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AN INTRODUCTION TO TECHNICAL HANDS-ON TRAINING SYSTEM (THOTS). (U)

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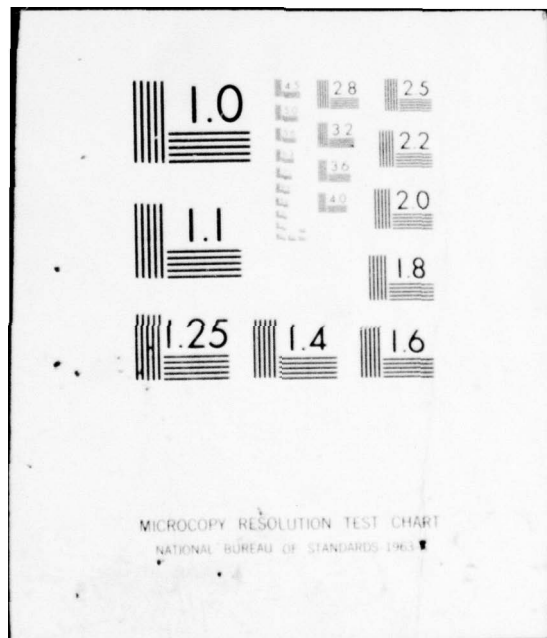
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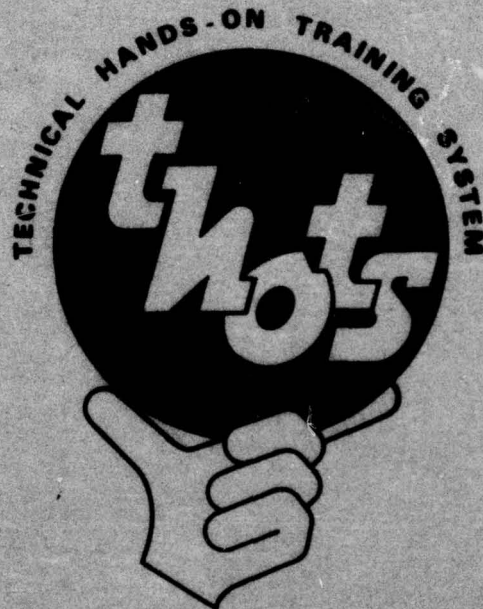
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Technical Report: NAVTRAEQUIPCEN IH-259

AN INTRODUCTION TO:

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Support Documentation and Training Division
Naval Training Equipment Center
Orlando, Florida 32813

November 1976 (Revised)

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Technical Report: NAVTRAEQUIPCEN IH-259

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→ This report presents the background of the program's initiation and development, points out some advantages and disadvantages, describes the steps involved in developing THOTS packets, and provides a description of the Data Item Description used to procure THOTS Training Programs. →

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SUMMARY

This report provides an introduction to Technical Hands-On Training Systems Packets (THOTS), gives background on the program's initiation and development, and points out some of its advantages and disadvantages. It was prepared by the Support Documentation and Training Division, Naval Training Equipment Center, Orlando, Florida.

THOTS is an instructional system, comprised of individualized, self-paced instructional packets which lead the student through learning and troubleshooting problems in a logical manner by utilizing maintenance documentation. The THOTS packets serve as the principal method of instruction for students receiving training on the training equipment. The "hands-on" approach will provide the practical experience needed to fully develop the technical skills of prospective technicians. THOTS is essentially a threefold concept of training designed to include the following components: (1) individualized, self-paced learning, (2) maintenance manual utilization, and (3) "hands-on" training operation and maintenance activities on training equipment.

Although the Navy is referred to throughout this report, the same THOTS techniques may be readily adaptable to the other Armed Services.

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SECTION I

AN INTRODUCTION TO THOTS

One of the most pervasive themes dominating American vocational instruction during the last few years is the practical or "hands-on" approach to training. The resurgence and rapid expansion of this instructional technique during the past decade stems from its concentration on the ultimate objectives of vocational education and the performance of specific skills. In the past, students often received an intense indoctrination on the theoretical operation of technical equipment, but oddly enough, received little "hands-on" experience with the equipment itself. This often created a situation in which the vocational graduate possessed a theoretical understanding of the technical equipment, but did not actually have the expertise to operate and repair it. As a consequence, an instructional method emphasizing the "hands-on" approach to training is increasingly advocated as an acceptable alternative to the theory-oriented techniques of the past. The "hands-on" training approach will provide the practical experience needed to fully develop the technical skills of prospective technicians. Aside from its educational advantages, "hands-on" instruction provides an economical method of vocational training, on a life-cycle basis. For these reasons the Navy education and training community has proceeded to adopt a "hands-on" approach to training in many of its technical courses. One such innovative method of "hands-on" training is the Technical Hands-On Training System (THOTS) concept recently developed for technical courses.

THOTS is essentially a threefold concept designed to include the following components: (1) individualized, self-paced learning, (2) maintenance manual utilization, and (3) "hands-on" training activities. While these instructional features have been incorporated into an infinite variety of conventional teaching methods, the idea of combining all three into one pedagogical mode is quite innovative. A plausible description of the threefold nature of THOTS is contained in the following definition: THOTS is an individualized, self-paced method of instruction which directs students to utilize maintenance manuals normally used with operational equipment in the performance of numerous "hands-on" operation and maintenance activities on training equipment.¹

Each THOTS course is comprised of a series of individualized instructional packets which systematically lead the student through progressive operational and troubleshooting assignments. Although students are at liberty to work by themselves or with others, an instructor is always available for consultation and observation when learning difficulties arise. Students proceed to each new learning objective at essentially their own pace. All THOTS packets are based on behavioral objectives which denote the ultimate learning goals to be obtained from the packets, and from the overall course.

¹Refer to the Data Item Description in Appendix A for a more precise description of the THOTS concept.

As stated previously, another important element of the THOTS concept is the use of maintenance manuals. Maintenance manuals, as utilized in THOTS, afford an opportunity for students to become familiar with technical information about devices, and are used as aids in the development of practical troubleshooting repair and alignment procedures. Despite their apparent advantages, the maintenance manuals are often disregarded by many experienced maintenance personnel. Unfortunately, these particular types of technicians have never developed the habit of properly incorporating the manuals into their operational and maintenance activities. THOTS alleviates this by compelling and directing the student to constantly employ the manuals when conducting operational and troubleshooting assignments. In fact, it would be impossible for students to accurately perform THOTS "hands-on" experiments without the maintenance manuals. Consistent utilization of this technical material will enable the students to develop a genuine appreciation for the value of maintenance documentation and will instill in each the habit of referring to the manual when technical advice is sought.

The practical or "hands-on" approach to training is a third fundamental component of the THOTS system. "Hands-on" activities enable students to learn theoretical concepts thoroughly by giving them the opportunity to employ technical theory in the performance of real maintenance activities. Practical application reinforces the knowledge derived from printed materials, and makes the course relevant to ultimate vocational objectives. Practical application is such an important, vital part of THOTS instruction that a substantial amount of class time is usually devoted to "hands-on" activities. In addition to its utility in the instructional process, "hands-on" experimentation has proven to be a most acceptable learning activity for the students.

Under the THOTS technique, students begin a sequence of learning activities by commencing on a new packet. A THOTS packet is an individual, spiral-bound booklet containing a set of objectives, assignments, instructions, and supplemental information. THOTS packets are arranged in numerical sequence and students proceed from packet-to-packet as they progress through the course. The introductory page of the first packet usually lists the learning objectives to be accomplished, contains information on course prerequisites and supplemental facts, and provides a concise overview of the learning behaviors to be achieved upon course completion. Following the introductory page is a section containing a series of practical assignments. These assignments usually provide a "closed-loop" sequence of instruction, i.e., a sequence of learning activities that, upon completion, return to the initial objective by leading each student from the THOTS packet to the appropriate maintenance document, then to the equipment for practical "hands-on" application, and eventually back to the packet and the individual objective. Finally, the packet contains a series of information sheets which contain supplemental data and are designed to assist the student in completing the activities provided in the assignments. Appendix A provides more detailed information on the learning activities contained in THOTS packets.

After reading the contents of the first assignment, the student usually proceeds to the appropriate maintenance manual where he receives specific instructions for performing the maintenance and operational tasks delineated

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in the packet. Typical maintenance manual instructions would include such information as alignment, assembly, disassembly, and troubleshooting procedures. After performing the proper maintenance procedures, the student returns to the packet and records his findings in the allotted space. The Instructor conducts proper observations and evaluations as deemed necessary. The student subsequently proceeds to the next assignment listed in the packet and begins the "closed-loop" sequence of activities again.

SECTION II

HISTORY OF THOTS

While the origin of individualized "hands-on" instruction dates back many years, its impact on Navy training has occurred in relatively recent times. Some of the first attempts by the Navy to implement individualized "hands-on" training under the THOTS concept were provided by the Naval Education and Training Support Center, Pacific. THOTS instructional material was prepared for Device 14A2F, Surface Ship Anti-Submarine Warfare Attack Trainers and Device 21A38, Anti-Submarine Warfare Submarine Trainer. A THOTS packet was prepared for the Automatic Send-Receive Model 33 teletypewriter in 1972. Although the Model 33 teletypewriter employed the THOTS technique, the first training course to employ the full THOTS concept was the Device 2F95, F-14A Operational Flight Trainer, maintenance training course conducted at the Naval Air Station (NAS) Oceana, Virginia.

The 2F95 course at NAS Oceana was originally scheduled to be taught using conventional teaching methods by a contractor. Conventional teaching methods means that the instructor teaches theory in a classroom and then assembles students around the equipment for practical instruction. The contractor for Device 2F95 was originally required to provide a conventionally taught Device 2F95 course at NAS Miramar, California and, after completion of the NAS Miramar course, was scheduled to provide a similar Device 2F95 course at NAS Oceana. Unfortunately, the cost of the course at NAS Oceana was prohibitive. As a result, Naval Training Equipment Center (NAVTRAEQUIPCEN) personnel decided to develop an "in-house" (within the Navy organization) Device 2F95 course as a substitute for the contractor-conducted training course. After exploring various instructional alternatives for the "in-house" course, the idea of employing a "hands-on," self-paced, method was eventually formulated. Final plans called for three Field Engineering Representatives (FERs) at the Naval Education and Training Support Center, Pacific (NAVEDTRASUPPCENPAC) to attend the conventional Device 2F95 course taught by the contractor at NAS Miramar, determine the technical content of the course, and subsequently write individualized instructional pamphlets. Consequently, when the contractor-conducted course was eventually presented at NAS Miramar, three FERs from NAVEDTRASUPPCENPAC were allowed to attend the course, collect all necessary maintenance documentation, become technically competent, and begin developing individualized materials for the NAS Oceana course.

The in-house efforts of NAVEDTRASUPPCENPAC eventually culminated in a "hands-on," self-paced training course for Device 2F95, which started at NAS Oceana in December 1974 and ended in March 1975. A substantial amount of training funds was saved with this in-house effort. Because the NAS Oceana course utilized a "hands-on," individualized approach, the acronym THOTS was designated to represent this innovative teaching technique.

The response of students and instructors at NAS Oceana to the THOTS concept was quite complimentary and enthusiastic. Students and instructors

were impressed with the relevance of daily THOTS activities to the attainment of technical skills. The favorable response of students can also be attributed to the fact that course progression was at their own pace, and operational and maintenance procedures were similar to those performed by experienced technicians. The THOTS technique gained recognition in the Fleet as a viable instructional alternative to conventional methods. As a result, Fleet personnel have subsequently requested the development of additional THOTS courses. NAVTRAEQUIPCEN representatives may eventually utilize both Navy personnel and civilian contractors to develop future THOTS courses. Because of its ability to provide a high quality instructional approach, THOTS, when fully implemented, will have a tremendous impact on the entire structure of technical training courses which address specific complex equipment.

SECTION III

THE ADVANTAGES AND DISADVANTAGES OF THOTS

In comparing the THOTS concept with its conventional counterparts, distinct educational advantages are noted. For example, under the THOTS concept every student has the opportunity to acquire knowledge in an individualized, self-paced manner. Individualization can be especially beneficial in technological instruction where the acquisition of a skill is based on the successful comprehension of highly complex technical concepts, each more difficult than the one before it. The THOTS method allows students to competently acquire a technical concept, without being burdened with time constraints, as so frequently occurs in the conventional classroom. Stated specific behavioral objectives enhance the quality of THOTS instruction, since they provide a logical format for presenting new concepts, and include only information that is relevant to course learning goals. Objectives clearly describe what the trainee must be able to do, the conditions under which he must be able to perform, and the standard or criterion of acceptable performance. Indeed, self-paced and objective-oriented instruction can be advantageous in the acquisition of technological concepts.

When effectively combined with self-pacing and objective-oriented instruction, "hands-on" activities (practical application) provide another important advantage of the THOTS concept. "Hands-on" activities give the students a greater opportunity to use and learn the equipment than conventional methods, and thus improve the development of operational and maintenance skills. "Hands-on" benefits are often disputed by adherents of conventional instruction where the majority of class time is still devoted to the acquisition of technical theory. Proponents of the conventional approach often insist that students who possess a thorough understanding of technical theory can eventually maintain a greater variety of training devices than those technicians without this knowledge. Some advocates of the conventional approach claim that ample "hands-on" experience can be obtained during the student's eventual On-the-Job-Training (OJT) assignment. In reply, one must realize that a "hands-on" approach to training does not discard all theoretical learning. It simply reduces the amount of classroom theory that students receive and provides the opportunity for students to put into practice what they learn. THOTS instructors wish to eliminate extraneous theoretical information still conveyed in conventional classrooms, and allow students to thoroughly comprehend the more important concepts by demonstrating their ability on the equipment. There will always be debating between proponents of the "hands-on" approach and those supporting classroom theory concerning the merits of each approach. Probably, some valid criteria for determining the true success of the "hands-on" technique will be the actual job performance of graduates of THOTS courses. Recent requests from the Fleet for more THOTS courses, versus the conventional courses, indicate that the job performance of THOTS-trained personnel has been more than satisfactory.

THOTS also has advantages over conventional techniques in the areas of follow-on and replacement training. Follow-on training refers to the

training needed for additional personnel required to maintain an installation. Replacement training refers to the training required for personnel who replace the original technicians. Under conventional methods, follow-on and replacement personnel acquire technical information through formal classroom instruction or through OJT training. OJT was usually the preferred method since new trainees could contribute immediately to actual shop assignments. This was not possible, when students were occupied with formal classroom activities. Besides, time and monetary constraints usually restricted the number of maintenance personnel available for attending formal courses. With traditional training techniques, the technical expertise needed to maintain equipment gradually declines as originally trained personnel are transferred. Problems of this nature are alleviated under the THOTS system. Follow-on and replacement personnel can be exposed to the same quality of instruction as the original personnel, without returning to the classroom. New technicians can simply read the information contained in packets and progress at their own pace.

Although the THOTS concept offers an excellent method of instruction, there are also some disadvantages in its utilization. Because THOTS is an objective-oriented, individualized, self-paced approach to training, a considerable amount of time and effort may be needed before technical writers can develop valid packets. Thus, the implementation expenses of THOTS are anticipated to be greater than normal until developers gain more experience and expertise of the new system. Implementation costs may be initially higher because of the effort needed to become familiar with THOTS, to gather maintenance documentation, to write individualized instructional materials, and to validate the resulting instructional product. In all fairness, it should be further acknowledged that, while the implementation expense may be greater, subsequent costs are often similar to, or even less than, those of conventional courses. Once the packets have been developed, they need only be periodically revised in order to remain effective.

Another adversity is the fact that quality maintenance documentation must be available before THOTS packets can be competently written. Information in the maintenance manuals is used by the technical writer when preparing the packets. If the maintenance documentation is inaccurate or sub-standard, the packets will also have technical defects and be of less use.

With the advent of the Functional Oriented Maintenance Manual System (FOMMS), the publications specialists believe that maintenance documentation will be more accurate and easier to comprehend. Improvements in maintenance documentation will undoubtedly enhance the effectiveness of THOTS packets. The FOMM concept has considerable potential for developers of THOTS packets. The concept entails the use of tiered diagrams depicting all functions performed by the equipment at three or more levels, as follows:

- a. Overall functional block diagram.
- b. One or more levels of intermediate function diagrams.
- c. Detailed functional diagrams.
- d. Blocked schematics.

Some of the more significant features of FOMM are:

- a. Complete cross-referencing between levels of diagrams which provides rapid access to required data at any level, thus reducing time required for fault isolation.
- b. Detailed functional diagrams show complete circuitry and hardware details required for fault isolation to the printed circuit card or module level.
- c. Keyed text containing the theory required for understanding of the function is presented on the page facing each diagram.

As with any type of "hands-on" instruction, the teacher-pupil ratio will be lower for THOTS than for conventional methods. The THOTS system usually requires a teacher-pupil ratio of 1:6 or 1:7 to be successful. This low teacher-pupil ratio is necessary because of the many "hands-on" activities that occur in this form of instruction. Since inexperienced personnel are operating valuable training equipment, an instructor must be present to monitor safety regulations and to guard against costly equipment malfunctions. With conventional techniques, teacher-pupil ratios can be as high as 1:12 or 1:15 since the majority of class time is devoted to the acquisition of technical theory. Because of the lower teacher-pupil ratio, THOTS instruction can often become inconvenient when fiscal austerity is a vital consideration.

When evaluating the progress of students through a THOTS course, "hands-on" activities require a periodic observation by the teacher, since the student is continuously shifting from packets, to manuals, to training equipment. Activities such as these are complex, time-consuming, and difficult to evaluate accurately. Conventional evaluations are not burdened with such restrictions. The instructor can develop a new test composed of the theoretical concepts covered since the last exam. It is also a simple task to convert conventional test results into numerical and letter grades. Conventional tests also have disadvantages since they do not always reveal a student's ability to perform many of the manual skills needed in vocational training.

Possibly one of the most valuable attributes of the THOTS concept is its dependence on the learning initiative of each individual student. As with all forms of individualized instruction, the student has the primary responsibility for progressing through a THOTS course. Students are expected to read packets, perform "hands-on" activities, and study course materials in a conscientious manner. With students who are dedicated to the pursuit of technical knowledge, self-paced instruction is most beneficial since it allows students to study without the need for competing against each other. But, for those who are not so enthusiastic, independent initiative can often become a detriment to constructive learning. Thus, every attempt must be made to obtain students who are really devoted to the acquisition of course information, for without such interest, the advantages of THOTS are useless. Then again, here is where the instructor/training director must use his educational techniques and motivate the students to learn and progress.

SECTION IV

THE DEVELOPMENT OF THOTS MATERIALS

After having acquired some understanding of the philosophical characteristics and historical evolution of the THOTS concept, a brief explanation of the development of individualized packets is in order. Standard procedures for its preparation are in the developmental stage. There are several basic steps that must be accomplished if learning materials are to be representative of the THOTS instructional approach. For instance, writers must familiarize themselves with the THOTS concept if they are to create adequate learning materials. Hence, those involved usually devote a considerable amount of time learning the specific details of this technique. Next, all relevant maintenance documentation is gathered so that it can be utilized in the formation of learning concepts. There are approximately eight such steps that must be taken by the training activity from the time a THOTS course for specific hardware is initially planned. These eight fundamental steps are:

a. Learn the THOTS concept. As stated previously, all instructors and technical writers must familiarize themselves with the basic nature of the THOTS concept. Instructors must recognize that student learning occurs primarily through "hands-on" activities, and not through classroom discussions or lectures. They must also have an appreciation of individualized, self-paced instruction.

b. Gather maintenance documentation. Maintenance documents form the technical expertise upon which learning concepts for a THOTS course are devised. Thus, all relevant maintenance documentation must be gathered and reviewed for technical accuracy before being utilized in the learning packets.

c. Conduct task analysis. An analysis of the daily activities of experienced maintenance personnel must be conducted so that accurate course objectives can be formulated. Considerable time is spent discussing the specific work activities of veteran technicians. Task analysis also determines those skills which a student must acquire in order to accomplish the work activities of a specific job. Its purpose is similar to that of conventional courses.

d. Write behavioral objectives. After a task analysis has been conducted, course designers will determine specific, enabling, and terminal objectives. Objectives define the purpose and the learning behaviors to be acquired from a course. They help structure a course so that ultimate learning goals can be obtained. The procedure for devising THOTS specific behavioral objectives is similar to that established for conventional instruction.

e. Write THOTS packets. Writing the individualized packets will require a great deal of effort. Packet assignments have to be formulated which incorporate the technical information contained in maintenance manuals. Also, each "hands-on" activity must enhance student acquisition of course concepts and be accomplished with maximum safety precautions in mind. Because of the need to create relevant "hands-on" activities, and to effectively incorporate maintenance manuals into student learning experiences, the development of THOTS packets is a difficult, time-consuming activity.

f. Test and validation. The next logical step in the development of THOTS materials is the test and validation phase. After the packets are constructed, they are validated by administering the packets to a typical student population for technical accuracy and training effectiveness. Obviously, time is allotted in this step for needed revisions.

g. Course presentation. Students take the course using THOTS packets. Students proceed at their own pace and are constantly utilizing packets and maintenance manuals in the performance of "hands-on" activities with the equipment. Instructors are present to assist individual students whenever the need arises.

h. Updating. When information contained in the packets becomes inaccurate or is no longer applicable, it is subject to revision. Updating the packets is a continuing process which occurs at intervals throughout the entire life of a THOTS course.

Various methods may be used for conducting the eight steps previously mentioned. Some writers will devote more attention to these steps than others, but hopefully this information has provided a better conception of the activities that occur when THOTS materials are developed.

Civilian contractors or Navy in-house activities may be utilized to construct THOTS materials. While FERs from NAVTRASUPPCENPAC developed the individualized packets for the Device 2F95 course, such effort could also be accomplished by personnel from other Navy activities who have qualified personnel. Although in-house development of THOTS appears to be more economical, it may be more practical for the Navy to employ civilian contractors to develop THOTS courses. Personnel at Navy commands have many job-related activities to perform and may not be able to devote sufficient time to the development and conduct of a THOTS program. Thus, they are not always able to develop individualized instructional materials when the need arises. Contractors can be employed to develop THOTS materials on a contractual basis. They would simply have to become familiar with the THOTS concept, and develop learning materials that are truly representative of this "hands-on," self-paced, instructional approach. Hopefully, as the concept continues to be publicized throughout the Naval training organization, future instructional materials will be produced by both in-house and civilian contractor facilities.

SECTION V

THE COST-EFFECTIVENESS OF THOTS

Although THOTS is a method of instruction that would be effective in an infinite variety of courses, it is felt that its greatest potential lies in the area of contractor-conducted training. Such training occurs when the Navy purchases a new trainer or simulator and needs to instruct Navy technicians on the operation and maintenance of this new device. Contractor-conducted training courses are highly specialized and only presented to a small group of technicians. Because of the developmental costs involved in creating a highly specialized course, it would be impractical to create a THOTS course for one presentation. However, when such a course is repeated several times, average costs can become similar to those obtainable with traditional methods. For example, suppose the Navy decided to purchase identical trainers for three different training sites. While THOTS would be more expensive for the first (initial) course than conventional techniques, the lower costs of the two subsequent courses should help to compensate for this initial expense. Consequently, the costs of teaching all three courses should average out and be approximately the same, whether THOTS or conventional techniques are utilized.

In describing the cost-effectiveness of THOTS, it is well to be aware of the fact that the cost of an initial, follow-on, or replacement THOTS course will probably be higher than that of a conventional counterpart, but once the THOTS packets have been prepared, the costs of subsequent THOTS courses should be less than that of a conventional course and, as the number of course presentations increases, the more economical THOTS instruction will become. The amortization schedule of THOTS courses offsets the initial development expenses. The scarcity of previous THOTS courses prevents a more accurate appraisal of its cost effectiveness. While statistics from in-house THOTS projects are available, they do not constitute a valid indication of the total costs involved in contractor-conducted THOTS courses.

It should be realized that the THOTS self-paced, instructional approach may not be as cost-effective, in the same sense, as self-paced courses in the Service School Commands. Self-paced instruction is cost-effective in the service schools because it can reduce the amount of time students are in school. It is anticipated that the THOTS courses may reduce the amount of time students take the course, but its principal advantage has thus far been its learning effectiveness and student motivation. When students graduate from service schools in less time, they are able to devote more time to Fleet activities. This enables the Navy to realize a substantial savings from individualized instruction.

The conditions that enable individualization to be cost-effective in service schools do not exist in contractor-conducted training courses. Courses conducted by civilian contractors are usually composed of a small number of students, all of whom graduate from the course at the same time. There is no realization of a savings by having a large number of students

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graduate from a course sooner than expected. Thus, the utilization of THOTS will not be as cost-effective in contractor-conducted training as in the service schools. It is suspected that THOTS can save money over conventional methods in the area of follow-on and replacement training. Savings are possible in follow-on and replacement training, provided THOTS is utilized in the initial course. New personnel can obtain copies of the initial course packets, study at their own pace, and obtain the assistance of an instructor when the need arises. Even so, in ascertaining the advantages of THOTS, one must view the concept primarily from an educational perspective and not from an economical one.

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APPENDIX A

DATA ITEM DESCRIPTION FOR THOTS

| DATA ITEM DESCRIPTION | 2 IDENTIFICATION NO(S) | |
|---|--|---------------------|
| 1. TITLE | AGENCY | NUMBER |
| Packets, Technical Hands-On Training System | Navy | UDI-H-25536/MOD |
| 3. DESCRIPTION/PURPOSE THOTS is an instructional system comprised of individualized instructional packets which lead the student through learning and troubleshooting problems in a logical manner through maximum use of maintenance documentation. The purpose of THOTS is to serve as the principal method of instruction for students receiving training on equipment. The overall purpose of THOTS is to assist a student in researching documentation for needed information, troubleshooting, and to be self-sufficient and more proficient. Hands-on exercises, job plans and troubleshooting problems are used extensively for analyzing the documentation as well as for learning and testing. Each packet covers a unit, subject, or sub-systems pertaining to specific equipment or function(s). Each student works independently (or buddy-system) at essentially his own pace. An instructor(s) is present throughout the THOTS program to assist the student(s) as needed, and to follow and evaluate the progress of students. | 4. APPROVAL DATE | 1 November 1976 |
| | 5. OFFICE OF PRIMARY RESPONSIBILITY | NAVTRAEQUIPCEN, N-4 |
| | 6. DDC REQUIRED | |
| | 7. APPROVAL LIMITATION | |
| 7. APPLICATION/INTERRELATIONSHIP The maintenance handbooks and the equipment for which the THOTS packets have been designed for training shall be readily available to the students. THOTS packets are used in conjunction with maintenance documentation. THOTS packets provide a "closed-loop" of instruction by leading each student from the THOTS packet to the maintenance document, then to the equipment for practical hands-on application, and back to the THOTS packet for recording findings. THOTS packets provide opportunity for students to analyze problems, research documentation, and to ultimately solve and correct problems. | 9. REFERENCES (Mandatory as cited in block 10) | |
| | 10. PREPARATION INSTRUCTIONS | MCSL NUMBER(S) |
| 10.1 Unless otherwise indicated in the contract, the documents in this block of the issue in effect on the date of the invitation for bids or request for proposals or quotations form a part of this data item description to the extent specified herein. | | |
| 10.2 THOTS Packets are required when specified in the Contract Data Requirements List. | | |
| 10.3 The packets shall be 8 x 10½ inches or 8½ x 11 inches. Reproduction shall be on one side of approximately 60-pound white offset stock. Method of reproduction shall be either press or electrostatic, as required to produce sharp, clear illustration and text. Pages shall be assembled so that printing is on the right-hand page facing a blank left-hand page. Text material shall be double spaced, single column typing. | | |
| 10.4 Each packet shall be bound in a General Binding Corporation (GBC), or equivalent, binder having a plastic spiral ring/comb and a clear vinyl plastic cover of approximately 12- to 15-mil thickness. | | |
| 10.5 Cover - The first sheet under the clear vinyl plastic cover shall be prepared in the format and style shown in Exhibit 1. The first sheet will constitute the "cover sheet" for each THOTS packet. Each cover sheet shall contain the name of each packet and the packet number. The cover sheet shall be colored, a 110-pound index paper. The printing on the cover shall be of a contrasting color. | | |

10.6 Packets shall be as follows:

- a. Packet 1 - Introduction
- b. Packet 2 to (as required) - individually titled
- c. Last Packet - References
- d. Instructor's Guide Packet

10.7 Packet 1 - Introduction. The introduction packet shall describe the purpose of the THOTS packets and the training course for which the THOTS packets were developed. It shall contain a list of all packets and their assigned numbers. Detailed instructions shall be provided for the use of the THOTS packets. A brief description and summary of the contents of Sections I, II and III of each individualized instructional packet shall be provided. The role of the Instructor(s) shall be emphasized. A suggested completion time for the complete program will be indicated. Recommendations for maintaining copies and updating the packets shall also be provided. Safety precautions, rules for safety of the students, and instructions for the maintenance and care of the equipment shall be included. Safety precautions must also be emphasized throughout the entire group of THOTS packets.

10.8 Individual titled packets shall consist of two groups. The first group, Packets 2 to (as required) shall be Common Core Individualized Instructional Packets. The second group shall be Specific Equipment/Subject Matter Individualized Instructional Packets numbered in sequence to follow the common core packets.

10.9 Common Core Individualized Packets, Individually Titled. These packets shall contain packets which must be completed first and in numerical sequence. They will provide background, fundamental, prerequisite information, and an overall general framework of facts and skills the student will need before commencing work with each subsystem of the equipment for which training is being conducted. Each packet will be titled according to the subject matter it covers.

10.10 Specific Equipment/Subject Matter, Individualized Instructional Packets Individually Titled. These packets shall be packets or blocks of packets on specific pieces of equipment, subjects, and subsystems. Each packet shall be titled according to its subject matter. Following completion of all common core packets, the student will complete all packets on specific equipment/subject matter. The packets or blocks of packets may be completed in any order or at random. The student may be required to proceed sequentially through a given block of packets, if necessary, for continuity.

10.11 All individually titled packets shall consist of three sections and figures.

10.11.1 Section I shall contain:

a. A list of specific behavioral objectives to be accomplished in the packet. Common conditions and standards must be applied to all objectives unless otherwise stated.

b. A list of reference material required by each student for that particular packet.

c. A list of prerequisite requirements (packets, manuals, materials, supplementary or remedial instructions, etc.) to be completed prior to commencing the new packet.

d. An overview and summary of the subject matter covered in the packet, and how the packet of subject matter fits into the overall system. Guidance and emphasis necessary for particular areas should be indicated in this summary.

e. See attached Exhibit 2 as an example of Section I.

10.11.2 Section II shall contain:

a. A number of work or training assignments to provide instruction and manipulative exercises relative to normal operation and functioning of the equipment, including detailed instructions for the student in logical step-by-step order, with specific instructions, directions and questions. The instructions shall lead the student to the maintenance manuals, to the equipment, and then to the subsequent performance of exercises/jobs as directed by the assignment. The assignment will direct and guide the student to perform each exercise until the student is able to perform all of the actions/jobs/skills required of the assignment.

b. A complete list of all materials used as reference materials for the development and use of that particular THOTS packet.

c. A list of all Information Sheets (Exhibit 4) and Job Plans to be used with that particular THOTS packet.

d. Information Sheets, Job Plans, Figures and Diagrams used to supplement information provided in the maintenance documentation and as supportive materials required for the accomplishment of the objectives listed in the particular packet. Each Information Sheet and Job Plan shall be numbered so as to be identified with its appropriate packet.

e. See Exhibit 3 as an example of work assignments contained in Section II.

10.11.3 Section III shall contain:

a. Instructions that will direct the student(s) to obtain direction and instructions from the Training Director/Instructor for the problems that have been inserted into the equipment. These instructions will describe the symptoms of the malfunctions inserted or to be encountered for troubleshooting purposes.

b. Troubleshooting problems (paper and pencil and on the equipment) shall be designed and used to provide motivation for the trainee to research whatever information (e.g., theory of operation) is required to troubleshoot the problems.

c. Problems must be sufficiently varied so as to lead the student into significant or typical portions of the equipment for detailed theory of operation analysis.

d. Space which will allow for writing/recording the desired answers or actions after each terminal objective.

e. Organization such that each assignment will commence on a separate sheet of the packet.

f. An appropriate number of problems, commensurate with the complexity/difficulty of the topic, for the student to analyze and solve. The problems will generally start with simple problems and progressively advance to problems of greater difficulty.

g. For initial problems, the student is to be provided with references in the documentation, schematic diagram numbers for easy reference, and some hints. From these given references, the student must be able to analyze and select whatever information is needed from the documentation in order to solve the specific problem.

h. As the problems increase in difficulty, they shall be so designed that the student will be required to select and research whatever reference material and documentation they feel is required in order to solve the problem.

i. Reading material will be held to a minimum. It will contain troubleshooting worksheets, on which will be described the nature and symptoms of the problems. The student is to be required to analyze the problems and provide answers or supply information on the worksheet.

j. Commensurate with the complexity of the equipment and task, the THOTS packets shall contain organizational and intermediate level maintenance assignments. Intermediate level assignments will constitute working on the equipment in place but at a higher level of difficulty, or with special equipment, or at a more practical detailed level of technical study.

k. See Exhibit 5 for example of Section III.

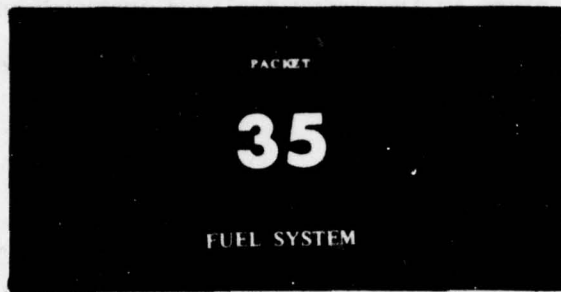
10.11.4 Figures. The figures in each individual packet may be line drawings, photographic, or illustrative as required by the subject. Reproduction will be on the same paper as used in the body of the packet. Printing or electrostatic reproduction shall be used. The figures shall be placed in numbered sequence after Section III. See Exhibits 6, 7, 8, and 9 as examples.

10.12 References - Last Packet. This packet shall contain a list of all information used throughout the THOTS course. The list shall be completely descriptive, similar to a bibliography.

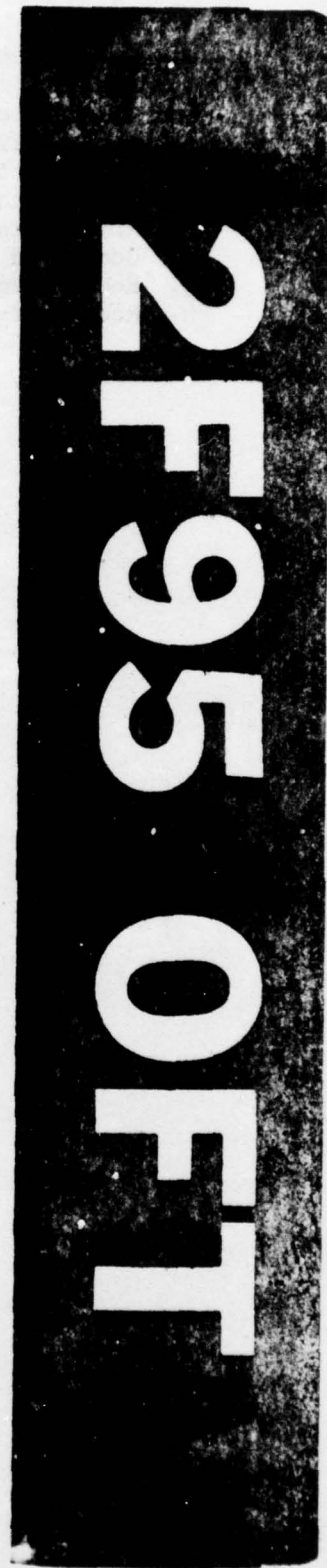
10.13 Instructor's Guide Packet. This packet shall be developed to support the complete THOTS program. The Instructor's Guide is to be used in conjunction with each THOTS packet and developed in sufficient depth to be used as the instructor's primary teaching document. No other guide or lesson plan shall be required, except for a complete set of THOTS packets and appropriate maintenance documentation. The Instructor's Guide shall contain, but not be limited to, the following:

- a. Guidelines and instructions for implementation of the course by the Training Director(s)/Instructor(s).
- b. An outline of the problems to be covered, stated in terms of specific behavioral objectives.
- c. Set-up procedures for each problem/objective.
- d. Malfunctions to be inserted.
- e. Answers to questions given in the individualized instructional packets.
- f. Completed job plans.
- g. Recommended evaluation procedures for each problem objective.
- h. Record of student progress by objectives.

P4087



THE TOST



TECHNICAL HANDS-ON TRAINING SYSTEM

EXHIBIT 1

PACKET 35

FUEL SYSTEM

SECTION I

- A. OBJECTIVES: Unless otherwise specified, the following objectives will be accomplished in accordance with the conditions and standards as described in Packet 1.
1. State the function of the fuel system indicators.
 2. State which indicators display the fuel quantity for each fuel tank.
 3. State the adjustments available for each fuel quantity indicator.
 4. Describe the function of any of the instructor's fuel system controls.
 5. Locate fuel equations, using the assembly listings.
 6. Troubleshoot problems inserted into the propulsion system.
- B. REFERENCES
1. Maintenance Work Package 627 oo.
 2. NAVAIR 01-F14AAA-1 (NATOPS)
 3. Utilization Handbook
 4. Material contained in this packet.
- C. PREREQUISITES
1. Common core packets.
 2. Prior completion of Packet 34 "Engine Systems" is recommended.
- D. OVERVIEW
1. As is the case with most of the simulated A/C systems in Device 2F95, the fuel system is simulated largely by software. Generally, if the computer is operating properly, software problems can be eliminated as causes of system malfunction. The most common causes will be DCE malfunctions, external stimuli malfunctions (such as switches) or, in rare cases, open wiring.
 2. This packet will cover mainly the simulated A/C fuel system. Work Package 627 oo, pages 1 through 12, and NATOPS Manual, Section 1, pages 1-40 through 1-55 may be referred to for a detailed description of the aircraft fuel system.
 3. Information Sheets 35-1 and 35-2 contain a synopsis of A/C and simulator fuel systems. Figures 35-1 through 35-5 are included for reference material.

SECTION II

ASSIGNMENT 1

- 1-1 Read paragraphs 23 through 49, pages 13 through 29 and refer to Figure 1, pages 12 through 21, of Work Package 627 oo.
- 1-2 How many fuel quantity states are available to the instructor during initial conditions and what are they?

.....

.....

.....

.....

- 1-3 With the OFT airborne, extend the refueling probe. During this time monitor IODOOD, bits 0 and 1 on the Star Box. Retract the probe and monitor the same bits. Record their states.

| | BIT 0 | BIT 1 |
|---------------|-------|-------|
| Probe extend | | |
| Probe retract | | |

- 1-4 Monitor IODIOO, bits 23 and 24 on the Star Box, position the Feed switch in the cockpit to NORM, FWD and AFT and record the results below.

| | BIT 23 | BIT 24 |
|------|--------|--------|
| NORM | | |
| FWD | | |
| AFT | | |

- 1-5 If the Feed switch is placed in the AFT position, what is the effect on the fuel feed system?

.....

.....

.....

SECTION II

ASSIGNMENT 2

- 2-1 Read paragraphs 50 through 63, pages 29 through 33 and refer to Figure 1, pages 12 through 21 of Work Package 627 oo.
- 2-2 With the OBT airborne, set the DUMP switch to "DUMP." Monitor signal AFAWTT (TOTAL FUEL) at the Digital to AC chassis (6A1A8). Is AFAWTT decreasing?
.....
- 2-3 Extend the speed brakes. What is the effect on AFAWTT?
.....
.....
- 2-4 What are the conditions for dumping fuel?
.....
.....
.....
.....
- 2-5 How many readouts are available from the fuel quantity indicator?
.....

ASSIGNMENT 3

3-1 Read paragraphs 64 through 79, pages 33 through 40 and refer to Figure 1, pages 12 through 21 of WP 627 oo.

3-2 With the OFT airborne, disengage the "FUEL MGT PNL" circuit breaker. Place "PROBE" switch to "EXTD." Does the probe extend?

.....

3-3 Under this condition, how does the probe extend circuit receive power for activation?

.....
.....
.....

3-4 How can you check for external tank pressurization when on the ground?

.....
.....
.....

3-5 Insert variable malfunction No. 49 while the OFT is airborne and observe results on any indicators or test equipment available. Describe what you used and what you observed.

.....
.....
.....
.....
.....

TITLE: Aircraft Fuel Management System

Fuel Tanks

The F-14A fuel tanks are divided into two (2) independent fuel systems with provisions for crossfeed. Each system consists of a similar tank arrangement that includes the following tanks:

1. External (optional)
2. Wing
3. Fuselage
4. Wing Box Beam
5. Engine Feed (SIMP)

External Tank

Fuel in these drop tanks located under each engine nacelle provides an option for extra fuel.

Wing Tank

The wing tank supplies fuel, as required, to the box beam tanks and is vented to a fuselage tank.

Forward Fuselage Bladder Tank

The forward fuselage tank comprises the center fuselage tank between the inlet ducts immediately ahead of the feed tanks. This tank is equipped with flapper ports that serve as check valves during gravity transfer and as inertia valves during arrestment.

AFT Fuselage Bladder Tank

The aft fuselage fuel tank group consists of four (4) bladder cells, and a vent tank. The foremost cell in the aft tank group lays laterally across the center fuselage.

Wing Box Beam Tank

These tanks are used to maintain the fuel level in the feed tanks.

TITLE: Simulated Fuel Management System

Simulation Design - The simulated fuel management system includes:

1. Fuel System Math Model
2. Fuel Quantity Measuring System
3. Fuel System Malfunctions
4. Instructor Fuel Quantity Input

Instructor Fuel Input/Output Program

This program enables the instructor to control total fuel quantity as required by flight problem.

Fuel Quantity Initialization

During reset mode the instructor is able to select the desired fuel loading via the ADDS.

In-Flight Refueling

During inflight refueling simulation, the instructor has a probe light to indicate that the refuel probe has been properly extended and locked.

Fuel Transfer/Refuel Logic

This routine represents the logic required to determine the status of low fuel caution lights, fuel dumping, external tank pressure, wing fuel transfer, fuselage fuel transfer, fuel interconnect valve, air refueling, and removal of fuel flow restrictions during low fuel level conditions.

R/L Wing/External Tank Computations

The computations associated with this program are the following:

1. Wing Tank Fuel Transfer
2. Wing Tank Quantity
3. External Tank Transfer
4. External Tank Quantity
5. Instructor Input/Output

PACKET 35

SECTION III

A. ASSIGNMENT:

At this time the training director will insert problems into the fuel system for you to troubleshoot.

B. OBJECTIVES:

When you complete this assignment you will be able to:

1. Locate and select the correct THOTS documentation needed in support of a maintenance problem in the fuel system.
2. Know the physical location of the fuel controls and indicators.
3. Determine conditions of abnormality in the fuel system.
4. Locate the cause of malfunctions of medium complexity in the fuel system and explain the action required to restore the fuel system to normal operating conditions.

NOTE: In this work assignment, you will not be required to actually repair the fault, but only to determine the fault and indicate corrective procedures.

C. REFERENCES FOR STUDY AND APPLICATION:

NAVAIR 01-245 FDP-1
Part II, Fuel System.
Page 1-88 through page 1-96

NAVTRADEV P-3993
Part 4-69 through 4-73
Fuel Management System

SITE DRAWINGS
663575-1, Fuel System

INSTRUCTOR'S TACTICS CONSOLE
Reference Book

D. WORK ASSIGNMENT:

In this assignment you have received instructions that the fuel system is not performing correctly in the trainer. One of the symptoms is that the fuel gage is reading incorrectly.

E. JOB STEPS:

Step 1: Review the reference material to familiarize yourself with the equipment in question.

Step 2. Physically locate the fuel management panel at the instructor's console.

Step 3. Perform the fuel loading sequence as outlined in the instructor's reference book.

Step 4. List below the reading obtained in Step 3 above:

Left Wing Tanks: _____

Right Wing Tanks: _____

Fuselage Tanks: _____

Hydraulic Pumps: _____

Electrical Pumps: _____

Step 5. Did you notice any erratic condition? If so, list the condition: _____

Step 6. Perform the pre-flight operation in the pilot's cockpit.

Step 7. Did you notice any abnormal fuel indication(s)? If so, list below.

Step 8. From the indications in Steps 4, 5 and 7, what statement can you make at this time concerning the condition of the fuel system? State below.

Step 9. Check with your training director at this time for verifications of your findings.

Step 10. Obtain the site drawings 663575-1 "Fuel System" from the site files.

Exhibit 5 (Sheet 2 of 4)

Step 11. Determine from the drawings in Step 10, and the indications obtained in the Steps 4, 5 and 7, what electronic circuit(s) is (are) giving you these indications. List below.

Step 12. With the aid of the test equipment available at the site, measure the electronic circuit(s) you have listed above. Answer the following:

a. Test equipment used:

b. Why you selected this piece of test equipment:

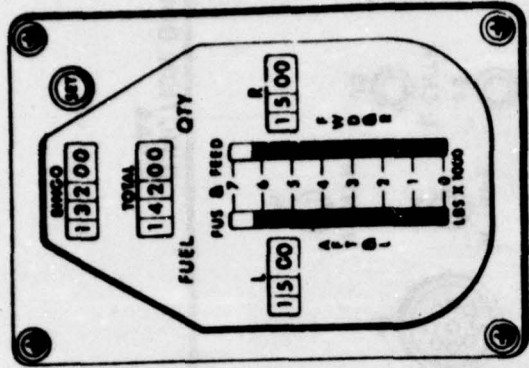
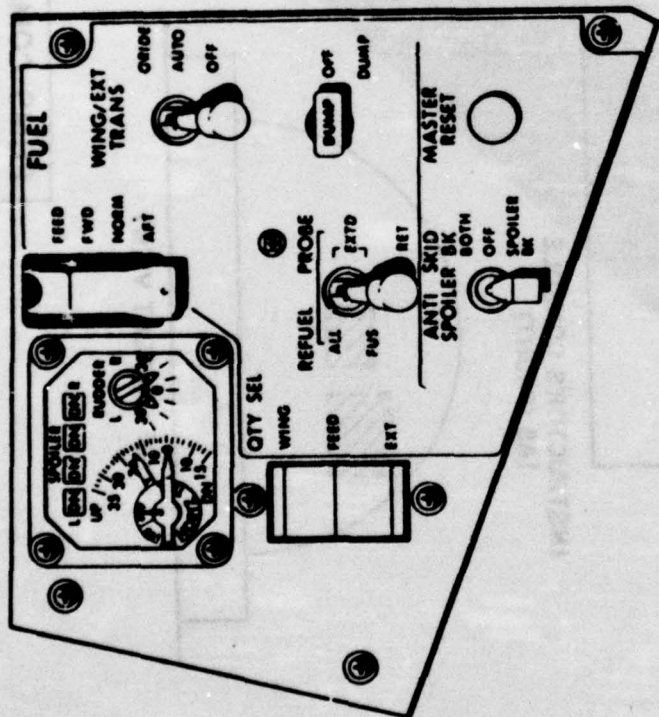
c. Circuitry measured:

Indications:

| | |
|-------|-------|
| <hr/> | <hr/> |
| <hr/> | <hr/> |
| <hr/> | <hr/> |
| <hr/> | <hr/> |

Step 13. Have you, or can you now, make any conclusion to the readings obtained in Step 12-C? State your conclusion:

Step 14. If you believe you have found the cause of the malfunction encountered, explain below:



PILOTS PANEL

NFO PANEL



FUEL SYSTEM SWITCHES AND DISPLAYS

FIGURE 35-1

UNIT 2412W 2412CH-1 AND DESIG 1/2

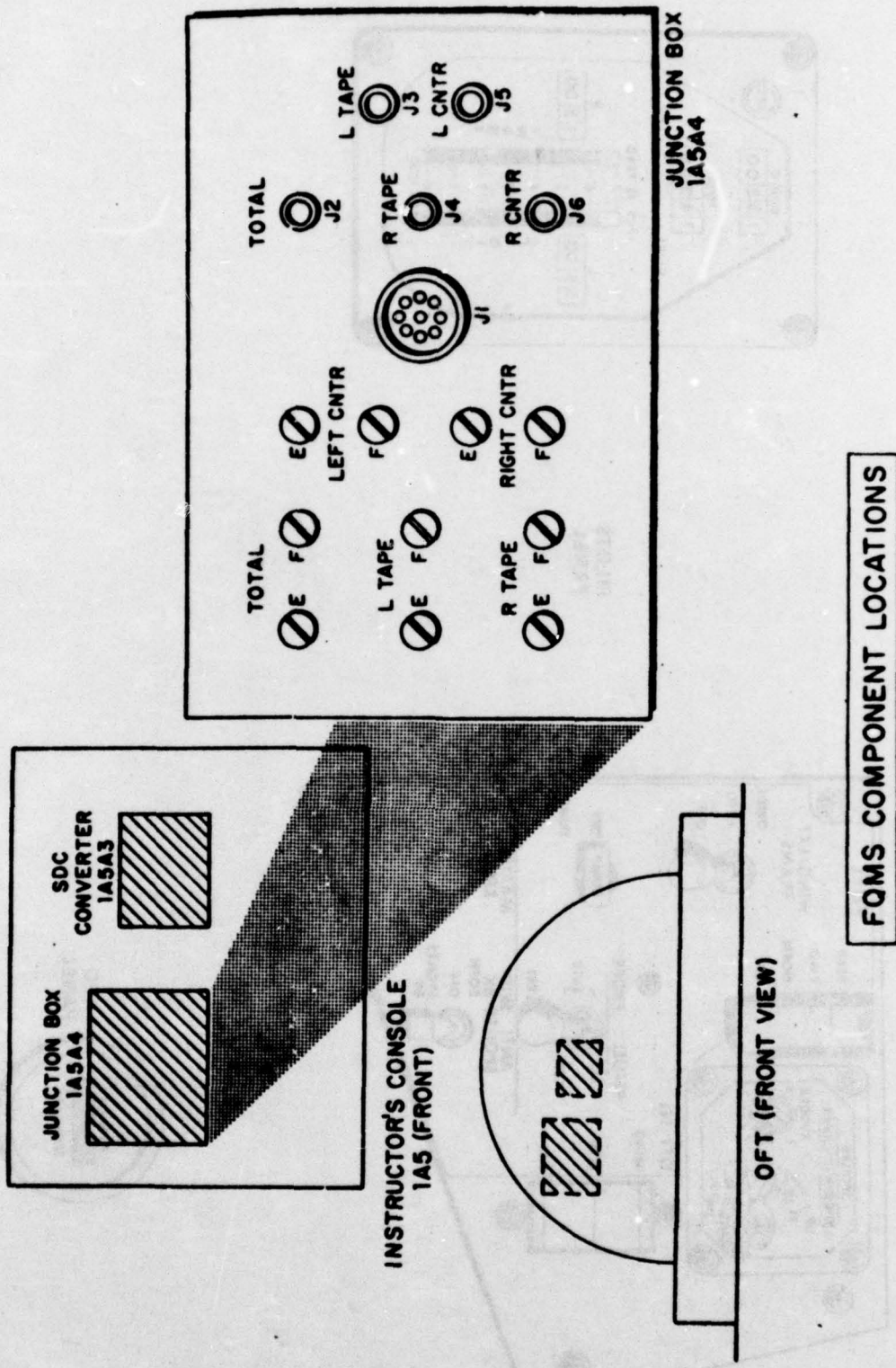
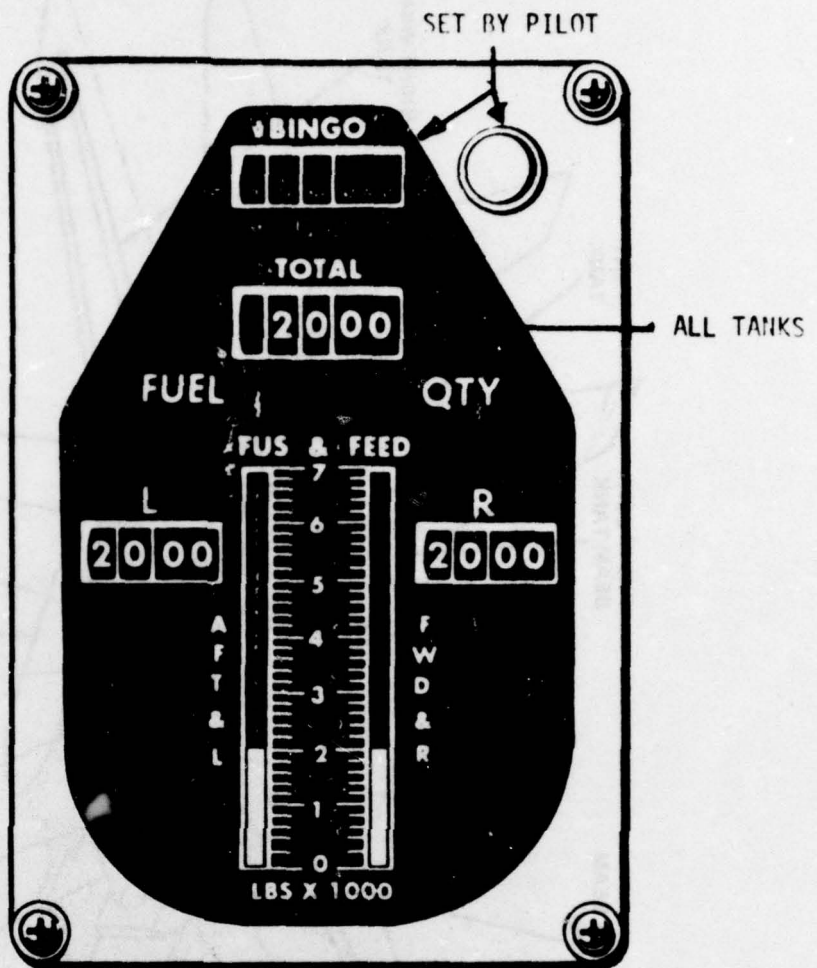


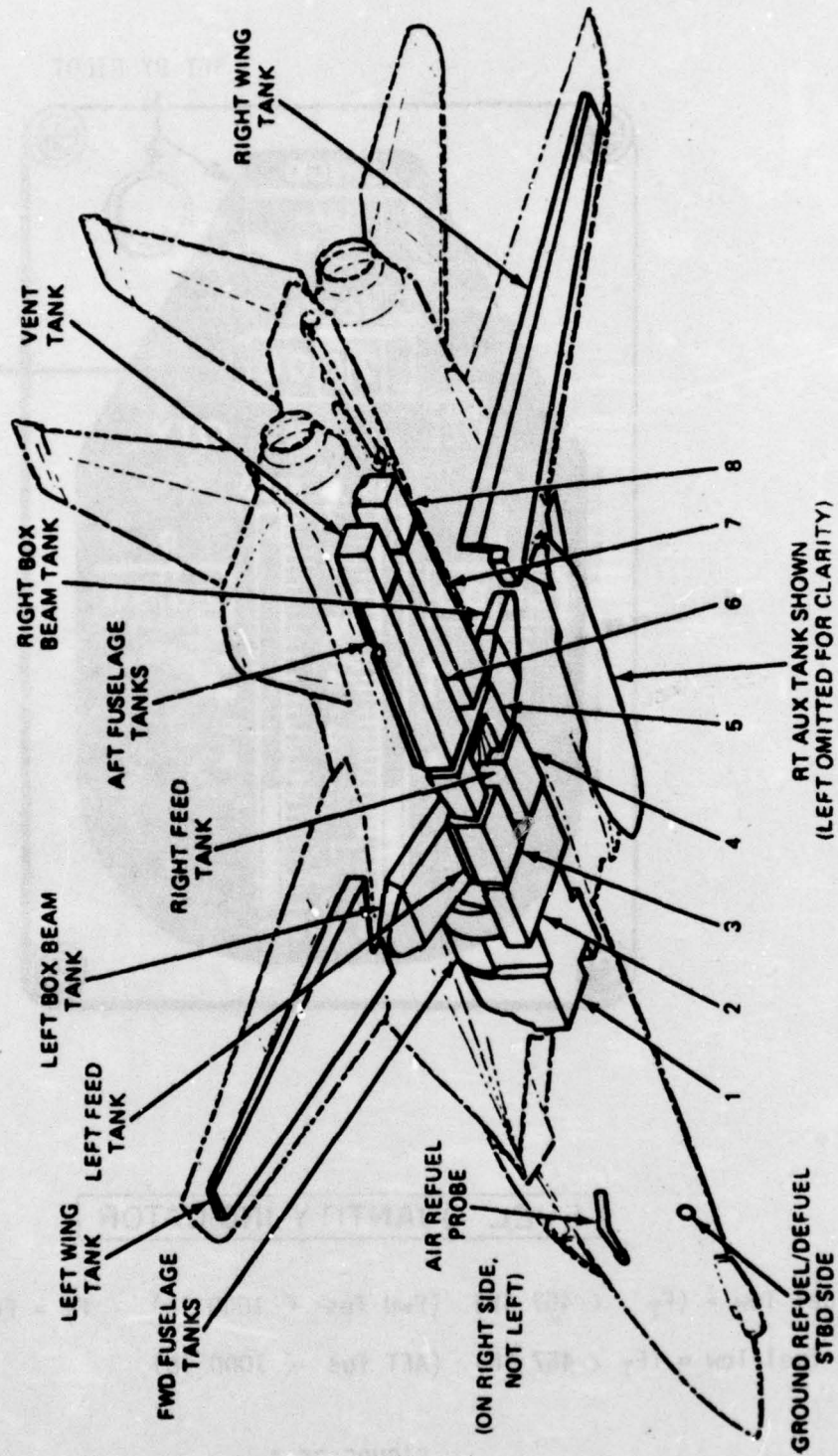
FIGURE 35-2



FUEL QUANTITY INDICATOR

Rt fuel low = ($F_T < 457 \text{ lb}$) ($\text{Fwd fus} < 1000 \text{ lb}$) $F_T = \text{Feed Tank}$
 Left fuel low = ($F_T < 457 \text{ lb}$) ($\text{AFT fus} < 1000 \text{ lb}$)

FIGURE 35-3



FUEL TANKS ARRANGEMENT

NAVTRAEQUIPCEN IH-259

DISTRIBUTION LIST

| | |
|---|----|
| Defense Documentation Center Cameron Station Alexandria, Virginia 22314 | 12 |
| Naval Training Equipment Center Orlando, Florida 32813 | 88 |