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</tbody>
</table>
EVALUATION FOR OFF-STATION TRAINING

As required by NADCRAINEST 12410.1D of 19 Apr 1971, Enclosure (1), this form will be completed and returned to Code 063, Building 5, after completion of training or attendance at conferences. Your honest evaluation of the training/conference that you just completed is important to the Training Division.

NAME: R Marks

DEPT: 30

1. Course Title: Quantum Mechanics I

2. Training Facility and Location: IU

Bloomington, IN

3. Date of training: From 14 January 1975 To 3 May 1975

4. Length of Training: 4 HRS/WEEK

5. Social Security No.: 282-48-2721

6. Graded: GS 855, GS-9

Series: Level 2

7. Ungraded: IQ

Series: Level

Step

8. Supervisory: Non-Supervisory

X

9. Is this training of immediate application to your present position?

YES

Explain why or why not THE COURSE provided the foundation for understanding the workings of quantum based instruments such as LEDs, LEDs, LASERS, AND TUNNELING DEVICES. EXTENSIVE USE OF PROBABILISTIC THEORY, THE FOUNDATION OF RELIABILITY, WAS EMPLOYED.

10. Do other employees in your Department need this training?

NO

11. In your opinion did the training justify the expenditure?

YES

12. Comments and recommendations concerning this training:

THE LEVEL OF THE COURSE WAS SUCH THAT A PREVIOUS QUANTUM MECHANICS COURSE WOULD BE A REASONABLE PREREQUISITE. THE COURSE WAS HUGELY THEORETICAL.

Signature

2nd Evaluation
<table>
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<tr>
<td>Please fill out the attached Evaluation For Off-Station Training form and return to Code 063, Building BOQ. We need this information to report you on your Official Record of Training.</td>
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</table>
Please fill out the attached Evaluation For Off-Station Training form and return to Code 063, Building BOQ. We need this information to report you on your Official Record of Training.
EVALUATION FOR OFF-STATION TRAINING

As required by NADCRANEINST 12410.1D of 19 Apr 1971, Enclosure (1), this form will be completed and returned to Code 063, Building 5, after completion of training or attendance at conferences. Your honest evaluation of the training/conference that you just completed is important to the Training Division.

NAME: R Marks
DEPT: 30

1. Course Title: Quantum Mechanics I

2. Training Facility and Location: Indiana University
   Bloomington, IN

3. Date of training: From 14 January 1975 To 3 May 1975

4. Length of Training: ____________ Grade: ____________

5. Social Security No.:

6. Graded: GS
   Series: ____________ Level: ____________ Step: ____________

7. Ungraded: WB
   Series: ____________ Level: ____________ Step: ____________

8. Supervisory: ____________ Non-Supervisory: ____________

9. Is this training of immediate application to your present position? ____________ Explain why or why not ____________

10. Do other employees in your Department need this training? ____________

11. In your opinion did the training justify the expenditure? ____________

12. Comments and recommendations concerning this training: ____________

Signature: ____________
TRAINING REQUEST, AUTHORIZATION, AND RECORD

PART 1 - TRAINING REQUEST

1. IDENTIFICATION OF TRAINING PROGRAM OR COURSE TITLE

Quantum Mechanics I

2. TOTAL TRAINEES

1

3. STATEMENT OF CONTENTS OF COURSE OR PROGRAM


4. OBJECTIVE OF PROPOSED TRAINING (Brief description of the specific work projects to which this training applies. Include career development aspects.)

Course provides foundation for understanding the workings of Quantum Based Instruments. Employs extensive use of Probability Theory (foundation of Reliability) and in support projects.

5. TRAINING PERIOD (Year, month, & day)

BEGINNING DATE

14 January 1975

ENDING DATE

3 May 1975

6. ESTIMATED COST

A. DIRECT COSTS (TOTAL)

$ 124.00

(1) Tuition and Fees

$ 124.00

(2) Books and Materials

$ 0.00

B. INDIRECT COSTS (TOTAL)

$ 0.00

(1) Travel

$ 0.00

(2) Per Diem

C. TRAINING DOES NOT INVOLVE EXPENDITURES OF FUNDS OTHER THAN SALARY, PAY, OR COMPENSATION

Copy for: ORIGINATING OFFICE ADC 75-472

PART II - AUTHORIZATION

$ 124.00

A. E. WITNER, Director, WOG

PART III - TRAINING RECORD

A

NAME (Last, Initial)

16

B

SOCIAL SECURITY NUMBER

M 0 0 3 0

INSTRUCTIONS

1. Originating office should complete all items on this page and route to Training Office.

2. DO NOT write below heavy lines.

3. Enter additional trainees on NAVSO 12410/19A.

Complete blocks A, B, C, D, H, and I only, and attach to this request.
REQUEST FOR TRAINING

PART A: TRAINING NEED

Date: 11/26/74

From: 
To: 
Via: (1) 
(2) 
(3) 

Trainee: Robert J. Marks II Pay Number: [redacted]

Position Title: Electronics Engineer Series No. of Position: 855

Grade Level: GS 9 Supervisory Status: Yes No X

Date of Employment at NAD Crane: 3/25/74 (not Comp. Date)

Social Security Number: 282-48-2721

Objective of Proposed Training: (Brief description of the specific work projects to which this training applies. Include career development aspects.)

PART B: TRAINING COURSE: Quantum Mechanics I

Government x Non-Government x Professional Management x Technical Skills


Training Facility: Indiana University Location: Bloomington, Ind. TUESDAYS AND THURSDAYS

Date: 13 Jan 75 to 3 May 75 Time of Training: 1:30 to 3:15 PM

Hours of Training: 64 Gov't

Employee: Robert J. Marks II 

Supervisor: [redacted]
TRAINING PROGRAM OUTLINE
PRODUCTION RELIABILITY SURVEILLANCE GROUP

Bob Marks

I. Orientation

A. Activity

1. Depot

2. Department - MQEC

3. Division - Plans & Programs Division (Code 3P4) Aircraft Equipment Division (Code 307)

4. Branch - Various Branch - (Code 304/307)

5. Section - Various Section (Code 304/307)

B. Working Area

1. Production Reliability Surveillance

II. Basic Instructions

A. Reliability Theory

1. Reading Assignments:

   OD 46574 Life Cycle Product Quality Program Requirements for Naval Ordnance Material

   AR-34

   MIL-STD-781B

   AV-2000-AV5000

   MIL-D-18300

   MIL-T-18303

   Reference Guide for Most Commonly used system effectiveness documents

   Other appropriate documents
2. Brain Storming Sessions
   AR-34
   MIL-STD-781B
   AR-10A
   AV 2000
   AV 5000
   Navy Contracts
   MIL-T-18303
   MIL-D-18300

B. Technical Indoctrinations

1. Navy Contracts

2. Equipments Specification
   a. AV-2000 2 weeks
   b. AV-5000

3. Reliability Specification
   a. AV-34
   b. MIL-STD-781
   c. MIL-R-22973
   d. MIL-HDBK-217
   e. MIL-STD-785
   f. MIL-STD-756
   g. MIL-STD-757

4. Format and Procedures
   a. MIL-T-18303
   b. MIL-D-18300
   c. Test Procedure
   d. Check List
e. Letters

5. Explanation of Duties and Responsibilities
   a. AIRTASK
   b. Test Procedure Approval
   c. Test Reports
   d. Contract Management Cards
   e. Surveillance of Manufacturer's Test Facilities
   f. Special Reports

III. On the job assignments

A. Technical Projects
   1. DKT-30 Transmitting Set Telemetric
   2. AAU-31A Altimeter
   3. AAU-32A Altimeter
   4. ARR-72 Sonobuoy Receiver Set
   5. ARR-75 Radio Receiving Set (Edmac)
   6. ARR-75 Radio Receiving Set (AEL)

B. Data Collection

C. Data Processing

D. Reliability Analysis

E. Investigation of Programs

F. Proposed Corrective Action

IV. Former Training

A. AMETA Course "Elements of Reliability and Maintainability.

B. ARINC application of Reliability and Maintainability Techniques.

C. Local Training - Technical Writing Course.
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<td>MARKS R</td>
<td>DEPT</td>
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MEMORANDUM

From: 304B (R. J. Marks II)
To: 304B

Subj: TDY Training Report for period 2 - 20 Dec 1974

1. Activities Visited and Persons Contacted: United States Army Management Engineering Training Center (AMETA), Rock Island, IL.
   a. Cary Chittenden
   b. George Kalemkarian

2. Purpose of visit:
   a. To attend course entitled "Elements of Reliability and Maintainability".
   b. To find out information concerning the AMETA course on probabilistic design.

3. Discussion:
   a. An outline of the material covered in the course with corresponding description follows:
      (1) Introduction
         (a) History of and need for reliability and maintainability (R&M).
         (b) Definitions of R&M.
         (c) R&M program philosophy.
      (2) Probability and Statistics
         (a) Review of basic probability definitions and laws.
         (b) Review of probabilistic tools.
            1. Set theory.
            2. "Tree" solutions to problems.
         (c) Common Probability Distributions
1. Weibull
2. Exponential
3. Binomial
4. Bernoulli
5. Poisson
6. Normal
7. Lognormal
8. Gamma

(d) Probability functions used in R & M.
1. Failure density
2. Cumulative failure
3. Reliability
4. Hazard

(e) Statistics
1. Distribution measures.
   a. Central tendency (ex: mean, median).
   b. Dispersion measures (ex: variance, range).

(3) System and Subsystem Reliability Models
(a) Models
1. General procedure
2. Series, parallel and mixed models.
3. Partial and standby redundancies.
4. Reliability apportionment.
   a. AGREE method.
   b. ARINC method.
(a) Monte Carlo simulation

(4) Reliability Demonstration and Testing

(a) Parameter estimation

1. Non-parametric analysis
2. Parametric Analysis
   a. Graphical procedures
   b. Goodness of fit tests.
   c. Normal, Exponential, and Weibull parameter estimations.

(b) Test of hypotheses (for)

1. Normal distributions
2. Weibull distributions
3. Exponential distributions

(c) Acceptance life testing

1. Exponential (MIL-HDBK-H108)
2. Weibull
   a. Mean life criterion (MIL-TR3)
   b. Reliable life criterion (MIL-TR6)
   c. Hazard rate criterion (MIL-TR4)
3. Normal (MIL-STD-414)
4. Non-Parametric (MIL-STD-105)

(d) Accelerated life testing

(5) Stress-Strength Analysis

(a) For known distributions

1. Graphical Solutions
2. For Normal densities

(b) Strength distribution determination
(c) For one-shot items

(6) Maintainability Analysis
   (a) Concepts of Maintainability
   (b) Maintainability functions
   (c) Maintainability indices
       1. Time
       2. Cost
       3. Effectiveness
   (d) Probabilistic Aspects of Maintainability.
   (e) Maintainability Apportionment
   (f) Maintainability Predictions (RCA method).

(7) Introduction to Systems Effectiveness
   (a) The Systems Effectiveness Model (-a function of Availability, Dependability and Capability) from WSEIAC effort.

Course materials obtained are:

1. Text: "Elements of Reliability and Maintainability".
2. Book of problem solutions from text.
4. Copies of:


All above material is published by AMETA, Rock Island, Illinois. Also obtained were copies of probabilistic paper for plotting of exponential, weibull, and normal statistics.

b. The first week course entitled "Introduction to Probabalistic Design for Reliability" will be offered by AMETA starting on 9 June 1975. The course text has not yet been printed, but a copy will be forwarded on completion by request. A bibliography of recent work in probabilistic design may be found in the most recent issue of the IEEE Transactions on Reliability. Materials obtained concerning AMETA include:

(1) AMETA Course book including course listings and abstracts.

(2) A bar graph in time of courses offered by AMETA through 1975.

4. Recommendations:

a. The course taken provides an introductive overview of the philosophy and theory of reliability, maintainability, and systems effectiveness. Although integral and differential calculus are listed as prerequisites, the mechanics of the course can be executed with a firm knowledge of algebra and graph techniques if the concept of topic can be grasped intuitively. Basic probability theory is reviewed, making an apriori knowledge unnecessary. The listed prerequisites are thus thought strong in comparison to the course demands.

b. The quality of instruction, including materials, text, and instructor, was excellent. A slide rule calculator, however, is a helpful, yet unprovided tool for problem working and tests.

c. Overall, the course met its purpose and is recommended as a theoretical introductive overview to all concerned with R & M.

R. J. MARKS II

Copy to:
G. Allen, C. Rice, R. Saum


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R. J. MARKS II

Copy to: G. Allen, C. Rice, R. Saum
1. THRU: 2. TO: 3. FROM (INSTALLATION/ACTIVITY):
AMTA, Rock Island, IL
Commanding Officer (Code 063)
Naval Ammunition Depot
Crane, Indiana 47522

4. COURSE TITLE AND NUMBER
Elements of Reliability & Maintenance

5. CONDUCTED BY
AMTA, Rock Island, IL

6. CLASS NUMBER

7. STARTING DATE
2-20 Dec 1974

8. QUOTA SOURCE

9. NOMINEE STATUS
Primary

10. AGE
24

11. SOCIAL SECURITY NO.

12. SECURITY CLEARANCE
Secret

13. PREVIOUS COURSES ATTENDED IN THIS SCHOOL
None

14. OTHER TRAINING IN COURSE AREA
Statistics Probability

15. NAME (Last, First, Middle Initial): HOME ADDRESS (include ZIP Code and Telephone No.) OF NOMINEE
MAKRS, Robert J., II
311 Leonard Springs Rd., Apt. 162
Bloomington, IL 47401
Send confirmation to address in Block 3.

16. IN CASE OF EMERGENCY NOTIFY:
A. NAME
Connie Lynn Marks

B. RELATIONSHIP
Wife

C. STREET, CITY AND STATE
Same as No. 15

D. AREA CODE & TEL. NO.
812-332-3922

17. MILITARY ONLY
A. RANK/GRADE
B. SERVICE
C. BRANCH
D. SOC. SEC. NO.
E. DATE OF RANK

18. RECORD OF EMPLOYMENT

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BRIEF RESUME OF PRESENT DUTIES
Project Engineer for Thermal Stability Program.

19. EDUCATION

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A. HIGHEST GRADE COMPLETED
B. HIGHEST DEGREE RECEIVED
C. NAME AND LOCATION OF COLLEGE
Rose-Hulman Institute of Tech.
Terre Haute, IN

20. IF BILLETING FACILITIES ARE NOT AVAILABLE, DOES NOMINEE REQUEST HOTEL RESERVATIONS?

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22. DOES NOMINEE MEET PREREQUISITES LISTED IN DOD 5010.16(a)?

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A. SIGNATURE OF REQUESTING OFFICIAL
B. DATE OF REQUEST

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24. TO:

25. FROM (COURSE SPONSOR):

26. HOTEL RESERVATIONS CONFIRMED AT
A. HOTEL RESERVATIONS BEGIN ON EVENING OF

27. ENROLLMENT & REGISTRATION IS APPROVED
A. APPROVED/DISAPPROVED BY
B. DATE

28. NOMINEE SUCCESSFULLY COMPLETED COURSE

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30. NOMINEE SUCCESSFULLY COMPLETED COURSE
A. GRADE

Replaces Deon D. Hersberger previously submitted.
Purpose: This course is designed to provide the enrollees with a working knowledge of the mathematical, engineering, and managerial aspects of reliability and maintainability, including an introduction to system effectiveness.

Scope: Among topics to be considered are the concepts of reliability (R) and maintainability (M), R&M requirements, R&M design consideration, managerial aspects of R&M programs, component and system reliability measurements, probability and statistics, data feedback and analysis, and an introduction to system effectiveness.

Prerequisites: This course is designed for engineers and scientists currently engaged in reliability and maintainability activities. Enrollees are required to have completed mathematics through differential and integral calculus.
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<td>3.90</td>
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Base Rate: 25.29

Overhead
Appendix B
EXTRACTS FROM THE ESPIONAGE LAWS AND FEDERAL STATUTES

*United States Code, Title 18, Section 793*

Gathering, Transmitting, or Losing Defense Information:

a. Whoever, for the purpose of obtaining information respecting the national defense with interest or reason to believe that the information is to be used to the injury of the United States, or to the advantage of any foreign nation, goes upon, enters, flies over, or otherwise obtains information concerning any vessel, aircraft, work or defense, navy yard, naval station, submarine base, fueling station, fort, battery, torpedo station, dockyard, canal, railroad, arsenal, camp, factory, mine, telegraph, telephone, wireless, or signal station, building, office, research laboratory, or station or other place connected with the national defense owned or constructed, or in progress of construction by the United States or under the control of the United States, or of any of its officers, departments, or agencies, or within the exclusive jurisdiction of the United States, or any place in which any vessel, aircraft, arms, munitions, or other materials or instruments for use in time of war are being made, prepared, repaired, stored, or are the subject of research or development, under any contract or agreement with the United States, or any department or agency thereof, or with any person on behalf of the United States, or any prohibited place so designated by the President by proclamation in time of war or in case of national emergency in which anything for the use of the Army, Navy, or Air Force is being prepared or constructed or stored, information as to which prohibited place the President has determined would be prejudicial to the national defense; or

b. Whoever, for the purpose aforesaid, and with like intent or reason to believe, copies, takes, makes, or obtains, or attempts to copy, take, make, or obtain and sketch, photograph, photographic negative, blueprint, plan, map, model, instrument, appliance, document, writing, or note of anything connected with the national defense; or

c. Whoever, for the purpose aforesaid, receives or obtains or agrees or attempts to receive or obtain from any person, or from any source whatever, any document, writing, code book, signal book, sketch, photograph, photographic negative, blueprint, plan, map, model, instrument, appliance, or note of anything connected with the national defense, knowing or having reason to believe, at the time he receives or obtains, or agrees or attempts to receive or obtain it, that it has been or will be obtained, taken, made or disposed of by any person contrary to the provisions of this Chapter; or

d. Whoever, lawfully having possession of, access to, control over, or being entrusted with any document, writing, code book, signal book, sketch, photograph, photographic negative, blueprint, plan, map, model, instrument, appliance, or note relating to the national defense, or information relating to the national defense which information the possessor has reason to believe could be used to the injury of the United States or to the advantage of any foreign nation, willfully communicates, delivers, transmits, or causes to be communicated, delivered, or transmitted, or attempts to communicate, deliver, transmit or cause to be communicated, delivered or transmitted the same to any person not entitled to receive it, or willfully retains the same and fails to deliver it on demand to the officer or employee of the United States entitled to receive it; or
APPENDIX B

On and after thirty days from the date upon which the President defines any vital military or naval installation or equipment as being within the category contemplated under Section 795 of this title, whoever reproduces, publishes, sells, or gives away any photograph, sketch, picture, drawing, map, or graphical representation of the vital military or naval installations or equipment so defined, without first obtaining permission of the commanding officer of the military or naval post, camp, or station concerned, or higher authority, unless such photograph, sketch, picture, drawing, map, or graphical representation has clearly indicated thereon that it has been censored by the proper military or naval authority, shall be fined not more than $1,000 or imprisoned not more than one year, or both. (June 25, 1948, ch. 645, 62 Stat. 738.)

United States Code, Title 18, Section 796

Use of Aircraft for Photographing Defense Installations:

Whoever uses or permits the use of an aircraft or any contrivance used, or designed for navigation or flight in the air, for the purpose of making a photograph, sketch, picture, drawing, map, or graphical representation of vital military or naval installations or equipment, in violation of Section 795 of this title, shall be fined not more than $1,000 or imprisoned not more than one year, or both. (June 25, 1948, ch. 645, 62 Stat. 738.)

United States Code, Title 18, Section 797

Publication and Sale of Photographs of Defense Installations:

Whoever willfully shall violate, attempt to violate, or conspire to violate any regulation or order promulgated by the Administrator of the National Aeronautics and Space Administration for the protection or security of any laboratory, station, base or other facility, or part thereof, or any aircraft, missile, spacecraft, or similar vehicle, or part thereof, or other property or equipment in the custody of the Administration, or any real or personal property or equipment in the custody of any contractor under any contract with the Administration or any subcontractor of any such contractor, shall be fined not more than $5,000, or imprisoned not more than one year, or both. (Added Pub. L. 85-568, title III, Section 304 (c) (1), July 29, 1958, 72 Stat. 434.)

United States Code, Title 50, Section 797
NOTICE OF POSITION DESCRIPTION NUMBER CHANGE

FROM DATE 06/26/74 TO DATE 07/25/74 RUN DATE 06/19/74

NAME SARKS ROBERT J II

SSN 282-48-2721

DEPT P D NUMBER JOB TITLE PLAN SERIES 6K

FROM 304000 01425 ELECTRONICS ENGINEER 65 00855 09
TO 304000 3042803 ELECTRONICS ENGINEER 65 00855 09

POSITION DESCRIPTION NUMBER CHANGED TO ESTABLISH AUTOMATED POSITION DESCRIPTION FILE
FROM THE COMMANDING OFFICER

This issue of Bursts and Duds provides current, up-to-date information which must be followed by the Civilian Personnel Department in effecting terminations and reduction-in-force actions directed by the Commander, Naval Sea Systems Command earlier this year.

Vigorous and continuing efforts have been made by the top managers of NAD Crane to maintain stable employment levels and avoid forced reductions of permanent personnel. Until now, we have been successful in that endeavor. All appropriate actions have also been taken, independently, by the Crane Management Association and AFGE Local 1415 to eliminate or relieve the directed reduction-in-force of permanent employees.

However, I have now been ordered to reduce the NAD Crane workforce to the level of 3830 employees by 30 June 1975. In addition to absorbing all normal attrition of employees, it will be necessary to terminate the services of temporary employees and to separate 475 career and career/conditional employees by reduction-in-force procedures. These actions are necessitated by manpower ceilings imposed upon the Department of Defense, which have resulted in manpower realignments at several Naval Activities.

I deeply regret the necessity for this action. I recognize that it will cause serious hardships for many families. During my tour of duty here I have become keenly aware of the industry and dedication of Crane employees. I want to assure all of you who are adversely affected that the actions being taken do not suggest any inadequacy of performance on your part. On the contrary, you have contributed magnificently to the defense posture and security of our nation.

One step which is being taken to alleviate the reduction in personnel is to obtain authority for the "early out" retirement provisions which can be authorized by the Civil Service Commission when an activity is undergoing reduction-in-force. Request for this authority has been initiated. You will be advised of the specific provisions as soon as it is authorized.

The procedures outlined in this publication are those required by law and regulations of the Civil Service Commission and the Navy Department. I suggest that each employee and supervisor retain this paper for future reference and to help in understanding how forced separations of employees must be effected. In addition, watch for future issues of Bursts and Duds. I will be furnishing additional information and clarification on RIF questions which come to my attention.

R. L. McArthy
Captain, USN
Commanding Officer
GENERAL INFORMATION ON REDUCTION IN PERSONNEL AT NAD CRANE

1. DEFINITIONS
   a. Temporary Employee--Employee serving under a Temporary limited appointment not to exceed one year.
   b. TAPER Employee--Employee serving under Temporary Authority issued by the Civil Service Commission pending the establishment of a register of eligibles.
   c. Career-Conditional Employee--Employee serving under an appointment made on a permanent basis but who has less than three years' continuing service under this appointment.
   d. Career Employee--Employee serving under a permanent appointment who has completed three years' or more substantially continuous service under career-conditional appointment.
   e. Excepted Employee--Employee holding an appointment excepted from the Competitive Civil Service System by law, executive order or regulation. (Examples include Vietnam veterans holding Veterans' Readjustment Appointments (VRA), severely handicapped employees and undergraduate college students working under cooperative work-study agreements.)
   f. Representative Rate--The step rate used in determining valid job offers in a reduction-in-force. Regulations prescribe that the step rates to be used for this purpose are the 4th step of the General Schedule (GS) for positions subject to the Classification Act, and the 2nd step for wage grade positions (supervisory and non-supervisory).
   g. Competitive Level--A group of positions that are of the same grade level and are sufficiently similar as to duties and knowledge and skills needed to perform the work that interchange of employees is feasible without undue interruption of the work. Characteristics shared by all positions in a competitive level are similarity of duties, responsibilities, and pay schedules; and similarity of requirements for experience, training, skills, and aptitudes.
   h. Competing Employee--Employee serving under appointment not limited to one year or less.
   i. Non-Competing Employee--Employee serving under appointment with specific time limitation of one year or less. An employee with unsatisfactory performance rating regardless of type of appointment is a non-competing employee.
   j. Retention Subgroups--A grouping of employees according to the type of appointment and veteran's preference. (This grouping is illustrated in paragraph 3b below).
   k. Retention Register--A list of employees by competitive level in retention order.

2. NOTICE PERIODS
   a. Temporary Employees.
      (1) Employees serving under temporary appointments not to exceed one year will be given an advance notice of five working days. The five days will be in a work status if possible.
      (2) Employees serving under TAPER and Term appointments (when present in workforce) will be given a 30-day advance notice in a work status if possible.
   b. Career and Career-Conditional Employees.
      (1) Employees affected by RIF action will be given an advance notice of 60 days in a duty status (if possible).
      (2) The employee, upon his request, shall be carried on leave without pay or annual leave (if available) for such additional time as necessary to provide a 90-day notice period prior to separation.

3. ORDER OF SEPARATIONS
   a. General. Employees serving under temporary appointments will be separated before employees in the same competitive level who hold career or career-conditional appointments.
      (1) Employees in Wage Grade Positions. Temporary employees will be the first employees separated from each competitive level by retention order. That is, employees with the shortest period of creditable federal service will be released first. Consideration will also be given to veteran's preference as explained in paragraphs 3b, 4 and 8 below.
      (2) Employees in Classification Act Positions. Temporary Classification Act employees will be separated in the order in which their positions are eliminated, rather than by retention order. This means that when a Classification Act position occupied by an employee on a temporary limited appointment is abolished, the employee occupying that position is terminated.
   b. Except as indicated above for temporary employees in Classification Act positions, the order of release from a competitive level will be according to the following retention subgroups (unless the employee involved is entitled to another job offer, release from his competitive level will also result in his separation):
      (1) OB - Non-veteran employees serving on temporary limited appointments in continuing positions.
      (2) OA - Veteran employees serving on temporary limited appointments in continuing positions.
      (3) 5B - Career-conditional non-veteran employees serving on temporary promotions.
      (4) 5A - Career-conditional veteran employees serving on temporary promotions.
      (5) 4B - Career non-veteran employees serving on temporary promotions.
      (6) 4A - Career veteran employees serving on temporary promotions.
      (7) 3B - Term and TAPER non-veteran employees.
      (8) 3A - Term and TAPER veteran employees.
      *(9) 2B - Career-conditional non-veteran employees.
      *(10) 2A - Career-conditional veteran employees.
      (11) 1B - Career non-veteran employees.
      (12) 1A - Career veteran employees.
* Also included in these retention subgroups are career employees who are serving a probationary period and career employee who are serving in obligated positions. (Obligated positions are positions to which other employees have statutory restoration rights.)
NOTES: 1. Employees in Groups 0, 5, and 4 and employees with an unsatisfactory performance rating are called non-competing employees. All employees in these groups in the same competitive level will be removed from the competitive level before any competing employee is released.

2. Employees on temporary promotion are non-competing employees in the competitive level to which temporarily promoted. They compete for retention only in the competitive level of their regular job.

3. Release from each retention subgroup above will be by retention order. That is, employees with the shortest period of creditable federal service will be released first. Release of employees in the same subgroup with the same service date (ties) will be based on performance ratings. If performance ratings are the same then other means of breaking the tie will be used in this order: (1) length of service in present position, (2) length of service at Crane, (3) length of pertinent experience related to present position.

4. Under the Dual Compensation Act, retired members of the Armed Forces working in Civil Service positions are considered to be non-veterans and have no veterans' preference in a reduction-in-force. Exceptions to this rule are those retired veterans who have less than 20 years of full-time active service, those whose retirement was based on disability incurred in the line of duty during a period of war, or those who have been employed on a federal civilian job continuously since 30 November 1964. For reduction-in-force purposes, retired members of the Armed Forces, not covered by one of the exceptions in the preceding sentence, receive credit for only that military service performed during wartime or in a campaign or expedition for which a campaign badge has been authorized.

4. REASSIGNMENT RIGHTS (BUMP AND RETREAT)

a. Temporary Employees.
(1) Employees holding temporary limited appointments have no reassignment rights.

b. Career and Career-Conditional Employees.
(1) Career and career-conditional employees released from a competitive level are entitled to assignment to another position in one of the following ways:
   a. To a continuing position in another competitive level for which he qualifies for displacement action, but is occupied by an employee in a lower retention subgroup. In this situation, a 1A employee can displace a 1B employee in group 2 or 3. A 1B can displace an employee in group 2 or 3. A 2A can displace a 2B or an employee in group 3. This right to displace on the basis of subgroup superiority is known as reassignment or bumping rights.
   b. To a position from which he was previously promoted and which is occupied by an employee with a later service date in the same or lower retention subgroup. In this situation, a 1A with a service date of 03-17-58, can displace another 1A with a service date of 03-18-58. He can also displace an employee in subgroup 1B or in group 2 or 3. This is known as “retreat rights.”

(2) A career or career-conditional employee reached for a reduction-in-force may be assigned to a vacant position for which he qualifies which is the same grade or level and/or equal representative rate to the best offer available under (1) (a) and (b) above. (This will satisfy his reduction-in-force rights.) The employee involved does not have the right to choose the position to which he will be assigned.

5. QUALIFYING FOR DISPLACEMENT (BUMP AND RETREAT)
To be eligible to bump or retreat, an employee must not only have superior retention rights to the employee in the position, but also he must be sufficiently qualified that he can assume the position without undue interruption of the work. This means that he must be fully qualified—including meeting the physical qualifications of the job for which he is being considered under bumping and retreat rights. If the physical requirements for the position for which he is considered are greater than the one in which he is performing, a current physical examination may be necessary. As the situations are identified, the Civilian Personnel Department requests the Medical Department to schedule and conduct physical examinations as rapidly as possible. Employees should protect their rights to possible job offers under RIF by cooperating fully in the physical examining process. If they subsequently wish to decline the offer or even to appeal the decision that it represents their “best offer,” they still have that right. However, if it cannot be determined that they are “fully qualified,” the offer cannot be made in the first place.

6. DECLINATION OF OFFERS IN REDUCTION IN FORCE
(a) Regulations require that an employee separated from a competitive level must be given his “best” offer based on available positions and his retention standing. The “best” offer is determined on the basis of pay, using the representative rate method.
(b) An employee may decline his “best” offer if he chooses. However, such a declination will not entitle him to an offer of another position. Rather, the declination of a valid (best) offer in RIF will result in separation of the employee involved.

7. RELEASE OF EXCEPTED EMPLOYEES. Excepted employees do not compete in reduction-in-force with employees in the competitive service. They do compete with other employees in the excepted service. Excepted employees are grouped separately on retention registers by competitive levels and subgroup retention standing the same as described above. As management determines that positions occupied by excepted employees must be excessed, the employees involved compete within the excepted service for the remaining positions. Those who are not entitled to an offer of another excepted position are separated.

8. VETERANS VS. NON-VETERANS. A mistaken impression seems to persist that it is illegal or improper to separate employees with veterans' preference while non-veteran employees remain in the workforce. A look at the provisions of RIF regulations as explained in paragraphs 3 and 4 above should readily reveal the true situation. Veterans’ preference applies within the retention group for RIF purposes. Since non-competing employees must be separated from a competitive level before any of the competing employees, it is required that temporary veteran employees be separated from a given competitive level of non-vetan employees in retention subgroups 3b, 2b, and 1b. Similarly, a career-conditional veteran employee (2A) will be separated from a competitive level before career non-veterans in retention group 1b.
9. SEVERANCE PAY

a. Temporary Employees.
   (1) Employees serving under these appointments are not eligible for severance pay.

b. Career and Career-Conditional Employees.
   (1) Employees working under career-conditional appointments are entitled to severance pay if they are separated in reduction-in-force, provided they have worked without any break in service of more than three days for a minimum of 12 calendar months preceding the date of separation.
   (2) A career-conditional or career employee is also entitled to severance pay if he meets the 12 months service requirement and if he declines an offer of lower grade and rate of pay (exclusive of a retained rate) and is separated in RIF as a result of that declination. The declaration of an "equivalent position" (which means one that provides a rate of pay at least equal to his current rate of pay) makes an employee ineligible for severance pay.
   (3) Severance pay is computed as follows: one week of basic compensation for each year of creditable service up to 10 years; two weeks of basic compensation for each year of creditable service beyond 10 years. In addition, the basic compensation is increased by 10 per cent for each year employee's age exceeds 40. The total amount cannot exceed one year's pay at the rate of pay in effect immediately prior to separation.
   (4) Employees entitled to an immediate annuity at the time of separation, or who are receiving compensation under the Federal Employee's Compensation Act are not entitled to severance pay.

10. RETENTION REGISTER

a. Official retention registers are maintained by the Civilian Personnel Department in Building 5. Employees may obtain information concerning their standing on the retention register by calling extension 1606. They may also make an appointment to see that part of the retention register in which their competitive level appears.

b. After an employee receives a RIF notice indicating a job offer or separation under RIF procedure, he is entitled to see any retention register which has a bearing on the action affecting him. Normally, this opportunity would be provided at the same time as his counseling interview as explained in paragraph 11.

11. COUNSELING

a. A member of the Civilian Personnel Department staff will be available for individual or group counseling on specific questions concerning reduction-in-force notices and to help enroll employees being separated in reemployment programs.

12. REEMPLOYMENT BENEFITS AND OUT-PLACEMENT SERVICE (CAREER AND CAREER-CONDITIONAL EMPLOYEES ONLY)

a. Reemployment Priority List (NAD Crane)
   (1) Employees' names will be entered on this list for the positions from which they were separated and for positions for which they qualify. Names will be listed in retention subgroup order and considered in that order for reemployment, as vacant positions are filled by outside hire.
   (2) Separated career status employees will be carried on the Reemployment Priority List for two years and separated career-conditional employees will be carried for one year, unless their reemployment rights are satisfied earlier.

b. Department of Defense Priority Placement Program

   (1) This program provides additional priority employment consideration over all types of staffing actions at federal establishments in locations where separated employees are registered for employment.

   (2) Employees entitled to an immediate annuity at the time of separation, or who are receiving compensation under the Federal Employee's Compensation Act are not entitled to severance pay.

13. OUT-PLACEMENT SERVICE (TEMPORARY EMPLOYEES)

a. Assistance will be given by advising on employment opportunities which may be possible through the Civil Service Commission registers.

b. Advice will also be provided on filing with the Indiana Employment Security Division for jobs which may be available in the area and for unemployment insurance benefits.
Purpose: This course is designed to provide the enrollees with a working knowledge of the mathematical, engineering, and managerial aspects of reliability and maintainability, including an introduction to system effectiveness.

Scope: Among topics to be considered are the concepts of reliability (R) and maintainability (M), R&M requirements, R&M design consideration, managerial aspects of R&M programs, component and system reliability measurements, probability and statistics, data feedback and analysis, and an introduction to system effectiveness.

Prerequisites: This course is designed for engineers and scientists currently engaged in reliability and maintainability activities. Enrollees are required to have completed mathematics through differential and integral calculus.
GRADE

O  Demonstrated outstanding comprehension of course principles and techniques and a commendable facility to apply them.

S+ Demonstrated above average comprehension of course principles and techniques and a commendable facility to apply them.

S  Demonstrated average comprehension of course principles and techniques and an apparent facility to apply them.

S- Demonstrated a limited comprehension of course principles and techniques. Opportunities for application should be carefully selected and supervision provided.

U  Demonstrated a lack of comprehension of the subject matter presented to the degree necessary for its use.

Inc. Student was unable to complete the course due to absence from class.
MEMORANDUM

From: 304
To: 301

Subj: Secret Security Clearance for Mr. Robert Jackson Marks II

1. It is requested that a Secret Security Clearance be obtained for Mr. Robert J. Marks II, Social Security Account Number 5512.

2. Mr. Marks, an electronics engineer GS-855-9, is employed in the Plans and Programs Div., Quality Evaluation and Engineering Laboratory.

Copy to:
304B (Saum)
304B (Allen)
304B (Marks)

S.S. Kalbermatt
By direction
### Position or Job Description

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<th>1. THIRD ACTION</th>
<th>2. SECOND ACTION</th>
<th>3. FIRST ACTION</th>
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#### Activity: Name and Location

**MDD Crane, Infinity**

#### Organizational Subdivisions

**Quality Evaluation Department**

**Electronic Systems & Components Division**

#### Purpose

**Electronic Engineer**

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#### Remarks

### Position or Job Location

**George Allen**

#### Reason for Submission

**REMARKS**

### Certifications

The description of the duties and responsibilities of this position or job is complete and accurate.

**SIGNATURE (Employer)**: ____________

**DATE**: ____________

**Signatures and Titles**

**M. YEAGER, Deputy Director, OE Dept.**

---

The classification of this position may be appealed by the incumbent at any time. Appeals from classification actions which result in demotion or reduction in compensation must be timely in order for retroactivity to apply. Consult your classifier or appropriate activity instruction for procedures. Civil Service Commission classification standards and Department of the Navy classification guides are available for review in the Wage and Classification Office.

### Recertification

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### Action

**ATTACHED FORMULATION**

**Amendment No.**

**POS. OR JOB #**

**CLASS. OR RATING**

---

**Amendment No.**

**TO**

**Identical To**

**Attatched Statement of Difference To**

**Replaces**

**Other (Specify)**
INSTRUCTIONS FOR CompleTING FORM NAVSO 12510/7

FOR GRADED POSITIONS

(Note: Optional Form B is to be used for proposed allocations to GS-16, GS-17, or GS-18 - see NCPI 937. General instructions for preparing position descriptions are contained in NAVSO 12510/7A. Special instructions are contained in applicable Special Question Lists.)

1. To be executed only by persons who have been officially authorized to take classification action. Space is provided for taking three separate actions on the same position; the second and third actions may be on maintenance review, the result of application of new standards or of review by higher authority, etc. The position title must be the official position authorized by CSC or Navy standards, NAVEXOS P-2440, or other appropriate instructions. The classification official must be a person officially authorized to classify the position.

2. Optional. A recommendation should reflect the considered judgment of the originator.

3. Enter name of employee regularly performing the work. If not regularly performed, enter "VACANT."

4. "Location" means city and state.

5. through 10. Enter as many organizational subdivisions as necessary to show the one in which the position is located.

11. Optional.


17. Complete whenever the position supersedes another, out of which it has developed in whole or in part. This information is necessary for historical continuity and to provide accurate data for personnel processes.

18. Examples of "other" reasons are "Survey," "Reorganization," and "Checklist."

19. Signature optional unless required by the activity or a higher management authority.

20. and 21. MUST be executed before forwarding to classification official.

22. For special notations by classification office, e.g., brief evaluation reports, reference to Navy or CSC postaudits, competitive levels, restrictions on filling position, or requirements for reviewing position later. This space should also be used to (a) identify any IA and "statement of difference" positions and the date each was established, and (b) the alternative series on interdisciplinary positions.

23. To be initialed and dated by the classification specialist whenever he has subsequently audited the position (e.g., on maintenance review) and found that the description is still current and accurate and that the classification assigned remains correct.

24. Description of duties and responsibilities. This is normally typed on plain bond and attached to the NAVSO 12510/7. Very brief descriptions, however, such as short amendments, statements of differences, or checklist descriptions should, if space permits, be inserted in Item 22.

FOR UNGRADED POSITIONS

(Note: General instructions for preparing job descriptions are contained in NAVSO 12510/7B. Special instructions for Masters and Foremen are given in NCPI 531, Encl. 5.)

In upper right-hand corner, check the "JD" box.

1. through 3. To be executed only by persons who have been officially authorized to take a rating action. Space is provided for taking three separate actions on the same job. This permits recording subsequent re-rating actions taken by the activity, as on maintenance review or application of new rating definitions, or by management bureaus or OCM.

Job Title. Enter the official, title authorized in NCPI 531, current OCM Notices, or OCM letters of authorization. (For a supervisory rating with a special designator, such as "Public Works," indicate the "rating concerned" in Item 22.)

Service. Enter appropriate Service, such as "W" (General Wage), "C" (Commission), etc.

Pay Level or Formula. Enter pay level or rating, e.g., "W-11" for Plumbers; or pay formula, e.g., "WF-18" for Leadingmen Carpenter.

Rating Official. This is a person officially authorized to make rating determinations.

4 & 5. Optional.

6. "Location" means city and state.

7. through 10. Enter as many subdivisions as necessary to locate the job.

11. Optional.

12. Enter the number of employees, by title, now performing work of the job, or "none," as appropriate.


15 & 16. Optional. Activities may cite the appropriate P-1005 rating definition by number, in lieu of describing the job, when the P-1005 definition adequately covers most or all of the duties performed.

17. Self-explanatory.

18. For actions not covered by items 13 through 17.


20. and 21. MUST be completed before forwarding to rating official.

22. To be used by rating office for purposes similar to those described in Item 22 for graded positions.

23. Optional. May be used for recording findings on maintenance review.

NAVSO 12510/7 (REV. 10-67) (BACK) © U.S. GOVERNMENT PRINTING OFFICE 1967
### Classification or Rating Official

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### Named Employee

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### Position or Job Location

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### Section

- **1.** ORGANIZATIONAL SUBDIVISION (Ex.)
- **2.** ORGANIZATIONAL TITLE OF POSITION OR JOB (If any)
- **3.** ORGANIZATIONAL TITLE OF POSITION OR JOB (If any)
- **4.** ORGANIZATIONAL TITLE OF POSITION OR JOB (If any)

### Employees Now Performing Duties

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### Reason for Submission

- **13.** DUTIES AND RESPONSIBILITIES NOT ELSEWHERE DESCRIBED - COMPLETE ATTACHED AMENDMENT NO. POS. OR JOB # CLASS. OR RATING

### Certifications

- **19.** SIGNATURE (Employee) DATE
- **20.** SIGNATURE AND TITLE (Immediate supervisor) DATE
- **21.** SIGNATURE AND TITLE (Person authorized to establish position or job) DATE

### Other

- **22.** REMARKS

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The classification of this position may be appealed by the incumbent at any time. Appeals from classification actions which result in demotion or reduction in compensation must be timely in order for retroactivity to apply. Consult your classificator or appropriate activity instruction for procedures. Civil Service Commission classification standards and Department of the Navy classification guides are available for review in the Wage and Classification Office.
I. Introduction

This position is located in the Systems Effectiveness Branch, Avionics Programs Division, Weapon Quality Assurance Center. This branch is responsible for development and implementation of a program for analysis and prediction of reliability and maintainability of aircraft electronic equipment and systems. The incumbent will perform engineering studies and analysis in implementing various aspects of the program as assigned.

II. Major Duties and Responsibilities

As assigned, accomplishes project work of the following nature in connection with the full range of Avionics equipment and systems under branch cognizance:

A. Reviews and evaluates the reliability and maintainability portions of technical development plans and proposals submitted by the avionics equipment manufacturers to NAVIRCOM. For projects assigned to this activity by NAVIRCOM, will serve as project manager with responsibilities of keeping the customer fully informed of progress and major obstacles requiring program changes for the R & M portions of major R & D or production contracts. In this capacity, the incumbent will review and provide detailed comments and/or recommendations on program plans, test procedures, math models, predictions, and testing reports as pertain to the reliability and/or maintainability of the system.
Appendix B

EXTRACTS FROM THE ESPIONAGE LAWS AND FEDERAL STATUTES

United States Code, Title 18, Section 793

Gathering, Transmitting, or Losing Defense Information:

a. Whoever, for the purpose of obtaining information respecting the national defense with interest or reason to believe that the information is to be used to the injury of the United States, or to the advantage of any foreign nation, goes upon, enters, flies over, or otherwise obtains information concerning any vessel, aircraft, work or defense, navy yard, naval station, submarine base, fueling station, fort, battery, torpedo station, dockyard, canal, railroad, arsenal, camp, factory, mine, telegraph, telephone, wireless, or signal station, building, office, research laboratory, or station or other place connected with the national defense owned or constructed, or in progress of construction by the United States or under the control of the United States, or of any of its officers, departments, or agencies, or within the exclusive jurisdiction of the United States, or any place in which any vessel, aircraft, arms, munitions, or other materials or instruments for use in time of war are being made, prepared, repaired, stored, or are the subject of research or development, under any contract or agreement with the United States, or any department or agency thereof, or with any person on behalf of the United States, or any prohibited place so designated by the President by proclamation in time of war or in case of national emergency in which anything for the use of the Army, Navy, or Air Force is being prepared or constructed or stored, information as to which prohibited place the President has determined would be prejudicial to the national defense; or

b. Whoever, for the purpose aforesaid, and with like intent or reason to believe, copies, takes, makes, or obtains, or attempts to copy, take, make, or obtain and sketch, photograph, photographic negative, blueprint, plan, map, model, instrument, appliance, document, writing, or note of anything connected with the national defense; or

c. Whoever, for the purpose aforesaid, receives or obtains or agrees or attempts to receive or obtain from any person, or from any source whatever, any document, writing, code book, signal book, sketch, photograph, photographic negative, blueprint, plan, map, model, instrument, appliance, or note of anything connected with the national defense, knowing or having reason to believe, at the time he receives or obtains, or agrees or attempts to receive or obtain it, that it has been or will be obtained, taken, made or disposed of by any person contrary to the provisions of this Chapter; or

d. Whoever, lawfully having possession of, access to, control over, or being entrusted with any document, writing, code book, signal book, sketch, photograph, photographic negative, blueprint, plan, map, model, instrument, appliance, or note relating to the national defense, or information relating to the national defense which information the possessor has reason to believe could be used to the injury of the United States or to the advantage of any foreign nation, willfully communicates, delivers, transmits, or causes to be communicated, delivered, or transmitted, or attempts to communicate, deliver, transmit or cause to be communicated, delivered or transmitted the same to any person not entitled to receive it, or willfully retains the same and fails to deliver it on demand to the officer or employee of the United States entitled to receive it; or
APPENDIX B

a. Whoever, with intent or reason to believe that it is to be used to the injury of the United States or to the advantage of a foreign nation, communicates, delivers, or transmits, or attempts to communicate, deliver, or transmit, to any foreign government, or to any faction or party or military or naval force within a foreign country, whether recognized or unrecognized by the United States, or to any representative, officer, agent, employee, subject, or citizen thereof, either directly or indirectly, any document, writing, code book, signal book, sketch, photograph, photographic negative, blueprint, plan, map, model, instrument, appliance, or information relating to the national defense, which might be useful to the enemy, shall be punished by death or by imprisonment for any term of years or for life.

b. Whoever, in time of war, with intent that the same shall be communicated to the enemy, collects, records, publishes, or communicates, or attempts to elicit any information with respect to the movement, numbers, description, condition, or disposition of any of the Armed Forces, ships, aircrafts, or war materials of the United States, or with respect to the plans or conduct, or supposed plans or conduct of any naval or military operations, or with respect to any works or measures undertaken for or connected with, or intended for the fortification or defense of any place, or any other information relating to the public defense, which might be useful to the enemy, shall be punished by death or by imprisonment for any term of years or for life.

c. If two or more persons conspire to violate this section, and one or more of such persons do any act to effect the object of the conspiracy shall be subject to the punishment provided for the offense which is the object of such conspiracy. As amended Sept. 3, 1954, c. 1261, Title II, Section 201, 68 Stat. 1219.

United States Code, Title 18, Section 795
Photographing and Sketching Defense Installations:

a. Whenever, in the interest of national defense, the President defines certain vital military and naval installations or equipment as requiring protection against the general dis-

B-2
B. Develop specifications for reliability and maintainability testing, prediction, estimations, calculations, and design analysis for a wide range of electronic and electromechanical equipment.

C. Evaluates contractors' work on projects involving studies in various aspects of systems effectiveness including writing of handbooks on failure rates and general reliability techniques, computer techniques for reliability analysis and specification writing. Participates in and coordinates continuing survey of electronic industry to maintain up-to-date knowledge of reliability testing and assurance methods and procedures.

D. Performs or coordinates studies for the purpose of establishing optimum methods and procedures for determining reliability and operating problem areas of avionics equipments in Fleet use. This includes performing reliability and maintainability analyses on this equipment as necessary as well as intensive study of methods used in the Fleet for trouble-shooting, repairing and reporting failures and problem areas. Develops or participates in development of methods for the efficient handling and analysis of this data (including computer application) and generates reports and recommendations to Naval Air Systems Command for implementation of same. This function requires considerable liaison effort between the Fleet personnel, within Government agencies and industry, and Naval Air Systems Command. This liaison is accomplished by the incumbent.

E. Performs special engineering investigations on electronic systems which are performing below the specified reliability level in the Fleet. The incumbent will gather such failure data as is available, review the applicable specifications, review the design and installation of the system-
and utilizing such techniques as circuit analysis, math modeling, failure rate predictions, redundancy, etc., will provide recommendations as will correct the areas of deficiency and improve the reliability of the systems. Such recommendations might include changing the inherent design, changing materials or circuitry, requiring new tests or methods of testing in the applicable specifications.

E. Performs tests on selected avionics equipment to determine the Mean-Time-Between-Failures. This includes responsibility for assuring adequacy of both the environmental and testing set-ups, for performing the tests, for evaluating the data, and for preparing the final report.

III. Controls Over the Position

This position is under the supervision of the Manager of the Systems Effectiveness Section, Electronic Engineer. Instructions as to priorities and time limitations are normally provided with new assignments. The incumbent is responsible for determining the proper approach, planning, and carrying out the project assignments with assistance only on the more unprecedented problems encountered. Technical problems of this nature as well as those involving policy matters are usually discussed jointly with the Section and Branch Managers. Completed work is reviewed for general adequacy in meeting program objectives and policy conformance. Written guides utilized include engineering handbooks and textbooks, military specifications, technical reports and studies, etc. A portion of the work includes consideration of areas for which little or no precedent exists.
IV. Qualification Requirements of the Work

This position requires knowledge of scientific and engineering principles and theories in the field of electronics and related fields such as can be learned through completion of a full four-year curriculum in electronic engineering or physics plus appropriate experience in the particular area of application or work closely related thereto. Also knowledge of Aeronautical AR-10, A-34, AR-104, AR-108, AR-113, MIL-STD-781B MIL-HDBK-217B, MIL-HDBK-472, MIL-STD-480 MIL-T-18303B
1. **INTRODUCTION**

   This position is that of Manager of the Systems Effectiveness Branch, Aircraft Equipment Division, Quality Evaluation and Engineering Laboratory Department.

   A. The Systems Effectiveness Branch develops and implements programs for the analysis, prediction, improvement, and assurance of reliability and maintainability of avionic electronic systems and equipment.

   B. The Branch staff consists of electrical and mechanical engineers, physicists, and technicians. Three basic operating groups comprise the Branch: Reliability Standardization, Production Reliability Surveillance, and Engineering Support and Advanced Systems. Each operating group has as its leader a GS-12, Senior Program Manager. These groups have broad responsibilities in program management, system effectiveness analysis and evaluation, preparation and evaluation of specifications and standards, testing, and professional consulting.

   1. **Program Management**

      a. The Branch manages Reliability and Maintainability Demonstration Test Programs on a variety of equipments and complex systems. Such assignments are conducted for NAVAIRSYSCOM Project Engineers by providing liaison with avionics manufacturers, reviewing and approving the test procedures, monitoring the tests, analyzing test reports, and summarizing progress and results. Reliability and maintainability data obtained from these programs is used to make recommendations to NAVAIRSYSCOM for new procurements and program changes.
b. A broader Branch function is that of developing and managing Reliability Program Plans. Contracts for very large and complex systems usually require that the prime contractor develop and implement a Reliability Program Plan in accordance with MIL-STD-785 and any special provisions of the contract. This Branch is presently responsible for assuring the adequacy of the contractor's Reliability Program for the AM/USM-247 Versatile Avionics Shop Test (VAST) System and the Joint-Services-In-Flight-Data-Transmission-Systems (JIFDATS). Personnel assist the contractor in preparing the program plan, review it for approval, and maintain a surveillance over the contractor's efforts to fulfill the plan's requirements and objectives.

2. Systems Effectiveness Analysis and Evaluation

a. As a consequence of analyzing reliability and maintainability test reports, the Branch has available a data base which, when combined with information collected from the Fleet, is used to identify failure trends and improve equipment. These studies often require statistical analysis and data processing. Besides analyzing test and Fleet data, the Branch develops statistical test plans for evaluating sampling test data and making accept/reject decisions. Several of these test plans have been published in MIL-STD-781. Additionally, the Branch prepares reliability predictions and systems math models.

b. The Branch evaluates technical proposals submitted by contractors in many areas of systems effectiveness. The Branch has participated in contractor selection for: MIL-HDBK-217 "Reliability Stress and Failure Rate Data for Electronic Equipment", F14 and S3A Aircraft avionics, various
systems effectiveness studies, equipment reliability improvement programs, and automatic test equipments. Other duties include state-of-the-art studies in areas such as Built-In-Test (BIT) and defining future design requirements.

3. Preparation and Evaluation of Specifications and Standards
   a. Capable of preparing documents from conception to final printing, personnel in this area review, revise, and establish the systems effectiveness requirements of detailed equipment specifications. This Branch is responsible for assuring that adequate reliability requirements exist in many flight instrument equipment specifications. Equipment specifications, MIL-Handbooks, MIL-Standards, and other procurement documents are prepared for various NAVAIR/COM and other DOD Offices. They included MIL-STD-781, MIL-HDBK-217, AR-10, MIL-I-8790, AR-34, and AV-2000.

4. Testing
   a. The Branch performs AGREE Reliability Tests, including temperature cycling and vibration, on fuel quantity, airspeed, and attitude indicators. Such testing can be performed once on a small number of equipments or by lots as production tests.

5. Consultation
   a. The experience gained through the variety of programs conducted by this Branch is often called upon by NAVAIR/COM when specific problems arise. These problems may be in avionic equipment systems effectiveness or, in many cases, far outside this realm. Representatives of this
Branch have been asked to represent NAVAIRSYSCOM in several design review, contract definition, and proposal evaluation meetings. Engineering analysis on such varied problems as waveguide corrosion, life-cycle costing, foam mount design, and TWT tube failures have been conducted.

b. Recently the Branch was requested to investigate medical instrument reliability to determine if reliability assurance requirements were being adequately specified. Now, a representative of this Branch is working with the Veterans Administration to update quality assurance provisions in their specifications and is serving as chairman of the recently organized Reliability Committee of the Association for the Advancement of Medical Instrumentation (AAMI).

II. MAJOR DUTIES AND RESPONSIBILITIES

A. Administrative Duties - The Branch Manager is responsible for the overall planning, organizing, staffing, directing, and controlling of the Branch. He coordinates the Branch effort to efficiently accomplish the objectives of assigned tasks; and, if necessary, personally accomplishes or participates in the more difficult project work.

Task assignments are usually received in the form of letters from NAVAIRSYSCOM and come via the Division Supervisor along with any special instructions from that level. Because of the broad scope of written task assignments under which the Branch works, frequently assignments are received verbally from cognizant Naval Command project engineers during liaison contacts by the incumbent.
b. Conduct such in-plant surveillance of the contractor's activities, testing, and scheduling for the reliability and maintainability effort as is necessary to determine their adequacy.

c. Review and comment on data resulting from the reliability and maintainability demonstrations, verify any calculations used, and note failure trends.

d. Report to NAVAIRSYSCON when poor design practices are employed, and make suggestions for improvements of equipment or procedures.

7. Reliability and Maintainability of Aircraft Bomb Racks - To report to NAVAIRSYSCON summaries of reliability and maintainability data received by this activity on aircraft bomb racks; and review and comment on the reliability and maintainability portions of armament equipment specifications.

C. Supervision Over Others - In carrying out the foregoing responsibilities, the Branch Manager exercises direct technical and administrative supervision over the work of the three Senior Program Managers, PD #1212, GS-855-12, PD #1352, GS-855-12; and PD #1252, GS-1910-12. Through them, he will exercise indirect supervision over the work of other engineering, scientific, and technical personnel in grades GS-5 through GS-11.

III. CONTROLS OVER THE POSITION

This position is under the supervision of the Manager of the Aircraft Equipment Division, PD #6100. Assignments defining program objectives are normally received by letter from Naval Commands and are usually relayed by the supervisor directly to the incumbent with instructions only as to personnel and budget limitations. Incumbent is expected to resolve problems regarding requirements of assigned projects directly with the originator. Problems of correlation
with other programs and policy questions are resolved through conferences and meetings with superiors. However, the incumbent is fully accountable for the effectiveness of Branch operations. Completed work is subjected to technical and administrative control for review of program accomplishments, economy of management, and adherence to established policies.

IV. QUALIFICATION REQUIREMENTS OF THE WORK

This position requires knowledge of scientific and engineering principles and theories in electronics and related fields such as can be acquired through completion of a full four year curriculum in a recognized college or university leading to a Bachelors Degree in Electrical Engineering or equivalent. The incumbent must also have an understanding of statistics, reliability and maintainability, and substantial experience in preparing test plans, specifications, procedures and program plans. The position also requires supervisory experience and capabilities to coordinate and guide work effort of engineers and scientists involved in the various Branch programs.
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### COMPREHENSIVE PLANS, continued

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### U.S. Civil Service Commission

**Bureau of Retirement, Insurance, and Occupational Health**

**FEDERAL EMPLOYEES HEALTH BENEFITS PROGRAM 1975 BIWEEKLY HEALTH BENEFITS RATES**

**BIWEEKLY WITHHOLDING RATES FOR ALL PLANS AND OPTIONS FOR 1975**

- These rates apply to all Federal employees on a biweekly pay schedule except Postal Service employees. Postal Service employees should contact their personnel office or head of installation for information. 
- For 1975, the biweekly Government contribution is increased from $5.49 to $7.64 for a self only and from $13.67 to $18.93 for a family enrollment, but no more than 75% of the total cost of any type of enrollment. 
- Your biweekly withholding from pay in 1974 and 1975 is shown below. 
- To find whether your biweekly withholding increases or decreases in 1975, compare amounts shown in last two columns for your plan and type of enrollment.
- Equivalent monthly withholding and contribution rates are approximately 2/3 times the biweekly rates.

### GOVERNMENT-WIDE PLANS

<table>
<thead>
<tr>
<th>Enroll. Code</th>
<th>Type of enrollment</th>
<th>In 1974 enrollee paid</th>
<th>In 1975 enrollee pays</th>
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<tbody>
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<td>Service Benefit Plan (Blue Cross-Blue Shield)</td>
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### EMPLOYEE ORGANIZATION PLANS

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**COMPREHENSIVE PLANS**

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*New plan effective January 1975.

<table>
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<tr>
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<th>In 1974 enrollee paid</th>
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<td>805*** Self and Family—Low Option</td>
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</table>

*New plan effective January 1975
**These are new enrollment codes.
***Low Option discontinued.
GENERAL INFORMATION ON REDUCTION IN PERSONNEL AT NAV CRANE

1. DEFINITIONS
   a. Temporary Employee - Employees serving under a Temporary limited appointment not to exceed one year.
   b. Taper Employee - Employees serving under Temporary Authority issued by the Civil Service Commission pending the establishment of a register of eligibles.
   c. Term Employee - Employees serving under temporary appointment with a four-year tenure or an extension beyond 4 years, but with specific limitation. All term employees at Crane were converted to these appointments 7 April 1968.
   d. Career-Conditional Employee - Employees serving under an appointment made on a permanent basis but who has less than three years continuing service under this appointment.
   e. Career Employee - Employees serving under a permanent appointment who has completed three years or more service under career-conditional appointment.
   f. Excepted Employee - Employees holding an appointment excepted from the Competitive Civil Service System by law, executive order or regulation. (Examples include Vietnam veterans holding Veterans' Reemployment Appointments (VRA), severely handicapped employees and undergraduate college students working under cooperative work-study agreements.)
   g. Representative Rate - The step rate used in determining valid job offers in a reduction-in-force. Regulations prescribe that the step rates to be used for this purpose are the 4th step of the General Schedule (GS) for positions subject to the Classification Act, the 2nd step rate for positions paid from a 3-step wage scale, and the 3rd step rate for positions paid from a 5-step wage schedule.
   h. Competitive Level - A group of positions that are of the same grade level and are sufficiently similar as to duties and knowledge and skills needed to perform the work that interchange of employees is feasible without undue interruption of the work.
   i. Competing Employees - Employees serving under appointment not limited to one year or less.
   j. Non-Competing Employee - Employees serving under appointment with specific time limitation of one year or less. An employee with unsatisfactory performance rating regardless of type of appointment is a non-competing employee.
   k. Retention Subgroups - A grouping of employees according to the type of appointment and veteran's preference. (This grouping is illustrated in paragraph 3 below).
   l. Retention Register - A list of employees by competitive level in retention order.

2. NOTICE PERIODS
   a. Temporary, Taper, and Term Employees
      (1) Employees serving under temporary appointments not to exceed one year, will be given an advance notice of five working days. The five days will be in a work status if possible.
      (2) Employees serving under Taper and Term appointments will be given a 30-day advance notice in a work status if possible.
   b. Career and Career-Conditional Employees
      (1) When a reduction in force involves 100 or more employees, an advance notice of 60 days in a duty status, if possible, is required.
      (2) When a reduction involves less than 100 employees, a 30-day advance notice in duty status, if possible, is required.
      (3) In either (1) or (2) above, the employee, upon his request, shall be carried on leave without pay or annual leave, if available, for such additional time as necessary to provide a 90-day notice period prior to separation.

3. ORDER OF SEPARATIONS
   a. General. Employees serving under Temporary appointments will be separated before employees in the same competitive level who hold Term and TAPER appointments.
      (1) Employees in Wage Grade Positions. Employees within each category of Temporary, Term and TAPER will be separated from each competitive level in retention order. That is, employees with the shortest period of creditable Federal Service will be released first. Consideration will also be given to Veteran’s Preference as explained in paragraphs 3b, 4 and 3 below.
      (2) Employees in Classification Act Positions. Temporary Classification Act employees will be separated in the order in which their positions are eliminated, rather than by retention order. This means that when a Classification Act position occupied by an employee on a temporary limited appointment is abolished, the employee occupying that position is terminated.
   b. Except as indicated above for temporary employees in Classification Act positions, the order of release from a competitive level will be according to the following retention subgroups (unless the employee involved is entitled to another job offer, release from his competitive level will also result in his separation):
      (1) OB - Non-veteran employees serving on temporary limited appointments.
      (2) OA - Veteran employees serving on temporary limited appointments.
      (3) 6B - Term non-veteran employees serving on temporary promotions.
      (4) 6A - Term veteran employees serving on temporary promotions.
      (5) 5B - Career-conditional non-veteran employees serving on temporary promotions.
      (6) 5A - Career-conditional veteran employees serving on temporary promotions.
      (7) 4B - Career non-veteran employees serving on temporary promotions.
      (8) 4A - Career veteran employees serving on temporary promotions.
      (9) 3B - Term and TAPER non-veteran employees.
(10) 3A - Term and TAPER veteran employees.
(11) 2B - Career-conditional non-veteran employees.
(12) 3A - Career-conditional veteran employees.
(13) 1B - Career non-veteran employees.
(14) 1A - Career veteran employees.

Also included in these retention sub-groups are career employees who are serving a probationary period and career employees who are serving in obligated positions. (Obligated positions are positions to which other employees have statutory restoration rights.)

NOTES: 1. Employees in Groups 0, 6, 5, and 4 and employees with an unsatisfactory performance rating are called non-competing employees. All employees in these groups in the same competitive level will be removed from the competitive level before any competing employee is reallocated.

2. Employees on temporary promotion are non-competing employees in the competitive level to which temporarily promoted. They compete for retention only in the competitive level of their regular job.

3. Release from each temporary promotion sub-group above will be by retention order. That is, employees with the shortest period of creditable Federal Service will be released first. Employees within the same sub-group with the same service date will be released in inverse alphabetical order.

4. Under the Dual Compensation Act, retired members of the Armed Forces working in Civil Service positions are considered to be non-veterans and have no veterans' preference in a reduction-in-force. Exceptions to this rule are those retired veterans who have less than 20 years of full-time active service, those whose retirement was based on disability incurred in the line of duty during a period of war, or those who have been employed on a federal civilian job continuously since 30 November 1964. For reduction-in-force purposes, retired members of the Armed Forces, not covered by one of the exceptions in the preceding sentence, receive credit for only that military service performed during wartime or in a campaign or expedition for which a campaign badge has been authorized.

4. REASSIGNMENT RIGHTS (Bump and Retreat)

a. Temporary Employees
(1) Employees holding temporary limited appointments have no reassignment rights.
(2) Employees holding TAPER appointments have no reassignment rights.
(3) Employees holding Term appointments have no reassignment rights, but may be administratively assigned to other SEA positions. Veteran's preference eligibles may displace non-veterans. It is NAD Crane policy that Term veterans will place Term non-veterans, and temporary employees in continuing SEA support positions for which they qualify.

b. Career and Career-Conditional Employees
(1) Career and Career-Conditional employees released from a competitive level are entitled to assignment to another position in one of the following ways:
(a) To a continuing position in another competitive level for which he qualifies, but is occupied by an employee in a lower retention sub-group. In this situation a 1A employee can displace a 1B or an employee in group 2 or 3. A 1B can displace an employee in group 2 or 3. A 2A can displace a 2B or an employee in group 3. This right to displace on the basis of sub-group superiority is known as reassignment or "bumping" rights.
(b) To a position from which he was previously promoted and which is occupied by an employee with a later service date in the same or lower retention sub-group. In this situation a 1A with a service date of 3-17-55, can displace another 1A with a service date of 3-18-58. He can also displace an employee in sub-group 1B or in group 2 or 3. This is known as "retreat rights".

2) A Career or Career-Conditional employee reached for a reduction-in-force may be assigned to a vacant position for which he qualifies, which is the same grade or level and/or equal representative rate to the best offer available under (1) (a) and (b) above. (This will satisfy his reduction-in-force rights.) The employee involved does not have the right to choose the position to which he will be assigned.

5. QUALIFYING FOR REASSIGNMENT (Bump & Retreat)

To be eligible to bump or retreat, an employee must not only have superior retention rights to the employee in the position, but also be sufficiently qualified so that he can assume the position without undue interruption of the work. This means that he must be fully qualified - including meeting the physical qualifications of the job for which he is being considered under bumping and retreat rights. If the physical requirements for the position for which he is being considered are greater than the one in which he is performing, a current physical examination is necessary. As the situations are identified, the Civilian Personnel Department requests the Medical Department to schedule and conduct physical exams as rapidly as possible. Employees should protect their rights to possible job offers under RIF by cooperating fully in the physical examining process. If they subsequently wish to decline the offer or even to appeal the decision that it represents their "best offer", they still have that right. However, if it cannot be determined that they are "fully qualified", the offer cannot be made in the first place!

6. DECLINATION OF OFFERS IN REDUCTION IN FORCE

a) Regulations require that an employee separated from a competitive level must be given his "best" offer based on available positions and his retention standing. The "best" offer is determined on the basis of pay, using the representative rate method.

b) An employee may decline his "best" offer if he chooses. However, such a declination will not entitle him to an offer of another position. Rather, the declination of a valid (best) offer in RIF will result in separation of the employee involved
7. RELEASE OF EXCEPTED EMPLOYEES. Excepted employees do not compete in reduction-in-force with employees in the competitive service. They do compete with other employees in the excepted service. Excepted employees are grouped separately on retention registers by competitive levels and subgroup retention standing the same as described above. As management determines that positions occupied by excepted employees must be exceeded, the employees involved compete within the excepted service for the remaining positions. Those who are not entitled to an offer of another excepted position are separated.

8. VETERANS vs NON-VETERANS. A mistaken impression seems to persist that it is illegal or improper to separate employees with veteran's preference while non-veteran employees remain in the workforce. A look at the provisions of RIF regulations as explained in paragraphs 3 and 4 above should readily reveal the true situation. Veteran's preference applies within the retention group for RIF purposes. Since non-competing employees must be separated from a competitive level before any of the competing employees, it is required that temporary veteran employees be separated from a given competitive level ahead of non-veteran employees in retention subgroups 3b, 2b, and 1b. Similarly, a term veteran employee will be separated from a competitive level before career/conditional and career non-veterans in retention groups 2b and 1b, etc.

9. SEVERANCE PAY
a. Temporary, Term and TAPER Employees
(1) Employees serving under these appointments are not eligible for severance pay.
b. Career and Career-Conditional Employees
(1) Employees working under career-conditional or career appointments are entitled to severance pay if they are separated in reduction-in-force, provided they have worked without any break in service of more than 3 days for a minimum of 12 calendar months preceding the date of separation.
(2) A career-conditional or career employee is also entitled to severance pay if he meets the 12 months service requirement and if he declines an offer of lower grade and rate of pay (exclusive of any retention reward) and is separated in RIF as a result of that declination. The declaration of an "equivalent position" (which means one that provides a rate of pay at least equal to his current rate of pay) makes an employee ineligible for severance pay.
(3) Severance pay is computed as follows: 1 week of basic compensation for each year of creditable service up to 10 years, 2 weeks of basic compensation for each year of creditable service beyond 10 years. In addition, the basic compensation is increased by 10% for each year employee's age exceeds 40. The total amount cannot exceed 1 year's pay at the rate of pay in effect immediately prior to separation.
(4) Employees entitled to an immediate annuity at the time of separation, or who are receiving compensation under the Federal Employee's Compensation Act are not entitled to severance pay.

10. RETENTION REGISTER
a. Official retention registers are maintained by the Civilian Personnel Department in Building 5. Employees may obtain information concerning their standing on the retention register by calling extension 1563. They may also make an appointment to see that part of the retention register in which their competitive level appears.
b. After an employee receives a RIF notice indicating a job offer or separation under RIF procedure, he is entitled to see any retention register which has a bearing on the action affecting him. Normally this opportunity would be provided at the same time as his counseling interview as explained in paragraph 11.

11. COUNSELING
a. A member of the Civilian Personnel Staff will be available for individual or group counseling on specific questions concerning reduction-in-force notices and to help enroll employees being separated in reemployment programs. Supervisors will arrange for counseling appointments.

12. REEMPLOYMENT BENEFITS AND OUTPLACEMENT SERVICE (CAREER AND CAREER-CONDITIONAL EMPLOYEES ONLY)
a. Reemployment Priority List (NAD Crane)
   (1) Employees' names will be entered on this list for the positions from which they were separated and for positions for which they qualify. Names will be listed in retention subgroup order and considered in that order for reemployment.
   (2) Separated career status employees will be carried on the Reemployment Priority List for 2 years and separated career-conditional employees will be carried for 1 year, unless their reemployment rights are satisfied earlier.
   (3) Priority consideration of employees on the Reemployment Priority List is limited to positions of representative rate equal to or below the position from which they were separated in RIF.
b. Department of Defense Priority Placement Program
   (1) This program provides additional priority employment consideration at Federal establishments in locations where separated employees are willing to accept employment.
c. Civil Service Commission's Displaced Career Employee Program
   (1) This program provides additional priority employment consideration at Federal establishments in locations where separated employees are willing to accept employment.
d. Details concerning the method used to apply for programs stated in (b) and (c) above, will be discussed with employees during their counseling interview.
e. In addition, every reasonable effort will be made to place employees with outside employers.

13. OUTPLACEMENT SERVICE (TEMPORARY EMPLOYEES)
a. Assistance will be given by advising on employment opportunities which may be possible through the Civil Service Commission registers.
b. Advice will also be provided on filing with the Indiana Employment Security Division for jobs which may be available in the area and for unemployment insurance benefits.
NOTIFICATION OF PERSONNEL ACTION

EMPLOYEE—See General Information on Reverse

STANDARD FORM 50

U.S. Civil Service Commission
FPM Chap. 295

FOR AGENCY USE

1. NAME (CAPS) LAST-FIRST-MIDDLE
   MARKS ROBERT J
   MR.-MISS-MRS.

2. (FOR AGENCY USE)

3. BIRTH DATE
   (Mo., Day, Year)
   06/25/50

4. SOCIAL SECURITY NO.
   0 282-40-2721

5. VETERAN PREFERENCE
   1-NO 3-10 PT. DISAB 5-10 PT. OTHER
   2-5 PT. .4-10 PT. COMP
   11

6. (FOR AGENCY USE)
   6A. TENURE GROUP
   2

7. SERVICE COMP. DATE
   03/25/74

8. FEGL
   1 - COVERED (Regular only—declared Optional)
   2 - INELIGIBLE
   3 - WAIVED
   4 - COVERED (Reg.—Opt.)

9. RETIREMENT
   10. REORGANIZATION CHANGE
   04/01/75

11. (FOR CSC USE)

12. CODE NATURE OF ACTION

13. EFFECTIVE DATE
   (Mo., Day, Year)

14. CIVIL SERVICE OR OTHER LEGAL AUTHORITY

15. FROM:
   POSITION TITLE AND NUMBER
   ELECTRONICS ENGINEER
   304260041

16. PAY PLAN AND OCCUPATION CODE
   GS 00855

17. (a) GRADE (b) STEP OR RATE
   09 02 PA 313269

18. SALARY

19. NAME AND LOCATION OF EMPLOYING OFFICE

20. TO:
   POSITION TITLE AND NUMBER
   ELECTRONICS ENGINEER
   304260041

21. PAY PLAN AND OCCUPATION CODE
   GS 00855

22. (a) GRADE (b) STEP OR RATE
   14 09 02 PA 313269

23. SALARY

24. NAME AND LOCATION OF EMPLOYING OFFICE
   WEAPONS QUALITY ENGR CENTER - 30
   MAD CRANE, INDIANA
   CRANE, MARTIN, INDIANA
   LAND AND PROGRAMS DIVISION - 304
   SYSTEMS EFFECTIVENESS OR - 3041

25. DUTY STATION (City—county—State)

26. LOCATION CODE
   18-1055-101

27. APPROPRIATION
   FAIR LABOR - EXEMPT

28. POSITION OCCUPIED
   1-COMPETITIVE SERVICE

29. APPORTIONED POSITION
   FROM:
   1 - PROVED - 1
   2 - WAIVED - 2

30. REMARKS
   A. SUBJECT TO COMPLETION OF 1
   YEAR PROBATIONARY (OR TRIAL) PERIOD COMMENCING
   B. SERVICE COUNTING TOWARD CAREER (OR PERMANENT) TENURE FROM
   C. DURING PROBATION

SEPARATIONS: SHOW REASONS BELOW, AS REQUIRED. CHECK IF APPLICABLE:
RESULT OF REORGANIZATION

31. DATE OF APPOINTMENT AFFIDAVIT (Accessions only)

32. CODE
   EMPLOYING DEPARTMENT OR AGENCY
   NV23

33. APPROVING OFFICE
   DEPARTMENT OF THE NAVY

34. SIGNATURE (Overprint Affidavit) AND TITLE
   T. SMITH
   PERSONNEL STAFFING SPECIALIST

35. DATE
   05/09/75

36. SUBMITTING OFFICE NUMBER
   29062

I. EMPLOYEE COPY
Payable to the order of Bob Wilke.

2/20/93

$20.00

JTS

DePauw State Bank

Farmersburg, Indiana
RESUME

JANUARY 1974

ROBERT J. MARKS II
2531 Jefferson
Terre Haute, Indiana 47802
(812) 234-2570

Education
Garfield Heights High School
Garfield Heights, Ohio
Rose-Hulman Institute of Technology
Terre Haute, Indiana
Major: Electrical Engineering
Degrees: B.S. (1972), M.S. (1973)

Major Course Work
Laser Optics (Linear Systems, Communications Systems,
Electromagnetic Waves, Fourier Optics, Thesis Research)
Acoustics (Traveling Waves, Acoustics, Advanced Acoustics)
Statistics (Probability and Statistics, Statistical Methods,
Statistical Inference)

Research Papers
"Holographic Recording of Variant Systems" (Master's Thesis)
"Derivations and Applications of the Modern Tempered Scale"

Scholarships and
Awards
Tuition Grant for Graduate Study at Rose-Hulman (1972-3)
Rose Honor Key for outstanding academic and extracurricular
activities)

Extracurricular
Activities
Broadcasting Club of Rose-Hulman (Member, Editorial Board
Chairman, Continuity Director, Chief Announcer, General
Manager)
The Rose Thorn (Cartoonist)
Rose-Hulman Glee Club (Member)
The Rose Technic (Cartoonist)

Employment and
Experience
Ford F. M. Inc. (WFRR-WKZI)
West Terre Haute, Indiana
Music Director, Disc Jockey
Undergraduate Physics Lab Instructor
FCC License Class Instructor
Guest Lecturer in Fourier Optics on Piecewise Isoplanic

Employment
Objectives
Position in research, development, or teaching in the field
of Laser Optics, Acoustics, or Statistics.

Personal
Single 6'11" 185 lbs. Born: 8-25-50
Draft Classification: 1-H
Church: Lutheran

Hobbies and Outside
Activities
Member of IEEE
Music (Theory, Guitar, Bass, Composition- 58 Musical
Compositions Copyrighted)
Cartooning

References
See attached list.
REFERENCES

Dr. Thomas F. Krile  
Professor of Electrical Engineering  
Rose-Hulman Institute of Technology  
118 LaSalle Drive  
Terre Haute, Indiana  
(812) 299-9189

Dr. Harold A. Sabbagh  
Professor of Electrical Engineering and Physics  
Rose-Hulman Institute of Technology  
20 Douglas Place  
Terre Haute, Indiana  
(812) 877-1415

Paul Dean Ford  
President of Ford FM Inc.  
Professional Engineer  
R.R. 2, Box 50  
West Terre Haute, Indiana  
(812) 533-1661

ADDITIONAL REFERENCES FURNISHED ON REQUEST
### PART A—NOTIFICATION OF BASIC PAY CHANGE

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17. PERFORMANCE IS SATISFACTORY OR BETTER

### PART B—DATA ON UNPAID ABSENCE

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### PART D—REMARKS

RESULT OF E 0 11811 APPROVED 7 OCTOBER 1974.

STANDARD FORM 1126 (5-part Cont.)

PAYROLL CHANGE SLIP — EMPLOYEE'S COPY

U.S. CIVIL SERVICE COMMISSION

FPM SUPPLEMENT 296-31

February 1966
1126-127
FAILURE DELETION CONFIDENCE UPON IMPLEMENTATION OF CORRECTIVE ACTION DURING EXPONENTIAL SEQUENTIAL TESTING

ROBERT J. MARKS II
CODE 3041
NAVAL AMMUNITION DEPOT
CRANE, INDIANA 47522
ABSTRACT

Confidence levels are placed on the action of deleting failures generated by a failure mode of a system which has been subjected to corrective action during an exponential sequential test.
Physical implementation of sequential testing many times violates the underlying assumption by which the test was formulated. For example, the often contractually required sequential test methods of MIL-STD-781B (1, 2) allow for deletion of failures generated by a troublesome failure mode upon implementation of a corrective action and subsequent substantiation testing (3). Ideally, a system change during a sequential test should be cause for test abortion and reinitiation. Such a practice, however, wastes information gained during initial testing and is thus clearly not always optimally cost effective. The level of confidence at which one may delete failures of an uncorrected mode is thus addressed with attention restricted to the exponential case.

The system under inspection is viewed as a number of statistically independent exponential series failure modes. The modes of interest (those having the higher failure rates) are those expected to be exposed during test. Consider a single mode which has experienced failures up to test time $T_u^*$ at which time corrective action is implemented. The system, and thus the corrected mode, is tested an additional time $T_c^*$ during which $T_c^*$ mode failures occur. In order to delete all failures occurring during $T$ at a confidence level of $1 - \alpha$, one must establish the probability of a non-occurrence of a failure during $T_u^*$ using information gained during $T_c^*$. This is equivalent to

$$P(\Theta_c \geq T_u | T_c, r_c) = 1 - \alpha$$ (1)

* $u$ and $c$ subscripts refer to parameters of the uncorrected and corrected mode respectively.
From elementary statistics (4)

\[ P(\Theta_c \geq \frac{2T_c}{\chi^2_{\alpha; \nu}}) = 1 - \alpha \]  

(2)

where \( \chi^2_{\nu} \) is the chi-squared PDF with \( \nu \) degrees of freedom. For the time terminated test, one usually lets

\[ \nu_p = 2(r + 1) \]  

(3)

This assignment, however, assumes a failure immediately after test termination at time \( T_c + dt \) and is employed primarily to avoid the awkward situation of \( \nu = 0 \). Thus the \( p \) (for pessimistic) subscript. A more optimistic assignment is

\[ \nu_o = 2r + 1 \]  

(4)

This condition essentially assumes the occurrence of 1/2 failure at test time \( T_c + dt \) and, although more favorable to the producer, is still weighted toward the customer. One might have the tendency to further reduce the assumed failure to 1/3 or 1/4, but in the limit, the undesirable situation of \( \nu = 0 \) is again encountered. The 1/2 failure case seems to be the golden mean between fairness to the producer and mathematical nicety.

Comparing equations 1 and 2 yields the relationship by which failure reclassification confidence can be found.

\[ \frac{T_c}{T_u} = \frac{1}{2} \chi^2_{\alpha; \nu} \]  

(5)
Consider now the optimal producer's case in which \( r_c = 0 \).

For the pessimistic case, \( \gamma_p = 2 \). Since

\[
\alpha = e^{-\frac{1}{2} \chi^2_{\alpha;2}}
\]  

(6)

the pessimistic reclassification confidence from equations 3 and 5 is

\[
1 - \alpha_p = 1 - e^{-\frac{T_c}{T_u}}
\]  

(7)

Curiously, this expression is recognized as the mode unreliability at \( T_c \) assuming a mode MTBF of \( T_u \). For the optimistic case \( \gamma_o = 1 \) and

\[ 1 - \alpha_o \]

is found from

\[
\frac{T_c}{T_u} = \frac{1}{2} \chi^2_{\alpha_o;1} = \frac{1}{2} z_{\alpha_o/2}
\]  

(8)

where \( z \) refers to the standardized normal distribution.

For purposes of comparison, \( 1 - \alpha_o \) and \( 1 - \alpha_p \) vs. \( T_c / T_u \) is offered in Figure 1.

For the case of \( m \) modes having undergone corrective action during test, the confidence, \( 1 - \alpha_M \), for reclassifying all of the failures resulting from the uncorrected mode is

\[
1 - \alpha_M = \prod_{n=1}^{m} (1 - \alpha_n)
\]  

(9)

where \( 1 - \alpha_n \) is the reclassification confidence of the \( n^{th} \) mode.

Note that no assumptions have been made concerning the underlying distribution of the uncorrected mode. Upon correction, however, a constant failure rate is assumed for the mode and thus the system.
(1) MIL-STD-781B "Reliability Tests: Exponential Distribution"
(2) B. Epstein, A. A. Patterson, C. R. Qualls "The Exact Analysis of Sequential Life Tests with Particular Application to AGREE Plans", Aerospace Reliability and Maintainability Conference 1963
FIGURE CAPTIONS:

Fig. 1: Optimistic $(1-\alpha_e)$ and pessimistic $(1-\alpha_p)$ reclassification confidence vs. $\frac{T_c}{T_u} = \text{corrected mode test time/uncorrected mode test time.}$
OTHER REPRESENTATIONS OF $\chi^2_{a;\nu}$; $\nu = 1, 2$

GENERAL:

$$f_{\chi^2_{\nu}}(x) = \frac{1}{\Gamma(\nu/2)} 2^{\nu/2} x^{\nu/2 - 1} e^{-x/2} \mu(x)$$

$$\alpha = \int_{\chi^2_{a;\nu}} f_{\chi^2_{\nu}}(x) \, dx$$

I. FOR $\nu = 1$:

$$f_{\chi^2_{1}}(x) = \frac{1}{\Gamma(1/2)} 2^{1/2} x^{-1/2} e^{-x/2} \mu(x)$$

$$\Gamma(1/2) = \sqrt{\pi}$$

$$\Rightarrow f_{\chi^2_{1}}(x) = \sqrt{\frac{1}{2\pi x}} e^{-x/2} \mu(x)$$

$$\alpha = \int_{\chi^2_{1;\alpha}} \sqrt{\frac{1}{2\pi x}} e^{-x/2} \, dx \ ; \ \chi^2_{1;\alpha} \geq 0$$

LET $x = z^2 \Rightarrow dx = 2z \, dz$

$x = \chi^2_{1;\alpha} \Rightarrow z = \sqrt{\chi^2_{1;\alpha}}$

$$\alpha = \int_{\chi^2_{1;\alpha}} \frac{2}{\sqrt{2\pi}} e^{-z^2/2} dz$$

$$\frac{\alpha}{2} = \int_{\chi^2_{1;\alpha}} \frac{1}{\sqrt{2\pi}} e^{-z^2/2} dz$$

WE KNOW: $\frac{\alpha}{2} = \int_{\chi^2_{1/2}} \frac{1}{\sqrt{2\pi}} e^{-z^2/2} \, dz$

THUS: $z_{a/2} = \chi^2_{1;\alpha}$
II. FOR $Y = 2$

$$f_{\chi^2_Y}(x) = \frac{1}{\Gamma(1/2)} e^{-x/2} \mu(x)$$

$$\Gamma(1) = 0! = 1$$

$$\Rightarrow f_{\chi^2_2}(x) = \frac{1}{2} e^{-x/2} \mu(x)$$

$$\alpha = \frac{1}{2} \int_{\chi^2_1;\alpha} e^{-x/2}$$

$$= e^{-\chi^2_{a/2}/2} \Rightarrow \chi^2_{a;2} = 2 \ln\alpha$$

---

APPLICATION TO RECLASSIFICATION CONFIDENCE

$(1 - \alpha)$

I. OPTIMISTIC: $Y = 1$

$$\chi^2_{a;1} = \frac{2T_e}{T_u} = z^2_{a/2}$$

II. PESSIMISTIC: $Y = 2$

$$\chi^2_{a;2} = \frac{2T_e}{T_u} \Rightarrow \alpha = e^{-\chi^2_{a;2}/2} = e^{-T_e/T_u}$$
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<th>( \frac{\alpha_o}{2} )</th>
<th>( 1 - \alpha_o )</th>
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<tr>
<td>1.5</td>
<td>1.791</td>
<td>0.0367</td>
<td>0.927</td>
<td>0.798</td>
</tr>
<tr>
<td>1.6</td>
<td>1.844</td>
<td>0.0327</td>
<td>0.934</td>
<td>0.817</td>
</tr>
<tr>
<td>1.7</td>
<td>1.904</td>
<td>0.0267</td>
<td>0.943</td>
<td>0.835</td>
</tr>
<tr>
<td>1.8</td>
<td>1.954</td>
<td>0.0256</td>
<td>0.949</td>
<td>0.850</td>
</tr>
<tr>
<td>1.9</td>
<td>1.995</td>
<td>0.0228</td>
<td>0.955</td>
<td>0.855</td>
</tr>
<tr>
<td>2.0</td>
<td>2</td>
<td>0.0179</td>
<td>0.964</td>
<td>0.859</td>
</tr>
<tr>
<td>2.2</td>
<td>2.101</td>
<td>0.0126</td>
<td>0.971</td>
<td>0.889</td>
</tr>
<tr>
<td>2.4</td>
<td>2.191</td>
<td>0.01130</td>
<td>0.977</td>
<td>0.909</td>
</tr>
<tr>
<td>2.6</td>
<td>2.281</td>
<td>0.00589</td>
<td>0.982</td>
<td>0.926</td>
</tr>
<tr>
<td>2.8</td>
<td>2.371</td>
<td>0.00714</td>
<td>0.985</td>
<td>0.939</td>
</tr>
<tr>
<td>3.0</td>
<td>2.451</td>
<td>0.03745</td>
<td>0.251</td>
<td>0.950</td>
</tr>
<tr>
<td>0.05</td>
<td>0.316</td>
<td>0.964</td>
<td>0.251</td>
<td>0.950</td>
</tr>
</tbody>
</table>
P[Correct Reclassification at 1-\(\alpha\) Confidence | \(\Theta\)]

\[= P[r = 0 \text{ in test time } T_c | \Theta] \]

\[= R(T_c | \Theta) \]

\[= e^{-T_c / \Theta} = \alpha e^{-T_u / \Theta} \]

\[e^{-T_c / \Theta} = e^{-\alpha / \Theta} \]

\[1 - \alpha = 1 - e^{-T_c / T_u} \]

\[\alpha = e^{-T_c / T_u} \]

\[-\frac{T_c}{T_u} = \frac{\ln \alpha}{T_c = T_u \ln \alpha} \]

\[\Rightarrow e^{-T_c / \Theta} = e^{-T_u \ln \alpha / \Theta} = e^{\ln \alpha \frac{T_u}{\Theta}} = \alpha^{\frac{T_u}{\Theta}} \]

\[e^{-T_c / \Theta} = \alpha^{\frac{T_u}{\Theta}} \]
'r


\begin{align*}
\beta(t, \theta) &= 1 - \sum_{n=0}^{\theta} \left( \frac{t}{\theta} \right) \left(1 - e^{-t/\theta} \right)^n \left( e^{-t/\theta} \right)^{\theta - n} \\
&= 1 - e^{-t/\theta} = \rho(t/\theta)
\end{align*}

Let \( t_0 = t_{m1}, \theta = t_m \)

Then \( t_{m1}/t_m = \rho(t_{m1}/t_m) \).

\begin{align*}
1.6 & \quad 0.63 \\
2.6 & \quad 0.86 \\
3.8 & \quad 0.95 \\
1.7 & \quad 0.75 \\
1.4 & \quad 0.64 \\
2.3 & \quad 0.60 \\
4.6 & \quad 0.94 \\
\end{align*}

Some other examples:

\begin{align*}
\beta(5, 10) &= 1 - 0.75 = 1 - 0.75 = 0.25 \\
\beta(11.56, 11.3) &= 1 - 0.9999 \\
\end{align*}

Find \( t_{m1} \) for a failure at 15% given \( \theta = t_m \).
For mixture, \( n = 2, \phi = 2 \)

\[
\theta(\rho, \phi) = 1 - e^{-(\rho)(1-e^{-\phi})^2} (e^{-\phi})^n
\]

\[
= 1 - (e^{-2\phi} + 2(1-e^{-\phi})(e^{-\phi}))
\]

If \( \rho = 1650, \phi = 1663, \rho/\phi = 0.99 \)

\[
= 1 - [e^{-0.99} + 2(1-e^{-0.99})(e^{-0.99})]
\]

\[
= 1 - [0.34 + 2(0.63)(0.34)]
\]

\[
= 1 - [0.34 + 0.46] = 1 - 0.78 = 0.22
\]

For alternative determination. \( \rho/\phi = 1.08 \)

\[
f(\rho, \phi) = 1 - e^{-2(1650)/1663} = 1 - e^{-1.08} = 0.86
\]

For mixture

\[
f(\rho, \phi) = 1 - [e^{-0.99} + 2(1-e^{-0.99})(e^{-0.99})]
\]

\[
= 1 - [0.02 + 2(0.82)(0.14)]
\]

\[
= 1 - [0.02 + 0.24] = 0.74
\]
**Failure Reclassification Substantiation (FRST) Time/Confidence Table**

**Terms:**
- $1 - \alpha = \text{Recategorization Confidence}$
- $t = \text{Uncorrected Mode's Total Test Time}$
- $T = \text{FRST Time}$
- $\chi^2 = \text{Area to the Right of Chi-Square Probability Density Function}$
- (with 1 Degree of Freedom) Ordinate

<table>
<thead>
<tr>
<th>$\alpha$</th>
<th>$T/t = \frac{1}{2} \chi^2_{\alpha,1}$</th>
<th>$1 - \alpha$</th>
<th>$T/t \chi^2_{\alpha,1}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5%</td>
<td>0.0000019.6</td>
<td>99.5%</td>
<td>3.938</td>
</tr>
<tr>
<td>1.0%</td>
<td>0.0000078</td>
<td>99.9%</td>
<td>5.412</td>
</tr>
<tr>
<td>2.0%</td>
<td>0.000314</td>
<td>99.99%</td>
<td>7.378</td>
</tr>
<tr>
<td>2.5%</td>
<td>0.000491</td>
<td>99.999%</td>
<td>9.492</td>
</tr>
<tr>
<td>5%</td>
<td>0.00197</td>
<td>99.9999%</td>
<td>11.641</td>
</tr>
<tr>
<td>10%</td>
<td>0.0079</td>
<td>99.99999%</td>
<td>13.817</td>
</tr>
<tr>
<td>20%</td>
<td>0.0321</td>
<td>99.999999%</td>
<td>16.021</td>
</tr>
<tr>
<td>25%</td>
<td>0.051</td>
<td>99.9999999%</td>
<td>18.247</td>
</tr>
<tr>
<td>30%</td>
<td>0.074</td>
<td>99.99999999%</td>
<td>20.483</td>
</tr>
<tr>
<td>50%</td>
<td>0.227</td>
<td>99.999999999%</td>
<td>30.483</td>
</tr>
<tr>
<td>70%</td>
<td>0.537</td>
<td>99.9999999999%</td>
<td>40.483</td>
</tr>
<tr>
<td>75%</td>
<td>0.662</td>
<td>99.99999999999%</td>
<td>50.483</td>
</tr>
<tr>
<td>80%</td>
<td>0.821</td>
<td>99.999999999999%</td>
<td>60.483</td>
</tr>
<tr>
<td>90%</td>
<td>1.353</td>
<td>99.9999999999999%</td>
<td>70.483</td>
</tr>
<tr>
<td>95%</td>
<td>1.920</td>
<td>99.99999999999999%</td>
<td>80.483</td>
</tr>
<tr>
<td>97.5%</td>
<td>2.512</td>
<td>99.999999999999999%</td>
<td>90.483</td>
</tr>
<tr>
<td>99%</td>
<td>3.318</td>
<td>99.9999999999999999%</td>
<td>100.483</td>
</tr>
</tbody>
</table>
GROUP RECLASSIFICATION CONFIDENCE

Given confidences \( 1 - \alpha_1 \) and \( 1 - \alpha_2 \) in reclassifying failure modes 1 and 2 respectively, the confidence for reclassifying both modes simultaneously, \( 1 - \alpha_{12} \), is given by

\[
1 - \alpha_{12} = (1 - \alpha_1)(1 - \alpha_2)
\] (1)

The reclassification confidence of \( m \) modes, the \( n \)th of which has reclassification confidence \( 1 - \alpha_n \), is

\[
1 - \alpha_m = \prod_{n=1}^{m} (1 - \alpha_n) = (1 - \alpha_1)(1 - \alpha_2) \ldots (1 - \alpha_m)
\]

These relationships are valid if the failure modes are statistically independent.
PROOF:

The reclassification confidence of two failure modes may be stated as

\[ 1 - \alpha_{12} = P[\Theta_1 \geq T_{u_1} \text{ and } \Theta_2 \geq T_{u_2}] \]  

Assuming independence,

\[ 1 - \alpha_{12} = P[\Theta_1 \geq T_{u_1}] P[\Theta_2 \geq T_{u_2}] \]

\[ = (1 - \alpha_1)(1 - \alpha_2) \]  

Eq. 2 may easily be arrived at by induction.

Note, from Eq. 4, that

\[ \alpha_{12} = \alpha_1 + \alpha_2 - \alpha_1 \alpha_2 \]

\[ = \alpha_1 (1 - \alpha_2) + (1 - \alpha_1) \alpha_2 + \alpha_1 \alpha_2 \]

\[ = P[\Theta_1 \leq T_{u_1}] P[\Theta_2 \geq T_{u_2}] \]

\[ + P[\Theta_1 \geq T_{u_1}] P[\Theta_2 \leq T_{u_2}] \]

\[ + P[\Theta_1 \leq T_{u_1}] P[\Theta_2 \leq T_{u_2}] \]

Each term in this expression contains a probabilistic statement within which is an undesirable statement. Note that the risk of combining modes is not \( \alpha_1 \alpha_2 \):

\[ \alpha_{12} \neq \alpha_1 \alpha_2 \]
FOR AEL ARR-75 FAILURE RECLASSIFICATION

MODE  \(1 - \alpha_p\)  \(1 - \alpha_0\)
RF FILTER #1  .63  .80
#2  .63  .8
TRANSFORMER  .63  .8
CONNECTOR  .63  .8
MIXER  .25  .35

GROUP RECLASSIFICATION:

PESSIMISTIC
\[1 - \alpha_N = (0.63)^4 (0.25) = 0.04\]

WITHOUT MIXERS:
\[1 - \alpha_N = (0.63)^4 = 0.16\]

OPTIMISTIC
\[1 - \alpha_N = (0.8)^4 (0.35) = 0.14\]

WITHOUT MIXERS
\[1 - \alpha_N = (0.8)^4 = 0.11\]
NOTES ON PAPER

1. Any failures occurring during first must be substantiated not to have been a result of the corrected mode.

2. Employing non-worst case derivation considerations into required confidence level first test time in "required failure reclassification test time for a given confidence level" is as follows:

<table>
<thead>
<tr>
<th>C = T/t</th>
<th>1 - α</th>
<th>Worst Case</th>
<th>Alternate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.50</td>
<td>50%</td>
<td>0.69</td>
<td>0.23</td>
</tr>
<tr>
<td>0.75</td>
<td>75%</td>
<td>1.39</td>
<td>0.66</td>
</tr>
<tr>
<td>0.90</td>
<td>90%</td>
<td>2.30</td>
<td>1.35</td>
</tr>
<tr>
<td>0.95</td>
<td>95%</td>
<td>3.00</td>
<td>1.92</td>
</tr>
<tr>
<td>0.99</td>
<td>99%</td>
<td>4.61</td>
<td>3.31</td>
</tr>
</tbody>
</table>
3. Assumption of a constant failure rate for a complex system, such as is done in MIL-STD-781B, is a common practice. On the part level, however, the exponential assumption is not necessarily the best assumption. A study by Kao of Cornell, for example, found that electron tubes fail according to a Weibull distribution. Thus, conclusions drawn in the papers are only as good as the exponential assumption's validity.
MEMORANDUM

From: 3041 (R. J. Marks)
To: 3041 (C. Rice) (R. Saum)
VIA: 3041 (C. Rice)

Subj: Work Statement and Present Status (Revision of AR-34)

Ref: (a) 14 Feb 1975 Meeting (R. Saum, C. Rice, and R. Marks) at NAD Crane
(b) AR-34, "Failure Classification for Reliability Testing, General Requirements for"

ENC: a. 19 Feb 75 phone con. with Wm. T. Sumerlin
b. "Required Failure Classification Test Times" for a given confidence level
   critical reclassification, confidence, plan stated, test times

Discussion:

In reference (a), the need for a more specified definition of paragraph 3.3, number 2 of reference (b) was stated. That is, what constitutes "sufficient data" for substantiation of failure reclassification. Current "sufficient data" is determined solely by engineering judgement. Investigation of formulation of statistical guidelines for more precise failure reclassification will be the method of attack by this activity for drafting more precise "sufficient data" requirements.

In-house consultation possibilities included D. Kent, W. T. Sumerlin, former member of the AGREE committee, was also suggested as a consultant in the effort. Mr. Sumerlin has been subsequently contacted and has offered his support in the effort. (see enclosure (A)).

Areas to be explored in regard to the establishment of sufficient data requirements for substantiation of failure reclassification, subject to revision, or expansion are as follows:

1. Statement in item 1 in enclosure (A).
2. Statement in item 2 in enclosure (A).
Reclassification requirements of corrected failure modes under test with both no and apriori assumptions.

Correlation of failure mode and corrective action types to apriori weighting of sufficient data requirements.

Employment of established and/or recent statistical works in determining sufficient test data requirements.

Other areas exposed by investigation of the above items.

The present work status in these investigative avenues is reflected in enclosure (b) and (3). Application of the results to the failure reclassification efforts on the ARR-75. (AEL-EMTECH) is contained in enclosure (3).
During introductory phase, Mr. Sumerlin recalled Carl Wigginton and Bob Saum. He stated he was reflected a great deal on AR-34 and MIL-STD-781B, and has as a result, developed definite opinions. Which were reflected during the conversation as follows:

1. No "random failure" should be reclassified since the test is to short to show the benefits of the reclassification. In case of a reject decision, due only to random failures, the system under test should be corrected (by redesign or other corrective action), and the test reinitiated. The stated philosophy behind this opinion is that forethought in design is better than corrective action under test.

2. "Pattern Failures" should be subject to a degree of reclassification, since usually sufficient test time exists for qualification. Mr. Sumerlin stated pattern failures were not characteristic of the exponential assumption. To include the occurrence of the pattern failure as a random failure, a single failure should be counted upon reclassification.

3. Upon being asked about a random failure reclassification with a "no risk" determined via test, Mr. Sumerlin said such action would be possible in certain instances, if sufficient test time, etc. exists. Sumerlin was enthusiastic in his response and welcomed future contact regarding questions and consultation in this matter.
Required Failure Reclassification Test Time
for a Given Confidence Level

The problem under inspection:
A system failure mode, \( m \), has experienced failure(s) in test time \( t \) at which time corrective action (denoted \( m' \)) is taken. Employing the exponential assumption and no apriori judgement as to the corrective action's effectiveness, how long must one test the corrected system with no failures to establish with \( 1-\alpha \) confidence the non-occurrence of a failure in the uncorrected system test time \( t \).

Stated more rigourously, we must determine the required test time \( T \) to establish that

\[
P[E(r) < 1] = 1 - \alpha
\]

where

\[
P \sum P = e^{-\alpha T} = 1 - \alpha
\]

\( P \) is read "the probability that"

\( r \) is the number of failures in test time \( T \)

\( E(r) \) is the "expected value of \( r \)"

For an exponentially modeled failure mode (ie one that fails "randomly"),

\[
E(r) = \lambda_m' T
\]

where \( \lambda_m' \) is the constant failure rate of the corrected failure mode.

Noting that \( \Theta_m' \), the corrected failure mode's MTBF, may be written

\[
\Theta_m' = \frac{1}{\lambda_m'}
\]

Enclosure (2)
we may rewrite Eq. 1 as follows:

\[ P[\Theta_m > t] = 1 - \alpha \]  

(4)

We are thus testing the corrected mode to determine if its MTBF is greater than the uncorrected system test time. This, then, is equivalent to testing for the non-occurrence of a failure in test time \( t \) with \( 1 - \alpha \) confidence.

From elementary statistics, if an exponential population is tested for time \( T \) with \( r \) failures, \((1,2)\), is

\[ P[\Theta \geq \frac{2r \hat{\Theta}}{X^2_{\alpha;2r}}] = 1 - \alpha \]  

(5)

where

\( \hat{\Theta} \) is the test estimate (in this case mean MTBF) of the parameter

\( \alpha \) is the area to the right of \( B \) in the chi-squared probability density function with \( 2r \) degrees of freedom.

Comparing Eqs. 4 and 5, the failure reclassification substantiation test (FRST) requires that

\[ t = \frac{2r \hat{\Theta}}{X^2_{\alpha;2r}} \]  

(6)

We now assume that the FRST runs for time \( T \) (yet to be determined) without failure. Our best estimate of \( \hat{\Theta} \) in the strict statistical sense is infinity. In order that the analysis be more realistic, we assume the worst case condition in which a failure occurs immediately after conclusion of the RRST at time \( T + dt \). Thus,

\[ r = 1 \]
\[ \hat{\Theta} = \frac{\text{TOTAL TEST TIME}}{r} = T \]  

(7)

Substituting into Eq. 6 followed by rearrangement gives

\[ T = \frac{1}{2} t X^2_{\alpha;2} \]
This is the final desired relationship giving the required FRST time to establish with confidence the non-occurrence of over one failure in test time $t$ under stated worst case conditions. Note that

$$T > t \quad \text{for} \quad \chi^2_{\alpha/2} > 2 \quad (9)$$

Roughly,

$$\chi^2_{\alpha/2} > 2 \quad \text{for} \quad 1 - \alpha < 0.7$$

Thus, more FRST time is required than original test time when the reclassification confidence, $1 - \alpha$, is greater than 70%. Some typical values of $\chi^2$ as a function of are offered below:

<table>
<thead>
<tr>
<th>$1 - \alpha$ (Confidence)</th>
<th>$\chi^2_{\alpha/2}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>0.693</td>
</tr>
<tr>
<td>0.75</td>
<td>1.386</td>
</tr>
<tr>
<td>0.90</td>
<td>2.302</td>
</tr>
<tr>
<td>0.95</td>
<td>2.995</td>
</tr>
<tr>
<td>0.99</td>
<td>4.605</td>
</tr>
</tbody>
</table>

References:


(2) *Elements of Reliability and Maintainability*, AMETA, Rock Island IL, 1973, pg IV-48
1. Parameter definitions:

- $t$ - test time on uncorrected mode
- $T$ - test time on corrected mode
- $r$ - tallied failures during test of corrected mode
- $\hat{\theta}$ - Point estimate of the corrected failure mode; $\text{MTBF} = \frac{T}{r}$.
- $1-\alpha$ - Confidence in reclassification
- $\chi^2_{\alpha;r}$ Chi-squared probability density function ordinate (with $r$ degrees of freedom) to the right of which is area $\alpha$.
- $\Theta$ - True MTBF of corrected failure mode.

2. Derivation (Worst case condition)

Under the exponential assumption, the MTBF confidence interval (1,2) for the failure reclassification substantiation that (FRST) (3) is

$$P[\Theta \geq \frac{2r\hat{\theta}}{\chi^2_{\alpha;2r}}] = 1 - \alpha$$

(1)

Since

$$\hat{\theta} = \frac{T}{r}$$

(2)

we have equivalently

$$P[\Theta \geq \frac{2T}{\chi^2_{\alpha;2r}}] = 1 - \alpha$$

(3)

To avoid the $r = 0$ situation, a worst case condition is assumed. This condition is the occurrence of a failure at FRST time $T + dt$. Thus,

$$r = \text{number of observed failures} + 1$$

(4)

In that we wish to test for:

$$P[\Theta \geq t] = 1 - \alpha$$

(5)

we compare with Eq. 3 and write

$$t = \frac{2T}{\chi^2_{\alpha;2r}}$$

(6)

or equivalently:

$$\chi^2_{\alpha;2r} = \frac{2T}{t}$$

(7)
Thus, given \( r \), \( T \), and \( t \) as defined in Eq. 4 and section 1, the reclassification confidence, \( 1 - \alpha \), must satisfy Eq. 7.

3. Application of Worst Case Condition Derivation to Reliability on ARR-75 Sonobuoy Receiver

In the latest (Feb 75) reliability test status report on the ARR-75 sonobuoy receiver from AEL-EMECH, the following data was cited:

**RAT: Reliability Acceptance Test (Production)**

Total test time = \( T = 1650 \) hrs.

Total failures: 3

Failure modes:

a. IC: failure at 317 hrs.

b. MIXER: failure at 706 hrs.

c. TRANSISTOR: failure at 1149 hrs.

**RQT: Reliability Qualification Test**

Total test time = \( t = 1663 \) hrs.

Total failures: 12

Failure Modes:

a. RF filter #1 558 hrs.

b. RF filter 628 hrs.

c. Transformers 1018 hrs.

   1018 hrs.

   1502 hrs

d. Connector 1562 hrs.

e. Mixers 1018 hrs.

   1370 hrs.
Need of the ARR-75 necessitated production and shipment of the unit prior to successful completion of the RQT. Since all RQT failures had corrective action imposed in over 90% of the RAT test, we may view the RAT as a FRST for the RQT. Examples follow:

a. In view of the cited data, what is the confidence, 1-\( \alpha \), in reclassifying the following RQT failures under worst case conditions:

- RF filter #1
- RF filter #2
- Transformers
- Connectors

For each of these four failure modes, a parts screening type corrective action was implemented. No further corresponding failures occurred in the FRST (RAT) test. Thus, from Eq. 7:

\[
\chi^2 \alpha; 2 = \frac{2(1650)}{1663} = 1.98
\]

From chi-squared tables:

\[
\chi^2 0.5; 2 = 1.38 \quad \chi^2 0.3; 2 = 2.40
\]

A rough interpolation gives a reclassification confidence of

\[1 - \alpha = 0.97\]
b. In view of the cited data what is the confidence of reclassifying the mixer failure under worst case conditions. Since there occurred one failure in the FRST we have from Eq. 7:

\[ X^2_{\alpha; 4} = 1.98 \]

From chi-squared tables:

\[ X^2_{0.75; 4} = 1.92 \quad X^2_{0.10; 4} = 2.71 \]

The failure reclassification confidence for this case is thus about

\[ 1 - \alpha = 25\% \]

4. Alternate derivation:

Assuming worst case conditions for FRST failure determination places the most stringent of test requirements on the contractor. A less stringent requirement is the assumption that if \( K \) failures are observed in FRST time \( T \), then \( 2K + 1 \) failures will occur in FRST time \( 2T \). In lieu of Eq. 4, we thus have

\[ r = \text{number of observed failures} + 1/2 \]  \hspace{1cm} (8)

This assumption, although still weighted toward the customer, requires less of the contractor in test time for a given confidence level.

5. Application of Alternate Derivation to Reliability Testing on the ARR-75

We shall now employ the less stringent failure reclassification test in the above section to the ARR-75 data.

a. With reference to section 3, the failure reclassification confidence for the RF filters, connector and transformers under the alternate derivation, is found from:

\[ X^2_{\alpha; 4} = 1.98 \]
From chi-squared tables:

\[ \chi^2_{0.2; 1} = 1.64 \quad \chi^2_{0.1; 1} = 2.71 \]

The reclassification risk is thus about:

\[ 1 - \alpha = 80\% \]

b. With reference to section 3, the failure reclassification confidence for the mixers under the alternate derivation is:

\[ \chi^2_{a; 3} = 1.98 \]

From chi-squared tables:

\[ \chi^2_{0.7; 3} = 1.42 \quad \chi^2_{a; 3} = 2.37 \]

Roughly, the reclassification confidence is then:

\[ 1 - \alpha = 35\% \]

Note that, in both of the above cases the reclassification risk, as predicted, is greater than the corresponding worst case condition calculations in section 3. The first by 20% and the second by 10%.

6. Discussion:

The failure reclassification risks discussed herein assume nothing about the effectiveness of the corrective action. That is, the corrected failure mode is not considered better or worse than the original failure mode. This allows no employment of engineering judgement, a feature which seemingly would be of significant value in the area of failure reclassification.

The two failure reclassification risks derived herein differ only in the method of FRST failure tallying assumptions. The lack of information on the occurrence of no failures in the FRST necessitates these assumptions. Patterns set up by sections 2 and 4 may be extended by assuming \( nk + 1 \) failures in test time \( nT \) given that \( k \) failures occurred in FRST time \( T \).
However, in the limit, one is again confronted with the original problem on the occurrence of no FRST failures. The alternate derivation of section 4 is thought to be the golden mean with respect to contractor and customer fairness and mathematical nicety, even though the worst case assumption of section 1 is primarily employed in reliability practice.

7. References


(2) Elements of Reliability and Maintainability, AMETA, Rock Island, IL, 1973, pg IV-48

(3) Required Failure Reclassification Test Time for a Given Confidence Level - R. J. Marks II
FOR A SINGLE FAILURE MODE

ZERO-FAILURE TEST TIME REQUIRED FOR CORRECTIVE ACTION SUBSTANTIATION

Q: A SYSTEM FAILURE MODE $m$, HAVING EXPERTISED SOME FAILURES IN TIME $t_c$, IS CORRECTED. THE NEW "FAILURE MODE" IS DENOTED BY $m'$. HOW LONG MUST ONE TEST TO GIVE A $1-\alpha$ CONFIDENCE THAT, UNDER THE EXPONENTIAL ASSUMPTION,

$$\theta_{m'} > t_c ?$$

A: THE QUESTION ABOVE MAY BE RESTATE AS:

AT WHAT TIME $T$ CAN A FAILURE OCCUR SUCH THAT WE ARE $1-\alpha$ SURE $\theta_{m'} > t_c$?

THIS WILL GIVE THE REQUIRED TEST TIME IF WE TERMINATE THE TEST AT TIME $T$ AT THE OCCURRENCE OF THE FIRST FAILURE, THEN

$$\hat{\theta} = T$$

THE GENERAL $1-\alpha$ CONFIDENCE INTERVAL FOR $\theta_{m'}$ IS

$$P \left[ \frac{\theta_{m'} - \hat{\theta}}{\chi^2_{\alpha, 2} / 2} \right] = 1-\alpha$$

WHERE $T = 1$ IS THE NUMBER OF FAILURES,

Thus:

$$P \left[ \frac{\theta_{m'} - \hat{\theta}}{\chi^2_{\alpha, 2} / 2} = t_c \right] = 1-\alpha$$

:. REQUIRED TEST TIME $T = \frac{1}{2} t_c \chi^2_{\alpha, 2}$

EXAMPLE: FOR $t_c = 2000$hrs

<table>
<thead>
<tr>
<th>$1-\alpha$</th>
<th>$T$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.50</td>
<td>1390hrs</td>
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<tr>
<td>0.75</td>
<td>2770hrs</td>
</tr>
<tr>
<td>0.90</td>
<td>4610hrs</td>
</tr>
<tr>
<td>0.95</td>
<td>5990hrs</td>
</tr>
</tbody>
</table>

NOTE: THIS INTERVAL MAY POSSIBLY BE TIGHTENED BY TAKING INTO ACCOUNT THE POSITION IN TIME OF THE FAILURE.
 COMMENT.

HAVING ESTABLISHED THAT
\[ P[\Theta_m' > t_c] = 1 - \alpha \]

WE HAVE
\[ P[\lambda_m' = \frac{1}{\Theta_m', \leq \frac{1}{t_c}}] = 1 - \alpha \]
\[ = P[\lambda_m' t_c \leq 1] \]

NOW, THE EXPECTED NUMBER OF FAILURES
IN TIME \( t_c \) IS
\[ E(r) = \lambda_m' t_c \]

THUS
\[ P[E(r) \leq 1] = 1 - \alpha \]

THE PHONY FAILURE USED TO ESTABLISH
TEST TIME \( \bar{t} \) IS HERE REFLECTED
SO THAT ACTUALLY:
\[ P[E(r) = 0] = 1 - \alpha \]

THUS, BY ESTABLISHING THAT \( \Theta_m' > t_c \)
AT A 1 - \alpha CONFIDENCE, WE ARE
ALSO ESTABLISHING THAT NO
FAILURES WOULD OCCUR IN TIME
\( t_c \) AT A 1 - \alpha DEGREE OF
CONFIDENCE.

NOTE: IN THIS ANALYSIS WE HAVE ASSUMED
A WORST CASE CONDITION OF SORTS IN
THAT A FAILURE IS ESSENTIALLY ASSUMED
AT TIME \( t + dt \).
MIL-STD-781B REJECT DECISION ACTION

- DURING RELIABILITY QUALIFICATION (5.4.8.4)
  - PERFORM CORRECTIVE ACTION
    DOES IT EFFECT THE THERMAL DESIGN?
    1. NO: RE-DO QUAL. TEST FROM 5.4.2
    2. YES: RE-DO QUAL. TEST FROM 5.1.4

- DURING SAMPLING TEST — STOP SHIPMENT
  - PERFORM CORRECTIVE ACTION
    1. FOR A DESIGN CHANGE:
      RE-DO QUAL. TEST FROM PAR. 5.14
    2. FOR A NOT A DESIGN CHANGE:
      IS THERMAL DESIGN CHANGED?
      a. NO: REINITIATE SAMPLING PHASE @ 5.15
      b. YES: RE-DO QUAL. TEST FROM 5.4.2.

NO TEST TIGHTENING OR LOOSENING INCLUDED HERE, NOR
ANY AR3.4 DOCUMENTATION THERE.
NOTES ON 2/14/75 MEETING
Bob Saum, Claude Rice, Bob Marks

MIL-STD-781B IS DUE FOR REWRITING. INCLUSION OF AR-34 IS DESIRED, BUT AR-34 AS IT STANDS, IS IN PARTS INADEQUATE. SPECIFICALLY, PARAGRAPH 3.3, #2. THAT IS, WHAT CONSTITUTES "SUFFICIENT DATA"? IT WAS DECIDED THAT A SEARCH FOR A MORE QUANTIFIED DEFINITION OF "SUFFICIENT DATA"

B.S. STATED THAT WM. T. SUMERLIN, WHO SERVED ON THE AGREE COMMITTEE SHOULD BE CONTACTED:

WM. T. SUMERLIN
McDonnell Aircraft
314-232-9666
P.O. Box 181
Hazelwood, Mo. 63042.

AT A NOV. '74 WAVEPLEX JOINT COMMAND RELIABILITY WORKSHOP ON REL. TESTING, B.S. RECOLECTED SUMERLIN SUGGESTING ON RECLASSIFICATION OF PATTERN FAILURES, AT LEAST ONE FAILURE SHOULD BE KEPT.
R.M. WAS TO CHECK ON THIS AND
OTHER IDEAS SUMERLIN MIGHT HAVE
CONCERNING FAILURE RECLASSIFICATION.
GENERAL FEELING WAS THAT
ORIGINAL TEST SPECS (θ₁, θ₀, α, B)
SHOULD BE INCORPORATED SOMEWAY
IN THE FAILURE RECLASSIFICATION
SCHEME. A "RISK" OF SORTS SHOULD
ALSO BE STATED.

Bob Martin
NAVAL AIR SYSTEMS COMMAND
DEPARTMENT OF THE NAVY

FAILURE CLASSIFICATION FOR RELIABILITY
TESTING, GENERAL REQUIREMENTS FOR

APPROVED
FAILURE CLASSIFICATION FOR RELIABILITY TESTING,

GENERAL REQUIREMENTS FOR

This specification has been approved by the
Naval Air Systems Command, Department of the Navy

1. SCOPE

1.1 PURPOSE. This specification establishes criteria for
classification of failures occurring during reliability tests.

1.2 APPLICABILITY. This specification, when made a part of the
procurement document or the equipment specification, applies to any reli-
ability test, including, but not limited to, tests performed in accordance
with MIL-R-22973, MIL-R-23094, and MIL-STD-781.

2. APPLICABLE DOCUMENTS

2.1 GENERAL. The following documents of the issue in effect
on the date of invitation for bids form a part of this specification to
the extent specified herein:

SPECIFICATIONS

Military

MIL-R-22973 Reliability Index Determination for
Avionic Equipment Models, General Speci-
fication For

MIL-R-23094 Reliability Assurance For Production
Acceptance of Avionic Equipment, General
Specification For
NOTE: MIL-R-23094 has been superseded by
MIL-STD-781 for all new procurements.

STANDARDS

Military

MIL-STD-721 Definitions of Effectiveness Terms for
Reliability, Maintainability, Human Factors
and Safety

MIL-STD-781 Reliability Tests: Exponential Distribution
2.2 **AVAILABILITY OF DOCUMENTS.** When requesting specifications, standards, drawings, and publications refer to both title and number. Copies of applicable specifications required by contractors in connection with specific procurement functions may be obtained upon application to the Commanding Officer, Naval Publications and Forms Center, (Code 105) 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

3. **REQUIREMENTS**

3.1 **FAILURES.** In addition to the definition of failure as given in MIL-STD-721, and any definition given in the applicable reliability test specification or standard, the following criteria for the determination of a failure shall apply:

Whenever any of the performance characteristics are outside of the requirements of the specification at any specified environmental conditions, at least one failure has occurred.

3.2 **FAILURE CLASSIFICATION.** All failures occurring during reliability tests, including failures occurring during equipment burn-in under the environmental conditions specified for the reliability test, shall be classified and reported as either relevant or nonrelevant. Only those failures classified relevant shall be used in computing equipment MTBF, or for making an accept/reject decision.

3.2.1 **RELEVANT FAILURES.** All failures are relevant unless determined by the procuring activity (or an authorized representative thereof) to be caused by a condition external to the equipment under test which is not a test requirement. Relevant failures include:

(1) **Design/Workmanship Failures:** Failures due to design deficiencies or poor workmanship of either the equipment or component parts shall be classified relevant.

(2) **Component Part Failures:** Failures due to defective component parts shall be classified as relevant failures. In the event that several component parts of the same type fail during the test, each one shall be considered a separate relevant failure, unless it can be shown that one failure caused one or more of the others (see MIL-STD-781, Dependent Failures).

(3) **Wearout Parts:** Certain parts of known limited life, such as batteries, may have a life stipulated prior to the initiation of testing as approved by the procuring activity. Failures of these parts occurring prior to the end of the stipulated period are relevant. Failures of these parts occurring after the stipulated period are nonrelevant, but any dependent failures caused thereby are relevant.
(6) **Multiple Failures:** In the event simultaneous part failures occur, each failed part which would independently prevent satisfactory equipment performance shall be counted as a relevant failure except as follows: If the contractor and the procuring activity agree that the failure of one part was entirely responsible for the failure of any other parts, then each such dependent part failure shall not be counted as a relevant failure. At least one equipment relevant failure shall be counted when a dependent failure is claimed.

(5) **Intermittent Failures:** The first occurrence of an intermittent failure on any one equipment shall be counted as a relevant failure, although subsequent occurrences of the same intermittency on that same unit will be considered nonrelevant. However, no equipment shall be shipped for which an intermittent failure remains unresolved, without specified approval of the government inspector.

(6) **Adjustments:**

(a) **Accessible Controls** - Each adjustment of a control which is accessible to the operator during normal use is a relevant failure if the information necessary to restore equipment operation is not available from indicators which are an integral part of the equipment under test.

(b) **Inaccessible Controls** - Each adjustment of a control which is inaccessible to the operator during normal use is a relevant failure, unless a period of operating (not standby) time has elapsed, since the last adjustment of any inaccessible control on that equipment, which is equal to or greater than the period specified for the equipment "operational stability."

(7) **Failures of Built-in Test:** Any malfunction (including a false alarm) of the Built-in Test features of the equipment shall be classified as a relevant failure.

### 3.2.2 Nonrelevant Failures

Although nonrelevant failures are not used for MTBF calculations, all failures shall be recorded and reported. Only those failures listed below may be counted as nonrelevant.

1. Failures directly attributable to improper installation in the test chamber.
2. Failures of test instrumentation or monitoring equipment (other than the Built-in Test function).
3. Failures resulting from test operator error in setting up, or in testing the equipment.
4. Dependent failures, unless caused by degradation of items of known limited life. (At least one relevant failure shall be counted when a dependent failure is claimed).
(5) Failures attributable to an error in the test procedures.

(6) The second (and any subsequent) occurrences of the same intermittent failure on the same unit.

(7) Failures occurring during burn-in, trouble-shooting, repair verification, or set-up time.

(8) Malfunctions of the Time Totalizing Meters or certain lighting circuit failures, when the approved test procedures specifically designate them as nonrelevant.

(9) Failures clearly attributable to an overstress condition in excess of the design requirements.

(10) Adjustments:

(a) Accessible Controls - Adjustments of controls which are accessible to the operator during normal use shall be counted as nonrelevant failures provided the adjustment is accomplished without reference to test equipment, meters, indicators, etc., which are not a functional part of the equipment under test.

(b) Inaccessible Controls - Adjustments of controls which are not accessible to the operator during normal use are nonrelevant failures provided no such adjustment has been made to the unit under test for a period of operating time at least equal to that specified for the system "operational stability".

(11) Other, as explicitly defined in the approved test procedures.

3.3 RECLASSIFICATION. A failure, classified as relevant, may be reclassified to nonrelevant provided that all of the following conditions are met:

1. Corrective action (an equipment design, part, or production process change) has been made in accordance with the applicable reliability test specification or standard on all equipment of the lot from which the reliability test sample was drawn, and;

2. Sufficient test data has been accumulated to indicate the corrective action is effective in eliminating the failure mode, and;

3. Approval of the procuring activity (or authorized representative) is obtained for reclassification of the failure.

3.4 FAILURE ANALYSIS. An analysis of the cause of each failure shall be made in accordance with the applicable reliability test specification or standard. Production process changes includes changes such as a higher level of component screening.
3.5 FAILURE REPORTS. Any and all failures (both relevant and nonrelevant) which occur during equipment burn-in and the reliability tests shall be recorded and reported in accordance with the contract and the applicable reliability test specification. The reports shall include the results of the failure analyses.

4. QUALITY ASSURANCE PROVISIONS: Not applicable.

5. PREPARATION FOR DELIVERY: Not applicable.

6. NOTES:

6.1 DEFINITIONS. All definitions are in accordance with MIL-STD-721, and the applicable reliability test specification or standard.

6.2 PRECEDENCE OF DOCUMENTS. When the requirements of the contract, this specification or applicable subsidiary specification, are in conflict the following precedence shall apply:

   (1) Contract: The contract shall have precedence over any specification.

   (2) The Equipment Detail Specification: The equipment detail specification shall have precedence over all applicable subsidiary specifications.

   (3) This Specification: This specification shall have precedence over all applicable subsidiary specifications. Any deviation from this specification, or from subsidiary specifications, where applicable, shall be specifically approved in writing by the Naval Air Systems Command.

   (4) Reference Specifications: Any referenced specification shall have precedence over all applicable subsidiary specifications referenced therein. All referenced specifications shall apply to the extent specified.
Claude:

I am very concerned about this business of failures. We should have some documented for making these types of decisions. Such GUs might find there way into AR-34 and believe that such decisions can in some be stated in terms of a risk; and, that be aware of our risks. I have been in SE meetings where this aspect of AR-34 has criticized; and, I have found it difficult whenever asked now we know we made the decision. William T. Summerlin has even suggest that at least one of the reclassified failures counted.

As you know, I have been concerned with problem for some time now. I think it's I do something about it.

Marks might be a good man to this; and, we could get help from D-X.

Let's discuss it on Monday.
From: Commanding Officer, Naval Ammunition Depot, Crane, Indiana  
To: Bendix Electrodyamics Division, 11600 Sherman Way, North Hollywood, CA 91304  
Via: Chief, Defense Contract Administrative Services Offices, 8900 DeSoto Avenue, Canoga Park, CA 91304  
Subj: Contract N00019-73-C-0183 for Sonar Detecting Range Set, AN/AQS13B, Work Unit Assignment C112.139, Reliability Demonstration Test, Failure Reclassification Requests  
Ref:  (a) Bendix ltr E5787-064 of 13 Dec 1974 to NAVAIRSYSCOM  
(b) Failure Report ACA 088, Sonar Receiver Serial Number EXX0023, System Group Number 23  
(c) Bendix ltr E5787-065 of 20 Dec 1974 to NAVAIRSYSCOM  
(d) Failure Report ACA 070, Indicator 3183200  
(e) Failure Analysis Report 74-081  
(f) ECP-1309, Change Number 8  

1. As directed by Naval Air Systems Command, the Naval Ammunition Depot (Code 304B) has been given the responsibility for action upon references (a) and (c).  

2. Reference (a) requests authorization to reclassify a catastrophic failure of a NAFI-4 Doppler Processor Number 2 during the MTI Doppler Lockout test. Channel 6 failed to display the CW spoke within the ATP specified 400 to 3000 yard range of channel sweep.  

3. Failure Analysis Report, reference (b), substantiates the action requested by reference (a).  

4. Reference (c) requests authorization to reclassify a catastrophic failure of transistor Q1, JANTX 2N2484 on the Test Generator P.C. Assembly, part number 3185465, installed in the 3183200 Azimuth Range Indicator (serial number EXX-0018), at high temperature.  

5. Failure Analysis Report, references (d), (e) and (f) substantiate the action requested by reference (c).  

6. Having reviewed the corrective action and accumulated test hours since occurrence of these relevant failures, this activity concurs with the requests of references (a) and (c), and hereby reclassifies these relevant failures to nonrelevant.
7. The comments contained herein do not authorize or imply any changes in the requirements or conditions of the contract or applicable specification.

8. If further information or clarification is required concerning this letter, it should be directed to Commanding Officer, Naval Ammunition Depot (Code 304B), Crane, Indiana, or by telephoning Mr. Claude Rice at 812-854-1299.

S. S. KALBERER
By direction
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\[ A_n (\tilde{\theta}_R = 2 \tilde{t}_2 / \tilde{X}_{\tilde{a}_2}^2) = 1 - d_2 \]  

where \( \tilde{\theta}_R \) denotes the MVE of the recorded item, \( \tilde{t}_2 \) and \( \tilde{X}_{\tilde{a}_2}^2 \) are given by

\[ \tilde{t}_2 / \tilde{X}_{\tilde{a}_2}^2 = \tilde{t}_2 / \tilde{X}_{\tilde{a}_2}^2 \]

it can be stated that \( \tilde{\theta}_R \) is at least as good as \( \theta_N \) with \((1 - d_1)(1 - d_2)\) confidence. The equality of expression (4) is maintained if

\[ \tilde{t}_1 / \tilde{X}_{\tilde{a}_1}^2 = \tilde{t}_2 / \tilde{X}_{\tilde{a}_2}^2 \]

If \( \tilde{t}_2 \geq \tilde{t}_1 \), \( d_1 \) must equal \( d_2 \)
to maintain this equality and a confidence of \((1 - d)^2\) is obtained.

However, if \( \tilde{t}_2 < \tilde{t}_1 \), the \( \tilde{X}_{\tilde{a}_2}^2 \)
must equal \( 2 \tilde{X}_{\tilde{a}_1}^2 \) to maintain the equality and the confidence level is \((1 - d_1)(1 - d_2)\). Similarly if
$t_2 = 3t_1, \ \chi^2_{t_1},$ must equal $3\chi^2_{t_1},$

Table 1 gives some values for which the above equalities would hold. For example,

For $t_1 = 0.1, \ \chi^2_{0.1, 2} = 9.21034$ and $t_2 = 3t_1$, then $\chi^2$ must equal $0.501$ or $\chi^2_{0.501, 2} = 18.4237$ which is $\chi^2_{0.1, 2}$. Similarly, if $t_1 = 0.1, \ \chi^2_{0.1, 2} = 4.50847$ and if $t_2 = 3t_1$, then $\chi^2$ must equal $0.05$ or $\chi^2_{0.05, 2} = 13.8155$ which is $3\chi^2_{0.1, 2}$.

Table 2 gives the resultant confidence level as a result of both tests for the values given in Table 1. Using the above samples
in the above paragraphs, the resultant confidence for when \( t_2 = 2t \), is \((1 - 0.01)(.9899)\) or \((.99)(.9899)\) which equals \(.9899\) and for \( t_2 = 3t \), it is \((1 - 0.00)(1.00)0\) or \((.98)(.999)\) which equals \(.9891\).

It is interesting to note that it is another method to obtain the same resultant confidence. This is for \( t_2 \) to be a fraction of \( t \). Using this fact and equation (5),

\[
\frac{t_2}{t} = \frac{\chi}{\chi_0}
\]

\[
\frac{1/F_0,1\text{,}000}{t_2/1} = t_2/\chi_0 F_0,1\text{,}000
\]

where \( F \) is free.

Thus, \( F^2 \) must equal \( F^2 \), \( F \) or \( F^2 \) must equal \( F^2 \), \( F \) or \( F^2 \) must equal \( F^2 \), \( F \).

Using the two formulas given above and Table 1 and 2.
If $t = 5.181$, then $X^2 = 3.012 = \frac{113}{36} X^2$.

**Second**: $X^2 = 3.012 \geq 2.71$. Hence, there are few independent observations.

Confidence level of $(3.001)/1.96 = 98\%$.

From Table 1, $d_1 = 0.841$ and $d_2 = 0.01$ and a significant

For the first factor, $d_1$ and $d_2$ are first

The formula is $t = 3.21$. The value

A much lower value of $t$ will make

If $t_i$ than with $t = \text{dummy}

Of $t_i$.
<table>
<thead>
<tr>
<th>Multiples of $x_2$</th>
<th>$x_2$</th>
<th>$x_2^2$</th>
<th>$3x_2^2$</th>
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<td>Conf. Level for First Test (1-α)</td>
<td>Possible Conf. Levels for Second Test (1-β)</td>
<td>Resultant Second Test</td>
<td></td>
</tr>
<tr>
<td>----------------------------------</td>
<td>------------------------------------------</td>
<td>----------------------</td>
<td></td>
</tr>
<tr>
<td>t₁</td>
<td>t₂</td>
<td>ϕ₁</td>
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Table 2

*Note: Made up information.*
MEMORANDUM

From: 3041 (C. Rice)
To: 3041 (R. Saum)

Subj: Plan activities for Apr 1975

1. Ken Smith
   a. AN/DRQ-4(ANC) - Find out when testing is scheduled to resume. When received review the monthly report and the failure diagnosis and corrective action.
   b. AN/DRQ-4 (Reaction) - Keep in close contact with contractor to monitor progress of Reliability testing.
   c. AN/DSU-4/A - Reliability testing is scheduled to commence early in April. If testing is initiated, make a visit to the contractor's facilities to witness testing.

2. Deon Hersberger
   a. ARC-159 - Expect a monthly report.
   b. ARC-159(V) - Expect monthly report. Review reclassification requests for two failures.
   c. A24G-39 - Contact the contractor for Reliability reports for months of January, February and March 1975 testing.

3. Tom Shaw
   a. ARN-84 - Review reliability report and visit contractor's facility.
   b. ALQ-126 - Review reliability report.
   c. AQS-13B - Review reliability report and visit contractor to witness RAT on final system.
   d. ASN-27B - Review final report and visit plant to attend FRB since they are in reject.
   e. BIT - Finish quarterly report, ARN-84 report and initiate AR-10 investigation.
4. **Bob Marks**
   
   a. ARR-75-(AEL) - Continue monitoring the contractor's Reliability Test Program.
   
   b. DKT-30 - Check with the contractor regarding status of Reliability Testing and reports.
   
   c. AAU-31/A and AAU32/A - Check with DCAS-QAR regarding status of testing -- when reports can be expected.
   
   d. ARR-72 Edmac - Continue monitoring program status.
   
   e. ARR-75 Edmac - Continue monitoring program status.

5. **Claude Rice**
   
   a. ASW-25 - Contractor is deliquent in submitting Reliability Re.
   
   b. APN-202-/R1623 - Check with contractor regarding status of Reliability program status and test reports.
   
   c. ID 1481 - No action required.

C. F. RICE
1. Employment Limitations. The Commanding Officer referred to the article published in the Daily Bulletin on 29 January 1975 and stated there was nothing new since that date. He stated that NAVSEASYSCOM has imposed a civilian personnel ceiling of 3824 for 30 June 1975. There has been no decision made to conduct a reduction-in-force. NAVSEASYSCOM has requested authority for Crane to conduct a RIF of permanent employees and to release temporary employees if it becomes an absolute necessity. The Commanding Officer stated that he had indicated in a letter to NAVSEA that if no RIF is imposed that our projected ceiling is 4350 for 30 June 1975. However, he further stated that we have sufficient workload to not only support an allocation of 4450 for FY 1975 but also through 1976. If a RIF is necessary, notices will have to be issued no later than 1 May. Firm guidance should be received by 1 March. Later in the meeting Mr. Combs stated the Union is preparing information to submit to Congressmen in an effort to curtail the proposed RIF action.

2. Hiring Freeze. The Commanding Officer stated there was no blanket hiring freeze at this time. However, hiring is being restricted to those billets that are deemed absolutely necessary.

3. Reorganization of the Ordnance Department. While the Commanding Officer was in Washington, D. C. recently, he briefed Headquarters regarding the reorganization of the Ordnance Department. Additional information will be submitted regarding the reorganization. The Commanding Officer indicated that negotiations are still being conducted.

4. Junking of Materials. It was pointed out that materials that have not been issued within a year are being sent to the batcher for junking. It was felt that this was a great waste. The Commanding Officer stated that hard goods should not be junked and that he will look into this matter.

5. Change of Name for Depot. When asked concerning the status of the name change for the Depot, the Commanding Officer stated that Weapons Materials Center has been proposed, but no decision has been made at this time.

David Combs
President, AFGE Lodge No. 1415

Distribution:
A (All Supervisors and Bulletin Boards)
06 (5 copies)
Union Office (65 copies)
MINUTES OF AFGE MEETING
30 January 1975

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CHECKLIST

Reliability Test Procedures (For use with MIL-R-23094A and MIL-STD-781A)

General

1. Are separate test procedures provided for the Qualification (Pre-delivery) and Sampling (during delivery) tests?

2. Has a careful review been made of the applicable documents, including:
   a. the contract, modifications and changes
   b. the equipment specification
   c. the system specification
   d. the reliability specification
   e. the specification for format

Format

Is the specification properly titled?

4. Does the title page include:
   a. the title of the test
   b. equipment name and nomenclature
   c. contract number and date
   d. manufacturer's name
   e. the date of the test procedures
   f. any appropriate revision information

5. Is an equipment list provided?

6. Are diagrams of the test setup furnished?

7. Have schematics of any special test equipment been included?

8. Are the figures and tables numbered in sequence and referred to in the text?

9. Are the test procedures complete and self sufficient?

10. Have samples of the data sheets, test logs, failure analysis reports etc. been included?
Introduction

11. Does the first portion of the procedure list:
   a. the specified MTBF
   b. the documents which describe the test requirements, including, as 
      applicable:
      (1) the contract, and pertinent changes or amendments or waivers 
      (2) the equipment specification and amendments thereto 
      (3) the system specification 
      (4) the reliability test specification, with mention of:
         (a) the Test Level 
         (b) the Test Plan (or Figure) 
         (c) the Procedure (for MIL-R-23094 only)

Initiation of test

12. Does the procedure state what tests must be completed prior to initiation 
    of the reliability test?

13. Does the procedure either provide for a thermal survey or state that one 
    has been conducted? If previously done, has the data been submitted for 
    approval?

14. Does the procedure allow for an initial period of "burn in" or "de-bugging"?

15. Is the test equipment known to be capable of performing its intended 
    function? (This includes temperature chamber, vibration equipment, vibration/ 
    Scorsby equipment, recording apparatus, any special test equipment.)

Definition of Failure

16. Does the procedure fully define what constitutes a failure? [Should include 
    definitions of system/equipment failure, part failure, primary and secondary 
    failures, pattern failures, and "minor" failures; and should define relevant vs 
    nonrelevant failures.]

17. Does the procedure state that no repair action is to be taken unless a 
    failure can be demonstrated to exist? Is provision made for the verification 
    of a suspected failure?

18. Is any provision made for the verification of the completeness of a repair?

19. Is it stated that all failed parts will receive a complete analysis?

20. Is it clearly stated that ALL failures will be recorded and reported?
Test Samples

21. Does the procedure describe how the test samples will be selected?

22. How many equipments will be used on the test? Is there a range of sample sizes which is permissible?

Test Level and Duty Cycle

23. Have the periods of heating and cooling been fully detailed?

24. Has the vibration level, duration, and periodicity been fully described?

25. Have the "on" and "off" periods been defined?

26. Are any variations in the supply voltage required?

Performance/Operational Tests/Checks

27. Has the procedure provided for operational checks and performance tests as required? Are these to be made during stabilization at high temperature?

28. Are the performance tests sufficient to demonstrate satisfactory performance?

29. Are the tolerances clearly indicated? Are they in accordance with the equipment specification? Is any degradation allowed?

Length of Test

30. Does the procedure clearly state how the determination will be made to terminate the test? Does it state that only equipment "on" time will be counted toward the calculation of equipment MTBF?

31. Is there a description of the action to be taken when an accept decision is reached? a reject decision?

Accept/Reject Criteria

32. Does the procedure state the Test Plan (or Figure) from which the accept/reject criteria is drawn?

33. Is there a table delineating the accept/reject criteria? Is it given in hours, rather than multiples of MTBF? (A chart may be included if desired, but is neither sufficient nor necessary.)

Preventive Maintenance

34. Does the procedure delineate all necessary scheduled maintenance?

35. Does the procedure prohibit unscheduled maintenance?
36. Are the test logs generally in accordance with the specified requirements?

**Reports**

37. Does the procedure mention the reporting requirements?

38. Will the initial report include a failure rate prediction and description of the contractors organization?

39. Will the monthly reports be summaries - not merely point reports, and include a log of all adjustments as well as a report and failure analysis of ALL failures?
MEMORANDUM

From: 3048 (C. Rice)
To: 3048 (R. Saum)

Subj: Planned Activities for Jan 1975

1. Ken Smith
   a. DRQ-4 (American Nucleonics) - Production Reliability Testing is scheduled to begin January 20. A visit to contractor's facilities is planned in order to witness the testing.
   b. DSU-4A/A - Testing was initiated and then suspended due to failures. It is planned to review the corrective action to see if it remedies the situation. Plan to witness restart of testing.
   c. (DRT-30) - Plan to continue to monitor the progress of the reliability test schedule.
   d. (ARR-75 (AE)) - Plan to follow-up on failures that have occurred during Production Reliability Testing. A plant visit may be necessary to resolve these failures.
   e. (DRQ-4) - (Reaction Instrument) - Plan to keep in close touch with the contractor to monitor progress on the contract.
   f. (ARR-75 (Edmac)) - Plan to monitor progress on the reliability test schedule.

2. Tom Shaw
   a. ALQ-126 - Review and comment on 29 failure reclassification requests.
   b. AQM-13B - Visit contractor's facility to review corrective actions on previous failures and discuss recent reclassification request.
   c. ASW-27B - Attend FRB at contractor's facility to review final report.
   d. ARN-84 - Visit contractor's facility to receive update on production contract and review last 3 month reliability reports.
   e. BIT - Review available system specs and initiate quarterly report. Initiate study on specification verification method.
   f. AAU 32/AAU/31 - Review failure and reliability data.
3. Deon Hersberger
   b. AAU-24/A - Follow-up on corrective action implementation for pattern failure problems.
   c. AQA-7(V) - Prepare comments on contractor's R & SE report #3. Discuss with contractor techniques used in preparation of the final Reliability Prediction Analysis Report. Expect Reliability Acceptance Test and TAAF Test Procedures. Attend contractor's monthly program review.
   d. ARC-159 - Expect month test report.
   e. ARC-159(V) - Expect reclassification requests for 2 RST failures and one R demo test failure.
   f. ASA-76 - Expect monthly report.
   g. DLQ-3 - Expect Reliability and Life Test Report.
   h. ARC-175(V) - Evaluate Reliability Potential and Report to JASC.

4. Claude Rice
   a. ASW-25 - Contact contractor regarding status of monthly reliability reports.
   b. APa202/R1623 - Keep in touch with contractor and JASC as to the progress of testing on these equipments.
   c. ID 1431/A - No action required.
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I. Pre-Inspection:

A. Prepare the travel requests at least 10 days in advance of scheduled departure.

B. Be certain to co-ordinate the trip with the local DCAS Representative and the Contractor.

C. Review the test procedure and make notes of any peculiarities.

D. Review the project folder and any other literature which might provide insight to the contractor or this particular contract.

II. Plant Inspection:

A. Review with DCAS Representative the purpose of your visit, of the Production Reliability Surveillance AIR TASK, and the Test Procedures. Offer your assistance in supervising the tests, and interpreting the Reliability Test Procedures and test data.

1. What type of monitoring does DCAS perform?

2. Do they witness failure analysis and observe the implementation of corrective action?

3. Do they check for non-standard parts approval?

4. How often is the test equipment calibrated? Is the calibration program traceable to the National Bureau of Standards?

5. Are the record keeping methods adequate?

6. Are test procedures strictly adhered to?

7. Does the DCAS office approach their work objectively and in an impartial manner or do they seem to be influenced by the company?

B. Generally, review the Reliability Test Procedures with DCAS and the contractor's representatives. The Reliability Procedures check-list should be used as a guide during this discussion.

C. Inspect the contractor's test set-up and operation:

1. Temperature chamber. (High and Low Temperature limiting devices).

2. Method of temperature cycling.
3. Vibration equipment. (Monitoring and overtravel control).

4. Vibration cycle.

5. Method of operating the equipment during duty cycle. (Transient control).

   a. Compare this with the schematic or block diagram in the test procedures.
   b. Check it for technical accuracy.

7. Make sure that the contractor is properly measuring those performance characteristics required in the test procedures.

8. Check the method of failure documentation and the failure data they intend to put into the reports.

D. Inspect the contractor's documentation.
   1. Review the laboratory notebook.
   2. Review the method and procedure of preparing and circulating failure reports.
   3. Review failure reports that have already been prepared to be assured that they are prepared correctly and processed properly.
   4. Discuss the problems the contractor and the DCAS Representative might have in classifying failures.

E. Obtain names and telephone numbers of persons visited.

III. Post Inspection:

A. After returning from the trip prepare a trip report. Be sure that all of the items discussed in the meetings with DCAS and contractor personnel are included in the trip report.

B. Be sure to follow-up on any verbal agreements or other commitments made during your trip. Follow-up is important: Be sure that you re-establish contact with the DCAS Representative and the company representatives, especially if there were reports or other information that were to be supplied to you after the trip. Make plans also for a revisit if necessary.
CHECKLIST

Reliability Test Procedures (For use with MIL-R-23094A and MIL-STD-781)

General

1. Are separate test procedures provided for the Qualification (Pre-delivery) and Sampling (during delivery) tests?  
2. Has a careful review been made of the applicable documents, including:
   a. the contract, modifications and changes
   b. the equipment specification
   c. the system specification
   d. the reliability specification
   e. the specification for format of test procedures

Format

3. Is the specification properly titled?
4. Does the title page include:
   a. the title of the test
   b. equipment name and nomenclature
   c. contract number and date

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</table>
d. manufacturer's name

e. the date of the test procedures

f. any appropriate revision information

5. Is a test equipment list provided?  
   4.3  5.1.3  3.11

6. Are diagrams of the test setup furnished?  
   --  --  3.11

7. Have schematics of any special test equipment been included?  
   --  --  3.11

8. Are the figures and tables numbered in sequence and referred to in the text?  
   --  --  --

9. Have samples of the data sheets, test logs, failure analysis reports etc. been included?  
   4.3  5.1.3  3.11

10. Are the test procedures complete and self sufficient?  
    --  --  3.1

Introduction

11. Does the first portion of the procedure list:  
    --  --  3.11

   a. the specified MTBF $\Theta_0$

   b. the documents which describe the test requirements, including, as applicable:

      (1) the contract, and pertinent changes or amendments or waivers

      (2) the equipment specification and amendments thereto

      (3) the system specification

      (4) the reliability test specification, with mention of:

           (a) the Test Level

           (b) the Test Plan (or Figure)
c. a description of the equipment and list of all components (R/T unit, control unit, etc.) to be tested

Initiation of test

12. Does the procedure state what tests must be completed prior to initiation of the reliability test?
13. Does the procedure either provide for a thermal survey or state that one has been conducted? If previously done, has the data been included with the test procedures or submitted for approval?
14. Does the procedure allow for an initial period of "burn-in" or "de-bugging"?
15. Is the test equipment known to be capable of performing its intended function? (This includes temperature chamber, vibration equipment, vibration/Scorsby equipment, recording apparatus, any special test equipment.)

Definition of Failure

16. Does the procedure fully define what constitutes a failure? Should include definitions of system/equipment failure, part failure, primary and secondary failures, pattern failures, and "minor" failures; and should define relevant vs nonrelevant failures.
17. Does the procedure state that no repair action is to be taken unless a failure can be demonstrated to exist? Is provision made for the verification of a suspected failure?
18. Is any provision made for the verification of the completeness of a repair?
19. Is it stated that all failed parts will receive a complete analysis?
20. Is it clearly stated that ALL failures will be recorded and reported?

Test Samples

21. Does the procedure describe how the test samples will be selected?

22. How many equipments will be used on the test? Is there a range of sample sizes which is permissible?

Test Level and Duty Cycle

23. Have the periods of heating and cooling been fully detailed?

24. Has the vibration level, duration, and periodicity been fully described?

25. Have the "on" and "off" periods been defined?

26. Are any variations in the supply voltage required?

Performance/Operational Tests/Checks

27. Has the procedure provided for operational checks and performance tests as required? Are these to be made during stabilization at high temperature?

28. Are the performance tests sufficient to demonstrate satisfactory performance?

29. Are the tolerances clearly indicated? Are they in accordance with the equipment specification? Is any degradation allowed?

Length of Test

30. Does the procedure clearly state how the determination will be made to terminate the test? Does it state that only equipment "on" time will be counted toward the calculation of equipment MTBF?
31. Is there a description of the action to be taken when an accept decision is reached? a reject decision?  

Accept/Reject Criteria

32. Does the procedure state the Test Plan (or Figure) from which the accept/reject criteria is drawn?  

33. Is there a table delineating the accept/reject criteria? Is it given in hours, rather than multiples of MTF? (A chart may be included if desired, but is neither sufficient nor necessary.)  

Preventive Maintenance

34. Does the procedure delineate all necessary scheduled maintenance?  

35. Does the procedure prohibit unscheduled maintenance?  

Logs

36. Are the test logs generally in accordance with the specified requirements?  

Reports

37. Does the procedure mention the reporting requirements?  

38. Will the initial report include a failure rate prediction and description of the contractors organization?  

39. Will the monthly reports be summaries -- not merely point reports, and include a log of all adjustments as well as a report and failure analysis of ALL failures?
I. ELECTRONIC PARTS

A. Resistors
   *1. Fixed
      a. Film
         - Carbon
         - Ceramic
         - Carbon Ceramic
         - Coaxial
         - Metal
         - Metal Oxide
      b. Conductive Plastic
      c. Fluidic
      d. Ribbon
      e. Wirewound
   *2. Thermistors
   *3. Varistors

B. Capacitors
   *1. Fixed
      a. Gas and Air Dielectric
      b. Ceramic
      c. Fluidic
      d. Glass Dielectric
      e. Lacquer Dielectric
      f. Semiconductor
      g. Mica Dielectric
      h. Mica-Paper Dielectric
      i. Paper Dielectric
      j. Paper-Plastic Dielectric
      k. Plastic Dielectric
      l. Quartz Dielectric
      m. Tantalum
         - Fluid Electrolyte
         - Foil
         - Solid Electrolyte
   *2. Variable

C. Inductors
   *1. Fixed
      a. AF, IF, and RF
      b. Filters
      c. Other
   *2. Variable
   *3. Transformers
      a. Impedance Matching
      b. Power Distribution
      c. Isolation
      d. Pulse
      e. Variable

*O. Filters
  1. Bandpass
  2. Broadband
  3. Highpass
  4. Lowpass
  5. Noise and Interference

D. Diodes
   *1. LVA Type
   *2. Zener
   *3. Voltage Reference
   *4. Varactor Type
   *5. Rectifier, Small Signal, Switching
   *6. Tunnel

F. Transistors
   1. Uni-Junction
   2. FET
   3. Small Signal Chopper
   4. High Power

G. I.C.'s.
   *1. Linear
      a. OP Amps
      b. Voltage Followers
      c. Voltage Regulators
      d. Voltage Comparitors
      e. Receivers
      f. Drivers
   *2. Digital
      a. Gates
      b. Flip Flops
      c. Memories
      d. Latches
      e. Adders
      f. Shift Registers
      g. Decoders/Drivers
      h. Counters
   *3. Converters

*H. Piezoelectric Crystals
   1. Frequency Determining
   2. Filters

I. Electronic Tubes
   *1. Receiving
   *2. Transmitting
   *3. Tuning Indicators
   *4. Rectifiers
   *5. Thyatrons
   *6. Regulator and Control

*J. Connectors and Adaptors
   1. Coaxial Connectors
      a. Flexible
         - BN Series
         - BNC Series
         - C Series
         - HM Series
         - LC Series
         - LN Series
         - LT Series
         - MW Series
         - H Series
         - SC Series
         - SM Series
         - TNC Series
         - TPS Series
         - UNF Series
         - Multiple
         - Triaxial
         - Twinaxial
      b. Rigid/Semi-Rigid
   2. AC Power
      a. Pin and Socket
      b. Switch Interlocked
      c. Spring Contact

* Separate Data Sheet
3. Audio
   a. Jacks
   b. Plugs
   c. Pin and Socket

4. Printed Circuit

5. Misc. Connectors
   a. Banana Plugs
   b. Alligator Clips

6. Adaptors
   a. Alligator Clip/Banana Plug
   b. Binding Post/Coaxial
   c. Banana Plug/Binding Post
   d. Waveguide/Coaxial
   e. Connector/Test Clips
   f. Tube Socket Conversion
   g. Other
II. ELECTROTHERMAL AND ELECTROCHEMICAL DEVICES

*A. Fuses
*B. Thermocouple
*C. Batteries

1. Dry Cell
   a. Carbon-Zinc
   b. Manganese-Zinc
   c. Mercury-Zinc
   d. Silver Chloride
2. Cadmium-Mercury Oxide
3. Lead
   a. Acid
   b. Lead Dioxide
4. Water Activated
   a. Cuprous Chloride-Magnesium
   b. Magnesium-Magnesium Perchlorate
   c. Silver Chloride-Magnesium
5. Mercury-Cadmium
6. Nickel
   a. Iron
   b. Zinc
   c. Cadmium
7. Nuclear
8. Silver-Zinc
9. Solar
10. Zinc-Copper Oxide

* Separate Data Sheet
III. ELECTROMAGNETIC AND ELECTRONUCLEAR DEVICES

A. Microwave Devices
1. Diodes
2. Klystron
   a. Amplifier
   b. Reflex Oscillator
3. Magnetron
4. Traveling Wave Tubes
5. Backward Wave Oscillator
6. Switches

B. Electromagnetic Devices
1. Receiving and Transmitting Tubes
2. Antennas

C. Electronuclear Devices
1. Alpha Counters
2. Beta Counters

IV. ELECTRO-OPTIC AND DISPLAY DEVICES

A. Photo Sensitive Devices
1. Photodiodes
   a. Tubes
   b. Semiconductors
2. Photocells
3. Phototransistors
4. T.V. Pick-up Tubes

B. Light-Emitting Devices
1. Monochromatic
   a. L.E.D.'s
   b. L.E.T.'s
   c. Laser Tubes
2. Flash Tubes
3. Black Light
4. Incandescent
5. Fluorescent

C. Display Devices
1. C.R.T.'s
2. Liquid Crystal
3. Nixie Tubes

D. Hybrid
1. Photo-Isolation Devices

V. ELECTROMECHANICAL DEVICES
DISTRIBUTION OF $\frac{1}{X}$

THEOREM: IF STATISTIC $X$ HAS PROBABILITY DENSITY FUNCTION $f_X(x)$, THEN $\frac{1}{X}$ HAS A PDF OF $\frac{1}{y^2} f_X\left(\frac{1}{y}\right)$ IF $X > 0$.

PROOF: GIVEN $X > 0 \sim f_X(x)$

$$p\left[x_u \leq x \leq x_v\right] = \int_{x_u}^{x_v} f_X(x) \, dx \quad ; x_u, x_v > 0$$

$$= p\left[\frac{1}{x_v} \leq \frac{1}{x} \leq \frac{1}{x_u}\right]$$

LET $x = \frac{1}{y} \Rightarrow dx = -\frac{1}{y^2} \, dy$

$$p\left[\frac{1}{x_v} \leq \frac{1}{x} \leq \frac{1}{x_u}\right] = -\int_{\frac{1}{x_u}}^{\frac{1}{x_v}} f_X\left(\frac{1}{y}\right) \, dy$$

LET $y_u = \frac{1}{x_v}$ ; $y_v = \frac{1}{x_u}$

$$\Rightarrow p\left[y_u \leq \frac{1}{x} \leq y_v\right] = \int_{y_v}^{y_u} \frac{f_X\left(\frac{1}{y}\right)}{y^2} \, dy$$

$$\therefore f_{\frac{1}{X}}(y) = \frac{1}{y^2} f_X\left(\frac{1}{y}\right) \quad ; x, y > 0$$

QED
REMARK: $f_{\frac{1}{X}}(y)$ is a good P.D.F.

\[
\int_0^\infty f_{\frac{1}{X}}(y) \, dy = 1
\]

PROOF:

Let $x = \frac{1}{y} \Rightarrow dy = -\frac{1}{x^2} \, dx$

$x = 0 \Rightarrow y = \infty$, \quad x = \infty \Rightarrow y = 0$

\[
\int_0^\infty f_{\frac{1}{X}}(y) \, dy = \int_0^\infty y \frac{1}{y^2} f_X(y) \, dy
\]

\[
= \int_0^\infty x^2 f_x(x) \left( -\frac{dx}{x^2} \right)
\]

\[
= \int_0^\infty f_x(x) \, dx
\]

\[
= 1
\]
EX: Uniform Distribution:

\[ f_X(x) = \frac{1}{a} \mu(x) \mu(a-x) \]

WHERE

\[ \mu(x) = \begin{cases} 1; & x \geq 0 \\ 0; & x \leq 0 \end{cases} \]

THEN

\[ f_X(x) = \frac{1}{a} \mu\left(\frac{x}{a}\right) \mu\left(a - \frac{x}{a}\right) \]

BUT

\[ \mu\left(\frac{x}{a}\right) = \mu(y) \]

\[ \mu\left(a - \frac{x}{a}\right) = \mu(-y) \mu\left(y - \frac{1}{a}\right) \]

THUS

\[ f_X\left(\frac{x}{a}\right) = \frac{1}{a} \mu\left(y - \frac{1}{a}\right) \]

AND

\[ f_{\frac{1}{a}}(y) = \frac{1}{a} y^2 \mu\left(y - \frac{1}{a}\right) \]

NOTE:

\[ \int_{-\infty}^{\infty} f_{\frac{1}{a}}(y) \, dy = \int_{\frac{1}{a}}^{\infty} \frac{dy}{\sqrt{a}} = 1 \]
COMPUTING $X^2_{0.05}$ FOR LARGE $Y \geq 31$

From the Central Limit Theorem, a $X^2_{Y}$ random variable approaches a normal distribution as $Y \to \infty$ [1]. $X^2_{Y}$ probability density function (PDF) parameters are

$$\sigma^2 = 2Y$$
$$\mu = Y$$

(1)

The PDF for a normal random variable is

$$f_x(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

(2)

Thus, the PDF for $X^2_{Y}$ for large $Y$ is

$$f_{X^2_{Y}}(x) \approx \frac{1}{\sqrt{4\pi Y}} e^{-\frac{(x-Y)^2}{4Y}}$$

(3)

BY DEFINITION:

\[ a = \int_{x_0, r}^{\infty} \int \chi^2(x) dx \quad (4) \]

Thus, for large \( \gamma \)

\[ a = \int_{x_0}^{\infty} \frac{1}{\sqrt{4\pi \gamma}} e^{-\frac{(x - \gamma)^2}{4\gamma}} dx \quad (5) \]

Making the variable substitution

\[ z = \frac{(x - \gamma)}{\sqrt{2\gamma}} \]

gives

\[ a = \int_{x_0}^{\infty} \frac{1}{\sqrt{\gamma} \sqrt{2\pi}} e^{-\frac{z^2}{2}} dz \quad (6) \]

We know that

\[ a = \int_{z_0}^{\infty} \frac{1}{\sqrt{2\pi}} e^{-\frac{z^2}{2}} dz \quad (7) \]
COMPARING Eqs. 6 and 7 GIVES

\[ z_\alpha = \frac{X_{1-\alpha, n}}{\sqrt{2V}} \]  \hspace{1cm} (8)

OR EQUIVALENTLY

\[ X_{Y, n}^2 = \sqrt{2V} \cdot z_\alpha + V \]  \hspace{1cm} (9)

Eq. 9 can be considered as the value of \( X_{Y, n}^2 \) for large values of \( V \) \((V > 30)\).
CONFIDENCE FOR \( r > 14 \)

A TOTAL OF \( r \) FAILURES OCCURRED IN A TIME TERMINATED TEST OF DURATION \( T \). THE MTBF POINT ESTIMATE IS
\[
\hat{\theta} = \frac{T}{r}
\]  \( (1) \)

FROM STATISTICS,
\[
P[\theta \geq \frac{2T\hat{\theta}}{\chi^2_{\alpha;2r+2}}] = 1 - \alpha 
\]  \( (2) \)

OR EQUIVALENTLY,
\[
P[\theta \geq \frac{2T}{\chi^2_{\alpha;2r+2}}] = 1 - \alpha 
\]  \( (3) \)

THE LOWER POINT OF CONFIDENCE, \( \theta_L \), IS THUS
\[
\theta_L = \frac{2T}{\chi^2_{\alpha;2r+2}} 
\]  \( (4) \)
FOR LARGE VALUES OF \( \nu \) (> 30)

\[
X^2_{\nu, \alpha} = \sqrt{2\nu} \cdot Z_{\alpha} + \nu
\]  

(5)

SINCE

\[
\nu = 2r + 2
\]  

(6)

EQ 4 BECOMES

\[
\Theta_2 = \frac{I}{\sqrt{r+1}} Z_{\alpha} + (r+1)
\]  

(7)

THUS, FOR LARGE VALUES OF \( \nu \) (>15),
ONE IS \( 1-\alpha \) CONFIDENT
THAT THE TRUE MTBF IS
GREATER THAN \( \Theta_2 \). THAT IS

\[
P[\Theta \geq \Theta_2 = \frac{I}{\sqrt{r+1}} Z_{\alpha} + (r+1)] = 1-\alpha
\]  

(8)
CONFIDENCE STATEMENTS

1. CONFIDENCE INTERVAL
\[ P \left[ \frac{2 \hat{\theta}}{\chi^2_{1-\alpha/2; Y}} \leq \theta \leq \frac{2 \hat{\theta}}{\chi^2_{1-\alpha/2; Y} = \Theta_U} \right] = 1 - \alpha \]

2. LOWER BOUND
\[ P \left[ \theta \geq \frac{2 \hat{\theta}}{\chi^2_{\alpha; Y} = \Theta_0} \right] = 1 - \alpha \]

3. UPPER BOUND
\[ P \left[ \theta \leq \frac{2 \hat{\theta}}{\chi^2_{1-\alpha/2; Y} = \Theta_U} \right] = 1 - \alpha \]

FOR TIME-TERMINATED TEST \[ Y = 2T + 2 \]
FOR FAILURE-TERMINATED TEST \[ Y = 2F \]
\[ \hat{\theta} = \frac{\text{TOTAL TEST TIME}}{\text{TOTAL FAILURES}} = \frac{T}{F} \]
PROPOSED INVESTIGATIVE AVENUES
FOR IMPROVEMENT AND EVALUATION OF
AVIONICS BUILT-IN TEST SYSTEM EFFECTIVENESS

A sole effort has been extended toward quantifying avionic effectiveness with the inclusion of BIT. Although incomplete the ARINC report offers a sound basis for such a measure based on previous models. This paper briefly reviews the ARINC report and suggests some possible areas of evaluation and refinement in need of examination.

I. THE ARINC MODEL

ARINC Research Corporation (1) has provided a foundation for evaluating system effectiveness for avionics embellished with built-in test. Their model is an expanded version of that proposed by the WSEIAC effort (2) and (3), which defined system effectiveness as the "measure of the extent to which a system may be expected to achieve a set of specific mission requirements".

The elements of system effectiveness are:

1. Availability: A measure of the system at the start of a mission
2. Dependability: A measure of the system condition during the mission
3. Capability: A measure of the system's ability to achieve mission objectives given the system condition at time of mission execution.

A basic overview of these elements are offered in Fig. 1:
In order to quantify the effectiveness measure, availability, dependability, capability and system effectiveness are expressed probabilistically. If there are \( n \) possible mutually exclusive states of the system in question and there are \( m \) objectives, the system effectiveness relationship is

\[
[\mathbf{E}] = [\mathbf{A}][\mathbf{D}][\mathbf{C}]
\]  

(1)

where

\[
[\mathbf{E}] = [E_1, \ldots, E_j, \ldots, E_m]
\]  

(2)

\( E_j \) = System Effectiveness for \( j^{TH} \) Objective (Probability of Mission Success)

and

\[
[\mathbf{A}] = [A_1, \ldots, A_i, \ldots, A_n]
\]  

(3)

\( A_i \) = Probability the system is in state \( i \) at the start of the mission

and

\[
[\mathbf{D}] = 
\begin{bmatrix}
D_{i1} & \cdots & D_{ik} & \cdots & D_{in \, k} \\
\vdots & \ddots & \vdots & \ddots & \vdots \\
D_{i1} & \cdots & D_{ik} & \cdots & D_{in \, n} \\
\vdots & \ddots & \vdots & \ddots & \vdots \\
D_{n1} & \cdots & D_{nk} & \cdots & D_{nn}
\end{bmatrix}
\]  

(4)

\( D_{ik} \) = Probability the system will change from state \( i \) to state \( k \) during the mission.
The above relationship views system effectiveness as the probability of meeting mission objectives. Factors include how the equipment functions at the time of mission initiation (availability), how the equipment operates in transient to the mission sight (dependability), and how the equipment will operate in various states at the time of mission execution (capability).

Addition of Built-in-Test (BIT) equipment to the avionics effects system effectiveness in three basic ways:

1. BIT will indicate (to a degree) the system state
2. The operator will be forced to make a decision as to the validity of the BIT indication.
3. The types and number of states will be changed.

These changes effect the availability and dependability measures of the avionics (and also the capability in the sense the number and types of states are changed). ARINC (1) incorporates these concerns by expanding the effectiveness equation by expanding the three element matrices of the system effectiveness measure.

The \( i^{th} \) element in the "new" availability matrix, \( \hat{A}_{ij} \), is given by

\[
\hat{A}_{ij} = A_{ij} \sum_{\delta=1}^{\alpha} \frac{\Gamma_{\delta,i}}{L_{\delta,i}}
\]  

(6)
where

\[ A_1 \text{ is defined in Eq. 3} \]

\[ I_{ji} \text{ is the probability BIT indicates the system is in state } j \text{ when actually it is in state } i. \]

\[ L_{ji} \text{ is the probability of initiating the mission when BIT shows the system is in state } j \text{ when actually the system is in state } i. \]

We may write Eq. 6 in matrix form as

\[
[\hat{A}] = [A][I][IL]^T
\]

(7)

where

\( (A) \) is defined in Eq. 3

\( (I) \) is an NXN matrix of "1's"

\( (IL)^T \) is the transpose of the NXN matrix \( (IL) \), the \( ji^{TH} \) element of which is \( I_{ji} L_{ji} \).

Note that \( I \) and \( L \) respectively represent the monitoring and decision making BIT characteristics which effect system availability.

As with availability, the dependability matrix must be altered with the inclusion of BIT. The \( ik^{TH} \) element of the "new" dependability matrix, \( \hat{D}_{ik} \), is written:

\[
\hat{D}_{ik} = D_{ik} \sum_{q=1}^{Q} J_{qk} G_{qk}
\]

(8)
where
\( D_{ik} \) is defined in Eq. 4
\( J_{qk} \) is the probability that BIT indicates state \( q \) during the mission when the true state is \( k \)
\( G_{qk} \) is the probability of a mission completion decision when BIT indicates the system is in state \( q \) when actually the system is in state \( k \).

In matrix form Eq. 8 becomes

\[
[D] = [O] \left[ \left[ [1] \right]_R \left[ J \ G \right] \right]^T \left[ [1] \right]_C
\]

(9)

where
\( (D) \) is defined in Eq. 4
\( (JG) \) is an \( NXN \) matrix the \( qk \)th element of which is \( J_{qk} G_{qk} \)
\( (1)_R \) is an \( n \) element row vector of "1's"
\( (1)_C \) is an \( n \) element column vector of "1's"

Again the monitoring characteristics of BIT are reflected in \( J \) and the decision characteristics in \( G \).

As previously mentioned, inclusion of BIT into avionics does not effect the form or definition of the capability matrix as given in Eq. 5. The meaning of the matrix however, is changed in that BIT will alter the number and type of system states. This change also effects the meaning of the previously defined availability and dependability matrices in the same manner.

With inclusion of BIT the system effectiveness equation becomes

\[
[E] = [\hat{A}] [\hat{D}] [\hat{C}]
\]

(10)
This is the basic model proposed by ARINC for measuring the system effectiveness of avionics with built-in-test equipment.

II. POSSIBLE AREAS OF REFINEMENT AND EXPANSION OF THE ARINC MODEL

The ARINC BIT system effectiveness scheme provides an intuitively sound model for measuring system effectiveness. As with any model, the dexterity and exactness of the ARINC method can only be validated by statistical verification. To follow are suggested areas in which the BIT system effectiveness model might possibly be matured.

A. Confidence in Effectiveness

Any computed measure is only as good as its component elements. Many of the elements comprising the BIT system effectiveness relationship are difficult to quantize. System reliability, inherent in the availability and dependability elements of system effectiveness, is perhaps the most sophisticated measure in the effectiveness equation. Maintainability, inherent also in availability and dependability follows. The capability concept, however, has not been developed to the extent that it can be quantified by standard techniques*. Likewise, the human factor of decision introduced by the inclusion of BIT is also difficult to quantize. With such low confidence in these measures, how good can the resulting point estimate of system effectiveness be considered? One possible answer lies in the employment of confidence intervals (4) (5).

Consider again the system effectiveness equation given in Eq. 10 and their corresponding relationships in Eqs. 7, 9 and 5. We assume each of these elements can be assigned an arbitrary confidence interval. Specifically, if \( b \) is a statistical matrix element, and \( 1-\alpha \) is the degree of confidence, we write

\[
P[x_l < b < x_u] = 1 - \alpha
\]  

(11)

*ARINC REPORT (1), p. 9-46
where \( X_L \) and \( X_U \) are respectively the lower and upper points of the confidence interval and \( P() \) is read, "The probability that . . .". In other words, Eq. 11 says that we are 100 \((1-a)\)% certain that the true value of \( b \) lies between \( X_L \) and \( X_U \).

Examining the mechanics of the matrix multiplication needed to compute system effectiveness, we find we are solely concerned with addition and multiplication of statistical elements. To assign a confidence interval to the resulting system effectiveness, we must determine how confidence intervals interrelate upon multiplication and addition of statistics.

As an example of such a combination, consider the addition of two statistics \( X_1 \) and \( X_2 \) sampled respectively from two independent distributions \( f_{X_1}(x) \) and \( f_{X_2}(x) \). The distribution of \( X_1 + X_2 \) is then the convolution of the two density functions. Specifically:

\[
\begin{align*}
&f_{X_1 + X_2}(x) = f_{X_1}(x) \ast f_{X_2}(x) \\
&= \int_{-\infty}^{\infty} f_{X_1}(y) f_{X_2}(x - y) \, dy
\end{align*}
\]

For an example of how such notions might be applied towards confidence interval combination, consider the case where \( f_{X_1}(x) \) is normally distributed with mean \( \mu_1 \) and variance \( \sigma_1^2 \) and \( f_{X_2}(x) \) is normally distributed with mean \( \mu_2 \) and variance \( \sigma_2^2 \). That is

\[
\begin{align*}
&f_{X_1}(x) = N(\mu_1, \sigma_1^2) \\
&f_{X_2}(x) = N(\mu_2, \sigma_2^2)
\end{align*}
\]
It can be shown via Eq. 12 that

\[ f_{X_1 + X_2}(x) = N\left( \mu_1 + \mu_2, \sqrt{\sigma_1^2 + \sigma_2^2} \right) \]

(15)

If both \( \sigma_1 \) and \( \sigma_2 \) are known, a 1 - \( \alpha \) confidence intervals for \( \mu_1 \) and \( \mu_2 \) (the best estimates of the statistics)** are

\[
\begin{align*}
P\left[ X_1 - \sigma_1 Z_{\alpha/2} \leq \mu_1 < X_1 + \sigma_1 Z_{\alpha/2} \right] &= 1 - \alpha \\
P\left[ X_2 - \sigma_2 Z_{\alpha/2} \leq \mu_2 < X_2 + \sigma_2 Z_{\alpha/2} \right] &= 1 - \alpha
\end{align*}
\]

(16)

where

\[
Z_\alpha = \int_\beta^\infty N(0,1) \, dx
\]

\[
= \frac{1}{\sqrt{2\pi}} \int_\beta^\infty e^{-\frac{1}{2}x^2} \, dx
\]

(17)

Similarly a 1 - \( \alpha \) confidence interval for \( \mu_1 + \mu_2 \) is

\[
P\left[ (X_1 + X_2) - \sqrt{\sigma_1^2 + \sigma_2^2} Z_{\alpha/2} \leq \mu_1 + \mu_2 < (X_1 + X_2) + \sqrt{\sigma_1^2 + \sigma_2^2} Z_{\alpha/2} \right] = 1 - \alpha
\]

(18)
The lengths of the confidence intervals given by Eqs. 16 and 18 are then

\[ CI_{X_1} = 2\sigma_1 \frac{Z_\alpha}{2} \]
\[ CI_{X_2} = 2\sigma_2 \frac{Z_\alpha}{2} \]
\[ CI_{X_1 + X_2} = 2\sqrt{\sigma_1^2 + \sigma_2^2} \frac{Z_\alpha}{2} \] (19)

The confidence interval for the mean of the sum of the two random variables is thus larger than for the mean of either of its components (See Fig. 2). Thus, for the same degree of confidence, we are less certain about the location of \( \mu_1 + \mu_2 \) than we are about the location of either \( \mu_1 \) or \( \mu_2 \). We have added two somewhat uncertain numbers and have arrived at a more uncertain number. This, unfortunately, is the tradeoff required in the condensation of a number of statistics into a single measure. We lose information. We look at one number instead of at each of many individual numbers, but the single number is more comprehensible.

Fig. 2: 1 - \( \alpha \) confidence intervals, CI, for \( \mu_1, \mu_2 \) as determined respectively by \( X_1, X_2 \), and \( X_1 + X_2 \) sampled from normal populations of known variance, \( \sigma_1^2, \sigma_2^2 \), and \( \sigma_1^2 + \sigma_2^2 \).
Such notions can be extended to the non-parametric case. Again consider statistics $X_1$ and $X_2$ with estimated even two-sided $(1-\alpha)$ confidence intervals $\Delta X_1$ and $\Delta X_2$. That is:

\begin{align*}
P \left[ X_1 - \Delta X_1 < \mu_1 < X_1 + \Delta X_1 \right] &= 1 - \alpha \\
P \left[ X_2 - \Delta X_2 < \mu_2 < X_2 + \Delta X_2 \right] &= 1 - \alpha 
\end{align*}

(20)

To determine $(1-\alpha)$ confidence intervals for operations concerning these statistics we need consider only worst case conditions. Thus, for addition and subtraction we

\begin{align*}
P \left[ (X_1 \pm X_2) - (\Delta X_1 \pm \Delta X_2) < \mu_1 + \mu_2 < (X_1 \pm X_2) + (\Delta X_1 + \Delta X_2) \right] &= 1 - \alpha 
\end{align*}

(21)

For division, the worst case conditions for the non-parametric case dictate:

\begin{align*}
P \left[ \frac{X_1 - \Delta X_1}{X_2 + \Delta X_2} \leq \frac{\mu_1}{\mu_2} \leq \frac{X_1 + \Delta X_1}{X_2 - \Delta X_2} \right] &= 1 - \alpha 
\end{align*}

(22)

Similarly, for multiplication:

\begin{align*}
P \left[ (X_1 - \Delta X_1)(X_2 + \Delta X_2) \leq \mu_1 \mu_2 \leq (X_1 + \Delta X_1)(X_2 - \Delta X_2) \right] &= 1 - \alpha 
\end{align*}

(23)
Note that the confidence interval for the addition of statistics in Eq. 21 is

\[ C_{\Delta x_1 + \Delta x_2} = 2(\Delta x_1 + \Delta x_2) \]  

(24)

For the previous normal test, the confidence intervals added as in the right triangle in Fig. 2. For the non-parametric case, the resulting confidence interval is the sum of the legs, rather than the hypotenuse, and is thus longer. Thus, knowledge of the underlying distribution tightens the confidence in the sum in that more information about the statistics are available.

How, then, does all of this apply to system effectiveness? Simply, if it is possible to extend the preceding notions to multiplication and addition of statistics sampled from various populations, a confidence interval may be placed on the computed system effectiveness. Thus, the rather shaky measures of system capabilities and human factors inherent in the BIT effectiveness equation would have their uncertainty reflected in the final effectiveness measure. This is opposed to the point estimate of system effectiveness which reflects none of these uncertainties.
B. On The Measure Of Capability

As previously mentioned, system capability to date has defied effective quantization. A rough proposal follows for capability methodology.

The definition of capability previously presented can be expressed as:

\[ C_{KP} = P\left( \frac{O_p}{S_K} \right) \]  \hspace{1cm} (25)

where

- \( C_{KP} \) is defined in Equation 5
- \( O_p \) is objective P success
- \( S_K \) is system state K
- "/" is read "given that"

We may view \( O_p \) as a distribution. That is, objective \( P \) demands a certain strain on the executing system. Likewise, the system has a certain strength distribution in state \( K \). If such strength-strain relationships can be determined for a system, the capability could be determined via established methods (6). We may rewrite Eq. 25 as

\[ C_{KP} = \frac{P\left( O_p \land S_K \right)}{P\left[ S_K \right]} \]  \hspace{1cm} (26)

Where \( \land \) denotes "and" or intersection. Examination of Fig. 3 exposes \( P(O_p \land S_K) \) as the intersection of the \( O_p \) and \( S_K \) distributions:
The quantity $P(S_k)$ is merely the probability that the system will be in state $S_k$ at mission execution time.

Although determining the distribution for $O_p$ and $S_k$ might presently involve rather subjective measures, the result is better than pure bull-dozer reasoning.

C. Model Verification

As previously mentioned a model can only be validated by statistical verification. As such, a system for reporting effectiveness elements generated in the field is direly needed. Careful attention to the form and recording of such data would be necessary.

D. Conclusions

The body of this paper lists only a few of the areas in which the BIT effectiveness measure is in need of examination and expansion.

A closer examination of the ARINC report coupled with familiarization with the WSEIAC and SEM (System Effectiveness Methodology) efforts would reveal other areas.

Proposed are the effectiveness confidence and capability measure. Development of these ideas would necessitate study of the literature and consultation.

A method for collection of BIT avionics data pertinent to the avionics system effectiveness is the only method by which the ARINC model can be verified. No such data collection system has even been initiated even though the need for one is obvious.
1. Aeronautical Radio Inc. (ARINC) Research Corporation, Final Report, 
"A Technique for Evaluating Avionics Built-In Test," Publication 974-02-1-1132, 
September 1971.

2. Weapons System Effectiveness, Industry Advisory Committee (WSEIAC), 
Final Report of Task Group II, Air Force Systems Command Publication 

3. United States Army Management Engineering Training Agency (AMETA), 
"Elements of Reliability and Maintainability", Rock Island Arsenal, Rock Island, 
Ill., October 1973, Section VII.

4. Irwin Miller and John E. Freund, "Probability and Statistics for Engineers", 

5. IBID. 3 Section IV

6. IBID. 3 Section V and Bibliography
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# Integrated Circuits

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<th>Commercial Designation</th>
<th>PART Type</th>
<th>Functional Description</th>
<th>Recommended Manufacturer</th>
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<td>Same as commercial designation 5461 (07) with different pin configuration</td>
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<td>SINGLE, 8-INPUT POSITIVE NAND GATE</td>
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<td>54H30</td>
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</table>
POINT STATISTICS

\[ r = \text{TOTAL NUMBER OF FAILURES} = 89 \]
\[ b = \text{TOTAL BIT FAILURES (CR)} = 10 \]
\[ n = \text{FAILURES NOT DETECTED} = 4 \]
\[ t = \text{TOTAL TEST TIME} = 19,500 \text{ HRS} \]

RATIOS

DEPENDIBILITY = \[ d = \frac{r - n}{r} = 1 - \frac{n}{r} \]
FAILURES NOT DETECTED = \[ f = \frac{n}{r} \]
70% BIT FAILURES = \[ p = \frac{b}{r} \]

ASSUME
\[ \frac{t}{n} \text{ IS EXPONENTIAL} \]
\[ \frac{t}{f} \text{ IS EXPONENTIAL} \]

ONLY DEPEND. IS EXAMINED.
\[ \hat{d} = 1 - \frac{\hat{p}}{\hat{r}} \]  

(1)

Find \( \hat{d}_e \) such that

\[ P[d > d_e] = 1 - \alpha \]  

(2)

A non-parametric approach is

\[ \overline{d}_e = 1 - \frac{n_U}{r_e} \]  

(3)

where \( \overline{d}_e \) is the nonparametric measure and

\[ P[n < n_U] = 1 - \alpha \]  

(4)

\[ P[r_i > r_e] = 1 - \alpha \]  

(5)

This will yield a value of \( 1 - \alpha \) for \( \overline{d}_e \) such that

\[ \overline{d}_e < d_e \]  

(6)

This is true since the result of combining the statistical estimates of \( n \) and \( r \) is not known. If it was, we could get \( 1 - \alpha \) for \( d \) in a parametric analysis,
\[
\Pr \left[ \frac{T}{\hat{\Theta}_n} < \frac{2n\hat{\Theta}_n}{X^2_{1-\alpha}; 2r+2} \right] = 1 - \alpha \quad (7)
\]

or equivalently

\[
\Pr \left[ \frac{n}{T} \geq \frac{X^2_{1-\alpha}; 2r+2}{2n\hat{\Theta}_n} \right] = 1 - \alpha
\]

\[
\Rightarrow \Pr \left[ \eta > \frac{T X^2_{1-\alpha}; 2r+2}{2n\hat{\Theta}_n} \right] = 1 - \alpha
\]

since

\[
\hat{\Theta}_n = \frac{T}{\eta}
\]

we have

\[
\Pr \left[ \eta > \frac{1}{2} X^2_{1-\alpha}; 2r+2 \right] = 1 - \alpha \quad (9)
\]

thus, comparing with Eq. \#5

\[
\rho = \frac{1}{2} \chi^2_{1-\alpha; 2r+2}
\]

(10)
WE KNOW ALSO THAT

\[ P \left[ \frac{1}{n} = \theta_n > \frac{2n \hat{\theta}}{X^2_{\alpha; 2(n+2)}} \right] = 1 - \alpha \]  (13)

REARRANGING

\[ P \left[ \frac{1}{n} < \frac{X^2_{\alpha; 2(n+2)}}{2n \hat{\theta}} \right] = 1 - \alpha \]

= \[ P \left[ n < \frac{TX^2}{2r \hat{\theta}} \right] \]

= \[ P \left[ n < \frac{1}{2} X^2_{\alpha; 2(n+2)} \right] \]  (14)

COMPARING WITH EQUATION 8.4

\[ n_0 = \frac{1}{2} X^2_{\alpha; 2(n+2)} \]  (15)

FOR LARGE VALUES OF \( Y (> 30) \)

\[ X^2_{\alpha; \alpha} = \sqrt{2} Y + \frac{z_\alpha + Y}{Y} \]  (16)

\[ X^2_{2n+2, \alpha} = 2 \sqrt{r + 1} \frac{z_\alpha + X[1 + 1]}{Y} \]  (17)

THUS

\[ n_0 = \]
If $r$ is so large we must employ the fact that for large $r$

$$X^2_{r; \alpha} = \sqrt{2r} - Z_{\alpha} + r \quad (16)$$

Thus, from Eq. 10

$$r_0 = \frac{1}{2} X^2_{1-\alpha; 2r+2}$$

$$= \frac{1}{2} \left[ 2\sqrt{r+1} \right] Z_{1-\alpha} + 2(r+1)$$

$$= \sqrt{r+1} Z_{1-\alpha} + (r+1) \quad (17)$$
Now the numbers on pg 1:

1. \( 1 - \alpha = 90\% \)

   \[ r_2 = \sqrt{90} \cdot z_{0.9} + (90) \]
   
   \[ = \sqrt{90} \cdot z_{0.1} + 90 \]
   
   \[ = \sqrt{90} (1.28) + 90 \]
   
   \[ = -0.28 \sqrt{90} + 90 \]
   
   \[ = 87.34 \]

   From 15

   \[ n_U = \frac{1}{2} \chi^2 \alpha; 2n+2 \]
   
   \[ = \frac{1}{2} \chi^2_{0.1; 10} \]
   
   \[ = \frac{1}{2} (15.987) \]
   
   \[ = 7.99 \]
\[
\begin{align*}
\bar{d}_e &= 1 - \frac{n_u}{n_e} \\
&= 1 - \frac{7.99}{87.34} \\
&= 1 - 0.0915 \\
&= 0.9100 \\
1 - \alpha &= 90\% \\
\text{Thus, we are } 90\% \text{ confident (non-parametrically) that} \\
d &> 91\%
\end{align*}
\]
\[ 1 - a = 95.90 \]

From 17

\[ r_e = \sqrt{90} \cdot Z_{0.95} + 90 \]

\[ = \sqrt{90} \cdot Z_{0.05} + 90 \]

\[ = \sqrt{90} \cdot (1.65) + 90 \]

\[ = 74.35 \]

From 15

\[ n_u = \frac{1}{2} X^2_{a; 2n+2} \]

\[ = \frac{1}{2} X^2_{0.05; 10} \]

\[ = \frac{1}{2} (18.307) \]

\[ = 9.153 \]
\[
\begin{align*}
\bar{d}_2 &= 1 - \frac{\nu}{\bar{d}_2} \\
&= 1 - \frac{9.153}{74.35} \\
&= 1 - 0.123 \\
&= 0.87770
\end{align*}
\]

Thus, we are 95% confident (non-parametrically) that
\[
d > 88.90
\]
MEMORANDUM

From: 3041 (R. J. Marks)  
To: 3041 (C-Rice) (R. Saum)  
VIA: 3041 (C. Rice)  
Subj: Work Statement and Present Status (Revision of AR-34)

Ref: (a) 14 Feb 1975 Meeting (R. Saum, C. Rice, and B. Marks) at NAD Crane  
(b) AR-34, "Failure Classification for Reliability Testing, General Requirements for"

Discussion:

In reference (a), the need for a more specified definition of paragraph 3.3, number 2 of reference (b) was stated. That is, what constitutes "sufficient data" for substantiation of failure reclassification. Currently, "sufficient data" is determined solely by engineering judgement. Investigation of formulation of statistical guidelines for more precise failure reclassification will be the method of attack by this activity for drafting more precise "sufficient data" requirements.

In-house consultation possibilities include W. D. Kent, W. T. Sumerlin, former member of the AGREE committee, was also suggested as a consultant in the effort. Mr. Sumerlin has been subsequently contacted and has offered his support in the effort. (see enclosure (a)).

Areas to be explored in regard to the establishment of sufficient data requirements for substantiation of failure reclassification, subject to revision or expansion, are as follows:

- Statement in item 1 in enclosure (a).
- Statement in item 2 in enclosure (a).
3. Reclassification requirements of corrected failure modes under test with both no and apriori assumptions.

4. Correlation of failure mode and corrective action types to apriori weighting of sufficient data requirements.

5. Employment of established and/or recent statistical works in determining sufficient test data requirements.

6. Other areas exposed by investigation of the above items.

The present work status in these investigative avenues is reflected in enclosure (b) and (c). Application of the results to the failure reclassification efforts on the ARR-75. (AEL-EMTECH) is contained in enclosure (3).
Revision of AR-34 on Failure Reclassification

McDonnell Aircraft
P. O. Box 181
Hazelwood, MO 63042

During introductive phase, Mr. Sumerlin recalled Carl Wiggington and Bob Saum. He stated he has reflected a great deal on AR-34 and MIL-STD-781B, and has as a result, developed definite opinions. Which were reflected during the conversation as follows:

1. No "random failure" should be reclassified since the test is too short to show the benefits of the reclassification. In case of a reject decision, due only to random failures, the system under test should be corrected (by redesign or other corrective action), and the test reinitiated. The stated philosophy behind this opinion is that forethought in design is better than corrective action under test.

2. "Pattern Failures" should be subject to a degree of reclassification, since usually sufficient test time exists for qualification. Mr. Sumerlin stated pattern failures were not characteristic of the exponential assumption. To include the occurrence of the pattern failure as a random failure, a single failure should be counted upon reclassification.

3. Upon being asked about a random failure reclassification with a "no risk" determined via test, Mr. Sumerlin said such action would be possible in certain instances, if sufficient test time, etc. exists. Sumerlin was enthusiastic in his response and welcomed future contact regarding questions and consultation in this matter.

Enclosure (1)
The problem under inspection:
A system failure mode, m, has experienced failure(s) in test time t at which time corrective action (denoted \( \overline{m} \)) is taken. Employing the exponential assumption and no apriori judgement as to the corrective action's effectiveness, how long must one test the corrected system with no failures to establish with \( 1-\alpha \) confidence the non-occurrence of a failure in the uncorrected system test time t.

Stated more rigourously, we must determine the required test time \( T \) to establish that

\[
P[E(r) < 1] = 1 - \alpha
\]

where

\[
\alpha = P[r > 1]
\]

\( P \) is read "the probability that"
\( r \) is the number of failures in test time \( T_c \)
\( E(r) \) is the "expected value of r"

For an exponentially modeled failure mode (ie one that fails "randomly"),

\[
E(r) = \lambda_m' \cdot t
\]

where \( \lambda_m' \) is the constant failure rate of the corrected failure mode.
Noting that \( \Theta_m' \), the corrected failure mode's MTBF, may be written

\[
\Theta_m' = \frac{1}{\lambda_m'}
\]

Enclosure (2)
We may rewrite Eq. 1 as follows:
\[ P\left[ \Theta > \frac{t}{\hat{\Theta}} \right] = 1 - \alpha \]

(4)

We are thus testing the corrected mode to determine if its MTBF is greater than the uncorrected system test time. This, then, is equivalent to testing for the non-occurrence of a failure in test time \( t \) with \( 1 - \alpha \) confidence.

From elementary statistics, if an exponential population is tested for time \( T \) with \( r \) failures, then, is the one tail \( 1 - \alpha \) confidence interval for \( \Theta \) is

\[ P\left[ \Theta \geq \frac{2r \hat{\Theta}}{X^2 \alpha; 2r} \right] = 1 - \alpha \]

(5)

where
\[ \hat{\Theta}_m = \frac{T}{r} \]

is the test estimate (in this case mean MTBF) of the parameter \( \Theta \) is the area to the right of \( \hat{\Theta} \) in the chi-squared probability density function with \( r \) degrees of freedom.

\[ X^2 \alpha; r \]

is the chi-squared probability density function ordinate (with \( r \) degrees of freedom) to the right of which is area \( \alpha \).

Comparing Eqs. 4 and 5, the failure reclassification substantiation test (FRST) requires that

\[ T = \frac{2r \hat{\Theta}_m}{X^2 \alpha; 2r} = \frac{2r^2 T \hat{\Theta}_m}{X^2 \alpha; 2r} = \frac{2 \hat{\Theta}_m}{X^2 \alpha; 2r} \]

(6)

We now assume that the FRST runs for time \( T \) (yet to be determined) without failure. Our best estimate of \( \hat{\Theta} \) in the strict statistical sense is infinity.

In order that the analysis be more realistic, we assume the worst case condition in which a failure occurs immediately after conclusion of the FRST at time \( T + dt \). Thus,

\[ \hat{\Theta} = \frac{\text{TOTAL TEST TIME}}{r} = \frac{T}{T_m} \]

(7)

Substituting into Eq. 6 followed by rearrangement gives

\[ T = \frac{1}{2} \hat{\Theta} \frac{T^2}{X^2 \alpha; 2r} \]

2
This is the final desired relationship giving the required FRST time to establish with confidence the non-occurrence of over one failure in test time $t$ under stated worst case conditions. Note that

$$T_{\alpha} > t_{\min} \text{ for } \chi^2_{\alpha;2} > 2 \quad (9)$$

Roughly,

$$\chi^2_{\alpha;2} > 2 \text{ for } 1 - \alpha \leq 0.7$$

Thus, more FRST time is required than original test time when the reclassification confidence, $1 - \alpha$, is greater than 70%. Some typical values of $T$ as a function of $t$ are offered below:

<table>
<thead>
<tr>
<th>$1 - \alpha$ (Confidence)</th>
<th>$\chi^2_{\alpha;2}$</th>
<th>$T/t = \frac{1}{2} \chi^2_{\alpha;2}$</th>
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<tbody>
<tr>
<td>0.5</td>
<td>$1.80$</td>
<td>0.693</td>
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<tr>
<td>0.75</td>
<td>$1.86$</td>
<td>1.076</td>
</tr>
<tr>
<td>0.90</td>
<td>$2.95$</td>
<td>2.302</td>
</tr>
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<td>0.95</td>
<td>$3.05$</td>
<td>2.995</td>
</tr>
<tr>
<td>0.99</td>
<td>$4.605$</td>
<td>4.605</td>
</tr>
</tbody>
</table>

References:


(2) Elements of Reliability and Maintainability, AMETA, Rock Island IL, 1973, pg IV-48

$$\alpha = 0.10 = P[K \geq 1]$$
Failure Reclassification Confidence from Stated Test Times

1. Parameter definitions:
   \( t \) - test time on uncorrected mode  
   \( T \) - test time on corrected mode  
   \( r \) - tallied failures during test of corrected mode  
   \( \hat{\Theta} \) - Point estimate of the corrected failure mode \( \mu_{TBF} = \frac{T}{r} \).  
   \( 1-\alpha \) - Confidence in reclassification  
   \( \chi^2_{\nu} \) - Chi-squared probability density function ordinate (with \( \nu \) degrees of freedom) to the right of which is area \( \alpha \).  
   \( \Theta \) - True MTBF of corrected failure mode.

2. Derivation (Worst case condition)

Under the exponential assumption, the MTBF confidence interval \((1,2)\) for the failure reclassification substantiation that \((FRST)(3)\) is

\[
P[\Theta \geq \frac{2r\hat{\Theta}}{\chi^2_{\alpha;2r}}] = 1 - \alpha
\]

(1)

Since

\[
\hat{\Theta} = \frac{T}{r}
\]

(2)

we have equivalently

\[
P[\Theta \geq \frac{2T}{\chi^2_{\alpha;2r}}] = 1 - \alpha
\]

(3)

To avoid the \( r = 0 \) situation, a worst case condition is assumed. This condition is the occurrence of a failure at FRST time \( T + dt \). Thus,

\[
r = \text{number of observed failures} + 1
\]

(4)

In that we wish to test for:

\[
P[\Theta \geq t] = 1 - \alpha
\]

(5)

we compare with Eq. 3 and write

\[
t = \frac{2T}{\chi^2_{\alpha;2r}}
\]

(6)

or equivalently:

\[
\chi^2_{\alpha;2r} = \frac{2T}{t}
\]

(7)
Thus, given $r$, $T$, and $t$ as defined in Eq. 4 and section 1, the reclassification confidence, $1-\alpha$, must satisfy Eq. 7.

3. Application of Worst Case Condition Derivation to Reliability on ARR-75 Sonobuoy Receiver

In the latest (Feb 75) reliability test status report on the ARR-75 sonobuoy receiver from AEL-EMECH, the following data was cited:

RAT: Reliability Acceptance Test (Production)

Total test time $= T = 1650$ hrs.
Total failures: 3
Failure modes:
  a. IC: failure at 317 hrs.
  b. MIXER: failure at 706 hrs.
  c. TRANSISTOR: failure at 1149 hrs.

RQT: Reliability Qualification Test

Total test time $= t = 1663$ hrs.
Total failures: 12
Failure Modes:
  a. RF filter #1 558 hrs.
  b. RF filter 628 hrs.
  c. Transformers 1018 hrs.
      1018 hrs.
      1502 hrs
  d. Connector 1562 hrs.
  e. Mixers 1018 hrs.
      1370 hrs.
Need of the ARR-75 necessitated production and shipment of the unit prior to successful completion of the RQT. Since all RQT failures had corrective action imposed in over 90% of the RAT test, we may view the RAT as a FRST for the RQT. Examples follow:

a. In view of the cited data, what is the confidence, 1-\(\alpha\), in reclassifying the following RQT failures under worst case conditions:

- RF filter #1
- RF filter #2
- Transformers
- Connectors

For each of these four failure modes, a parts screening type corrective action was implemented. No further corresponding failures occurred in the FRST (RAT) test. Thus, from Eq. 7:

\[
\chi^2_{\alpha; 2} = \frac{2(1650)}{1663} = 1.98
\]

From chi-squared tables:

\[
\chi^2_{0.05, 2} = 1.38 \quad \chi^2_{0.01, 2} = 2.40
\]

A rough interpolation gives a reclassification confidence of

\[1 - \alpha = 60.7\%\]
b. In view of the cited data what is the confidence of reclassifying the mixer failure under worst case conditions. Since there occurred one failure in the FRST we have from Eq. 7:

\[ X^2_{2; \alpha} = 1.98 \]

From chi-squared tables:

\[ X^2_{0.75; 2} = 1.92 \quad X^2_{0.70; 2} = 2.19 \]

The failure reclassification confidence for this case is thus about

\[ 1 - \alpha = 25\% \]

4. Alternate derivation:

Assuming worst case conditions for FRST failure determination places the most stringent of test requirements on the contractor. A less stringent requirement is the assumption that if \( K \) failures are observed in FRST time \( T \), then \( 2K + 1 \) failures will occur in FRST time \( 2T \). In lieu of Eq. 4, we thus have

\[ r = \text{number of observed failures} + 1/2 \quad (8) \]

This assumption, although still weighted toward the customer, requires less of the contractor in test time for a given confidence level.

5. Application of Alternate Derivation to Reliability Testing on the ARR-75

We shall now employ the less stringent failure reclassification test in the above section to the ARR-75 data.

a. With reference to section 3, the failure reclassification confidence for the RF filters, connector and transformers under the alternate derivation, is found from:

\[ X^2_{2; \alpha} = 1.98 \]
From chi-squared tables:

\[
\chi^2_{0.2;1} = 1.64 \quad \chi^2_{0.1;1} = 2.71
\]

The reclassification risk is thus about:

\[
1 - \alpha = 80\%
\]

b. With reference to section 3, the failure reclassification confidence for the mixers under the alternate derivation is:

\[
\chi^2_{0.1;3} = 1.98
\]

From chi-squared tables:

\[
\chi^2_{0.7;3} = 1.42 \quad \chi^2_{0.5;3} = 2.37
\]

Roughly, the reclassification confidence is then:

\[
1 - \alpha = 35\%
\]

Note that, in both of the above cases the reclassification as predicted, is greater than the corresponding worst case condition calculations in section 3. The first by 20% and the second by 10%.

6. Discussion:

The failure reclassification risks discussed herein assume nothing about the effectiveness of the corrective action. That is, the corrected failure mode is not considered better or worse than the original failure mode. This allows no employment of engineering judgement, a feature which seemingly would be of significant value in the area of failure reclassification.

The two failure reclassification risks derived herein differ only in the method of FRST failure tallying assumptions. The lack of information on the occurrence of no failures in the FRST necessitates these assumptions. Patterns set up by sections 2 and 4 may be extended by assuming \( nk + 1 \) failures in test time \( nT \) given that \( k \) failures occurred in FRST time \( T \).
However, in the limit, one is again confronted with the original problem on the occurrence of no FRST failures. The alternate derivation of section 4 is thought to be the golden mean with respect to contractor and customer fairness and mathematical nicety, even though the worst case assumption of section 1 is primarily employed in reliability practice.

7. References


(2) *Elements of Reliability and Maintainability*, AMETA, Rock Island, IL, 1973, pg IV-48

(3) Required Failure Reclassification Test Time for a Given Confidence Level - R. J. Marks II
4 R TEST REQUIREMENTS

.1 R TEST CATEGORIES

.1 QUALIFICATION

.1 SAMPLE SIZE (4.2.3)

.2 EVALUATION CRITERIA (4.2.3.1)

.2 ACCEPTANCE (SAMPLING) (4.2.4)

.1 SAMPLE SIZE (4.2.4.1)

.1 MAXIMUM (4.2.4.1.1)

.2 MINIMUM (4.2.4.1.2)

.2 EVALUATION CRITERIA (4.2.4.2)

.3 LONGEVITY (5.4.8.6) (4.2.7)

.3.1 GENERAL (4.2.7.1)

.3.2 SAMPLE SIZE (5.4.8.6.2)

.3.3 EVALUATION (5.4.8.6.3)

.4 REQUIREMENTS (5.4.8.6)

NOTE: IF TEST PLAN XXVII (FIXED LENGTH PROD. VERIF. TEST) AND TEST PLAN XXVI
(FIXED LENGTH DEMONSTRATION TEST) ARE TO BE INCLUDED, STICK THEM HERE
.2 PRE-TEST REQUIREMENTS (5.1)
   .1 FAILURE PREDICTION (5.1.1)
   .2 DETAIL R TEST PROCEDURES (5.1.3)
   .3 TEST FACILITIES REQUIREMENTS (5.3)
      .1 TEST CHAMBERS (5.3.1)
      .2 VIBRATION REQ (5.3.2)
      .3 EQUIP. COOLING (5.3.3)
         .1 EXTERNAL (5.3.3.1)
         .2 INTERNAL (5.3.3.2)
      .4 INSPECTION (5.1.4)
   .4 PRE-R TESTS (5.4.1)
      .1 SELECTION OF EQUIP (5.4.1.1)
      .2 DESIGN AND PERFORMANCE TESTS (5.1.2)
   .3 SURVEYS (5.1.5)
      .1 THERMAL (5.1.6)
      .2 VIBRATION (5.1.6)
   .3 BURN IN (5.1.7)
   .4 PRECEDING R TEST (5.4.2)
      .1 EQUIP. INSTALLATION (5.4.2.1)
      .2 TESTING THE SET UP (5.1.7)
      .3 BURN-IN (5.1.7)
      .4 INITIATING THE TEST (5.4.3)
.3 R TESTING REQUIREMENTS
 .1 TEST LEVELS
 .1 BASIS FOR TEST LEVEL (6.2)
 .2 GENERAL REQUIREMENTS (4.1)
 (TEST LEVELS A-J)
 .3 SPECIFIC REQ.
 .1 EQUIP. CYCLING (5.4.4) (5.4.5) (5.2)
 .2 PREVENTIVE MAINT. (5.8)
 .2 TEST PLANS
 .1 GENERAL (4.2)
 .2 DISCUSSION (4.2.1.1)
 .1 SELECTION OF A TEST PLAN (6.3.7)
 .1 RECOMMENDATIONS & CONSIDERATION (6.3.7.2)
 .2 USE OF TEST PLANS (4.2.1.2)
 .2 REQUIREMENTS (4.2.2)
 .2 TERMINOLOGY AND INTERPRETATION
 .1 BASIS OF TEST PLANS (6.3.2)
 .2 SAMPLING RISKS (6.3.3)
 .3 DECISION RISKS (6.3.4)
 .4 DISCRIMINATION RATIO (6.3.5)
 .5 O.C. AND EXPECTED TEST TIME (6.3.6)
 .6 SPECIFIED MTRFE'S (6.5.1.1)
 .4 SPECIFIC TEST PLANS
 .1 SUMMARY (6.3.1)
 .2 SPECIFIC (TEST PLANS)
 .3 DETERMINATION OF COMPLIANCE (5.4.8)
 .1 GENERAL (5.4.8.1)
 .2 ACCEPT (5.4.8.5)
 .3 CONTINUE TEST (5.4.8.3)
 .4 REJECT DECISION
 .1 RQT (5.4.8.4)
 .2 RAT (5.4.8.5)
4. ON THE OCCURANCE OF A FAILURE

1. FAILURE ACTIONS (5.5)
   1. FAILURE CLASSIFICATIONS (5.5.1)
   2. FAILURE ANALYSIS (5.5.2)
   3. FAILURE CONFIRMATION (5.5.3)

2. VERIFYING REPAIR (5.6)

3. CORRECTIVE ACTION (5.7)

4. PREVENTIVE MAINTAINANCE (5.8)

5. RESTORATION OF FAILED EQUIP (5.9)
.5 Required Documentation

.1 Test Records (5.10)
  .1 Test Log and Data Record (5.10.1)
  .2 Equipment Failure Record (5.10.2)
  .3 Failure Summary Record (5.10.3)
  .4 Failure Tag (5.10.4)
  .5 Failure I.D. Report (5.10.5)

.2 Test Reports (5.11)
  .1 Monthly Summary (5.11.1)
  .2 Final Report (5.11.2)
  .1 Failure Summary & Analysis (5.11.3)
  .2 Reliability Design Data (5.11.2.1)
  .3 Correlation of Test Results (5.11.2.2)
6 MISC.

1. AIR FORCE REQUIRE
   1. GROUND SYSTEMS (6.5)
   2. PROCEDURES (6.6)
2. CONSIDERATION OF APPLICATION (6.4)
NOTICE TO FEDERAL EMPLOYEE ABOUT UNEMPLOYMENT COMPENSATION

This form has been given to you because (1) you have been separated from your job, or (2) you are expected to be in nonpay status for 7 calendar days or more, or (3) you have been transferred to another payroll office.

Federal workers have unemployment compensation rights similar to those of workers in private industry. If you become unemployed or are in nonpay status for 7 consecutive calendar days or more and you want to file a claim, go to the nearest Public Employment Office.

TAKE WITH YOU—

1. Your SOCIAL SECURITY ACCOUNT NUMBER CARD. (If you do not have a Social Security card, apply for one, but you do not need to delay filing your claim pending its receipt.)
2. The OFFICIAL NOTICE of your most recent SEPARATION or of your present NONPAY status (Standard Form 50, Payroll Change Slip SF-1126 or similar document), if you have received it.
3. THIS FORM, and all similar forms which you have received. The office where you file your claim will obtain information needed for your claim from

COMMANDING OFFICER
NAVAL AMMUNITION DEPOT (CODE 02)
CRANE, INDIANA 47522

(Federal agency will insert in the box above name and address of office where your payroll records are maintained.)

KEEP THIS FORM with your Standard Form 50 and other personnel records. It is important to have it if you file a claim for unemployment compensation.
Concern has been expressed at this activity regarding the statistical distribution resulting from elementary combinations of parametric statistics [1, 2]. The following are methods of determining the resulting distribution upon addition, subtraction, division, and multiplication of two independent statistics with known distributions. Statistics $X$ and $Y$ will be combined to give a statistic $Z$. The respective probability density functions will be denoted by $f_X(x)$, $f_Y(y)$, and $f_Z(z)$. The cumulative distribution function (CDF) for $X$ is defined as
The definition of reliability follows:

\[ F_Z(x) = \int_{-\infty}^{x} f_Z(z) \, dz \]  \\

\[ R_Z(x) = 1 - F_Z(x) \]  \\

Additional representations of the PDF of the \( Z = X + Y \):

\[ f_Z(z) = f_X(x) + f_Y(y) \]  \\

\[ f_Z(z) = \int_{-\infty}^{\infty} f_X(x) f_Y(y) \, dx \]  \\

The joint distribution of the PDF is found through the convolution of \( X \) and \( Y \).
For example, consider the two exponential distributions

\[ f_1(t) = \lambda_1 e^{-\lambda_1 t} \mu(t) \]
\[ f_2(t) = \lambda_2 e^{-\lambda_2 t} \mu(t) \]

where \( \mu(t) \) is the unit step function defined as

\[ \mu(t) = \begin{cases} 1 & \text{if } t > 0 \\ 0 & \text{if } t < 0 \end{cases} \]

Substituting into eq. 4 gives

\[ f_2(t) = \int_0^\infty \left[ \lambda_1 e^{-\lambda_1 (t-\xi)} \right] \left[ \lambda_2 e^{-\lambda_2 \xi} \right] \mu(t-\xi) d\xi 
\]
\[ = \lambda_1 \lambda_2 e^{-\lambda_1 t} \int_0^\infty e^{-(\lambda_1 + \lambda_2)\xi} d\xi 
\]

Evaluation gives the PDF final answer

\[ f_2(t) = \frac{\lambda_1 \lambda_2}{\lambda_1 - \lambda_2} \left[ e^{-\lambda_2 t} - e^{-\lambda_1 t} \right] \]

Combination of PDF's in this manner is of course valid and not be limited to PDF's of the same type
3. Subtraction

To determine the resulting relationship distribution of \( z \)

\[ z = x - y \]  

(2)

where \( f_x(x) \) and \( f_y(y) \) are known, one merely has to

impose the relationship

\[ f_{-z}(-x) = f_z(-x) \]  

(10)

Equation 9 may be then

Briefly as

\[ z = x + (-y) \]  

(11)

and the result in Tid of

addition can be similarly

to form the distribution of \( z \).

Consider the equation \( x + y \)

as opposed to the subtraction

operation of eq. 9. From eq. 10,

we write

\[ f_{-z}(-x) = \lambda_2 e^\lambda_2 t \mu(-t) \]  

(12)
\[ f_2(t) = \int_{\infty}^{t} f_1(s) \, ds \]

\[ f_1(t) = \int_{t}^{\infty} \lambda_2 e^{-\lambda_2 s} \, ds = \frac{\lambda_2}{\lambda_2 - \lambda_1} e^{-\lambda_1 t} + \frac{\lambda_1}{\lambda_2 - \lambda_1} e^{-\lambda_2 t} \]

\[ f_2(t) = \frac{\lambda_2}{\lambda_2 - \lambda_1} e^{-\lambda_1 t} + \frac{\lambda_1}{\lambda_2 - \lambda_1} e^{-\lambda_2 t} \]
The CDF of \( z \) where
\[
z = \frac{X}{Y}
\] (14)
may be determined from the following relationship [3,4]:
\[
F_z(x) = \int_{-\infty}^{\infty} F_X(\xi x) \, dF_Y(\xi)
\] (15)

Employing the same reasoning as in eq. 5 becomes 0

Thus
\[
F_z(t) = \left[ 1 - e^{-\lambda_1 t} \right] \mu(t)
\] (16)
\[
F_z(t) = \left[ 1 - e^{-\lambda_2 t} \right] \mu(t)
\] (17)

Thus
\[
dF_z(t) = \lambda_2 e^{-\lambda_2 t} \mu(t) \, dt
\]

Substituting into eq. 15 gives
\[
F_z(t) = \int_{-\infty}^{\infty} \left[ 1 - e^{-\lambda_1 \xi} \right] \mu(\xi) \left( \lambda_2 e^{-\lambda_2 \xi} \right) \, d\xi
\]
\[
= \lambda_2 \int_0^{\infty} \left[ 1 - e^{-\lambda_1 t\xi} \right] e^{-\lambda_2 \xi} \, d\xi \mu(t)
\] (18)
Evaluation gives the CDF of $Z$.

\[ F_z(t) = \int_{-\infty}^{\infty} f_z(z) \, dz = \int_{-\infty}^{\infty} \frac{\lambda_1 e^{-\lambda_1 t}}{\lambda_1 t + \lambda_2} \, dt \]

By linearity,

\[ \frac{d}{dt} F_z(t) = f_z(t) \]  

we have the PDF of $Z$,

\[ f_z(z) = \frac{\lambda_1 e^{-\lambda_1 t}}{(\lambda_1 t + \lambda_2)^2} \]
In general:

\[ dF_{\frac{t}{\tau}}(t) = f_{\frac{t}{\tau}}(t)\,dt \] \hspace{1cm} (26)

Thus, from eq. 25

\[ dF_{\frac{t}{\tau}}(t) = \frac{1}{\tau} f_{\frac{t}{\tau}}(\frac{t}{\tau})\,dt \] \hspace{1cm} (27)

Substituting appropriately into eq. 15 (with \( dF_{\frac{t}{\tau}}(t) \) substituted for \( dF_{\frac{t}{\tau}}(\tau) \)) gives

\[ F_{\frac{t}{\tau}}(t) = \int_{0}^{\infty} F_{\frac{t}{\tau}}(\xi x) \left[ \frac{1}{\tau} f_{\frac{t}{\tau}}(\frac{t}{\tau}) \right] d\xi \] \hspace{1cm} (28)
Consider, as an example, the following uniform PDF \( f(x) \):
\[
f_x(t) = \frac{1}{b} \cdot \mu(t) \cdot \mu(b-t) ; \quad b > 1
\]
\[
f_x(t) = \frac{1}{a} \cdot \mu(t) \cdot \mu(a-t) ; \quad a > 1
\]
\[\text{(2a)}\]

From eq. 2:
\[
F_x(t) = \frac{t}{b} \cdot \mu(t) \cdot \mu(b-t) + \mu(t-b)
\]
\[\text{(2b)}\]

Substituting into eq. 2a gives:
\[
F_x(t) = \int_{-\infty}^{\infty} \left[ \frac{\xi}{b} \mu(\xi) \mu(b-\xi) + \mu(\xi-b) \right] \cdot \frac{1}{a} \mu(\frac{\xi}{a}) \mu(a-\frac{\xi}{a}) \, d\xi
\]
\[\text{(3)}\]

Since
\[
\mu(\frac{\xi}{a}) = \mu(\xi)
\]
\[\text{(3a)}\]

and
\[
\mu(a-\frac{\xi}{a}) = \mu(\xi - b) ; \quad b, a > 0
\]
\[\text{(3b)}\]

eq. 3a simplifies to:
\[
F_x(t) = \int_{0}^{\infty} \left[ \frac{t}{b} \mu(t) \mu(b-t) + \frac{t}{a} \mu(t-b) \right] \, dt
\]
\[\text{(3c)}\]
1. Multiplication

The remaining elementary arithmetic operation is the parametric statistical parameter multiplication:

\[ z = xy \quad (23) \]

One may employ the division method for analyzing multiplication of the PDF or CDF of the inverse of either \( x \) or \( y \) can be generated. That is, we look at eq. 23 as

\[ z = \frac{z}{xy} \quad (24) \]

Under certain regulatory conditions, the PDF or a statistic's inverse may be written as: [see Appendix]

\[ f_{\frac{1}{x}}(t) = \frac{1}{x} f_{\frac{1}{x}}(\frac{1}{t}) \quad (25) \]

Thus, for the exponential distribution of eq.

Thus, from eq. 1

\[ F_{\frac{1}{x}}(t) = \int_{-\infty}^{\frac{1}{t}} \frac{1}{t^2} f_{\frac{1}{x}}(x) dx \quad (26) \]
1. Test Instrument Status:

The Thermal Stability Program has been reactivated. All needed test equipment has been sent to calibration for reactivation. Sufficient instruments have been returned to execute periodic and functional testing except for the capacitance bridge. A bridge was borrowed, but does not measure capacitance to a sufficient range.

2. Thermal Chamber Status:

All but one thermal chamber (Standard #2413) is incapable of testing. The constant temperature (Associated) chamber needs the strip chart recorder which is presently in electromechanical calibration on priority. Standard Chambers #2427 and #2413 have faulty mechanical refrigeration. Standard Chamber #2426 does not cycle properly. Steps toward repair of these three chambers through their warranty have been taken. Peters, of Contract Administration, is handling manufacturer contact.

3. Testing Status:

In reference to the attached topological overview of the testing plan:

a. Darkened in cells correspond to completed testing prior to cancellation of funds (1 Oct 74).

b. Additional testing executed in the only operational chamber (Standard #2413) is

(1) Completion of $10^0$ to $20^0$ at 3 hours, rep. 1 to 750 hours

(2) Initiation of $15^0$ to $55^0$ at 3 hours, rep. 2. This test is scheduled for completion to 250 hours on 2 Dec 74.

c. Previous program philosophy calls for executing each run in the same environmental chamber. Identical runs from different repetitions are to be run in different chambers. (Chambers in which runs were executed are listed in the 0 hour blocks of the attached test plan topological overview.) The present program aim is test completion in repetitions 1 and 2 to 1000 hours as chamber capability, program philosophy, and time permit.

4. Test Instrument Procurement Status:

The following test instruments are in the process of being requested from DIPEC:

a. Frequency Counters (1)

b. Precision Noise Generators (1)

c. Automatic Capacitance Bridges (2)

d. Percision Digital Voltmeters (2)

e. General Purpose Curve Tracer (1)
5. Lab Security Status: 
Jimmy Stevens of the Lock Shop has inspected the lockers in the lab, and is presently procuring necessary items for their additional security.

6. Report Status: 
The Test Procedure for the Thermal Stability Program has been completed and is awaiting high level approval.

The quarterly report for the first quarter of FY 75 has been completed and is awaiting high level approval.
\[ \int (x) = x^2 + (y - \frac{1}{2})^2 = 1 \Rightarrow f(x) = \sqrt{1 - x^2} + \frac{1}{2} \]

\[ A = 2 \int_0^{\sqrt{3}/2} \left[ \sqrt{1 - x^2} + \frac{1}{2} \right] \, dx \]

\[ x = \sin \phi \Rightarrow dx = \cos \phi \, d\phi \]
\[ x = 0 \Rightarrow \phi = 0 \]
\[ x = \frac{\sqrt{3}}{2} \Rightarrow \phi = \frac{\pi}{3} \]

\[ A = 2 \int_0^{\pi/6} \left[ \cos \phi \right] \cos \phi \, d\phi \]
\[ = 2 \int_0^{\pi/3} \cos^2 \phi + \frac{1}{2} \cos \phi \, d\phi \]
\[ = \left[ \sin \phi \cos \phi + \frac{1}{2} \right]_0^{\pi/3} + \left. \sin \phi \right|_0^{\pi/3} \]
\[ = \left[ \frac{\sqrt{3}}{2} \cdot \frac{1}{2} \right] + \frac{\pi}{3} + \frac{\sqrt{3}}{2} \]
\[ = \frac{3\sqrt{3}}{2} + \frac{\pi}{3} \]

\[ A_T = 2 \]
\[ A_F = 2 - \frac{\sqrt{3}}{2}; \quad A_T = 4 \]

\[ A_S = A_T - A_F = 2 + \frac{\sqrt{3}}{2} \]

\[ \rho[\text{success}] = \frac{A_S}{A_T} = \frac{1}{2} + \frac{\sqrt{3}}{8} \]
\[ \rho[\text{success}] = \frac{\pi}{2} - 1 \]

\[ 2\left(\frac{A_s}{4}\right) + \frac{A_F}{4} = \frac{1}{4}(2\pi) \Rightarrow 2A_s + A_F = 2\pi \]

\[ A_T = A_s + A_F = 4 \]

\[ \therefore A_s = 2\pi - 4 \]

\[ \rho[\text{suc}] = \frac{A_s}{A_T} = \frac{\pi}{2} - 1 \]
As·CJC . I : lf (2 + I) = Lf (3 - 2\sqrt{2})

\[ A_s = \left[ 2(\sqrt{2} - 1) \right]^2 \]

= 4 (2 + 1 - 2\sqrt{2})

= 4 (3 - 2\sqrt{2})

A_f = 4

P(suc) = 3 - 2\sqrt{2}
From Figure's Geometry:

\[ A_s = \frac{1}{\sqrt{2}} - 1 \]

\[ \Rightarrow P[\text{success}] = \frac{A_s}{A_T} = \frac{1}{\sqrt{2}} - 1 \]
\[ P[\text{success}] = \frac{\pi}{8} \]
\[ P[\text{success}] = \frac{\pi}{4} - \frac{1}{2} \]

\[ p^2 + y^2 = 2 \]

\[ A_1 = 2 \int_{-1}^{1} \sqrt{2 - x^2} \, dx \]
\[ x = \sqrt{2} \sin \phi \Rightarrow dx = \sqrt{2} \cos \phi \, d\phi \]
\[ x = 0 \Rightarrow \phi = 0 \]
\[ x = 1 \Rightarrow \phi = \frac{\pi}{4} \]

\[ A_1 = 2 \int_{0}^{\pi/4} \sqrt{2 - 2 \sin^2 \phi} \times \sqrt{2} \cos \phi \, d\phi \]
\[ = 2 \int_{0}^{\pi/4} \sqrt{2} \cos^2 \phi \, d\phi \]
\[ = 2 \left[ \sin \phi \cos \phi + \phi \right]^{\pi/4}_{0} \]
\[ = 2 \left[ \frac{1}{2} + \frac{\pi}{4} \right] = 1 + \frac{\pi}{2} \]

\[ A = 4 - A_1 \]
\[ = 4 - \left( 1 + \frac{\pi}{2} \right) \]
\[ = 3 - \frac{\pi}{2} \Rightarrow A_2 = 4 - 2A_2 = 4 - 6 + \pi \]
\[ = \pi - 2 \]

\[ \frac{P[\text{success}]}{\text{area of square}} = \frac{\pi}{4} - \frac{1}{2} \]
As with #2:

\[ \rho[\text{success}] = \frac{\pi}{8} \]
\[ \rho_{\text{Success}} = \frac{\pi}{8} \]

\[ A_s = \frac{\pi}{2} \]

\[ \frac{\rho_{\text{Success}}}{A_r} = \frac{\frac{\pi}{2}}{A_r} = \frac{\pi}{8} \]
\[ P[\text{success}] = \frac{\pi}{4} \]

\[ A_s = \pi \]

\[ P[\text{success}] = \frac{A_s}{\text{square area}} = \frac{\pi}{4} \]
"THERMAL CYCLING REVIEW MEETING"

PRESENTED AT
NAD CRANE
WQEC

by George Allen
Bob Marks
Tim Williams
7/16/74
PRESENTATION OUTLINE

I. Introduction

II. Thermal Surveys

III. Data File Presentation

IV. Temperature Cycling Results

V. Test Units and Procedure

VI. PROM Programming Data

VII. Lab Tour and Demonstration

VIII. Summary, Conclusions, Discussion
FIGURE 4

F-4 AIRCRAFT ENVIRONMENTAL CONTROL SYSTEM PERFORMANCE

ASD-TR-65-15

FLT NO. 9 SEGMENT NO. 2
- GUN EQUIP, COOL AIR IN (S-22)
- GUN COMPT, LOWER RIGHT FWD (S-21)
OBJECTIVES

• Determine When Thermal Cycling Degrades Reliability

• Identify Limits of Degradation Effect
  - Cycle Period
  - Temperature Range
  - Mean Temperature

• Identify Specification Parameters to Control Future Degradation
Approach

- Procure Test Samples
- Identify Environments
- Obtain Test Equipment
- Identify Test Parameters
- Initiate Testing
- Monitor Testing
- Identify Failures
- Analyse Results
- Report Analyses
SIDE STUDY (PROMS)

• Nichrome Resistor "Link" Fusing Analysis

• Nichrome Programming History

• Vender Product Evaluation

• FMEA on Nichrome Proms
CARD #1

* AIR OUT

- DIVIDER

- Q1

- Q2

- C3

- C2

- ZENER

- 0.499 A

- 1.2 kΩ

- 33.2 kΩ

- 1.2 kΩ

- 1.5 kΩ

- C4

- C5

- C1

* AIR IN

* MONITORED COMPONENTS
FLOW DIAGRAM

TEMPERATURE CONTROL

FAN

TO TEST PANEL

FLYWOOD BRACE

WIRING

HEAT EXCHANGE

10"
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<th>Mean Temperature</th>
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Data Representation of a Single Test at a Given Test Time
Data Organization for Entire Test
| DATA CODE | MEAN TEMP | AMP | PERIOD | TEST | TIME | CRKT | REP | CHAMBR
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<td>3</td>
<td>5 2 3 3</td>
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<td>3 3 1 4</td>
<td>3 2 4 3</td>
<td>4 3 2 4</td>
<td>1 4 5 2 4</td>
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DATA ANALYSES APPLICATIONS

- Comparison of One Part Class Against Another for "Weak Links"
- Vendor Comparisons
- Reliability Evaluation of State-of-Art Devices
- Reliability Modeling of Cycling Parameters - Prediction Improvement
- Failure Prediction Correlation
- Identification of Inter-Acting Effects of Thermal Cycling Parameters
HISTOGRAM OF 45 TO 55°C CYCLING 1.5 HRS

- △ CALIBRATION
- □ TEST CONDUCTED
- ○ NUMBER OF FAILURES

Scale: 1" = 50 HRS
HISTOGRAM OF -5 TO 35°C CYCLING 3 HRS

- CALIBRATION
- TEST CONDUCTED
- NUMBER OF FAILURES

SCALE: 1" = 50 HRS

1/2/23
HISTOGRAM OF 15-55°C CYCLING 3 HR.

CALIBRATION

TEST CONDUCTED

NUMBER OF FAILURES

SCALE: 1" = 50 HRS

2/2/2/1/2/1/2
HISTOGRAM of 15-55°C CYCLING 15 HR

- CALIBRATION
- TEST CONDUCTED
- NUMBER OF FAILURES

TEST TIME (HRS)

- 12.5 - 107 - 131
- CHAMBER OFF FOR 7 HRS
- REFRIGERATION FAILURE FOR 16.5 HRS. CO2 STARTED
- FAULTY CYCLING OK FOR 168 HRS

SCALE: 1" = 50 HRS

2/2/1/5/2/1/1/2
HISTOGRAM of -5 to 38°C CYCLING 1.5 HRS

- CALIBRATION
- TEST CONDUCTED
- NUMBER OF FAILURES

ESTIMATE
150
0

CHAMBER OFF FOR 2.5 HRS
2/4

CHAMBER OFF FOR 67 HRS
250

CHAMBER OFF FOR 50 HRS FOR TESTING
322

REFRIGERATION FAILURE CO2 STARTED
369

CHAMBER OFF FOR 150 HRS FOR HOLIDAY
500

SCALE: 1" = 50 HRS

1/2/1 3/4/1/1
HI'STOMGRAPH 35° CYCLING

TEST TIME (HRS)

CHAMBER OFF FOR 54.5 HRS DUE TO ERROR IN LOW LIMIT CONTROLS

CALIBRATION

TEST CONDUCTED

NUMBER OF FAILURES

POWER OFF 15 HRS DUE TO INSTALLATION OF C.0.

POWER OFF 14.5 HRS DUE TO CHANGER MISEFUNCTION

SCALE: 1"=50 HRS

2/1/0/3/1/11
TESTING FAILURE
SUMMARY

REPETITION

TEST TIME

500 hr

250 hr

OUR

1 2 3
Functional Test Parameters

- Supply Voltage
- Zener Voltage
- Zener Current
- Regulator Voltage
- Oscillator Frequency
- PROM Programming
- RAM Programmability
- Divider Operation
FIGURE 2-A
POWER REGULATOR SCHEMATIC

UNREGULATED VOLTAGE

VOLTAGE REGULATOR

R1 C5
D1

R4

C2

R5

C1

REGULATED VOLTAGE

FIGURE 2-B
OSCILLATOR SCHEMATIC

REGULATED VOLTAGE

Q1

R6

C4

Q2

R7

R8

R9

DECADE COUNTER

DATA SELECT FREQUENCY
FIGURE 2-C

MEMORY SCHEMATIC

DATA ADDRESS

REGULATED VOLTAGE

DATA OUTPUT

DATA INPUT

DIGITAL BIPOLAR RANDOM ACCESS MEMORY 256 BIT

DIGITAL BIPOLAR PROGRAMMABLE READ ONLY MEMORY 512 BIT
FUNCTIONAL TEST PANEL
**Test Classes and Parameters**

4-Microcircuits (TTL/Linear)
- Supply Current
- Logic Level Voltages
- Input Currents
- Voltage Regulation
- Leakage Current

1-Transistor (Silicon npn)
- Saturation Voltage
- DC Gain
- Leakage Current

1-Zener Diode (Power)
- Reverse Leakage Current
- Breakdown Voltage

5-Capacitors (Mica/Tantalum)
- Capacitance
- Dissipation

9-Resistors (Film/Wire Wound)
- Resistance
**EMPLOYEE SERVICE STATEMENT**
*(See information on reverse)*

1. **N° (CAPS) LAST-FIRST-MIDDLE**
   Marks, Robert Jackson II

2. **BIRTH DATE**
   08-25-50

3. **SOCIAL SECURITY NO.**

4. **STATEMENT NO.**
   1

5. **SERVICE SUMMARY**

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6. **ACCUMULATE ALL SERVICE AND ENTER TOTAL SERVICE HERE**
   01 04 20

6. **COMPLETE THIS ITEM ONLY FOR EMPLOYEES SEPARATING FROM POSITIONS SUBJECT TO THE CIVIL SERVICE RETIREMENT SYSTEM**
   - **YOUR RETIREMENT BENEFIT, BASED ON THE ABOVE SEPARATION, IS INDICATED BELOW:**
     - [ ] NONE - TRANSFER TO ANOTHER POSITION SUBJECT TO CSC RETIREMENT
     - [ ] DEFERRED ANNUITY AT AGE 62 OR LUMP SUM REFUND
     - [X] LUMP SUM REFUND ONLY
     - [ ] IMMEDIATE ANNUITY

**REMARKS CONCERNING SERVICE ENTRIES ABOVE:**

---

8. **SIGNATURE OF EMPLOYEE**
   [Signature]
   08-08-75

9. **SIGNATURE OF AGENCY OFFICIAL**
   [Signature]
   08-08-75

10. **AGENCY NAME, INCLUDING BUREAU AND DIVISION, AND ADDRESS**
    NAVSEASYSCOM
    Naval Weapons Support Center
    Crane, Indiana 47522

**STANDARD FORM 2115**
MARCH 1974
FPM SUPPLEMENT
631-1

1. Employee Copy – See information on reverse.
From: Commanding Officer, Naval Weapons Support Center, Crane, Indiana
To: Commander, Naval Electronic Systems Command (ELEX-470), Washington, DC 20360

Subj: Monthly Status Report for Jun 1975

Ref: (a) NAVELEXSYSCOM ltr 470-CDM-92 #920 Ser 73-470 of 23 Apr 1975

Encl: (1) Verdin TSA Monthly Status Report - Jun 1975

1. This report is submitted to describe those tasks performed during the subject reporting period as required by reference (a).

2. Milestone status - the status for FRAP milestones is shown in Figure 1.

3. LFA Progress Summary:

   a. February 1975 - Received task assignment, reference (a). NMSC Crane designated LFA, HELC, NMSC Crane, and NESTED designated as TSA's. TSA responsibilities: NMSC Crane - Verdin system, NESTED - AN/URC-65, HELC - AN/5RR-1 and AN/MSR-3.

   b. March 1975 - Reviewed Verdin ILS plan. Identified discrepancies in ILS plan. Identified other documents needed. Verbal coordination with NESTED and HELC to prepare program plans. Reviewed NDCS for compatibility with FRAP objectives and data requirements. Attended NDCS review meeting between NESTED (027), NMSC Crane (024), NAVELEX (470), and NAVSECORDIV (6640). Attended coordination meeting between NAVELEX (470) and NMSC Crane (304) discussing need for new tasking letter.

   c. April 1975 - New tasking letter, reference (a), was received. Corrected March 1975 monthly status report. Showed sample size dependence on confidence intervals and duty cycle. NMSC Crane (304) hosted coordination meeting between NESTED (027), NAVELEX (470), and NAVSEC (TOM-2). NAVSEC was given HELC TSA responsibilities due to HELC travel restrictions. Meeting minutes distributed.

   d. May 1975 - Prepared and submitted LFA Implementation Plan. This plan explained how the program objectives would be met, defined detailed LFA responsibilities, and TSA responsibilities, and defined the program milestones and schedule.
4. Progress during reporting period 1 June through 30 June 1975 is as follows:

a. During week of 2 June 1975, visited NESEC Vallejo to discuss submission of AN/SRR-1 and AN/VSC-3 Implementation plans. Data collection method could not be specified. NESEC Vallejo decided to wait until the meeting with fleet representatives to define the data collection method. Also discussed was the kind of information desired to be submitted in fulfilling other TSA responsibilities.

b. During the week of 16 June, a visit was made to NAVELEX and NESTED. At NAVELEX, met with the Verdin project engineer to discuss data requirement needs of FRAP. Specific Verdin documents were requested. Informal comments were given on Collins monthly depot repair status reports to Verdin project engineer. Obtained several AM/INV-20 CDRL items from ELEX-470. At NESTED, discussed the AM/VIC-75 Implementation Plan and NESTED indicated that the submittal date for the AM/VIC-75 Implementation Plan would be slipped about two or three weeks. Submittal of this plan will be made subsequent to changes desired by NESTED.

c. During the week of 23 June, met with representatives of the Pacific Fleet and FRAP activities at NESEC San Diego to brief details of FRAP to Fleet and obtain Fleet comments/concurrence prior to implementation. Outcome of meeting was fleet data collection by 2K and 2L forms, 2L form to be formatted for information required but not found on 2K form (time meter readings, etc.). Further, the 2L and 2K form would be sent to one addresser shortly after preparation. Follow-up is necessary to document these requirements to 31 coordinating committee by submission of addresses, format for 2L form, request for submission of forms at time of completion, and samples size required.

d. The following steps toward documenting the fleet data requirements have been initiated:

(1) specified MTBF's for each equipment are being verified with the help of each TSA.

(2) Sample sizes based upon the specified MTBF will be determined for each equipment considering total population size, confidence levels required during procurement where applicable.
(3) Determining 2L format.

(4) Submittal of documentation by 10 July 1975.

5. Plans for next month include:

a. Trips to NESTED and NESEC Vallejo to obtain results of characterization of equipment necessary to complete the reliability math models and sampling plans by 1 August 1975. These characterization which are due by 10 July will be submitted in the TSA monthly status reports for July.

b. Prepare and submit documentation necessary to define data collection requirements from fleet personnel using HDCS as outlined in paragraphs 4c and 4d of this submittal.

c. Prepare and submit reliability math models and sampling plan to TSA's and ELEX-470.

6. Progress made in support of Verrin TSA responsibilities is discussed in enclosure (1).

7. Funding status at end of this reporting period is shown in Figure 2.

8. Any questions regarding this submittal should be directed to Commanding Officer, Naval Weapons Support Center (Code 3041), Crane, Indiana or to Mr. George Allen at automatic 462-1235.

S. S. KALFEBER
By direction
<table>
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<th>Activity</th>
<th>Expected Completion Date</th>
<th>Date</th>
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<td>1. Prepare general management plan</td>
<td>ELEX</td>
<td>21 Apr 1975</td>
<td>23 Apr 1975</td>
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<td>2. Prepare LFA implementation plan</td>
<td>LFA</td>
<td>9 May 1975</td>
<td>16 May 1975</td>
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<tr>
<td>3. Review and approve LFA implementation plan</td>
<td>ELEX</td>
<td>16 May 1975</td>
<td>in progress</td>
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<td>4. TSA System implementation plan</td>
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<td>10 Jul 1975</td>
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<td>7. System reliability model and data collection requirements</td>
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<td>1 Aug 1975</td>
<td>N/S</td>
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<td>8. Prepare sampling plan</td>
<td>LFA</td>
<td>15 Aug 1975</td>
<td>N/S</td>
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<td>10. Data collection</td>
<td>TSA</td>
<td>31 May 1975</td>
<td>N/S</td>
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<td>11. Failure analysis procedure</td>
<td>LFA</td>
<td>1 Jul 1976</td>
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<td>12. Fault isolation and failure analysis</td>
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<td>13. Recommend corrective action</td>
<td>TSA</td>
<td>1 Jul 1976</td>
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<td>15. Propose ECP's and submit final engineering report</td>
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<td>N/S</td>
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Verdin TSA Monthly Status Report
June 1975

Ref:  (a) NAVELEXSYSCOM ltr 470 CEM:dm 3920 Ser 73-470 of 23 Apr 1975
     (b) Fleet Reliability Assessment Program Implementation Plan Report
         WQEC/C 75-193 of 3 Jun 1975

1. This report is submitted to describe those tasks performed during
   the subject reporting period as required by references (a) and (b).

2. Verdin TSA Progress Summary:

   a. Feb 1975 - Received task assignment, NWSC Crane designated URC-62
      (Verdin) TSA.

   b. Mar 1975 - Reviewed Verdin ILS Plan. Identified discrepancies
      in ILS plan. Identified other documents needed.

   c. Apr 1975 - New tasking letter received. Participated in NWSC Crane
      sponsored TSA meeting.

   d. May 1975 - LFA direction received delineating TSA responsibilities,
      reference (b).

3. Progress during reporting period 1 June 1975 through 30 June 1975 is
   as follows:

   a. NELC (1300) was visited by this activity to obtain information
      on Verdin system, obtain baseline reliability parameters, and assess
      installation status. Documents reviewed are listed in Appendix A, paragraph
      B. Pertinent information was extracted from these documents toward
      accomplishing the Verdin TSA responsibility of system characterization.
      Verdin equipment installation schedules were also obtained at NELC.

   b. An informal interface has been made with Collins Radio, the prime
      Verdin contractor. NWSC (3041) has been placed on the mailing list for
      the monthly Verdin field failure reports generated by Collins Radio which
      documents Collins' effort as the depot level maintenance activity for
      Verdin.

   c. Drafting of the Verdin TSA Implementation Plan has been initiated
      and is scheduled for completion on 18 July 1975.
d. Verdin related documents received and reviewed toward meeting FRAP TSA system characterization efforts are listed in Appendix A, paragraph C.

4. Plans for next month include:
   

b. Characterize the Verdin system by 30 July 1975 to include:
   
   (1) Functional Flow Diagram and description.
   
   (2) Identification of System Operating Modes and Duty Cycle.
   
   (3) Reliability Baselines.
   
   (4) System Operational Status.
   
   (5) Gross Installation Environment Characteristics.
   
   (6) Maintenance Planning Description.

   c. Trip to Verdin contractor (Collins Radio) to discuss depot maintenance data, collection of failed parts, and failure tracking.
   
   d. Obtaining other necessary Verdin documents as listed in Figure A.
Appendix A: Documents necessary for the Verdin TSA Effort

A. Obtained by NWSC Crane prior to 30 May 1975:

   b. Applicable Documents
   c. Abbreviations and Acronyms.
   d. Depot Repairable Repair Parts and Part Number to FSN Cross Reference Listing


B. Reviewed during June 1975 visit to NELC:


7. Preliminary Operational Instructions for Receiving Set Digital Data (U) AN/WRR-7 NAVELEX 0976-462-3031.


C. Received or Procured during reporting period 1 June 1975 through 30 June 1975:

1. Document #1
2. Document #2
3. Monthly Report (#) for Verdin Field Failure Monitoring Program Line Item 38, Task 13, Contract N00039-70-C-1507, Collins Radio Company. These reports will be received by NWSC Crane (3041) on a monthly basis. The first report was generated 1 April 1975.

D. To be obtained:


4. TDP X32-54 of April 1967 Technical Development Plan Verdin (U)

6. SOR S32-54 Specific Operational Requirements, Verdin (U).

7. Contractor's (Collins) Verdin Reliability and Maintainability Predictions.


9. AN/ARC Transmitting Set Digital Data AS-1237.

10. ELEX R-27A/ELEX R-119 AN/WRR-7 Receiver

11. NAVMATINST 4200.31A Advance Procurement Planning.
To: Commander, Naval Electronic Systems Command (ELEX-470), Washington, DC 20360

Subj: Monthly Status Report for May 1975

Ref: (a) NAVELEXSYSCOM ltr 470 CEM:cn 3920 Ser 73-470 of 23 Apr 1975
(b) NAVELEXSYSCOM ltr 47024:DF:lc 9670 Ser 41-4702 of 14 Feb 1975
(c) NAD Crane ltr 3041-GRA:rjr 3010/3 of 16 May 1975

1. This report is submitted to describe those tasks performed during the subject reporting period as required by reference (a).

2. Milestone status - The status for milestones is shown in Figure 1.

3. LFA Progress Summary:

   a. February 1975 - Received task assignment, reference (b). NAD Crane designated LFA, HELC, NAD Crane, and HESTED designated as TSA's. TSA responsibilities: NAD Crane - Verdin system, HESTED - AN/URC-35, HELC - AN/SRR-1 and AN/MSC-3.

   b. March 1975 - Reviewed Verdin ILS plan. Identified discrepancies in ILS plan. Identified other documents needed. Verbal coordination with HESTED and HELC to prepare program plans. Reviewed MDCS for compatibility with FRAP objectives and data requirements. Attended MDCS review meeting between HESTED (027), NAD Crane (3041), NAVELEX (470), and NAVSECHORDIV (6640). Attended coordination meeting between NAVELEX (470) and NAD Crane (304) discussing need for new tasking letter.

   c. April 1975 - New tasking letter, reference (a), was received. Corrected March 1975 monthly status report. Showed sample size dependence on confidence intervals and duty cycle. NAD Crane (304) hosted coordination meeting between HESTED (027), NAVELEX (470), and NESEC (TOM-2). NESEC was given HELC TSA responsibilities due to HELC travel restrictions. Minutes distributed.

4. Progress during reporting period 1 May through 31 May 1975 is as follows:

   a. The Lead Field Activity Implementation plan was completed and submitted for review and approval, reference (c). This plan will be appended by each TSA (equipment) Implementation plan as it is prepared. The LFA Implementation contains an identification of the following:
(1) Background
(2) Objectives
(3) Equipment scope
(4) Approach
(5) Definitions
(6) Program organization
(7) LFA organization
(8) Program interface
(9) LFA milestone and schedule
(10) TSA milestone and schedule
(11) Characterizing operational system
(12) Reliability model and data collection requirements
(13) Sampling plan
(14) Data collection plan
(15) Data collection
(16) Fault isolation and failure analysis
(17) Data analysis
(18) Recommend corrective action
(19) Reports
(20) LFA functions
(21) TSA functions
b. Preliminary work has been done to define the procedure for completing the reliability math model and the sampling plan. This includes identification of statistical programs, techniques, and data required for the model and sampling plan.

5. Plans for next month include:

a. Trip to NELE (1300) to obtain information on Verdin system, review system documents, resolve discrepancies discovered in ILS plan, obtain baseline reliability parameters and identify any system problems/corrective action taken.

b. Trip to NESEF (TOM-2), Vallejo to coordinate and help NESEC prepare the TSA AN/SSR-1 Implementation plan and the TSA AN/MSC-3 Implementation plan.

c. Trip to NESTED and NAVELEX to coordinate FRAP implementation plans Tyco interfaces, data collection requirements, and to discuss Verdin support requirements.

d. Approval of TSA (equipment) implementation plans.

e. Trip to Verdin Contractor to discuss depot maintenance data, collection of failed parts, and failure tracking.

6. Funding status at the end of this reporting period is shown in Figure 2.

7. Any questions regarding this submittal should be directed to Commanding Officer, Naval Ammunition Depot (Code 3041), Crane, Indiana or to Mr. George Allen at autovon 482-1285.

S. S. KALBERER
By direction

Copy to:
NESTED (027)
NESEC (TOM-2)
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<tr>
<td>13. Recommend corrective action</td>
<td>TSA</td>
<td>1 Jul 1976</td>
<td>N/S</td>
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<tr>
<td>14. Evaluate corrective action</td>
<td>TSA</td>
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<td>N/S</td>
</tr>
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<td>15. Propose ECP's and submit final engineering report</td>
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<tr>
<td>16. Configuration control sub-board action of ECP's</td>
<td>ELEX-470</td>
<td>1 Aug 1976</td>
<td>N/S</td>
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</tbody>
</table>
Figure 2
LFA Program Status

% Expenditures

Funding Status

Reporting Date
From: Commanding Officer, Naval Ammunition Depot, Crane, Indiana
To: Commander, Naval Electronics Systems Command (ELEX 470),
Washington, D. C. 20360

Subj: Monthly status report for Apr 1975

Ref: (a) NAVELEXSYSCOM Itr 470:CEM:dm 3920 Ser 73-470 of 23 Apr 1975
     (b) NAD Crane Itr 3041:GEA 13070 of 29 Apr 1975
     (c) NELC San Diego Itr R142 ENG:drw SER 1100-11 of 14 Apr 1975

1. Reference (a) requires monthly status reports for all the tasks performed
   by the Lead Field Activity (LFA) and all tasks performed by the Technical
   Support Activities (TSA's). This report covers those tasks performed during
   the subject reporting period.

2. The following changes to the March 1975 monthly status report are hereby
   promulgated for clarification:

   a. Paragraph 2.a.(3) last sentence is corrected to read, "MTBF's of the
      following Verdin equipments have not been identified:

      (1) Shore based processor/control unit and modulator
      (2) Airborne processor/demodulator, processor/control unit and
          modulator
      (3) Shipboard processor/demodulator"

   b. Paragraph 2.a.(7) is amended to include the following item:

      (1) "The discrepancy in the identifiction of Verdin components versus
          necessary auxiliary equipments as indicated by Figures 1-1, 1-2, 1-3, 1-4,
          1974."

   c. Paragraph 2.c. last sentence is corrected to read, "This meeting
      explored the features of the NDCS (Maintenance Data Collection System) and
      determined that it could meet the requirements of the FRAP (Fleet Reliability
      Assessment Program) only by modifying the present reporting system by CNM
      (Chief of Naval Material) approval".

3. Those LFA tasks performed during the subject reporting period are:

   a. Further progress was made toward completing the sampling plan for the
      Verdin system as follows:
(1) Initial contact has been made with Naval Electronics Laboratory Center (NELC) Code 1300. A trip will be scheduled during the next reporting period to review and/or obtain those data sources identified in paragraph 2.a.(6) and to resolve those items identified in paragraph 2.a(7) as amended by this correspondence.

(2) Preliminary analysis has determined that the equipment duty cycle and the width of the 90% confidence interval are critical parameters determining the equipment sample size. Under the assumptions of a fixed length test of six months, zero repair time and an exponential distribution, sample sizes were from three systems to 42 systems for the AN/ART-50. These results are shown in Figures 1 and 2 for the AN/ART-50 specified MTBF of 750 hours.

(3) The reliability demonstration test report for the AN/ART-50 was reviewed and showed that the true MTBF of the AN/ART-50 system is below 750 hours. The point estimate for the MTBF is 3653 hours divided by seven failures, which is 522 hours MTBF. Further investigation is necessary to identify corrective action performed or required as a result of the reliability demonstration test.

(a) From the analysis demonstrated in Figures 1 and 2 and results of demonstration tests previously mentioned, it is evident that prior to sample size determination details of the duty cycle, usage rate, repair rate, down time, mission profile, other test results must be thoroughly investigated. Too large a sample size will result in excessive data acquisition costs.

(b) LFA hosted a coordinated meeting for all FRAP participants on 17 and 18 April 1975. NELC could not attend because of travel restrictions. Naval Electronics Systems Engineering Center (NESEC), Vallejo was given the TSA responsibilities for the AN/MSC-3 and AN/SSR-1 in place of NELC when it was determined that these travel restrictions would continue into the indefinite future. The results of this meeting have been distributed to all participants by means of reference (b).

(c) As required by reference (a) this activity is preparing the LFA Implementation Plan. This plan will be submitted during the next reporting period.

(4) This activity has not received a monthly status report for April from Naval Electronics Systems Test and Evaluation Detachment (NESTED) but Mr. John White and Mr. Marty Leopold of NESTED attended the coordination meeting at NAD Crane on 17 and 18 April 1975.

(5) NELC performed those activities listed in reference (c) for the period 15 May through 15 April 1975.
Reference (a) directs this activity to issue a work request to NESEC Vallejo to support FRAP as a TSA. This will be accomplished during the next reporting period as soon as the LFA Implementation Plan has been completed.

7. Figure 3 shows expenditures for FRAP below planned levels. This is due to the curtailment of activities while preparing for and participating in the coordination meeting of 17 and 18 April 1975.

8. Questions regarding this submittal should be directed to the Commanding Officer, Naval Ammunition Depot (Code 3041), Crane, Indiana or to Mr. George Allen at autovon 482-1285 or 1370.

S. S. KALIDERER
By direction
From: Commanding Officer, Naval Ammunition Depot, Crane, IN  
To: Commander, Naval Electronic Systems Command (Code 470),  
Naval Electronic Systems Headquarters, Washington, DC 20360  

Subj: Monthly Status Report for Mar 1975  

Ref: (a) NAVLEX ltr 47024:JF:jc 9670 Ser 41-4702 of 14 Feb 1975  
(b) HELC ltr 1142 CMG:irm Ser 4109-10 of 13 Mar 1975

1. Reference (a) requires monthly status reports for the tasks performed  
by the Load Field Activity (LFA) and all tasks performed by the Technical  
Support Activities (TSA's). This report covers those tasks performed  
during the subject reporting period.

2. The following LFA tasks were performed during the subject reporting  
period:

   a. The Integrated Logistic Support Plan for the Verdin system was  
      reviewed for determination of a suitable sampling plan. The following  
      summary details the progress toward completing this sampling plan.

      (1) Verdin is a one, two, or four channel broadcast system capable  
          of transmitting encrypted information by means of minimum shift keying  
          (MSK) techniques at VLF frequencies. The Verdin system designated the  
          AN/URC-62 consists of transmitting site equipment located at a shore  
          installation, relay equipment in an airborne installation aboard TACAMO  
          aircraft, and receiver configured equipment found in ship installations.  
          The Verdin components are those processor-control units, modulators and  
          cesium frequency standards required for the transmit functions and the  
          receivers, processor-demodulator units and cesium frequency standards used  
          for the receiver functions.

      (2) The AN/ART-50, AN/ART-30 associated antennas and certain other  
          periphery equipment, though not specifically Verdin system equipment,  
          must be considered in any reliability block diagram of the Verdin operational  
          system because of their series connection with the Verdin equipments.

      (3) Shore based portions of the Verdin system are designated to  
          operate continuously. The AN/ART-30 is the associated transmitter for  
          shore installations having a specified MTBF of 1000 hours. Airborne portions  
          of the Verdin system are specified to operate continuously for at least  
          seven days and a maximum of twelve days. The AN/ART-50 transmitter alone  
          and AN/ARR-77 receiver with frequency standard has a specified MTBF of  
          750 hours while the frequency standard has a specified MTBF of 2500 hours.
Shipboard installations are designated to operate continuously. The AN/WRR-7 receiver has a specified MTBF of 1000 hours. MTTR's have not been identified for any Verdin equipments or serially connected associated equipments. MTBF's of Verdin equipments have not been identified.

(4) Verdin equipment contains diagnostic circuitry to aid fault isolation to a replaceable circuit card which can be replaced at the organizational level. The depot level repair activity is the contractor.

(5) Shipboard installation are fully operational in submarine tenders AS-19, 31, 32, 33, 34, and all FBM submarines (SSBN's) except the 600, 602, and 608. Reports are being received on these installations already. Eighteen aircraft installations have already been completed while no shore stations are operational except training sites.

(6) Following documents have been identified as data sources for Verdin system equipments:

(a) NAVER 0967-462-2010, "Theory and Functional Description, Communication System, Digital Data AN/URC-62(S)."

(b) OPNAVINST 00510.112, "Clarinet Verdin Classification Guide".

(c) SOP S32-54, "Specific Operational Requirement Verdin (U)."

(d) Maintenance Requirement Cards.

(7) Items to be resolved before sampling plan can be completed are:

(a) The actual numbers of equipment installed, where located, and deployment schedule of ships or aircraft involved.

(b) The mission times for installations and preventive maintenance schedules.

(c) The specified MTTR's for each equipment and MTBF's presently unknown and other R&M indices determined at specified life cycle assessment points.

b. Preliminary program plans were received from the TSA's and verbal comments were passed to each TSA. RESTED has resubmitted a second draft corrected in accordance with verbal directions. Formal guidelines are being prepared to assist the TSA's in meeting the guidelines established in the 20 March 1975 meeting between the LFA and NAVEREX (470). This will be completed during the next reporting period.

c. The Maintenance Data Collection Subsystem (MDCS) for ships has been reviewed for compatibility with the data requirements of the Fleet...
Reliability Assessment Program (FRAP). The results of this analysis were presented at a meeting on 26 March 1975 at WAVELEXSYSCOM. The analysis is summarized below:

1. MDCS meets the data requirements of the FRAP program designated equipments of AH/MSC-3, FH/SPC-1 and Verdon with the following exceptions:

   (a) Operational time is not explicitly available, i.e., daily, weekly, or monthly cumulative operating hours are not reported, nor is cumulative hours by mode of operation available.

   (b) Traceability of the depot repairs of a maintenance action initiated at organizational level is not provided explicitly. There is some question whether the records can be traced by means of special printouts. The key to answering this is in how the job control number is generated for each maintenance action. Satisfactory resolution of this could also be used to maintain histories on spares.

   (c) Time lag for data processing by 3rd Center.

   (d) Shallow detail of data reported.

2. MDCS exceptions to FRAP data requirements require CNO direction to the Fleet TYCOM's or their alternatives. Means to overcome these will be researched during the next reporting period.

3. MDCS evaluation of individual TSA data requirements has been completed item by item. This analysis has been submitted to the appropriate TSA under separate correspondence.

4. Attended a coordination meeting between WAVELEX (470) and HAD Crane (Code 304) on 20 March 1975. This meeting established the need for a WAVELEX (470) management plan and a LFA management plan to clearly define responsibilities and program milestones.

5. Attended a MDCS meeting with RESTED (Code 027), NAVSECMORDIV (Code 6640) and WAVELEX (470), at WAVELEXSYSCOM on 26 March 1975. This meeting explored the features of the MDCS and determined that all MDCS information would be useful but it could meet all data requirements of the FRAP program only with slight modifications in the reporting system.

6. This activity is preparing the LFA management plan for submittal during the next reporting period. This will contain a Pert chart showing all activities necessary to complete the FRAP tasks and their time relationships. In addition it will identify personnel available for participation in FRAP, the approach to be followed in management of FRAP, specify activities participating and the approach to be followed in implementing FRAP.
3. HESTED has performed the following during the period 20 February to 15 March 1975:

a. Obtained the following AN/URC-35 background information:
   (1) Equipment specification.
   (2) Contract.
   (3) Maintainability program plan.
   (4) Maintainability test report.

b. Established liaison with the FMA.

c. Identified additional data requirements consisting of:
   (1) Reliability test reports.
   (2) Reliability program plan.
   (3) Failure reports.
   (4) System mission requirements.

d. Identified specified MTBF of 500 hours and MTTR's of 10 minutes and 30 minutes for 0-level and 1-level maintenance respectively.

e. Submitted a program plan per paragraph 7g of reference (a).

f. Identified data requirements and arranged to collect this data from the FMA.

g. Identified the need to collect data from the depot repair activity and is planning to initiate contact with the depot activity to arrange the collection of this data.

h. Recognized the need for a reliability model and is pursuing baseline data to define the model.

4. MELC has performed those activities listed in reference (b) for the FRAP program for the period 20 February through 15 March 1975.

5. Figure 1 shows expenditures slightly beyond planned levels, but this is due simply to initial planning activity and is expected to be at planned levels at the end of the next reporting period. Milestone completion status is behind schedule due primarily to redirection of 20 March meeting and is expected to catch up over the next reporting period.
6. Questions regarding this submittal should be directed to the Commanding Officer, Naval Ammunition Depot (Code 3041), Crane, Indiana or to Mr. George Allen at autovon 482-1295 or 1370.

Copy to:
HELC (Code 410)
NESTED (Code 027)

S. S. KALBERER
By direction
FROM: Commander, Naval Electronics Laboratory Center
TO: Commander, Naval Ammunition Depot, Crane (304B)

SUBJ: Submission of FRAP Monthly Status Report (April 1975)

REF: (a) NAVELEX ltr. Ser. 41-4702 of 14 February 1975
(b) TELCON, NAVELEX 470 and Mr. E. Glunt, NELC 21 March 1975
(c) TELCON, G. Allen (NAD) and G. Pillion (NELC) 2 April 1975
(d) Memorandum Ser. 80-4702, J. Fong to G. Allen, 11 March 1975
(e) NAVELEX TWX (S.E.L. INFORMATION) 4 March 1975

ENCL: (1) April 1975 FRAP Progress/Status Report
(2) VERDIN Equipment Breakdown

1. In accordance with paragraph 8.b of reference (a), the progress of this Center's effort in support of the Fleet Reliability Assessment Program (FRAP), covering the last two weeks of March 1975 and the first two weeks of April 1975, is hereby submitted as Enclosure (1) for your review.

2. Reference (b) verbally informed Code 4100 that a change of assigned equipments to NELC had been made by NAVELEX 470. NELC is now responsible for assessing the operational reliability of the AN/WSC-3 and VERDIN systems.

3. Reference (c) verbally confirmed the change in program assignments and indicated NELC will be receiving a new tasking statement from NAVELEX 470 along with an approved Management Plan and Milestone Charts on or about 15 April 1975.

4. To facilitate the assessment of the VERDIN equipments, NELC hereby requests the documentation supplied to NAD by NAVELEX as indicated in reference (d).

5. Reference (e) supplies a list of FRAP designated equipments that were requested by COMNAVELECSYSCOM for inclusion on the Maintenance Data Collection System (MDCS) Selected Equipment List (SEL). An assumption was made that all equipments including the VERDIN RCVR(AN/WRR-7) will be included in the SEL. NELC hereby requests confirmation of this action so as to include MDCS as a major source of operational reliability data.
6. Although official confirmation of the change in NELC assignment has not been received as of this date, NELC will proceed on the assumption that the verbal changes as stated in references (b) and (c) will be forthcoming in the very near future.

7. Enclosure (2) VERDIN EQUIPMENT BREAKDOWN, is included for information only and lists the equipments of the VERDIN surface, air, and land sites that will be included as part of the reliability assessment program.

E. W. GLUNT
By direction

Copy to:
6460 (4) w/o encls.
4000 (1) w/encls.
4100 (5) w/encls.
NAVELEX 470 (Cdr. Mandel) (1 copy w/encls.)
NAVELEX 470 (J. Fong) (1 copy w/encls.)
March 1975, NELC final Program Plan Submission - Not now required due to change in assignment and direction of program that includes development of an overall FRAP Management Plan generated by NAVELEX 470 and the Lead Field Activity, NAD, Crane. This Management Plan to include revised Milestones and due dates as described to NLC per reference (c).

Tasks as assigned by the LFA and, upon receipt of the new FRAP Management Plan, any Milestone requirements spelled out therein.

Acquisition of data on AN/WSC-3 and VERDIN System. (Historic)
Refining Specific data requirements.
Reviewing accumulated data on assigned equipments.
Support to Lead Field Activity as requested and required.
Awaiting revised FRAP Milestone Chart.

FUNDING STATUS

As of 11 April 1975 Code 4100 has charged 380 hours of direct labor to FRAP and has expended $8,388.00. This amount covers a seven (7) week time frame.
CURRENT CRITICAL PROBLEMS  (State: Nature of problem, impact on project, action to be taken or recommended, and when for each problem)

NONE.

ANTICIPATED CRITICAL PROBLEMS  (State: Nature of problem, impact on project, action to be taken or recommended, and when for each problem)

NONE AS OF THIS DATE.

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NELC expects the Lead Field Activity, NAD, Crane to visit Code 4100 sometime during the latter part of April 1975. This visit is to discuss a wide range of FRAP related subjects and specifically to address the "Implementation Plan" that will be the means for the acquisition of operational reliability data direct from the fleet.
VERDIN
EQUIPMENT
BREAKDOWN

ENCLOSURE (2)
AN/WRR-7  VLF/LF Receiver
Comprised of:
- Receiver R-1738/WR
- Processor CP/1071/WR
- Demodulator/Power Supply MD-855/WRR-7
- Frequency Standard 0-1695/URC

AN/URT-30 Transmitter
- Processor CP/1071/WR
- Control Unit/Power Supply C-8979/URT-30
- Modulator MD-856/ART-50
- Frequency Standard 01695/URC

AN/ART Airborne Transmitter
- Processor CP-1072/AR
- Control Unit C-8784/ART-50
- Power Supply PP 6628/AR
- Modulator MD-856/ART-50
- Frequency Standard 0-1612/URC
From: Commander, Naval Electronics Laboratory Center  
To: Commander, Naval Ammunition Depot, Crane (304B)  

Subj: Submission of FRAP Monthly Status Report (March 1975)  

Ref: (a) NAVELEX ltr. ser. 41-4702 of 19 February 1975  

Enclosure: (1) March 1975 FRAP Progress/Status Report  
(2) AN/WSC-3 and AN/SSR-1 Equipment Breakdown  

1. In accordance with paragraph 8.b of reference (a), the progress of this Center's effort in support of the Fleet Reliability Assessment Program (FRAP), covering the latter part of February to the second week of March 1975, is hereby submitted as Enclosure (1) for your review.  

2. Enclosure (2) contains selected pages from OPNAVINST 1543.4 of September 1974, addressing the AN/WSC-3 and AN/SSR-1. This enclosure is sent for information only.  

3. It is the intention of NELC to include the Antenna groups utilized with the AN/133-3 (OE-82B/WSC-1(V)) for shipboard installations, and, (OE-168/BRQ, OE-176/BRQ or AN/BR-34) for submarine installations as part of the AN/WSC-3 reliability assessment unless otherwise directed.  

4. Due to the delay in the transfer of FRAP funds from NESTED to NELC, the Funding Status Chart is not included in this status report. It will be updated and included in the next (April) status report.  

E. W. GLUNT  
By direction
1. FRAP Task Acceptance. In response to instructions contained in NAVELEX ltr. Ser. 41-4702 of 19 February 1975, NELC mailed acceptance ltr. Ser. 4100-8 on 20 February 1975. NESTED transferred $50K and it was received by NELC 10 March 1975.

2. NELC FRAP Program Plan. A draft of NELC's Program Plan for the prosecution of FRAP tasks related to the west coast candidate systems (WSC-3 and SSR-1) was submitted to NAD, Crane 5 March 1975. This draft is for review and comment and is in response to item #4 of the FRAP Milestone Chart. The final version will require approval of the Lead Field Activity (LFA) NAD Crane, 304B.

DUE NEXT REPORTING PERIOD

2. Tasks as assigned by LFA and FRAP milestone requirements. (NELC REQUESTS TASK ASSIGNMENTS FROM LFA TO BE SUBMITTED IN MEMORANDUM FORM TO ENSURE ACCURACY OF ASSIGNMENT).

ACTIVITIES IN PROCESS AT END OF REPORTING PERIOD

1. Continued review of acquired documentation (Specifications, Technical Manuals)
2. Continuing exploration for possible west coast sources of AN/WSC-3 and AN/SSR-1 reliability data.
3. Support to the Lead Field Activity as requested and required.
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<td>Submit NECL FRAP Program Plan to NAD</td>
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<td>SUPPORT NAD IN THE FOLLOWING:</td>
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<td>2.</td>
<td>Develop overall FRAP Program Plan</td>
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<td>3.</td>
<td>Indoctrinate FRAP Implementation Teams</td>
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<td>Begin Indoctrinating Fleet personnel</td>
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<td>5.</td>
<td>Begin Data Collection</td>
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<td>3/1/75</td>
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<td>6.</td>
<td>Begin Data and Failure Analysis</td>
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<td>8.</td>
<td>Begin Corrective Action Implementation</td>
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DISCUSS MILESTONES MISSED (Include reasons, affect on problem/project, remedial action taken, end when)
1. The success of this pilot program will be dependent on the acquisition, review and analysis of many and varied types of data and relevant program information. The Reliability data (Historic and Current) must become available as soon as possible to achieve the desired results. It is recommended that a major effort of the Lead Field Activity should be directed towards the acquisition of the data requirements stated in the NELC FRAP Program Plan (Figure 5-1) submitted to NAD, Crane 5 MAR 1975.

2. The system performance and failure report forms that will be the official selection by the LFA must require equipment serial numbers for definite identification of equipments. This requirement is essential because of the proposed cascading of three (3) or more AN/WSC-3s on some ship installations.
None None

**VISITORS/BRIEFINGS**

LTJG Monte Green, OPTEVFORPAC (on FRAP Task ltr. dist.) visited NELC to discuss a mutual transfer of information on AN/SSR-1. Lt. Green will be conducting the OPEVAL on the AN/SSR-1 beginning approximately 1 May 1975. This appears to be one source of data that may prove useful if the results of the OPEVAL are obtained in time to factor them into our overall analysis.

Code 4100 formally requests the LFA to make this source of data available to NELC via an official action. Code 4100 also reiterates its formal request for Fleet data on the AN/WSC-3 and AN/SSR-1 now available at the Fleet Maintenance Support Office (FMSO), Division of Ships Parts Control Center (SPCC) Mechanicsburg Pennsylvania.
FIGURE 1
LFA PROGRAM STATUS

% EXPENDITURES

FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC
20  31  30  31  30  31  31  30  31  30  31

REPORTING DATE

-FUNDING STATUS-

% COMPLETION

FEB  MAR  APR  MAY  JUN  JUL  AUG  SEP  OCT  NOV  DEC
20  31  30  31  30  31  31  30  31  30  31

REPORTING DATE

-MILESTONE STATUS-
NOTIFICATION OF PERSONNEL ACTION

(EMPLOYEE—See General Information on Reverse)

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11. CODE NATURE OF ACTION

101 Career-Cond Appt

12. effective date

03-25-74

13. PAY PLAN AND OCCUPATION CODE

Electronics Engineer

PD #1425.1

14. PAY PLAN AND OCCUPATION CODE

GS 0855

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16. PAY PLAN AND OCCUPATION CODE

21b. FUNCTION CLASS

99

17a. GRADE OR LEVEL

09

17b. STEP OR RATE

01

18. SALARY

PA $12167

19. NAME AND LOCATION OF EMPLOYING OFFICE

Quality Evaluation & Engineering Laboratory Department

Craft Equipment Division

Systems Effectiveness Branch

NAD, CRANE, INDIANA

Crane, Martin, Indiana

20. TO:

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21. PAY PLAN AND OCCUPATION CODE

PD #1425.1

21b. FUNCTION CLASS

99

22a. GRADE OR LEVEL

09

22b. STEP OR RATE

01

23. SALARY

PA $12167

24. NAME AND LOCATION OF EMPLOYING OFFICE

Quality Evaluation & Engineering Laboratory Department

Craft Equipment Division

Systems Effectiveness Branch

NAD, CRANE, INDIANA

Crane, Martin, Indiana

25. DUTY STATION [City - county - State]

Crane, Martin, Indiana

26. LOCATION CODE

18-1055-101

27. APPROPRIATION

28. POSITION OCCUPIED

1. COMPETITIVE SERVICE

2. EXCEPTED SERVICE

29. APPORTIONED POSITION

1. PROVINCIAL

2. Waived-2

30. Remarks:

X A. SUBJECT TO COMPLETION OF 1 YEAR PROBATIONARY OR TRIAL PERIOD COMMENCING

03-25-74

X B. SERVICE CREDITING TOWARD CAREER OR PERMANENT TENURE FROM

03-25-74 to 03-25-77

ED: 04(1968)

17(1973 - Rose-Hulman Inst of Tech., Terre Haute, IN)

D. RETIRED UNIFORMED SERVICE:

F. PAY RATE DETERMINANT:

G. SPECIAL PROGRAM ID:

M. SMITH, Personnel Staffing Specialist

31. DATE OF APPOINTMENT AFFIDAVIT (Accessions only)

03-25-74

32. OFFICE MAINTAINING PERSONNEL FOLDER (If different from employing office)

33. LUCAD

34. SIGNATURE (Or other Authenticating Authorization)

DEPARTMENT OR AGENCY

DEPARTMENT OF THE NAVY

35. DATE

03-25-74 js

36a. SUBMITTING OFFICE NUMBER

NV17

0103 - 200 - 4241

1. EMPLOYEE COPY
**POSITION OR JOB DESCRIPTION**

**DEPARTMENT OF THE NAVY**

NAVS 125107 (REV. 10-67)
(See Instructions on Reverse)

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<th>GRADE/ PAY LEVEL/FORMULA</th>
<th>CLASSIFIERS INITIALS</th>
<th>CLASSIFICATION OR RATING OFFICIAL (Signature, Title and Date)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronics Engineer</td>
<td>65 855 9</td>
<td></td>
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</tbody>
</table>

**OFFICIAL CLASSIFICATION OR RATING ACTION**

1. THIRD ACTION

**SECOND ACTION**

2. SECOND ACTION

**FIRST ACTION**

3. FIRST ACTION

**RECOMMENDED**

4. RECOMMENDED

**POSITION OR JOB LOCATION**

6. ACTIVITY - NAME AND LOCATION

NAVS 125107 (REV. 10-67)
(See Instructions on Reverse)

7. ORGANIZATIONAL SUBDIVISIONS (1st)

QEEL Dept.

8. (2nd)

AIRCRAFT EQUIPMENT DIV.

Plans & Programs Div.

**12. EMPLOYEES NOW PERFORMING DUTIES (Ungraded jobs only)**

**REASON FOR SUBMISSION**

**CERTIFICATIONS:**

The description of the duties and responsibilities of this position or job is complete and accurate.

13. DUTIES AND RESPONSIBILITIES NOT ELSEWHERE DESCRIBED - COMPLETE DESCRIPTION ATTACHED.

**FOR INITIATING OFFICE ACTION**

14. ATTACHED AMENDMENT NO. POS. OR JOB # CLASS. OR RATING

15. IDENTICAL TO-

16. ATTACHED STATEMENT OF DIFFERENCE TO-

17. REPLACES-

**22. REMARKS**

The classification of this position may be appealed by the incumbent at any time. Appeals from classification actions which result in demotion or reduction in compensation must be timely in order for retroactivity to apply. Consult your classifier or appropriate activity instruction for procedures. Civil Service Commission classification standards and Department of the Navy classification guides are available for review in the Wage and Classification Office.

**19. SIGNATURE (Employee)**

**20. SIGNATURE AND TITLE (Immediate supervisor)**

**21. SIGNATURE AND TITLE (Person authorized to establish position or job)**

**23. CLASSIFICATION OR RATING RECERTIFICATION:**

**1. NAME OF EMPLOYEE**

Robert G. Barnwell

Pos. Class. Spec.

20 FEB 1974

**2. NAME AND LOCATION**

NAVS 125107 (REV. 10-67)
(See Instructions on Reverse)

**3. (3rd)**

**SYSTEMS EFFECTIVENESS BRANCH**

**4. (4th)**

**5. (5th)**

**6. (6th)**

**7. (7th)**

**8. (8th)**

**9. (9th)**

**10. (10th)**

**11. ORGANIZATIONAL TITLE OF POSITION OR JOB (If any)**

**12. EMPLOYEES NOW PERFORMING DUTIES (Ungraded jobs only)**

**13. DUTIES AND RESPONSIBILITIES NOT ELSEWHERE DESCRIBED - COMPLETE DESCRIPTION ATTACHED.**

**14. ATTACHED AMENDMENT NO. POS. OR JOB # CLASS. OR RATING**

**15. IDENTICAL TO**

**16. ATTACHED STATEMENT OF DIFFERENCE TO**

**17. REPLACES**

**22. REMARKS**

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**20. SIGNATURE AND TITLE (Immediate supervisor)**

**21. SIGNATURE AND TITLE (Person authorized to establish position or job)**

**23. CLASSIFICATION OR RATING RECERTIFICATION:**

**1. NAME OF EMPLOYEE**

Robert G. Barnwell

Pos. Class. Spec.

20 FEB 1974

**2. NAME AND LOCATION**

NAVS 125107 (REV. 10-67)
(See Instructions on Reverse)

**3. (3rd)**

**SYSTEMS EFFECTIVENESS BRANCH**

**4. (4th)**

**5. (5th)**

**6. (6th)**

**7. (7th)**

**8. (8th)**

**9. (9th)**

**10. (10th)**

**11. ORGANIZATIONAL TITLE OF POSITION OR JOB (If any)**

**12. EMPLOYEES NOW PERFORMING DUTIES (Ungraded jobs only)**

**13. DUTIES AND RESPONSIBILITIES NOT ELSEWHERE DESCRIBED - COMPLETE DESCRIPTION ATTACHED.**

**14. ATTACHED AMENDMENT NO. POS. OR JOB # CLASS. OR RATING**

**15. IDENTICAL TO**

**16. ATTACHED STATEMENT OF DIFFERENCE TO**

**17. REPLACES**

**22. REMARKS**

**The classification of this position may be appealed by the incumbent at any time. Appeals from classification actions which result in demotion or reduction in compensation must be timely in order for retroactivity to apply. Consult your classifier or appropriate activity instruction for procedures. Civil Service Commission classification standards and Department of the Navy classification guides are available for review in the Wage and Classification Office.**
II. MAJOR DUTIES AND RESPONSIBILITIES

Specifications and contracts for Navy Avionics Equipment require the use of Built-In Test (BIT) provisions for equipment checkout, and the requirement to test equipment to demonstrate the effectiveness of the BIT. This testing is performed at the contractor's facility; however, prior to the testing, the contractor is required to prepare and submit for approval or comment to Naval Aviation detailed test procedures outlining the proposed method, procedure and equipment to be utilized in conducting the test program. The incumbent is responsible for accomplishing the services required in administering this program. Any reports on this process to be submitted to the NAVY. In fulfillment of these responsibilities, the incumbent will take action as follows: inasmuch as it is applicable for each project assignment.

Advised NAVY: Advise the contractor of appropriate action in order to facilitate the testing and acceptance of equipment.
The classification of this position may be appealed by the incumbent at any time. Appeals from classification actions which result in demotion or reduction in compensation must be timely in order for retroactivity to apply. Consult your classifier or appropriate activity instruction for procedures. Civil Service Commission classification standards and Department of the Navy classification guides are available for review in the Wage and Classification Office.

23. CLASSIFICATION OR RATING RECERTIFICATION:

<table>
<thead>
<tr>
<th>POSITION OR JOB TITLE</th>
<th>SCHED. OR SERV.</th>
<th>SERIES</th>
<th>GRADE/ PAY LEVEL</th>
<th>CLASS- INITIALS</th>
<th>CLASSIFICATION OR RATING OFFICIAL</th>
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</thead>
<tbody>
<tr>
<td>Electronics Engineer</td>
<td>65 855 9</td>
<td></td>
<td></td>
<td></td>
<td>ROBERT G. BARNWELL</td>
</tr>
</tbody>
</table>

20. SIGNATURE AND TITLE (Immediate supervisor) DATE

S. S. KALBERER
Mgr., Plans & Programs Div.
(Position No., Classification or Rank)

21. SIGNATURE AND TITLE (Person authorized to establish position or job) DATE

A. E. WHITNER
Director, QEEL Dept.
INSTRUCTIONS FOR COMPLETING FORM NAVSO 12510/7

FOR GRADED POSITIONS

(Note: Optional Form 8 is to be used for proposed allocations to GS-16, GS-17, or GS-18 - see NCPI 531. General instructions for preparing position descriptions are contained in NAVSO 12510/7A. Special instructions are contained in applicable Special Question Lists.)

1. 2. & 3. To be executed only by persons who have been officially authorized to take classification action. Space is provided for taking three separate actions on the same position; the second and third actions may be on maintenance review, the result of application of new standards or on review by higher authority, etc. The position title must be the official title authorized by CSC or Navy standards, NAVEXOS P-2440, or other appropriate instructions. The classification official must be a person officially authorized to classify the position.

4. Optional. A recommendation should reflect the considered judgment of the originator.

5. Enter name of employee regularly performing the work. If not regularly performed, enter "VACANT."

6. "Location" means city and state.

7 through 10. Enter as many organizational subdivisions as necessary to show the one in which the position is located.

11. Optional.


17. Complete whenever the position supersedes another, out of which it has developed in whole or in part. This information is necessary for historical continuity and to provide accurate data for other personnel processes.

18. Examples of "other" reasons are "Survey," "Reorganization," and "Checklist."

19. Signature optional unless required by the activity or a higher management authority.

20 and 21. MUST be executed before forwarding to classification official.

22. For special notations by classification office - e.g., brief evaluation reports, reference to Navy or CSC postaudits, competitive levels, restrictions on filling position, or requirements for reviewing position later.

   This space should also be used to (a) identify any IA and "statement of difference" positions and the date each was established, and (b) the alternative series on interdisciplinary positions.

23. To be initialed and dated by the classification specialist whenever he has subsequently audited the position (e.g., on maintenance review) and found that the description is still current and accurate and that the classification assigned remains correct.

Description of duties and responsibilities.

This is normally typed on plain bond and attached to the NAVSO 12510/7. Very brief descriptions, however, such as short amendments, statements of differences, or checklist descriptions should, if space permits, be inserted in Item 22.

FOR UNGRADED POSITIONS

(Note: General instructions for preparing job descriptions are contained in NAVSO 12510/7A. Special instructions for Masters and Foremen are given in NCPI 531, Encl. 5.)

In upper right-hand corner, check the "JD" box.

1. 2. & 3. To be executed only by persons who have been officially authorized to take a rating action. Space is provided for taking three separate actions on the same job. This permits recording subsequent re-rating actions taken by the activity, as on maintenance review or application of new rating definitions, or by management bureaus or OCMM.

Job Title. Enter the official title authorized in NCPI 531, current OCMM Notices, or OCMM letters of authorization. (For a supervisory rating with a special designator, such as "Public Works," indicate the "rating concerned" in Item 22.)

Service. Enter appropriate Service, such as "W" (General Wage), "C" (Commissary), etc.

Pay Level or formula. Enter pay level for rating, e.g., "W-11" for Plumbers; or pay formula, e.g., "WF-18" for Leadingmen Carpenter.

Rating Official. This is a person officially authorized to make rating determinations.

4 & 5. Optional.

6. "Location" means city and state.

7 through 10. Enter as many subdivisions as needed to locate the job.

11. Optional.

12. Enter the number of employees, by title, now performing work of the job, or "none," as appropriate.


15 and 16. Optional. Activities may cite the appropriate P-1005 rating definition by number, in lieu of describing the job, when the P-1005 definition adequately covers most or all of the duties performed.

17. Self-explanatory.

18. For actions not covered by Items 13 through 17.


20 and 21. MUST be completed before forwarding to rating official.

22. To be used by rating office for purposes similar to those described in Item 22 for graded positions.

23. Optional. May be used for recording findings on maintenance review.

NAVSO 12510/7 (REV. 10-67) (BACK)
2. Become thoroughly familiar with the design and performance requirements of the equipment by review of applicable specifications and documents, and through contracts with cognizant personnel at NAVAIR and the contractor's plant.

3. Attend and participate in conferences as necessary and as requested by NAVAIR in support of this assignment.

4. Review contractor's test procedures and approve them if acceptable. Advise contractor of changes or conditions necessary for approval and maintain adequate files on all contractor's and equipment for use in reprocurement or revision of procedures. Oversee responsible for all assigned.

5. Conduct in-plant surveillance of the contractor's facilities, testing, and scheduling for the test program and determine if they are adequate. Review of contractor's test reports by inspector and maintain adequate.

6. Establish liaison with the resident inspector in order to give assistance in supervising tests and/or interpreting test procedures.

7. Report to NAVAIR when poor design or production practices are employed, and make suggestions for improvements of equipment or procedures.

NAVAIR shall be notified of major equipment failures.

8. Obtain and review the built-in-test and maintainability reports for verification of calculations and conclusions. Effect or scientific and engineering.

9. Prepare quarterly reports on this program to be reviewed by the Program Manager.

10. Develop expertise in the area of Built-In Test in order to advise NAVAIRSYSCOM of new BIT developments and to assist NAVAIRSYSCOM in preparing BIT procurement specifications.
C. The incumbent shall make Electronic Equipment Reliability Predictions under the guidance of the Program Manager. This shall include reliability modeling, circuit stress analysis, and failure rate data analysis.

D. The incumbent performs, as assigned, other special projects requiring application of engineering principles, methods, and techniques. These special assignments are designed to advance the incumbent's competence and experience, and will be under the technical direction of a higher grade engineer.

III. CONTROLS OVER THE POSITION

The incumbent is supervised by the Program Manager responsible for all assigned projects of the section in the area of Engineering Support and Advanced Systems Programs. Instructions as to priorities, time limitations, general sources of information, and general approach to be followed are normally provided with new assignments. The incumbent is expected to plan and accomplish assignments with technical advise and guidance from the supervisor only on problems where standard engineering techniques and practices cannot be applied. Work is reviewed for technical accuracy, adequacy, and soundness of engineering judgment.

IV. QUALIFICATION REQUIREMENTS OF THE WORK

This position requires knowledge and application of scientific and engineering principles and theories in the field of electronics such as can be acquired through experience and the completion of a full four year curriculum at a recognized college or university leading to a degree in Electronic Engineering.
**TRAVEL VOUCHER OR SUBVOUCHER**

(Complete with ink, ball-point pen or typewriter. DO NOT use lead pencil.)

**PAYMENT FOR**

<table>
<thead>
<tr>
<th>TOV/TAD PER DIEM</th>
<th>TOV/TAD TRAVEL</th>
<th>PCS TRAVEL</th>
<th>CHECK</th>
<th>CASH</th>
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</thead>
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**PAYMENT DESIRED**

<table>
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<tr>
<th>BUREAU VOU NO.</th>
<th>SUBVOUCHER NO.</th>
<th>DO VOUCHER NO.</th>
</tr>
</thead>
</table>

**TRAVEL VOUCHER OR SUBVOUCHER**

(Please, S. O. No., Issuing Hq. Date. Include amending orders.)

3/26-74 3/27-74 MAD, CRANE, INDIANA

**PRIOR TRAVEL PAYMENTS OR ADVANCES UNDER THESE ORDERS**

(Make list of payments, Voucher No., date received, paid by, or Station No. If none, so state.)

**PAYMENT FOR**

<table>
<thead>
<tr>
<th>BUREAUVOU NO.</th>
<th>PAYMENT DESIRED</th>
</tr>
</thead>
</table>

**ORDERS**

(Paragraph, S. O. No., Issuing Hq. Date. Include amending orders.)

**MARKS, ROBERT J. II**

**LAST NAME** - FIRST NAME - MIDDLE INITIAL (Soundex Code) (Print/Type)

**PAYMENT FOR**

<table>
<thead>
<tr>
<th>BUREAUVOU NO.</th>
<th>PAYMENT DESIRED</th>
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</thead>
</table>

**CHECK MAILING ADDRESS**

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**ORGANIZATION AND STATION**

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<th>PAYMENT DESIRED</th>
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</table>

**I. ITINERARY (See Reverse for Definition)**

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<tr>
<th>DATE</th>
<th>LOCAL STANDARD TIME</th>
<th>PLACE (Base, Activity, City and State; City and Country, Etc.)</th>
<th>GOVT QTS</th>
<th>NON-GOVT QTS</th>
<th>GOVT MEALS USED</th>
<th>NON-GOVT MEALS USED</th>
<th>OIFTv MEALS USED</th>
<th>SPEEDOMETER READING OR MILEAGE</th>
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<tbody>
<tr>
<td>3/21</td>
<td>DEP 2300</td>
<td>Terre Haute, In</td>
<td></td>
<td>X</td>
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<td>X</td>
<td></td>
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<tr>
<td></td>
<td>ARR 0030</td>
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**MILEAGE: 822.05 = 4.92**

**REIMBURSABLE EXPENSES**

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<tr>
<th>DATE</th>
<th>NATURE AND EXPLANATION</th>
<th>AMOUNT CLAIMED</th>
<th>ALLOWED</th>
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<tr>
<td></td>
<td>HUG 1043 CuPt 47 = 7441 = - HUG 5000 M 58 441 M $ = 8.58</td>
<td>429.00</td>
<td>BAS/COLA ADJ NOT REQUIRED</td>
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**REIMBURSABLE EXPENSES**

<table>
<thead>
<tr>
<th>DATE</th>
<th>AMOUNT CHARGED TO ACCOUNT CLASS</th>
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<tbody>
<tr>
<td></td>
<td>440.17</td>
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</tbody>
</table>

**TRANSPORTATION REQUESTS/MEAL TICKETS USED**

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>FROM</th>
<th>TO</th>
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</thead>
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<td></td>
<td>ODT</td>
<td>CC</td>
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**CHARGES - BOQ OR NON-GOVT MEALS AND QTS**

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<tr>
<td></td>
<td></td>
<td>(Net Payable)</td>
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<td></td>
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</tbody>
</table>

**VI. LEAVE STATEMENT**

I was authorized __ days leave. __ days were taken between and inclusive.

**SIGNATURE OF CLAIMANT AND DATE**

I hereby claim any amount due me. The statements on face, reverse, and attached are true and complete. Payment or credit has not been received.

**APPROPRIATION SYMBOL AND SUBHEAD**

<table>
<thead>
<tr>
<th>OBJECT CLASS</th>
<th>BUREAU CONTROL NO.</th>
<th>AUTH. ACCT'G ACTIVITY</th>
<th>TYPE</th>
<th>PER DIEM</th>
<th>COST CODE</th>
<th>AMOUNT</th>
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<tr>
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<td>440.17</td>
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</table>

**COLLECTION DATA**

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<th>POSTED BY</th>
<th>RECEIVED (Payee signature &amp; date, or check no.)</th>
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<tbody>
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<td></td>
<td>70,110,810</td>
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</tbody>
</table>

**FORM APPROVED BY COMPTROLLER GENERAL, U. S. 2 JUNE 1965**
### REQUEST AND AUTHORIZATION FOR DOD CIVILIAN PERMANENT DUTY TRAVEL

(Reference: Joint Travel Regulations)

TRAVEL AUTHORIZED HEREIN AS NECESSARY IN THE PUBLIC SERVICE

**REQUEST FOR OFFICIAL TRAVEL**

1. **DATE REQUESTED:** 03-24-74

2. **NAME (Last, First, Middle Initial):** MARKS, Robert J. II
   **SSN:** 282-48-2721

3. **NEW POSITION TITLE AND GRADE OR RATING:** Electronics Engineer, CS-2

4. **RELEASING OFFICIAL STATION AND LOCATION, OR ACTUAL PLACE OF RESIDENCE:**
   **STATION:** 2531 Jefferson
   **LOCATION:** Terre Haute, Indiana 47802

5. **NEW OFFICIAL STATION AND LOCATION, ACTUAL PLACE OF RESIDENCE, OR ALTERNATE DESTINATION:**
   **STATION:** Indian Ocean Ammunition Depot
   **LOCATION:** Crane, Indiana
   **DUTY REPORTING DATE AT NEW STATION:** 03-25-74

6. **PURPOSE OF TRAVEL**
   - [ ] TRAVEL BETWEEN OFFICIAL STATIONS
   - [ ] RENEWAL AGREEMENT TRAVEL
   - [X] OTHER:
     **SUPPORT:**
     - [ ] OFFICIAL STATION
     - [ ] RETURN FROM OVERSEAS FOR SEPARATION

7. **MODE OF TRANSPORTATION**
   - [ ] GOVERNMENT
   - [ ] RAIL
   - [ ] AIR
   - [ ] BUS
   - [ ] OTHER (Specify)

8. **PRIVATELY OWNED CONVEYANCE**
   - [ ] ADVANTAGEOUS
   - [ ] AUTOMOBILE
   - [ ] OTHER (Specify)
   **RATE PER MILE:** $ .68

9. **PER DIEM FOR EMPLOYEE AND DEPENDENTS (if applicable) AUTHORIZED PER JTR:**
   **TIME:** [ ] IS [X] IS NOT AUTHORIZED TO SEEK PERMANENT RESIDENCE
   **DAYS:** [ ] IS [X] IS NOT AUTHORIZED FOR DAYS

10. **TEMPORARY QUARTERS SUBSISTENCE EXPENSE**
    **IS [X] IS NOT AUTHORIZED PER JTR:

11. **MISCELLANEOUS EXPENSES**
    - [ ] REAL ESTATE EXPENSES
    - [ ] UNEXPIRED LEASE EXPENSES
    - [X] AUTHORIZED PER JTR

12. **DEPENDENT OVERSEA TRAVEL**
    - [ ] CONCURRENT
    - [ ] DELAYED
    - [ ] EARLY RETURN
    - [ ] NOT AUTHORIZED

13. **TRANSPORTATION OF DEPENDENTS AUTHORIZED**
    **FROM:** Terre Haute, Indiana
    **TO:** Crane, Indiana
    **NAMES OF DEPENDENTS:**
    **RELATIONSHIP:**
    **DATE OF BIRTH (Children):**

14. **SHIPMENT OF HOUSEHOLD GOODS AUTHORIZED NOT IN EXCESS OF 5000 Pounds:**
    **FROM:** Terre Haute, Indiana
    **TO:** Crane, Indiana
    **NONTEMPORARY STORAGE OF HOUSEHOLD GOODS AUTHORIZED**
    - [ ] YES
    - [X] NO

15. **OVERSEAS SHIPMENT OF PRIVATELY OWNED MOTOR VEHICLE AUTHORIZED**
    **IS [X] IS NOT AUTHORIZED:**

16. **ADVANCE AUTHORIZATION**
    **IS [X] IS NOT AUTHORIZED:**

17. **REMARKS OR OTHER AUTHORIZATION**
    (Use this space for special requirements, leave, excess baggage, etc. or other authorizations)

18. **ESTIMATED COST**
    **PER DIEM:** $ 4.36
    **TRAVEL:** $ 2.40
    **OTHER:** $ 91.31
    **TOTAL:** $ 128.07

19. **TRANSPORTATION AGREEMENT SIGNED**
    - [X] YES
    - [ ] NO

20. **REQUESTING OFFICIAL (Title and Signature):**
    **NAME:** SMITH, Personnel Staffing Specialist
    **TITLE:** P. OUTF, Acting Manager, Employment Div

21. **APPROVING OFFICIAL (Title and Signature):**
    **NAME:** GOEHR, Acting Director, Civilian Personnel Department
    **TITLE:** ARCC 26-74

22. **ACCOUNTING CITATION**

23. **ORDER AUTHORIZING OFFICIAL (Title and Signature) OR AUTHENTICATION**
    **DATE ISSUED:** 03-24-74

24. **TRAVEL ORDER NUMBER**

**DD FORM 1614**

1 JUL 67
1. 5 U.S.C. 5723, provides, under certain conditions, for travel and transportation expenses of persons appointed, student trainees, and their immediate families, movement and storage of household goods and personal effects, incident to appointment or assignment to a position within the 50 States and the District of Columbia, for which there is determined by the Civil Service Commission to be a manpower shortage. Under the law, the allowances contained therein shall not be authorized unless the appointee or student trainee agrees in writing to remain in the service of the DOD component concerned for 12 months. Accordingly, to establish eligibility for the authorized allowances, the following agreement must be executed.

2. I understand and agree that:

   a. I will remain in the employ of the (Department or Agency) for at least 12 months beginning with the effective date of my appointment or assignment to a position within Hawaii, Alaska, Continental United States, for which there is determined by the Civil Service Commission to be a manpower shortage, unless separated for reasons beyond my control and acceptable to the employing activity.

   b. If, before the expiration of the period of time shown in paragraph 2a above, I fail to fulfill the terms of this agreement by resigning, vacating the position without authority, or if I am removed for cause, I will, upon demand, repay to the Government a sum of money equivalent to that expended by the Government for transportation and subsistence of myself, transportation of dependents, and cost of shipment or storage of my household goods and personal effects, if involved, incident to my transfer, from beginning point of travel to duty station, and I authorize the employing Department or Agency to withhold any final pay due to me to apply against or liquidate any indebtedness arising from a violation of this agreement.

3. I understand that the period of service specified above is for the purpose of establishing my eligibility for the travel and transportation allowances which may be authorized.

4. I fully understand that upon completion of the 12-month period of service specified in this agreement, I will not be eligible for return transportation at Government expense for myself, my dependents and household goods to my place of actual residence at time of my appointment. I further understand that completion of the above period of service does not terminate my employment and I may continue to serve in the same position or any other position to which I am assigned for a longer period in accordance with the employing Department or Agency regulations. This agreement neither limits nor guarantees the duration of my employment.
Electronics Engineer, GS-9

FOR AGENCY USE ONLY

Part A. TO BE COMPLETED BY APPLICANT OR EMPLOYEE (type or print in ink)

1. NAME (last, first, middle)  
Marks, Robert Jackson II

2. SOCIAL SECURITY ACCOUNT NO.  

3. SEX  
X MALE  

4. DATE OF BIRTH  
08-25-50

5. DO YOU HAVE ANY MEDICAL DISORDER OR PHYSICAL IMPAIRMENT WHICH WOULD INTERFERE IN ANY WAY WITH THE FULL PERFORMANCE OF THE DUTIES SHOWN BELOW?  
Yes  
X No

(If your answer is "YES" explain fully to the physician performing the examination)

6. I CERTIFY THAT ALL THE INFORMATION GIVEN BY ME IN CONNECTION WITH THIS EXAMINATION IS CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF  

(signature of applicant)

Part D. TO BE COMPLETED BY AGENCY MEDICAL OFFICER (if one is available)

NOTE: Review the attached certificate of medical examination and make your recommendations in item 1 below. If the medical examination was done for pre-appointment purposes, circle the appropriate handicap code in part F.

1. RECOMMENDATION:  

☐ HIRE OR RETAIN. DESCRIBE LIMITATIONS, IF ANY, HERE.

☐ TAKE ACTION TO SEPARATE OR DO NOT HIRE. EXPLAIN WHY.

2. AGENCY MEDICAL OFFICER’S NAME (type or print)  
DR. W. C. COLEMAN

3. LOCATION (city, State, ZIP Code)  
MEDICAL DEPARTMENT

4. DATE  
MAR 25 1974

Part E. TO BE COMPLETED BY AGENCY PERSONNEL OFFICER

NOTE: Enter the action taken below. If this form is used for pre-appointment purposes, be sure the appropriate handicap code in part F is circled. IMPORTANT: See FPM Chapter 293, Subchapter 3; FPM Chapter 339; and FPM Supplement 339-31 for disposition and/or filing of both parts of this form, either separately or together.

1. ACTION TAKEN:  

☐ HIRED OR RETAINED.  
☐ NON-SELECTED FOR APPOINTMENT, OR ELIGIBILITY OBJECTED TO.

☐ ACTION TAKEN TO SEPARATE.

2. AGENCY PERSONNEL OFFICER’S NAME (type or print)  

3. SIGNATURE  

4. DATE

Part F. HANDICAP CODE (to be completed only in pre-appointment cases)

If the person examined has or had a handicap listed below, circle the code number which pertains to that handicap. If more than one handicap applies, circle the one considered most limiting. If none of the handicap codes apply, circle code "00".

00  No handicap of the type listed  
10 Amputation—one major extremity  
11 Amputation—two or more major extremities  
20 Deformity or impaired function—upper extremity  
21 Deformity or impaired function—lower extremity or back  
30 Vision—one eye only  
31 No usable vision  
40 Hearing aid required  
41 No usable hearing  
42 No usable hearing, with speech malfunction  
43 Normal hearing, with speech malfunction  
50 Tuberculosis—inactive pulmonary  
51 Organic heart disease (compensated) —valvular, arrhythmia, arteriosclerosis, healed coronary lesions  
52 Diabetes—controlled  
53 Epilepsy—adequately controlled  
54 History of emotional behavioral problems requiring special placement effort  
55 Mentally retarded  
56 Mentally restored

1. EXAMINING PHYSICIAN’S NAME (type or print)  
DR. W. C. COLEMAN

ADDRESS (including ZIP Code)  
MAIL DEPARTMENT

2. SIGNATURE OF EXAMINING PHYSICIAN  

3. DATE  
MAR 25 1974

(IMPORTANT: After signing, return the entire form intact in the pre-addressed "Confidential-Medical" envelope which the person you examined gave you.)

© U.S. GOVERNMENT PRINTING OFFICE 1972-487-737
DEPARTMENT OF THE NAVY
NAVAL AMMUNITION DEPOT
CRANE, INDIANA 47522

Mr. Robert J. Marks II
2531 Jefferson
Terre Haute, Indiana 47802

Dear Mr. Marks:

This is to confirm our offer of career-conditional appointment to the position of Electronics Engineer, GS-9, $12,167 per year in the Quality Evaluation and Engineering Laboratory Department.

This position offer is contingent upon your satisfactorily completing a medical examination which will be administered on 25 March when you report for your first day of duty. The employment processing will be accomplished at Bldg. 5, this Station. You should plan to report there at approximately 7:30 a.m. If you will bring this letter with you, it will expedite your entry through the security gate.

You will be authorized reimbursement to the maximum extent allowed under Department of Defense travel regulations for the expenses associated with your move from Terre Haute to the Crane area.

If you have any questions regarding this job offer, please telephone Mr. Kenneth Thompson, collect, at area code 812 854-1835.

We look forward to seeing you on 25 March.

Sincerely yours,

L. H. Conrad
Manager, Employment Division
Civilian Personnel Department
By direction of the Commanding Officer

Copy to:
William Sisson, Rose-Hulman Inst. of Technology
ORIENTATION MAP
NAVAL AMMUNITION DEPOT
CRANE, INDIANA

LEGEND

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To: Each New Employee of U. S. NAD Crane

WELCOME! You are now a Member of the Team - dedicated to upholding the policies and interests of the United States of America.

Our success depends on the individual performance of each of us in our combined efforts.

Of course, you can contribute most when you have an understanding and appreciation of the Depot's Purpose and Organization. Following are a few interpretations of our rules, regulations, and conditions of work that will affect you:

1. No Smoking in vehicles at any time on the Depot; no cameras permitted; no firearms; employees are not permitted to bring intoxicating beverages on the Depot.

2. If you are unable to report for work because of illness (sick leave), you will be expected to notify your supervisor as soon as possible on the first day you are sick. In emergencies, unscheduled annual leave may be granted if you contact your supervisor.

3. Personal mail of an employee should be directed to his home address.

4. The regular tour of duty for almost all Depot employees is from 0730 until 1600, Monday through Friday, with 30 minutes for lunch.

5. Employees are warned against participation in partisan political activities. You should read the Warning Posters found in all departments on the Depot.

6. It is your responsibility to keep the Industrial Relations Department advised of your current address, next of kin, who to notify in case of emergency, etc.

7. If you are injured in line of duty, report the accident immediately to your supervisor. Report all accidents however minor.

Your attention is especially invited to the material enclosed in this folder concerning employee health benefits. If you want to take advantage of the opportunity to enroll in a health benefit plan, you have 31 days from the date of your appointment. Arrange with your supervisor to come to Building 5, Employee Services Division, to complete your enrollment.

Arrangements will be made for you to attend an indoctrination class within the next 30 days.

B. E. GALLAGHER
APPROACHES TO N.A.D. CRANE FROM PRINCIPAL CITIES AND TOWNS

NEAREST RAILROAD - B.R.O. WASHINGTON OR MICHIGAN EXPRESS VIA LOOGOTEE

NEAREST AIRPORTS BLOOMINGTON AND BEDFORD

POST OFFICE - CRANE, INDIANA

HOSPITALS

NO. AMBULANCES

VICINITY MAP
U.S. NAVAL AMMUNITION DEPOT
CRANE, INDIANA
Any Person In Government Service Should:

Put loyalty to the highest moral principles and to country above loyalty to persons, party, or Government department.

UPHOLD the Constitution, laws, and legal regulations of the United States and all governments therein and never be a party to their evasion.

GIVE a full day's labor for a full day's pay; giving to the performance of his duties his earnest effort and best thought.

SEEK to find and employ more efficient and economical ways of getting tasks accomplished.

NEVER discriminate unfairly by the dispensing of special favors or privileges to anyone, whether for remuneration or not; and never accept, for himself or his family, favors or benefits under circumstances which might be construed by reasonable persons as influencing the performance of his governmental duties.

MAKE no private promises of any kind binding upon the duties of office, since a Government employee has no private word which can be binding on public duty.

ENGAGE in no business with the Government, either directly or indirectly, which is inconsistent with the conscientious performance of his governmental duties.

NEVER use any information coming to him confidentially in the performance of governmental duties as a means for making private profit.

EXPOSE corruption wherever discovered.

UPHOLD these principles, ever conscious that public office is a public trust.

(This Code of Ethics was agreed to by the House of Representatives and the Senate as House Concurrent Resolution 175 in the Second Session of the 85th Congress. The Code applies to all Government Employees and Office Holders.)
EQUAL EMPLOYMENT OPPORTUNITY

1. IT IS THE POLICY OF NAD CRANE TO PROVIDE EQUAL OPPORTUNITY FOR ALL PERSONS, TO PROHIBIT DISCRIMINATION IN EMPLOYMENT BECAUSE OF RACE, COLOR, RELIGION, SEX, OR NATIONAL ORIGIN, AND TO PROMOTE THE FULL REALIZATION OF EQUAL EMPLOYMENT OPPORTUNITY THROUGH A CONTINUING AFFIRMATIVE EEO PROGRAM IN EACH DEPARTMENT.

2. THE PRESIDENT OF THE UNITED STATES, BY HIS EXECUTIVE ORDERS, HAS SET FORTH HIS POLICY AND GUIDELINES FOR PROMULGATING THE POLICY OF EQUAL EMPLOYMENT OPPORTUNITY TO PERSONS LOOKING FOR EMPLOYMENT OR ALREADY EMPLOYED BY THE GOVERNMENT. EQUAL EMPLOYMENT OPPORTUNITY MEANS EQUAL RIGHTS IN ALL ACTIONS WHICH ARE PERSONAL TO A PARTICULAR EMPLOYEE. THIS POLICY WILL APPLY TO APPOINTMENTS, PROMOTIONS, REASSIGNMENTS, TRAINING, EMPLOYEE DEVELOPMENT, AND APPEALS OF ANY NATURE. THERE WILL BE ABSOLUTE FREEDOM FROM RESTRAINT, AND AN ABSOLUTE RIGHT FOR EQUAL EMPLOYMENT OPPORTUNITY IN ALL MATTERS.

3. SPECIAL EFFORTS WILL BE MADE TO ASSURE THAT JOB OPPORTUNITIES IN ALL DEPARTMENTS ARE MADE KNOWN TO MEN AND WOMEN OF ALL RACES, RELIGION, AND ETHNIC BACKGROUNDS, FOR IT IS THE INTENTION OF THIS COMMAND TO ELIMINATE ANY AND ALL REASONS WHICH WOULD EVEN ALLOW AN EMPLOYEE TO THINK THAT DISCRIMINATION PREVAILS IN ANY AREA.

4. IT IS EXPECTED THAT ALL MANAGEMENT PERSONNEL, SUPERVISORS, AND EMPLOYEES PUT FORTH A SPECIAL EFFORT TO ADHERE STRICTLY TO THE PRINCIPLES OF FULL AND FAIR OPPORTUNITY IN ALL PERSONNEL AND PERSONAL ACTIONS ON OR OFF THE DEPOT. THERE IS NO PLACE ON THIS DEPOT FOR ANY PERSON WHO DOES NOT WHOLE-HEARTEDLY SUPPORT THIS PROGRAM.

5. TO ACCOMPLISH THE ABOVE REQUIRES THAT EACH OF US UNDERSTAND AND ACCEPT THEIR RESPONSIBILITY TO THE EQUAL EMPLOYMENT OPPORTUNITY PROGRAM. THE IMPLEMENTATION OF THIS POLICY CAN BE ACCOMPLISHED ONLY IF EACH OF US RESOLVES TO MEET THE PERSONAL CHALLENGE TO PROVIDE EQUAL OPPORTUNITY TO ALL WHO PARTICIPATE IN NAD CRANE'S PROGRAMS AND ACTIVITIES.

6. I ASK YOUR SINCERE SUPPORT IN CARRYING OUT BOTH THE SPIRIT AND THE LETTER OF THE EQUAL EMPLOYMENT POLICIES.

R. L. McARTHUR
Captain, USN
Commanding Officer
MATERNITY POLICY

1. Report of Pregnancy. Employees will:

   a. Report to the Medical Officer, via their immediate supervisors, as soon as they are reasonably sure they are pregnant, so that steps can be taken to protect their health.

   b. Report to Medical Department as requested for regular interviews.

   c. Provide a doctor's statement including information on the expected date of confinement and any conditions which might affect their work.

   d. Advise Medical Department immediately of any conditions or complications arising after original doctor's statement is provided.

2. Maternity Leave

   a. Duration

      (1) Normally, a woman should cease work six weeks before the expected confinement date and will return to work no later than eight weeks after delivery.

      (2) Requests for leave for longer periods must be supported by a doctor's certificate.

   b. Requests for Leave. Employees will submit a memorandum request for maternity leave thru their supervisors to Industrial Relations together with a physician's certificate indicating the expected date of delivery and any complications which might be aggravated by continued employment.

   c. Granting Leave

      (1) Career and career-conditional employees will be granted maternity leave for all reasonable periods of absence because of pregnancy or complications of pregnancy which are substantiated by a doctor's statement.

      (2) Temporary employees will be granted maternity leave only to the extent that production requirements are not jeopardized. The decision in each case will be reached after consideration of workload, effect on production requirements, date of expiration of appointment, etc.

Enclosure (1)
Policy Statement: Restriction on Employment of Relatives

I. The following information is extracted from Sub Part A of Part 310 of the Commission's regulations concerning the employment of relatives. This information is intended to indicate generally how the new restrictions are being applied. A station instruction on this subject will be issued soon.

"Section 221 of the Federal Salary Act of 1967 incorporates into title 5 of the U.S. Code (S. C. 3110) sweeping restrictions on the employment of relatives by agency officials. These restrictions apply throughout all three branches of the Federal Government and the government of the District of Columbia."

"Under the law, an official may not appoint, employ, promote or advance one of his relatives to a position in his agency, nor may he advocate a relative for appointment, employment, promotion, or advancement in the agency. Likewise, an individual may not be appointed, employed, promoted or advanced if the action was "advocated by a public official serving or exercising jurisdiction or control over the agency who is a relative of the individual."

The following definitions apply in implementing the new law:

(a) Relative means father, mother, son, daughter, brother, sister, uncle, aunt, first cousin, nephew, niece, husband, wife, father-in-law, mother-in-law, son-in-law, daughter-in-law, brother-in-law, sister-in-law, stepfather, stepmother, stepson, stepdaughter, stepbrother, stepsister, half brother, or half sister."
NADCRANE INSTRUCTION 12410.15

From: Commanding Officer
To: Directors of all Departments
Subj: NAD Crane Upward Mobility Program

Ref: (a) COMMINST 12410.1, Subj: Upward Mobility
     (b) NADCRANEINST 12340.2B, Subj: Merit Promotion and Internal Placement Program

Encl: (1) Basic Position Coverage
      (2) Putting It All Together

1. Purpose. To facilitate Department of the Navy Training Agreement for Upward Mobility of lower-graded general schedule and wage grade employees at NAD Crane.

2. Background. As part of NAD Crane's maximum utilization of all skills, there is a need for more flexibility in the assignment of personnel than is possible under current regulations. As a first step, NAD Crane will activate a planned program of upward mobility with self-established departmental goals.

3. Discussion. As an integral part of Personnel Management, upward mobility provides lower level employees intensive, accelerated development in order to equip each employee with the skills and specific knowledges necessary to perform successfully in a target position. These target positions provide a career opportunity for individuals presently occupying either "dead-end" positions or positions with limited career possibilities. Selection criteria under the agreement is based on the job element approach by matching people to jobs according to their potential for being successful in performing the duties of the target position. Employees may be moved out of dead-end jobs into a new career field with advancement opportunity within the general schedule series, between the craft/trade and labor occupations, and between the general schedule and craft/trade and labor occupations.

4. Policy. It is the policy of NAD Crane that all management levels encourage and support the upward mobility opportunities and assist employees in identifying these opportunities. It is recognized that current personnel retrenchments and reduction of average grade levels
d. Position Management Committee will when conducting annual surveys, identify and encourage the use of Upward Mobility Program.

Copy to:
A3 (Division Managers)
A4 (Managers of Major Branches)
A5 (Other Supervisors)
AFGE 1415
FOP 158
01 Files

R. L. McARTHY
1. Trainee positions. The trainees will be selected from on-board employees in the grades GS-2 through GS-9, or their wage grade equivalents, who demonstrate skills or potential for development to enter a technical, administrative, professional, or craft/trade career. The trainee position will initially be established at the current grade or wage level of the trainee. The trainee may either be detailed or reassigned to the trainee position.

2. Target positions. A training agreement, reference (a), provides either for reassignment or promotion to a different occupational series upon the satisfactory completion of training. The target position, therefore, may be at the same grade level as the trainee position or at the next higher grade level in the occupational series for which being trained. For example, a Management Technician, GS-344-6, might be trained for position as Management Analyst, GS-345-7, or a Motor Vehicle Operator, WG-5703-6 for a position as Management Technician, GS-344-5. Trainees who enter a series where positions are properly classified at two grade intervals and whose agreement calls for a two grade promotion to the target position will be eligible for such promotion upon successful completion of the training program. The variety of training assignments anticipated under this agreement precludes preparing a single position description which would cover all the occupations.

Additional development of candidates beyond the target position will follow normal Merit Promotion Program and/or Career Management Program procedures. The target positions apply to positions properly classified at one or two grade intervals within the occupational groups listed on the following page and craft/trade and labor occupations properly grouped as semi-skilled or skilled:
Note: Candidates must meet the minimum educational requirement where such is specified in the qualification standard for the target position for which selected.
1. Establishment of Positions

   a. It is in the interests of both management and employees to review the mix of levels of positions making up the workforce and the types of qualifications required. It is the responsibility of the first line supervisor and higher level managers to determine whether positions in the GS-2 to GS-9 grades or WG equivalents, would assist persons in senior positions to operate more effectively with no increase in total staffing, before submitting requests to either establish or fill positions at higher grade levels. All actions establishing or filling positions at all grade levels will be reviewed from the standpoint of the most effective utilization of command manpower and average grade controls. In determining opportunities for Upward Mobility, Departments will coordinate request with Code 06. The Equal Employment Opportunity Coordinator will assess on a continuing basis the progress toward attainment of desired goals.

   b. This policy is not appropriate for the initial intake of veterans appointed under the Veterans Readjustment Appointment.

2. Advertisement

   a. NAD Crane Upward Mobility openings will be well-publicized in vehicles like the Bursts and Duds, Daily Bulletin, and Bulletin Board notices. The publicity will not oversell the opportunities available, but will emphasize actual job vacancies, specific training plans, and other means of implementing the program.

   b. Specific positions will be advertised under the NAD Crane Merit Promotion Program, and will be labeled "Upward Mobility Position" on both the vacancy announcement and in publicity about the positions to identify these opportunities to eligible employees. Some announcements may have very basic prerequisites. The advertisements will state a training plan will be accepted in lieu of established CSC qualification requirements.

3. Selection of Trainees

   a. Qualifying Standard. Trainees will be selected under the Navy Merit Promotion Plan from those applicants who are currently in positions rated GS-2 through GS-9 or their craft/trade and labor equivalents, who have competitive Civil Service status, and who can reasonably be expected to perform the duties of the target position within two years. The
b. The length of training may range from six months to two years depending upon the time required to equip the employee with the skills and specific knowledges necessary in the target job and his ability to perform required elements of the position satisfactorily. Ordinarily the target position will be one or two grades higher than the trainee's present grade or wage grade equivalent depending upon whether the target job is normally classified at one or two grade intervals. In cases where the trainee already possesses some of the qualifying skill or knowledge elements, the period of training may be established at a minimum of six months. In all cases where the trainee possesses only potential for advancement, a minimum of twelve months of training will be required to achieve eligibility for promotion.

c. To achieve eligibility for reassignment in another series at GS-7 and below, a minimum of six months will be required to qualify in the target series and 12 months additional experience is required to qualify for promotion, making a total of 18 months from entrance to eligibility for promotion. The trainee will receive career counseling before he enters the development assignment program, and at appropriately spaced intervals after he enters the program. In no case does this agreement authorize exception to the time-in-grade restrictions. Trainees who fail to meet the performance requirements of the development program may be returned to their former positions or those of similar duties and grades depending on whether original action was detail or reassignment. The development plan will be designed to have generally the same pattern for the career field to assure that the trainee acquires the necessary knowledges and skills for the career field at the appropriate level of the target position but will provide for the individual aptitudes, interests, and background of the trainee.

d. Within 30 days after reassignment to the trainee position, individual plans will be mapped out by Code 063 and receiving department, and may include any part of the following:

(1) Formal Instruction. Specially planned education courses which contribute to the career field may be taken during or after regular work hours at government expense and after consultation with the supervisor. This may include courses offered at local schools and colleges, Department of Defense Schools, or through Civilian Personnel.

(2) On-The-Job Training. All duty assignments will be meaningful and productive and provide for supervised development in the target position. Special familiarization assignments may be made to other program areas that interface with the career field; i.e., an assignment in ADP for budget or personnel. Occasionally the trainee may attend special staff meetings and conferences as orientation to special policy considerations for the activity and the career field.
5. Evaluation of Trainee's Progress. Within 30 days after assignment to a trainee position, a preliminary evaluation will be made to assess development needs of the employee in terms of meeting the job element requirements and to plan a development schedule to meet them. Subsequently, written supervisory reports on the employee's application of training received and overall development on the job will be made at regular intervals of 30 days during the first six months and 90 days thereafter as appropriate. Upon completion of the training program, supervisors will make a final summary evaluation of the achievement and performance of the trainee. Trainees, likewise, will be expected to make written evaluations of any formal training provided at government expense and to make a self-assessment of their development. The trainee will be considered to have met the qualification requirements established for the target position upon successful performance of the job element criteria identified for the position. He is then eligible for reassignment or promotion to the target position.

6. Flexibility Provisions. To avoid frequent minor amendments to the agreement caused by variation in mission of the organizational element changes in concepts of methodology in subject fields, or trainee needs, it is permissible to:

a. Tailor within the total scope and overall objectives of the development program, the length and intensity of the subject matter to meet the individual needs of trainees.

b. Adjust elapsed training time as appropriate in individual cases to cover contingencies such as excessive leave, or trainee's inability to grasp a portion of the development assignment.

c. Alter sequence of training to allow for learning experience to be responsive to actual work situations as they arise during the development period when conditions or experience indicate the desirability of such changes.

d. Add or modify subject matter material depending on technological changes, the needs of the Department, and the trainees, and evaluation experience of the development program.
Suppose, as in Question No. 6, the total severance pay to which you are entitled is $4,500. Because your at the time of separation is $100 it will take 45 weeks to pay you your entire severance pay. After receiving severance pay for 20 weeks, you are reemployed in the Federal Government under an appointment without time limitation, and the severance pay is terminated.

You work for three full years and are again separated under circumstances entitling you to severance pay. You are now 48 years of age and have 23 years of creditable service. At the time of your second separation your basic weekly pay is $125. Your severance pay fund is computed as follows:

\[
\text{Severance pay fund:} = (4,500 \text{ basic allowance}) + (3,600 \text{ age adjustment allowance})
\]

The severance pay fund equals $8,100. It will take 54 weeks ($8,100 divided by $125) to pay you your entire severance pay. However, since total severance pay may not exceed 52 weeks, and since you have already received 20 weeks of severance pay, you are entitled to only 32 weeks of severance pay at $125 a week.

20. Q. What is the authority for paying severance pay?

A. The severance pay statute is section 5595 of title 5, United States Code; the severance pay regulations issued by the United States Civil Service Commission are in subpart G of part 550 of title 5, Code of Federal Regulations.

21. Q. Where can I get additional information about severance pay?

A. The personnel office of your agency, or the United States Civil Service Commission, will answer any other questions you have about severance pay.


U.S. GOVERNMENT PRINTING OFFICE: 1970-0-382-931
Severance Pay—What It Is

A law passed in 1965 authorized, for the first time, severance pay for Federal employees who are involuntarily separated from the service. How much money an employee gets is computed on the basis of his basic pay at time of separation, his years of Federal service, and age, if he is over 40. He gets it at the same rate, and at the same intervals, as he was paid his salary.

There are some limitations on eligibility for severance pay. For example, if, when separated, an employee is receiving payments from the Labor Department's Bureau of Employees' Compensation for a job-related injury he is not entitled to severance pay. Neither is an employee who is entitled to an immediate annuity which includes a reduced annuity, a disability annuity or annuity earned as a member of the uniformed services.

The following material answers the most frequently asked questions about severance pay.

1. Q. How do I know if I am eligible for severance pay?
   A. To be eligible for severance pay, you must be serving under one of the following types of appointments at the time of your separation:

   (1) A career or career-conditional appointment in the competitive service, or their equivalent in the excepted service;

   (2) An indefinite-appointment system that preceded the career-conditional appointment system;

   (3) An indefinite appointment without time limitation in the excepted service, except a Presidential appointment, an appointment filled by a non-career executive assignment, or an appointment to a Schedule C position;

   (4) An overseas limited appointment without time limitation;

   (5) An appointment held as a status quo employee including an appointment by which you became an indefinite employee upon promotion, demotion, or reassignment;

   (6) A time-limited appointment in the Foreign Service to which you were assigned under a statutory authority that entitled you to reemployment in your former agency, but your right to reemployment had expired.

In addition, you must have been currently employed for a continuous period of at least 12 months. If you were either a part-time or a full-time employee and you meet these requirements you are eligible for severance pay.

reemployment. The offer of equivalent employment at a later time, or entitlement to an annuity beginning at a later time, has no effect on your entitlement to severance pay.

3. Q. What if I start drawing severance pay but later become entitled to a disability annuity?
   A. Since the disability annuity will be retroactive to the date of your separation from the service, you will have to return all severance pay that you received.

4. Q. Who determines whether I am entitled to severance pay?
   A. The separating agency makes this determination. If you are eligible, your agency advises you of the maximum amount of severance pay you may receive (referred to as the severance pay fund), the date payment will begin, and the number of weeks required to exhaust the severance pay fund.

5. Q. What should I do if my agency determines that I am not entitled to severance pay, and I believe that I am?
   A. You should file a claim for pay with the Claims Division, General Accounting Office, Washington, D.C. 20548.

6. Q. How is the amount of my severance pay determined?
   A. Your severance pay fund (that is, the maximum amount of severance pay you may receive) is determined on the basis of your basic rate of pay at the time of separation and years of creditable service (basic allowance). If you are over 40 years of age, an age adjustment allowance is also a part of the formula.

   Your basic allowance is computed on the basis of one week's basic salary for each year of creditable service for the first 10 years, and two weeks' basic salary for each year of service thereafter. Your age adjustment allowance is computed on the basis of 10 percent of the basic allowance for each year your age exceeds 40 years of age.

   For example, if you are 45 years old with 20 years of creditable service, and your basic weekly salary is $100, your severance pay fund would be computed as follows:

   **Basic allowance:**
   
   $100 (weekly salary) \times 10 (first 10 years) = $1,000
   
   $100 (weekly salary) \times 2 \times 10 (years in excess of 10) = $2,000
   
   **Age adjustment allowance:**
   
   $3,000 (basic allowance) \times 5 (years over 40) = $15,000
   
   The same amount as you received from your previous employer is allowed as a credit against your severance pay fund.

8. Q. What is creditable service? Does it include service?
   A. Creditable service for severance pay is service which is creditable for leave purposes, including military service, provided no service interrupts otherwise creditable civil service, which precedes civilian creditable service.

9. Q. If I resign will I be entitled to severance pay?
   A. Generally speaking, a resignation is separation and would not entitle you to severance pay. However, there are three circumstances in which your resignation is considered involuntary and you are entitled to severance pay:

   (1) A specific notice in writing by your agency which states that all or part of your competitive area will be abolished or transferred to another area;

   (2) A general notice of reduction-in-force which announces that all or part of your competitive area area because of a transfer of function;

   (3) A notice by your agency proposing to refuse to accompany you for declining to accompany you for a transfer of function.

10. Q. What is an "equivalent position"?
    A. For purposes of entitlement to severance pay an "equivalent position" is one of like seniority and the same amount as you received from your previous employer. If the position is not one of like seniority then it must be one of like seniority and include a status quo. If the position is not one of like seniority and includes a status quo, then it must be one of like seniority and include a status quo.

11. Q. My agency is transferring the function of a position to a part of an installation located 500 miles away. If I do not move with my position, will I be separated?
    A. If you do not move with your position, your position will be abolished or transferred to another area within a period of no more than one year before the abolition or transfer.
Essentially the civilian employees at Crane do the same type things as personnel in any business enterprise. We supply products and services. This brochure is intended to provide specific information relating to our involvement today, especially in those areas having engineering and scientific orientations and personnel requirements.

A broad variety and scope of activities permit Crane to offer the professional a choice—in terms of his current interests and also, most probably, with respect to his future interests.

Our environment includes facilities and laboratories which allow you to develop in your field: holography, solid-state electronics, rotating components, chemical research, environmental testing, underwater acoustics, and more.

May we invite your attention to:

The Environment  
Crane Laboratories and Facilities  
Technology Transfer  
The Living  
Fringe Benefits  
Application Information  
Advanced Educational Opportunities

Page 1
Pages 2-14
Page 15
Pages 16-17
Pocket—Back Cover
Pocket—Back Cover
Pocket—Back Cover

NAD CRANE IS AN EQUAL OPPORTUNITY EMPLOYER.
The Environment

Larger than the District of Columbia, encompassing over 62,000 acres with modern, permanently constructed buildings, roads, and railroads—Crane is a city away from city congestion. Nearby interstates bring us closer to Indianapolis, Indiana and Louisville, Kentucky.

Unspoiled terrain is the setting for scientific and industrial activities. Man hasn't spoiled Nature at Crane. Numerous wildlife, trees, plants, and flowers live and grow in protection and freedom.

As delicate as a Japanese silk screen print,
wooded Lake Greenwood covers 600 of Crane's acres. A beautiful means for natural conservation.
Physics

Think of the different fields of physics—spectroscopy, holography and laser optics, thermodynamics, mechanics, acoustics, ultrasonics—and Crane is involved in conceptual research or applied studies.

Applied
Methods of detecting persons who generate unusual amounts of static electricity is an applied research study.

Research
Spectral distribution of radiation and flame kinetics are two disciplines in the electro-magnetic spectrum we're researching. Laser radiation is another research area.

Physics Majors
Electricity and magnetism, quantum mechanics, and atmospheric physics major areas of concentration are needed for today's and tomorrow's programs.
Environmental Testing

The worst environments that nature and man conceive are reproduced in our laboratory to test tiny microcircuits and two-thousand pound gun turrets.

Producing a multitude of environments, either sequentially or simultaneously, we can simulate the real environment of nearly any device. Engineers devise test regimes for a gamut of operational environments and climates.

Over 8 Million $ Laboratory

From a humble beginning—a single homemade saltspray tank—our laboratory has grown in the past 20 years to include seven buildings housing equipment worth over eight million dollars. This equipment simulates harsh corrosive action of salt water spray and various climates, insidious vibration, damaging impact of mechanical shock, and sudden acceleration.

Explosive hardware from detonators to one-ton cast loaded items are tested in instrumented steel and concrete cells. Equipment for automatically controlled tests and data acquisition is among the best in the country.

1 Shock machine produces up to 400,000 lbs. thrust.

2 Model tower for testing SHRIKE antenna is located in an isolated place.

3 MAPI tower 100 feet high measures pyrotechnic items.

4 Salt spray chamber tests items as large as rocket launchers.
Crane's large and secluded land area is ideal for constructing facilities to test practically any pollutant, explosive, or noxious element without endangering wildlife or surrounding population.

Specialized Outdoor Test Facilities

Multi-Aspect Assessment of Pyrotechnic Illumination (MAPI) Range
Two instrumented 300 and 100 foot towers evaluate flare candlepower from several directions, including the ground.

Centrifuge
22 foot radius centrifuge tests large packages and explosive items.

Elevated Microwave Antenna Range
Nearly every type of microwave antenna for fuzes, aircraft, or shipboard can be tested.

Fast Cook-Off Facility
Resistance to fire or burning time of material containing up to 1000 pounds of TNT is measured.

Drop Towers
Several towers up to 100 foot high equipped with hoisting and releasing mechanism for drop testing.

Demolition Ground
Remote 160 acres for detonation and destruction of up to 850 pounds of explosives.

Cloud Chamber
Controls moisture content at different temperatures (-30°C to +20°C) and produces rain in the same way that cold clouds do.

Sonobuoy Water Plane Antenna Range
Tests radio frequency over simulated ocean environment.

Mobile & Hand Launched Rocket Test Site
For firing tests.

Rocket Motor Test Stand
Up to 10,000 pounds of thrust available, in instrumented facility.
Electronics

Ecology and missile systems are tied together by one thing—Crane’s electronics competence.

Our competency derived from missile system work, transmitter fabrication helped the Forestry Service locate natural predators of gypsy moths.

Diverse programs require skills in solid state electronics.

Plain & Fancy

Fifteen different laboratories contain a myriad of equipment—both analog and digital. Fancy facilities include a scanning electron microscope for three dimensional analysis and a television monitored X-ray. Radio frequency free test, radiation, holographic and human visual systems performance laboratories are representative of unusual facilities.
A sign by electronic engineers leads to custom fabrication of specialized electronic equipment.

Systems Design - Mathematical models employing computer analysis eliminate guesswork in design decisions for printed circuitry, test equipment, and analog or digital systems.

Applied Research - State-of-the-art research for semiconductor reliability tests, and acoustical delay lines involves engineers.

Testing - Leading in devising electrical, chemical, mechanical/environmental tests for solid state components and monolithic, hybrid, MSI, and LSI microcircuits, our testing facilities cover all kinds of electronic devices and components. Controlling production of integrated circuits and transistor devices at manufacturer's plants is part of our total test program.

Instrumentation - Instrumenting a variety of tests, measuring, and controlling mechanical, electrical or chemical parameters requires adept personnel.

Failure Analysis - Distinguishing Crane from other activities, this engineering function isolates failure mechanisms or potential failures in a variety of electronic devices and parent systems. Improvements ensuring longer life and increasing operation reliabilities are direct benefits.

Product Development - Modules, electrooptical, and SONAR Systems are some of our product developments.
Aircraft Instruments And Equipment

Aircraft instrument performance greatly concerns our biggest customer—the Navy. That is why Crane has separate facilities for evaluating flight and engine instruments, navigation systems, avionics, and the associated ground support equipment. Preproduction and production sample testing, reliability and failure analysis are included in programs for Navy aircraft.

Test & Evaluation

Specialized facilities evaluate instrument lighting, fuel flow performance, and electromagnetic interference. Our laboratories include equipment for simulating aircraft environment, radio navigation aids (TACAN Beacon Simulator), pressure sensing systems, and precision altitude controls.

Predictable Performance

This adds up to safety assessment, reliability, and predictable performance of aircraft equipment under actual use.

Medical & Audio

Electronic medical instruments, audio equipment, and aircraft armament are evaluated in our facilities.
Rotating Components

Directional ability of Navy aircraft, ships, and missiles is crucial.

Unerring Accuracy

Comprehensive automated failure analysis at Crane leads to rework and redesign of servo mechanisms, motor tacs, gyroscopes, synchros, and resolvers for unerring directional accuracy.

Gyroscope Specialists

State-of-the-art research and development of gas bearing gyroscopes, infinite variable testing, and rework makes us gyroscope specialists. Program-controlled digital equipment tests gyroscopes and inertial equipment for exact directional ability.

Rate Tables

An ultra-precision air bearing rate table, part of inertial digital test system, is one of a few in the country. Precision rate tables capable of polar axis alignment are here, too.

Extending our horizons with rotating component failure analysis and redesign is another reason for Crane's success.

Computerized test system and precision rate tables give widest test and evaluation range, and greatest accuracy within the state-of-the-art.
Behavioral Sciences

Man's behavior in an environment, particularly an industrial environment, is observed in the Behavioral Sciences Laboratory. Major emphasis of the laboratory is precisely measuring human behavior patterns discovered through various psychological methodology.

Primate Laboratory

The instrumented laboratory has rodents, primates, or other animal subjects learning operant conditioning schedules in controlled experiments.

Multi Disciplined

The team approach, psychologists teamed with electronic, human factors, and mechanical engineers and other specialists, allows multi-discipline experiments and comprehensive analysis.

Stimulating

Physiological-psychological effects of drugs, alcohol, chemicals and pollutants; energy source effects and visual task efficiency can be studied in the laboratory.

Primate learns variable interval reinforcement schedule in anechoic chamber for microwave study.
Technology Transfer

Crane's capabilities involve the Navy, other Department of Defense, government and non-government agencies.

The illustrations at the top of this page visually represent a few Crane programs.

Bureau Of Mines

Human factors research in underground bituminous mining for the Department of Interior involved psychologists, electronic and mechanical engineers.

Public Health Service

Chemists analyzed drugs to determine deterioration in storage. Department of Health, Education and Welfare requested this study for civil defense information.

Forestry Service

Electronic engineers and technicians devised and produced transmitters for the Department of Interior.

Federal Aviation Administration

Computer simulation of a pilot's visibility range and runway detection abilities for the Department of Transportation ultimately ensures greater aircraft safety.

NASA

NASA spacecraft batteries undergo various test regimes with our computer controlled system. Spacecraft initiators undergo comprehensive testing in our modern explosive components test facility.

Indiana Department Of Correction

Mathematicians and operations researchers devised a computerized system of correctional information for the Department of Justice.

Federal Railroad Administration

Projects for the Department of Transportation concern human factors in railroad cab design and in railroad car vandalism.
You can choose the size community in which to live. Within commuting distance of Crane are towns like Loogootee - population 3,000 or Bloomington with over 70,000 students and permanent residents.

Crane employees enjoy a rustic setting with ready access to "big city" conveniences. Nearby Indiana University offers not only a wide range of educational programs but also brings in "Big Ten" sporting events and entertainment of various kinds. Additionally, water recreation, hunting, fishing, camping and golf may be pursued right on Station or in community and state park facilities.

All this, yet only hours away from the Indianapolis "500", the Kentucky Derby, St. Louis and Cincinnati baseball and football games.
Flipping through our brochure, you've discovered that we're more than an ammunition depot.

Special facilities make us highly diversified—covering a spectrum of modern technology.

There's a lot going on at Crane and you can be part of it.

FOR MORE INFORMATION ABOUT YOUR INVOLVEMENT talk to our interviewer when he visits your campus or write to:

Commanding Officer
Naval Ammunition Depot (Code 06)
Crane, Indiana 47522

NAD CRANE IS AN EQUAL OPPORTUNITY EMPLOYER.
CHIEFS TOWING SERVICE INC.

13008 Oakview Blvd, Garfield Hts, Ohio 44125

April 4, 1972

SUBJECT—Appointment of officers for the board of directors, due to the resignation of Vice-President and the Secretary-Treasurer.

As President I appoint as Vice-President ROBERT J. MARKS 2nd and as Secretary-Treasurer JOHN D. McKSON.

ROBERT J. MARKS

PRESIDENT
ARTICLE I

CODE OF REGULATIONS

1. Stockholders' meetings shall be held at the principal office or place of business of this Company in the State of Ohio.

2. The annual meeting of the stockholders of this Company shall be held at three o'clock in the afternoon on the first Monday in April of each year, beginning with the year 1971, at which time there shall be elected by the stockholders of the Company, by ballot, a board of three (3) directors for the ensuing year, and the stockholders shall transact such other business as shall properly come before them.

3. A notice setting out the time and place of such annual meeting shall be mailed postage prepaid, to each stockholder of record, at his address as the same appears on the stock book of the Company, or if no such address appears, at his last known place of address, at least thirty (30) days prior to the annual meeting.

4. If a quorum be not present at the annual meeting, the stockholders present in person or by proxy may adjourn to such future time as shall be agreed upon by them, and notice of such adjournment shall be mailed postage prepaid, to each stockholder at least thirty (30) days before such adjourned meeting; but if a quorum be present, they may adjourn from day to day as they see fit, and no notice of such adjournment need be given.

5. A majority of the stock issued and outstanding, either in person or by proxy, shall constitute a quorum for the transaction of business at any meeting of the stockholders.

6. Each stockholder shall be entitled to one (1) vote for each share of stock standing in his own name on the books of the Company, whether represented in person or by proxy.

7. All proxies shall be in writing and properly signed.

8. The following order of business shall be observed at all annual and special meetings of the stockholders so far as practicable, viz:

1. Calling the roll.
2. Reading, correction and approval of minutes of previous meeting.
3. Reports of officers.
4. Reports of committees.
5. Election of directors.
6. Unfinished business.

ARTICLE II

STOCK

1. Certificates of stock shall be in a form adopted by the board of directors and shall be signed by the president or vice-president and the treasurer, and be attested by the corporate seal.

2. All certificates shall be consecutively numbered. The name of the person owning the shares represented thereby, with the number of such shares and the date of issue, shall be entered on the Company's books.

3. All certificates of stock transferred by endorsement thereon shall be surrendered for cancellation and new certificates issued to the purchaser or assignee.

4. Shares of stock shall be transferred only on the books of the Company by the holder thereof in person or by his attorney.

ARTICLE III

DIRECTORS

1. A board of three (3) directors shall be chosen annually by the stockholders at their annual meeting, to manage the affairs of the Company. Their term of office shall be one (1) year.

2. Vacancies in the board of directors by reason of death, resignation or other causes shall be filled by the remaining directors choosing from among the stockholders a director to fill the unexpired term.

3. Regular meetings of the board of directors shall be held on the first Friday of each month, at the office of the Company in Ohio, or at such other time as the board of directors shall by resolution appoint. Special meetings may be called by the president, or any two directors by giving thirty (30) days' notice to each director.

4. The directors shall have the general management and control of the business and affairs of the Company and shall exercise all the powers that may
be exercised or performed by the corporation, under the statutes, the certificate of incorporation and the by-laws.

5. Each director shall receive one (1) dollar for attendance at any meeting of the board, and shall receive no other salary or compensation for his services as a director of the Company.

6. The board of directors of the corporation has the sole power to amend by unanimous consent the original articles of incorporation.

ARTICLE IV
OFFICERS

1. The officers of this Company shall consist of a president, ROBERT J. MARKS, of Garfield Heights, Ohio; a vice-president, KEVIN G. MASTAI, of Garfield Heights, Ohio; and a secretary and treasurer, WILLIAM A. PEIZ, of 24440 Miles Avenue, Bedford Heights, Ohio.

2. The president shall preside at all meetings of the directors and stockholders and shall have general charge of and control over the affairs of the corporation subject to the board of directors.

3. The vice president shall perform such duties as may be assigned to him by the board of directors. In case of the death, disability or absence of the president, he shall perform and be vested with all of the duties and powers of the president.

4. The secretary shall countersign all certificates of stock of the Company. He shall keep a record of the minutes of the proceedings of meetings of stockholders and directors, and shall give notice as required in these by-laws of all such meetings. He shall have custody of all books, records, and papers of the Company, except such as shall be in the charge of the treasurer, or of some other person authorized to have custody and possession thereof by a resolution of the board of directors.

5. The treasurer shall keep accounts of all moneys of the Company received or disbursed, and shall deposit all moneys and valuables in the name and the credit of the Company in such banks and depositaries as the board of directors shall designate. All checks for the payment of money shall be counter-
6. The salaries of all officers shall be fixed by the board of directors, and may be changed from time to time by a majority vote of the board.

7. Each of such officers shall serve for the term of one (1) year or until the next annual election.

ARTICLE V

SEAL

1. The corporate seal of this Company shall be a circular seal with the name of the corporation around the border and the year of incorporation in the center.

ARTICLE VI

AMENDMENTS

1. Any of these by-laws may be amended by majority vote of the stockholders at any annual meeting, or at any special meeting called for the purpose.

2. Holders of the common stock reserve the sole right to control the management of the corporation and all voting rights as specified in the by-laws of the corporation, and said right as to control of such corporation shall not be abridged by any subsequently enacted by-law.
# NAVAL AMMUNITION DEPOT, CRANE, INDIANA

Effective: 14 October 1973
E. O. 11739, Approved 10-03-73

## SALARY CHART

### ADMINISTRATIVE, TECHNICAL, NON PROFESSIONAL AND PROFESSIONAL ENTRANCE RATES WITHIN GRADE & WAITING PERIOD FOR STEP INCREASES ARE:

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DOLBY B NOISE REDUCTION UNIT

LDB 220: The LDB 220 Dolby B noise reduction unit may be used with any reel-to-reel or cassette tape recorder, and will produce up to 10dB reduction in high frequency noise and hiss. It may also be used with an FM tuner to deprocess Dolby B encoded broadcasts, and will give up to 10dB reduction in transmission hiss and high frequency interference.

Recordings may also be made of Dolby B encoded broadcasts without deprocessing, and the LDB 220 may then be used to deprocess the signal on playback to give a reduction in both the transmission noise and the tape hiss in one deprocessing operation.

The LDB 220 has two Dolby processors, switchable between record and playback functions, line inputs, record and playback calibration controls, Dolby calibration oscillator, multiplex filter (for use when deprocessing stereo FM), Dolby level meters, record level controls and a switchable 10dB attenuator to match the outputs of the LDB 220 to the amplifier being used. It is complete with interconnecting cables and calibration tape.

LDB 240: The LDB 240 is a four processor version of the LDB 220, and has independent record and playback processors. This enables recordings to be Dolby encoded and on a three-head recorder simultaneously decoded for monitoring purposes, so that the signal is monitored at all times in its non-processed form.

SPECIFICATIONS:

Output: RECORD: 580mV from 50 ohms source; minimum load 5 Kiloohms. PLAYBACK: 580mV from 5 Kiloohms source; minimum load 50 Kiloohms. Overload capacity record and replay +10dB.


Frequency Response: MPX filter "OUT", 20Hz to 15kHz±1dB; 15kHz to 20kHz±2dB. MPX filter "IN", 20Hz to 15kHz ±1dB; 19kHz-36dB. A low pass filter is permanently connected in both the "RECORD" and "PLAYBACK" modes operating at frequencies above 20kHz. It reduces considerably interference from switching frequency (38kHz) on stereo decoders and bias frequency (55 to 105kHz) from tape recorders in the "RECORD" mode. Insertion loss 38kHz-24dB Increasing to -50dB at 105kHz and above.

Channel Separation: Better than 50dB at 1kHz.

Signal/Noise Ratio: (including hum) Better than 70dB reference 580mV unweighted.

MINI STUDIO

The Lamb Laboratories mini studio consists of all the essentials to create top quality, professional stereo recordings. The complete outfit, which condenses down into three portable cases, contains the widely acclaimed Lamb/Revox high speed, two track tape recorder with built in monitor amplifiers, speakers, sel-sync, variable pitch control and separate remote control all designed to give studio performance with ease of operation. The mini studio, in addition, includes the Lamb Laboratories PML 420 four channel, two group mixer which incorporates separate input sensitivity, separate low, medium and high equalization, pan pots, echo send and return and limiters; features usually only found in a multi-thousand dollar studio console. Four Beyer microphones are also included to meet all recording needs. To complete the package are all the necessary jacked cable runs, plus a pair of Beyer DT100 studio monitor headphones, four collapsible microphone stands, two boom arms and absolutely everything else needed to handle any kind of recording session.
## PML 420 MIXER

The PML 420 is a four input, two output mixing unit designed to operate in conjunction with transportable stereo tape recorders such as the Revox A77. All input and output levels are controlled through slide faders, the output pair being positioned for independent or simultaneous operation.

The PML 420 contains all the essentials of a modern studio control desk. Each input channel incorporates input sensitivity preselection, separate low, mid and high frequency equalizers, panoramic potentiometers and echo send controls. Limiters may be switched into each output group and adjusted to the desired threshold and release time, either for special effects or to prevent overmodulation.

Other features include separate left and right echo return controls and illuminated VU meters registering the output level from each group. The PML 420 is designed for maximum ergonomic efficiency. The matt black fader panel will accept chinagraph labelling and may be used for extended durations without fatiguing hands or vision.

The unit accepts signals from low or high impedance microphones and from tuner or auxiliary tape sources at studio line level. Lamb Laboratories are able to advise customers regarding suitable microphones for particular applications.

### SPECIFICATIONS:

| Case Size: | 16½ x 14½ x 8½ |
| Channels: | Four, each incorporating mic sensitivity, high, medium and low frequency equalization, echo send, pan pot and channel fader controls; inputs on Cannon XLR 3 plugs. |
| Groups: | Two, each with echo return, group fader, limiter in/out adjustable threshold and release. Outputs via standard jack sockets. |
| Monitoring: | Two VU meters. |
| Faders: | Six calibrated linear faders fitted as standard. |
| Performance: | INPUTS: Unbalanced, switchable to line or variable from 50 K ohm to 1 K ohm: 500 microvolt to 1.2 volts sensitivity. OUTPUTS: +10 dB into 600 ohm. GAIN: 70 dB. REFERRED INPUT NOISE: 120 dBm (200 ohm source). DISTORTION: Less than 0.1% at normal levels. LIMITER RATIO: Approximately 12 to 1. LIMITER RISE TIME: 1 millisecond. LIMITER RELEASE TIME: Adjusted from 0.25 to 3 seconds. EQUALIZER: High:12 dB lift and cut at 10 kHz. Medium: 12 dB lift at 3 kHz. Low: 12 dB lift at 10 kHz. Low: 12 dB lift and cut at 60 Hz. |
| Power Requirements: | EXTERNAL SUPPLY: 200mA at 24V, ripple less than 0.5mV. Available from LPS10 Power Supply. |
| Accessories: | LPS10 Power Supply will provide 24V at less than 0.5mV ripple from 110V 60Hz supply. |
| Finish: | External case natural teak or matt black. Panel work in etched anodized aluminum, silver and black. |
| Uses: | Designed for location stereophonic recordings in conjunction with Revox A77 or similar type machine. can be used for reduction, over-dubbing with the use of the limiters, or 2 channel mono recording. |

### SEL-SYNC (MODIFICATION FOR REVOX A77)

The Sel-Sync modification enables track one of a previously recorded tape to be heard through the top section of the record head, thereby permitting a synchronized recording to be made on the lower section (track two). This system permits two consecutive tracks to be recorded, in full synchronization, without the extra noise inherent in track-to-track (second generation) recording.

### VARIABLE PITCH (MODIFICATION FOR REVOX A77)

The Variable Pitch modification is a continuous rotary control which enables any speed to be selected and held within a range of -10% to +15% of the chosen speed. Also permits a continuous slow sweep of speed within the same parameters. Uses include; correction to speed of tapes previously recorded off-speed, demonstration of the effects of pitch-change in music studies, controlled sweeping pitch-changes in electronic music, composing, etc. Removal of plug-in variable pitch control box restores the Revox A77 to normal operation.
SPECIAL ORDER UNITS
Modifications available for Revox A77 and A77 Dolby B tape recorders. Please use Revox Form RV51B price list. Choose desired unit and add to price...

<table>
<thead>
<tr>
<th>Modification</th>
<th>Price</th>
</tr>
</thead>
<tbody>
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<td>SEL-SYNC FOR DOLBY B</td>
<td>150.00</td>
</tr>
<tr>
<td>VARIABLE PITCH</td>
<td>75.00</td>
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</table>

The Sel-Sync modification enables track one of a previously recorded tape to be heard through the top section of the record head, thereby permitting a synchronized recording to be made on the lower section (track two). This system permits two consecutive tracks to be recorded, in full synchronization, without the extra noise inherent in track-to-track (second generation) recording.

The Variable Pitch modification is a continuous rotary control which enables any speed to be selected and held within a range of -10% to +15% of the chosen speed. Also permits a continuous slow sweep of speed within the same parameters. Uses include: correction to speed of tapes previously recorded off-speed, demonstration of the effects of pitch-change in music studies, controlled sweeping pitch-changes in electronic music, composing, etc. Removal of plug-in variable pitch control box restores the Revox A77 to normal operation.

<table>
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<tr>
<th>Model</th>
<th>Price</th>
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<tbody>
<tr>
<td>PML-420 MIXER</td>
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<tr>
<td>LPS-10 MIXER POWER SUPPLY</td>
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<td>LDB-220 TWO PROCESSOR DOLBY B NOISE REDUCTION UNIT</td>
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<td>LDB-240 FOUR PROCESSOR DOLBY B NOISE REDUCTION UNIT</td>
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<td>MINI STUDIO</td>
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April 10, 1973

Prices are subject to change without notice, especially on imported items where duties and currencies may fluctuate due to conditions beyond our control.

Our prices of all goods offered are those prevalent at time of delivery.

This listing supercedes all previous prices.

155 Michael Drive, Syosset, New York 11791 (516) 364-1900
3637 Cahuenga Blvd. West, Hollywood, California 90068 (213) 876-1200
The new salary schedule for graded employees was effective Oct. 13. The paychecks on the Nov. 1 payday will reflect the increase. Hourly rates for each step are shown in parentheses.

**GENERAL SCHEDULE PROVIDING COMPARABILITY WITH 1974 PRIVATE ENTERPRISE PAY**

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<td>11,486(504)</td>
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<td>11,994(534)</td>
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*The rate of basic pay for employees at these rates is limited by section 5308 of title 5 of the United States Code to the rate for level V of the Executive Schedule (currently $36,000).*
MEMORANDUM

From: 3041 (R. J. Marks)
To: 3041 (G. Allen)

Subj: Trip Report for the period of 2 Jun 1975 to 6 Jun 1975

Encl: (1) Verdin location and installation schedule

1. Activities Visited and persons contacted:

   a. Naval Electronics Laboratory Center (NELC), San Diego, CA

   b. Roger Dishong
      Herb Greenstein
      George Pillion
      Al Villereal
      G. Hudnall
      J. Richter
      Project Engineer
      Reliability Engineer
      Reliability Engineer
      Installations
      Verdin Shore Installation
      Program Manager

2. Purpose of visit:

   a. Review documents on the Verdin system for familiarization with
      operation and determination of past system effectiveness measures.

   b. Determine location of Verdin equipment in the fleet including
      installation schedules.

   c. Determine the extent of involvement of NELC in the Verdin effort
      and NELC's overall temperament in possible future consultation and support.

3. Discussion:

   a. Verdin related documents which were reviewed during the NELC visit
      along with relevant content are:

      (1) Preliminary Operational Instructions for Receiving Set Digital
          Data (U) AN/WRR7, NAVELEX 0976-462-3031.

      (2) Special Operational Instructions for Transmitting Set AN/

      (3) NELC Contract Specification VLF/LF Radio Receiving Set

          (a) Specified MTBF: \( \theta_0 = 1000 \text{ hrs.} \)
(b) Reliability via MIL-STD-785.

(c) Reliability prediction required via MIL-HDBK-217 at 65°
at Class IV environment.

(d) Maintainability program required via MIL-STD-470.

(e) Maintainability prediction required via MIL-HDBK-472.

(f) Reliability qualification: test plan V, level A of MIL-STD-78.

(g) Maintainability demonstration required: method III of
MIL-STD-471.

(h) Operating life = 10 years.

(i) Operational stability: must operate continuously for
a period of 24 hours without adjustment.

(4) Naval Air Systems Command: Specification for Radio Group
AN/ARA-1238B (AV) (24 Sep 1973).

(a) "... (a) VLF/LF digital data communication system
consisting of the transmitting set, digital data AN/ART-50 and a radio
receiving set AN/ARR# ... " for aircraft.

(b) Operating life = 50,000 hours.

(c) Specified MTBF including BIT electronics = 750 hours.

(d) BIT via AR 10.

(e) All equipment screening required via test plan II (reject
line) test level E (cycle limits of -10° to 50°C) of MIL-STD-781.

(f) Operational stability: must operate continuously for
1500 hours without adjustment.

(5) HELC: Contract Specification Fixed Plant Digital Data Transmitting
Set AN/URT 30 (U) ELEX-T848 (24 Sep 1973).
(a) Maintainability program from MIL-STD-470.

(b) Maintainability prediction from procedure II of MIL-HDBK 472.

(c) Total operating life = 10 years.

(d) Operational stability: Must operate 24 hours continuously without adjustment.

(e) Specified MTBF: $\theta_0 = 1000$ hours.

(f) Reliability prediction required via MIL-HDBK 217.

(g) Reliability Qualification via test level A, test plan V of MIL-STD-781.

(h) Reliability Sampling via test level A, test plan V of MIL-STD-781.

(i) Operational stability: Must operate continuously for 24 hours without control adjustment.

(6) Collins Radio Group: Verdin Field Failure (1 May 1975)

(a) This report, issued first in April 1975 and generated monthly, lists all Verdin equipment returned to Collins for repair.

(b) Also listed are failure trends and suggested corrective action.

(7) Collins Radio Group: Verdin first article tests and documents

(a) Introduction and Summary

(b) Environmental Test Report AN/WRR-7 Vols I and II.

(c) Environmental Test Report AN/ART-50 Vols I and II

(d) Performance Test Report AN/VRC-62 Vols I, II, III, and IV.

(e) Tempest Test Report AN/WRR-7

(f) Tempest Test Report AN/ART-50

All first article testing has been completed successfully.

(8) NELC: Shore Installation Planning Guide

(a) This document contains the best overview of Verdin vet
b. The Verdin system consists of a shore transmitter, an aircraft relay, and a ship receiver. For the most part, Verdin has been installed on all the SSBN (ballistic) submarines. Installation on shore and in Tacamo aircraft is scheduled for initiation in June of this year. A more detailed schedule is included in enclosure (1).

c. The reception of this activity by NELC by those involved directly with Verdin was for the most part formal. The reliability group at NELC, which was initially assigned TSA responsibility in the FRAP effort prior to travel restrictions, was most helpful to this activity during visitation. Ideas and thoughts concerning implementation of FRAP were shared freely and are discussed in section 4.

(1) NELC is extensively involved in the Verdin effort including participation in the following:

(a) Awarding and performance surveillance on the Trident radio room contract. At the time of visit the awarding of the contract to either ITT or RCA (to which the Collins Radio Group is subcontracted) was being determined.

(b) Verdin shore installation.

(c) Logistic support

(d) Design and production of Verdin software (Collins was unable to successfully fulfill this contractual area).

(e) Verdin first article test surveillance.

(f) NELC was also extensively involved in the early development of Verdin.

(2) NELC was initially assigned TSA responsibilities in the FRAP effort. Lack of travel however, prohibited their participation. This activity was informed that travel was again allowed at NELC almost immediately after cancellation of their TSA status, is still allowed, and is not expected to be restricted in the future.

4. Recommendations:

a. During the visitation, FRAP philosophy and ideas were discussed by Herb Greenstein and this activity. Mr. Greenstein has been involved in the area of reliability since its birth over twenty years ago and seems to mix well the statistical and physics aspects of reliability in his
engineering philosophy. He said he would have been involved extensively in the FRAP effort had NELC retained its TSA status.

b. Upon being told that FRAP might be collecting its own data from the fleet, Mr. Greenstein replied that this would largely be a duplication of effort with some of the many already existing governmental data collection effort. When told that the MDCS system had been determined inadequate as is for FRAP, he stated that most people, being only exposed to the MDCS data itself, did not appreciate the total capability of the MDCS data when coupled with the other available information. He suggested contacting Mr. J. Bell at Naval Ship Engineering Center at Norfolk for further information concerning MDCS capabilities.

c. Mr. Greenstein also offered other advice on execution of FRAP. Do not be overly concerned with exact data such as operating time per month or down times. Estimates suffice. Look, rather, for failure trends and other problems. The purpose of FRAP, he stated, is finding new system problems in the fleet in a timely manner, determining the physics of the failure or problem mode, and recommending timely corrective action. The purpose is not to measure exact MTBF's and generate lengthy reports.

R. J. MARKS II
<table>
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<tr>
<th>COMMSTA/BCA VERGIN INSTALLATIONS</th>
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<tr>
<td><strong>COMMSTA</strong></td>
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**NOTE**
CONSUBLANT, COMSUBPAC
AND USCOMEASTLAN
EACH GET 1 WRR-7 AND 1
FTS IN FFB 76 FOR NON
VERDIN BROADCAST

**LEGEND**

- <  BROADCAST EQUIP AVAILABILITY
- ▲  2 CHANNEL
- □  4 CHANNEL
- □  SYSTEM CHECKOUT
-  INSTL PERIOD

**25 APRIL 1976**
PROJECT: VERDIN

FUNDING: OPN-2 (ROT&E)

<table>
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A. PRODUCTION/INSTALLATION

1. FIRST BUY (FY 74)
   a. FIRST YEAR (FY 74)
   b. SECOND YEAR (FY 75)
      ARR 77 LTR CONTRACT
2. SECOND BUY (0152)
   a. FIRST YEAR (FY 74)
   b. SECOND YEAR (FY 75)
3. THIRD BUY (FY 76)
   a. FIRST YEAR
   b. 2ND INCREMENT (77)
   c. 3RD INCREMENT (77)
4. PLANNED CSFS PROCUREMENT
   a. CURRENT BUY (FY 73 & FY 74)
   b. FY 76 (2ND BUY)
   c. FY 77
5. AN/UYK-20

B. INITIAL DEPLOY COMPL

C. R-1590 MOD

STATUS
1. FUNDS  KG 38 28V DC POWER SUPPLY; PROVISIONING/SYSTEMS STOCK
2. SCHEDULE KG 38s; SHIP/SHORE INSTL; 3RD BUY.
3. TECHNICAL FTS RELIABILITY
4. SUPPORT SUPPLY SUPPORT

FUNDING
- FY 74 PRIOR - PROC SUM
- FY 75/76 - SPENDING PLAN
- FY 77 - FYDP
- FY 77 - FYDP/POM 77

SYMBOLS
- CONTRACT
- DLVRY/INSTALL
- CRITICAL EVENT

DATE OF REPORT: 25 APRIL 1975
## SECTION I - IDENTITY

### SHIP ALT BRIEF

**LF/HF COMMUNICATIONS**

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**SHIP ALTERATION**

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**APPROVAL**

- **SIGNATURE:**
- **DATE:**

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### PURPOSE

Provide flexibility and increased capability needed for communication on the VLF/LF bands.

### References:

See Page 3

---

### APPLICABLE SHIPS

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**DESCRIPTION PHYSICAL BOUNDARIES:** Describe the SHIPALT and area of the ship and compartment involved. Refer to separate documents as necessary.

**THIS DOCUMENT IS SUBJECT TO SPECIAL EXPORT CONTROLS AND EACH TRANSMIT TO FOREIGN GOVERNMENTS OR FOREIGN NATIONS MAY BE MADE ONLY WITH THE PRIOR APPROVAL OF THE COMMANDER, NAVAL SHIP SYSTEMS COMMAND, WASHINGTON, D.C. 20360.**

1. This alteration has been developed to define the LF/HF portion of the radio communications system installation required to support assigned missions of the CVA/CVS ship types. Other closely associated radio communications systems functional capabilities are defined in the following Ship Alterations:

   - SINGLE SIDEBAND COMMUNICATIONS - CVA-4355/CVS-801/CVAN-4356
   - UHF COMMUNICATIONS - CVA-4357/CVS-802/CVAN-4358
   - VHF COMMUNICATIONS - CVA-4361/CVS-804/CVAN-4362

   **THIS ALTERATION HAS BEEN ENTERED IN THE CSMP DO NOT RESUBMIT**

---

**SHIP ALTERATION RECORD**

NAVSIP 4720/4 (REV. 2-69) (Formerly NAVSHIPS 99)
SECTION I - IDENTITY

SHIPALT BRIEF

INSTALL VLF/LF/MF RECEIVE CAPABILITY

TYPE OF ALTERATION:
- TECH
- MIL

CIP - OPNAV INST 4720.xx

SIG. NO. 0132a
CAT./FUNCT 13000
CIP DATE 077
09 JAN 69

EIC NO. FF 0000 00

PURPOSE Provide VLF/LF/MF Radio Receiver Capability

DESCRIPTION/PHYSICAL BOUNDARIES (Describe the SHIPALT and area of the ship and compartment involved. Refer to scoping documents as necessary.)

Install in appropriate spaces the equipment listed in Section II Paragraph I to achieve Radio Receiving capabilities in the VLF/LF/MF frequencies. Install additional air conditioning and ventilation as necessary.

APPLICABLE SHIPS

GALVESTON CLG 3
LITTLE ROCK 4
OKLAHOMA CITY 5
PROVIDENCE 6
SPRINGFIELD 7
TOPEKA 8
UNCLASSIFIED

DEPARTMENT OF THE NAVY
NAVAL SHIP SYSTEMS COMMAND
WASHINGTON, D.C. 20360

SECTION 1 - IDENTITY

SHIP ALT BRIEF

| INSTALL AN/WRR-7 (VERDIN) RECEIVE SYS |

TYPE OF ALTERATION

- [X] TECH
- [ ] NIL

CIP-ORNAV INST

- 4720.XX

SIG. NO.

- 3860

CAT./FUNCTION

- 1300

CIP DATE

- 180769

SHIP ALTERATION

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EIC NO.

- QB11000

PURPOSE

To install an on-line multichannel VLF/LF communications system (Type "Q").

This alteration developed from Provisional Alteration A1491.

This alteration should be accomplished concurrently with SHIPALT SSN-1363, or subsequent there-to.

DESCRIPTION/PHYSICAL BOUNDARIES (Describe the SHIPALT and area of the ship and component involved. Refer to scope documents as necessary.)

EACH TRANSMITTAL OF THIS DOCUMENT OUTSIDE THE AGENCIES OF THE U.S. GOVERNMENT MUST HAVE PRIOR APPROVAL OF THE COMMANDER, NAVAL SHIP SYSTEMS COMMAND, WASHINGTON, D.C. 20360

1. The following items are to be installed in the Radio Room under this ShipAlt:

   a. R-1738/URR Receiver (replaces AN/BRR-3 receiver)

   b. 0-1612/URC Frequency and Time Standard (replaces AN/URQ-9 or AN/URQ-10)

   CONT'D ON PAGE 1A

THIS ALTERATION HAS BEEN ENTERED IN THE CSMP----DO NOT RESUBMIT CODE C K-5
**SECTION I - IDENTITY**

**SHIP ALTERATION RECORD**

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**CURRENTSHIP**

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</table>

**PURPOSE**

To install Verdin Receiver System (AN/WRR-7)

This ShipAlt developed from Provisional ShipAlt A1491.

**DESCRIPTION/PHYSICAL BOUNDARIES**

Each Transmittal of this document outside the agencies of the U.S. Government must have prior approval of the commander, Naval Ship Systems Command, Washington, D.C. 20360.

1. The VERDIN (AN/WRR-7) Receiver System is to be installed in the Radio Room on applicable submarines. VERDIN equipment consists of one R-1738/URR VLF/LF Receiver; one 0-1612/URC Frequency and Time Standard; one CP-1071/WR Processor and one MD-555/WRR-7 Demodulator-Power Supply in a CV-7113/WR Enclosure; two TSEC/KG-38 Key Generators; one 310275 Teletypewriter Power Supply; and one RA-8 Relay Panel with four R-91 Relays. (CONT'D ON PAGE 1A)

This alteration has been entered in the CSMP---do not resubmit code C

**APPLICABLE SHIPS**

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<td>575</td>
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SECTION I - IDENTITY

SHIPALT BRIEF

INSTL VERDIN (AN/WRR-7) REC SYS

TYPE OF ALTERATION

TECH

CIP

OPNAV

INSTR

4720.XX

CIP DATE

3 3 E

1 8 0 7 6 9

SHIP ALTERATION

TYPE

CIP

CLASS

6 3 7

NUMBER

6 7 1

1 5 4 7

EIC NO.

Q B 1 1 0 0 0

APPROVAL

SIGNATURE

/ s/ P. R. SACILOTTO

TITLE

DEP. LOC. MGR.

SHIPS 425

DATE (Mo, Da, Ye)

4/17/72

10/12/72

PURPOSE

To install VERDIN System (AN/WRR-7)

This alteration developed from Provisional Alteration A1491.

DESCRIPTION/PHYSICAL BOUNDARIES

Each transmitting office of this document outside the agencies of the U.S. Government must have prior approval of the commander, Naval Ship Systems Command, Washington, D.C. 20360.

(1) Install one VERDIN Receive System (AN/WRR-7) in the radio room as outlined below.

SSN637 Class Short Hull (Refer to Ref 13) (SSN 637-639), SSN 646-653, SSN660-670, SSN672-677)

A. Install (1 each) 0-1612 frequency and time standard and (1 each) CY 7113 Cabinet (containing the CONT'D ON PAGE 1A)

THIS ALTERATION HAS BEEN EXTENDED IN THE CSHM---DO NOT RESUBMIT CODE C

K-15
<table>
<thead>
<tr>
<th>Shore Stations</th>
<th>Verdin Schedule</th>
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<tbody>
<tr>
<td></td>
<td>AN/URT-30</td>
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<table>
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<tr>
<th>Location</th>
<th>Key/XMT</th>
<th>Dates</th>
</tr>
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<tr>
<td>1 NORVA (Training)</td>
<td></td>
<td>Jan 1975</td>
</tr>
<tr>
<td>1 Spare</td>
<td></td>
<td>Jan 1975</td>
</tr>
<tr>
<td>1 Spare/Support</td>
<td></td>
<td>Feb 1975</td>
</tr>
<tr>
<td>2 Cutler Key/XMT</td>
<td></td>
<td>Del Jul 1975, Inst Sep 1975</td>
</tr>
<tr>
<td>2 Holt Key/XMT</td>
<td></td>
<td>Del Oct 1975, Inst Nov 1975</td>
</tr>
<tr>
<td>2 Lualualei Key/XMT</td>
<td></td>
<td>Del Nov 1975, Inst Dec 1975</td>
</tr>
<tr>
<td>2 Annapolis Key/XMT</td>
<td></td>
<td>Del Nov 1975, Inst Dec 1975</td>
</tr>
<tr>
<td>2 Jim Creek Key/XMT</td>
<td></td>
<td>Del Dec 1975, Inst Jan 1976</td>
</tr>
<tr>
<td>2 Thurso Key/XMT</td>
<td></td>
<td>Del Jan 1976, Inst Feb 1976</td>
</tr>
<tr>
<td>2 Greece Key/XMT</td>
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<td>Del Feb 1976, Inst Mar 1976</td>
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<tr>
<td>2 Yosami XMT</td>
<td></td>
<td>Del Feb 1976, Inst Mar 1976</td>
</tr>
<tr>
<td>2 Yokosuka Key</td>
<td></td>
<td>Del Feb 1976, Inst Mar 1976</td>
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<tr>
<td>4 COMSUBLANT (WRR-7)</td>
<td></td>
<td>Inst Feb 1976</td>
</tr>
<tr>
<td>3 COMSUBPAC</td>
<td></td>
<td>Inst Feb 1976</td>
</tr>
<tr>
<td>2 USCOMEASTLANT</td>
<td></td>
<td>Inst Jun 1976</td>
</tr>
<tr>
<td>2 COMSUBGRU 7</td>
<td></td>
<td>Inst Jul 1976</td>
</tr>
<tr>
<td>2 COMSUBGRU 8</td>
<td></td>
<td>Inst Aug 1976</td>
</tr>
</tbody>
</table>

*NOTE: This enclosure not included in this edition.*

*Signature: 7/1/75*
CA.

GIST OF CONVERSATION

MA. IF. L.,

FROM R.

TO

PERSON CALLED (Name) DAVE ELY, B-ENGINEER, COLLINS RADIO, CA.

(Title) NWSC, CRANE IND.

,LOCATION)

REFERENCE (Serial, Contract, etc.)

ORIGIN

FROM CALL

TO

DURATION OF CALL

7/2/75

DATE

TELEPHONE CONVERSATION RECORD

This record will be used for both incoming and outgoing calls. The person originating an outgoing call or receiving an incoming call will sign the original.

AUTHORIZATION NO.

PERSON CALLED

(Name)

TITLE

(Dave Ely, B-Engineer)

LOCATION

(NWSC, Crane Ind.)

SUBJECT

VERDIN RELIABILITY

GIST OF CONVERSATION

MA. ELY WAS CONTACTED TO FURTHER

SHED LIGHT ON QUESTIONS 2 AND 3 OF

THE MARKS/SHAPLEIGH PHONE CON OF 7/1/75.

IN RESPONSE TO QUESTION 2, ELY

CONCURRED WITH THE SPEC,

THAT IS, THE FREQUENCY STANDARD

IS NOT ARR-77 RECEIVER EQUIPMENT.

AND IS THUS NOT EMPLOYED IN

COMPUTING THE ARR-77 RELIABILITY.

FREQUENCY STANDARDS ARE DESIGNATED

AS PART OF THE URT-30, WRA-7

AND ART-50. (THE ARR-77 NECESSITATES

THE USE OF A FREQUENCY STANDARD

HOWEVER, BUT EMPLOYS THE ART-50'S

STANDARD).

CONCERNING QUESTION 3 OF THE

REFERENCED PHONE CON, THE

ART-50 MODULATOR WRA, IS IN FACT

CONSIDERED URT-30 EQUIPMENT

WHEN USED ON THE SHORE AND

IS IDENTICAL TO THAT USED IN

THE AIRCRAFT, THUS, MIBF


TELEPHONE CONVERSATION RECORD

CONT
**GIST OF CONVERSATION**

**Computations Concerning the**

**URT-30 need include the**

**MTBF of the ART-50 (and the corresponding Modulator Shelves)**

To Mr. Ely's knowledge, no reliability requirements were ever specified for Verdin subsystems at the WRA level.

A reliability prediction, however, was generated quite some time back by Collins via MIL-HDBK-217A. An ambient temp of 50°C was used with a 15°C internal rise (giving total of 65°C). Some deviation from 217A was necessitated. For example, Collins uses non some non-standard connectors in Verdin which have been Navy approved. MIL-C-26482 was also used. The following predictions were arrived at.
### GIST OF CONVERSATION

<table>
<thead>
<tr>
<th>SUBSYSTEM</th>
<th>DESCRIPTION</th>
<th>MTBF PREDICTED</th>
<th>MTBF SPECIFIED</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARR-77</td>
<td>AIRBORNE RECEIVER</td>
<td>216</td>
<td>750</td>
</tr>
<tr>
<td>WRR-7</td>
<td>SHIPBOARD RECEIVER</td>
<td>345</td>
<td>1000</td>
</tr>
<tr>
<td>ART-50</td>
<td>AIRBORNE TRANSMITTER</td>
<td>164</td>
<td>750</td>
</tr>
<tr>
<td>URT-30</td>
<td>SHORE TRANSMITTER</td>
<td>514</td>
<td>1000</td>
</tr>
<tr>
<td>URC-62</td>
<td>VERDIN SYSTEM</td>
<td>64.2</td>
<td>214.3</td>
</tr>
</tbody>
</table>

The following are predicted failure rates (expressed in \(\text{per cent in } \frac{\text{1000 hrs}}{\text{1000 hrs}}\)) from which the above table was determined.

### EQUIPMENT

<table>
<thead>
<tr>
<th></th>
<th>AIRBORNE</th>
<th>SHIP</th>
<th>SHORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECEIVER</td>
<td>34.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DEMODULATOR</td>
<td>107.08</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PROCESSOR</td>
<td>262.97</td>
<td>126.53</td>
<td>96.51</td>
</tr>
<tr>
<td>*MTU</td>
<td>19.85</td>
<td>14.39</td>
<td>2.71</td>
</tr>
<tr>
<td>CONTROL UNIT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MODULATOR</td>
<td>104.76</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FREQ. STANDARD</td>
<td></td>
<td>36.44</td>
<td>27.31</td>
</tr>
<tr>
<td>MODULATOR SHELF</td>
<td>2.55</td>
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</tr>
</tbody>
</table>

**PROCESSOR/CONTROL UNIT/POWER SUPPLY ENCLOSURE**

**DOES NOT INCLUDE CAPACITOR, FAN, ETC**

*MAGNETIC TAPE UNIT*

**SIGNATURE**: P G 3 CONT
<table>
<thead>
<tr>
<th>SUBJECT</th>
<th>GIST OF CONVERSATION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DIOODES AND TRANSISTORS SCREENED WITH 5/1 APPROVALMENT FACTOR (NAVY APPROVED)</td>
</tr>
<tr>
<td></td>
<td>INCLUDES DEMODULATOR DRAWER FAILURE RATE AIRBORNE I.C.'S 0.1% FAILURE /1000 HRS</td>
</tr>
<tr>
<td></td>
<td>SHIP &quot; 0.57% &quot; &quot; &quot;</td>
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</tbody>
</table>

### Telephone Conversation Record

- **From:** ELY
- **To:** ELY
- **Date:** 7/2/75
- **Duration:**
  - Airborne Ship
  - Power Supply Shelf
  - Demodulator Drawer
  - Demodulator/PWR.
  - Power Supply Drawer
  - Modulator / PWR.
  - Power Supply (ATR)
  - Modulator - Sr.
  - Control Unit ATR
  - Proc/Pwr Supply
  - Control Equip Shelves

---

**Signature:**

---
TELEPHONE CONVERSATION RECORD

This record will be used for both incoming and outgoing calls. The person originating an outgoing call or receiving an incoming call will sign the original.

DATE
7/3/75

TELEPHONE CONVERSATION RECORD

MARKS

PERSON CALLED
ELY

SUBJECT

DUE TO THE NATURE OF THE METHOD IN WHICH THE SUBSYSTEM FAILURE RATES WERE OBTAINED (i.e., OVER THE PHONE), THEY SHOULD NOT BE TAKEN FOR GOSPEL TRUTH. THEY ARE ALL CONTAINED IN COLLIN’S RELIABILITY PREDICTION REPORTS WHICH WILL SOON BE OBTAINED BY THIS ACTIVITY.

ON PRESENT VERDIN STATUS, MR. ELY SAID NINE ALL MTU ON THE 0152 CONTRACT ARE NOW BEING SUBJECT TO AN APPROVED ECP. THEN (ONE FAILED A 100 SAMPLE HUMIDITY TEST). RETURNED MTU’S FROM THE 1507 CONTRACT ARE BEING CHECKED ALSO. THIS WILL BE DOCUMENTED IN THE MONTHLY FAILURE REPORT. ELY RECONFIRMED NWSC’S ADDITION TO THE MAILING LIST FOR THIS REPORT.

SIGNED:

TELEPHONE CONVERSATION RECORD

MARKS
**TELEPHONE CONVERSATION RECORD**

**DATE**: 7/1/75

**AUTHORIZATION NO.**

<table>
<thead>
<tr>
<th>FROM</th>
<th>TO</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOB MARKS</td>
<td>NWSC, CRANE IND</td>
</tr>
</tbody>
</table>

**PERSON CALLED**

<table>
<thead>
<tr>
<th>NAME</th>
<th>TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LARRY SHAPLEIGH</td>
<td>FLEX-4702, WASH</td>
</tr>
</tbody>
</table>

**SUBJECT**

**VERDIN CHARACTERIZATION**

**GIST OF CONVERSATION**

Mr. Shapleigh (731-202-0X.2-7526) is listed in the VERDIN ILSP as the Reliability Engineer ILSM Team Member for VERDIN. As such, some of the present categorization and reliability assessment concerning the VERDIN FRAP effort were posed. Questions asked and corresponding responses are as follows:

1. **How and when will the cesium frequency standards replace the rubidium standard? Are the reliability requirements for both cesium and rubidium standards equivalent?**

2. According to the Dick Kent/R. Saverese phone conversation of 3/12/75, the ARR-77

\[ \theta_c (ARR-77) = 1000 \text{ hrs and} \]

\[ \theta_c (FREQUENCY \text{ STANDARD}) = 2500 \text{ hrs} \]

Combining these gives

\[ \theta_c (ARR-77, FR. \text{ STANDARD}) = 750 \text{ hrs} \]
TELEPHONE CONVERSATION RECORD

This record will be used for both incoming and outgoing calls. The person originating an outgoing call or receiving an incoming call will sign the original.

DATE 7/1/75

AUTHORIZED NO. [Signature]

ORIGINATOR (Name) MARKS

PERSON CALLED (Name) SHAPLEIGH

[Signature]

DURATION OF CALL [Signature]

REFERENCE (Serial, Contract, etc.) [Signature]

SUBJECT

GIST OF CONVERSATION

THIS IS DIRECT CONFLICT WITH THE ARR-77 SPEC (#A5-12388, 24 Sept 73) WHICH STATES THAT G0 FOR THE ARR-77 "...THE UNDESIGNEATED AIRBORNE RECEIVER... AN ARR # ... RECEIVE TERMINAL " IS 750 HRS. YET THE FREQUENCY STANDARD IS NOT LISTED AS PART OF THE ARR-77 EQUIPMENT (IT IS LISTED AS PART OF THE ART-50 VERDIN SUBSYSTEM).

CAN YOU RESOLVE THIS DISCREPANCY?

3. ACCORDING TO THE ILS, THE ART-50 MODULATOR WRA IS USED IN THE SHORE SIGHT. THE COMPLETE ART-50 SYSTEM IS CONTAINED IN THE AIRCRAFT. WHAT THEN, IS THE MTBF OF THE ART-50 MODULATOR WRA?

ARE THE MTBF's OF THE ART-50 WRA'S SPECIFIED OR RATHER HAVE THEY BEEN ALLOCATED BY COLLINS?
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<tbody>
<tr>
<td></td>
<td>RESPONSES TO THESE QUESTIONS FROM SHAPEICH ARE AS FOLLOWS:</td>
</tr>
<tr>
<td></td>
<td>1. THE CESIUM FREQUENCY STANDARD WILL EVENTUALLY REPLACE ALL OF THE RUBIDIUM STANDARDS. WHEN MR. SHAPEICH DID NOT KNOW, THE R REQUIREMENTS ON THE CESIUM STANDARD, HE ALSO DID NOT KNOW.</td>
</tr>
<tr>
<td></td>
<td>2,3. MR. SHAPEICH DID NOT KNOW THE ANSWERS TO THESE QUESTIONS, SAW HE WOULD GET WITH BILL WALLACE AND TRY TO RESOLVE THEM (AS WELL AS THE REMAINING FREQ. STANDARD QUESTIONS).</td>
</tr>
</tbody>
</table>
TELEPHONE CONVERSATION RECORD

DATE: 7/1/75

ORIGINATOR (Name) | (Title) | (Location)
---|---|---
MARKS | | NWSC, CRANE, IN

PERSON CALLED (Name) | (Title) | (Location)
---|---|---
VILLERREAL | | NELC, SAN DIEGO

SUBJECT
VERDIN INSTALLATION STATUS

GIST OF CONVERSATION

MR. VILLERREAL (VAL) AT 714-225-7351 IS ASSOCIATED WITH LOGISTIC SUPPORT OF THE VERDIN SYSTEM AND IS THEREFORE KNOWLEDGEABLE OF VERDIN EQUIPMENT LOCATION AND INSTALLATION SCHEDULES. THE FOLLOWING, TO DATE INFORMATION WAS VOLUNTEERED BY MR. VILLERREAL:

1. ALL 55BN'S NOW ARE INSTALLED OR BEING INSTALLED WITH WRQ-7'S. WITH REFERENCE TO THE KENT/PETRECCA PHONE CON OF 3/13/75, THE 602 HAS HAD VERDIN INSTALLED AND THE 602 AND 608 ARE IN THE PROCESS OF HAVING VERDIN INSTALLED.

2. ALL TACAMO AIRCRAFT HAVE THE ART-50 INSTALLED. THE ARR-77 RECEIVER WON'T BE INSTALLED FOR QUITE SOME TIME.

3. THE VRT-30 TRANSMITTER INSTALLATION SCHEDULE IN 6/11/75 TRIP REPORT ENCLOSURE (MARKS TO NELC, 3041-RJM-5h 12340/2) HAS BEEN SUPERCEDED. THE SCHEDULE HAS BEEN MOVED BACK EXACTLY HOW MUCH, VAL DIDN'T KNOW.

SIGNED

TELEPHONE CONVERSATION RECORD
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<tr>
<td>DATE: 6/26/75</td>
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<th>REFERENCE (Serial, Contract, etc.)</th>
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<tr>
<td></td>
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<td>VERDIN TSA</td>
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<tr>
<th>ORIGINATOR (Name)</th>
<th>(Title)</th>
<th>(Location)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bob Marks</td>
<td>TSA ENG</td>
<td>NA D CRANE</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PERSON CALLED (Name)</th>
<th>(Title)</th>
<th>(Location)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dave Ely (EELEE)</td>
<td></td>
<td>NA D CRANE</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>SUBJECT: VERDIN SYSTEM CHARACTERIZATION AND FRAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>GIST OF CONVERSATION:</td>
</tr>
<tr>
<td>DAVID W. ELY (76) - 714-833-4899</td>
</tr>
<tr>
<td>Mr. Ely is the Project Engineer responsible for preparing monthly reports on VERDIN failures and analysis. Collins is the depot maintenance activity. Mr. Ely was told of the FRAP program, of which he was previously unaware, and of NAD CRANE's role as LFA and VERDIN TSA. He expressed extreme interest, and offered to help the VERDIN TSA effort in any reasonable manner. The as of yet unofficial visit to Collins by this activity was expressed. Mr. Ely said he would prepare and present any wanted VERDIN documentation desired and would want to further discuss FRAP's objectives and relationship with VERDIN. This activity will be sent the monthly reports. Mr. Ely prepares along with a documentary/picture description of VERDIN. The primary purpose of contacting Mr. Ely was to use his VERDIN expertise to resolve VERDIN system characterization.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SIGNATURE</th>
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<tbody>
<tr>
<td>CONT -&gt; Pg 1</td>
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</table>

TELEPHONE CONVERSATION RECORD
TELEPHONE CONVERSATION RECORD

This record will be used for both incoming and outgoing calls. The person originating an outgoing call or receiving an incoming call will sign the original.

DATE: 4/26/75

<table>
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<th>DURATION OF CALL</th>
<th>REFERENCE (Serial, Contract, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORIGINATOR</td>
<td>FROM</td>
<td>TO</td>
</tr>
<tr>
<td>PERSON CALLED</td>
<td>(Name)</td>
<td>(Title)</td>
</tr>
<tr>
<td>SUBJECT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

GIST OF CONVERSATION

PROBLEMS ENCOUNTERED BY THIS ACTIVITY IN WRITING THE VERDIN TSA IMPLEMENTATION PLAN. THE PROBLEM TURNED OUT TO BE THIS ACTIVITY'S CONFUSION BETWEEN VERDIN SUBSYSTEMS AND LOCATION SITES. WITH REFERENCE TO FIGS. 1-2, 1-3, AND 1-4 OF THE VERDIN ILS, EQUIPMENT DESIGNATED VERDIN IS AS FOLLOWS;

1. WRR-7 RECEIVER EQUIPMENT
   1. VLF/LF RECEIVER R-1738/WR
   2. PROCESSOR CP-1071/WR
   3. DEMODULATOR/POWER SUPPLY MD-855/WRR-7

B. AWR-77 AIRBORNE RECEIVER (UNDESIGNATED IN ILS)
   1. VLF RECEIVER & NOTCH FILTER
   2. PROCESSOR CP-1072/AR
   3. DEMODULATOR/POWER SUPPLY MD-1/AR PP6628/AR

C. ART-50 RELAY
   1. PROCESSOR CP-1072/AR MT-4368/AR
   2. CONTROL UNIT POWER SUPPLY C-4784/ART-50
   3. MODULATOR MO-856/ART-50 MT-4369/AR

SIGNATURE: [Signature]

TELEPHONE CONVERSATION RECORD
This record will be used for both incoming and outgoing calls. The person originating an outgoing call or receiving an incoming call will sign the original.

DATE: 6/26/75

TELEPHONE CONVERSATION RECORD

GIST OF CONVERSATION

Mr. Ely: The Verdin is only a short to ship link, not visa versa (a Verdin is not a two way communication system).
The frequency standard, included as Verdin equipment in each subsystem (C-1670 ship, C-1672 air) are rubidium vapor instead of cesium as previously reported in the Verdin TSA monthly report.

In summary, then, the four subsystems of Verdin (WR-7, AAR-17, ART-50 and URT-30) are essentially spread throughout the three site stations (shore, air, ship) with some WR-3A duplication.

THE WR-7 RECEIVER IN FIG 1.4 WISH NOT USUALLY BE USED AT SHORE SITES.
### TELEPHONE CONVERSATION RECORD

**Date:** 3/13/75

**Authorizations:**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
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<tbody>
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<tbody>
<tr>
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**Notes:**

- Status of SHIPALTS given in ILS Plan for VERDIN

Mr. Petrecca said going by SHIPALTS would be very difficult. However, he said he could give me the ships which had the WRR/7 Receiver installed. These are as follows:

a. Submarine Tenders AS-19, 31, 32, 33, 34.

b. All FBM submarines (SSBN's) except the 600, 602, 608 and these should have them by the end of this Fiscal Year.

I asked Mr. Petrecca if the ones installed was in a fully operational mode and being used as intended for the VERDIN System. He said he thought they were and reports were being received on them. He said he did not think they had the blessing of CINCLANT yet as they were more or less "shaking down" the receivers presently.

I also asked Mr. Petrecca if he had available the schedule for overhaul. He said yes but would hate to give specifics for more than one or two over the telephone. He suggested Mr. Fong set up a contact in NAVSEA for us to obtain this type of information as NAVSEA periodically publishes these and they are constantly changing. He said he thought this information was unclassified. He said he thought the reset schedule was classified. Reset pertaining to those worked on by tenders.

Mr. Petrecca asked how we got the ILS plan. I told him through NAVELEX 470.

---

**Signature:**

JAMES R. KENT
NADCRANE INSTRUCTION 11240.20A CHANGE TRANSMITTAL 2

From: Commanding Officer
To: Directors of all Departments


1. Purpose. To establish and clarify who has right-of-way at railroad crossings concerning railroad motor cars.

2. Action. Make the following pen and ink changes:

   Chapter 5, paragraph 5.c., change the last sentence to read, "Railroad equipment has the right-of-way, except that railroad motor-cars and attached track-cars shall yield right-of-way to highway traffic at crossing not protected by flasher signals. At crossings protected by flasher signals railroad motor-cars will have preference, provided the flasher signals are working."

3. Cancellation. This Change Transmittal is cancelled after the above change has been made.

   J. C. Domahs

Copy to:
A2 (Military Officers)
A3 (Division Managers)
AD Files
PWT (2000 copies)
AFGE-1415
AFGB-3072
CHAPTER IV
PRIVately OWNED VEHICLES

1. Identification

a. Privately owned vehicles entering the Depot shall display proper Depot vehicle identification in accordance with the requirements of current Depot Security Regulations.

b. Security Department will issue and affix Depot motor vehicle identification on presentation of proof of:
   (1) Employment by or attachment to the Depot.
   (2) Proper vehicle registration.
   (3) Adequate insurance coverage. ($5,000 Property Damage and $10,000/$20,000 Bodily Injury).
   (4) Vehicle is in sound mechanical condition.

c. Information must be updated annually on receipt of new license, change or renewal of insurance, or change of vehicle. Form 59D-RADC 5510/1 applies.

d. Depot motor vehicle identification decals will be removed and turned in to Security Department on sale of automobile or severance by RAD Crane.

2. Equipment

a. Vehicles shall have:
   (1) A jack and lug wrench.

b. School Bus. When meeting or overtaking a school bus which has stopped to load or unload school children, stop before you reach the bus. Do not proceed until the bus resumes its motion or until signaled ahead by the driver. Obey local laws on meeting and overtaking school buses.

c. Railroad Crossings. Do not pass within 100 feet of any railroad crossing. Do not pass vehicles stopped at crossings, including multilane highways. Railroad equipment has the right-of-way.

3. Parking

Parking is allowed in authorized parking areas only.

4. Trailers and Wagons

a. No more than two conveyances shall be drawn behind a motor vehicle.

b. When pulling two trailers, speed should be reduced by one-half to allow ample braking power and control.

5. Sentry Gates

When approaching a sentry gate, display personnel identification in plain view. Come to a complete stop and do not proceed until instructed to do so.

6. Securing Vehicles

Unattended Government motor vehicles shall be secured by:

a. Setting the hand brake.

b. Stopping the motor.

c. Turning off all electrical circuits.

d. Removing ignition keys and returning them to their authorized location. Ignition keys shall be left in vehicles temporarily parked within the Depot during normal working hours. Keys shall be

(2) A spare tire containing enough air to take the vehicle off the Depot.

(3) Enough fuel to assure departure from the Depot.

b. Oil flares and fusees are not permitted within the Depot.

c. No tools other than those listed above, or other articles or equipment, shall be carried in the vehicle unless they can readily be identified as not belonging to the Government, or are authorized by a Property Pass (NAVSAHA Form 155).

d. In emergency gas may be purchased from Security Department, Building 10. If the vehicle is out of gas, service may be obtained by calling phone 551. Purchases will be limited to $.10.00.

3. Accidents

a. General Procedures. When an accident occurs, the operator shall:

(1) Help the injured secure prompt medical care.

(2) Prevent additional accidents by placing flags and/or electric lanterns; by stationing traffic directors; by cleaning roadway, etc.

(3) Not smoke near the vehicles involved and warn others against smoking or other sources of ignition of gasoline which may be spilled. This is not only dangerous but is also a violation of Depot regulations.

b. Reporting

10. Traffic Violations

a. Security guards will issue Armed Forces Traffic Ticket, DD Form 1408, in triplicate for motor vehicle violations. The pink copy will be handed to the driver or put under the windshield wiper of an unattended vehicle. The original and duplicate copies will be forwarded to Security.

b. Security will forward the original of DD Form 1408, with recommendation for disciplinary action, to department directors.

c. Department Directors will review the circumstances and if in agreement with recommendations, complete "Report of Action Taken on Violations" space on DD Form 1408 and return to Security. If Department Director disagrees with recommendations the DD Form 1408, with his comments, will be forwarded to the Executive Officer for decision.

d. Security, on receipt of the report of action taken, will enter the violation and point assessment on operator's record and advise Public Works by memorandum of violations involving Government vehicles.

e. Civilian Personnel will send a copy of disciplinary actions to Public Works Licensing
(1) Operators shall promptly report accident to the Security Department, Extension 551.

(2) Accidents involving off-duty military personnel shall be reported in accordance with ODMJST 510.2A, Subj: Navy Traffic Safety Program for Off-Duty Military Personnel.

c. Security Department will investigate motor vehicle accidents. Investigators will prepare Standard Form 91A. If damage to Government property or personal injury is involved, Security Department will prepare a report for the Commanding Officer. A copy of Standard Form 91A will be sent to the Safety Department.

4. Wrecker Service. In case of an accident, Navy wreckers may be used to clear the highway so that traffic can continue. Private vehicles will be moved to the nearest convenient point which will not disturb traffic flow. Tow or wrecker service requiring less than one hour's work may be provided at the direction of the Transportation Division Manager. Service of more than one hour's work will be provided only by direction of the Public Works Officer, subject to collection of payment for services. In all cases, NADC 983, Claim Waiver Form shall be filled out by the owner and PW representative before towing service is performed.

18

CHAPTER V
TRAFFIC REGULATIONS

1. Regulations. Operators of motor vehicles on Depot Highways shall comply with applicable Indiana Motor Vehicle Laws and additional regulations as established by NADC Cranes.

2. Enforcement. The Security Department shall be responsible for the enforcement of Traffic Regulations on the Depot.

3. Speed Limit. Except where otherwise posted, speed limit on the Depot is 35 mph.

4. Emergency Vehicles. Emergency vehicles while sounding sirens and/or operating flashing red lights shall have the right-of-way. Do not pass them unless you are an official responding to an alarm. If you are meeting or are in front of them, pull to the right side of the road, stop, and wait for them to pass. Make sure there are no other fire trucks or emergency vehicles approaching before you pull back into the traffic lane. Do not follow emergency vehicles closer than 500 feet or park closer than 300 feet to fire equipment which has stopped in answer to a fire alarm.

5. Meeting and Passing.

a. Ammunition or Explosive Loaded Vehicles. When meeting explosive loaded trucks DO NOT STOP, but operate at a safe speed. Keep to the right of the center of the highway and proceed with caution in a direction parallel to the vehicle. DO NOT OVERTAKE AND PASS until there is ample safe operating space. Give an audible signal that can be heard by the driver before attempting to pass. DO NOT PASS on an icy, snow-covered, or otherwise hazardous road.

Examining for recording on Government Operator's Identification Card and in the driver's record.

11. Motor Vehicle Violation Point System. The point system is applicable to drivers of all vehicles on the Depot, and to operators of Government vehicles off the depot.

<table>
<thead>
<tr>
<th>Offense</th>
<th>Points Assessed</th>
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<tbody>
<tr>
<td>Driving under the influence of intoxicating liquor</td>
<td>12</td>
</tr>
<tr>
<td>Owner knowingly and willfully permitting another person under the influence of intoxicating liquor to operate his vehicle</td>
<td>12</td>
</tr>
<tr>
<td>Manslaughter, negligent homicide, or assault by an automobile</td>
<td>12</td>
</tr>
<tr>
<td>Intentionally leaving the scene of an accident involving death or personal injury without rendering aid or information</td>
<td>12</td>
</tr>
<tr>
<td>Using automobile to commit a felony</td>
<td>12</td>
</tr>
<tr>
<td>Operating a vehicle after suspension or revocation of the operator's permit or installation driving privilege</td>
<td>12</td>
</tr>
<tr>
<td>Reckless Driving. Moving violations other than those listed in which the driver is heedless of probable injury to the safety, the property or the rights of others. Two convictions in any 12-month period results in automatic suspension of installation driving privilege for 6 months.</td>
<td>5</td>
</tr>
</tbody>
</table>

Intentionally leaving the scene of an accident involving damage to property of another, without making identity known. 6

Speeding:

Up to 10 MPH over speed limit 2
11 - 15 MPH over speed limit 4
16 or more MPH over speed limit 6

Failure to obey traffic signs or signals, or instructions of traffic officer. 3

Knowingly operating an unsafe vehicle. 3

Other violations. 2

Failure to comply with installation registration requirements. 1

If the point assessment or accumulation is a total of 12 or more points, the operator's driving privilege on this Depot will be suspended for a fixed period of time not to exceed one year. Points assessed against an individual will remain in effect for a 24-month period. Expiration of a suspension period will, of itself, serve to cause removal of the record of all points assessed.
CONVERSATION RECORD

AUTHORIZATION NO. 117-00001000  DATE  3/12/75

ORIGINATOR (Name) James R. Kent

PERSON CALLED (Name) Mr. Rudolph Savarese, PME 117-222 (VERDIN Project Engineer) NELC Washington, D.C.

REFERENCE (Serial, Contract, etc.)

DURATION OF CALL FROM 304B TO NAD Crane, IN

SUBJECT Information on VERDIN System Required for Preparation of FRAP Program Plan

GIST OF CONVERSATION

Mr. Savarese confirmed the following: AN/ARR-7 shipboard receiver specified MTBF = 1000 hrs., AN/URT-30 Shore Transmitter specified MTBF = 1000 hrs., specified MTBF for Airborne Transmitter AN/ART-50 = 750 hrs., specified MTBR for Airborne equipment = .36 hrs., and specified MTTR for ship and shore based equipment = .62 hrs.

Mr. Savarese also stated that the undesignated airborne receiver has been now specified and is the AN/ARR-77 which has a specified MTBF by itself of approximately 1000 hrs. and the accompanying time and frequency standard has a specified MTBF = .500 hrs., (which gives a MTBF = 750 hrs. for the receiver and standard combined).

He also stated that the longest mission time for the aircraft would be 12 days, for the submarines the mission time would be 60 days, and the shore stations would have a continuous mission. He could not say what a typical mission time would be.

Mr. Savarese said that there were very few, if any of the shipboard receivers in the fully operational mode and doubted very much if any valid reliability assessment data could be obtained.

He said that there were 30 usable receivers on nuclear submarines, 4 on tenders and 4 at training sites. (The integrated logistic support (ILS) plan for VERDIN of 9 Aug 1974 indicates 57 to have been allocated to nuclear submarines, 6 to tenders, and 5 to training sites in March 1975 but all may not have been installed). However, he stressed these are not presently being used as intended.

Mr. Savarese said there were no AN/URT-30 Transmitter in fleet use but there were four at training sites, 3 at submarine training sites and 1 at Pax River (The ILS Plan indicates there are 2 scheduled for shore stations in Sept 1975).

He also stated that 18 of the AN/ART-50 Airborne Transmitter were on board aircraft
**TELEPHONE CONVERSATION RECORD**

**ORIGINATOR**
James R. Kent

**PERSON CALLED**
Mr. Radolph Savarese, PME 117-222 (VERDIN Project Engineer) NELC Washington, D.C.

**SITUATION**
Information on VERDIN System Required for Preparation of FRAP Program Plan

**GIST OF CONVERSATION**

and one at Pax River for training. (The ILS plan indicates only 10 scheduled for aircraft up through Sept 1975). He thought we should concentrate our FRAP efforts on the receiver as it is fully operational.

Mr. Savarese said it would be another year until the airborne receiver, the AN/ARR-77, would be out.
**TRAVEL VOUCHER OR SUBVOUCHER**

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<th>DO. VOUCHER NO.</th>
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<td>TDY/TAD TRAVEL</td>
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**TRAVEL PAYMENTS OR ADVANCES UNDER THESE ORDERS**

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**Mailing Address**

Crane, IN

**ITINERARY**

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<th>NUMBER MEALS USED</th>
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**CHARGES - BOO OR NON-GOVT MEALS AND QTS**

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**LEAVE STATEMENT**

I was authorized ___ days leave, ___ days were taken between ___ and ___.

I hereby claim any amount due me. The statements on face, reverse, and attached are true and complete. Payment or credit has not been received.

**SIGNATURE OF CLAIMANT AND DATE**

ROBERT J. MARX, II

**APPROPRIATION SYMBOL AND SUBHEAD**

| 1704912.2463 | 7117 | 0000104 | 2E | TO-0300 | 000190110535 | 218.54 |

**COMPUTED BY**

1 JUL 65

**AMOUNT PAID**

48.54

**FORM APPROVED BY COMP. GEN., U.S. APRIL 28, 1972**
CLAIMANT'S STATEMENTS

I have included herein all travel and transportation used on leave, delay en route or travel to home or permanent station for personal reasons. If travel by POV was authorized as more advantageous to the Government, I, as owner or operator of the vehicle, was primarily responsible for payment of its operating expenses.

I have not included travel, transportation and/or TDY for which I have received pay or credit from any other agency of the U.S., foreign government, or the United Nations, except as jointly authorized by the secretaries concerned.

I actually performed the travel herein. Government quarters and Government mess were not utilized except as indicated.

PENALTY

The penalty for willfully making a false claim is: A maximum fine of $10,000 or maximum imprisonment of 5 years, or both. (U.S. Code, Title 18, section 287, formerly section 80.)

REQUIRED ATTACHMENTS

1. Original and/or copies of travel orders and amendments as instructed.
2. Traveler's copy of each transportation request (SF 1169B) used.
3. All receipts from transportation officer for unused transportation requests, carriers' tickets, and meal tickets.
4. Receipts from carriers if cost of transportation is claimed.
5. Charge letters for transportation requests received en route.
6. Statements of nonavailability (quarters, mess and directed mode of transportation).

SYMBOLS

MEANS (Mode) OF TRAVEL

FIRST LETTER
1. TRNSPN REQ.................. T
2. GOVT TRNSPN............. G
3. COML TRNSPN............. C
4. PRIVATE VEHICLE........ P

SECOND LETTER
1. AUTO.................A
2. BUS..B
3. PLANE..P
4. VESSEL..V

REASONS FOR STOPS

10. AWAITING TRNSPN............ AT
11. CHANGE MODE OF TRNSPN...... CM
12. CREW REST............... CR
13. DISCH CARGO (passengers)..... DC
14. LEAVE/Delay EN ROUTE........ LV
15. MAINTENANCE (refuel)........ MA

TYPE OF CHARGES

22. BACHELOR OFFICER'S QTS..... BOQ
23. NON-GOV'T MEALS.............. NGM
24. NON-GOVERNMENT QTS......... NGQ

DEFINITION (This definition pertains to military personnel only)

NON-GOVERNMENT QUARTERS AND MEALS

Meals and quarters furnished (with or without charge) incident to temporary duty by: (1) Local or State governments; (2) Foreign governments; (3) Other U.S. Government agencies, (4) U.S. Government contractors; or (5) Private organizations such as the National Red Cross during disasters.

REMARKS

VII. APPROVED FOR PAYMENT (When required by individual service regulations)

DATE

SIGNATURE OF AUTHORIZED APPROVING/CERTIFYING OFFICER
Thank you.
### Rental Agreement

**Rental Agreement No.** 93441

**Customer Information**

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</tr>
<tr>
<td>Lessor</td>
<td>AIRWAYS RENT-A-CAR SYSTEM, INC.</td>
</tr>
<tr>
<td>Lessor Address</td>
<td>2677 N. HOLLYWOOD WAY, BUR. (714) 845-2681</td>
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<tr>
<td>Lessor Phone</td>
<td>(714) 991-9533</td>
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**Due Back Date**

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**Car Charges**

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**Payment**

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**Conditions**

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<td>Personal Accident Insurance</td>
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<td>InterCity Charge</td>
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**Vehicle Condition Information**

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**Credit Card Identification**

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**Acknowledgement**

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<thead>
<tr>
<th>Field</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer</td>
<td></td>
</tr>
<tr>
<td>Signature</td>
<td></td>
</tr>
</tbody>
</table>

**Rental Agreement**

**Authorized To Drive**

<table>
<thead>
<tr>
<th>Field</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>Authorized To Drive In Originating State Only</td>
<td>Airways</td>
</tr>
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</table>

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1988 AIRWAYS RENT-A-CAR SYSTEM, INC.
TRAVEL AUTHORIZATION REQUEST

Robert J. Marks II  
Electronics Engineer GS-9

HOME ADDRESS (If rural, include directions, when G/V is requested to and from Air Terminal)
3111 Leonard Springs Road
Apr. 162
Bloomington, IN 47401

TO 011A VIA (1) 3041 (2) 3041 (3) 304 (4) 30 DATE

ACTIVITIES TO BE VISITED AND PERSONNEL TO CONTACT REPORT HOUR AND DATE COMPLETE
EDMAC Associates, Inc. 0800 28 May 1975 1200 30 May 1975
333 W. Commercial Street
East Rochester, New York 14445

PURPOSE OF VISIT
(see attached)

DESIRED MODE OF TRANSPORTATION

X AIR □ RAIL □ BUS □ POV □ G/V □ TO AND FROM COMMERCIAL CARRIER □ G/V □ □ POV

X RENTAL CAR AT TDY STATION (Justification if required) Previous experience dictates the necessity of a rental car for transportation to and from contractor facilities.

WILL YOU PROVIDE POV TRANSPORTATION FOR OTHERS YES NO □
WILL YOU ACCOMPANY OTHERS IN POV X □
TAD CONNECTED LEAVE IS REQUESTED FOR DAYS 0
EXCESS BAGGAGE (Government owned material) POUNDS ONE WAY □ ROUND TRIP
CLEARANCE REQUIRED □ SECRET □ CONFIDENTIAL □ NONE

IF REQUIRED FORWARD TO (Activity and address)

REMARKS (Continue on reverse side if necessary)
1. Contractor controlled travel.
2. Traveler requests departure from Indianapolis on AL Flight 524 at 1820 connecting to AL Flight 814 in Buffalo on 27 May 1975.
3. Traveler requests departure from Rochester on AL Flight 441 at 1336 connecting to AL Flight 837 in Pittsburg on 30 May 1975.
Purpose of visit:

NAVAIR contracts require contractor to demonstrate that Avionic equipment designed and manufactured by them are capable of meeting the requirements of the contract and/or equipment specification with a specified minimum reliability. Details of the reliability demonstration tests to be performed by contractor are detailed in the reliability test procedures which were previously submitted to Crane for approval for use in conducting these tests. NAD Crane Code 3041 is assigned technical cognizance of production reliability acceptance test programs for Avionics System being procured by NAVAIRSYSCOM.

The purpose of this trip is to audit contractor's test facility, witness initiation of reliability testing and resolve any discrepancies in conducting these tests. Contract N00019-74-C-0539 is for the acquisition and testing of the ARR-75 sonobuoy receiver, Engineering Support Control C112.175.
### TRAVEL VOUCHER OF SUBVOUCHER

(Complete with ink, ball-point pen or typewriter. DO NOT use lead pencil.)

<table>
<thead>
<tr>
<th>NO.</th>
<th>PAYMENT FOR</th>
<th>PAYMENT L.</th>
<th>SUBVOUCHER No.</th>
<th>DO. VOUCHER No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>19716</td>
<td>TMD/AIR PER DIEM</td>
<td>TED/VAD TRAVEL</td>
<td>PCS TRAVEL</td>
<td>X</td>
</tr>
<tr>
<td>TMD/AIR PER DIEM</td>
<td>TED/VAD TRAVEL</td>
<td>PCS TRAVEL</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

**TRAVEL VOUCHER NO.**

NO016475TO-02977, 3/18/75, NAD Crane, IN

**PAYMENT FOR**

Prior Travel Payments or Advances Under These Orders (Amount, DO Voucher No., date received, placed paid, or Do Station No. If used as O.P.):

<table>
<thead>
<tr>
<th>Date</th>
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**FOOTNOTE:**

Do not use lead pencil.

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<td>ORDER</td>
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**FOOTNOTE:**

Do not use lead pencil.
I have included herein all travel and transportation used on leave, delay en route or travel to home or permanent station for personal reasons. If travel by POV was authorized as more advantageous to the Government, I, as owner or operator of the vehicle, was primarily responsible for payment of its operating expenses.

I have not included travel, transportation and/or TDY for which I have received pay or credit from any other agency of the U.S., foreign government, or the United Nations, except as jointly authorized by the secretaries concerned.

I actually performed the travel herein. Government quarters and Government mess were not utilized except as indicated.

**PENALTY**

The penalty for willfully making a false claim is: A maximum fine of $10,000 or maximum imprisonment of 5 years, or both. (U.S. Code, Title 18, section 287, formerly section 80.)

**REQUIRED ATTACHMENTS**

1. Original and/or copies of travel orders and amendments as instructed.
2. Traveler's copy of each transportation request (SF 116B) used.
3. All receipts from transportation officer for unused transportation requests, carriers' tickets, and meal tickets.
4. Receipts from carriers if cost of transportation is claimed.
5. Charge letters for transportation requests received en route.
6. Statements of nonavailability (quarters, mess and directed mode of transportation).

**SYMBOLS**

<table>
<thead>
<tr>
<th>FIRST LETTER</th>
<th>SECOND LETTER</th>
<th>REASONS FOR STOPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. TRNSPN REQ</td>
<td>T</td>
<td>10. AWAITING TRNSPN</td>
</tr>
<tr>
<td>2. GOVT TRNSPN</td>
<td>G</td>
<td>11. CHANGE MODE OF TRNSPN</td>
</tr>
<tr>
<td>3. CMPL TRNSPN (own expense)</td>
<td>C</td>
<td>12. CREW/REST</td>
</tr>
<tr>
<td>4. PRIVATE VEHICLE</td>
<td>P</td>
<td>13. DISCH CARGO (passengers)</td>
</tr>
<tr>
<td>5. AUTO</td>
<td>A</td>
<td>14. LEAVE/DELAY EN ROUTE</td>
</tr>
<tr>
<td>6. BUS</td>
<td>B</td>
<td>15. MAINTENANCE (refuel)</td>
</tr>
<tr>
<td>7. PLANE</td>
<td>P</td>
<td>16. MISSION COMPLETE</td>
</tr>
<tr>
<td>8. RAIL</td>
<td>R</td>
<td>17. MECHANICAL DIFFICULTY</td>
</tr>
<tr>
<td>9. VESSEL</td>
<td>V</td>
<td>18. PICKUP CARGO (passengers)</td>
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<tr>
<td></td>
<td></td>
<td>19. REMAIN OVERNIGHT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>20. TEMPORARY DUTY</td>
</tr>
<tr>
<td></td>
<td></td>
<td>21. WEATHER ADVERSE</td>
</tr>
</tbody>
</table>

**TYPE OF CHARGES**

22. BACHELOR OFFICER'S QTS BOQ
23. NON-GOVERNMENT MEALS NGM
24. NON-GOVERNMENT QTS NGQ

**DEFINITION** *(This definition pertains to military personnel only)*

NON-GOVERNMENT QUARTERS AND MEALS

Meals and quarters furnished *(with or without charge)* incident to temporary duty by: (1) Local or State governments; (2) Foreign governments; (3) Other U.S. Government agencies; (4) U.S. Government contractors; or (5) Private organizations such as the National Red Cross during disasters.

**REMARKS**

**VII. APPROVED FOR PAYMENT** *(When required by individual service regulations)*

<table>
<thead>
<tr>
<th>DATE</th>
<th>SIGNATURE OF AUTHORIZED APPROVING/CERTIFYING OFFICER</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

U.S. GOVERNMENT PRINTING OFFICE: 1973 -- 526 - 063

A-4024
# Request and Authorization for TDY Travel of DoD Personnel

**Reference:** Joint Travel Regulations  
Travel Authorized as Indicated in Items 2 through 21.

## Request for Official Travel

### 1. Date of Request

**18 Mar 1975**

### 2. Name (Last, First, Middle Initial)

**MARKS, Robert J., II**

### 3. Position Title and Grade or Rating

**Elec. Engr.**

### 4. Official Station

**NAD Crane, IN**

Bldg. 38, Code 304B

### 5. Official Station

**TDY Single**

### 6. Purpose of TDY

1. Audit contractor's test facility, witness initiation of reliability testing and resolve any discrepancies.  
2. Investigate in-house failure reports, discuss failures encountered and witness reliability testing currently in progress.

### 7. Itinerary

From:  

- NAD Crane, IN
- 3111 Leonard Springs Road
- Bloomington, IN 47401

To:  

- Microcon Corporation
- 1115 Mears Road, Harminter, PA 18974
- AEL-ENTECH
- PO Box 507, Lansdale, PA 19446

(mode) 

- (and return)

### 8. Mode of Transportation

- RAIL
- AIR
- GOVERNMENT
- PRIVATELY OWNED CONVEYANCE

### 9. Rate Per Mile

- **12¢**

**MILEAGE REIMBURSEMENT AND PER DIEM LIMITED TO CONSTRUCTIVE COST OF COMMON CARRIER TRANSPORTATION & RELATED PER DIEM AS DETERMINED IN JTR, TRAVEL TIME LIMITED AS INDICATED IN JTR.**

### 10. Other Rate of Per Diem

- **$87.50**
- **$195.00**
- **$282.50**

### 11. Remarks

- Authorized to drive POV to Indpls airport and return.

- Authorized to drive GSA comm/lease (compact) car from Philadelphia to destinations and return. Vehicle authorized for official travel only. DIRECTED TO PAY CASH FOR RENTAL OF CAR.

### Receiving Official (Title and Signature)

**S. S. Kalberer, Acting Director, WOEQ**

### Approving Official (Title and Signature)

**Richard L. McGarvey, Dir., Adm. Dept.**

### Authorization

<table>
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<td>000164</td>
<td>2E</td>
<td>TO-02977</td>
<td>0019010110115</td>
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</tbody>
</table>

### Date Issued

**3/19/75**
3/19/75: TC, NAD Crane, Ind., arranged transportation from Indianapolis, Indiana to Philadelphia, Pa. (and return), VIA: REG FARE Y/TW(PHL); S/AL(IND). 1 jet-mixed cl incl coach/std air furnished, est. cost $120.73. Issued against T/R #T-0994218.

V. L. GREEN
Travel Clerk

DO: NAD CRANE, INDIANA 47522
NIF NO. 6913 DTD 3/20/75
PD ADVANCE PER DIEM 4/9.9
PD REGISTRATION FEE
T. BECKMAN 5132

TOTAL PAID 164.11
T. BECKMAN 5132
TRAVEL AUTHORIZATION REQUEST
9ND-NADC 4650/1(Rev. 7/74)

FROM (Name of Traveler)  | TITLE AND GRADE  | SOCIAL SECURITY NO.
---------------------------------|------------------|---------------------
J. Marks II  | Electronics Engineer  | [Redacted]  

HOME ADDRESS (If rural, include directions, when G/V is requested to and from Air Terminal):  
Apt. 162  
3111 Leonard Springs Road  
Bloomington, IN 47401

OFFICE PHONE  
854-1299

BLDG  
38  
CODE  
304B

HOME PHONE  
332-3892

TO  
(1) 011A  
VIA  
(2) 304  
(3) 3041  
(4)  
DATE  
14 Mar 1975

TRAVEL ORDERS ARE REQUESTED AS FOLLOWS

<table>
<thead>
<tr>
<th>ACTIVITIES TO BE VISITED AND PERSONNEL TO CONTACT</th>
<th>HOUR AND DATE REPORT</th>
<th>COMPLETE</th>
</tr>
</thead>
</table>
| Microcon Corporation  
1115 Mearns Road  
Warminster, PA 18974  
25 Mar 75  
1300  
1200 |
| AEL-EMTECH  
P. O. Box 507  
Lansdale, PA 19446  
27 Mar 75  
1200  
1730 |

PURPOSE OF VISIT

Attached

DESired MODE OF TRANSPORTATION

<table>
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<tr>
<th>AIR</th>
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RENTAL CAR AT TDY STATION (Justification if required)  
Previous experience dictates the necessity of a rental car for transportation to and from contractor facilities.

WILL YOU PROVIDE POV TRANSPORTATION FOR OTHERS  
YES  
NO

ADVANCE OF FUNDS  
YES  
NO  
X MAX

WILL YOU ACCOMPANY OTHERS IN POV  
YES  
NO  
X

TAD CONNECTED LEAVE IS REQUESTED FOR  
DAYS

EXCESS BAGGAGE (Government owned material)  
POUNDS  
ONE WAY  
ROUND TRIP

CLEARANCE REQUIRED

SECRET  
CONFIDENTIAL  
NONE

IF REQUIRED FORWARD TO (Activity and address)  
Send 6 month clearance to above addresses

REMARKS (Continue on reverse side if necessary)

1. Contractor controlled travel.
2. Traveler requests departure from Indianapolis on TWA Flight 266 on 25 Mar 75, and departure from Philadelphia on TWA Flight 961 on 28 Mar 75.

SIGNATURE (Department Director)  
Robert J. Marks II

SIGNATURE (Traveler)  
[Redacted]
1. MICROCOM

NAVAIR contracts require contractor to demonstrate that Avionic equipment designed and manufactured by them are capable of meeting the requirements of the contract and/or equipment specification with a specified minimum reliability. Details of the reliability demonstration tests to be performed by the contractor are detailed in the reliability test procedures which were previously submitted by them and approved by Crane for use in conducting these tests. The following travel is in support of NAVAIR AIRTASK A5335331/1592/50050000002. NAD Crane Code 3041 is assigned technical cognizance of production reliability acceptance test programs for Avionics System being procured by NAVAIRSYS.

The purpose of this trip is to audit contractor's test facility, witness initiation of reliability testing and resolve any discrepancies in conducting these tests. This Contract N00019-74-C-0106 is for the acquisition and testing of DKT-30 transmitting sets, Engineering Support Control C112.140.

2. AEL-EMTECH

NAVAIR Contract N00019-74-C-0135 is for the acquisition and testing of the AN/ARR-75 sonobuoy receiver. Engineering Support Control C112-158 assigned this activity responsibility for performing production reliability surveillance on this contract.

The purpose of this trip is to further investigate in-house failure reports, discuss failures encountered and witness reliability testing currently in progress.
Paid for 2 nights:
3/25 + 3/26

Paid 3/27
RECEIVED AND AUTHORIZATION FOR TDY TRAVEL OF DOD PERSONNEL

(Reference: Joint Travel Regulations)

Travel Authorized as Indicated in Items 2 through 21.

REQUEST FOR OFFICIAL TRAVEL

1. NAME (Last, First, Middle Initial)
   MARKS, Robert J., II

2. OFFICIAL STATION
   NAD Crane, IN
       Bldg. 38, Code 304B

3. POSITION TITLE AND GRADE OR RATING
   Elect. Engr.

4. ORGANIZATIONAL ELEMENT
   Weapons Quality Engr. Center Plans & Programs Div.

5. PHONE NO.
   1299

6. PURPOSE OF TDY
   1. NAVAIR Contract N00019-74-C-0135 for the acquisition of AN/ARR-75 Sonobuoy Receiver Set Work Unit Assignment C112.158. 2. Review and discuss Reliability Qualification and Sampling Test Procedures.

7. TYPE OF ORDERS
   3

8. CODE OF TDY (Including travel time)
   3 days

9. APPROX. NO. OF DAYS OF TDY (Including travel time)
   3 Mar 1975

10. ITINERARY
    From: NAD Crane, IN
        or
        Apt. 162
        311 Leonard Springs Rd.
        Bloomington, IN 47401

    To: AEL-EMTECH, P.O. Box 507
        Lansdale, PA 19446
        Microcon Corporation, 1115 Mearns Road
        Warminster, PA 18974

11. ITINERARY
    12. MODE OF TRANSPORTATION
        COMMERCIAL

        GOVERNMENT

        PRIVATELY OWNED CONVEYANCE (Check one)

        RAIL
        AIR
        BUS
        SHIP

        RAIL
        AIR
        BUS
        SHIP

        RATE PER MILE:
        $12

        13. OTHER RATE OF PER DIEM (Specify)

        14. ESTIMATED COST
            PER DIEM
            TRAVEL
            OTHER
            TOTAL
            $62.50
            $175.00
            $237.50

        15. ADVANCE AUTHORIZED
            $95.00

        16. REMARKS (Use this space for special requirements, leave, superior or 1st-class accommodations, excess baggage, registration fees, etc.)
            Authorized to drive POV to Indpls airport and return.

            Authorized to drive GSA comm/lease (compact) car from Philadelphia to destinations and return. Vehicle authorized for official travel only. DIRECTED TO PAY CASH FOR RENTAL OF CAR.

17. REQUESTING OFFICIAL (Rate and signature)
    RICHARD L. McGARVEY, Dir., Adm. Dept.

18. APPROVING OFFICIAL (Rate and signature)
    RICHARD L. McGARVEY, Dir., Adm. Dept., By direction

authorized

19. SECURITY CLEARANCE

20. PURPOSE OF TRAVEL

21. DATE ISSUED
    2/26/75

22. TRAVEL ORDER NUMBER
    N001647502-02830

DD FORM 1610 S/NO102-0167702

GPO: 1972-708-520
NAVY OVERPRINT - JAN 1971
2/26/75: TC, NAD Crane, Ind., arranged transportation from Indianapolis, Indiana to Philadelphia, Pa (and return), VIA: REG FARE Y/TW(PHL); Y/TW(IND). 1 jet coach cl air furnished, est. cost $120.73. Issued against T/R #T-0994213.

V. L. GREEN
Travel Clerk
**Travel Voucher or Subvoucher**

(Circle with ink, ball-point pen or typewriter - DO NOT use lead pencil.)

<table>
<thead>
<tr>
<th>Payment</th>
<th>TAD Per Diem</th>
<th>TAD Travel</th>
<th>PCS Travel</th>
<th>Check</th>
<th>Cash</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Travel Orders** (Paragraph, S.O. No., Issuing Hq. Date. Include amending orders.)

N0016475TO-02830 2/26/75 NAD Crane, IN

**For Travel Payments or Advances Under These Orders** (Amount, DO No., date received, place paid, DO Station No. If none, so state.) $95.00, NIF #6594, 2/26/75, NAD Crane, IN.

<table>
<thead>
<tr>
<th>Last Name - First Name - Middle Initial (Soundex Code) (Print/Type)</th>
<th>Grade/Rank</th>
<th>SSN</th>
</tr>
</thead>
<tbody>
<tr>
<td>MARKS, ROBERT J. II</td>
<td>GS-9</td>
<td>262-46-2721</td>
</tr>
</tbody>
</table>

**Check Mailing Address**

NAD Crane, IN.

**Organization and Station**

WQEC, NAD Crane, IN

### I. Itinerary

(See Reverse for Definition)

<table>
<thead>
<tr>
<th>Date</th>
<th>Local Standard Time</th>
<th>Place</th>
<th>Mode of Travel</th>
<th>Govt Qts</th>
<th>Govt Non-Govt Officers</th>
<th>Meals Used</th>
<th>Speedometer Reading</th>
<th>Mileage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar 3</td>
<td>0545</td>
<td>Residence</td>
<td>PA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARR</td>
<td>0730</td>
<td>Weir Cook</td>
<td>CP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar 5</td>
<td>0835</td>
<td>Indianapolis, IN</td>
<td>CP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARR</td>
<td>1115</td>
<td>Philadelphia, Int'l</td>
<td>TDY</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar 5</td>
<td>1205</td>
<td>Airport, Phila., Pa.</td>
<td>CP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARR</td>
<td>1340</td>
<td>Weir Cook</td>
<td>CM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mar 5</td>
<td>1415</td>
<td>Indianapolis, IN</td>
<td>PA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ARR</td>
<td>1600</td>
<td>Residence</td>
<td>HM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total actual cost of lodging (2 nights)$29.66</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
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</table>

**II. For DO Use Only**

1. Computations

### III. Reimbursable Expenses

<table>
<thead>
<tr>
<th>Date</th>
<th>Nature and Explanation</th>
<th>Amount Claimed</th>
<th>Amount Allowed</th>
<th>BAS/Colo Adj on MP R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mar 3, 5</td>
<td>Mileage to and from airport 108 mi.</td>
<td>12.96</td>
<td>2.10</td>
<td>BAS/Colo Adj not required</td>
</tr>
</tbody>
</table>

### IV. Transportation Requests/Meal Tickets Used

<table>
<thead>
<tr>
<th>Number</th>
<th>From</th>
<th>To</th>
<th>Meal Type</th>
<th>Rate</th>
<th>Total Paid</th>
</tr>
</thead>
<tbody>
<tr>
<td>T/R ST-0994213</td>
<td>Indianapolis, IN</td>
<td>Philadelphia, PA</td>
<td>(and return)</td>
<td>Date</td>
<td>Date</td>
</tr>
</tbody>
</table>

### V. Charges - BOQ or Non-Govt Meals and QTS

<table>
<thead>
<tr>
<th>FROM (Date)</th>
<th>TO (Date)</th>
<th>Type</th>
<th>Rate</th>
<th>Total Paid</th>
</tr>
</thead>
</table>

I hereby claim any amount due me. The statements on face, reverse, and attached are true and complete. Payment or credit has not been received.

**Signature of Claimant and Date**

ROBERT J. MARKS II

**Appropriation Symbol and Subhead**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>6X94912.2463</td>
<td>000</td>
<td>77777</td>
<td>000164</td>
<td>2E</td>
<td>TO-02230 00019011115</td>
<td>128.08</td>
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</table>

**Collection Data:**

<table>
<thead>
<tr>
<th>Computed By</th>
<th>Audited By</th>
<th>TDL BCRD</th>
<th>Posted By</th>
<th>Received (Payee signature &amp; date, or check no.)</th>
<th>Amount Paid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>70 121 934</td>
<td>33.06</td>
</tr>
</tbody>
</table>

**DD 783 | HI WY**

**Form Approved by Comp. Gen., U.S. April 28, 1972**

**1351-2 (6 PT) (NAVY OVERPRINT)**
CLAIMANT'S STATEMENTS

I have included herein all travel and transportation used on leave, delay en route or travel to home or permanent station for personal reasons. If travel by POV was authorized as more advantageous to the Government, I, as owner or operator of the vehicle, was primarily responsible for payment of its operating expenses.

I have not included travel, transportation and/or TDY for which I have received pay or credit from any other agency of the U. S., foreign government, or the United Nations, except as jointly authorized by the secretaries concerned.

I actually performed the travel herein. Government quarters and Government mess were not utilized except as indicated.

PENALTY

The penalty for willfully making a false claim is: A maximum fine of $10,000 or maximum imprisonment of 5 years, or both. (U. S., Code, Title 18, section 287, formerly section 80.)

REQUIRED ATTACHMENTS

1. Original and/or copies of travel orders and amendments as instructed.
2. Traveler's copy of each transportation request (SF 1169B) used.
3. All receipts from transportation officer for unused transportation requests, carriers' tickets, and meal tickets.
4. Receipts from carriers if cost of transportation is claimed.
5. Charge letters for transportation requests received en route.
6. Statements of nonavailability (quarters, mess and directed mode of transportation).

SYMBOLS

<table>
<thead>
<tr>
<th>MEANS (Mode) OF TRAVEL</th>
<th>REASONS FOR STOPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FIRST LETTER</td>
<td>SECOND LETTER</td>
</tr>
<tr>
<td>1. TRNSP Req.</td>
<td>10. AWAITING TRNSP</td>
</tr>
<tr>
<td>2. GOVT TRNSP</td>
<td></td>
</tr>
<tr>
<td>3. COML TRNSP</td>
<td></td>
</tr>
<tr>
<td>(own expense)</td>
<td></td>
</tr>
<tr>
<td>4. PRIVATE VEHICLE</td>
<td></td>
</tr>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TYPE OF CHARGES

22. BACHELOR OFFICER'S QTS. 23. NON-GOV'T MEALS 24. NON-GOVERNMENT QTS

DEFINITION (This definition pertains to military personnel only)

Meals and quarters furnished (with or without charge) incident to temporary duty by: (1) Local or State governments; (2) Foreign governments; (3) Other U. S. Government agencies, (4) U. S. Government contractors; or (5) Private organizations such as the National Red Cross during disasters.

REMARKS

VII. APPROVED FOR PAYMENT (When required by individual service regulations)

DATE

SIGNATURE OF AUTHORIZED APPROVING/CERTIFYING OFFICER

RU.S. GOVERNMENT PRINTING OFFICE: 1973 — 825 - 083
REQUEST AND AUTHORIZATION FOR TDY TRAVEL OF DOD PERSONNEL

(Relationship: Joint Travel Regulations)

Travel Authorized as Indicated in Items 2 through 21.

1. DATE OF REQUEST

25 Feb 1975

NAME (Last, First, Middle Initial)

MARKS, Robert J., II 232-46-2721

3. POSITION TITLE AND GRADE OR RATING

Elect. Engr.

4. OFFICIAL STATION

NAD Crane, IN

5. ORGANIZATIONAL ELEMENT

Weapons Quality Engr. Center Plans & Programs Div.

6. PHONE NO.

1299

7. TYPE OF ORDERS

TDY Single

8. SECURITY CLEARANCE

9. PURPOSE OF TDY

1. NAVAIR Contract HO0019-74-C-0135 for the acquisition of AH-1XU Reiver Set Work Unit Assignment C112.165. 2. Review and discuss Reliability Qualification and Sampling Test Procedures.

10. APPROX NO. OF DAYS OF TDY (Including travel time)

11. ITINERARY

3 days

3 Mar 1975

12. MODE OF TRANSPORTATION

<table>
<thead>
<tr>
<th>COMMERCIAL</th>
<th>GOVERNMENT</th>
<th>PRIVATELY OWNED CONVEYANCE (Check one)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAIL</td>
<td>AIR</td>
<td>BUS</td>
</tr>
<tr>
<td>[]</td>
<td>A</td>
<td>B</td>
</tr>
</tbody>
</table>

13. VARIATION AUTHORIZED

14. ESTIMATED COST

<table>
<thead>
<tr>
<th>PER DIEM</th>
<th>TRAVEL</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>62.50</td>
<td>175.00</td>
<td>237.50</td>
</tr>
</tbody>
</table>

15. ADVANCE AUTHORIZED

$ 95.00

16. REMARKS (Use this space for special requirements, leave, superior or 1st-class accommodations, excess baggage, registration fees, etc.)

Authorized to drive POV to Indpla airport and return. Authorized to drive CSA cam/lease (compact) car from Philadelphia to destinations and return. Vehicle authorized for official travel only. DIRECTED TO PAY CASH FOR RENTAL OF CAR.

17. REQUESTING OFFICIAL (Title and signature)

18. APPROVING OFFICIAL (Title and signature)

A. E. WITTMER, DIRECTOR, WECL

RICHARD L. McGARRY, Dir., Adm. Dept.

AUTHORIZED

RICHARD L. McGARRY, Dir., Adm. Dept., By direction

APPROPRIATION

SUBHEAD

OBJECT

CLASS

BUREAU

CONTROL

NUMBER

SUB-

AUTH.

AUTHORIZATION

ACCOUNTING

ACTIVITY

TYPE

TRAVEL

ORDER

(Tango) NO.

COST

CODE

174912.2463

000

77777

0

000164

2E

20-22630

000190110115

2. ORDER AUTHORIZING OFFICIAL (Title and signature) OR AUTHENTICATION

21. DATE ISSUED

2/26/75

22. TRAVEL ORDER NUMBER

DD

1 JUN 67 1610

GPO: 1972-709-520

NAVY OVERPRINT - JAN 1971

5/NO102 - 016 7702
**TRAVEL AUTHORIZATION REQ. 217**

**FROM (Name of Traveler)**

Robert J. Marks II

**TITLE AND GRADE**

Electronics Engineer

**SOCIAL SECURITY NO.**

[Redacted]

**OFFICE PHONE**

854-1299

**BLDG CODE**

38 304B

**HOME PHONE**

332-3892

**FROM**

(NBtM traveler)

Apt. 162
3111 Leonard Springs Rd.
Bloomington, IN 47401

**TO**

011A

VIA (1) 30 (2) 304 (3) 304B (4)

**DATE**

2/20/75

**TRAVEL ORDERS ARE REQUESTED AS FOLLOWS**

<table>
<thead>
<tr>
<th>ACTIVITIES TO BE VISITED AND PERSONNEL TO CONTACT</th>
<th>HOUR AND DATE</th>
<th>COMPLETE</th>
</tr>
</thead>
<tbody>
<tr>
<td>AEL-EMTECH</td>
<td>1300 3 Mar 75</td>
<td>1300 4 Mar 75</td>
</tr>
<tr>
<td>P. O. Box 507</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lansdale, PA 19446</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Microcon Corporation</td>
<td>1400 4 Mar 75</td>
<td>1000 5 Mar 75</td>
</tr>
<tr>
<td>1115 Mearns Road</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warminster, PA 18974</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PURPOSE OF VISIT**

Attached

**DEDUDED MODE OF TRANSPORTATION**

<table>
<thead>
<tr>
<th>AIR</th>
<th>PAIL</th>
<th>BUS</th>
<th>POV</th>
<th>G/V</th>
<th>TO AND FROM COMMERCIAL CARRIER</th>
<th>G/V</th>
<th>X</th>
<th>POV</th>
</tr>
</thead>
</table>

**RENTAL CAR AT TDY STATION (Justification if required)**

Previous experience dictates the necessity of a rental car for transportation to and from contractor facilities.

**WILL YOU PROVIDE POV TRANSPORTATION FOR OTHERS**

[ ] YES [X] NO

**ADVANCE OF FUNDS**

[ ] YES [X] NO

**WILL YOU ACCOMPANY OTHERS IN POV**

[ ] YES [X] NO

**TAD CONNECTED LEAVE IS REQUESTED FOR**

[ ] YES [X] NO

**EXCESS BAGGAGE (Government owned material)**

POUNDS [ ] ONE WAY [ ] ROUND TRIP

**CLEARANCE REQUIRED**

[ ] SECRET [ ] CONFIDENTIAL [ ] NONE

**REMARKS (Continue on reverse side if necessary)**

1. Contractor controlled travel
2. Traveler requests departure from Indianapolis on TWA Flight 266 on 3 Mar 75 and departure from Philadelphia on Flight 539 (TWA) on 5 Mar 75.

**SIGNATURE (Department Director)**

Robert J. Marks II

**SIGNATURE (Traveler)**

[Signature]

[Printed Name]
Under the authority of Avionics Production Reliability Surveillance AIRTASK A5335331/1592/50050000002 NAD Crane (304) is assigned technical cognizance of production reliability acceptance test programs for Avionics System being procured by NAVAIRSYSOC.

AEL-EMETECH - NAVAIR Contract N00019-74-C-0135 for the acquisition of AN/ARR-75 Sonobuoy Receiver Set Work Unit Assignment C112.158 from AEL Emtech Corp. The reliability qualification test on this equipment has resulted in a reject decision. The contractor is required conditions set forth in specifications and the contract to propose a plan of corrective action and demonstration of same. The purpose of this meeting is to investigate in-house failure reports, discuss the failures encountered and evaluate contractor's corrective actions to eliminate these failures.

MICROCON - Review and discuss with DCASR and the contractor the Reliability Qualification and Sampling Test Procedures that will be used in conducting the reliability test. Any areas of conflict will be dissolved during this meeting.
REQUEST AND AUTHORIZATION FOR TDY TRAVEL OF DOD PERSONNEL

Travel Authorized as Indicated in Items 2 through 21.

1. DATE OF REQUEST
   22 Nov 1974

REQUEST FOR OFFICIAL TRAVEL

2. NAME (Last, First, Middle Initial)
   MARKS, ROBERT J.

3. POSITION TITLE AND GRADE OR RATING
   Elect. Engr., GS-9

4. OFFICIAL STATION
   NAD Crane, IN
   Bldg. 120, Code 304B

5. ORGANIZATIONAL ELEMENT
   Weapons Quality Engr. Center
   Plans & Programs Divn.

6. PHONE NO.
   1370

7. TYPE OF ORDERS
   TDY Single

8. SECURITY CLEARANCE
   Training: Elements of Reliability & Maintenance Training Course.

9. PURPOSE OF TDY
   Training: Elements of Reliability & Maintenance Training Course.

10. APPROX NO. OF DAYS OF TDY (Including travel time)
    21 days
    1 Dec 1974

11. ITINERARY
    From: NAD Crane, IN
    or
    311 Leonard Springs Rd., Apt. 162
    Bloomington, IN
    To: AMETA
    Rock Island, IL
    (and return)

12. MODE OF TRANSPORTATION
    [ ] COMMERICAL
    [ ] GOVERNMENT
    [ ] PRIVATELY OWNED CONVEYANCE (Check one)
    [ ] RAIL
    [ ] AIR
    [ ] BUS
    [ ] TRUCK
    [ ] SHIP
    [ ] VEHICLE
    [ ] SHIP

13. [ ] PER DIEM AUTHORIZED IN ACCORDANCE WITH JTR: Vol 2.

14. ESTIMATED COST
    PER DIEM
    $ 493.75
    TRAVEL
    $ 90.00
    OTHER
    $ 0
    TOTAL
    $ 583.75
    [ ] ADVANCE AUTHORIZED
    $ 550.00

16. REMARKS (Use this space for special requirements, leave, superior or 1st-class accommodations, excess baggage, registration fees, etc.)
   Authorized to drive POV to destination and return.
   POV not authorized for daily transportation - several motels in Rock Is. area furnish daily transportation to AMETA and return.

DD Form 1556 approved by James E. Fultz, Mgr., Training Div., 11/25/74.

A. E. WHITNER, Director, WQEC

RICHARD L. McGARVEY, Director, Adm. Dept.

AUTHORIZATION

17. REQUESTING OFFICIAL (Name and signature)
   RICHARD L. McGARVEY, Director, Adm. Dept.

18. APPROVING OFFICIAL (Name and signature)
   [Signature]

19. AUTHORIZATION NUMBER
    17X0912.2463
    000
    77777
    0
    000164
    2E
    TO-02146
    000190110115

20. TRAVEL ORDER NUMBER
    N0016475T0-02146

21. DATE ISSUED
    11/27/74

22. TRAVEL ORDER NUMBER
    N0016475T0-02146
DO: NAD CRANE, INDIANA 47522
NIF NO. 4801 DTD 11/27/74
PD ADVANCE PER DIEM 550.00
PD REGISTRATION FEE
T. BECKMAN 5132

DO: NAD, CRANE, INDIANA 47522
NIF NO. 5983 DTD 1/21/75
TOTAL PAID 580.15
T. BECKMAN 5132
### I. ITINERARY (See Reverse for Definition)

<table>
<thead>
<tr>
<th>DATE</th>
<th>LOCAL STANDARD TIME</th>
<th>PLACE</th>
<th>GOVT QTS</th>
<th>GLOBAL LGA</th>
<th>NUMBER MEALS USED</th>
<th>AMOUNT PAID</th>
<th>SPEEDOMETER READING OR MILEAGE</th>
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<tbody>
<tr>
<td>12/7</td>
<td>DEP 0730</td>
<td>Bloomington, IN</td>
<td>PA</td>
<td></td>
<td></td>
<td>0</td>
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<tr>
<td></td>
<td>ARR 1800</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>390</td>
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</tr>
<tr>
<td>12/8</td>
<td>DEP 1330</td>
<td>Rock Island, IL</td>
<td>PA</td>
<td></td>
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<td>0</td>
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<td></td>
<td>ARR 2130</td>
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<td></td>
<td>387</td>
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</table>

### III. REIMBURSABLE EXPENSES

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<thead>
<tr>
<th>DATE</th>
<th>NATURE AND EXPLANATION</th>
<th>AMOUNT CLAIMED</th>
<th>ALLOWED</th>
<th>BAS/COLA ADJ ON MP R</th>
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<tbody>
<tr>
<td>12/1</td>
<td>Mileage to and from Rock Island (See Remarks)</td>
<td>93.24</td>
<td>xx</td>
<td>BAS/COLA ADJ ON MP R</td>
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<tr>
<td>12/1</td>
<td>Actual total cost of lodging at TOY location</td>
<td>264.84</td>
<td>xx</td>
<td>BAS/COLA RATE</td>
</tr>
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</table>

### IV. TRANSPORTATION REQUESTS/MEAL TICKETS USED

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>FROM</th>
<th>TO</th>
<th>QTD</th>
<th>CC</th>
</tr>
</thead>
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### V. CHARGES - BOQ OR NON-GOVT MEALS AND QTS

<table>
<thead>
<tr>
<th>FROM (Date)</th>
<th>TO (Date)</th>
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<tbody>
<tr>
<td>08/7-1</td>
<td>08/1-1</td>
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</table>

### VI. LEAVE STATEMENT

I hereby claim any amount due me. The statements on face, reverse, and attached are true and complete. Payment or credit has not been received.

**SIGNATURE OF CLAIMANT AND DATE**

### APPROPRIATION SYMBOL AND SUBHEAD

<table>
<thead>
<tr>
<th>OBJECT CLASS</th>
<th>BUR. CONT. NO./SUB ALLOT. NO.</th>
<th>AUTH. ACCT'S ACTIVITY</th>
<th>TYPE</th>
<th>TRAVEL ORD. NO./AUX. COST CODE</th>
<th>COST CODE</th>
<th>AMOUNT</th>
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<tbody>
<tr>
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<td></td>
<td></td>
<td>580.15</td>
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</tbody>
</table>

### COLLECTION DATA:

**AMOUNT PAID** 30.15
I have included herein all travel and transportation used on leave, delay en route or travel to home or permanent station for personal reasons. If travel by POV was authorized as more advantageous to the Government I, as owner or operator of the vehicle, was primarily responsible for payment of its operating expenses.

I have not included travel, transportation and/or TDY for which I have received pay or credit from any other agency of the U. S., foreign government, or the United Nations, except as jointly authorized by the secretaries concerned.

I actually performed the travel herein. Government quarters and Government mess were not utilized except as indicated.

**PENALTY**

The penalty for willfully making a false claim is: A maximum fine of $10,000 or maximum imprisonment of 5 years, or both. (U. S., Code, Title 18, section 287, formerly section 80.)

**REQUIRED ATTACHMENTS**

1. Original and/or copies of travel orders and amendments as instructed.
2. Traveler’s copy of each transportation request (SF 1169B) used.
3. All receipts from transportation officer for unused transportation requests, carriers’ tickets, and meal tickets.
4. Receipts from carriers if cost of transportation is claimed.
5. Charge letters for transportation requests received en route.
6. Statements of nonavailability (quarters, mess and directed mode of transportation).

**SYMBOLS**

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<th>REASONS FOR STOPS</th>
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<td>SECOND LETTER</td>
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<td>2. GOVT TRNSPN........</td>
<td>G</td>
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<td>3. COML TRNSPN........</td>
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<td>(own expense)</td>
<td>P</td>
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<td>4. PRIVATE VEHICLE....</td>
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<tr>
<td>5. AUTO................</td>
<td>A</td>
</tr>
<tr>
<td>6. BUS..................</td>
<td>B</td>
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<tr>
<td>7. PLANE..............</td>
<td>P</td>
</tr>
<tr>
<td>8. RAIL..............</td>
<td>R</td>
</tr>
<tr>
<td>9. VESSEL...........</td>
<td>V</td>
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**TYPE OF CHARGES**

22. BACHELOR OFFICER’S QTS........ BOQ 23. NON-GOVERNMENT MEALS........ NGM 24. NON-GOVERNMENT QTS........ NSQ

**DEFINITION** *(This definition pertains to military personnel only)*

**NON-GOVERNMENT QUARTERS AND MEALS**

Meals and quarters furnished *with or without charge* incident to temporary duty by: (1) Local or State governments; (2) Foreign governments; (3) Other U. S. Government agencies; (4) U. S. Government contractors; or (5) Private organizations such as the National Red Cross during disasters.

**REMARKS**

**VII. APPROVED FOR PAYMENT** *(When required by individual service regulations)*

<table>
<thead>
<tr>
<th>DATE</th>
<th>SIGNATURE OF AUTHORIZED APPROVING/CERTIFYING OFFICER</th>
</tr>
</thead>
</table>
REQUEST AND AUTHORIZATION FOR TDY TRAVEL OF DOD PERSONNEL

Travel Authorized as Indicated in Items 2 through 21.

1. DATE OF REQUEST
22 Nov 1974

2. NAME (Last, First, Middle Initial)
MARKS, ROBERT J.

3. POSITION TITLE AND GRADE OR RATING
Elect., Engr., GS-9

4. OFFICIAL STATION
NAD Crane, IN
Bldg. 120, Code 304B

5. ORGANIZATIONAL ELEMENT
Weapons Quality Engr. Center
Plans & Programs Divn.

6. PHONE NO. 1370

7. TYPE OF ORDERS
TDY Single

8. SECURITY CLEARANCE
Training: Elements of Reliability & Maintenance Training Course.

9. PURPOSE OF TDY
Training:

10. APPROX NO. OF DAYS OF TDY (Including travel time)
21 days 1 Dec 1974

11. ITINERARY
From: NAD Crane, IN

311 Leonard Springs Rd., Apt. 162
Bloomington, IN

To: AMETA
Rock Island, IL

12. MODE OF TRANSPORTATION

<table>
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<td>AIR VEHICLE</td>
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<td>SHIP</td>
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<td>AIR</td>
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<tr>
<td>BUS</td>
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<tr>
<td>SHIP</td>
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RATE PER MILE: 12c

13. ☐ OTHER RATE OF PER DIEM (Specify)

14. ESTIMATED COST

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<th>OTHER</th>
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<tr>
<td>$ 493.75</td>
<td>$ 90.00</td>
<td>$</td>
<td>$ 583.75</td>
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15. ADVANCE AUTHORIZED $ 550.00

16. REMARKS (Use this space for special requirements, leave, superior or 1st-class accommodations, excess baggage, registration fees, etc.)

Authorized to drive POV to destination and return.

POV not authorized for daily transportation - several motels in Rock Is. area furnish daily transportation to AMETA and return.

DD Form 1556 approved by James E. Fultz, Mgr., Training Div., 11/25/74.

17. REQUESTING OFFICIAL (Name and signature)
A. T. WHITNER, Director, WQEC

18. AUTHORIZING OFFICIAL (Name and signature)
RICHARD L. McGARVEY, Director, Adm. Dept.

19. AUTHORIZATION

<table>
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<th>OBJECT CLASS</th>
<th>BUREAU CONTROL NUMBER</th>
<th>SUB-AUTH.</th>
<th>AUTHORIZATION ACCOUNTING ACTIVITY</th>
<th>TYPE</th>
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<td>2E</td>
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20. ORDER AUTHORIZING OFFICIAL (Name and signature) OR AUTHENTICATION
RICHARD L. McGARVEY, Director, Adm. Dept., By direction

21. DATE ISSUED 11/27/74

22. TRAVEL ORDER NUMBER N00164750-02146
DO: NAD CRANE, INDIANA 47522
NIF NO. 4801 DTD 11/27/74
PD ADVANCE PER DIEM $50.00
PD REGISTRATION FEE
T. BECKMAN 5132

DO: NAD, CRANE, INDIANA 47522
NIF NO. 5983 DTD 1/21/75
TOTAL PAID $800.15
T. BECKMAN 5132
MEMORANDUM

From: 3041 (R. J. Marks)
To: 3041 (G. Allen)

Subj: Trip Report for the period of 2 Jun 1975 to 6 Jun 1975

Encl: (1) Verdin location and installation schedule

1. Activities Visited and persons contacted:

   a. Naval Electronics Laboratory Center (NELC), San Diego, CA

   b. Roger Dishong
      Herb Greenstein
      George Pillion
      Al Villerreal
      G. Hudnall
      J. Richter

     Project Engineer
     Reliability Engineer
     Reliability Engineer
     Installations
     Verdin Shore Installation Manager
     Program Manager

2. Purpose of visit:

   a. Review documents on the Verdin system for familiarization with operation and determination of past system effectiveness measures.

   b. Determine location of Verdin equipment in the fleet including installation schedules.

   c. Determine the extent of involvement of NELC in the Verdin effort and NELC's overall temperament in possible future consultation and support.

3. Discussion:

   a. Verdin related documents which were reviewed during the NELC visit along with relevant content are:

      (1) Preliminary Operational Instructions for Receiving Set Digital Data (U) AN/WRR7, NAVELEX 0976-462-3031.

      (2) Special Operational Instructions for Transmitting Set AN/ART50, NAVELEX 0967-462-5010, NAVAIR 16-30 ART 50-2.


         (a) Specified MTBF: $\theta_0 = 1000$ hrs.
Reliability via MIL-STD-785.

Reliability prediction required via MIL-HNBK-217 at 65° at Class IV environment.

Maintainability program required via MIL-STD-470.

Maintainability prediction required via MIL-HNBK-472.

Reliability qualification: test plan V, level A of MIL-STD-781


Operating life = 10 years.

Operational stability: must operate continuously for a period of 24 hours without adjustment.


(a) "... (a) VLF/LF digital data communication system consisting of the transmitting set, digital data AN/ART-50 and a radio receiving set AN/ARR# ... " for aircraft.

(b) Operating life = 50,000 hours.

(c) Specified MTBF including BIT electronics = 750 hours.

(d) BIT via AR 10.

(e) All equipment screening required via test plan II (reject line) test level E (cycle limits of -10° to 50°C) of MIL-STD-781.

(f) Operational stability: must operate continuously for 1500 hours without adjustment.

(a) Maintainability program from MIL-STD-470.

(b) Maintainability prediction from procedure II of MIL-HDBK 472.

(c) Total operating life = 10 years.

(d) Operational stability: Must operate 24 hours continuously without adjustment.

(e) Specified MTBF: $\theta_0 = 1000$ hours.

(f) Reliability prediction required via MIL-HDBK 217.

(g) Reliability Qualification via test level A, test plan V of MIL-STD-781.

(h) Reliability Sampling via test level A, test plan V of MIL-STD-781.

(i) Operational stability: Must operate continuously for 24 hours without control adjustment.

(6) Collins Radio Group: Verdin Field Failure (1 May 1975)

(a) This report, issued first in April 1975 and generated monthly, lists all Verdin equipment returned to Collins for repair.

(b) Also listed are failure trends and suggested corrective action.

(7) Collins Radio Group: Verdin first article tests and documents

(a) Introduction and Summary

(b) Environmental Test Report AN/WRR-7 Vols I and II.

(c) Environmental Test Report AN/ART-50 Vols I and II

(d) Performance Test Report AN/VRC-62 Vols I, II, III, and IV.

(e) Tempest Test Report AN/WRR-7

(f) Tempest Test Report AN/ART-50

All first article testing has been completed successfully.

(8) NELC: Shore Installation Planning Guide

(a) This document contains the best overview of Verdin yet encountered by this activity.
b. The Verdin system consists of a shore transmitter, an aircraft relay, and a ship receiver. For the most part, Verdin has been installed on all the SSBN (ballistic) submarines. Installation on shore and in Tacamo aircraft is scheduled for initiation in June of this year. A more detailed schedule is included in enclosure (1).

c. The reception of this activity by NELC by those involved directly with Verdin was for the most part formal. The reliability group at NELC, which was initially assigned TSA responsibility in the FRAP effort prior to travel restrictions, was most helpful to this activity during visitation. Ideas and thoughts concerning implementation of FRAP were shared freely and are discussed in section 4.

(1) NELC is extensively involved in the Verdin effort including participation in the following:

(a) Awarding and performance surveillance on the Trident radio room contract. At the time of visit the awarding of the contract to either ITT or RCA (to which the Collins Radio Group is subcontracted) was being determined.

(b) Verdin shore installation.

(c) Logistic support

(d) Design and production of Verdin software (Collins was unable to successfully fulfill this contractual area).

(e) Verdin first article test surveillance.

(f) NELC was also extensively involved in the early development of Verdin.

(2) NELC was initially assigned TSA responsibilities in the FRAP effort. Lack of travel however, prohibited their participation. This activity was informed that travel was again allowed at NELC almost immediately after cancellation of their TSA status, is still allowed, and is not expected to be restricted in the future.

4. Recommendations:

a. During the visitation, FRAP philosophy and ideas were discussed by Herb Greenstein and this activity. Mr. Greenstein has been involved in the area of reliability since its birth over twenty years ago and seems to mix well the statistical and physics aspects of reliability in his
engineering philosophy. He said he would have been involved extensively in the FRAP effort had NELC retained its TSA status.

b. Upon being told that FRAP might be collecting its own data from the fleet, Mr. Greenstein replied that this would largely be a duplication of effort with some of the many already existing governmental data collection effort. When told that the MDCS system had been determined inadequate as is for FRAP, he stated that most people, being only exposed to the MDCS data itself, did not appreciate the total capability of the MDCS data when coupled with the other available information. He suggested contacting Mr. J. Bell at Naval Ship Engineering Center at Norfolk for further information concerning MDCS capabilities.

c. Mr. Greenstein also offered other advice on execution of FRAP. Do not be overly concerned with exact data such as operating time per month or down times. Estimates suffice. Look, rather, for failure trends and other problems. The purpose of FRAP, he stated, is finding new system problems in the fleet in a timely manner, determining the physics of the failure or problem mode, and recommending timely corrective action. The purpose is not to measure exact MTBF's and generate lengthy reports.
<table>
<thead>
<tr>
<th>Item</th>
<th>Pages</th>
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</thead>
<tbody>
<tr>
<td>Milestone Charts (U)</td>
<td>1-2</td>
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<tr>
<td>SHIPALT Briefs (U)</td>
<td>3-7</td>
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<td>Shore Statron (U)</td>
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<tr>
<td>WRR-7 Installation (C)</td>
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(this page unclassified)

(Enclosure 1)
## COMMSTA/BCA VERDIN INSTALLATIONS

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<td>SEP</td>
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<td>COMMSTA</td>
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<td>④ LUALUALEI</td>
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<td>⑥ THURSO</td>
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<tr>
<td>⑨ GREECE</td>
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BCA

| COMSUBPAC         |     |     |     |     |     |     |     |     |     |     |     | (1)   | |      |
| COMSUBLANT        |     |     |     |     |     |     |     |     |     |     |     | (1)   | |      |
| COMSUBGRU 7       |     |     |     |     |     |     |     |     |     |     |     | 0     | |      |
| COMSUBGRU 8       |     |     |     |     |     |     |     |     |     |     |     | 0     | |      |

### LEGEND
- **BROADCAST EQUIP AVAILABILITY**
- **INSTALL PERIOD**
- **SYSTEM CHECKOUT**
- 2 CHANNEL
- 4 CHANNEL

### NOTE
COMSUBLANT, COMSUBPAC, AND USCOMEASTLANT EACH GET 1 WRR-7 AND 1 FTS IN FFB 76 FOR NON VERDIN BROADCAST.
<table>
<thead>
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<th>FY 74-PRIOR</th>
<th>FY 75</th>
<th>FY 76</th>
<th>7T</th>
<th>FY 77</th>
<th>FY 78</th>
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A. Production/Installation

1. First Buy (1507)
   a. First Year (FY 74)
   b. Second Year (FY 75)
      Arr 77 LTR Contract

2. Second Buy (0152)
   a. First Year (FY 74)
   b. Second Year (FY 75)
      Arr 77 LTR Contract

3. Third Buy (FY 76)
   a. First Year
   b. 2nd Increment (7T)
   c. 3rd Increment (7T)

4. Planned CBFS
   Procurement
      a. Current Buy (FY 73 & FY 74)
      b. FY 75 (2nd Buy)
      c. FY 77

5. AN/UYK-20

B. Initial Deploy Compl

C. R-1590 Mod

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<th>FY 75/76 – Spending Plan</th>
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<td>KG 38; Ship/Shore Instl; 3rd Buy.</td>
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<td>FYDP/POM 77</td>
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<td>Support</td>
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Symbols:
- Contract
- DLVRY/INSTALL
- Critical Event

Date of Report: 25 April 1975

Unclassified
Provide flexibility and increased capability needed for communication on the VLF/LF bands.

References:
See Page 3

1. This alteration has been developed to define the LF/MF portion of the radio communications system installation required to support assigned missions of the CVA/CVG ship types. Other closely associated radio communications systems functional capabilities are defined in the following Ship Alterations:

   SINGLE SIDEBAND COMMUNICATIONS - CVA-4355/CVS-801/CVAN-4356
   UHF COMMUNICATIONS - CVA-4357/CVS-802/CVAN-4358
   VHF COMMUNICATIONS - CVA-4361/CVS-804/CVAN-4362

   THIS ALTERATION HAS BEEN ENTERED IN THE CMF-DO NOT RESUBMIT
## SECTION I - IDENTITY

### SHIP ALT BRIEF

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### TYPE OF ALTERATION

- [ ] TECH
- [ ] MIL

### SIGN. NO.

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### EIC NO.

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### PURPOSE

Provide VLF/LF/MF Radio Receiver Capability

### DESCRIPTION/PHYSICAL BOUNDARIES

Install in appropriate spaces the equipment listed in Section II Paragraph I to achieve Radio Receiving capabilities in the VLF/LF/MF frequencies. Install additional air conditioning and ventilation as necessary.

### APPlicable SHIPS

- GALVESTON CLG 3
- LITTLE ROCK 4
- OKLAHOMA CITY 5
- PROVIDENCE 6
- SPRINGFIELD 7
- TOPEKA 8

### SIGNATURE

GUSTAV E. SHATINSON

### TITLE

CAPT USN

### DATE

8/7/73

---

PAGE 1
SECTION I - IDENTITY

SHIPALT BRIEF

INSTALL AN/WRR-7 (VERDIN) RECEIVE SYS

TYPE OF ALTERATION:
☐ TECH ☑ MIL

CIP -
SIG. NO. CAT./FUNCT
3860 1300
OPNAV
CIP DATE
4720.xx
33E 180769
INST

EIC NO.
QB1L000

SCOPE Dwg# 0441-065-015

DATE
11-5-72

NAVSHIPYD CHASN

SIGNATURE
/s/ P. R. Sacilotto

APPROVAL

TITLE DEP. LOG. MGR. DATE (Mo, Da, Yr)
SHIPS 425 7-19-72

APPLICABLE SHIPS

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DESCRIPTION/PHYSICAL BOUNDARIES (Describe the SHIPALT and area of the ship and compartment involved. Refer to scoping documents as necessary.)

EACH TRANSMITTAL OF THIS DOCUMENT OUTSIDE THE AGENCIES OF THE U.S. GOVERNMENT MUST HAVE PRIOR APPROVAL OF THE COMMANDER, NAVAL SHIP SYSTEMS COMMAND, WASHINGTON, D.C. 20360

1. The following items are to be installed in the Radio Room under this ShipAlt:
   a. R-1738/URR Receiver (replaces AN/BRR-3 receiver)
   b. 0-1612/URC Frequency and Time Standard (replaces AN/URQ-9 or AN/URQ-10)

CONT'D ON PAGE 1 A

THIS ALTERATION HAS BEEN ENTERED IN THE CSMP--DO NOT RESUBMIT CODE C

K-5
SECTION I - IDENTITY

SHIPALT BRIEF

INSTALL VERDIN (AN/WRR-7) RCVR SYS

TYPE OF ALTERATION:

☐ TECH ☑ MIL

CIP - OPNAV INST 4720.xx

Sig. No. CAT/FUNCT CIP DATE EIC NO.

386 Q 33E 180769 QB1L00

SCOPE DWG#:

See Ref 16

CHASN N.S.Y. 1/13/72

PURPOSE

To install Verdin Receiver System (AN/WRR-7)

This ShipAlt developed from Provisional ShipAlt A1491.

DESCRIPTION/PHYSICAL BOUNDARIES (Describe the SHIPALT and area of the ship and compartment involved. Refer to scoping documents as necessary.)

EACH TRANSMITTAL OF THIS DOCUMENT OUTSIDE THE AGENCIES OF THE U.S. GOVERNMENT MUST HAVE PRIOR APPROVAL OF THE COMMANDER, NAVAL SHIP SYSTEMS COMMAND, WASHINGTON, D.C. 20360

1. The VERDIN (AN/WRR-7) Receiver System is to be installed in the Radio Room on applicable submarines. VERDIN equipment consists of one R-1738/URR VLF/LF Receiver; one 0-1612/URC Frequency and Time Standard; one CP-1071/WR Processor and one MD-855/WRR-7 Demodulator-Power Supply in a CY-7113/WR Enclosure; two TSEC/KG-38 Key Generators; one 310275 Teletypewriter Power Supply; and one RA-8 Relay Panel with four R-91 Relays. (CONT'D ON PAGE 1A)

THIS ALTERATION HAS BEEN ENTERED IN THE CSMP---DO NOT RESUBMIT CODE C

K-9
To install VERDIN System (AN/WRR-7)

This alteration developed from Provisional Alteration A1491.

(1) Install one VERDIN Receive System (AN/WRR-7) in the radio room as outlined below.

SSN637 Class Short Hull (Refer to Ref 13)
(SSN 637-639), SSN 646-653, SSN660-670, SSN672-677)

A. Install (1 each) 0-1612 frequency and time standard and (1 each) CY 7113 Cabinet (containing the CONT'D ON PAGE 1A)

THIS ALTERATION HAS BEEN EXTENDED IN THE CSMP--DO NOT RESUBMIT CODE C K-15
## SHORE STATIONS

### VERDIN SCHEDULE

#### AN/URT-30

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This page contains the UNCLASSIFIED section of the document.
MEMORANDUM

From: 3041 (R. J. Marks II)  
To: 3041 (R. Saum)  
Via: 3041 (C. Rice)  

Subj: Trip Report for the Period of 25 Mar to 28 Mar 1975

Ref: (a) Trip report for period 3 Mar to 5 Mar 1975, 304B-RJM:1cb, 12340/2 6 Mar 1975  
(b) Acceptance Test Procedure, Part III, Reliability Qualification Test for AN/DKT-30 Transmitting Set Contract NO0019-74-C-0106 Procedure AS2185B of 18 Apr 1974

1. Activities Visited and Persons Contacted

a. AEL-EMTECH Corporation, Lansdale, PA.

- George McCumber: Engineering Manager  
- Howard Nobel: Contract Administrator  
- Jim Deering: Project Engineer

b. Microcom Corporation, Warminster, PA.

- Morris Levine: Quality Control Manager  
- J. Reis: Production Manager  
- T. Azzaro: Technician

2. Purpose of Visit

a. AEL-EMTECH

Further investigation and consultation concerning failures encountered during the Reliability Qualification Test (RQT) on the ARR-75 sonobuoy receiver as discussed in paragraph 2a and 3a of reference (a) was the aim of this visitation.

b. Microcom

The RQT test on the DKT-30 transmitting set was executed during the visitation period. This activity's policy is to audit the contractor's test facility and witness initiation and resolve discrepancies for these tests.
MEMORANDUM

From: 3041 (R. J. Marks II)
To: 3041 (R. Saum)
Via: 3041 (C. Rice)

Subj: Trip Report for the Period of 25 Mar to 28 Mar 1975

Ref: (a) Trip report for period 3 Mar to 5 Mar 1975, 3048-RJM:1cb, 12340/2 6 Mar 1975
(b) Acceptance Test Procedure, Part III, Reliability Qualification Test for AN/DKT-30 Transmitting Set Contract No0019-74-C-0106 Procedure AS2185B of 18 Apr 1974

1. Activities Visited and Persons Contacted
   a. AEL-EMTECH Corporation, Lansdale, PA.
      George McCumber  Engineering Manager
      Howard Nobel  Contract Administrator
      Jim Deering  Project Engineer
   b. Microcom Corporation, Warminster, PA.
      Morris Levine  Quality Control Manager
      J. Reis  Production Manager
      T. Azzaro  Technician

2. Purpose of Visit
   a. AEL-EMTECH

      Further investigation and consultation concerning failures encountered during the Reliability Qualification Test (RQT) on the ARR-75 sonobuoy receiver as discussed in paragraph 2a and 3a of reference (a) was the aim of this visitation.

   b. Microcom

      The RQT test on the DKT-30 transmitting set was executed during the visitation period. This activity's policy is to audit the contractor's test facility and witness initiation and resolve discrepancies for these tests.
3. Discussion

a. AEL-EMTECH

(1) On production Failures

With reference to reference (a), two hand soldered connectors were recently discovered open prior to unit burn-in on the Reliability Acceptance Test (RAT). Even though the status of these failures is non-relevant, a production procedure change has been initiated to prevent future failures of this type. Failure analysis revealed that solder used in manufacturing the connectors was melting upon hand soldering leads in the production process. The vendor, Segalectro, is presently producing the connectors with solder of a higher melting temperature (SP-5 type). The contractor has likewise abandoned hand mounting of the connectors in favor of the previously employed flow solder process. No further connector problems have been experienced after initiation of the above changes.

The mixers which are responsible for a gross pattern failure in the RQT and a single failure in the RAT are now being screened by thermal shock by the vendor (MCL). In-house screening of the mixers, which is still in practice, has reduced in rejection of these mixers from 50% to about 5%. The soldering and screening changes, as outlined above, will be incorporated into the production of the final 34 units.

(2) On Failure Reclassification Action

The contractor has forwarded, official letters of reclassification request for all RQT failures to Jim McHugh (NAVAIR), this activity, and other concerned parties. The contractor was advised that this activity has no authority for reclassification of failures unless such responsibility is assigned by NAVAIR. In view of the lack of action on the subject letter, the contractor was advised to telephone to speed resolution of the failure reclassification matter. No commitment was made on this activity's view concerning the RQT failure reclassification status.

b. Microcom

The RQT was undertaken at the AEL environmental test facilities. Eight units were pretested for performance and then subjected to four thermal cycles which altogether spanned approximately 21 hours. Testing was performed at the end of each temperature plateau of each cycle. To facilitate testing, the temperature cycling was completed before vibration in accordance with footnote on page 4 of reference (b). After cycling, the units were vibrated for four minutes. Due to the shortness of these vibration period and the length of time needed for an entire performance test, measurements were made only after the vibration was completed. No relevant failures were
experienced. One non-relevant failure occurred due to faulty test equipment wiring.
It is this witness's opinion that the RQT on the DKT-30 was executed in a completely professional and conscientious manner by the contractor.

ROBERT J. MARKS II
MEMORANDUM

From: 304B (R.J. Marks II)
To: 304B (R. Saum)
Via: 304B (C. Rice)

Subj: Trip report for the period 3 March to 5 March 1975

1. Activities Visited and Persons Contacted

   a. AEL-EMTECH Corporation, Lansdale, Pa.

      George McCumber
      Art Freedman
      Bill Haas
      Howard Nobel
      John Carnevalle
      C. Garron
      Dick Hay
      Bob Lohmas
      Bill Latimer
      Harold Casale
      Jim Deering

      Engineering Manager
      Quality Control Manager
      Design Engineer
      Contract Administrator
      DCAS
      Head DCAS at AEL-EMTECH
      Test Manager (RQT)
      Test Manager (RAT)
      Test Engineer
      VP and General Manager EMTECH
      Project Engineer


      Morris Levine
      Charles King

      Quality Control Manager
      DCAS

2. Purpose of Visit

   a. AEL-EMTECH

      The contractor is presently required to propose corrective action on numerous failures encountered in the Reliability Qualification Test (RQT) of the ARR-75. The purpose of the meeting was to investigate in-house failure reports, discuss the failures encountered, and evaluate the contractor's corrective action to eliminate these failures.
b. Microcom

The Reliability Qualification Test on the DKT-30 is scheduled for initiation on 26 March 75. The purpose for Microcom visitation was for familiarization with facilities and personnel and for discussion of test procedures.

3. Discussion

a. AEL-EMTECH

On Failure Status: A total of thirteen failures, including two pattern and one dependent failure, have occurred in the now aborted Reliability Qualification Test on the ARR-75:

i. 1 - Resistor (dependent)
ii. 6 - Mixers (pattern)
iii. 3 - Transformers (pattern)
iv. 1 - RF Filters (isolated)
v. 1 - RF Filters (isolated)
vi. 1 - Connector (isolated)

Failure analysis reports have been officially received by this activity on all but three of the above. Through these reports and information gained during the visit, respective corrective actions are as follows:

i. None (The contractor was informed that substantiation of the dependency of the resistor failure must be made before official failure reclassification)

ii. Noisy diodes manufactured by HP for the MCL mixer have been isolated as the failure mode. Presently, the contractor is screening mixers for all production units.

iii. Open windings induced by thermal shock are the mode of these failures seemingly resulting from the fineness of the winding wire. In concurrence with vendor's (United Transformer Company's) analysis, the corrective action presently incorporated into production units is use of a pre-thermal shocked transformer. An alternative under consideration for future units is use of a "dilesil" type transformer which has a much higher thermal enertia. Choice of corrective action will depend primarily upon required testing and cost effectiveness.

iv-v. All RF filters are presently being subjected to in-house screening procedures.

vi. Faulty mechanical soldering techniques have been determined to be the failure mode of the subject connectors. These connectors are presently being mounted by hand.

Corrective action, as outlined above, has been incorporated into over 90% of the production units. The effect of the corrective action as reflected in the Reliability Acceptance Test (RAT) and screening efforts is as
follows:

i. Not applicable

ii. In-house screening has resulted in rejection of approximately 50% of the MCL mixers. Jim Deering estimated that the screening procedure is roughly 95% efficient. A mixer that failed in the RAT had gone through the screening process and is thought to be a result of the lack of totally efficient screening procedures.

iii. No transformer failures have occurred in the RAT. The thermal shock burn in, in this sense, has been effective.

iv-v. All filters have passed in-house screening procedures and no RAT failures have occurred. To date, the filter failures have thus truely earned the "isolated failure" title.

vi. No connector problems have been encountered since initiation of the hand mounting corrective action.

Concern was expressed for the large number of failures encountered in view of the lack of such failures on a previous EDMAC contract for the ARR-75. The AEL unit has identical parts, design, and test requirements. The contractor (AEL) is presently in the red on the subject contract and is anxious to take action toward reclassification of the RQT failures. Direction was promised concerning these matters during the week of 10 March 1975.

On Visitations and Observations

A Tour of AEL-EMTECH Facilities Founded the Following Remarks:

The Reliability testing facilities were impressive in size and diversity.

- All calibration can be traced to NBS.
- Different DCAS inspect different reliability aspects of the program due to the distance between AEL and EMTECH plants.
- No specific failure analysis facilities exist. Dr. Pessel, a consultant, does much of this type of work. Other analysis is done employing available facilities.
- Screening locations for the mixers and filters were visited. One individual is responsible for each effort.
- DCAS primarily observes testing by contractor invitation. Testing of all final production units is observed by DCAS.

b. Microcom

A tour of facility areas included the engineering design, production, thin film product fabrication, reliability test facilities, and machine shop. The contractor employs extremely rigorous step testing in production and part fabrication. The DKT-38 was observed in such a production profile.
MEMORANDUM

From: 304B (R. J. Marks II)
To: 304B

Subj: TDY Training Report for period 2 - 20 Dec 1974

1. Activities Visited and Persons Contacted: United States Army Management Engineering Training Center (AMETA), Rock Island, IL.
   a. Cary Chittenden
   b. George Kalemkarian

2. Purpose of visit:
   a. To attend course entitled "Elements of Reliability and Maintainability".
   b. To find out information concerning the AMETA course on probabilistic design.

3. Discussion:
   a. An outline of the material covered in the course with corresponding description follows:
      (1) Introduction
         (a) History of and need for reliability and maintainability (R&M).
         (b) Definitions of R&M.
         (c) R&M program philosophy.
      (2) Probability and Statistics
         (a) Review of basic probability definitions and laws.
         (b) Review of probabilistic tools.
            1. Set theory.
            2. "Tree" solutions to problems.
         (c) Common Probability Distributions
1. Weibull
2. Exponential
3. Binomial
4. Bernoulli
5. Poisson
6. Normal
7. Lognormal
8. Gamma

(d) Probability functions used in R & M.
1. Failure density
2. Cumulative failure
3. Reliability
4. Hazard

(e) Statistics
1. Distribution measures.
   a. Central tendency (ex: mean, median).
   b. Dispersion measures (ex: variance, range).

(3) System and Subsystem Reliability Models
(a) Models
1. General procedure
2. Series, parallel and mixed models.
3. Partial and standby redundancies.
4. Reliability apportionment.
   a. AGREE method.
   b. ARINC method.
(a) Monte Carlo simulation

(4) Reliability Demonstration and Testing

(a) Parameter estimation

1. Non-parametric analysis

2. Parametric Analysis
   a. Graphical procedures
   b. Goodness of fit tests.
   c. Normal, Exponential, and Weibull parameter estimations.

(b) Test of hypotheses (for)

1. Normal distributions

2. Weibull distributions

3. Exponential distributions

(c) Acceptance life testing

1. Exponential (MIL-HDBK-108)

2. Weibull
   a. Mean life criterion (MIL-TR3)
   b. Reliable life criterion (MIL-TR6)
   c. Hazard rate criterion (MIL-TR4)

3. Normal (MIL-STD-414)

4. Non-Parametric (MIL-STD-105)

(d) Accelerated life testing

(5) Stress-Strength Analysis

(a) For known distributions

1. Graphical Solutions
2. For Normal densities
   (b) Strength distribution determination
(c) For one-shot items
(6) Maintainability Analysis
   (a) Concepts of Maintainability
   (b) Maintainability functions
   (c) Maintainability indices
      1. Time
      2. Cost
      3. Effectiveness
   (d) Probabilistic Aspects of Maintainability.
   (e) Maintainability Apportionment
   (f) Maintainability Predictions (RCA method).
(7) Introduction to Systems Effectiveness
   (a) The Systems Effectiveness Model (-a function of Availability, Dependability and Capability) from VSEIAC effort.

Course materials obtained are:
1. Text: "Elements of Reliability and Maintainability".
2. Book of problem solutions from text.
4. Copies of:


All above material is published by AMETA, Rock Island, Illinois. Also obtained were copies of probabilistic paper for plotting of exponential, weibull, and normal statistics.

b. The first week course entitled "Introduction to Probabalistic Design for Reliability" will be offered by AMETA starting on 9 June 1975. The course text has not yet been printed, but a copy will be forwarded on completion by request. A bibliography of recent work in probabalistic design may be found in the most recent issue of the IEEE Transactions on Reliability. Materials obtained concerning AMETA include:

(1) AMETA Course book including course listings and abstracts.

(2) A bar graph in time of courses offered by AMETA through 1975.

4. Recommendations:

a. The course taken provides an introductive overview of the philosophy and theory of reliability, maintainability, and systems effectiveness. Although integral and differential calculus are listed as prerequisites, the mechanics of the course can be executed with a firm knowledge of algebra and graph techniques if the concept of topic can be grasped intuitively. Basic probability theory is reviewed, making an apriori knowledge unnecessary. The listed prerequisites are thus thought strong in comparison to the course demands.

b. The quality of instruction, including materials, text, and instructor, was excellent. A slide rule calculator, however, is a helpful, yet unprovided tool for problem working and tests.

c. Overall, the course met its purpose and is recommended as a theoretical introductive overview to all concerned with R & M.

R. J. MARKS II

Copy to:
G. Allen, C. Rice, R. Saum
MEMORANDUM

From: 3041 (R. J. Marks II)
To: 3072 (J. Tumey)
Via: 3041 (C. Rice)


Ref: (a) MIL-R-81859

1. The subject test procedure's reliability provisions have been reviewed for compliance with applicable documents and specifications and has been found to be in need of revision.

2. The following comments apply to the subject test procedure:

   a. It is implied on page 9 and elsewhere that the thermal survey on the ARR-72 has not yet been run. If subsequent running of the thermal surveys concurs with estimate, the procedure should be revised accordingly.

   b. If the thermal survey concurs with estimate:

      (1) Paragraph 3.2, paragraph 4 - substitute "45" for "43" so that paragraph 5 follows.

      (2) Similarly, substitute "45" for "43" on the top of page 6.

      (3) Page 6, last sentence - substitute "5" for "6" and delete "plus the test time required to stabilize at the high temperature".

   c. Paragraph 3.6 - include: the requirements delineated in sections 3 and 4 of the specification (reference (a)).

   d. Paragraph 3.7, end of paragraph 4 - after "has been obtained" add the following sentence: "The procuring activity shall be notified immediately upon the occurrence of a suspicioned pattern failure".

   e. Paragraph 3.7, paragraph 5 - change the phrase "cannot be determined to be determined" to "cannot be determined".

   f. Paragraph 3.9.1 - The first "sentence" is truncated prematurely. Add, at its end, "the equipment will be tested to assure satisfactory operation".

3. It is requested that a copy of your letter be forwarded to Code 3041 (C. Rice).

R. J. MARKS
From: Commanding Officer, Naval Ammunition Depot, Crane, Indiana
To: Kollsman Instrument Company (Mr. J. McAll), 7 Capitol Street, Nashua, NH 03060

Subj: Reliability Test Procedures and Reports for the AAU-31/A Altimeter Contract NO0019-74-C-0212 and AAU-32/A Altimeter Contract NO0019-73-C-0541

Ref: (a) Kollsman ltr OS/44k of 25 Oct 1974
(b) Kollsman ltr LS/75-0031 of 26 Feb 1975
(c) NAD Crane ltr JHS/ofu 13920 of 8 Nov 1975
(d) NAD Crane ltr 3041-RJH:sh 13070 of 27 Mar 1975
(e) NAD Crane ltr 3048-RJH:sh 13070 of 17 Mar 1975

1. Naval Air Systems Command has assigned this activity the responsibility to determine that the Reliability Program requirements for the AAU-31A and AAU-32A altimeters procured under the subject contracts conform to the applicable contractual requirements. This assignment includes the responsibilities for reviewing and taking appropriate action on various aspects of the data requirements.

2. Reliability Test Procedures for the AAU-31/A were submitted by reference (a), revised by the contractor, and resubmitted by reference (b). The necessary modifications required before approval could be granted were requested by reference (c) and reiterated in reference (d). This activity is awaiting resubmittal of this test procedure so that final approval can be granted.

3. Reference (e) requested that copies of test results, failures, and corrective actions be forwarded to this activity on all phases of reliability testing. Reference (f) partially fulfilled this request.

4. During review of reference (f) it was noted that this report was insufficient in meeting requirements delineated in MIL-STD-781B, paragraph 5.11.1. The Reliability Test Reports should also include any testing executed previously to aborts, failures encountered, and the corrective action initiated.
5. Concern is expressed that although Reliability testing on the subject contracts has been in progress several months, reference (f) is the only Reliability Report received to date.

6. Comments contained herein do not authorize or imply any changes in requirements or conditions of the contract or applicable specification.

7. If further information or clarification is required concerning this letter, please contact Mr. J. Selb or Mr. P. J. Marks II at 312-654-1259.

Copy to:
HAWAII'SYS/COM (AIR-53302), (AIR-53351B)
DCA/S (Mr. Manealy, Kollsman)

Blind copy to:
1078 (J. Selb)
From: Commanding Officer, Naval Ammunition Depot, Crane, Indiana 47522
To: Commander, Naval Air Systems Command (AIR-533418)

Subj: Contract NO0019-74-C-0135 for Sonobuoy Receiver AN/URQ-75, Work Unit Assignment C112.158, Reliability Qualification Test, Failure Reclassification Requests

Ref: (a) AEL-EMTECH Reliability Reclassification Request (20136-0049) of 17 Mar 1975 to NAD Crane

1. As requested by Naval Air Systems Command, the Naval Ammunition Depot (Code 3041) has been given responsibility for review and recommendations for NAVAIRSYSCOM action upon reference (a).

2. Reference (a) requests authorization to reclassify 12 relevant failures to non-relevant. Each failure will be listed by part number (P/N) and recommended or not recommended for reclassification. For those not recommended, reasons will be given.

   a. Failure on P/N 99992901 (RF filter) is recommended for reclassification.

   b. Failure on P/N 9999-2900001 (RF filter) is recommended for reclassification.

   c. The three failures on P/N TF5RX13YY (transformers) are recommended for reclassification.

   d. Failure of the Sealectro connector (no P/N) is recommended for reclassification.

   e. The six failures on P/N MCLSRA-1M (mixers) are not recommended for reclassification.

      (1) The occurrence of a similar failure in the Reliability Acceptance Test (RAT), after corrective action was imposed, suggests that the corrective action taken was not totally effective.

      (2) A total of 1650 hours of RAT time has accumulated as of February 1975. In view of this test history and the recently initiated vendor screening, this activity feels that sufficient test data for a reasonable confidence of reclassification would exist upon completion of an additional 350 hours of RAT time without recurrence of the subject failure.
3. If further information or clarification is required, it should be directed to Commanding Officer, Naval Ammunition Depot (Code 3041), Crane, Indiana 47522 or by contacting Mr. R. J. Marks II or Mr. Claude Rice at (812) 854-1299.

Copy to:
NAVAIRSYSCOM (AIR-533D2)
From: Commanding Officer, Naval Ammunition Depot, Crane, Indiana  
To: Kollsman Instrument Company, 3 Capitol Street, Nashua, NH 03060  
Subj: Production Reliability Test Procedure for Altimeter AAU-31/A of  
20 Feb 1975, Contract N00019-74-C-0212  
Ref: (a) NAD Crane ltr 3073-MISS ofw 13920 of 8 Nov 1975  
(b) Production Reliability Test Procedure (not dated) for Altimeter  
AAU-31/A submitted Kollsman ltr BS/mak of 25 Oct 1975 to  
NAD Crane  

1. Reference (a) directed that reference (b) was insufficient in some  
areas and required revisions prior to final approval.  

2. The subject revised test procedure has been reviewed for compliance  
with reference (a) and the following discrepancies were still noted:  

   a. Paragraph 2.5.1.1 Relevant Failure, subparagraph (2) - Delete  
etirely and rewrite to comply with 5.5.1(2) and 5.5.3 MIL-STD-781B.  
   It should be noted that the, "non-reoccurrence of a failure is insufficient  
grounds for deletion of failures".  

   b. Paragraph 2.2.1.4 Attitude Cycle - Include after the first  
sentence -- "The lower cycling limit shall not exceed 1500 ft. and  
the upper cycling limit shall not be less than 48,500 ft. In the second  
sentence delete "such" and insert "altitude".  

3. The above comments must be incorporated in the subject test procedures  
and resubmitted to this activity before approval can be granted. If  
any questions arise, please contact Mr. J. Seib or Mr. C. Rice, 812-854-1299.  

4. No change in the terms or conditions of the subject contract is  
implied or authorized by this letter.  

Copy to:  
NAVAIRSYSCOM (AIR-633O2), (AIR-63301B)  
DCASR (Mr. G. Manley, Kollsman)  

Blind copy to:  
3073 (J. Seib)
From: Commanding Officer, Naval Ammunition Depot, Crane, Indiana
To: Kollsman Instrument Company, 3 Capitol Street, Mashua, WI 53060

Subj: Reliability Test Status Monthly Reports for Altimeter AAU-31/A,
Contract N00019-74-C-0212 and Altimeter AAU-32/A, Contract
N00019-73-C-0541

Ref: (a) Kollsman Instrument Company ltr AU-2.5-75 of 25 Feb 1975
(b) MIL-A-81851(AS) - "Altimeter AAU-31/A"
(c) MIL-A-81852(AS) - "Altimeter AAU-32/A"
(d) MIL-STD-781B - "Reliability Tests: Exponential Distribution"

1. Reference (a) was reviewed and found insufficient in fulfilling contractual reliability data reporting requirements.

2. The subject contracts delineates the Reliability Sampling Phase tests requirements.

3. Paragraph 4.4.3.2.1 of reference (b) and (c) states in part, "at the conclusion of each test, the test results shall be sent to the procuring activity and Naval Air Systems Command. At any time that the test results show a reject situation, the procuring activity shall be notified". The Naval Air Systems Command has assigned this activity the responsibilities for reviewing and taking appropriate action on various aspects of these reports. Therefore, it is requested that copies of test results, failures and corrective actions be forwarded to this activity on all phases of reliability testing of the subject contracts. These reports should include, but not limited to, information specified in reference (d), paragraph 5.11.1.

4. All correspondence concerning reliability sent to this activity shall be addressed to the Commanding Officer, Naval Ammunition Depot (Code 304B), Crane, Indiana. All correspondence addressed to this activity shall be submitted via the cognizant Defense Contract Administration Services Office.

5. Comments contained herein do not authorize or imply any changes in requirements or conditions of the contract or applicable specifications.
6. If further information or clarification is required concerning this letter, it should be directed to Commanding Officer, Naval Ammunition Depot (Code 304B), Crane, Indiana or by telephoning Mr. Robert Marks at 812-854-1299.

S. S. KALBERGER

By direction

Copy to:
NAVAIRSYSCOM (AIR-533D2), (AIR-53351B)
DCASR (Mr. G. Mansely)

Blind copy to:
3073 (J. 51ab)
**PART A: NOTIFICATION OF BASIC PAY**

<table>
<thead>
<tr>
<th>CODE</th>
<th>NATURE OF ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>892</td>
<td>ADMINISTRATIVE PAY INCREASE</td>
</tr>
<tr>
<td>893</td>
<td>QUALITY INCREASE</td>
</tr>
<tr>
<td>894</td>
<td>WITHIN GRADE INCREASE</td>
</tr>
<tr>
<td>OTHER</td>
<td>PAY ADJUSTMENT</td>
</tr>
</tbody>
</table>

| EFFECTIVE DATE | 03-30-75 |

| GRADE OR LEVEL | GS 00855 |

| EMPLOYEE'S DATE | 01-01-75 |

**PART B: DATA ON UNPAID ABSENCE**

| PERIOD(S) | NONE |

**PART C: PAYROLL CHANGE DATA**

<table>
<thead>
<tr>
<th>BASE PAY</th>
<th>OVERTIME</th>
<th>GROSS PAY</th>
<th>FEDERAL TAX</th>
<th>FICA</th>
<th>STATE TAX</th>
<th>BOND</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PREV. NORM.</th>
<th>NEW NORM.</th>
<th>THIS PYR.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>CSR</th>
<th>GROUP LIFE INS</th>
<th>HEALTH BENEFITS</th>
<th>ORGAN. DUES</th>
<th>NET PAY</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>PREV. NORM.</th>
<th>NEW NORM.</th>
<th>THIS PYR.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>APPROPRIATIONS</th>
<th>27. PREPARED BY</th>
<th>28. AUDITED BY</th>
</tr>
</thead>
</table>

**PART D: REMARKS**

I CERTIFY THAT THE ABOVE-NAMED EMPLOYEE'S WORK (IS / IS NOT) OF AN ACCEPTABLE LEVEL OF COMPETENCE AS REQUIRED BY THE FEDERAL SALARY REFORM ACT OF 1983 AND PFM 531 AND HAS BEEN DISCLOSED WITH EMPLOYEE CONCERNED (EMPL INIT)...
ACCOMPLISHMENTS, DUTIES AND RESPONSIBILITIES (1974-5)

Thermal Stability Program
-Generation of all reports (weekly, quarterly, etc)
-Formulation of test procedure
-Unofficial supervision and training of three engineering aids
-Unofficial supervision of electronic technition
-Responsibility for all testing
-Coordination of computer Data Analysis effort

Production Reliability Surveillance
-Projects Responsibilities
  Attend and participate in conferences as necessary
  Advise contractor of appropriate action for facilitation of testing
  Review contractor’s proposed test procedures and reliability system’s analysis
  Update and maintain test data files
  Determine adequacy of contractor’s test facilities via in-plant surveillance
  Establish liaison with Inspector in order to give assistance in test supervision and test procedure interpretation
  Report to procuring activity any poor design or production practices and recommend improvements
  Obtain and review reliability test reports
-Other efforts
  Expansion of Built-in Test System Effectiveness measures
  Revision of statistical portions of in-house documents

Preferred Parts List
-Development of categories
-Assistance in first draft listing
-Unofficial supervision of Engineer
**AMENDMENT TO PERSONAL QUALIFICATIONS STATEMENT**

This form may be used to update your Personal Qualifications Statement provided you have had no more than three additional positions since the statement being updated was completed. Agencies are required to accept a previously completed Personal Qualifications Statement as current when this form is attached. Before completing this form, review carefully your answers to all items on the statement being updated. Use typewriter if available. Otherwise write or print legibly in dark ink.

### 1. NAME (Last) (First) (Middle) (Maiden, if any) [ ] MR.  [ ] MISS  [ ] MRS. [ ] AOI!II!SS

- Marks, Robert, Jackson II
- Apt. 362, 3111 Leonard Springs Rd.
- Bloomington, Ind., 47401

### 2. DATE OF THIS STATEMENT

- 3-10-75

### 3. BIRTH DATE (month, day, year)

- 8-25-50

### 4. KIND OF POSITION YOU ARE FILING FOR (Or title and number of announcement)

- Electronics Engineer

### 5. REASON FOR SUBMISSION (Check One)

- [ ] To update Personal Qualifications Statement in my Official Personal Folder
- [ ] To update Personal Qualifications Statement on file with you
- [ ] To update attached Personal Qualifications Statement
- [ ] As requested

### 6. LOWEST PAY OR GRADE YOU WILL ACCEPT

- PAY
- GRADE

### 7. EXPERIENCE (Start with your PRESENT position and work back. Account for periods of unemployment in separate blocks in order)

May inquiry be made of your present employer regarding your character, qualifications, and record of employment? [ ] Yes [ ] No (A "No" will not affect consideration for employment opportunities.)

#### DATES OF EMPLOYMENT (month, year)

<table>
<thead>
<tr>
<th>FROM</th>
<th>TO</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-25-74</td>
<td>PRESENT TIME</td>
</tr>
</tbody>
</table>

#### SALARY OR EARNINGS

<table>
<thead>
<tr>
<th>STARTING $</th>
<th>PER</th>
</tr>
</thead>
<tbody>
<tr>
<td>12,841</td>
<td>yr</td>
</tr>
</tbody>
</table>

#### AVG. HRS. PER WEEK

| 40 |

#### PLACE OF EMPLOYMENT

| Crane |
| Ind. |

#### NUMBER AND KIND OF EMPLOYEES SUPERVISED

- NAD Crane

#### KIND OF BUSINESS OR ORGANIZATION

- Manufacturing, accounting, insurance, etc.

#### NAME OF IMMEDIATE SUPERVISOR

- Bob Saum

#### NAME OF EMPLOYER (firm, organization, etc.) AND ADDRESS (including ZIP Code, if known)

- 812-854-1370

#### DESCRIPTION OF DUTIES, RESPONSIBILITIES, AND ACCOMPLISHMENTS

See attached sheet

---

### FOR AGENCY USE (skill codes, etc.)

#### DATES OF EMPLOYMENT (month, year)

<table>
<thead>
<tr>
<th>FROM</th>
<th>TO</th>
</tr>
</thead>
</table>

#### SALARY OR EARNINGS

<table>
<thead>
<tr>
<th>STARTING $</th>
<th>PER</th>
</tr>
</thead>
</table>

#### AVG. HRS. PER WEEK

| 40 |

#### PLACE OF EMPLOYMENT

|  |

#### NUMBER AND KIND OF EMPLOYEES SUPERVISED

- NAD Crane

#### KIND OF BUSINESS OR ORGANIZATION

- Manufacturing, accounting, insurance, etc.

#### NAME OF IMMEDIATE SUPERVISOR

- Bob Saum

#### NAME OF EMPLOYER (firm, organization, etc.) AND ADDRESS (including ZIP Code, if known)

#### DESCRIPTION OF DUTIES, RESPONSIBILITIES, AND ACCOMPLISHMENTS

---

THE FEDERAL GOVERNMENT IS AN EQUAL OPPORTUNITY EMPLOYER

Standard Form 172

U.S. Civil Service
POSITION OR JOB DESCRIPTION

See Instructions on Reverse

ON OR JOB TITLE

SCHD.
SERV.

GRADE/
PAY LEVEL
FORMULA

CLASS-
IFIERS
INITIALS

CLASSIFICATION OR RATING OFFICIAL

(Signature, Title and Date)

FIRST ACTION

RECOMMENDED

Engineer

GS 855 11

POSITION OR JOB LOCATION

NAME AND LOCATION

Crosly, Indiana

SYSTEMS EFFECTIVENESS

1. ORGANIZATIONAL SUBDIVISION

Evaluation Division

SYSTEMS & COMPONENTS DIVISION

12. EMPLOYEES NOW PERFORMING DUTIES (Ungraded jobs only)

REASON FOR SUBMISSION

CERTIFICATIONS:

The description of the duties and responsibilities of this position or job is complete and accurate.

13. DUTIES AND RESPONSIBILITIES NOT ELSEWHERE DESCRIBED - COMPLETE DESCRIPTION ATTACHED.

ATTACHED AMENDMENT NO.

POS. OR JOB #

CLASS. OR RATING

TO-

IDENTICAL TO-

ATTACHED STATEMENT OF DIFFERENCE TO-

REPLACES-

OTHER (Specify)

19. SIGNATURE (Employer)

DATE

20. SIGNATURE AND TITLE (Immediate supervisor)

DATE

R. SNM

MGR. SYSTEM EFFECTIVENESS SECTION

(Position No., Classification or Rank)

21. SIGNATURE AND TITLE (Person authorized to establish position or job)

DATE

V. WAGG, Deputy Director, OE Dept.

The description of the duties and responsibilities of this position or job is complete and accurate.

If the classification of this position may be appealed by the incumbent at any time. Appeals from classification action result in demotion or reduction in compensation must be timely in order for retroactivity to apply. Our classifier or appropriate activity instruction for procedures. Civil Service Commission classification standards and Department of the Navy classification guides are available for review in the Wage and Classification Office.
**POSITION OR JOB DESCRIPTION**

<table>
<thead>
<tr>
<th>ON OR JOB TITLE</th>
<th>CLASS. OR RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electronic Engineer</strong></td>
<td><strong>655</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASSIFICATION OR RATING OFFICIAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Signature, Title and Date)</td>
</tr>
</tbody>
</table>

**REASON FOR SUBMISSION**

<table>
<thead>
<tr>
<th>12. EMPLOYEES NOW PERFORMING DUTIES (Ungraded jobs only)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**CERTIFICATIONS:**

The description of the duties and responsibilities of this position or job is complete and accurate.

<table>
<thead>
<tr>
<th>19. SIGNATURE (Employer)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>20. SIGNATURE AND TITLE (Supervisor)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

**CLASSIFICATION OR RATING**

<table>
<thead>
<tr>
<th>PD</th>
<th>JO</th>
<th>NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**REMARKS**

The classification of this position may be appealed by the incumbent at any time. Appeals from classification actions which result in demotion or reduction in compensation must be timely in order for retroactivity to apply. Consult your classifier or appropriate activity instruction for procedures. Civil Service Commission classification standards and Department of the Navy classification guides are available for review in the Wage and Classification Office.

<table>
<thead>
<tr>
<th>21. SIGNATURE AND TITLE (Person authorized to establish position or job)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>N. VIBER, Deputy Director, CE Dept.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
</tbody>
</table>
INSTRUCTIONS FOR COMPLETING FORM NAVSO 12510/7

FOR GRADED POSITIONS

Optional. Form 8 is to be used for proposed actions to GS-16, GS-17, or GS-18—see NCPI.

General instructions for preparing position specifications are contained in NAVSO 12510/7A. (Special instructions are contained in applicable Question Lists.)

2. To be executed only by persons who have been officially authorized to take classification action. Space is provided for taking separate actions on the same position; the action to be taken is to be clearly indicated. Additional action may be on maintenance review or application of new standards, etc. The Position must be the official title authorized in Navy standards, NAVEXOS P-2440, or other relevant instructions. The classification action must be the official title authorized to fill the position.

Optional. A recommendation should reflect the judgment of the originator.

Enter name of employee regularly performing work. If not regularly performed, enter "NT."

"Location" means city and state.

Draft 10. Enter as many organizational subdivisions as necessary to show the one in which position is located.

Optional.


Draft 17. Complete whenever the position superseded out of which it has developed in whole or in part. This information is necessary for posting continuity and to provide personnel processes.

Optional. Examples of other reasons are "Survey," "Evaluation," and "Checklist."

Signature optional unless required by the rating official.

Draft 21. MUST be executed before forwarding to rating official.

For optional notations by classification e.g., brief evaluation reports, reference to CSC postaudits, competitive levels, statements on filling position, or requirements of personnel position, this space should also be used to identify authority determining critical and "disability" positions on interdisciplinary series.

Position of duties and responsibilities normally typed on plain bond paper and inserted in NAVSO 12510/7. Very brief descriptions of short amendments, state differences, or checklist descriptions if space permits, may be inserted in Item 22.

FOR UNGRADED POSITIONS

(Note: General instructions for preparing job descriptions are contained in NAVSO 12510/7B. Special instructions for Masters and Foremen are given in NCPI 531, Encl. 5.)

In upper right-hand corner, check the "JD" box.

Draft 1, 2, & 3. To be executed only by persons who have been officially authorized to take a rating action. Space is provided for taking separate actions on the same job. This permits recording subsequent re-rating actions taken by the activity, as on maintenance review or application of new rating definitions, or by management bureau or OCM.

Draft Job Title. Enter the official title authorized in NCPI 531, current OCMN Notices, or OCM letters of authorization. (For supervisory rating with a special designator, such as "Public Works," indicate the "rating concerned" in Item 22.)

Draft Service. Enter appropriate Service, such as "W" (General Wage), "C" (Commissary), etc.

Draft Pay Level or Formula. Enter pay level for rating, e.g., "W-11" for Plumbers; or pay formula, e.g., "WF-18" for Leadingmen Carpenter.

Rating Official. This is a person officially authorized to make rating determinations.

4 & 5. Optional.

Draft 6. "Location" means city and state.

Draft 7 through 10. Enter as many subdivisions as needed to locate the job.


Draft 12. Enter the number of employees, by title, now performing work of the job, or "none," as appropriate.


Draft 15 and 16. Optional. Activation may cite the appropriate P-1005 rating definition by number, in lieu of describing the job, when the P-1005 definition adequately covers most or all of the duties performed.


Draft 18. For actions not covered by items 13 through 17.


Draft 20 and 21. MUST be completed before forwarding to rating official.

Draft 22. To be used by rating office for purposes similar to those described in Item 22 for graded positions.

Draft 23. Optional. May be used for recording findings on maintenance review.
I. **Introduction**

This position is located in the Systems Effectiveness Section, Avionics Equipment Branch, Electronic Systems and Components Division, O. E. Department. This section is responsible for development and implementation of a program for analysis and prediction of reliability and maintainability of aircraft electronic equipment and systems. The incumbent will perform engineering studies and analysis in implementing various aspects of the program as assigned.

II. **Major Duties and Responsibilities**

As assigned, accomplishes project work of the following nature in connection with the full range of Avionics equipments and systems under section cognizance:

A. Reviews and evaluates the reliability and maintainability portions of technical development plans and proposals submitted by the avionics equipment manufacturers to NAVAIRSYSCOM. For projects assigned to this activity by NAVAIRSYSCOM, will serve as project manager with responsibilities of keeping NAVAIRSYSCOM fully informed of progress and major obstacles requiring program changes for the R & M portions of major NAVAIRSYSCOM R & D or production contracts. In this capacity, the incumbent will review and provide detailed comments and/or recommendations on program plans, test procedures, math models, predictions, and testing reports as pertain to the reliability and/or maintainability of the system.
a. Develops specifications for reliability and maintainability testing, prediction, estimations, calculations, and design analysis for a wide range of electronic and electromechanical equipment.

C. Evaluates contractors' work on projects involving studies in various aspects of systems effectiveness including writing of handbooks on failure rates and general reliability techniques, computer techniques for reliability analysis and specification writing. Participates in and coordinates continuing survey of electronic industry to maintain up-to-date knowledge of reliability testing and assurance methods and procedures.

D. Performs or coordinates studies for the purpose of establishing optimum methods and procedures for determining reliability and operation problem areas of avionics equipment in Fleet use. This includes performing reliability and maintainability analyses on this equipment as necessary as well as intensive study of methods used in the Fleet for trouble-shooting, repairing and reporting failures and problem areas. Develops or participates in development of methods for the efficient handling and analysis of this data (including computer application) and generates reports and recommendations to Naval Air Systems Command for implementation of same. This function requires considerable liaison effort between the Fleet, prime contractors, manufacturers, and Naval Air Systems Command. This liaison is usually accomplished by the incumbent.

E. Performs special engineering investigations on electronic systems which are performing below the specified reliability level in the Fleet. The incumbent will gather such failure data as is available, review the applicable specifications, review the design and installation of the system
and utilizing such techniques as circuit analysis, math modeling, failure rate predictions, redundancy, etc. will provide to NAVAFSYSCOM such recommendations as will correct the areas of deficiency and improve the reliability of the systems. Such recommendations might include changing the inherent design, changing materials or circuitry, requiring new tests or methods of testing in the applicable specifications.

E. Performs tests on selected avionics equipment to determine the Mean-Time-Between-Failures. This includes responsibility for assuring adequacy of both the environmental and testing set-ups, for performing the tests, for evaluating the data, and for preparing the final report.

III. Controls Over the Position

This position is under the supervision of the Manager of the Systems Effectiveness Section, Electronic Engineer. Instructions as to priorities and time limitations are normally provided with new assignments. The incumbent is responsible for determining the proper approach, planning, and carrying out the project assignments with assistance only on the more unprecedented problems encountered. Technical problems of this nature as well as those involving policy matters are usually discussed jointly with the Section and Branch Managers. Completed work is reviewed for general adequacy in meeting program objectives and policy conformance. Written guides utilized include engineering handbooks and textbooks, military specifications, technical reports and studies, etc. A portion of the work includes consideration of areas for which little or no precedent exists.
IV. Qualification Requirements of the Work

This position requires knowledge of scientific and engineering principles and theories in the field of electronics and related fields such as can be learned through completion of a full four-year curriculum in electronic engineering or physics plus appropriate experience in the particular area of application or work closely related thereto.
Personal

Married    6' 1"    190lbs    8-25-50

Paul Dean Ford
Pres. of Ford FM Inc.
RR2, Box 50, W Terre Haute, Ind.

Dr. Thomas F. Krile
Prof. of Electrical Engineering

Dr. Harold A. Sabbagh
Prof. of Electrical Engineering and Physics

(Both Dr. Krile and Dr. Sabbagh are employed at NAD Crane and may be reached during regular working hours at Bldg. 2530, 854-1363)

ADDITIONAL REFERENCES FURNISHED ON REQUEST
### PERSONAL QUALIFICATIONS STATEMENT

**STANDARD FORM 171**

**PERSoval QUALIFICATIONS STATEMENT**

**OPTICS RESEARCH AND RELATED AREAS**

**C. Options for which you wish to be considered (if listed in announcement)**

- [ ] Crane Naval Ammunitions Dep't

**1. Home phone (including Area Code)**

- 812-234-2570

**2. Office phone (including Area Code)**

- PHONE: NONE

**3. Name (Last) (First) (Middle) (Maiden, if any)**

- MARKS ROBERT JACKSON II

**4. Address (Number, Street, City, State, and ZIP Code)**

- 1308 Oakview Blvd. Garfield Hts., Ohio 44125

**5. Legal or voting residence (State)**

- Indiana

**6. Height without shoes**

- 6 Feet 1 inches

**7. Weight**

- 185 lbs.

**8. Birthplace (City and State, or foreign country)**

- Sutton, West Virginia

**9. Date of birth (Month, day, year)**

- 8/25/50

**10. Social Security Account Number**

- [Redacted]

**11. If you have ever been employed by the Federal Government as a civilian, give your last classification series, grade, and job title.**

- N.A.

**12. If you are currently on a list of eligibles for appointment to a Federal position, give the name of the announcement, the name of the office maintaining the list, the date on your notice of rating, and your rating.**

- N.A.

**13. Lowest pay or grade you will accept**

<table>
<thead>
<tr>
<th>PAY</th>
<th>GRADE</th>
</tr>
</thead>
<tbody>
<tr>
<td>$9,400 per year</td>
<td></td>
</tr>
</tbody>
</table>

**14. When will you be available?**

- IMMEDIATELY

**15. Will you accept temporary employment for:**

<table>
<thead>
<tr>
<th>Acceptance or refusal of temporary employment will not affect your consideration</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>1 month or less</em></td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td><em>1 to 4 months</em></td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td></td>
</tr>
</tbody>
</table>

**16. Where will you accept a job?**

<table>
<thead>
<tr>
<th>Option</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washington, D.C.</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Any place in the United States</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Outside of the United States</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Only in (specify): Crane, Ind.</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

**17. Will you accept less than full time work?**

<table>
<thead>
<tr>
<th>Option</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td></td>
</tr>
</tbody>
</table>

**18. Are you willing to travel? (Check one)**

- NO
- SOME
- OFTEN

**19. VETERAN PREFERENCE. Answer all parts. If a part does not apply to you, answer “No.”**

<table>
<thead>
<tr>
<th>Part</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Have you ever served on active duty in the United States military service? (Exclude tours of active duty for training as a reservist or Guardian.)</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>B. Have you ever been discharged from the armed services under other than honorable conditions? (You may omit any such discharge changed to honorable by a Discharge Review Board or similar authority.)</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>C. Do you claim 5-point preference based on active duty in the armed forces?</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>D. Do you claim 10-point preference?</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>E. List Dates, Branch, and Serial or Service Number of All Active Service (Enter &quot;N/A&quot; if not applicable)</td>
<td>From</td>
<td>To</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Branch of Service</th>
<th>Serial or Service Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>N.A.</td>
<td>N.A.</td>
</tr>
</tbody>
</table>

**THE FEDERAL GOVERNMENT IS AN EQUAL OPPORTUNITY EMPLOYER**

Standard Form 171
September 1971 U.S. Civil Service Commission
171-193
ATTACH ADDITIONAL SHEETS OR FORMS HERE
* ANSWER ALL QUESTIONS CORRECTLY AND FULLY

21. A. Special qualifications and skills (knowledge of machines; patents or inventions; your most important publications; do not submit copies unless requested; your public speaking and publications experience; membership in professional or scientific societies; etc.)

   1) OPTICS: "Holographic Recording of Optical Space Variant Systems" (Master's Thesis), Familiarity with Fourier Optics and Holography Theory, Experience in the Optics Lab and in Optics Research.

   2) Member of IEEE

   3) Teaching Experience (Physics Lab Instructor)

   4) Fifty Three Musical Compositions Copyrighted

B. Kind of License or Certificate (For example, pilot, registered nurse, lawyer, radio operator, C.P.A., etc.)

   FCC Third Phone License

   C. State or other licensing authority

   D. Year of first license or certificate

   E. Year of latest license or certificate

   F. Approximate number of words per minute: Typing Shorthand

22. A. Did you graduate from high school, or will you graduate within the next nine months?

<table>
<thead>
<tr>
<th>YEAR</th>
<th>MONTH</th>
<th>GRADE COMPLETED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1968</td>
<td>6-6</td>
<td>HONORS</td>
</tr>
</tbody>
</table>

B. Name and location (city and State) of last high school attended

   GARFIELD HTS. HIGH SCHOOL

   GARFIELD HTS., OHIO

C. Name and location (city, State, and ZIP Code if known) of college or university. (If you expect to graduate within 9 months, give MONTH and year you expect degree.)

   Rose-Hulman Institute of Technology

   930 16th Street, Terre Haute, Indiana

D. Chief undergraduate college subjects

   No. of credits completed

   Semester hours | Quarter hours
   ----------------|-----------------|
   4              |                |

   E. Chief graduate college subjects

   No. of credits completed

   Semester hours | Quarter hours
   -----------------|-----------------|
   4              |                |

F. Major field of study at highest level of college work

   Fourier Optics

   Communication Systems

   (See Attached Transcript)

   Thesis (Optics Research)

   Acoustics

   (See Attached Transcript)

   Electrical Engineering

   G. Other schools or training (for example, trade, vocational, armed forces, or business). Give for each the name and location (city, State, and ZIP Code if known) of school, dates attended, subjects studied, number of classroom hours of instruction per week, certificates, and any other pertinent data.

   Sanderson Ground School (Chagrin Falls Airport, Chagrin Falls, Ohio 44022)

23. Honors, Awards, and Fellowships Received

   (1) Rose Honor Key for Outstanding Academic and Extra-Curricular Activities

   (2) Tuition Grant (1972-73 at Rose-Hulman)

24. Languages Other Than English

   List the languages and indicate your knowledge of each by placing "X" in proper columns

   Reading | Speaking | Understanding | Writing
   -------|----------|---------------|-------
   Excl | Good | Fair | Excl | Good | Fair | Excl | Good | Fair
   None

25. References. List three persons who are NOT related to you and who have definite knowledge of your qualifications and fitness for the position for which you are applying. Do not repeat names of supervisors listed under Item 20, Experience.

   DR. THOMAS F. KRILE
   418 Lasalle Dr., Terre Haute, Ind. 47802
   47895
   Prof. of Electrical Engineering at Rose-Hulman

   DR. HAROLD A. SABBAGH
   20 Douglas Place, Terre Haute, Ind. 47802
   Prof. of Mathematics at Rose-Hulman

   OR ARMAND V. SMITH
   130 Bluebird Dr., Terre Haute, Ind. 47802
   Institute
### 1. Experience Block

<table>
<thead>
<tr>
<th>Dates of employment (month, year)</th>
<th>Exact title of position</th>
<th>If Federal service, civilian or military grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>From 9 - 71 To PRESENT TIME</td>
<td>DISC JOCKEY (PROGRAM DIRECTOR)</td>
<td>N.A.</td>
</tr>
<tr>
<td>Salary or earnings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starting $ 1.85 per HOUR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Present $ 2.00 per HOUR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg. hrs. per week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FULL TIME</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place of employment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W. TERRE HAUTE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State: INDIANA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number and kind of employees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>supervised</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kind of business or organization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(manufacturing, accounting, insurance, etc.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reason for leaving</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO PROFESSIONAL FUTURE IN FIELD OF INTEREST</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 2. Experience Block

<table>
<thead>
<tr>
<th>Dates of employment (month, year)</th>
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<th>If Federal service, civilian or military grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>From To</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salary or earnings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starting $ 52,200 per week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final $ 1,400 per week</td>
<td></td>
<td></td>
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<tr>
<td>Avg. hrs. per week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FULL TIME</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Place of employment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W. TERRE HAUTE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State: MICHIGAN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number and kind of employees</td>
<td></td>
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</tr>
<tr>
<td>supervised</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kind of business or organization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(manufacturing, accounting, insurance, etc.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 3. Experience Block

<table>
<thead>
<tr>
<th>Dates of employment (month, year)</th>
<th>Exact title of position</th>
<th>If Federal service, civilian or military grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>From To</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salary or earnings</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starting $ 5,200 per week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final $ 5,000 per week</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg. hrs. per week</td>
<td></td>
<td></td>
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<tr>
<td>FULL TIME</td>
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<td></td>
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<tr>
<td>Place of employment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>W. TERRE HAUTE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State: INDIANA</td>
<td></td>
<td></td>
</tr>
<tr>
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</tr>
<tr>
<td>supervised</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kind of business or organization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(manufacturing, accounting, insurance, etc.)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
ANSWER ITEMS 26 THROUGH 36 BY PLACING AN "X" IN THE PROPER COLUMN

<table>
<thead>
<tr>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>26. Are you a citizen of the United States?</td>
<td></td>
</tr>
<tr>
<td>&quot;Yes,&quot; give country of which you are a citizen:</td>
<td></td>
</tr>
<tr>
<td>27. Are you now, or within the last ten years have you been, a member of:</td>
<td></td>
</tr>
<tr>
<td>The Communist Party, U.S.A., or any subdivision of the Communist Party, U.S.A.?</td>
<td></td>
</tr>
<tr>
<td>28. An organization that to your present knowledge seeks the overthrow of the constitutional form of government of the United States by force or violence or other unlawful means?</td>
<td></td>
</tr>
<tr>
<td>(A) The name of the organization? (B) The dates of your membership? (C) Your understanding of the aims and purposes of the organization at the time of your membership?</td>
<td></td>
</tr>
<tr>
<td>29. To insure that you are not placed in a position which might impair your health, or which might be a hazard to you or to others, we need information about the following: Do you have, or have you had, heart disease, a nervous breakdown, epilepsy, tuberculosis, or diabetes?</td>
<td></td>
</tr>
<tr>
<td>If your answer is &quot;Yes,&quot; concerning any one of these, identify which one(s) and give details in Item 37.</td>
<td></td>
</tr>
<tr>
<td>30. Within the last five years have you been fired from any job for any reason?</td>
<td></td>
</tr>
<tr>
<td>If your answer is &quot;Yes,&quot; give details in Item 37. Show the name and address (including ZIP Code) of employer, approximate date, and reasons in each case. This information should agree with your answers in Item 20. EXPERIENCE.</td>
<td></td>
</tr>
<tr>
<td>31. Within the last five years have you ever quit a job after being notified that you would be fired?</td>
<td></td>
</tr>
<tr>
<td>If your answer is &quot;Yes,&quot; give details in Item 37. Show the name and address (including ZIP Code) of employer, approximate date, and reasons in each case.</td>
<td></td>
</tr>
<tr>
<td>32. Have you ever been convicted of an offense against the law or forfeited a collateral, or are you now under charges for any offense against the law?</td>
<td></td>
</tr>
<tr>
<td>(You may omit: (1) traffic violations for which you paid a fine of $10.00 or less; and (2) any offense committed before your 21st birthday which was finally adjudicated in a juvenile court or under a Youth Offender law.)</td>
<td></td>
</tr>
<tr>
<td>If your answer to Item 27 or 28 is &quot;Yes,&quot; write your answers to the following questions in Item 37 or on a separate piece of paper: (a) the offense; (b) the name and address of the court; (c) the date; (d) place; (e) court; and (f) action taken.</td>
<td></td>
</tr>
<tr>
<td>33. Have you ever been suspended from school?</td>
<td></td>
</tr>
<tr>
<td>If your answer to Item 32 or 33 is &quot;Yes,&quot; give details in Item 37. Show for each offense: (1) date; (2) place; (3) charge; (4) action taken.</td>
<td></td>
</tr>
<tr>
<td>34. Does the United States Government employ in a civilian capacity or as a member of the Armed Forces any relative of yours (by blood or marriage)?</td>
<td></td>
</tr>
<tr>
<td>(A) Your understanding of the aims and purposes of the organization at the time of your membership?</td>
<td></td>
</tr>
<tr>
<td>(C) Your understanding of the aims and purposes of the organization at the time of your membership?</td>
<td></td>
</tr>
<tr>
<td>35. Do you live with, or within the past 12 months have you lived with, any of these relatives who are employed in a civilian capacity?</td>
<td></td>
</tr>
<tr>
<td>(1) Name of employer, approximate date, and present address (including ZIP Code); (2) relationship; (3) appointment held; (4) date of hire.</td>
<td></td>
</tr>
<tr>
<td>36. Do you receive or do you have a pending application for retirement, or other compensation based upon military, Federal civil, or District of Columbia Government service?</td>
<td></td>
</tr>
<tr>
<td>If your answer is &quot;Yes,&quot; give details in Item 37.</td>
<td></td>
</tr>
</tbody>
</table>

Your Statement cannot be processed until you have answered all questions, including Items 26 through 36 above. Be sure you have placed an "X" to the left of EVERY number listed above, either in the "Yes" or the "No" column.

37. Space for detailed answers. Indicate Item number to which answers apply.

<table>
<thead>
<tr>
<th>Item No.</th>
<th>34</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) EDWARD HERSMAN - UNCLE (NASA: CHEMICAL ENGINEER)</td>
<td></td>
</tr>
<tr>
<td>237 FAIRVIEW AVE., DOYLESTOWN, PENNSYLVANIA</td>
<td></td>
</tr>
<tr>
<td>2) JOHN ANDERSON - UNCLE (IRS)</td>
<td></td>
</tr>
<tr>
<td>4415 ISLAND RD., 305 BAY POINT, MIAMI FLORIDA 33137</td>
<td></td>
</tr>
<tr>
<td>3) TROY MILLER - SPOUSE OF FIRST COUSIN (U.S. AIR FORCE)</td>
<td></td>
</tr>
<tr>
<td>BASE TRADER COURT, GOLDSBORO, N. CAROLINA 27530</td>
<td></td>
</tr>
<tr>
<td>4) RAY HERSMAN - UNCLE (DECEASED) (CIVIL ENGINEER)</td>
<td></td>
</tr>
<tr>
<td>% Rt. 2, BOX 4940, NEW ALBANY, INDIANA</td>
<td></td>
</tr>
</tbody>
</table>

If more space is required, use full sheets of paper approximately the same size as this page. Write on EACH sheet your name, birth date, and registration number and the page number. Attach all sheets to this Statement at the top of Page 3.

ATTENTION — THIS STATEMENT MUST BE SIGNED

Read the following paragraph carefully before signing this Statement.

A false answer to any question in this Statement may be grounds for not employing you, or for dismissing you after you begin work, and may be punishable by fine or imprisonment (U.S. Code Title 18, Sec. 1001). All statements are subject to investigation, including a check of your fingerprints, police records, and former employers. All the information you give will be considered in reviewing your Statement and is subject to investigation. A false answer to Items 27 or 28 could deprive you of your right to an appeal when you reach retirement age. In addition to the penalties described above.

CERTIFICATION

I CERTIFY that all of the statements made in this Statement are true, complete, and correct to the best of my knowledge and belief, and are made in good faith.

SIGNATURE (Sign in ink) |

Robert J. Marks II |

DATE SIGNED 8-20-73 |
1. Working outside of P.D.'s (A.R. 34 revision)
   (Passing the sour grapes)
2. Imply - no I1's until 13's, but 13's are froze
3. Personal, upon hiring, states 11 is engineer's journeyman level
4. Statement: I20 work will get an 11
5. 11 total in the same boat
6. George Allen & Brian promoted in 8.S.'s absence
7. Sponsors fund for 11 position (A.V.E.)
   (GS-11 step 2)
8. Low opinion of position
9. We have been given no 11 criteria.
I. INTRODUCTION

This position is located in the System's Effectiveness Branch, Plans and Programs Division, Weapons Quality Engineering Center.

The incumbent will perform within a group that has broad responsibilities in program management, systems effectiveness analysis and evaluation, preparation and evaluation of specifications and standards, testing and professional consulting. The incumbent will also perform engineering studies and analysis in implementing various aspects of the program.

II. MAJOR DUTIES AND RESPONSIBILITIES

The incumbent accomplishes project work of the following nature in connection with the full range of Avionics systems and instruments branch cognizance:

A. Reviews and evaluates the reliability and maintainability portions of technical development plans and proposals submitted by the equipment manufacturers to customers including ASO, NAVAIR, NAVSEA and NAVELEX. For projects assigned to this activity by the customer, will serve as project manager with responsibilities of keeping customer fully informed of progress and major obstacles requiring program changes for the R & M portions of major R & D or production contracts. In this capacity, the incumbent will review and provide detailed comments and/or recommendations on program plans, test procedures, math models, predictions, and testing reports as pertain to the reliability and/or maintainability of the system. Reliability testing will include Reliability Development (Test, Analyze, and Fix) Tests, Reliability Demonstration (Qualification) Tests, and Reliability Production Acceptance Tests. Maintainability testing consists of the maintainability demonstration.
B. Writes, reviews, revises specifications for reliability and maintainability testing, prediction, estimations, calculations, and design analysis for a wide range of electronic and electromechanical equipment.

C. Evaluates contractors' work on projects involving studies in various aspects of systems effectiveness including writing of handbooks on failure rates and general reliability techniques, computer techniques for reliability analysis and specification writing. Participates in and coordinates continuing survey of electronic industry to maintain up-to-date knowledge of reliability testing and assurance methods and procedures.

D. Performs or coordinates studies for the purpose of establishing optimum methods and procedures for determining reliability and operation problem areas of avionics equipments in Fleet use. This includes performing reliability and maintainability analyses on this equipment as necessary as well as intensive study of methods used in the Fleet for trouble-shooting, repairing and reporting failures and problem areas. Develops or participates in development of methods for the efficient handling and analysis of this data (including computer application) and generates reports and recommendations to the customer for implementation of same. This function requires considerable liaison effort between high level management personnel within governmental agencies and industry. This liaison is accomplished by the incumbent.

E. Performs special engineering investigations on electronic systems which are performing below the specified reliability level in the Fleet. The incumbent will gather such failure data as is available, review the applicable specifications, review the design and installation of the system
and utilizing such techniques as circuit analysis, math modeling, failure rate predictions, redundancy, etc. will provide the customer such recommendations as will correct the areas of deficiency and improve the reliability of the systems. Such recommendations might include changing the inherent design, changing materials or circuitry, requiring new tests or methods of testing in the applicable specifications.

F. Reviews specifications of equipment containing Built-In-Test features for compliance with AR-10 and related publications. Prepares special reports on BIT functions for these equipments.

G. Performs Reliability and maintainability surveillance and engineer support which includes the following functions:

1. Attends and participates in program reviews and other conferences as necessary and as requested by the customer.

2. Becomes informed and involved during development stage of the R/1 programs in order to assure the intent of the contract is achieved.

3. Becomes thoroughly familiar with the design and performance requirements of equipments by reviewing applicable specifications and documents through contracts with management personnel within industry and government.

4. Assist customer in evaluating the contractors Reliability and Maintainability program plans and any associated test plans. Make recommendation to customer for approval or disapproval of plans. Approve or disapprove associated test procedures. Assist contractor in preparation or correction of these plans and procedures as necessary.
5. Review reliability and maintainability prediction analyses and derating analyses and provide comments to customer.

6. Monitor thermal surveys and comment to customer upon appropriateness.

7. Assist the customer and contractor in interpretation of reliability results and classification of failures. Analyze the test rationale and report to customer on all findings. Coordinate with DCAS for their witnessing of equipment performance testing and for verifying reliability test time. Provide guidance to DCAS in performing this function. Review failure analyses and failure reports, failure analysis reports and corrective actions, and provide recommendations to the customer regarding their appropriateness. Review the reliability test reports and recommend action to the customer.

8. Conduct periodic surveillance of the contractor's facilities assuring the adequacy of the test equipment and the adherence to the approved test procedure. For all reliability tests, assist in classification of failures into either relevant or non-relevant categories.

9. Study and analyze the Maintainability and Support Equipment reports. These reports will contain the Maintainability Program Plan, the Maintainability Prediction, the Maintainability Analysis, and reports of maintainability considerations applied to design reviews. Report significant conclusions and/or recommendations regarding these reports to customer.

III. CONTROLS OVER THE POSITION

This position is under the supervision of the Manager of the Systems Effectiveness Section, Electronic Engineer. The incumbent is responsible
responsible for determining the proper approach, planning, and carrying out the project assignments. Technical problems involving policy matters or of an unprecedented nature are usually discussed jointly with the Division and Branch Managers. Work is periodically reviewed for general policy conformance and meeting program objectives. Written guides utilized include engineering handbooks and textbooks, military specifications, technical reports and studies, etc. A portion of the work includes consideration of areas for which little or no precedent exists.

IV. QUALIFICATION REQUIREMENTS OF THE WORK

This position requires knowledge of scientific and engineering principles and theories in the field of electronics and related fields such as can be learned through completion of a full four-year curriculum in electronic engineering or physics plus appropriate experience in the particular area of application or work closely related thereto. The incumbent must also have an understanding of statistics, reliability and maintainability, and experience in preparing test plans, specifications, procedures and program plans. This requires an understanding and working knowledge of such documents as AR-104, AR-10, AR-34, MIL-HDBK-217B, MIL-STD-781, etc. An understanding of the 3-M data acquisition is also required.
1. IN PARTICULAR,
2. ON THE OTHER HAND
3. AS A RESULTANT IMPLICATION
4. IN THIS REGARD
5. BASED ON INTEGRAL
6. SUBSYSTEM CONSIDERATIONS
7. IN RESPECT TO SPECIFIC
8. GOALS
9. FOR EXAMPLE
10. IN A CONVERSE SENSE
11. ON THE OTHER HAND
12. AS A RESULT OF COST-
13. EFFECTIVENESS CONSTRAINTS
14. WITHIN SPECIFIED BOUNDS
15. FURTHERMORE
16. WHICH LEADS ONE TO THE
17. CONCLUSION THAT
18. BASED ON PRIOR CONCERNS
19. WITH REFERENCE TO
20. AVAILABLE RESOURCES
21. IN A MORE RIGOROUS
22. SENSE
23. PREVIOUS EFFORTS TOWARD
24. RESOLUTION HAVE CONCLUDED THAT
25. INSIDE THE LIMITS OF
26. PRESENT DIRECTIONS
27. THEREFORE
28. WITHIN THE SCOPE OF
29. THESE CONSIDERATIONS
30. DISREGarding MISCELLANEOUS
31. DIFFERENCES IN
32. INTERPRETATION OF THE
33. SYSTEM METHODOLOGY
34. IDEALLY
35. WITH RESPECT TO
36. CONFLICTING VIEWS
37. WITH REGARD TO THE
38. IMPLEMENTATION PLAN
39. A LARGE PORTION OF
40. THE INTERFACE
41. COMMUNICATION
42. COORDINATION
43. A CONSTANT FLOW OF
44. INFORMATION
45. THE CHARACTERIZATION
46. OF SPECIFIC CONCERNS
47. INITIATION OF INTEGRAL
48. SUBSYSTEM DEVELOPMENT
49. THE FULLY INTEGRATED
50. TEST PROGRAM
51. THE INCORPORATION
52. OF ADDITIONAL
53. MANAGERIAL CONSTRAINTS
54. ANY ASSOCIATED
55. SUPPORTING ALLIANCE
56. THE INDEPENDENT
57. FUNCTIONAL PRINCIPLE
58. A PRIMARY INTERRELATIONSHIP
59. BETWEEN SYSTEM
60. AND SUBSYSTEM
61. TECHNOLOGIES
62. COMPLEX ANALYSIS IN
63. THIS AREA
64. STATE-OF-THE-ART
65. GROWTH
66. THE RESULT, IF IN
67. FACT DIFFERENT FROM
68. THOSE PREDICTED,
69. EXTENSIVE SURVEILLANCE
70. STATISTICAL ANALYSIS
71. OF THE TYPE REQUIRED
72. ISOLATED OCCURRENCES
73. OF THE TYPE UNDER
74. INVESTIGATION
75. PRELIMINARY INVESTIGATION
76. HAS REVEALED
77. THAT A ANY SYSTEM
78. REDESIGN
79. FLEX SPECIFIC PERFORMANCE
80. LIMITS TO
81. MAXIMIZES THE PROBABILITY
82. OF PROJECT SUCCESS
83. WHILE MINIMIZING THE
84. COST AND TIME OF
85. MOST UTILIZED AND BE
86. FUNCTIONALLY INTEGRATED
87. WHEN TAKEN INTO ACCOUNT, THE TOTAL
88. SYSTEM PROFILE
89. THE SEEMINGLY
90. INADEQUATE DATA
91. COLLECTION PLAN
92. OPERATIONAL
93. MODE DOCUMENTATION
94. PRELIMINARY
95. FUNCTIONAL TASKS
96. THE DEVELOPMENT
97. PHASE OF THE SYSTEM
98. MORE IMPORTANT
99. BEAUCRATIC
100. NECESSITIES
101. SPECIFICATION
102. REQUIREMENTS
103. THE PRESENT
104. INVESTIGATIVE EFFORTS
105. PREVIOUS
106. ATTEMPTS AT
107. OPERATIONAL
108. ENVIRONMENTAL
109. MEASURES
110. THE ANTICIPATED
111. FOURTH GENERATION
112. EQUIPMENT
113. REPRESENTATIVE
114. SYSTEM CHARACTERIZA-
115. TION
116. THE OVERALL PROJECT
117. OBJECTIVE DEFINITION
118. THE ALREADY
119. SUBJECTIVE SYSTEM
120. DEVELOPMENT
121. STATUS
122. PHILOSOPHY OF COMMONALITY
123. THE CONFINEMENT
124. OF STANDARDIZATION
125. SYSTEM
126. THE TOTAL
127. PROFILE
128. INACCURATE DATA
129. COLLECTION PLAN.
130. MODE DOCUMENTATION
131. FUNCTIONAL TASKS
132. THE DEVELOPMENT
133. PHASE OF THE SYSTEM
134. MORE IMPORTANT
135. BEAUCRATIC
136. NECESSITIES
137. SPECIFICATION
138. REQUIREMENTS
139. THE PRESENT
140. INVESTIGATIVE EFFORTS
141. PREVIOUS
142. ATTEMPTS AT
143. OPERATIONAL
144. ENVIRONMENTAL
145. MEASURES
\[ f(x) = x^2 + (y + \frac{1}{2})^2 = 1 \]
\[ f(x) = \sqrt{1 - x^2} - \frac{1}{2} \]
\[ A_T = 2 \int_{0}^{\sqrt{3}/2} \left( \sqrt{1 - x^2} - \frac{1}{2} \right) dx \]

\[ x = \sin \phi, \quad dx = \cos \phi \, d\phi \]
\[ x = 0 \Rightarrow \phi = 0 \quad ; \quad x = \frac{\sqrt{3}}{2} \Rightarrow \phi = \frac{\pi}{3} \]

\[ A_T = \int_{0}^{\pi/3} [\cos \phi - \frac{1}{2}] \cos \phi \, d\phi \]
\[ = \int_{0}^{\pi/3} [\cos^2 \phi - \frac{1}{2} \cos \phi] \, d\phi \]
\[ = \frac{1}{2} \sin \phi \cos \phi + \frac{1}{2} \phi - \frac{1}{2} \sin \phi \Bigg|_{0}^{\pi/3} \]

\[ = \frac{1}{2} \left[ \frac{\sqrt{3}}{2} x + \frac{1}{2} \pi - \frac{\sqrt{3}}{4} \right] \]
\[ = \frac{1}{2} \left[ \frac{\sqrt{3}}{3} - \frac{\sqrt{3}}{4} \right] \]
\[ A_T = \]
"I SLEPT WITH MY MOUTH OPEN... HONEST."
**Problem**

**Minimize**

\[ R(\vec{e}, \vec{X}) = \int_{-\infty}^{\infty} \left| \sum_{n=1}^{m} \int_{l_n}^{l_{n+1}} g_2(\xi) [h(x-\xi; \xi) - h(x-\xi; x_n)] d\xi \right|^2 dx \]

\[ = \int_{-\infty}^{\infty} \left| \sum_{n=1}^{m} \hat{g}_n(\xi-x_n) \hat{h}_n [h(x; \xi) - h(x; x_n)] \right|^2 df_x \]

**With respect to**

\[ \vec{e} = [e_1, e_2, ..., e_n, ..., e_m, e_{m+1}] \]
\[ \vec{X} = [X_1, X_2, ..., X_n, ..., X_m] \]

**Where:**

\[ l_n \leq X_n \leq l_{n+1} \]
\[ l_1 \text{ and } l_{m+1} \text{ are fixed} \]
\[ m \text{ is fixed} \]

**Notation Remarks:**

\[ g_n(\xi-x_n) = g_2(\xi) \mu(\xi-l_n) \mu(l_{n+1} - \xi) \]
\[ \mu(\xi) = \begin{cases} 1 & ; \xi \geq 0 \\ 0 & ; \xi < 0 \end{cases} \]

\[ \hat{f}_\xi [f(x; \xi)] = \int_{-\infty}^{\infty} f(x; \xi) e^{-i2\pi \xi f_x} d\xi \]
\[ \hat{f}_x [f(x; \xi)] = \int_{-\infty}^{\infty} f(x; \xi) e^{-i2\pi \xi f_x} dx \]