.

System Eleven: Polysulfide Sealant (MIL-S-81733, Type IV)

This system is a corrosion inhibitive sealing compound. The polysulfide sealant has soluble chromates to help protect the metal against any moisture which may ultimately penetrate the barrier. The sealant is intended for use only as a sealing compound at faying surfaces where metals are joined or fastened tightly together. This is a two part system that will only cure in a joint in the absence of air. The curing process forms a resilient seal and will adhere well to steel, aluminum, and other metals. MIL-S-81733 is the applicable military specification. The Type IV sealing compound under this specification is suitable for application to faying surfaces by spatula, or gun.

TRAINING AID

THE NAVSEA CC SYSTEM															1	2	3	4	5	6	7	8	9	10	11	11	11	11	11			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15																		
															W/A High Temp.																	
															W/A Low Temp.																	
															Exterior Topside Coatings																	
															Powder Coatings																	
															Non-Skid Deck Coatings																	
															Ceramic Coatings																	
															Water Displacing Coatings																	
															Anti-Seize Compounds																	
															Improved Fasteners																	
															Seal & Coating Compounds																	
															Polysulfide Sealants																	
															Multi-Pin Conn. Prot.																	
															Plastic Dielectric Barrier																	
															Vapor Phase Inhibitor																	
															Stripable Coating																	

System Twelve: Protection of Electrical Connectors

The following three systems are for protecting topside electrical connections and are especially useful for multi-pin or cannon-plug connections on electronic equipment such as interior communications or radio handsets, fire-control devices, and other electrical, radar, or radio components. The systems are discussed in order of preference; heat shrinkable tubing, sealant with vinyl tape, and vinyl tape with putty.

1. Heat shrinkable tubing

The heat shrinkable tubing is rubber sleeving material which is flexible, non-corrosive and thermally stable. The standard material conforms to MIL-I-23053/15.

2. Sealant with vinyl tape

This system consists of brushing on a fast-drying sealant over vinyl tape.

3. Vinyl tape and putty

This system uses a special insulation compound which is further covered by tape.

THE NAVSEA CC SYSTEM

[illegible]

In this system, a plastic dielectric barrier of ABS (Acrylonitrile Butadiene-styrene) is used to provide improved preservation for identification labels.

NOTE: CC Sys 13 is used to designate dielectric or non-conducting materials in general to prevent dissimilar metal contact.

System fourteen, Vapor Phase Inhibitor (VPI), is intended as a preservation for ferrous, aluminum, aluminum-base alloys, and components in closed or low air flow spaces. When VPI material is exposed, it sublimes into a vapor which penetrates through the spaces to all exposed metallic surfaces. On contact with the surface, the vapors condense into a highly protective, invisible molecular film which provides corrosion resistance. As a rule, the application of vapor phase inhibitors must be in confined areas with limited air flow such as tool boxes, lockers, and small containers.

In this system a synthetic rubber compound is used as a strippable coating for fasteners and similar components for corrosion protection when these components are exposed to marine environments. It is a two part system which cures at room temperatures to form a resilient coating which adheres well to steel, aluminum and other metals. MIL-S-8802 is the applicable specification. The class A compound is intended for brush application; class B compound is intended for application by gun or spatula. Dash number are used to designate time in hours in which compound can be used in mixing. Available dash numbers are 1/2, 1, 2, and 4.

TRAINING AID

FASTENER REQUIREMENTS FOR DD-963 CLASS SHIP

316 - 6S FASTENERS

DIAMETER (IN)	LENGTH (IN)										HEX NUTS	LOCK NUTS	FLAT WASHERS	NYLON WASHERS	PYRO CLIP
	1/2	3/4	1	1 1/4	1 1/2	1 3/4	2	2 1/2	3	3 1/2					
9/16	112	0	1084	0	0	0	0	0	0	0	1084	0	2280	2308	0
1/4	0	180	3874	0	0	0	0	0	0	0	3968	24	7844	8656	234
5/16	0	246	1522	0	0	0	0	16	0	0	1474	0	1784	1832	1474
3/8	0	856	1384	2820	648	144	264	172	0	0	3052	364	8784	9610	352
1/2	0	48	24	0	688	0	124	72	0	0	484	360	1704	1920	0
5/8	0	0	0	0	0	0	0	16	0	0	16	24	80	240	0
3/4	0	0	48	0	0	0	0	0	2	2	44	0	88	508	0

CERAMIC COATED FASTENERS

DIAMETER (IN)	LENGTH (IN)						HEX NUTS	FLAT WASHERS
	1 1/4	1 1/2	1 3/4	2	2 1/2	3		
3/8	16	0	0	0	0	0	16	32
1/2	0	16	12	32	24	0	92	168
5/8	0	0	0	0	76	96	172	344
3/4	0	16	0	0	0	64	208	416

WATERTIGHT CLOSURE PARTS

DIAMETER (IN)	LENGTH (IN)		DESCRIPTION	QUANTITY
	1/2	3/4		
1/2	76	0	HINGE PIN (RAISED HATCH)	28
5/8	0	216	WASHER (RAISED HATCH)	28
			COTTER PIN	232
			HINGE PIN (SCUTTLE)	0
			COLLAR (SCUTTLE)	0
			UPPER LINK PIN (SCUTTLE)	4
			LOWER LINK PIN (SCUTTLE)	4
			COLLAR (LINK PIN)	4
			HINGE PIN (DOOR)	204
			COLLAR (DOOR)	204

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

PAGE 11 OF 16

TITLE Installation Kits		COURSE CC-Shop Technician	UNIT I	LESSON NO. 10	
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
- CC System 9: Improved Fasteners - Preference priority - SS, CRES and monel bolt head markings - CC System 10: Sealing and Coating Compound (MIL-S-81733, Type II). - CC System 11: Polysulfide Sealant (MIL-S-18733, Type IV). - CC System 12: Protection of Electrical Connectors. - CC System 13: Dielectric Barriers. - CC System 14: Vapor-Phase Inhibitor (MIL-I-22110). - CC System 15: Strippable Coating (MIL-S-8802).		- Show/discuss T:I-10-4. Show fastener samples. - 316 - 304 - other 18-8 CRES - Monel - Show/discuss T:I-10-5 Show samples of CC Systems 10 and 11. - Show/discuss T:I-10-6. Show samples of heat shrinkable tubing. - Show/discuss T:I-10-7. Show samples of CC Systems 13, 14 and 15.			
III. MAKEUP AND ISSUE OF INSTALLATION KITS A. <u>Pre-Expend Bin</u> CC-Shop Installation Kit Station will have a pre-expend bin stocked with sufficient fasteners to service two ships of each class tended by the SIMA.		Show/discuss T:I-10-8, an example of the stockage for the DD-963 Class.			

TECHNICAL DATA SHEET

SHIP CLASS: FFG7

COMPONENT: CONTROLLER, BOAT DAVIT

FASTENERS

	DIAM	LNTH	QTY	MATERIAL
F1	5/16	2 1/8	8	316 BOLT
F2	5/16	3	4	316 BOLT
F3	1/2	7/8	12	316 PIN
F4	1/2	2	4	CER BOLT
F5	3/8	1 1/4	4	CER BOLT
F6	1/2		4	CER HEX NUT
F7	3/8		4	CER HEX NUT
F8				
F9				
F10				

NAVSEA CC SYSTEMS

1.	WSA (HT)	
2.	WSA (LT)	X
3.	TOPCOATS	
4.	POWDERED COATINGS	
5.	NON - SLID DECK COATINGS	
6.	CERAMIC COATINGS	X
7.	WATER DISPLACING COMPOUND	
8.	ANTI - SEIZE COMPOUND	X
9.	IMPROVED FASTENERS	X
10.	SEALING & COATING COMPOUND	
11.	POLYSULFIDE SEALANT	X
12.	PROTECTION OF ELEC CONN.	
13.	DIELECTRIC BARRIER (ABS)	
14.	VAPOR PHASE INHIBITOR (VPI)	
15.	STRIPPABLE COATINGS	

WASHERS

	DIAM	QTY	MAT'L
W1	5/16	12	316
W2	5/16	12	NYLON
W3	1/2	8	CER
W4	1/2	8	NYLON
W5	3/8	8	CER
W6	3/8	8	NYLON
W7			
W8			
W9			
W10			

GASKETS

	MATERIAL
G1	
G2	
G3	
G4	
G5	
G6	
G7	
G8	
G9	
G10	

COMPONENT

	MATERIAL
M1	STEEL
M2	ALUMINUM
M3	
M4	
M5	

SEE PAGE TWO
FOR
DETAILED ASSEMBLY
DRAWING

INSTALLATION INSTRUCTIONS

PREPARE ALUMINUM MOUNTING AS FOLLOWS:

- REMOVE ANY OIL OR GREASE USING APPROPRIATE SOLVENTS.
- PREPARE MOUNTING SURFACE BY REMOVING ALL CORROSION PRODUCTS USING AN ALUMINUM OXIDE ABRASIVE DISK.
- APPLY A PRIMER COAT IMMEDIATELY USING FORMULA 150 TO A DRY FILM THICKNESS (DFT) OF 3 MILS.
- APPLY A BARRIER COAT AFTER A MINIMUM OF 8 HOURS BUT NOT MORE THEN 72 HOURS HAS ELAPSED SINCE THE APPLICATION OF THE PRIMER COAT USING FORMULA 151 TO A DFT OF 3 MILS.
- APPLY A TOP COAT WHILE THE BARRIER COAT IS TACKY (APPROXIMATELY 3-4 HOURS) USING TT-E-490 TO A DFT OF 15 MILS.
- APPLY A SECOND TOP COAT WITHIN 24 HOURS USING TT-E-490 TO A DFT OF 15 MILS.
- ALLOW PAINT SYSTEM TO THOROUGHLY DRY BEFORE REINSTALLATION OF THE COMPONENT.

PREPARE STEEL MOUNTING AS FOLLOWS:

- REMOVE ANY OIL OR GREASE USING APPROPRIATE SOLVENTS.
- PREPARE MOUNTING SURFACE BY REMOVING ALL CORROSION PRODUCTS USING A STAINLESS STEEL POWER WIRE BRUSH.
- APPLY A PRIMER COAT IMMEDIATELY USING INORGANIC ZINC PRIMER TO A DRY FILM THICKNESS (DFT) OF 3 MILS.
- APPLY A BARRIER COAT AFTER A MINIMUM OF 8 HOURS BUT NOT MORE THEN 72 HOURS HAS ELAPSED SINCE THE APPLICATION OF THE PRIMER COAT USING FORMULA 150 TO A DFT OF 35-1 MIL.
- APPLY A SECOND BARRIER COAT AFTER WAITING A MINIMUM OF 8 HOURS USING EITHER FORMULA 150 OR FORMULA 151 TO A DFT OF 3 MILS.
- APPLY A TOP COAT WHILE THE SECOND BARRIER COAT IS TACKY (APPROXIMATELY 3-4 HOURS) USING TT-E-490 TO A DFT OF 15 MILS.
- APPLY A SECOND TOP COAT WITHIN 24 HOURS USING TT-E-490 TO A DFT OF 15 MILS.
- ALLOW PAINT SYSTEM TO THOROUGHLY DRY BEFORE REINSTALLATION OF THE COMPONENT.

MOUNT COMPONENT AS FOLLOWS:

- APPLY ANTI-SEIZE COMPOUND TO ALL FASTENER THREADS.
- APPLY POLYSULFIDE SEALANT TO ALL MATING SURFACES AS SHOWN IN THE ILLUSTRATION ON PAGE 2.
- INSTALL THE FASTENER ASSEMBLIES PROVIDED AS SHOWN IN THE ILLUSTRATION ON PAGE 2 ENSURING THAT THE NYLON WASHERS ARE INSTALLED NEXT TO THE MOUNTING SURFACE AND/OR THE COMPONENT TO FORM A PROTECTIVE BARRIER FOR THE COATINGS.
- REPAIR ANY CHIPS OR SCRATCHES IMMEDIATELY BY FEATHERING THE EDGES AND APPLYING A PAINT SYSTEM.

PAGE 1 OF 2

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

PAGE 13 OF 16

TITLE <u>Installation Kits</u>		COURSE <u>CC-Shop Technician</u>		UNIT <u>I</u>	LESSON NO. <u>10</u>
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
T:I-10-8 gives the topside fastener requirements for one DD-963 Class ship. • 316-SS • Ceramic-coated • 316-SS toggle pins • WTD Door parts Requirements based on estimate of the total number of ship-to-shop items that could be preserved by SIMA. B. <u>Installation-Kit Technical Data Sheet</u> by • Ship Class • Component that can be preserved by SIMA CC Shop • Fasteners - Bolt size/material - Washer - Gasket • NAVSEA CC System Designation • Installation Instruction - Onto steel - Onto aluminum		• T:I-10-8			
		• T:I-10-9			

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

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TITLE Installation Kits		COURSE CC-Shop Technician	UNIT 1	LESSON NO. 10	
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
- Assembly drawing (exploded view) <u>Makeup Installation Kit in Accordance with Installation-Kit Technical Data Sheet</u> - Start with "Shop IK makeup order" from the Receipt Inspection Station. - Pull components from pre-expended bin. - fasteners - gasketing - anti-seize - etc. per IK Tech Data Sheet - Bag in "zip-lock plastic" with copy of the IK Tech Data Sheet which S/F will use for reinstallation. - Stow in shelves designated for customer ship. - Attach to preserved component and/or issue to customer when he picks up his goods. - Log IK-components issued to customer ship (needed for charging customer ship and restocking).		T:1-10-10			
D. <u>Supply Support</u> - CC-Shop Master develop order procedure and schedule with Supply Department. - IK Petty Officer routinely reorder to "keep pre-expended bins" stocked.		- Question trainee on the - IK Tech Data Sheet - Makeup/issue of IKs			

SIMA CC-SHOP
Lesson Plan

INSTRUCTOR FOLLOW-THROUGH

PAGE 16 OF 16

TITLE <u>Installation Kits</u>		COURSE <u>CC-Shop Technician</u>		UNIT <u>1</u>	LESSON NO. <u>10</u>
PRACTICAL APPLICATIONS			TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
1. SUMMARIZE • Purpose and makeup of Installation Kit - prevent dissimilar metal contact - provide explicit instructions for reassembly/reinstallation • CC-Shop facilities and procedures for makeup and issue of Installation Kits. • Supply Support			• Question trainees on purpose and scope of Installation Kits. • Ask trainees what to use if 316-SS fasteners not available.	• Discuss relevant issues and rationale. • Preference order given in T:I-10-4.	

INSTRUCTOR PREPARATION

SIMA CC-SHOP
Lesson Plan

PAGE 1 OF 9

TITLE INTRODUCTION TO CORROSION FOR WSA TECHNICIANS		COURSE	UNIT	II* LESSON NO. 1
LEARNING OBJECTIVES		TRAINING AIDS/MATERIALS		
The trainees will understand: 1. The requirements of a simple electrolytic cell. 2. The four (4) elements needed for corrosion to occur. 3. The four (4) types of corrosion found topside. 4. The seven (7) common paint failures. 5. The effects of corrosion on: (a) Steel (b) Stainless Steel (c) Brass (d) Aluminum 6. The basic corrosion control methods.		<u>Materials:</u> 1. Film MN-11154 "Corrosion of Metals in Marine Environments". 2. 35mm slides of various examples of shipboard corrosion. <u>Note:</u> Slides must be procured from local sources. 3. Transparency T:II-1-1 4. 16mm movie projector. 5. 35mm slide projector. 6. Overhead projector. 7. Chalk or dry erase markers. <u>References:</u> 1. NAVSEA S9630-AG-MAN-010/FFG-7CI, Manual, Control for FFG-7 Class, 30 November 1983.		

* WSA: Equipment and application.

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

PAGE 2 OF 9

TITLE <u>INTRODUCTION TO CORROSION FOR WSA TECHNICIANS</u>		COURSE <u>CC Shop Technician</u>	UNIT <u>II*</u>	LESSON NO. <u>1</u>
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
I. INTRODUCTION Discuss marine corrosion and corrosion control systems. II. FILM: CORROSION OF METALS IN MARINE ENVIRONMENT, MN-11154 III. WHAT IS CORROSION? A. Corrosion is the deterioration that occurs when a metal reacts with it's environment. It comes in many forms. These can cause economic and social problems. B. There are many direct and indirect consequences due to corrosion: • Replacement of corroded equipment. • Overdesign to allow for corrosion. • Preventive maintenance (painting). • Shutdown of equipment due to corrosion failure. • Contamination of a product. • Loss of efficiency (overdesigning and corrosion products decrease the heat transfer rate in heat exchangers).	• Write instructor's name, lesson number and title on board. • Show film. • Discuss film. • What is corrosion? • Types of corrosion. • Importance of corrosion control. • Cathodic protection. • Show/discuss shipboard corrosion slides: - description - cause(s) - fix(es)	• Take notes. • Watch film. • Participate in class discussion and activities.		

INSTRUCTOR PRESENTATION

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Lesson Plan

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TITLE	INTRODUCTION TO CORROSION FOR WSA TECHNICIANS	COURSE	CC Shop Technician	UNIT	II*	LESSON NO.	1
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE			
• Loss of valuable product (from a container that has corroded through). • Inability to use otherwise desirable materials. • Damage of equipment adjacent to that in which corrosion failure occurs. • Safety (sudden failure may cause fire, explosion, release of toxic product, construction collapse). • Health (pollution due to escaping product from corroded equipment or to a corrosion product itself). • Depletion of natural resource metals and the fuels used to manufacture them. • Appearance-corroded material is usually unpleasing to the eye. IV. FORMS OF CORROSION Classification is usually based on one of three factors: A. <u>Nature of the Corrodent</u> (a) "Wet" liquid or moisture. (b) "Dry" reaction with high-temperature gases.							

INSTRUCTOR PRESENTATION

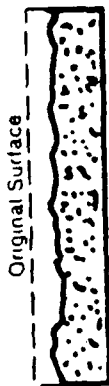
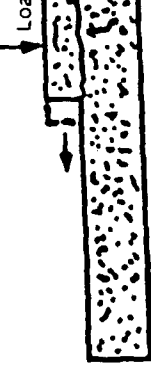
SIMA CC-SHOP
Lesson Plan

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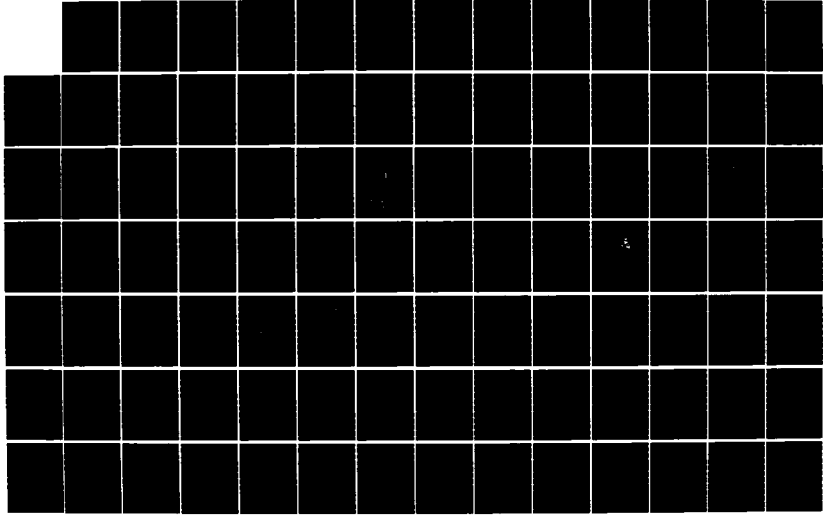
TITLE		INTRODUCTION TO CORROSION FOR WSA TECHNICIANS		COURSE	CC Shop Technician	UNIT	II*	LESSON NO.	1	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
KEY POINTS/ACTIVITIES B. <u>Mechanism of Corrosion</u> (a) Electrochemical. (b) Direct chemical reactions. C. <u>Appearance of Corroded Metal</u> (a) Uniform - occurs at same rate over entire object. (b) Localized - only small areas are affected. V. COMMON TYPES OF CORROSION A. Introduction 1. General 2. Localized Attack • Pitting • Crevice 3. Galvanic Attack 4. Cracking Phenomena • Stress corrosion cracking • Hydrogen embrittlement • Corrosion fatigue											
• Show/discuss T:II-1-1.											

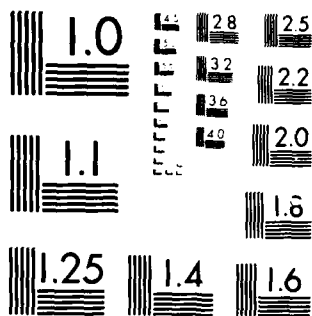
TRAINING AID

COMMON FORMS OF CORROSION & THEIR SCHEMATICS

1 General Attack  Original Surface	4. Cracking Phenomena a. Stress Corrosion Cracking b. Hydrogen Embrittlement c. Liquid Metal Embrittlement d. Corrosion Fatigue  Static Stress  Dynamic Stress
2. Localized Attack a. Localized Corrosion 	5. Velocity Phenomena a. Erosion  Flow
b. Pitting 	b. Cavitation c. Impingement  Bubbles
c. Crevice Corrosion d. Pouchlike Corrosion e. Deposition Corrosion f. Filiform Corrosion 	6. Fretting  Load Vibr
3 Galvanic Attack  Active Metal Noble Metal	7. Intergranular Attack 8. Dealloying 

AD-A163 672 CORROSION-CONTROL (CC) PROGRAM SIMA (SHORE INTERMEDIATE 3/4
MAINTENANCE ACTIV. (U) INTEGRATED SYSTEMS ANALYSTS INC
NATIONAL CITY OH W ADKINS ET AL. 30 NOV 85
UNCLASSIFIED ISA(MC)-107-VOL-3 N66001-85-C-0350 F/G 11/6 NL





MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

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TITLE INTRODUCTION TO CORROSION FOR WSA TECHNICIANS		COURSE	CC Shop Technician	UNIT	II*	LESSON NO. 1
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE
5. Velocity Phenomena • Erosion • Cavitation 6. Fretting 7. Intergranular 8. De-alloying B. <u>Galvanic Corrosion</u> Galvanic corrosion occurs when two different metals in contact (or connected by an electrical conductor) are exposed to a conductive solution. Note that galvanic corrosion causes increased deterioration of one of the metals. That is, the one that would have corroded the most in the corrodent even if immersed just by itself (more "active" metal). It now corrodes even more, whereas the other metal in the couple corrodes less than it would by itself (called the more "noble" metal).				• Show/discuss slides on the tape of corrosion being discussed; question trainees on: - description - cause(s) - fix(es)		
C. <u>Crevice Corrosion</u> The environmental conditions in a crevice can, with time, become quite different to those on a nearby, clean, open surface. A more aggressive environment may develop and cause local corrosion in the crevice. Crevices commonly exist at gaskets, lap joints, bolts, rivets, etc. They are also created by dirt deposits, corrosion products, scratches in paint, films, etc. Crevice corrosion is usually attributed to one or more of the following:						

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

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TITLE	INTRODUCTION TO CORROSION FOR WSA TECHNICIANS	COURSE	CC Shop Technician	UNIT	II*	LESSON NO.	1
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE					
(a) Changes in acidity in the crevice. (b) Lack of oxygen in the crevice. (c) Buildup of a detrimental ion species in the crevice. (d) Depletion of an inhibitor in the crevice. The materials that are more susceptible to this type corrosion can be alloyed to improve their resistance and this approach, along with designing to minimize crevices and maintenance to keep surface clean, is used to combat the problem. D. <u>Pitting</u> Pitting is the formation of holes in an otherwise relatively unattacked surface. It is usually a slow process (taking several months or years to become visible) but it still can cause unexpected failures. Surface cleanliness and selection of materials known to be resistant to pitting in the given environment are usually the safest ways of avoiding the problem. E. <u>Erosion</u> When movement of a corrodent over a metal surface increases the rate of attack due to mechanical wear and corrosion, the attack is called erosion corrosion. This type of corrosion can be avoided by design changes and the use of a more resistant metal.	• Continue slides of common types of corrosion. • Continue discussion.						

INSTRUCTOR PRESENTATION

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TITLE <u>INTRODUCTION TO CORROSION</u> FOR WSA TECHNICIANS		COURSE <u>CC Shop Technician</u>	UNIT <u>II*</u>	LESSON NO. <u>1</u>
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		
F. <u>Corrosion Fatigue</u> Corrosion fatigue is a special form of stress-corrosion cracking. Fatigue failures occur in the absence of corrosidents and are caused by repeated cyclic stressing. Such failures are common in structures subject to continued vibration. When susceptibility to fatigue is increased by the presence of a corrosident, the resulting failure is attributed to corrosion fatigue. A corrosident will sometime lower by half the stress normally required to cause fatigue in dry air.		• Continue slides of common types of corrosion. • Continue discussion.		
		TRAINEE RESPONSE		

INSTRUCTOR FOLLOW-THROUGH

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TITLE INTRODUCTION TO CORROSION FOR WSA TECHNICIANS		COURSE	CC Shop Technician	UNIT	II*	LESSON NO. I
PRACTICAL APPLICATIONS				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE
- Summarize lesson. - Question trainees on key points; repeat and amplify the instruction as required.						Answer questions and explain issues asked by the instructor.

INSTRUCTOR PREPARATION

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Lesson Plan

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TITLE CC USING WSA, PART I - SURFACE PREPARATION	COURSE	CC Shop Technician	UNIT	LESSON NO. 2
LEARNING OBJECTIVES	TRAINING AIDS/MATERIALS			
<u>Trainees will understand:</u> 1. The importance of corrosion control on Naval vessels. 2. The purpose and technical requirements for the WSA. 3. The purpose of masking, cleaning and grit blasting for WSA. 4. The procedures and quality assurance requirements for grit blasting. <u>Trainees will be able to:</u> 1. Operate the surface preparation equipments in the CC-Shop. - degreaser - masking - strip blasting - anchor-tooth blasting 2. Perform the PMS for the surface preparation equipments. 3. Perform the QC visual inspections and physical measurements for surface preparation.				
		<u>Materials:</u> 1. 35mm slides and audio cassette, "Corrosion Control Using Wire-Sprayed Aluminum, Part I," 106 slides/tape of Ref. 4 below. 2. Transparency T:II-2-1. 3. 35mm carousel cassette-tape/slide projector and screen. 4. Overhead projector. 5. Chalk/marker, board and eraser. <u>References:</u> 1. NAVSEA S9630-AG-MAN-010/FFG-7CI, Manual, Corrosion Control for FFG-7 Class, 30 November 1983. 2. DoD-STD-2138(SH), Metal-Sprayed Coating Systems for Corrosion Protection Aboard Naval Ships, 23 November 1981. 3. NAVSEA 0655-AA-JPA-010, Job Performance Aid for Metal Sprayed Coating Systems, 30 May 1983. 4. Naval Reserve IMA-7 Training Program, Corrosion-Control Using Wire-Sprayed Aluminum, CNAVRES (Code 323A). 5. Shore Intermediate Maintenance Activity, San Diego Process Instruction No. 7100-18-84 Rev. 1, Wire-Sprayed Aluminum (WSA) for Corrosion Protection; NAVSEA Corrosion-Control (CC) Systems 1 and 2, 25 October 1985.		

• WSA: Equipment and Application

INSTRUCTOR PREPARATION

SIMA CC-SHOP
Lesson Plan

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TITLE	CC USING WSA, PART I - SURFACE PREPARATION	COURSE	CC Shop Technician	UNIT	II*	LESSON NO.	2
LEARNING OBJECTIVES				TRAINING AIDS/MATERIALS			
				<u>Handouts (if not already handed out in Unit I training):</u> 1. Reference 2 2. Reference 3 3. Reference 5 <u>On-The-Job Training (OJT) in CC-Shop - Surface Preparation:</u> 1. Shop tour followed by OJT: • Degreasing/Masking Stations - 4 hours. • Strip-Blasting Station - 4 hours. • Anchor-Tooth-Blasting Station - 4 hours.			

INSTRUCTOR PRESENTATION

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TITLE	COURSE	CC Shop Technician	UNIT	LESSON NO. 2	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
CC USING WSA, PART I - SURFACE PREPARATION I. INTRODUCTION (Part I of Reference 4) A. Importance of corrosion control on Navy vessels. B. Learning goals summary. II. CORROSION DEFINED A. Corrosion B. Iron and steel products. 1. Manufactured in a blast furnace. 2. Iron (Fe) and oxygen (O₂).					- Write instructor's name, lesson number and title on the board. - Handout materials to those trainees who do not have them from the Unit I instruction. - Briefly describe the content and format of the handouts. - DoD WSA Std (Ref. 2). - WSA JPA (Ref. 3). - SIMA(SD) WSA Process Instruction (Ref. 5). - Start 35mm tape/slide and stop as necessary to amplify material and/or answer questions. - Slides 6 thru 11.	- Take notes. - Participate in class activities and discussions. - Ask questions during tape/slide presentation.

INSTRUCTOR PRESENTATION

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Lesson Plan

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TITLE CC USING WSA, PART I - SURFACE PREPARATION	COURSE	CC Shop Technician	UNIT	LESSON NO. 2	
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION				TRAINEE RESPONSE
C. Chemically 1. Steel is iron, carbon and other various alloying elements. 2. Iron oxide is natural state. 3. Tendency to revert back to natural state (corrosion). D. Galvanic corrosion 1. One metal sacrificially corrodes. 2. Metals form a galvanic cell.					
III. CORROSION AREAS A. Three distinct zones 1. Immersion zone 2. Splash zone 3. Atmospheric zone	• Slides 12 thru 18.				
IV. PRESERVATION A. Reasons for preservation 1. Elements that promote corrosion. (a) Sea water (b) Salt (c) Oxygen (d) Sun	• Slides 19 thru 29.				

INSTRUCTOR PRESENTATION

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TITLE	CC USING WSA, PART 1 - SURFACE PREPARATION	COURSE	CC Shop Technician	UNIT	II*	LESSON NO.	2
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE			
2. Painting serves three basic functions. (a) Preservation of the structure (b) Functional (c) Decorative B. Preservation system 1. High-performance preservation systems. 2. The metallized coating system. C. Wire-sprayed aluminum authorization. V. WIRE-SPRAYED ALUMINUM (WSA) COATING SYSTEM A. Proven method of providing a high-performance barrier. B. Provides protection in high-corrosion prone areas. C. Operators must be trained and certified. D. Primarily accomplished at a shipyard or at the IMA. VL WSA EQUIPMENT REQUIRED A. WSA system components 1. Air flow meter 2. Air control unit		• Slides 30 thru 36. • Slides 37 thru 42.					

INSTRUCTOR PRESENTATION

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Lesson Plan

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TITLE	CC USING WSA, PART I - SURFACE PREPARATION	COURSE	CC Shop Technician	UNIT	II*	LESSON NO.	2
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE					
3. Gas flow meter 4. Hoses 5. Extension arm for spraying around parts 6. Metallizing wire-spray gun 7. Elcometer thickness gauge 8. Surface-temperature measuring gauge 9. Aluminum wire 10. Bottled gases 11. Sealer 12. Thinner for sealer 13. Test coupons B. Necessary shop equipments for flame spraying. 1. Available in existing installations. (a) Exhaust system (b) Portable units (c) Floor and bench hoods (d) Air supply							

INSTRUCTOR PRESENTATION

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TITLE CC USING WSA, PART I - SURFACE PREPARATION	COURSE CC Shop Technician	UNIT II*	LESSON NO. 2
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
(e) Grit blasting equipment 2. Additional useful equipment. (a) Movable turntable (b) Counterweight support system (c) Truck or cart VII SURFACE PREPARATION - MASKING AND CLEANING A. Overview 1. Purpose 2. Cleaning 3. Masking B. Cleaning material nomenclature and use. C. Cleaning procedures. D. Masking material nomenclature and use. E. Masking procedures. F. Discussion. 1. Cleaning 2. What to mask		• Slide 43 thru 62.	

INSTRUCTOR PRESENTATION

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TITLE	CC USING WSA, PART 1 - SURFACE PREPARATION	COURSE	CC Shop Technician	UNIT	II*	LESSON NO.	2
KEY POINTS/ACTIVITIES							
VIII. SURFACE PREPARATION - ABRASIVE BLASTING							
A. Overview 1. Purpose 2. Importance of process B. Nomenclature and use 1. Abrasive blasting system components 2. Pressure blasting 3. Nozzle features 4. Protective clothing 5. Quality assurance C. Start-up procedures D. Daily system operation test E. Abrasive blasting procedure F. Component handling procedure G. Discussion 1. Equipment settings 2. Ventilation capacity							
TRAINING AID/ DEMONSTRATION						• Slides 63 thru 106.	
TRAINEE RESPONSE						• End Part 1 tape/slides. Review, discuss, ask questions.	

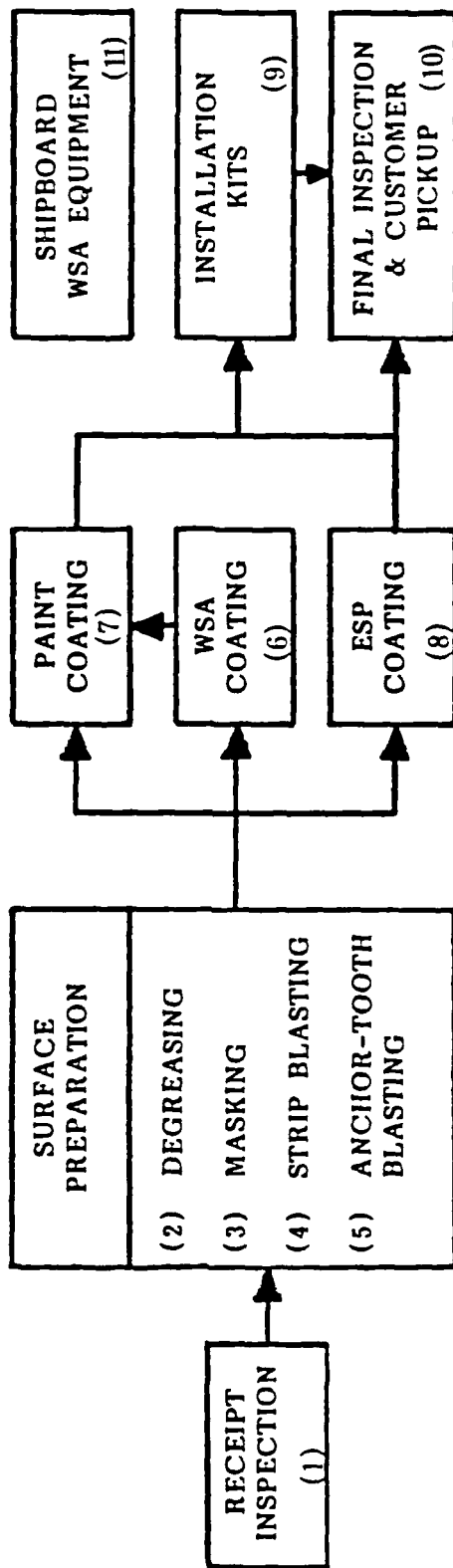
INSTRUCTOR PRESENTATION

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CC USING WSA, PART I - SURFACE PREPARATION		COURSE	CC Shop Technician	UNIT	II*	LESSON NO. 2
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE		
IX. TOUR OF THE SURFACE PREPARATION STATIONS IN THE CC-SHOP		• T:II-2-1. • Walk trainees through the following CC-Shop stations and explain activities and materials used: - degreasing - masking - strip blasting - abrasive blasting				
X. OJT IN THE CC-SHOP - SURFACE PREPARATION STATIONS		• Show equipments, give nomenclature, explain use and all health/safety issues. Have trainees perform all operations: - degreasing - strip blasting - anchor-tooth blasting - QC and records - equipment PM and CM		• Identify equipments. • Explain function and operations. • Operate equipments safely and properly.		

CORROSION-CONTROL SHOP



INSTRUCTOR FOLLOW-UP-THROUGH

SIMA CC-SHOP
Lesson Plan

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TITLE CC USING WSA, PART I - SURFACE PREP		COURSE	CC Shop Technician	UNIT	II*	LESSON NO. 2
PRACTICAL APPLICATIONS	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE				
- Summarize lesson. - Question trainees on key points; repeat and amplify the instruction as required.		- Answer questions and explain issues asked by the instructor. - Demonstrate knowledge of - need for shipboard corrosion control - marine corrosion environment - reasons for WSA coatings - WSA equipments - masking - surface preparation - QC in surface preparation - Demonstrate skill in - degreasing - masking - strip blasting - anchor-tooth blasting - QC visual inspection and profile measurement				

INSTRUCTOR PREPARATION

SIMA CC-SHOP
Lesson Plan

PAGE 1 OF 7

TITLE	CC USING WSA, PART II - WIRE SPRAYING	COURSE	CC Shop Technician	UNIT	II*	LESSON NO.	3
LEARNING OBJECTIVES				TRAINING AIDS/MATERIALS			
Trainees will be able to: 1. Start-up, operate and secure the METCO 10E and 12E flame spray equipments. 2. Apply the WSA coating to include: (a) Spray distances and spray angles, (b) eliminating/minimizing overspray, (c) wrapping corners, (d) feathering into unsprayed areas, (e) sealing and topcoating in accordance with DoD-STD-2138(SH), and (f) quality control equipments and procedures.				<u>Materials:</u> 1. 35mm slides and audio cassette, "Corrosion Control Using Wire-Sprayed Aluminum, Part II," 144 slides/tape of Reference 3 below. 2. 35mm carousel cassette-tape/slide projector and screen. 3. Chalk/markers, board and eraser. <u>References:</u> 1. DoD-STD-2138(SH), Metal Sprayed Coatings Systems for Corrosion Protection Aboard Naval Ships, 23 November 1981. 2. NAVSEA 0655-AA-JPA-010, Job Performance Aid for Wire-Sprayed Coating Systems, 30 May 1983. 3. Naval Reserve IMA-7 Training Program, Corrosion Control Using Wire Sprayed Aluminum, Part II, CNAVRES (Code 323A). <u>On-The-Job Training in CC-Shop - Wire Spraying:</u> 1. WSA Station - 8 hours.			

* WSA: Equipment and application.

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

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TITLE	CC USING WSA, PART II - WIRE SPRAYING	COURSE	CC Shop Technician	UNIT	II*	LESSON NO.	3
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
INTRODUCTION DoD-STD-2138(SH) permits the use of metal-sprayed coating systems for corrosion prevention and control aboard Naval Surface Ship. To use the WSA System, an operator must be trained and certified by an authorized agent (Para. 3.2.3, DoD-STD-2138(SH), 23 November 1983). L APPLYING WSA COATING A. Overview 1. Purpose 2. Description B. Wire-spray equipment nomenclature. 1. Compressed air line 2. Air cleaner unit 3. Air control unit 4. Air flow meter 5. Gas control unit 6. Gas flow meter 7. Gas and air hoses 8. Wire control unit				• Write instructor's name, lesson title and number on board.		• Take notes. • Participate in class discussion and activities.	

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

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TITLE CC USING WSA, PART II - WIRE SPRAYING COURSE		UNIT II°	LESSON NO. 3
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
9. Wet collector 10. Flame spray booth C. 10E wire-spray gun nomenclature. D. Preliminary adjustments. 1. Preliminary equipment adjustments 2. Preliminary gun adjustments E. Lighting F. Spraying sample metal coupon. 1. Bend test 2. Cut test G. Spraying the item. H. Shutting down. I. Discussion 1. Quality assurance 2. Avoiding trouble 3. Safety measures		• Slides 49 thru 74. • Slides 75 thru 98. • Slides 99 thru 114.	

INSTRUCTOR PRESENTATION

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Lesson Plan

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TITLE CC USING WSA, PART II - WIRE SPRAYING COURSE CC Shop Technician UNIT II* LESSON NO. 3			
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
II. SEALING A. Overview 1. Purpose 2. Sealer B. Nomenclature and use C. Sealing procedure D. Discussion		Slides 115 thru 123.	
III. COMPONENT HANDLING, WSA-COATING AND TOUCH-UP A. Overview - purpose B. Handling procedure C. Materials required for reassembly D. Reassembly procedure E. Materials required for WSA-coating repair and touch-up F. Touch-up procedures		Slides 124 thru 129.	

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TITLE	CC USING WSA, PART II - WIRE SPRAYING	COURSE	CC Shop Technician	UNIT	II*	LESSON NO.	3
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE					
IV. GUN ASSEMBLY AND MAINTENANCE A. Overview 1. Purpose 2. Importance of process B. Troubleshooting the WSA gun and field maintenance. 1. Materials 2. Routine maintenance (a) Gas siphon plug (b) Gas head (c) Drive roll carriage (d) Wire grip assembly V. CONCLUSION A. Summary of learning objectives B. Importance of WSA to corrosion control	- Slides 130 thru 144. - End Part II tape/slides. Review, discuss/ask questions.						

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TITLE	CC USING WSA, PART II - WIRE SPRAYING	COURSE	CC Shop Technician	UNIT	LESSON NO. 3
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION				TRAINEE RESPONSE
VL ON-THE-JOB TRAINING IN THE CC-SHOP - WSA STATION A. WSA Equipment and Use 1. Refer to NAVSEA 0655-AA-JPA-010 Job Performance Aid for Metal Sprayed Coating Systems, pages 47 through 68. 2. Preliminary Gun Set Up Refer to NAVSEA 0655-AA-JPA-010, pages 69 through 77. 3. Lighting the Gun Refer to NAVSEA 0655-AA-JPA-010, pages 78 through 81. 4. Spraying Sample Metal Coupon Refer to NAVSEA 0655-AA-JPA-010, pages 82 through 88. 5. Spraying the "Training Valve or Shapes" Refer to NAVSEA 0655-AA-JPA-010, pages 89 through 97. 6. Shutting Down Refer to NAVSEA 0655-AA-JPA-010. B. Avoiding trouble 1. Refer to NAVSEA 0655-AA-JPA-010, pages 101 through 103.	• Show equipments, give nomenclature, explain use and all health and safety issues. Have trainees perform all operations. • Spray non-preheated and preheated coupons and demonstrate difference in the bend-alligatoring. • How to evaluate item for spraying sequence and to minimize overspray. Demonstrate on training shape.				• Identify equipments. • Explain functions and operations. • Operate equipments safely and properly. • Practice spraying demonstrating proper spraying evaluation and execution.

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TITLE CC USING WSA, PART II - WIRE SPRAYING		COURSE	CC Shop Technician	UNIT II*	LESSON NO. 3
PRACTICAL APPLICATIONS	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE			
- Summarize lesson. - Question trainees on key points; repeat and amplify the instruction as required. - Have trainees demonstrate proper use and maintenance of equipments.		- Answer questions and explain issues asked by the instructor. - Demonstrate skill in - startup, operation and shutdown of the METCO 10E/12E flame spray system. - proper spraying techniques. - QC procedures and measurements.			

INSTRUCTOR PREPARATION

SIMA CC-SHOP
Lesson Plan

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TITLE	CC USING WSA, PART III - PMS	COURSE	CC Shop Technician	UNIT	II •	LESSON NO.	4
LEARNING OBJECTIVES				TRAINING AIDS/MATERIALS			
Trainees will understand: - The requirements and schedule for preventive maintenance of the WSA equipments. Trainees will be able to: - Disassemble, maintain and reassemble the following components of wire-spray gun: - Gas siphon-plug/nozzle - Gas-head - Drive roll carrier - Wire-grip assembly - Lower drive roll and gear - Perform the daily, 16-hour and 40-hour maintenance of the METCO 10E/12E flame-spray gun.				Materials: 35mm slides and audio cassette, "Corrosion Control Using Wire-Sprayed Aluminum, Part III", 109 slides/tape of Reference 2 below. - One METCO 10E or 12E flame-spray gun for every four students. - Maintenance tools/supplies (one set per gun): - Special METCO: - Spanner wrench - Insertion tool for drive roll - Cleaning wire kit - Gear lube - Valve lube - Standard - Blade screwdriver - Adjustable wrench - Socket wrench - Offset screwdriver - Set of Allen Wrenches (metric) - Clean rags - Machine oil - Wire brush - Metal can for storing parts 35mm carousel cassette-tape/slide projector and screen. - Chalk/marker board and eraser.			

• WSA: Equipment and application.

INSTRUCTOR PREPARATION

SIMA CC-SHOP
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TITLE	CC USING WSA, PART III - PMS	COURSE	CC Shop Technician	UNIT	II*	LESSON NO.	4
LEARNING OBJECTIVES				TRAINING AIDS/MATERIALS			
				<u>References:</u> 1. NAVSEA 0655-AA-JPA-010, Job Performance Aid for Metal Sprayed Coating Systems, 30 May 1983. 2. Naval Reserve IMA-7 Training Program, Corrosion-Control Using Wire-Sprayed Aluminum, CNAVRES (Code 323A). 3. METCO Instruction Manual for Type 10E or 12E Flame Spray Gun.			

INSTRUCTOR PRESENTATION

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TITLE CC USING WSA, PART III - PMS	COURSE	CC Shop Technician	UNIT	II ^o	LESSON NO. 4	
KEY POINTS/ACTIVITIES			TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
I. INTRODUCTION A. Importance of preventive maintenance. B. Preventive maintenance requirements and schedule. II. DISASSEMBLY, MAINTENANCE, REASSEMBLY A. Materials required. B. Maintenance schedule. C. Gas siphon-plug/nozzle. 1. Disassembly 2. Maintenance 3. Reassembly D. Drive roll carrier 1. Disassembly 2. Maintenance 3. Reassembly			• Write instructor's name, lesson number and title on board. • Start 35mm tape/slide and stop as necessary to amplify material and/or answer questions. • Slides 1 thru 7. • Slides 8 thru 15. • Slides 16 thru 27. • Slides 28 thru 30.		• Take notes. • Participate in class discussion and activities. • Perform gun disassembly, maintenance and reassembly actions on "training gun." • Gas siphon-plug/nozzle. • Drive roll carrier.	

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TITLE CC USING WSA, PART III - PMS		COURSE	CC Shop Technician	UNIT	II°	LESSON NO. 4	
KEY POINTS/ACTIVITIES							TRAINING AID/ DEMONSTRATION
E. Lower drive roll and gear 1. Disassembly 2. Maintenance 3. Reassembly F. Gas-head 1. Disassembly 2. Maintenance 3. Reassembly G. Wire-grip assembly 1. Disassembly 2. Maintenance 3. Reassembly							• Slides 31 thru 36. • Slides 37 thru 58. • Slides 59 thru 65.
							• Lower drive roll and gear. • Gas head. • Wire-grip assembly.

INSTRUCTOR FOLLOW-THROUGH

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TITLE	CC USING WSA, PART III - PMS	COURSE	CC Shop Technician	UNIT	II*	LESSON NO.	4
PRACTICAL APPLICATIONS				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
- Summarize lesson. - Question trainees on key points; repeat and amplify the instruction as required. - Have trainees demonstrate proper use and maintenance of equipments.						- Answer questions and explain issues asked by the instructor. - Demonstrate knowledge of practical skills.	

INSTRUCTOR PREPARATION

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TITLE CC USING WSA - CERTIFICATION TESTS		COURSE	CC Shop Technician	UNIT II	LESSON NO. 5
LEARNING OBJECTIVES		TRAINING AIDS/MATERIALS			
1. Trainee will understand the DoD-STD-2138(SH) requirements and tests required for wire-spray operator certification. 2. Trainee will be able to pass the qualifying tests specified by DoD-STD-2138(SH).		<u>Materials:</u> 1. 2" x 3" x 0.050" mild steel coupons; 7 each per trainee (3 for practice; 4 for certification). 2. One T-Shape per trainee, 3" x 3" x 6" x 1/2" thick. 3. Five 1" diameter x 1" long ASTM-C-633 tensile fixtures. 4. One Pipe-Shape per trainee, 6" x 2" ips. 5. Coupon bending device with 1/2" diameter rod. 6. 10x loop or magnifying glass. 7. Transparency T-II-5-1. 8. Overhead projector. 9. One copy of WSA CC Examination per student. <u>References:</u> 1. DoD-STD-2138(SH), Metal-Sprayed Coating Systems for Corrosion Protection Aboard Naval Ships, 23 November 1981. 2. Shore Intermediate Maintenance Activity, San Diego Process Instruction No. 7100-18-84 Rev. 1, Wire-Sprayed Aluminum (WSA) for Corrosion Protection; NAVSEA Corrosion-Control (CC) Systems 1 and 2, 25 October 1985. 3. ANSI/ASTM C633-79, Standard Method for Adhesion or Cohesive Strength of Flame-Sprayed Coatings.			

• WSA: Equipment and Application.

INSTRUCTOR PREPARATION

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TITLE	CC USING WSA - CERTIFICATION TESTS	COURSE	CC Shop Technician	UNIT	II	LESSON NO.	5
LEARNING OBJECTIVES				TRAINING AIDS/MATERIALS			
<u>Handouts:</u> - Paper copy of T:II-5-1. <u>CC-Shop and Quality Assurance (QA) Laboratory Services:</u> - CC Shop: - Anchor-tooth blasting. - Profile tape and micrometer. - WSA gun and water wash booth. - Contact pyrometer. - Elcometer. - QA Laboratory: - ASTM C633 tensile testing of the 1" diameter x 1" long steel fixtures.							

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Lesson Plan

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INSTRUCTOR PRESENTATION

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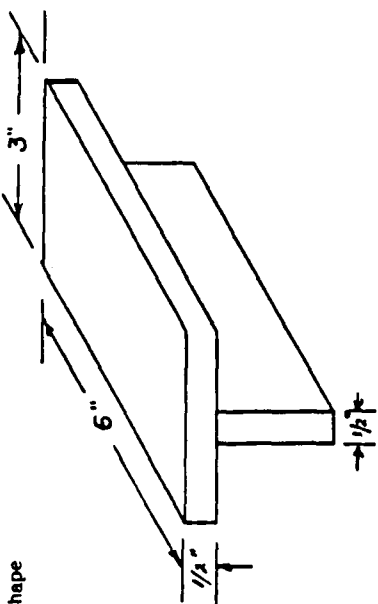
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TITLE CC USING WSA - CERTIFICATION TESTS			COURSE CC Shop Technician		UNIT II	LESSON NO. 5
KEY POINTS/ACTIVITIES			TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
3. Complete absence of: • Blisters, • cracks, • chips or loosely-adhering particles, • oil or other internal contaminants, and • pits exposing the undercoat or substrate.			• Inspect with 10X magnification. Point out defects to trainees. Explain causes/remedies.		• Inspect defects and explain causes/remedies.	
IV. BEND TEST 1. Bend sprayed panels 180° on a 1/2" diameter rod with WSA coating on the outer radius. 2. Visual examination for no disbonding, delamination or gross cracking of the coating shall occur due to bending. Small hairline cracks or alligatoring of the coating in the vicinity of the bend are permissible. Acceptable and non-acceptable bend test results are illustrated below:			• Inspect with 10X magnification. Point out defects to trainees. Explain causes/remedies.		• Spray 4 bend coupons for certification. • Inspect defects and explain causes/remedies.	

INSTRUCTOR PRESENTATION

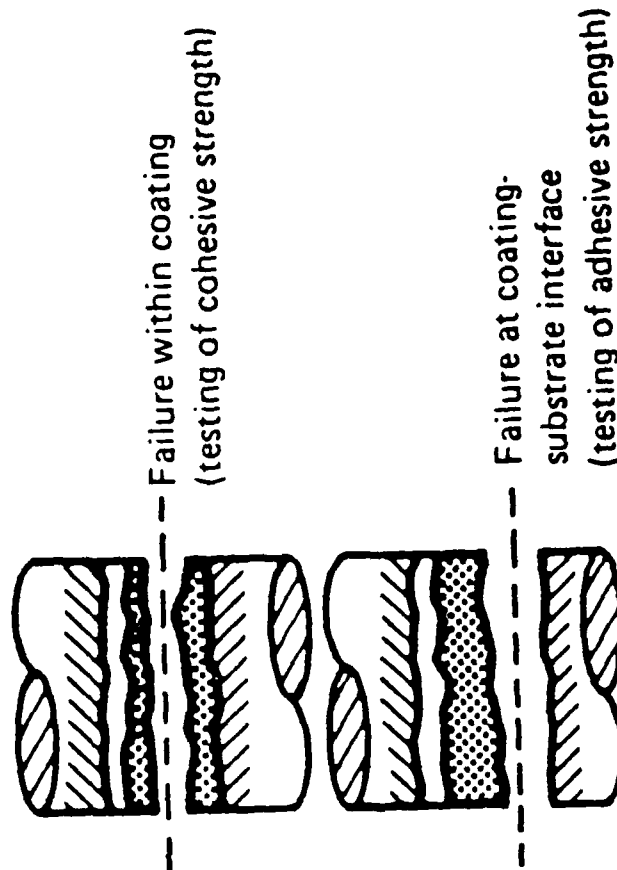
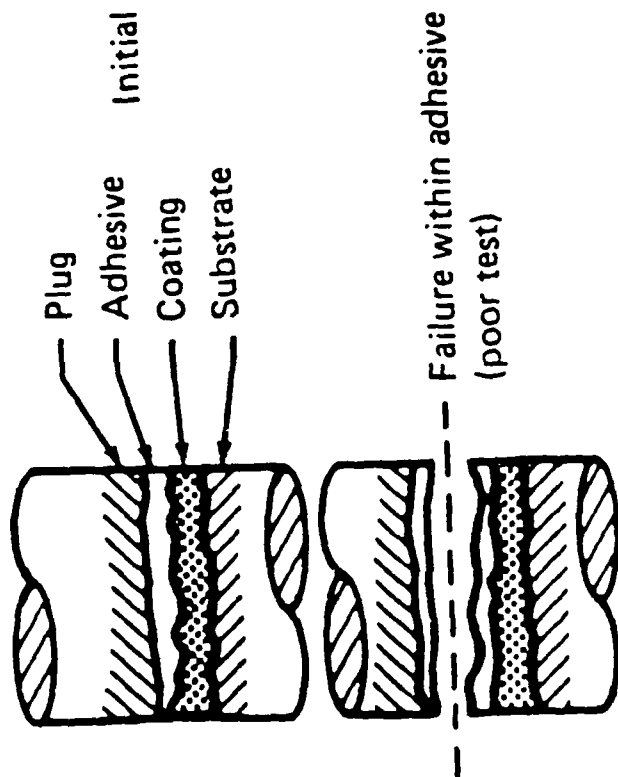
SIMA CC-SHOP
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TITLE	CC USING WSA - CERTIFICATION TESTS	COURSE	CC Shop Technician	UNIT	II	LESSON NO.	5
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
V. BOND TEST The bond test of five 1" diameter x 1" long steel fixtures conducted in accordance with ASTM C633 must have an average tensile strength greater than 2000 psi with no tensile strength less than 1500 psi. The ASTM C633 test requires a minimum WSA coating thickness of 15 mils "because an adhesive bonding agent is used in the test...and tends to penetrate flame-sprayed coatings and may invalidate results unless the coating thickness are thick enough to prevent penetration through the coating."				- Explain specification for 15-mil thickness. Emphasize that 7- to 10-mil thickness range is the WSA System 2 (low-temperature component) requirement. - Show/discuss T-II-5-1 on modes of tensile coating failures.	Trainees spray bond test samples for certification.		
VI. SHAPE TEST "T" Shape 				Review the spraying techniques to minimize overspray. Explain spraying sequence for the T- and Pipe-shapes.	Trainees spray shapes for certification.		

TRAINING AID

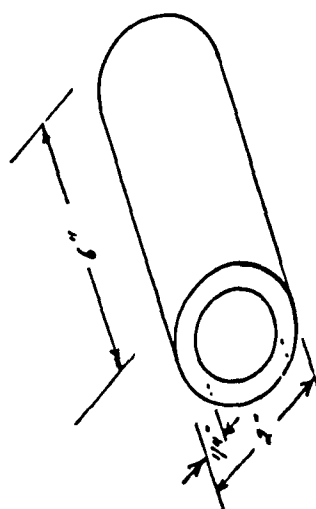
MODES OF TENSILE COATING FAILURE



INSTRUCTOR PRESENTATION

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TITLE	CC USING WSA - CERTIFICATION TESTS	COURSE	CC Shop Technician	UNIT	II	LESSON NO.	5
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
"Pipe" Shape  - The "T" and "pipe" shapes must be coated with 7-10 mils WSA and pass the coating thickness and visual examination. VIL QA JOB EVALUATE CERTIFICATION - TEST SPECIMENS FOR SUITABILITY				- Mark, log and package specimens. - Deliver to QA Test Job. - Obtain QA Test Lab results and request WSA certification certificate for those passing. Retest those that fail.			

INSTRUCTOR FOLLOW-THROUGH

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TITLE CC USING WSA - CERTIFICATION TESTS		COURSE CC Shop Technician	UNIT II	LESSON NO. 5
PRACTICAL APPLICATIONS	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
- Summarize lesson. - Question trainees on key points; repeat and amplify the instruction as required. - Have trainees complete the spraying, bend coupon, tensile fixtures and the T- and Pipe-shapes for certification.		- Answer questions and explain issues asked by the instructor. - Complete surface preparation and spraying of all certification specimens.		

TRAINING AID

NAME _____
 RATE _____
 DATE _____

WIRE-SPRAY ALUMINUM CC EXAMINATION

CORROSION

The following questions are multiple choice. Circle the best answer.

1. Wire-Sprayed Aluminum is

- (a) a time proven corrosion-control system.
- (b) requires 8 hours chipping prior to application.
- (c) guarantees at least 5 months between coatings.
- (d) uses non-metallic coatings to preserve metal surfaces for at least 5 years.

2. To be qualified and certified as a WSA operator, you must

- (a) be an EA or above.
- (b) be a qualified welder.
- (c) be properly trained in both the classroom and on the job.
- (d) all of the above.

3. Corrosion is a process

- (a) that is not important in today's Navy.
- (b) where metals degrade as a result of reaction to their environment.
- (c) metals upgrade because of the environment.
- (d) of concern to surface ships only.

4. Corrosion is considered to be

- (a) Unimportant in the WSA system.
- (b) an unnatural process.
- (c) mostly an EPA concern.
- (d) a natural process.

5. At what temperature is the aluminum wire melted in the wire-spray gun?

- (a) 2000 Degrees Fahrenheit
- (b) 300 Degrees Centigrade
- (c) 3000 Degrees Fahrenheit
- (d) 500 Degrees Centigrade

6. What is the required bond strength between the surface and WSA coating for proper bonding to the substrate?

- (a) No less than 2000 PSI
- (b) Greater than 1500 PSI
- (c) No greater than 1500 PSI
- (d) Less than 1500 PSI

7. Disbonding or delamination of the Test Coupon indicates the wire-spray coating is:

- (a) Not acceptable.
- (b) Not acceptable for items that bend.
- (c) Acceptable.
- (d) Acceptable for flat surfaces.

9. Which of the following is a characteristic of a sacrificial coating?
 - (a) A lower galvanic number than the metal being protected.
 - (b) Bond strength less than 1500 psi.
 - (c) A higher galvanic number than the metal being protected.
 - (d) Porosity.
10. The process by which all metals degrade as a result of reaction with the environment is called
 - (a) breakdown
 - (b) galvanic corrosion
 - (c) preservation
 - (d) corrosion
 - (e) all of the above
11. A Wire-Sprayed aluminum coating
 - (a) must be bonded to a 2-3 mil electrolyte.
 - (b) is a sacrificial coating to protect steel.
 - (c) is a bonding control for thickness.
 - (d) should be used only in below deck spaces.
12. Which of the following statements best describes galvanic corrosion?
 - (a) The process by which all metals degrade.
 - (b) The result of two dissimilar metals corroding through an electrolyte.
 - (c) Protection of the surface using WSA.
 - (d) The elimination of rust.
13. What is the proper distance and angle for grit blasting components for preparation of WSA?
 - (a) 5 to 6 inches at a 45° angle.
 - (b) 8 to 12 inches, angle doesn't matter.
 - (c) 8 to 12 inches at a 90° angle.
 - (d) 5 to 6 inches at a 90° angle.
14. What is the main reason for using preservation systems aboard ship?
 - (a) To create oxygen to keep surfaces dry.
 - (b) To save money on paint scrapers and chipping hammers.
 - (c) To form a circuit between the surface and the elements that promote corrosion.
 - (d) To form a barrier between the surface and the elements that promote corrosion.
15. What are the primary purposes for paint preservation systems aboard ship?
 - (a) preservation
 - (b) functional
 - (c) decoration
 - (d) all of the above
16. Which of the following statements describes the correct procedure for applying WSA?
 - (a) Spray the coating at least 8-inches from the surface at a 90-degree angle.
 - (b) Spray the coating 10 to 12 inches from the surface at a 45-degree angle.
 - (c) Spray the coating 5 to 8 inches from the surface, the angle of application does not matter.
 - (d) Spray the coating 5 to 8 inches from the surface at a 90-degree angle.

16. Anchor-Tooth Blasting requires the use of

- (a) sand
- (b) aluminum oxide
- (c) garnet
- (d) all of the above

17. Which metal will sacrifice itself to protect steel?

- (a) Stainless Steel
- (b) Platinum
- (c) Gold
- (d) Aluminum

18. Which of the following safety devices of the grit blasting equipment provides for securing the equipment quickly?

- (a) Dead man lever.
- (b) Air pressure mechanism.
- (c) Dead man nozzle.
- (d) Shut down solenoid.

19. Items that have been wire sprayed must be sealed within how many hours?

- (a) 2
- (b) 4
- (c) 8
- (d) 16

20. Which of the following metals are sacrificial to steel?

- (a) Zinc
- (b) Stainless Steel
- (c) Gold
- (d) None of the above

Match Quality Assurance equipment with appropriate description of each item listed below.

21. _____	Press-O-Film
22. _____	Pull Tester (Mil Gauge)
23. _____	Bead Test
24. _____	Pyrometer
25. _____	Metallography
26. _____	Tensile Test
27. _____	Visual Inspection
28. _____	Dial Micrometer

- A. Testing procedure that can be accomplished easily and quickly to determine acceptable bonding of the coating to the test specimen.
- B. Instrument used to determine anchor tooth profile height.
- C. Compressible material that produces an exact replica of anchor tooth profile so that it can be measured.
- D. One of the most simple and yet effective Quality Assurance procedures at your disposal.
- E. Measuring device used to determine part temperature.
- F. Used to determine coating thickness.
- G. Magnified picture of a cross section of a sprayed test panel used to examine coating integrity.
- H. Testing procedure that involves gluing a test piece to a sprayed test panel and mechanically pulling the two apart to determine bond strength.

The equipment listed below can be separated into one of three groups designated by the letters A, B, C or D. Write in the correct group letter (A, B, C or D) next to the equipment listed.

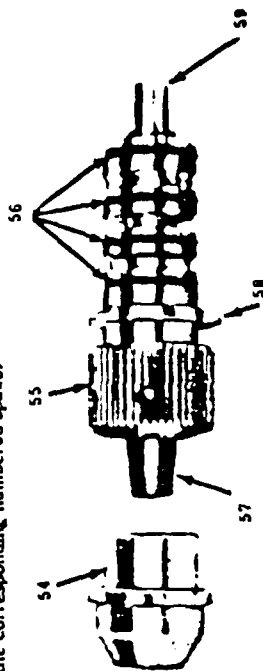
- A. Equipment to clean, dry and compress air
- B. Blasting equipment
- C. Spraying equipment (Flame Spraying)
- D. Spraying equipment (paint)

Example: B Blast Pot (This would fall into the category "B" because it would be used for blasting.)

- 29. _____ Blast Pot (example)
- 30. _____ Blasting Gloves
- 31. _____ Air Pressure Regulator
- 32. _____ Water Separator
- 33. _____ Oxy-Acetylene Hose (From control console to gun)
- 34. _____ Air Fed Helmet
- 35. _____ Metal Spray Gun
- 36. _____ Control Console
- 37. _____ Air Compressor
- 38. _____ Wire Feed Rack
- 39. _____ After Cooler
- 40. _____ Oxy-Acetylene Hose (From bottles to console)
- 41. _____ Air Line (From dryer to console)
- 42. _____ Air Dryer
- 43. _____ Air Line (From console to gun)
- 44. _____ Oil Separator
- 45. _____ Aluminum Oxide Grit
- 46. _____ Blast Line and Nozzle

- 47. _____ Oxy-Acetylene Gauges
- 48. _____ Dead Man Line and Switch
- 49. _____ Aluminum Wire
- 50. _____ Air Line (From breather filter to air fed helmet)
- 51. _____ Waterwash Booth
- 52. _____ Air Spray Gun
- 53. _____ Jiffy Mixer

Identify each item that is part of the gun. Write the correct letter that identifies the part in the corresponding numbered space.



- a. Valve Core
- b. Air Cap
- c. Gas Head
- d. Valve Screw
- e. Nozzle
- f. Hose Connection
- g. Nozzle Retainer Nut
- h. O-Rings
- i. Mounting Stud
- j. Siphon Plug
- k. Plunger Spring
- l. Wire Guide

- 54. _____
- 55. _____
- 56. _____
- 57. _____
- 58. _____
- 59. _____

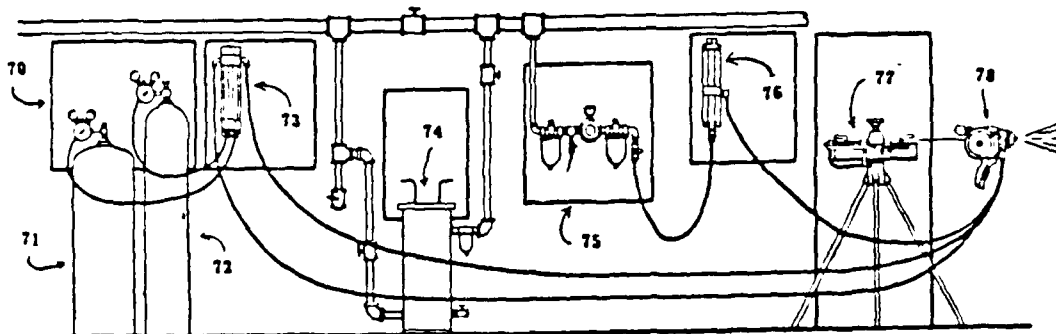
List the parameters for the 12E gun, U.S. system with jetted hardware and acetylene fuel gas, spraying 1/8 inch aluminum wire.

60	61	62	63	64	65	66	67	68
AIR CAP	LIGHTING PRESSURE			FLOWMETER READINGS			GUN DISTANCE	NOZZLE
	OXY	ACTY	AIR	OXY	ACTY	AIR		

69. The most important point in the care and PMS of the 12E gun is:

- (a) temperature
- (b) cleanliness
- (c) lubrication
- (d) spraying

Identify each unit of the WSA installation by writing the correct identifying letter in blank space provided next to the component number.



70. _____	77. _____	a. Wire Control Unit	k. Air Control Unit
71. _____	78. _____	b. Gas Flow Meter	l. Line Pressure for Acetylene
72. _____		c. Air Cap	m. Pyro-Psychrometer
72. _____		d. O-Rings	n. Oxygen
72. _____		e. Acetylene	o. Air Compressor
74. _____		f. Air Flow Meter	p. Dew Point Regulator
75. _____		g. Gas Control Unit	q. Air Cleaner
		h. Modular Redundant	r. Air Cap Equivalency Meter
		i. 12E Gun	s. Annular Gauge Bottle
		j. Air Receiver	t. After Cooler

79. What is the proper depth of an acceptable anchor-tooth profile?

- (a) 1 to 2 thousandths inch.
- (b) 2 to 3 hundredths inch.
- (c) 2 to 3 thousandths inch.
- (d) up to 1/8 inch.

80. Which of the following indicates the correct distance and angle for applying WSA coatings?

- (a) 8 inches at 90 degrees.
- (b) 10 to 12 inches at 45 degrees.
- (c) 5 to 8 inches, angle does not matter.
- (d) 5 to 8 inches at 90 degrees.

81. The frequency for the preventive maintenance of the wire-spray gun is based on:

- (a) Continuous spraying and normal use.
- (b) Infrequent spraying and normal use.
- (c) Continuous spraying and abnormal use.
- (d) Infrequent spraying and abnormal use.

82. Which of the following preventive maintenance requirements is not accomplished at the end of the work shift (8 hour duty)?

- (a) Clean outside of gun.
- (b) Clean drive rolls.
- (c) Clean air cap.
- (d) Clean nozzle jets.

WIRE SPRAY GUN DISASSEMBLY

83. Disassembly of the 10E and 12E Wire Spray Gun and Turbine PMS. The following WSA gun disassembly steps are not in their proper order. Write the correct letter of each step in the space provided next to the proper step number. (One (1) point for each correct answer.)

- Step 1 _____
- Step 2 _____
- Step 3 _____
- Step 4 _____
- Step 5 _____
- Step 6 _____
- Step 7 _____
- Step 8 _____
- Step 9 _____
- Step 10 _____
- Step 11 _____
- Step 12 _____
- Step 13 _____
- Step 14 _____
- Step 15 _____

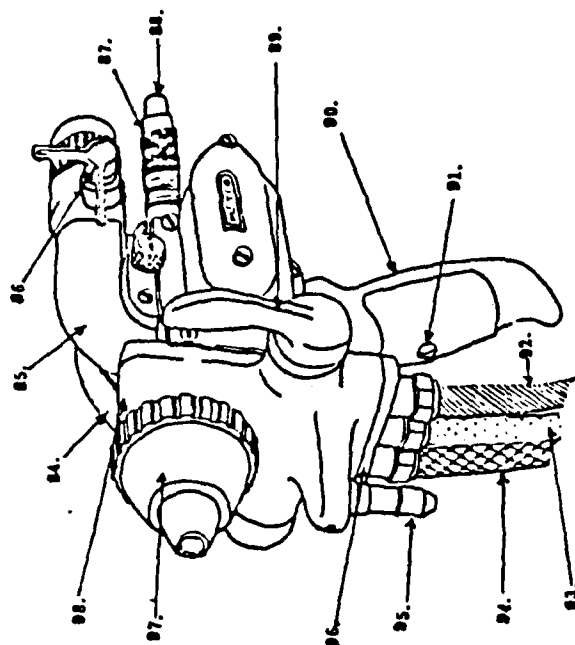
- (a) Remove Wire Grip Mechanism, Spring, Cap, Spring and Push Rod.
- (b) Remove Gas Head Valve Handle.
- (c) Remove Air Cap.
- (d) Remove Snubber Assembly.
- (e) Remove Nozzle Retaining Nut
- (f) Remove Pivot Pin.
- (g) Remove Detent Pin and Spring.
- (h) Remove Siphon Plug, Inspect O-Rings, Clean Jets.
- (i) Remove Air Cap Body.
- (j) Remove Hose Connection Block, Inspect Springs, Plungers and O-Rings.
- (k) Remove Gas Core, Inspect O-Rings.
- (l) Remove Nozzle, Inspect O-Rings, Clean Nozzle Jets.
- (m) Remove Gas Head.
- (n) Remove Drive Roll Carrier, Inspect Drive Roll and Drive Roll Gear.
- (o) Remove Spring Retainer, Spring Roller Pin Retainer and Roller Pin Retainer.

TURBINE PMS DISASSEMBLY

- Step 1 _____
 Step 2 _____
 Step 3 _____
 Step 4 _____
 Step 5 _____
 Step 6 _____
 Step 7 _____

- Firmly hold Turbine Roller with hand, remove Shaft Nut with 8mm Socket Wrench.
- Remove Speed Control Ring and Cover.
- Inspect Turbine Shaft, clean with lint-free rag, lubricate with Gear Lube.
- Remove Bearing Cover.
- Inspect and clean Brake Disc and Brake Shoes (Inside Turbine Cover). **DO NOT LUBE.**
- Gently pull Turbine Roller and Turbine Shaft from Control Housing. Do not let Turbine Shaft Bearings fall from Gear Cover.
- Remove Name Plate and Detent Spring.

NSA Gun Nomenclature. Identify each item that is part of the gun. Write the correct letter that identifies the part in the corresponding numbered space.



84. _____	89. _____	94. _____
85. _____	90. _____	95. _____
86. _____	91. _____	96. _____
87. _____	92. _____	97. _____
88. _____	93. _____	98. _____
-
(a) Gun Handle	(b) Air Cap Body
(c) Wire Input	(d) Gas Head
(e) Gun Handle Screw	(f) Tool Post Fixture
(g) Air Hose Connector	(h) Speed Control
(i) Drive Roll Carrier	(j) Hose Connection Block
(k) Wire Snubber Assembly	(l) Acetylene Connector
(m) Valve Handle Assembly	(n) Oxygen Nose Connector
(o) Wire Grip Mechanism	

TRAINING AID

Write the correct answer.

99. What size wire is used in WSA?

100. What kind of wire is used in WSA?

101. When must a steel item be wire sprayed?

102. What type of abrasive is used in anchor-tooth blasting?

103. Simply stated, what is corrosion?

104. When will corrosion not occur on steel?

105. Why is strip blasting required?

106. At what angle should the Wire Spray Gun be held?

107. What is the acceptable coating thickness for corrosion control high-temperature WSA?

108. What happens if the Wire Spray Gun angle is less than a 45° angle?

109. How much aluminum is sprayed onto a part by the 132 gun in one (1) hour of continuous spraying?

110. What type of stainless steel fasteners are approved for use for corrosion control?

111. Which of the following will produce back firing in the wire spray gun?

- (a) High oxygen pressure.
- (b) Acetylene leaks.
- (c) Blocked siphon-plug-bleeder holes.
- (d) Low oxygen pressure.

112. Which of the following is a function of the wire snubber?

- (a) It adjusts the rate of wire feed.
- (b) It feeds wire into the gun.
- (c) It releases or grips the wire depending on its position.
- (d) It controls the amount of pressure on the wire.

113. To prevent explosive gases from collecting in the air cap, which procedures must be followed?

- (a) Secure the gas head valve first then the wire grip.
- (b) Secure the wire grip first then the turbine.
- (c) Secure the wire grip first then the gas head.
- (d) Set turbine speed control to stop then secure the gas head valve.

114. When the gas head valve is turned off, the air regulator should show a pressure increase no greater than?

- (a) 5 psi
- (b) 10 psi
- (c) 15 psi
- (d) 20 psi

115. When reinstalling the plungers into the gas-head body, how do you determine if they are installed properly?
- (a) The large diameter section is completely inside the shaft.
 - (b) The O-Rings are on the outer edge of the shaft.
 - (c) The small diameter section is completely inside the shaft.
 - (d) The spring slides on the plunger easily.
116. When reassembling the siphon plug, push the siphon plug into the gun until the flange is seated against the:
- (a) Air Cap.
 - (b) Gas Head.
 - (c) Nozzle.
 - (d) Air-Cap Body.
117. The lighting detent pin and spring are located:
- (a) In the gas-head body.
 - (b) On the wire-grip mechanism.
 - (c) Inside the gas-head assembly.
 - (d) On the siphon-plug assembly.
118. To ensure proper connection of the hoses, acetylene hoses have left-handed threads and are color coded:
- (a) Red.
 - (b) Green.
 - (c) Black.
 - (d) Gray.
119. Restrictions in the air line or reduced air supply will be indicated by a decrease in flow rate in which of the following?
- (a) Air control unit sight glass.
 - (b) Air flow meter.
 - (c) Gas control unit.
 - (d) Oxygen control unit.
120. Which of the following procedures should be used when cleaning bleeder holes in the siphon plug?
- (a) Blow out holes with HP air.
 - (b) Push cleaning wire straight in and rotate to clean.
 - (c) Clean with solvent only.
 - (d) Push cleaning wire straight in and out; do not rotate.

TRAINING AID

1. (a)	27. D	53. D	79. (c)	Step 6 f	105. Remove all paint and corrosion
2. (c)	28. B	54. b	80. (d)	Step 7 c	106. 900
3. (b)	29. B	55. g	81. (a)	84. h	107. 10-15 mills
4. (d)	30. B	56. h	82. (d)	85. i	108. Overspray
5. (c)	31. A,C,D	57. e	83. Step 1 i	86. o	109. 120 cu.in.
6. (b)	32. A	58. j	Step 2 c	87. k	110. CRES 316-SS
7. (a)	33. C	59. i	Step 3 e	88. c	111. (C)
8. (c)	34. B	60. EC	Step 4 i	89. m	112. (C)
9. (d)	35. C	61. 50	Step 5 h	90. a	113. (a)
10. (b)	36. C	62. 45	Step 6 d	91. e	114. (b)
11. (d)	37. A,B,C,D	63. 75	Step 7 o	92. i	115. (a)
12. (b)	38. C	64. 67	Step 8 f	93. n	116. (b)
13. (d)	39. A	65. 30	Step 9 n	94. g	117. (a)
14. (d)	40. C	66. 52	Step 10 a	95. f	118. (a)
15. (d)	41. C	67. 5-8"	Step 11 j	96. j	119. (b)
16. (b)	42. A	68. 1/8"	Step 12 b	97. b	120. (d)
17. (d)	43. C	69. b	Step 13 g	98. d	
18. (a)	44. A	70. g	Step 14 k	99. 1/8"	
19. (b)	45. B	71. e	Step 15 m	100. 1/8" Aluminum 99.0+%	
20. (a)	46. B	72. n	Turbine PMS Disassembly	101. Within 2 hrs. after blasting	
21. C	47. C	73. b	Step 1 d	102. Aluminum Oxide	
22. F	48. B	74. q	Step 2 g	103. The process by which all metals degrade	
23. A	49. C	75. k	Step 3 b	104. When WSA is used properly	
24. E	50. B	76. f	Step 4 e		
25. G	51. C,D	77. a	Step 5 a		
26. H	52. D	78. i			

INSTRUCTOR PREPARATION

SIMA CC-SHOP
Lesson Plan

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TITLE	GEMA ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	1
LEARNING OBJECTIVES				TRAINING AIDS/MATERIALS			
Trainees will learn: 1. The differences between thermoplastic and thermoset plastics. 2. Crosslinking. 3. Why powder coating is used. 4. Environmental concerns. 5. Shipboard items to be powder coated. 6. Powder coating processes. The Trainees will be able to: 1. Follow proper safety rules. 2. Start up and operate equipment. 3. How to change colors. 4. Perform proper PMS. 5. Disassemble, clean and reassemble gun. 6. Replace insert sleeve and clean injector. 7. Troubleshoot equipment problems.				Materials: 1. GEMA Manual ESP Gun. 2. GEMA 701 ESP Unit. 3. Examples of powder-coated items of various shapes and sizes. (Note: Items must be procured from local sources.) 4. 35mm slides of GEMA Equipments and use. 5. Transparencies T:III-1-1 through T:III-1-8. 6. 35mm slide projector. 7. Overhead projector. References: 1. NAVSEA S9630-AG-MAN-010/FFG-7CL, Manual, Corrosion Control for FFG-7 Class, 30 November 1983. 2. Dod-STD-XXXX, Powder Coating Systems for Corrosion Protection Aboard Naval Ships, SEA 05M draft circa August 1985. 3. GEMA Electrostatic Spray Technical Manual.			

SIMA CC-SHOP
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INSTRUCTOR PREPARATION

TITLE	GEMA ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	1
LEARNING OBJECTIVES				TRAINING AIDS/MATERIALS			
				<u>Handouts:</u> 1. Paper copies of T:III-1-1 through T:III-1-8. <u>CC Shop:</u> 1. Tour of ESP Stations. 2. OJT with GEMA Equipments (6 hours).			

INSTRUCTOR PRESENTATION

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TITLE	GEMA ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT III	LESSON NO. 1
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
REVIEW OF ELECTROSTATIC POWDER COATING L. GENERAL A. Powder Coating: the covering of a surface with a finish or protective layer of "resin" in a dry powder form that when heated will melt and flow into a smooth finish. B. Types of Powder Coating 1. Sprayed (a) preheated object (b) electrostatic (c) combination of "a" and "b". 2. Fluidized Bed (a) preheated object (b) electrostatic (c) combination of "a" and "b".		• Write instructor's name, lesson number and title on board. • Write definition on board. Explain and discuss. • Describe and pass around ESP samples.		• Take notes. • Participate in class discussion and activities. • Copy definition from board. • Examine samples and pass on.	

INSTRUCTOR PRESENTATION

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TITLE	GEMA ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	1
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE			
C. Attributes 1. Dry powder; no solvents; no "VOC" concerns. 2. Uniformly covers large variety of differently sized and shaped objects. 3. More wear resistant than paints. D. Application - Electrostatic Sprayed Powder coating is applied: 1. onto a clean, pretreated object, (a) white metal blast (b) priming required on some surfaces 2. preheated at or above curing temperature, 3. in powdered resin form, 4. with an electrostatic spray gun. B. Curing 1. Item is placed in a 200-450°F oven, exact temperature and curing time are functions of resin type. 2. Powder melts and begins to cure: (a) If two coats are desired, the item is removed from oven during the partial cure (gel state), coated again and returned to oven. (b) Complete cure in oven occurs in 5-20 minutes.		• Show slides. Explain and discuss.					

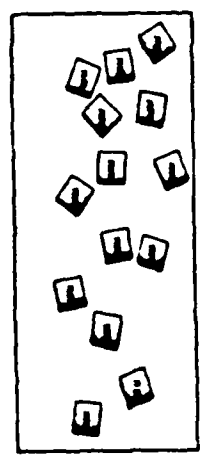
INSTRUCTOR PRESENTATION

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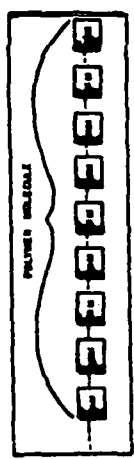
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TITLE	GEMA ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT	LESSON NO.	1
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE
3. Item may be handled immediately after cooling. II. TYPES OF POWDER The coating powders are plastics. A. Basically, two types of coating powders 1. Thermoplastics (a) Can be melted, formed, cooled and hardened separately. 2. Thermosetting (a) heated, cured (set) into permanent state. (b) when reheated at high enough temperature will burn or char. B. Thermosetting Resins 1. They are the only type we will use because of their durability, flexural strength and chemical resistance. 2. Chemical difference between a thermoset resin and a typical plastic. (a) a plastic is made up of long molecules called polymers. (b) in cross-linking (curing), the polymers become chemically attached to each other.				• T:III-1-1		

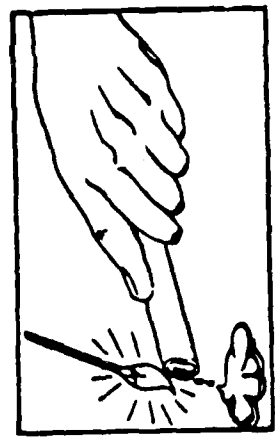
TRAINING AID



Monomer molecules.
Monomer molecules are small molecules. They are not connected to each other.



Polymer molecule.
A polymer molecule is composed of hundreds to thousands of monomer molecules joined in a chain.

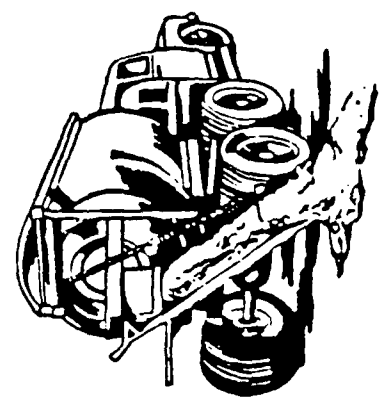


Thermoplastics act like candle wax when heated or cooled.

TWO TYPES OF PLASTICS

All Plastics are either

1. Thermoplastic (heat softening)
2. Thermosetting (heat curing)



Thermosetting plastics act like concrete when set

INSTRUCTOR PRESENTATION

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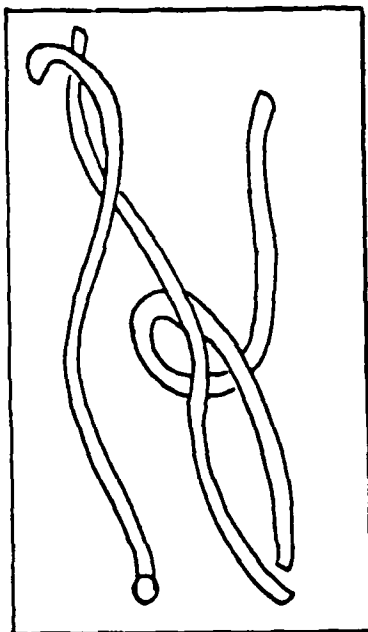
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TITLE GEMA ESP EQUIPMENT	COURSE CC-Shop Technician	UNIT III	LESSON NO. 1
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
(c) Cross-linking is a chemical reaction that results in a permanent change. 3. Powdered resins are formulated to allow enough time between powder melting and polymer cross-linking so that a good, smooth coating results. C. <u>Thermosetting Powders:</u> Powdered epoxy coatings are approved for interior and exterior application on steel surfaces above the upper limit of boot topping. There are several coatings which can be applied by this process, including polyvinyl chloride, polyethylene, polyester, epoxy, acrylic, and nylon. The epoxy systems are preferred. Current NAVSEA policy requires that only an epoxy meeting the standards of ASTM A775-81, and providing a total film thickness of 8-12 mils, shall be used for topside shipboard application. Chalking of the epoxy coating is to be prevented by the application of silicone alkyd paint. Polyesters are less affected by sunlight (ultraviolet, in particular), retaining their color and gloss longer.	• T:III-1-2		

TRAINING AID

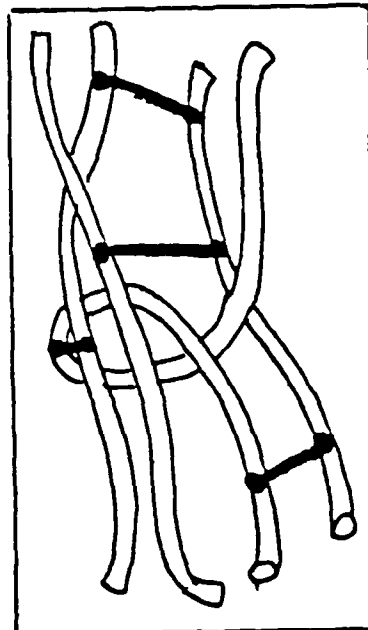
POLYMERS

Regular Plastic



Molecules Are Simply In Contact With Each Other.

Cross-Linked Plastic



Polymer Molecules Are Cross-Linked.

INSTRUCTOR PRESENTATION

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Lesson Plan

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TITLE GEMA ESP EQUIPMENT		COURSE	CC-Shop Technician	UNIT III	LESSON NO. 1	
KEY POINTS/ACTIVITIES						TRAINEE RESPONSE
III	WHY POWDER COAT INSTEAD OF PAINT? A. <u>More durable.</u> Powder coatings resist physical abrasion better than paint. Also the P.C. will retain color and gloss longer. Saves maintenance time and money. B. <u>A more complete barrier coating.</u> Because there is no solvent evaporating from the coating during the cure, there are very few pores. C. <u>EPA - 85% reduction of VOC.</u> In other words, of all the solvent in your wet paint, only 15% may be released into the atmosphere. The 85% must be captured and safely disposed as hazardous waste. 1. Solvent recovery systems are expensive. 2. Alternate paint systems have problems with poor curing or inadequate adhesion. D. <u>OSHA - Safety.</u> Coating powders are classified as a "nuisance dust" and are non-toxic. Proper respirators must be worn. E. <u>Clean-up.</u> 1. No hazardous waste. 2. No solvents to clean up spills. 3. Washes off skin and clothing with soap and water.					- List on board: - More durable. - More complete barrier coating. 85% reduction in VOC. - Explain and discuss
						Explain OSHA.

INSTRUCTOR PRESENTATION

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TITLE	GEMA ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	1
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE			
IV. WHERE SHOULD POWDER COATING BE USED ON SHIP COMPONENTS? A. It may be used in low-abrasion environments. WSA is to be used in high abrasion environments. B. Powder coatings supply corrosion protection as barrier coatings only. They supply no cathodic protection. C. List of approved ship components that may be powder coated: • Vent Screens • Door Screens • Ventilation Discharge Screens • Light Brackets • Light Shock Mounts • Switch Cover Plates • Fog Applicators • Battle Helmets		• List items for approved application on board.		• Copy list of approved application items from board.			

INSTRUCTOR PRESENTATION

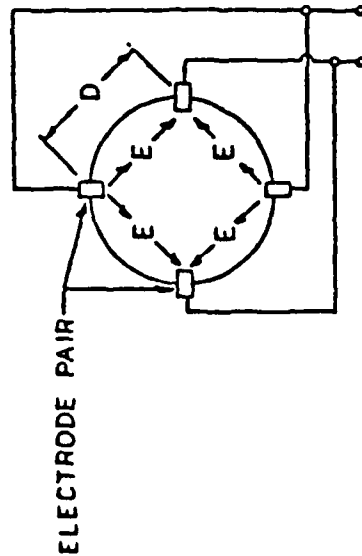
SIMA CC-SHOP
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TITLE	GEMA ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	1
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
V.	GEMA TYPE 701 ESP UNIT						
A.	<u>Description and Operations.</u>						
1.	Functional description: The fluidized powder in the powder hopper is sucked up in the injector by the conveying air (red hose). Through the powder hose, the powder/air mixture reaches the gun. The powder is electrostatically charged immediately before it reaches the gun muzzle. An intense electrostatic field also exists between the gun muzzle and the grounded workpiece. The electrostatically charged powder sprayed onto the workpiece adheres to the latter's surfaces. The line voltage is converted in the control module to a high-frequency current. This current is then stepped up by the high-voltage transformer (1) and the HV-cascade (2) in the gun to 70 to 100kV and applied to the electrodes (3). The conveying air and the dosing air is to be regulated on the control module, the fluidizing air on the pneumatic unit. The function of the injector is explained in the description EPM-228. The powder is fluidized by forcing air from below through a porous plastic plate. The fluidized powder gets liquid-like properties.						
					• T:III-1-3		

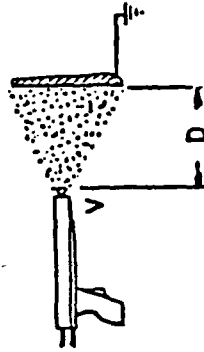
TRAINING AID

WHAT MAKES ELECTROSTATICS WORK



GEMA GUN
DISTANCE IS FIXED, FIELD
STRENGTH IS CONSTANT

$$E = \frac{6000V}{.6CM} = \frac{7500V/CM}{CONSTANT}$$



CONVENTIONAL GUN
FIELD STRENGTH VARIES
WITH DISTANCE

$$E = \frac{75,000V}{10CM(4")} = \frac{7500V/CM}{VARIABLE}$$

$$\frac{CHARGE\ ON\ POWDER}{Q = KEf(t)}$$

$$\frac{FIELD\ STRENGTH(E)}{= \frac{(V)VOLTAGE}{(D)DISTANCE}}$$

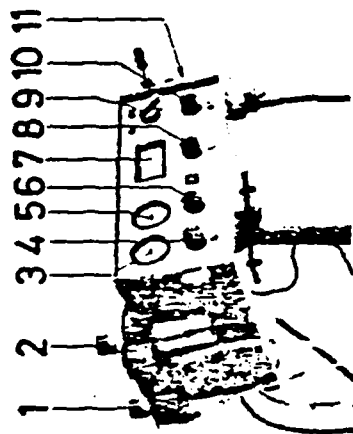
INSTRUCTOR PRESENTATION

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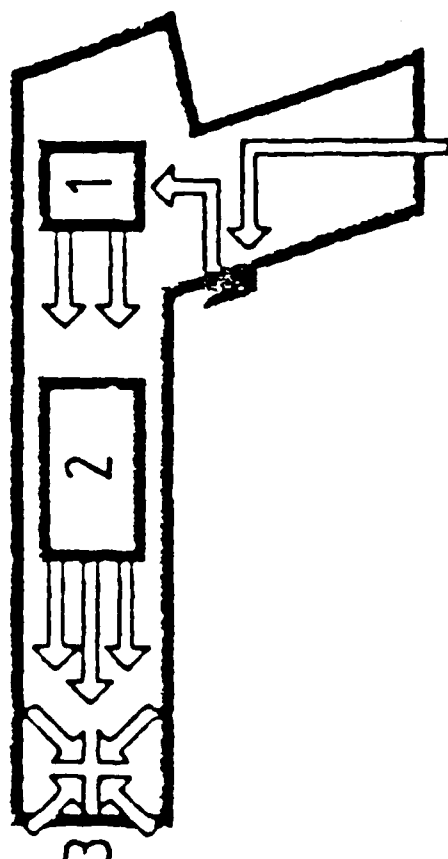
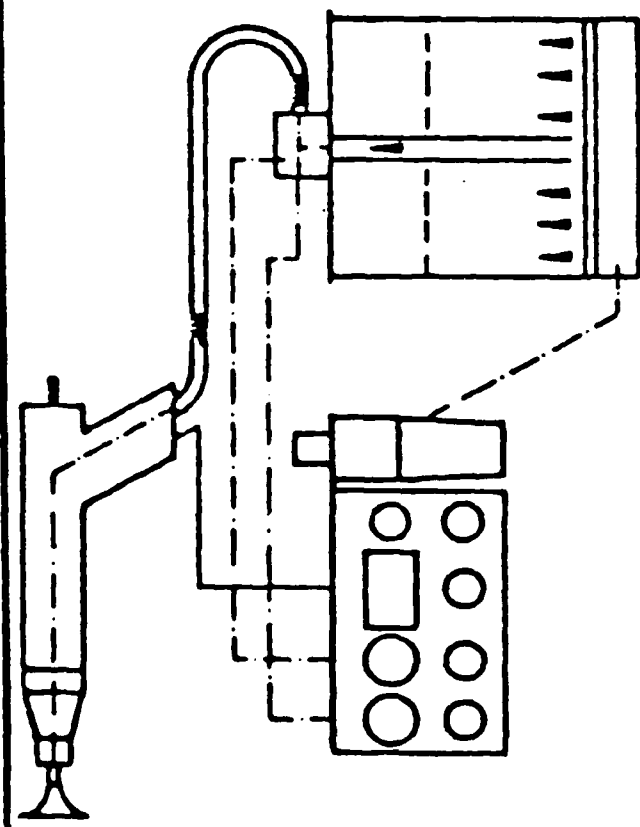
TITLE	GEMA ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	1
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
2.	Operator Controls:			● T:III-1-4			
3.	Spray Gun:			● T:III-1-5			
	(a) Hand Gun 70kV						
	(b) Maximum output current 0.12mA						
	(c) Short circuit current 0mA						
4.	Pneumatic Data:			● Explain use of metric units.			
	(a) Maximum input pressure 176 psi						
	(b) Minimum input pressure 88 psi						
	(c) Maximum compressed air consumption is 13.2Nm ³ /hr. (Newton meters-cubed per hour; standard cubic feet per second)						
5.	Working method of the injector and the influence of the dosing air:			● T:III-1-6			

Operator controls

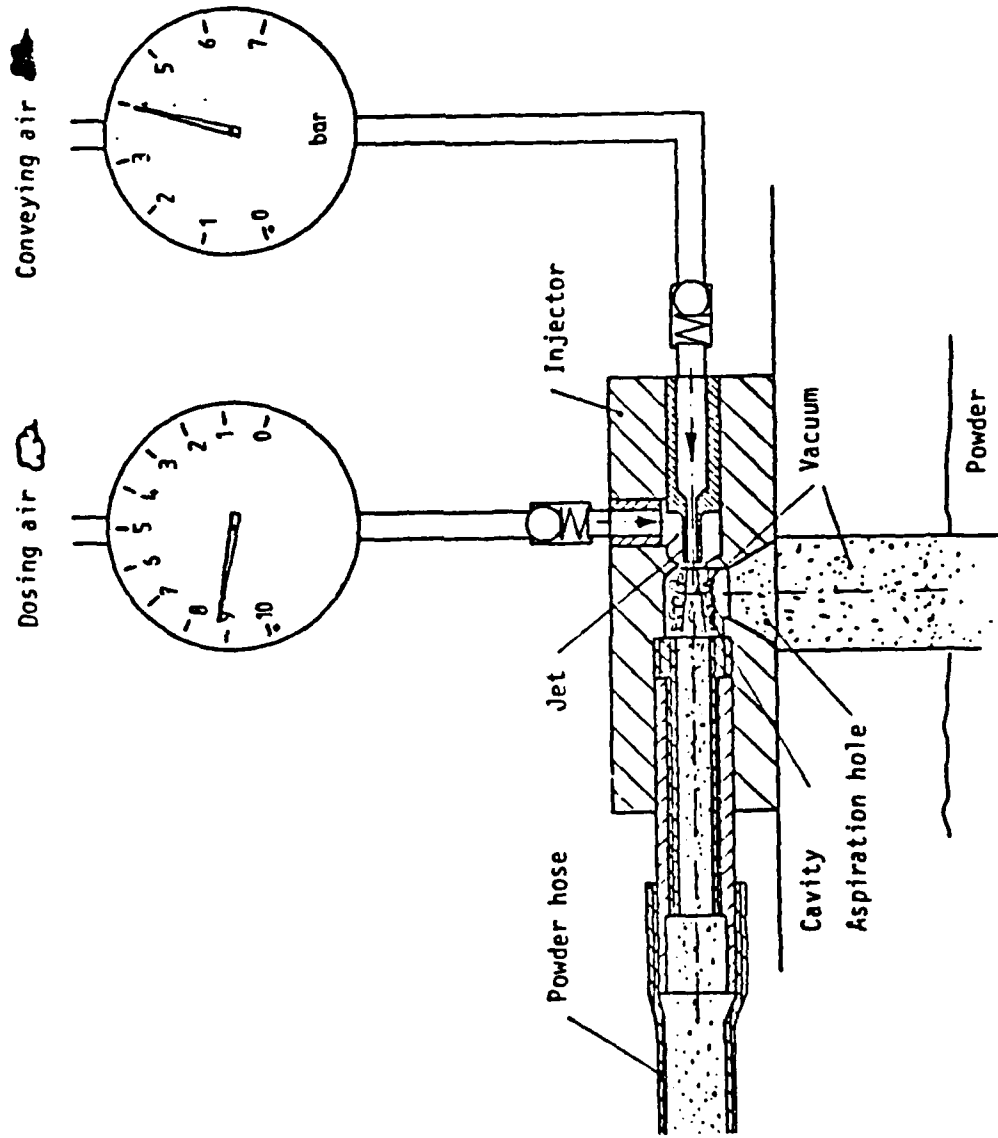


1. Pressure reducing valve for regulating the fluidizing air
2. Inlet pressure reducing valve with water separator
3. Manometer for monitoring conveying-air pressure
4. Pressure reducing valve for regulating the conveying-air pressure
5. Manometer for monitoring the dosing air
6. Pressure reducing valve for regulating the dosing air
7. High-voltage meter
8. Control knob for regulating the high voltage
9. Power switch
10. Green illuminated push button. The discharge current can be read on dial gauge 7 by pressing this button.
11. Gun switch

TRAINING AID



TRAINING AID



A7-1-251

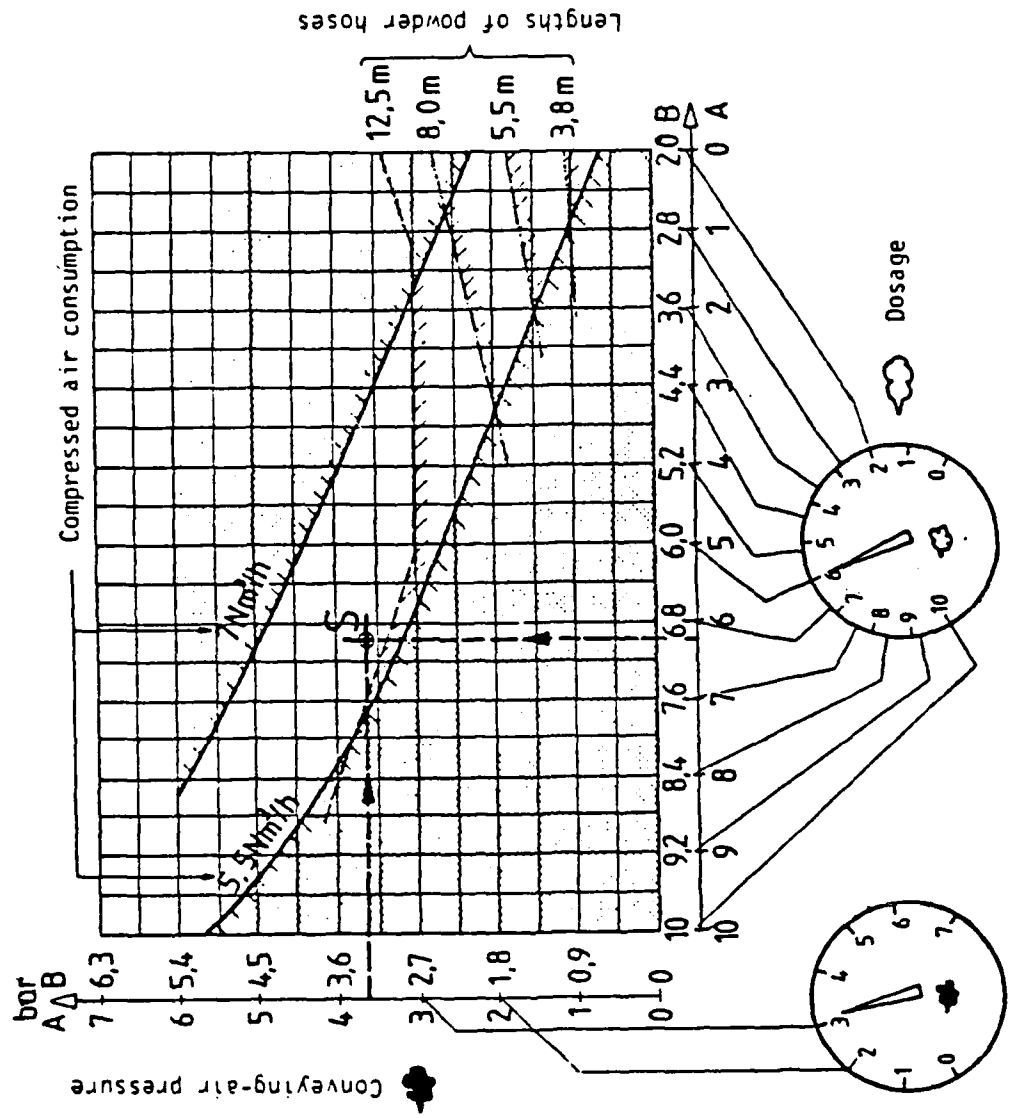
INSTRUCTOR PRESENTATION

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TITLE	GEMA ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT III	LESSON NO. 1
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE			
5. (Cont'd) To decrease the powder output without reducing the conveying speed, the vacuum in the hollow has to be decreased. For that purpose, the dosing air is blown into the cavity as secondary air. By raising the dosing air, the powder output decreases. The scale of the dosing-air manometer does not indicate the pressure but an index which proceeds corresponding to the conveying-air pressure. The zero on the scale of the dosing air does not correspond with the zero of the effective powder output. It is dependent on the conveying-air pressure: the higher the conveying-air pressure, the lower the scale value of the dosing air for the effective zero point of the powder output. Thus the scale does not indicate an absolute value, but one which depends on the conveying-air. The division on the dosing-air manometer does not indicate constant output values but serves as adjusting help for better reproducibility of the coating values. 6. Graphics for the Determination of Adjustment for Perfect Powder Output: To obtain a regular pulsating free powder output, the adjusting of conveying-air and dosage have to be chosen in such a way that the whole compressed air consumption per gun does not fall below 5.5 Nm³/h, see example. To avoid an eventual blow-off, the consumption should not exceed 7 Nm³/h. A regular and pulsating free powder output depends also on the length of the powder hose. The intersecting point (S) of the adjustment of conveying-air and dosage thus have to be set above the line which corresponds with the length of the powder hose. The determination of the graphics is based upon epoxide powder IG EP 149P (density: 1.55 g/m³).	T:III-1-7				

TRAINING AID



INSTRUCTOR PRESENTATION

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TITLE GEMA ESP EQUIPMENT		COURSE CC-Shop Technician	UNIT III	LESSON NO. 1
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
7. Installation of ES Powder Sprayer: <u>Type 701</u> The ES powder sprayer is preassembled at the factory to the point where only the individual subassemblies must be connected. The gun support can be mounted either on the left-hand or the right-hand side of the control housing. The pneumatic unit is mounted on the opposite side. Connect conveying-air (red hose) to the angular fitting of the injector. Connect dosing-air (blue hose) to the straight fitting of the injector. Connect fluidizing air (white 6mm hose) to the angular fitting of the pressure reducing valve (No. 1, refer to operator controls) of the pneumatic unit and to the angular fitting of the powder hopper bed. <u>B. Safety Rules for Electrostatic Powder Coating</u> 1. All electrostatically conductive parts located within 5m of the coating equipment must be properly grounded. 2. The work floor of the coating area must be electrostatically conductive. 3. The operating staff must wear electrostatically conductive shoes (e.g., leather soles).		• Show slides of the Type 701 ES Powder Sprayer. • T:III-1-8.	• Trainees discuss reasons for these safety rules.	

TRAINING AID

Safety Rules for Electrostatic Powder Coating

1. All electrostatically conductive parts located within 5m of the coating equipment must be properly grounded.
2. The work floor of the coating area must be electrostatically conductive.
3. The operating staff must wear electrostatically conductive shoes (e.g., leather soles).
4. The operating staff should hold the gun in the bare hand. If gloves are worn, they must be electrostatically conductive.
5. The ground cable supplied with the equipment (yellow/green) must be connected to the ground terminal of the electrostatic sprayer. This cable must have proper metallic connection with the coating booth, the recovery unit and the conveyor chain or the suspension devices of the workpieces to be coated.
6. The electric and the powder feed lines to the guns must be routed in such a manner that they are suitably protected against mechanical damage.
7. Power to the powder sprayer should only be available after the booth has been switched on. If the booth is switched off, the powder sprayer must also shut off.
8. The ground connection of all conductive parts must be checked at least weekly.

INSTRUCTOR PRESENTATION

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TITLE	GEMA ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	1
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE			
4. The operating staff should hold the gun in the bare hand. If gloves are worn, they must be electrostatically conductive. 5. The ground cable supplied with the equipment (yellow/green) must be connected to the ground terminal of the electrostatic sprayer. This cable must have proper metallic connection with the coating booth, the recovery unit and the conveyor chain or the suspension devices of the workpieces to be coated. 6. The electric and the powder feed lines to the guns must be routed in such a manner that they are suitably protected against mechanical damage. 7. Power to the powder sprayer should only be available after the booth has been switched on. If the booth is switched off, the powder sprayer must also shut off. 8. The ground connection of all conductive parts must be checked at least weekly.		• Point out all these items during tour of the ESP Station in the CC Shop. • Equipment safety, operation and maintenance, and QC.		• Operate equipments and spray parts.			
VL CC SHOP OUT AT ESP STATION (6 hours)							

INSTRUCTOR FOLLOW-THROUGH

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Lesson Plan

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TITLE <u>GEMA ESP EQUIPMENT</u>		COURSE <u>CC-Shop Technician</u>	UNIT <u>III</u>	LESSON NO. <u>1</u>
PRACTICAL APPLICATIONS	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
• Summarize lesson. • Question trainees on key points; repeat and amplify the instruction as required. • Have trainees demonstrate the proper use and maintenance of equipments.		• Answer questions and explain issues asked by the instructor. • Demonstrate knowledge of practical skills.		

INSTRUCTOR PREPARATION

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Lesson Plan

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TITLE	NORDSON ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	2
LEARNING OBJECTIVES				TRAINING AIDS/MATERIALS			
Trainees will be able to: 1. Set up, 2. Operate, 3. Maintain, and 4. Troubleshoot the Nordson ESP gun, hopper/feeder and console.				<u>Materials:</u> 1. 35mm slides of set up, operation, PMS and troubleshooting of: • Nordson ESP Console, • Nordson ESP Hopper/Feeder, and • Nordson ESP Hand Gun. (Make up slides comparable to the photographs in Ref. 2,3 and 4 and number similarly. Tape/slide training programs for Ref. 2,3 and 4 may be purchased from Nordson Corporation, Finishing Equipment Division, Technical Training Department, 555 Jackson Street, P.O. Box 151, Amherst, OH 44001.) 2. Transparencies T:III-2-1 through T:III-2-3. 3. 35mm slide projector. 4. Overhead projector. 5. Nordson Control Console in the CC Shop. 6. Nordson Feeder/Hopper in the CC Shop. 7. Nordson ESP Gun in the CC Shop.			

INSTRUCTOR PREPARATION

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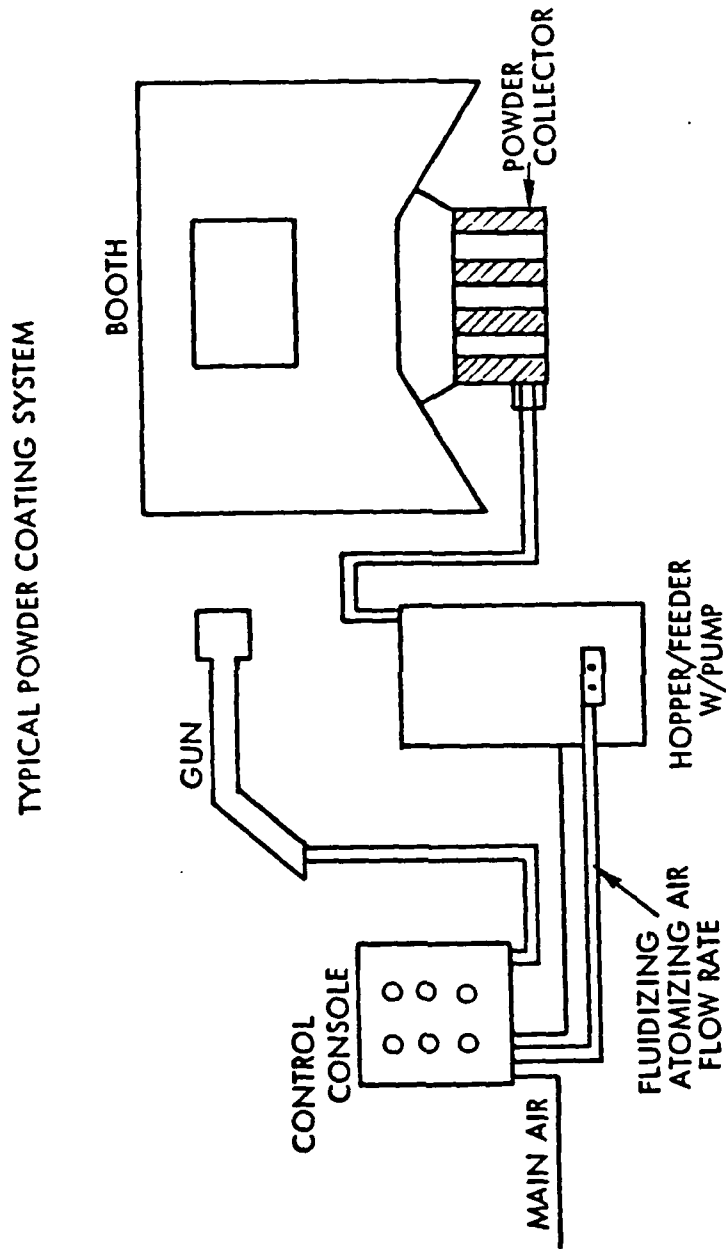
TITLE <u>NORDSON ESP EQUIPMENT</u>	COURSE <u>CC-Shop Technician</u>	UNIT <u>III</u>	LESSON NO. <u>2</u>
LEARNING OBJECTIVES		TRAINING AIDS/MATERIALS	
		<u>References:</u> 1. DoD-STD-XXXX, Powder Coating Systems for Corrosion Protection Aboard Naval Ships, SEA 05M draft circa August 1985. 2. Nordson Training Module "Y", NPE-2M Gun, Resource Guide Y-O, 1980. 3. Nordson Training Module "O", H2,3,4 & 5 Hoppers, Resource Guide O-O, July 1980. 4. Nordson Training Module "X", NPE-CC8, Resource Guide X-O, November 1980. <u>Handouts:</u> 1. Paper copy of transparencies. 2. Copy of Ref. 2,3 and 4. <u>CC Shop:</u> 1. OJT with Nordson Equipments (6 hours).	

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TITLE NORDSON ESP EQUIPMENT		COURSE CC-Shop Technician	UNIT III	LESSON NO. 2
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
I. INTRODUCTION				
<u>Typical Powder-Coating System.</u>				
II. NPE-2M ESP HAND GUN				
A. <u>Description:</u>				
A manually-operated Powder Spray Gun that incorporates electrostatic features.				
• Lightweight, balanced • Magnetic reed switch trigger • Positive and adjustable control of spray pattern • Central external antenna for maximum charge efficiency • Positive governing of powder velocity and volume • Equipped with 25' (7.62m) feed tubing • Resistor in gun limits current • Short internal powder passage				
Specifications:				
		USA	METRIC	
(a) Height	8.25"	226mm		
(b) Length	13.25"	325mm		
(c) Powder Tubing Length	25.0'	7.62m		
The Nordson Powder Electrostatic gun NPE-2M is a simple powder hand gun easy to use and maintain. However, it does require some maintenance if it is expected to operate at high efficiency. This training module pertains to the				
		Slide 3	• Take notes. • Participate in class discussion and activities.	



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TITLE	NORDSON ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	2
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B. Functions Most people who work with tools and have to maintain them find it easier if they understand the operation of the NPE-2M gun. Let's look at the different functions that occur within the gun, starting with the flow of powder from the hose into the gun, through the nozzle, the deflector, sleeve and out the front of the gun in an evenly-shaped pattern. An electrostatic charge is fed to the gun through a special cable (1) then through a resistor (2) in an insulated extension (3) and finally to a charging electrode at the front of the gun. The third function in the gun, the trigger, controls the other two. In this function, a permanent magnet in the trigger is moved close to a switch as the trigger is pulled. The magnet pulls one contact in the switch against another making a circuit allowing a low-voltage current to pass to the control counsel turning on the powder flow and electrostatic charge.		- Slide 4 - Slide 5 - Slide 6					
C. Maintenance Because a static electric charge will always seek out a path to ground, cleanliness of the gun becomes very important. 1. Wipe all powder and foreign matter from the gun so all the charge intended to move from the electrode to the powder cloud will do so. This procedure will prevent leaking back through the contaminant to the grounded gun handle..		Slide 7					

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KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE				
2. Powder allowed to accumulate on the inner parts of the gun will cause an uneven distribution of powder in the cloud and also the same lack of efficiency that dirt on the outside of the gun will cause. 3. Never use solvent or soap and water to clean the gun. These liquids may cause the flow of harmful efficiency-robbing particles to accumulate in pores and small voids in the gun. <u>D. Disassembly</u> As we proceed with the disassembly steps of this module, you will see that some clean, dry, compressed air and a fiber brush or course cloth is al that is needed to clean the gun. 1. Lift the sleeve adjuster up off the extension. You may encounter some resistance caused by friction between the rear of the adjuster and the extension. Don't be afraid to lift or even pry upward with a screwdriver. 2. Slide the sleeve forward off the front of the extension. 3. Carefully pull the deflector from the front of the extension, making sure not to damage the electrode. 4. If the deflector fits too loosely, the O-ring inside the deflector must be replaced. 5. An uneven or narrowing powder cloud are the most common symptoms of a worm deflector. Inspect the deflector. If it has grooves in it or if its outside diameter has diminished, it should be replaced. Remember, new deflectors measure 38 or 16mm in diameter.	• Slide 8 • Slide 9 • Slide 10 & 11 • Slide 12 • Slide 13 • Slide 14					

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KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE				
6.	Pull the nozzle with a twisting motion from the front of the gun. Sometimes when this is done the sleeve around the deflector mount may slide off. Be careful not to lose it.	• Slide 15					
7.	Slide the sleeve from the deflector mount. On guns used to spray porcelain enamel, the sleeve and deflector mount are one part and are disassembled from the rear of the extension. We will see this a little later in the program when we remove the deflector mount.	• Slide 16					
8.	Remove the two slotted screws from each side of the extension and pull the extension forward away from the handle until it clears the insulation tube.	• Slide 17					
9.	The resistor which has the electrode attached to it also has dielectric grease on it. The grease may cause the resistor to stick in either the extension or the insulating tube. Shake the resistor out of the part it is in. Any further disassembly steps would result in replacing the resistor and grease. To overcome the cohesion of the grease, shake the part vigorously to get the resistor out.	• Slide 18					
10.	Hold the extension front-end down and tap the front tip of the deflector mount on the work bench. This will force the mount out the back of the extension. On guns used for porcelain enamel, the part being removed is made of ceramic and is equivalent to the mount and the sleeve used in organic powder guns.	• Slide 19					
11.	Disconnect the control wire leads by pulling the plug on the cable away from the switch plug attached to the handle.	• Slide 20					
12.	Unscrew the cable nut and pull the cable from the adaptor in the base of the handle.	• Slide 21					

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TITLE	NORDSON ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	2	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
KEY POINTS/ACTIVITIES									
13. Pull the switch and plug from the gun handle. This part fits in very tightly and may require a hard pull to remove it. 14. Pull the insulating tube from the gun handle. 15. If the trigger or spring requires replacement, hold the trigger pivot with one screwdriver and remove the screw with another. <u>This completes disassembly of the gun.</u> <u>B. Reassembly</u> Reassembly of the NPE-2M gun is basically the reverse of disassembly except for a few steps. When replacing the deflector mount, it is important for it to be fully inserted. To do this, line it up so it is started straight into the extension and then hand press it in with a round dowel until it protrudes about 13mm or 1/2 inch from the front of the extension. Place the spring of the resistor assembly on the end of a pencil. Gently slide the electrode, resistor and spring into the extension and align the electrode so it passes through the deflector mount. Hold the electrode and pull out the pencil.									
• Slide 22 • Slide 23 • Slide 24 • On completion of showing and explaining slides of gun disassembly, demonstrate "hands on" gun step by step gun disassembly to trainees. • Demonstrate reassembly of the gun. • Slide 25 • Slide 26									• Trainees working in groups will reassemble the gun.

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KEY POINTS/ACTIVITIES									
Push the insulating tube into the gun handle. When it is seated against the cable adapter, fill the end protruding from the front of the handle with dielectric grease. It is important to put all the grease from the applicator into the tube. This will fill all the voids in the resistor-spring and cable contact areas and will prevent electrical breakdown due to arcing. F. Troubleshooting - Mechanical - Puffing - Uneven Pattern - Inadequate Powder - Poor Efficiency or Poor Wrap. - Powder does not flow - Too much film. - Electrostatic - Loss of Wrap - Red light ON, Feeder/Power Unit ON - Loss of Wrap - Red light ON, Feeder/Power Unit OFF - Electrical sparks between workpiece and conveyor rack.									
Slide 27									
T:III-2-2a									
T:III-2-2b									
T:III-2-2c									
DANGER - SHUT DOWN									

TRAINING AID

TROUBLESHOOTING THE NPE-2M GUN

Mechanical:

PROBLEM	PROBABLE CAUSE	SUGGESTED CORRECTION
Poor efficiency or poor wrap	Output voltage is not sufficient.	Increase the output voltage.
Electrode bent or broken off	Rough handling during use or in cleaning.	Remove and replace the Resistor Assembly.
Powder does not flow	Air supply to the system is "OFF" or below minimum required.	Check air supply to the system to insure it is "ON". Also check for kinked air lines.
	Interlock malfunction.	Check and replace if necessary.
	Faulty solenoid.	Check solenoids and replace if necessary.
Too much film build	Improper placement of gun.	Relocate gun and trial-and-error until proper thickness is achieved.

TROUBLESHOOTING THE NPE-2M GUN (CONT.)

Mechanical:

PROBLEM	PROBABLE CAUSE	SUGGESTED CORRECTION
Puffing	Ejector pressure and/or Diffuser flow are not adequate.	Increase the Ejector pressure, or increase the Diffuser flow, or both.
	Hopper vent hose kinked or too long.	Straighten or shorten hose.
	Powder feed hose too long.	Move hopper closer to booth and shorten feed hose.
Uneven pattern (heavy spots)	Diffuser flow is not adequate.	Increase the Diffuser flow.
	Deflector is not press fit into the mounting deflector correctly.	Properly press fit the deflector into the mounting deflector.
	Deflector is worn or damaged.	Remove and replace the deflector.
Inadequate powder	Wet or damp powder is causing the metering orifice in the Venturi Assembly of the Feeder/Power Unit or in the powder pump to clog.	Clean the metering orifice in the Venturi Assembly of the Feeder/Power Unit or in the powder pump.
	Venturi throat worn out or is distorted.	Replace the Venturi throat in the Venturi Assembly of the Feeder/Power Unit or in the powder pump.
	Venturi Nozzle is partially blocked.	Clean or replace the Venturi Nozzle in the Venturi Assembly of the Feeder/Power Unit or in the powder pump.
	Excessive Diffuser pressure.	Decrease the Diffuser pressure.

TRAINING AID

Electrostatic: TROUBLESHOOTING THE NPE-2M GUN (CONT.)

PROBLEM	PROBABLE CAUSE	SUGGESTED CORRECTION
Loss of wrap (red light on Feeder/Power Unit "ON")	Poorly grounded workpieces.	Clean hooks, conveyor rollers, and channels.
	Dirt on the outside of gun, inside extension resistor, and/or cable end at Feeder/Power Unit.	Clean using a clean cloth or brush.
	Damaged resistor.	Check resistivity with megohm-meter. Replace if necessary.
	Defective cable.	Check voltage output with Nordson hand KV meter.** Replace if necessary.
	Defective Power Unit package in the Feeder/Power Unit.	Check output with Nordson hand KV meter.**
Loss of wrap (red light on Feeder/Power Unit "OFF")	Power Unit package in the Feeder/Power Unit or Control Console.	Check Power Unit using instructions provided with that unit.
Electrical sparks between workpiece and conveyor or rack.	Poor ground contact for workpiece or rack.	Danger! Shut down operation and correct ground deficiency. Fire may result if not corrected.

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III. NORDSON ESP HOPPER/FEEDER This training module will deal with the theory of operation, troubleshooting and repair of the hopper and the pumps. A. Description The H2, H3, H4 and H5 Hopper Feeders are designed to hold and fluidize a supply of powder to be transmitted via an attached powder pump to a single Electrostatic Powder Spray Gun. The H2, H3, H4 or H5 Hopper Feeder, in conjunction with an NPE-F3 or CC-1 (high-voltage and control) module, regulates the amount of powder and the ratio of air and powder being emitted in the form of a cloud from the electrostatic Powder Spray Gun. B. Specifications <table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="5">U.S.A. (in.)</th> <th colspan="5">METRIC (mm)</th> </tr> <tr> <th>H2</th> <th>H3</th> <th>H4</th> <th>H5</th> <th>H6</th> <th>H2</th> <th>H3</th> <th>H4</th> <th>H5</th> </tr> </thead> <tbody> <tr> <td>Dimensions:</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Height</td> <td>42.50</td> <td>31.12</td> <td>15.38</td> <td>10.88</td> <td></td> <td>1078</td> <td>791</td> <td>390</td> <td>276</td> </tr> <tr> <td>Width</td> <td>21.31</td> <td>14.5</td> <td>9.0</td> <td>7.0</td> <td></td> <td>541</td> <td>368</td> <td>229</td> <td>178</td> </tr> <tr> <td>Depth</td> <td>23.00</td> <td>14.5</td> <td>7.0</td> <td>5.0</td> <td></td> <td>584</td> <td>368</td> <td>178</td> <td>127</td> </tr> <tr> <td>Capacity:</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Powder (Sieve 7/3 full)</td> <td>130 lb.</td> <td>50 lb.</td> <td>6 lb.</td> <td>2 lb.</td> <td></td> <td>59 kg</td> <td>23 kg</td> <td>2.7 kg</td> <td>.91 kg</td> </tr> <tr> <td>Air Requirements (SCFM/liter/sec)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Air to plenum (fluidizing)</td> <td>10</td> <td>3</td> <td>1</td> <td>1</td> <td></td> <td>5.7</td> <td>1.41</td> <td>.47</td> <td>.47</td> </tr> <tr> <td>Air to pump</td> <td>5</td> <td>5</td> <td>5</td> <td>5</td> <td></td> <td>2.3</td> <td>2.3</td> <td>2.3</td> <td>2.3</td> </tr> <tr> <td>Ejector</td> <td>5</td> <td>5</td> <td>5</td> <td>5</td> <td></td> <td>2.3</td> <td>2.3</td> <td>2.3</td> <td>2.3</td> </tr> <tr> <td>Average operating PSI/Ag/cm²</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Fluidizing</td> <td>5-15</td> <td>5-15</td> <td>5-15</td> <td>5-15</td> <td></td> <td>.35-1</td> <td>.35-1</td> <td>.35-1</td> <td>.35-1</td> </tr> <tr> <td>Ejector</td> <td>60</td> <td>60</td> <td>60</td> <td>60</td> <td></td> <td>4.2</td> <td>4.2</td> <td>4.2</td> <td>4.2</td> </tr> <tr> <td>Diffuser</td> <td>40</td> <td>40</td> <td>40</td> <td>40</td> <td></td> <td>2.8</td> <td>2.8</td> <td>2.8</td> <td>2.8</td> </tr> </tbody> </table>													U.S.A. (in.)					METRIC (mm)					H2	H3	H4	H5	H6	H2	H3	H4	H5	Dimensions:										Height	42.50	31.12	15.38	10.88		1078	791	390	276	Width	21.31	14.5	9.0	7.0		541	368	229	178	Depth	23.00	14.5	7.0	5.0		584	368	178	127	Capacity:										Powder (Sieve 7/3 full)	130 lb.	50 lb.	6 lb.	2 lb.		59 kg	23 kg	2.7 kg	.91 kg	Air Requirements (SCFM/liter/sec)										Air to plenum (fluidizing)	10	3	1	1		5.7	1.41	.47	.47	Air to pump	5	5	5	5		2.3	2.3	2.3	2.3	Ejector	5	5	5	5		2.3	2.3	2.3	2.3	Average operating PSI/Ag/cm ²										Fluidizing	5-15	5-15	5-15	5-15		.35-1	.35-1	.35-1	.35-1	Ejector	60	60	60	60		4.2	4.2	4.2	4.2	Diffuser	40	40	40	40		2.8	2.8	2.8	2.8	- Hopper/Feeder Slide Set - Slide 1. Point out hopper/feeder. - Slide 2		
	U.S.A. (in.)					METRIC (mm)																																																																																																																																																																								
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KEY POINTS/ACTIVITIES			TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
C. <u>Nomenclature</u> 1. There are no controls or electronics in the hopper or in the pump. These are contained in the control console(3) which can be mounted away from the spray area adding a great safety factor to the system. 2. The control console contains the on-off switch and the electric voltage selector. It also contain the "Flow Rate" regulator and the "Atomizing Air" regulator which controls air to the pump. 3. Some consoles, such as the CC8, also contain a third regulator and gage feeding the proper amount of fluidized air to the hopper plenum. 4. Automatic and hand guns operate identically except for turn on and turn off. On automatic units all functions turn on when the on-off switch is moved to the on position. 5. On hand guns only the hopper is fluidized when the switch is turned on. All other functions are activated when the operator pulls the trigger.			• Slide 7 • Slide 8 • Slide 9 • Slide 10		
D. <u>Operation</u> 1. In operation, air passes through the: (a) Fluidizing regulator, and (b) into the plenum of the hopper (c) where it is distributed across the surface of a porous membrane.			• Slide 11		

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KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE		
2.	Air then passes through the membrane and into the powder where it is mixed with it and elevates it to a fluid-like consistency.		• Slide 12			
3.	When a hand gun is triggered or an automatic gun is turned on, two streams of air pass through tubes from the control console to each pump. One of these streams is the "Flow Rate" stream. This stream passes through a venturi in the pump where it pulls the fluidized mixture of powder and air from the hopper and propels it along with itself to the gun. The greater the air pressure applied on the venturi nozzle, the more powder the venturi propels to the gun.		• Slide 13			
4.	Working in conjunction with the Flow Rate control is the Atomizing Control. This control passes a stream of air from the control console to the metering orifice of the pump, which is between the hopper and the venturi. Here air is mixed with the fluidized powder passing into the venturi and eventually to the gun. It controls the ratio of powder particles to air in the cloud being emitted from the gun.		• Slide 14			
5.	At this point, you would like to see a magical set of numbers appear before you telling just exactly at which pressure to set each regulator. This is not possible because there is no one combination of pressure regulator settings for all possible part configurations, powder formulas, and desired fill thickness combination. Without tests or experience, the most magical thing that can be said is to spray at the lowest possible pressure setting that still gives good results. This will give you maximum efficiency.		• Slide 15			

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KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
6. Hoppers require little or no maintenance. However, if the membrane should become broken by a heavy object falling into the hopper or if it should become plugged by dirty or oily air, it would have to be replaced. When it is replaced, clean all the metal surfaces that contact the membrane and apply silicone rubber sealant to them before putting the new membrane in place. The sealant will assure you of a leakproof joint at the membrane.				• Slide 16			
7. The single gun pump is attached to the side of the hopper with two socket head screws passing through the sheet metal of the hopper and into the pump.				• Slide 17			
8. Once it has been attached to the hopper, it would rarely be removed. Our disassembly procedure will deal with only those parts of the pump that would be removed.							
E. <u>Disassembly</u>							
1. Before beginning disassembly, notice the words "up" stamped on both the flow valve retainer and the pump body.				• Slide 18			
2. It is important that these two parts are always assembled in this position. If they were not assembled in this position, let's say the pump body was turned 180°, the center of the metering orifice of the pump body would not line up with the flow valve opening. This would cause lack of proper powder flow and possibly puffing at the gun.							
3. Pull the powder feed hose from the pump and remove the barbed venturi fitting from it.				• Slide 19			

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TITLE	NORDSON ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	2	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
KEY POINTS/ACTIVITIES									
4. Disconnect the two air tubes from the pump at their quick-disconnect fittings. 5. Remove the two thumb screws and lift the pump off the powder flow valve retainer. 6. Turn the valve 90° and pull out the metering orifice and O-ring. 7. Turn the male half of the quick-disconnect coupling counter-clockwise and remove it from the pump. 8. Turn the pump over and shake out the venturi nozzle. If it does not fall out, place the eraser end of a pencil in the opposite side of the pump and push it out. 9. If the flow valve is worn, unscrew the two socket head screws and replace the valve. 10. Examine the (a) metering valve orifice, (b) barbed venturi throat, (c) venturi nozzle, and (d) powder flow valve for wear. Also make sure powder is not clinging in a hard mass to any part. If either condition exists after a short time in production, an optimal part may be used to prevent the problem.									
P. Troubleshooting 1. Puffing 2. Uneven pattern (heavy spots) 3. Inadequate powder flow									
• Slide 20 • Slide 21 • Slide 22 • Slide 23 • Slide 24 • Slide 25 • Slide 26 • T:III-2-3									

TRAINING AID

TROUBLESHOOTING THE HOPPER FEEDER

CONDITION	PROBABLE CAUSE	SUGGESTED CORRECTION
Puffing	Flow Rate pressure and/or Atomizing pressure are not adequate.	Increase the Flow Rate pressure, or increase the Atomizing pressure, or both.
Uneven pattern (heavy spots) Inadequate powder flow	Vent hose too long or kinked.	Straighten or shorten vent hose.
	Atomizing pressure is not adequate.	Increase the Atomizing pressure.
	Wet or damp powder is causing the metering orifice in the powder pump to clog.	Clean the metering orifice in the powder pump.
	Venturi throat is worn out and distorted.	Replace the venturi throat in the powder pump.
Powder does not flow	Venturi nozzle is partially blocked.	Clean or replace the venturi nozzle.
	Excessive Atomizing pressure.	Decrease the Atomizing pressure.
	Air supply to the system is OFF or below minimum required.	Check the air supply to the system and insure it is ON.
Uneven fluidization in hopper; "rat holing"	Faulty solenoid.	Check solenoids and replace if necessary.
	Too high Fluidizing Air pressure.	Decrease Fluidizing Air pressure.
	Wet powder in hopper.	Change to dry powder.
	Dirty or wet air has clogged membrane.	Try blowing dry air back through membrane. May require membrane replacement.

INSTRUCTOR PRESENTATION

SIMA CC-SHOP
Lesson Plan

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TITLE	NORDSON ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	2
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE			
4. Powder does not flow 5. Uneven fluidity in hopper; "rat holing" G. <u>OJT in the ESP Station of the CC Shop</u>		Take trainees to the CC Shop and physically demonstrate disassembly and reassembly of the hopper/feeder.		Trainees disassemble and reassemble citing nomenclature of parts and cautions required.			

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TITLE		NORDSON ESP EQUIPMENT		COURSE		CC-Shop Technician		UNIT		III		LESSON NO.		2																																		
KEY POINTS/ACTIVITIES																																																
IV. THE NORDSON NPE-CC8 CONTROL CONSOLE A. Definition The CC8 is the electrostatic and pneumatic control console for a single gun manual or automatic powder coating system. Continuous high-voltage control from 30 to 90 kV. Gages, regulators and controls conveniently located. Solid state, regulated voltage supply. B. Specifications <table border="1"> <thead> <tr> <th></th> <th>USA</th> <th>METRIC</th> </tr> </thead> <tbody> <tr> <td>Dimensions:</td> <td></td> <td></td> </tr> <tr> <td>Height</td> <td>15.5"</td> <td>392mm</td> </tr> <tr> <td>Width</td> <td>13.0"</td> <td>330mm</td> </tr> <tr> <td>Depth</td> <td>6.0"</td> <td>152mm</td> </tr> <tr> <td>Electrical:</td> <td></td> <td></td> </tr> <tr> <td>Input</td> <td>120/240 VAC +/- 15% @ 50/60 Hz</td> <td></td> </tr> <tr> <td>Output</td> <td>30-90 kV DC +/- 3 kV (continuous)</td> <td></td> </tr> <tr> <td>Short Circuit Current (Gun,cable and power unit)</td> <td>150 Microamperes (maximum)</td> <td></td> </tr> <tr> <td>Air (Dry):</td> <td></td> <td></td> </tr> <tr> <td>Input</td> <td>60psi (min) 100psi (max)</td> <td>4.2kg/cm² (min) 7.0kg/cm² (max)</td> </tr> </tbody> </table>																	USA	METRIC	Dimensions:			Height	15.5"	392mm	Width	13.0"	330mm	Depth	6.0"	152mm	Electrical:			Input	120/240 VAC +/- 15% @ 50/60 Hz		Output	30-90 kV DC +/- 3 kV (continuous)		Short Circuit Current (Gun,cable and power unit)	150 Microamperes (maximum)		Air (Dry):			Input	60psi (min) 100psi (max)	4.2kg/cm ² (min) 7.0kg/cm ² (max)
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- NPE-CC8 Console Slide Set - Slide 1																																																
TRAINEE RESPONSE																																																

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TITLE <u>NORDSON ESP EQUIPMENT</u> COURSE <u>CC-Shop Technician</u> UNIT <u>III</u> LESSON NO. <u>2</u>	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
CCY POINTS/ACTIVITIES C. <u>Description and Operation</u> 1. Understanding how to properly operate and maintain the NPE-CC8 will result in long service life and high efficiency for your Nordson powder coating system. 2. The NPE-CC8 is a 30 to 90 kV DC output, low current, electrostatic power unit. Its purpose is to charge the powder coating, producing an attraction of the powder to the workpiece. 3. The CC8 is also a pneumatic console for controlling the fluidizing flow and atomization of the powder coating. 4. The CC8 is used with any Nordson feeder hopper and may be used for manual or automatic gun operation. 5. The CC8 has a variable output voltage of between 30 kV and 90 kV. The lowest setting is appropriate for overcoming Faraday caging and thus for penetrating into recesses. Maximum wrap and efficiency are produced at the 90 kV setting. 6. In the pneumatic section, fluidizing, atomizing and flow rate are regulated and monitored by the CC8. 7. Fluidizing air is then sent to the feed hopper. Atomizing and flow rate air are sent to the powder pump. D. <u>External Troubleshooting</u> 1. If you are experiencing powder problems, such as puffing, uneven pattern on the workpiece or an inability to control the powder flow, chances are the problem is in the powder pump (1), hose (2) or gun (3); not in the CC8.	• Slide 3 (There is no Slide 2) • Slide 4 • Slide 5 • Slide 6 • Slide 7 • Slide 8 • Slide 9	

INSTRUCTOR PRESENTATION

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TITLE	NORDSON ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	2
KEY POINTS/ACTIVITIES			TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE			
2. A simple test to find out if the CC8 is at fault is to disconnect the output air tubes. Turn the unit on. Then adjust each regulator control to see the effect on each air output. No air from any output means that the 3-way air valve is not working. Call for an electrician. Work is needed inside the unit.			• Slide 10				
3. If the regulator controls and gages are acting erratically, this is usually an indication that powder has gotten into these components.			• Slide 11				
4. Do not clean the tip of the gun with compressed air while the gun is attached to its hose.			• Slide 12				
5. That procedure forces powder back through the system and into the regulator and gages of the CC8.			• Slide 13				
6. To properly clean the system, disconnect the fluidizing, flow rate and atomizing tubing from the CC8, or the output hose from the powder pump. Then go ahead and use compressed air to force material toward the gun end of the system.			• Slide 14				
7. As stated earlier, the NPE-CC8 produces an electrostatic charge that assists atomization, producing a more even distribution of powder on the workpiece. In addition, the electrostatics permit the powder to actually wrap around to the backside of the workpiece. If trouble occurs with the electrostatics, usually the first indication is the loss of wrap. However, before calling in an electrician, look at the following.			• Slide 15				

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TITLE <u>NORDSON ESP EQUIPMENT</u>		COURSE <u>CC-Shop Technician</u>	UNIT <u>III</u>	LESSON NO. <u>2</u>	
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
8. The front panel lamps are good indicators of the CC8's operating condition, that is as long as they haven't burned out or loosened.		• Slide 16			
9. In fact, it's a good idea to check the condition of the bulbs frequently.		• Slide 17			
10. Assuming the lamps are okay, both lamps out indicate that a circuit breaker or other fused device has tripped, cutting off power to the unit.		• Slide 18			
11. Or the one amp fuse has blown. Take the fuse out and inspect it.		• Slide 19			
12. If it looks blackened or burned, replace the fuse and try the unit again. If the fuse continues to blow, call for an electrician.		• Slide 20			
13. If both lamps are on, the problem may not be in the control console. Check out the following:		• Slide 21			
(a) Is the workpiece in good contact with its hanger? Does the hanger have good metal-to-metal contact with the conveyor? Cured powder on these parts can interrupt a good electrical path to ground, reducing or stopping electrical attraction of powder to the workpiece.		• Slide 22			
(b) Check your spray gun. A bent, broken or dirty electrode or even powder on the extension can decrease or stop the wrap effect.		• Slide 23			
(c) Likewise, the electrostatic cable must not be cut or nicked. If it is, the electrostatic charge will leak out before reaching the electrode on the gun.		• Slide 24			

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TITLE	NORDSON ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	2
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
(d) If the amber lamp is on, but the red one is not, work is needed inside the unit. All internal repairs must be performed by qualified service technicians in accordance with all applicable safety codes. E. OJT in the ESP Station of the CC Shop - Console Operations and Troubleshooting - Training Shapes and Production OJT				- Slide 25 - Take trainees to the CC Shop and physically demonstrate operation and external troubleshooting of the console. - Powder spray training shape emphasizing safety issues and demonstrating proper spraying techniques.		- Trainees check out and operate console. - Trainees spray training shapes followed by production spraying under direct supervision of a "journeyman" powder coating sprayer.	

INSTRUCTOR FOLLOW-UP-THROUGH

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TITLE	NORDSON ESP EQUIPMENT	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	2
PRACTICAL APPLICATIONS		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE			
- Summarize Lesson. - Question trainees on key points; repeat and amplify the instruction as required. - Have trainees demonstrate proper use and maintenance of equipments.				- Answer questions and explain issues asked by the instructor. - Demonstrate knowledge of practical skills.			

INSTRUCTOR PREPARATION

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Lesson Plan

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TITLE <u>ESP Spray Booth, Curing Oven and Container</u> COURSE <u>CC-Shop Technician</u> UNIT <u>III</u> LESSON NO. <u>3</u>	
LEARNING OBJECTIVES	TRAINING AIDS/MATERIALS
The trainees will be able to: 1. Start-up, operate, shut down and perform the PMS for the containerized ESP Spray Booth and Curing Oven, and 2. Apply ESP Coatings to production products. The trainees will learn the: 1. Principles of operation of and the PMS requirements for the ESP Spray Booth and Curing Oven, 2. Safety requirements and procedures, and 3. Major elements of the industrial process instruction for applying ESP coatings at the ESP Station of the CC Shop.	Materials: 1. 35mm slide of spray booth, oven and containers. (Note: Slides must be procured from local sources.) 2. Transparency T:III-3-1. 3. 35mm slide projector. 4. Overhead projector. 5. Chalk or dry erase markers for board. References: 1. SIMA(SD) Process Instruction No. 7100-19-84, <u>Powder Coatings, Electrostatically Applied: NAVSEA Corrosion-Control System 4</u>, draft 30 December 1985. 2. "Installation and Operating Instructions for BAYCO Curing Ovens," BAYCO Industries of California, 1982. 3. Standard #33, National Fire Protection Association, 1985. Handouts: 1. Copy of Ref. 1 above.

INSTRUCTOR PREPARATION

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TITLE <u>ESP Spray Booth, Curing Oven and Container</u>		COURSE <u>CC-Shop Technician</u>	UNIT <u>III</u>	LESSON NO. <u>3</u>
LEARNING OBJECTIVES		TRAINING AIDS/MATERIALS		
		<u>CC Shop:</u> 1. OJT in ESP Coating of production products and equipment PMS (6 hours).		

INSTRUCTOR PRESENTATION

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TITLE <u>ESP Spray Booth, Curing Oven and Container</u>		UNIT <u>III</u>	LESSON NO. <u>3</u>
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE
L SPRAY BOOTH The spray booth container is designed for the electrostatic spray application of powder coatings. The spray booth is a cyclic purge cartridge type, with two modules having 3 filter cartridges each. The purge air cleans the filters with a reverse flow 0.3 pulse every 20 seconds. The powder over-spray that is purged from the filters falls into collection troughs for disposal. The filter booth was designed with openings to allow access by applicator but also maintaining a high enough air velocity to keep the powder in the booth. The booth is designed as a one gun booth; the use of two guns at once is both impractical and dangerous. The area outside of the spray booth is where the electrostatic spray guns control consoles must be kept during the application process. It is the location of all power and pneumatic outlets and booth control switches. The electrical outlet for the spray unit is interlocked with the booth blower to prohibit powder spraying without ventilation. The area located behind the filter modules houses the blower, final filter, purge valves and utilities. A. Operation 1. Procedures - Connect umbilical - Throw main power - Lights - Check electrical connections - Check outside and inside of booth for powder. Clean up if necessary. - Turn on blower - Open sliding doors by first raising dead bolt - Move spraying/curing cart into booth - Connect ground		- Write Instructor's name, lesson number and title on board. - Show/discuss slides of the spray booth mounted in the 8'x8'x20' container.	- Take notes. - Participate in class discussion and activities.
		Show/explain slide series.	

INSTRUCTOR PRESENTATION

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TITLE ESP Spray Booth, Curing Oven and Container COURSE CC-Shop Technician UNIT III LESSON NO. 3

KEY POINTS/ACTIVITIES

- (j) Close doors and lower dead bolts
- (k) Spray
- (l) Open doors
- (m) Disconnect
- (n) Remove cart

B. Maintenance

1. Daily

- (a) Clean floor and collect troughs by vacuum cleaner (wet/dry type).
- (b) Clean hoppers, powder tubing and guns of all powder.

2. Weekly

- (a) Check filter cartridge to make sure powder is being cleared from them.
- (b) Check magnetohelic gages in rear of container.
- (c) Cartridge plenum should read 8" of water (adjust dampers, both dampers equally, to maintain 8". If the gage is still not reading 8", remove filters and tap out loose powder. Return filters to modules and check gage reading. If pressure is still not correct, replace filters with new ones.

3. Gage Inspection (Note: Sliding doors on booth must be closed.)

Gage on final filter should be around 0" to 2" water. If gage is reading outside of this range, remove filters and tap loose powder from them. Reinstall filters and check gage. If readings are still outside of this range, replace filters.

TRAINING AID/ DEMONSTRATION

- Write maintenance schedule on board.
- Explain and discuss.

TRAINEE RESPONSE

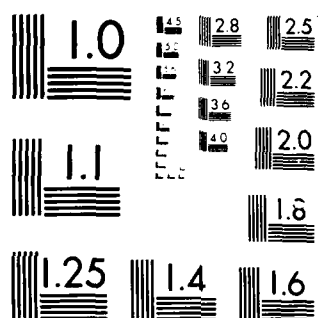
- Copy maintenance schedule from board.

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MAINTENANCE ACTIV. (U) INTEGRATED SYSTEMS ANALYSTS INC
NATIONAL CITY CA W ADKINS ET AL. 30 NOV 85
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MICROCOPY RESOLUTION TEST CHART
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INSTRUCTOR PRESENTATION

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TITLE	ESP Spray Booth, Curing Oven and Container	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	3
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
II. CURING OVEN CONTAINER A. <u>Description</u> 1. This container houses the powder cooling systems curing oven and electrical main. 2. The oven has an interior work space of 4w x 4h x 7d and is heated electrically. 3. A recirculation blower maintains an even distribution of heat and an exhaust blower helps assure adequate venting of accumulated volatiles. 4. Oven controls include: (a) System operation timer (b) Temperature control (c) Purge timer 5. The system's electrical controls include: (a) The 440v system main (b) A step down transformer for 110v with disconnect (c) The 440v oven main, and				• Show/discuss slides of the curing oven mounted in the 8'x8'x20' container.			

INSTRUCTOR PRESENTATION

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TITLE	ESP Spray Booth, Curing Oven and Container	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	3
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
(d) an auxiliary trailer main. B. System Start Up Procedure 1. Open the oven container end doors and the spray booth container side doors. 2. Slide ramp into place and bring up to level using the four screw jacks. 3. Connect umbilical between containers. 4. Throw main power on. 5. Throw transformer on. 6. Throw oven power on. 7. Throw auxiliary trailer power on. 8. Turn oven system on, located on oven control panel, system light should go on. 9. Set oven timer to 8 hours or another applicable work time. The blowers will start operation. 10. Open right oven door and hold all the way open so that the interlock light comes on. Hold the door in this position for approximately 110 seconds until the purged light comes on.				• Show/discuss slides showing step-by-step operating procedures.			

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TITLE	ESP Spray Booth, Curing Oven and Container	COURSE	CC-Shop Technician	UNIT III	LESSON NO. 3	
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
11. Close door. 12. Set temperature to desired setting. 13. Allow oven to come up to temperature (a half hour should be sufficient). 14. Safety check spray booth. 15. Refer to Powder Coating Application Process Instruction. C. <u>System Shut Down</u> 1. If time has not run out, then return it to zero. 2. Turn system off on oven control panel. 3. Throw oven main off. 4. Throw auxiliary trailer power off after first deactivating all equipment in powder spray booth container. 5. Throw step down transformer off. 6. Throw main power off. 7. Disconnect umbilical.				• Show/discuss slides.		

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TITLE		ESP Spray Booth, Curing Oven and Container		COURSE		CC-Shop Technician		UNIT		III		LESSON NO.		3	
KEY POINTS/ACTIVITIES							TRAINING AID/ DEMONSTRATION			TRAINEE RESPONSE					
D. Maintenance • Check oven operating Instructions for BAYCO Model CB112. E. Safety 1. Do not cook food in a curing oven. - o Volatiles released during curing could contaminate food and poison recipient. 2. Do not sit, rest or sleep in oven. 3. Do not override interlock on purge system. 4. Do not readjust any vents or purge timer settings not authorized by equipment manufacturer. 5. Wear protective gloves when moving curing racks/carts in and out of oven. F. Tour of ESP Station in the CC Shop							• Write safety precautions on board. • Explain/discuss.			• Copy safety instructions from board.					
							• Demonstrate operation and maintenance of the oven. Emphasize safety and quality control issues.								

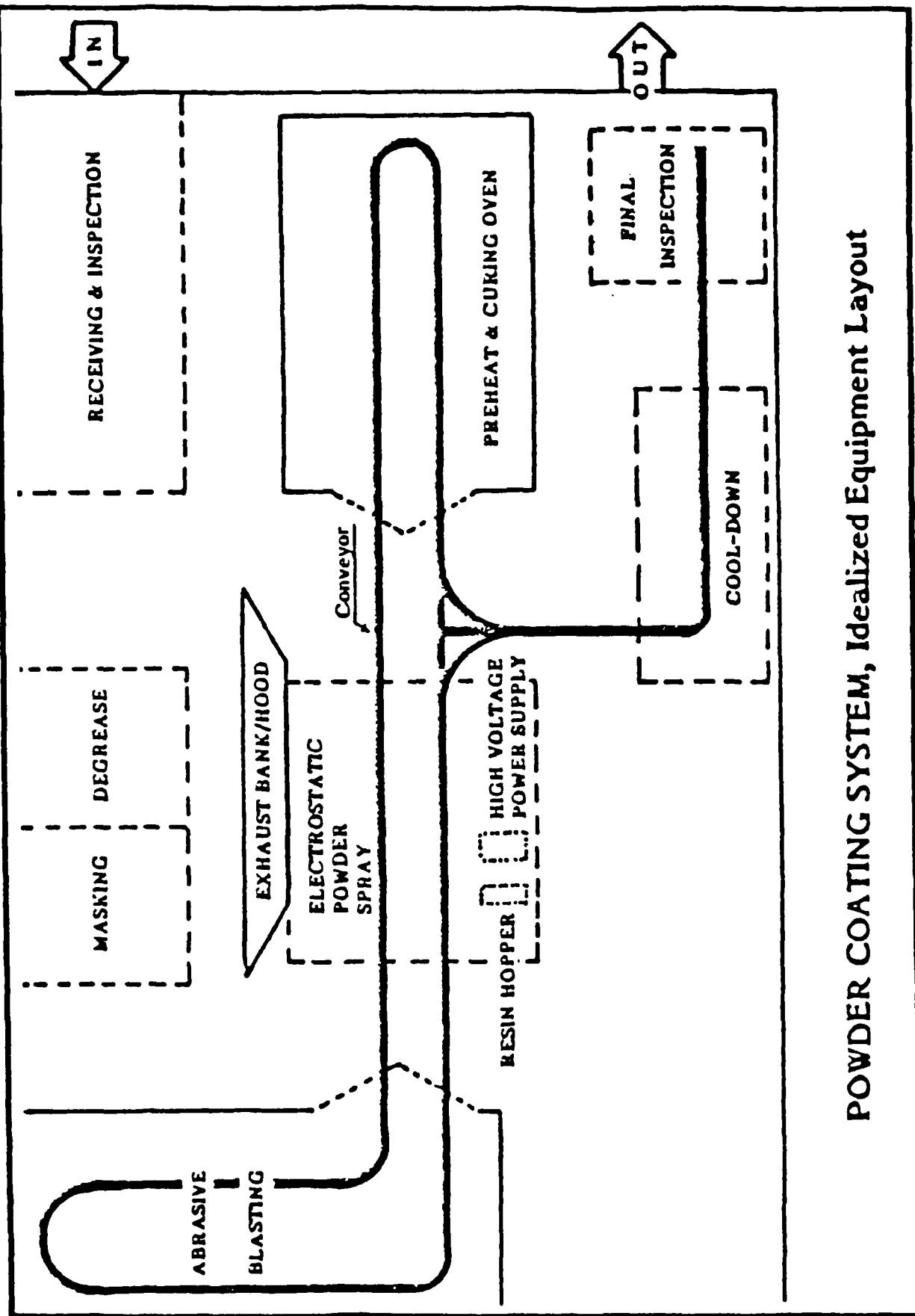
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TITLE	ESP Spray Booth, Curing Oven and Container	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	3
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
III. ESP COATING PROCESS INSTRUCTION This is the integration of all the elements for the actual shop operations. A. <u>Equipment</u> 1. Surface Preparation (a) Degreaser (b) Strip Blaster (c) Anchor-Tooth Blaster with media for 1- to 2-mil anchor tooth 2. ESP Spraying and Curing (a) Spray Gun (b) Power Supply (c) Resin Hopper/Feeder (d) Dry-Filter Booth (e) Dry Air and Air Purification (f) Oven (g) Oven Racks and Hangers for Products 3. Quality Control (a) Pyrometer (100-600°F Range) (b) Surface Profile Gage (Testex Profile Tape) (c) Elcometer (0-25 mil Range) (d) Color Standards (e) Impact Tester (being designed) (f) 10x Magnification Glass				• T:III-3-1. Handout • SIMA Process Instruction No. 7100-19-84 (draft, 30 December 1985). • Discuss/explain the various sections.		• Follow and make notes in copy of Process Instruction.	

TRAINING AID



POWDER COATING SYSTEM, Idealized Equipment Layout

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TITLE ESP Spray Booth, Curing Oven and Container		COURSE	CC-Shop Technician	UNIT III	LESSON NO. 3
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
B. Materials 1. Powdered Epoxy meeting ASTM A775/755M-84 2. Abrasive Blasting Media 3. Process Air 4. Masking Materials 5. Cleaning Materials C. Safety 1. Solvents 2. Abrasive Blasting 3. ESP Spray Equipments (a) Powder Concentrations (b) Electrical Grounding 4. Personnel (a) Respirator (b) Electrical (c) Heat		• Ask trainees to summarize the safety issues and procedures.			

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TITLE ESP Spray Booth, Curing Oven and Container		COURSE	CC-Shop Technician	UNIT III	LESSON NO. 3	
KEY POINTS/ACTIVITIES						TRINEE RESPONSE
D. <u>Quality Control</u> 1. Receipt Inspection 2. Masking 3. Strip Blasting 4. Anchor-Tooth Blasting 5. Powder Coating 6. Silicone-Alkyd Topcoating 7. Final Assembly Inspection E. <u>Method</u> 1. Receipt Inspection 2. Precleaning 3. Masking 4. Strip Blasting 5. Anchor-Tooth Blasting 6. Preheat						• Have trainees summarize the QC items and measurement procedures.

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TITLE <u>ESP Spray Booth, Curing Oven and Container</u> COURSE <u>CC-Shop Technician</u> UNIT <u>III</u> LESSON NO. <u>3</u>			
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE	
7. ESP Powder Application (a) Single Coat (b) Two Coat 8. Curing 9. Silicone-Alkyd Topcoating 10. Final Inspection and Packaging <u>P. Feedback</u> <u>G. OJT in the ESP Station of the CC Shop</u>	- Have trainees summarize the methods and all of the QC checkpoints. - Trainees man and operate all equipments directly supervised by the Instructor and/or ESP Station Supervisor.	Complete all ESP spraying/curing operations and equipment PMS.	

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TITLE ESP Spray Booth, Curing Oven and Container		COURSE	CC-Shop Technician	UNIT III	LESSON NO. 3
KEY POINTS/ACTIVITIES		TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
D. Maintenance - o Check oven operating instructions for BAYCO Model CB112. B. Safety 1. Do not cook food in a curing oven. - o Volatiles released during curing could contaminate food and poison recipient. 2. Do not sit, rest or sleep in oven. 3. Do not override interlock on purge system. 4. Do not readjust any vents or purge timer settings not authorized by equipment manufacturer. 5. Wear protective gloves when moving curing racks/carts in and out of oven. F. Tour of ESP Station in the CC Shop		• Write safety precautions on board. • Explain/discuss.		• Copy safety instructions from board.	
		• Demonstrate operation and maintenance of the oven. Emphasize safety and quality control issues.			

INSTRUCTOR PRESENTATION

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TITLE	ESP Spray Booth, Curing Oven and Container	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	3
KEY POINTS/ACTIVITIES				TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE	
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INSTRUCTOR PRESENTATION

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TITLE <u>ESP Spray Booth, Curing Oven and Container</u>		COURSE <u>CC-Shop Technician</u>	UNIT <u>III</u>	LESSON NO. <u>3</u>
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
<u>B. Materials</u> 1. Powdered Epoxy meeting ASTM A775/755M-84 2. Abrasive Blasting Media 3. Process Air 4. Masking Materials 5. Cleaning Materials <u>C. Safety</u> 1. Solvents 2. Abrasive Blasting 3. ESP Spray Equipments (a) Powder Concentrations (b) Electrical Grounding 4. Personnel (a) Respirator (b) Electrical (c) Heat	• Ask trainees to summarize the safety issues and procedures.			

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TITLE <u>ESP Spray Booth, Curing Oven and Container</u> COURSE <u>CC-Shop Technician</u> UNIT <u>III</u> LESSON NO. <u>3</u>	
KEY POINTS/ACTIVITIES	TRAINING AID/ DEMONSTRATION
D. Quality Control 1. Receipt Inspection 2. Masking 3. Strip Blasting 4. Anchor-Tooth Blasting 5. Powder Coating 6. Silicone-Alkyd Topcoating 7. Final Assembly Inspection E. Method 1. Receipt Inspection 2. Precleaning 3. Masking 4. Strip Blasting 5. Anchor-Tooth Blasting 6. Preheat	• Have trainees summarize the QC items and measurement procedures.
TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE

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TITLE		ESP Spray Booth, Curing Oven and Container	COURSE	CC-Shop Technician	UNIT	III	LESSON NO.	1
KEY POINTS/ACTIVITIES			TRAINING AID/ DEMONSTRATION		TRAINEE RESPONSE			
7. ESP Powder Application (a) Single Coat (b) Two Coat 8. Curing 9. Silicone-Alkyd Topcoating 10. Final Inspection and Packaging <u>P. Feedback</u> <u>G. OJT in the ESP Station of the CC Shop</u>			- Have trainees summarize the methods and all of the QC checkpoints. - Trainees man and operate all equipments directly supervised by the Instructor and/or ESP Station Supervisor.		Complete all ESP spraying/curing operations and equipment PMS.			

INSTRUCTOR FOLLOW-THROUGH

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TITLE <u>ESP Spray Booth, Curing Oven and Container</u>		COURSE <u>CC-Shop Technician</u>	UNIT <u>III</u>	LESSON NO. <u>3</u>
PRACTICAL APPLICATIONS	TRAINING AID/ DEMONSTRATION	TRAINEE RESPONSE		
• Summarize Lesson. • Question trainees on key points; repeat and amplify the instruction as required. • Have trainees demonstrate proper use and maintenance of equipments.		• Answer questions and explain issues asked by the instructor. • Demonstrate knowledge of practical skills.		

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