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DEVELOPMENT OF PRACTICAL PERFORMANCE MEASURES

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VOLUME I

Prepared for

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By

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Arthur Siegel, Research Associate

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Douglas Courtney, Program Director

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ABSTRACT

This study was concerned with the construction of a manual, the content of which covered the uses for performance tests and methods of constructing performance tests in the Naval situation. An outline of the manual as constructed is appended to this report and the manual itself has been published separately.

The study was further concerned with the field test of the manual by constructing performance tests in Naval situations in line with the manualized procedures. First, a manual was written and then a battery of eight performance tests for the Aviation Structural Mechanic's rating was prepared on the basis of the manualized procedures. This test construction took place in at the NATTU, Memphis, and Naval instructor personnel acted as technical consultants during the test construction. The tests, as constructed, were tried out in two operational squadrons. In one squadron the Naval instructor personnel, who acted as technical consultants during the construction of the tests, served as test administrators. In the other squardron, Chief Petty Officers with minimal indoctrination in testing procedures were used as test administrators.

Throughout the test construction, changes in the manualized procedures were made, as indicated, so that the procedural recommendations would be compatible with operational conditions.

The manualized procedures were then reapplied in constructing a battery of tests which could serve as a hurdle for the rate of second class Aerial Photographer. This test construction was performed at the Naval Photographic School, Pensacola and again instructor personnel served as technical consultants during the test development. This Aerial Photographers' Battery was also field tested in two operational situations. In the first situation the instructors who acted as technical consultants during the test construction served as test administrators. In the second operational situation, test administrators with minimal indoctrination in testing procedures were used.

Data on inter-examiner reliability, intra examiner reliability, test-retest reliability, examiner errors, face validity, acceptability of the tests to enlisted personnel, willingness of enlisted personnel to administer and support performance tests were gathered.

In regard to the Aviation Structural Mechanics' Battery, our results seemed to indicate that:

1. The Naval personnel who served as technical advisors during the development of the tests were competant as test administrators.

2. The Chief Petty Officers who had a minimal indoctrination into testing procedures, but who were ralatively naive in testing practices, were competant as test administrators.

3. The Chief Petty Officers with minimal indoctrination into testing procedures demonstrated adequate between observer reliability and adequate within observer reliability.

4. For the two tests investigated, test-retest reliability was moderately high.

5. The Chief Petty Officers who administered the tests and the enlisted personnel who took them found the tests acceptable from the point of view of face validity.

6. The tests in the battery were adequately homogeneous, and seemed to have acceptable discriminating power.

Considering the Aerial Photographers' Battery, our results seemed to indicate that:

7. The Naval personnel who served as technical advisors during the development of the tests were competent as test administrators.

8. The enlisted personnel with minimal indoctrination in testing procedures but who were relatively naive in testing procedures were not completely competent as test administrators.

9. However, these personnel with minimal indoctrination in testing procedures did show acceptable inter-examiner and intra-examiner reliability.

10. The test administrators and the men who took the tests found the tests acceptable from the point of view of face validity.

11. The tests in the battery were adequately homogeneous and seemed to demonstrate acceptable discriminating power.

ACKNOWLEDGMENTS

We would like to acknowledge the contributions of the many who helped to make this research possible. The research could not have been completed without the ample, cooperative support we received from the staff and enlisted personnel at the Naval Aviation Structural Mechanics' School at Memphis and the Naval Photographers' School at Pensacola. Special thanks are extended to Lieutenant Commander J. H. Stone, Lieutenant Commander T. H. Campbell and Mr. L. W. Gordon for their support at Memphis. Gratitude is also expressed to Chiefs H. W. Latsch and A. E. McBee for their many suggestions and contributions to the AM Performance Battery. At Pensacola, Commander C. Simonson and Lieutenant P. Guss generously supported our research and Chief J. Camp made many practical suggestions in regard to the Aerial Photographers' Performance Battery. Lieutenant J. Lloyd unselfishly provided the facilities of the photographic laboratory at the Naval Air Station, Pensacola, for the first field test of the Aerial Photographers' Battery.

Dr. Douglas Mayo, Mr. John Howard and Mr. Robert Waite at the Naval Air Technical Training Command made methodological suggestions, particularly in the early phases of the investigation at Memphis, Tenn.

Our performance measures were field tested at the Naval Air Station, Atlantic City. This would not have been possible without the consideration shown by Captain R. Young and Captain J. Gardiner. Others who were specially helpful at Atlantic City were Chiefs J. Bushman, R. Robinson, H. Nabors and M. Wherr.

We would also like to express a very special debt of gratitude to the enlisted personnel who served as experimental subjects in the field testing of our practical performance measures.

Finally, a special bow and tip of the hat is due to Miss H. Dumick, Miss B. Einbinder, Mrs. J. Millstein, Miss S. Pinkerton and Miss M. Taylor for their aid in typing and proof reading the entire manuscript.

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INTRODUCTION

A performance test is a test in which the examinee does something or makes something under standard conditions. It differs from the usual type of written examination in which the examinee shows knowledge about or makes judgments about a task. In a performance test the role of language is minimized, that is, the examinee must do a job rather than write about the job. For instance, a performance test for photographers might be the taking of a standard picture, and a performance test for electricians might be the routine maintenance of a battery.

The roles which performance tests can play in the Naval situation are many. They can be used:

1. to evaluate methods of training and instruction
2. to evaluate students in training
3. to classify personnel, to assign billets and special job codes
4. as a criterion against which written tests can be validated
5. as a basis for "checking-out" a man on his "practical-factors" for advancement in rating.

Evaluation of Training and Instructional Methods

One of the uses of performance tests is the evaluation of methods of training and instruction. In order to evaluate any instructional method we must have an adequate criterion against which to validate our instructional method. The closer the criterion to on the job proficiency, the better the criterion. It goes without saying that performance measures offer fruitful and interesting possibilities as an ultimate criterion for the evaluation of methods of instruction. If students,

study opportunities, subject matter, and instructors are matched, while methods of instruction varied, then the instructional method yielding the highest performance test scores is the best instructional method.

Evaluation of Students in Training

School instructors must know when their students have mastered one phase or unit of the work and are ready to go on to the next. Performance tests offer a means through which instructors can answer the question "What can Smith or Jones do?" with some assurance.

Classification and Assignment of Personnel

Enlisted Naval personnel, like anyone else, are usually more able in one part of their job than another. With advancing technology there has been a tendency towards specialization, and this specialization has been imposed on enlisted personnel by the difficulty of "keeping up" with all aspects of rapidly changing Naval ratings. It is particularly apparent in the aviation and electronic ratings. By using an adequately constructed performance battery, one may assign personnel in line with their own demonstrated abilities and specialties to different work areas within a rating.

Likewise, through the use of performance tests, special job codes may be assigned on a real rather than an a priori basis.

Criterion for Validation of Written Examinations

In terms of investment of time and money, the most economical examination is the written examination. Usually, written examinations are validated against some criterion of job proficiency. The criterion of on the job proficiency usually consists of some measure such as supervisors' judgments, or quantity of output. Measures such as these are commonly called intermediate criteria, because

they may or may not correlate perfectly with what the test constructor is trying to predict. In the case of predicting on the job proficiency, the closer or more relevant the criterion to the job itself, the better the criterion. Since performance measures are, at least, a sample of the job itself, they represent a good criterion against which written tests may be validated.

Check Out on "Practical Factors" for Advancement of Rating

In order for enlisted Naval personnel to advance in rating, they must pass a written examination prepared by the U. S. Naval Examining Center and be certified as competent in the technical or "practical factors" aspect of their rate. The "practical factors" requirements are defined in the Manual of Qualifications for Advancement in Rating (NAVPERS 18068) as:

> "Those qualifications which are best determined by observation of the candidate in situations that require a demonstration of his knowledge, skill and ability under actual or simulated working conditions."

The actual mechanics of the "check out" on "practical factors" are left to the discretion of local officials and variation is manifested throughout the service in the content, structure, and method of "check out". The effects of this variation on the morale of the enlisted personnel, and on the actual on the job proficiency of the enlisted personnel cannot be estimated. However, performance examinations offer interesting possibilities as a means of standardizing the method, structure, and content of the "practical factors" "check out" as well as for assuring that enlisted personnel are proficient, before advancement, in the tasks actually performed in a rating.

Performance examinations have been used for purposes analogous to those outlined above in American industry. The possibility of using performance examinations in line with their own general functions in the Naval situation has never been systematically studied. That is, while there have been previous investigations into problems connected

with performance testing and performance test development, these previous investigations have not considered the special conditions of the Naval situation. The danger of quick and easy generalization from the school and industrial situations, to the Naval situation is apparent. The question of whether the techniques and procedures generally used by professional test makers in performance test construction will produce reliable, valid and discriminating tests in the Naval situation has remained unanswered. If the usual procedures and methods are not applicable, what modifications are needed in them in order that performance testing may be implemented in the Navy?

Moreover, we usually think that a good test administrator needs some formal training in tests and measurements. Can Naval personnel who are relatively untrained in test administrative practices effectively administer the performance tests constructed by professional psychologists? If not, what modifications are needed in the procedures usually recommended for standardized test administration in order that performance tests may be effectively administered by Naval personnel?

In addition, if reliable, valid and discriminating performance measures which are applicable to training programs, advancement in rating structures, and selection and assignment systems in the Navy, can be built by psychologists, what do these tests contribute, if anything, to the already existing structures? Do they point up areas in which training is not achieving desired goals? Do they help select and assign men so that square pegs are fitted to square holes? Do they help those personnel who have the responsibility for recommending enlisted personnel for advancement in rating and the responsibility for certifying to the proficiency of the enlisted personnel in the "practical factors" aspects of their jobs to arrive at a better estimate of the proficiency of their men? Are the people who are responsible for this certification ready and willing to accept performance measures? Are performance measures really practical in this situation? With these and simular questions in mind the present research was begun.

CHAPTER I

PURPOSES

The principal purposes of the current study were then:

I. To prepare a manual the content of which covered the preparation, administration and uses of performance tests, for use in Naval situations, in line with the general purposes of performance tests.

II. Using as a guide the manual developed under I above, to prepare a "model" battery of performance examinations for the Aviation Structural Mechanics' rating and a "model" battery for candidates for the rate of second class Aerial Photographer.

III. To field test the Aviation Structural Mechanics' Battery using test administrators who were influential in their development, more specifically, to administer the Aviation Structural Mechanics' Battery using as test administrators the school instructors and Naval personnel who gave technical advice and assistance during the development of the battery, and to evaluate the test administration.

IV. To field test the Aerial Photographers' Battery using as test administrators, those school instructors and Naval personnel who rendered technical advice and assistance during the development of the battery and to evaluate the test administration.

V. To further field test the Aviation Structural Mechanics' Battery in an operating squadron using as test administrators Naval personnel who were not influential

during the developmental aspects of the battery and who have minimal indoctrination in testing procedures; and to evaluate this test administration.

VI. To further field test the Aerial Photographers' Battery in an operating squadron using test administrators who were not influential during the developmental aspects of the battery and who have minimal indoctrination in testing procedures; and to evaluate this test administration.

Secondary purposes of the current study were:

a. To evaluate, within the limits of operational conditions, the tests produced with regard to their validity, reliability, and discriminating power.

b. To evaluate the tests produced and the test results in order to ascertain whether they can contribute to the training programs of operating squadrons, specifically to determine the usefulness of these tests in measuring in-service achievement.

CHAPTER II

The Manual - Purpose I

Method of Manual Development

In line with our first general purpose, at the outset, a preliminary manual covering the construction, administration, and uses of performance examinations in the Naval situation was prepared. The basic principles of performance test preparation and administration as were available in the psychological, and the tests and measurements literature were incorporated into this manual. Typical of the sources consulted were Adkins (1), Stuit (4), Ryans and Frederiksen (3), and Tiffin (6). These basic principles were synthesized with the practical experience in work sample test construction in the Naval situation gained by Hill, Buckley and Older (2). The manual in this primitive form was then forwarded to the Management and Market Research Corporation, who were concurrently preparing a similar manual, for comments and criticisms. In the meanwhile, the Management and Market Research Corporation had forwarded to the Institute its manual for similar criticisms. After this exchange of manuals and comments, a series of meetings were held between members of the Management and Market Research Corporation and the Institute. In these meetings the content, style, development, and technique of the manual were discussed. After these meetings the Institute stabilized upon what it believed to be a workable procedure for developing performance tests in Naval situations. A member of the Institute staff proceeded to Memphis where he held discussions with the Training Officer and the Maintenance Officer at the Naval Air Station, and with various Chief Petty Officers at the Naval Air Technical Training Unit. One purpose of these discussions was to obtain the opinions of these men in regard to the practicality of the manualized procedures in the situations with which they were familiar. A second purpose of the field interviews was to gain an appreciation of the job of a training and maintenance officer and of the possible limitations of the manualized procedures in situations with which they were familiar. Where changes were indicated, the manualized procedures were further altered. Thus the manual, during this period was in a constant state of flux. After a while, it appeared as if the procedures in the manual were

firm and an attempt was then made to follow through on the manualized procedures in actual performance test construction. In this case, the rate for which tests were to be prepared, as a test of the manual, was that of Aviation Structural Mechanic. The actual test construction was performed by an Institute research associate and the test development took place at the Naval Air Station and the Naval Air Technical Training Unit, Memphis. An attempt was made throughout this preliminary test of the manual to adhere to the procedures that had evolved as a result of the above discussed work, but where these procedures were found impractical, they were departed from and the appropriate changes made in the manual. As a result of this test construction activity, eight performance tests, which represented the battery for the Aviation Structural Mechanics' rating, emerged. The tests proper are discussed in later chapters of this report.

At this point, another meeting between the research personnel of the Institute and the Management and Market Research Corporation took place. Experiences and ideas gained in the field by the separate organizations were exchanged and considered for inclusion in the respective manuals of the two organizations.

The Institute's manual was then further revised, as a result of this meeting and as a result of the test construction experience at Memphis, and was taken to the Naval Air Technical Training Unit and the Naval Air Station, Pensacola for further test. At Pensacola, a procedure was followed analogous to that pursued at Memphis. In this case, it was our purpose to construct a "model" battery of performance tests which might act as a hurdle for advancement in rating from Aerial Photographer, third class, to Aerial Photographer, second class. As before, in order to gain an appreciation of their problems, ongoing discussions were held with school personnel, with the Information and Education Officer at the Photographers' School and with the Training Officer at the Photographic Laboratory at the Naval Air Station, Pensacola. The procedures, as specified in the manual, were followed and eight separate performance examinations were constructed. After this experience, it seemed that the manualized procedures were quite stable and practical. The manual was therefore given to a Chief Aerial Photographer, and he was asked to try his hand at test construction using the manual as a guide book. Only slight difficulty was experienced by this man in following the manual. His difficulties were more of the nature of inability to understand some

parts of the expository material than of the nature of inability to use the prescribed procedures once they were understood. However, the sections of the manual which were unclear to this chief, were rewritten and clarified. The manual was then given to several (more than 10) instructors and chiefs working on the line for reading and comments. This resulted in additional comments regarding needs for clarification. Those sections of the manual which were unclear to these people were further clarified.

Another meeting then took place between the research personnel of the two organizations constructing manuals and again ideas were interchanged. The need for consolidation of the separate manuals was discussed and it was decided that the two manuals would be combined unless a theoretical, or methodological impasse was met. The possibility of such an impasse was evident since the two organizations were working on different ratings and in different Naval situations. The Institute was confining itself to aviation ratings while the Management and Market Research Corporation was confining its efforts to surface ratings. With this in mind a scheme for possible consolidation was derived. The scheme consisted of the free interchange, by mail, of ideas between the two organizations for another month. At that point, another conference was held at the Institute and during this conference the procedures, style and content of the two manuals was discussed. It was decided that there were no apparent basic differences between the two manuals so a decision was made to consolidate them. Hence, the separate efforts were consolidated, edited, and pictorialized. Thus the final manual represents the best joint professional estimate of two separate research organizations as to what constitutes a maximally fruitful manual, and is based upon the field experiences of these two separate organizations. The recommended procedures are based upon actual test construction experiences in four ratings and in aerial and surface situations. Moreover, although the manual has been in a state of flux from its conception to its final publication, the procedures prescribed therein are close to those actually followed in test construction. All the procedures recommended in the manual have been tested in actual Naval situations. An outline of the final manual is appended as Appendix A to the present report.* The manual was also published as a separate for further research or field use if indicated.

* The manual itself may be obtained from Pers. 15, Personnel analysis Division, Bureau of Naval Personnel.

As stated above, the procedures recommended for use in test construction were all field tested by applying them to actual test construction before their final inclusion. It is well to point out at this juncture that this test construction was performed by a psychologist and the question of whether Naval personnel can construct performance tests by way of the manualized procedures remains unanswered. Moreover, if the manual as a tool, cannot stand alone, the questions of "How much support" and "What kinds of support does the manual need?", remain open.

The tests produced by the Chief Photographer at Pensacola who was given a preliminary form of the manual and asked to produce performance tests therefrom, are presented in an unedited form as Appendix B to the present report. Any inadequacies, in these tests, may reflect inadequacies in the manual at that primitive stage more than inadequacies in the chief who was kind enough to "guinea pig" the manual for us. The Chief Photographer who acted as test constructor was a structural mechanic at one stage of his Naval career. He asked for, and received permission to construct a test for structural mechanics in addition to the tests for aerial photographers. This Structural Mechanics' Test is also included in Appendix B.

Considering the tests constructed by the Chief Photographer from the evaluative point of view, on the positive side, there is the fact that performance tests did emerge as a result of this chief's efforts. Moreover, the test tasks chosen represent good, operational performance test problems. On the negative side, crude language is in evidence, as well as a lack of objectivity in item writing. Likewise, the examiner and examinee instructions seem lacking in clarity.

Returning to the manual, an attempt was made to use simple, straightforward, unambiguous language throughout. Pictures were interspersed to add clarity and to hold attention. Print size, style, and type were varied for purposes of emphasis, continuity, and interest. Theoretical issues and academic discussions of performance testing were purposely omitted. The final manual is a step by step "cook book" for use in constructing, administrating, and using performance tests in the Naval situation.

Flesch Analysis of the Manual

A Flesch analysis of the manual was carried out.* The results of this analysis are presented in Table 1. Flesch recommends as a sampling procedure that every third paragraph be taken and that the first 100 words of each sampled paragraph be analyzed. However, we abbreviated this sampling procedure. We randomly selected two paragraphs from each chapter in the manual and analyzed the first 100 words of these paragraphs. However, since analyzing the introductory paragraphs to a chapter would have tended to spuriously raise our results, no introductory paragraphs were analyzed. Moreover, words such as Chief Petty Officer, Boatswain, etc., which are of doubtful personal reference were not counted as being of personal reference.

A mean "reading ease" for the manual of 52.8 with a standard deviation of 9.5 was indicated. A "reading ease" of 52.8 is typical of such publications as Harpers or Atlantic.

The mean "human interest" of the manual was found to be 31.5 with a standard deviation of 10.00. A "human interest" score of 31.5 is classified by Flesch as "interesting" and is typical of various Digests or Time.

* We are indebted to Miss M. Taylor for this analysis.

TABLE 1

Results of Flesch Analysis

CHAPTERS I - VI OF MANUAL

	READING EASE	HUMAN INTEREST	MEAN READING EASE	MEAN HUMAN INTEREST
CHAPTER I			36.0	33.0
Sample 1	44	36		
Sample 2	28	30		
CHAPTER II			50.0	30.0
Sample 1	63	49		
Sample 2	37	11		
CHAPTER III			49.0	15.0
Sample 1	44	26		
Sample 2	54	4		
CHAPTER IV			66.5	49.0
Sample 1	65	52		
Sample 2	68	46		
CHAPTER V			58.5	33.5
Sample 1	64	39		
Sample 2	53	28		
CHAPTER VI			56.5	28.5
Sample 1	50	11		
Sample 2	63	46		

Reading Ease, Chs. I - VI Mean = 52.8
S. D.= 9.5

Human Interest, Chs. I - VI Mean = 31.5
S. D.= 10.0

CHAPTER III

Development of the "Model" Aviation Structural Mechanics' and Aerial Photographers' Batteries

(PURPOSE II)

Our second principal purpose was to prepare, using as a guide the manual discussed in Chapter I, a "model" battery of performance examinations for the Aviation Structural Mechanics' rating and a "model" battery for candidates for the rate of second class Aerial Photographer.

Development of the Aviation Structural Mechanics' Battery

In an attempt to adhere to the manualized procedures in developing the Aviation Structural Mechanics' Battery, NAVPERS 18068 and 15105 were first analyzed in order to ascertain the requirements of that rating. Then discussions were held with Chief Structural Mechanics at the NATTU, Memphis, in an attempt to ascertain jobs which could be used to measure the requirements, as stated in the above mentioned publications of the Aviation Structural Mechanics' rating. In all, 66 tasks were suggested. The tasks suggested were:

1. Fabricating a flexible hose assembly
2. Fabricating a rigid tube assembly
3. Making an L-type fabric repair and surface taping
4. Making a T-type fabric repair plus surface taping
5. Sharpening a drill for drilling plastic
6. Sharpening a drill for drilling metal
7. Welding a T-joint on a tubular structure
8. Repairing, by means of the insertion method, a hole in a spar
9. Straightening a piece of bent tubing
10. Making a fabric insert patch including the necessary painting and doping
11. Manufacturing a stressed skin inspection door
12. Splicing a wing rib section
13. Aluminum butt welding
14. Aluminum fillet welding

15. Replacing a stressed skin panel
16. Assembling and disassembling a gear type pump and testing pump for operation
17. Assembling and disassembling a piston type pump and testing pump for operation
18. Patching, with rubber, the corner of a self sealing fuel cell
19. Repairing a minor slit on a self sealing fuel cell
20. Fabricating a plastic lap patch using soak method of cementing
21. Fabricating a wooden former block for a false nose rib
22. Hand swedging a cable assembly
23. Fabricating a lace plastic repair
24. Adjusting and testing brakes that are operating unevenly
25. Bleeding and adjusting aircraft brakes
26. Adjusting linkages on retractable landing gear
27. Testing and adjusting external ball check type regulator
28. Testing and adjusting internal ball check type regulator
29. Preloading an accumulator
30. Inspecting and adjusting an accumulator that has become sluggish because of dirt on the oil screen
31. Replacing the diaphram in an accumulator
32. Servicing shock struts
33. Making a lap or flush curved plastic patch
34. Making a straight lap or flush plastic patch
35. Fabricating a wedge block
36. Cutting metal using gas cutting methods
37. Chrome-molybdenum vertical butt welding
38. Welding a fish mouth splice
39. Welding a three tube cluster (with gussets)
40. Tubular butt welding
41. Fabricating a lap watertight patch
42. Fabricating a round pan with a wired edge
43. Removing rivets
44. Installing Dzus fasteners
45. Installing Camloc fasteners
46. Fabricating a lap patch for stressed skin
47. Splicing a channel
48. Repairing minor crack in stressed skin
49. Repairing minor crack in non-stressed skin
50. Repairing a trailing edge damage

51. Hand shrinking a piece of angle to form a given curve
52. Repairing a damaged rib
53. Splicing a cracked stringer
54. Making a nose rib, with blocks supplied
55. Flush riveting
56. Performing a 30-hour hydraulic inspection
57. Performing a 60-hour hydraulic inspection
58. Testing and adjusting regulators
59. Cleaning a filter
60. Flaring and bending a tube
61. Blue print reading
62. Adjusting linkages on wings which won't fold or won't lock
63. Making a pressure adjustment on a relief valve
64. Fabricating a C-channel
65. Removing dents from metal
66. Fabricating a flush patch for stressed skin

Elimination, on the Basis of Practical Considerations, of Tasks

Each of these tasks was written on an individual 3 x 5 index card and the cards were given to a Chief Aviation Structural Mechanic who was asked to go through the deck and pick out any tasks which require more than one hour for completion. After doing this, he was asked to pick out any tasks which required material and equipment not usually found in operating squadrons. This elimination procedure was repeated for tasks which seemed costly to the chief in terms of the amount or kinds of material needed and for tasks which might cause an interruption of normal operations. This screening procedure was repeated with two other Chief Aviation Structural Mechanics. Before giving the deck of tasks to the chiefs for screening, the test constructor carefully explained to the chiefs the purposes and uses of performance examinations, the purpose for the screening, and the eventual roles that the ultimate test tasks might play. The conscientiousness of the chiefs who did the screening is attested to by the fact that of 17 tasks eliminated by this preliminary screening, the same criteria for elimination was mentioned for 8 tasks (47%) by all three of the chiefs. Of the remaining nine tasks, eliminated by this screening, two chiefs agreed that two of the tasks (12%) should be eliminated according to the same criteria, and the remaining eliminations (41%) were made on the

suggestion of an individual chief. The tasks eliminated by this screening were:

1. Repairing a hole in a spar by the insertion method
2. Fabricating a stressed skin panel replacement
3. Assembling and disassembling a gear type pump and testing pump for operation
4. Assembling and disassembling piston type pump and testing pump for operation
5. Patching, with rubber, the corner of a self sealing fuel cell
6. Making a fabric insert patch including necessary painting and doping
7. Making a lap or flush curved plastic patch
8. Making a nose-rib with blocks supplied
9. Aluminum fillet welding
10. Manufacturing a stressed skin inspection door
11. Splicing a wing rib section
12. Adjusting the linkages on a retractable landing gear
13. Adjusting and testing brakes that are operating unevenly
14. Bleeding and adjusting aircraft brakes
15. Fabricating a wooden former block for a false nose rib
16. Performing a 60-hour hydraulic inspection
17. Fabricating a wedge block

The surviving tasks were then further screened by the test constructor, who with the aid of two Chief Structural Mechanics, eliminated tasks which were not amenable to objective measurements, tasks which aren't usually performed at the squadron level, and tasks which contain recurring routine operations such as removing and replacing a whole series of nuts and bolts. The following tasks were eliminated by this screening.

1. Fabricating a wooden former block for a false nose rib
2. Preloading an accumulator
3. Straightening a piece of bent tubing
4. Welding a three tube cluster (with gussets)
5. Welding a fish mouth splice
6. Chrome-molybdenum vertical butt welding
7. Hand swedging a cable assembly

Prior to this screening the Institute staff member attended classes at the Naval Air Technical Training Unit, Memphis and did actual shop work in the Aviation Structural Mechanics' rating. He thus gained actual work experience in, as well as knowledge about, the Aviation Structural Mechanics' rating. This experience was helpful because it made the statements of the chiefs about the tasks more meaningful than if the statements would have been if the test constructor had no background of experience against which to interpret them.

At this point, the test constructor felt qualified to proceed with the final screening and the actual test construction. With the help of three Chief Structural Mechanics, an attempt was made to select tasks which would yield a final battery that:

1. maintained a balance between repairing, replacing, maintaining, and trouble shooting

2. tapped as many as possible of the diversified skills that an Aviation Structural Mechanic is called on to use by sampling as many seemingly different types of operational tasks as possible

3. cut across the Aviation Structural Mechanics' rating e.g. was not limited to any particular pay grade within the rating

4. contained tasks about which the chiefs answered the question "Would you be willing to assign a man to (welding) after having seen him complete this (welding) task?" with unanimous, affirmative replies.

Result of the Screening

On the basis of this screening, the final test tasks chosen were:

a. Sharpening a drill for drilling metal (care and maintenance of tools)

b. Fabricating a flush patch for stressed skin, (metal work, use of measuring instruments, blue print reading, riveting)
c. Splicing a cracked C-channel, (metal work, measuring instruments, blue print reading, riveting)
d. Making a flush plastic patch, (plastics)
e. Aluminum butt welding, (welding)
f. Performing a 30-hour hydraulic check, (hydraulics, "trouble shooting")
g. Fabricating a rigid tubing assembly, (hydraulics, metal working)
h. Repairing an L-type fabric damage and surface taping, (fabrics, paints, and dopes)

Method of Test Preparation

Following the selection of the test tasks, the test construction proper was started. As stated above, the test constructor had previously developed proficiency in, and knowledge about, the technical aspects of the Aviation Structural Mechanics' rating. This was an important prerequisite to the test construction proper since, without this background, the emergent tests might have assumed a "scholarly" appearance to men on the line. That is, by doing the work in the Aviation Structural Mechanics' rating and by working alongside the men in that rating, it was possible to learn their technical language. This made it possible to word the final tests in the language of the men who used them. This familiarity with the work also made it possible to analyze the test tasks chosen so that the task could be broken down and scored in terms of the elements comprising the total task. Further, the work and school experience helped the test constructor to interpret the statements of the structural mechanics who were used as technical consultants during the test construction proper.

The specific method of constructing tests from the chosen tasks follows. In line with the manualized procedures, each test task was analyzed in terms of its scorable aspects. The manual recommended a task analysis in terms of the following categories:

1. Correct completion of each sub-operation in the total task
2. Care of equipment and tools
3. Regard for safety rules
4. Finishing the job in the time allowed
5. Correct operation of the final product
6. Precision of the final product.

Where possible, each test task was analyzed in these terms. Of course, in the case of the 30-hour hydraulic check, in which there was no end product to evaluate, no analysis could be made in terms of "precision of the final product".

On the basis of the task analysis a record sheet was prepared. In essence, the record sheet consisted of a series of objective statements each of which referred to an aspect of the task as listed in the task analysis. Thus, the record sheet contained a series of items, and a portion of the total series related to each category listed in the task analysis. Since it was foreseen that the tests eventually would be used by personnel without wide backgrounds in test administration, and since opportunities for examiner training might be limited, an attempt was made to keep the items as specific and objective as possible. Thus typical items such as the following were written: "Deburrs both inside and out using burring tool or pen knife"; taps plunger (no credit unless plunger rotated after each tap)"; "Minimum of 4 stitches per inch".

The sequence in which the items appeared on the record sheet, was the same sequence in which the task components actually appeared in doing a job and in the task analysis. Where alternative procedures were possible, the various alternatives were stated on the record sheet. An attempt was made to use only simple, understandable language in the items.

Following the item writing, examiner and examinee directions were prepared. Included in the examiner directions were:

1. A statement regarding the task of the examinee.

2. General directions to the examiner.

3. Directions for scoring the examination.

4. A statement regarding the time allowance.

Included in the examinee instructions were:

1. A statement regarding the task of the examinee.

2. A statement telling the examinee what he would be scored on.

3. A list of the tools provided to complete the task.

4. Any other necessary directions bearing upon the specific task.

The examiner and examinee directions as well as the record sheet were then given to three separate Chief Aviation Structural Mechanics for review and criticisms. Points brought up by these men were discussed and where changes seemed indicated, the appropriate changes were made. The test was then given a quick, preliminary run using three or four randomly picked men as examinees in order to eliminate any obvious quirks. Any test changes indicated, as a result of this preliminary run, were made.

One major change which did become evident in this preliminary testing was a change in regard to the weights assigned to the items in the various scoring categories. At the outset, it was decided that no matter what the scoring category ("safety precautions followed", "care and use of tools", "procedure", or "measurements of the final product") equal weights would be assigned to all items within the categories. However, it soon became evident that this scoring procedure underweighted a good finished product. Most of the tests contained as many items in scoring categories other than "measurements of the final product" as items in this category. Therefore a man, who went through the act of doing a job, without actually turning out a good end product, received as many points as the examinee who may have deviated from the correct procedures but who finished with a good end product. It was the opinion of the Chief Petty Officers that this end product underemphasis was an unfair situation. The chiefs felt that the heaviest emphasis in scoring should be on turning out a good end product. In the words of one chief, "I don't care if a man stands on his head while doing a job, long as it's OK when he's finished". Therefore, the items were weighted so that all items pertaining to "measurements of the final product" were weighted three times as heavily as items referring to any other scoring category. Thus, in the final scoring,

three points were allowed for success in items pertaining to the adherence of the final product to prescribed dimensions (measurements of the final product) while only one point was allowed for items relating to other scoring areas.

The tests were then pilot-tested using four strikers, four third class, four second class and three first class Aviation Structural Mechanics as examinees. These subjects were drawn from the crew which maintains the aircraft at the Naval Air Station, Memphis and the subjects were completely unknown by the examiners prior to the test situation. By and large, very few changes became apparent during this pilot-testing. That is, most of the needed changes had become evident during the preliminary run. However, changes as indicated by this pilot run were made. The following sections describe the Aviation Structural Mechanics' Battery in detail.

The Drill Point Grinding Test

One of the practical factors for Aviation Structural Mechanics listed by NAVPERS 18068 is care of tools. Although, some of the items in all the tests in the Aviation Structural Mechanics' Battery were directed at the proper use and care of the tools employed while doing a job, it seemed advisable to include one test task specifically aimed at sampling ability in this area. Drill point grinding, while not a particularly high level task, is never-the-less an important skill. For instance, before any rivet is driven, a hole must be drilled for it, and in many cases men have thrown away dull drills because they were not able to sharpen them. Moreover , the man who can grind a drill can probably grind a chisel and a screw driver. A man who operates a grinding wheel correctly when drill grinding, probably operates the grinding wheel correctly in other grinding or buffing operations. The drill point grinding task consisted of giving the examinee a two fluted 3/8" drill, the point of which was ground down 3/8" by the examiner. The task of the examinee was to grind the drill. The examinee was scored on his care and use of the grinding wheel, the procedure he followed in grinding the drill, the precision of the final product, and the safety precautions he followed while grinding the drill. The complete test is presented in Exhibit I.

EXHIBIT I

Sample Drill Point Grinding Test

AM PERFORMANCE EXAMINATION

TOOLS - CARE AND MAINTENANCE

DRILLPOINT GRINDING

EXAMINEE INSTRUCTIONS

TASK This is a test of your ability to hand grind a two fluted 3/8" drill point. You are to grind the point as you would ordinarily hand grind it. Be sure you understand what you are to do before you begin. Time will start after you understand what you are to do and the examiner tells you to begin. Be sure you understand what you are to do, before you start.

SCORING You will be scored in the following areas:

1. The QUALITY of the finished product.
2. The PROCEDURE you follow in doing the job.
3. The MANNER in which you do the job.
4. The SAFETY precautions you observe.
5. The TIME it takes you to complete the job.

The principal emphasis however, will be on the quality of the finished product, so do not sacrifice doing a good job for speed.

TOOLS

1. Grinding wheel (complete)
2. 3/8" drill

EXHIBIT I (Cont'd.)

AM PERFORMANCE EXAMINATION

TOOLS - CARE AND MAINTENANCE

DRILL-POINT GRINDING

EXAMINER INSTRUCTIONS

TASK — This is a test of the examinee's ability to grind a two fluted 3/8" drill point.

GENERAL DIRECTIONS TO EXAMINER

1. Read the examinee instructions and scoring sheet very carefully and thoroughly. Be sure you understand the test and the method for scoring it before giving it to the examinee.

2. Assign the examinee to a grinding wheel and provide him with a 3/8" drill.

3. Have the examinee read the examinee instructions. Then reread them to him out loud. Ask him if he has any questions. If there is anything he does not understand, re-read to him that part of the instructions which answers his question. Supply no accessory information. Remember this is a test situation, not an instructional one. Make sure that the examinee fully understands what he is to do before he starts.

4. Have the examinee secure the work station when he is finished.

EXAMINER'S NOTE

Dull the drill point, before the examinee arrives, by grinding down the "chisel" point 3/8".

EXHIBIT I (Cont'd.)

EXAMINER INSTRUCTIONS (Cont'd.)

SCORING — Carefully observe the examinee as he works. If you think that an examinee should receive credit on an item, do nothing to the number which appears after the observation called for on that item. If no credit is to be allowed on an item, encircle or X over the number which appears after that item. Do not (repeat), do not rely on your memory. Give complete attention to the scoring. Of course, the measurements of the final product will be made after the examinee has completed the job. When the ground drill is handed in, place a number 1 on one lip surface and a number 2 on the other lip surface. Then proceed with the measurements of the final product. The total score is the sum of the non-encircled or non-Xed credits. On completion of the scoring, add the non-encircled or non-Xed credits and enter the total in the space provided.

TIME — Time is counted as soon as the examinee understands what he is to do and is told to start. Record the time that the examinee starts and finishes in the appropriate spaces. For credit on the time item, the examinee must finish in 10 minutes or less. Do not tell the examinee what the time allowance is. If the examinee does not finish in 10 minutes, allow him to finish. He receives no credit, however, on the time item unless he finishes in 10 minutes or less.

EXHIBIT I (Cont'd.)

AM PERFORMANCE EXAMINATION

TOOLS - CARE AND MAINTENANCE

DRILL - POINT GRINDING

SCORING SHEET

NAME_____ RATE_____

SERVICE NUMBER_____ DATE_____

Time Started_____

CARE AND USE OF TOOLS

1. Checks tool rest for proper distance from periphery of grinding wheel..... 1

2. Never adjusts tool rest while wheel is in motion..... 1

3. Uses specified coolant while grinding drill... 1

PROCEDURE

4. Starts wheel, and applies point of one flute, keeping shank slightly lower than point..... 1

5. While grinding continually oscillates drill so that heel is moved along the surface of the grinding wheel..... 1

6. Grinds second flute or alternates from flute to flute until satisfied with job. Secures grinder..... 1

7. Checks shank for bends and burns. Removes same if present..... 1

8. Time finished_____. Finished in 10 minutes or less..... 3

EXHIBIT I (Cont'd.)

SCORING SHEET (Cont'd.)

MEASUREMENTS OF FINAL PRODUCT

9.	Lip angle of both lips the same.....	3
10.	Lip angle No. 1, 59° (tolerance ± 2°).....	3
11.	Lip angle No. 2, 59° (tolerance ± 2°).....	3
12.	Both lips of same length (tolerance ± 1/64")..	3
13.	Lip clearance angle 1, 12° - 15°	3
14.	Lip clearance angle 2, 12° - 15°	3
15.	Lip No. 1 neither chipped, rounded, nor burned	3
16.	Lip No. 2 neither chipped, rounded, nor burned	3
17.	Angle across center of web 135° (tolerance ± 6°)	3

SAFETY PRECAUTIONS

18.	Uses eyeshields or goggles while grinding.....	1
19.	Taps wheel or checks for cracks in wheel prior to its use.....	1

Total Score_____

Fabrication of a Flush Patch for Stressed Skin

The practical factors requirements for Aviation Structural Mechanics include "use of power driven tools", "use of measuring instruments", "reading and working from simple blue prints and drawings", "use of riveting tools and riveting machinery" and "repair (of).....fuselage structures". Fabricating a flush patch for stressed skin includes work in all of these areas. In this task, the examinee was given a piece of aluminum with a slight hole in it. The examinee's instructions stated that the aluminum piece represented damaged stressed skin on an aircraft and that the examinee's task was to repair the damage. This is an operational type job, since this is the type of repair that would be done on a stressed skin area damaged in operations --. For instance, a repair of a bullet hole. A schematic (Figure 1) was drawn, photostated, and provided for the examinee's use while he did the job. Although on the surface it may appear that many arithmetical calculations are needed to complete this job, the actual arithmetic involved was reduced to a simple nature. For instance, five rivets were to be set on the 4 1/2" side of the filler. The requirements for distance between the edge of a piece of metal and the first rivet is two times the diameter of the rivet used. In this case the rivet diameter was 1/8" or a required edge distance of 1/4" (2 x 1/8" = 1/4"). Since each edge of the filler has two edge rivets, 1/2" was taken up by the two edge rivets. Thus there remained three rivets to be set over 4 inches or exactly 3/4" between rivet edges. Of course, in order to be able to complete the calculations, the examinee had to know what type of rivet is meant by the term AN430 AD4 (standard identification). All other calculations involved only simple arithmetic such as the above.

The examinee was instructed to omit doing any zinc chromating that he might ordinarily perform, as chromate paint will cover many defects in workmanship. Since half the riveting on the job provided an adequate basis for scoring, the examinee was required to perform only that half of the riveting. The examinee was scored on: the use of tools, the procedure he followed in doing the job, the precision of the final product, and the safety precautions he observed. The complete metal working test is presented in Exhibit II.

EXHIBIT II

Sample Metal Working Test

AM PERFORMANCE EXAMINATION

METAL WORKING

FABRICATION OF A FLUSH PATCH FOR STRESSED SKIN

EXAMINEE INSTRUCTIONS

TASK This is a test of your ability to fabricate a flush patch for stressed skin. Look at the piece of skin in front of you. You are to imagine that this is stressed skin on a plane. The skin has a hole in it and your task is to fabricate a flush patch for that hole. A schematic is provided. Look at it. Read it. You may refer to it whenever you wish. All the specifications that you need are given on the schematic. Do the replacement exactly as you would ordinarily do it, only this time you will be working at a bench instead of on a plane. Omit doing any zinc chromating that you would ordinarily perform. Use normal transverse pitch. Be sure you understand what you are to do before you start.

SCORING You will be marked in the following areas;

1. The QUALITY of the finished product.
2. The PROCEDURE you follow in doing the job.
3. The MANNER in which you use your tools.
4. The SAFETY precautions you observe.
5. The TIME it takes you to complete the job.

The principal emphasis, however, will be on the quality of the finished product, so do not sacrifice doing a good job for speed.

EXHIBIT II (Cont'd.)

EXAMINER INSTRUCTIONS (Cont'd.)

TOOLS The following tools have been provided.

1. Pneumatic drill motor
2. Steel scale
3. Dividers
4. Pencil
5. Wiss Aviation snips
6. Center punch
7. Drills - #40 and #30
8. Bucking bar
9. Rivet hammer
10. Drift punch
11. Rough and smooth file
12. Burring tool or pen knife
13. Schematic
14. Pencil
15. Compass

If you need more tools you may draw them.

MATERIAL

Three (3) pieces of aluminum as specified on schematic.

EXAMINEE'S NOTE:

Drill and set only those rivets which are X'd in the schematic.

EXHIBIT II (Cont'd.)

AM PERFORMANCE EXAMINATION

METAL WORKING

FABRICATION OF A FLUSH PATCH FOR STRESSED SKIN

EXAMINER INSTRUCTIONS

TASK — This is a test of the examinee's ability to fabricate a flush patch for stressed skin.

GENERAL DIRECTIONS TO EXAMINER

1. Read very carefully and thoroughly the "Examinee Instructions". Be sure you understand the test and the method for administering it before attempting to give it to the examinee.

2. Assign the examinee to a work station and provide him with the tools and material as listed in the "Examinee Instructions".

3. Have the examinee read the "Examinee Instructions," then read them out loud to him. Ask him if he has any questions. If he has a question, re-read to him that part of the instructions which answers his question. If he does not understand which rivets are to be drilled and set, say "You are to drill and set these rivets" and point to the X'd rivets on the schematic. Supply no accessory information. Remember, this is a test situation, not an instructional one. Make sure that the examinee understands what he is to do before he starts.

4. Have the examinee secure the work station when he is finished.

SCORING — Carefully observe the examinee as he works. If you think that the examinee should receive credit on an item, do nothing to the number which appears after the observation called for on that item. If no credit is to be allowed on an item, encircle or X over the number which appears after

EXHIBIT II (Cont'd.)

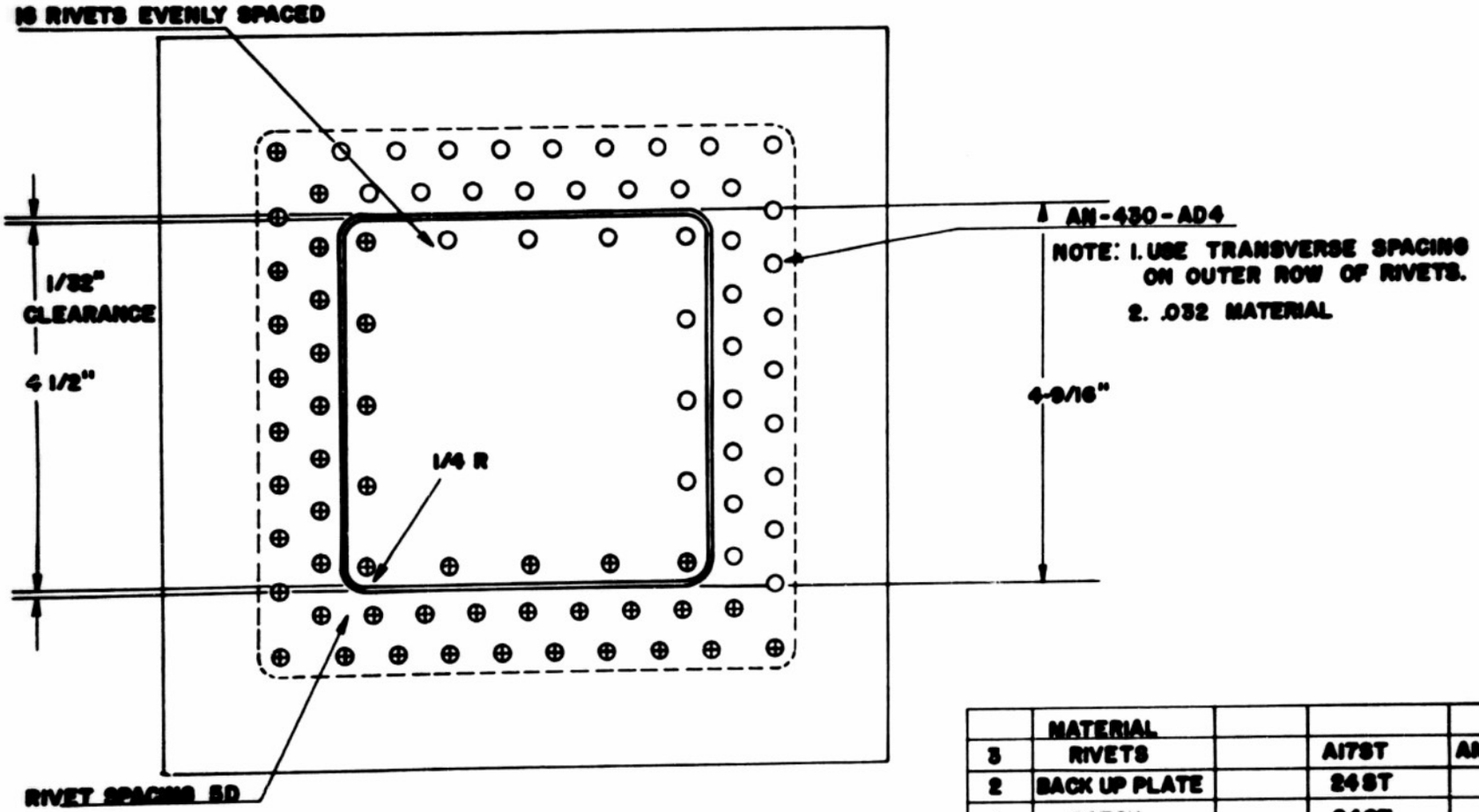
EXAMINER INSTRUCTIONS (Cont'd.)

that item. Do as much of the scoring as possible at the time that a particular sub-operation is performed. Do not (repeat), do not rely on your memory. Give complete attention to the scoring. Of course, the measurements of the final product will be made after the task is completed. The total score is the sum of the non-encircled or non-Xed credits. On completion of the test, add the non-encircled or non-Xed credits and enter the total in the space provided.

TIME — Time is counted as soon as the examinee understands what he is to do and told to start. Record the time that the examinee starts and finishes in the appropriate spaces. For credit on the time item, the examinee must finish in 2 1/4 hours or less. Do not tell the examinee what the time allowance is. If the examinee does not finish in 2 1/4 hours, allow him to finish. He receives no credit on the time item, however, unless he finishes in 2 1/4 hours or less.

EXAMINER'S NOTE

Do not allow examinee to drill out and replace any rivets.



	MATERIAL			
3	RIVETS		A17ST	AN 430AD4
2	BACK UP PLATE		24ST	
1	PATCH		24ST	
PART	NAME	NO. REQ.	MATERIAL	SPEC.

PERFORMANCE TEST - PATCH - FLUSH STRESSED SKIN

Fig. 1. Flush Patch Schematic Provided for Metal Working Test.

EXHIBIT II (Cont'd.)

AM PERFORMANCE EXAMINATION

METAL WORKING

FABRICATION OF A FLUSH PATCH FOR STRESSED SKIN

SCORING SHEET

NAME _____ RATE _____

SERVICE NUMBER _____ DATE _____

Time Started _____

TOOLS

1. Always uses back-up plate when center punching.. 1
2. Always uses 1" mark or mark away from end when using scale..... 1
3. Always checks dividers when finished with measurement transference to make sure that dividers did not slip..... 1
4. Always uses pencil for making layout, except if layout marks are to be cut away..... 1
5. Never forces too large a hole with aviation snips..... 1
6. Cleans file after operation and always files in one direction..... 1
7. Always holds drill at 90 degrees to work and never applies excess pressure to drill..... 1
8. Never aims rivet hammer in any direction other than at work and checks rivet hammer against block of wood prior to use..... 1
9. Checks bucking bar for mars prior to its use.. 1
10. Disconnects drill motor when not in use and when changing drills..... 1
11. Never elongates drill holes with drill..... 1

EXHIBIT II (Cont'd.)

SCORING SHEET (Cont'd.)

PROCEDURE

12. Lays out and cuts out damaged area using drill and aviation snips; rough files, smooth files, rounds corners.....1

13. Lays out first row of rivets; lays out second row of rivets..... 1

14. Center punches (see item 1 under tools)..... 1

15. Centers filler under damaged area. Scribes around filler to obtain proper filler size..... 1

16. Lays out, cuts out, trims back-up plate to size. 1

17. Pilot drills four corner holes in second row of rivet layout on skin..... 1

18. Aligns back-up plate and pilot drills through skin and back-up plate. Cleecos..... 1

19. Cuts, files, fits insert to fit cut out hole.... 1

20. Lays out rivet pattern on insert..... 1

21. Center punches (see item 1 under tools)..... 1

22. Holds insert in place and drills holes using Cleecos to hold skin, insert, and back-up plates together..... 1

23. Disassembles, deburrs, cleans..... 1

24. Reassembles and rivets..... 1

25. Time finished_____. Finished in less than 2 1/2 hours..... 3

EXHIBIT II (Cont'd.)

SCORING SHEET (Cont'd.)

MEASUREMENTS OF THE FINAL PRODUCT

26. Clearance between insertion and skin as specified throughout entire perimeter (tolerance ± or 1/64")..... 3

27. Correct rivet type used..... 3

28. Correct rivet spacing on skin (no tolerance).... 3

29. Correct rivet spacing on insert (no tolerance).. 3

30. Correct edge distance on back-up plate (no tolerance)..... 3

31. Correct edge distance on skin (no tolerance).... 3

32. Correct edge distance on insert (no tolerance).. 3

33. Not more than one rivet head out of line with buck tail..... 3

34. Not more than one buck tail missized or misshaped. (Height 1/2 D. max., 0.65 D. min; Width 1 3/4 D. max., 1 1/2 D. min.)..... 3

35. No rivet heads incorrectly seated (e.g., canted or too deep)..... 3

36. Not more than 1 rivet head marred..... 3

37. No rough edges or tool marks..... 3

38. All corner radii 1/4"..... 3

39. Two lateral edge lengths as specified on schematic (tolerance ± 1/16" each edge)..... 3

SAFETY PRECAUTIONS OBSERVED

40. Uses goggles when drilling..... 1

EXHIBIT II (Cont'd.)

SCORING SHEET (Cont'd.)

41. Completely closes dividers when dividers not in use..... 1

42. Equipment orderly stowed while working..... 1

43. Does not aim compressed air hose or attached equipment at self or other persons..... 1

Total Score_____

Splicing a Cracked C-Channel

The same practical factors areas are sampled in splicing a cracked C-Channel as are sampled in fabricating a flush patch. However, inclusion of C-Channel splicing as a test task provided an opportunity to "check out" the examinee on his ability to use different types of heavy apparatus such as the cornice brake and the squaring shear. Moreover, in order to complete the C-Channel splice, the examinee must solve a "bend allowance" problem. The bend allowance problem must be solved by the Aviation Structural Mechanic whenever he does a task which involves metal bending. Thus this task is not a duplication with the flush patch fabrication. Furthermore, since the structural mechanic spends a good deal of his time in the metal shop, it seemed advisable to include two tasks which involve metal working. For this task the examinee was given a standard C-Channel, and a standard crack was produced in the channel. Specifically, the task of the examinee was to lay out and cut out a reinforcement and then to rivet the reinforcement in place. As with the flush patch, a schematic (Fig. 2) was provided for the examinees use. For this test (Exhibit III) the examinee was scored in his care and use of tools, the procedure he followed in doing the job, the adherence of his finished product to the prescribed dimensions, and his adherence to safety precautions.

EXHIBIT III

Sample Structural Maintenance Test

AM PERFORMANCE EXAMINATION

STRUCTURAL MAINTENANCE

SPLICING OF A CRACKED CHANNEL

EXAMINEE INSTRUCTIONS

TASK — This is a test of your ability to repair a cracked channel. There is a channel in front of you which is cracked. Your task is to splice the channel exactly as you would on the job. A schematic is also provided. Look at it. Read it. Be sure you understand what you are to do before you start.

SCORING — You will be checked on the following:

1. The QUALITY of the finished product.
2. The PROCEDURE you follow in doing the job.
3. The MANNER in which you handle your tools.
4. The SAFETY precautions you observe.
5. The TIME it takes you to complete the job.

The principal emphasis however, is on the quality of the finished product, so do not sacrifice doing a good job for speed.

TOOLS AND MATERIAL

The following tools have been provided.

1. Scribe
2. Combination square head
3. Steel scale
4. Center punch
5. File
6. Pneumatic drill motor
7. Drill #40; Drill #30

EXHIBIT III (Cont'd.)

EXAMINEE INSTRUCTIONS (Cont'd.)

8. Pneumatic rivet gun
9. Rivet set, 1/8 RH
10. Ball peen hammer
11. Bucking bar
12. Cornice brake
13. Squaring shear
14. Cleeco fasteners
15. Schematic
16. Clamps
17. Aviation snips or shears
18. Material - as specified on schematic

If you need more tools you may draw them. Omit doing any zinc chromating that you might ordinarily perform.

EXHIBIT III (Cont'd.)

AM PERFORMANCE EXAMINATION

STRUCTURAL MAINTENANCE

SPLICING A CRACKED CHANNEL

EXAMINER INSTRUCTIONS

TASK This is a test of the examinee's ability to splice a cracked channel.

GENERAL DIRECTIONS TO EXAMINER

1. Read very carefully and thoroughly the "Examinee Instructions". Be sure you understand the test and the method for administering it before attempting to give it to the examinee.

2. Assign the examinee to a work station and provide him with the tools and materials.

3. Have the examinee read the "Examinee Instructions", then read them to him out loud. Ask him if he has any questions. If he does not understand any part of his directions, re-read that part out loud to him until he understands what he is to do. Supply no accessory information. Remember, this is a test situation, not an instructional one. Make sure the examinee understands what he is to do before he starts.

4. Have the examinee secure the work station when he is finished.

SCORING Carefully observe the examinee as he works. If you think that the examinee should receive credit on an item, do nothing to the number which appears after the observation called for on the item. If no credit is to be allowed on an item, encircle or X over the number which appears after that item. Do as much of the scoring as possible at the time that particular sub-operation is performed. Do not (repeat), do not rely on your memory. Give

EXHIBIT III (Cont'd.)

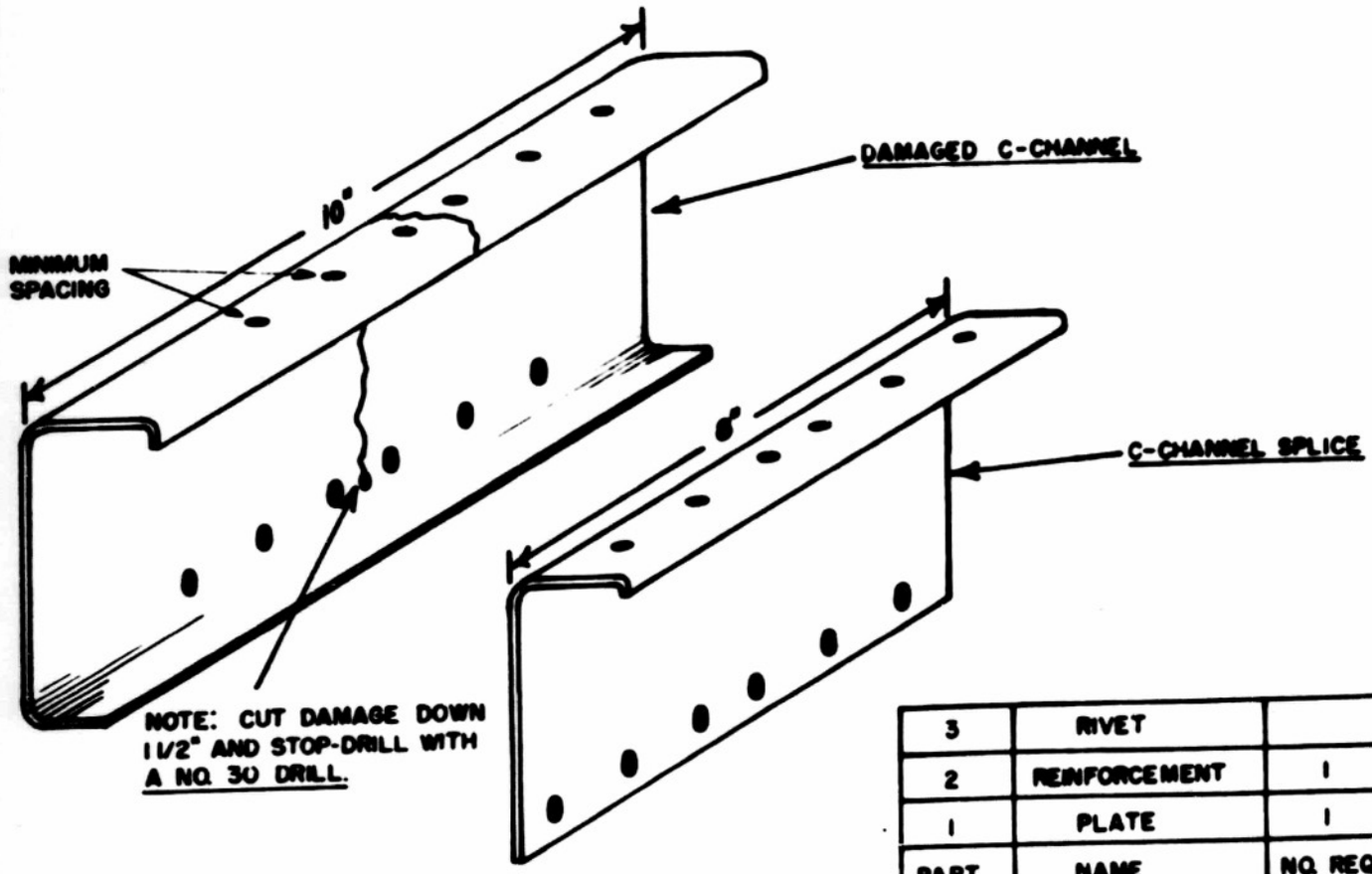
EXAMINER INSTRUCTIONS (Cont'd.)

complete attention to the scoring. Of course, the measurements of the final product will be made after the task is completed. The total score is the sum of the non-encircled or non-Xed credits. On completion of the test, add up the non-encircled or non-Xed credits and enter the total in the space provided.

TIME — Time is counted as soon as the examinee understands what he is to do and is told to start. Record the time that the examinee starts and finishes in the appropriate spaces. For credit on the time item, the examinee must finish in 70 minutes. Do not tell the examinee what the time allowance is. If the examinee does not finish in 70 minutes, allow him to finish. He receives no credit on the time item, however, unless he finishes in 70 minutes or less.

EXAMINER'S NOTE

Do not allow the examinee to drill out and replace any rivets.



PART	NAME	NO. REQ.	MATERIAL	SPEC.	STOCK SIZE
3	RIVET		A17ST	AN430 AD 4-4	
2	REINFORCEMENT	1	24ST	47 A 10	8" .032
1	PLATE	1	24ST	47 A10	10" .032

"C" CHANNEL REPAIR – LIMITS UNLESS OTHERWISE SPECIFIED ± 1/64"

Fig. 2. Schematic Provided for Structural Maintenance Test.

EXHIBIT III (Cont'd.)

AN PERFORMANCE EXAMINATION

STRUCTURAL MAINTENANCE

SPLICING OF A CRACKED CHANNEL

SCORING SHEET

NAME _____ RATE _____

SERVICE NUMBER _____ DATE _____

Time Started _____

TOOLS

1. When using scribe, never gouges metal..... 1
2. When using scale always start measurements from 1" mark or some mark away from end..... 1
3. Does not handle pneumatic drill motor carelessly at any time..... 1
4. Never lays down assembled drill and drill motor, drill end first..... 1
5. Tests rivet gun against block of wood, prior to its use..... 1
6. Uses pencil for laying out all bend lines and all rivet locations..... 1
7. Files at all times in one direction only..... 1
8. Examines material for bumps, scratches, etc. prior to using it..... 1

PROCEDURE

9. Solves bend allowance problem..... 1
10. Lays out material for splice. Bends laid out across the grain..... 1
11. Cuts flat layout to proper dimension on squaring shear..... 1

EXHIBIT III (Cont'd.)

SCORING SHEET (Cont'd.)

12.	Burrs edges with file.....	1
13.	Bends up legs of splice in cornice brake.....	1
14.	Lays out rivet pattern - one row laid out on reinforcement and two rows laid out on channel..	1
15.	Center punches holes.....	1
16.	Clamps splice plate in place and pilot drills all holes.....	1
17.	Drills holes to proper size. Uses appropriate Cleecos.....	1
18.	Disassembles and burrs holes.....	1
19.	Assembles, Cleecos, and rivets top.....	1
20.	Rivets back starting from crack and working out from crack.....	1

MEASUREMENTS OF THE FINAL PRODUCT

21.	Width of splice $\pm$ 1/64.....	3
22.	Height of splice $\pm$ 1/64.....	3
23.	Length of splice $\pm$ 1/64.....	3
24.	Radius of bends of splice correct (no daylight)	3
25.	Correct center of splice $\pm$ 1/64.....	3
26.	Clean damaged area, bottom of damage stop drilled.....	3
27.	Correct edge distance on reinforcement (both sides).....	3
28.	Rivet pattern completely correct (aside from edge distances).....	3

EXHIBIT III (Cont'd.)

SCORING SHEET (Cont'd.)

29. Rivet head and buck tail alignment (No more than 5% in error)..... 3

30. Size and shape of buck tail (No more than 5% in error)..... 3

31. Damaged rivet heads (No more than 5% in error). 3

32. All rivet heads properly seated..... 3

33. No tool marks on work..... 3

34. No rough edges or unrounded corners on work.... 3

35. Splice does not enter radius on bottom..... 3

36. Time finished_____. Total time on job _____. Finished in less than 70 minutes_____..... 3

SAFETY PRECAUTIONS

37. Rivet gun not aimed nor operated other than at work..... 1

38. Never holds material in such a manner as to be potentially dangerous while drilling..... 1

39. Never aims compressed air hose at self or other persons..... 1

40. Equipment orderly stowed while working..... 1

Total Score_____

Fabrication of a Flush Plastic Patch

A further requirement of the Aviation Structural Mechanic is that he "repair.....plastic aircraft fittings". Repair of a plastic panel, such as a damaged canopy, is a typical job. The flush plastic patch simulated this job. The examinee was given a piece of plastic such as aircraft canopies are made of. A standard hole was made in the plastic piece and the task of the examinee was to patch the hole. In order to do this, a man must first cut and fit a plug for the hole. The plug is then cemented in place and the patch buffed, waxed and polished. A properly patched panel does not look significantly different from an unpatched panel. The plastics test also provided an opportunity for check out on the use of the use of hand tools, and measuring instruments different from those used in the other tests as well as for check out on the use of the buffing wheel. The plastics test, (Exhibit IV) was scored in the same scoring areas -- care and use of tools, following the correct procedure, quality of the final patch, and adherence to safety rules -- as the previous tests.

EXHIBIT IV

Sample Plastic Repair Test

AM PERFORMANCE EXAMINATION

PLASTICS

FABRICATION OF A FLUSH PATCH

EXAMINEE INSTRUCTIONS

TASK This is a test of your ability to fabricate a plastic patch. A damaged panel is provided and your task is to repair the damage by fabricating a flush patch using the soak method. Do the job exactly as you would ordinarily do it. That is, imagine that the damaged panel is in a plane. Be sure you understand what you are to do before you start.

SCORING You will be marked in the following areas:

1. The QUALITY of the finished product.
2. The PROCEDURE you follow in doing the job.
3. The MANNER in which you use your tools.
4. The SAFETY precautions you observe.
5. The TIME it takes you to complete the job.

The principal emphasis in the scoring, however, will be on the quality of the finished product, so do not sacrifice doing a good job for speed.

TOOLS AND MATERIALS

The following tools have been provided:

1. Wood rasp
2. Smooth half round file
3. Circle dividers
4. Scribe
5. Masking tape
6. Shallow pan

EXHIBIT IV (Cont'd.)

EXAMINER INSTRUCTIONS

7. File card
8. Solvent methylene chloride, dichloride or type 1A
9. Drill
10. Buffing wheel
11. Masking or scotch tape
12. Acrylic-plastic panel 1/4" thick, acrylic-plastic patch 1/2" thick

If you need more tools you may draw them.

EXAMINEE'S NOTE

Hand file the joint. Remove one inch of damaged area.

EXHIBIT IV (Cont'd.)

AM PERFORMANCE EXAMINATION

PLASTICS

FABRICATION OF A FLUSH PATCH

EXAMINER INSTRUCTIONS

TASK This is a test of the examinee's ability to fabricate a flush plastic patch.

GENERAL DIRECTIONS TO EXAMINER

1. Read very carefully and thoroughly the "Examinee Instructions". Be sure you understand the test and the method for administering it before attempting to give it to the examinee.

2. Assign the examinee to a work station and provide him with the tools and materials.

3. Have the examinee read the "Examinee Instructions", then read them out loud to him. Ask him if he has any questions. If he has a question, re-read to him that part of his instructions which answer his question. Supply no accessory information. Remember, this is a test situation, not an instructional one. Make sure the examinee knows what he is to do before he starts.

4. Have the examinee secure the work station when he is finished.

SCORING Carefully observe the examinee as he works. If you think that the examinee should receive credit on an item, do nothing to the number which appears after the observation called for on that item. If no credit is to be allowed on an item, encircle or X over the number which appears after that item. Do as much of the scoring as possible at the time that a particular sub-operation is performed. Do not (repeat), do not rely on your memory. Give complete attention to the scoring. Of course, the

EXHIBIT IV (Cont'd.)

EXAMINER INSTRUCTIONS (Cont'd.)

measurements of the final product will be made after the task is completed. The total score is the sum of the non-encircled or non-Xed credits. On completion of the test, add up the non-encircled or non-Xed credits and enter the total in the space provided.

TIME — Time is counted as soon as the examinee understands what he is to do and is told to start. Record the time that the examinee starts and finishes in the appropriate spaces. For credit on the time item, the examinee must finish in 120 minutes (Exclusive of drying time). Do not tell the examinee what the time allowance is. If the examinee does not finish in 120 minutes, allow him to finish. He receives no credit on the time item, however, unless he takes 120 minutes or less of working time.

EXAMINER'S NOTE

Remove file handle from file prior to arrival of examinee.

EXHIBIT IV (Cont'd.)

AM PERFORMANCE EXAMINATION

PLASTICS

FABRICATION OF A FLUSH PATCH

SCORING SHEET

NAME _____ RATE _____

SERVICE NUMBER _____ DATE _____

Time Started _____

TOOLS

1. Never lays rasp or file on metal bench..... 1
2. Never handles circle dividers or scribe in such a manner as to dull points..... 1
3. Always pats dry. Never rubs dry..... 1
4. Never leaves solvent container uncapped..... 1
5. Continually moves work while buffing..... 1

PROCEDURE

6. Removes damaged area and produces clean round hole..... 1
7. Bevels edges of hole to approximately 30 degrees. Finishes smooth..... 1
8. Takes thicker piece and finds center on both sides..... 1
9. Fabricates plug. Plug tapered at a sharper angle than section under repair. Finishes smooth..... 1
10. Heats patch; presses into section under repair, holds until cool..... 1
11. Marks plug so that direction of fitting is known 1

EXHIBIT IV (Cont'd.)

SCORING SHEET (Cont'd.)

12. Masks off top and bottom of plug and cleans area to be cemented with methyl (wood) alcohol..... 1

13. Emerges in solvent (methylene chloride 2-3 min.) (methylene dichloride 7-10 min.) (solvent 1A 10-30 min.)... 1

14. Shakes off excess solvent; places patch in hole in correct direction..... 1

Time to this point_____

15. Leaves in jig for 4 hours and allows to set for 24 hours before working..... 1

16. Removes masking tape, rough files, smooth files, sands. No file marks remaining when sanding finished..... 1

17. Buffs with hard wheel using tallow and coloring compound..... 1

18. Buffs with soft wheel using only tallow. Washes in pure soap and water and pats dry with "Kleenex" or soft cloth..... 1

19. Buffs, waxes, polishes..... 1

Time finished_____. Working time less than 80 minutes_____..... 3

MEASUREMENTS OF FINAL PRODUCT

20. No bubbles in joint..... 3

21. No scratches or scars on plug..... 3

22. No spaces in joint..... 3

23. Thinning of canopy piece (panel) on outside (not more than 5%)..... 3

EXHIBIT IV (Cont'd.)

SCORING SHEET (Cont'd.)

24. Thinning of canopy piece (panel) on inside (not more than 5%)..... 3

25. No scratches or scars on panel..... 3

26. No cloudiness in joint..... 3

27. No dirt in joint..... 3

28. No crazing in joint..... 3

29. Area surrounding patch clean..... 3

SAFETY

30. Puts on goggles before using wheel..... 1

31. Does not breathe excess solvent fumes..... 1

32. Never uses file without handle..... 1

33. Uses file with forward strokes only..... 1

Total Score_____

Aluminum Butt Weld

The art of welding is an indispensable part of aircraft maintenance work. Thus one of the important practical factors requirements for Aviation Structural Mechanics is the ability to "weld aluminum alloys".

Aluminum welding, was preferred as a test situation over ferrous welding since the man who can weld aluminum can probably weld ferrous metals. However, the reverse probably does not hold for the aluminum butt welding test. The examinee was given two 6" pieces of .064,2 S0 aluminum and his task was to butt weld the two pieces. When scoring the quality of the weld, the examiner made a mark 3" from one end of the weld and then scored each half of the weld separately. Thus, in effect, the examinee was scored on two separate welds. This method of scoring was incorporated so that the examinee who was a little rusty in welding technique, but who warmed up after a few minutes, would not be over penalized. The welding test, of course, provided an opportunity for observations on the examinees' dexterity and acquaintanceship with welding apparatus. Similar apparatus is used in cutting metal. The examinee was scored on his use of tools, the procedure he followed, the quality of his final weld, and the safety precautions he observed. The complete test is shown in Exhibit V.

EXHIBIT V

Sample Welding Test

AM PERFORMANCE EXAMINATION

WELDING

ALUMINUM BUTT WELD

EXAMINEE INSTRUCTIONS

TASK This is a test of your ability to weld aluminum. You will be provided with two pieces of aluminum. Your task is to butt weld the two pieces together along the length. Do the weld as you would ordinarily do it. Be sure you understand what you are to do before you start. Make sure that you make the weld along the 6" side of the metal.

SCORING You will be marked in the following areas:

1. The QUALITY of the finished product.
2. The PROCEDURE you follow in doing the job.
3. The MANNER in which you use your tools.
4. The SAFETY precautions you observe.
5. The TIME it takes you to complete the job.

The principal emphasis however, is on the quality of the finished product, so do not sacrifice doing a good job for speed.

TOOLS The following have been provided:

1. Welding bench
2. Pliers
3. Oxy-acetylene bottles
4. Flux
5. Welding torch and tips
6. Steel wool, wire brush or emery cloth
7. Stiff bristle brush

If you need anything else, you may draw it.

MATERIAL 2 pieces of aluminum 6" long, .064,2 SO.

EXHIBIT V (Cont'd.)

AM PERFORMANCE EXAMINATION

WELDING

ALUMINUM BUTT WELD

EXAMINER INSTRUCTIONS

TASK This is a test of the examinee's ability to make an aluminum butt weld.

GENERAL DIRECTIONS TO EXAMINER

1. Read very carefully and thoroughly the "Examinee Instructions". Be sure you understand the test and the method for administering it before attempting to give it to the examinee.

2. Assign the examinee to a work station and provide him with the tools and material.

3. Have the examinee read the "Examinee Instructions", then read them out loud to him. Ask him if he has any questions. If he does not understand any part of his directions, re-read that part out loud to him until he understands what he is to do. Supply no accessory information. Remember, this is a test situation, not an instructional one. Make sure the examinee understands what he is to do before he starts.

4. Have the examinee secure the work station when he is finished.

SCORING Carefully observe the examinee as he works. If you think that the examinee should receive credit on an item do nothing to the number which appears after the observation called for on that item. If no credit is to be allowed on an item, encircle or X over the number which appears after that item. Do as much of the scoring as possible at the time that a particular sub-operation is performed. Do not (repeat), do not rely on your memory. Give complete attention to the scoring. Of course, the measure-

EXHIBIT V (Cont'd.)

EXAMINER INSTRUCTIONS (Cont'd.)

ments of the final product will be made after the task is completed. To perform these measurements, first measure in 3" from the start of the weld. Make a mark at this point. Then make the measurements and score those observations called for which pertain to the first half of the final weld. On finishing those measurements and observations which pertain to the first half of the final weld, make those which pertain to the second half. The total score is the sum of the non-encircled or non-Xed credits. On completion of the test, add up the non-encircled or non-Xed credits and enter the total in the space provided.

TIME — Time is counted as soon as the examinee understands what he is to do and is told to start. Record the time that the examinee starts and finishes in the appropriate spaces. For credit on the time item, the examinee must finish in 17 minutes or less. Do not tell the examinee what the time allowance is. If the examinee does not finish in 17 minutes, allow him to finish. He receives no credit, however, on the time item unless he finishes in 17 minutes or less.

EXAMINERS NOTE:

Make sure that the weld is made lengthwise, e.g., the weld should be 6" long.

EXHIBIT V (Cont'd.)

AM PRACTICAL FACTORS EXAMINATION

WELDING

ALUMINUM BUTT WELD

SCORING SHEET

NAME_____ RATE_____

SERVICE NUMBER_____ DATE_____

Time Started_____

TOOLS AND MATERIALS

1. Holds torch at 45° angle to work except for start or finish..... 1

2. Always concentrates flame on base metal, not on rod..... 1

3. Uses proper flux consistency (free flowing flux). 1

4. Selects proper size rod for given metal thickness 1

5. Selects proper size welding tip for given metal thickness..... 1

6. Restricts cleaning of base metal to width of weld 1

PROCEDURE

7. Examines metal for dirt or grease. Cleans both metal and rods..... 1

8. Sets metal on jigs. Mixes flux. Fluxes both base metal and rods..... 1

9. Adjusts oxygen-acetylene regulators to 3-8 pounds (No credit if pressure on oxygen does not equal pressure on acetylene)..... 1

10. Lights torch and adjusts to slightly carburizing flame (feather should be no more than 1 1/2 times inner cone)..... 1

EXHIBIT V (Cont'd.)

SCORING SHEET (Cont'd.)

11.	Pre-heats base metal.....	1
12.	Tacks metal from center to each end, or from center to each end alternately; tacks 1 1/4 to 1 1/2 in. apart.....	1
13.	Welds from center to one end.....	1
14.	Reverses metal and welds from center to other end.....	1
15.	Uses correct torch and rod motions while welding	1
16.	Dips and washes making sure that all flux is removed.....	1
17.	Time finished_____. Finished in 17 minutes or less.....	1

MEASUREMENT OF THE FINAL PRODUCT

18.	Start of weld uniform with rest of weld.....	3
19.	End of weld uniform with rest of weld.....	3
20.	Uniform penetration for entire first 3".....	3
21.	Uniform penetration for entire last 3".....	3
22.	Bead width 3-5 times metal thickness for entire first three inches.....	3
23.	Bead width 3-5 times metal thickness for entire last three inches.....	3
24.	Bead height 25-50% of thickness for entire first three inches.....	3
25.	Bead height 25-50% of thickness for entire last three inches.....	3
26.	No bead irregularity in entire first three inches.....	3
27.	No bead irregularity in entire last three inches	3

EXHIBIT V (Cont'd.)

SCORING SHEET (Cont'd.)

SAFETY

28. Shirt neck and sleeves buttoned..... 1

29. Makes sure fire extinguisher in area before igniting torch..... 1

30. Makes sure that gas bottles are in an upright position..... 1

31. Uses friction lighter to ignite torch and holds lighter on bench when igniting torch..... 1

32. Does not open acetylene cylinder valve more than 1 1/2 turns..... 1

33. Uses goggles when welding..... 1

Total Score_____

30-Hour Hydraulic Inspection - Trouble Shooting

Systems such as the brake, landing gear, wing flap, wing fold, seat elevation, canopy release, etc. in an aircraft are often hydraulically operated. Thus, hydraulic maintenance is of paramount importance in maintaining the readiness of an aircraft. The burden of this maintenance falls on the Aviation Structural Mechanic. The hydraulic "practical factors" requirements are put by NAVPERS 18068 in this manner.

> "Trace through aircraft landing gear, bomb bay, automatic pilot, brake, and other systems; repair and service individual parts and linkages as required. Make periodic checks and inspections to facilitate preventive maintenance. Vent, bleed, drain, flush and refill hydraulic systems. Remove, service, repair, and install hydraulic units and accessories".

In operations 30, 60, 90 and 120-hour hydraulic checks are performed. The 30-hour hydraulic check was chosen as a test task, since this task is quite representative. The task of the examinee was to perform an actual 30-hour hydraulic check. The 30-hour hydraulic check was performed on an operating aircraft, the F4U. In order to test the examinees' ability to "trouble shoot" a hydraulic system, a rivet was placed in the line of one of the unit systems. This effectively blocked the flow of hydraulic fluid through the blocked system. The "trouble shooting", therefore, consisted of a test of the examinees' ability to locate the blocked system and to locate the cause and location of the restriction. In one sense, merely performing a routine hydraulic check is a "trouble shooting" ability test, since in trouble shooting a hydraulic system, the structural mechanic must follow the same procedure that he follows when performing a 30-hour hydraulic check.

The examinee was scored on the manner in which he prepared for the inspection, the thoroughness of his check on each of the major aircraft hydraulic systems, the finding of the restricted line ("trouble shooting") and the safety precautions he observed. Exhibit VI presents this test.

EXHIBIT VI

Sample Hydraulic Inspection Test

AM PERFORMANCE EXAMINATION

HYDRAULICS

HYDRAULIC INSPECTION - TROUBLE SHOOTING

EXAMINEE INSTRUCTIONS

TASK This is a test of your ability to perform a routine 30-hour hydraulic check on an aircraft. You are to perform the check exactly as you would ordinarily do it. If you find anything that is not O.K., report it to the examiner. The examiner will inform you whether or not you are to remedy the defect.

SCORING You will be scored in the following areas:

1. The TIME it takes you to complete the job.
2. The SAFETY precautions you observe.
3. The PROCEDURE you follow in doing the job.

However, the principal scoring emphasis is on doing the job well, so do not sacrifice doing a good job for speed.

TOOLS You may draw the tools needed for the check. Draw your tools. Then report to the examiner that you are ready to begin. Time will start after you draw your tools and report to the examiner that you understand what you are to do and are ready to begin. Be sure you understand what you are to do before you begin.

EXAMINEE NOTE:

If you come to a part of the check which requires more than one man, tell the examiner what help you need. He will give you any necessary help. If you want the plane turned up, the examiner will have it turned up for you. Be sure to verify the operation of unit systems using the hand or emergency pump.

EXHIBIT VI (Cont'd.)

AM PRACTICAL FACTORS EXAMINATION

HYDRAULICS

HYDRAULIC INSPECTION - TROUBLE SHOOTING

EXAMINER INSTRUCTIONS

TASK — This is a test of the examinee's ability to perform a routine 30-hour hydraulic check, and of his ability to find the reason why a hydraulic unit system is not operating and to remedy it.

GENERAL DIRECTIONS TO EXAMINER

1. Read the "Examinee Instructions" and scoring sheet thoroughly. Be sure you understand the test and the method for scoring it before giving it to the examinee.

2. Assign the examinee to an aircraft.

3. Have the examinee read the "Examinee Instructions". Then re-read them to him out loud. Ask him if he has any questions. If there is anything he does not understand, re-read to him that part of the instructions which answers his question. Make sure that the examinee fully understands what he is to do before he starts.

EXAMINER'S NOTE

Make any unit system non-operative before the examinee arrives by placing a restriction (rivet) at any fitting in the system. If, after finding the non-operative unit, the examinee is unable to remedy the defect within 20 minutes, have him proceed with the remainder of the periodic check. The way to do this is to say - "All right, go on with the remainder of the check and go back to that at the end". At the finish of the check do not, however, allow the examinee to go back.

EXHIBIT VI (Cont'd.)

EXAMINER INSTRUCTIONS (Cont'd.)

THESE INSTRUCTIONS AND WORDINGS ARE TO BE FOLLOWED EXACTLY.

The only defect the examinee is to remedy is the line restriction. If he comes across any other defect, say - "That's good, go on with the check". The only help you are to give the examinee is to step on the brakes if the examinee so requests, and to help him with any heavy lifting (e.g., such as wheel replacement) if necessary.

SCORING Carefully observe the examinee as he works. If you think that an examinee should receive credit on an item, do nothing to the number which appears after the observation called for on that item. If no credit is to be allowed on an item, encircle or X over the number which appears after that item. Give complete attention to the scoring. Do not (repeat), do not rely on your memory. The total score is the sum of the non-encircled or non-Xed credits. On completion of the scoring, add up the non-encircled or non-Xed credits and enter the total in the space provided.

TIME Time is counted as soon as the examinee understands what he is to do and is told to start. Record the time that the examinee starts and finishes in the appropriate spaces. For credit on the time item the examinee must finish in 80 minutes or less. Do not tell the examinee what the time allowance is. If the examinee does not finish in 80 minutes or less, allow him to finish. He receives no credit on the time item, however, unless he finishes in 80 minutes or less. Be sure that the examinee does not spend more than 20 minutes correcting or attempting to correct the line restriction.

EXHIBIT VI (Cont'd.)

AM PRACTICAL FACTORS EXAMINATION

HYDRAULICS

HYDRAULIC INSPECTION - TROUBLE SHOOTING

SCORING SHEET

NAME_____ RATE_____

SERVICE NUMBER_____ DATE_____

Time Started_____

PREPARATION FOR INSPECTION

1. Draws all of the following tools and materials.. 1

   a. Flashlight
   b. 7/16" wrench
   c. 9/16" wrench
   d. 11/16" wrench
   e. 13/16" wrench
   f. Diagonals
   g. Clean rag
   h. Oily rag (hydraulic fluid)
   i. Pliers
   j. Length of safety wire
   k. Screwdriver
   l. High pressure gauge

2. Checks aircraft for grounding or grounds aircraft..... 1

3. Checks ignition switch for "OFF" position and landing gear selector valve for "down" and "locked" position..... 1

4. Places drip pans under aircraft or checks for pressure of drip pans..... 1

BRAKES

5. Inspects for general evidence of leakage. Reports discrepancy, if any..... 1

6. Checks for loose hydraulic fittings and evidence of leaking cup seal. If discrepant, so reports..... 1

EXHIBIT VI (Cont'd.)

SCORING SHEET (Cont'd.)

7. Inspects flex hose for chafing and security. Reports any discrepancy..... 1

8. Checks system for correct reaction by operating master cylinders. Checks fluid level in Warner master brake cylinder. If level low reports same..... 1

9. Checks security of hydraulic line clamps. If insecure so reports..... 1

LANDING GEAR STRUTS AND MECHANICAL LINKAGES

10. Checks struts for leakage, and general cleanliness. Reports discrepancy, if any..... 1

11. Checks inflation of tail wheel strut. Reports discrepancy, if any..... 1

12. Checks Arens control for proper seating in selector valve or safety lock on landing gear to "down" position..... 1

13. Inspects ALL mechanical linkages and connections. Reports any discrepancies..... 1

14. Checks landing gear emergency systems, e.g., verifies air bottle for proper pressure or CO_2 bottle for proper weight and reports any discrepancy..... 1

15. Cleans and lubricates all exposed piston rods with prescribed hydraulic fluid..... 1

POWER SYSTEM

16. Checks fluid level in reservoir. Reports any discrepancy..... 1

17. Kills pressure in system and checks accumulator for prescribed preload. Reports any discrepancy..... 1

EXHIBIT VI (Cont'd.)

SCORING SHEET (Cont'd.)

18. Checks flex hose fittings between reservoir and engine driven pump for twists, leaks, and chafing. Reports any discrepancy..... 1

19. Checks on filters. Reports necessary cleaning or replacement as necessary..... 1

20. Verifies operation of hand pump..... 1

UNIT SYSTEMS

21. Verifies operation of all selector valves and actuating cylinders using hand pump. Reports any discrepancy..... 1

22. Checks landing gear actuating cylinders, selector valves, mechanical linkage and lines for leakage and security. Reports any discrepancy 1

23. Checks wing flap actuating cylinders, selector valve, mechanical linkage and lines for leakage and security. Reports any discrepancy... 1

24. Checks cowl flap actuating cylinders, selector valve, mechanical linkage and all lines for leakage and security. Reports any discrepancy 1

25. Checks oil cooler and inter-cooler actuating cylinders, selector valves, mechanical linkages and lines for leakage and security. Reports any discrepancy..... 1

26. Checks wing lock actuating cylinders, selector valve and lines for leakage and security. Reports any discrepancy..... 1

27. Verifies operation of wing lock sequence valve. Checks for security and leaks. Reports any discrepancy..... 1

28. Verifies operation of safety locking pin and lock indicator. Checks mechanical linkage for security. Reports any discrepancy..... 1

EXHIBIT VI (Cont'd.)

SCORING SHEET (Cont'd.)

29. Checks gun charger control valves and actuating cylinders for leaks and security. Reports any discrepancies..... 1

Makes checks 30, 31, and 32 if they are applicable:

30. Checks seat elevation system..... 1

31. Checks canopy system and canopy emergency release and jettison apparatus. Reports discrepancy, if any..... 1

32. Checks wing fold system. Reports discrepancy, if any..... 1

33. Reverifies operation of all unit systems with hand pump..... 1

TROUBLE SHOOTING

34. At appropriate time in check, reports trouble.. 3

35. Finds cause of trouble..... 3

36. Removes rivet..... 3

37. Reattaches fitting..... 3

38. Time finished _____. Finished in less than 80 minutes..... 3

SAFETY PRECAUTIONS

39. Wears no jewelry that will snag..... 1

40. Keeps sleeves buttoned while working on plane. 1

41. Takes care in climbing and uses work stands where appropriate..... 1

42. If any fluid dropped on deck, swabs up same immediately..... 1

EXHIBIT VI (Cont'd.)

SCORING SHEET (Cont'd.)

43.	Carries no tools in pockets.....	1
44.	Leaves no tools in area or aboard aircraft after finishing check.....	1
45.	Before disconnecting hydraulic lines kills system pressure.....	1
46.	Works on folded wings only when wing locks or jury struts are in position.....	1
47.	Makes sure personnel clear of aircraft if motor turned up.....	1

Total Score_____

Fabrication of a Rigid Tubing Assembly

The hydraulic lines, fuel lines, air lines and similar parts of an aircraft are made of tubing. ".....flaring, cutting, bending, threading, and assembling" of tubing are among the practical factors requirements for the Aviation Structural Mechanic. In addition he should be able to "install and maintain hydraulic lines....." Since it seemed unwarranted and unnecessary to tie up a complete aircraft for this test, a "mock up", (Figure 3) was constructed. The "mock up" was suggested by personnel at the Aviation Structural Mechanics' School, Memphis, as a result of test constructor's request for ideas as to how the tube fitting task could be simulated. A standard fitting was fixed to the back of the "mock up" and another fitting fixed at bottom. The task of the examinee was to fit a tube to the boxed standard fittings. To do this the examinee had to cut, bend, flare and fit a 18" length of 52 SO, .040 wall thickness tubing. The type of bends made are typical of those found in operational aircraft. Since the box was closed on three sides, the examinee was forced to work in a relatively confined space, such as is usually found in an aircraft. This test, (Exhibit VII) provided an opportunity for observations of the examinees' use of tools that were not used in the other tests and the examinee was scored on his care and use of tools, the procedure he followed in doing the job, the safety precautions he observed and the quality of his finished tubing assembly.

EXHIBIT VII

Sample Tubing Replacement Test

AM PERFORMANCE EXAMINATION

HYDRAULICS

FABRICATION OF A RIGID TUBING ASSEMBLY

EXAMINEE INSTRUCTIONS

TASK This is a test of your ability to fabricate a rigid tubing assembly. Look at the "mock up" of a typical rigid tubing assembly which is in front of you. The tubing in the "mock up" is damaged and your task is to replace that tubing. Do the replacement exactly as you would ordinarily do it. That is, imagine that the damaged tubing is in a plane. In order to facilitate the scoring, first form the back piece bend (vertical leg) with fitting, (repeat) first form the vertical bend with fitting and then the horizontal bend and fitting. You may assume that the pressure in the system is zero.

SCORING You will be marked in the following areas:

1. The QUALITY of the finished product.
2. The PROCEDURE you follow in doing the job.
3. The MANNER in which you use your tools.
4. The SAFETY precautions you observe.
5. The TIME it takes you to complete the job.

However, the principal scoring emphasis is on doing the job well, so do not sacrifice doing a good job for speed.

TOOLS The following tools have been provided.

1. Tubing cutter
2. Hand tube bender
3. File
4. Mallet
5. Parker flaring tool
6. Pencil
7. Burring tool or pen knife

If you need additional tools, you may draw them.

MATERIAL Three (3) pieces 52 SO tubing, 18" long, .040 wall thickness.

EXHIBIT VII (Cont'd.)

AM PERFORMANCE EXAMINATION

HYDRAULICS

FABRICATION OF A RIGID TUBING ASSEMBLY

EXAMINER INSTRUCTIONS

TASK — This is a test of the examinees' ability to fabricate a rigid tubing assembly.

GENERAL DIRECTIONS TO EXAMINER

1. Read very carefully and thoroughly the "Examinee Instructions". Be sure you understand the test and the method for administering it before attempting to give it to the examinee.

2. Assign the examinee to a work station and provide him with the "mock up", tools and material.

3. Have the examinee read the "Examinee Instructions" then read them to him out loud. Ask him if he has any questions. If he does not understand any part of his directions, re-read that part out loud to him until he understands what he is to do. If he does not understand the sequence in which the job is to be done, point to the vertical bend and say, "First make this bend and then (pointing to the horizontal bend) make this bend." Make sure that he understands what he is to do before he starts.

4. Have the examinee secure the work station when he is finished.

SCORING — Carefully observe the examinee as he works. If you think that an examinee should receive credit on an item, do nothing to the number which appears after the observation called for on that item. If no credit is to be allowed on an item, encircle or X over the number which appears after that item. Give complete attention to the scoring. Do not (repeat), do not rely on your memory. Of course, the measurements of the final product will be made after the examinee has completed the job. The total score is the sum of the non-encircled or non-Xed credits. On completion of the scoring, add the non-encircled or non-Xed credits and enter the total in the space provided.

EXHIBIT VII (Cont'd.)

EXAMINER INSTRUCTIONS (Cont'd.)

TIME Time is counted as soon as the examinee understands what he is to do and is told to start. Record the time that the examinee starts and finishes in the appropriate spaces. For credit on the time item, the examinee must finish in 23 minutes or less. Do not tell the examinee what the time allowance is. If the examinee does not finish in 23 minutes or less, allow him to finish. He receives no credit, however, on the time item unless he finishes in 23 minutes or less.

EXAMINER'S NOTE

File handle is to be removed from file and placed among tools before the examinee arrives.

EXHIBIT VII (Cont'd.)

AM PERFORMANCE EXAMINATION

HYDRAULICS

FABRICATION OF A RIGID TUBING ASSEMBLY

SCORING SHEET

NAME_____ RATE_____

SERVICE NUMBER_____ DATE_____

Time Started_____

TOOLS

1. Uses file for no work other than filing..... 1
2. Places handle on file prior to use..... 1
3. Refrains from horse play with mallet or other tools..... 1
4. Uses pencil to mark tubing..... 1

PROCEDURE

5. Removes damaged tubing..... 1
6. Inspects replacement tubing to see that it is free from surface defects..... 1
7. Inspects replacement tubing to see that it is of required thickness..... 1
8. Marks tubing at end of recess on back board fitting to get first bend..... 1
9. Places tubing in hand tube bender, lines bend mark on tubing up with 45° mark on radius block and makes first bend..... 1
10. Removes tube from hand tube bender, and marks tube at level with bottom of threads. Cuts tubing on pencil mark. (No credit unless mark made at level with bottom of threads)..... 1

EXHIBIT VII (Cont'd)

SCORING SHEET (Cont'd.)

11. Deburrs both inside and out using burring tool or pen knife..... 1

12. Places standard fitting on tubing..... 1

13. Places tubing in flaring block, sets plunger in tubing and tightens vise. (No credit on this item if clamp tightened before flaring pin set)..... 1

14. Taps plunger (No credit unless plunger rotated after each tap)..... 1

15. Does not tap plunger after dull thud heard... 1

16. Removes from flaring block and secures standard fitting to back board fitting. Measures out from bottom fitting and makes 45° mark on tube..... 1

17. Places tubing in hand tube bender, lines up 45° mark and checks to see if bend is going in the right direction. (No credit unless check made) Makes bend..... 1

18. Holds first flare against back board fitting, and makes pencil mark at bottom of threads at end of recess box fitting. (No credit unless mark made at level with bottom of threads)..... 1

19. Cuts tubing on mark. Deburrs both inside and out..... 1

20. Places triple type fitting on tubing. (No credit unless nut put on first, then sleeve with collar up on first attempt)..... 1

21. Places tubing in flaring block, sets plunger in tubing and tightens vise. (No credit on this item if clamp tightened before flaring pin set in tube)..... 1

22. Taps plunger (No credit unless plunger rotated after each tap)..... 1

EXHIBIT VII (Cont'd.)

SCORING SHEET (Cont'd.)

23. Does not tap plunger after dull thud heard.... 1

24. Removes from flaring block, places tubing in project box, hand tightens each fitting as far as possible. Finishes tightening with wrench. 1

25. Time at finish_____. Time to complete job_____. Time to complete job 23 minutes or less..... 3

QUALITY OF FINAL PRODUCT

26. One tube used to complete job..... 3

27. Entire surface of tube and fittings completely free from scratches..... 3

28. Back board flare fits snugly into "go and no go"gage..... 3

29. Bottom flare fits snugly into "go and no go" gage..... 3

30. Back board flare completely free of burrs inside and out..... 3

31. Bottom flare completely free of burrs inside and out..... 3

32. Back board flare at least 80% of original thickness..... 3

33. Bottom flare at least 80% of original thickness 3

34. Back board flare square and concentric..... 3

35. Bottom flare square and concentric..... 3

36. Back board bend 90° (no tolerance)..... 3

37. Bottom bend 90° (no tolerance)..... 3

EXHIBIT VII (Cont'd.)

SCORING SHEET (Cont'd.)

38. Neither flaring pock marked or chipped..... 3

39. No filings, chips or other matter on inside of tube or fittings..... 3

40. Back board bend neither kinked, flattened, or wrinkled..... 3

41. Bottom bend neither kinked, flattened or wrinkled..... 3

Total Score_____

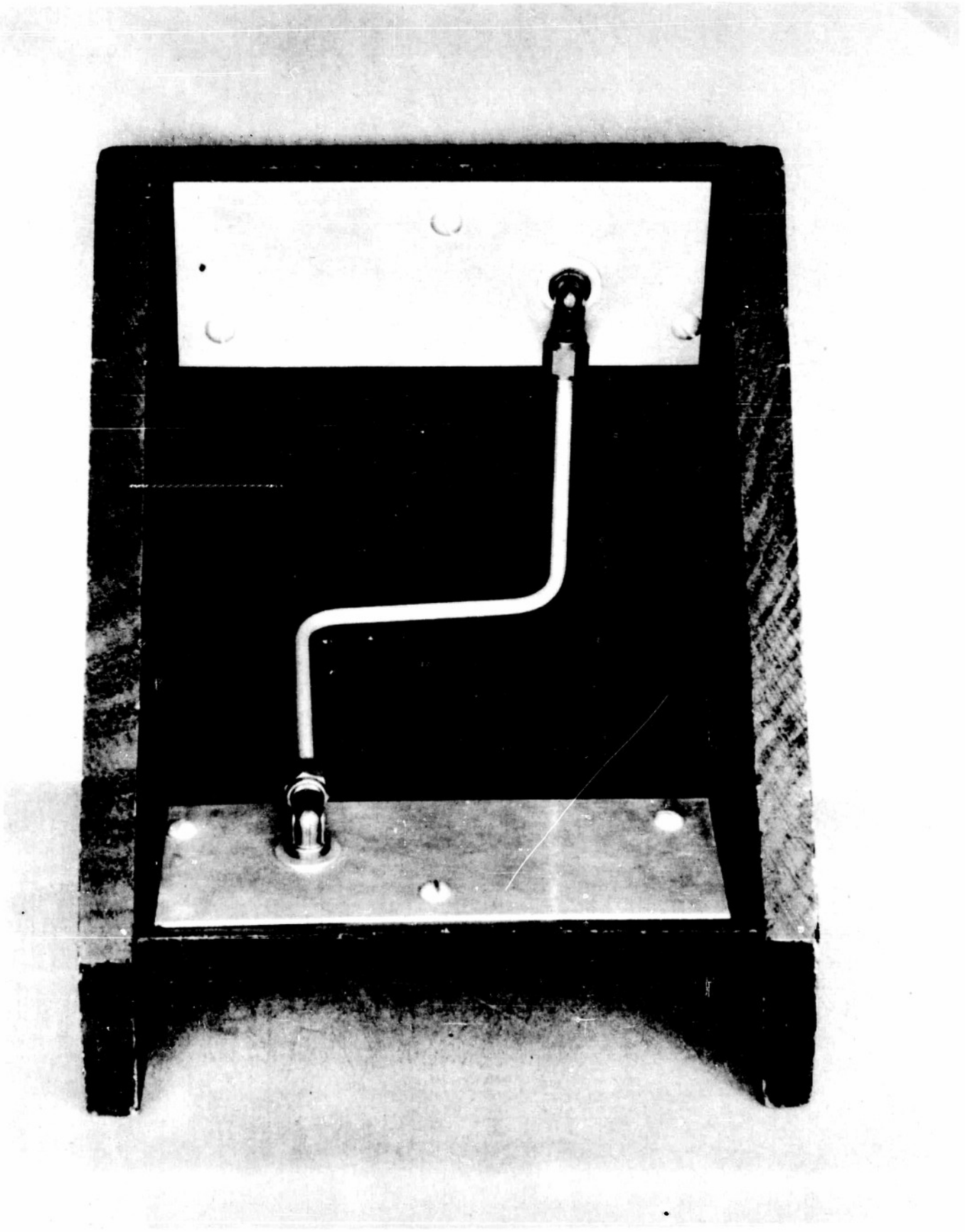


Fig. 3. Mock up used in Rigid Tubing Assembly Test.

L-Type Fabric Repair

Certain aircraft surfaces, subject to severe vibration, are subject to failure if covered with riveted metal. These surfaces, are accordingly covered with fabric. A typical example is the airfoil. The "repair of fabric covered surfaces" is the responsibility of the structural mechanic. In order to tap ability at fabric repair a "mock up" (Figure 4) of an airfoil was constructed. The "mock up" was, in essence, a small, portable sewing bench across the top of which could easily be stretched a piece of fabric. (Figure 5)

An-L type cut, each leg of which was 3" long, was cut into the fabric. The task of the examinee was to sew, surface tape, and dope the cut. The L-type cut was chosen, since a T-cut is merely an inverted L with an extra leg, and an X-type of cut is merely two L's. Procedure, quality of the final product, and safety precautions observed were scored. As with the weld, each leg of the cut was separately scored. The complete test is presented in Exhibit VIII.

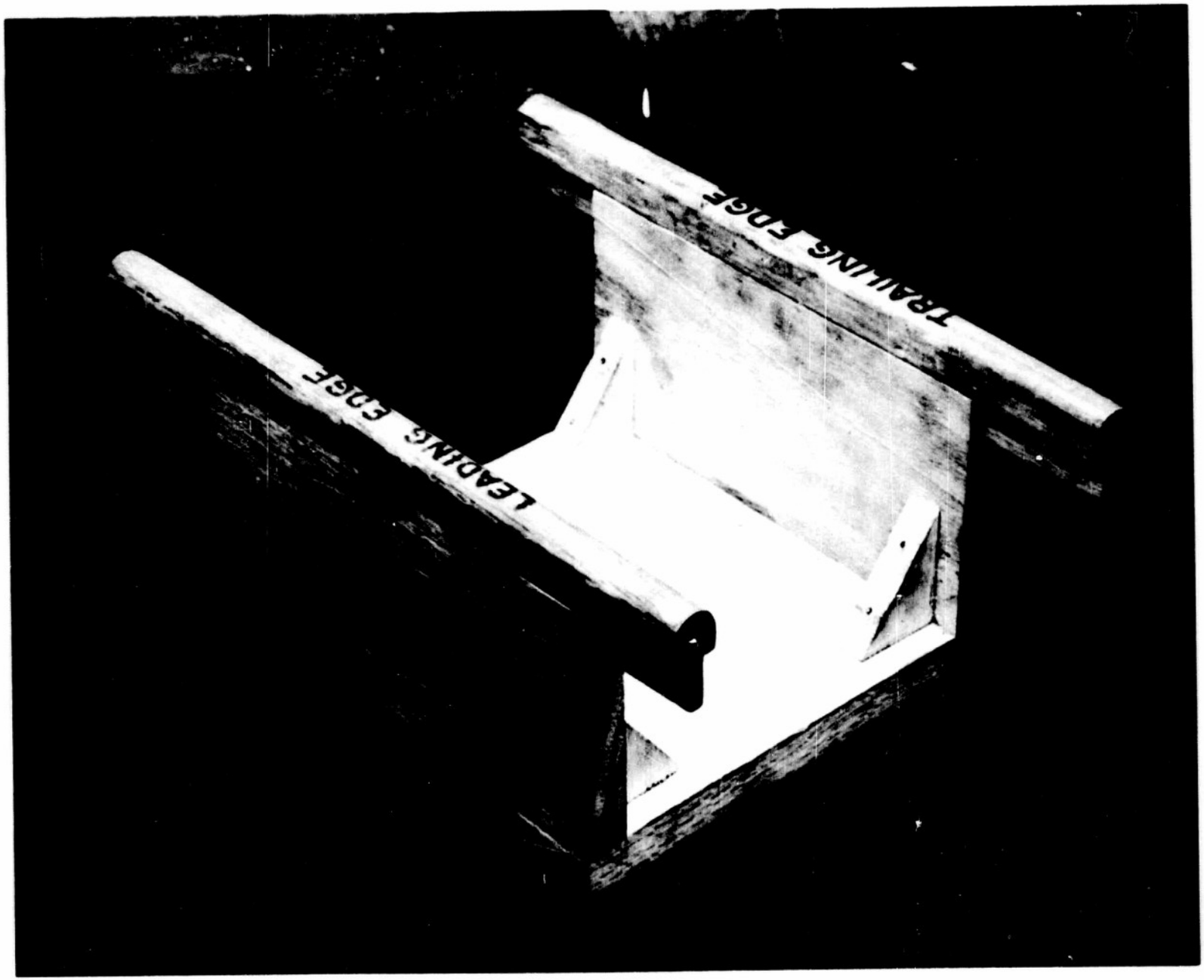


Fig. 4. Mock up used in Fabric Repair Test.

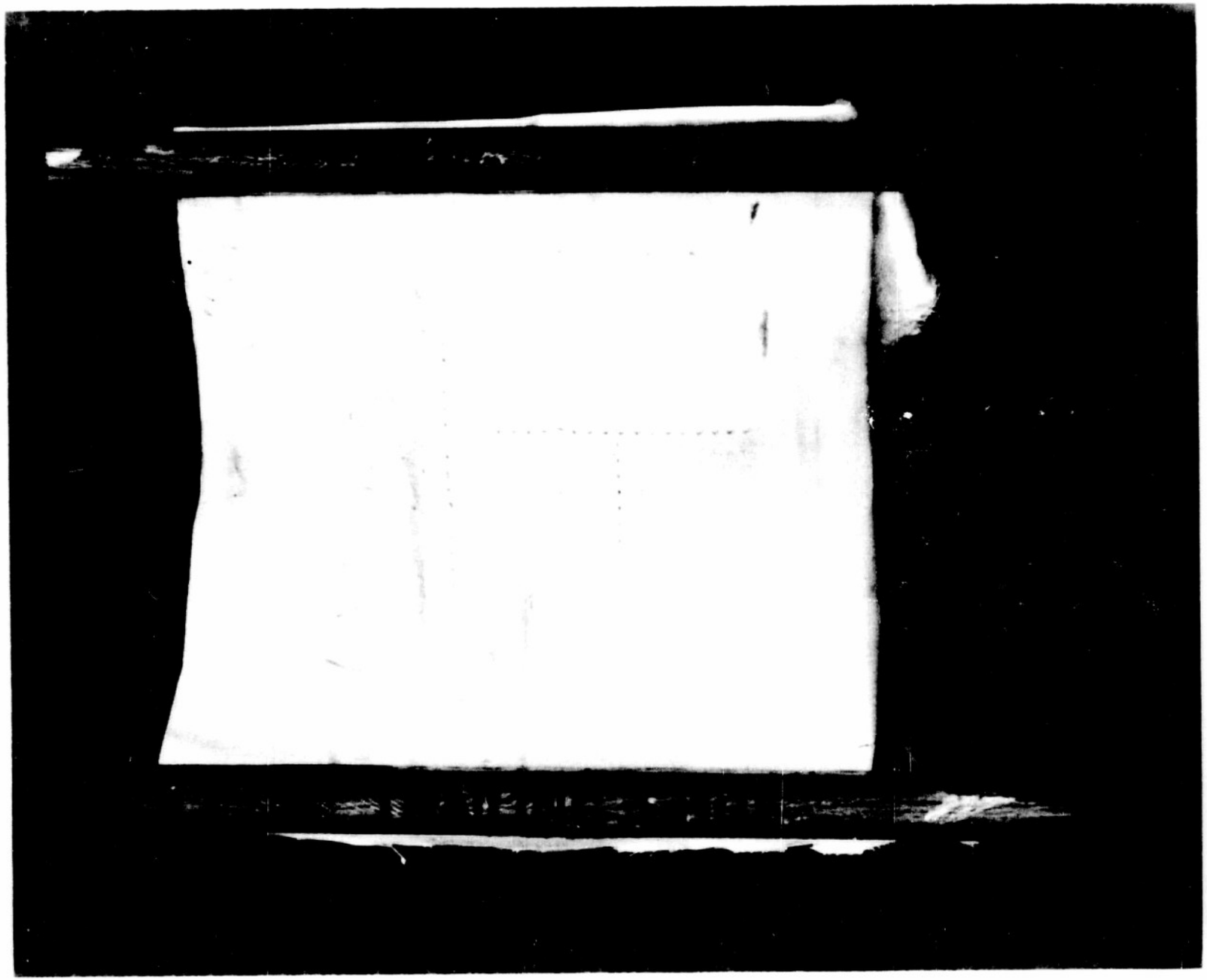


Fig. 5. Mock up used in Fabric Repair Test. (with fabric inserted and work completed)

EXHIBIT VIII

Sample Fabric Repair Test

AM PERFORMANCE EXAMINATION

FABRICS

L-REPAIR

EXAMINEE INSTRUCTIONS

TASK This is a test of your ability to repair an L-type fabric damage. You are to sew and dope the damage exactly as you would ordinarily sew it. In front of you is a "mock up" of a typical L-type cut. That is the damage you are to repair. Be sure you understand what you are to do before you start.

SCORING You will be scored in the following areas:

1. The QUALITY of the finished product.
2. The PROCEDURE you follow in doing the job.
3. The MANNER in which you do the job.
4. The SAFETY precautions you observe.
5. The TIME it takes you to complete the job.

However, the principal emphasis is on doing the job well, so do not sacrifice doing a good job for speed.

TOOLS AND MATERIALS

You will be provided with the following:

1. Curved needle
2. Wax
3. Surface tape - 3 3/4" wide
4. Dope
5. Mock up
6. Thread
7. Cotton fabric

If you need additional tools, you may draw them.

EXHIBIT VIII (Cont'd.)

AM PERFORMANCE EXAMINATION

FABRICS

L-REPAIR

EXAMINER INSTRUCTIONS

TASK This is a test of the examinee's ability to repair an L-type fabric damage.

GENERAL DIRECTIONS TO EXAMINER

1. Read very carefully and thoroughly the "Examinee Instructions". Be sure you understand the test and method for scoring before giving it to the examinee.

2. Cut a piece of AN-CC-C-399 cotton fabric and fit it into the mock-up. In the center of the fabric make an L-shaped cut. Make each leg of the cut exactly 3" long.

3. Assign the examinee to a work station and provide him with the appropriate tools and materials.

4. Have the examinee read the "Examinee Instructions". Then re-read them to him out loud. Ask him if he has any questions. If there is anything he does not understand, re-read to him that part of the instructions which answers his question. Supply no accessory information. Remember, this is a test situation, not an instructional one. Make sure that the examinee fully understands what he is to do before he starts.

5. Have the examinee secure the work station when he is finished.

EXHIBIT VIII (Cont'd.)

EXAMINER INSTRUCTIONS (Cont'd.)

SCORING Carefully observe the examinee as he works. If you think that the examinee should receive credit on an item, do nothing to the number which appears after the observation called for on that item. If no credit is to be allowed on an item, encircle or X over the number which appears after that item. Give complete attention to the scoring. Do not (repeat), do not rely on your memory. Of course, the measurements of the final product will be made after the examinee has completed the job. When the examinee has finished, write a figure 1 on one leg of the repair and write a figure 2 on the other leg. Then proceed with the measurements of the final product. The total score is the sum of the non-Xed or non-encircled figures. On completion of the scoring, add up the non-encircled or non-Xed figures and enter the total in the space provided.

TIME Time is counted as soon as the examinee understands what he is to do and is told to start. Record the time that the examinee starts and finishes in the appropriate spaces. For credit on the time item, the examinee must finish in 30 minutes or less. Do not tell the examinee what the time allowance is. If the examinee does not finish in 30 minutes, allow him to finish. He receives no credit, however, on the time item unless he finishes in 30 minutes or less.

EXHIBIT VIII (Cont'd.)

AM PERFORMANCE EXAMINATION

FABRICS

L-REPAIR

SCORING SHEET

NAME_____ RATE_____

SERVICE NUMBER_____ DATE_____

Time Started_____

PROCEDURE

1. Tacks corner with single thread and ties square knot..... 1
2. Lays out stitch pattern..... 1
3. Double threads needle and waxes thread..... 1
4. Ties proper slip knot, and sews up one leg, waxes thread every six stitches..... 1
5. Ties proper slip knot, and sews up other leg, waxes thread every six stitches..... 1
6. Secures thread at intersection..... 1
7. Applies first coat of dope (Allows 30 minutes drying)..... 1
8. Cuts surface tape, dopes, applies surface tape, dopes over surface tape..... 1
9. Time finished_____. Finished in 30 minutes or less. (Time finished is exclusive of drying time)..... 3

EXHIBIT VIII (Cont'd.)

SCORING SHEET (Cont'd.)

MEASUREMENTS OF THE FINAL PRODUCT

10.	NO loose pinked edges	3
11.	NO air bubbles under tape	3
12.	Correct edge distance on surface tape over leg No. 1	3
13.	Correct edge distance on surface tape over leg No. 2	3
14.	Spanwise tape applied first	3
15.	NO dope dropped through to opposite surface	3
16.	Minimum of 4 stitches per inch	3
17.	Completely correct edge distance for ALL sewing on leg No. 1	3
18.	Completely correct edge distance for ALL sewing on leg No. 2	3
19.	Correct baseball stitch on leg No. 1	3
20.	Correct baseball stitch on leg No. 2	3
21.	Hidden slip knot on leg No. 1	3
22.	Hidden slip knot on leg No. 2	3
23.	Thread at intersection secure with square knot	3
24.	NO stitches torn through fabric	3
25.	NO loose stitches	3

SAFETY

26.	Grounds work before doping	1
27.	Catches needle with finger when going through fabric	1
28.	No smoking while doping	1

Total Score_____

The Aerial Photographers' Battery

In line with our second general purpose, the development of a "model" battery for candidates for the rate of Aerial Photographer second class, the test constructor went to the Aerial Photographers' School at Pensacola. Here, as at the Aviation Structural Mechanics' School, an attempt was first made by the researcher to obtain the working skills and knowledges of the Aerial Photographer. NAVPERS 18068 and 15105 were then studied in order to determine the requirements for the pay grade of Aerial Photographer second class. Chief Aerial Photographers were questioned as to tasks which would test these requirements. The following list of suggested tasks emerged:

1. Using the Speed Graphic Camera with photoflash equipment
2. Using the view camera
3. Using the copying camera
4. Color photography
5. Using the Sonne continuous strip printer
6. Using the Houston movie processing machine
7. Using Stineman movie processing equipment
8. Installing a K-19B night aerial camera
9. Using the Photo Lab. Index
10. Processing aerial film
11. Loading two different types of aerial magazines -- a venturi system and a self contained vacuum back system
12. Installing a K-17 camera for high altitude automatic operation
13. Plotting flight lines
14. Using the intervalometer
15. Synchronizing a shutter by one specified method
16. Retiming the shutter of an aerial camera
17. Speed checking a movie camera
18. Timing a focal plane shutter
19. Routine maintenance of any camera
20. Inspecting and lubricating a K-20 or K-19 shutter
21. Setting up a filing system
22. Taking an inventory
23. Producing a standard negative

24. Preparing an open purchase order
25. Exposing and processing transparencies
26. Using the densitometer-plotting curves and noting results
27. Controlled bromide printing
28. Printon printing
29. Checking a dye transfer curve against a H and D curve
30. Filter correction photography
31. Installing a camera on fighter type aircraft
32. Making a rough lay of an aerial mosaic
33. Corrective photography
34. Shooting aerial oblique photographs
35. Processing cut film
36. Mixing developer
37. Mixing hypo
38. Mixing toners
39. Mixing intensifiers
40. Mixing reducers
41. Printing a negative of known quality to a stated standard; e.g. getting a good print from a soft or hard negative
42. Using the vertical view finder
43. Loading and operating the Bell and Howell or the Eyemo movie camera
44. Loading and operating the Filmo movie camera
45. Splicing movie film
46. Loading and operating the Mitchell movie camera
47. Filling in forms for forwarding official photographs —. preparation of Photographers Data Sheets and covering letter
48. Making a quarterly photographic report
49. Enlarging
50. Contact printing
51. Portraiture or P.I.O. work
52. Projection printing

As with the Aviation Structural Mechanics' tasks, the Aerial Photographers' tasks were written on individual 3" x 5" index cards and the deck of cards was given to three separate Chief Aerial Photographers for screening. The Chief Photographers were asked to pick out:

1. Tasks which took more than one hour for completion
2. Tasks which required material and equipment not usually found in operational photographic units
3. Tasks which seemed costly in terms of amounts or kinds of material needed
4. Tasks which might interrupt normal operations

Care was taken prior to the screening to explain to the chiefs the purposes and uses of performance tests, the purposes of the screening and the roles that the surviving tasks could play. The tasks eliminated by this screening were:

1. Color photography
2. Setting up a filing system
3. Taking an inventory
4. Exposing and processing transparencies
5. Controlled bromide printing
6. Printon printing
7. Checking a dye transfer curve against a H and D curve
8. Making a rough lay of an aerial mosaic
9. Shooting oblique photographs
10. Loading and operating the Bell and Howell movie camera
11. Loading and operating the Mitchell movie camera
12. Loading and operating the Eyemo movie camera

A greater degree of consistancy in the reasons for task elimination was shown by the Chief Aerial Photographers than was shown by the Chief Aviation Structural Mechanics. The three Chief Aerial Photographers spontaneously and independently gave the same reason for elimination of 8 tasks (66%). For the remaining 4 tasks (33%), the same reason for elimination was given by two of the three Chief Aerial Photographers.

The surviving tasks were then further screened by the test constructor aided by two Chief Aerial Photographers eliminating from consideration tasks which were not amenable to objective measurements, tasks which just aren't usually performed at the squadron level, and tasks which contain recurrent, routine operations. The tasks eliminated by this screening were:

1. Plotting flight lines
2. Synchronizing a shutter by one specified method
3. Timing a focal plane shutter
4. Routine maintenance of any camera
5. Producing a standard negative
6. Use of densitometer-plotting curves and noting results
7. Producing a standard negative

The final battery was selected by the test constructor aided by two Chief Aerial Photographers from the tasks that remained after the above screening. In selecting the final tasks an attempt was made to pick tasks that:

1. Tapped as many of the diversified skills that the Aerial Photographer is called on to display by sampling as many seemingly different types of operational skills as possible.

2. Tasks about which the chiefs answered the question, "Would you be willing to accept performance of this task as a partial test for advancement to the rate of Aerial Photographer Second Class?" with unanimous affirmative replies.

The tasks selected to compose the final battery were:

1. Using the Sonne continuous strip printer (Aerial photography, film processing)

2. Installing a K-19B night aerial camera (camera installation, use of accessories)

3. Using the Speed Graphic camera (photography, use of photo-flash equipment, corrective photography, operation of dark room equipment and projective printing)

4. Preparation of Photographers Data Sheets and covering letter. (records and reports, publications)

5. Loading and setting of K-17 or F-56 aerial camera (aerial photography)

6. Retiming the shutter of an aerial camera (camera maintenance and repair)

7. Motion Picture processing - Using the Houston machine (motion picture laboratory processing)

8. Chemical mixing (solutions, publications)

General Method of Test Preparation

The general method followed in preparing the Aerial Photographers' Battery paralleled that followed in preparing the tests in the Aviation Structural Mechanics' Battery. After having gained work experience in the duties of the Aerial Photographer, the test constructor analyzed the individual tasks chosen to provide the basis of the performance tests.

The same scoring categories--correct completion of each sub-operation in the total task, care of equipment and tools, finishing the job in the time allowed, regard for safety rules, correct operation of the final product, and adherence of the final product to prescribed standards--were again used as appropriate. Laboratory technique was also scored, where indicated.

On the basis of a task analysis, an objective record sheet was prepared and, as before, an attempt was made to have at least one scoring item on the record sheet for each relevant statement in the task analysis. Examiner and examinee instructions were then written. The examiner's directions contained:

1. a statement regarding the nature of the examinee's task,
2. general directions to the examiner,
3. directions for scoring,
4. a statement pertaining to the time allowance, and
5. where necessary, a series of notes explaining what to do in the case of certain exceptional occurrences.

The examinee instructions included:

1. a statement telling the examinee what his task was,
2. a statement telling the examinee what he would be scored on,
3. a list of the materials with which he would be supplied,
4. any accessory information which seemed necessary in order to clear up points which might be questionable to the examinee.

The complete tests were then submitted to three separate Chief Aerial Photographers for review. The suggestions of these chiefs were noted, and changes made in the content of the tests as indicated. After these revisions were consummated, each test was pre-tested on three or four Aerial Photographers. This pre-testing brought out some additional, needed changes and was particularly valuable in checking the time allowances, which had been set, at the outset, by the "impression" method.

Following this pre-testing, the battery was pilot tested using 14 third class Aerial Photographers as subjects. Since the battery was constructed as a hurdle for the rate of Aerial Photographer 2/c, only third class Petty Officers were considered as eligible examinees. Some of these men were going up for the rate of second class Aerial Photographer at the next service wide examination while others had held the rate of third class Aerial Photographer for only a few months. Two of the subjects had taken and failed the last service wide examination for Aerial Photographers, second class. Very few changes in the tests became evident during the pilot testing. However, those needed changes that did manifest themselves were made. The following eight sections describe in detail the Aerial Photographers' Battery.

Use of the Sonne Continuous Strip Printer

The Sonne printing machine, a piece of apparatus which is comparatively new in photographic laboratories, was made necessary by the continuous strip aerial camera. This camera will take a continuous strip, up to 200 feet in length, of photographs. These strips are used in making aerial mosaic maps. The Sonne machine allows the developed reel of negatives, in contact with the sensitized photographic paper, to pass over a printing lamp. Thus, the paper becomes exposed uniformly and automatically. The exposed paper then is placed in a Morse or Smith developing unit for print development. Sonne machines are found in almost all aerial photographic laboratories.

In the test situation, the examinee was given a standard reel of negative and asked to produce a test strip on the Sonne machine. Although the complete test was given in a dark room, the "safe light" permitted, when Sonne printing was bright enough to read the scoring sheet and bright enough to clearly view the examinee. The examinee was scored on his care of the equipment, the safety precautions he observed, the procedure he followed in doing the job, and the quality of the final prints that he produced. The examination, as administered is shown in Exhibit IX.

EXHIBIT IX

Sample Sonne Continuous Strip Printing Test

AF PERFORMANCE EXAMINATION

CONTINUOUS STRIP PRINTING

USE OF SONNE STRIP PRINTER

EXAMINEE INSTRUCTIONS

TASK — This is a test of your ability to print continuous strips using the Sonne printer and the Smith (or Morse) developing kit. You will be provided with the necessary material for producing a test strip. Your task is to produce the test strip. Do the job exactly as you would ordinarily do it. Be sure you understand what you are to do before you start.

MATERIAL — The following have been provided:

1. Sonne printer
2. Roll of Sonne paper
3. Ten foot roll of negatives (with 6 foot leader and 6 foot trailer)
4. Morse or Smith developing kit
5. Developer, D-72, diluted 12 parts water to 1 part D-72.
6. Hypo

SCORING — You will be scored in the following areas:

1. The QUALITY of the finished product
2. The MANNER in which you do the job
3. The TIME it takes you to do the job

EXAMINEE'S NOTE:

Use a basic developing time of 5 minutes.

EXHIBIT IX (Cont'd.)

AF PERFORMANCE EXAMINATION

CONTINUOUS STRIP PRINTING

USE OF SONNE STRIP PRINTER

EXAMINER INSTRUCTIONS

TASK This is a test of the examinee's ability to print a continuous strip using the Sonne printer and the Smith (or Morse) developing kit.

GENERAL DIRECTIONS TO EXAMINER

1. Read very carefully and thoroughly the "Examinee Instructions". Be sure you understand the test and the method for administering it before attempting to give it to the examinee.

2. Assign the examinee to a Sonne printer and provide him with the necessary materials.

3. Have the examinee read the "Examinee Instructions". Ask him if he has any questions. If he has a question, answer it by re-reading to him that part of the instructions which answer his question. Supply no accessory information. Remember, this is a test situation, not an instructional one. Be sure that the examinee understands what he is to do before he starts.

4. Have the examinee secure the work station when he is finished.

SCORING Carefully observe the examinee as he works. If you think that the examinee should receive credit on an item, do nothing to the number which appears after the observation called for on that item. If you think that the examinee should not receive credit on an item, encircle or cross out the number which appears after that item. Do as much of the scoring as possible at the time that a particular sub-operation is performed. Do not (repeat), do not rely on your memory. Give complete attention to the scoring. Of course, the measurements of the final product will be made after the strip is printed. The total score is the sum of the non-encircled or non-crossed out credits. On completion of the scoring add up the non-encircled or non-crossed out credits and enter the total in the space provided.

EXHIBIT IX (Cont'd.)

AF PERFORMANCE EXAMINATION

CONTINUOUS STRIP PRINTING

USE OF SONNE STRIP PRINTER

EXAMINER INSTRUCTIONS

TIME — Time is counted as soon as the examinee understands what he is to do and is told to start. Record the time that the examinee starts and finishes in the appropriate spaces. For credit on the time item, the examinee must finish in 23 minutes or less. Do not tell the examinee what the time allowance is. If the examinee does not finish in 23 minutes, allow him to finish. He receives no credit, however, on the time item unless he finishes in 23 minutes or less.

EXAMINER'S NOTE

If loading diagram is attached to side of Sonne printer, it is to be covered prior to the arrival of the examinee.

EXHIBIT IX (Cont'd.)

AF PERFORMANCE EXAMINATION

CONTINUOUS STRIP PRINTING

USE OF SONNE STRIP PRINTER

SCORING SHEET

NAME _____ RATE _____

SERVICE NUMBER _____ DATE _____

Time Started _____

CARE OF EQUIPMENT
SAFETY PRECAUTIONS

1. Keeps fingers out of area between focal and guide rollers..... 3
2. Examines printing aperture glass for cleanliness prior to operating printer (cleans if dirty)..... 3
3. Keeps chemicals well out of machine area..... 3
4. Checks view glass for cleanliness prior to running strip (cleans if dirty)..... 3
5. Checks exposure light for operating order and steadiness prior to running strip..... 3
6. Checks view light for operating order and steadiness prior to running strip..... 3
7. Keeps detachable motor dry and free from chemicals..... 3
8. Rewinds film to supply spool before securing Sonne printer..... 3
9. Rinses developing unit prior to use..... 3
10. Rinses developing unit after use..... 3
11. Places unit holding developer on left, wash in center and hypo on right..... 3

EXHIBIT IX (Cont'd.)

SCORING SHEET (Cont'd.)

PROCEDURE

12. Fills developing unit with chemicals..... 3

13. Checks film to ascertain if emulsion side is facing inwards. If emulsion side faces outwards, rewinds..... 3

14. Opens frame assembly; loads film so that film feeds off top of roller (emulsion side up) and flows over guide rollers emulsion side down..... 3

15. Inserts film into takeup spool; tapes film to spool..... 3

16. Turns take up spool several times by hand with emulsion on the outside..... 3

17. Inserts supply roll of paper on front spindle of frame assembly..... 3

18. Feeds paper around focal roller emulsion side down and over take up spool emulsion side out... 3

19. Aligns film with paper..... 3

20. Tapes paper to take up spool. Takes up several turns by hand (emulsion in). Lowers frame assembly..... 3

21. Sets printing aperture knob at "8" and dodging levers on "2", "5" and "8"..... 3

22. Checks speed selector switch for fast position (40 Feet per minute)..... 3

23. Illuminates printing and viewing lights. Does not start machine until both operating steadily 3

24. Turns motor switch to "ON" position and prints strip..... 3

25. Stops printer. Removes exposed paper..... 3

26. Winds paper on developing roll emulsion side out. Secures tail end on second spool..... 3

EXHIBIT IX (Cont'd.)

SCORING SHEET (Cont'd.)

27. Presoaks exposed paper for at least two cycles.. 3

28. Drains excess water..... 3

29. Places unit into developer. (If motor used, winds through at least two cycles by hand) Drains excess developer..... 3

30. Places unit into wash. (If motor used, winds through at least two cycles by hand) Drains excess water..... 3

31. Places unit into hypo. (If motor used, winds through at least two cycles by hand)..Drains excess hypo..... 3

32. Places unit into wash. Winds through two cycles by hand..... 3

33. Time finished_____. Total time to complete job_____. Finished in 23 minutes or less..... 3

MEASUREMENTS OF THE FINAL PRODUCT

34. Three strips of different density and contrast visible..... 3

35. No dust spots on test strip..... 3

36. No chemical spots on test strip..... 3

37. Complete image visible on all prints e.g. black border on each side..... 3

Total Score_____

Installation of K-19B Night Aerial Camera

The ability to "install gun cameras and other fixed installation cameras" is required of aerial photographers from third class up to chief. The same is true of camera accessories. Installation of the night aerial camera is more difficult a job than the installation of some daylight types of cameras, since the night camera installation requires the handling and use of a photo-electric cell. For this test, the standard NR-1 mount was placed in a bench and the task of the examinee was to install the camera, with a B-1 cut film adapter, on the mount exactly as he would install the camera if he were preparing for a mission. He then unmounted the camera as he would on returning from a mission. A standard 24 volt power source was provided. An assumed aircraft bow was pointed out, since the examinee had to have this information before he could properly install the photo-electric cell. Use of the B-1 cut film adapter made possible a sub-check on the use of camera accessories, while the major task was being performed. In this test, (Exhibit X) the examinee was scored on his care of the equipment, the safety precautions he observed, and the procedure he followed in doing the job.

EXHIBIT X

Sample Camera Installation Test

AF PERFORMANCE EXAMINATION

CAMERA INSTALLATION

INSTALLATION AND DISMOUNTING

OF A K-19B AERIAL CAMERA

EXAMINEE INSTRUCTIONS

TASK — This is a test of your ability to install, for night operation, and to dismount a K-19B aerial camera with B-1 cut film adapter. In front of you is an NR-1 mount. First install the camera on the mount. Then install the adapter on the camera. You are to do the job exactly as you would do it if you were preparing for a mission. When you have completed the installation you are to dismount the camera exactly as you would upon returning from a mission. The examiner will tell you which part of the room is the assumed bow of the plane. Be sure you understand what you are to do before you start. Do the job exactly as you would ordinarily do it.

MATERIAL — The following have been provided:

1. K-19B camera (complete)
2. NR-1 mount
3. 24 volt power source
4. Flashlight

SCORING — You will be scored on the MANNER in which you do the job and the TIME it takes you to complete the installation and dismounting.

TIME — Time starts as soon as you understand what you are to do and report to the examiner that you know what your task is and are ready to start. Be sure you understand what you are to do before you start.

EXHIBIT X (Cont'd.)

AF PERFORMANCE EXAMINATION

CAMERA INSTALLATION

INSTALLATION AND DISMOUNTING

OF A K-19B AERIAL CAMERA

EXAMINER INSTRUCTIONS

TASK — This is a test of the examinee's ability to install and dismount a K-19B aerial camera. First the examinee is to install the camera for the night operation with a B-1 cut film adapter. Then he is to dismount the camera.

GENERAL DIRECTIONS TO EXAMINER

1. Read very carefully and thoroughly the "Examinee Instructions". Be sure you understand the test and the method for administering it before attempting to give it to the examinee.

2. Assign the examinee to a work station and provide him with the necessary materials.

3. Have the examinee read the "Examinee Instructions". Ask him if he has any questions. If he has a question, answer it by re-reading him that part of his instructions which answers his question. Supply no accessory information. Remember, this is a test situation, not an instructional one. Be sure that the examinee understands what he is to do before he starts.

4. Point out the assumed bow of the plane to the examinee.

5. Have the examinee secure the work station when he is finished.

EXHIBIT X (Cont'd.)

EXAMINER INSTRUCTIONS (Cont'd.)

SCORING Carefully observe the examinee as he works. If you think that the examinee should receive credit on an item, do nothing to the number which appears after that item. If you think that the examinee should not receive credit on an item, encircle or cross out the number which appears after that item. Do the scoring at the time that a particular sub-operation is performed. Do not (repeat), do not rely upon your memory. The total score is the sum of non-encircled or non-crossed out credits. On completion of the test, add up the non-encircled or non-crossed out credits and enter the total in the space provided.

TIME Time is counted as soon as the examinee understands what he is to do and is told to start. Record the time that the examinee starts and finishes in the appropriate spaces. For credit on the time item, the examinee must finish in 10 minutes. Do not tell the examinee what the time allowance is. If the examinee does not finish in 10 minutes, allow him to finish. He receives no credit, however, on the time item unless he finishes in 10 minutes or less.

EXHIBIT X (Cont'd.)

AF PERFORMANCE EXAMINATION

CAMERA INSTALLATION

INSTALLATION AND DISMOUNTING

OF A K-19B AERIAL CAMERA

SCORING SHEET

NAME_____ RATE_____

SERVICE NUMBER_____ DATE_____

Time Started_____

CARE OF EQUIPMENT
SAFETY PRECAUTIONS

1. Leaves photo cell unhooded only when testing camera..... 3
2. Never touches lens with fingers or lens tissue and takes care to keep foreign matter from lens vicinity..... 3
3. Connects photo cell to camera BEFORE camera is connected to power supply..... 3
4. Checks camera switch for "OFF" position prior to installation or before attaching power supply 3

PROCEDURE

5. Attaches camera, motor on port side, to NR-1 mount..... 3
6. Checks security of mounting..... 3
7. Attaches photo connector unit to photo cell and attaches unit to camera..... 3
8. Checks two above connections for security..... 3
9. Photo cell faces aft..... 3
10. Attaches power supply cable. Hand tightens and checks for security..... 3
11. Removes case motor..... 3

EXHIBIT X (Cont'd.)

SCORING SHEET (Cont'd.)

12. Removes lens cap..... 3

13. Turns camera switch to "ON" position. Waits 45 seconds.. Opens photo hood..... 3

14. Checks camera manually by winding case drive and flashing beam of light across photo cell... 3

15. Watches to see if shutter trips..... 3

16. Performs above test more than one time..... 3

17. Closes photo cell hood and switches camera to "OFF" position..... 3

18. Attaches B-1 cut film adapter..... 3

19. Disconnects power connector cable..... 3

20. Disconnects all other cables and removes camera from mount..... 3

21. Replaces lens cap and motor..... 3

22. Time finished _____. Total time on job _____. Finished in 10 minutes or less. 3

Total Score _____

Use of Speed Graphic Camera

Perhaps the most versatile of all cameras is the Speed Graphic. The Speed Graphic may be used in an almost unlimited number of photographic situations. The aerial photographer, is required to "operate service types of ground cameras", "install and operate photoflash equipment", "operate all types of laboratory and darkroom equipment", and "make projection prints", The Speed Graphic test, as written, covered all of these requirements. In this test, the examinee was asked to take a standard picture of two rulers which were placed in a standard manner parallel to each other on a table. This picture was amenable to scoring for corrective photographic ability, since if the picture was taken improperly, it appeared as if the rulers were converging. The ruler situation also simplified scoring for the amount of detail (clarity of focus) present, since the ruler was lined every millimeter. The stimulus situation, as photographed by one examinee is shown in Figure 6. After taking the picture the examinee was asked to develop his film and make two 8" x 10" projection prints. In making the prints, the examinee was limited to four pieces of sensitized paper. The examinee was scored on the care he took of his equipment, his adherence to safety precautions, the procedure he followed in doing the job and the quality of the finished print. The complete examination is shown in Exhibit XI. Allowable tolerances in regard to photographic composition, in the absence of standards, were established on the basis of interviews with Chief Aerial Photographers at the Photographers' School, Pensacola.

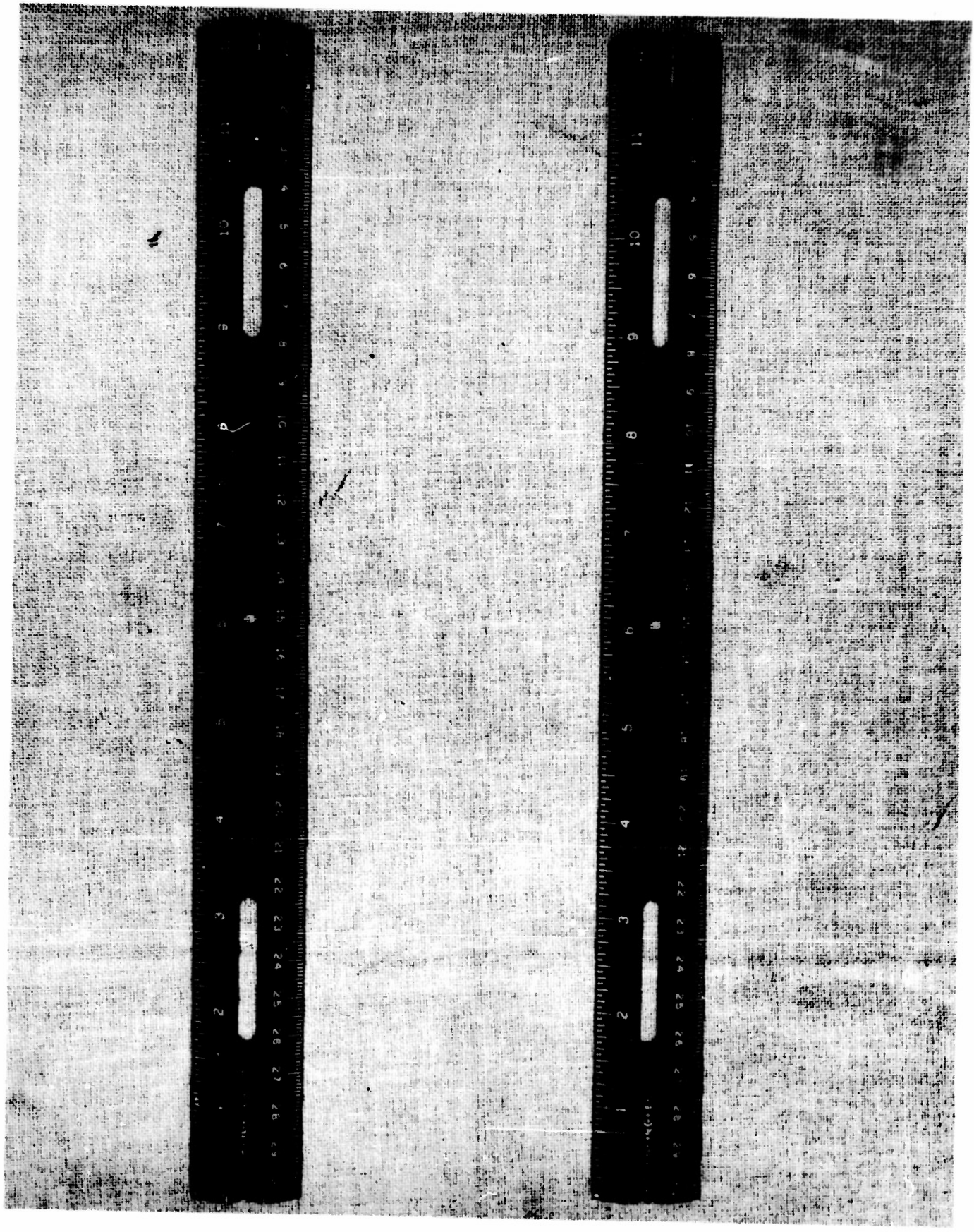


Fig. 6. Sample end product from Speed Graphic Test.

EXHIBIT XI

Sample Speed Graphic Test

AF PERFORMANCE EXAMINATION

CAMERAS - FILM PROCESSING

USE OF SPEED GRAPHIC

EXAMINER INSTRUCTIONS

TASK — This is a test of your ability to use the Speed Graphic camera and to develop and make prints from the exposed film. In front of you are two rulers, on a table. You are to photograph the two rulers. Try to catch as much detail as possible. You may make two exposures. Print your better negative and make two captioned 8" x 10" matched prints of your better negative. Be sure you understand what you are to do before you start.

SCORING — You will be scored on the MANNER in which you do the job and the QUALITY of the finished photos.

EQUIPMENT

The following have been provided:

1. Speed Graphic Unit (complete)
2. Film (Speed Group 50)
3. Paper, 4 sheets as requested
4. Film processing equipment
5. Projection printing equipment
6. Print finishing equipment
7. Exposure meter.

EXAMINEE'S NOTE

For full credit the two exposures must be made in 20 minutes or less. Time starts when you report to the examiner that you understand what you are to do and are ready to begin. You will be allowed only four pieces of paper on which to make your prints. Load your film and then report to the examiner that you are ready to start.

EXHIBIT XI (Cont'd.)

AF PERFORMANCE EXAMINATION

CAMERAS - FILM PROCESSING

USE OF SPEED GRAPHIC

EXAMINER INSTRUCTIONS

TASK — This is a test of the examinee's ability to use the Speed Graphic camera and to develop and make prints from the exposed film.

GENERAL DIRECTIONS TO EXAMINER

1. Read very carefully and thoroughly the "Examinee Instructions". Be sure you understand the test and the method for administering it before attempting to give it to the examinee.

2. Cover a table with the cloth that has been provided. Place each ruler at a 90° angle to the table edge. Set the rulers parallel and 3 inches from the table edge. Allow 3 inches between the inner edges of the rulers.

3. Have the examinee read the "Examinee Instructions". Ask him if he has any questions. If he has a question, answer it by re-reading to him that part of the "Examinee Instructions" which applies to his question. Supply no accessory information. Remember that this is a test situation, not an instructional one.

4. Have the examinee secure the work station when he is finished.

EXHIBIT XI (Cont'd.)

EXAMINER INSTRUCTIONS (Cont'd.)

SCORING — Carefully observe the examinee as he works. If you think that the examinee should receive credit on an item, do nothing to the number which appears after that item. If the examinee is not to receive credit on the item, encircle or X over the number which appears after the observation called for on that item. Do as much of the scoring as possible at the time a particular sub-operation is performed. Do not(repeat), do not rely on your memory. Give complete attention to the scoring. Of course, the measurements of the final product will be made after the prints are turned in. Before scoring the quality of the prints, label one print with a Figure 1 and the other with a Figure 2. Then proceed with the measurements of the final product. The total score is the sum of the non-encircled or non-Xed credits. On completion of the test, add up the non-encircled credits or non-Xed credits, and enter the total in the space provided.

TIME — Time is started after the examinee has loaded his film and reports that he understands what he is to do and is told to start. Record the time that the examinee starts and finishes in the appropriate spaces. For credit on the time item the examinee must finish the actual shooting in 20 minutes or less. If the examinee does not finish shooting the picture in 20 minutes, allow him to finish. He receives no credit, however, on the time item unless he finishes the actual shooting in 20 minutes or less.

EXAMINER'S NOTE

ALLOW ONLY 4 PIECES OF PAPER FOR MAKING PRINTS. PROVIDE A CROWN TILT HEAD, BUT ALLOW ITS USE TO BE OPTIONAL.

EXHIBIT XI (Cont'd.)

AF PERFORMANCE EXAMINATION

CAMERAS - FILM PROCESSING

USE OF SPEED GRAPHIC

SCORING SHEET

NAME _____ RATE _____

SERVICE NUMBER _____ DATE _____

Time Started _____

CARE OF EQUIPMENT
SAFETY PRECAUTIONS

1. When carrying camera always keeps hand inside carrying straps.....1
2. Does not remove camera from or insert into carrying case by grasping range finder.....1
3. Checks flash bulbs for cracks prior to their use..... 1
4. Does not mouth tips of bulbs..... 1
5. Checks bulb contacts for cleanliness prior to use..... 1
6. When carrying tripod, always has spurs trailing aft and downwards..... 1
7. Checks tripod legs for firmness prior to placing camera on same..... 1
8. Checks shutter for proper operation prior to shooting picture..... 1

PROCEDURE

9. Sets tripod on deck and uses tripod brace (spider)..... 1
10. Fixes ground glass on camera; assures that ground glass is properly fitted..... 1
11. Opens shutter and diaphram, focuses and composes subject in ground glass. (position of lens standard on bedrack optional)..... 1

EXHIBIT XI (Cont'd.)

SCORING SHEET (Cont'd.)

12. Focuses 1/3 of distance into subject area; stops lens down so that complete area is in sharp focus.. (If shot made from vertical position, allow credit on this item)..... 1

13. Closes shutter, arranges lights, and determines exposure time..... 1

14. Removes ground glass, inserts film holder, removes dark slide, shoots picture..... 1

15. Inserts dark slide, reverses film holder, RECHECKS CAMERA, removes other dark slide, shoots second exposure..... 1

16. Time finished _____. Total time spent making two exposures _____. Finished making two exposures in 20 minutes or less..... 1

MEASUREMENTS OF THE FINAL PRODUCT

17. Proper captioning on print No. 1 (why, what, where, when, who, how)..... 3

18. Proper captioning on print No. 2 (why, what, where, when, who, how)..... 3

19. Print No. 1 completely free from dust spots. 3

20. Print No. 2 completely free from dust spots. 3

21. Print No. 1 completely free from finger prints..... 3

22. Print No. 2 completely free from finger prints..... 3

23. No mismasking on print No. 1..... 3

24. No mismasking on print No. 2..... 3

25. Borders on print No. 1 clear..... 3

26. Borders on print No. 2 clear..... 3

EXHIBIT XI (Cont'd.)

SCORING SHEET (Cont'd.)

27. Equal tone and quality between images on print No. 1..... 3

28. Equal tone and quality between images on print No. 2..... 3

29. All detail clear on print No. 1..... 3

30. All detail clear on print No. 2..... 3

31. No chemical stains on print No. 1..... 3

32. No chemical stains on print No. 2..... 3

33. Even borders on print No. 1..... 3

34. Even borders on print No. 2..... 3

35. Complete image sharp on print No. 1..... 3

36. Complete image sharp on print No. 2..... 3

37. Matched images and tone on two prints..... 3

38. Images perfectly centered on print No. 1(tolerance 1/2 inch each side, 1 inch top and bottom)..... 3

39. Images perfectly centered on print No. 2 (tolerance 1/2 inch each side, 1 inch top and bottom)..... 3

40. Images parallel on print No. 1 (tolerance 1/8 inch)..... 3

41. Images parallel on print No. 2 (tolerance 1/8 inch)..... 3

42. Image length 7 1/2 to 8 1/2 inches..... 3

Total Score_____

Preparation of Photographer's Data Sheet and Covering Letter

The Photographer's Data Sheet is prepared whenever still or motion pictures are forwarded to the central files of U. S. Naval Photography. A test of a photographer's ability to correctly fill in these forms, and of his ability to prepare a covering letter for these forms, samples his knowledge of how to "prepare necessary reports and correspondence". In this test, (Exhibit XII) the examinee was given a description of a series of fictitious photographs and his task was to prepare the Photographer's Data Sheets and the necessary letter covering shipment of these pictures. This test is somewhat different from the others herein described in that it was completely self-administering. In a task of this type there are no safety precautions involved, no equipment to take care of, and no particular procedure that is prescribed. The total scoring is limited to considerations of the correctness and completeness of the final data sheets and covering letter. Thus, the need for an individual examiner for each examinee is eliminated.

As a partial check on the examinee's familiarity with the publications pertinent to effective work as an Aerial Photographer, the examinee was given four publications — Photography (NAVPERS 10371), Photography, (NAVPERS 10372), Photo Lab Index, and the Photography Technical Bulletins, Cummulative Edition— which he could use to aid him in this task. Thus, in essence, this was an "open book" examination. Actually, the examinee, who was familiar with the literature, knew that example data sheets and covering letters could be found in one of the Photography Technical Bulletins and that no substantial help could be gained from the other publications. We hoped to limit accidental finding of the examples by the multiple choice situation in publications provided, and by emphasizing in the examinee instructions that the test was timed. By this emphasis on time, we hoped to deter the non-informed examinee from aimlessly perusing through the books provided and accidently discovering the examples. The books were always stacked in front of the examinee in the same serial order.

The style of this test approaches that of the traditional essay type of examination. In scoring the essay examination, difficulty has been encountered previously because different scorers used different frames of references when scoring. Not only have different scorers expected different content, but also different amounts of credit have been awarded for the same content. In an attempt to correct for these defects and to stabilize and objectify the scoring, the scoring keys shown in Exhibits XIII and XIV were prepared, and given to examiners for their use in scoring. Each test item had a correspondingly numbered scoring key item. Let us suppose that the

examiner wanted to score item 3, "LOCATION - 'at Sea' or fictitious location stated", on the scoring sheet. Not only was the desired content and amount of allowable credit stated on the scoring sheet (Exhibit XII), but also a glance at number 3 on the scoring key gave a visual example of what was acceptable. Acceptable content was decided on, on the basis of the stated requirements in the Photo. Tech. Bulletin. The data sheet and covering letter were separately scored (Exhibit XII) with the total score on the test being the sum of the scores earned on each sub-section.

EXHIBIT XII

Sample Records and Reports Test

AF PERFORMANCE EXAMINATION

RECORDS AND REPORTS

SHIPMENT OF MATERIAL TO FILM LIBRARY

EXAMINEE INSTRUCTIONS

TASK — This is a test of your ability to prepare the forms required to cover mailing of motion or still picture material to the official U. S. Navy Photographic film library at the Naval Photographic Center, Anacostia, D. C. The material that you are to mail is described below. Your task is to fill out the Photographer's Data Sheet and to compose a rough letter of transmittal, both of which are needed to implement this shipment.

MATERIAL TO MAIL

You are the photographer aboard the U.S.S. RANDOLPH (CV-15). You have shot in black and white the following sequence of photographs and are mailing the negatives to the film library.

Negative 1 shows an F4U which on catapulting, has engine failure and has fallen into the sea. The pilot is shown climbing from the cockpit.

Negative 2 shows an escort destroyer, the U. S. S. SMITH (DD-120), launching a small boat to pick up the pilot.

Negative 3 shows the pilot back on the carrier after rescue, receiving medical treatment from the medical officer.

In addition to the above sequence you are including in the shipment a fourth negative.

Negative 4 shows an aerial oblique of your carrier.

Any information which you might need but which is not supplied is to be filled in fictitiously. For instance, since you do not know when the photos were made, you may fill in any date as the date of the event.

All of your shots have been made with a K-20 camera.

EXHIBIT XII (Cont'd.)

EXAMINER INSTRUCTIONS (Cont'd.)

SCORING You will be scored on the QUALITY of the finished forms.

TEST MATERIAL

The following have been provided for your use:

1. Pencil
2. Pen
3. Carbon paper
4. "Photographer's Data Sheets" (NAVAER - 1086, Rev. 12 - 45)
5. 8 1/2" x 11 1/2" paper
6. Photography Technical Bulletin - Cumulative Edition
7. Photo Lab Index
8. Photography (NAVPERS 10371)
9. Photography (NAVPERS 10372)
10. Paper clips

EXAMINER'S NOTES

1. This is a timed test.
2. Use the white 8 1/2" x 11 1/2" paper for all work other than work which you would ordinarily do on the "Photographer's Data Sheets".
3. Be sure to supply all necessary data, using fictitious data where necessary.

TIME Time starts as soon as you understand what you are to do and report to the examiner that you know what your task is, and are ready to start. Be sure you understand what you are to do before you start.

EXHIBIT XII (Cont'd.)

AF PERFORMANCE EXAMINATION

RECORDS AND REPORTS

SHIPMENT OF MATERIAL TO FILM LIBRARY

EXAMINER INSTRUCTIONS

TASK This is a test of the examinee's ability to prepare the forms necessary for shipping motion and still picture material to the Central files of official U. S. Naval Photography at the Naval Photographic Center, Anacostia, D. C.

GENERAL DIRECTIONS TO EXAMINER

1. Read very carefully and thoroughly the "Examinee Instructions". Be sure you understand the test and the method for administering it before attempting to give it to the examinee.

2. Assign the examinee to a desk and provide him with the test material.

3. Have the examinee read the "Examinee Instructions". Ask him if he has any questions. If he has a question, re-read to him that part of his instructions which answers his question. Make sure that the examinee understands what he is to do before he starts. Supply no accessory information. Remember, this is a test situation, not a training one. Make sure that the examinee understands what he is to do before he starts.

4. Have the examinee secure the work station when he is finished.

EXHIBIT XII (Cont'd.)

EXAMINER INSTRUCTIONS (Cont'd.)

SCORING — You should receive each of the following products from the examinee:

1. Photographer's Data Sheet
2. Letter of Transmittal

Each of these is to be scored separately on the appended scoring sheets. Also appended is a sample data sheet, correctly filled in and a sample covering letter. REFER TO THESE SAMPLES WHEN SCORING. DO NOT ATTEMPT TO SCORE THIS TEST WITHOUT THE USE OF THESE SAMPLES. If you think that the examinee should receive credit on an item, do nothing to the number appearing after that item. If the examinee is not to receive credit on an item, encircle or X over the number appearing after that item. On completion of the scoring, add up the non-encircled or non-Xed credits and enter the total in the space provided.

TIME — Time is counted as soon as the examinee understands what he is to do and is told to start. For credit on the time item, the examinee must finish in 45 minutes or less. If he does not finish in 45 minutes or less, allow him to finish. He receives no credit on the time item, however, unless he completes the data sheets and covering letter in 45 minutes or less.

EXHIBIT XII (Cont'd.)

AF PERFORMANCE EXAMINATION

RECORDS AND REPORTS

SHIPMENT OF MATERIAL TO FILM LIBRARY

SCORING SHEET

NAME_____ DATE_____

SERVICE NUMBER_____ RATE_____

I. PHOTOGRAPHER'S DATA SHEET

1. Photographer's Data Sheet filled out in triplicate..... 3
2. SUBJECT - Mention made both of crash and rescue operation..... 3
3. LOCATION - "At Sea" or fictitious location stated..... 3
4. SHIP - Name and number stated..... 3
5. DATE SHIPPED - Fictitious date stated, sequence of day, month and year followed..... 3
6. PHOTOGRAPHER - Name and Rate stated..... 3
7. TOTAL SHIPMENT - "Four" stated..... 3
8. TYPE FILM - "B-W STILL" checked..... 3
9. CAMERA TYPE - K-20 stated..... 3
10. CAMERA SERIAL NO. - Fictitious number stated... 3
11. GENERAL INFORMATION - Statement of any elaborating information not given under SUBJECT DESCRIPTION..... 3
12. SUBJECT DESCRIPTION - Negative 1. Plane type stated..... 3
13. SUBJECT DESCRIPTION - Negative 1. Scene described and some fictitious statement made of where event occurred..... 3

EXHIBIT XII (Cont'd.)

SCORING SHEET (Cont'd.)

14. SUBJECT DESCRIPTION - Negative 1. Fictitious pilot's name, rank, and status stated..... 3

15. SUBJECT DESCRIPTION - Negative 2. Name and Number of destroyer stated..... 3

16. SUBJECT DESCRIPTION - Negative 2. Scene described..... 3

17. SUBJECT DESCRIPTION - Negative 3. Fictitious pilot's name, rank, and status stated..... 3

18. SUBJECT DESCRIPTION - Negative 3. Scene described and mention of carrier made..... 3

19. SUBJECT DESCRIPTION - Negative 3. Fictitious name, rank, and status of medical officer stated..... 3

20. SUBJECT DESCRIPTION - Negative 4. Aerial oblique stated and view stated..... 3

21. SUBJECT DESCRIPTION - Negative 4. Name and number of carrier stated..... 3

22. SUBJECT DESCRIPTION - Negative 4. Fictitious altitude from which shot was made stated..... 3

23. SUBJECT DESCRIPTION - Negative 4. Fictitious exposure time stated..... 3

24. SUBJECT DESCRIPTION - Negative 4. Fictitious f-stop stated..... 3

25. SUBJECT DESCRIPTION - Negative 4. Location stated..... 3

26. DATE - Four dates fictitiously stated. Sequence of day, month and year followed..... 3

27. TIME - Four times fictitiously stated..... 3

28. PACK AND NEGATIVE NO. - Negative numbers and accurate reference given..... 3

EXHIBIT XII (Cont'd.)

SCORING SHEET (Cont'd.)

II. COVERING LETTER

29. Correct number of initiating source stated..... 3

30. Correct or fictitious file number stated..... 3

31. Date stated and in proper sequence..... 3

32. Correct or fictitious serial number stated..... 3

33. Exact form followed for recipient..... 3

34. Exact form followed for initiating source..... 3

35. Words "Still" and "Negatives" used under subject..... 3

Allow credit on items 36 and 37 if Photography Technical Bulletin NAVAER 10-1r-91 dated 1 April 1948 mentioned as reference, or if Manual of Photography, OPNAV INSTR 3150-6 mentioned.

36. Reference name stated..... 3

37. Reference number and date stated..... 3

38. Mention of reference (a) made in paragraph 1... 3

39. Mention of enclosure (1) made in paragraph 1... 3

40. Mention of correct quantity under enclosure.... 3

41. Time started_____. Time finished_____
Finished in 45 minutes or less..... 3

Total Score_____

EXHIBIT XIII

Key Used for Scoring Photographer's Data Sheet

PHOTOGRAPHER'S DATA SHEET
UNITED STATES NAVAL PHOTOGRAPHIC SERVICE
NAVAER-1088 (REV. 12-48)

(1) Fill out in triplicate

SUBJECT (Give project number, if any)
Scenes of Crash and Rescue at Sea

LOCATION	SHIP OR STATION	DATE SHIPPED
At Sea (3)	U.S.S. RANDOLPH (CV-15) (2) (4)	9 September 1952 (5)
PHOTOGRAPHER (6)	SIZE OF ROLLS, NEGATIVES	TOTAL THIS SHIPMENT (7)
A. B. SKE, AP1		4 Negatives

LOG No. (DO NOT WRITE IN THIS SPACE. FOR FILE USE ONLY)
INDEX No.

TYPE OF FILM (Check one box only. Use separate data sheet for each type of film)

☐ BW, 16 MM. ☐ COLOR, 16 MM. ☐ BW, 35 MM. ☐ COLOR, 35 MM. ☒ BW, STILLS (8) ☐ COLOR, STILLS

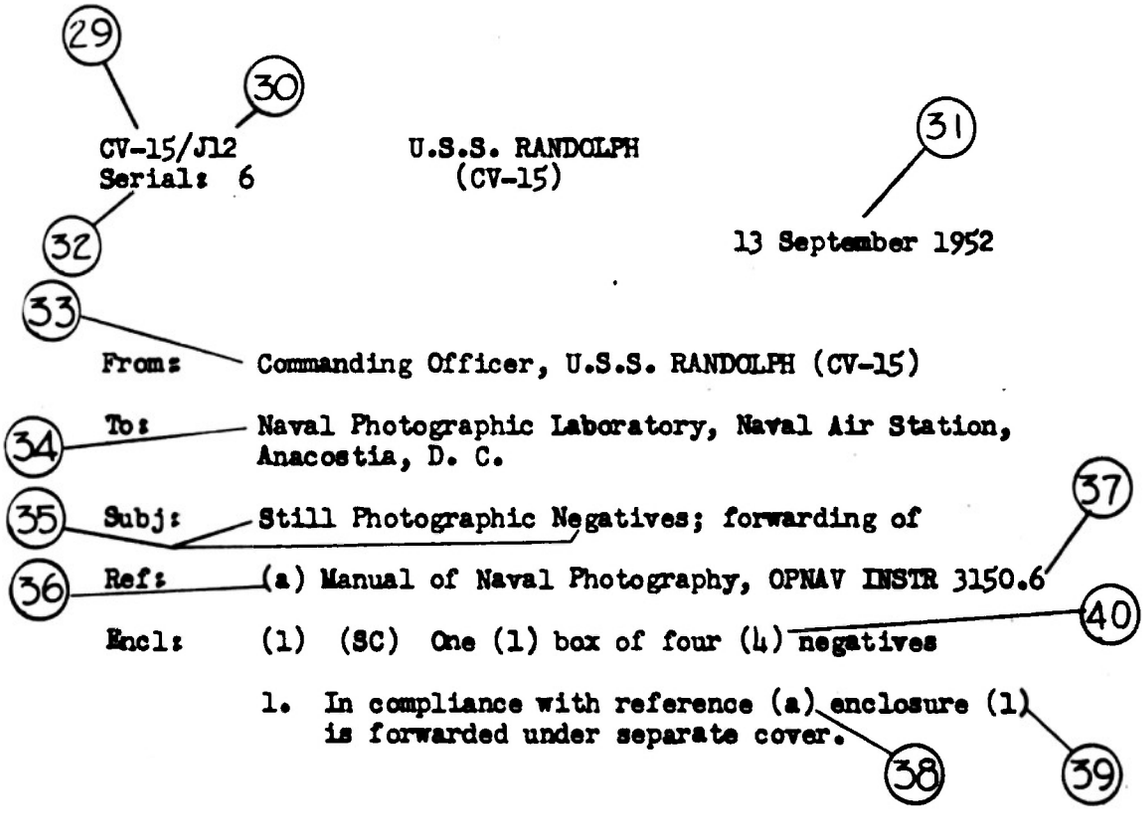
CAMERA TYPE	CAMERA SERIAL NO.
K-20 (9)	18068 (10)

GENERAL INFORMATION (In addition, state any unusual conditions or problems. If made with sound, state system—wire, film, disc, etc.)
Crash occured because of engine failure on catapulting. (11)

ROLL AND SCENE NO. OR PACK AND NEGATIVE NO. (12)	SUBJECT DESCRIPTION (List scenes, names, and events accurately. Attach newspaper clippings, programs, speech copies, Plan of the Day, etc.) (13) (15) (16) (18) (14)	DATE AND TIME OF IMPORTANT EVENTS (26)
Negative Nos. CV-15 1 (28)	F4U crashed into sea off coast of Korea. Pilot LT J. DOE, USN climbing from cockpit.	0800 9 Sept. 1952
2	Escort Destroyer, U.S.S. SMITH (DD-120) launching small boat to pick up pilot.	0804 9 Sept. 1952 (27)
3 (17)	Pilot LT J. DOE, USN aboard carrier receiving medical aid from carrier medical officer, CDR D. MANY, USN	0815 9 Sept. 1952
4 (20)	Aerial oblique: Port Side: U.S.S. RANDOLPH (CV-15) at sea; altitude 500 feet: Exposure data: 1/500 sec. @ f/8 (22) (19) (23) (21) (24) (25)	0900 9 Sept. 1952

EXHIBIT XIV

Key Used for Scoring Covering Letter to Data Sheets



Loading and Setting of K-17 or F-56 Aerial Camera

Any aerial camera must be properly loaded before it can be used effectively. The results of careful picture taking may be vitiated completely by poor film loading. Therefore, a test (Exhibit XV) of film loading seemed mandatory. Aerial cameras are usually loaded in a dark room. However, this dark room situation would not allow an observer to see what the examinee was doing. In order to keep the examinee in the dark, and still maintain a condition in which the examiner could see, the examinee was blindfolded. Aside from this, the task of the examinee was to load the camera exactly as he would ordinarily load it. Large core and small core take up spools were provided in an attempt to separate those examinees who knew what type of core to use with the K-17 or F-56 from those who did not. Although both types of core will fit into these cameras, only the large core spool will take up film properly. For the test the spools were always set in front of the examinee in the same relative positions.

Both the loading and the setting of the camera were scored with emphasis on the safety precautions followed, the care of equipment shown, and the procedure followed in doing the film loading.

EXHIBIT XV

Sample Camera Loading Test

AF PERFORMANCE EXAMINATION

AERIAL CAMERAS

LOADING AND SETTING K-17 OR F-56

EXAMINEE INSTRUCTIONS

TASK — This is a test of your ability to load and set an aerial camera. You will be provided with a K-17 or F-56 aerial camera. Your task is to load the magazine and to set the camera for operation at 1/150 sec. at f/11. Be sure you understand what you are to do before you start.

SCORING — You will be scored on the MANNER in which you do the job along with the TIME it takes you to complete the loading and setting.

MATERIAL — The following have been provided:

1. K-17 or F-56 aerial camera.
2. Film
3. Cores

EXAMINEE'S NOTE

Since an observer is going to watch you work you are to work with the lights on. However, in order to keep the conditions as realistic as possible, the examiner is going to blind-fold you. Do as much of the job as you normally do in the light. Then at the point at which you would ordinarily extinguish the lights, tell the examiner. He will blindfold you at that point.

EXHIBIT XV (Cont'd.)

AF PERFORMANCE EXAMINATION

AERIAL CAMERAS

LOADING AND SETTING K-17 OR F-56

EXAMINER INSTRUCTIONS

TASK This is a test of the examinee's ability to load and set a K-17 or F-56 aerial camera.

GENERAL DIRECTIONS TO EXAMINER

1. Read very carefully and thoroughly the "Examinee Instructions". Be sure you understand the test and the method for administering it before attempting to give it to an examinee.

2. Assign the examinee to a work station and provide him with a K-17 or F-56 camera and the materials needed.

3. Have the examinee read the "Examinee Instructions". Ask him if he has any questions. If he has a question, re-read to him that part of his directions which answers his question. Supply no accessory information. Remember, this is a test situation, not an instructional one. Make sure that the examinee understands what he is to do before he starts.

4. Have the examinee secure the work station when he is finished.

SCORING Carefully observe the examinee as he works. If you think that the examinee should receive credit on an item, do nothing to the number which appears after that item. If you think that the examinee should not receive credit on an item, cross out or X over the number which appears after that item. Do the scoring at the time that a particular operation is performed. Do not (repeat), do not rely on your memory. Give complete attention to the scoring. The total score is the sum of the non-crossed out or non-Xed credits. On completion of the test add up the non-Xed credits or the non-crossed out credits and enter the total in the space provided.

EXHIBIT XV (Cont'd)

EXAMINER INSTRUCTIONS (Cont'd.)

TIME Time is counted as soon as the examinee understands what he is to do and is told to start. Record the time that the examinee starts and finishes in the appropriate spaces. For credit on the time item, the examinee must finish in 6 minutes or less. If the examinee does not finish the loading and setting in 6 minutes, allow him to finish. He receives no credit on the time item, however, unless he finishes in 6 minutes or less.

EXAMINER'S NOTE

1. Examinee is to be provided with a supply roll of film and 3 cores. One core is to be a large core while the other two are to be small cores. All cores are to be removed from the camera and placed next to it, prior to the examinee's arrival.

2. Blindfold the examinee when he so requests.

EXHIBIT XV (Cont'd.)

AF PERFORMANCE EXAMINATION

AERIAL CAMERAS

LOADING AND SETTING OF K-17 OR F-56

SCORING SHEET

NAME _____ RATE _____

SERVICE NUMBER _____ DATE _____

Time Started _____

CARE OF EQUIPMENT
SAFETY PRECAUTIONS

1. Checks dark slide for bends or light leaks... 3
2. Never leans dark slide on its edge..... 3
3. Never handles dark slide or magazine cover in rough manner or in manner which may cause insecurity of light tightness..... 3
4. Checks pressure plate for burrs or rough edges which may scratch film..... 3
5. Checks magazine camera locks for security.... 3
6. (If F-56) Checks exposure counter for proper operation..... 3
7. Uses large core take up spool..... 3

PROCEDURE

8. Unlocks magazine camera locks and removes magazine from camera..... 3
9. Checks magazine visually for cleanliness.... 3
10. Releases fiducial marks by turning magazine drive coupling..... 3
11. Installs large core take up spool (If K-17 hand tightens)..... 3

EXHIBIT XV (Cont'd.)

SCORING SHEET (Cont'd.)

12. Removes roll of film from can, and installs supply roll on supply side of magazine. FILM COMES OFF BOTTOM OF ROLL (emulsion out). 3

13. Pulls out 1 - 2 feet of film and threads around film guide roller..... 3

14. Tips magazine so that spools do not fall out 3

15. Threads film across pressure plate. Insures that film passes under fiducial marks..... 3

16. (If F-56) Threads film between metering roller and pressure roller. (If K-17) Threads film around metering roller..... 3

17. Leads film under take up spool and tapes film to same. Takes up a few turns. Checks to see that take up is even..... 3

18. Installs magazine cover. Checks to see if cover fully seated and latching screw properly shouldered..... 3

19. Reinserts dark slide, handle up..... 3

20. Seats magazine on camera and checks for proper operation by hand winding camera and tripping shutter. Visually checks to see if pie disk makes one complete revolution..... 3

21. (If K-17) Sets exposure counter to zero..... 3

POINT AT WHICH FOLLOWING OPERATIONS ARE PERFORMED IS OPTIONAL

22. Sets shutter speed at 1/150 sec..... 3

23. Sets f/stop at 11..... 3

24. Holds camera to light and trips shutter to insure that shutter and diaphram operating 3

25. Time finished_____Finished in 6 minutes or less..... 3

Total Score_____

Shutter Retiming

The ability to "correct common equipment faults" is required of Aerial Photographers second class, Aerial Photographers first class, and Chief Aerial Photographers. A common camera defect is the shutter that is out of time. It is important for Aerial Photographers to know how to remedy this defect since a shutter may go out of time at any moment. If the photographer doesn't know how to retime a shutter, it may mean that a mission cannot be accomplished and that the time and money involved in tieing up an aircraft and its crew over a period of time are wasted. In the Shutter Retiming Test, the examinee was given an aerial camera whose shutter was out of time and his task was to retime the shutter. The examinee was scored on his care of equipment, and the procedure he followed. The test proper is presented in Exhibit XVI.

EXHIBIT XVI

Sample Camera Repair Test

AF PERFORMANCE EXAMINATION

CAMERA MAINTENANCE

SHUTTER RETIMING

EXAMINEE INSTRUCTIONS

TASK — This is a test of your ability to retime the shutter of an aerial camera. In front of you is an F-56 (or K-17) aerial camera with the magazine removed. Your task is to retime the shutter. Be sure you understand what you are to do. Report to the examiner when you understand what you are to do and are ready to start.

SCORING — You will be scored on the MANNER in which you do the job and the TIME it takes you to finish retiming the shutter.

EXHIBIT XVI (Cont'd.)

AF PERFORMANCE EXAMINATION

CAMERA MAINTENANCE

SHUTTER RETIMING

EXAMINER INSTRUCTIONS

TASK — This is a test of the examinee's ability to re-time the shutter of an aerial camera.

GENERAL INSTRUCTIONS TO EXAMINER

1. Read very carefully and thoroughly the "Examinee Instructions". Be sure you understand the test and the method for administering it before attempting to give it to the examinee.

2. Assign the examinee to a K-17 or F-56 aerial camera. Remove the magazine.

3. Have the examinee read the "Examinee Instructions". Ask him if he has any questions. If he has a question, re-read to him that part of his directions which answers his question. Supply no accessory information. Remember that this is a test situation, not an instructional one. Make sure that the examinee understands what he is to do before he starts.

4. Have the examinee secure the work station when he is finished.

SCORING — Carefully observe the examinee as he works. If you think that the examinee should receive credit on an item, do nothing to the number which appears after that item. If the examinee is not to receive credit on the item, encircle or X over the number which appears after the observation called for on that item. Do as much of the scoring as possible at the time that a particular sub-operation is performed. Do not (repeat), do not rely on your memory. Give complete attention to the scoring. The total score is the sum of the non-encircled or non-Xed credits. On completion of the test, add up the non-encircled or non-Xed credits and enter the total in the space provided.

EXHIBIT XVI (Cont'd.)

EXAMINER INSTRUCTIONS (Cont'd.)

TIME — Time is started after the examinee reports that he understands what he is to do and is told to start. Record the time that the examinee starts and finishes in the appropriate spaces. For credit on the time item, the examinee must finish in 7 minutes or less. Do not tell the examinee what the time allowance is. If the examinee does not finish retiming the shutter in 7 minutes, allow him to finish. He receives no credit on the time item, however, unless he finishes in 7 minutes or less.

EXAMINER'S NOTE

DO NOT ALLOW EXAMINEE TO INSTALL WIND AND TRIP RODS, UNLESS HE HAS WOUND AND TRIPPED CASE DRIVE.

EXHIBIT XVI (Cont'd.)

AF PERFORMANCE EXAMINATION

CAMERA MAINTENANCE

SHUTTER RETIMING

SCORING SHEET

NAME _____ RATE _____

SERVICE NUMBER _____ DATE _____

Time Started _____

CARE OF EQUIPMENT

1. Never touches lens with fingers..... 3
2. Assures that wind and trip rods are fully seated in shutter couplings before winding camera..... 3
3. Winds and trips case drive before installing wind and trip rods..... 3
4. Does not wind camera except when wind and trip rods are in position..... 3
5. Does not smoke over lens and keeps foreign matter from lens vicinity..... 3

PROCEDURE

6. Removes tension or checks to see if tension removed by motion of trip rods..... 3
7. Removes wind and trip rods..... 3
8. Examines wind and trip rods for trueness..... 3
9. Winds shutter until initial tension obtained and trips shutter..... 3
10. Winds and trips case drive..... 3
11. Rewinds shutter until initial tension obtained 3

EXHIBIT XVI (Cont'd.)

SCORING SHEET (Cont'd.)

12. Reinserts wind and trip rods..... 3

13. Winds and trips complete unit. Checks to assure that shutter blades remain closed..... 3

14. Time finished_____. Total time on job _____. Finished in 7 minutes or less 3

Total Score_____

Motion Picture Processing - Use of Houston Machine

The Houston machine is used whenever motion pictures are processed. The Aerial Photographer, second class, is required to know how to "operate photographic laboratory equipment to process motion pictures." The Motion Picture Processing Test was a test of the examinee's ability to load, operate, and develop film in the Houston machine. In this test, (Exhibit XVII) as in the film loading test, the examinee was blindfolded for that portion of the test which would ordinarily be performed in the dark room. The examinee was scored on his care of equipment, the safety precautions he observed, his dark room technique, the procedure he followed in doing the job, and the final product he produced.

EXHIBIT XVII

Sample Motion Picture Processing Test

AF PERFORMANCE EXAMINATION

MOTION PICTURES

MOTION PICTURE PROCESSING

EXAMINER INSTRUCTIONS

TASK — This is a test of your ability to process motion picture film using the Houston Model 11B or A11 continuous processing machine. You will be supplied with two 15 foot rolls of 16 mm. black and white reversal film. The film supplied you has been processed. However, you are to handle it as if it were unprocessed film. Likewise there is water in the tanks instead of chemicals. Assume the water to be the appropriate chemicals mixed according to standard Navy reversal formulae. Assume the film to be unprocessed plus X. Be sure you understand what you are to do before you start.

SCORING — You will be scored on the MANNER in which you do the job and the TIME it takes you to complete the job.

MATERIALS

The following materials have been provided:

1. Two (2) fifteen (15) foot rolls of 16 mm. film--spooled
2. Leader
3. Stapler
4. Two (2) magazines and flanges
5. Rewind apparatus
6. Dark room
7. Sponge
8. Blindfold
9. Houston machine

EXHIBIT XVII (Cont'd.)

EXAMINEE INSTRUCTIONS (Cont'd.)

EXAMINEE'S NOTE

1. In loading the magazine, do not attach leader to film. Re-thread the Houston by changing the magazine after the film has run through.

2. When loading the magazine, be sure to splice the two fifteen foot lengths.

3. Since you are working with processed film, there is no need for you to work in a dark room. However, in order to make the conditions as realistic as possible, the examiner will blindfold you for all operations that you would ordinarily perform in the dark room. Tell the examiner the point in your loading at which you would ordinarily extinguish the lights. He will then blindfold you.

4. Read again the above 3 notes and be sure you understand them.

EXHIBIT XVII (Cont'd.)

EXAMINER INSTRUCTIONS

TASK — This is a test of the examinee's ability to run the Houston (Model 11B or A11) continuous processing machine.

GENERAL DIRECTIONS TO EXAMINER

1. Read very carefully and thoroughly the "Examinee Instructions". Be sure you understand the test and the method for administering it before attempting to give it to the examinee.

2. Assign the examinee to a Houston machine and provide him with the necessary materials.

3. Have the examinee read the "Examinee Instructions". Ask him if he has any questions. If he has a question, answer it by re-reading to him that part of the "Examinee Instructions" which answers his question. Make sure that the examinee understands what he is to do before he starts.

4. Have the examinee secure the work station when he is finished.

SCORING — Carefully observe the examinee as he works. If you think that the examinee should receive credit on an item, do nothing to the number which appears after the observation called for on that item. If the examinee is not to receive credit on an item, encircle or X over the number which appears after that item. Do as much of the scoring as possible at the time that a particular sub-operation is performed. Do not (repeat), do not rely on your memory. Give complete attention to the scoring. Of course, the measurements of the final product will be made after the task is completed. The total score is the sum of the non-encircled or non-Xed items. On completion of the test, add up the non-encircled or non-Xed items and enter the total in the space provided.

EXHIBIT XVII (Cont'd.)

EXAMINER INSTRUCTIONS (Cont'd.)

TIME — Time is counted as soon as the examinee understands what he is to do and is told to start. Record the time that the examinee starts and finishes in the appropriate spaces. For credit on the time item, the examinee must finish in 40 minutes or less. Do not tell the examinee what the time allowance is. If the examinee does not finish in 40 minutes, allow him to finish. He receives no credit, however, on the time item unless he finishes in 40 minutes or less.

EXAMINER'S NOTE

1. Blindfold the examinee at his request or at the point at which he states that he would customarily extinguish the lights.

2. If the examinee does not finish loading the magazine in 10 minutes, or if he is unable to load the magazine, unblindfold him and load the magazine for him. Let him then continue with the processing. He may still receive credit, in this case, on as many "dark room techniques items" as are correctly applicable and were correctly completed.

EXHIBIT XVII (Cont'd.)

AF PERFORMANCE EXAMINATION

MOTION PICTURES

MOTION PICTURE PROCESSING

SCORING SHEET

NAME_____ RATE_____

SERVICE NUMBER_____ DATE_____

Time Started_____

CARE OF EQUIPMENT
SAFETY PRECAUTIONS

1. Inspects machine for cleanliness prior to use. Cleans if dirty..... 3

2. Checks entire leader for twists prior to operating machine. Corrects any twisting..... 3

3. Checks solution temperature gauges for proper temperature prior to processing film..... 3

4. Checks flash lamps for proper exposure and intensity prior to processing film..... 3

5. Checks operation of elevators, riser rods, transfer rollers and film moving mechanism prior to loading film..... 3

6. Checks drying elements for proper operation prior to running machine..... 3

7. Checks wash water periodically for proper level 3

8. Never changes or sets machine speed unless machine running..... 3

EXHIBIT XVII (Cont'd.)

SCORING SHEET (Cont'd.)

DARK ROOM TECHNIQUE

10. Sets up, in orderly manner, all necessary equipment prior to "extinguishing lights"..... 3

11. Clears work area of all excess material..... 3

12. Brings all necessary equipment into dark room.. 3

13. Checks film edge with finger tips during rewind 3

14. Rewinds at moderate speed..... 3

15. After loading flange, checks edges of roll for evenness. If uneven, unwinds and rewinds..... 3

16. Checks to see that follower arm out of way before easing flange into magazine..... 3

17. After threading light trap and securing magazine cover, but before "illuminating lights", checks film for free unreeling..... 3

18. Loop stapled around flange pin..... 3

19. Film wound on flange emulsion in and feeds off reel bottom..... 3

20. Film wound flat against flange..... 3

21. Time loading completed _____. Loading completed by examinee in 10 minutes or less.... 3

PROCEDURE

(Observations from this point until "final product" are to be made by the examiner as the examinee works)

22. Places magazine on loading bracket..... 3

23. Splices film to machine leader..... 3

24. Splice overlap at least 1 1/2 inches..... 3

25. Both ends of splice double stapled..... 3

EXHIBIT XVII (Cont'd.)

SCORING SHEET (Cont'd.)

26. End staple lengths evenly distributed over splice ends and supply rolls..... 3

27. Splice stapled in middle as well as at ends.... 3

28. Ends and sides of splice perfectly square..... 3

29. No buckle in splice..... 3

30. Secures magazine to loading bracket in such a manner as to prevent buckling of film..... 3

31. Starts machine. Makes periodic checks for proper mechanical operation..... 3

32. When leader all run off magazine, changes magazine and splices film to leader..... 3

33. When film all run off magazine, changes magazine and splices leader to film end..... 3

34. Continues operation until film emerges from drier cabinet.. Then changes take up spool..... 3

35. After film wound on take up spool replaces flanges..... 3

36. Loop stapled around flange pin..... 3

37. Secures machine, secures wash water, and wipes down machine..... 3

38. Time finished_____. Total time on job _____. Finished in 30 minutes or less. 3

EXHIBIT XVII (Cont'd.)

SCORING SHEET (Cont'd.)

FINAL MEASUREMENTS

(After the examinee has finished the processing, the examiner will examine the splice made in the dark room for the following:)

39. Splice overlap at least 1 1/2 inches..... 3

40. Both splice ends double stapled..... 3

41. End staple lengths evenly distributed over splice end and supply rolls..... 3

42. Splice middle stapled as well as end stapled.. 3

43. Ends and sides of splice perfectly square..... 3

44. No buckle in splice..... 3

Total Score_____

Chemical Mixing

All photographers are required to "mix photographic chemicals and solutions according to specifications". Moreover, no film can be adequately processed unless the chemicals are properly mixed. In brief, almost all photography eventually involves a chemical mixing process. Here again, we chose to combine the test of chemical mixing with a test of familiarity with and ability to use photographic publications. The examinee was given four publications and was told that he was to mix a bleach for Kodak blue base Super XX film. His task then consisted of finding the formula for the correct bleach and mixing the bleach. This is a typical photographic situation.

An examinee, familiar with the photographic publications, should know that the bleach formula can be found only in the Photo Lab Index. Moreover, the effective photographer should have little difficulty in locating the correct formula, since familiarity with the index is almost a prerequisite to effective photographic practice.

If the examinee did not locate the correct bleach within a specified time allowance, he was given the formula and allowed to proceed with the mixing. The examinee was scored in this test (Exhibit XVIII) on his laboratory technique, his use of publications, and the procedure he followed.

Laboratory technique items were developed on the basis of opinions of Chief Petty Officers as to what constitutes good photographic laboratory technique. Mixing a bleach was selected as a test task because a component of a bleach is an acid, and this provided an opportunity to check the examinee on the handling and mixing of acids.

EXHIBIT XVIII

Sample Chemical Mixing Test

AF PERFORMANCE EXAMINATION

LABORATORY PROCESSES - PUBLICATIONS

CHEMICAL MIXING

EXAMINER INSTRUCTIONS

TASK — This is a test of your ability to mix chemicals in order to produce specified results. Your task is to mix one quart of a solution which will remove the blue base from Kodak blue base Super XX film. You may make use of any of the following publications for any information you require.

1. Photography; 1947 edition (NAVPERS 10372)
2. Photography; 1952 edition (NAVPERS 10371)
3. Photo Lab Index; (NAVAER 10-1-510)
4. Photography Technical Bulletin (Cumulative Edition)

Be sure you understand what you are to do before you start.

SCORING — You will be scored on the MANNER in which you do the job.

MATERIALS

1. Publications as listed above
2. Chemicals and reagents as requested
3. 32 ounce graduate and stirring rod
4. Balance
5. Tank
6. Quart container
7. Labels

The examiner will provide you with any chemicals you request.

EXHIBIT XVIII (Cont'd.)

EXAMINEE INSTRUCTIONS (Cont'd.)

EXAMINEE'S NOTE

Fill the quart bottle with the solution and give it to the examiner who is going to store it.

EXHIBIT XVIII (Cont'd.)

AF PERFORMANCE EXAMINATION

LABORATORY PROCESSES - PUBLICATIONS

CHEMICAL MIXING

EXAMINER INSTRUCTIONS

TASK — This is a test of the examinee's ability to mix chemicals and use the Photo Lab Index.

GENERAL DIRECTIONS TO EXAMINER

1. Read very carefully and thoroughly the "Examinee Instructions". Be sure you understand the test and the method for administering it before attempting to give it to the examinee.

2. Assign the examinee to a work station. Provide him with the four publications listed in the "Examinee Instructions".

3. Have the examinee read the "Examinee Instructions". Ask him if he has any questions. If he does not understand any part of his directions, re-read to him that part of his directions which answers his questions. Supply no accessory information. Remember, this is a test situation, not an instructional one. Make sure that the examinee understands what he is to do before he starts.

4. Allow the examinee three minutes to locate the correct bleach in the Photo Lab Index. If he does not locate the correct bleach in the Photo Lab Index in three minutes, point out the correct bleach to him and have him proceed with the mixing of the solution.

EXHIBIT XVIII (Cont'd.)

EXAMINER INSTRUCTIONS (Cont'd.)

SCORING Carefully observe the examinee as he works. If you think that the examinee should not receive credit on an item, encircle or X over the number which appears after that item. If credit is to be allowed on an item, do nothing to the number appearing after the observation called for on that item. Do as much of the scoring as possible at the time that a particular sub-operation is performed. Do not (repeat), do not rely on your memory. Give complete attention to the scoring. The total score is the sum of the non-encircled or non-Xed credits. On completion of the test, add up the non-encircled or non-Xed credits and enter the total in the space provided.

TIME Time is counted as soon as the examinee understands what he is to do and is told to start. Record the time that the examinee starts, the time that he locates the bleach, the time that he starts mixing the bleach, and the time that he finishes mixing in the appropriate spaces on the answer sheet. For credit on item 26, the examinee must finish the actual mixing in 8 minutes or less. If the examinee does not finish within this time, allow him to finish. He receives no credit, however, on item 26 unless he finishes in 8 minutes or less.

EXAMINER'S NOTE

1. If the examinee locates the wrong bleach, point out his error to him and have him mix the correct one.

2. If he starts to mix a solution without consulting the Photo Lab Index, ask him what he is going to do. If he is going to mix any solution other than the correct one, give him the formula for the correct bleach and allow him no credit on items 11, 12, 13 and 14.

3. If the examinee attempts to mix the correct solution without consulting the Photo Lab Index, he receives no credit on items 11, 12, and 14, but receives credit on item 13.

EXHIBIT XVIII (Cont'd.)

AF PERFORMANCE EXAMINATION

LABORATORY PROCESSES - PUBLICATIONS

CHEMICAL MIXING

SCORING SHEET

NAME _____ RATE _____

SERVICE NUMBER _____ DATE _____

Time Started _____

A. GENERAL LABORATORY TECHNIQUE

1. Uses clean paper on both scale pans..... 3
2. Discards paper immediately after use..... 3
3. Wipes pans clean prior to use..... 3
4. Checks scale for "trueness", prior to use..... 3
5. Centers counterweights..... 3
6. Evenly distributes chemicals over pan..... 3
7. Uses only cold water in making mixture..... 3
8. Never leaves acid bottle uncapped and restows immediately after use..... 3
9. Never pours acid in drain..... 3
10. Washes all glass equipment prior to use..... 3

B. USE OF PUBLICATIONS

11. Immediately (prior to consulting other books) takes Photo Lab Index..... 3
12. Uses index of Photo Lab Index prior to looking into body of book..... 3
13. Locates correct bleach in text of Photo Lab Index..... 3
14. Time correct bleach located _____. Correct bleach located in _____ minutes. Correct bleach located in less than 3 minutes..... 3

EXHIBIT XVIII (Cont'd.)

SCORING SHEET (Cont'd.)

C. CHEMICAL MIXING

Time Mixing Started_____

15. Draws appropriate chemicals..... 3

16. Weighs out exactly 3 ounces of potassium-dichromate..... 3

17. Weights placed on right side of scale, chemicals on left..... 3

18. Slowly adds dichromate to small quantity of water and stirs while chemical is added..... 3

19. When all of chemical completely dissolved, adds water to make one quart..... 3

20. Measures out exactly 12 ounces of sulfuric acid..... 3

21. Adds acid to dichromate solution (not reverse). 3

22. Adds acid slowly at side of dichromate mixture. 3

23. Stirs rapidly, but not violently, when adding acid..... 3

24. Fills quart container with solution..... 3

25. Correctly labels solution (Name, who mixed, date mixed)..... 3

26. Time mixing finished_____. Time spent mixing. Finished mixing in 8 minutes or less. 3

27. Wipes scale pans and work area with damp cloth when securing..... 3

28. Places weights in proper places when securing. 3

Total Score_____

In one sense, all the chapters which follow the present chapter constitute an evaluation of the "model" Aerial Photographers' and Aviation Structural Mechanics' Batteries. However, in the present chapter, we would like to evaluate the practicality of the two batteries developed.

Evaluation of the Practicality of the Aviation Structural Mechanics' Battery

For purposes of discussion, practicality may be divided into two areas: (1) practicality of administration, and (2) practicality of scoring and interpretation.

Practicality of Administration

In order for a performance battery to be administratively practical it must, in the first place, be administrable in a short time interval. The aspect of brevity was one of our screening criteria. The time allotted for credit on the time item and the per cent of examinees receiving credit on the time item in each of our Aviation Structural Mechanics' Tests is shown in Table 2. The examinees are described in Chapters IV and V of the present report.

TABLE 2

Time Allowance for Credit on the Time Item and the Percent of Examinees Receiving Credit on the Time Item in Each Structural Mechanics' Test

Test	Time Allowance in Minutes	Percent Receiving Credit
Rigid tubing assembly	23	38.23
Drill point grinding	10	85.29
Welding	17	64.71
Metal Working	135	14.71
Fabrics	30	32.35
Hydraulic inspection	60	50.00
Plastics	120	41.17
Structural maintenance	70	35.29
Total	465	

It is clear that the times allowed for credit on the time item in the Structural Mechanics' Tests were not liberal enough. Most men did not finish most of the tests within the time allowance. The man who finished each test in exactly the time allowed for credit on the time item would have spent 7 3/4 hours in actual work. The majority of the men spent more working time than this. However, in the field situation it was found that 1 1/2 work days were sufficient to administer the total battery. This 1 1/2 days of administrative effort included time for instruction giving, smoke breaks, lunch hours, etc. We do not feel this amount of time to be excessive. If performance tests are considered as diagnostic instruments, then even 1 1/2 days in testing compares favorably with other diagnostic psychological batteries. Moreover, the total battery need not be taken at one time. In operations an examinee may take one test on one day, a second test three days later, a third test a week later and so on until the total battery is completed. Thus, the complete battery may be administered without interferring with a man's routine work duties.

The objection may be raised that the man hours spent in testing actually represent twice the time invested by an individual examinee. This argument of double time investment is tenable because each examinee was observed by an individual examiner or test administrator while the examinee took the entire battery. However, if in a particular situation a 1 to 1 ratio between examiner and examinee seems to represent an unwise or impossible time expenditure, this expenditure can be minimized by limiting the scoring to "measurements of the final product". In this case, one examiner can administer a performance test to 10 - 15 examinees. Of course, this type of thinking cannot apply to the 30-Hour Hydraulic Inspection since no "final product measurements" were included in that test. Thus, seven of our eight tests may also be adapted for group testing such as that most reconcilable with school situations. Since the "measurements of the final product" section is sometimes thought to be the section of performance tests in which the greatest objectivity in item writing can be introduced and since this section was found to have the greatest face validity, limiting scoring to "measurements of the final product" may not be objectionable. On the other hand, by following such a procedure we miss the contribution to the variance of the test sections not scored. Whether it is desirable to eliminate from scoring the test sections entitled "Care and Use of Tools" and "Adherence to Safety Precautions", no matter how little their contribution to the variance is a moot question.

The second practical administrative requirement for any performance battery is that it be easily administered. The ease of administration of our Aviation Structural Mechanics' Battery is discussed under the evaluation of the test administration. However, in essence, the findings indicate that Naval personnel with minimal test and measurements backgrounds and with only a brief indoctrination into test administration found the Aviation Structural Mechanics' Battery easy to administer.

A third administrative requirement for a good performance battery is that the tests contained therein contain simple, clear, administrative directions. The data (also presented and discussed under the evaluation of the test administration) which seems to indicate that the examiners were familiar with the tests and the methods for administering them, would tend to uphold a contention supporting the clarity of the directions for the tests in our Aviation Structural Mechanics' Battery.

The fourth practical administrative requirement for a performance battery is that the test materials required be easily accessible and inexpensive. This requirement of accessibility and cost was one of our original screening criteria. The materials needed for the tests in our Aviation Structural Mechanics' Battery were all inexpensive. The metal, fabrics and plastics needed for our Structural Maintenance Test, our Metal Working Test, our Aluminum Butt Weld, our Fabrics Test, and our Plastics Test was usually available from scrap. The Drill Point Grinding Test required the expenditure of no material. Likewise, the 30-Hour Hydraulic Inspection necessitated the expenditure of no material, but did require that an operational aircraft be grounded for test purposes. However, aircraft were grounded for other purposes during certain periods and these aircraft were used for our testing purposes during these periods.

The "mock ups" required for the Fabrics Test and for the Tube Fitting Test could have been fabricated easily at any operational base.

Practicality of Scoring and Interpretation of Structural Mechanics' Battery

The practicality of our Aviation Structural Mechanics' Battery from the point of view of scoring and interpretation may also be considered from several aspects.

In the first place, the most practical types of scoring situations are those in which the amount of judgment that the scorer must exercise is minimal. When writing our items we attempted to minimize the judgmental aspect by clearly stating what the examiner was to look for and score on a test, by writing items which were specific and which referred to "seeable" and measureable aspects of the work, by stating what tolerances to allow in the case of "measurements of the final product", by keeping items clearly worded and unambiguous, etc. Most of our items attained these standards. However, in some instances, not all of our items always attained all of these standards. For instance, one of the items on the Aluminum Butt Welding Test read, "Uses proper flux consistency (free flowing flux)". How stiff flux must be before it is no longer free flowing is problematic and subjective. The effects of these subjective items on the examiner reliability is discussed under our evaluation of the test administration in Chapters V and VI of this report. However, items of the subjective type were kept to a minimum. Subjective items were included only when it was felt that the act which the item represented was a "critical" one and the observation required was an observation that could not be presented in a more objective manner.

To increase scoring objectively, only full credit or no credit was allowed on an individual item. Thus, a subjective estimate on the part of the examiner on the amount of credit to allow within a given item was eliminated.

A second qualification for a practical scoring method in performance tests is that only simple calculations be required in obtaining scores. For the tests in the Aviation Structural Mechanics' Battery, only simple addition of credits was required for deriving total scores.

From the interpretive aspect, our Aviation Structural Mechanics' Battery is lacking as a measurement instrument.

This is so because the normative data that we gathered is of a limited nature in terms of number of examinees tested. However, the data are sufficient to allow for interesting rough comparisons and our data do represent a start towards the establishment of general norms.

Practicality of Administration of Aerial Photographers' Battery

Considered from the aspect of the time required for administration, the Aerial Photographers' Battery was superior to the Aviation Structural Medhanics' Battery. The time allowed for credit on the time item and the percent of men receiving credit on the time item is shown in Table 3. The examinees are described in Chapters IV and VI of this report.

TABLE 3

Time Allowance for Credit on the Time Item and Percent of Examinees Receiving Credit on Time Item in Each Aerial Photographers' Test

Test	Time Allowance in Minutes	Percent Receiving Credit
Motion picture processing	40	13.79
Camera maintenance	7	13.79
Speed graphic	20	55.17
Sonne continuous strip prints	23	34.48
Aerial cameras	6	10.34
Records and reports	45	62.07
Chemical mixing	16	17.24
Camera installation	10	10.34
Total	167	

In terms of the time allowance the Aerial Photographers' Battery appears to consume only about one quarter of the time that the Aviation Structural Mechanics' Battery consumes. However, as with the structural mechanics, most men were not able to finish the total battery within the 4 1/2 hour time allowance. In operations it took about 3/4 day to administer the total Aerial Photographers' Battery to each man. The Records and Reports Test was largely self-administering and this served to cut down on the investment of examiner time in each examinee.

Regarding the ease of administration and the clarity of the directions of the Aerial Photographers' Battery, here again the general findings seem to indicate that the administrators, in spite of their test naivete, seemed to experience little or no difficulty in administering the battery. Administrative ease would also favor a contention in support of simple, clear directions. The data upon which these statements are based are presented under the evaluation of the administration of the Aerial Photographers' Battery. (Chapter VI).

Considering the Aerial Photographers' Battery from the points of view of accessibility and cost of equipment, here again the evidence seems favorable. The Camera Installation, Records and Reports, Camera Loading, Camera Repair and Motion Picture Processing Tests each required the expenditure of no material. The Sonne Continuous Strip Printing Test involved expending about $.45 worth of printing paper per examinee and the cost of the materials expended for the Speed Graphic Test was about $.74.* The solution compounded in the Chemical Mixing Test was actually used by both of the photographic laboratories we visited. Thus, no loss or waste of material was involved in this test. This total cost of material expended would not usually be considered excessive for diagnostic testing.

Practicality of the Scoring and Interpretation of the Aerial Photographers' Battery

From the scoring and interpretive side, here again the judgmental aspects of scoring were minimized. Objective type observations and scorings were stressed throughout all items written and, as with the Aviation Structural Mechanics' Battery, only simple addition was needed to derive a total score. Due to the lack of adequate norms, as with the Aviation Structural Mechanics' Battery, our Aerial Photographers' Battery cannot be considered to be a completely finished product. Here again, however, we have made a start in the proper direction.

* We are indebted to C. E. Wherr, AFC for the cost estimates.

CHAPTER IV

First Field Test of the Aviation Structural Mechanics' and Aerial Photographers' Batteries Using Test Administrators Who Rendered Technical Advice and Assistance During the Test Development - Evaluation of the Test Administration (PURPOSES III and IV)

Our third purpose was to field test the Aviation Structural Mechanics' Battery using test administrators who rendered technical advice and assistance during the development of the tests and to evaluate the test administration of these men. As stated above, the Aviation Structural Mechanics' Battery was developed at the Naval Air Technical Training Unit, Memphis, Tenn. During the development of the battery, the test constructor was in constant touch with the instructor personnel at the Structural Mechanics' School at Memphis. At the advent of the test construction program, the instructors were made cognizant of the general purposes of the program and by and large were sympathetic towards our overall objectives. These instructor personnel assisted in the screening of the tasks, and helped in the task analyses. Moreover, they read and criticized the scoring sheets, examiner instructions and examinee instructions before these forms were put in final shape.

Being school personnel, these men were experienced in test administration and were well indoctrinated into proper test administrative practices for paper and pencil tests. Moreover, as a result of their school backgrounds, they were well motivated toward proper test administration.

It was these instructors who acted as test administrators for the first field test of the Aviation Structural Mechanics' Battery at Memphis. Field observations on the adaptivity to the test situation, the adherence to good performance test administrative practices, the conscientiousness and alertness of the test administrators as well as errors committed in test administration were made.

These instructors administered the Structural Mechanics' Battery to 15 unselected (aside from rating held) Aviation Structural Mechanics - four strikers, four third class, four second class, and three first class. The length of service for these examinees ranged from 15 months to 120 months with a mean of 54.06 months. The instructors were unfamiliar with the subjects prior to the test situation. Thus the backgrounds of the examinees were unknown to the examiners. In all, eight examiners were used, and each examiner (except for one) administered the complete battery to two examinees.

The results of this test administration in terms of the score achieved by each subject on each test as well as the means and standard deviations obtained for each test are presented in Table 4. Also included in the same table are the pay grades and lergth of service of each examinee. The test administrators have been previously described.

TABLE 4

Test Scores, Means, Sigmas, and Actuarial Data on Each Test
For Memphis Sample of Aviation Structural Mechanics

Subject	Pay Grade	Fabrication of Rigid Tubing Assembly	Drill Point Grinding	Welding	Metal Working	Structural Maintenance	Plastics	Fabrics	Service Length in Months
1	1	52	16	7	28	52	23	45	120
2	3	51	23	7	25	52	27	35	37
3	2	60	5	9	37	38	30	37	36
4	2	42	21	14	47	36	22	20	93
5	2	66	20	15	25	38	16	46	74
6	An	60	9	9	29	42	9	34	14
7	1	60	27	24	56	42	18	33	114
8	1	50	22	27	47	45	21	29	120
9	3	71	17	14	29	59	29	27	36
10	2	60	17	14	40	39	17	25	54
11	An	43	18	12	25	41	17	51	15
12	3	54	8	32	38	39	22	19	36
13	3	60	10	12	49	55	26	30	24
14	An	58	21	16	21	47	10	41	15
15	An	56	14	13	11	40	25	29	23
Mean		56.23	16.53	15.00	33.80	44.33	20.8	33.4	54.06
Sigma		7.54	6.00	6.93	11.92	6.83	6.53	9.00	38.29
Total Score Possible		75	36	53	67	74	49	62	

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The data from the field observations at Memphis indicated that the Chief Petty Officers who worked with the Institute researcher throughout the developmental aspects of Aviation Structural Mechanics' Battery at the Structural Mechanics' School adapted immediately to the testing situation. This adaptivity may have been a function of working with the researcher during the test development, or it may have been a function of stimulus generalization from other school testing situations with which they were familiar. More likely, it was a function of both. The Chief Structural Mechanics were able to administer the battery without any instructions other than those found in the examiner instructions which were appended to the tests and the examiners often made spontaneous comments to the researcher in terms of range of scores obtained, maintenance of standard conditions and objectivity of scoring. Moreover, the chiefs seemed to know what they were supposed to do and went about the test administration in a business-like manner. The chiefs were alert and attentive as test administrators and by and large seemed to adhere to the prescribed methods for administering the tests. Work and test materials were usually ready for test purposes prior to the examinees' arrivals and the examinees' questions were well handled. The Institute researcher did not observe many examinee errors that the test administrators missed. The principal errors noted by the researcher were those connected with subtraction in order to derive the time spent on the job and those connected with addition in order to obtain a total score. Aside from these arithmetical incompetences it was our opinion that these Chief Structural Mechanics who acted as administrators at Memphis demonstrated a high degree of competence in test administration.

First Field Test of the Aerial Photographers' Battery Using Test Administrators who Rendered Technical Advice and Assistance During the Test Development - Evaluation of the Test Administration

(PURPOSE IV)

The same general procedure was followed in developing the Aerial Photographers' Battery that was adhered to in developing the Aviation Structural Mechanics' Battery. The test constructor was in close, constant contact with the instructor personnel at the Naval Air Technical Training Unit, Pensacola, during the evolution of the Aerial Photographers' Battery. Aside from their specialty, these aerial photographic instructors possessed approximately the same backgrounds as their counterparts at Memphis. Moreover, they seemed to have similar motivations. The aerial photographic instructors served in the same roles during the construction of the Aerial Photographers' Battery as did the Chief Structural Mechanics during the construction of the Aviation Structural Mechanics' Battery. Four of these instructors were randomly selected to serve as test administrators during the first field test of the Aerial Photographers' Battery. Each of three examiners administered the battery to four aerial photographers. The remaining examiner administered the battery to two aerial photographers (N=14). The subjects all held the rate of third class Aerial Photographer and were the entire complement of men in that rate at the Aerial Photographic Laboratory, Naval Air Station, Pensacola. The examinees were unknown to the examiners prior to the testing situation. The results of this test administration in terms of individual scores, test means, and test standard deviations are presented in Table 5.

TABLE 5

Test Scores, Means, and Sigmas On Each Test For Pensacola Sample of Aerial Photographers

Subject	Motion Picture Processing	Camera Maintenance	Speed Graphic	Sonne Printer	Aerial Cameras	Records & Reprints	Camera Installation	Chemical Mixing
1	124	0	73	102	69	78	54	72
2	98	18	56	90	60	69	42	63
3	117	24	67	90	51	54	36	69
4	93	21	72	87	51	66	33	63
5	42	33	67	96	55	61	54	75
6	93	19	74	90	48	71	39	66
7	27	36	66	102	63	60	54	54
8	99	9	56	63	36	60	36	57
9	42	9	50	84	39	39	30	54
10	24	0	45	81	51	48	27	45
11	0	9	37	90	48	60	9	63
12	0	24	38	90	0	57	30	66
13	0	24	14	87	27	42	30	63
14	0	0	56	0	23	0	0	72
Mean	54.21	16.14	55.07	82.28	44.36	55.07	44.13	63.00
Sigma	45.86	11.40	16.46	25.46	17.49	18.52	15.10	7.81
Total Score Possible	132	45	94	111	75	129	66	84

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The field observations of the Chief Aerial Photographers who acted as test administrators at Memphis indicated that the chiefs adapted quite readily to the test administrative situation, in spite of the fact that they were given no formal instructions other than those affixed to the tests. Standard conditions from the points of view of instruction giving, test environment, and test equipment were well maintained. The chiefs were alert and seemed to enjoy administering the tests. They seemed adept at establishing proper examiner-examinee rapport. The chiefs were methodologically diligent and were efficient in their test adminstration. In brief, the same high caliber of test administration was performed by the Chief Aerial Photographers at Pensacola as was carried out by the Chief Structural Mechanics at Memphis. Whether this high caliber test administration was a function of the school experience of the chiefs, a function of having been in contact with the tests during their development, a function of some of them having read our manual, or a function of all three of these factors is difficult to say. Considering that these tests were administered in an operational situation, it was the general conclusion of the observer, that a professional test administrator would not have performed much better.

CHAPTER V

Second Field Test of Aviation Structural Mechanics' Battery with Test Administrators Who Had Minimal Indoctrination into Testing Practices - Evaluation of the Test Administration

PURPOSE V

Our fifth purpose was to administer the Aviation Structural Mechanics' Battery in an operational situation using test administrators who had minimal indoctrination into testing practices and procedures. In line with this purpose, the Aviation Structural Mechanics' Battery was taken to VC4 at the Naval Air Station, Atlantic City, for further field test. VC4 is a typical "all weather", composite squadron. In this second field test, the test administrators were randomly drawn from the chiefs in the complement of the Structural Maintenance Shop at VC4. None of the chiefs who served as test administrators had previous experience in test administration nor had they a background in educational practices or testing procedures. Thus these chiefs, who acted as test administrators, were typical of chiefs in operational squadrons. Their principal duties for the past several years were connected with the operational maintenance of aircraft. In all, six chiefs were used as examiners.

A total of 19 men were tested - 4 strikers, 10 third class, 3 second class, and 2 first class petty officers. Two chiefs independently but simultaneously administered the battery to each examinee. Chief A acted as one of the test administrators throughout and tested all 19 examinees. Chiefs B through F each administered the battery to a portion of the total group. Thus each examinee was independently evaluated by two examiners, Examiner A and one other, both of whom simultaneously but independently watched him work. The number of men tested by each chief is presented below:

TABLE 6

Test Scores, Basic Battery Scores, Means, and Standard Deviations for Each Subject and Each Test on Atlantic City Sample of Aviation Structural Mechanics

Name	Pay Grade	Fabrication of a Rigid Tubing Assembly	Drill Point Grinding	Welding	Metal Working	Fabrics	Hydraulic Inspection	GCT	Ari.	Mech.	Cler.
1*	2	47	19	12	35	31	29				
2	2	61	16	29	24	28	38	49	53	54	60
3	An	49	22	12	43	49	40	59	54	62	52
4	3	2	7	25	23	29	33	56	52	46	42
5	An	35	6	0	0	29	38	62	52	57	63
6	3	61	28	13	31	28	37	55	60	53	56
7	3	49	15	20	37	46	39	69	62	56	52
8	3	54	6	0	0	19	34	55	48	53	46
9	3	48	25	30	38	47	35	70	56	68	47
10	An	6	16	27	23	19	12	26	38	34	35
11	3	51	14	16	42	34	28	51	54	42	47
12	1	9	10	28	24	28	35	59	49	58	57
13	3	9	16	28	45	39	27	53	59	55	59
14	An	36	7	5	27	27	26	51	45	48	42
15	3	58	17	10	43	54	30	62	60	65	52
16	3	42	14	0	35	18	35	37	39	46	43
17	2	41	27	22	48	36	34	68	56	65	50
18	3	38	18	18	38	19	31	52	51	57	73
19	1	4	14	10	6	26	17	42	47	47	57
Mean		36.84	15.63	16.05	29.58	31.89	31.47	54.22	51.94	53.66	51.83
Sigma		19.82	6.48	3.16	4.47	10.49	7.09	10.86	6.59	8.48	8.81
Total Score Possible		75	36	53	67	62	58				

* Basic battery scores not available for this man

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Number of Men Tested by Each Chief Structural Mechanic Who Acted as a Test Administrator at Atlantic City

CHIEF	NUMBER OF MEN TESTED
A	19
B	4
C	3
D	4
E	5
F	3

The results of this test administration in terms of the scores assigned each examinee by Examiner A are presented in Table 6. Also presented are the means and standard deviations for each test and the basic battery scores for each subject.

Examiner Training

After a short indoctrination into testing procedures and practices, the testing program at VC4 was largely left in the hands of the Chief Structural Mechanics. The researcher merely acted in an advisory role; he answered questions when they were asked but otherwise made no comments, criticisms, or suggestions about the test administration.

The actual indoctrination into the testing for the Chief Structural Mechanics follows. On the first day an Institute Research Associate and its Program Director were introduced to the chiefs by the Commanding Officer of VC4. The introduction was performed in a classroom type situation. The Program Director made a brief general presentation of the purposes, uses, and scope of performance examinations and of our proposed research program at VC4. After the talk, the questions of the chiefs were answered, and then the group was dismissed.

On the next day Chief A was given 2½ hours of individual instruction in test administration. The first portion of this instructional session was devoted to carefully going over the structural mechanics' tests with Chief A. Trouble areas and key points in the tests in the Structural Mechanics' Battery were pointed out. This required about one hour. For the next hour Chief A was drilled in proper test administrative practices. Such factors as the importance of uniform tools and testing conditions, the importance of maintaining a proper test environment, the importance of exactly following instructions, typical scoring errors such as "halo", the consequences of not answering examinees' questions and the correct manner of so doing, how to score the tests, etc., were pointed out. About one hour was so consumed. Following this, Chief A administered two tests to a practice examinee and this test administration was criticised by the researcher. Chief A was then asked if he was adverse to taking charge of the testing program at VC4 and to accepting the responsibility for indoctrinating the other chiefs into proper test administrative practices. Chief A was perfectly amenable to assuming these responsibilities and seemed intrigued and flattered with these functions. The role of the researcher from this point forward was that of passive ovserver of the testing program, rather than one of administrator of a testing program.

All the tests except the 30-hour hydraulic check were administered in the Structural Maintenance Shop at VC4. Thus it was impressed on Chief A that his aim was to establish good testing conditions within the limitations of the operational situation. For instance, equipment like grinding wheels,

cornice brakes, and squaring shears are fixed to the floor. Moreover, these types of equipment can not be isolated for test purposes, since this equipment is used and shared by all the men in the shop.

The 30-hour Hydraulic Check, which required an actual aircraft, was administered on an F4U aircraft located in VC4's hangar.

Tests Not Administered

The Plastics Test and the C-channel repair were not administered at VC4. VC4 has no facilities for plastic repairing. The C-channel splice requires the use of a cornice brake. The cornice brake at VC4 was out of order during the period of the test administration.

Evaluation of the Test Administration

In order to evaluate the administration of the Structural Mechanics' Battery at Atlantic City, a four-fold approach was taken. The first approach was of the "field observation" type. The researcher made daily "field observations" of the chiefs as they administered the tests during which he gathered data of two types. The first was the filling in of a structured form called the Examiner Evaluation Form (Exhibit XIX). The Examiner Evaluation Form systematized the observer's attention on certain routine behavioral manifestations and the form was based largely on and derived from the field observations made during the test administrations at Memphis and at Pensacola. In order to complete the Examiner Evaluation Form, the researcher had to center observations on the readiness of all examination materials at the time of the examinee's arrival, the familiarity of the test administrator with the test, the examiner's method of instructing the examinee, the examiner's method and manner of scoring the examinee, and the manner in which the examinee was secured.

EXHIBIT XIX

Sample Examiner Evaluation Form

EXAMINER EVALUATION FORM

EXAMINER'S NAME_____

DATE_____

1. WORK MATERIAL

   A. All necessary tools and material prepared and ready prior to examinee's arrival._____

      Some overlap between arrival of examinee and readiness of tools and material._____

      No attempt to gather tools and material before the examinee arrives._____

2. TEST MATERIAL

   A. Scoring sheets and examinee instructions prepared before arrival of examinee.

      Yes_____ No_____

   B. Presence of timing device.

      Yes_____ No_____

   C. Presence of examiner instructions.

      Yes_____ No_____

   D. Presence of extra pencils.

      Yes_____ No_____

3. FAMILIARITY WITH TEST

   A. Completely familiar with procedure prescribed for administering test._____

      Some unfamiliarity with prescribed procedures, but refers to examiner directions and avoids errors._____

EXHIBIT XIX (Cont'd.)

EXAMINER EVALUATION FORM (Cont'd.)

Unfamiliar with administrative procedures. Makes errors in test administration._____

4. INSTRUCTIONS TO EXAMINER

A. Answers examinee's questions tactfully and patiently._____

Is cold towards examinee and discourages questions._____

No questions._____

B. Checks to assure that examinee understands what he is to do before he starts.

Yes_____ No_____

C. Follows standardized procedures when giving instructions.

Yes_____ No_____

D. Answers examinee's questions on what to do by telling him how to do the job.

Yes_____ No_____

5. SCORING

A. Quietly checks examinee as he works without interfering with work._____

Some interruptions and talk with examinee as he works.

_____

Considerable interruption, interference, and disruption of examinee as he works._____

B. Checks required observations as work operation is performed._____

Relies to some extent on memory. Checks slightly behind operation._____

Completely relies on memory. Checks performance when test is finished._____

EXHIBIT XIX (Cont'd.)

EXAMINER EVALUATION FORM (Cont'd.)

C. Pays complete attention to scoring. No talk with others._____

Some inattention and talk with others but not to the extent that it interferes with scoring._____

Talk and/or "horseplay" with others to the extent that it interferes with scoring._____

D. Instructs and aids examinee during test.

Yes_____ No_____

6. SECURING

A. Has examinee secure work station.

Yes_____ No_____

B. Completely collects all test material. Leaves no "samples" around.

Yes_____ No_____

Results from Examiner Evaluation Form

The observer made observations while 22 tests were administered. The results in terms of the per cent of the behaviors manifested by the test administrators that fell in each category listed are presented in Table 7. The high percentage of favorable behaviors noted in some categories is an outgrowth, to some extent, of the situation we imposed on the examiners. For instance, prior to the test administration each examiner was provided with a clip board upon which was clipped complete examinee instructions, examiner instructions, and scoring sheets for the tests the examiner was to administer. Thus, unless the examiner forgot his clip board, he was bound to have these materials with him prior to the arrival of the examinee. Likewise, unless the examiner left his clip board behind, it was hard for him not to collect all his test materials. Table 7 indicates that the Chief Structural Mechanics in our sample were strongest in the formal aspects of the test administration, such as preparation of work material prior to the examinees' arrival, instructing examinees in their task, and securing the examinees. Table 7 also indicates that the chiefs were weakest in their propensity for talking with the examinee and with others while administering tests. However, it was the observer's opinion that this talk was not to the extent that it interfered with proper scoring practices. The test administrators were moderately strong in the manner in which they handled examinees' questions. By and large, Table 7 indicates that in spite of their minimal indoctrination into testing procedures these test administrators were quite proficient. It may be that the high motivational level noticed in these chiefs compensated to some extent for their minimal technical knowledge in test administration.

TABLE 7

Per Cent of Behaviors Manifested by Chief Structural Mechanics When Administering the Structural Mechanics' Battery (Number of Observations = 22)

1. WORK MATERIAL

   A. All necessary tools and material prepared and ready prior to examinee's arrival. 91%

      Some overlap between arrival of examinee and readiness of tools and materials. 0%

      No attempt to gather tools and material before the examinee arrives. 9%

2. TEST MATERIAL

   A. Scoring sheets and examinee instructions prepared before arrival of examinee.

      Yes 100% No 0%

   B. Presence of timing device.

      Yes 91% No 9%

   C. Presence of examiner's instructions.

      Yes 100% No 0%

   D. Presence of extra pencils.

      Yes 32% No 68%

3. FAMILIARITY WITH TEST

   A. Completely familiar with procedure prescribed for administering test. 91%

      Some unfamiliarity with prescribed procedures, but refers to examiner's directions and avoids errors. 9%

      Unfamiliar with administrative procedure. Makes errors in test administration. 0%

TABLE 7 (Cont'd.)

4. INSTRUCTIONS TO EXAMINEE

A. Answers examinee's questions tactfully and patiently. 95%

Is cold towards examinee and discourages questions. 5%

B. Checks to assure that examinee understands what he is to do before he starts.

Yes 95% No 5%

C. Follows standardized procedures when giving instructions.

Yes 86% No 14%

Answers examinee's questions on <u>what</u> to do by telling him <u>how</u> to do the job.

Yes 27% No 73%

5. SCORING

A. Quietly checks examinee as he works without interfering with work. 90%

Some interruptions and talk with examinee as he works. 5%

Considerable interruption, interference, and disruption of examinee as he works. 5%

B. Checks required observations as work operation is performed. 59%

Relies to some extent on memory. Checks slightly behind operation. 41%

Completely relies on memory. Checks performance when test is finished. 0%

TABLE 7 (Cont'd.)

5. SCORING (Cont'd.)

C. Pays complete attention to scoring. No talk with others. 45%

Some inattention or talk with others but not to the extent that it interferes with scoring. 45%

Talk and/or "horseplay" with others to the extent that it interferes with scoring. 10%

D. Instructs and aids examinee during test.

Yes 9% No 91%

6. SECURING

A. Has examinee secure work station.

Yes 91% No 9%

B. Completely collects all test material. Leaves no "samples" around.

Yes 100% No 0%

Field Observations of the Test Administration

In addition to these structured observations, the observer made field observations and notes on areas, occurrences, and incidents not mentioned in the Examiner Evaluation Form but which nevertheless were of interest.

These tended to confirm the structured observations. The tendency to talk with others during the test administration was the principal negative aspect noticed.

Semi-Structured Interviews

The third approach to examiner evaluation was a self-evaluation on the part of the examiners. After a chief had completed his portion of the test administration, a semi-structured interview based on the Interviewer's Record Form shown on Exhibit XX was conducted. The interview was structured to the extent that the interviewer always made a judgment on the basis of the test administrator's reply in one of the structured categories of each item.

The interviewer was allowed leeway, however, in his method of arriving at the judgment. Thus the wordings of the questions asked of the examiners varied from chief to chief, as did the amount of probing. The interviewer's stress was upon assuring that his categorization properly reflected the chief's own self-evaluation rather than on maintaining a rigid interview structure. The items preceded by an asterisk, item numbers 1, 2, 9, 10, 11, 12, 13, 17 and 19a of Exhibit XX, were aimed at determining the test administrator's evaluation of his own test administration.

Item 1, "How difficult did you find the tests to administer?", was based on the assumption that the man who found the test administration within his grasp probably did a better job than the man who found it exceedingly difficult.

Item 2, "How did you enjoy administering the tests?", was based on the assumption that the examiners who enjoyed the test administration probably actually performed a better test administrative job than those who did not enjoy it.

EXHIBIT XX

Sample Interviewer's Record Form

INTERVIEWER'S RECORD FORM

* Items pertinent to examiners' self evaluation.
** Items pertinent to face validity of tests.

NAME _____

*1. How difficult did you find the tests to administer?

very difficult ____
difficult ____
average ____
easy ____
very easy ____

Remarks _____

_____

*2. How did you enjoy administering these tests?

very unenjoyable ____
unenjoyable ____
average ____
enjoyable ____
very enjoyable ____

Remarks _____

_____

3. Would you like to administer these tests as a full time duty? Yes____ No____

As a collateral or part-time duty? Yes____ No____

Remarks _____

_____

4. Do you think that you could make up tests like this? Yes____ No____

Remarks _____

_____

EXHIBIT XX (Cont'd.)

INTERVIEWER'S RECORD FORM (Cont'd.)

5. How much time would you have to construct tests like these?

considerable_____
slight _____
none _____

Remarks_____

_____

6. How much time would you need to construct these tests?

considerable_____
slight _____
none _____

Remarks_____

_____

**7. What could we do to improve these tests?

Remarks_____

_____

**8. What could we do to improve the scoring?

Remarks_____

_____

9.**Were the items too detailed? Yes_____ No_____

**Were the items too general? Yes_____ No_____

*Did you understand the language in the items? Yes_____
No _____

Remarks_____

_____

EXHIBIT XX (Cont'd.)

INTERVIEWER'S RECORD FORM (Cont'd.)

*10. What else should have been told you when you were checked out in the test administration?

More information wanted? Yes_____ No_____

Remarks_____

_____

*11. Were you a good test administrator?

good _____
mediocre _____
poor _____

Remarks_____

_____

*12. Were you better than Chief A?

better _____
about as good _____
poorer _____

Remarks_____

_____

*13. Were the items too long, i.e., were you able to watch, read, and write at the same time?

able to watch and write _____
unable to watch and write _____

Remarks_____

_____

**14. What else should have been on the scoring sheet?

Remarks_____

_____

EXHIBIT XX (Cont'd.)

INTERVIEWER'S RECORD FORM (Cont'd.)

**15. Do you think these test separate good (AMs) (AFs) from poor?

discriminate well _____
discriminate fairly well _____
don't discriminate _____

Remarks _____

_____

**16. Do you consider this to be a practical way for checking men out on "practical factors" for advancement in rating in your squadron?

highly practical _____
practical _____
impractical _____

Remarks _____

_____

*17. Everyone who administers these test feels a little shaky at first, but after a while they become quite confident. After how long were you confident?

½ day _____
1 day _____
2 days _____
3 days _____
over 3 days _____

Remarks _____

_____

**18. Would you be willing to go to sea with men selected on the basis of these tests?

Yes _____
No _____

Remarks _____

_____

EXHIBIT XX (Cont'd.)

INTERVIEWER'S RECORD FORM (Cont'd.)

19. Here is a list of the tests you administered.

Regarding the (welding) (chemical mixing) test:

*a) Was its administration easy or hard?_____

**b) Do you think that this is a practical way to check men out on (welding) (chemical mixing)?

Yes_____
No _____

**c) If you were in charge of the (shop) (lab), would you be willing to assign men to (welding) (chemical mixing) after having seen them complete this (welding) (chemical mixing) test?

Yes_____
No _____

Remarks_____

_____

Repeat a, b, and c above for remaining tests and enter data on following page.

EXHIBIT XX (Cont'd.)

INTERVIEWER'S RECORD FORM (Cont'd.)

	Administration				Assign men on basis of	Not assign men on basis of
	Easy	Hard	Practical	Impractical		
Welding test						
Drill grinding						
Metal working						
Struct. maintenance						
Plastics						
Hydraulic inspect.						
Hydraulic repair						
Fabrics						
Motion picture proc.						
Speed graphic						
Camera inst.						
Records & reports						
Camera maintenance						
Use of Sonne machine						
Aerial cameras						
Laboratory proc.						

Item 10 was based on the assumption that the man who felt that he needed more information in his check-out may also have felt that he would have avoided certain errors in test administration if he had possessed this information before he started.

Item 9, "Did you understand the language in the items?", assumed that the examiner who didn't understand the test language couldn't have done an effective test administrative job.

Item 11, "Were you a good test administrator?", is a straightforward self-evaluation while item 12, "Were you better than Chief A?", is an evaluation with a definite anchoring point supplied. In asking question 12, the interviewer filled the blank with the name of Chief A. Since A administered the battery to all examinees and since he was presumably our best test administrator, an additional insight into the examiner's self estimate was thus provided.

In Item 17 we attempted to ascertain how long it took each chief to become confident in his ability as a test administrator. Obviously the examiner with little self confidence could not command an examinee's respect.

Likewise, Item 13 assumed that the chief who couldn't simultaneously watch an examinee, read test items, and check off as necessary couldn't have done his job well.

In Item 19a, the examiners were asked about the administration of each individual test. Thus rather than give an overall estimate of how easy or how hard the test administration was for them, the chiefs who acted as test administrators were forced to consider each test in the battery separately and individually and to state an opinion regarding the ease of the administration of each of the individual tests.

The interviewer was an Institute research associate with a background and publications in interviewing.

Results from Self-Evaluation of the Chief Structural Mechanics

The data from the items in the Interviewer's Record Form (Exhibit XX) which reflected the examiner's self-evaluation are presented in Table 8.

Table 8 indicates that none of the Chief Structural Mechanics found the tests difficult to administer and that none of the examiners found the task unenjoyable. The test administrators were able to understand the language in the tests (Item 9) and 5 of the 6 test administrators self-rated themselves as being "good" examiners. However, 5 out of 6 also felt that they were poorer test administrators than Examiner A, our standard examiner. On probing, differential experience was usually stated as the reason for this distinction. By and large, after one day at test administrative duties, the chiefs were confident in their test administration. If confidence reflects competence, then this confidence is a positive attribute. Moreover, our test administrators felt that they were able to simultaneously watch the examinee and make the proper scoring notations. This would seem to indicate that our method of listing the scorable aspects of a task is acceptable if considered from the point of view of the difficulty of handling the required simultaneous operations.

EXHIBIT XXI

Sample Movie Evaluation Form

MOVIE EVALUATION FORM

CARE AND USE OF TOOLS

1. Did the examinee check the tool rest for proper distance from periphery of the grinding wheel?
   Yes_____ No_____

2. Did the examinee ever adjust the tool rest while the wheel was in motion?
   Yes_____ No_____

3. Did the examinee use a coolant while grinding the drill?
   Yes_____ No_____

PROCEDURE

4. Did the examinee read the "Examinee Instructions"?
   Yes_____ No_____

5. While grinding, did the examinee oscillate the drill so that heel was moved along the surface of the grinding wheel?
   Yes_____ No_____

6. Did the examinee hold the shank slightly lower than the point while grinding?
   Yes_____ No_____

7. Did the examinee alternate from flute to flute while grinding?
   Yes_____ No_____

8. Did the examinee grind one flute and then other?
   Yes_____ No_____

9. Did the examinee check the shank of the drill for bends and burns?
   Yes_____ No_____

EXHIBIT XXI (Cont'd)

MOVIE EVALUATION FORM (Cont'd)

10. Did the examinee secure the grinding wheel?
Yes_____ No_____

11. Did the examinee "police up" the work area when securing?
Yes_____ No_____

SAFETY PRECAUTIONS

12. Did the examinee wear eyeshields or goggles while grinding?
Yes_____ No_____

13. Did the examinee tap the grinding wheel or check it for cracks prior to its use?
Yes_____ No_____

14. Did the examinee wear loose clothing or clothing that could snag in the grinding wheel?
Yes_____ No_____

Name_____

Date_____

TABLE 8

Frequency of Self-Evaluations by Chief Structural Mechanics Who Acted as Test Administrators Placed in Each Category On the Basis of a Semi-Structured Interview (N=6)

1. How difficult did you find the tests to administer?

Very difficult	
Difficult	
Average	1
Easy	4
Very easy	1

2. How did you enjoy administering these tests?

Very unenjoyable	
Unenjoyable	
Average	2
Enjoyable	4
Very enjoyable	

9. Did you understand the language in the items?

Yes 5 No 1

10. What else should I have told you when I checked you out in the test administration?

More information wanted?

Yes 1 No 5

11. Were you a good test administrator?

Good	5
Mediocre	1
Poor	

TABLE 8 (Cont'd)

12*. Were you better than "A"?

Better	
About or as good	1
Poorer	4

13. Were the items too long, i.e., were you able to watch, read and write at the same time?

Able to watch and write	5
Unable to watch and write	1

17. Everyone who administers these tests feels a little shaky at first, but after a while they become quite confident. After how long were you confident?

1/2 Day	2
1 Day	3
2 Days	
3 Days	1
Over 3 Days	

19. Here is a list of the tests you administered.

Regarding the (welding) test:

a) Was its administration easy or hard? _____

	Administration Easy	Hard
Welding Test	6	0
Drill Grinding	5	1
Metal Working	5	1
Hydraulic Inspection	5	1
Fabrics	5	1
Hydraulic Repair	6	0

* One examiner could make no response to this item.

Consistency (Reliability) of the Test Administrators

In general the term "reliability" in test and measurements literature means "consistency". The fourth and last approach to examiner evaluation was in terms of the consistency of the chiefs who acted as test administrators.

In performance testing a test's unreliability can be broken down into several categories. An academic discussion of the conceptualization and categorization of all of the sources of unreliability is outside the scope of the present report. However, we were particularly concerned with the reliability of the tests and the reliability of the observations of the people who administered the tests. Of course, the reliability of the tests could not be high if the reliability of the observations of the people who administered them was low. In this section we will discuss our methods of investigating the reliability of the observations of our test administrators while a discussion of the reliability of the tests per se is left for consideration under our first general sub-purpose (Chapter VII). If the reliability of the test administrators was high, then we may make inferences as to the quality of the test administration.

Reliability of the Observations of the Chiefs Who Administered the Aviation Structural Mechanics' Battery at Atlantic City.

Two aspects of the reliability of the observations of the Chief Structural Mechanics who acted as test administrators were considered. It was our aim to answer two questions:

1. Were the scorings of different chiefs who scored the same performance test consistent with each other? (Inter-examiner reliability).

2. Were the scorings of a chief who scored, on two separate occasions, the same subject on exactly the same job performed in exactly the same manner consistent with each other; and were the scorings of a chief who scored the same end product on two separate occasions consistent with each other. (Intra-examiner reliability)

Inter-Examiner Reliability

It will be recalled that two chiefs separately but simultaneously scored each structural mechanic who took the Aviation Structural Mechanics' Battery at Atlantic City. Chief A scored all the examinees while each of Chiefs B, C, D, E, and F scored a portion of the total group. This provided a basis for comparison of the scorings of the two chiefs (A and one other) who simultaneously scored the same examinee. Precautions were taken to assure that the two chiefs did not compare their scorings and thus spuriously increase the inter-examiner reliability. The chiefs were instructed to neither communicate with each other during the test administration nor to talk over their scorings after they had administered a test. The presence of the researcher as an observer of the test administration served to enforce these instructions; no instances of direct collaboration were noticed by the observer. As a further assurance against collaboration, the scoring sheets were collected immediately after the chiefs had finished their scorings. Thus the chiefs were unable to change belatedly any estimates, even if they decided on the basis of post-facto cross-communication that they had erred.

An item tally was first made which compared Chief A's scoring for each item within a test with the scoring of the co-administrator who simultaneously scored the same examinee. The per-cent of agreement between the two examiners who tested each examinee is presented in Table 9. This type of consistency-discrepancy comparison is a more powerful test of reliability than the product-moment correlation. For instance, if in a given group of examinees, each co-examiner gave each examinee exactly the same total score a product-moment correlation of plus one would appear. Yet the two examiners may have been totally inconsistent in the items upon which they derived their total scores, and in this case their actual "consistency" would be 0.

TABLE 9

Percent of Agreement Between Observers for Each Subject Taking Each Test in Structural Mechanics' Battery (Atlantic City Sample)

Observers	Examinee	Fabrication of Rigid Tubing Assembly	Drill Point Grinding	Welding	Metal Working	Fabrics	Hydraulic Inspection	Mean Rows
	1	73.17	89.47	100.00	78.05	89.29	95.83	
A	2	70.73	94.74	84.85	95.12	92.86	100.00	
and	3	85.37	63.16	90.91	75.61	85.71	97.92	
B	4	100.00	89.47	78.79	65.85	96.43	97.92	
Mean 1 - 4		82.31	84.21	88.63	78.66	91.07	97.91	87.96
A	5	78.05	89.47	100.00	100.00	57.14	93.25	
and	6	87.80	47.37	72.73	73.17	89.29	95.83	
C	7	70.73	89.47	75.76	87.80	96.43	95.83	
Mean 5 - 7		78.86	75.43	82.83	86.98	80.95	94.97	83.33
	8	95.27	94.74	100.00	100.00	89.29	91.67	
A	9	75.61	84.21	75.76	95.12	85.71	95.83	
and	10	90.24	89.47	75.76	80.49	82.14	95.83	
D	11	95.27	73.68	78.79	90.24	89.29	95.83	
Mean 8 -11		89.09	85.52	82.57	91.46	86.60	94.79	88.33
	12	92.68	100.00	81.82	87.80	96.43	97.92	
A	13	82.93	94.74	93.94	95.12	78.57	84.09	
and	14	82.93	84.21	90.91	82.92	71.43	91.67	
E	15	82.93	73.68	84.85	90.24	82.14	91.67	
	16	73.17	94.74	100.00	97.56	92.86	97.92	
Mean 12-16		82.92	89.47	90.30	90.73	84.29	92.65	88.39
A	17	75.61	89.47	90.91	97.56	92.86	100.00	
and	18	92.68	100.00	69.70	78.05	78.57	97.92	
F	19	65.85	100.00	81.82	90.24	75.00	100.00	
Mean 17-19		78.04	96.49	80.81	88.62	82.14	99.30	87.56
Grand Mean Columns		83.24	86.22	85.02	88.49	85.01	95.92	

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Thus:

$$\% \text{ of observer agreement} = \frac{\text{number of items scored in same manner by simultaneous test administrators}}{\text{total number of items in test}} \times 100$$

Table 10 was derived from table 9. Table 10 indicates the percent of examiner agreements that fell in each of the class intervals indicated therein. Thus 49% of the examiner agreements in Table 9 fell between 90% and 100% while 26% of the examiner agreements fell between 80% and 89.9% and 19% of the agreements fell between 70% and 79.9% agreement. Three percent of the examiner agreements fell between 60% and 69.9%. If we think of the percentage of inter-examiner agreement in terms of a correlation coefficient, and if we accept an inter-examiner reliability coefficient of .80 as being acceptable, then the inter-examiner reliability in 112 out of 114 of the tests administered by the Chief Structural Mechanics is acceptable.

TABLE 10

Frequency and Percentage of Examiner Agreements Falling in Each of the Listed Class Intervals

Class Interval	Frequency	Percent
40% - 49.9%	1	1
50% - 59.9%	1	1
60% - 69.9%	4	3
70% - 79.9%	22	19
80% - 89.9%	30	26
90% - 100%	56	49

Moreover, the examiners in our sample did not show a trememdous spread of consistency. The means between rows, Table 9, (between-examiners) ranged from 83.33% agreement to 88.39% agreement. This is a high degree of stability and would represent a correlation coefficient of over .90. Mean consistency between columns (between-tests) Table 9 ranged from 83.24% to 95.92%. However, if we exclude the 30-hour hydraulic inspection from consideration the range for the other 5 tests was from 83.24% to 88.49% consistency. Why the consistency of examiners watching the 30-Hour Hydraulic Inspection Test should be greater than their consistency for the other tests is a matter of conjecture. This greater consistency for the 30-Hour Hydraulic Inspection Test is particularly surprising in view of the fact that the 30-Hour Hydraulic Inspection Test contained no "measurements of the precision of the final product". All of the other tests in the Structural Mechanics' Battery contained "measurements of the final product". Since "measurements of the precision of the final product" can be made at the examiner's leisure and since gauges or other measuring instruments can be employed to make these measurements, it is usually felt that scorings of measurements of the final product will yield greater examiner consistency than measurements of performance in process. This should have tended to raise the consistency percentages for the other tests over that of the 30-Hour Hydraulic Inspection Test.

In order to investigate the conjecture that measurements of the final product yield no greater consistency between examiners than observations of performance in process Tables 11 to 16 were prepared. In Tables 11 to 16 the percentage of consistency between simultaneous examiners for each section of the tests in the Aviation Structural Mechanics' Battery is presented. Thus:

$$\text{Inter-observer consistency within a test section} = \frac{\text{Number of items in a section scored in same manner by simultaneous observers}}{\text{Total number of items in section}} \times 100$$

TABLE 11

Percentage of Inter-Examiner Agreement for Sections of Rigid Tubing Assembly Test

		TEST SECTIONS			
Observers	Examinees	Care and Use of Tools (Items 1-4)	Procedure (Items 5-25)	Measurements of Final Product (Items 26-41)	Safety Precautions (No Items)
A and B	1 - 4	100.00	84.52	75.00	
A and C	5 - 7	100.00	80.95	70.83	
A and D	8 - 11	81.25	90.48	89.06	
A and E	12 - 16	90.00	74.29	92.50	
A and F	17 - 19	75.00	88.88	87.50	
Mean	1 - 19	89.25	83.82	82.98	

TABLE 12

Percentage of Inter-Examiner Agreement for Sections of Drill Point Grinding Test

		TEST SECTIONS			
Observers	Examinees	Care and Use of Tools (Items 1-3)	Procedure (Items 4-8)	Measurements of Final Product (Items 9-17)	Safety Precautions (Items 18-19)
A and B	1 - 4	66.66	90.00	83.33	100.00
A and C	5 - 7	77.77	60.00	85.19	83.33
A and D	8 - 11	91.66	90.00	77.77	100.00
A and E	12 - 16	66.66	88.00	95.55	100.00
A and F	17 - 19	100.00	100.00	92.59	100.00
Mean	1 - 19	85.55	85.60	86.89	96.66

TABLE 13

Percentage of Inter-Examiner Agreement for Sections of Metal Working Test

Observers	Examinees	TEST SECTIONS: Care and Use of Tools (Items 1-11)	Procedure (Items 12-25)	Measurements of Final Product (Items 26-37)	Safety (Items 38-40)
A and B	1 - 4	72.23	87.50	70.83	87.50
A and C	5 - 7	81.82	88.10	86.11	100.00
A and D	8 - 11	88.64	96.43	89.58	87.50
A and E	12 - 16	94.55	90.00	93.33	80.00
A and F	17 - 19	78.79	97.62	88.88	83.33
Mean	1 - 19	83.61	91.93	85.75	87.66

TABLE 14

Percentage of Inter-Examiner Agreement for Sections of 30-Hour Hydraulic Inspection Test

Observers	Examinees	TEST SECTIONS: Preparation for Inspection (Items 1-4)	Procedure (Items 5-39)	Measurements of Final Product (No Items)	Safety (Items 40-48)
A and B	1 - 4	100.00	97.86		97.22
A and C	5 - 7	83.33	95.24		96.30
A and D	8 - 11	100.00	95.71		88.88
A and E	12 - 16	90.00	94.29		97.77
A and F	17 - 19	100.00	99.05		100.00
Mean	1 - 19	94.67	96.43		96.03

TABLE 15

Percentage of Inter-Examiner Agreement for Sections of Aluminum Butt Welding Test

		TEST SECTIONS			
Observers	Examinees	Care and Use of Tools (Items 1-6)	Procedure (Items 7-17)	Measurements of Final Product (Items 18-27)	Safety (Items 28-33)
A and B	1 - 4	87.50	90.91	87.50	87.50
A and C	5 - 7	72.22	72.73	93.33	94.44
A and D	8 - 11	66.66	90.91	80.00	87.50
A and E	12 - 16	80.00	90.91	94.00	86.66
A and F	17 - 19	72.22	81.82	80.00	88.88
Mean	1 - 19	75.22	85.46	86.97	88.99

TABLE 16

Percentage of Inter-Examiner Agreement for Sections of Fabrics Test

		TEST SECTIONS			
Observers	Examinees	Care and Use of Tools (No Items)	Procedure (Items 1-9)	Measurements of Final Product (Items 10 - 25)	Safety (Items 26-28)
A and B	1 - 4		94.44	84.09	100.00
A and C	5 - 7		85.19	63.64	100.00
A and D	8 - 11		91.66	77.27	83.33
A and E	12 - 16		80.00	76.36	100.00
A and F	17 - 19		88.88	69.70	77.77
Mean	1 - 19		88.03	74.21	92.22

Tables 11 to 16 show no consistent trend indicating that the inter-examiner consistency in our samples of test administrators was greater for "measurements of the final product" than for measurements pertaining to areas for which "gauges" were not available. For two tests, the mean inter-examiner consistency was greater for all other measurements than it was for "measurements of the final product". The reason for the high inter-examiner reliability shown for observations of performance in process may be an outgrowth of the objectivity introduced into the item writing and the grossness of the observations called for in the observations of performance in process as compared with the observations called for in measuring adherence of the final product to prescribed dimensions. If we want to know if someone is dead or alive we can use a stethoscope, but if the man is moving around all observers will agree that he is alive without the use of the measuring instrument. Similarly, our observations of performance in process were gross enough and well defined enough so as to preclude the need for a stethoscope.

Thus the introduction of certain "non-objective" items into our measurements of performance in process does not seem to have exerted too large an effect on the inter-examiner consistency for these items.

Intra-Examiner Consistency (Reliability)

In reference to our tests for Aviation Structural Mechanics, on a logical basis, we separated intra-examiner reliability into two components: The first was the reliability of the scorings that the chiefs made on the basis of seeing a process performed. This included scorings based on those sections of our scoring sheets labeled: "Care and Use of Tools", "Procedure", and "Safety Precautions Followed". The second was the reliability of the scorings that the chiefs made on the adherence of end products produced by the examinees to the prescribed dimensions and standards. This included scorings based on those sections of our scoring sheets labeled: "Measurements of the Final Product".

Intra-Examiner Consistency for Measurements of Performance in Process

Ascertaining the intra-examiner reliability for performance in process is difficult since no one can possibly perform the same job in exactly the same manner on two separate occasions. The ideal situation for determining the consistency of an individual examiner is the situation in which the examinee's performance is held constant over two separate occasions and the examiner allowed to vary. Since the stimulus situation is then constant, any unreliability can then be attributed to variation within the examiner.

One method by means of which performance may be held constant is that of having the examiner score a motion picture of the examinee performing a job, rather than have the examiner score the actual live performance. The motion picture may be shown to the same examiner on two separate occasions. Thus the stimulus situation is held constant and any unreliability shown may be attributed to variation within the examiner. The assumptions of this method are that the motion picture situation presents the same stimulus configuration to the examiner as does the actual performance test situation and that the examiner scores the movie in the same manner as he would ordinarily score an actual performance test.

A further disadvantage is that motion pictures are difficult and expensive to produce. This is especially true for long, involved jobs. However in a partial attempt to ascertain intra-examiner reliability for performance in process, we made a movie of our Structural Mechanics' Drill Point Grinding Test.

The subject in the motion picture was an actual Aviation Structural Mechanic, and the action was unrehearsed. Thus, the film was as near to the actual test situation as possible. Although in taking the film, the cameras were not hidden, the cameras did not seem to effect the subject's behavior.

The film was first shown to a group consisting of the six Chief Structural Mechanics who acted as test administrators for our Aviation Structural Mechanics' Battery and two other Chief Structural Mechanics. On the second showing only five of the original eight were aboard. Two of the chiefs went to sea and one to the hospital during the interim. The interval between showings of the film was one month. One month is a sufficient time interval to allow for the forgetting of original responses.

The chiefs were asked to fill in the movie evaluation form shown in Exhibit XXI, during each showing. The movie evaluation form is based on the items found in the "Care and Use of Tools", "Procedure", and "Safety Precautions Followed" sections of our Drill Point Grinding Test. Sufficient light was allowed in the theatre so that the chiefs could fill in the blanks as the appropriate action was performed.

Results

The table below indicates the consistency of the observations of the structural mechanics who viewed on two separate occasions, the drill point grinding movie. It will be recalled that 8 Chief Structural Mechanics at Atlantic City saw the movie on its first showing and 5 on the second showing. Thus, only the consistencies of the men who were available for the two showings of the movie could be included when preparing the table below. This table, as our other tables, is based on a consistency comparison.

Intra-Examiner Consistency for Measurements of Performance in Process

Observer	A	B	D	L	M	Mean
Percent Consistency	85.6	71.4	100	64.3	92.8	82.8

The grand mean for intra-examiner consistency was 82.8% agreement on items relating to two observations of performance in process by five structural mechanics who viewed the same movie on two separate occasions. Of course, two of the men included in this sample did not actually administer any tests. However, in terms of backgrounds, these men did not seem significantly different from the chiefs who acted as test administrators. This 82.8% consistency would also be considered adequate if interpreted as correlation coefficients are usually interpreted. Of course, these intra-examiner reliability estimates are based on only one motion picture. The danger of generalization from one measure of the reliability of observations of performance in process to all observations of performance in process is self evident.

Consistency of Measurements of End Products

The intra-examiner reliability for measurements made on end products is somewhat easier to obtain. For performance tests which involve measurements of end products, all that is necessary is that the same examiner score the same end product on two separate occasions. In conformity with this design, the end products of our Aluminum Butt Welding Test, our Metal Working Test, and our Fabrics Test were submitted for re-scoring to the chief who originally scored them three to five weeks after the original scoring. The end products from the Fabrication of a Rigid Tubing Assembly Test could not be re-scored since it was necessary to destroy the tubing in order to restore the "mock-up" to its original condition for each succeeding examinee.

The consistency in terms of the percent of items scored in the same manner on each scoring for each test administrator and each subject is presented in Table 17. In determining consistency, a test administrator who allowed credit or no credit on an item on the first scoring was called consistent on that item if he scored the item in exactly the same manner on the re-scoring. Consistency was then:

$$\text{Intra-Examiner Reliability for End Product Measurements} = \frac{\text{Number of items referring to end product measurements scored in same manner on separate scorings of test}}{\text{Total number of items referring to end product measurements on test}} \times 100$$

The intra-examiner reliability in terms of percent of agreement of the chiefs on the two scorings is shown in Table 17.

It is interesting to note in Table 17 that Chief A, our standard examiner, showed the highest mean intra-examiner reliability for measurements of end products of any of the Chief Structural Mechanics who acted as test administrators. The mean intra-examiner reliability ranged from 70.83% to 97.22% agreement. The grand mean for intra-examiner reliability was 81.93% agreement. This percent of agreement would represent a correlation coefficient of around .90. A correlation coefficient of .90 would usually be considered adequate for this type of work. Here again, it is well to point out that an item comparison such as we performed is a more sensitive and powerful test of examiner consistency than the product-moment correlation.

TABLE 17

Intra-Examiner Consistencies in Percentages for Chief Structural Mechanics*

Examiner	Examinee	Metal Working	Welding	Fabrics	Mean Rows
	1	66.66	100.00	62.50	
	2	58.33	60.00	75.00	
B	3	75.00	100.00	68.75	
	4	83.33	80.00	93.15	
Mean 1 - 4		70.83	85.00	75.00	76.94
D***	10	83.33	60.00	87.50	
	11	66.66	100.00	62.50	
Mean 10-11		75.00	80.00	75.00	76.67
	12	91.67	**	93.75	
	13	83.33	80.00	81.25	
A	14	83.33	100.00	87.50	
	15	58.33	100.00	75.00	
	16	83.33	100.00	81.25	
Mean 12-16		80.00	95.00	86.25	87.08
	12	66.66	**	62.50	
	13	75.00	90.00	68.75	
E	14	83.33	100.00	56.25	
	15	83.33	100.00	93.75	
	16	75.00	100.00	87.50	
Mean 12-16		76.67	97.50	73.75	82.64
	17	100.00	80.00	93.75	
F	18	91.67	80.00	75.00	
	19	100.00	100.00	56.25	
Mean 17-19		97.22	86.67	75.00	86.30
Grand Mean		74.94	88.83	76.98	81.93

* Examiner C not available for re-scoring purposes.

** The end products of this examinee were misplaced in the interval between scoring and re-scoring.

*** Our examinees #9 and #10 actually were the last two men tested. The experiment was finished before a sufficient time had elapsed between the scoring and re-scoring of their end products. Since re-scoring these end products may have spuriously increased the intra-examiner reliability, the end products of examinees 9 and 10 were not re-scored.

It is also interesting to note that here, as with our inter-examiner reliability comparisons, the intra-examiner reliability for measurements of end products does not appear to be significantly greater than the intra-examiner reliability for measurements of performance in process.

CHAPTER VI

Second Field Test of Aerial Photographers' Battery Using Test Administrators Who Have Had Minimal Indoctrination Into Testing Practices -- Evaluation of the Test Administration

(PURPOSE VI)

In accordance with our sixth general purpose, the Aerial Photographers' Battery was taken to the Photographic Laboratory at the Naval Air Station, Atlantic City, for its second field test. The principal roles of this laboratory are to provide photographic support to the squadrons flying from that air station. This photographic support consists of making photographers available for squadron aerial photographic work, installation and service of gun cameras, map making, film processing, etc.. The photo-lab also performs the more routine types of photography such as public information work, identification photography, copying, etc.

The Test Administrators

Only two Chief Petty Officers were assigned to the photo-lab at Atlantic City. For our purposes, two test administrators were too few in number. Therefore, for the Aerial Photographers' Battery, it was decided to use test administrators who were in pay grades below that of Chief Petty Officer. The test administrators were four aerial photographers randomly chosen from the enlisted personnel at the photo-lab. One examiner (W) was constant throughout and administered the entire battery to the total group of examinees, while a portion of the total group was independently but simultaneously tested by one of the other test administrators (X, Y, or Z). This paralleled the test administrative paradigm for structural mechanics. The number of men to whom each test administrator administered the entire battery, together with the rates of the test administrators, is shown in Table 18.

TABLE 18

Number of Men Tested by Each Examiner and Rates of the Examiners for Aerial Photographers Who Acted as Test Administrators at Atlantic City

Examiner	Rate	Number of Men Tested
W	AF_3	15
X	AFAN	5
Y	AF_3	5
Z	AF_3	5

None of the examiners had previous experience in test administration or education per se. Examiner W had more formal schooling than any other examiner, either photographer or structural mechanic used in the present research. W completed two years of college, as a mathematics major, prior to his entry into the service and seemed genuinely interested in the research program and in its experimental nature. The remaining examiners seemed to be typical of the personnel found in the Aerial Photographers' rating.

Examiner Indoctrination

The indoctrination into testing for test administrators paralleled that of the Aviation Structural Mechanics. All test administrators were first given an over-view of our general research purpose and an over-view of the general uses of performance tests. After their questions were answered, they were dismissed. As with the structural mechanics, examiner W was then given 2½ hours of detailed instruction in test administrative pratices. The first part of the indoctrinative session was spent familiarizing examiner W with the tests in the Aerial Photographers' Battery. This took approximately one hour. Following this, the factors which may influence the results of a testing program were pointed out to W along with the methods for their control. Examiner W was then given test administration experience by practice administering two of the tests in the Aerial Photographers' Battery to a practice examinee, and his test administration was criticized.

Following this, W was asked if he cared to accept the responsibility for administering the testing program at the photo-lab and for indoctrinating the other personnel into test administrative practices. Since W was willing, the researcher withdrew at that point from active participation in the testing situation. From that time forward, the researcher answered questions as they were asked, but initiated no direct comments on testing procedures and methodology.

Subjects

The subjects were 15 Aerial Photographers, 3/c. This was the entire complement of Aerial Photographers in that pay grade at the photo-lab at NAS, Atlantic City. Since the Aerial Photographers' Battery was directed as an experimental hurdle for the rate of Aerial Photographer, second class, we attempted to limit our experimental population to those people who were as typical as possible of those who could eventually take the battery.

Test Not Administered

The photo-lab at Atlantic City was not equipped with a K-19B night aerial camera. Therefore, the Camera Installation Test was not administered at Atlantic City.

Test Results

The test scores for each subject as well as the test means, and test standard deviations are presented in Table 19. Also presented in Table 19 are the basic battery scores for the Aerial Photographers tested at Atlantic City.

TABLE 19

Test Scores, Means, Standard Deviations and Basic Battery Scores for Atlantic City Sample of Aerial Photographers

Subject	Motion Picture Processing	Camera Maintenance	Speed Graphic	Sonne Printing	Aerial Cameras	Records & Reports	Chemical Mixing	GCT	Ari.	Mech.	Cler.
1	0	0	67	69	48	81	45	72	74	67	66
2	0	0	66	78	63	39	48	55	53	60	52
3	87	30	72	0	48	66	54	70	73	63	52
4	0	0	63	72	48	0	57	68	60	53	52
5	0	0	40	63	45	54	51	65	57	54	58
6	60	0	55	0	45	0	60	47	34	47	46
7	0	0	51	51	42	66	39	59	60	59	54
8	0	0	61	90	51	42	51	55	59	64	54
9	0	0	54	0	51	0	39	59	53	39	59
10	0	0	71	0	48	51	48	59	67	65	53
11	87	0	74	72	63	82	63	67	68	63	50
12	0	0	12	63	42	63	63	64	62	60	48
13	0	0	49	54	42	69	45	64	57	61	47
14	96	0	75	0	54	0	60	58	53	68	54
15	0	0	83	0	33	0	48	66	62	59	72
Mean	22.00	2.00	59.93	40.80	48.20	40.87	55.07	61.87	59.47	58.80	54.47
Standard Deviation	6.78	7.48	16.85	33.44	7.48	4.79	7.62	6.45	9.39	7.52	6.75
Total Score Possible	132	45	94	111	75	129	84				

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Evaluation of Administration of Photographic Tests

One aspect of our sixth general purpose was an evaluation of the test administration of the Aerial Photographers who administered the Aerial Photographers' Battery. In accordance with this general purpose, "field observations" of the test administration of the aerial photographers who acted as test administrators were made and the Examiner Evaluation Form (Exhibit XIX) filled in. Semi-structured interviews, based upon Exhibit XX, were again held in an attempt to determine the examiner's self-evaluation of his test administration. The single asterisked items in Exhibit 20 were considered appropos for this purpose, and the same thinking that was considered pertinent for the Aviation Structural Mechanics who acted as test administrators again seemed to hold.

The four Aerial Photographers who acted as test administrators were interviewed accordingly and the interviewer was the same person who interviewed the Chief Aviation Structural Mechanics who served as test administrators.

Results from Examiner Evaluation Form

The Examiner Evaluation Form was filled in by the observer while 23 of the tests in the Aerial Photographers' Battery were being administered. These results are presented in Table 20. Examination of Table 20 indicates that here again our test administrators were strongest in the formal aspects of test administration such as the preparation, prior to the examinee's arrival, of the test materials and the equipment needed for testing, following prescribed directions for test administration, etc. This efficiency in the formal aspects of test administration may here again be an outgrowth of the situation we imposed on the test administrators. For instance, complete clip boards were supplied the Aerial Photographers who acted as test administrators as well as the Chief Structural Mechanics. Thus, the presence of the examiner's and examinee's instructions were almost forced into the test administrative situation. The tendency for the Aerial Photographers who acted as test administrators to rely slightly on their memories and to talk with others while administering the tests becomes apparent here as it did with the Chief Structural Mechanics who administered the Structural Mechanics' Battery.

TABLE 20

Per Cent of Behaviors Manifested by Aerial Photographers

When Administering the Aerial Photographers' Battery

(Number of Observations = 23)

EXAMINER EVALUATION FORM

1. WORK MATERIAL

A. All necessary tools and material prepared and ready prior to examinee's arrival. 87%

Some overlap between arrival of examinee and readiness of tools and material. 13%

No attempt to gather tools and material before the examinee arrives. 0%

2. TEST MATERIAL

A. Scoring sheets and examinee instructions prepared before arrival of examinee.

Yes 100% No 0%

B. Presence of timing device.

Yes 87% No 13%

C. Presence of examiner's instructions.

Yes 100% No 0%

D. Presence of extra pencils.

Yes 26% No 74%

3. FAMILIARITY WITH TEST

A. Completely familiar with procedure prescribed for administering test. 82%

Some unfamiliarity with prescribed procedures, but refers to examiner's directions and avoids errors. 9%

Unfamiliar with administration procedures. Makes errors in test administration. 9%

4. INSTRUCTIONS TO EXAMINEE

A. Answers examinee's questions patiently and tactfully. 100%

Is cold towards examinee and discourages questions. 0%

B. Checks to assure that examinee understands what he is to do before he starts.

Yes 65% No 35%

TABLE 20 (Cont'd)

4. INSTRUCTIONS TO EXAMINEE (Cont'd)

C. Follows standardized procedures when giving instructions.

Yes 100% No 0%

D. Answers examinee's questions on what to do by telling him how to do the job.

Yes 9% No 91%

5. SCORING

A. Quietly checks examinee as he works without interferring with work. 87%

Some interruptions and talk with examinee as he works. 13%

Considerable interruption, interference and disruption of examinee as he works. 0%

B. Checks required observations as work operation is performed. 87%

Relies to some extent on memory. Checks slightly behind operation. 13%

Completely relies on memory. Checks performance when test is finished. 0%

C. Pays complete attention to scoring. No talk with others. 87%

Some inattention or talk with others but not to the extent that it will interfere with scoring. 13%

Talk and/or "horseplay" with others to the extent that it interferes with scoring. 0%

D. Instructs and aids examinee during test.

Yes 0% No 100%

6. SECURING

A. Has examinee secure work station.

Yes 100% No 0%

B. Completely collects all test material. Leaves no "samples" around.

Yes 95% No 5%

Field Observations of the Test Administration

The structured observations seem to indicate a high level of competence for Aerial Photographers who acted as test administrators. However, to some extent the data from these structured observations were vitiated by several unstructured field observations. The Aerial Photographers were less adept at scheduling examinees and on several occasions needed an "assist" from the Institute researcher. Moreover, two of the examiners themselves were not familiar with some of the tasks contained in tests they were going to administer. Thus it was necessary to "check out" the examiners on the tasks before they could act as test administrators. It is probably certain that these unfamiliarities would have mitigated the effectiveness of these Aerial Photographers who acted as test administrators had these unfamiliarities not been ascertained and corrected. Some carelessness in regard to the security of the test materials was also noted on the part of the Aerial Photographers who acted as test administrators. Thus while the Aerial Photographers who held rates below that of Chief Petty Officer compared favorably with the Chief Structural Mechanics in our structured observations, certain other behavioral manifestations were noticed which must be considered when drawing conclusions about the competence of our Aerial Photographers below the rate of Chief Petty Officer as test administrators. In general, these field observations would serve to mitigate any unqualified endorsement of these Aerial Photographers as test administrators.

Results from Self Evaluation of Aerial Photographers

Table 21 was prepared on the basis of our third approach to examiner evaluation --- a self-evaluation as reflected in a semi-structured interview.

TABLE 21

Frequency of Examiner Self-Evaluations by Aerial Photographers Who Acted as Test Administrators Placed in Each Category on Basis of Semi-Structured Interview (N=4)

1. How difficult did you find the tests to administer?

Very difficult	____
Difficult	____
Average	____
Easy	3
Very Easy	1

2. How did you enjoy administering these tests?

Very unenjoyable	1
Unenjoyable	____
Average	1
Enjoyable	1
Very enjoyable	1

Did you understand the language in the items? Yes 4 No ____

10. What else should I have told you when I checked you out in the test administration?

More information wanted?

Yes 1 No 3

TABLE 21 (Cont'd)

11. Were you a good test administrator?

Good	2
Mediocre	2
Poor	

*12. Were you better than "W" ?

Better	
About or as good	
Poorer	3

13. Were the items too long, i.e., were you able to watch, read and write at the same time?

Able to watch and write	4
Unable to watch and write	

17. Everyone who administers these tests feels a little shaky at first, but after a while they become quite confident. After how long were you confident?

1/2 day	
1 day	3
2 days	1
3 days	
over 3 days	

19. Here is a list of the tests you administered.

Regarding the (speed graphic) test:

a) Was its administration easy or hard? _____

* One examiner could make no response to this item.

TABLE 21 (Cont'd)

19.	Administration Easy	Hard
Motion picture processing	2	2
Speed graphic	4	0
Records and reports	4	0
Camera maintenance	2	2
Use of Sonne machine	2	2
Aerial cameras	4	0
Laboratory processes	4	0

Table 21 indicates that the Aerial Photographers who acted as test administrators, on the whole, found the tests easy to administer (Item 1), in spite of their minimal indoctrination into testing practices and procedures. However, when probed regarding the specific tests (Item 19) some difficulties in test administration became manifest. As would be expected, those test administrators who were unfamiliar with a test task prior to their check-out on the task for testing purposes, found the test incorporating that task difficult to administer.

The Aerial Photographers who acted as test administrators expressed opinions all the way from very enjoyable to very unenjoyable when asked how they enjoyed administering the tests (Item 2). The test administrators understood the language in the tests and by and large seemed to think that they were given sufficient information in their minimal indoctrination into test administration. All the test administrators thought themselves to be "good" test administrators although none of them thought he was better than "W", our standard (Items 11 and 12). This self-evaluation on the part of the test administrators tends to support the structured observations noted in the Examiner Evaluation Form as well as the unstructured field observations. The test administrators were able to watch, read and write at the same time (Item 13). After one day at test administration, the majority felt confident in their test administrative ability (Item 19). In general, these data indicate that the Aerial Photographers who acted as test administrators did not find the performance check lists in our Aerial Photographers' Battery difficult to administer, handle, or understand. This administrative ease is in conformity with the data presented for the Aviation Structural Mechanics' Battery.

Consistency (Reliability) of the Observations of the Aerial Photographers who Acted as Test Administrators at Atlantic City.

As with the Chief Structural Mechanics, we were interested in the inter-examiner reliability and the intra-examiner reliability of the Aerial Photographers who acted as test administrators during the second field test of our Aerial Photographers' Battery. It was possible to compare agreement of examiner W's scores with those of examiners (X, Y and Z). The same controls over collaboration and answer changing that were instituted for the Structural Mechanics were also instituted in the case of the Aerial Photographers' Battery who acted as test administrators.

TABLE 22

Percent of Agreement Between Observers for Each Subject Taking Each Test in Aerial Photographers' Battery

(Atlantic City Sample)

Observers	Examinee	Motion Picture Processing	Speed Graphic	Sonne Printer	Aerial Cameras	Records and Reports	Chemical Mixing	Mean Rows
W	1	100.00	64.79	75.68	84.00	87.80	82.14	
	2	100.00	78.57	75.68	80.00	87.80	75.00	
and	3	75.00	64.29	100.00	92.00	92.68	82.14	
	4	100.00	80.95	83.78	84.00	100.00	78.57	
X	5	100.00	73.81	83.78	92.00	85.37	78.57	
Mean 1 - 5		95	72.38	83.78	86.40	90.73	79.28	84.59
W	6	79.55	92.86	100.00	88.00	100.00	85.71	
	7	100.00	83.33	94.59	84.00	90.24	75.00	
and	8	100.00	92.86	91.89	72.00	100.00	96.82	
	9	100.00	83.33	100.00	88.00	100.00	82.14	
Y	10	100.00	88.10	100.00	80.00	92.68	89.29	
Mean 6 - 10		95.91	88.09	97.29	82.40	96.58	85.00	90.88
W	11	79.55	88.10	91.89	92.00	85.37	75.00	
	12	100.00	73.83	72.97	84.00	87.80	96.43	
and	13	100.00	97.62	86.49	80.00	92.68	89.29	
	14	97.73	88.10	100.00	96.00	100.00	100.00	
Z	15	100.00	92.86	100.00	80.00	100.00	85.71	
Mean 11 - 15		95.46	88.09	90.27	86.40	93.17	84.28	90.44
Grand Mean Columns		95.46	83.19	90.45	85.06	93.49	84.52	

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A comparison between each item simultaneously scored by two examiners was first made. The results of this comparison in terms of the percent of unit agreement between observers for each man on each test is presented in Table 22.

In constructing Table 22, comparisons on the basis of the Camera Maintenance Test were omitted due to the fact that 14 out of 15 of our examinees at Atlantic City were completely unable to perform this task. The table below indicates the percent of the examiner agreements in Table 22 which fell into each of the indicated class intervals.

Frequency and Percent of Examiner Agreements Falling in Each of the Listed Class Intervals

Class Interval	Frequency	Percent
50 - 59.9%	0	0
60 - 69.9%	2	2
70 - 79.9%	15	17
80 - 89.9%	31	34
90 - 100%	42	47

As with the structural mechanics the between rows mean percentages (between examiners, Table 22) did not vary greatly. Two of the mean percentages between rows fell at 90% and one at 84%, with a grand mean of 88.70%. If stated in terms of correlation coefficient, these mean inter-examiner agreement percentages would represent a coefficient of over .90. If the individual test agreements are considered, 98% of them fall above 69.9% agreement. At 70% agreement, a correlation coefficient of about .84 would be represented. All of the previous would seem to indicate that the agreement between examiners on the Aerial Photographers' Battery was adequate.

Let us next consider the inter-examiner agreement between tests (between columns, Table 22). The grand means between columns in Table 22 ranged from 83.19% agreement to 95.46% agreement. On the basis of Table 22 there appears to be no apparent greater inter-examiner consistency for those tests in the Aerial Photographers' Battery which include only "measurements of performance in process" than for those tests which include these measurements plus "measurements of the final product". For the structural mechanics we found no lower consistency for tests including only measurements of performance in process. Tables 23 to 28 were prepared in order to more systematically investigate the consistency between observers for different sections of the Aerial Photographers' Battery. Tables 23 to 28 indicate the percentage of consistency between simultaneous examiners for each section of the tests in the Aerial Photographers' Battery.

TABLE 23

Percentage of Examiner Agreement for Sections of Motion Picture Processing Test

		TEST SECTION		
Observers	Examinees	Care of Equipment - Safety Precautions (Items 1 - 4)	Procedure (Items 10-38)	Measurement of Final Product (Items 39 - 44)
W and X	1 - 5	93.33	95.49	93.33
W and Y	6 - 10	97.78	94.41	96.67
W and Z	11 - 15	93.33	96.57	93.33
Mean	1 - 15	94.81	95.49	94.44

TABLE 24

Percentage of Examiner Agreements for Sections Of Speed Graphic Test

Observers	Examinees	TEST SECTION: Care of Equipment - Safety Precautions (Items 1 - 8)	Procedure (Items 9 - 16)	Measurements of Final Product (Items 17-42)
W and X	1 - 5	85.00	82.50	66.38
W and Y	6 - 10	77.50	90.00	90.77
W and Z	11 - 15	82.80	87.50	90.00
Mean	1 - 15	81.67	86.67	82.05

TABLE 25

Percentage of Examiner Agreements for Sections of Sonne Printing Test

Observers	Examinees	TEST SECTION: Care of Equipment - Safety Precautions (Items 1 - 11)	Procedure (Items 12- 33)	Measurement of Final Product (Items 34-37)
W and X	1 - 5	76.36	90.91	65.00
W and Y	6 - 10	94.55	98.18	100.00
W and Z	11 - 15	87.27	98.18	95.00
Mean	1 - 15	86.06	95.76	86.67

TABLE 26

Percentage of Examiner Agreement for Sections Of Aerial Camera Test

		TEST SECTIONS		
Observer	Examinee	Care of Equipment - Safety Precautions (Items 1 - 7)	Procedures (Items 8 - 25)	Measurement of Final Product (No Items)
W and X	1 - 5	80.00	91.07	
W and Y	6 - 10	85.71	86.07	
W and Z	11 - 15	82.86	96.78	
Mean	1 - 15	82.86	91.27	

TABLE 27

Percentage of Examiner Agreement for Sections of Records and Reports Test

		TEST SECTIONS		
Observer	Examinee	Care of Equipment - Safety Precautions (No Items)	Procedure (No Items)	Measurement of Final Product (Items 1 - 4)
W and X	1 - 5			90.74
W and Y	6 - 10			97.09
W and Z	11 - 15			92.91
Mean	1 - 15			93.58

TABLE 28

Percentage of Examiner Agreements for Sections of Chemical Mixing Test*

Observers	Examinees	TEST SECTION: Care of Equipment - Safety Precautions (Items 1 - 10)	TEST SECTION: Procedure (Items 5 - 28)	TEST SECTION: Measurements of Final Product (No Items)
W and X	1 - 5	74.00	84.29	
W and Y	6 - 10	80.00	88.57	
W and Z	11 - 15	86.00	88.57	
Mean	1 - 15	80.00	87.14	

* Items relating to use of literature omitted from consistency comparison.

Tables 23 to 28 indicate no superiority in consistency for "measurements of the final product" as compared to consistency for measurements of performance in process. These data are in agreement with the consistency comparisons made for the sections of the Aviation Structural Mechanics' Battery and the principle of grossness of observations involved might again serve as an explanatory principle. The high consistency between examiners for the Records and Reports Test is of interest because it was in this test that we tried to introduce an objective method of scoring an essay type examination (Exhibits XIII and XIV). These data would seem to indicate that scoring performance examinations of the essay type with a "gauge" such as we provided is acceptable if considered from the point of view of consistency of scoring between observers.

Intra-Examiner Reliability

Due to limitations of time and facilities no movie was made of any of our aerial photographic tests.

Data on the intra-examiner reliability for measurements of the final products produced by the aerial photographers was obtained however. The end products from our aerial photographers' tests which involved measurements of the final products, - the Records and Reports test and the Speed Graphic test, - were re-scored approximately one month later by the same examiners who originally scored them.. These data are presented in Table 29.

TABLE 29

Intra-Examiner Consistencies in Percentages For Chief Structural Mechanics

Observer	Examinees	TEST: Speed Graphic	TEST: Records and Reports	Mean
	1	88.46	87.80	
	2	76.92	92.68	
X	3	69.23	90.24	
	4	73.08	*	
	5	69.23	100.00	
Mean 1 - 5		75.38	92.68	84.03
	6	69.23	100.00	
	7	84.62	97.56	
Y	8	100.00	97.56	
	9	92.31	100.00	
	10	92.31	100.00	
Mean 6 - 10		87.69	99.02	93.36
	11	84.62	87.80	
	12	100.00	80.49	
W	13	88.46	80.49	
	14	76.92	100.00	
	15	73.08	100.00	
Mean 11 - 15		84.62	87.76	87.19
	11	84.62	92.68	
	12	100.00	95.12	
Z	13	92.31	82.93	
	14	88.46	100.00	
	15	100.00	100.00	
Mean 11 - 15		93.08	94.15	93.62
Grand Mean		85.19	93.40	89.29

* This end product was misplaced in the interval between original scoring and re-scoring.

The mean intra-examiner consistencies for "measurements of the final product" by the Aerial Photographers who acted as test administrators ranged from 75.38% consistency to 99.02% consistency for item agreement between two separate scorings of the same end product by the same observer. The grand mean consistency was 89.29%. If this grand mean percentage was to be converted into a correlation coefficient it would represent a correlation coefficient well over .90. A correlation coefficient of this magnitude would usually be considered as adequate.

General Discussion

By necessity, our presentation of our evaluation of the test administration of the Chief Structural Mechanics and Aerial Photographers has been separate. However, the salient points can be quickly summarized. The Chief Structural Mechanics at Memphis who rendered technical advice and assistance during the development of the tests as well as the Chief Structural Mechanics at Atlantic City, who had minimal indoctrination into testing procedures acted at a high level of competence. This statement regarding competence is supported by the field observations at Memphis and Atlantic City as well as the data pertaining to inter-examiner reliability, intra-examiner reliability, and examiner self-evaluation at Atlantic City.

The field observations at Pensacola also indicated a high level of competence at test administration for the Chief Aerial Photographers who acted as test administrators and who acted as technical consultants during the development of the Aerial Photographers' Battery. The data pertaining to inter-examiner reliability, intra-examiner reliability for measurements made on end products, and examiner self-evaluations tended to support a contention in favor of a high level of competence in the test administration of the Aerial Photographers below the rate of Chief Petty Officer who acted as test administrators at Atlantic City. However, certain field observations of these Aerial Photographers who acted as test administrators were such as to mitigate a statement in terms of a high level of competence for these men.

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DEVELOPMENT OF PRACTICAL PERFORMANCE MEASURES

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VOLUME I I

Prepared for

Personnel Analysis Division — **Psychological Sciences Division**

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By

Arthur Siegel

Douglas Courtney

INSTITUTE FOR RESEARCH IN HUMAN RELATIONS

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DEVELOPMENT OF PRACTICAL PERFORMANCE MEASURES

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Arthur Siegel, Research Associate

and

Douglas Courtney, Program Director

July 1, 1953

CHAPTER VII

The Validity, Reliability, and Discriminating Power of the Structural Mechanics' and Aerial Photographers' Batteries

(SUBPURPOSE a)

Our first general subpurpose was to evaluate the validity, reliability, and discriminating power of the tests in the Structural Mechanics' and Aerial Photographers' Batteries.

Validity of the Structural Mechanics' Tests

The concept of validity in regard to performance tests is difficult to apply. The so-called validity of a test answers the question; "to what extent does this test measure what it is being used to measure?" Two types of validity are usually considered; face validity and empirical validity. In stating the empirical validity of a test, an estimate of the extent to which a test measures what it is being used to measure is customarily given in the form of a correlation coefficient. This coefficient is derived by correlating test results with some measure of on-the-job proficiency, the criterion. Sometimes the criterion consists of an estimate of on-the-job proficiency such as ratings by supervisors. Criteria of this type are called "intermediate" criteria, since they lack complete communality with what we are trying to predict -- i.e., the actual job or "ultimate" criterion. After all, we are interested in how well a man actually does his job, and not in how well someone says he does it. Thus, the best criterion is the job itself or a job sample. This is exactly what our Structural Mechanics' Battery was -- a job sample. Thus our tests and the criterion are identical. The criterion has become our test, and an empirical estimate of validity is difficult. Of course, the extent to which this assumption of identity holds is dependent upon the communality between our performance battery and the actual working characteristics of the Aviation Structural Mechanics' rating. The steps taken to maximize communality have been previously described.

To correlate the ultimate criterion with something lesser, such as rating scales, would be working backwards. Thus, in the case of our performance tests, the only validity with which we were able to be concerned was face validity. This argument favoring face validity is particularly appropos if we approach validity from the point of view of "valid for what?" rather than from the usual approach. According to Thorndike (5), face validity is "that quality in a test which makes it appear sensible for the use to which it is being put". This includes sensibleness of the test to the subjects, or, in our case, the Aviation Structural Mechanics who were tested; and sensibleness to the chiefs who ultimately will decide whether they really want to support a program of performance testing in the Naval service.

We decided to approach face validity from both of the above mentioned points of view: e.g. did the tests appear sensible to the chiefs who administered them? and did the tests appear sensible to the Structural Mechanics who took them?

Acceptability of the Tests to the Chief Aviation Structural Mechanics

We deliberately included in our interview with the chiefs (Exhibit XXI), items which probed into the face validity of the battery and the face validity of the individual tests. The following items, which are preceded by two asterisks in Exhibit XX, were designed to determine this type of validity:

7. What could we do to improve these tests?

8. What could we do to improve the scoring?

9. Were the items too detailed?

10. Were the items too general?

11. What else should have been on the scoring sheets?

15. Do you think these tests separate good AMs from poor AMs?

16. Do you consider this to be a practical way for checking men out on "practical factors" for advancement in rating in your squadron?

18. Would you be willing to go to sea with men selected on the basis of these tests?

19. Here is a list of the tests you administered: regarding the (Welding) test:

b) Do you think that this is a practical way to check men out on (welding)?

c) If you were in charge of the (shop) would you be willing to assign men to (welding) after having seen them complete this (welding) test?

Repeat b and c above for remaining tests and enter the data on the following page:

Items 7 and 8 were based on the assumption that tests which the chiefs felt needed improvement were not entirely acceptable to the chiefs. Items 9 and 10 were based on the assumption that items which the chiefs found to be too general or too specific were not acceptable to the chiefs. The reasoning underlying the remaining items is self evident. It is well, at this juncture, to point out again that the interview was of the semi-structured nature. The items merely served as guide-posts for areas in which the interviewer was asked to make a judgment. Thus, the wordings of the questions varied. The emphasis was upon the interviewer deriving an estimate which maximally reflected the real points of view of the Chief Structural Mechanics who acted as test administrators in the prescribed areas, rather than upon strict standardization.

The six chiefs who acted as test administrators for the Aviation Structural Mechanics were so interviewed.

Interview Results

The replies of the chiefs interviewed in terms of frequency of response categorized into each of the indicated classifications, are presented in Table 30.

Table 30 indicates that by and large the tests in the Aviation Structural Mechanics' Battery were acceptable to the chiefs who administered them. Although some of the chiefs felt that the tests could be improved in one way or another, the chiefs were unanimous in their belief that the tests separated good structural mechanics from poor ones. All of the chiefs interviewed considered the tests as being a practical method for checking a man out on his "practical-

factors" for advancement in rating and the large majority felt that the tests presented a practical way to "check a man out" on his ability to perform a specific task. This favorable reaction on the part of the chiefs to the use of performance tests as a "check out" for a specific task, has important implications in the use of performance tests for selection and placement purposes. Moreover, all the chiefs expressed a willingness to go to sea with men selected on the basis of performance measures. All of this would seem to indicate that the tests in our Aviation Structural Mechanics' Battery were acceptable to the men who administered them.

TABLE 30

Frequency of Response Pertaining to Acceptability of the Aviation Structural Mechanics' Battery to the Chiefs Who Administered the Battery

INTERVIEWER'S RECORD FORM

7. What could we do to improve these tests?

No improvement needed	2
Improve content	2
Improve method of administration	1
Improve method of scoring	1

8. What could we do to improve the scoring?

No improvement needed	4
Improvement needed	2

9. Were the items too detailed?

Yes	0
No	6

10. Were the items too general?

Yes	1
No	5

11. What else should have been on the scoring sheet?

Nothing else needed	5
Something else needed	1

15. Do you think these tests separate good from poor (AM's)?

Discriminate well	6
Discriminate fairly well	0
Don't discriminate	0

16. Do you consider this to be a practical way for checking men out on "practical factors" for advancement in rating in your squadron?

Highly practical	3
Practical	3
Impractical	0

TABLE 30 (Cont'd.)

INTERVIEWER'S RECORD FORM (Cont'd.)

18. Would you be willing to go to sea with men selected on the basis of these tests?

Yes	6
No	0

19. b. Do you think that this is a practical way to check men out on welding?

	Practical	Impractical
Welding	5	1
Drill Grinding	6	0
Metal Working	6	0
Hydraulic Inspection	5	1
Rigid Tubing Replacement	6	0
Fabrics	6	0

c. Would you be willing to accept men into your shop on the basis of a test such as this?

	Accept men on basis of	Not accept men on basis of
Welding	5	1
Drill Grinding	6	0
Metal Working	6	0
Hydraulic Inspection	6	0
Rigid Tubing Replacement	6	0
Fabrics	5	1

Face Validity of the Tests From the Points of View of the Structural Mechanics Who Were Tested

Our second approach to face validity was from the point of view of the enlisted personnel who took the tests. In order to elicit the opinions of the enlisted personnel who took the Structural Mechanics' Battery on the face validity of the tests, the AM Opinion Questionnaire, shown in Exhibit XXII was administered to the 15 structural mechanics who took the Structural Mechanics' Battery at NAS, Atlantic City. Before the AM Opinion Questionnaire was administered, the usual assurances of our intentions to keep the opinions of the men confidential, were given. The men were also told that they were not required to sign their names to the questionnaires if they did not want to.

EXHIBIT XXII

Sample AM Opinion Questionnaire

AM OPINION QUESTIONNAIRE

You have just taken a series of eight tests. You took a welding test, a plastics test, a fabric repair test, a hydraulic inspection test, a tube fitting test, and a drill point grinding test. You also fabricated a flush patch. The Institute for Research in Human Relations, a private, non-government agency, is conducting research on these tests. We would appreciate your opinions on them and ask your cooperation in filling in these forms. Of course, your answers will be held in strict confidence. They will become and remain the property of the Institute.

NAME_____ DATE_____

SERVICE NUMBER_____ RATE_____

1. We would like your general, overall opinion on these tests.

   a. In general, did you enjoy taking these tests more than you would written tests? Yes___ No___

   b. Do you think that tests like these separate the men from the boys? Yes___ No___

   c. Would you rather take tests for advancement in rating like these, than written tests? Yes___ No___

   d. In general, do you think that tests like these in which you must do something, rather than write, are fair? Yes___ No___

   e. In general, do you think that these tests were too hard? Yes___ No___

   f. Do you think that you learned what you don't know as well as what you know from taking these tests? Yes___ No___

   g. In general, would you say that these tests need improvement? Yes___ No___

2. In each column, place a check along side the two words which you feel most adequately describe your feelings about the test named at the top of the column. You may want to use more than two checks, but you are limited to only <u>two</u>: So check the <u>two</u> which most adequately describe your feelings:

	WELDING	TUBE	FITTING	FABRICS	HYDRAULIC INSPECTION	DRILL	GRINDING	FLUSH	PATCH
Fair	___	___	___	___	___	___	___	___	___
Hard	___	___	___	___	___	___	___	___	___
Easy	___	___	___	___	___	___	___	___	___
Stupid	___	___	___	___	___	___	___	___	___
Right on	___	___	___	___	___	___	___	___	___
Unfair	___	___	___	___	___	___	___	___	___
Bad	___	___	___	___	___	___	___	___	___
Out of bounds	___	___	___	___	___	___	___	___	___
Good	___	___	___	___	___	___	___	___	___
Common sense	___	___	___	___	___	___	___	___	___

Results From Administration of AM Opinion Questionnaire

The results of this administration of the AM Opinion Questionnaire are presented in Table 31.

On the basis of the replies to items 1 a through 1 f (Table 31) of the AM Opinion Questionnaire, we may infer that the tests in the Structural Mechanics' Battery were acceptable to the majority of the men who took them. Item 2 also supports this contention. When asked to check two adjectives which most adequately described their feelings about each test, "fair", "easy", and "good" were most often checked by the structural mechanics and "bad", "out of bounds", and "stupid" least often checked. The responses to item 1 f, "In general, would you say that these tests need improvement?", is in conflict with these data. Conversations with the Structural Mechanics indicated that item 1 f was misinterpreted by the majority of the men and that this misunderstanding was causal in the inversion of the results pertaining to item 1 f.

TABLE 31

Percentage of Responses Falling into Each Category on AM Opinion Questionnaire (N = 18)

1. We would like your general, overall opinion on these tests.

a.	In general, did you enjoy taking these tests more than you would written tests?	Yes 88.9 No 11.1
b.	Do you think that tests like these separate the men from the boys?	Yes 55.6 No 44.4
c.	Would you rather take tests for advancement in rating like these, than written tests?	Yes 88.9 No 11.1
d.	In general, do you think that tests like these in which you must do something, rather than write, are fair?	Yes 94.4 No 5.6
e.	In general, do you think that these tests were too hard?	Yes 5.6 No 94.4
f.	Do you think that you learned what you don't know as well as what you know from taking these tests?	Yes 77.8 No 22.2
g.	In general, would you say that these tests need improvement?	Yes 88.9 No 11.1

2. In each column, place a check along side the two words which you feel most adequately describe your feelings about the test named at the top of the column. You may want to use more than two checks, but you are limited to only two: So check the two which most adequately describe your feelings:

	WELDING	TUBE	FITTING	FABRICS	HYDRAULIC	INSPECTION	DRILLING	GRINDING	FLUSH	PATCH	MEAN	ROWS
Fair	25.0	19.4	25.0	22.2	27.8	38.8	26.4					
Hard	22.2	0	0	0	16.6	5.6	7.4					
Easy	2.8	41.7	13.9	16.7	11.1	5.6	15.3					
Stupid	0	0	2.8	0	0	2.8	.9					
Right on	2.8	0	2.8	8.3	2.8	2.8	3.2					
Unfair	11.1	5.6	2.8	0	5.6	0	4.2					
Bad	0	0	0	0	0	0	0.0					
Out of bounds	8.3	0	2.8	0	8.3	2.8	3.7					
Good	16.7	19.4	33.3	19.4	22.2	30.5	23.6					
Common Sense	11.1	13.9	16.7	33.3	5.6	11.1	15.3					
Sum	100.0	100.0	100.1	99.9	100.1	100.0	100.0					

Reliability of the Structural Mechanics' Tests

In previous sections we discussed our rationale and methods for obtaining the reliability of the observations of the people who acted as test administrators. We mentioned that examiner reliability may be considered separately from test reliability although the two were not mutually exclusive. That is, if observer reliability was low, then test reliability could not be high.

There are certain problems inherent in obtaining the reliability of a test. In brief, there is no such thing as "the" reliability. Just as in determining the validity of a test we asked, "Validity for what?", so too, the determination of a test's reliability is a rational problem as well as a statistical one. In determining the reliability of a test, one of three procedures is commonly used. These procedures include: 1) administering equivalent forms of a test on two different occasions, or administering the same test on two different occasions and measuring the consistency of the results among the two administrations. 2) Artificially splitting the test in some manner and measuring the consistency of the scores of same subjects on the two test halves. 3) Estimating reliability on the basis of an analysis of variance among single items.

The equivalent-form method of estimating reliability is difficult to apply in performance testing due to the relative impossibility of finding test tasks and items that are equivalent in terms of difficulty and skills involved. Moreover, if the two tasks are really equivalent, the performance of the initial task may induce a certain amount of learning. Consequently, the individual is not the same person for the second administration of the test that he was for the first administration. Thus, it is difficult to state whether any unreliability shown is a function of the test or a function of a change in the examinee.

Determining the reliability of performance tests by way of the test-retest method does not bypass unreliability introduced into the situation as a result of learning during the original testing. However, it does obviate the difficulty of finding equivalent test tasks and items. When working in an operational military situation, a further difficulty in working with the test-retest method is that of freeing subjects from their military duties for periods of time on two separate occasions.

In regard to split-half methods of determining the reliability of performance tests, the principal objection seems to be that this method tends to produce spuriously high reliabilities. Since only one test administration takes place, day-to-day variations tend to be distributed equally over both parts of the test. Thus, unreliability is spuriously converted into, and considered as, reliability.

All methods of estimating reliability on the basis of an analysis of variance among the separate test items (and also the Kuder-Richardson method) make the assumption of homogeneity of test items. This means that these methods are applicable only if we meet the assumption that all the items in a test measure the same function. The assumption of homogeneity of test items does not hold for our performance tests.

We felt that the most meaningful reliability for our performance test was test-retest reliability. Test-retest reliability is not only the most meaningful type of reliability, but also is based on the fewest assumptions. If the test tasks are of such a nature that little or no learning takes place during one performance of the task, and if a time interval is allowed for the forgetting of original responses, then test-retest reliability is the most indicative.

With this in mind, those tests in the Aviation Structural Mechanics' Battery which seemed to involve a minimum of learning during the original administration were re-administered to 12 of the subjects who originally took them. Chief A acted as test administrator for this second administration and the period between the original test and the re-test, was three to five weeks. The tests which were re-administered were the Drill Point Grinding Test and the Aluminum Butt Weld.

Test-Retest Reliability - Results

Rank difference correlations were calculated between examinees' scores for each test session. For the Drill Point Grinding Test the rank difference correlation was .68 while for the Aluminum Butt Welding Test the rank difference correlation was .50. These reliability coefficients are only moderately high as compared with those usually considered adequate for written tests. However, since examiner unreliability is higher in performance tests than in written tests, part of the unreliability of these two performance tests may

be attributed to examiner unreliability. With better examiner training, a higher examiner reliability might be produced and this increase in examiner reliability might result in an increase in test-retest reliability. Moreover, it is probable that the amount of learning that an examinee derives from the first administration of a performance measure is greater than the learning derived from the first administration of a written examination, and if this is so, then we cannot expect test-retest reliabilities to be as high for performance tests as they are for written examinations.

Discriminating Power of the Aviation Structural Mechanics' Battery

Our first general subpurpose also included an evaluation of our test in terms of their discriminating power. By discriminating power we mean:

1. The ability of tests to separate or spread men along a scoring continuum.

2. The ability of the tests to distinguish between groups of men.

In order to visualize the ability of the tests in the Aviation Structural Mechanics' Battery to spread men along a scoring continuum, the histograms in Figures 7 to 14 were prepared. In preparing Figures 7 to 14 the scores on those tests which were administered to both the groups in our sample were combined. For those tests which were administered to only one group, the polygon was drawn on the basis of the scores in that group. Figures 7 to 14 indicate adequate spread for all the tests. However, the distribution of scores for the 30-Hour Hydraulic Inspection, shows a piling up of test scores at the high end of the scale. This piling up would not be the type of distribution normally considered adequate for testing purposes. Considering the small number of scores involved in Figures 7 to 14, it is probable that some of the unevenness seen in a few of these distributions would be smoothed out if the tests were applied to a larger group of subjects. However, the distributions for the Fabrics Test, the Drill Point Grinding Test, and the Rigid Tubing Assembly Test, start to appear bell shaped even with the limited number of men tested. A suitable cutting point could be easily superimposed on any of the plots presented in Figures 7 to 14 if we had been actually confronted with the task of passing or failing the men on a given test.

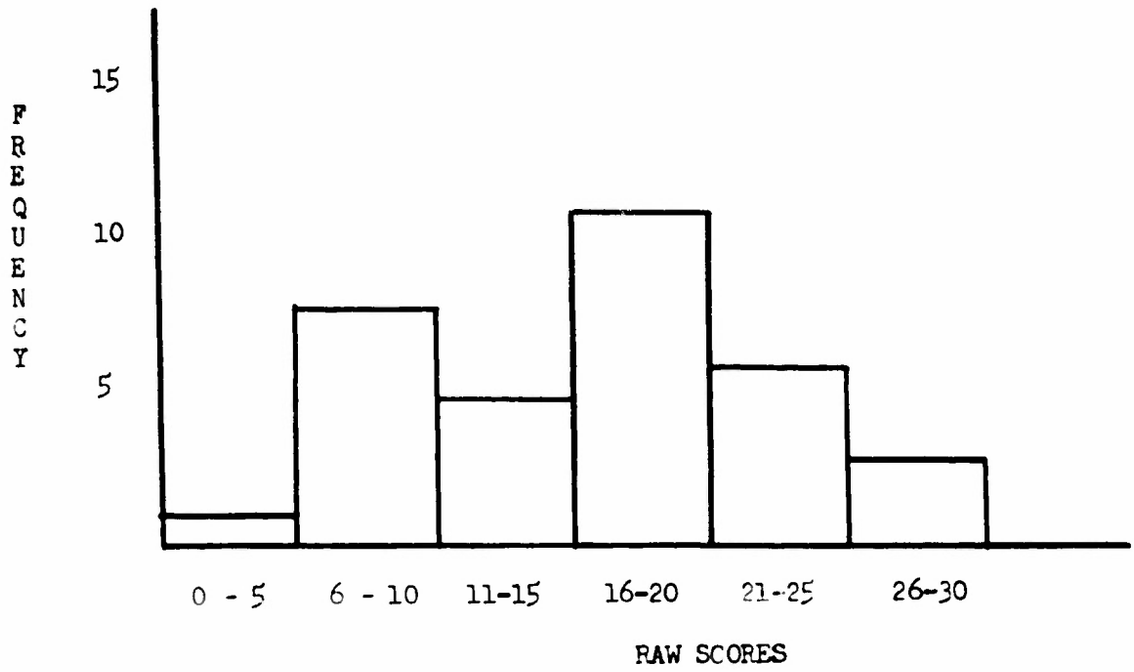


Fig. 7 Histogram for Drill Point Grinding Test

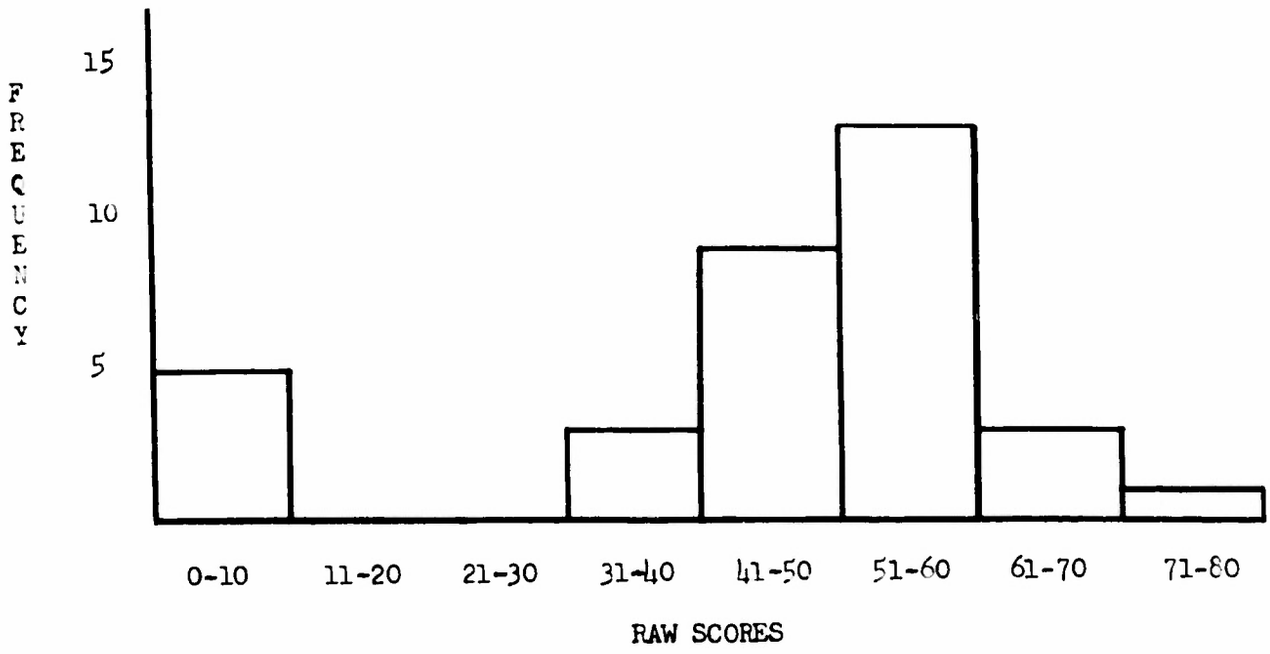


Fig. 8 Histogram for Rigid Tubing Assembly Test

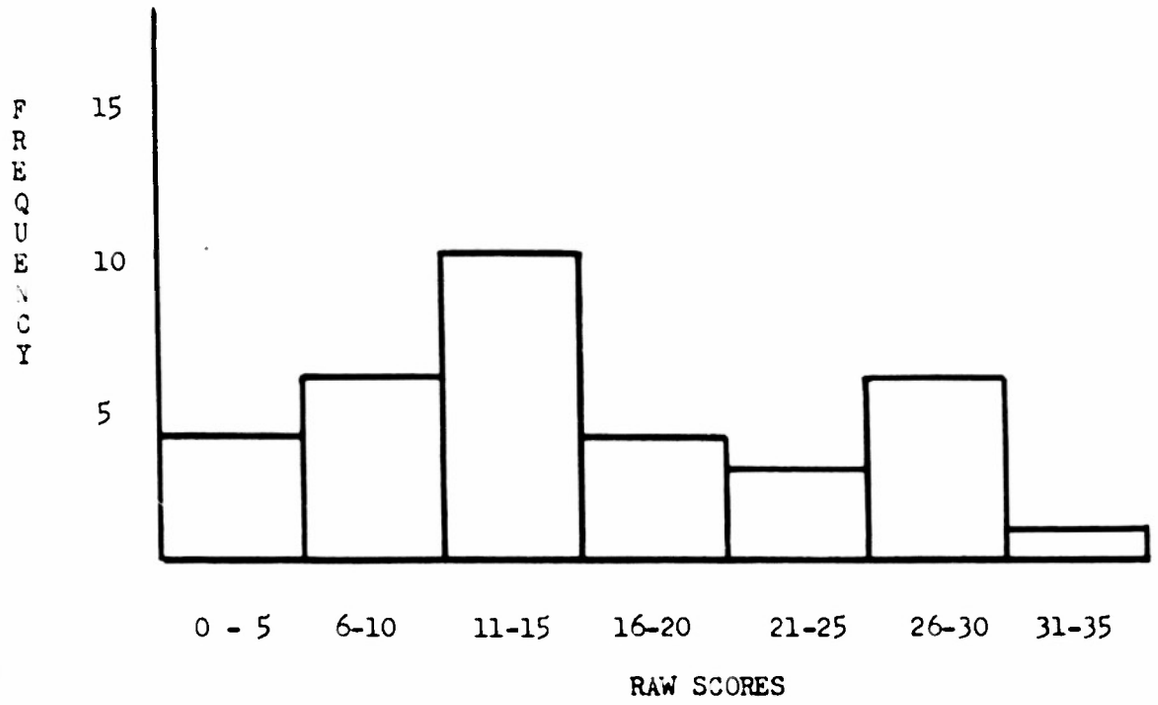


Fig. 9 Histogram for Welding Test

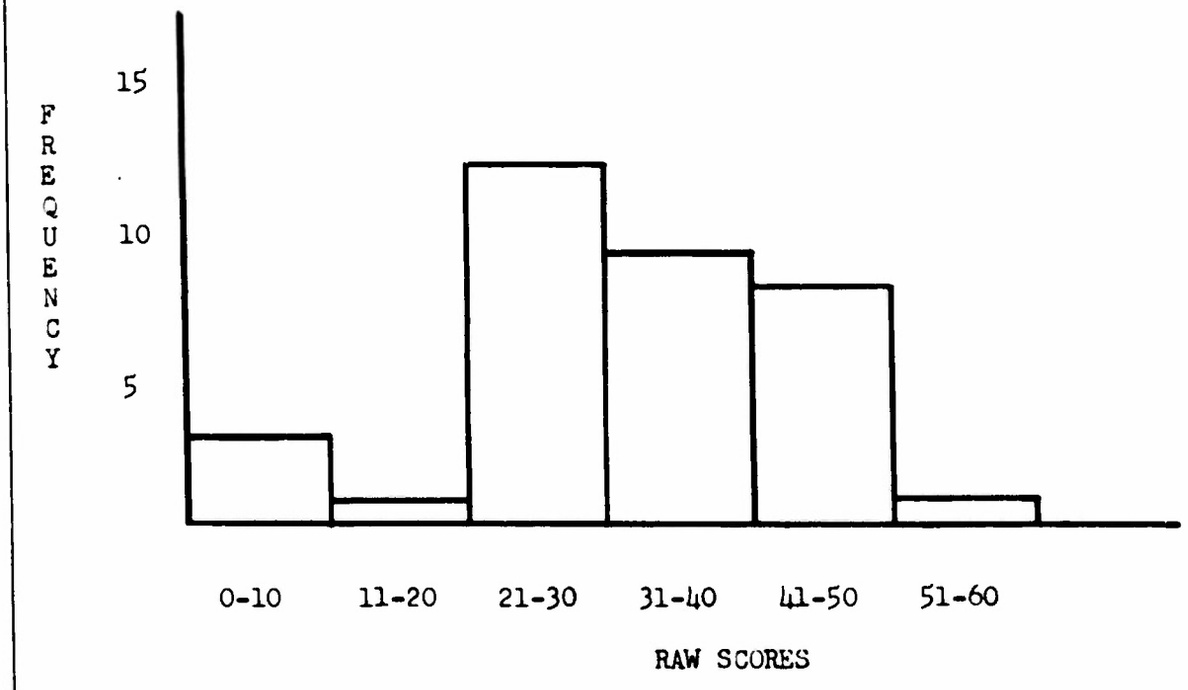


Fig. 10 Histogram for Metal Working Test

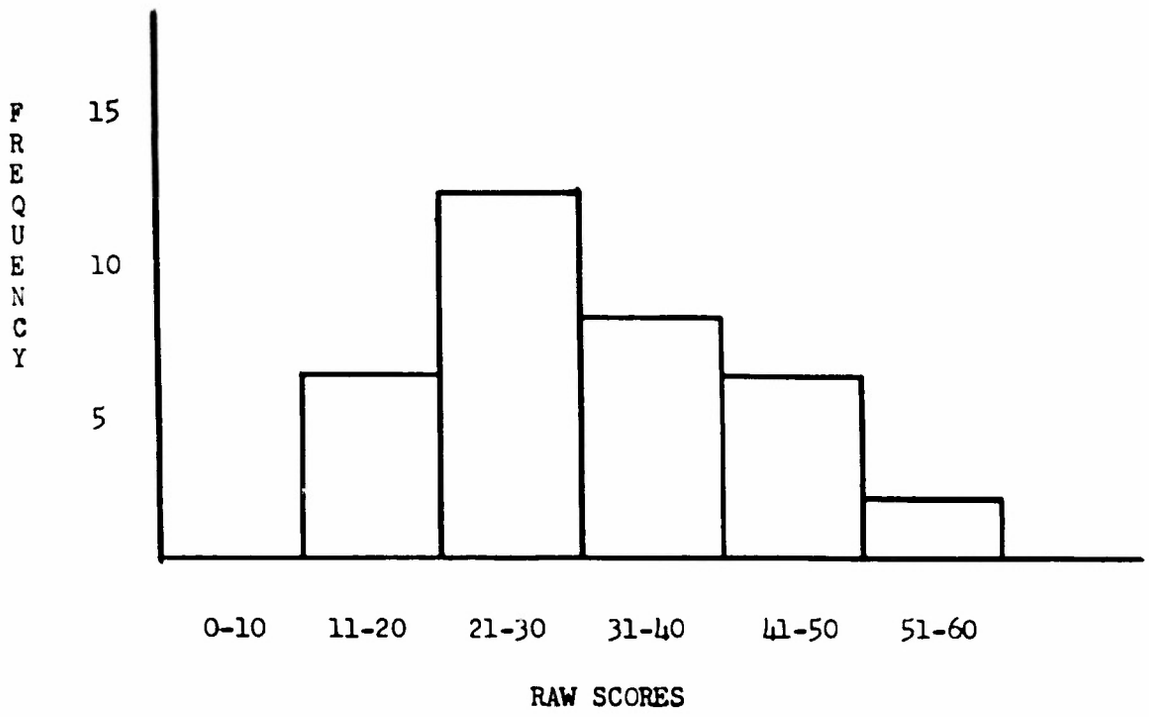


Fig. 11 Histogram for Fabric Repair Test

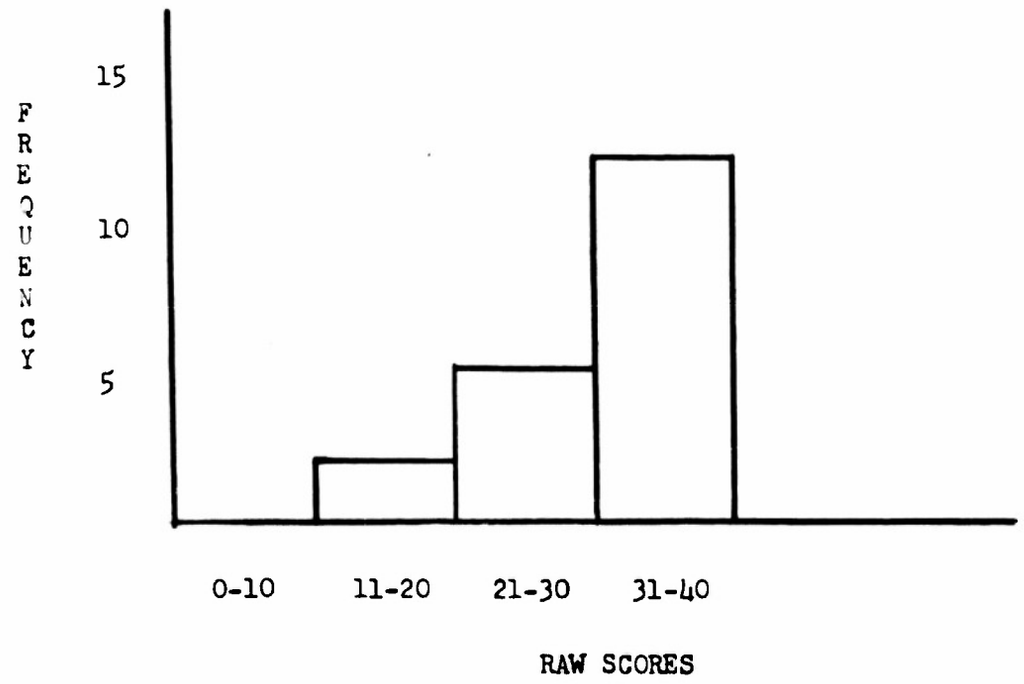


Fig. 12 Histogram for 30-Hour Hydraulic Inspection Test

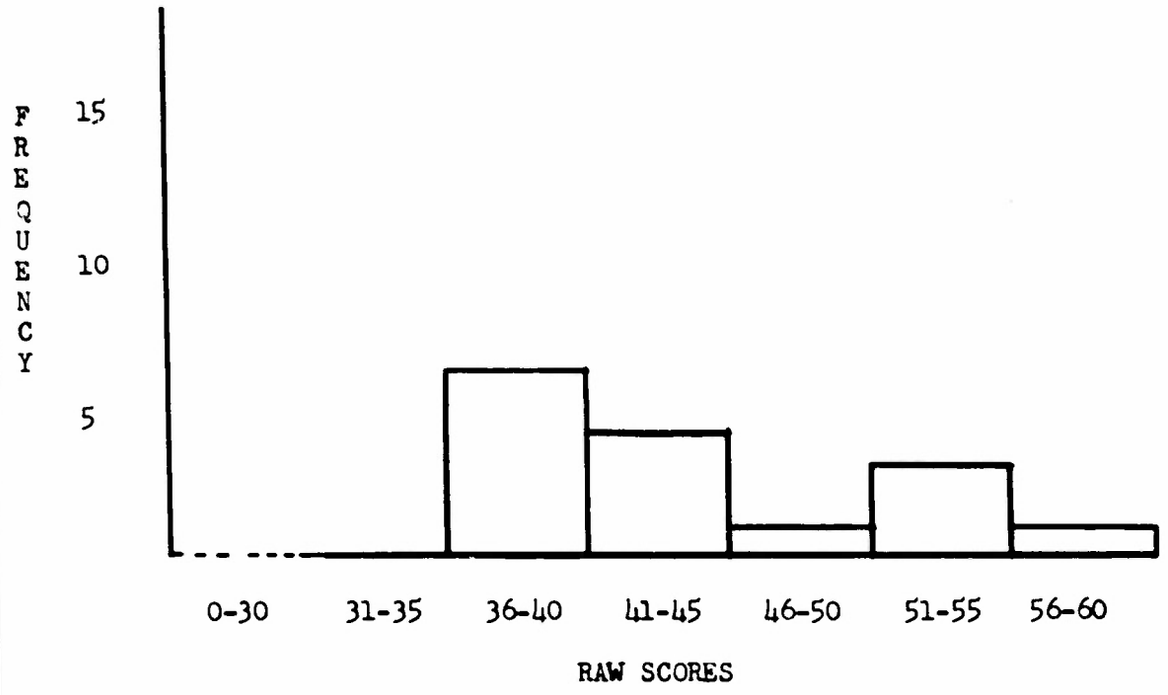


Fig. 13 Histogram for Structural Maintenance Test

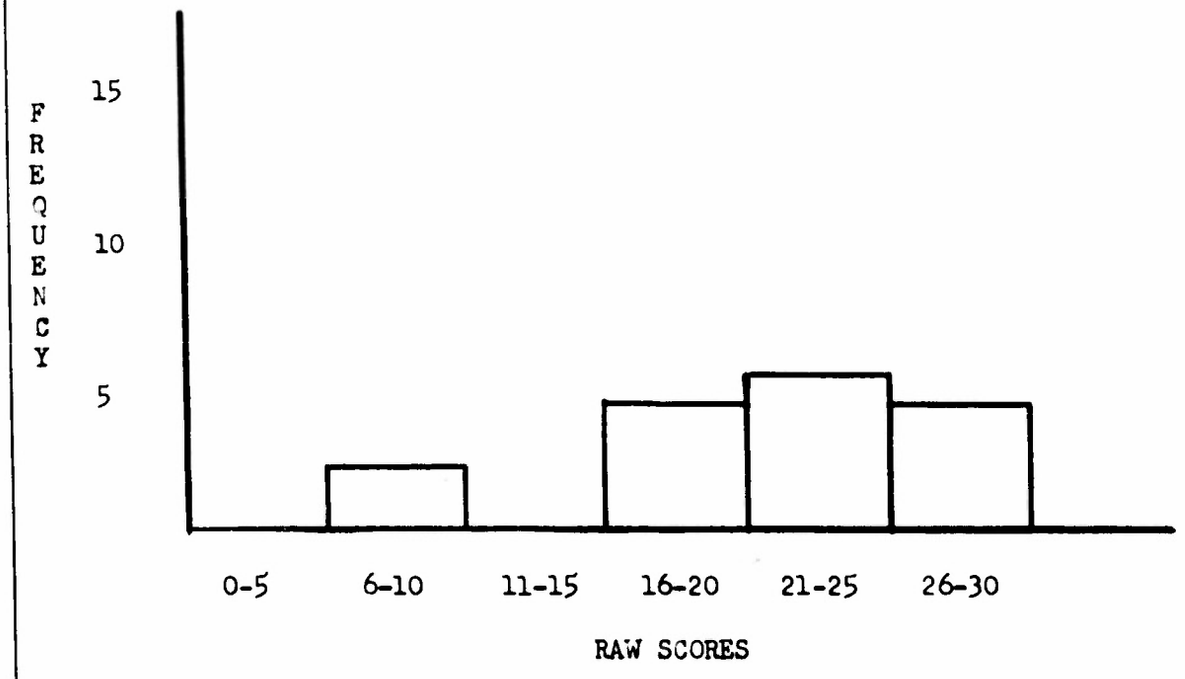


Fig. 14 Histogram for Plastics Test

Discrimination of Structural Mechanics' Battery between Groups

In order to answer the question of whether the Aviation Structural Mechanics' Battery discriminated between the two groups who took the battery, "t" tests were performed comparing the test means for those tests which both the Memphis and the Atlantic City groups of Structural Mechanics completed. The scores given each of the Structural Mechanics at Atlantic City by Examiner A were used in calculating the Atlantic City mean test scores. Table 32 presents the data pertinent to these "t" tests. Of the five "t"'s calculated, (Table 32), only one is significant at or below the .05 level. These data seem to indicate that either the two groups were largely equivalent in ability or that the tests were not effective in distinguishing between the groups involved.

TABLE 32

Means, Standard Deviations, and "t"'s between Mean Scores of Groups Completing Same Structural Mechanics' Tests

Test		Mean	S.D.	"t"
Drill Point Grinding	Atlantic City	15.63	6.48	
	Memphis	16.53	6.00	.41
Metal Working	Atlantic City	29.58	4.47	
	Memphis	33.80	11.92	.44
Aluminum Butt Weld	Atlantic City	16.05	3.16	
	Memphis	15.00	6.93	.57
Rigid Tubing Assembly	Atlantic City	36.84	19.82	
	Memphis	56.23	7.54	3.41*
Fabrics	Atlantic City	31.9	10.49	
	Memphis	33.4	9.00	.43

*Significant below .01 level.

Evaluation of the Validity of the Aerial Photographers' Test

The same reasoning that was applied in the approach to the validity of the Structural Mechanics' Battery holds equally well (or poorly?) for the tests in the Aerial Photographers' Battery. We felt again, and for the same reasons as before, that the only validity accessible to us was "face validity".

Hence, as before, we approached the problem of validity of the tests from the points of view of: a) sensibleness of the tests to the Aerial Photographers who administered them; and b) sensibleness of the tests to the Aerial Photographers who took them. We therefore included in our interview with the Aerial Photographers who administered the Aerial Photographers' Battery the same items probing into the validity of their tests as were included for the evaluation of the validity of the Structural Mechanics' test (items 7, 8, 9, 10, 15, 16, 18, 19b and 19c, Exhibit XX). The same person who interviewed the test administrators for the structural mechanics also interviewed the test administrators for the Aerial Photographers.

Face Validity of the Aerial Photographers' Battery

As stated above, the acceptability of the Aerial Photographers' Battery to the Aerial Photographers who administered it at Atlantic City was ascertained via a semi-structured interview. The results in terms of the frequency of response classified in each category are presented in Table 33.

In general, Table 33 indicates that, although these Aerial Photographers who acted as test administrators felt that some improvements were needed in the tests in the Aerial Photographers' Battery, they also felt that the tests discriminate between good and poor Aerial Photographers. All these test administrators felt that the performance tests were highly practical as a device for check-out on "practical factors" for advancement in rating in their squadron, and they all would be willing to go to sea with men selected on the

basis of tests such as those found in the Aerial Photographers' Battery. The test administrators maintained that tests such as those in the Aerial Photographers' Battery represent a good method for "checking men out" on their ability to perform a specific job, and the test administrators expressed a willingness to accept men into their shop on the basis of tests similar to those in the Aerial Photographers' Battery. These data, which seem to indicate an acceptable face validity for the Aerial Photographers' Battery, are in substantial agreement with the data pertaining to the face validity of the Aviation Structural Mechanics' Battery.

Face Validity of the Aerial Photographers' Battery from the Viewpoints of the Aerial Photographers Who Were Tested

In order to elicit the opinions of the Aerial Photographers who acted as subjects in the second field test of the Aerial Photographers' Battery, the AF Opinion Questionnaire (Exhibit XXIII) was administered. The form was administered to each of the 15 Aerial Photographers at Atlantic City who took the Aerial Photographers' Battery two days after he had completed the battery. The usual assurances of anonymity of response were given to each subject prior to the administration of the form.

The AF Opinion Questionnaire was analogous to the AM Opinion Questionnaire, except that the AF Opinion Questionnaire was build around the Aerial Photographers' Battery rather than the Aviation Structural Mechanics' Battery. The results in terms of the percentage of the responses which fell into each category of each item are presented in Table 34. The majority of the Aerial Photographers indicated that they enjoyed taking the performance tests more than they enjoy written tests; that our performance tests separate "the men from the boys"; and that the performance tests were fair. The men did not feel that the tests were too hard. The adjectives most often chosen by the Aerial Photographers as describing the tests (item 2, Table 34) were "fair", "good", and "common sense". The adjectives least often checked were "stupid", "bad" and "unfair ". As with the structural mechanics, here again, the responses of the Aerial Photographers to item 1 g are incompatible with their responses to the rest of the questionnaire, and probing indicated that item 1 g was misunderstood by the Aerial Photographers as it was by the structural mechanics.

TABLE 33

Frequency of Response Pertaining to Acceptability of the Aerial Photographers' Battery to the Aerial Photographers Who Administered the Battery (N = 4)

7. What could we do to improve these tests?

No improvement needed	2
Improvement needed	2

8. What could we do to improve the scoring?

No improvement needed	4
Improvement needed	0

9. Were the items too detailed?

Yes	0
No	4

Were the items too general?

Yes	0
No	4

14. What else should have been on the scoring sheet?

Nothing else needed	4
Something else needed	0

15. Do you think these tests separate good from poor (AF's)?

Discriminate well	1
Discriminate fairly well	3
Don't discriminate	0

16. Do you consider this to be a practical way for checking men out on "practical factors" for advancement in rating in your squadron?

Highly practical	4
Practical	0
Impractical	0

18. Would you be willing to go to sea with men selected on the basis of these tests?

Yes	4
No	0

TABLE 33 (Cont'd.)

19. Here is a list of the tests you administered. Regarding the Houston test:

b) Do you think that this is a practical way to check men out on motion picture processing?

Repeat for remaining tests.

	Practical	Impractical
Motion picture processing	3	1
Speed graphic	4	0
Records and reports	4	0
Camera Maintenance	3	1
Sonne Printing	4	0
Aerial Cameras	4	0
Lab. processes	4	0

c) Would you be willing to accept men into your shop on the basis of a test such as this?

	Accept Men on Basis of	Not Accept Men on Basis of
Motion picture processing	3	1
Speed graphic	4	0
Records and reports	4	0
Camera maintenance	3	1
Sonne printing	4	0
Aerial cameras	4	0
Lab processes	4	0

EXHIBIT XXIII

Sample AF Opinion Questionnaire

You have just taken a series of eight tests. You took a Houston test, a Speed Graphic test, a Camera Maintenance test, a Sonne test, and a Camera Loading test. You also mixed chemicals and prepared reports covering the shipment of film to the film library. The Institute for Research in Human Relations, a private non-government agency, is conducting research on these tests. We would appreciate your opinions on them, and ask your cooperation in filling in these forms. Of course, your answers will be held in strict confidence. They will become and remain the property of the Institute.

NAME_____ DATE_____

SERVICE NUMBER_____ RATE_____

1. We would like your general, overall opinion on these tests.

   a. In general, did you enjoy taking these tests more than you would written tests? Yes____ No____

   b. Do you think that tests like these separate the men from the boys? Yes____ No____

   c. Would you rather take tests for advancement in rating like these, than written tests? Yes____ No____

   d. In general, do you think that tests like these in which you must do something, rather than write something, are fair? Yes____ No____

   e. In general, do you think that these tests were too hard? Yes____ No____

   f. Do you think that you learned what you don't know as well as what you know from taking these tests? Yes____ No____

   g. In general, would you say that these tests need improvement? Yes____ No____

EXHIBIT XXIII (Cont'd.)

2. In each column place a check along side the two words which you feel most adequately describe your feelings about the test named at the top of the column. You may want to use more than two checks, but you are limited to only two. So check the two which most adequately describe your feelings.

	HOUSTON	SPEED	GRAPHIC	CAMERA	MAINTENANCE	SONNE	CAMERA	LOADING	CHEMICAL	MIXING	RECORDS	AND	RECEPTORS
Fair	___	___		___		___	___		___		___		
Hard	___	___		___		___	___		___		___		
Easy	___	___		___		___	___		___		___		
~~Stupid~~	___	___		___		___	___		___		___		
Right on	___	___		___		___	___		___		___		
Unfair	___	___		___		___	___		___		___		
Bad	___	___		___		___	___		___		___		
Out of bounds	___	___		___		___	___		___		___		
Good	___	___		___		___	___		___		___		
Common sense	___	___		___		___	___		___		___		

TABLE 34

Percentage of Responses Falling in Each Category on AF Opinion Questionnaire (N = 14)

1. We would like your general, overall opinion on these tests.		
a. In general, did you enjoy taking these tests more than you would written tests?	Yes 92.3	No 7.7
b. Do you think that tests like these separate the men from the boys?	Yes 61.5	No 38.5
c. Would you rather take tests for advancement in rating like these, than written tests?	Yes 76.9	No 23.1
d. In general, do you think that tests like these in which you must do something, rather than write something, are fair?	Yes 92.3	No 7.7
e. In general, do you think that these tests were too hard?	Yes 0	No 100
f. Do you think that you learned what you don't know as well as what you know, from taking these tests?	Yes 76.9	No 23.1
g. In general, would you say that these tests need improvement?	Yes 69.2	No 30.8

TABLE 34 (Cont'd.)

2. In each column, place a check along side the two words which you feel most adequately describe your feelings about the test named at the top of the column. You may want to use more than two checks, but you are limited to only two. So check the two which most adequately describe your feelings.

	HOUSTON	SPEED	GRAPHIC	CAMERA	SONNET	CAMERA	LOADING	CHEMICAL	MIXING	RECORDS	RECORDS AND	MEAN	ROWS
Fair	26.9	26.9		7.7	30.8	73.1	26.9			28		24.3	
Hard	15.4	3.8		19.2	3.8	3.8	0			12		8.3	
Easy	0	11.5		3.8	7.7	11.5	15.4			8		8.3	
Stupid	0	0		0	0	0	0			0		0	
Right on	0	7.7		0	11.5	17.1	23.1			0		8.8	
Unfair	3.8	11.5		19.2	0	0	0			4		5.5	
Bad	0	3.8		7.7	0	0	0			4		2.2	
Out of bounds	11.5	0		23.1	3.8	0	0			4		6.1	
Good	30.8	26.9		11.5	26.9	23.1	23.1			32		24.9	
Common Sense	11.5	7.7		7.7	15.4	11.5	11.5			8		11.6	
Sum	99.9	100.0		99.9	99.9	100.1	100.0			100		100.0	

Evaluation of the Reliability of the Aerial Photographers' Tests

It was not possible to evaluate any of the Aerial Photographers' tests in terms of test-retest reliability. The work load on the photographic laboratory at Atlantic City was such that the responsible personnel were not entirely amenable towards freeing the subjects for additional testing. Since reliability ascertainment was not one of our primary purposes, we did not feel that pressing too hard on this point was judicious.

Discriminating Power of the Aerial Photographers' Battery

In order to apply graphic techniques as an aid in visualizing the discriminating power of the tests in the Aerial Photographers' Battery, the histograms presented in Figures 15 to 22 were prepared. In preparing these histograms, we again have combined, where possible, the scores of the two groups of examinees involved.

Adequate spreads are seen in all of the distributions presented for the Aerial Photographers' Battery. The large number of scores falling into the lowest class interval in the distributions for the Motion Picture Processing Test (Figure 15), the Camera Maintenance Test (Figure 16), and the Records and Reports Test (Figure 20) is apparent. The majority of these low scores were supplied by the Atlantic City group of Aerial Photographers. The resemblance of the distributions for the Chemical Mixing Test (Figure 21), the Aerial Cameras Test (Figure 19) and the Speed Graphic Test (Figure 17) to a bell shaped curve is clear. If the scores in the lowest class interval, 0 to 20, were eliminated from the Records and Reports distribution, this distribution, too, would start to approach a bell shape.

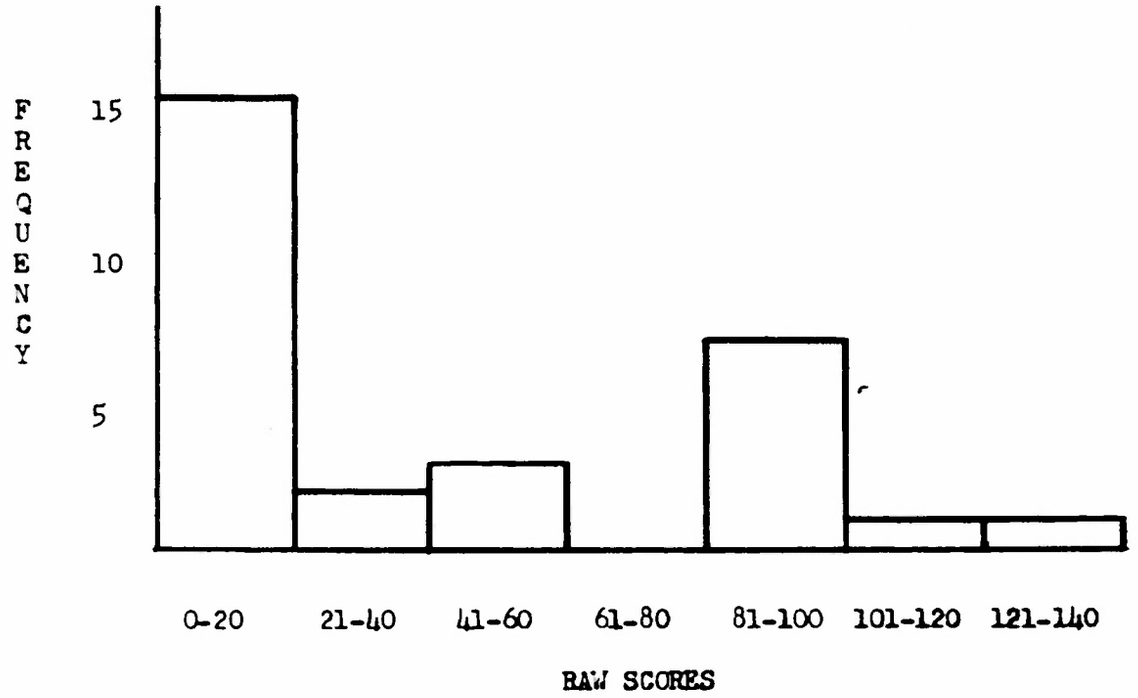


Fig. 15 Histogram for Motion Picture Processing Test.

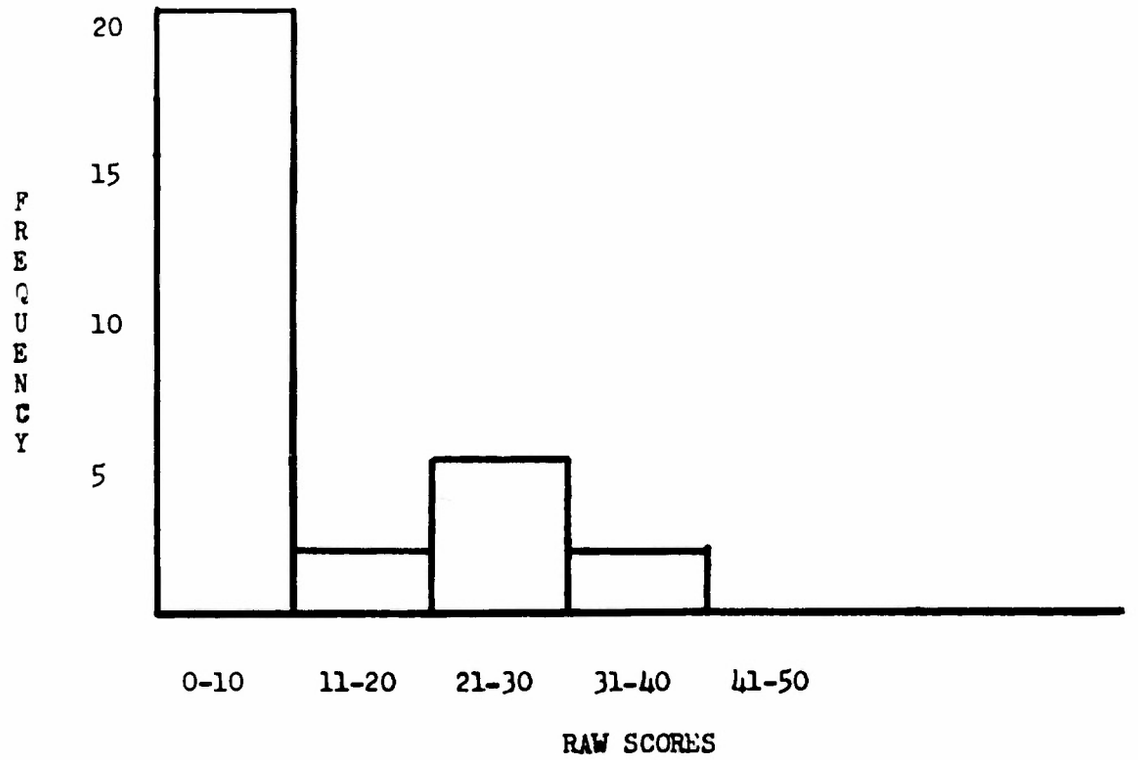


Fig. 16 Histogram for Camera Maintenance Test

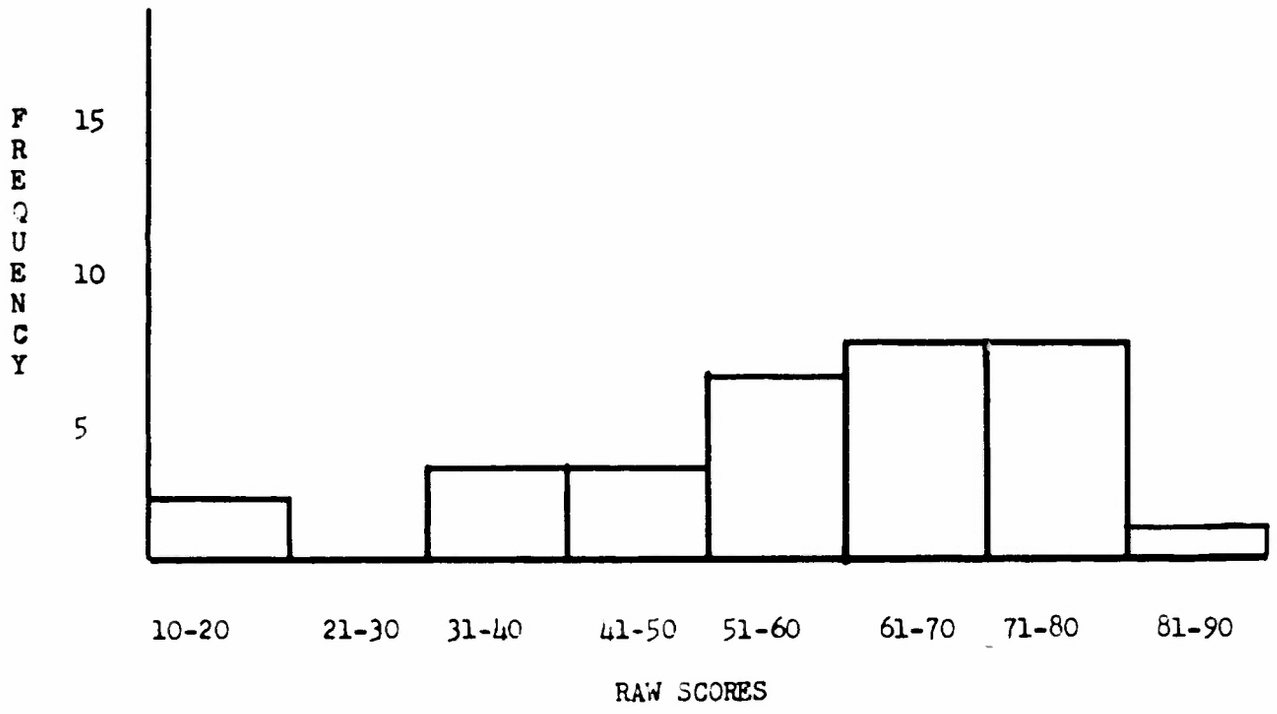


Fig. 17 Histogram for Speed Graphic Test

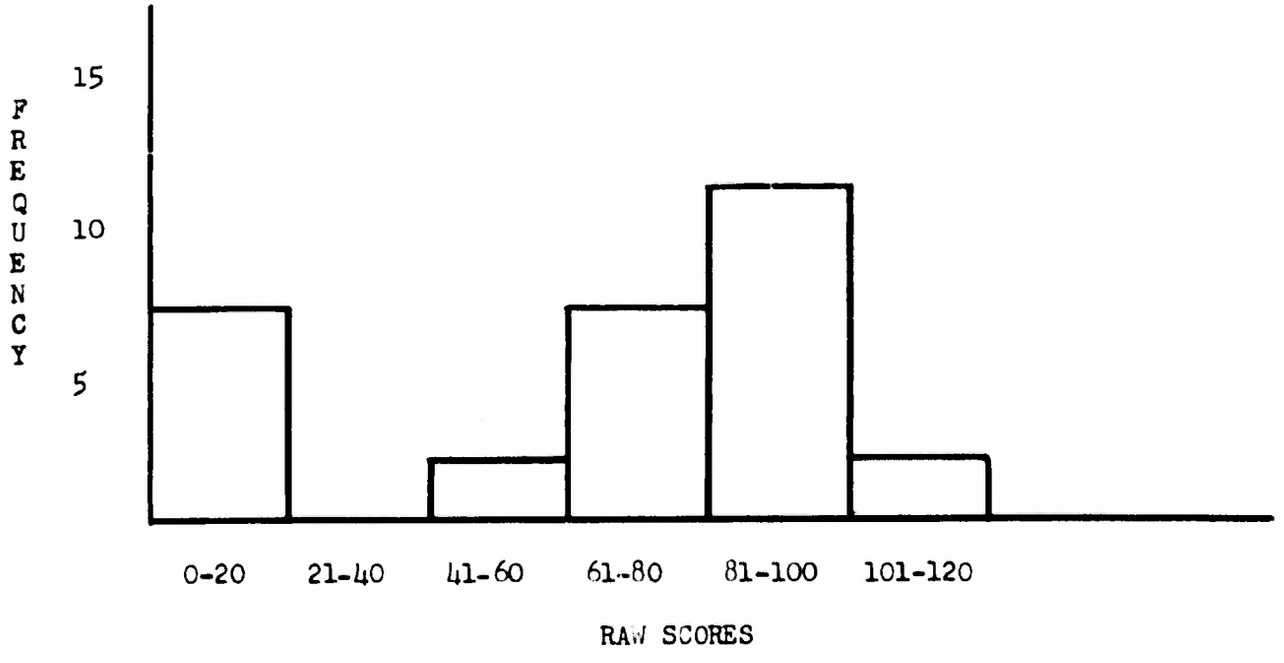


Fig. 18 Histogram for Sonne Printing Test

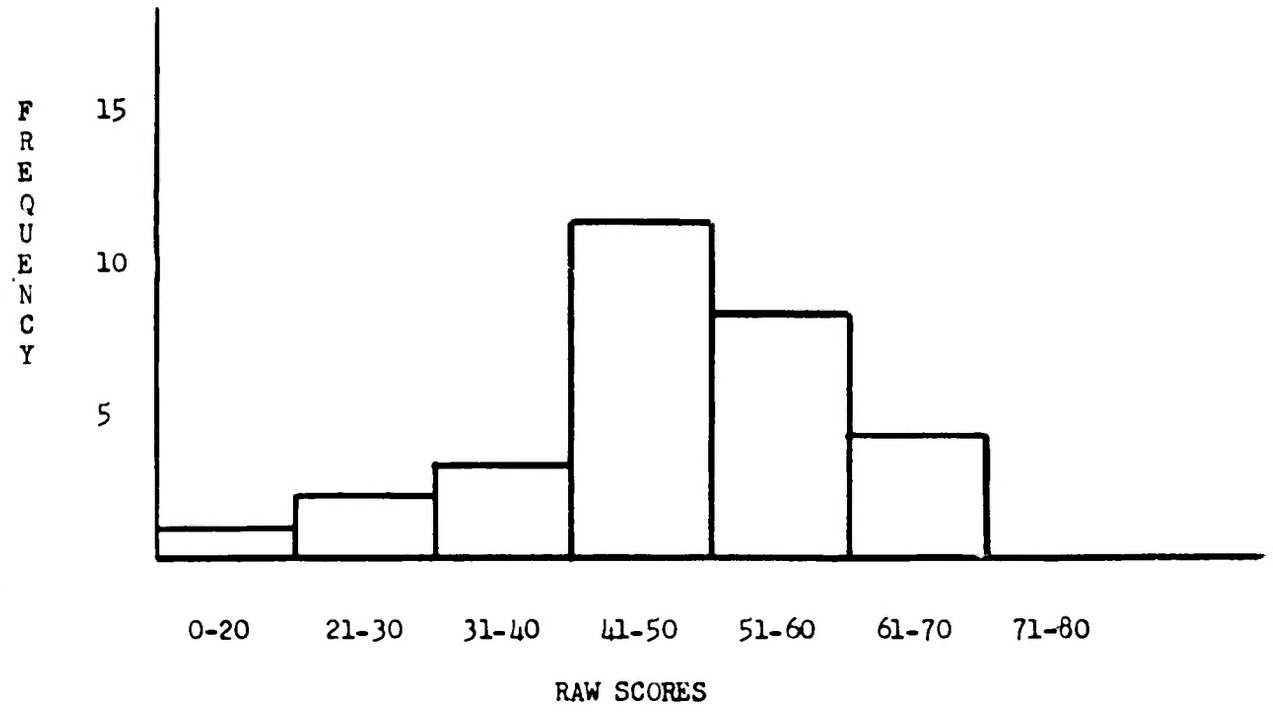


Fig. 19 Histogram for Aerial Cameras Test

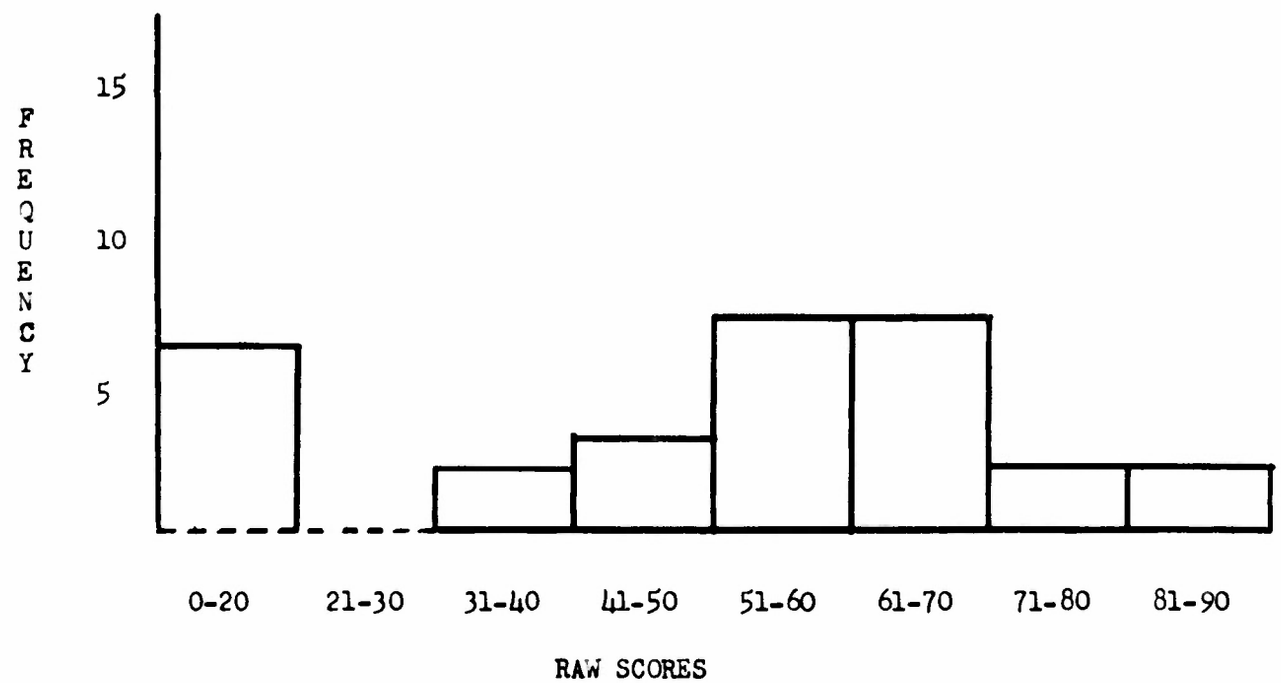


Fig. 20 Histogram for Records and Reports Test

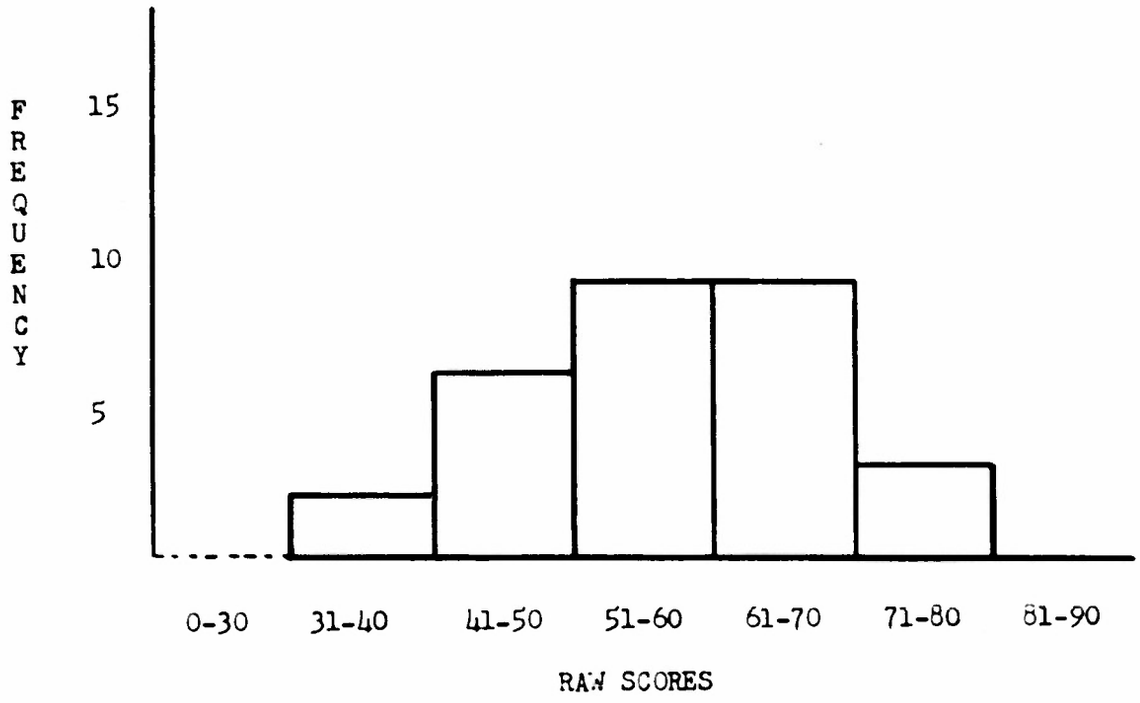


Fig. 21 Histogram for Chemical Mixing Test

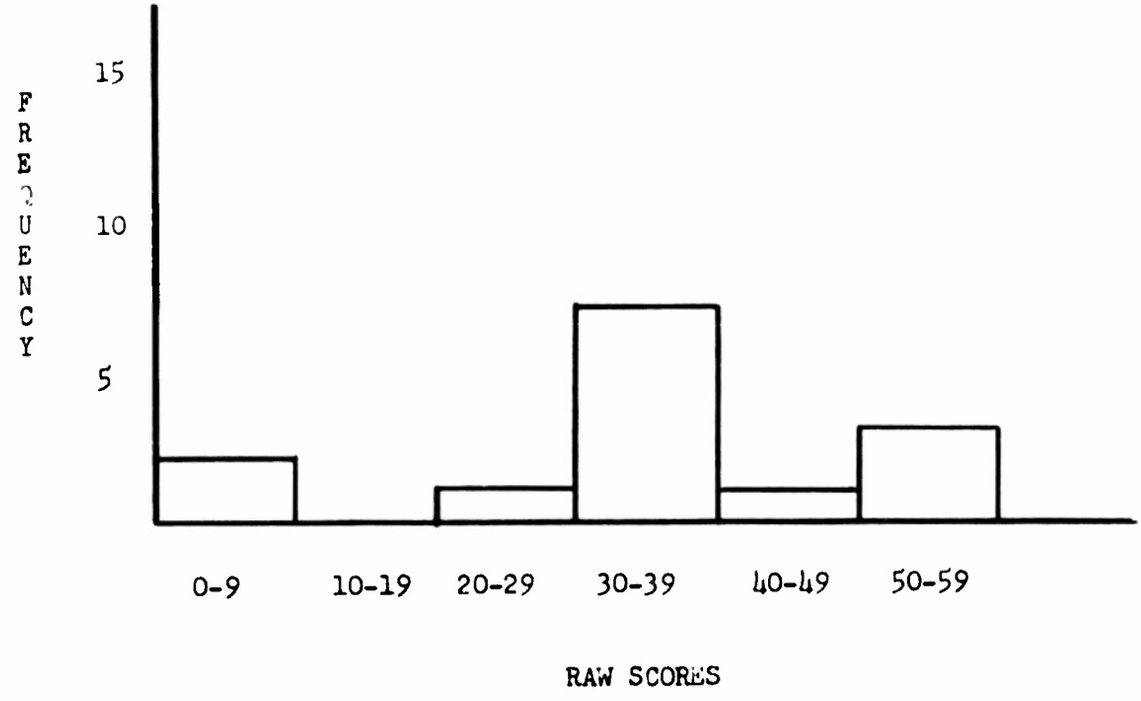


Fig. 22 Histogram for Camera Installation Test

Discrimination of Aerial Photographers' Battery between Groups

In order to investigate the question of whether the tests in the Aerial Photographers' Battery discriminated between the two groups involved, "t" tests were performed comparing the mean scores for each of the tests completed by both the Atlantic City group and the Pensacola group of Aerial Photographers. These data are presented in Table 35. For five of the seven comparisons noted in Table 35, statistically significant differences in favor of the Pensacola group of photographers are evidenced. The observations of the researcher were such as to support this statistical indication. Thus, it seems that the tests in the Aerial Photographers' Battery were such as to effectively discriminate between the Pensacola group of Aerial Photographers and the Atlantic City group.

TABLE 35

Means, Standard Deviations, and "t"'s between Mean Scores of Groups Completing Same Aerial Photographers' Tests

Test		Mean	S.D.	"t"
Motion Picture Processing	Atlantic City	22.00	6.78	
	Pensacola	54.21	45.86	2.61**
Camera Maintenance	Atlantic City	2.00	7.48	
	Pensacola	16.14	11.40	3.84***
Speed Graphic	Atlantic City	59.93	16.85	
	Pensacola	55.07	16.46	.22
Sonne Printer	Atlantic City	40.80	33.44	
	Pensacola	82.28	24.56	3.59***
Aerial Cameras	Atlantic City	48.20	7.48	
	Pensacola	44.36	17.49	.75
Record and Reports	Atlantic City	40.87	9.79	
	Pensacola	55.07	18.52	2.53**
Chemical Mixing	Atlantic City	22.00	6.78	
	Pensacola	54.21	45.86	2.66**

*** Significant below .01 level.
** Significant between .02 and .01 levels.
* Significant between .05 and .02 levels.

Communality of Tests in Structural Mechanics' and Aerial Photographers' Batteries

A further requisite in any battery of performance tests is that the tests composing the battery measure different abilities. That is, it is desirable that each test in a battery measure a separate ability. Stated otherwise, the test constructor's aim is to include tests with as little common factor variance as possible and as much uniqueness as possible. (Of course, in this discussion we are ignoring the concept of the "supressor variable"). In order to investigate the relationship (overlap) between the tests in the Aviation Structural Mechanics' Battery product moment correlations were calculated between the test scores within each of the groups who took the Aviation Structural Mechanics' Battery. Similar treatment was given to the test scores within each of the groups who took the Aerial Photographers' Battery. The correlational matrices so calculated, are presented in Tables 36 to 39. Table 36 also includes the correlations between the tests in the Structural Mechanics' Battery and the number of months in the service of the Memphis group of Structural Mechanics, while Tables 37 and 39 also indicate the relationship between the performance tests and the "basic battery" scores for each of the Atlantic City groups.

TABLE 36

Intercorrelations of Tests in Aviation Structural Mechanics' Battery as Derived from Test Scores of Memphis Group

	Drill Point Grinding	Metal Working	Structural Maintenance	Plastics	Welding	Rigid Tubing Assembly	Fabrics	Months in Service
Metal Working	.121							
Structural Maintenance	.087	.071						
Plastics	.225	.104	.003					
Welding	.502	.452	.130	.401				
Rigid Tubing Assembly	.198	.027	.306	.038	.027			
Fabrics	.149	.440	.085	.287	.478	.026		
Months in Service	.514	.517	.074	.073	.295	.191	.058	____

TABLE 37

Intercorrelations of Tests in Aviation Structural Mechanics' Battery as Derived from Test Scores of Atlantic City Group (Basic Battery also Included)

	Drill Grinding	Metal Working	Welding	Rigid Tubing Assembly	Fabrics	Hydraulic Inspection	GCT	Ari.	Mech.	Cler.
Metal Working	.217									
Welding	.342	.392								
Rigid Tubing Assembly	.372	.254	.313							
Fabrics	.388	.545	.232	.295						
Hydraulic Inspection	.128	.152	.088	.573	.318					
GCT	.219	.252	.108	.379	.674	.218				
Ari.	.427	.429	.266	.406	.741	.160	.783			
Mech.	.424	.324	.098	.432	.645	.198	.837	.643		
Cler.	.132	-.015	.199	.121	.033	.102	.294	.419	.452	

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TABLE 38

Intercorrelations of Tests in Aerial Photographers' Battery as Derived from Test Scores of Pensacola Group

	Motion Picture Processing	Camera Maintenance	Speed Graphic	Sonne Printer	Aerial Cameras	Records and Reports	Camera Installation	Chem. Mixing
Camera Maintenance	.045							
Speed Graphic	.706	.079						
Sonne Printer	.295	.493	.088					
Aerial Cameras	.567	.035	.589	.455				
Records and Reports	.568	.341	.474	.851	.551			
Camera Installation	.539	.515	.480	.712	.560	.739		
Chemical Mixing	.187	.166	.280	-.132	.058	-.013	.059	

TABLE 39

Intercorrelations of Tests in Aerial Photographers' Battery
As Derived from Test Scores of Atlantic City Group

	Motion Picture Processing	Camera Maintenance	Speed Graphic	Sonne Printer	Aerial Cameras	Records and Reports	Chemical Mixing	GCT	Ari.	Mech.	Cler.
Camera Maintenance	-.467										
Speed Graphic	.378	.197									
Sonne Printer	-.375	-.316	-.319								
Aerial Cameras	.388	-.007	.269	.307							
Records and Reports	-.035	.216	-.232	.483	.133						
Chemical Mixing	.604	-.090	-.091	.056	.237	-.075					
GCT	-.030	.337	.088	.197	-.155	.445	-.011				
Ari.	-.043	.384	.212	.207	.012	.640	-.113	.830			
Mech.	.216	.149	.295	.235	.138	.527	.195	.317	.589		
Cler.	-.307	.097	.402	-.157	.335	-.174	-.449	.387	.343	.043	

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Communality of Tests in Structural Mechanics' and Aerial Photographers' Batteries (Cont'd.)

Tables 37 to 39 indicate low intercorrelations between the tests in both the Aviation Structural Mechanics' Battery and the Aerial Photographers' Battery. However, due to the small number of subjects in each of our groups, these correlations are to be regarded as indicative rather than final.

For the Aviation Structural Mechanics the correlations between tests in the battery remained low for both groups tested. The highest correlations noted were between some of the tests in the Aviation Structural Mechanics' Battery and the tests in the "Basic Battery". Likewise the intercorrelations between the tests in the "Basic Battery" were moderately high.

Similarly, for both groups of Aerial Photographers the intercorrelations between tests in the Aerial Photographers' Battery were low and in the Atlantic City group, many of the correlations were negative. These negative correlations are in part an outgrowth of the high degree of specialization noted in the men at the photo-lab. at Atlantic City.

These low correlations would seem to indicate an adequate degree of homogeniety for the tests in both the Aviation Structural Mechanics' and Aerial Photographers' Batteries.

CHAPTER VIII

Usefulness of the Tests in Measuring In-Service Training Achievement

(SUBPURPOSE b)

Our second subpurpose was an evaluation of the Aviation Structural Mechanics' Tests and Aerial Photographers' Tests in order to obtain some insights into their usefulness in measuring in-service training achievement and their potential usefulness in operational situations. In order to accomplish this general purpose, items 3, 4, 5, 6 and 16 were included on the Interviewer's Record Form (Exhibit XX) and in the interview with the men who acted as test administrators. Items 1a, 1c, and 1b in the AM and AF Opinion Questionnaires (Exhibits XXII and XXIII) were also considered to have implications on this question. Furthermore, towards the end of the interview session all test administrators were intensively probed in line with this general purpose.

From all of the above discussion it appears that performance measures are useful in determining in-service training achievement. The results indicated significant differences between the Pensacola and Atlantic City groups of aerial photographers and also that the Aerial Photographers' Battery and the Structural Mechanics' Battery spread the men adequately for evaluative purposes. Moreover, in all groups visited, the cognizant personnel expressed an interest and need for an evaluation device such as performance tests. Perhaps the general opinion was best expressed by a Chief Photographer at Atlantic City who said, "From now on I'm going to have one man on training full time. — It (the testing program) opened our eyes to the fact that we could push a lot more on training than we have. — The tests helped the boys and started the administration thinking more on it. I wouldn't mind something like that when I was going up for a rate". This need and point of view was also expressed by the training and educational officers with whom we consulted. Moreover, the mere act of taking the tests appears to have benefited the men, in that the tests pointed out areas in which they were weak. In answer to the question, "Do you think that you learned what you don't know as well as what you know from taking these tests?" 77.8% of the structural mechanics tested at Atlantic City replied affirmatively. In response to the same question 76.9% of the Aerial Photographers tested at Atlantic City replied affirmatively.

Five of the six Chief Structural Mechanics interviewed at Atlantic City maintained that they would like to administer performance tests as a full time duty and all six would like test administration as a part time duty. All of the chiefs interviewed thought that they could make up performance tests, although two of them maintained that they had no time to do so. Three of the chiefs indicated that they had only a "slight" amount of time for test construction activities, while the remaining Chief Structural Mechanic had a "considerable" amount of time. Four of the six felt that it would take them a "considerable" amount of time to construct performance tests. Three of the four Aerial Photographers who acted as test administrators maintained that they would like to administer performance tests as a full time duty and three out of four maintained that they would like test administration as part time duty. All four of the Aerial Photographers who acted as test administrators felt that they could make up performance tests, although three of these felt that they had only a slight amount of time available for application to such duty and one felt he had no time available for such activity. Thus, it seems that Naval personnel are willing to work with performance tests and that performance tests are acceptable to the man "on the line".

CHAPTER IX

Summary and Conclusions

This study had seven objectives.

Objective I: To develop a manual which can be used as a guide in the construction of performance tests.

Attainment I: With the aid of Naval squadron personnel a manual was constructed. An outline of the manual is a part of this report and the manual itself has been published as a separate.

Objective II: To use the manual in the field to see if field performance tests could be developed following its recommendations.

Attainment II: A member of the Institute staff attended Aviation Structural Mechanics' School in Memphis. He then attended the Aerial Photographers' School at Pensacola. Working through squadron personnel at Memphis and Atlantic City, he constructed a) 8 performance tests for the Aviation Structural Mechanics' rating; b) 8 performance tests for the Aerial Photographers' rating.

Objective III: To see if the Naval personnel who served as technical consultants during the test construction could administer these tests.

Attainment III: The Naval personnel who served as technical advisors during the development of the tests were considered competent as test administrators.

Objective IV: To see if Naval personnel with minimal indoctrination into testing practices could administer these tests.

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Attainment III: The Naval personnel who served as technical advisors during the development of the tests were considered competent as test administrators.

Objective IV: To see if Naval personnel with minimal indoctrination into testing practices could administer these tests.

Attainment IV: Working in operational squadrons the Institute staff member obtained Chief Petty Officers and other rated men as test administrators. He trained them in test administration and then observed their success in the administration itself. Considering the Aviation Structural Mechanics' Battery, he found:

a) The Chief Petty Officers who had a minimal indoctrination into testing procedures, but who were relatively naive in testing practices were considered competent as test administrators.

b) The Chief Petty Officers with minimal indoctrination into testing procedures demonstrated adequate inter-examiner reliability and adequate intra-examiner reliability.

Considering the Aerial Photographers' Battery, we found:

a) Enlisted personnel below the rate of Chief Petty Officer with minimal indoctrination into testing procedures but who were relatively naive in testing procedures were not considered completely competent as test administrators.

b) However, these personnel with minimal indoctrination into testing procedures did show acceptable inter-examiner reliability and adequate intra-examiner reliability.

Objective V: To apply the usual statistical tests to the tests themselves.

Attainment V: In so far as possible this was done. Considering the Aviation Structural Mechanics' Battery, we found:

a) For the two tests investigated test-retest reliability was moderately high.

b) The tests in the battery were adequately homogeneous, and seemed to have acceptable discriminating power.

Considering the Aerial Photographers' Battery, he found:

a) The tests in the battery were adequately homogeneous and seemed to demonstrate acceptable discriminating power.

Objective VI: To determine the acceptability of these tests on the part of Naval personnel. The Naval personnel were questioned concerning attitudes toward the tests. The results indicated that:

Attainment VI: a) The Chief Petty Officers who administered the Structural Mechanics' Battery and the enlisted personnel who took them found the tests acceptable from the point of view of face validity.

b) The test administrators and the men who took the tests in the Aerial Photographers' Battery found the tests acceptable from the point of view of face validity.

Objective VII: To determine the usefulness of performance tests in in-service training situations. Naval personnel were questioned as to their needs for such a training measure.

Attainment VII: The concensus of opinions indicated a desire and need for a such a device.

CHAPTER X

The Validity of Synthetically Scored Job Samples

In all the tests in the Aviation Structural Mechanics' and the Aerial Photographers' Batteries, an analytic and synthetic approach was taken in scoring. That is, each task was broken down into the elements comprising the total task and an examinee was given credit for each of the elements he successfully completed. Scoring of end products was done in the same manner. In scoring end products, the examinee was given credit for each aspect of his end product which met prescribed dimensions. A total score was derived for an examinee by adding the credits he obtained on each of the performance and end product elements credited.

The problem presented by this type of scoring is well put by Thorndike (5) who, in regard to measuring flight performance, wrote:

> "There may be aspects of flight performance which are lost in an analytical approach, so that a scoring of elementary items of performance can never give an adequate evaluation of over-all quality of flying."

In order to investigate the relationship between our synthetically derived scores and an over-all judgment by experts of the quality of an end product, five Chief Structural Mechanics at NAS, Atlantic City were asked to rank order from best to worst the C-Channel splices, the welds, the plastic repairs, and the fabric repairs produced by the Memphis group of structural mechanics. Each chief individually performed his ranking. The rankings of each of these chiefs were then correlated with the rankings produced by our synthetic approach to evaluation. Rank difference correlations were also calculated between the rankings of the chiefs. The correlations between the chiefs' rankings and the rankings produced by the synthetic approach are presented in Tables 40 to 43. Also included are the correlations between the chiefs' rankings for the end products involved.

TABLE 40

Correlations Between Rankings by Chiefs and Between Rankings of Chiefs With Rankings by Synthetic Approach for Welding Test

Chief	1	2	3	4	5
2	.95	---			
3	.67	.94	---		
4	.93	.95	.96	---	
5	.93	.90	.94	.98	---
Synthetic Approach	.60	.30	.52	.09	.41

TABLE 41

Correlations Between Rankings by Chiefs and Between Rankings of Chiefs With Rankings by Synthetic Approach for Fabrics Test

Chief	1	2	3	4	5
2	.01	---			
3	.20	.54	---		
4	.38	-.38	.08	---	
5	.38	.49	.61	.19	---
Synthetic Approach	.29	.33	.69	.10	.66

TABLE 42

Correlations Between Rankings by Chiefs and Between Rankings of Chiefs with Rankings by Synthetic Approach for Plastics Test

Chief	1	2	3	4	5
2	.96	---			
3	.92	.91	---		
4	.96	.89	.89	---	
5	.86	.81	.89	.87	---
Synthetic Approach	.60	.66	.80	.66	.82

TABLE 43

Correlations Between Rankings by Chiefs and Between Rankings Of Chiefs with Rankings by Synthetic Approach for Structural Maintenance Test

Chief	1	2	3	4	5
2	.65	---			
3	.79	.58	---		
4	.44	.34	.36	---	
5	.39	.31	.32	.32	---
Synthetic Approach	.47	.08	.26	.74	.11

The median rank difference correlation between the chiefs' rankings of the end products from each test was then obtained. The median rank difference correlations of the chiefs' rankings with the rankings produced by the synthetic approach was also calculated. These median "rhos" are presented in Table 44. These median rank difference correlations were then converted to producted moment correlations and the product moment correlations transformed to z's (r to z' transformation). The significance of the difference was then calculated between the z's which represented the median correlations between the chiefs' rankings of the end products from each test and the z's which represented the median correlations of the chiefs' rankings with the rankings produced by the synthetic approach for the same tests.

TABLE 44

Median Correlations Between Chiefs and Between Rankings of Chiefs with Synthetic Approach

Test	Median Rho Between Chiefs	Median Rho of Chiefs with Synthetic Approach
Welding	.95	.41
Plastics	.89	.66
Structural Maintenance	.37	.26
Fabrics	.29	.33

For the welding test, the median rank difference correlation of the chiefs' rankings with the rankings produced by the analytic and synthetic approach was .41. For the plastics test, the structural maintenance test and the fabrics test, the median rank difference correlations of the chiefs' rankings with the rankings produced by the analytic and synthetic approach were .66, .26 and .33 respectively. For the welding test, the plastics test and the structural maintenance test, the median rank

difference correlations between the chiefs' rankings were .95, .89, and .29 respectively and these three rhos were greater than the correlation of the chiefs' rankings with the rankings produced by the analytic and synthetic approach. However, the reverse was true for the fabrics test; median rho between chiefs .29, median rho of chiefs with synthetic approach .33.

Of the four tests of significance calculated, only the difference between the median correlation between the chiefs' rankings and the median correlation produced by the synthetic approach on the Welding Test was statistically significant. However, these findings must be cautiously interpreted since three of the four median rank difference correlations between the chiefs' rankings were greater than the median correlations of the rankings produced by the chiefs with the rankings produced by the synthetic approach.

Thus, although the chiefs seemed to agree with each other more than they agreed with the rankings produced by the synthetic approach, only one of the differences between the medians involved was statistically significant. If we are willing to accept agreement between chiefs as a criterion, the synthetic method of scoring seems to have lost little. In view of the bias (here controlled) that enters into judgments of end products, when the judgments are made in operational situations, it seems probable that any loss indicated by the three lower correlations of the chiefs' rankings with the rankings produced by the synthetic approach as compared with the correlations between the chiefs' rankings would be compensated for by an increase in bias in the operational situation.

Moreover, some procedural elements were not apparent to the chiefs when they made their judgments of the final products. For instance, a man may break certain safety rules and receive a down check. Infractions such as these are not seen in end product judgments, but may be too important to omit from consideration when estimating a man's operational ability. Since the chiefs who did the ranking had only end products to evaluate, it seems probable that part of the loss indicated by the lower correlations between the chiefs' rankings and the rankings produced by the synthetic approach as compared with the between chiefs correlations may be also assignable to distortions in the rankings of the synthetic approach due to poor care and maintenance of equipment, violation of safety precautions, etc. on the part of the examinees.

CHAPTER XI

The Relationship Between the Practical Performance Measures and Advancement in Rating Examinations

We were interested in determining the relationship between the tests in our Aviation Structural Mechanics' and Aerial Photographers' Batteries and professional requirements sections of the written advancement in rating examinations prepared by the U. S. Naval Examining Center. Therefore, written Aviation Structural Mechanics' and Aerial Photographers' tests were prepared.

For the Aviation Structural Mechanics, the Series 4, January 1952, advancement in rating examination was used as a source of items. In selecting items, every fourth item was taken from the tests for the rate of AM1, AM2, and AM3. However, no items were taken which did not seem to measure a professional factor. Thus, items such as item number 138, "What is the specialist device worn by a chief radio electrician?" were not included.

For the Aerial Photographers, the Series 4, January 1952 test for the rate of AF2 was used as an item source, since our Aerial Photographers' Battery was directed as a hurdle for the rate of Aerial Photographer, 2/c. Here again an attempt was made to limit our items to those pertaining to the professional factors of the rate.

Both written examinations are presented as Appendix C to the present report.

The written examination prepared for the structural mechanics was administered to the group of Aviation Structural Mechanics who completed the Aviation Structural Mechanics' Battery at NAS, Atlantic City. The Aerial Photographers' written examination was administered to the subjects who completed the Aerial Photographers' Battery at NAS, Pensacola and at NAS, Atlantic City. The examinees' written test scores were correlated with their scores on the tests in the performance batteries. These product-moment correlations are presented in Tables 45 and 46.

TABLE 45

Correlation Between Written Test and Tests in Aviation Structural Mechanics' Battery and Basic Battery for Atlantic City Group of Structural Mechanics

Performance Test	Written
Drill grinding	.512
Hydraulic inspection	.629
Aluminum butt weld	.069
Metal working	.351
Fabrics	.404
Rigid tubing assembly	.584
GCT	.657
Ari.	.648
Mech.	.720
Cler.	.291

TABLE 46

Correlation Between Written Test and Tests in Aerial Photographers' Battery and Basic Battery for Atlantic City and Pensacola Groups of Aerial Photographers

Group Performance Test	Written-Atlantic City	Written-Pensacola
Aerial cameras	.265	.083
Records and reports	.222	.066
Camera maintenance	.203	.140
Chemical mixing	.268	.346
Motion picture processing	.486	.311
Sonne printing	.049	-.189
Speed graphic	.431	.305
Camera installation	----	.114
GCT	.088	----
Ari.	.212	----
Mech.	.295	----
Cler.	.402	----

The correlations between the written examination and the tests in the Aviation Structural Mechanics' Battery are not high. Similarly, all the correlations between the written test and the tests in the Aerial Photographers' Battery are moderately low. In view of these low but positive correlations it seems probable that for the groups tested, our performance tests measured something that was not measured in the two written tests from which our items were drawn.

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APPENDIX A

In Appendix A is presented an outline of the manual on performance test construction mentioned in the body of this report. The complete manual may be received upon written request to Pers. 15, Research Division, Bureau of Naval Personnel.

I. FOREWARD

II. ADVANTAGES AND USES OF PERFORMANCE TESTS.-Chapter I

A. Advantages

1. Work sample
2. Non-verbal
3. Objectivity
4. Ease of administration

B. Uses

1. Selection and assignment
2. Determination of readiness to perform
3. Determination of comparative ability for special job code assignment
4. Determination of readiness for advancement
5. Establishment of achievements of school graduates
6. Indication of progress in schools
7. Indication of strength and weaknesses in training
8. Pre-testing of men entering schools

III. DECIDING WHAT TO USE FOR TEST TASKS.-Chapter II

A. Decision on requirements to be met by examinee

1. Tasks
2. Skills
3. Sources
   a. NAVPERS 18068
   b. Experienced personnel
   c. Training curricula
   d. Navy training courses

B. Considerations in selecting test tasks

1. Representative sample
2. Importance
3. Practicality
4. Number of examiners required
5. Difficulty level

C. Types of performance test recording

1. The final product method
2. The check list method
3. The examinee-recorded method

D. General utility of all types

1. Provision of information for derivation of scores
2. Opportunity for scoring all examinees on same basis
3. Possibility for scoring tests at a later, more convenient time
4. Lack of necessity for reliance on examiner's memory
5. Formilization and simplification of testing procedure

IV. FINAL PRODUCT PERFORMANCE TESTS.-Chapter III

A. Determination of type of product to be made

1. Testing of many aspects of ability
   a. One product requiring several aspects of a skill
   b. Several products each requiring different aspects of a skill

2. Possibility of simple, objective scoring

B. Determination of scoring methods to be used

1. Measurement of physical dimensions of product
2. Determination of freedom of product from defects
3. Comparison of product with scale model
4. Determination of whether product works
5. Measurement of amount of time taken to make product

C. Instructions

1. To examinee
2. To examiner

V. CHECK LIST PERFORMANCE TESTS.-Chapter IV

A. Development of recording form for performance

1. Selection of features to be scored
   a. Completion of each step in task
      1. Observation of steps experienced and competent man takes
      2. Consultation of manufacturer's instruction book for equipment concerned

   b. Care and equipment of tools
   c. Regard for safety rules
   d. Time
   e. The final product

2. Task analysis and review of task analysis by others

3. Construction of test items
   a. Clarity and lack of ambiguity
   b. Simplicity
   c. Correct working order
   d. Coverage of all scorable aspects

B. Choice of scoring weights for check list items

1. Assignment of weights of one or zero
2. Assignment of differential weights

C. Instructions

1. To examinee
2. For examiner

D. Problems in using check lists

1. Subjectivity
2. Hazardous steps
3. Serial steps
4. Alternate methods of performance
5. Non-essential steps
6. Examiner time

VI. EXAMINEE-RECORDED PERFORMANCE TESTS.-Chapter V

A. Consideration devising test tasks

1. Relationship of task to performance or skill to be tested
2. Kinds of resultant information that can be recorded
   a. Measurements
   b. Locations
   c. Interpretations
   d. Records and reports

B. Considerations in designing record form

1. Space for all possible types of information
2. Lack of clues as to correct information
3. Simple scoring

C. Scoring

1. Methods
   a. Number of correct responses
   b. Number of errors
   c. Time

2. Aids
   a. Scoring template
   b. Examiner's check list

D. Instructions

1. To examinee
   a. Description of task
   b. Instructions for recording
   c. List of tools and other equipment which may be used
   d. Precautionary statement about any hazard
   e. Statement of time limit

2. For examiner
   a. Description of task
   b. Description of tools and other equipment to be provided
   c. Instructions for inserting casualties or other special conditions in equipment
   d. Instructions for maintaining good testing conditions
   e. Statement of time limit
   f. Instructions for scoring

VII. USING PERFORMANCE TESTS.-Chapter VI

A. Test administration
1. Testing area
   a. Regularly assigned
   b. Comfortable, ventilated, well-lighted
   c. Quiet

2. Test equipment
   a. In good condition
   b. Uniform when different tools of the same kind are used

3. Uniform time limits
4. Test instructions
   a. Job to be accomplished
   b. Equipment which may be used
   c. General features of performance to be scored
   d. Time limit

B. Pre-testing

1. Information yielded by pre-testing
   a. Adequacy and clarity of instructions
   b. Length of time required
   c. Adequacy of equipment
   d. Difficulty level
   e. Adequacy of task as measure of skill
   f. Clarity of recording form
   g. Adequacy of check list
   h. Suitability of final product for scoring

2. Requirements for pre-test population

C. Distribution of scores

1. Obtaining a distribution
   a. Frequency tabulation
   b. Frequency polygon

2. Information yielded by distribution
   a. Discriminative power of test
   b. Difficulty level of test
   c. Adequacy of test for given purposes

D. Establishment of minimum passing scores

1. Population norms
2. Minimum effective performance or acceptable product
3. Expert judgment

E. Testing teams

1. Construction of tests
2. Scheduling of tests
3. Analysis and revision of tests

F. Performance testing as a continual process

APPENDIX B

In Appendix B, the performance measures developed by the Chief Aerial Photographer, at Pensacola, who read a preliminary version of our manual and attempted to construct performance tests on the basis of that manual. The performance tests as constructed by this man are presented aside from layout in unedited form.

EXHIBIT A

PRACTICAL EXAMINATION FOR AF2

DIRECTIONS TO EXAMINER

This is an examination to determine the examinee's ability to make photographic copies. Read the instruction for examinee, making sure you understand the examination and the methods to be evaluated in its administration.

You will provide the subject a 4" x 5" glossy print with an ink stain on it. You will further provide a 4 x 5 speed graphic camera, two photo-flood lights, the sensitized materials, two sheets of film for each negative desired, a filler pit containing at least one each of the following colors; Blue, Green, Yellow, Orange and Red. The ideal situation is to provide a whole kit containing the C4 and C5 (Blue) X^1, X^2 and B filters (Green) K1 and K2 (Yellow), G (Orange), and A and F (Red). Contrast in copy is controlled to a great extent by contrast fillers and they are a MUST. You will provide a 24" rule, an exposure meter, a means of keeping his original (work to be copied) in place.

You will explain the task to the examinee, have him read the instructions to examinee. If there is any point he doesn't understand clearly re-read that portion of the instruction remembering that this is a testing and not an instructional situation.

The operation will be timed, time to count from the time the candidate says he understands and is ready to commence.

You will permit him to draw any materials from the store room which he considers necessary for the job which have not already been provided.

Record time started, time ended, and total time consumed.

EXHIBIT A (Cont'd.)

PRACTICAL EXAMINATION FOR AF2

INSTRUCTIONS TO EXAMINER

You are to make a 1:1 copy negative of a 4" x 5" glossy print, which has been defaced by an ink stain. You will, by the choice of film, or film and filter combination, eliminate the stain and get a satisfactory negative to reproduce the picture.

You have been provided necessary materials and equipment for the job; however, in the event there is anything you deem necessary for the job, you may procure it from the store room.

You will be graded on your technique in using the camera, rigging your flood lights, checking the subject for even illumination, and in general on your facility at doing a creditable copy job — and on your finished negative.

You will be timed. Your time will be the average time taken by 75% of the people who have taken it. Although I cannot tell you just how long you are allowed, I will not stop you when allotted time is up. You will be permitted to finish the job and your finished product graded. However, you will receive no credit on this score sheet for fulfilling the time requirement. There being no further question, you may proceed. Remember, there is ample time for doing the job, take your time, but don't waste it.

EXHIBIT A (Cont'd.)

PRACTICAL EXAMINATION FOR AF2

SCORING SHEET

Mark the numbers for which the candidate is to receive no credit leaving the ones for credit unmarked and add the ones in the credit side for final score. Mark at time of action; don't rely on memory.

		Yes	No
1.	Did he set up camera properly?.....	2	
2.	Did he rig his lights properly?.....	2	
3.	Did he screw light bulbs in while lead was plugged into electrical outlet?.....		2
4.	Did he use ground glass focus?.....	2	
5.	Did he secure subject with no bulges or bubbles, tightly against a flat surface?.....	2	
6.	Did he check for even illumination?.	2	
7.	Did he have hot spots, shadows or reflections on the subject?.....		2
8.	Did he have any evidence of direct light into lens?.....		2
9.	Did he (unless due to space limitation) have his lights less than four feet from subject?.....		2
10.	Did he determine normal exposure?...	2	
11.	Did he compensate for filter factor?	2	
12.	Did he compensate for bellows extension?.....	5	

EXHIBIT A (Cont'd.)

SCORING SHEET

		Yes	No
13.	Did he use a short scale film?.....		4
14.	Did he use a normal contract developer?.....	2	
15.	If proper developer was not available, did he mix suitable developer?.....	2	
16.	Did he use a filter the color (or a little darker than) the stain on original?.....	2	
17.	Did he place subject perpendicular (90°) to the primary axis of lens?...	5	
18.	Did he shoot at any f/stop larger than f/16? (Ideal step for copy is f/16 on speed Graphic. Give credit for one up or down).....		2
19.	Did he have subject parallel to plate or film?.....	3	
20.	Did he have normal contrast and density in his finished negative?.....	5	
21.	Did he allow 4 times normal indicated exposure for bellows extension? (exclusive of filter factor).....	2	
22.	Did his film have correct color sensitivity?.....	2	
23.	Did he use a filter darker than stain to be removed? (if available).....	2	

Time Started_____ Time Finished_____

Finished within forty (40) minutes, exclusive of time for drying negative.

EXHIBIT B

PRACTICAL FACTORS EXAMINATION FOR AF2

CORRECTIVE PHOTOGRAPHY OR USE OF VIEW CAMERA

EXAMINEE INSTRUCTION

TASK

You are to photograph two vertical blocks of wood placed 4 inches apart. The blocks are to be 10 inches long and 2 inches square. Photograph them showing two sides and tops of both blocks and reproducing parallel lines in subject parallel in the negative image. Fill usable negative area.

You will be provided with:

1. The two blocks.
2. View Camera complete with 2 lenses if available.
3. Tripod and accesecories.
4. Necessary lights.
5. Rule for measuring distance between blocks and to check distance between lines on ground glass.
6. Film - choice of 2.
7. Magnifying glass.

EXHIBIT B (Cont'd.)

PRACTICAL FACTORS EXAMINATION FOR AF2

CORRECTIVE PHOTOGRAPHY OR USE OF VIEW CAMERA

EXAMINER INSTRUCTION

Read carefully the "Instructions for the Examinee." Be sure you understand what he is to do before you attempt to administer the test.

Furnish him the materials listed under examinee's instructions and inform him if there is anything he wants which has not been provided, he may draw some from store room. Give the examinee his instructions and let him read them. If there is any point he doesn't understand, read that portion of the instructions for examinee until he understands. Remembering that this is a test and not (REPEAT NOT) an instructional situation.

Each item is worth a certain number of points. If the man is to get credit for an item, leave the number opposite stand as is, if he is not to receive credit, circle or x out the number. In scoring add the unchecked or unencircled numbers for total score. Check all items possible at the time of their performance. NEVER rely on your memory.

EXHIBIT B (Cont'd.)

PRACTICAL FACTORS EXAMINATION FOR AF2

CORRECTIVE PHOTOGRAPHY OR USE OF VIEW CAMERA

SCORING SHEET

		Yes	No
1.	Did he attach the camera in closed position to the tripod?.....	2	
2.	Did he open the camera and attach lens?....	2	
3.	Did he adjust height of head of the tripod?	2	
4.	Did he fail to tip camera bed where necessary?.....		2
5.	Did he correct for vertical distortion?....	2	
6.	Did he focus on a point 1/3 of the way down the greatest depth of field?.....	2	
7.	Did he correct for lateral distortion?.....	2	
8.	Did he use depth of field control, by swinging lens on its nodal point in the direction of any given plane to bring it into sharp focus?.....	2	
9.	Did he light the subject to best advantage?	2	
10.	Did he watch closely the changes on the ground glass while making his adjustment?..	2	
11.	Did he use magnification for critical focus?	2	
12.	Did he set up at the proper view in distance and choose lens to get necessary image size (if available)?.....	2	
13.	Did he check ground glass for vertical distortion after correcting for depth of field?.....	2	

EXHIBIT B (Cont'd.)

SCORING SHEET

		Yes	No
14.	Did he move lens on rail after it was set up to give correct image size (focus) (tilts OK-swings OK)?.....		2
15.	Did he move front of camera on rail to focus (Note: once image size is fixed, do all critical focusing by moving back of camera back and forth on rail).....		2
16.	Did he swing the camera back toward the parallel to remove vertical distortion?..	2	
17.	Did he experiment with wide angle lens (if furnished)?.....		2
18.	In larger labs where there are several lenses available, did he use largest focal length possible?.....	2	
19.	Did he leave lens axis parallel to monorail when shooting for depth of field?.....	2	
20.	Did he use a combination of front swing and stopping down lens to get sufficient depth of field?.....	2	
21.	Did he measure distance between both ends of certain pairs of parallel lines to see that they were the same distance apart at top and bottom?.....	2	
22.	Did he choose the best available background?.....	2	
23.	Did he start with all adjustments in "battery position"?.....	2	
24.	Does he have tripod braced sturdily?.....	2	

EXHIBIT B (Cont'd.)

SCORING SHEET

		Yes	No
25.	Moves tripod and camera to slightly shift image from left to right or vice versa? (should use lateral slides)		2
26.	Did he eliminate vertical distortion?..	2	
27.	Did he eliminate horigontal distortion?	2	
28.	Did he utilize all usable negative area?	2	
29.	Both images were sharp from extreme corners of image, throughout.....	2	
30.	Time finished..... Finished in 35 minutes or less.....	2	
	Measurements of final product:		
1.	Negative sharp throughout.....	2	
2.	Negative has normal contrast and density.....	2	
3.	Made prints on correct contrast paper..	2	
4.	Did print show any evidence of "dodging" or "burning in"?.....		2

EXHIBIT C

PRACTICAL EXAMINATION FOR AM3

INSTRUCTIONS TO EXAMINER

You will give the examinee a copy of "Instructions to Examinee". Have him read them and be sure he understands them -- Clarify any point he seems to be hazy on, IN THE INSTRUCTIONS, remembering this is a test and not an instructional situation. As soon as the candidate says he thoroughly understands instruction, he may begin.

This task will be scored according to examinee's ability exhibited in the several sub-operations and in keeping with the quality of the finished product. If more than one hour is required for the completion of the task, no score is allowed on the time element.

EXHIBIT C (Cont'd.)

PRACTICAL EXAMINATION FOR AM3

INSTRUCTIONS TO EXAMINER

You are to manufacture a "drip pan" 8" long, 6" wide and 2" deep -- inside dimensions. You will leave no "raw" or sharp edges at the top edges along corner seams. Being a drip pan, it will necessarily be water and oil tight. Material will be .038 or approximately 1/32" thick, copper or brass. You will "flange" and react the corners for strength, obtaining water-tightening by use of hard or soft soldering.

You will be graded on procedure, ability to use the right tools, use them properly, on the quality of the finished product commensurate with time for doing job. "Are there any questions?" If you understand the instructions, thoroughly, you may begin.

EXHIBIT C (Cont'd.)

PRACTICAL EXAMINATION FOR AM3

SCORING SHEET

Check yes or no for deduction, leaving all points accomplished correctly unmarked.

	Yes	No
CARE AND USE OF TOOLS		
1. Does he use the correct tools for layout? Square is necessary unless power shears with a guide set perpendicular to cutting edge of shears is available. If these are provided, he may use rule and straight edge for layout.....		3
2. Does he use sharp instrument for drawing his lines? No blunt instrument such as soft lead pencils, file, center punches or screw drivers used in lieu of scribes or layout pencils.....		3
3. Does he use scribe where pencil is appropriate? Does he allow for thickness of metal when computing dimensions?.....		3
4. Completed layout should look:.....		
(Rough figure drawn here)		
Examinee may place flanges for riveting by extending length of longside rather than short.		3
Flanges to be turned 180° to eliminate raw edges.		

EXHIBIT C (Cont'd.)

SCORING SHEET

	Yes	No
CARE AND USE OF TOOLS (Cont'd)		
5. Does he set brake to proper tolerance before placing his work in machine?.....		3
6. Does he allow thickness of metal between outer edge of brake fingers and actual "lund line" of brake?		3
7. Does he clamp work so tight metal must stretch in the bending process?		3
8. Are there marks from brake on finished product?.....		3
9. Does he use proper size drill for the size rivet he is to use?.....		3
10. Does he use rivet in excess of 2 lbs?		3
11. Does he dent or otherwise mar the outer surface of pan?		3
SAFETY PRECAUTIONS		
1. Does he get his fingers under blade of shear?		3
2. Does he remove burrs and rough edges with file or small hand emery stain before proceeding further? ..		3
3. Does he hold drill perpendicular to surface to be drilled?.....		3
4. Does he reduce pressure on drill before going thru metal to avoid scarring surface with drill chuck?		3

EXHIBIT C (Cont'd.)

SCORING SHEET

	Yes	No
SAFETY PRECAUTIONS (Cont'd.)		
5. Is rivet driven straight and "up set" uniformly throughout?...	3	
6. Is rivet headed properly and is it perfectly round, head conforming to shape of rivet set?	3	
7. Does he hold rivet set perpendicular to surface of work?....	3	
PROCEDURE		
8. Does he use killed acid for soldering flux? (In cases where the various patented fluxes are used, this will not be necessary.)		3
9. Does he stand down wind of work? Should stand up wind to avoid breathing fumes of flux.....	3	
10. If using torch to solder, does he hold tip almost against table top to avoid burning himself or any one else?.....	3	
11. If torch soldering, does he use goggles?.....		3
12. If using iron, does he sling iron to have it shed excess solder?....	3	

EXHIBIT C (Cont'd.)

SCORING SHEET

	Yes	No
MEASURING FINAL PRODUCT		
1. Are sides within 1/32" of perpendicular to bottom?.....	3	
2. Are inside dimensions within 1/16" of specified inside dimensions?..	3	
3. Is job over all smooth, no prominent scratch, dent, elongated rivets, etc.?.....		3
4. Is pan water tight?.....	3	
5. Are soldered seams smooth and free of excess solder?.....	3	

EXHIBIT D

PRACTICAL FACTORS EXAMINATION FOR AF2

REPLACING THE K-17 CASE-DRIVE

INSTRUCTIONS TO EXAMINEE

TASK

1. You are to remove and replace the case-drive of a (K-17) 12" or larger or other aerial camera requiring the standard case drive.

2. You will have 30 minutes in which to remove, replace and restore camera to normal operation.

3. You may use current technical orders at your discretion.

4. You will be graded on your facility at doing the various sub-operations and on the general operational condition of the finished job.

5. The necessary tools are provided for the job. You may draw any additional tools you may desire from the store room.

6. If you understand, thoroughly, all the above instruction, you may proceed.

7. There is a time limit to the job. The time allotted is ample if you do the job correctly; take your time, but don't waste it.

   Time will not be called on you; however, no credit will be allowed for time if you do not meet time requirements.

EXHIBIT D (Cont'd.)

PRACTICAL FACTORS EXAMINATION FOR AF2

REPLACING THE K-47 CASE-DRIVE

INSTRUCTIONS TO EXAMINER

1. You will provide necessary tools and equipment for the task to be performed.

2. You will clarify any instructions to examinee which he may be hazy on. Remembering that this is a testing and NOT an instructional situation.

3. You will score examinee on his facility at choosing the proper tools for a given step and his ability to use it properly.

   a. He will be graded on each sub-operation at the time of its occurrence. DO NOT, at any time, rely on your memory in grading. In other words, do not wait until after 2nd or 3rd step is completed before grading step 1.

   b. Do not interfere with examinee's procedure unless equipment is being subjected to damage. For instance, do not let examinee overwind case drive as this entails renewing of over-wound springs.

4. The allotted time for this task is 30 minutes; you are not to call time, however. Let the examinee finish job for overall grading, but do not give credit for time element unless job is finished in 30 minutes.

5. Score so that the unmarked answers will receive credit encircled or x'd answers none.

EXHIBIT D (Cont'd.)

PRACTICAL FACTORS EXAMINATION FOR AF2

REPLACING THE K-17 CASE-DRIVE

SCORING SHEET

		Yes	No
1.	Did the examinee complete job in allotted time?.....		3
2.	Is mechanism operative?.....		4
3.	Did examinee place lens caps or other protective covering on lens assembly before commencing work in lens cone?.....		5
4.	Did he set shutter speed to fastest obtainable shutter (1 225 second) on 12" K-17?		2
5.	Did he set diaphragm opening to correspond with diameter control dial?.....		3
6.	Did he check to see if tension is on case drive? Did he wind and trip case drive prior to any other operation?.....		3
7.	Did he release initial tension?.....		3
8.	Did he remove diaphragm and shutter speed setting rods?.....		3
9.	Did he remove motor drive connector? (The step is not mandatory - but enables examinee to remove nuts easier than if left in place.).....	3	
10.	Did he remove the 4 nuts by taking one off completely followed by the other three, in order, or did he slack tension on all before completely removing any?	3	
11.	Replace unit.....	3	
12.	Did he remove operating tension from shutter and case drive before installing wind and trip rods?.....	4	
13.	Did he check to see if motor drive connector needed? And provide, if needed?.....		3

EXHIBIT E

PRACTICAL FACTORS EXAMINATION FOR PO2

DIRECTIONS TO EXAMINEE

You are to shoot a 100' production with a 16mm Cine magazine camera or a Bell & Howell Filmo 16mm using reversal film. You will be given the camera complete with film, filters, tripod, tripod brace, flood flights (if film is to be exposed inside), any additional material you need may be drawn from the store room.

You may shoot the production on any subject of your choice; a training movie, some don'ts of the photo lab, a production depicting "How the well-dressed sailor will look", "Military Courtesy", "A visit to the boss", etc. You will be timed from the time you tell examiner you understand all instructions.

EXHIBIT E (Cont'd.)

PRACTICAL FACTORS EXAMINATION FOR PO2

DIRECTIONS TO EXAMINER

You will provide all equipment listed in the "Instructions to Examinee" plus any materials he may wish to request from the store room.

The examinee shall have 2-1/2 hours to complete the production; time to start when he thoroughly understands all instructions. Remember this is a testing and not an instructional situation. You are permitted to explain instructions ONLY.

The examinee should first write a short story from which to produce his script; he should then break it up into scenes, i.e. long shots, medium shots and close-ups for the actual shooting.

EXHIBIT E (Cont'd.)

PRACTICAL FACTORS EXAMINATION FOR PO2

SCORING SHEET

		Yes	No
1.	Did he write a story?.....	3	
2.	Did he prepare a script?.....	3	
3.	Did he follow the script?.....	3	
4.	Did he just set up camera and start shooting?.....		3
5.	Did he safeguard equipment?.....	3	
6.	Did he use filter and auxiliary lens?....	3	
7.	Did he shoot any scenes with camera hand-held?.....		2
8.	Did he shoot all scenes at 24 frames per second? (This is standard).....	2	
9.	Did he use tripod brace (spider) to steady tripod?.....	2	
10.	Did he turn in less than 60% usable for production?.....		2
11.	Did he use exposure meter or other method to obtain proper exposure?.....	2	
12.	Did he show facility at the job generally?	3	
13.	Did he clean lenses, filters before using?	2	
14.	Were his scenes from 2 to 4 feet long?...	2	
15.	Did he secure equipment properly?.....	2	
16.	Did he have each scene rehearsed before shooting it?.....	2	
17.	Did he try to choose spots without confusing backgrounds?.....	2	

SCORING FINISHED PRODUCT: - Following page.

EXHIBIT E (Cont'd.)

PRACTICAL FACTORS EXAMINATION FOR PO2

SCORING SHEET

1. CAMERA TECHNIQUES

   a. Focus _____

   b. Exposure _____

   c. Parallax _____

   d. Panning _____

   e. Tripod Tilt _____

   f. Rewind _____

   g. Camera Movement _____

   h. Stop & Go Action _____ _____Points off

2. COVERAGE

   a. Sequence _____

   b. Continuity _____

   c. Angles/Composition _____

   d. Image Size _____

   e. Scene Length _____

   f. Footage Utilization _____ _____Points off

TOTAL _____%
DATA SHEET 0-10
SLATE 0-10
SCRIPT/JOB PLAN 0-10
FINAL GRADE _____

GRADING INSTRUCTOR _____

REMARKS:

_____ I have discussed this grade
Trainee Signature with the Grading Instructor.

Mark off for each scene out of focus, etc. i.e., if two scenes are out of focus, knock off double, etc.

APPENDIX C

In Appendix C are presented the written Aviation Structural Mechanic's test and the written Aerial Photographer's test mentioned in Chapter XI of this report.

AM WRITTEN EXAMINATION

October 28, 1952

NAME_____ RATE_____

SERVICE NUMBER_____ DATE_____

INSTRUCTIONS

1. Read each question carefully. Be sure that you know what is asked.
2. Although more than one of the answers may be correct - ONE will be BEST!
3. Indicate your choice of the answers by marking or filling in the item as listed in the examination.
4. Indicate ONE CHOICE only.
5. Take your time - be thorough - AVOID HASTE!
6. Check with the examiner on any item which may be confusing to you.
7. Do not write on or otherwise mutilate this examination.

DO NOT MAKE ANY MARKS IN THIS TEST BOOKLET

Mark your answers on the separate answer sheet

1. During normal drilling operations, high speed drills which become hot should be cooled in

   1. water
   2. high flash point oil
   3. still air
   4. cutting oil

2. When an improperly ground twist drill has cutting edges of unequal angles the hole cut by the drill will be

   1. off-center
   2. countersunk
   3. oversize
   4. counter-bored

3. The axis of an airplane that extends from the propeller to the tail is called the

   1. lateral axis
   2. vertical axis
   3. horizontal axis
   4. longitudinal axis

4. For soldering a wrapped cable splice, the recommended flux is

   1. muriatic acid
   2. hydrochloric acid
   3. stearic acid
   4. sal ammoniac

5. When using bolts for fastening structural members, what is the maximum number of threads permitted within the material being bolted?

   1. One
   2. Five
   3. Three
   4. Four

6. What does the letter "W" mean when it follows the code number markings on aluminum alloys?

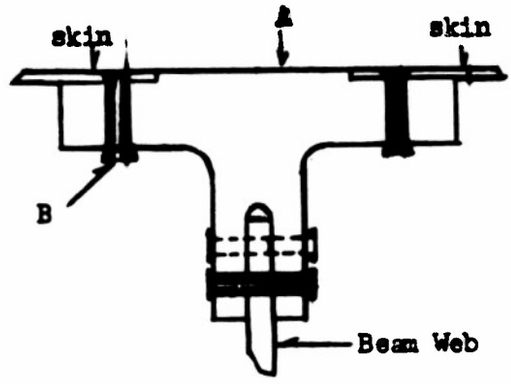
   1. The alloys have been artificially aged
   2. The alloys require artificial aging
   3. The alloys are weldable
   4. The alloys have been cold worked

7. It is best to use the Type A Parker Kalon screw when

   1. The materials to be joined are more than 0.050 inch in thickness
   2. The hole alignment is difficult
   3. The materials to be joined are less than 0.050 inch in thickness
   4. Permanent fastenings are installed on instrument panels

DO NOT STOP. GO ON TO THE NEXT PAGE

Question #8 involves the use of the below illustration.



8. The code number of the rivet indicated by figure "B" is

1. AN426
2. AN430
3. AN442
4. AN456

9. When heat treating aluminum alloys, the "soaking time" is measured from the time at which the load

1. is placed in the furnace or bath
2. reaches the maximum heat-treating temperature
3. reaches the median heat-treating temperature
4. reaches the minimum heat-treating temperature

10. The flux most commonly used for high temperature brazing with a brass filler is

1. rosin
2. stearine
3. borax
4. zinc chloride

11. One characteristic of a good flux for brazing is its ability to

1. form a hard, glassy scale on the surface of the base metal
2. remain fluid and active at the melting point of the brazing alloy
3. vaporize at the melting point of the base metal
4. ball up and roll away as the brazing progresses

DO NOT STOP. GO ON TO THE NEXT PAGE

12. Which of the following types of hydraulic tubing is prescribed for use on systems where the operating pressure does NOT exceed 1500 p.s.i.?

1. Stainless steel (18-8)
2. Aluminum alloy (52S0)
3. Aluminum alloy (61ST)
4. Flexible hose (specification AN-H-28)

13. What is the main purpose of a pressure regulator on a hydraulic system?

1. To maintain constant pressure in the system
2. To regulate the pressure feed to the accumulator
3. To relieve the power pump of its load when the system is not in operation
4. To regulate the working pressure on the actuating cylinder lines

14. How are gear type hydraulic pumps designed to operate?

1. Clockwise in relation to the driven gear
2. Counterclockwise in relation to the driven gear
3. Either clockwise or counterclockwise in relation to the driving gear
4. Through a system of gears that reduce the pump's speed to one half of the driving gear's speed.

15. A double-acting hydraulic hand pump is equipped with

1. one check valve
2. two check valves
3. three check valves
4. four check valves

16. The rate of the recoil stroke of a hydraulic shock strut is controlled by

1. communication holes located directly beneath the piston head
2. a spacer sleeve between the inner and outer cylinders
3. a flapper valve located at the bottom of the piston tube
4. a metering pin and orifice plate

17. The removal of adhesive masking paper from the surface of plastic sheets may be accomplished without injury to the plastic by the use of

1. kerosene
2. alcohol
3. carbon tetrachloride
4. unleaded gasoline

DO NOT STOP. GO ON TO THE NEXT PAGE

18. The appearance of blisters on a painted surface is an indication that

1. The paint was improperly mixed
2. Too much air pressure was used
3. There was water in the air lines
4. The surface was improperly cleaned

19. The reason for using fungicidal dope on fabric is

1. To protect the fabric against mildew
2. To prevent sunlight from harming the fabric
3. To provide a more suitable base for the paint
4. Its ease of application

20. What is the volume of a tank that is 14 inches wide, 39 inches long and 9 inches deep?

1. 4726 cu. in.
2. 4819 cu. in.
3. 4914 cu. in.
4. 4975 cu. in.

21. How are chips and shavings removed from a drill press or other cutting machine during drilling or machining operations?

1. With a stream of air from an air hose
2. The coolant oil floats them off
3. With a brush or hook
4. The machine is stopped frequently and the chips and shavings are removed with a rag

22. Bolts, nuts, and rivets are listed in the ASO catalog under class

1. 43
2. 42
3. 44
4. 45

23. Who is responsible for operating time entries in an auxiliary power unit log?

1. The pilot
2. The plane captain
3. The navigator
4. The co-pilot

24. The publication that contains the proper procedure for splicing a stringer on a PBM-5 is the

1. Erection and Maintenance Manual
2. General Manual for Structural Repair
3. Handbook of Structural Repair
4. Pilot's Handbook

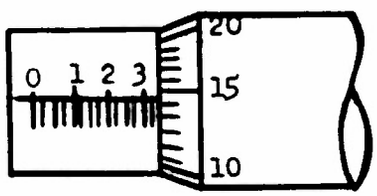
DO NOT STOP. GO ON TO THE NEXT PAGE

25. Which of the following tools is used to transfer measurements in lay-out work?

1. Caliper rule
2. Spring dividers
3. Protractor
4. Duck weights and spline

26. The tapered end of a file that fits into the handle is called the

1. tip
2. heel
3. tang
4. point



27. What is the reading of the micrometer scale illustrated above?

1. 0.325 inch
2. 0.335 inch
3. 0.340 inch
4. 0.345 inch

28. The two materials currently being used for the manufacture of aircraft tire plies are

1. cotton and nylon
2. rayon and cotton
3. nylon and rayon
4. silk and nylon

29. The stress that tends to shorten or push together a rigid member is known as

1. tension
2. torsion
3. compression
4. shear

30. The balance obtained by adding weight forward of the hinge line of a control surface is

1. hydrostatic balance
2. neutral balance
3. aerodynamic balance
4. static balance

31. Aluminum parts being anodized should be held in the anodizing bath, at the proper voltage, for approximately

1. 20 minutes
2. 30 minutes
3. 40 minutes
4. 60 minutes

DO NOT STOP. GO ON TO THE NEXT PAGE

32. Navy specifications require that the alloy and temper of aluminum alloy aircraft tubing be marked by identification bands every

1. 12 inches
2. 2 feet
3. 3 to 5 feet
4. 18 inches

33. The element that imparts hardness, strength, and corrosion resistance when added to steel, is

1. nickel
2. tungsten
3. chromium
4. molybdenum

34. What type of fastener requires the use of the key slot cutter for proper installation?

1. Thompson rivet
2. Chobert rivet
3. Dill Lok-Skru
4. Rivnut

35. The lightest structural metal used in the construction of aircraft is

1. magnesium
2. aluminum
3. "18-8" stainless steel
4. bismuth

36. The most satisfactory method of joining a piece of cast iron to steel is by

1. bronze welding
2. arc welding
3. oxy-acetylene welding
4. forging

37. Acetylene cylinders are frequently charged to pressure as high as

1. 150 p.s.i.
2. 250 p.s.i.
3. 400 p.s.i.
4. 450 p.s.i.

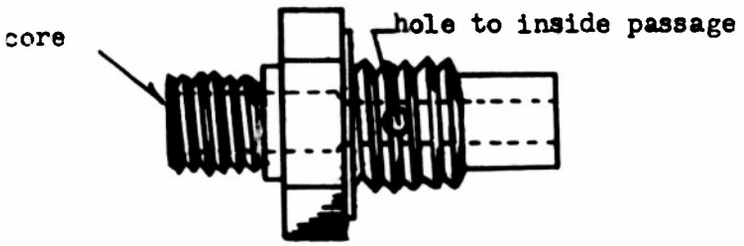
38. Where do foreign particles or sludge collect when hydraulic fluid is passed through the filter element of a mesh-type hydraulic filter?

1. At the bottom of the filter housing
2. On the inside of the filter element
3. On the outside surface of the filter element
4. In the mesh in the interior of the filter element

DO NOT STOP. GO ON TO THE NEXT PAGE

39. Hydraulic system surge chambers are similar to hydraulic

1. accumulators
2. reservoirs
3. deboosters
4. pressure regulators



40. What is the hydraulic fitting illustrated above?

1. Brake line bleeding valve
2. Shock strut filler plug
3. Thermal relief valve
4. Unloading valve

41. The most commonly used selector valves in aircraft hydraulic systems are

1. two-way valves
2. three-way valves
3. four-way valves
4. five-way valves

42. What is the color of hydraulic fluid manufactured with a vegetable oil base?

1. Clear
2. Blue
3. Red
4. Green

43. When rotary output motion is desired, what hydraulic unit should be employed?

1. Seven-piston type pump
2. Rotor-type selector valve
3. Vane type pump
4. Hydraulic motor

DO NOT STOP. GO ON TO THE NEXT PAGE

44. Sealers are applied to aircraft wood primarly to

1. Produce a smooth and glossy surface
2. Produce a surface that will offer little resistance to the slip-stream
3. Seal in and maintain the moisture content of the wood
4. Camouflage and color the finished part.

45. What identification markings does a self-sealing fuel hose have?

1. One solid red stripe
2. Two broken red stripes
3. One solid red stripe and one solid white stripe
4. One broken red stripe and one solid white stripe

46. The main purpose of turpentine in oil based paints is to

1. increase the drying rate
2. protect the surface being painted
3. slow the drying rate
4. make the paint spread more freely and evenly

47. The most common cause of blushing of doped surfaces is

1. improper relative humidity
2. the addition of too much thinner
3. improper drying of previous coats
4. the use of the wrong type of thinner

48. What is the decimal equivalent of 9/32, to the nearest thousandth?

1. 0.028
2. 0.035
3. 0.281
4. 0.355

49. Oxy-acetylene welding and cutting torches should NEVER be ignited with

1. pilot flames
2. safety matches
3. friction lighters
4. spark lighters

DO NOT STOP. GO ON TO THE NEXT PAGE

50. To determine if a wing for a PBM-3 could be used on a PBM-5, one should refer to the

1. Erection and Maintenance Manual
2. Illustrated Parts Catalogue
3. Interchangeability Charts
4. Handbook of Structural Repair

51. The head of department for an aviation structural mechanic in an aircraft squadron is the

1. maintenance officer
2. airframes officer
3. engineer officer
4. assistant maintenance officer

52. The number of threads per inch of a bolt is best determined by the use of a

1. screw pitch gauge
2. single thread lead gauge
3. screw thread micrometer
4. thread comparator

53. The tension adjustment on the sewing machines used in aircraft fabric work determines the

1. length of the stitch
2. speed of the cloth through the machine
3. number of stitches per minute
4. tightness of the stitch

54. Serve tabs are used primarily on large aircraft in order to

1. eliminate aileron flutter
2. aid the pilot in moving the control surface
3. trim aircraft
4. provide inherent stability

55. A bolt requires greater than normal edge distance when it is to be subjected to

1. tension
2. shear
3. compression
4. torsion

DO NOT STOP. GO ON TO THE NEXT PAGE

56. The addition of carbon causes steel to become harder and

1. more resistant to shock
2. tougher
3. more resistant to fatigue
4. more weldable

57. Which of the following precautions must be taken when clamping a holddown plate over a form block in order to hold the sheet metal to be formed in place?

1. Clamp tightly or the metal will slip
2. Clamp near the edge of the form
3. Clamp so the metal may slip slightly
4. Clamp tightly and loosen as forming progresses

58. A primary objective of bonding aircraft parts is to provide a low resistance electrical path. This requires that the bonds must be good conductors of ample size and be

1. installed in pairs
2. as short as possible
3. provided with copper terminals
4. installed at 18-inch intervals or less

59. S.A.E. 3140 steel is

1. chrome molybdenum steel
2. low carbon steel
3. stainless steel
4. high carbon steel

60. Rods to be drawn into wire are pickled in acid, dipped in lime water, and then dried in a steam room. The lime coating adhering to the rods acts to

1. neutralize the acid pickle
2. prevent corrosion while in storage
3. prevent the formation of scale when the rods are reheated for drawing
4. lubricate the rods during drawing

61. One reason for using a small flame for welding 18-8 stainless steel is that

1. stainless steel is a poor heat conductor
2. the melting point is much lower than that of mild steel
3. formation of iron oxides is prevented
4. its rate of heat conduction is very rapid

DO NOT STOP. GO ON TO THE NEXT PAGE

62. One purpose of the coating on some arc welding electrodes is to

1. improve the stability and characteristics of the arc stream
2. supply a coating of oxides over the weld
3. eliminate slag
4. identify the various types of electrodes



63. What does the above symbol represent when used on a hydraulic system diagram?

1. A pressure gauge and snubber
2. A pressure gauge and air bleed
3. A pressure gauge and relief valve
4. A pressure gauge and sniffler valve

64. Gear-type hydraulic pumps are designed for continuous operation at pressures up to

1. 1,000 p.s.i.
2. 1,500 p.s.i.
3. 2,000 p.s.i.
4. 3,000 p.s.i.

65. When filling aircraft shock struts with air, you should

1. remove the weight of the aircraft from the landing gear
2. level the aircraft to normal flying attitude
3. extend the struts beyond their static load point and deflate to the proper extension
4. rock the aircraft while inflating the struts

DO NOT STOP. GO ON TO THE NEXT PAGE

66. Immediately prior to each flight from an aircraft carrier, the exposed surfaces of shock and actuating cylinder pistons of an aircraft should be

1. wiped clean and coated with light oil
2. wiped clean and left dry
3. wiped clean and coated with hydraulic fluid
4. wiped clean, checked for packing leaks and proper operation, and coated with grease

67. In a gear-type hydraulic pump, the gear that rotates in a direction opposite to the rotation of the drive coupling is called a

1. floating gear
2. spur gear
3. driven gear
4. free gear

68. Which of the following drill specifications is correct for drilling acrylic plastics?

1. A lip angle of 62° and a flute angle of 22°
2. A lip angle of 62° and a flute angle of 17°
3. A flute angle of 17° and a lip angle of 70°
4. A flute angle of 25° and a lip angle of 59°

69. Approximately how much aluminum paste is required to mix five gallons of aluminum dope?

1. 1 3/4 pounds
2. 3 1/2 pounds
3. 5 pounds
4. 7 1/2 pounds

70. What are the two types of spray gun commonly used for painting and doping?

1. Suction type and gravity type
2. Single-stage type and double-stage type
3. Pressure type and suction type
4. Attached-container type and separate-container type

71. The base of a right triangle is 7 inches and the hypotenuse is 18 inches. What is the altitude?

1. 14.7 inches
2. 15.4 inches
3. 16.0 inches
4. 16.6 inches

DO NOT STOP. GO ON TO THE NEXT PAGE

72. What is the radius of a circle that has a circumference of 10 feet?

1. 15 inches
2. 19 inches
3. 24 inches
4. 30 inches

73. What special precaution should be taken when it is necessary to oxy-acetylene weld in a confined space?

1. Have a CO_2 fire extinguisher close at hand
2. Wear a respirator
3. Do not weld for long periods of time
4. Have some one stand by the gas cylinder valves

74. The procurement symbol "N" preceeding the stock class of an item means that the

1. part is to be manufactured locally
2. item is stocked only as a complete assembly
3. item is not available for issue
4. item indicated may be drawn from the procurement division of the Treasury Department

75. The responsibility for initiating the appropriate log books for naval aircraft lies with the

1. Bureau of Aeronautics
2. contractor
3. accepting authority
4. Deputy Chief of Naval Operations

76. All Bureau of Aeronautics publications that are coded "07" contain information on

1. hardware and rubber
2. power plants
3. airframes
4. dopes and paints

77. Which of the following types of BuAer publications is of greatest concern to the AM ratings?

1. Aviation Circular Letters
2. Maintenance Notes
3. Aircraft Service Changes
4. Flight Safety Bulletins

DO NOT STOP. GO ON TO THE NEXT PAGE

78. Yellow identification bands on aluminum tubing indicate that the alloy is

1. 17S
2. 24S
3. 52S
4. 61S

79. What type of aircraft brakes, used by the Navy, provides the greatest braking surface?

1. Single disc brakes
2. Multiple disc brakes
3. Expander tube brakes
4. Internal-expanding shoe brakes

80. The station numbering on the fin of an aircraft starts at the

1. top
2. bottom
3. leading edge
4. trailing edge

END OF TEST

AF WRITTEN EXAMINATION

October 22, 1952

NAME_____ RATE_____

SERVICE NUMBER_____ DATE_____

INSTRUCTIONS

1. Read each question carefully. Be sure that you know what is asked.
2. Although more than one of the answers may be correct - ONE will be BEST!
3. Indicate your choice of the answers by marking or filling in the item as listed in the examination.
4. Indicate ONE CHOICE only.
5. Take your time - Be thorough - AVOID HASTE!
6. Check with the examiner on any item which may be confusing to you.
7. Do not write on or otherwise mutilate this examination.

DO NOT MAKE ANY MARKS IN THIS TEST BOOKLET

Mark your answers on the separate answer sheet

1. How are camera doors on a carrier type aircraft operated?

   1. Electrically
   2. Hydraulically
   3. Manually
   4. Mechanically

2. With reference to refraction, the "critical angle" is that angle of incidence of a ray of light in the denser medium at which the refracted ray is

   1. coincident with and parallel to the surface at the point of incidence
   2. 90 degrees from the surface
   3. 180 degrees from the surface
   4. totally reflected into the denser medium

3. What filters will produce yellow when used over two separate lights that are projected and superimposed on a screen?

   1. Red-orange and blue-violet
   2. Cyan and blue-violet
   3. Cyan and magenta
   4. Green and red-orange

4. A K-2 filter may be used as a

   1. haze filter when shooting distant outdoor scenes where haze is excessive
   2. correction filter for pictorial improvement of a scene containing blue sky or blue water
   3. contrast filter when copying a blue print in blue fluorescent light on panchromatic film
   4. correction filter when shooting outdoors on a dull, cloudy day, using panchromatic film and more contrast is desired

5. A type of lens best suited for precision color photography is a/an

   1. anastigmatic lens
   2. rectilinear lens
   3. apochromatic lens
   4. process lens

6. A 20 candlepower lamp 5 feet from a screen, and a lamp of unknown power 20 feet away illuminate a screen equally. The intensity of the second lamp is

   1. 80 candlepower
   2. 160 candlepower
   3. 320 candlepower
   4. 740 candlepower

7. What is the index of refraction of a medium through which light passes at the rate of 83,000 miles per second?

1. 1.64
2. 2.24
3. 2.72
4. 3.32

8. What is the color of a light whose wave length is 500 to 600 millimicrons?

1. Red
2. Yellow
3. Blue
4. Green

9. A submarine periscope, which contains two right-angle prisms, makes use of the principles of

1. diffusion
2. total reflection
3. atmospheric reflection
4. action and reaction

10. A recilinear lens is used to prevent

1. spherical aberration
2. chromatic aberration
3. distortion
4. coma

11. Two colors of light which unite to form white light are called

1. primary colors
2. secondary colors
3. complementary colors
4. monochromatic colors

12. Which of the following statements is NOT true of a developer which has become exhausted?

1. There is a loss of developing power
2. There is a loss of ability to render shadow detail
3. Fogging tendency is decreased
4. Staining tendency is decreased

13. What chemical, when added to the developer, makes it possible to develop negatives at temperatures up to 95 degrees Fahrenheit?

1. Sodium bisulfite
2. Sodium sulfate
3. Sodium nitrate
4. Chrome alum

14. What would happen if the accelerating agent were left out of a D-76 developing formula?

1. The film would develop slowly
2. The developer would turn brown due to oxidation
3. The film would tend to have less density
4. All of the above

15. Which of the following chemicals is NOT related to the others in its action as a photographic chemical?

1. Potassium hydroxide
2. Sodium carbonate
3. Sodium bisulfate
4. Sodium borate

16. Why must hygroscopic chemicals be stored in airtight containers?

1. They give off moisture to the atmosphere
2. They absorb moisture from the atmosphere
3. They crystallize readily upon exposure to air
4. They solidify upon exposure to air

17. What is the function of the second developer in the color reversal process?

1. It produces a black and white negative color separation image in the three emulsions
2. It produces brilliant dye images in the three emulsion layers and forms the final positive image
3. It develops all the silver in the film, either as a part of the negative image or the positive image
4. It converts the black silver to a compound which dissolves in plain hypo without affecting the dye image

18. A synonym for potassium hydroxide is

1. cyanide of potash
2. pyrosulfite
3. caustic potash
4. sodium bisulfate

19. Aerial emulsions supplied on topographic supports have been specially treated to minimize the

1. film defects due to static electricity at high altitudes
2. shrinkage and equalize changes in length and width
3. stretching and equalize changes in length
4. changes in length and width due to changes in atmospheric conditions at various altitudes

20. A developer that produces high-contrast in under exposed aerial negatives is

1. D-72
2. DK-76
3. DK-50
4. D-19

21. Which of the following forms of chemicals can be substituted, weight-for-weight, for a desiccated chemical?

1. Anhydrous
2. Hygroscopic
3. Crystal
4. Monohydrated

22. In order to judge the final quality of a print, you should first inspect it by means of

1. reflected light
2. white light
3. diffused light
4. a safelight

23. A developed print that has a dark olive green tone indicates that it has been

1. overdeveloped
2. overexposed
3. underdeveloped
4. underexposed

24. Prints for a class "A" map should be printed on

1. double weight matte paper
2. double weight glossy paper
3. single weight matte paper
4. single weight glossy paper

25. Shrinkage of mosaic map prints is minimized by

1. rapid drying with a heating unit
2. slow drying in a cool room with average humidity
3. drying the prints, emulsion down, on cheese cloth at room temperature
4. placing the prints in a 1% solution of formaldehyde before drying

26. The most satisfactory adhesive for mounting file prints is

1. dry mount tissue
2. rubber cement
3. gum arabic
4. thermount tissue

27. The process of making a color print on Ansco Printon paper is accomplished by

1. the print being exposed through a color negative
2. the print being exposed through a color transparency
3. a three colored image being superimposed on a final print
4. the image being dyed with special complementary dyes

28. A dense, flat negative should be printed on a paper that has a

1. short scale
2. medium scale
3. medium long scale
4. long scale

29. Prints intended for newspaper publicity should have contrast that is

1. low
2. medium
3. slightly greater than medium
4. high

30. When processing Ansco color Printon, you may turn the white lights on after the print has passed through the

1. first developer
2. bleach
3. color developer
4. short stop

31. A negative printed on #2 paper lacks sufficient contrast for good reproduction of the original scene. No other grade of paper is available. What can you do to produce a better print?

1. Expose longer and give less development
2. Expose longer and give longer development
3. Add more carbonate to the developer
4. Use a more concentrated developer

32. Which of the following is a warm-tone paper developer?

1. D-72
2. D-52
3. D-11
4. D-88

33. Photographic papers which will subdue the brilliance of a scene, as is often desirable with high key pictures, should have a surface that is

1. glossy
2. matte
3. rough
4. fine-grained

34. What type of emulsion can resolve the most lines per millimeter?

1. Slow speed enlarging paper
2. High speed enlarging paper
3. Slow speed panchromatic
4. High speed panchromatic

35. An outdoor photograph taken with daylight Kodachrome film under a heavy overcast sky would be high in

1. red content
2. yellow content
3. green content
4. blue content

36. What is the color of the opaque base from which Printon can be identified?

1. White
2. Black
3. Red
4. Green

37. What developer is most generally used for processing lantern slides?

1. DK-50
2. D-11
3. D-72
4. DK-76

38. Kodachrome type B professional film is color-balanced to a Kelvin temperature of

1. 3200°
2. 3400°
3. 5400°
4. 6100°

39. Which of the following films should be used to copy a multi-colored oil painting?

1. Super Panchro press
2. Process pan
3. Commercial ortho
4. Commercial

40. In order to prevent serious curling of films during the drying process, the back of the film is coated with

1. a clear emulsion
2. various dyes
3. clear-matte backing
4. gelatin

41. What film would you select to emphasize character when making portraits of men under tungsten light?

1. High-speed panchromatic film
2. Slow-speed panchromatic film
3. High-speed orthochromatic film
4. Slow-speed orthochromatic film

42. What effect does a change in the shutter speed setting have on the Graphex shutter after the shutter has been cocked?

1. The shutter will immediately trip when moved to another setting
2. The shutter will operate slower than the new speed setting
3. The shutter mechanism may be damaged to the extent where repairs are necessary
4. There is no harmful effect

43. The shutter speed of the Mitchell Hi-Speed motion picture camera operating at 128 frames per second at its widest shutter opening is

1. 1/271 of a second
2. 1/281 of a second
3. 1/291 of a second
4. 1/301 of a second

44. What is the interval of exposure on a mapping run at an air speed of 195 knots against a wind of 10 knots, if one exposure covers a ground distance of 3,340 feet?

1. 8 seconds
2. 10 seconds
3. 12 seconds
4. 14 seconds

45. An aerial mapping run is made with the K-17 6" camera using the B-3B intervalmoter set at a 40 second interval. How will you know when to level the camera for each exposure?

1. By timing the interval with a stop watch
2. By the warning light which goes on 4 seconds after the shutter trips
3. By careful signalling from the pilot
4. By a warning light which goes on two seconds before the shutter trips

46. Which one of the following photo-flash lamps can safely be fired by a 125 volt power source?

1. Synchro-Press #5
2. Synchro-Press #22
3. Focal Plane #6
4. Focal Plane #31

47. Which one of the following exposures cannot be accomplished with Kodak Medalist?

1. Automatic exposure for one full second
2. Automatic exposure for 1/400 of a second
3. Exposure with a lens opening of f/2.5
4. Exposure with a lens opening of f/32

48. When photographing with the speed graphic, which of the following adjustments would you make after changing from a normal to a wide angle lens?

1. The lens must be drawn off the short section of the track and placed on the end of the front standard
2. The rising front must be adjusted to the uppermost position so the lens will exclude parts of the camera
3. The front bed must be lowered below the normal position and out of the field of view
4. The infinity stops must be removed to the rear to provide a support for the short bellows extension

49. All shutter controls of the Graflex camera are grouped on a panel on the right side with the exception of the

1. tension release knob
2. mirror release lever
3. shutter winding key
4. mirror setting lever

50. When the range finder on the Speed Graphic camera does not coincide with the focus of the camera, it can in most cases be quickly corrected by an adjustment of the

1. eccentric screw on the right rear side of the camera bed
2. vernier scale on the right front side of the camera bed
3. ground glass position
4. parallax scale

51. What lubricant would you use to properly lubricate between the lens shutter leaves and lens diaphragms?

1. Light camera oil
2. Vaseline
3. Powdered graphite
4. None of the above

52. You are flying an aerial photomission at an altitude of 15,000 feet. Light conditions are favorable and relatively no haze is apparent. Which of the following filters would you recommend?

1. Aero 1
2. Red #25
3. Aero 2
4. K-2

53. Why is a K-18 camera NOT recommended for low altitude vertical photography?

1. Its shutter speeds are too slow
2. Its lens speed is too slow
3. Its film size is too large
4. Its magazine capacity is too small

54. The K-19 camera is designed to take photographs of

1. areas requiring camera and ground synchronization
2. areas requiring flash illumination
3. torpedo attacks at fixed intervals
4. gunnery targets at low altitudes

55. The shutter speed of a motion picture camera operating at a shutter opening of 150° and a film speed of 60 fps is

1. 1/96
2. 1/125
3. 1/144
4. 1/168

56. A ship 600 feet long photographed from an altitude of 4,800 feet with the K-18 camera would have an image length of

1. 1 inch
2. 3 inches
3. 5 inches
4. 8 inches

57. What is the best preventive measure against bacterial growths on lens cells?

1. Lowering the relative humidity
2. Raising the relative humidity
3. Frequent cleaning
4. Storing in light tight cases

58. If cold storage space for sensitized materials is limited, preference should be given to

1. bromide paper
2. chloride paper
3. slow-speed negative film
4. high-speed negative film

59. Protection of camera leather from mildew and rot in the tropics may be obtained by treatment with a solution of

1. shellac and mercuric chloride
2. formaldehyde and acetic acid
3. tannic acid and varnish
4. paraffin and gasoline

60. What climatic conditions would most likely increase the possibility of static electricity marks occurring on films?

1. High temperature and low humidity
2. Low temperature and low humidity
3. Low temperature and high humidity
4. High temperature and high humidity

61. Why should large quantities of nitrate base motion picture film NOT be stored in the photographic laboratory?

1. Laboratory space is limited
2. It requires refrigeration
3. It creates a fire hazard
4. It is seldom used

62. What information is contained in the Manual of Naval Photography?

1. Repair and maintenace of photographic equipment
2. Technical orders and bulletins pertaining to photography
3. Detailed information pertaining to aerial photogrammetry
4. Administrative matters pertaining to photography

63. Major changes in aircraft camera installations require prior approval from the

1. Chief of the Bureau of Aeronautics
2. Chief of the U. S. Naval Photographic Center
3. Chief of Naval Photography
4. Chief of the Bureau of Yards and Docks

64. Photographs for all aerial photographic mapping shall have a forward overlap coverage of

1. 40%
2. 50%
3. 60%
4. 65%

65. Operational instructions for the technical control of photographic interpretation units are issued by the

1. Chief of the Bureau of Aeronautics
2. Graphic Section, Division of Naval Intelligence
3. Assistant Secretary of the Navy for Air
4. Chief of Naval Photography

66. Which of the following need NOT be listed on the Quarterly Photographic Report?

1. Sensitized materials
2. Accountable equipment
3. Photographic work performed
4. Photographic chemicals

67. What classification is given the General Negative Log?

1. Unclassified
2. RESTRICTED
3. CONFIDENTIAL
4. SECRET

68. What should be done with photographic equipment in excess of allowance?

1. It should be turned in to the nearest photographic supply point
2. It should be turned in to the Aviation Supply Office
3. It should be listed as "in excess" on the quarterly report
4. It should be surveyed in accordance with instructions contained in the Manual of Naval Photography

69. What additional information is required on a stub requisition when ordering a piece of photographic equipment?

1. Quantity expended the past six months
2. Quantity on order
3. Quantity on hand
4. All of the above

70. What procedure is followed concerning the forwarding of negatives and prints of a news or historical value?

1. Send the original negative and two 8" x 10" prints to the U. S. Naval Photography Center
2. Send a copy negative and three 8" x 10" prints to the U. S. Naval Photography Center
3. Send the original negative and two 8" x 10" prints to the Office of the Chief of Naval Photography
4. Send a copy negative and three 8" x 10" prints to the Office of the Chief of Naval Photography

71. Who is responsible for preparing the Quarterly Photographic Report and forwarding it via the commanding officer, at the end of each quarter?

1. The head of department
2. The supply officer
3. The photographic officer
4. The chief photographer's mate

72. Who determines the requirements for and approves technical publications and instructions concerning photographic equipment?

1. The Chief of Naval Photography
2. The Bureau of Aeronautics
3. The Chief of Naval Operations
4. The Office of Photographic Research

73. When a photographic activity aboard a naval base, naval air base or naval air station requires additional facilities, authority is granted by the

1. Chief of Naval Photography
2. Chief of the Bureau of Aeronautics
3. The Chief of Naval Operations
4. The Office of Photographic Research

74. The administration and operation of a photographic unit of a naval air station is the responsibility of the

1. photographic officer
2. executive officer
3. operations officer
4. commanding officer

APPENDIX D

Appendix D contains a list of comments by the test administrators which were noted by the researcher.

COMMENTS OF TEST ADMINISTRATORS NOTED BY INTERVIEWER

1. Regarding difficulty in test administration:

"It wasn't too hard."
"Outside of a question here and there, they were easy."
"Not difficult at all."
"After first ones, it gets easy."
"Easy because things don't come easy to me and I followed it fairly well. It usually takes me a long time to understand things."
"I'd say it was just about average."

2. Regarding enjoyment derived from test administration:

"Thought it was very nice."
"Enjoyable because I don't get much chance to do these kind of things."
"Enjoyable, after awhile it gets boring but there was pleasure in giving them."
"I liked some and didn't like others."
"I had to keep my eyes open all the time like on the Houston machine, if you looked around you were out of luck; I'd say enjoyable."
"I didn't mind doing it at all."
"I didn't mind doing it, I'll put it that way."
"I didn't mind it."

3. Regarding test administration as full time duty:

"I'd rather work on an airplane."
"I wouldn't mind it."
"I wouldn't want it permanent time."
"I don't especially dislike it, I'm interested in training."
"It'd take me away from other work."
"Sure, it's a job that you carry out to the best of your qualifications, wouldn't want to get hung up with a school though."
"If I had no other duties it would be all right."
"I certainly would like it because I'd learn something."

COMMENTS OF TEST ADMINISTRATORS NOTED BY INTERVIEWER

(Cont'd.)

4. Regarding their ability to compose performance tests.

"If I was given time, I could figure it out."
"If I had a book to go by."
"I think so."
"I sure could."
"I believe I could."
"To a certain extent, in the things I have a knowledge of."

5. Regarding improvements in scoring procedures:

"I think it's pretty good as it is."
"I don't think there's anything else you can do."
"I don't quite understand the scoring since I'm not mathematically inclined; the item by item scoring is good since a guy can turn out good work and still do terrible things."
"Scoring seemed pretty fair to me."
"Biggest part was on end product and that was fair."
"Scoring is all right, final product counts more than the rest, that's the main thing."
"'Safety' is good, most people fail on safety; I'd say it's OK."
"Nothing wrong with scoring, very fair I believe."
"Don't really know, it was all right."
"I don't think it could be improved."

6. General remarks about tests:

"They clearly show what a man knows."
"They really weed men out."
"They point out training needs."
"I think they were very practical."
"I really think it's about the best test way, it's an honest way, the examiner has no partiality or anything."
"Filling in a data sheet left no room for a guy's imagination."

COMMENTS OF TEST ADMINISTRATORS NOTED BY INTERVIEWER

(Cont'd.)

6. General remarks about tests: (Cont'd.)

"Mighty good way of putting in practical factors."
"I think they were fine; in some cases you may have to vary from time to time to meet squadron requirements."
"I'd say there's too many fellows around today that haven't been doing the rate that have been given the rate, you can soon tell once you start giving him a test whether he knows his rate or not."
"The tests are practical right here in the squadron like this."
"The tests have their good points."
"I don't think they're a bunch of crap; I don't think it takes up too much time and I'm in favor of practical work on an exam, even if a man writes out a 4.0 exam, he may not be able to do the work."
"I'd like to see tests like this in use because I think they are going to cause more men to study a little more and actually practice a lot more."
"It was a good practical factors test, it shows what you know about a man, both good and bad; it's a very good method."
"Overall, I think they were very good tests."
"They covered everything, handling, cleanliness."
"I think they were very good, not only do they tell you what you know but, they tell what you don't know."