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MIARS

Maintenance Information Automated Retrieval System

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MIARS is a program or group of programs designed to transform hard copy into usable microform.

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FOREWORD

This monograph describes some aspects of the MIARS* program. The first part of the monograph is devoted to an overview of MIARS in context of today's status; the second part proposes a collaborative system in support of weapon systems of the immediate future. Although management control of the MIARS program is vested in NAVAIRSYSCOM, NAVMAT has issued a policy statement which in effect states that the rest of the Navy will get on board. The purpose of this monograph is, therefore, to bring MIARS to the attention of all those who now have or may have responsibility for preparation of technical manuals.

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*A glossary of Acronyms appears at the back of the Monograph.

MIARS

Current Situation. The MIARS Program, initiated by OPNAVINST 4790.1, promises to have an explosive effect on military technical manuals as they are known today. MIARS, which stands for Maintenance Information Automated Retrieval System, is a program or group of programs designed to transform as much hard copy as possible into some microform. The needs for microfilming technical manuals became evident many years ago, most notably in connection with the procurement of aircraft manuals, particularly the maintenance manuals. As military aircraft and their supporting systems, both airborne and ground, have become more and more sophisticated, the manuals required for fleet support of the total weapons systems grew exponentially. For example, the technical manual pages to maintain the F-4B, RF-4B, and F-4J number approximately 93,500.

Paper is fairly compact; a little more than 9 reams of 8-1/2 x 11 paper can be stored per cubic foot. Thus, the 93.5K pages of F-4 technical manuals occupy only a little more than 10 cubic feet. This modest figure, however, does not include the manuals covering all the weapons the F-4 can carry. These manuals undoubtedly would add considerably more than another 10 cubic feet of storage space. In comparison, the same 93.5K pages can be stored in 71+ microfilm packs, representing only about 1/9th of the total storage capacity of MIARS and occupying only 7/10 cubic feet of storage space.

Microfilm storage bank systems have been designed by many companies, including those outside of the microfilming business (generally, however, using basic microfilm equipments). In the forefront of the system designers are airframe manufacturers who have put together the software package for storage and retrieval of microfilm technical manuals so that aircraft can be maintained with such systems at the squadron level. There are many names for these systems, and they all have similar features. Some of these are: WSMAC (Weapons Systems Maintenance Action Center); a special NARF - designed microfilm storage and retrieval system; and RAPIDS (Rapid Automated Problem Identification System). The retrieval and viewing components of WSMAC are shown in Figure 1.

The most significant features of these systems are the ability to store and retrieve microfilm reels, each of which can carry one or more manuals and be coded by content as to reel and material within the reel. Each reel has a capacity of two thousand 8-1/2 x 11 pages. The WSMAC/Miracode system has a storage capacity of 900,000 pages. If a user requires information related to the landing structure of an F-4 aircraft, for example, he consults an index which tells him what binary codes to punch in the machine so that the proper reel of information is selected, put on line, and spun to the section concerning the landing structure or whatever part or subsection of the aircraft he wishes to maintain or troubleshoot.

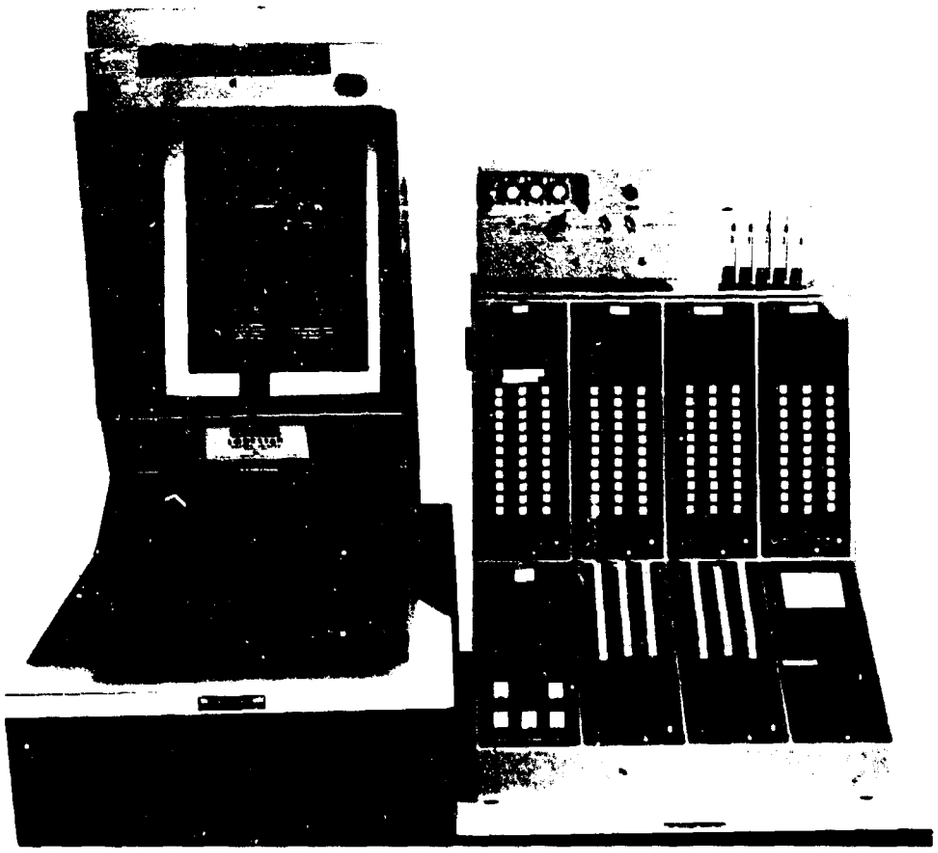


Figure 1 WSMAC

The NAVAIRSYSCOM has been evaluating several competing systems for several years, and although WSMAC has been tested most extensively, evaluation of all systems has not been completed. The plan is to microfilm existing manuals and to control the changes to such manuals more effectively than they have been controlled in the past. When any manual is changed, the affected microfilm reels are replaced by complete new reels rather than attempting to splice new microfilm pages into the reels. Currently, the plan is for each major element, such as a Naval Air Station or an attack carrier, to have its own data bank, so that all of its data needs can be stored in the bank and most of the hard copy technical manuals can be surveyed.

Many refinements and added features to a basic MIARS are possible and necessary. Considering an attack carrier as an example, equipped with only one system, would require miles of walking by maintenance technicians if remote address equipments or duplicate systems were not provided. If the torpedo workshop is to have technical manuals on the torpedoes, nuclear weapons, and other airborne stores carried by and maintained by the carrier, stored in the MIARS rather than in a huge library of technical manuals, it is clear that a remote address or duplicate system must be provided in the torpedo workshop if the Air Squadron's system is housed either on the hangar deck or below decks.

Remote Data Bank. WSMAC, or equivalent, can be and should be relieved of much of its work by use of other systems. A promising collaborative system is one with a data bank at a remote location with address and receipt of information capability aboard each major ship such as aircraft carriers, submarine tenders, and destroyer tenders. Such a system would work very much like the already initiated EDMICS which is a centralized storage bank of engineering drawings and other engineering data located at the Naval Air Technical Services Facility, Philadelphia. EDMICS, (Engineering Data Management Information Control System) is an internal NAVAIRSYSCOM organization containing the NAVAIRSYSCOM master file with the objective of filling external user requests for data rapidly and, not incidentally, maintaining all such data in an updated status. As such it is a computerized retrieval system of engineering drawings immediately capable of taking more than half the technical manual material out of the MIARS hopper (see Fig. 2).

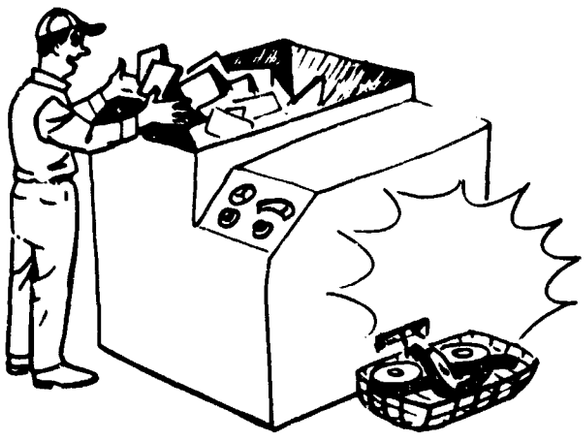


Figure 2 MIARS

Simplified, this is the way EDMICS works. All drawings relating to a particular weapons system (which we will define for example, as a fighter aircraft, all avionics equipment aboard the aircraft, all ground support equipment and special support equipment necessary for the support of the aircraft with its associated ancillary gear) will be stored in the computer. The storage could either be physical storage of the actual drawing plus storage by microfilm aperture card or aperture card only. At any rate, the aperture card is the device which stores into the computer the information that the drawing is available. The computer in turn is connected to the AUTODIN network so that a person with an AUTODIN terminal can request a drawing or series of drawings by putting a punched DD 1348 card into his input terminal and addressing it to the computer in Philadelphia. The computer receives the order, searches its memory, retrieves the drawing or microfilm card, and sends the microfilm card to a transmission machine that transmits information back over the AUTODIN network to the requester who is equipped with a receiving machine (see Fig. 3) that reconstitutes the information into microfilm.

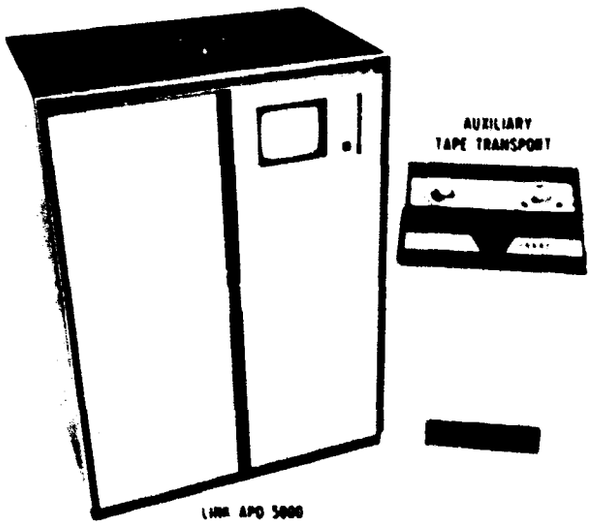


Figure 3 Link APD 5000 and Auxiliary Tape Transport

The microfilm is developed by a piece of auxiliary equipment and if a hard copy of the reproduced microfilm is needed, it can be obtained by use of another piece of auxiliary equipment. The entire process from ordering at the remote station with AUTODIN through the computer, Philadelphia and transmission of the microfilm drawing back to the carrier takes less than a minute, actually much less time than it would take for the man to manually retrieve the same drawing if he had this drawing stored aboard ship either in a drawing file or in a technical manual.

EDMICS is coming on "stream" in the near future. Several hundred thousand drawings have been stored in the memory and the programs now in preparation will be debugged in a matter of months. The system then will be operational. It will take a number of years to get more than five million drawings associated with the NAVAIRSYSCOM Weapons Systems stored in the computer during which time more and more stations will come on line as AUTODIN-EDMICS users. Later, remote stations will be able to use EDMICS via international telephone satellite systems. Therefore, a carrier in Southeast Asia or Subic Bay would have no greater requirement to carry tons of technical manuals and other data for support of aircraft aboard than would a carrier home-ported in San Diego.

Classifying Maintenance Information. As exciting as the MIARS and EDMICS concepts are, a combination of the two systems may achieve a breakthrough of the equivalent order of magnitude as that represented by MIARS over the hard copy manuals. Briefly, the idea is to reduce the size of maintenance manuals drastically before microfilming them. One of several ways of doing this is to strip most of the unscheduled maintenance reference information from the books and put such information on microfilm aperture cards. Categorizing maintenance information by classes (see Fig. 4), Class I will be used most frequently such as IPB types of illustrations required for disassembly, reassembly, and repair, and all scheduled maintenance. Other information such as cable and wire lists, schematics, single function troubleshooting loops and drawings, program sheets and electrical wiring diagrams would also be put on microfilm. These data are generally used for "unscheduled maintenance" which according to one source (see Fig. 5) accounts

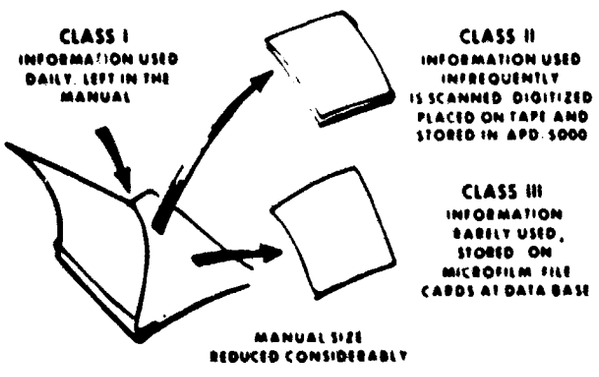


Figure 4 TMMICS - Technical Manual Management Information Control System

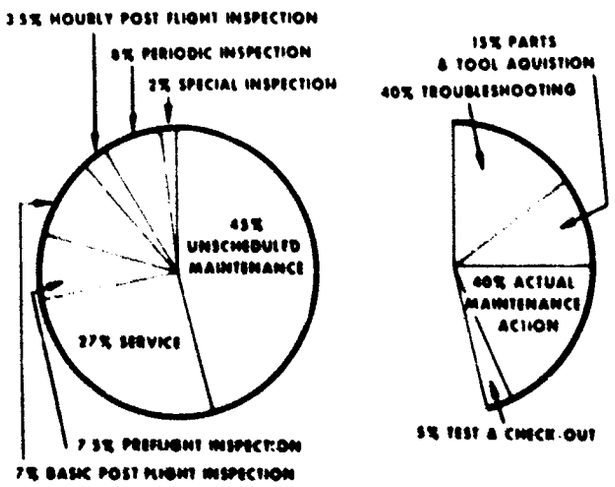


Figure 5 Distribution of Inspection and Maintenance Times for Aircraft

for 45% of total maintenance time. These reference data in turn will be grouped into two classes; one Class II which is expected to be used rather frequently, and the other Class III data that will probably be used infrequently, if ever. Data of the latter type will be simply stored in the central bank and recalled by a user as described in the following section, starting with the microfilm aperture card. Data that would be expected to be used rather frequently can be predigested on magnetic tape (see Auxiliary Tape Transport Fig. 3) and ready for instant transmission.

TMMICS (Technical Manual Management Information Control System). To use TMMICS effectively, users will have to have an AUTODIN terminal and a microfilm receiving machine. Technical manuals would have to be written in such a way that the needed reference data to perform any particular troubleshooting or repair function are merely listed in the manual rather than provided in the manual as indicated previously. When the user finds that he needs a set of drawings (or other data) by conferring with the manual (to troubleshoot an airborne gun fire control system for example), he orders the needed drawings by first obtaining the numbers from the manual from a test or troubleshooting repair index similar to the one shown in Figure 6 and punches the numbers of these drawings on AUTODIN form punch cards DD 1348. The DD 1348 is then dropped into the input terminal and the order is transmitted automatically and instantaneously to the central storage bank in Philadelphia or other appropriate data base. On receipt of the order the computer searches its memory to see if it has all the drawings and whether the data is class II or Class III. (See Fig. 7.) If it does, it delivers them to a transmitting machine which reads or rather optically scans microfilm, digitizes it, and puts it on magnetic tape. The magnetic tape is then played into data phone or AUTODIN

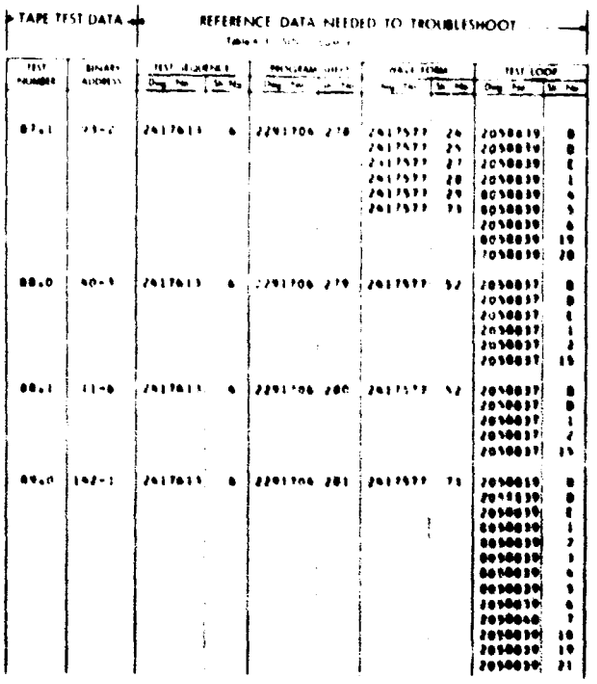


Figure 6 Test Index of Reference Data to Troubleshoot Malfunctions

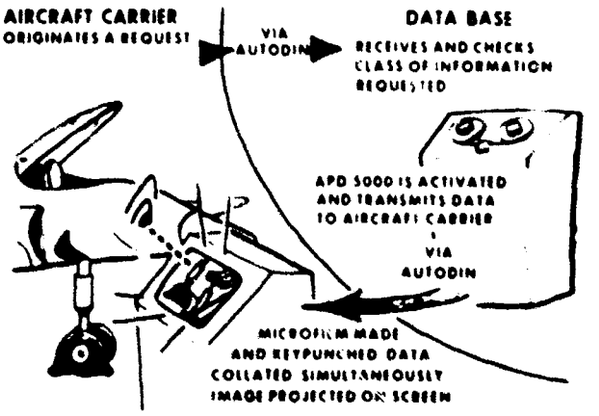
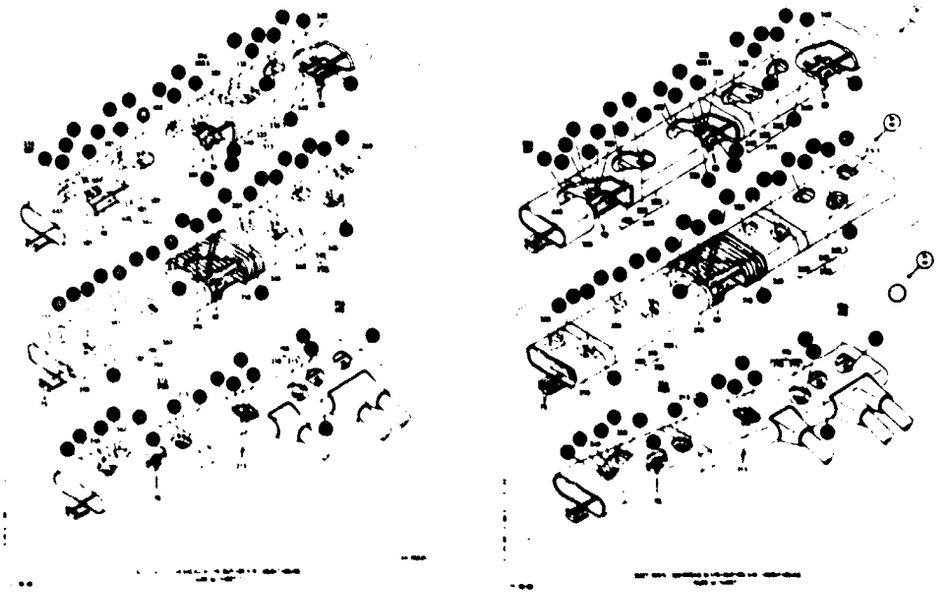


Figure 7 EDMICS/TMMICS Operational Sequence

and transmitted automatically to the requesting activity. At that end, the receiver reverses the procedure: it converts the digitized information to analog, decompresses it, and in effect, reproduces the microfilm on film strip with remarkably little loss of detail. Samples of an original microfilm and a transmitted microfilm are shown in Figure 8.



(Before) (After)

Figure 8 AUTODIN Transmission of Microfilm

By this method, a user can get reference information more quickly than he could by going to his own library, for the whole process takes less than one minute. Actually Class II data (frequently used) will be optically scanned, compressed, digitized, and stored on tape (Fig. 9) in the tape transport so that it will not have to be submitted to these procedures for each order. This will save significant time and reduce the total time for receipt of such information to seconds rather than minutes.

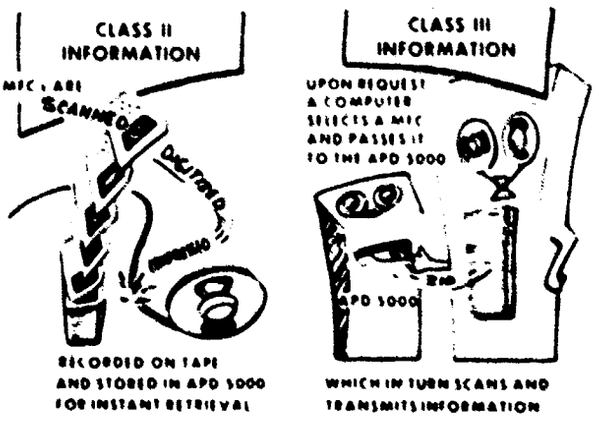


Figure 9 EDMICS/TMMICS Information Storage and Retrieval System

Reduction of Technical Manual Size Via TMMICS. In one maintenance manual covering a complex tape-programmed test set, 8738 pages (most of them 11 x 17 drawings) of maintenance reference information were packaged into 13 volumes weighing approximately 130 pounds. Of these total pages, approximately 4% were Class I, 47% were

Class II, and the remaining 49% Class III. With a TMMICS, using a test index as shown in Figure 6, the maintenance technician will be relieved of more than 8300 sheets of data - data that he can order and receive in a fraction of the time it now takes when he possesses hard copy.

The foregoing figures represent a tremendous MIARS compression, and this is for only one test set for one program. It is at this point that the need for TMMICS in addition to a MIARS can be demonstrated most dramatically. The capacity to store and retrieve Class II and Class III data via TMMICS is infinite, whereas MIARS has finite capacities, so much so that MIARS will have to be duplicated if a decision were made to put into MIARS every sailor-maintained item of equipment aboard a carrier. With TMMICS, a standardized MIARS tool, computer capacity can be enlarged as needed by using the planned data banks of other Naval Systems Commands for storage of maintenance information on items under their cognizance. One look at NAVSHIPS 96042, the maintenance manual for Radar Set AN/SPS-48, or any radar manual for that matter, will show what a boon TMMICS will be to the radar maintenance technicians.

Adaptability. TMMICS is adaptable to any using activity having significant maintenance and repair capability, and with access to the AUTODIN system or with data phone link (Fig. 10). Each activity will have access to any data bank. The only requirement to put such a using organization on "stream" with this system is the acquisition of a receiving machine such as the Link APD-5000 and auxiliary equipment. This means of course that carriers, Naval Air Stations, and their hosted rework facilities (NARFs), submarine tenders (both Polaris and attack type), surface missile system support ships, and practically every intermediate level maintenance activity in the Navy can use the system.

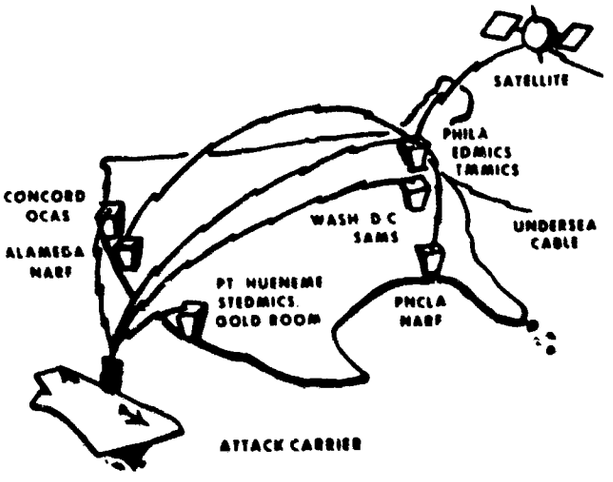


Figure 10 EDMICS/TMMICS Capabilities

The use of TMMICS has implications that exceed speeding the repair and maintenance of equipment by making the maintenance information more accessible to the user. It also means providing greatly needed space by jettisoning literally tons of technical manual material. For example, as submarine and destroyer tenders become responsible for more weapon systems, their ability to maintain them decreases under the increasing requirements for space for support equipment, spares, and technical data. With the TMMICS, it may be possible to keep the intermediate level of maintenance on the tender, rather than having to deport it back to the depot organization.

TMMICS is not being actively considered at this time, but it will be submitted to the Navy MIARS Committee for evaluation and possible trial.

GLOSSARY OF ACRONYMS

AUTODIN	Automated Data Information Network
EDMICS	Engineering Data Management Information Control System
IPB	Illustrated Parts Breakdown
MIARS	Maintenance Information Automated Retrieval System
NARF	Naval Air Rework Facility
NAVAIRSYSCOM	Naval Air Systems Command
NAVMAT	Chief of Naval Material
RAPIDS	Rapid Automated Problem Identification System
SAMS	Ships Alteration Management System
TMMICS	Technical Manual Management Information Control System
WSMAC	Weapon System Maintenance Action Center

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13. ABSTRACT

Microfilming of technical manuals prepared by and for the Navy is reviewed; retrieval systems and the need to use collaborative systems to reduce the amount of information stored at user levels are discussed.

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