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CORROSION CONTROL/PREVENTION AND CLEANING OF INSTALLED SHIPBOARD AVIONICS SUPPORT EQUIPMENT

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7 August 1975

FINAL REPORT
Work Request: WR-4-0423

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Prepared for
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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

An investigation sponsored by the Naval Air Systems Command Representative, Atlantic (ASCR-2233) was conducted on-board USS NIMITZ and USS F.D. ROOSEVELT to determine the extent of corrosion and cleaning problems in new construction and operational aircraft carriers. The report covers findings, scope and recommendations to arrest and alleviate the conditions existing by the application of new materials and procedures.

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SUMMARY

INTRODUCTION

References (a), (b), and (c) requested the Naval Air Development Center, ARP/SLP Corrosion Team to conduct an on-board review of installed shipboard electronics corrosion on USS NIMITZ and USS F.D. ROOSEVELT in April 1974.

SUMMARY OF RESULTS

During the study on-board the USS NIMITZ, all the avionics workshops were visited and the following conditions were observed.

Generally, all shops displayed a varying degree of mildew, dust and dirt accumulation in cabinets and drawers, light corrosion internally on bare metal components and corrosion externally on front face plates, magnesium frames, bare metal handles and hardware.

It was evident that these new shops had set for a period of time, after completion and equipment installation, in a still, humid environment without benefit of conditioned circulating air. The AN/AWG-10 support assembly, consisting of a magnesium framework with steel fittings, had a thin coat of paint in some areas, but was primarily bare metal. Both the painted and unpainted portions of the assembly were pitted.

Antenna maintenance fixtures (MX-7340C/AWM-21) were corrosion pitted and dusty.

Large amounts of bare and unprotected metal chassis, housings and components were observed throughout the benches and drawers, such as the test equipment gyro MX-2680/ASN-26, MT-2337/ASN-26, and AN/USM-281M oscilloscope. Although dust, dirt and light pitting corrosion were found in most shops, it is not considered to be serious if corrected in a timely manner.

On-board the USS ROOSEVELT, an active operating carrier, a similar survey was conducted. Conditions in the avionics shop were much the same as on the USS NIMITZ but caused by a different set of factors. The dust and dirt found in equipment on the USS NIMITZ was caused primarily by construction and equipment installation whereas on the USS ROOSEVELT it was normal dust accumulation over a long period of time. Pitting and surface corrosion in this case were caused by chill water systems and cooling systems lowering the temperature of the metallic mass, thereby permitting the moisture in the atmosphere to condense on these surfaces. Subsequent evaporation and repetition of this cycle eventually caused corrosion.

Due to the large number of avionics chassis, drawers and components coupled with the high incidence of dirt/contamination found, it is evident that hand cleaning methods, although effective would be very time consuming.

A Bendix Model SEC 1825 Ultrasonic Cleaning System was located in the teletype repair shop. NAVAIRDEVCEN, in conjunction with Bendix, arranged to sonically clean an avionics chassis and a few standard RFI printed circuit boards using a water detergent system with fresh water rinse and circulating warm air drying. All components were cleaned effectively, reinstalled and found to be operationally satisfactory. Due to the large size of some of the drawer assemblies, it may be necessary to fabricate a metal hood to cover the dryer unit. This will increase the size of the dryer without allowing hot air to escape. For specific materials and procedures used, see Appendix A. Most operating carriers have a similar sonic cleaning system on-board.

In the period between initiation of construction and commissioning, three different groups of personnel come in direct contact with the shipboard electronic equipment:

(1) Shipyard workers - install the equipment

(2) Naval Air Rework Facility technicians - perform operational check-out

(3) Ships company personnel - operate and maintain equipment

Varying degrees of corrosion prevention/control procedures must be applied by each group to insure that shipboard electronics equipment will survive long periods of construction, and remain functional during its service life. The corrosion prevention/control procedures for each group are detailed in Appendices B, C, and D respectively. Corrective measures, ideally would include thorough cleaning of the equipment after installation, corrosion removal where necessary, and protection of the equipment with the application of lubricants, preservatives and protective coatings. However, the shipbuilders are limited in what they can accomplish at this point by lack of time, materials, and expertise. When an avionics shop has been completed and the test equipment installed, the shipbuilders should assist with certain minimum procedures which are described in detail in Appendix B.

Chronologically, the next group to come in contact with the installed equipment is the NAVAIREWORKFAC Verification Team. They are responsible for the correct operation and checkout of the test benches. As far as corrosion control and cleaning are concerned, they are able to do more than the shipbuilders, but are still somewhat limited by lack of time and materials. Minimum procedures to be accomplished by the Verification Team are set forth in Appendix C. Frequency of the application is also included. Finally, upon complete manning of the ship/shops by military personnel, a complete cleaning, corrosion removal and preservation program can be implemented. Complete details including procedures and materials are contained in Appendices D and E.

CONCLUSIONS

It was concluded that carriers under construction present a dusty/dirty environment which could be detrimental to the operation of shipboard avionics equipment. An effective and comprehensive cleaning program is necessary.

New ships may be under construction for several years before they are fully manned and operational. During this static period, a corrosion control and protection plan is vital. Unoperated electronic equipment will corrode faster than equipment that is operating daily.

RECOMMENDATIONS

It is recommended that the materials and procedures cited in Appendices A through E be adopted for all aircraft carriers under construction and in-service.

REFERENCES

(a) NAVAIRSYSCOMREPLANT (ASCR 2233) msg 121438Z of Apr 1974

(b) NAVAIRSYSCOMREPLANT (ASCR 2233) msg 191644Z of Apr 1974

(c) NAVAIRSYSCOMREPLANT (ASCR 2233) msg 251426Z of Apr 1974

APPENDIX A

IN-SERVICE ULTRASONIC CLEANING PROCEDURES

IN-SERVICE ULTRASONIC CLEANING PROCEDURES

CHASSIS AND DRAWERS

1. Remove drawer (Power Supply)
2. Remove meter/gage glass if applicable
3. Remove plastic plug covers and dust covers for optimum cleaning
4. Lay drawer on bottom of sonic tank immersed in solution
5. Set timer for three (3) minutes
6. Automatic/manual selector switch - automatic
7. Close lid
8. When unit stops, raise lid, drain, remove chassis
9. Place unit in spray rinse - select automatic
10. Close lid
11. Spray rinse for approximately 30 seconds. Turn chassis/drawer 180°. Repeat 9, 10, 11 above.
12. Visually inspect for complete cleaning/rinsing
13. Repeat above steps 4-12 if necessary to insure complete cleaning and rinsing
14. Manually blow off residual moisture, with low pressure dry air (30 PSI or less) while unit is still in rinse tank. (Blow off only gross amounts of water, do not blow dry).
15. Place unit in dryer
16. Circuit breaker in "on" position
17. Preset temperature control to number #6 = 140°F
18. Close lid - dry for 30 minutes
19. Open lid, remove unit (caution) use rubber gloves to prevent contamination (fingerprints).

20. Lubricate rollers with small amount of VV-L-800 (Item 9, Appendix E).

21. Spray lubricate guide tracks with dry film lubricant (Item 10).

22. Reprotect bare metal surfaces with corrosion preventive compound (wet or dry) (Item 5 or 15).

23. To insure 100% drying of moisture in deep crevices, do not use equipment for 24 hours.

NOTE: Use same procedures for sonic cleaning of module drawers. Insure that PC boards are removed prior to sonic cleaning.

MATERIALS AND MIXING INSTRUCTIONS FOR SONIC CLEANING

Ultrasonic Unit - Bendix SEC 1825

Cleaning Solution Preparation and Changing

1. Fill the Sonic Energy Cleaner with water at a temperature of approximately 145°F to a depth of approximately 11 inches. This will require about 21 gallons of water.

2. Turn on the Sonic Energy only, and slowly add to the cleaner tank 42 ounces of Bendix 25-I Concentrate (2 oz/gal) and 11 ounces of Bendix Dirl-Tel powder concentrate (14 gms/gal). (See NOTE Appendix E).

3. Allow the Sonic Energy agitation to mix the solution for approximately five minutes to insure that the detergent is thoroughly dissolved into the water. Turn the pump on and circulate the solution for about five minutes prior to cleaning to insure that all the solid chemicals have gone into solution and that the solution is thoroughly mixed.

4. The solution temperature should be maintained at 145°F, during cleaning operations. This is accomplished by placing the filter unit control to the "Pump On" position and dialing the temperature control knob to the 145°F position.

5. Changing Cleaning Solutions: For production cleaning of communication equipment, it is estimated that one day (eight hours operation) can be obtained from the cleaning solution without changing.

It is suggested that the cleaning solution be changed at the end of eight hours until results obtained indicate that the solution can be used for a longer time.

Parts Processing

NOTE: Most component parts of communication equipment can be cleaned in the Sonic Energy activated solution of water-base detergents. The only limitation is that the part must not contain areas where the rinsing cycle will not flush away the cleaning solution. For this reason, electrical motors are removed, disassembled, and then cleaned using the same solutions and cleaning cycle.

1. Place large parts directly into the cleaning chamber resting the parts on the bottom of the chamber. Small parts can be put into a cleaning basket. (A specially designed parts cleaning basket can be ordered separately). Set the timer for a 2 or 3 minute cleaning cycle. Set switch for automatic operation. Closing the lid will automatically start the cleaning cycle. At the end of the cycle, the Sonic Energy will shut off automatically.

2. Remove the part(s) and transfer to the rinse tank. Set the switch for "Automatic" and close the lid. Rinse for approximately two minutes. Raising the lid will shut off rinse water.

3. Using the rinse tank, blow excess water from part(s) with clean, filtered compressed air.

4. Transfer part(s) to dryer and dry for approximately 10-15 minutes at 160^{o}F.

APPENDIX B

PROCEDURES FOR SHIPBUILDER

PROCEDURES FOR SHIPBUILDER

STEP 1	Sweep and vacuum clean electronic space thoroughly.
STEP 2	Using clean dry cloths (Item 1) and solvent (Item 2 or 3) dampen cloth and remove dust and dirt from all exterior surfaces of installed test equipment. Wipe dry with clean cloth.
STEP 3	Spray interior/exterior of all loose electrical connector (cannon plugs) with electrical contact cleaner MIL-C-81964 (Item 4) and shake out excess solvent.
STEP 4	Spray a light coat of corrosion preventive compound (Item 5 or 15) on all exterior bare metal surfaces such as face plates, handles, screw heads, frames and hardware.
STEP 5	Spray a light coat of corrosion preventive compound (Item 5) on the interior and exterior surfaces of all electrical connectors.
STEP 6	Place desiccant bags (Item 11) inside equipment using the following formula to determine the amounts of units: factor 1.6 X volume of cabinet/drawer in cubic feet = number of units CAUTION: do not place desiccant where liquid water might contact bags.
STEP 7	Cover completely, all equipment using transparent plastic (L-P-378) (Item 6) held in place with tape (PPP-T-60, Type III) (Item 7).
STEP 8	Turn on conditioned re-circulating air.

APPENDIX C

PROCEDURES FOR VERIFICATION TEAM

PROCEDURES FOR VERIFICATION TEAM

STEP 1	Remove transparent plastic covers and save.
STEP 2	Using clean dry cloths (Item 1) and solvent (Item 2 or 3) dampen cloth and remove dust, dirt and old corrosion preventative compound from internal/external surfaces of test equipment. Dry with cloth (Item 1).
STEP 3	Inspect areas for corrosion.
STEP 4	Should surface corrosion be found, remove by abrading with abrasive mats (Item 8).
STEP 5	After corrosion has been removed, repeat STEP 2 above in those areas and re-preserve with Item 5 or 15.
STEP 6	Re-lubricate hinges, drawer track, fasteners, front locking assemblies, rollers and other moving mechanical assemblies using either Item 9 or 10 depending whether or not a dry or wet surface is desired.
STEP 7	If (Item 9) is used, remove excess oil to minimize dust attraction by wiping with clean dry cloth (Item 1).
STEP 8	Re-preserve all bare metal surfaces such as handles, chassis, frames, gimbels, cannon plugs, locking devices, tracks, rollers, etc. with light coat of Item 5.
STEP 9	Replace desiccant with new bags (Item 11) using the following formula to determine the amount of desiccant units:

factor 1.6 X volume of cabinet/drawer in cubic feet = number of units

EXAMPLE: 1.6 X 20 cubic feet = 32
Use two (2) 16 unit bags

CAUTION: do not place desiccant where liquid water might contact bags.

NOTE:: the above procedures should be applied every six (6) months.

STEP 10	Carefully recover all benches, units, consoles with transparent film (Item 6) and secure with tape (Item 7).

NOTE: previously used transparent film may be re-used.

APPENDIX D

PROCEDURES FOR SHIP'S COMPANY PERSONNEL

PROCEDURES FOR SHIP'S COMPANY PERSONNEL

STEP 1	Remove transparent film (Item 6) from all equipment.
STEP 2	Remove and discard all desiccant bags.
STEP 3	Using clean dry cloths (Item 1) and solvent (Item 2 or 3), dampen cloth and remove dust and dirt and old corrosion preventative compound from internal/external surfaces of equipment.
STEP 4	Wipe equipment dry with clean cloth (Item 1).
STEP 5	Inspect surfaces for corrosion.
STEP 6	Bare Metal Surfaces - for bare metal surfaces where corrosion is found, remove with abrasive mats (Item 8), abrasive cloth (Item 12) or plastic eraser (Item 18), as applicable.
STEP 7	Remove loosened corrosion products by wiping, with clean cloth (Item 1) dampened with mineral spirits or dry cleaning solvent (Item 2 or 3) and allow surfaces to dry.
STEP 8	Aluminum and magnesium surfaces must be treated with chemical conversion coating (Item 16) in accordance with NAVAIR 01-1A-509, Chapter 6, paragraph 15.
STEP 9	After surface is dry, apply corrosion preventive compound (Item 15).

Painted Metal Surfaces

STEP 10	After complying with STEPS 1 through 7, if surface is aluminum or magnesium apply chemical conversion coating (Item 16) in accordance with NAVAIR 01-1A-509, Chapter 6, paragraph 15.
STEP 11	Prime all bare surfaces with (Item 13 or Item 17) and allow to dry a minimum of 30 minutes.
STEP 12	Apply topcoat paint over primed surfaces using (Item 14) (matching color) and allow to dry a minimum of one hour.

Drawer Tracks and Similar Sliding Surfaces

STEP 13	Comply with STEPS 3, 4, 5, 6, and 7.
STEP 14	Carefully apply a uniform coating of dry film lubricant (Item 10) and allow to dry.
	NOTE: Some masking may be necessary to prevent over-spray of lubricant in unwanted areas. Actuate drawer a few times to insure ease of operation.

Hinges and Latches

STEP 15	Clean with electrical contact cleaner (Item 4) and allow to dry.
STEP 16	Apply thin film of lubricating oil (Item 9) and wipe excess with dry cloth (Item 1).

Plugs and Connectors

STEP 17	For the removal of dust, dirt and other contaminants, spray with electrical contact cleaner, (Item 4) or use ultrasonic cleaning procedures outlined in Appendix A.
STEP 18	For removal of stubborn or heavy deposits, cleaning can be facilitated using acid brush (Item 19).
STEP 19	Coat interior surface and pins with corrosion preventive compound (Item 5).

Painted Circuit Boards/Plug in Modules

STEP 20	Utilize ultrasonic cleaning procedures outlined in Appendix A or use STEPS 17 and 18.
STEP 21	Coat printed circuit board with corrosion preventive compound (Item 15).
STEP 22	Coat pins and contacts with light coat of corrosion preventive compound (Item 5).

Chassis and Module Drawers

STEP 23	Clean in accordance with STEPS 3 and 4, or clean ultrasonically using procedures outlined in Appendix A.

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APPENDIX E

MATERIALS LIST

MATERIALS LIST

ITEM #	NOMENCLATURE	SPECIFICATION	FEDERAL STOCK NUMBER (FSN)
ITEM 1	Cloths	CCC-C-46	7920-292-9204
ITEM 2	Mineral Spirits	TT-T-291	8010-242-2089
ITEM 3	Dry Cleaning Solvent	P-D-680	6850-281-1985
ITEM 4	Electrical Contact Cleaner	MIL-C-81964	6850-148-7161
ITEM 5	Corrosion Preventive Compound (Wet)	MIL-C-81309, Type III	8030-546-8637
ITEM 6	Film, Transparent	L-P-378	8 ft. 8135-584-0610 10 ft. 8135-855-3387
ITEM 7	Tape, Packaging	PPP-T-60, Type III	8135-663-0197
ITEM 8	Abrasive Mats	MIL-A-9962	5350-967-5089
ITEM 9	Lubricating Oil G.P., Preservative	VV-L-800	9150-231-6089
ITEM 10	Lubricant, Dry Film	MIL-L-8937	9150-834-5608
ITEM 11	Desiccants (Activated) in Bags	MIL-D-3464 Class I	1 Unit 9GL6850-264-6562 2 Units 9GL6850-264-6573 4 Units 9GL6850-264-6574 8 Units 9GL6850-264-6571 16 Units 9GL6850-264-6572
ITEM 12	Cloth, Abrasive Aluminum Oxide	P-C-451, Type I Class I	9Q5350-246-0330

MATERIALS LIST

ITEM #	NOMENCLATURE	SPECIFICATION	FEDERAL STOCK NUMBER (FSN)
ITEM 13	Primer, Epoxy	MIL-P-23377	9Q8010-935-7080
ITEM 14	Lacquer, Acrylic	MIL-L-81352	See NAVAIR 01-1A-509, Appendix A, ITEM 31 for FSN's and Color
ITEM 15	Corrosion Preventive Compound (Dry)	MIL-C-81309, Type I Class 2	8030-263-7357
ITEM 16	Chemical Conversion Coating	MIL-C-81706	8030-00-142-9272
ITEM 17	Primer, Zinc Chromate	TT-P-1757	8010-297-0593
ITEM 18	Magic Rub, Plastic Eraser		7510-00-949-5055
ITEM 19	Acid Brush		9QC-7920-514-2417

NOTE: "Bendix 25-I Concentrate and Bendix DIRL-TEL" powder concentrate may be open purchased from:

Bendix
Instruments & Life Support Division
Davenport, Iowa 52808

Telephone # (319)-324-9101 - for further information

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