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ADVISORY GROUP FOR AEROSPACE RESEARCH & DEVELOPMENT

AGARD ADVISORY REPORT No. 27

on

The Use of Microfiche for Scientific and Technical Reports

by

H.F. Vessey

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NORTH ATLANTIC TREATY ORGANIZATION

ADVISORY GROUP FOR AEROSPACE RESEARCH AND DEVELOPMENT

(ORGANISATION DU TRAITE DE L'ATLANTIQUE NORD)

THE USE OF MICROFICHE FOR SCIENTIFIC AND TECHNICAL REPORTS

by

H. F. Vessey

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SUMMARY

This paper considers the use of the 105 x 148 mm microfiche for the report material of NATO Nations. It emphasises the economies that are obtained once user acceptance has been obtained and discusses the reluctance of scientists to use this report material which requires a special reader. Readers and reader printers are discussed and advice is given on the examination and test of a new reader or reader printer. The large number of proposed "standards" for microfiche are outlined and it is stated that the present 105 x 148 mm microfiche is adequate and that there is little conflict between European and American standards. Much of the American report material is already available in Europe only as microfiche and the proportion is expected to grow and it is therefore recommended that European Documentation Centres should produce their own reports as microfiche and encourage their customers to make full use of this material. Better and many more readers are stated to be required in firms, Universities and Laboratories and some advice on minimum numbers is given. Possible action by AGARD is discussed.

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1. INTRODUCTION

Microfiche are sheets of cut film on which a number of photographic images are printed. The size of those discussed here is 105 x 148 mm or about 4 x 6 in. but many other sizes are in existence. Microfiche were introduced in Europe in 1940 but it was not until a few years ago that they were produced in large quantities when this form of micro-image was introduced in America by the A.E.C. and NASA. All the large American Aerospace organisations are now making and using microfiche which, in this area, have replaced microfilm (16 mm or 35 mm film) and, to a large extent, hard copy. As a report is reduced to a single sheet of film there is a considerable saving in cost and there is no doubt that the use of microfiche will continue to expand and it is already true that many American reports are only available in Europe as microfiche (or as very expensive photocopies of microfiche). In addition, most of the AGARD documents not on sale have been put on microfiche in America and are available to the general public. Thus many of these papers (issued as hard copy in limited numbers) can only be obtained as microfiche. Availability of these and other American microfiche has been considerably improved and most can now be bought from ESRO/ELDO in Paris and from the Ministry of Technology Reports Centre, Station Square House, St. Mary Cray, Orpington, Kent BR5 3RE, United Kingdom.

The purpose of this report is to explain the advantages of microfiche and to encourage the full use of them in the report literature of all NATO nations.

2. MICROFICHE STANDARDS

There is a bewildering number of standards and so called standards in microfiche. In the context of reports the most important are I.S.O[1] and British Standards[2] in Europe and Federal Standards[3] in the U.S.A. and fortunately in practice they are compatible in the 105 x 148 mm size. There are variations which will be discussed later but fortunately all three can be used with suitable reading and printing equipment even if fully automatic. Dimensions and tolerances from ref. 3 are shown in fig. 1 while figs. 2 and 3 indicate the image layout. It will be seen that while 72 image areas are available not all are used. Thus a title strip occupies the first line and two or three of the remaining image areas are used for identification etc. In all these areas the lettering is readable without magnification, in the image areas the photographic reduction is from 18 to 1 (for A4 size pages) to 20 or 22 to 1 (for foolscap pages). Thus a 56 page report and its cover can be recorded on a single fiche. A very large proportion of reports do not exceed 56 pages so that about 90% go on one sheet. For longer reports a continuation or trailer fiche is used as fig. 3 in which case the title line is not required and 69 images can be accommodated. The following table gives the number of fiche required for various lengths of reports.

TABLE 1

Number of Report pages (including cover)	Up to 57	58 to 126	127 to 195	196 to 264	265 to 333	334 to 402
Number of fiche required	1	2	3	4	5	6

Fig. 1 indicates the position of a resolution chart although in practice it is usually also repeated on the END frame. This is a National Bureau of Standards line resolution chart to check photographic resolution by means of a microscope. The American standard requires at least 127 lines per millimeter for the photographic master and at least 90 lines per millimeter for all subsequent copies. The British Standard[2] uses "mires", a pattern recognition system, but, as amended 27th September 1968, the resolution required is roughly equivalent. This order of resolution is considerably better than that obtained by normal photographic techniques and many microfiche fail to meet it but by care satisfactory microfiche can now be made and copied. An inferior resolution is not necessarily disastrous except for small print but fortunately most organisations are now producing fiche approaching specification.

Density is specified in terms of transmission density with comparatively wide tolerances, nevertheless many copy fiche used by the author have been unsatisfactory due to the fact that they were overdense. Fortunately, if copying facilities are available it is possible to copy again and so improve density at a very small sacrifice in resolution. The improvement in ease of reading is surprising and is well worth trying in bad cases.

Film thickness is specified for distribution copies as 0.1778 mm to 0.2032 mm in the U.S.A. Standard[3] but B.S.I.[2] allows a wider tolerance of 0.1 mm to 0.2 mm "of sufficient rigidity for the purpose for which it is to be used". In the author's opinion fiche to the upper limit are to be preferred as thin fiche tend to distort in a hot reader or reader printer.

Only the American standard defines the form of the document images:-

"Distribution copies shall have all document pages, including text and halftones, printed in negative form (background dark, image information light)".

The other two standards apparently allow either negative or positive microfiche. This can be argued for the main disadvantage of negative fiche is that half-tone illustrations, in negative form, are generally unreadable and that text in positive is easier to read. The determining factor appears to be that negative fiche are easier to print from and that reading of half-tone illustrations is not important as they are so degraded by the photographic and diazo processes to be unreadable even in positive form. Nevertheless it is true that most users would prefer to read positive fiche.

Again, only the American specification deals with the title:-

"Row A of microfiche sheet 1 shall be dedicated for numbering, security markings and title information, all of which shall appear positive (opaque on clear or on contrasting backing) and shall be readable without magnification".

This appears to be desirable as it is important to be able to sort and select microfiche without visual aids. The phrase "opaque on clear or on contrasting backing" appears to refer to the NASA practice of backing the title strip with a streak of opaque white paint so that each fiche in a pack is readily identifiable. Other organisations, producing clear headings, send their fiche in envelopes, the top of which provides the backing required for easy reading. The first alternative is the more economical in first cost and storage (the thickness of the envelope is about the same as that of the fiche) but the paint strip prevents the title being copied although it can be removed by paint stripper. To be fair it should be noted that NASA will, on request, provide fiche with clear title strips.

3. THE ECONOMICS OF MICROFICHE

The economics of microfiche are dealt with in Appendix 1. The treatment is unfortunately approximate for the information required for a complete analysis is not yet available. Nevertheless it is clear that the economic advantages are overwhelming:-

Less first cost

Cheap copies

Low postage costs

Low storage costs

Low cost copying.

4. OTHER FORMS OF MICROFICHE

Although the majority of fiche (certainly those in the Aerospace field) are to the standards already described, there are a considerable number of alternatives. users may well have some of these or be pressurised to invest in "new" (and therefore better!) systems the more important of these will be discussed briefly.

The early NASA fiche were on 5" x 8" film and used larger frames at a magnification of about 12 (instead of the present 18) giving the same number of image frames as the present standard (60 with heading strip). Later when 16 mm film was adopted for the camera work the present image size was used on the 5" x 8" film giving 72 image areas with a heading strip.

Smaller microfiche 75 x 125 mm are specified by I.S.O. and B.S.I., these allow 30 image areas and heading strip or 40 image areas for trailer fiche. Image magnification and spacing is the same as the larger microfiche and the small can, in fact, be considered as a portion of the larger one.

Microfiche in the form of I.B.M. punch cards are available and have the advantage that, by reducing the image area, they can be punched for machine retrieval.

An interesting development is the use of photo-chromic emulsions to allow of much higher reductions. The PCMI (Photo-Chromic Micro Image) system allows 2000 to 4000 images to be used on a 6" x 4" transparency.

A number of jacket systems are on the market to allow customers to make their own microfiche from 16 mm film. The film is inserted in pockets in a transparent envelope and can then be copied by the normal diazo process. Unfortunately the need to form pockets forces a greater separation of the 16 mm film than the 1.0 mm allowed by the ISO, BSI or Federal standards.

5. CHOICE OF MICROFICHE FOR REPORT LITERATURE

The availability of a large number of American reports in Europe only on microfiche is the strongest argument for the adoption here of a compatible system but nevertheless it is thought to be worthwhile to set down the arguments for this rather than other alternatives. Some of the alternatives are microfilm and other possible forms of microfiche.

The early supply of American reports to Europe was by means of the "NATO" ASTIA (and subsequently D.D.C.) film. This started as 16 mm film which was later modified to 35 mm because of reproduction difficulties. In most countries the film was cut into its separate report lengths and then stored in small canisters marked for retrieval and subsequent reading and printing. In this form, to the author's surprise, it took up almost exactly the same storage space as the original reports, (in hard copy) stored on shelves. Reading the 35 mm film was comparatively easy and reproduction, by Rank Xerox Copyflo, was relatively cheap. However, storage was difficult and if cheap printing was required heavy capital expenditure was involved.

PCMI systems allow for much higher density packing and may well have applications for direct retrieval with computer systems. However, for normal information services one report is required at a time and PCMI, offering say, 80 reports per fiche shows no real advantage. In addition, PCMI is very expensive in first cost and in reading equipment.

In considering possible changes to the present standard microfiche a case could be made for a slight increase in row separation and a corresponding increase in height to allow jacket fiche to be used and for the frame numbers, previously used on NASA fiche, to be restored. The advantages would however be marginal and the conclusion is inescapable: the present microfiche is a very good compromise and we in Europe must learn to live with it.

6. USER ACCEPTANCE

User acceptance is the most formidable hurdle to be overcome before full use of microfiche is possible. Acceptance in the U.K. has certainly been delayed by the provision of bad copy fiche, the lack of really good microfiche viewers and the small number available. In all these respects the position is improving but is, as yet, not satisfactory. Even in the U.S.A. acceptance is far from complete and Dr. Wooster's recent report[4] is a useful corrective to the glowing accounts we read in the literature of the use of microfiche. It is clear that, even when fiche are readily available there is resistance to their use, mainly on the grounds of difficulty of reading, having to walk to a fiche viewer and not being able to use fiche when away from the place of work. In the U.K. and probably in the rest of Europe the proportion of non-users is probably much higher.

There are three steps which must be taken if acceptance is to be obtained:-

1. The ready supply of good quality microfiche of all the report material of interest to NATO scientists and engineers.
2. The provision of a sufficient number of good quality viewers and of a smaller number of good reader-printers for the copying of an occasional page or table.
3. The availability of good, really portable (preferably pocket) readers for home and travel use.

Dealing with these in turn:-

1. Most American reports in Europe are on microfiche and the numbers of those which are on microfiche only will certainly increase. These are available from most National Documentation centres and several other sources.
2. Some satisfactory readers and reader printers are available although prices are still too high. The numbers in use are however, much too low. A 100 yard walk to the Library will prevent most scientists using microfiche and while the other extreme of one reader per scientist or engineer is clearly too lavish a greatly increased supply is required in all U.K. firms and establishments. One per section would be a useful start. No management would quibble at the supply of an oscilloscope to a radio lab and a viewer is now just as essential and should cost less.

3. Most scientists do a large amount of their peripheral reading in the train, at home or on trips. The present pocket readers known to the author would do nothing to encourage this habit. Portable viewers are in better supply but the cost and weight of those known is too high.

In the author's opinion the most important factor acting against user acceptance is the limited availability of viewers. If the position can be improved in this respect other means of encouragement can then be used. Thus copy fiche can be offered at a low price and in some cases it may be possible to follow American practice where a subject enquiry results in a free supply of fiche and a statement of the cost of the same reports in hard copy. Advertisement of holdings has been neglected in the past, except in America, but should now be considered.

Publicity will however be self-defeating if good quality fiche cannot be obtained, supplied quickly and if the customer has not a good viewer easily accessible.

7. READERS

There are now a very large number of microfiche readers available of which one is shown in fig. 4 and most are included in one or other of the "Reviews" which are issued by various organisations. Others too, with very attractive specifications are promised in "six months time". The market is changing so rapidly that in place of giving a list it is proposed to describe the principles and then discuss details of the requirements which define a good reader and advise those examining competitive viewers.

Most make use of a similar optical system to that of the home movie or slide projector. A brilliant, almost point source lamp is mounted behind a condensor (which may be a single or double lens) and in front of a reflector. The condensor provides a slightly converging beam of intense light which then passes through the film. The lens views the film and focusses the image on a distant screen. The magnification is solely dependant on the focal length of the lens and on the distance of the screen. The screen intensity and evenness of illumination are determined by:-

a) The lamp intensity.

b) The reflector which although not essential doubles the screen intensity.

c) The condensor design; the closer the lamp is to the condensor when the system is focussed, the greater the efficiency.

d) The aperture of the lens. However, any increase in aperture above that required to pass the images of the lamp formed by the condensor and reflector will produce no improvement in image intensity.

e) Then finally the image sharpness is determined by the quality of the lens although it can be degraded if the film is not held flat. Modern lenses should give pin sharp images over the whole of the field.

A few fiche readers do project directly on to a screen but most use short focus projection lenses and "fold the beam" by means of one or two mirrors. Thus a 45° mirror may throw the image forward to a translucent screen which is viewed from the other side (back projection) while in another arrangement two mirrors are used to project the image on to a white screen in the interior of the viewer. Other arrangements are possible but most manufacturers appear to prefer a single mirror and a translucent screen viewed by back projection. Unlike a plain white opaque screen, back projection introduces new problems of illumination chief of which are loss of image intensity or a "hot spot". A "hot spot" of intense illumination in the middle of the screen is given by a screen which is too transparent and can be reduced in intensity by increasing the density of the screen at some sacrifice in overall intensity.

The basic requirements are a sharp image and a sufficiently high light intensity, these and other desirable (or undesirable) features can be determined by a short test.

Take a good quality negative fiche and insert it in the carrier, if the image is inverted turn it top to bottom, if the image is the right way up but reversed right to left (mirror writing) turn it over. Put a label on the viewer recording the result. "Wrong reading, title top" might be the result.

Test in normal room lighting but with no bright lights shining on the screen.

a) Focus the first frame and check that image is sharp top to bottom and side to side.

b) Check image intensity, is there a "hot" spot and is it possible to read corners and centre easily without moving the head?

c) Shift to the next frame, is the movement easy and positive and is the whole of the image still in focus?

d) Pick a frame in the top row, focus carefully and then transfer to the corresponding frame in the bottom row; repeat the test from side to side. Does the focus shift?

e) Leave one frame on the viewing screen for 5 minutes and then take the fiche out quickly and test its temperature (on the cheek). Gentle warmth is all that should be felt but some readers are hot enough to cockle fiche.

Few readers will be found to be perfect optically but with those that are acceptable the further considerations should be on convenience in reading.

1. Screen A vertical or near vertical screen gives those of us who have bifocal spectacles a crick in the neck. In this respect the internal sloping screen is better and some makers offer variable position screens.

2. Screen Size The size of image offered varies considerably. Ideally it should be of the original size i.e. A4 210 x 297 mm but some reduction is practicable. With a good fiche, good optics and good eyesight half size images are readable but a better compromise is 140 x 195 mm.

3. Indexing Some makers allow you to choose the line and frame number by means of an external frame or similar device. This is useful if the user wishes to record frame number for future reference but unless this is important the author considers this a luxury which is much more appropriate to reader-printers (see later).

4. Light Intensity Control Except in those readers where the illumination is inadequate (a large number), intensity control is highly desirable. In particular positive fiche need less light than negative ones and too much light causes eye strain. "Automatic" adjustment is sometimes offered, a photocell on the top of the viewer adjusting the illumination to the ambient light. To the author the advantage appears marginal.

5. Stray Light Light spill which can be seen by the user when viewing is very annoying and can quickly cause eye-strain.

6. Coated Screens Non-reflective translucent screens are available and although not essential are useful for a reader which is used in difficult conditions.

7. Two-up Projection Some viewers allow two adjacent frames of the fiche to be projected side by side on the screen. If the screen is long enough, i.e. about 300 x 420 mm it will show two A4 images side by side. If it does not cost too much this is a luxury well worth while.

8. Image Rotation With some fiche the diagrams and perhaps tables are photographed sideways. This makes reading very difficult and is overcome in some readers by rotating the fiche holder or mirror system. Although not essential this is a well worth while luxury.

9. Fiche Holder The microfiche is generally held between two glass plates and viewers vary in behaviour. The holder should be easy to use, should hold the fiche flat and should be easy to clean. Lack of flatness will be shown up by the necessity for re-focussing on certain frames and is of considerable nuisance value.

8. READER-PRINTERS

Reader-printers are similar to viewers and allow the user to view a fiche and to print selected pages, one such reader-printer is shown in fig. 5. In most cases the mirror is changed in angle to throw the beam on the printing paper which is photographic or one of the more recent light printing papers. Pressing a button moves the mirror and starts the timing cycle which exposes the paper and then passes it to the automatic developing system. A timing clock is used to determine the exposure.

In examining a reader-printer the same checks should be made as for readers. Then one or two pages should be printed to determine whether the image sharpness is the same as on the screen.

Indexing, if it is accurate and repeatable is a useful feature in a reader-printer for it is then possible to note the frames requiring printing during the reading process and return to them for printing, if still considered necessary, at the end.

Speed of printing, unless a complete print out is required, is not of primary importance. Times of the order of half a minute are typical for the full printing process. If complete print out is frequently required it is as well to consider putting this out to contract for few reader-printers are economical. They are slow and the cost of special paper plus solutions is high.

Permanence may or may not be a requirement. If it is then probably the electrostatic processes are to be preferred. A rough check can be made by exposing a sheet of print in a southerly facing window in summer for two weeks. Half the sheet should be exposed to the light while the other half is covered by black card. Most photographic stabilization processes will be markedly affected by this treatment while, of course, it is known that they will last several years in normal circumstances.

Image size will again vary from full size (A4) or even more but because of cost of paper a smaller size is usually preferred. With good fiche and a good print, half size (or two-up on A4) is readable except perhaps for the small print sometimes used for footnotes. The ability to print half or full size on A4 paper would be a considerable convenience. Failing this a magnification of 12 or 13, to give three-quarters original size, is a useful compromise. It should be noted that magnification of a poor fiche does not make it more readable, it merely magnifies the defects.

Image rotation, as with readers, is a useful feature.

9. COPYING MICROFICHE

Several methods of copying microfiche, such as that shown in fig. 6, are now available which are simple to use and are not expensive. Large scale copying results in lower unit costs but the equipment requires heavy capital expenditure and skilled labour. At the present time simple equipment at, say, National Centres, and access to an agency for bulk copying appears to be the best compromise.

10. MAKING MICROFICHE

The preparation of a master microfiche requires skilled operators, and at present, expensive cameras. This work, for the time being, appears best left to one or two centres in each country.

11. PRINTING FROM MICROFICHE

Printing by reader-printers is expensive and should ideally be used in combination with reading to take copies of, say, important tables. Large scale copying reduces the cost but requires expensive equipment and again one or two centralised agencies for bulk orders appears desirable.

12. SCALE OF EQUIPMENT REQUIRED

This will depend on the size of the organisation and the acceptance of microfiche as a form of report material to be read regularly. The equipment must be sufficient to encourage reading and must be much more than it is at present (at least in the U.K.). As a minimum the following is suggested:-

	Readers	Reader Printers	Fiche Copying
National Documentation Centres	2	1	1
Research Establishment Libraries	2	1	1
University Libraries	1	1	-
Firms Libraries	1	1	-
Firms R&D Teams, per team	1	in library	-
Research Laboratories, per team	1	" "	-

In addition, National Centres and the more active libraries should have, or have ready access to:-

a) Large scale printing of paper copies from microfiche.

b) Large scale duplicating of microfiche.

c) Facilities for the preparation of master microfiche for its own or other reports.

d) When satisfactory hand readers are available these should be provided in sufficient numbers so that officers travelling to meetings or wishing to read at home should be able to borrow one at short notice.

13. RECOMMENDATIONS

1. All National Documentation Centres should ensure that all reports they handle in quantity are reproduced as standard 105 x 146 mm microfiche and should gradually increase the circulation of microfiche rather than hard copy.

2. In parallel Centres should encourage their customers to obtain sufficient equipment to make full use of microfiche.

3. As encouragement some of the financial saving should be passed on to the customers by reduced charges or, in some cases, by supplying free microfiche with the alternative of paying for hard copy.

4. AGARD should arrange for all papers circulated to National Centres to be currently produced as microfiche and for part of the present supply of hard copy to be replaced by microfiche. There will no doubt be resistance from some of the final customers so it is suggested that 25% as fiche might be a useful starting point which will produce savings. This could be later extended to 80% so giving substantial savings in AGARD publications costs.

5. At some later stage those AGARD publications to be circulated to National Centres but not of permanent interest should be circulated as microfiche only so saving printing costs.

6. Finally, a rigid check should be made by all concerned to avoid the circulation of badly copied microfiche.

REFERENCES

1 I.S.O. Recommendation R193. I.S.O./R/193 -- 1961 (E)

2 B.S.I. Specification BS 4187:1967

3 COSATI 1965 PB 167 630

4 Wooster, H. Microfiche 1969. A User Study. AFOSR--1969-1847TR

5 Claridge, P.R.P. Microfiching Periodicals. ASLIB Proceedings, Vol. 21 No. 8.

APPENDIX

THE ECONOMICS OF MICROFICHE

1. Costs

The following costs have been assumed as applying to the U.K. They are average costs derived from all information available to the author and it is emphasised that there is considerable spread.

Cost of making master microfiche	£ 1.50 per master
Cost of copy microfiche	£ 0.05 per copy
Representative selling price	£ 0.15 per copy
Cost of paper copies from microfiche	£ 0.03 per page
Postage for up to 25 microfiche	£ 0.02

These costs are to be compared with printing and distributing hard copy in comparable numbers (by say, photo-litho).

Cost of 50 page in hard copy	£ 0.50
Cost of postage	£ 0.03

The total cost of preparing and distributing 1000 copies of a 50 page report will then be:-

	Microfiche	Hard Copy
1000 copies	£150	£500
Postage	£ 20*	£ 30
	£170	£530

These figures are approximate only but are probably representative of a Government "no profit" operation. It is interesting to note that the Clearinghouse figures for selling reports either as hard copy or microfiche are even more favourable to the latter:-

Cost of microfiche per report	$0.65
Cost of hard copy	$3.00

The above figures are overwhelmingly in favour of microfiche but it should be noted that the financial gain may well be lost if the recipients of the microfiche insist on paper prints from them.

Thus if 1000 microfiche are sent to the same number of customers instead of hard copy there is a saving of £360 but if only 24% of them insist on printing the full report from the microfiche the saving is wiped out and if more than 24% require prints there is an overall loss. This of course emphasises

2. Storage

Microfiche offer large economies in storage space for in simple terms the contents of 8 file cabinets of reports can be kept in 2 index drawers on an individual's desk.

cabinets of reports can be kept in 2 index type draers on an individual's desk.

Index cabinets are made cheaply in an appropriate size and are very suitable for both large and small collections. About 1000 microfiche can be stored in each drawer.

For large collections where frequent access is required automated storage is very convenient. A type available in Europe stores more than 50,000 microfiche in open-top drawers which, at the touch of a numbered button are rotated into the access position. A seated operator has therefore immediate access to any fiche in the collection.

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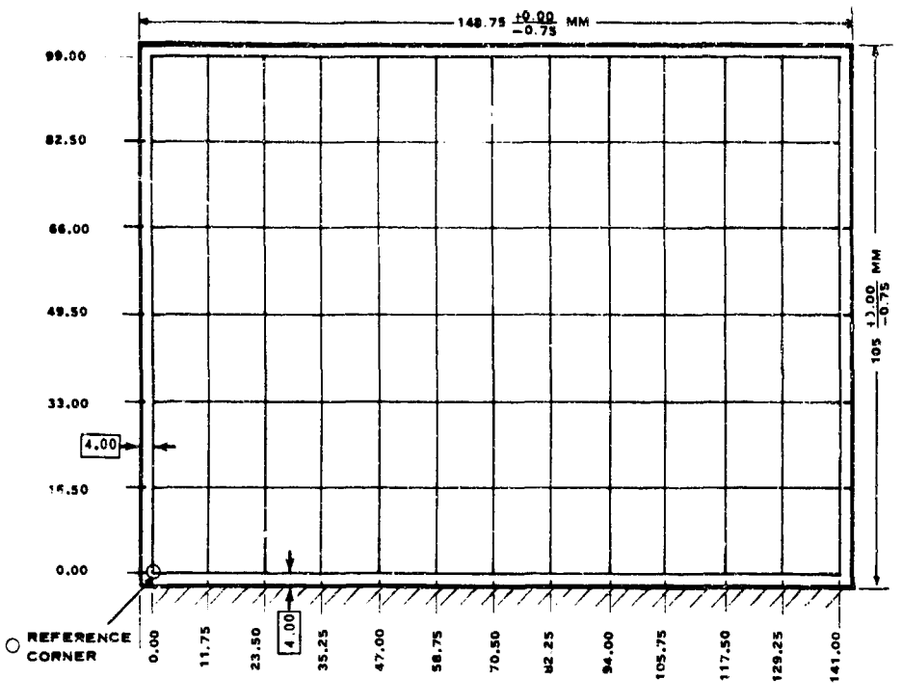
* This is the cost of posting 1 microfiche to each customer and it should be noted that 24 other microfiche can be inserted in each envelope without increasing postage. This does not apply for hard copy and is an additional economy.

In large organisations the use of microfiche exclusively in place of hard copy can save an astonishing amount of storage space and Claridge (Ref. 5) suggests that this may amount to a 90% saving.

This figure can certainly be substantiated but should be used with caution for at the present time few document centres would be prepared to rely solely on microfiche. Now, however, that pressure on space is growing rapidly and the cost of additional storage rising steeply so with reasonable even if not complete, acceptance of microfiche considerable savings can be made merely by reducing the number of shelf copies held as hard copy.

3. "Microfiche Only"

Although the author knows of no organisation doing so it is interesting to speculate on the possibility of issuing microfiche only in place of hard copy. The microfiche would be prepared directly from typescript then copied for distribution. In this case there would be further economies in addition to those already considered in the cost of the printing masters and of the capital cost of printing equipment. For this course to be successful however almost complete acceptance of reading microfiche is required. A small proportion of customers would still, no doubt, call for a complete print out but if the proportion was small it is considered that such an operation could be economic.



1. DIMENSIONS ARE IN MILLIMETERS.
2. LINE WIDTHS ARE 0.25 MM.
3. DIMENSIONS ARE TO CENTER OF LINES.
4. TOLERANCE ON POSITION OF OVERALL GRID PATTERN, FROM FAR LEFT TO FAR RIGHT, AND FROM TOP TO BOTTOM, IS ± 0.5 MM.

Fig. 1 - Microfiche Dimensions

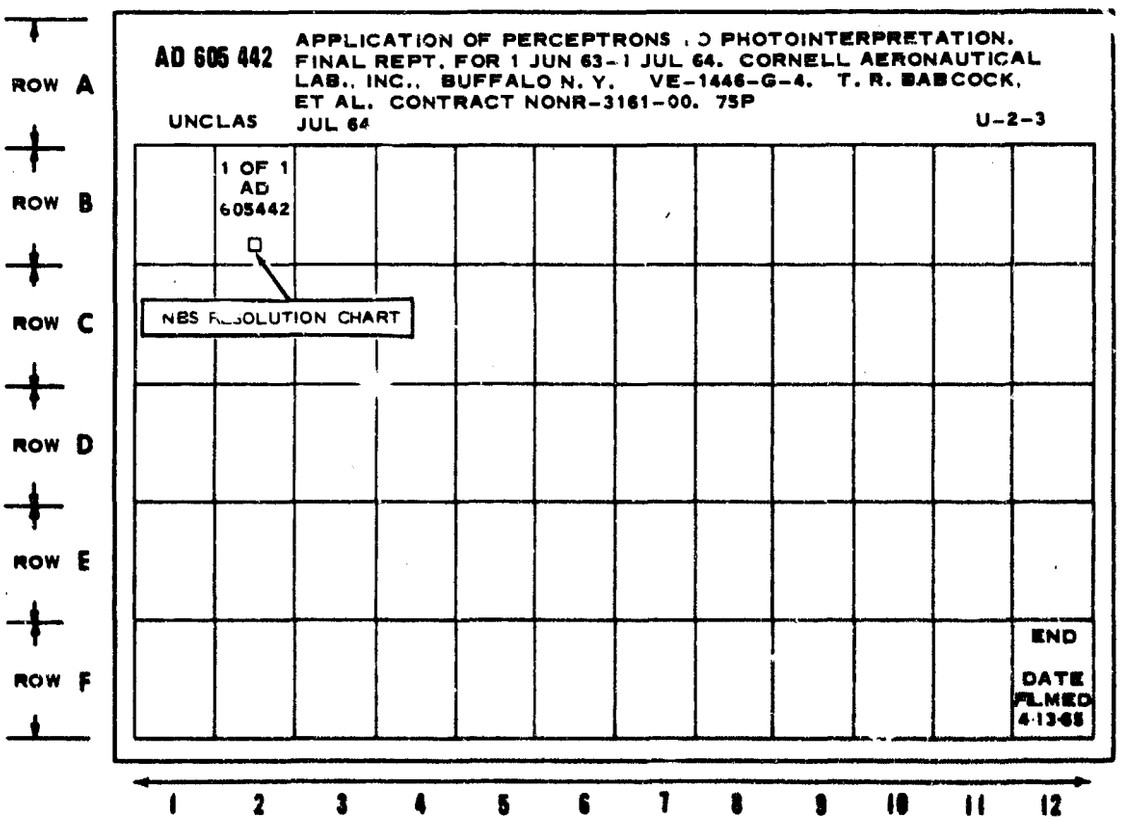


Fig. 2 - Grid area coordinates and arrangement of information on first microfiche sheet

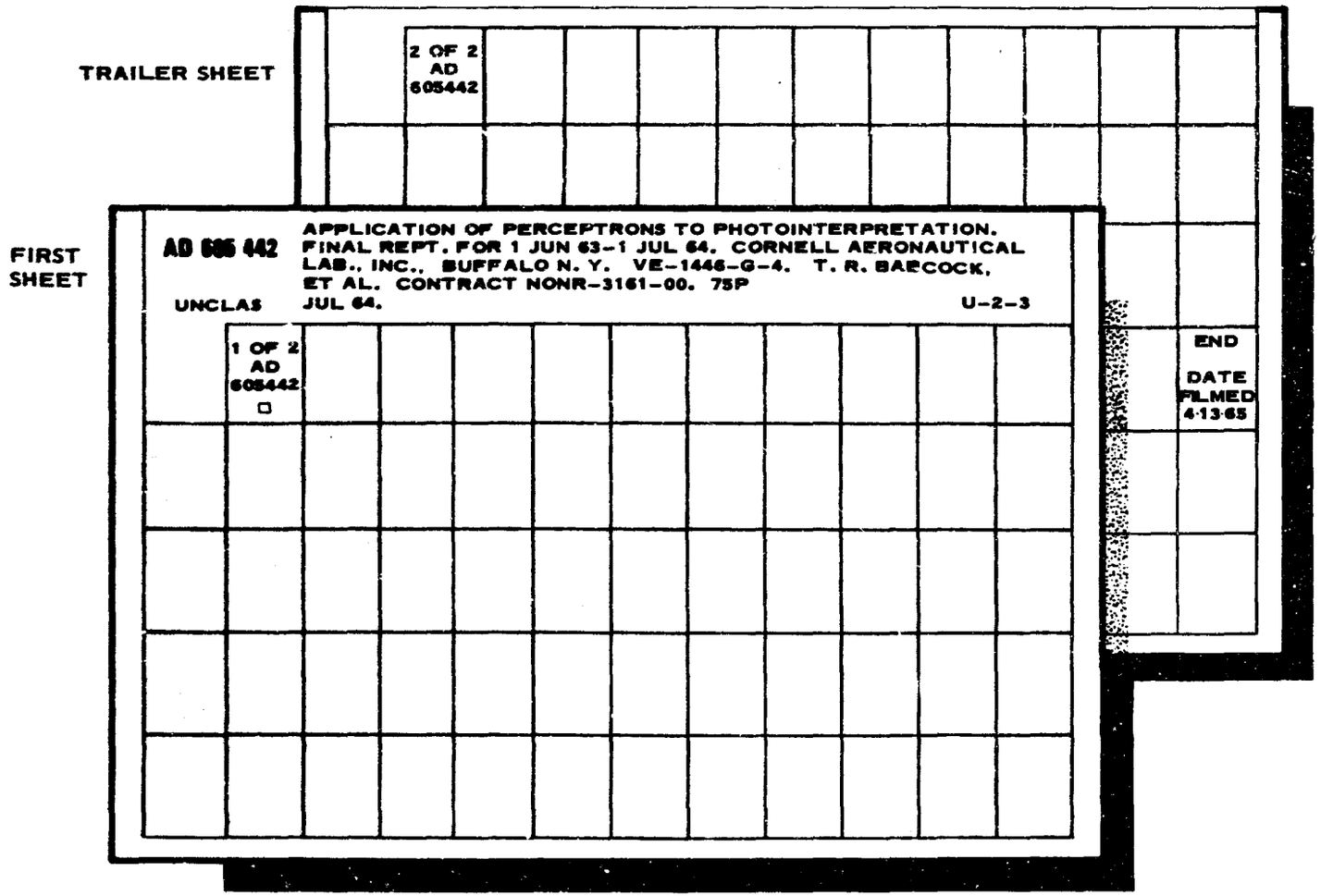


Fig. 3 - Relation of first and trailer microfiche sheets

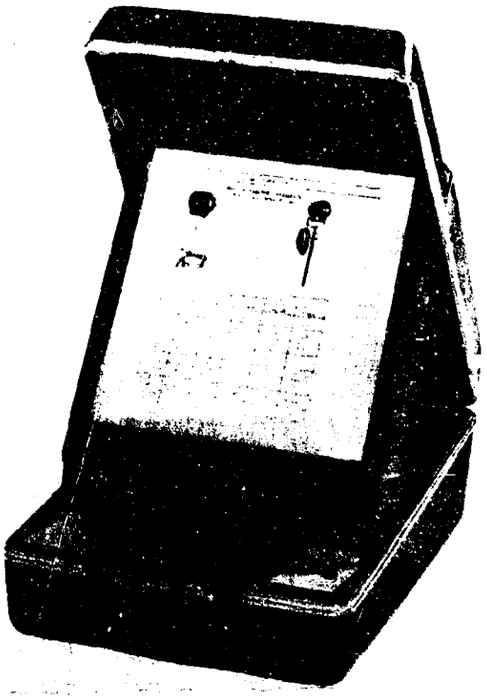


Fig. 4 - Typical Reader
Courtesy Bell & Howell

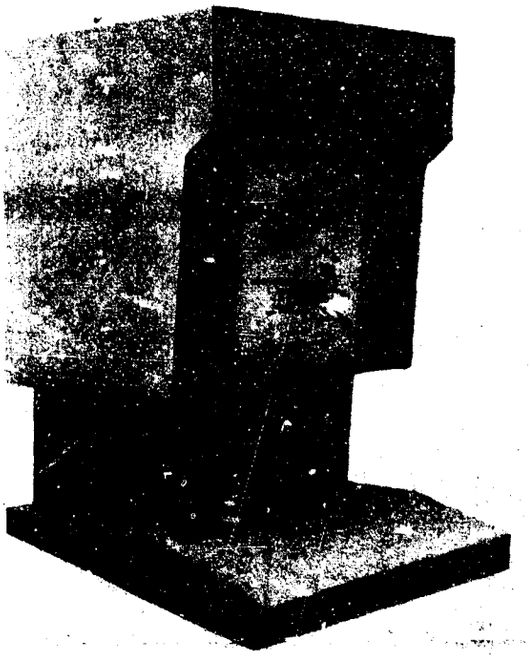


Fig. 5 - Typical Reader-Printer
Courtesy Bell & Howell

Fig. 6 - Copying Microfiche
Courtesy Bell & Howell

AGARD Advisory Report No.27
North Atlantic Treaty Organization, Advisory Group for Aerospace Research and Development
THE USE OF MICROFICHE FOR SCIENTIFIC AND TECHNICAL REPORTS
H.F.Vessey
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