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MICROFICHE USER EQUIPMENT EVALUATION. PORTABLE VIEWERS. VIEWER/--ETC(U)
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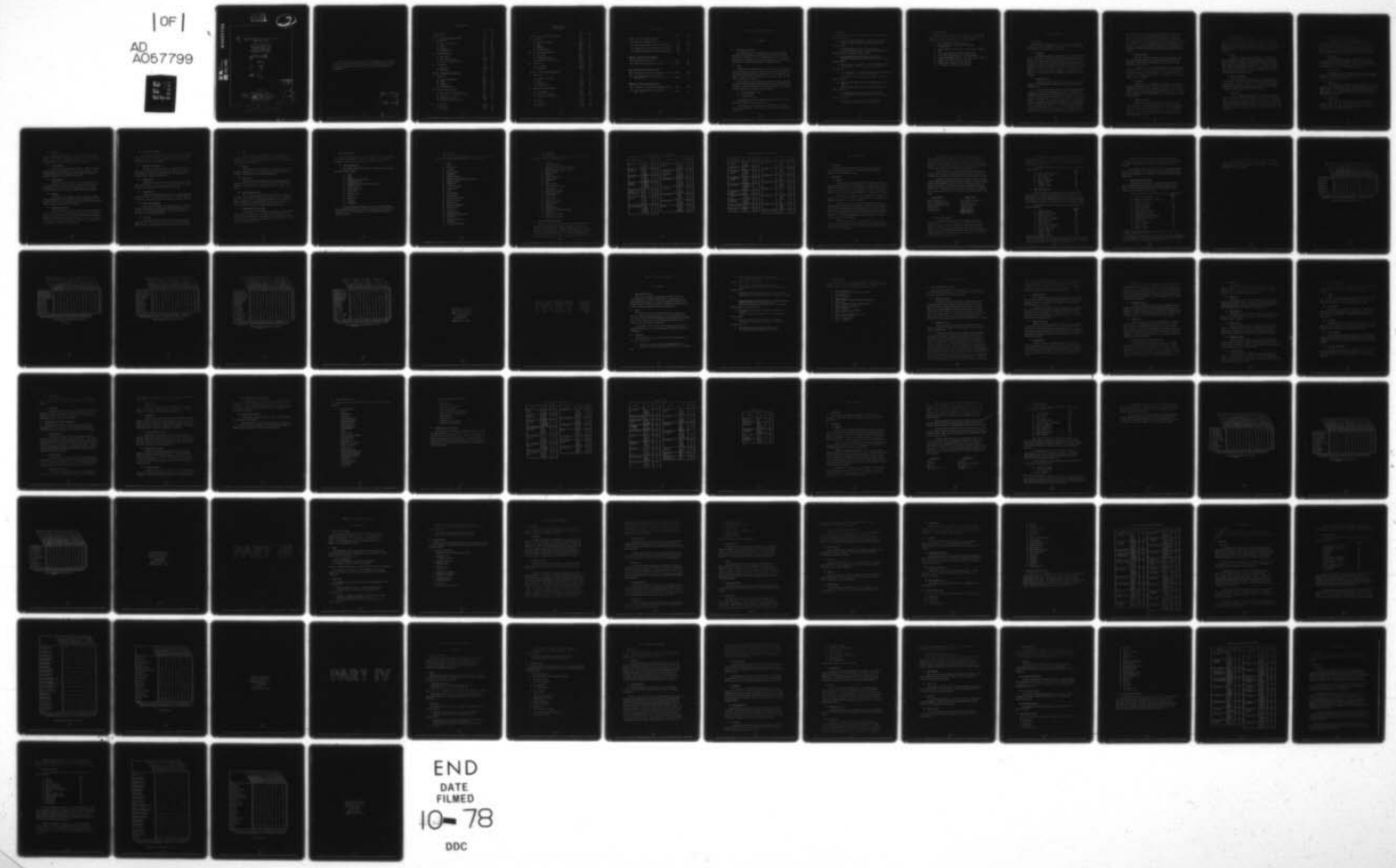

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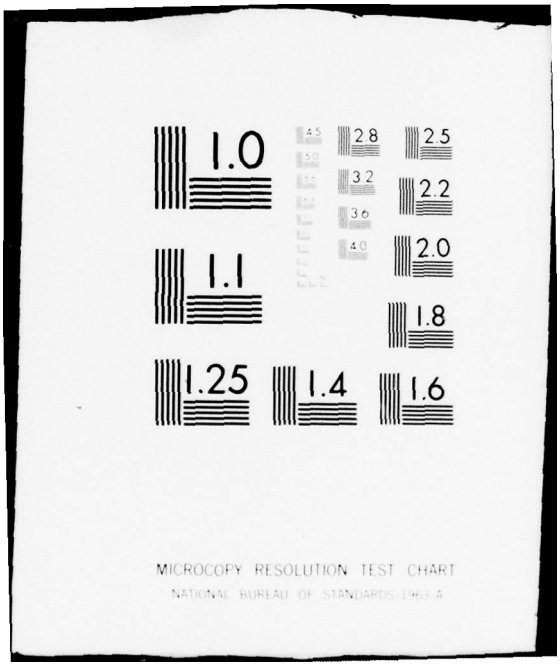
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NATIONAL BUREAU OF STANDARDS-1963-A

LEVEL II

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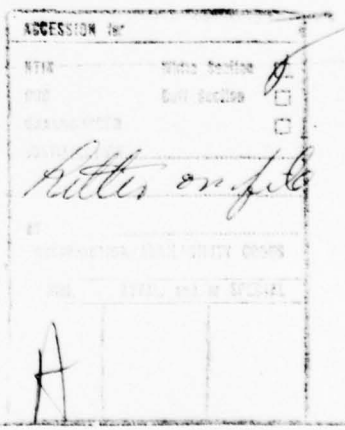

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PART I. PORTABLE MICROFICHE VIEWERS

I. INTRODUCTION

A. Purpose of Evaluation

The following portable microfiche viewer evaluation report was commissioned by the Adjutant General's Office - Micrographics Management Branch, Washington, D.C. The intended purpose for initiating the evaluation was to acquire an up-to-date comprehensive technical comparison of all commercially available portable Microfiche Viewers.

B. Scope

The selection of microfiche viewers to be evaluated was made in two steps; the first was to conduct a thorough market survey to identify all commercially available portable microfiche viewers as of July 1977; and second: to select, based on pre-established functional criteria, specific units for testing and evaluation.

The criteria for unit evaluation was divided into three categories. Although all of the microfiche viewers selected were considered portable. a close correlation between intended use and viewer performance required the following grouping according to user conditions:

- Personal/desktop portable
- Workshop/mobile
- Off-road/field usage

The performance of each microfiche viewer was compared and ranked with other units in the selected categories.

A description of test methods used and evaluation parameters, are presented in Section II. Summary data and unit rankings are provided in Section III.

C. References

The following list of sources was utilized in the preparation of this technical report.

1. Evaluating Microfiche Readers: a Handbook for Librarians

William R. Hawken, Council on Library Resources, Inc., Washington. D.C.

2. Guide to Micrographic Equipment - User Equipment

Edited by Hubbard W. Ballou. National Micrographics Association, Colesville Road, Silver Spring. Maryland.

3. How to Select a Microform Reader or Reader/Printer

National Micrographics Association, Colesville Road, Silver Spring, Maryland.

4. Micrographic Equipment - Directory and Buying Guide - 1977

Information and Records Management, Inc., Fulton Ave., Hempstead, N.Y.

5. National Standard - Method for Measuring the Screen Luminance, Contrast and Reflectance of Microform Readers

National Micrographics Association, Colesville Road, Silver Spring. Maryland.

6. 1977 Buyers Guide to Micrographic Equipment, Products, and Services

National Micrographics Association, Colesville Road, Silver Spring. Maryland.

7. Precision Measurement and Calibration - Image Optics

U.S. Department of Commerce, National Bureau of Standards Special Publication.

8. The Focal Dictionary of Photographic Technologies

D.A. Spencer Focal Press, Englewood Cliffs, N.J.

D. Acknowledgements

PRC/ISC would like to express appreciation to the following manufacturers and/or distributors for their cooperation in providing both equipment and information for this viewer evaluation effort.

- AGFA - GEVAERT Inc., Teterboro, N.J.
- Bell & Howell Inc., Business Equipment Group, Bethesda, MD.
- Eastman Kodak Co., Business Systems Markets Div., Washington, D.C.
- The Micobra Corporation, Hanover, Massachusetts.
- Micro Information Systems Inc., Atlanta, Georgia.
- National Micrographics Systems, Inc., Silver Spring, Maryland.
- Realist, Inc., Menomonee Falls, Wisconsin
- Visidyne Inc., Burlington, Massachusetts.
- Yates Business Systems, Richmond, Virginia.

II. VIEWER EVALUATION

A. Test Methods

Each selected portable microfiche viewer was tested and evaluated in each of the following categories. Evaluation data summaries for each unit is presented in Section III of this report.

1. Resolution

The display resolution was determined for each unit using test microfiche containing National Bureau of Standards 1010 resolution test patterns. The actual number of line pairs per millimeter were recorded for each unit. This was accomplished by viewing the display with an 8X optical magnification device which allowed visual discrimination of actual line pairs. Mathematical calculations were performed to adjust recorded values to a standard 24/48 X format. Both the central and peripheral screen areas were measured, and the percentage of resolution fall-off was recorded.

2. Display Luminance

The luminance (brightness) of each viewer unit as well as the evenness of luminance across the display screen were given extensive consideration.

A Photo Research Spectra Spot-meter with a one quarter degree reading area was used to accurately measure screen luminance values. The American National Standard method of measuring screen luminance was followed to obtain results that best represent a valid approximation of actual viewing conditions. An Elgar Corporation AC-Line conditioner was selected to regulate the input voltage and eliminate line voltage fluctuations. The single eyepoint method of meter placement was selected for use. The objective lens of the [illegible]e meter was located on a line perpendicular to the center of the screen, and also fifteen inches or a distance equal to the screen diagonal, which ever was greater, from the

surface of the screen. The measurements were made with the light source in the reader operated as recommended by the manufacturer, the reader being in focus and without film in the microform holder. The luminance meter was positioned on a swivel point which allowed readings to be recorded for peripheral areas, while simulating the actual user conditions of head movements. The readings were ranked according to maximum luminance and percentages of fall-off, both at intermediate distances and at the screen corners.

3. Display Contrast

The viewer display contrast was measured in accordance with the American National Standard method for measuring screen luminance. The actual contrast of the viewer display was measured using a spot photometer and a test mask.

The test mask was placed in the microform holder, and readings were recorded for both the exposed and unexposed areas of the test mask. The mask was reversed to allow for an averaged set of recorded values. A division computation was performed, which was expressed as the contrast ratio of the viewer display.

4. Distortion

The amount of image distortion was determined by the use of a precision test microfiche which contain pairs of lines of equal lengths located horizontally, vertically, and diagonally across the image. After these pairs were identified and measured on the screen surface, a calculation was performed to arrive at the percent of image distortion measured for that viewer.

5. Screen Reflectance

Viewer screen reflectance was determined by measuring the ratio of apparent screen luminance in foot lamberts with the light source of the reader turned off to the incident illuminance in foot candles on the screen. The reflectance was measured with the use of the Spectra Spot meter, while the ambient illuminance was measured with a Weston Model 756 illuminance meter.

6. Viewing Angles

A number of factors can influence the viewing angles, among these being the presence of a screen hood, angle of the screen, uneven screen luminance, and the basic design of the unit itself. The measurement of screen angle was accomplished with the use of an angular compass, which permitted an accurate angle measurement from normal viewing distances.

7. Focus

This test was conducted in two segments. The first was a test simulating the scanning of a single microfiche, from edge to edge and top to bottom. The microfiche was focused on image A1 and then the other corners, and center were brought into view. The number of times the unit had to be refocused was recorded. The second segment entailed the insertion and removal of five microfiche, recording the frequency of refocusing after an initial alignment.

8. Platen Temperature

The temperatures generated by lamp systems within the viewers can ultimately damage microfilm, including melting of the emulsion, if allowed to reach extremes. A Tektronix TM 503 digital multimeter with a voltage temperature probe was utilized to measure the actual film gate temperatures after various elapsed times were clocked.

9. Noise Level

The noise levels of the various viewers was recorded with the use of a General Radio Type 1565-A sound-level meter. The C range indicates the over-all sound pressure present. The A-weighing characteristic discriminates heavily against low-frequency sound, closely correlated with subjective estimates of loudness, annoyance, and speech interference. The B-weighing characteristic is used when the subjective effects of noise are of interest.

10. X-Y Grid Index/Frame Position Indicator

The accuracy of the X-Y grid index and the frame position indicator were determined with a precision test microfiche. Random areas of the microfiche were selected with the use of the grid index, and the actual final areas located were matched to determine the reliability of the index system. A similar procedure was performed with the frame position indicator when the tested unit offered this feature.

11 Set-Up Time

This section is best applied to the field usage category, as a workshop or office situation generally requires set-up and take down of the viewers with much less frequency. The elapsed time was arrived at by actually simulating a set-up of the viewer being tested.

12. Unit Stability

The viewers were tested individually for stability, simulating actual user conditions as much as possible. Lateral as well as front-to-back movements were observed and recorded.

13. Portability

This category dealt specifically with some of the more important aspects of unit transportability, such as fold-up capability, cord storage, carrying handle and micr fiche storage areas. The units were rated on these features as they appeared on the units, as not all the units tested had every feature listed.

14. Maintenance

The need for lamp changes occur on occasion, therefore the procedure required to change a lamp was included. The ease of removal and insertion of a new lamp was determined by actually performing this task with every viewer under consideration.

15. Materials

The units were disassembled and inspected to obtain the best evaluation of component materials as possible. The ratings were based on the quantities of steel, plastic, and fiberglas used in construction, with steel being rated as the preferred component material.

16. Unit Operation

The actual operator interface required to operate the viewers was considered a valuable addition to the evaluation criteria. Under field conditions the ideal viewer would be as operator independent as possible, allowing more time for the task at hand.

17. Platen Carrier

Microfiche handling and platen movement was found to be one of the most varied areas of unit design. Microfiche positioning for viewing was examined for each unit. Evaluation was based on ease of platen movement and amount of positive control in platen positioning.

18. Cleaning

The components most likely to require some type of cleaning by the operator were used as a basis for cleaning accessibility criteria. Operator access to the lens, condenser, and the mirrors system was selected as the evaluation parameter for this category.

19. Electrical Interlocks

User safety should be of prime consideration in an evaluation of equipment of this type. The readers should be designed and constructed so as to be safe under almost all operating conditions, including being operated by individuals who may not be thoroughly familiar with microfiche reading devices. Therefore the presence or absence of power interlocks was considered as a prime evaluation criteria.

20. Projection Capability

Each unit was evaluated for the capability of image projection onto a separate screen for group viewing. The capability of image projection for simultaneous viewing by several persons was considered a desirable feature in portable viewers.

21. Microfiche Load/Unload

The ease of microfiche handling and insertion/removal procedures were considered for this category. An automatic opening microfiche carrier was considered a positive feature, in addition to the general microfiche handling characteristics.

22. Screen Angle

Considering the variety of user situations that could be encountered, a variable screen angle was considered desirable. Each unit was evaluated for adaptability to various viewer positions.

23. Image Rotation

The ability of each viewer to accept a wide variety of microfiche formats was considered desirable, therefore, the ability to rotate an image in the viewer itself was established as an evaluation criteria.

24. Lamp Intensity Switch

The ability to increase screen brightness when room conditions or microfiche quality hinder reading was considered a valuable user criteria. A lower intensity position on the lamp switch extends usable lamp life and was considered desirable.

25. Lamp Life

Lamp life was included in the evaluation criteria because a high frequency of lamp changes can increase the possibility of viewer damage to the lamp socket or wiring system, increasing unit downtime.

26. Size

Size of each unit was considered as an important feature for both the off-road and the workshop categories. The capability for units to be stored away and easily transported was considered essential for portable viewers in these categories.

27. Weight

The weight of each portable viewer was considered in the same category as the size of the unit. Portability and ease of use under a variety of user situations being prime considerations.

28. Screen Size

Screen size has an important effect on user comfort and the ability to read an entire page of data at optimum magnification, with a minimum of microfiche movement. A larger screen size was given a higher rating.

29. D.C. Voltage Operation

This category was involved with the workshop/mobile group, as the units were evaluated according to the availability of usage with a 12 VDC power supply. This was considered in a different respect than the following category, self-contained power, since a source such as a car or truck battery would be needed to operate the particular viewer.

30. Self-Contained Power Supply

The ability to view microfiche in a situation where no external power source was available was the prime selection criteria for the off-road/field usage category. Only six-viewers evaluated had this capability, either with an internal rechargeable battery source, or a separate but portable power supply option.

B. Evaluation Parameters

There were three categories that were most applicable to the evaluation of portable microfiche viewers for this report. An explanation and description of these categories is contained in this section.

1. Off-Road Field Usage

The off-road field usage category is concerned with the following viewer characteristics:

- Size
- Weight
- Self-contained power supply
- Display Luminance
- Display Luminance Fall-Off intermediate
- Display contrast
- Screen reflectance
- Set-up time
- Unit operation
- Materials
- Maintenance
- Cleaning
- Portability

These characteristics were chosen as most important in situations encountered in field usage; since work situations and environmental considerations are more varied and much less predictable than a normal office environment.

2. Workshop Mobile

The following viewer characteristics were considered important for conditions encountered in a workshop/mobile work situation:

- Size
- Weight
- Screen size
- Lamp life
- D.C. Operation
- Resolution
- Display Luminance
- Display Luminance Fall-Off intermediate
- Display contrast
- Distortion
- Screen reflectance
- Viewing angle
- Focus
- X-Y Grid index
- Unit operation
- Lamp intensity switch
- Platen temperature
- Screen angle
- Electrical interlocks
- Unit stability
- Materials
- Platen carrier
- Microfiche load/unloading
- Maintenance
- Cleaning requirements
- Portability
- Projection capability

3. Personal/Desktop

The third category, personal/desktop portable units were evaluated against the following criteria:

- Screen size
- Resolution Fall-Off
- Display Luminance Fall-Off intermediate
- Display Luminance Fall-Off corners
- Display contrast
- Distortion
- Screen reflectance
- Viewing angle
- Focus
- Image rotation
- Frame position indicator
- X-Y Grid index
- Lamp intensity switch
- Platen temperature
- Noise level
- Screen angle
- Electrical interlocks
- Unit stability
- Materials
- Platen carrier
- Microfiche load/unload procedure
- Maintenance
- Cleaning requirements
- Projection capability

C. Evaluation Weighting Factors

Each viewer evaluated was compared against a numerical weighting matrix which assigned a number value to the performance of the unit for each characteristic tested. The higher the number, the better the unit performed in that category. The numerical weighting matrix formed the basis for comparing each unit for overall performance in relation to other units tested. The weighting matrix used is presented in Table I-1.

Table I-1. Evaluation Weighting Matrix (Page 1 of 2)

Characteristic	Range	Score
Size	Large	1
	Medium	2
	Small	3
Weight (in pounds)	0-4	4
	4.1-9	3
	9.1-15	2
	15.1-20	1
Screen Size	Small	1
	Medium	2
	Large	3
	Adjustable	3
Lamp Life (in hours)	0-500	0
	501-1000	1
	1001-2000	2
	Over 2000	3
Self Contained Power Supply	Yes	2
	No	0
D.C. Operation	Yes	2
	No	0
Resolution (LP/MM)	0-2	0
	2.1-4	1
	4.1-5	2
	5.1-7	3
	Over 7	4
Resolution % Fall-Off	0-10	4
	10.1-25	3
	25.1-40	2
	40.1-60	1
	Over 60	0

Characteristic	Range	Score
Display Luminance (in nits)	0-137	0
	138-205	1
	206-308	2
	309-411	3
Luminance Display % Fall-Off Intermediate and Corners	0-10	4
	10.1-25	3
	25.1-40	2
	40.1-60	1
	Over 60	0
Display Contrast	0-4	0
	4.1-10	1
	10.1-15	2
	15.1-20	3
	Over 20	4
Distortion (percent of)	0-2	3
	2.1-5	2
	5.1-10	1
	Over 10	0
Screen Reflectance	0-.1	3
	.11-.2	2
	.21-.5	1
	Over .5	0
Viewing Angle	Poor	0
	Average	1
	Good	2
Focus	Poor	0
	Average	1
	Good	2
	Excellent	3

Table I-1. Evaluation Weighting Matrix (Page 2 of 2)

Characteristic	Range	Score
Set-up Time (in seconds)	0-30	2
	31-60	1
	Over 60	0
Image Rotation	Yes	1
	No	0
Frame Position Indicator	Good	2
	Average	1
	Poor	0
	None	0
X-Y Grid Index Accuracy	Good	3
	Average	2
	Poor	0
	None	0
Unit Operation	Right or Left Hand	1
	Either	2
	Both	0
Lamp Intensity Switch	Yes	1
	No	0
Platen Temperature (in °F)	0-90	2
	91-105	1
	Above 105	0
Noise Level (in Decibels)	0-40	2
	41-70	1
	Above 70	0
Electrical Interlocks	Yes	1
	No	0
Screen Angle	Yes	1
	No	0

Characteristic	Range	Score
Unit Stability	Poor	0
	Average	1
	Good	2
	Excellent	3
Materials	Poor	0
	Average	1
	Good	2
	Excellent	3
Platen Carrier	Poor	0
	Average	1
	Good	2
	Excellent	3
Maintenance	Poor	0
	Average	1
	Good	2
	Excellent	3
Cleaning	Poor	0
	Average	1
	Good	2
	Excellent	3
Portability	Excellent	4
	Good	3
	Average	2
	Fair	1
	Poor	0
Fiche Load/Unload	Poor	0
	Average	1
	Good	2
	Excellent	3
Projection Capability	Yes	1
	No	0

III. TEST SUMMARY

A. Introduction

The results of the portable microfiche viewer evaluations are shown in Tables I-2 through I-4. A discussion of the summary data is provided in the following section.

B. Discussion

1. General

The selection of evaluation criteria and weighting factors was made based upon subjective analysis of user needs for the various categories of portable microfiche viewers. The final rankings of viewers evaluated for this report reflect these subjective judgements. The actual performance of viewers may not adhere to these rankings under different user conditions.

The units were not subjected to a ruggedized testing series, and as a result no conclusions or recommendations are made as to ability to withstand extreme environmental or user conditions.

Additional data not presented in the summary tables, such as optional lenses available, unit costs, screen colors, narrative descriptions, etc. was collected for each portable microfiche viewer evaluated. This data was not considered significant for ranking purposes, but does provide a more complete overall description of each unit. This additional data is contained in the data collection forms which are available upon request from the Adjutant General's Office.

Certain ranked criteria was eliminated from the summary tables when all viewers evaluated had the same ranking. This was done to simplify the data summary tables and to present those factors which truly differentiate the viewers evaluated.

Each viewer was evaluated and ranked upon its performance at 24X magnification ratio. Although many units are available at 48X, not all units obtained for evaluation had this capability. For fairness of comparison, values obtained at 48X were not included in the summary tables. However, the collected data is included in the data collection forms which are available upon request from the Adjutant General's Office.

The data presented is based upon the testing and evaluation of one unit supplied by the respective manufacturer and/or distributor and considered by the supplier to be representative of the product's capability

The units selected for evaluation were representative of commercially available models of portable microfiche viewers. During the initial market survey described in Section I of this report, several units were found to be the same in configuration, although marketed under different company names. In these cases only one unit was evaluated. The following is a listing of those units which are similar to those selected for evaluation:

Unit Evaluated	Similar Units
Bell & Howell Commuter	Micro Design "The Portable"
Eastman Kodak Ektalite 120	Kodak Ektalite 140
Eastman Kodak Ektalite 220	Kodak Ektalite 20/40
Micobra K-100	Microscan K-100
Realist Educator	Realist Executive Realist Agent Realist Technician

2. Off-Road Field Usage

A basic selection process in the evaluation of portable microfiche viewers to meet the requirements of off-road field environment was to consider only those units having totally contained power sources. Of the fourteen units evaluated in this report, only six met this requirement. Only the Realist Educator series had a reasonably sized battery power supply. The other units had, as an option, a much heavier and expensive power pack attachment.

Although the viewer units have been ranked within the off-road field usage category, it was felt that no unit currently available is really suitable for the rugged use and environmental conditions that can be encountered in field operations.

The portable microfiche viewers evaluated in this category were scored as follows:[1/]

	RATING
• Bell and Howell - Commuter	25
• WSI - Informant II	25
• MISI - Monitor	23
• Realist - Educator	21
• Micobra - K100	20
• Realist - Viking	19

3. Workshop/Mobile Usage

The basic selection criteria for this category consisted of those portable microfiche viewers capable of being operated from a D.C. power source, but not necessarily self contained. This category included all units evaluated in the off-road field usage (6) and five (5) additional units providing a total of eleven (11) viewers evaluated in this category.

The portable microfiche viewers evaluated in this category were scored as follows:[1/]

	RATING
• Realist - Valiant	54
• Agfa - Gevaert - LF202	52
• Visidyne - Showkit	52
• Bell & Howell - Commuter	49
• WSI - Informant II	49
• MISI - Monitor	48
• Bell & Howell - Briefcase	43
• Kodak - Ektalite 120	42
• Realist - Educator	38
• Micobra - K100	37
• Realist - Viking	33

1/ Selection of equipment should not be made based on aggregate totals alone, but should include consideration of features desired for specific applications. Cost was not considered in ranking the equipment, however cost is a necessary consideration in connection with government purchasing.

Units with a rating of 50 or higher, would provide excellent service for a maintenance or shop environment and also have the capability for limited mobile operation when external AC or DC power sources are available.

Units with ratings in the 40's would provide adequate capability in the above situations. Units rated in the 30's would be deficient either in image display quality or construction to be useful in the workshop mobile environment.

4. Personal/Desktop Office Use

All selected portable microfiche viewers were evaluated for use in the personal or desktop office use environment. The emphasis in this category was image quality and ease of use for prolonged viewing. Fourteen microfiche viewers were evaluated.

The viewers evaluated in this category were scored as follows:[1/]

	RATING
• Agfa - Gevaert - LF202	46
• Northwest Microfilm Inc. - NMI - 75	44
• Realist - Valiant	44
• Kodak - Ektalite 220**	39
• Visidyne - Showkit	39
• MSI - Informant II	38
• Bell & Howell - Commuter	37
• Kodak - Ektalite 120**	36
• Taylor-Merchant - 300 Projector	35
• Bell & Howell - Briefcase	32
• MISI - Monitor	32
• Realist - Educator	28
• Nicobra - K100	27
• Realist - Viking	24

**Showed considerable image distortion in upper screen area, but was not objectionable for textural data.

1/ Selection of equipment should not be made based on aggregate totals alone, but should include consideration of features desired for specific applications. Cost was not considered in ranking the equipment, however cost is a necessary consideration in connection with government purchasing.

In this category, units rated at 36 or higher would provide good to excellent service as personal or desktop viewers. The remaining units were judged to be lower in overall image quality or suitability for prolonged viewing of microfiche.

	Size	Weight	Self-Contained Power Supply	Display Luminance	Display Luminance Fall Off - Intermediate	Display Contrast	Screen Reflectance	Set-Up Time	Unit Operation	Materials	Maintenance	Clearing	Portability	Totals
Bell & Howell Commuter	1	2	2	0	3	1	3	2	2	2	1	2	4	25
Micobra K-100	2	3	2	1	1	0	2	2	1	1	1	2	2	20
Misi Monitor	2	2	2	2	2	1	2	2	2	1	2	1	2	23
Realist Viking	2	4	2	2	0	0	1	1	0	1	1	2	3	19
Realist Educator	3	4	2	2	0	1	2	1	0	1	2	2	1	21
WSI Informant II	1	2	2	1	3	1	2	2	2	2	2	1	4	25

Note. See Section III.B. for further data analysis. Selection of equipment should not be made based on aggregate totals alone, but should include consideration of features desired for specific applications. Cost was not considered in ranking the equipment, however cost is a necessary consideration in connection with government purchasing.

Table I-2. Off-Road/Field Usage Evaluation Data Summary

	Size	Weight	Screen Size	Lamp Life	D. C. Operation	Resolution	Display Luminance	Display Luminance Roll-Off Uniformities	Display Contrast	Distortion	Screen Reflectance	Viewing Angle	Focus	X - Y Grid Intgy	Subtotals
Agfa-Gevaert LF-202	1	1	3	1	2	3	0	3	1	3	2	2	1	3	26
Bell & Howell Briefcase	1	3	2	1	2	4	2	1	1	3	3	2	1	2	28
Bell & Howell Commuter	1	2	3	1	2	3	0	3	1	3	3	2	2	2	28
Kodak Ekta Lite 120	1	3	1	0	2	4	0	3	4	0	3	0	3	3	27
Micobra K-100	2	3	2	1	2	4	1	1	0	3	2	2	2	0	25
Misi Monitor	2	3	3	2	2	4	2	2	1	3	2	2	2	2	32
Realist Educator	3	4	3	0	2	4	2	0	1	3	2	2	0	0	26
Realist Valiant	1	2	3	2	2	4	0	4	2	3	3	2	3	3	34
Realist Viking	2	4	2	0	2	4	2	0	0	3	1	1	0	0	21
Visidyne Showkit	1	1	3	1	2	4	3	1	1	3	2	2	1	2	27
WSI Informant II	1	2	3	0	2	4	1	3	1	3	2	1	3	2	28

Note: *See Section III.B. for further data analysis.* Selection of equipment should not be made based on aggregate totals alone, but should include consideration of features desired for specific applications. Cost was not considered in ranking the equipment, however cost is a necessary consideration in connection with government purchasing.

Table I-3. Workshop/Mobile Usage Evaluation Data Summary

Page 1 of 2

	Unit Operation	Lamp Intensity Switch	Platen Temperature	Screen Angle	Electrical Interfaces	Unit Stability	Materials	Platen Carrier	Fiche Load/Unload	Maintenance	Cleaning	Portability	Projection Capability	Subtotals	Totals
Agfa-Gevaert LF-202	2	0	1	0	0	3	3	3	3	3	3	4	1	26	52
Bell & Howell Briefcase	0	0	2	0	0	2	2	1	1	2	1	3	1	15	43
Bell & Howell Commuter	2	0	2	0	0	3	2	2	2	1	2	4	1	21	49
Kodak Ektalite 120	1	0	2	1	0	2	2	1	1	2	2	1	0	15	42
Micobra K-100	1	0	1	1	0	2	1	1	0	1	2	2	0	12	37
Misi Monitor	2	0	1	1	1	2	1	1	2	2	1	2	0	16	48
Realist Educator	0	0	2	0	0	3	1	0	0	2	2	1	1	12	38
Realist Valiant	2	1	0	0	0	3	2	3	3	1	2	3	0	20	54
Realist Viking	0	0	2	0	1	1	1	0	0	1	2	3	1	12	33
Visidyne Showkit	2	0	2	0	0	3	3	2	2	3	3	4	1	25	52
WSI Informant II	2	0	0	0	0	3	2	3	3	2	1	4	1	21	49

Note: See Section III.B. for further data analysis. Selection of equipment should not be made based on aggregate totals alone, but should include consideration of features desired for specific applications. Cost was not considered in ranking the equipment, however cost is a necessary consideration in connection with government purchasing.

Table I-3. Workshop/Mobile Usage Evaluation Data Summary
page 2 of 2

	Screen Size	Resolution Fall-off	Display Luminance Fall-off Interpretation	Display Luminance Fall off Corners	Display Contrast	Screen Distortion	Screen Reflectance	Viewing Angle	Focus	Image Rotation	Frame Position Indicator	X-Y Grid Index	Lamp Intensity Switch	Subtotals
Agfa-Gevaert-LF 202	3	3	3	1	1	3	2	2	1	0	2	3	0	24
Bell & Howell Briefcase	2	3	1	0	1	3	3	2	1	0	0	2	0	18
Bell & Howell Commuter	3	1	3	1	1	3	3	2	2	0	0	2	0	21
Kodak Ektalite 120	1	2	3	2	4	0	3	0	3	0	0	3	0	21
Kodak Ektalite 220	3	2	4	2	4	0	3	0	3	0	0	2	1	24
Micobra K-100	2	4	1	0	0	3	2	2	2	0	0	0	0	16
Misi Monitor	3	1	2	0	1	3	2	2	2	0	0	2	0	18
NMI NMI-75	3	3	2	0	1	3	2	2	3	0	1	2	1	23
Realist Educator	3	3	0	0	1	3	2	2	0	1	0	0	0	15
Realist Valiant	3	3	4	1	2	3	3	2	3	0	0	3	1	28
Realist Viking	2	4	0	0	0	3	1	1	0	1	1	0	0	13
Taylor-Merchant 300	3	2	4	4	0	3	0	2	2	0	0	0	0	20
Viewdyne Showkit	3	4	1	0	1	3	2	2	1	0	0	2	0	19
WSI Informant II	3	3	3	0	1	3	2	1	3	0	1	2	0	22

Note: See Section III.B. for further data analysis. Selection of equipment should not be made based on aggregate totals alone, but should include consideration of features desired for specific applications. Cost was not considered in ranking the equipment, however cost is a necessary consideration in connection with government purchasing.

Table I-4. Personal/Desktop Usage Evaluation Data Summary
page 1 of 2

	Platen Temperature	Noise Level	Screen Angle	Electrical Interlocks	Unit Stability	Materials	Platen Carrier	Fiche Load/Unload	Maintenance	Cleaning	Projection Capability	Subtotals	Totals
Agfa-Gevaert LF-202	1	2	0	0	3	3	3	3	3	3	1	22	46
Bell & Howell Briefcase	2	2	0	0	2	2	1	1	2	1	1	14	32
Bell & Howell Commuter	2	1	0	0	3	2	2	2	1	2	1	16	37
Kodak Ektalite 120	2	2	1	0	2	2	1	1	2	2	0	15	36
Kodak Ektalite 220	2	2	1	0	2	2	1	1	2	2	0	15	39
Micobra K-100	1	2	1	0	2	1	1	0	1	2	0	11	27
Misi Monitor	1	2	1	1	2	1	1	2	2	1	0	14	32
NMI NMI-75	2	1	0	1	3	2	3	3	3	3	0	21	44
Realist Educator	2	2	0	0	3	1	0	0	2	2	1	13	28
Realist Valiant	0	2	0	0	3	2	3	3	1	2	0	16	44
Realist Viking	2	2	0	1	1	1	0	0	1	2	1	11	24
Taylor-Merchant 300	2	1	0	0	3	3	0	1	2	2	1	15	35
Visidyne Showkit	2	1	0	0	3	3	2	2	3	3	1	20	39
WSI Informant II	0	1	0	0	3	2	3	3	2	1	1	16	38

Note: See Section III.B. for further data analysis. Selection of equipment should not be made based on aggregate totals alone, but should include consideration of features desired for specific applications. Cost was not considered in ranking the equipment, however cost is a necessary consideration in connection with government purchasing.

Table I-4. Personal/Desktop Usage Evaluation Data Summary
page 2 of 2

EVALUATION FORMS AND RAW
TEST DATA FOR EACH UNIT
TESTED ARE AVAILABLE UPON
REQUEST FROM:
HQDA (DAAG-AMH-T)
WASHINGTON, D.C. 20314

PART II

PART II. MICROFICHE VIEWER/PRINTER

I. INTRODUCTION

A. Purpose of Evaluation

The following Microfiche Viewer/Printer evaluation report was commissioned by the Adjutant General's Office - Micrographics Management Branch, Washington, D.C. The intended purpose for initiating the evaluation was to acquire an up-to-date comprehensive technical comparison of commercially available Microfiche Viewer/Printers.

B. Scope

The selection of Microfiche Viewer/Printers to be evaluated was made in two steps; the first was to conduct a thorough market survey to identify commercially available Microfiche Viewer/Printers as of July 1977; and second; to select, based on pre-established functional criteria, specific units for testing and evaluation.

A description of test methods used and evaluation parameters, are presented in Section II. Summary data and unit rankings are provided in Section III.

C. References

The following list of sources was utilized in the preparation of this technical report.

1. Evaluating Microfiche Readers: A Handbook for Librarians
William R. Hawken, Council on Library Resources Inc., Washington, D.C.

2. Guide to Micrographic Equipment - User Equipment

Edited by Hubbard W. Ballou. National Micrographics Association, Colesville Road, Silver Spring Maryland.

3. How to Select a Microform Reader or Reader/Printer

National Micrographics Association, Colesville Road, Silver Spring, Maryland.

4. Micrographic Equipment - Directory and Buying Guide - 1977

Information and Records Management, Inc., Fulton Ave., Hempstead, N.Y.

5. National Standard - Method for Measuring the Screen Luminance, Contrast and Reflectance of Microform Readers

National Micrographics Association, Colesville Road, Silver Spring, Maryland, ANSI/NMA MS12-1977.

6. 1977 Buyers Guide to Micrographic Equipment, Products, and Services

National Micrographics Association, Colesville Road, Silver Spring, Maryland.

7. Precision Measurement and Calibration - Image Optics

U.S. Department of Commerce, National Bureau of Standards Special Publication.

8. The Focal Dictionary of Photographic Technologies

D.A. Spencer Focal Press, Englewood Cliffs, N.J.

D. Acknowledgements

PRC/ISC would like to express appreciation to the following manufacturers and/or distributors for their cooperation in providing both equipment and information for this viewer/printer evaluation effort.

- Bell & Howell, Inc.
  Business Equipment Group, Bethesda, Maryland.
- Datagraphix, Inc.
  Bethesda, Maryland.
- Eastman Kodak Co.
  Business Systems Markets Division, Washington, D.C.
- 3-M Company
  Microfilm Products Division, Washington, D.C.
- Micro Information Systems, Inc.
  Atlanta, Georgia
- National Educational Consultants
  Hyattsville, Maryland.
- National Micrographics Systems, Inc.
  Silver Spring, Maryland.
- Yates Business Systems
  Richmond, Virginia.

II. VIEWER/PRINTER EVALUATION

A. Test Methods - Unit Evaluation

Each selected Microfiche Viewer/Printer was tested and evaluated in each of the following categories. Evaluation data summaries for each unit are presented in Section III of this report.

1. Display Resolution

The display resolution was determined using test microfiche containing National Bureau of Standards 1010 resolution test patterns. The actual number of line pairs per millimeter were recorded for each unit. This was accomplished by viewing the display with an 8X optical magnification device which allowed visual discrimination of actual line pairs. Mathematical calculations were performed to adjust recorded values to a standard 24/48 X format. Both the central and peripheral screen areas were measured, and the percentage of resolution fall-off was recorded.

2. Display Luminance

The luminance (brightness) of each Viewer/Printer display as well as the evenness of luminance across the display screen were given extensive consideration.

A Photo Research Spectra Spot-meter with a one quarter degree reading area was used to accurately measure screen luminance values. The American National Standard method of measuring screen luminance was followed to obtain results that best represent a valid approximation of actual viewing conditions. An Elgar Corporation AC-Line conditioner was selected to regulate the input voltage and eliminate line voltage fluctuations. The single eyepoint method of meter placement was selected for use. The objective lens of the luminance meter was located on a line perpendicular to the center of the screen, and also fifteen inches or a distance equal to the screen diagonal, which ever was greater, from the surface of the screen. The measurements were made with the light source in the reader operated as recommended by the manufacturer, the reader being in focus and without film

in the microform holder. The luminance meter was positioned on a swivel point which allowed readings to be recorded for peripheral areas, while simulating the actual user conditions of head movements. The readings were ranked according to maximum luminance and percentages of fall-off, both at intermediate distances and at the screen corners.

3. Display Contrast

The Viewer/Printer display contrast was measured in accordance with the American National Standard method for measuring screen luminance. The actual contrast of the Viewer/Printer display was measured using a spot photometer and a test mask.

The test mask was placed in the microform holder, and readings were recorded for both the exposed and unexposed areas of the test mask. The mask was reversed to allow for an averaged set of recorded values. A division computation was performed, which was expressed as the contrast ratio of the Viewer/Printer display.

4. Screen Reflectance

Viewer/Printer screen reflectance was determined by measuring the ratio of apparent screen luminance in foot lamberts with the light source of the reader turned off to the incident illuminance in foot candles on the screen. The reflectance was measured with the use of the Spectra Spot meter, while the ambient illuminance was measured with a Weston model 756 illuminance meter.

5. Viewing Angles

A number of factors can influence the viewing angles, among these being the presence of a screen hood, angle of the screen, uneven screen luminance, and the basic design of the unit itself. The measurement of screen angle was accomplished with the use of an angular compass, which permitted an accurate angle measurement from normal viewing distances.

6. Focus

This test was conducted in two segments. The first was a test simulating the scanning of a single microfiche. From edge to edge and top to bottom. The microfiche was focused on image A1 and then the other corners, and center were brought into view. The number of times the unit had to be refocused was recorded. The second segment entailed the insertion and removal of five microfiche, recording the frequency of refocusing after an initial alignment.

7. Platen Temperature

The temperatures generated by lamp systems within the Viewer/Printers can ultimately damage microfilm, including melting of the emulsion, if allowed to reach extremes. A Tektronix TM 503 digital multimeter with a voltage temperature probe was utilized to measure the actual film gate temperatures after various elapsed times were clocked.

8. Noise Level

The noise levels of the various Viewer/Printers was recorded with the use of a General Radio Type 1565-A sound-level meter. The C range indicates the over-all sound pressure present. The A-weighing characteristic discriminates heavily against low-frequency sound, closely correlated with subjective estimates of loudness, annoyance, and speech interference. The B-weighing characteristic is used when the subjective effects of noise are of interest.

9. X-Y Grid Index/Frame Position Indicator

The accuracy of the X-Y grid index and the frame position indicator were determined with a precision test microfiche. Random areas of the microfiche were selected with the use of the grid index, and the actual final areas located were matched to determine the reliability of the index system. A similar procedure was performed with the frame position indicator when the tested unit offered this feature.

10. Maintenance

The need for lamp changes occur on occasion, therefore the procedure required to change a lamp was included. The ease of removal and insertion of a new lamp was determined by actually performing this task with every Viewer/Printer under consideration.

11. Materials

The units were disassembled and inspected to obtain the best evaluation of component materials as possible. The ratings were based on the quantities of steel, plastic, and fiberglas used in construction, with steel being rated as the preferred component material.

12. Unit Operation

The actual operator interface required to operate each Viewer/Printer was considered and evaluated, with a one-handed operation considered an optimum situation.

13. Platen Carrier

Microfiche handling and platen movement was found to be one of the most varied areas of unit design. Microfiche positioning for viewing was examined for each unit. Evaluation was based on ease of platen movement and amount of positive control in platen positioning.

14. Cleaning of Optics

The components most likely to require some type of cleaning by the operator were used as a basis for cleaning accessibility criteria. Operator access to the lens, condenser, and the mirrors system was selected as the evaluation parameter for this category.

15. Fiche Load/Unload

The ease of microfiche handling and insertion/removal procedures were considered for this category. An automatic opening microfiche carrier was considered a positive feature, in addition to the general microfiche handling characteristics.

16. Mechanical Operation

The overall mechanical functioning of the units was considered for this section. Factors such as the frequency of jams, ease of paper loading, and the ease of clearing paper jams were evaluated.

17. Weight

Weight of the units was considered for this evaluation. Although the units are not designed with portability as the main concern in the user environment, the need to transport them may arise.

18. Screen Size

Screen size has an important effect on user comfort and the ability to read an entire page of data at optimum magnification, with a minimum of microfiche movement. A larger screen size was given a higher rating.

19. Lamp Life

This was included in the evaluation criteria because a high frequency of lamp changes can increase the possibility of unit damage to the lamp socket or wiring system, increasing unit downtime.

20. Image Rotation

The ability of the viewer to accept a wide variety of microfiche formats was considered a positive feature, therefore, the ability to rotate an image in the viewer itself was established as an evaluation criteria.

21. Lamp Intensity Switch

The ability to increase screen brightness when room conditions or microfiche quality hinder reading was considered a valuable user evaluation criteria. The lower intensity position also extends usable lamp life.

22. Screen Vibrations

The presence of screen vibrations can reduce the legibility of the projected image. Therefore, this was included as an evaluation criteria.

23. Accessories

The availability of accessories such as interchangeable lenses, dual fiche carriers, alternate power options, and screen hoods were included in the evaluation and the units were rated as to the number of features that could be purchased as an option.

B. Test Methods - Paper Print Evaluation

Paper prints were produced on each selected Microfiche Viewer/Printer and were then evaluated in each of the following categories. Evaluation data summaries are presented in Section III of this report.

1. Print Resolution

A paper print was made of the test microfiche containing National Bureau of Standards 1010 resolution test patterns. The patterns were viewed with an 8X optical magnification device which allowed visual discrimination of actual line pairs. Mathematical calculations were performed to adjust recorded values to a standard 24/48X format. Both the central and peripheral print areas were measured, and the percentage of resolution fall-off was recorded.

2. Print Contrast

A paper copy of the contrast test mask was made for each unit. Readings were recorded for the maximum and minimum density areas with the use of a Welch reflectance densitometer. A division computation was performed, which was expressed as the contrast ratio of the paper print.

3. Condition of Final Print

This category refers to the condition of the final print as it emerges from the unit. An evaluation was made as to whether it was

dry, semi-dry or in a wet condition when removed for use by the operator, with a dry print considered to be the ideal condition.

4. Printing Speed

An actual clocking of unit print speed was made for initial prints as well as for a series of prints. The units were set for the optimum exposure setting to equalize machine cycle times.

5. Warm-Up Time

Warm-up time refers mainly to the units utilizing a dry silver process, as this process is developed using a heat source of some type. Units containing a stand-by mode, which allows for instant printing, were considered for the evaluation as requiring no warm-up time. The electrostatic process units require no appreciable warm-up time.

6. Cleaning - Printer Section

This category was approached from the aspect of what was actually involved in maintaining the print section of the units involved. Dry silver units are basically a clean operation, using no chemical toner. The electrostatic process is a wet process, using a toner solution which has to be replenished or replaced periodically.

7. Print Cycle Noise Level

The noise levels during the print cycle were recorded in addition to normal unit operation noise levels. The same recording device (General Radio Type 1565-A) was utilized to monitor the various levels of noise generated. The paper cut operation was generally found to record the highest readings, with an average taken for the remainder of the print cycle.

8. Smear-Proof Prints

The ability of the print to withstand normal handling without having the image become illegible was considered a valuable test for print evaluation. Prints were allowed to dry before the smear test was conducted.

9. Film to Print Polarity Capability

The ability to create a positive paper print from both positive and negative microfiche masters was a prime consideration for the print evaluation. The units employing the dry silver print production technique were not able to make a positive print from a positive microfiche, and were scored accordingly.

10. Film to Print Selection

The procedure required to arrive at a change in print polarity was evaluated in this category.

The presence of a selector switch on the unit was considered to be the best for ratings purposes, as this allows untrained operators to produce prints of different polarity with little difficulty.

C. Evaluation Parameters

Each microfiche Viewer/Printer was evaluated in each of the following categories:

- Viewer Performance

  --Weight
  --Screen Size
  --Lamp Life
  --Display Resolution
  --Display Luminance
  --Display Contrast
  --Screen Reflectance
  --Viewing Angle
  --Focus
  --Image Rotation
  --Frame Position Indicator
  --X-Y Grid Index
  --Unit Operation
  --Lamp Intensity Switch
  --Platen Temperature
  --Noise Level
  --Screen Vibrations
  --Platen Carrier Movements
  --Microfiche Load/Unload
  --Mechanical Operation
  --Maintenance
  --Cleaning of Optics
  --Accessories
  --Materials

- Hardcopy Print Quality/Operation

  --Resolution
  --Print Contrast
  --Condition of Final Prints
  --Smear Proof Prints
  --Film to Print Polarity Capability
  --Film to Print Polarity Selection
  --Printing Speed
  --Warm-Up Time
  --Cleaning of Print Section
  --Print Cycle Noise Level

D. Evaluation Weighting Factors

Each Viewer/Printer evaluated was compared against a numerical weighting matrix which assigned a number value to the performance of the unit for each characteristic tested. The higher the number, the better the unit performed in that category. The numerical weighting matrix formed the basis for comparing each unit for overall performance in relation to other units tested. The weighting matrix used is presented in Table II-1.

Table II-1. Evaluation Weighting Matrix (Page 1 of 3)

Parameter	Range	Score
Weight (in pounds)	0-100	2
	101-150	1
	Over 150	0
Screen Size ($in inches^2$)	0-100	0
	101-180	1
	Over 180	2
Lamp Life (in hours)	0-500	0
	501-1000	1
	1001-2000	2
	Over 2000	3
Display Resolution (in LP/MM)	0-2	0
	2.1-4	1
	4.1-6	2
	6.1-8	3
	Over 8	4
Display Resolution % Fall-off	0-12	4
	12.1-25	3
	25.1-40	2
	40.1-60	1
	Over 60	0
Display Luminance (in nits)	0-100	0
	101-200	1
	201-300	2
	Over 300	3
Luminance % Fall-Off Intermediate and Corners	0-10	4
	10.1-25	3
	25.1-40	2
	40.1-60	1
	Over 60	0

Parameter	Range	Score
Display Contrast	0-4	0
	4.1-10	1
	10.1-15	2
	15.1-20	3
	Over 20	4
Screen Reflectance	0-.1	3
	.11-.2	2
	.21-.5	1
	Over .5	0
Viewing Angle	Poor	0
	Average	2
	Good	4
Focus	Poor	0
	Average	1
	Good	2
	Excellent	3
Image Rotation	Yes	1
	No	0
Frame Position Indicator	Good	3
	Average	2
	Poor	0
	None	0
X-Y Grid Index	Good	3
	Average	2
	Poor	0
	None	0

Table II-1 (Page 2 of 3)

Parameter	Range	Score
Unit Operation	Poor	0
	Average	1
	Good	2
	Excellent	3
Lamp Intensity Switch	Yes	1
	No	0
Platen Temperature (in °F)	0-90	2
	91-105	1
	Over 105	0
Noise Level (in decibels)	0-40	2
	41-70	1
	Above 70	0
Screen Vibrations	None	0
	Minor	-2
	Major	-5
Materials	Poor	0
	Average	1
	Good	2
	Excellent	3
Platen Carrier Movements	Poor	0
	Average	1
	Good	2
	Excellent	3
Maintenance	Poor	0
	Average	1
	Good	2
	Excellent	3
Fiche Load/Unload	Poor	0
	Good	1
	Excellent	2
Mechanical Operation	Poor	0
	Average	1
	Good	2
	Excellent	3

Parameter	Range	Score
Cleaning of Optics	Poor	0
	Average	1
	Good	2
	Excellent	3
Accessories	Poor	0
	Average	1
	Good	2
	Excellent	3
Print Resolution (in LP/MM)	0-2	0
	2.1-4	2
	4.1-5	4
	5.1-7	6
	Over 7	8
Print Resolution % Fall-Off	0-10	8
	10.1-25	6
	25.1-40	4
	40.1-60	2
	Over 60	0
Print Contrast	0-1	0
	1.1-2	2
	2.1-3	4
	3.1-4	6
	Over 4	8
Condition of Final Print	Wet	0
	Semi-Dry	2
	Dry	4
Smear Proof Prints	Yes	2
	No	0
Film to Print Polarity Capability	Yes	2
	No	0

Table II-1 (Page 3 of 3)

Parameter	Range	Score
Film to Print Polarity Selection	Yes No	2 0
Printing Speed (in seconds)	0-5 5.1-9 9.1-12 Above 12	6 4 2 0
Warm-Up Time (in seconds)	0-30 31-60 Over 60	4 2 0
Cleaning - Print Section	Poor Good	0 2
Print Cycle Noise Level (in decibels)	0-60 61-70 Over 70	4 2 0

III. TEST SUMMARY

A. Introduction

The Microfiche Viewer/Printer evaluation results are shown in Table II-2. A discussion of the summary data is provided in the following section.

B. Discussion

1. General

The selection of evaluation criteria and weighting factors was made based upon subjective analysis of user needs for microfiche Viewer/Printers. The final rankings of Viewer/Printers evaluated for this report reflect these subjective judgements. The actual performance of Viewer/Printers may not adhere to these rankings under different user conditions.

The units were not subjected to a ruggedized testing series, and as a result no conclusions or recommendations are made as to ability to withstand extreme environmental or user conditions.

Additional data not presented in the summary tables, such as optional lenses available, unit costs, screen colors, narrative descriptions, etc. was collected for each microfiche Viewer/Printer evaluated. This data was not considered significant for ranking purposes, but does provide a more complete overall description of each unit. This additional data is contained in the data collection forms which are available upon request from the Adjutant General's Office.

Certain ranked criteria was eliminated from the summary tables when all Viewer/Printers evaluated had the same ranking. This was done to simplify the data summary tables and to present those factors which truly differentiate the Viewer/Printers evaluated.

Each Viewer/Printer was evaluated and ranked upon its performance at 24X magnification ratio. Although many units are available at 48X, not all units obtained for evaluation had this capability. For fairness of comparison, values obtained at 48X were not included in the summary tables. However, the collected data is included in the data collection forms which are available upon request from the Adjutant General's Office.

The data presented is based upon the testing and evaluation of one unit supplied by the respective manufacturer and/or distributor and considered by the supplier to be representative of the product's capability.

One commercially available microfiche Viewer/Printer unit which was not included in this evaluation study, was the Reporter II, manufactured by Bell & Howell. This unit was not available from the manufacturer during the period of this study.

The units selected for evaluation were representative of commercially available models of microfiche Viewer/Printers. During the initial market survey described in Section I of this report, several units were found to be the same in configuration, although marketed under different company names. In these cases only one unit was evaluated. The following is a listing of those units which are similar to those selected for evaluation:

Unit Evaluated	Similar Units
OCE' 3650	OCE' 3655
OCE' 3650	NCR Corporation 500 Series
3-M 500 M	3-M 500 F
Micro Design RP 550	Bruning Model 5500

2. Evaluation Results

The nine (9) Microfiche Viewer/Printers evaluated for this report were ranked as follows:[1/]

	RATING
• 3M - Model 800*	93
• Canon - CP370	86
• OCE' - 3650	85
• Datagraphix - 1500	82
• Bell and Howell - Spacemaster	81
• Kodak - Starfiche*	81
• MISI - 21st Century	80
• 3M - Model 500*	76
• Micro-Design - RP55[illegible]	72
• GAF - 5000 MRP	71

Units with a rating of 80 or higher were judged to provide good to excellent printing capability combined with good image display and mechanical operation. Units with ratings of less than 80 were judged to be deficient either in print quality, viewer display or mechanical operation.

The Datagraphix 1500 was judged to be an excellent unit, mechanically and operationally except for the difficulty in changing image magnification. A lens conversion and condenser change could require a field technician for installation.

An unusual amount of paper jamming and mechanical malfunctions were found with the following units:

- MISI - 21st Century
- Micro-Design RP550
- GAF - 5000 MRP

*Uses dry silver printing/developing process with no liquid chemicals in unit.

1/ Selection of equipment should not be made based on aggregate totals alone, but should include consideration of features desired for specific applications. Cost was not considered in ranking the equipment, however cost is a necessary consideration in connection with government purchasing.

The MISI unit was a brand new unit from the factory, and was installed by our evaluation team rather than a factory trained technician. With adjustments, we feel the MISI could operate satisfactorily, and the jamming problem would be eliminated.

The area of paper loading was addressed as to the system used, such as cartridge load, cassette, or a roll type of paper system. The cartridge and cassette system were used in the Kodak Starfiche and Canon 370, while the other units employed a roll system of paper handling.

	Weight	Screen Size	Lamp Life	Display Resolution	Display Resolution % Fall off	Display Luminance	Display Luminance Intermediate	Display Luminance F's Fall off Corners	Display Contrast Fall off	Screen Reflectance	Viewing Angle	Focus	Image Rotation	Frame Position Indicator	Subtotals
1. B&H Spacemaster	2	1	0	2	3	3	1	0	3	3	3	3	1	3	28
2. Canon CP370	1	1	1	3	3	1	4	2	1	3	2	3	0	3	28
3. Datographix 1500	1	1	1	3	4	3	2	0	1	3	3	2	0	2	26
4. GAF 5000MRP	1	1	0	3	4	3	2	0	3	3	3	1	0	2	26
5. Kodak Star Fiche	0	1	0	2	2	2	2	0	3	3	3	2	1	3	25
6. Micro Design MP550	2	1	0	3	4	3	1	0	3	2	3	3	0	3	28
7. 3M 800	1	2	1	3	3	3	2	0	3	3	3	3	0	3	30
8. 3M 500M	1	2	1	4	3	3	0	0	4	3	3	3	1	0	28
9. Misi 21st Century	1	1	0	4	4	3	1	0	3	3	4	2	1	0	27
10. OCÉ 3650	1	1	0	4	3	3	2	0	3	2	4	3	1	3	30

Note: See Section III B. for further data analysis. Selection of equipment should not be made based on aggregate totals alone, but should include consideration of features desired for specific applications. Cost was not considered in ranking the equipment, however cost is a necessary consideration in connection with government purchasing.

Table II-2. Viewer/Printer Evaluation Data Summary
page 1 of 3

	X-Y Grid Index	Unit Operation	Lamp Intensity Switch	Paper Temperature	Noise Level	Screen Vibrations	Platen Carrier Movements	Fiche Load/Unload	Mechanical Operation	Maintenance	Cleaning of Optics	Accessories	Subtotals	Viewer Section—Totals	
1. B&H Spacemaster	3	2	1	1	1	0	2	2	2	3	1	2	3	23	...
2. Canon CP370	3	2	0	1	1	0	3	1	2	3	3	3	2	24	52
3. Datagraphix 1500	2	2	0	1	1	0	3	3	2	3	3	2	2	24	50
4. GAF 5000MRP	2	1	1	0	1	0	2	0	1	1	*	2	3	15	41
5. Kodak Star Fiche	3	0	0	2	1	0	3	2	2	3	3	3	2	24	49
6. Micro Design RP550	3	2	1	1	1	0	2	2	2	0	1	2	3	20	48
7. 3M 800	3	2	0	2	1	0	2	3	2	3	2	2	3	25	50
8. 3M 500M	2	2	0	1	1	−2	2	1	0	2	1	2	2	14	42
9. Misi 21st Century	3	0	1	2	1	0	2	1	2	0	3	2	2	19	46
10. OCÉ 3650	3	2	0	2	1	0	2	2	2	3	2	2	2	23	53

Note: See Section III.B. for further data analysis. Selection of equipment should not be made based on aggregate totals alone, but should include consideration of features desired for specific applications. Cost was not considered in ranking the equipment, however cost is a necessary consideration in connection with government purchasing.

Table II-2. Viewer/Printer Evaluation Data Summary
page 2 of 3

	Print Resolution	Print Resolution % Fall-off	Print Contrast	Condition of Final Print	Smear Proof Prints	Film to Print Polarity Capability	Film to Print Polarity Selection	Printing Speed	Warm-up Time	Print Cycle Noise Level	Clearing of Print Section	Subtotals for Printer Section	Viewer/Printer Evaluation Totals
1. B&H Spacemaster	8	6	0	2	0	4	2	4	4	0	0	30	81
2. Canon CP370	6	6	6	2	0	4	0	2	4	2	2	34	86
3. Data graphix 1500	6	6	4	2	0	4	0	2	4	2	2	32	82
4. GAF 5000 MRP	6	6	4	2	0	4	0	4	4	0	0	30	71
5. Kocak Star Fiche	4	8	8	4	2	0	0	0	4	2	0	32	81
6. Micro Design MP 550	2	6	0	2	0	4	2	4	4	0	0	24	72
7. 3M 800	6	8	8	4	2	0	0	2	4	2	2	38	93
8. 3M 500M	6	8	8	4	2	0	0	2	2	2	0	34	76
9. Misi 21st Century	6	8	2	0	0	4	2	4	4	2	2	34	80
10. OCÉ 3050	6	8	2	2	0	4	0	4	4	0	2	32	65

Note: See Section III.B. for further data analysis. Selection of equipment should not be made based on aggregate totals alone, but should include consideration of features desired for specific applications. Cost was not considered in ranking the equipment, however cost is a necessary consideration in connection with government purchasing.

Table II-2. Viewer/Printer Evaluation Data Summary (page 3 of 3)

EVALUATION FORMS AND RAW
TEST DATA FOR EACH UNIT
TESTED ARE AVAILABLE UPON
REQUEST FROM:
HQDA (DAAG-AMM-T)
WASHINGTON, D.C. 20314

PART III

PART III. 3/4 SIZE MICROFICHE VIEWERS

I. INTRODUCTION

A. Purpose of Evaluation

The following 3/4 Size Microfiche Viewer evaluation report was commissioned by the Adjutant General's Office - Micrographics Management Branch, Washington, D.C. The intended purpose for initiating the evaluat n was to acquire an up-to-date comprehensive technical comparison of 3/4 Size Microfiche Viewers.

B. Scope

The selection of the 3/4 size viewers to be evaluated was made by the Adjutant General's Office - Micrographics Management Branch. Selection was based upon the following criteria:

- Dual lens capability
- 75% optical enlargement for 24X and 48X microfiche
- Available on G.S.A. schedule as of March 1978

Units selected were requested from the manufacturer for testing and evaluation.

A description of test methods used and evaluation parameters are presented in Section II. Summary data and unit rankings are provided in Section III.

C. References

The following list of sources was utilized in the preparation of this technical report.

1. Evaluating Microfiche Readers: a Handbook for Librarians
William R. Hawken, Council on Library Resources, Inc., Washington, D.C.

2. National Standard - Method for Measuring the Screen Luminance, Contrast and Reflectance of Microform Readers
National Micrographics Association, Colesville Road, Silver Spring, Maryland.

3. Precision Measurement and Calibration - Image Optics
U.S. Department of Commerce, National Bureau of Standards Special Publication.

4. The Focal Dictionary of Photographic Technologies
D.A. Spencer Focal Press, Englewood Cliffs, N.J.

D. Acknowledgements

PRC/ISC would like to express appreciation to the following companies for their cooperation in providing both equipment and information for this evaluation effort.

- Bell and Howell, Inc.
  Business Equipment Group, Bethesda, Maryland
- Datagraphix, Inc.
  San Diego, California
- Eastman Kodak Company
  Washington, D..C
- NCR Corporation
  Dayton, Ohio
- Northwest Microfilm, Inc.
  Minneapolis, Minnesota
- Quantor Corporation
  Columbia, Maryland
- Realist Inc.
  Menomonee Falls, Wisconsin

II. 3/4 SIZE VIEWER EVALUATION

A. Test Methods

Each selected 3/4 size microfiche viewer was tested and evaluated in each of the following categories. Evaluation data summaries for each unit is presented in Section III of this report.

1. Resolution

The display resolution was determined for each unit using test microfiche containing National Bureau of Standards 1010 resolution test patterns. The actual number of line pairs per millimeter were recorded for each unit. This was accomplished by viewing the display with an 8X optical magnification device which allowed visual discrimination of line pairs. Values were adjusted to match the actual magnification of the reader tested. Both the central and peripheral screen areas were measured, and the percentage of resolution fall-off was recorded.

2. Display Luminance

The luminance (brightness) of each viewer unit as well as the evenness of luminance across the display screen were given extensive consideration.

A photometer with one quarter degree reading area was used to accurately measure screen luminance values. The American National Standard method of measuring screen luminance was followed to obtain results that best represent a valid approximation of actual viewing conditions. An AC-line conditioner was used to regulate the input voltage and eliminate line voltage fluctuations. The single eyepoint method of meter placement was selected for use. The objective lens of the luminance meter was located on a line perpendicular to the center of the screen, and also fifteen inches or a distance equal to the screen diagonal, which ever was greater, from the surface of the screen. The measurements were made with the light source in the reader operated as recommended by the manufacturer, the

reader being in focus and without film in the microform holder. The luminance meter was positioned on a swivel point which allowed readings to be recorded for peripheral areas, while simulating the actual user conditions of head movements. The readings were ranked according to maximum luminance and percentages of fall-off, both at intermediate distances and at the screen corners.

3. Display Contrast

The viewer display contrast was measured in accordance with the American National Standard method for measuring screen luminance. The actual contrast of the viewer display was measured using a spot photometer and a test mask.

The test mask was placed in the microform holder, and readings were recorded for both the exposed and unexposed areas of the test mask. The mask was reversed to allow for an averaged set of recorded values.

4. Distortion

The amount of image distortion was determined by the use of a precision test microfiche which contained pairs of lines of equal lengths located horizontally, vertically, and diagonally across the image. After these pairs were identified and measured on the screen surface, a calculation was performed to arrive at the percent of image distortion measured for that viewer.

5. Screen Reflectance

Viewer screen reflectance was determined by measuring the ratio of apparent screen luminance in foot lamberts with the light source of the reader turned off, to the incident illuminance in foot candles on the screen. The reflectance was measured with the use of a photometer, while the ambient illuminance was measured with a foot candle meter.

6. Legibility

A value measure for legibility was obtained through a numerical weighting process of the optical display characteristics of each viewer unit. The following parameters were used:

- Resolution - maximum
- Resolution - percent fall-off
- Image distortion
- Display luminance - maximum
- Display luminance - percent fall-off
- Display contrast
- Screen reflectance

The weighting matrix is shown in Table III-1.

7. Viewing Angles

A number of factors can influence the viewing angles, among these being the presence of a screen hood, angle of the screen, uneven screen luminance, and the basic design of the unit itself. The measurement of screen angle was accomplished with the use of an angular compass, which permitted an accurate angle measurement from normal viewing distances.

8. Focus

This test was conducted in two segments. The first was a test simulating the scanning of a single microfiche, from edge to edge and top to bottom. The microfiche was focused on image A 1 and then the other corners and center were brought into view. The number of times the unit had to be refocused was recorded. The second segment entailed the insertion and removal of five microfiche, recording the frequency of refocusing after an initial alignment.

9. Platen Temperature

A digital multimeter with a voltage temperature probe was utilized to measure the actual film gate temperatures after various elapsed times were clocked.

10. Noise Level

The noise level of the viewer unit was recorded with the use of a sound-level meter. The C range indicates the over-all sound pressure present. The A-weighing characteristic discriminates heavily against low-frequency sound, closely correlated with subjective estimates of loudness, annoyance, and speech interference. The B-weighing characteristic

is used when the subjective effects of noise are of interest. The average value of these readings were recorded.

11. X-Y Grid Index/Frame Position Indicator

The accuracy of the X-Y grid index and the frame position indicator were determined with a precision test microfiche. Random areas of the microfiche were selected with the use of the grid index, and the actual final areas located were matched to determine the reliability of the index system. A similar procedure was performed with the frame position indicator.

12. Unit Stability

The viewers were tested individually for stability, simulating actual user conditions as much as possible. Lateral as well as front-to-back movements were observed and recorded.

13. Maintenance

The procedure required to change a lamp was determined. The ease of removal and insertion of a new lamp was tested by actually performing this task with each viewer under consideration.

14. Materials

The units were disassembled and inspected to obtain an evaluation of component materials. The ratings were based on the quantities of steel, plastic, and fiberglas used in construction.

15. Unit Operation

The actual operator interface required to operate the viewers was evaluated. Emphasis was placed on whether the units could be operated with either hand.

16. Platen Carrier

Microfiche handling and platen movement was found to be one of the most varied areas of unit design. Microfiche positioning for viewing was examined for each unit. Evaluation was based on ease of platen movement and amount of positive control in platen positioning.

17. Cleaning

The components most likely to require some type of cleaning by the operator were used as a basis for cleaning accessibility. Ease of operator access to the lens, condenser, and the mirror system was evaluated.

18. Microfiche Load/Unload

The ease of microfiche handling and insertion/removal procedures were considered for this category. An automatic opening microfiche carrier was considered a positive feature, in addition to the general microfiche handling characteristics.

19. Lamp Intensity Switch

The ability to adjust screen brightness was examined. A lower intensity position on the lamp switch to extend usable lamp life was considered desirable.

20. Construction Design

Unit design was evaluated in relation to the modularity of the viewer components.

B. Evaluation Parameters

Each 3/4 size microfiche reader was evaluated in the following areas:

- Screen size
- Unit weight
- Resolution
- Image distortion

- Luminance
- Contrast
- Screen reflectance
- Legibility
- Viewing Angle
- Focus
- Frame position indicator
- X-Y grid index
- Platen/carrier movement
- Loading/unloading
- Unit operation
- Lamp intensity control
- Platen temperature
- Noise level
- Vibration
- Stability
- Construction
- Cleaning
- Lamp replacement

C. Evaluation Weighting Factor

Each 3/4 size viewer evaluated was compared against a numerical weighting matrix which assigned a number value to the performance of the unit for each characteristic tested. The higher the number, the better the unit performed in that category. The numerical weighting process formed the basis for comparing each viewer in overall performance in relation to other units tested. The weighting matrix used is presented in Table III-1.

Table III-1. Microfiche Viewer Evaluation Weighting Matrix

Parameter	Range	Score
Resolution—Maximum (in Lp/mm)	0-2	0
	2.1-4	1
	4.1-6	2
	6.1-8	3
	Over 8	4
Resolution % Fall-Off	Over 60	0
	40.1-60	1
	25.1-40	2
	12.1-25	3
	0-12	4
% Image Distortion	Over 1	0
	Less than 1	1
Display Luminance Maximum (in NITS)	0-100	0
	101-200	1
	201-300	2
	301-400	3
Luminance % Fall-Off *Intermediate or Corners*	Over 60	0
	40.1-60	1
	25.1-40	2
	10.1-25	3
	0-10	4
Display Contrast	0-4	0
	4.1-10	1
	10.1-15	2
	15.1-20	3
	Over 20	4
Screen Reflectance	Over .5	0
	.21-.5	1
	.11-.2	2
	0-.1	3
Legibility Summary	0-5	0
	6-12	2
	13-18	4
	19-23	6
Viewing Angle	Poor	0
	Satisfactory	1
	Good	2
Focus Uniformity	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3
Frame Position Indicator	Poor	0
	Satisfactory	1
	Good	2

Parameter	Range	Score
X-Y Grid Index	Poor	0
	Satisfactory	1
	Good	2
Platen Carrier Movement	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3
Fiche Load/Unload	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3
Unit Operation	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3
Lamp Intensity Switch	No	0
	Yes	1
Platen Temperature (In °F)	Over 105	0
	91-105	1
	0-90	2
Noise Level (In Decibels)	Above 70	0
	41-70	1
	0-40	2
Unit Vibration	Major	-5
	Minor	-2
	None	0
Unit Stability	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3
Unit Design	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3
Construction Materials	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3
Cleaning Access	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3
Lamp Replacement	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3

III. TEST SUMMARY

A. Introduction

The 3/4 Size Microfiche Viewer evaluation results are shown in Table III-2. A discussion of the summary data is provided in the following section.

B. Discussion

1. General

The selection of evaluation criteria and weighting factors was made based upon subjective analysis of user needs for microfiche viewers. The final rankings of the 3/4 size viewers evaluated for this report reflect these subjective judgements. The actual performance of specific viewer units may not adhere to these rankings under different user conditions.

The viewers were not subjected to a ruggedized testing series, and as a result no conclusions or recommendations are made as to ability to withstand extreme environmental or user conditions.

Additional data, not presented in the summary tables, such as optional lenses available, screen colors, narrative descriptions, etc., was collected for each microfiche viewer evaluated. This data was not considered significant for ranking purposes, but does provide a more complete overall description of each unit. This additional data is contained in the data collection forms which are available upon request from the Adjutant General's Office.

Certain ranked criteria was eliminated from the summary tables when all viewers evaluated had the same ranking. This was done to simplify the data summary tables and to present those factors which truly differentiate the viewers evaluated.

Each 3/4 size viewer was evaluated and ranked upon its performance at both 18X and 36X magnification ratios, or as close to these magnifications as manufacturers were able to provide.

The data presented is based upon the testing and evaluation of one unit supplied by the respective manufacturer and/or distributor and considered by the supplier to be representative of the product's capability.

2. Evaluation Results

The eleven 3/4 Size Microfiche Viewers evaluated for this report were ranked as follows:

	Rating
• Bell and Howell - SR 1010	72
• Datagraphix - Datamate 150	71
• NCR-456-5	70
• NMI-11	68
• NMI-75	67
• Datagraphix - Datamate 80	65
• Bell and Howell - SR900	61
• Kodak-Trimlite	61
• Bell and Howell - SR VIII	60
• Realist Vantage IV	60
• Quantor 304	51

All units evaluated were judged to perform satisfactorily for the intended purpose of viewing and reading 24X and 48X microfiche. The ratings above reflect unit performance in terms of use by an operator. The higher ratings indicate equipment design and performance that would minimize operator fatigue and increase efficiency over extended periods of time due to better image display and unit operation.

Selection of equipment should not be made based on aggregate totals alone, but should include consideration of features desired for specific applications. Cost was not considered in ranking the equipment. However, cost is a necessary consideration in connection with government purchasing.

	B&H SP VIII	B&H SR 900	B&H SR 1010	Datamedix 60	Datagraphix 4	Datagraphix 150	Kodak Trimline	NCR 456-5	RMH 11	RMH 75	Quantor 504	Redist Vantage IV
Resolution—Maximum Low Magnification	3	3	4	2	2	2	3	2	2	3	3	
Resolution—Maximum High Magnification	2	3	4	2	2	3	2	2	2	2	1	
Resolution—% Fall-Off Low Magnification	1	4	3	4	4	4	4	4	4	2	3	
Resolution—% Fall-Off High Magnification	4	3	4	3	2	2	4	3	4	2	3	
Image Distortion Low Magnification	1	0	1	1	1	1	1	1	1	1	1	
Image Distortion High Magnification	1	0	1	1	1	1	1	1	1	1	1	
Luminance—Maximum Low Magnification	3	1	3	3	3	2	3	3	2	1	3	
Luminance—Maximum High Magnification	2	0	1	1	3	0	1	1	1	1	1	
Luminance—% Fall-Off Intermediate—Low Magnification	1	2	2	2	2	3	1	2	3	1	1	
Luminance—% Fall-Off Intermediate—High Magnification	2	2	0	2	2	3	1	2	3	1	2	
Luminance—% Fall-Off Corners—Low Magnification	0	1	0	0	0	1	0	0	0	0	0	
Luminance—% Fall-Off Corners—High Magnification	0	1	0	0	0	0	0	0	0	0	0	
Display Contrast Low Magnification	4	4	4	4	4	4	4	4	4	1	3	
Display Contrast High Magnification	2	4	2	1	4	1	4	1	1	1	1	
Screen Reflectance	3	3	3	3	3	2	3	3	3	3	3	
Legibility Summary Low Magnification	4	4	6	6	6	6	6	6	6	2	4	
Legibility Summary High Magnification	4	4	4	4	4	2	4	4	4	2	2	
Subtotal	37	39	42	39	43	37	42	39	41	24	32	

Note: See Section III.B. for further data analysis. Selection of equipment should not be made based on aggregate totals alone, but should include consideration of features desired for specific applications. Cost was not considered in ranking the equipment, however cost is a necessary consideration in connection with go ernment purchasing.

Table III-2. ¾ Size Viewer Evaluation Data Summary

	B&H SR VIII	P&H SR 900	B&H SR 1010	Datagraphix Datamate 60	Datagraphix Datamate 150	Kodak Trimline	NCR 4636-5	NMI 11	NMI 75	Quantor 304	Realist Vantage IV
Viewing Angle	2	1	2	1	2	2	1	2	2	2	2
Focus Uniformity	2	1	3	2	2	2	2	2	1	1	3
Frame Position Indicator	1	1	2	1	1	1	2	1	1	1	1
X-Y Grid Index	1	1	1	1	1	1	1	1	1	1	1
Platen/Carrier Movement	3	3	3	2	2	1	3	3	3	2	2
Microfiche Loading/Unloading	2	2	2	2	2	2	3	3	3	3	1
Unit Operation	1	0	1	2	2	2	2	1	1	2	1
Lamp Intensity Control	1	1	1	0	1	1	0	1	1	0	1
Platen Temperature	2	2	2	2	2	2	2	2	2	2	2
Noise Level	1	1	1	2	2	1	1	1	1	2	2
Unit Vibration	-2	0	0	0	0	0	0	0	-2	0	0
Unit Stability	2	2	3	2	2	2	3	2	2	2	2
Unit Design	1	1	2	2	2	1	1	2	2	2	2
Construction Materials	2	2	2	2	2	2	3	2	2	2	2
Cleaning Access	2	3	2	2	2	2	2	3	3	2	3
Lamp Replacement	2	1	3	3	3	2	2	3	3	3	3
Subtotal	23	22	30	26	28	24	28	29	26	27	28
TOTAL	60	61	72	65	71	61	70	68	67	51	60

Note: See Section III B. for further data analysis. Selection of equipment should not be made based on aggregate totals alone, but should include consideration of features desired for specific applications. Cost was not considered in ranking the equipment, however cost is a necessary consideration in connection with government purchasing.

Table III-2. (Continued)

EVALUATION FORMS AND RAW
TEST DATA FOR EACH UNIT
TESTED ARE AVAILABLE UPON
REQUEST FROM:
HQDA (DAAG-AMM-T)
WASHINGTON, D.C. 20314

PART IV

PART IV. FULL SIZE MICROFICHE VIEWERS

I. INTRODUCTION

A. Purpose of Evaluation

The following Full Size Microfiche Viewer evaluation report was commissioned by the Adjutant General's Office - Micrographics Management Branch, Washington, D.C. The intended purpose for initiating the evaluation was to acquire an up-to-date comprehensive technical comparison of Full Size Microfiche Viewers.

B. Scope

The selection of the full size viewers to be evaluated was made by the Adjutant General's Office - Micrographics Management Branch. Selection was based upon the following criteria:

- o Dual lens capability
- o 100% optical enlargement for 24X and 48X microfiche
- o Available on G.S.A. schedule as of March 1978

Units selected were requested from the manufacturer for testing and evaluation.

A description of test methods used and evaluation parameters are presented in Section II. Summary data and unit rankings are provided in Section III.

C. References

The following list of sources was utilized in the preparation of this technical report.

1. Evaluating Microfiche Readers: a Handbook for Librarians
William R. Hawken. Council on Library Resources, Inc., Washington, D.C.

2. National Standard - Method for Measuring the Screen Luminance, Contrast and Reflectance of Microform Readers
National Micrographics Association, Colesville Road, Silver Spring, Maryland

3. Precision Measurement and Calibration - Image Optics
U.S. Department of Commerce, National Bureau of Standards Special Publication

4. The Focal Dictionary of Photographic Technologies
D.A. Spencer Focal Press, Englewood Cliffs, N.J.

D. Acknowledgements

PRC/ISC would like to express appreciation to the following companies for their cooperation in providing both equipment and information for this evaluation effort.

- Bell and Howell, Inc.
  Business Equipment Group, Bethesda, Maryland
- Datagraphix, Inc.
  San Diego, California
- GAF Corporation
  New York, New York
- NCR Corporation
  Dayton, Ohio
- Northwest Microfilm, Inc.
  Minneapolis, Minnesota
- Quantor Corporation
  Columbia, Maryland
- Realist Inc.
  Menomonee Falls, Wisconsin
- Washington Scientific Industries, Inc.
  Long Lake, Minnesota

II. FULL SIZE VIEWER EVALUATION

A. Test Methods

Each selected full size microfiche viewer was tested and evaluated in each of the following categories. Evaluation data summaries for each unit is presented in Section III of this report.

1. Resolution

The display resolution was determined for each unit using test microfiche containing National Bureau of Standards 1010 resolution test patterns. The actual number of line pairs per millimeter were recorded for each unit. This was accomplished by viewing the display with an 8X optical magnification device which allowed visual discrimination of line pairs. Values were adjusted to match the actual magnification of the reader tested. Both the central and peripheral screen areas were measured, and the percentage of resolution fall-off was recorded.

2. Display Luminance

The luminance (brightness) of each viewer unit as well as the evenness of luminance across the display screen were given extensive consideration.

A photometer with one quarter degree reading area was used to accurately measure screen luminance values. The American National Standard method of measuring screen luminance was followed to obtain results that best represent a valid approximation of actual viewing conditions. An AC-line conditioner was used to regulate the input voltage and eliminate line voltage fluctuations. The single eyepoint method of meter placement was selected for use. The objective lens of the luminance meter was located on a line perpendicular to the center of the screen, and also fifteen inches or a distance equal to the screen diagonal, which ever was greater, from the surface of the screen. The measurements were made with the light source in the reader operated as recommended by the manufacturer, the

reader being in focus and without film in the microform holder. The luminance meter was positioned on a swivel point which allowed readings to be recorded for peripheral areas, while simulating the actual user conditions of head movements. The readings were ranked according to maximum luminance and percentages of fall-off, both at intermediate distances and at the screen corners.

3. Display Contrast

The viewer display contrast was measured in accordance with the American National Standard method for measuring screen luminance. The actual contrast of the viewer display was measured using a spot photometer and a test mask.

The test mask was placed in the microform holder, and readings were recorded for both the exposed and unexposed areas of the test mask. The mask was reversed to allow for an averaged set of recorded values.

4. Distortion

The amount of image distortion was determined by the use of a precision test microfiche which contained pairs of lines of equal lengths located horizontally, vertically, and diagonally across the image. After these pairs were identified and measured on the screen surface, a calculation was performed to arrive at the percent of image distortion measured for that viewer.

5. Screen Reflectance

Viewer screen reflectance was determined by measuring the ratio of apparent screen luminance in foot lamberts with the light source of the reader turned off, to the incident illuminance in foot candles on the screen. The reflectance was measured with the use of a photometer, while the ambient illuminance was measured with a foot candle meter.

6. Legibility

A value measure for legibility was obtained through a numerical weighting process of the optical display characteristics of each viewer unit. The following parameters were used.

- Resolution - maximum
- Resolution - percent fall-off
- Image distortion
- Display luminance - maximum
- Display luminance - percent fall-off
- Display contrast
- Screen reflectance

The weighting matrix is shown in Table IV-1.

7. Viewing Angles

A number of factors can influence the viewing angles, among these being the presence of a screen hood, angle of the screen, uneven screen luminance, and the basic design of the unit itself. The measurement of screen angle was accomplished with the use of an angular compass, which permitted an accurate angle measurement from normal viewing distances.

8. Focus

This test was conducted in two segments. The first was a test simulating the scanning of a single microfiche, from edge to edge and top to bottom. The microfiche was focused on image A 1 and then the other corners and center were brought into view. The number of times the unit had to be refocused was recorded. The second segment entailed the insertion and removal of five microfiche, recording the frequency of refocusing after an initial alignment.

9. Platen Temperature

A digital multimeter with a voltage temperature probe was utilized to measure the actual film gate temperatures after various elapsed times were clocked.

10. Noise Level

The noise level of the viewer unit was recorded with the use of a sound-level meter. The C range indicates the over-all sound pressure present. The A-weighing characteristic discriminates heavily against low-frequency sound, closely correlated with subjective estimates of loudness, annoyance, and speech interference. The B-weighing characteristic

is used when the subjective effects of noise are of interest. The average value of these readings were recorded.

11. X-Y Grid Index/Frame Position Indicator

The accuracy of the X-Y grid index and the frame position indicator were determined with a precision test microfiche. Random areas of the microfiche were selected with the use of the grid index, and the actual final areas located were matched to determine the reliability of the index system. A similar procedure was performed with the frame position indicator.

12. Unit Stability

The viewers were tested individually for stability, simulating actual user conditions as much as possible. Lateral as well as front-to-back movements were observed and recorded.

13. Maintenance

The procedure required to change a lamp was determined. The ease of removal and insertion of a new lamp was tested by actually performing this task with each viewer under consideration.

14. Materials

The units were disassmebled and inspected to obtain an evaluation of component materials. The ratings were based on the quantities of steel, plastic, and fiberglas used in construction.

15. Unit Operation

The actual operator interface required to operate the viewers was evaluated. Empahsis was placed on whether the units could be operated with either hand.

16. Platen Carrier

Microfiche handling and platen movement was found to be one of the most varied areas of unit design. Microfiche positioning for viewing was examined for each unit. Evaluation was based on ease of platen movement and amount of positive control in platen positioning.

17. Cleaning

The components most likely to require some type of cleaning by the operator were used as a basis for cleaning accessibility. Ease of operator access to the lens, condenser, and the mirror system was evaluated.

18. Microfiche Load/Unload

The ease of microfiche handling and insertion/removal procedures were considered for this category. An automatic opening microfiche carrier was considered a positive feature, in addition to the general microfiche handling characteristics.

19. Lamp Intensity Switch

The ability to adjust screen brightness was examined. A lower intensity position on the lamp switch to extend usable lamp life was considered desirable.

20. Construction Design

Unit design was evaluated in relation to the modularity of the viewer components.

B. Evaluation Parameters

Each full size microfiche reader was evaluated in the following areas:

- Screen size
- Unit weight
- Resolution
- Image distortion

- Luminance
- Contrast
- Screen reflectance
- Legibility
- Viewing Angle
- Focus
- Frame position indicator
- X-Y grid index
- Platen/carrier movement
- Loading/unloading
- Unit operation
- Lamp intensity control
- Platen temperature
- Noise level
- Vibration
- Stability
- Construction
- Cleaning
- Lamp replacement

C. Evaluation Weighting Factor

Each full size viewer evaluated was compared against a numerical weighting matrix which assigned a number value to the performance of the unit for each characteristic tested. The higher the number, the better the unit performed in that category. The numerical weighting process formed the basis for comparing each viewer in overall performance in relation to other units tested. The weighting matrix used is presented in Table IV-1.

Table IV-1. Microfiche Viewer Evaluation Weighting Matrix

Parameter	Range	Score
Resolution—Maximum (in Lp/mm)	0-2	0
	2.1-4	1
	4.1-6	2
	6.1-8	3
	Over 8	4
Resolution % Fall-Off	Over 60	0
	40.1-60	1
	25.1-40	2
	12.1-25	3
	0-12	4
% Image Distortion	Over 1	0
	Less than 1	1
Display Luminance Maximum (in NITS)	0-100	0
	101-200	1
	201-300	2
	301-400	3
Luminance % Fall-Off Intermediate or Corners	Over 60	0
	40.1-60	1
	25.1-40	2
	10.1-25	3
	0-10	4
Display Contrast	0-4	0
	4.1-10	1
	10.1-15	2
	15.1-20	3
	Over 20	4
Screen Reflectance	Over .5	0
	.21-.5	1
	.11-.2	2
	0-.1	3
Legibility Summary	0-5	0
	6-12	2
	13-18	4
	19-23	6
Viewing Angle	Poor	0
	Satisfactory	1
	Good	2
Focus Uniformity	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3
Frame Position Indicator	Poor	0
	Satisfactory	1
	Good	2

Parameter	Range	Score
X-Y Grid Index	Poor	0
	Satisfactory	1
	Good	2
Platen Carrier Movement	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3
Fiche Load/Unload	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3
Unit Operation	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3
Lamp Intensity Switch	No	0
	Yes	1
Platen Temperature (In °F)	Over 105	0
	91-105	1
	0-90	2
Noise Level (In Decibels)	Above 70	0
	41-70	1
	0-40	2
Unit Vibration	Major	- 5
	Minor	- 2
	None	0
Unit Stability	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3
Unit Design	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3
Construction Materials	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3
Cleaning Access	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3
Lamp Replacement	Poor	0
	Satisfactory	1
	Good	2
	Excellent	3

III. TEST SUMMARY

A. Introduction

The Full Size Microfiche Viewer evaluation results are shown in Table IV-2. A discussion of the summary data is provided in the following section.

B. Discussion

1. General

The selection of evaluation criteria and weighting factors was made based upon subjective analysis of user needs for microfiche viewers. The final rankings of the full size viewers evaluated for this report reflect these subjective judgements. The actual performance of specific viewer units may not adhere to these rankings under different user conditions.

The viewers were not subjected to a ruggedized testing series, and as a result no conclusions or recommendations are made as to ability to withstand extreme environmental or user conditions.

Additional data, not presented in the summary tables, such as optional lenses available, screen colors, narrative descriptions, etc., was collected for each microfiche viewer evaluated. This data was not considered significant for ranking purposes, but does provide a more complete overall description of each unit. This additional data is contained in the data collection forms which are available upon request from the Adjutant General's Office.

Certain ranked criteria was eliminated from the summary tables when all viewers evaluated had the same ranking. This was done to simplify the data summary tables and to present those factors which truly differentiate the viewers evaluated.

Each full size viewer was evaluated and ranked upon its performance at both 24X and 48X magnification ratios, or as close to these magnifications as manufacturers were able to provide.

The data presented is based upon the testing and evaluation of one unit supplied by the respective manufacturer and/or distributor and considered by the supplier to be representative of the product's capability.

2. Evaluation Results

The eleven Full Size Viewers evaluated for this report were ranked as follows:

	Rating
• NMI-90	71
• NCR-456-A	67
• WSI - Mini-Cat TN	67
• WSI - Mini-Cat Mod II	66
• Datagraphix - Datamate 100	65
• NMI-14	63
• Realist Vantage COM IV	60
• Bell and Howell SR 1020	59
• Quantor 310	59
• Realist-FP14	57
• GAF 728700	54

All units evaluated were judged to perform satisfactorily for the intended purpose of viewing and reading 24X and 48X microfiche. The ratings above reflect unit performance in terms of use by an operator. The higher ratings indicate equipment design and performance that would minimize operator fatigue and increase efficiency over extended periods of time due to better image display and unit operation.

Selection of equipment should not be made based on aggregate totals alone, but should include consideration of features desired for specific appl cations. Cost was not considered in ranking the equipment. However, cost is a necessary consideration in connection with government purchasing.

	B&H SR 1020	Datagraphix Datascope 100	GAF 729-700	NCR 456-A	NMI 14	NMI 50	Realist Vantage COM IV	Quentor 210	Realist FPT6	WSI Mini-Cat Model II	WSI Mini-Cat TN
Resolution–Maximum Low Magnification	4	3	2	3	2	3	3	3	3	2	3
Resolution–Maximum High Magnification	3	2	2	2	1	1	3	2	2	1	2
Resolution–% Fall-Off Low Magnification	2	4	4	4	4	4	3	1	4	4	3
Resolution–% Fall-Off High Magnification	3	3	3	3	3	3	3	4	2	4	2
Image Distortion Low Magnification	1	1	1	1	1	1	1	1	1	1	1
Image Distortion High Magnification	0	1	1	1	1	1	1	1	1	1	1
Luminance–Maximum Low Magnification	2	3	3	2	3	3	3	2	0	1	3
Luminance–Maximum High Magnification	1	2	1	0	1	1	1	1	0	0	2
Luminance–% Fall-Off Intermediate–Low Magnification	0	2	1	1	1	1	2	1	3	4	3
Luminance–% Fall-Off Intermediate–High Magnification	0	1	2	2	2	2	2	1	3	4	3
Luminance–% Fall-Off Corners–Low Magnification	0	0	0	0	0	0	0	0	1	1	1
Luminance–% Fall-Off Corners–High Magnification	0	0	0	0	0	0	0	0	1	3	0
Display Contrast Low Magnification	4	4	4	4	4	4	4	4	3	3	4
Display Contrast High Magnification	1	1	1	4	2	3	2	2	1	1	3
Screen Reflectance	3	3	3	3	3	3	3	3	3	3	3
Legibility Summary Low Magnification	4	6	4	4	4	6	6	4	4	6	6
Legibility Summary High Magnification	2	4	4	4	4	4	4	4	4	4	4
Subtotal	30	40	36	38	36	40	41	34	36	43	44

Note: See Section III.B. for further data analysis. Selection of equipment should not be made based on aggregate totals alone, but should include consideration of features desired for specific applications. Cost was not considered in ranking the equipment, however cost is a necessary consideration in connection with government purchasing.

Table IV-2. Full Size Viewer Evaluation Data Summary

	GBH SR 1020	Datagraphix Datamate 100	GAF 728 700	NCR 455-A	INMI 14	NMI 90	Quantor 310	Realist Vantage COM I-V	Realist FP14	VSI Mini-Cat Mod II	VSI Mini-Cat TN
Viewing Angle	2	1	1	1	1	2	1	2	1	1	1
Focus Uniformity	1	2	1	2	2	2	2	2	3	2	2
Frame Position Indicator	2	1	1	2	1	1	0	1	1	0	0
X-Y Grid Index	2	1	0	2	1	1	0	1	1	0	0
Platen/Carrier Movement	3	1	2	3	2	3	0	2	1	2	1
Microfiche Loading/Unloading	2	2	1	2	2	3	2	1	1	3	2
Unit Operation	1	2	0	2	2	2	1	1	2	2	2
Lamp Intensity Control	1	1	1	1	1	1	0	1	1	1	1
Platen Temperature	2	2	2	2	2	2	2	2	2	2	2
Noise Level	1	2	2	1	1	1	1	1	2	1	1
Unit Vibration	0	0	0	0	0	0	0	0	0	0	0
Unit Stability	3	1	2	3	2	3	1	2	1	2	2
Unit Design	2	2	1	1	2	2	2	2	1	1	2
Construction Materials	2	2	2	3	2	3	2	2	1	2	2
Cleaning Access	2	2	1	2	3	3	2	3	2	2	2
Lamp Replacement	3	3	1	2	3	2	2	3	1	2	3
Subtotal	29	25	18	29	27	31	18	26	21	23	23
TOTAL	59	65	54	67	63	71	59	60	57	66	67

Note: See Section III.B. for further data analysis. Selection of equipment should not be made based on aggregate totals alone, but should include consideration of features desired for specific applications. Cost was not considered in ranking the equipment, however cost is a necessary consideration in connection with government purchasing.

Table IV-2. (Continued)

EVALUATION FORMS AND RAW
TEST DATA FOR EACH UNIT
TESTED ARE AVAILABLE UPON
REQUEST FROM:
HQDA (DAAG-AMM-T)
WASHINGTON, D.C. 20314