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NATIONAL AIRSPACE SYSTEM MICROFICHE PILOT PROJECT

MICHAEL J. MCCRORY

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FINAL REPORT

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16. Abstract

The original impetus for this project came from the Computer Program production tools task. The approach chosen was to provide microfiche readers and reader/printers to representative test sites. Participants were the New York Air Route Traffic Control Center (ARTCC), Houston ARTCC, and Houston Intercontinental Tower, as well as the Air Traffic Service (AAT-500) and Airway Facilities Service (AAF-600) elements located at NAFEC. AAT-500 and AAF-600 supplied the documentation for the microfiche distribution test.

During the course of this study approximately eighty thousand pages of documentation were photographed and another eighty thousand pages of computer listings were produced using the computer output to microfiche (COM) technique.

Microfiche Production culminated with the delivery of the complete documentation for the A3d2.1 Enroute and the A0.9 Terminal Systems.

The users had mixed reactions to a microfiche documentation system.

In general there was acceptance of the printed documentation but resistance to the computer listings on microfiche. The problems encountered in addition to the obvious one of not being able to annotate film can, for the most part, be overcome with better control over the production facility. These problems included poor turn-around time and a need to educate the contractor in the unique aspects of FAA documentation.

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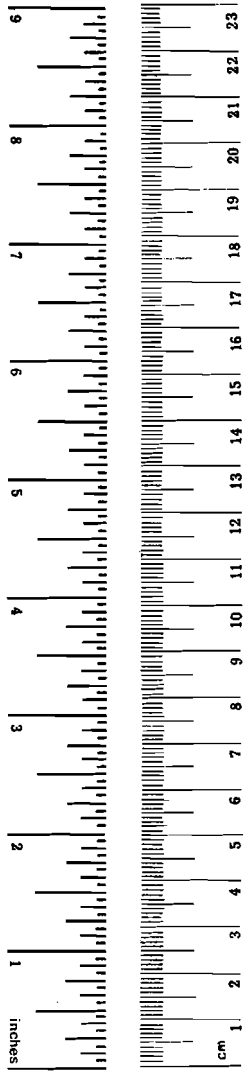
METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

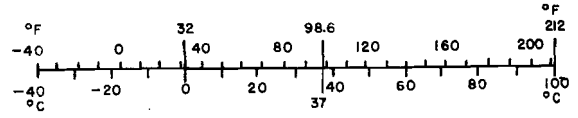
Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
in	inches	*2.5	centimeters	cm
ft	feet	30	centimeters	cm
yd	yards	0.9	meters	m
mi	miles	1.6	kilometers	km
		AREA		
in^2	square inches	6.5	square centimeters	cm^2
ft^2	square feet	0.09	square meters	m^2
yd^2	square yards	0.8	square meters	m^2
mi^2	square miles	2.6	square kilometers	km^2
	acres	0.4	hectares	ha
		MASS (weight)		
oz	ounces	28	grams	g
lb	pounds	0.45	kilograms	kg
	short tons (2000 lb)	0.9	tonnes	t
		VOLUME		
tsp	teaspoons	5	milliliters	ml
Tbsp	tablespoons	15	milliliters	ml
fl oz	fluid ounces	30	milliliters	ml
c	cups	0.24	liters	l
pt	pints	0.47	liters	l
qt	quarts	0.95	liters	l
gal	gallons	3.8	liters	l
ft^3	cubic feet	0.03	cubic meters	m^3
yd^3	cubic yards	0.76	cubic meters	m^3
		TEMPERATURE (exact)		
°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C

*1 in = 2.54 (exactly). For other exact conversions and more detailed tables, see NBS Misc. Publ. 286, Units of Weights and Measures, Price $2.25, SD Catalog No. C13.10:286.



Approximate Conversions from Metric Measures

Symbol	When You Know	Multiply by	To Find	Symbol
		LENGTH		
mm	millimeters	0.04	inches	in
cm	centimeters	0.4	inches	in
m	meters	3.3	feet	ft
m	meters	1.1	yards	yd
km	kilometers	0.6	miles	mi
		AREA		
cm^2	square centimeters	0.16	square inches	in^2
m^2	square meters	1.2	square yards	yd^2
km^2	square kilometers	0.4	square miles	mi^2
ha	hectares (10,000 m^2)	2.5	acres	
		MASS (weight)		
g	grams	0.035	ounces	oz
kg	kilograms	2.2	pounds	lb
t	tonnes (1000 kg)	1.1	short tons	
		VOLUME		
ml	milliliters	0.03	fluid ounces	fl oz
l	liters	2.1	pints	pt
l	liters	1.06	quarts	qt
l	liters	0.26	gallons	gal
m^3	cubic meters	35	cubic feet	ft^3
m^3	cubic meters	1.3	cubic yards	yd^3
		TEMPERATURE (exact)		
°C	Celsius temperature	9/5 (then add 32)	Fahrenheit temperature	°F



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ACKNOWLEDGEMENT

The author wishes to thank the participants in this project for their indispensable cooperation and dedicated effort. The valuable information in the evaluations of the New York and Houston Facilities is particularly gratifying in view of the difficulty of fitting another time consuming task into an already overcrowded schedule.

BACKGROUND

Operational

Operation of the National Airspace System (NAS) requires the Federal Aviation Administration (FAA) to produce, store, distribute and, at frequent intervals, update a very large volume of documentation. This documentation is produced at the National Aviation Facilities Experimental Center (NAFEC), Atlantic City, New Jersey from where it is distributed to facilities throughout the world.

The present method of accomplishing this task is essentially manual. The documentation is typed, as much as feasible with the aid of an outdated semi-automatic system using magnetic tape selectric typewriters (MTST). After the information has been typed in final form and format and illustrations, including engineering drawings, have been hand drawn, print plates are made from which the required documents are printed and then distributed, chiefly by mail. This system is used to produce and distribute hundreds of thousands of pages per year and is often overloaded due to the nature of the documentation which requires immediate distribution.

Recognition of the many problems inherent in the documentation production and distribution system presently employed by the FAA has resulted in several suggestions for a new system.

One of the suggestions for improvement came from the participants in the computer program production tool task. This group defined the "Microfilm InfoSystem" activity. The approach chosen for this activity was to provide microfilmed (Microfiche) documents, readers and reader/printers at NAFEC, Houston ARTCC, New York ARTCC, and Houston Intercontinental Tower. The evaluation activity was scheduled for a period of one year. After the working group specified the equipment and the microfiche format the project was turned over to ARD-140 for management.

Technical

The type of microfilm used to distribute documentation for this project was microfiche. Microfiche means, literally, small card, in this case the small card was a piece of film 105mm by 148mm (approximately 4 inches by 6 inches). The production methods chosen for this project were traditional photography for the printed documentation and computer output to microfilm (COM) for the non-printed documentation which consisted mainly of computer program listings for our purposes but could be expanded to include any material available on computer compatible magnetic tape.

Reduction factors of 24x and 42x were chosen for printed or source document (SDM) material and computer output to microfilm (COM) respectively. At these reductions each microfiche can contain a maximum of ninety-eight frames of SDM or two hundred and eight frames of COM generated data. For the purposes of this project each frame was one page of data.

The photographic techniques used to reduce SDM to microfiche are an old, thoroughly proven technology, a camera, generally planetary or rotary, is used to photograph the document one page at a time, the film is then developed, processed and made up into microfilm. This technique has been in use since approximately 1880 although it did not come into common use until after World War II.

Computer output to microfilm (COM) however, is a relatively new technology; it has been available for about ten years but is just coming into wide spread use. Although there are innumerable COM devices on the market with a wide range of prices and capabilities, there are three basic types. Some COM recorders:

1. Display data with light emitting diodes and transfer the data to film by fiber optics through a lens.

2. Record data directly onto microfilm by use of an electro-mechanically controlled Laser Beam.

3. Display data on the face of a cathode ray tube, recording it on microfilm through the lens of a camera which is an integral part of the COM Unit. This type of COM Unit consists basically of one or more computer compatible tape drives, a mini computer, a cathode ray tube and a camera.

   In practice tapes are produced on the computer system from which output is required. These tapes are mounted on the COM Unit tape drives, the COM Unit mini-computer is programmed to format the data as required, display it on the cathode ray tube, trigger the camera and read the next set of data. When the photography has been accomplished the film is processed and made into the form desired (eg: microfiche).

In addition to considerations noted above there are three major types of film used in microfilm technology, each with its advantages and disadvantages. These three major types of film are (1) silver-halide, (2) diazo and (3) vesicular. Silver halide films are faster and have a higher resolution than any other kind of film; they are also much more expensive. The COM industry in general, uses this type of film for making the master copy. One of the most impressive qualities of silver halide film is its extremely long shelf life giving it genuine archival properties. There are many examples of film in storage for over 25 years with no deterioration. Some film specimens over 50 years old showing no sign of degradation are in existence. The two major limitations of silver halide films are their high price and the requirement for wet chemical processing. Standard development for silver halide produces a tone reversal.

The most widely used duplicating film is diazo. This type film is not only far less expensive than silver halide film but processing it is much simpler. The process begins with the introduction of ammonia. The master film is placed in contact with the diazo film and exposed to ultraviolet light. The clear areas of the master film allow photons to pass through to the diazo molecules while the image areas absorb them. The diazo molecules shielded from the ultraviolet light react with color formers to create a dye. This dye reproduces the original image from the master film, on the duplicate film. Since the reproduction is clear area to clear area and dark area to dark area the diazo process is a positive or nonreversal reproduction process.

The third major type of film used in microfilm technology is vesicular film. This relatively new type film is similar to diazo in that it also uses diazonium compounds. It differs greatly, however, in its processing. While also requiring exposure to ultraviolet light, no ammonia is needed. The process involves two ultraviolet light exposures and is a reversal process, that is the dark areas on the master will be clear on the duplicate and the clear areas will be dark.

There are many things which must be taken into consideration when deciding which type of film will best suit the needs of the system. The military specification for COM film is in Appendix II to provide some guidance.

PROJECT CONDUCT

The "Request for Proposal" prepared by the Computer Program Production Tool Task Working Group divided the Microfiche Production into two parts: (1) source document material (SDM) which was photographed at a reduction ratio of 24X and (2) computer output to Microfilm (COM) consisting of Computer Program Listings. COM was produced at a reduction ratio of 42X. The Microfiche used is a strip of film 105mm by 148.75mm (Approximately 4 inches by six inches).

Air Traffic Service and Airway Facilities Service supplied all of the material for Microfilming. The source document material was in the form of printed documents. The computer listings were in the form of standard computer tapes in a format agreed upon by the participants and the contractor producing the Microfiche. Appendix III contains the work statement agreed upon when the contract was awarded. It very quickly became apparent that several things were overlooked. To assure total understanding the following agreements between the contractor and the FAA were made:

(1) On source document material the contractor will provide a unique index on each microfiche correlated with the document Table of Contents.

(2) For computer output to Microfiche (COM) material the responsibilities will be:

a. FAA responsibilities:

(1) Forward the specifications for determining where the titling information can be extracted on the various listing formats.

(2) Send a letter with any tapes detailing the sequence in which the tapes should be processed. Also give a starting fiche number and tape batching instructions.

b. Contractor responsibilities:

(1) Sequentially number each fiche with no duplication of fiche numbers.

(2) Title information will include the following:

(a) Program Name

(b) Date of Run

(c) Version Number

(d) Date on Listing

(e) Page Number of First Frame on Fiche

(f) Four Digit Number

(3) Index information will include:

(a) Program name

(b) Line number, card number or blank depending upon the following:

(1) If constant "line" is indicated on second headerline of listing, a five digit line number will be extracted from the following line.

(2) If constant "card" is indicated on second headerline of listing, a four digit card number will be extracted from first line with data.

(3) If neither of the above, blanks will be placed in the index.

These agreements were the result of close coordination between the FAA and the contractor. While the agreements were being formulated production and distribution of microfiche went on. The result of this method of operation was that some of the initial objections to Microfiche were corrected immediately. Among the improvements achieved by the close coordination was the vastly improved indexing system.

As part of the Microfiche Pilot Project an experiment was conducted in which magnetic tapes produced on and for magnetic tape selectric typewriters were translated, stored on computer tape and entered into a computer used by a Department of Transportation (DOT) contractor for text editing purposes. After the documents were manually edited, they were transferred to computer tape, given to the Microfiche Production contractor and put onto Microfiche using a computer output to Microfilm (COM) device. This experiment required some knowledge of the text editing system being used. The text editing contractor conducted training classes at NAFEC for operators from NAFEC, ARD-100, AAT-500, and AAF-600. This experiment turned out very well, not only for the Microfiche Production but also for text editing problems. The system is still being used extensively at NAFEC.

Microfiche Readers were distributed to the evaluators as follows:

New York ARTCC	12
Houston ARTCC	12
Houston Tower	2
AAT-500 (Washington)	1

AAT-500	(NAFEC)	17
AAF-600	(NAFEC)	10
ARD-100	(NAFEC)	3

At the conclusion of the Pilot project, all of the readers were transitioned to the Airway Facilities Service.

FINDINGS

Although the project was designed as a test of the feasibility of Microfilmed documentation distribution, some evaluation of the relative merits of the Microfiche Readers provided was unavoidable. The Microfiche Readers fell into the following general catagories:

(1) Reader/Printers. These devices are capable of producing a paper copy of a Microfiche Frame (page).

(2) "Drop-In" changeable single lens, single carriage reader.

(3) Variable (zoom) lens, single carriage reader.

(4) Single lens (changeable) dual carriage reader.

(5) Dual lens, dual carriage reader.

The Reader/Printers got very little use during this project. This type of equipment, although undoubtedly convenient, could probably be eliminated in a documentation distribution system designed for the FAA National Airspace System automation needs.

The evaluators' comments leave no doubt that the least desirable reader was the single lens, single carriage reader while the most desirable was the dual lens, dual carriage reader. There is also no doubt that all of the readers have deficiencies. Cited were screen glare and bulk of all of the readers. The glare problem can easily be overcome with any of several models on the market which project the microfilm image in such a manner as to make glare virtually impossible. The same is true of reader size; there are many truly portable readers available. Unfortunately the state-of-art in microfiche readers has not reached the stage where dual independent optic systems are available on the same reader. The most useable "off the shelf" reader available today would have dual carriage, dual lens capabilities. These centrally located readers should be supplemented with light weight, easily portable readers which can be carried to a desk or in the case of maintenance personnel to the equipment requiring repair.

If the FAA decides to use microfiche documentation distribution the possibility of designing a reader or readers specifically for FAA needs should be explored.

Evaluation of microfiche documentation distribution can be broken into two major categories: (1) source documents on microfiche and (2) computer program listings on microfiche. At the present state-of-the-art it is unlikely that microfiche can replace printed listings of computer programs in a programming environment. Some of the problems are the inability to annotate film and the requirement of a programmer to reference many pages in rapid sequence when tracing a program problem. These problems do not, however, preclude the use of microfilm in a non-

programming environment where the computer program listings are used primarily as reference. The places where this could be done include Headquarters and Regional offices as well as many of the offices at NAFEC. The same principal holds true for source document material. Although many offices have a continuing need for printed copies of some subset of the available documentation, many more could make use of microfilmed documentation for all or part of the documentation they keep on file. The savings which could accrue to the FAA by using this partial replacement of printed documentation by microfiche are illustrated by the cost figures in Tables I and II below. When using these tables it should be kept in mind that they are based on the contract costs experienced in the Microfiche Pilot Project. An in-house system such as discussed in Appendix I would reduce these costs appreciably.

SOURCE DOCUMENT

	PRINT METHOD	MICROFICHE METHOD
Number Per Set	45,000 Pages	500 Microfiche (24X)
Cost	$337.50 Per Set ($168,750-500 Copies)	$3000 Plus $100 Per Copy ($53,000-500 Copies)
Weight Per Set	1000 Pounds	2 Pounds
Storage	20 Feet of Shelf Space	2 - Three Inch 3 Ring Binders
Suggested Distribution	500 Copies	200 Copies
Cost	$168,750.00	$20,700.00

TABLE I

COMPUTER OUTPUT DOCUMENTATION

	PRINT METHOD	MICROFICHE METHOD
Number Per Set	50,000 Pages	250 Microfiche (42X)
Computer Time To Generate	40 Hours Per Site (800 hours)	2 Hours
Costs	Paper-20Cartons @$20.-$400 Per Site $8000	$332.50 Plus $50. per copy-$1332.50
Set Weight	700 Pounds	1 Pound
Storage Required	25 Cubic Feet	One 3" Ring Binder

TABLE II

Evaluators objections fell in the following categories:

Hardware:

- Readers not truly portable
- Single lens and/or single carriage readers not suited to problem
- Some screens scratch easily
- Glare problem in normal ambient light conditions.

Start-up-type problems:

- Poor turn around time
- Microfiche and current operational program not always the same.
- Lack of a library cross reference system.
- Pages of data photographed in cine (horizontal) mode rather than comic (vertical) mode. This occurred when the pages were printed that way. As one evaluator commented "It is easy to turn the book but turn the reader?".
- Inadequate updating/correction method.

Microfiche:

- Cannot annotate
- Does not lend itself to use by a programming team as readily as a printed listing.
- Cannot cross reference many pages simultaneously. This is very important for programmers who frequently lay out six or seven sheets of a listing. This method of operation would require one reader per sheet of listing.

Special Problem:

- Indexing. This frequently mentioned problem is, unfortunately, not unique to the system used on this project. Although the indexing scheme used by the contractor was the best available, it, in common with all the others, is an adaptation of indexing used for printed documents. Apparently no one has, as yet, worked out a simple indexing scheme specifically for microfiche.

All of these objections can be overcome. The hardware problems, as previously mentioned, can be solved by careful selection of

off-the-shelf equipment. The start up problems lend themselves to simple solutions. Improved turn around time, photographic mode and keeping documentation and current program synchronous all can be easily achieved with an in-house system. Library cross reference systems and updating/correction systems are a matter of proper procedures.

The objections to microfiche itself illustrate the wisdom of not attempting to completely replace paper with film. Microfiche can achieve great savings if properly used but experience with this project shows that trying to use it where it is not suited could prove counter productive.

The special problem of indexing is one which apparently has not been adequately studied by anyone. This would be a worthwhile effort which could produce a very favorable cost/benefit ratio.

This project has provided a cadre of experienced people within the FAA. It is strongly recommended that a team be formed from this group to resolve the problems uncovered before proceeding with establishment of the system delineated in Appendix I.

CONCLUSIONS

The conclusions reached as a result of this project are that:

1. COM software must be tailored to FAA needs.

2. Indexing needs improvement.

3. Readers and Reader/Printers must be matched to needs.

4. Resistance is especially strong to microfilmed program listings.

5. Microfiche documentation distribution would reduce costs.

RECOMMENDATIONS

As the result of experience gained on this project, the following recommendations are made:

1. Establish a microfilm production/distribution facility.

2. Establish a documentation base on a computer resident text edit system.

3. Carefully evolve into a full microfilm production/distribution system starting with the more readily acceptable printed documentation.

Appendix I is a description of the recommended microfilm production/distribution facility.

APPENDIX I

Recommended Microfilm Production System

This Appendix is intended for use as a source of basic information. Figure 1, below, presents a simple block diagram of the recommended system.

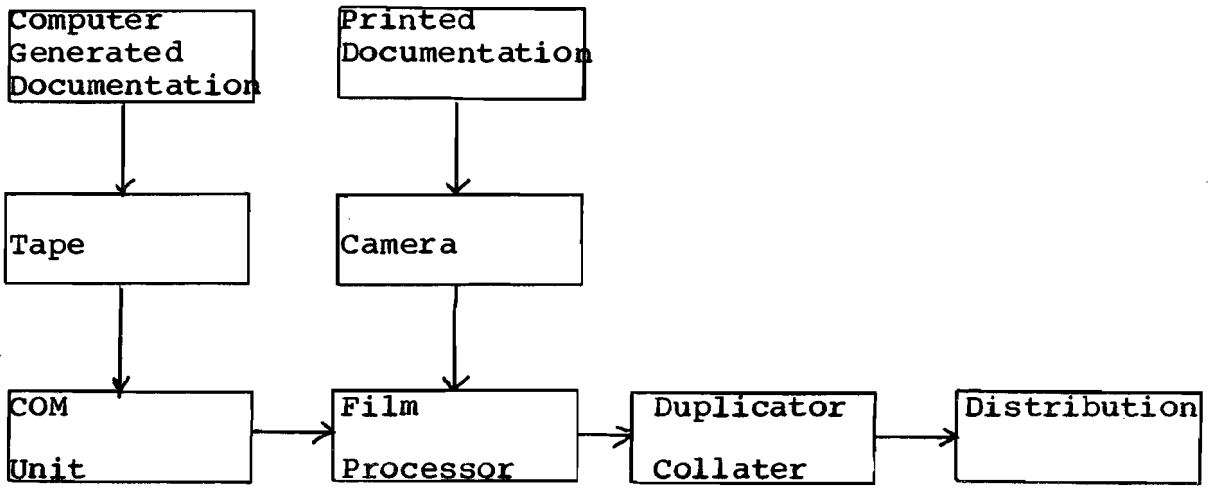


Figure 1

The equipment shown in Figure 1 can be located any place convenient for the Agency. In addition each user will require microform readers designed to accommodate the type of microform distributed.

Since the type of microform to be used has a direct bearing on the equipment needed it should be one of the first decisions made. The most commonly used microforms are:

1. Aperture cards
2. Microfiche
3. Ultra Fiche
4. Roll

Aperture cards are tab punch cards in which an aperture has been cut to allow the insertion of a microform in the form of a piece of 35mm film. Aperture cards are used primarily for graphic applications in which illustrations, such as engineering drawings, are photographed and stored. Information pertaining to the drawings is punched into the tab card. This type of microform is very expensive particularly since it requires equipment which can not be used with other microforms. Rather than using aperture cards consideration should be given to

graphic requirements when specifications are written for a computer output to microfilm (COM) unit.

Ultrafiche is a specially prepared fiche containing upwards of 10,000 pages. This relatively new technology is very expensive, difficult to handle and really only suited for very special applications. It is very doubtful that the Federal Aviation Administration (FAA) has a use for ultrafiche at this time.

Roll film is commonly used for larger files which are updated in their entirety rather than the partial updates which the FAA uses.

Microfiche is generally used in two sizes. The most common size is 105mm by 148.75mm or approximately 4 inches by 6 inches. The other commonly used size is 82.5mm by 187.25mm or approximately 3.25 inches by 7.36 inches. The 105mm fiche lends itself to our application more readily than the 82.55mm fiche since it can be produced easier and will fit lower cost readers.

Among other advantages of microfiche are the very important aspects of cost. Both the microfiche copies and microfiche readers are relatively inexpensive, copies generally cost between $.10 and $.25 each, depending on such factors as type of film used and volume generated. These costs are contract costs. When using in-house equipment and diazo copy film, the cost is approximately $.06 each.

Microfiche readers come in a wide variety of types and prices. For our purposes it would be possible to use an inexpensive reader. Since aesthetics such as cabinet finish are not likely to be an important consideration, the most important decision affecting reader choice is the reduction ratio/ratios used for the microfiche. The following table shows the maximum amount of data per microfiche at various reduction ratios, all figures are for 105mm microfiche.

Reduction	Number of Frames
20x	60
24x	98
42x	208
48x	270

The reason there are a variety of reduction ratios still in use is simply that the microfilm industry is still young and involved in experimentation. It is obvious, however, that 24x for source documents and 48x for COM are rapidly becoming an industry standard. Most large users including the Department of Defense (DOD) have specified these reductions for all future work. Presuming the FAA will agree with 24x and 48x as a standard the readers issued to the ultimate users of the microfiche will have to be specified accordingly. These readers must have, as a

minimum, dual lens and dual carriage capabilities; in addition, it is strongly recommended that they be built so that they can be used in all reasonable ambient light conditions without glare. There are many microfiche readers on the market able to satisfy these minimum conditions.

The system depicted in Figure 1 is modular. Each piece of equipment shown can be obtained, off the shelf, from any of several sources. This should be kept firmly in mind when writing the acquisition specifications. It is not necessary that the total system be acquired at the same time. It is possible, perhaps desirable, to purchase the camera, film processor and duplicator/collater while investigating the various COM units available. This would allow the FAA to establish a microfilm distribution system, catch up on existing documentation and train people in the use of microfilm while having a minimum investment in equipment. There is no technical requirement for the modules of the system to be co-located although it might prove convenient; particularly for the film processor and duplicator/collater.

There are, basically, two camera options, planetary and rotary. A planetary camera consists of a flatbed over which a camera and lights are suspended. The document to be photographed is placed on the flatbed and a picture is taken. The reduction ratio is varied by changing the distance between the camera and the flatbed. The advantages of a planetary camera include its versatility; it can accommodate a wide variety of size and type of documents photographed at virtually any reduction ratio. The primary disadvantage of a planetary camera is the fact that it is a manual operation and as such is slow. A rotary camera, on the other hand, can be operated in a manual or automatic mode and is much faster than a planetary camera. In addition, rotary cameras generally cost less than planetary models. The major disadvantage of a rotary camera is size limitation for the documents being microfilmed. This, however, should not be a serious restriction for FAA purposes since very little, if any, FAA documentation is outside the scope available in rotary camera equipment.

When considering a film processing unit it should be remembered that film from the camera as well as from the COM unit must be processed into microfiche. For this reason Figure 1 shows the film processor as a stand-alone module. Another advantage of a stand-alone processor is that it could easily be located at a place where the conditions and expertise for handling such equipment already exist (e.g., a photographic laboratory). Although some COM units have integral film processing units purchase of that type could well result in duplication or even result in a decision not to include a camera in the production facility. If this exclusion were to come about, it could conceivably result in a delay of months or even years in microfilm acceptance by the users.

The microfiche duplicator/collater shown in Figure 1 is intended to produce and collate as many sets of copies of microfiche as

the National Airspace System requires. There are several models on the market which could satisfy this requirement. The major considerations are reliability and price. In addition to being available on the open market, this type of equipment is on the General Services Administration (GSA) list to facilitate procurement.

The remaining equipment required for the recommended system is the COM unit. Since this module will undoubtedly represent more than fifty percent of the cost of the system, requirements should be very carefully considered before specifications are written. The types of COM units available are discussed in the technical background section of this report; very briefly, they are: (1) Fiberoptics Unit, (2) Laser Beam Unit, (3) Cathode Ray-Camera Unit.

The Fiberoptics technique records a single line of data on film, the film is advanced and the process is repeated. This technique generates data by selectively illuminating a matrix of luminous fibers. The film is exposed to this line of characters and advanced. This technique is not well suited for FAA documentation purposes; it is slow and restricted in its applications.

The Laser Beam Units record directly onto film. This technique records a full page at a time on a special light and electron sensitive silver film. This film can be developed using heat rather than wet chemical processing. This distinct advantage is overcome, however, by the fact that the state of the art in this technology is such that the units are limited in the type of data they can handle. This limitation is imposed by a restricted character set and an inability to handle graphics.

The final type of COM unit is one which uses a Cathode Ray Tube (CRT) to display data which is photographed by a camera which is an integral part of the unit. There are three methods of character generation commonly used with a CRT COM recorder, they are (1) DOT generation in which locations on the face of the CRT are activated to form the desired character. This method generally produces poor quality characters; (2) stenciling, a technique in which a wafer containing the available characters is enclosed in the neck of the CRT. The characters are painted on the face of the CRT by directing the electron beam at the desired character. This method is obviously restricted to the character set in the wafer and doesn't have any graphic capability; (3) The Third and recommended type of character generation is stroke generation. Using this method, each character is stroked on the face of the CRT. The electronics required for this method are more complicated and consequently more expensive than other methods but the product is of higher quality. In addition to better quality characters, the stroke generation method lends itself to reproduction of graphic material. This is a major consideration in the FAA System since there are several hundred thousand pages of graphic documentation which are frequently updated.

In summary, the recommended microfilm production system consists of a COM unit which uses stroke generation on a CRT to produce silver halide master film of both character and graphic data. A rotary camera which produces silver halide master film of previously printed data. A stand-alone film processor capable of processing film from either the camera or the COM unit and producing a silver halide master 105mm by 148.75mm microfiche. A duplicator collater capable of using the microfiche from the film processor as input to produce and collate at least fifty copies of diazo microfiche.

APPENDIX II

MILITARY SPECIFICATION FILM,

MICROFICHE, 48X

1. SCOPE

1.1 Scope - This specification contains requirements for producing distribution fiche (see 6.3.6) at a 48:1 reduction ration.

1.2 Classification - The 105.0 +0 or -0.75 mm X 148.0 +0 or -1.0 mm fiche shall be of the following types, classes, and kinds, as specified (see 6.2):

Type I.	Silver-halide fiche
Type II	Diazo fiche
Type III	Vesicular fiche
Type IV	Other film that satisfies the performance requirements of this specification.
Class 1	Original camera master fiche first generation (see 6.3.4).
Class 2	Intermediate copy fiche.
Class 3	Distribution copy fiche.
Kind N	Negative form (clear characters, numeral, etc. on a dark background).
Kind P	Positive form (dark characters, numeral, etc. on a light background).

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

FEDERAL

L-F-315	-	Film, Diazotype, Sensitized (Direct Image Microforms).
L-F-00320	-	Film, Thermal, Developing.
L-F-334	-	Film, Photographic, Roll, Microfilm (Black and White).
QQ-S-781	-	Strapping, Steel, Flat and Seals.

PPP-B-566 - Boxes, Folding, Paperboard.

PPP-B-585 - Boxes, Wood, Wirebound

PPP-B-601 - Boxes, Wood, Cleated-Plywood.

PPP-B-621 - Boxes, Wood, Nailed and Lock-corner.

PPP-B-636 - Boxes, Shipping Fiberboard.

PPP-B-676 - Boxes, Setup.

PPP-T-60 - Tape: Packaging, Waterproof.

PPP-T-76 - Tape, Pressure-Sensitive Adhesive, Paper, (For Carton Sealing).

MILITARY

MIL-P-116 - Preservation-Packaging, Method of.

MIL-B-43014 - Boxes: Water Resistant Paperboard; Folding, Set-up, and Metal-Stayed.

MIL-C-45662 - Calibration System Requirements.

STANDARDS

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection Attributes.

MIL-STD-129 - Marking for Shipment and Storage

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. - The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on the date of invitation for bids or request for proposal shall apply.

AMERICAN NATIONAL STANDARDS INSTITUTE, INC.

PH1.25-1965 Safety Photographic Film, Specifications for.

PH1.41-1973 Photographic Film for Archival Records, Silver-Gelatin Type, on Polyester Base, Specifications for.

PH2.19-1959 Diffuse Transmission Density.

(ANSI standards may be obtained from the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.)

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.

3. REQUIREMENTS

3.1 First article. - Film furnished under this specification shall be products which have been tested and have passed the first article inspection specified in 4.5.

3.2 Material. - All film procured under this specification shall be made of safety stock as defined by ANSI Standard PH1.25-1965.

3.3 Design and construction. - All film shall be of the design and construction specified herein.

3.3.1 Microfilm characteristics.

Type I, Silver-Halide fiche shall be in accordance with L-F-334 (except for size) or PH1.41-1973 when applicable.

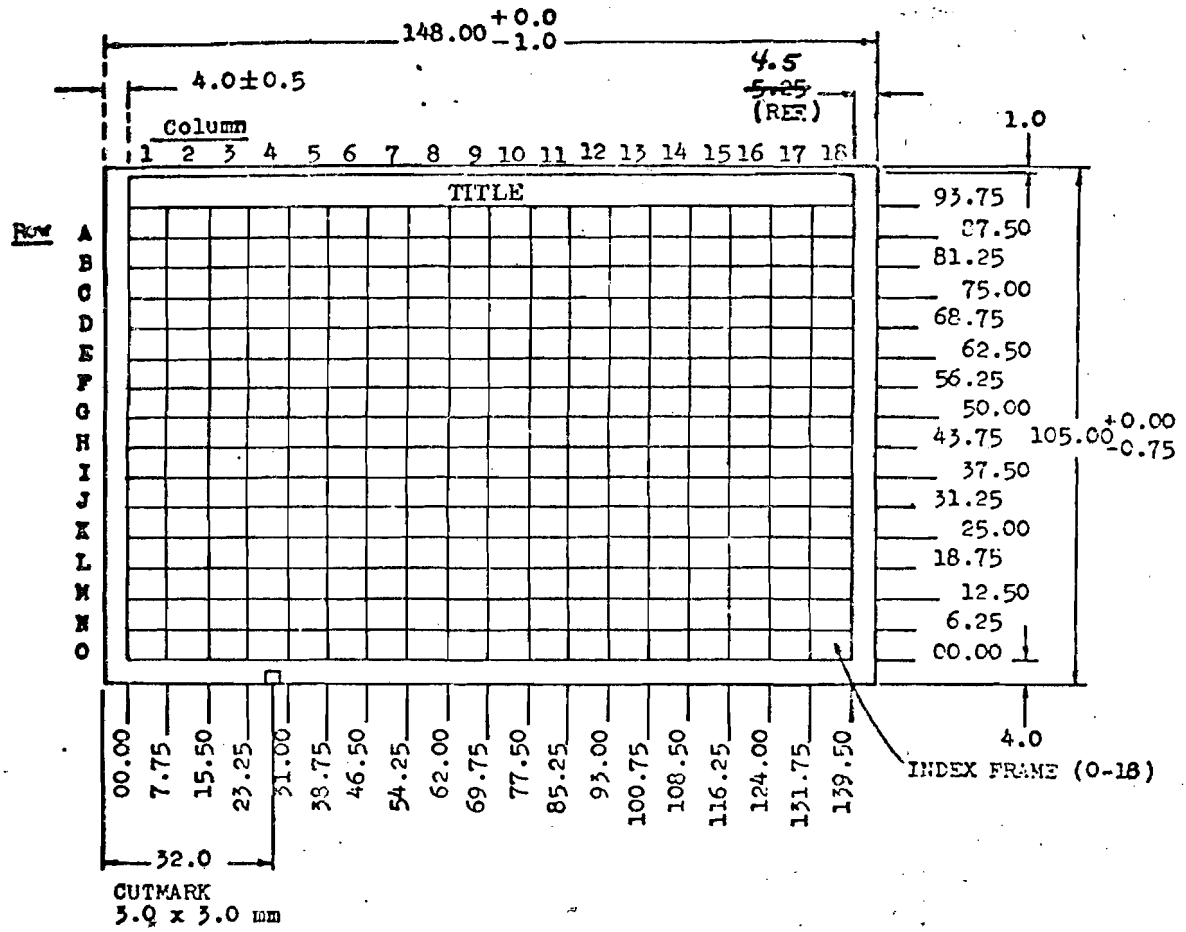
Type II, Diazo fiche shall be in accordance with L-F-315 (except for size).

Type III Vesicular fiche shall be in accordance with L-F-320 (except for size).

3.3.2 Title area - The title area (see 6.3.10) for each fiche shall be located above row A (see 6.3.9) and contain eye legible characters at least 3 mm high for a one line title. Characters shall not be "filled-in" or "light" to the extent they are illegible.

3.3.3 Pagination - When the fiche title is right reading, the placement of the first microimage shall be located completely within the theoretical grid lines in the top left frame. Succeeding images shall appear in sequence from top to bottom and from left to right. When an index to the fiche is provided, the placement of the index shall be at the bottom right frame of the grid area. Additional index frames shall appear in reverse sequence subtracting from the allotted format.

3.3.4 Cutting mark - Each class 1 and 2 fiche shall have a cutting mark to provide for automatic cutting of processed 105 mm roll film into fiche sheets. This cutting mark shall be 3 mm square, and the center of the square shall be located 32 mm from the left edge of the fiche along the bottom (see figure 1).



NOTES:

1. Page size 14 x 11 in. (text 13.20 x 10.67 in.)
2. Effective reduction 48X ±2%.
3. Format 18 columns x 15 rows. 270 frames. (See 6.3.1 and 6.3.3).
4. Dimensions are in millimeters, except as noted.
5. Grid lines shown do not appear on microfiche.

48X

FIGURE I FICHE FORMAT

3.3.5 Protective coating (optional) - When specified (see 6.2) by the procuring activity, type I fiche shall have a protective coating applied to the emulsion after processing. The protective coating shall not adversely affect in any manner the resolution of or the ability to produce further film generations. Coating used must remain within clear line density tolerances and shall entirely cover the emulsion of each fiche. The protective coating shall not contain any streaks, bubbles, lap marks, lumps, etc., or other foreign material.

3.3.6 Fiche format - Each fiche shall contain a horizontal title area along the length above the microimage (see 6.3.6) frames. The grid configuration of frames shall be 15 horizontal rows and 18 vertical columns (see figure 1).

3.3.7 Trailer fiche identification (see 6.3.11). When trailer fiche are used, each fiche in the set including the first one shall be sequentially identified. This information shall appear in the right-most portion of the title area.

3.4 Fiche size and thickness - When tested as specified in 4.7.2, the overall dimensions of the distribution fiche shall be 105.0 +0.0 or -075 mm X 148.00 +0 or -1.0 mm (approximately 4" x 6"). The thickness of films used may vary from 0.004 to 0.008 inch for polester base film and 0.005 to 0.009 inch for acetate base film. When colored backing material is specified (see 6.2) to increase legibility of the title area, it shall not exceed 0.0005 inch thickness.

3.5 Reduction ratio - When tested as specified in 4.7.3 the effective reduction ratio (see 6.3.8) for fiche shall be 48:1 plus or minus 1X.

3.6 Microimage placement and orientation. - When tested as specified in 4.7.4, microimages shall be located completely within the theoretical grid lines as shown in figure 1. When the fiche title is right reading and upright, microimage data lines shall be right reading and upright.

3.7 Curl and bow - When film is tested as specified in 4.7.5, the curl or bow of a sheet of distribution fiche shall have no part more than 0.25 inch above a flat surface.

3.8 Density - When tested as specified in 4.7.6, the densities shall be as follows:

(a) Type I, Silver-Halide fiche:
Class 1, not applicable
Class 2, not applicable
Class 3, (Kind N)
D max 1.50 min
D min .20 max

(b) Type II, Diazo fiche:

Class 1, not applicable
Class 2, not applicable
Class 3, (Kind N)
D max 1.40 min
D min .20 max

(c) Type III, Vesicular fiche:
Class 1, not applicable
Class 2, not applicable
Class 3, (Kind N)
D max 1.80 min
D min .35 max

3.9 Reproducibility (class 3) - When fiche is tested as specified in 4.7.7, it shall be of sufficient quality to produce a legible paper print.

3.1.9 Workmanship - All types and classes of fiche shall be free of scratches, holes, tears, finger marks, blisters, processing stains, foreign material, or any other defect that might adversely affect the use an/or quality of subsequent reproductions. Microimages shall not be observed, illegible, or out-of-focus.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection - Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein except as otherwise specified in the contract or order, the supplier may use his own or any other location suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Test equipment and inspection facilities - Test and measuring equipment and inspection facilities of sufficient accuracy, quality and quantity to permit performance of the required inspection shall be established and maintained by the supplier. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with MIL-C-45662.

4.2 Classification of inspections - The inspections specified herein are classified as follows:

(a) Materials inspection (see 4.3)

(b) First article inspection (see 4.5)

(c) Quality conformance inspection (see 4.6)

4.3 Materials inspection - Materials inspection shall consist of certification supported by verifying data that the materials used in fabricating the film are in accordance with the applicable referenced specifications or requirements prior to such fabrication.

4.4 Inspection conditions - Unless otherwise specified, sampling for inspection and acceptance shall be performed in accordance with the provisions set forth in MIL-STD-105. The manufacturer's sampling for inspection and acceptance procedures may be utilized providing such sampling for inspection and acceptance methods will assure quality equal to or better than that obtained by following the provisions set forth in MIL-STD-105, and provided the manufacturer's methods have been approved by the procuring activity.

4.5 First article inspection - First article inspection shall be performed by the supplier, after award of contract and prior to production, at a location acceptable to the Government. First article inspection shall be performed on sample units which have been produced with equipment and procedures normally used in production. First article approval is valid only on the contract or purchase order under which it is granted, unless extended by the Government to other contracts or purchase orders.

4.5.1 Sample size - Three samples selected from a first article run of 100 fiche of the same classification and information, or 10 fiche sets of the same information as applicable in accordance with the following procedure:

1 sample from the beginning of the run
1 sample from the middle of the run
1 sample from the last part of the run

4.5.2 Inspection routine - The samples shall be subjected to the inspections and examinations specified in table I.

4.5.3 Failures - One or more failures or defects shall be cause for refusal to grant first article approval.

TABLE I. First article inspection.

Examination or test	Requirement paragraph	Method paragraph
Visual examination	3.2, 3.3, and 3.10	4.7.1
Fiche size and thickness	3.4	4.7.2
Reduction ratio	3.5	4.7.3
Microimage placement and orientation	3.6	4.7.4
Curl and bow	3.7	4.7.5
Density	3.8	4.7.6
Reproducibility	3.9	4.7.7

4.6 Quality conformance inspection

4.6.1 Inspection of product for delivery - Inspection of product for delivery shall consist of the inspection shown in table II.

TABLE II. Inspection of product for delivery

Examination or test	Requirement paragraph	Method paragraph	Inspection level	AQL (percent defective)
Visual examination	3.2, 3.3, and 3.10	4.7.1	General inspection level II	2.5
Fiche size and thickness	3.4	4.7.2	S-2	4.0
Reduction ratio	3.5	4.7.3	1 each lot	
Microimage placement and orientation	3.6	4.7.4	S-2	2.5
Curl and bow	3.7	4.7.5	S-4	4.0
Density	3.8	4.7.6	S-2	4.0
Reproducibility	3.9	4.7.7	2 each lot	

4.6.1.1 Inspection lot - An inspection lot shall consist of all the production distribution fiche produced to fulfill each individual Government print order. Sampling unit shall consist of all frames within the fiche (up to 270). Sample shall consist of up to 3 percent of the total lot submitted for inspection.

4.6.1.2 Sampling plan - Statistical sampling and inspection shall be in accordance with MIL-STD-105 for the inspection levels (see table II). The acceptable quality level (AQL) shall be as specified in table II.

4.6.1.3 Rejected lots - If an inspection lot is rejected, the supplier may screen out and replace the defective units and resubmit for reinspection. Resubmitted lots shall be inspected using tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

4.6.2 Inspection of preparation for delivery - The sampling and inspection of the preservation-packing and interior package marking shall be in accordance with the groups A and B quality conformance inspection requirements of MIL-P-116. The sampling and inspection of the packing and marking for shipment and storage shall be in accordance with the quality assurance provisions of the applicable container specification and the marking requirements of MIL-STD-129.

4.7 Methods of examination and test

4.7.1 Visual examination (see 3.2, 3.3, and 3.10) The fiche or fiche sets shall be examined, as applicable, for defects. Examination shall be performed at any adequate magnification. All defects shall be verified with at least 48X magnification.

4.7.2 Fiche size and thickness (see 3.4) An examination shall be made of the end item to determine compliance with dimensions specified.

4.7.3 Reduction ratio3(see 3.5) - Reduction ration may be determined by any suitable method acceptable to the Government.

4.7.4 Microimage placement and orientation - Three frames shall be selected randomly on the distribution fiche. All measurements shall use the bottom edge and the bottom left-hand corner of the fiche as reference.

4.7.5 Curl and bow - The distribution fiche shall be placed convex side down, on a flat surface for at least 6 hours in an atmosphere of 70 degrees F and a 50 percent relative humidity.

4.7.6 Density - All densities mentioned in this specification are gross densities. The density measuring techniques shall be as follows:

4.7.6.1 Type I, class 3 The background density test shall be performed on type I fiche in accordance with ANSI Standard PH2.19-1959. The combined accurach and precision of densitometers shall be maintained so that measurements of diffuse density, type VI-b, defined in ANSI Standard PH2.19-1959, are within the following tolerances: Plus or minus .01 density units at density levels up to and including 1.00 and plus or minus .015 density units at density levels greater than 1.00. This shall be accomplished by determining the accuracy of densitometers at least once each week at density levels in the range of 0.05 to 0.30 and 1.00 to 1.20 using standard density patches. The calibration is then to be made either by adjusting the densitometers used to read accurately in terms of the standard patches or by adding or subtracting the observed differences from the designated densities of these patches. Sufficient readings of calibration patches shall be made to insure conformity with the above tolerances.

4.7.6.2 Type II, class 3, Kind N - Visual diffuse (type VI-b) as measured by the method described in ANSI Standard PH2.19-1959.

NOTE: Densitometers utilizing a photo tube with an S4 response generally require a Wratten 106 filter plus an IR Corning 4-94 infrared rejection filter, and a 2 mm aperture.

4.7.6.3 Type III, class 3 Kind N - Density shall be measured per L-F-00320.

4.7.7 Reproducibility test (class 3) - Two successive microimages shall be selected at random on the sample fiche.

Paper prints shall be made using an enlargement ratio of 100 to 75 percent of 48:1.

5. PREPARATION FOR DELIVERY

5.1 Preservation-packaging - Preservationpackaging shall be level A or C, as specified (see 6.2).

5.1.1 Level A.

5.1.1.1 Cleaning - Fiche film shall be cleaned in accordance with MIL-P-116, process C-1.

5.1.1.2 Drying - Fiche film shall be dried in accordance with MIL-P-116.

5.1.1.3 Preservation application - Preservatives shall not be used.

5.1.1.4 Unit packaging. - Each complete set of fiche film shall be packaged in accordance with MIL-P-116, submethod IC-1 insuring compliance with the general requirements paragraph under methods of preservation (unit protection) and the physical protection requirements paragraph therein. The fiche film shall be protected from bending, curling or distortion by the use of paperboard or fiberboard stiffeners.

5.1.1.5 Intermediate packaging - Fiche film, packaged as specified in 5.1.1.4, shall be placed in intermediate containers conforming to PPP-B-566 or PPP-B-676. Intermediate containers shall be uniform in size, shape and quantities, shall be of minimum tare and cube and shall contain multiples of five unit packages, not to exceed 50 unit packages. No intermediate packaging is required when the total quantity shipped to a single destination is less than 50 unit packages or when supplementary containers are used.

5.1.2 Level C - Fiche film shall be clean, dry and packaged in a manner that will afford adequate protection against deterioration and physical damage during shipment from the supply source to the first receiving activity.

5.2 Packing - Packing shall be level A, B, or C, as specified (see 6.2).

5.2.1 Level B - The packaged fiche film shall be packed in fiberboard containers conforming to PPP-B-636, class domestic, style optional, special requirements. Closures shall be in accordance with the appendix thereto.

5.2.3 Level C - The packaged fiche film shall be packed in shipping containers in a manner that will afford adequate protection against damage during direct shipment from the supply source to the first receiving activity. These packs

shall conform to the applicable carrier rules and regulations.

5.3 Marking - In addition to any special marking required by the contract or purchase order (see 6.2), each unit package, intermediate and exterior container shall be marked in accordance with MIL-STD-129. Interior packages containing class 1 (camera fiche) film shall also be marked "Avoid Finger Marking or Mishandling of Enclosed Master Camera Film".

5.4 General

5.4.1 Exterior containers - Exterior containers (see 5.2.1, 5.2.2, and 5.2.3) shall be of a minimum tare and cube consistent with the protection required and shall contain equal quantities of identical stock numbered items to the greatest extent practicable.

5.4.2 Army procurements

5.4.2.1 Leval A intermediate packaging - Containers conforming to PPP-B-566 or PPP-B-676 shall be overwrapped with waterproof barrier materials or shall conform to MIL-B-43014) (see 5.1.1.5).

5.4.2.2 Levels A and B packing - For level A, B, and C packing when quantities per destination are less than a unitized load, the fiberboard containers shall not be banded but shall be placed in a close fitting box conforming to PPP-B-601, overseas type; PPP-B-621, class 2, style 4, or PPP-B-585, class 3, style 2 or 3. Closure and strapping shall be in accordance with applicable container specification except that metal strapping shall conform to QQ-S-781, type 1, finish A. When the gross weight exceeds 200 pounds or the container length and width is 48 x 24 inches or more and the weight exceeds 100 pounds, 3 x 4 inch skids (laid flat) shall be applied in accordance with the requirements of the container specification. If not described in the container specification, the skids shall be applied in a manner which will be addequately support the item and facilitate the use of material handling equipment. For level B packing, fiberboard boxes shall be weather resistant as specified in level A and the containers shall be banded (see 5.2.1 and 5.2.2). When fiberboard containers are used for level C shipments, they shall be weather-resistant unless there are over-riding factors which make them less economical than domestic fiberboard.

6. NOTES

6.1 Intended use - Fiche procured to this specification are for use with 48:1 viewers and viewer/printers.

6.2 Ordering data - Procurement documents shall specify the following:

(a) Title, number and date of this specification
(b) Quantities and kinds of fiche required (see 1.2)
(c) Delivery data and destination(s) for fiche.
(d) Interior and exterior packaging (see 5.1 and 5.2)
(e) Protective coating (see 3.3.5).
(f) Levels of preservation-packaging and packing required (see 5.1 and 5.2).
(g) Special marking, if required (see 5.3).
(h) Title area colored backing, color required (see 3.4).

6.3 Definitions

6.3.1 Column - A vertical series of frames on a fiche.

6.3.2 COM:

(a) Computer output microfilm. Microfilm or fiche containing data produced by a recorder from computer generated electrical signals.

(b) Computer output microfilmer. A recorder device which converts computer digital data into human readable language and records it on microfilm or fiche.

(c) Computer output microfilming. A method of converting digital data from a computer into human readable images on microfilm or fiche.

6.3.3 Frame - A geometric subdivision of the fiche grid. That area of a COM produced fiche which contains microimage information, without margins.

6.3.4 Generation - A measure of the remoteness of the copy from the original material. The picture taken of a document or cathode ray tube is termed first generation microfilm (camera master). Copies made from this first generation are termed second generation, and copies from the second generation are termed third generation.

6.3.5 Header - The area at the top of the microfiche for eye readable characters, title, sequence number, etc.

6.3.6 Microimage - A unit of information, such as a page of text or drawing, too small to be read without magnification.

6.3.7 Fiche - A sheet of microfilm containing multiple microimages in grid pattern. The fiche normally displays the title of the recorded data in a size large enough to read without magnification.

6.3.8 Reduction ratio, effective - A measure of the number of times an imaginary document would have been reduced to equal the size of the COM generated microimage, expressed as 48:1.

6.3.9 Row - A horizontal series of frames on a fiche.

6.3.10 Title - The descriptive identification of data recorded in the microimage areas of the fiche.

6.3.11 Trailer fiche - A continuation fiche on which are recorded images, from a multipage document, which exceed the capacity of a single fiche sheet.

Custodians:
Army-EL
Navy - SA
Air Force - 70

Preparing activity:
DSA - ES

(Project 6750-0323)

Review activities:
Army - MI, AT, ME, AV, WC
Navy - AS, EC, YD, OS, SH, MC
Air Force - 07
DSA - ES

User activities:
Army - SM, TM, IH, GL
Navy - NM
Air Force -

APPENDIX III

WORK STATEMENTS

MICROFICHE FILM: Shall be the best type for clarity for short term use.

SIZE: Microfiche shall be a standard 4 x 6 inch card.

IMAGE RESOLUTION:

The quality of second generation processed microfilm shall be such that, using the NBS microcopy resolution chart, the following pattern is resolved:

24X	42X
3.6	3.6

PICK-UP:

Tapes and/or documents to be microfilmed, and/or microfiche shall be picked up by the contractor at Building 270, NAFEC, within three days of service order.

DELIVERY:

Contractor shall deliver the finished microfiche within 10 working days after receipt of the source material. Under special circumstances, finished microfiche shall be delivered within two working days after receipt of the source material.

The original microfiche, and designated number of copies of microfiche, if any, as well as the source documents or tape, shall be returned by the contractor to NAFEC.

Pick-up from, and delivery to NAFEC shall be performed by a messenger of the contractor, to insure the safety of original documents/tapes.

When directed, designated copies of the microfiche shall be mailed to the following addresses, concurrent with the delivery to NAFEC:

BY REGULAR MAIL:	BY AIRMAIL:
New York	Houston ARTCC
Islip-MacArthur Airport	P.O. Box 60308
Ronkonkoma, N.Y. 11779	Houston, Texas 77060

COM SERVICES REQUIRED:

Production of microfiche: Computer output magnetic tapes, produced at NAFEC on the IBM/9020 System; shall be converted to microfiche by the contractor.

Input Tapes: The following types of tapes will be furnished to the contractor for processing:

a. NOSS output tapes
b. OS/9020 output
c. ARTC/IOP computer sysout

NOTE:
NOSS is a non-standard operating system.
OS/9020 is a derivative of OS-360 which runs on NAFEC's computers.

REDUCTION FACTOR: 42X (208 frames + title)

TITLE: - The title shall be extracted from the information on the input tapes. The title shall identify, in eye-readable characters, the following information:

a. Microfiche contents (1.e., Program Name)
b. Version identification (e.g.,A3d2.1)
c. Contents classifications (e.g.,Program Listings)
d. Date the listing was produced
e. Date the microfiche was created
f. Microfiche serial number
g. Microfiche sequence (e.g., 1 of 1, 1 of 2, etc.)

INDEX: - Each microfiche shall have an index image in the lower right-most position. The index will correlate the listings page number with the microfiche grid position.

DUPLICATING: 22 copies of each master microfiche shall be produced.

SDM SERVICES REQUIRED:

PRODUCTION OF MICROFICHE: Typed or reproduced documents shall be converted to microfiche by the contractor. The majority of these documents will be 8 1/2 x 11 inch sheets; less than 5% will be fold-outs, charts, etc. in other sizes.

REDUCTION FACTOR: 24X (98 frames + title)

TITLE: The title shall be extracted from the document cover page. The title shall identify, in eye-readable characters, the following information:

a. Document Title (e.g.,NOSS, DART, user's manual)
b. Version Identification (e.g., A3d2.1)
c. Document Date
d. Document Number
e. Microfiche Serial Number
f. Microfiche Sequence (e.g.,1 of 1, 1 of 2, etc.)

FIRST FRAME: The standard NBS resolution chart will be on the first frame together with eye-readable information identifying the following:

a. Document Title, Possibly abbreviated (e.g., DART user's manual)
b. Microfiche Sequence (e.g., 1 of 1, 1 of 2, etc.)

LAST FRAME: Immediately following the last page image, the end frame shall contain the following information in eye-readable characters:

a. The work "END"
b. The words "DATE CREATED"
c. Date the microfilm was created.

DUPLICATING: 24 copies of each master microfiche shall be produced.

DEBUGGING AND UPDATING:

The Government will furnish microfiche panels to the contractor which are suitable for use in ordinary 3 ring binders. Each panel (housing frame) will contain pockets for 26 fiche.

Each batch of microfiche shall be placed in pockets in panels, as directed; the panels shall be assembled in sequential order, and shall be temporarily secured for mailing through one of the holes; and a typewritten index of the fiche, suitable for use in a 3 ring binder, shall be prepared for each set of master panels. The duplicate panel; sets shall be similarly prepared, except that the index may be a legible reproduction.

The original computer output magnetic tapes and/or source documents, and the master microfiche produced from them shall be delivered to NAFEC, and the duplicates shall be mailed as directed.

QUALITY ASSURANCE:

The contractor shall inspect each original and reproduced microfilm, image by image. Unacceptable microfiche shall be redone. The contractor shall also inspect each of the microfiche-containing binders to insure the integrity and orderliness according to the table of contents.

The Government reserves the right to perform spot checks of the contractor's work at the plant.

DELIVERIES:

Pursuant to each call for materials and/or services, contractor shall deliver work/items requested with a serially numbered delivery ticket in duplicate.

Upon delivery, the Government personnel authorized to receive the material will retain the copy of the delivery ticket, and will sign the original and return it to the delivering messenger of the contractor.

The contracting officer may require the contractor to support his invoice with the original of the delivery ticket.

Each delivery ticket shall contain the following information:

1. Blanket purchase order number
2. Call number under the blanket purchase order
3. Date the call was made
4. Name and title of person placing the call
5. Itemized list of materials and/or services furnished pursuant to the call
6. Unit price and extension for each item.