


RECOGNITION EQUIPMENT

*Incorporated
Dallas, Texas*



OPERATION AND
PERFORMANCE
REFERENCE MANUAL
FOR THE ELECTRONIC
RETINA COMPUTING
READER SYSTEM

RECOGNITION EQUIPMENT INCORPORATED

1500 WEST MOCKINGBIRD LANE

DALLAS, TEXAS

OPERATION AND
PERFORMANCE
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RETINA COMPUTING
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PREFACE

The purpose of this manual is to describe the component organization, functional capabilities, and performance characteristics of the Electronic Retina Computing Reader (ERCR). The principal emphasis of this information is on defining the specific functions performed by the ERCR and each of its major components.

Disciplines under which the various system elements operate are discussed to provide information about environmental requirements, operational parameters, and performance characteristics. Additional material is incorporated to provide planning criteria and guidance for site preparation.

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I. DESCRIPTION AND COMPONENT ORGANIZATION

DESCRIPTION

The Electronic Retina* Computing Reader (ERCR) is a general-purpose, program-controlled, optical character recognition system used as a basic input device for large-scale automatic data processing systems. Input to the ERCR normally consists of typed or printed information from a variety of forms and documents. Figure 1 shows the ERCR with a Rapid Index Page Carrier as the paper-handling element of the system. Figure 2 shows an ERCR with a Document Carrier as the paper handler. Input data is optically read, electronically recognized (interpreted), and converted to a language and format that is compatible with the data processing equipment for which it is intended. The usual output medium of the ERCR is magnetic tape, although punched paper tapes, punched cards, and line printers can also be used.

COMPONENT ORGANIZATION

The major functional components of the ERCR include the Rapid Index Page Carrier (RIPC), the Document Carrier (DC), the Retina and Recognition Unit (RRU), the Programmed Controller (PC), the Magnetic Tape Unit (MTU), and the Line Printer (LP). A typical system configuration is shown in figure 3. Note that the system can be used with either the RIPC or DC alone, or as a dual system using both devices. Observe also the variety of peripheral elements that are usable as system output devices.

COMPONENT FUNCTIONS

Rapid Index Page Carrier (RIPC)

The Rapid Index Page Carrier (figure 4) is one of the ERCR paper-handling units. Its functions are to feed, move, align, stack and mark the typed or printed page-size copy handled by the system. The RIPC handles page-size documents in a variety of intermixed sizes and paper weights. Paper size capabilities range from 4-7/8 inches to 14 inches in width and from 3-1/4 inches to 14 inches in height. Paper weights can vary from 12 pounds to 30 pounds.

Document Carrier (DC)

The Document Carrier (figure 5) is another paper-handling unit of the ERCR. It can be used separately or in conjunction with the RIPC as part of a dual system. DC functions include the feeding, moving, aligning, and stacking of unit record-size documents. These documents can vary in size from 3-1/4 inches x 3-1/4 inches to 5 inches x 8-3/4 inches inclusive. Intermixed paper weights can vary from 12-pound paper to card stock.

Retina and Recognition Unit (RRU)

The Retina and Recognition Unit provides the functions of character conditioning and recognition. More specifically, the RRU optically enlarges and orients the information being viewed, identifies the viewed character as a member of the machine vocabulary or as an invalid character, and electronically converts the interpreted information into the required language and format.

Programmed Controller (PC)

The Programmed Controller (figure 6) is a general-purpose digital computer, used as the master control unit of the ERCR to provide a number of important capabilities for the system. The PC coordinates the functions of the individual ERCR units and is the means through which an operator controls the overall system. More importantly, the inclusion of the digital computer (as an integral part of the ERCR) automatically enhances system flexibility and versatility to a very high degree. For example, the system can, under program control, rearrange and condense the incoming data and perform a wide variety of preliminary editing and preprocessing functions. A partial list of such operations includes sorting and marking documents, checking totals, accumulating and balancing data, verifying check digits, generating and inserting parity-check information, and printing details on a peripheral printer so that corrections can be made. Since the PC is also a fully buffered computer, the ERCR can perform reading, output operations, and any of the processing functions -- concurrently and independently of each other. Other important advantages provided by the PC are easier

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access to information in the system and a reduced cost of information storage.

Magnetic Tape Unit (MTU)

The Magnetic Tape Unit (figure 7) is an on-line output element of the ERCR, serving as the link between the character recognition system and the data processor being served. The function of the MTU is to record ERCR output data on magnetic tape in a language and form that is compatible with the computer language of the associated data processing system. The magnetic tape, once recorded, serves as an information storage medium and is ready for immediate use (with no additional preparation or processing) in the data processing system. The MTU transcribes data at a speed of 36 inches per second. The density of data on tape can be either 200 and 556 characters per inch or 556 and 800 characters per inch, depending on the model of tape unit employed.

Line Printer (LP)

The Line Printer (figure 8) is another on-line output element of the ERCR. It can be used to provide a printed record of information that has been viewed by the system. The LP can, in a typical system application, produce check prints of selected data items, print exception reports, provide interim and updated account data, or completely list all data being recorded on magnetic tape. Operating speeds of the available models of the Line Printer are 300 lines per minute and 1000 lines per minute.



Figure 1. The Electronic Retina Computing Reader with a Rapid Index Page Carrier.



Figure 2. The Electronic Retina Computing Reader with a Document Carrier

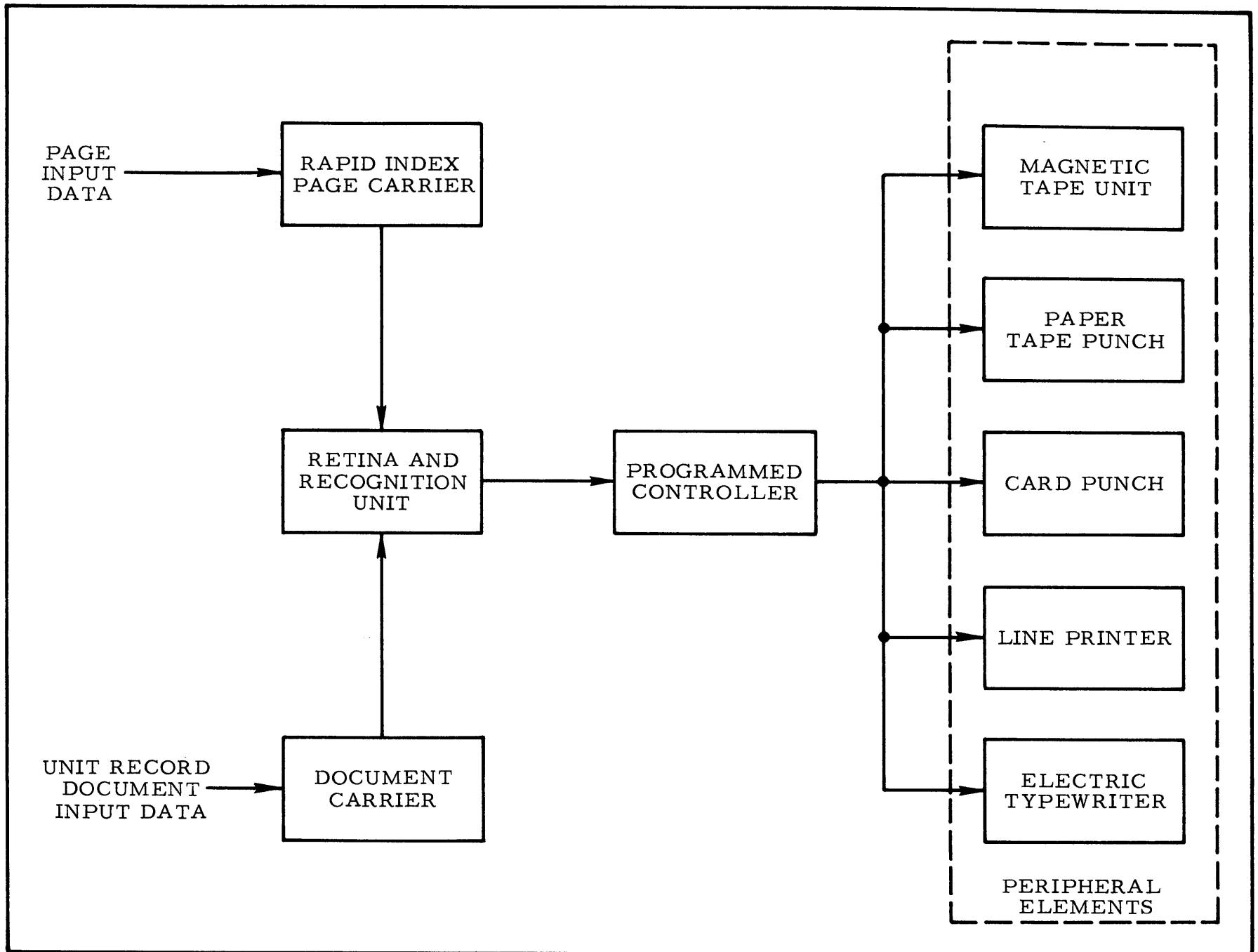


Figure 3. A Typical ERCR Equipment Configuration

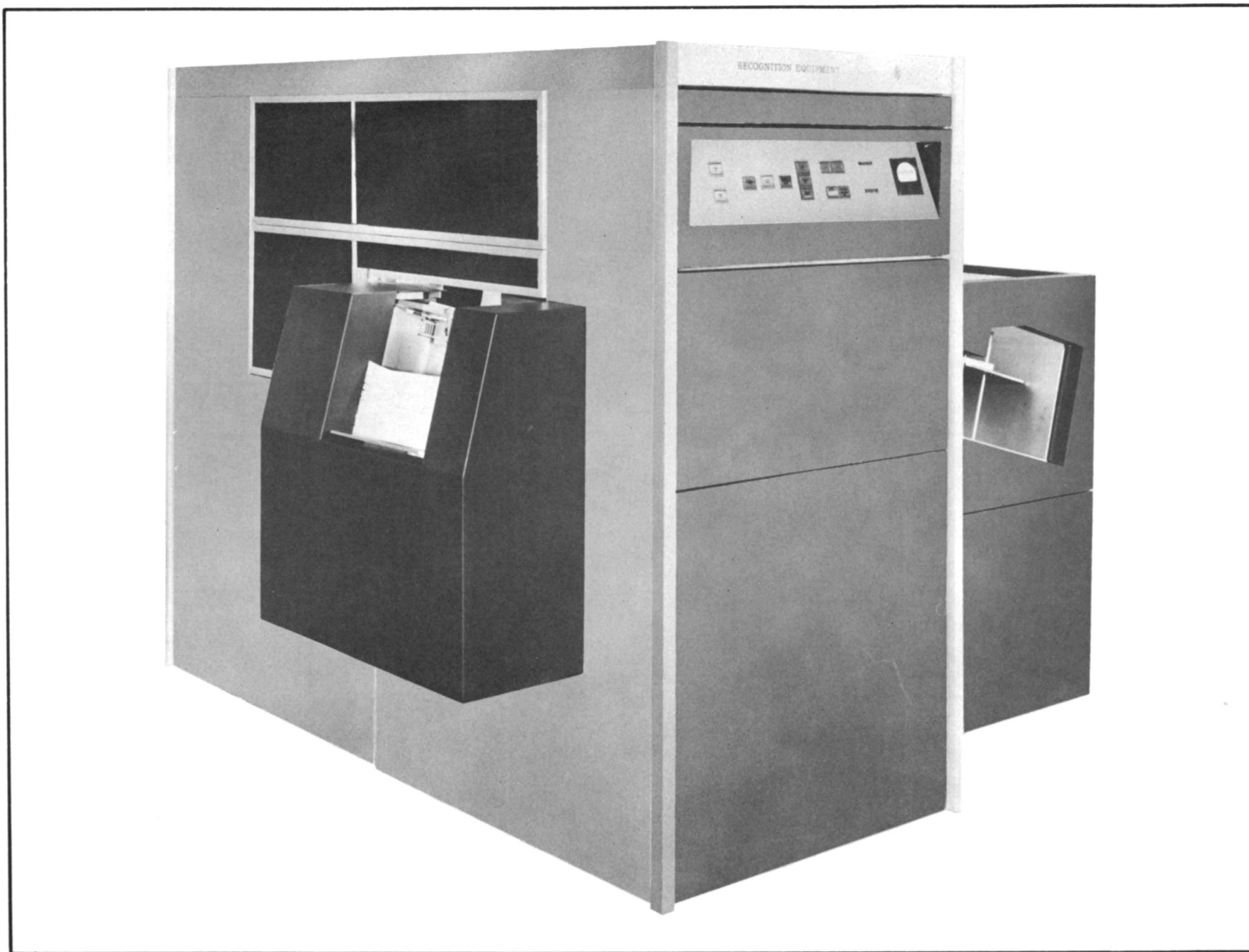


Figure 4. The Rapid Index Page Carrier



Figure 5. The Document Carrier

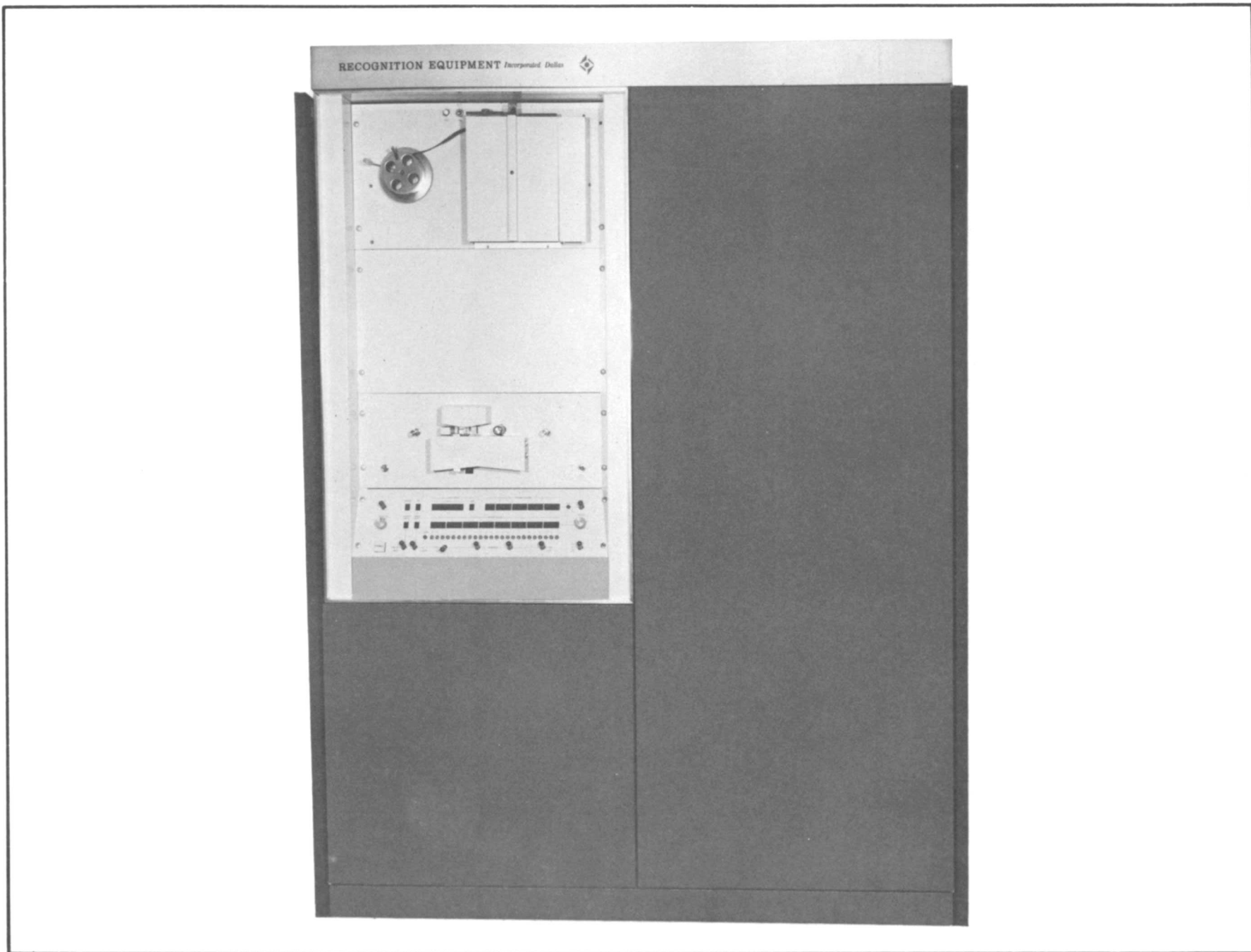


Figure 6. The Programmed Controller

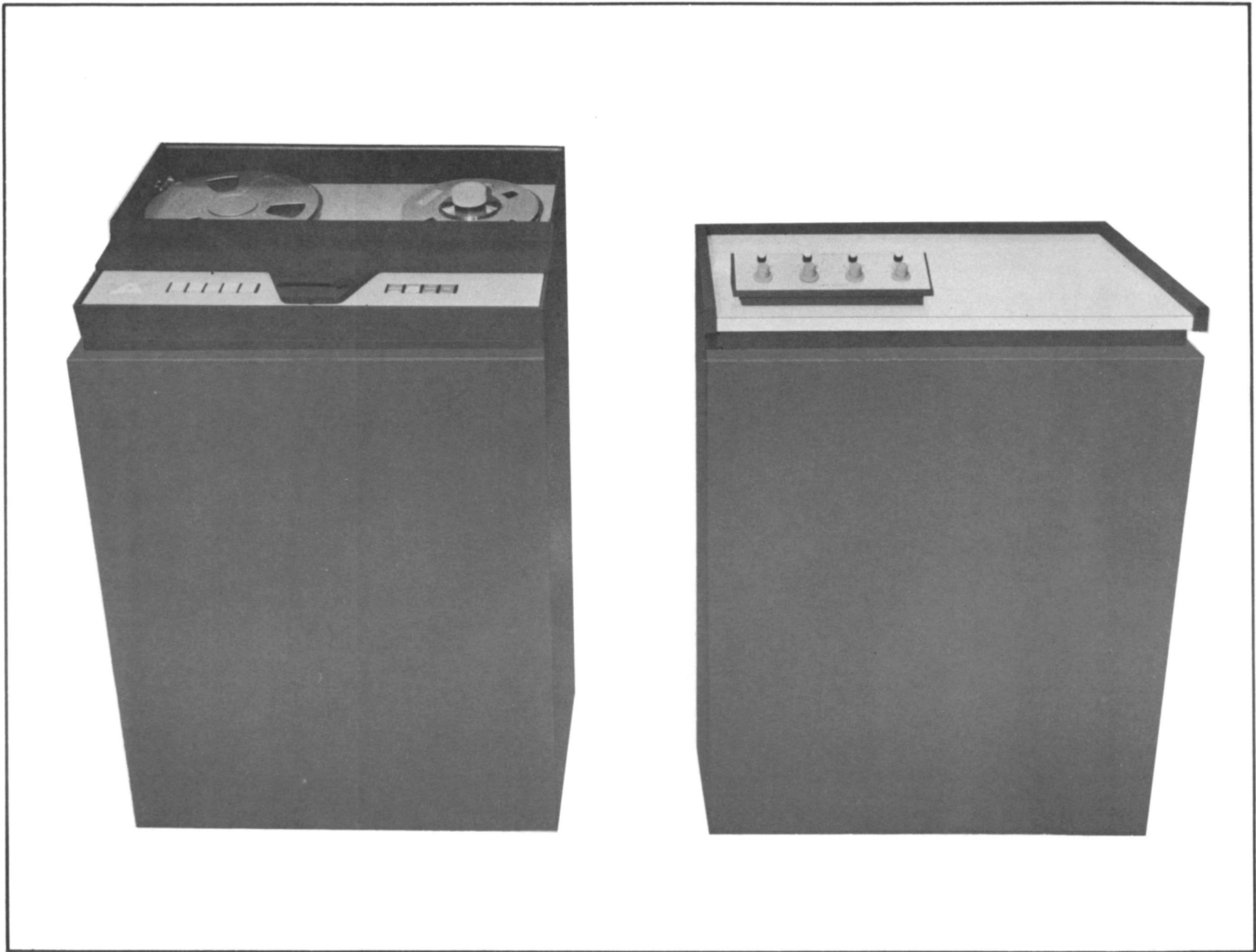


Figure 7. The Magnetic Tape Unit



Figure 8. The Line Printer

II. PERFORMANCE CHARACTERISTICS

RAPID INDEX PAGE CARRIER (RIPC)

Physical Characteristics

The physical and environmental characteristics of the Rapid Index Page Carrier (RIPC) are shown in Table I.

Operational Specifications

Page Specifications

SIZE -- The RIPC handles pages over the size range from 4-7/8 inches to 14 inches in width and from 3-1/4 inches to 14 inches in height (figure 9). The width-to-height ratio of any document should be approximately 2 to 1.

SIZE INTERMIX RANGE -- The ratio of the height of the tallest page to the height of the shortest page in a given batch of pages can not exceed 3 to 2. Thus, if the tallest page to be processed is 14 inches, the shortest page that can be processed intermixed is 9-1/3 inches and the page widths can range from 4-7/8 inches to 14 inches. If the minimum page height (3-1/4 inches) is to be processed, the tallest page that can be processed intermixed is 4-7/8 inches and the page widths can vary between a minimum of 4-7/8 inches and a maximum of twice the height of a page.

WEIGHT -- The RIPC can be supplied for either of two ranges of paper weights, from 12 pounds to 16 pounds or from 16 pounds to 30 pounds. (Paper weight is based on the weight of 500 sheets of paper of dimensions 17 inches x 22 inches, $\pm 5\%$).

DEFACEMENTS -- The RIPC will accommodate pages with staples, serrated edges, pasted labels, or tears up to one inch on any edge, as long as these defacements do not interfere with any reading areas on the page.

ATTACHMENTS -- The RIPC will not handle pages that are fastened together in any manner.

Data Format

MARGINS -- Characters must not extend any closer than 1/4 inch from the top or bottom of

any page, 1/4 inch from the left edge, and 1/2 inch from the right edge. (See figure 10).

ACTIVE READING AREAS -- The normal effective width of the active reading area in single-revolution reading is a nominal 8 inches. (Single-revolution reading is a reading mode of the RIPC in which one line on a page is read during a single revolution of the drum that holds the page). The left edge of the active reading area can, therefore, extend up to 8-1/2 inches from the right-hand (reference) edge of a page. The normal effective width of the active reading area in double-revolution reading is a nominal 12-1/8 inches. (Double-revolution reading is a reading mode of the RIPC in which two revolutions of the drum are required to read one line of a page on that drum. The double-revolution technique is used for reading lines of greater than 8 inches in length.) Hence, the left edge of the active reading area in double-revolution reading can extend up to 12-5/8 inches from the right-hand (reference) edge of a page. (See figure 10.)

LINE LENGTH -- The RIPC will process pages with irregular and inconsistent line lengths. However, each line must meet the margin and reading area requirements specified above.

PROGRAM CONTROL -- Under program control, the machine can skip over selected horizontal bands across and vertical bands down a page. The transition from program control back to automatic control requires a blank band, 0.35 inches wide, after each skipped band. The machine is also capable, under program control, of selectively rereading lines. The maximum number of rereads for a line is determined by program control. Five rereads is presently regarded as a maximum limit.

LINE SPACING -- The tolerance of the RIPC for character misplacement (vertical misregistration and line skew) is determined by the combined effect of the character heights being read and the line spacing. The effects of vertical misregistration and line skew on line reading area is shown in figure 11. Three standard character heights are available for

the ERCR: Recognition Equipment character heights 1 (0.100 inches), 2 (0.112 inches), and 3 (0.127 inches). Character units (1/16 of character height) for Recognition Equipment character heights 1, 2, and 3 are 0.00625 inches, 0.00700 inches and 0.00797 inches, respectively. The reading area of a line (figure 12) is the difference in character units between two parallel lines that are perpendicular to the reference edge of the paper, one tangent to the highest character top on the line and the other tangent to the lowest character bottom on the line. Line spacing for any document is the vertical distance, in inches or character units, between the tops of the reading areas of any two vertically adjacent lines on the document (figure 12).

MODES OF OPERATION -- The ERCR has three operational modes, designated as I, II, and III, and selectable by the Programmed Controller. Each mode of operation specifies character unit limits, or ranges, for line reading areas and line spacing on documents to be handled by the RIPC. In mode I, any line with a reading area of 19 character units can be read if the line spacing for the document is at least 23 character units. In mode II, any line with a reading area between 28 and 34 character units can be read if the line spacing for the document exceeds the reading area by at least eight character units. (Mode II contains seven switch-selectable effective reading areas.) In mode III, any line with a reading area of 34 character units can be read if line spacing for the document is greater than 43 character units. The particular mode of operation to be used with a given batch of documents is determined by the amount, or size, of retina used in reading from the given documents. Retina size is a function of character height, magnification ratio, line reading area, and line spacing. Once a retina size has been selected, a definite mode (I, II, or III) automatically ensues.

COLUMNAR LINES -- A columnar line has all characters aligned vertically with respect to characters on the line below and/or above it. If the line to be read contains a space with a character directly below it, the line is non-columnar data and may not be read as a columnar line. An example of both columnar and noncolumnar lines of data is shown in figure 13. The arrangement of data in columnar line

form provides a reading capability improvement by relaxing the line skew restrictions attendant to the reading of ordinary noncolumnar data format. Columnar line data permits a maximum skew tolerance without the normal line spacing restrictions. Blind areas can be minimized by adherence to the vertical character separation requirements stated below. Columnar lines can be read in modes I, II, or III if their line reading areas conform to mode specifications. They can also be read in mode III, regardless of line spacing, if their typing areas do not overlap and a minimum separation of four character units is maintained between any character bottom on a line and a vertically adjacent character top on the line immediately below, and provided that no space in a line is in vertical alignment with a character top less than 43 character units below the top of the reading area for that line. As an example of how columnar data can be effectively used, consider a page containing discrete areas of columnar and noncolumnar data (figure 14). The noncolumnar data can be read in the appropriate operational mode for that data, switching to operational mode III at the point of change from noncolumnar data to columnar data. Mode III permits reading of the columnar data with a maximum line skew tolerance. Return to an appropriate operational mode is made for following noncolumnar lines of data at the point of format change. Following noncolumnar data must, however, meet the vertical character separation requirements of no character top in the first line of noncolumnar data being closer than 43 character units to a space in the columnar line above it.

BAR CODES -- The minimum distance down from the bottom of a typing area to the top of a bar code below it is three character units less than the blind area between typing areas. Bottoms of bar codes that are not a part of the line may extend no more than four character units down into the reading area of a line. Bar code terminations must always be separated by at least four character units from any character on a line. Bar codes must extend to the top of the reading area of a line and at least eight character units below it. A bar code must be a minimum of 27 character units in height. Figure 15 illustrates the various dimensions associated with bar codes on page copy.

Throughput

CHARACTER READING RATE -- The rate at which characters are read from a line is a function of the pitch of the font. The instantaneous reading rate, in characters per second, can be determined by multiplying the lateral character pitch by 200. A pitch of twelve characters per inch, for example, indicates a reading rate of 2400 characters per second.

LINE READING RATE -- The time required to read one line of data (less than 8 inches in length) is 0.078 seconds providing the left edge of the line is no further than 8-1/2 inches from the right edge of the document. Lines of greater than 8 inches but less than 12-1/8 inches in length or extending more than 8-1/2 inches from the right edge of the document require 0.156 seconds and must be read in the double-revolution mode.

VERTICAL SKIPPING RATE -- In accomplishing vertical skips, each 1/3-inch skip requires 0.078 seconds. An additional 0.078 seconds is required to position the next line (after a skip) for reading. Any line spacing greater than 1/3 inch constitutes a vertical skip.

FIRST LINE TIME -- The RIPC requires 0.156 seconds to position the first line on a document for reading.

REREAD TIME -- Each reread of a line requires 0.078 seconds for single-revolution reading and 0.156 seconds for double-revolution reading.

PAGE INDEX TIME -- The time between pages is approximately 0.8 seconds.

MAXIMUM PAGE THROUGHPUT RATE -- The maximum rate at which pages can be read, regardless of data density, is 24 pages per minute. This rate presupposes minimum-size documents containing not more than ten lines of data.

AVERAGE PAGE THROUGHPUT RATE -- The average page throughput rate for jobs that do not require excessive editing or tape writing time can be computed by using the ERRCR PRODUCTION form, as shown by the simulated example in figure 16. The calculations and figures in this example are typical and are not

intended to convey the idea of a specific application.

Document Handling

TEST CONDITIONS -- Representative "live-work condition" documents, with and without allowable mutilations, over the extremes of at least three intermix ranges of size and weight will be processed one time each through the RIPC. Handling rates will apply to the accumulated percentage over these three runs. The tests will then be repeated using "mint-condition" documents.

NO-FEED RATE -- The total number of feed cycles that are executed without placing a page on a drum will be represented as a percentage of the total number of feed cycles executed. This percentage will not exceed 6 per cent for live work and 4 per cent for mint work.

MULTIPLE-FEED RATE -- The total number of feed cycles executed that place two or more pages in the transport are also represented as a percentage of the total number of feed cycles executed. This percentage will not exceed 1 per cent for live work and 0.8 per cent for mint work. The number of multiple feeds that are undetected by the machine will not exceed 0.05 per cent of the total number of feed cycles executed.

SKEW RATE -- The percentage of the total number of documents fed that are placed on the drum with skew in excess of 0.25 degrees will not exceed 0.7 per cent for live work and 0.5 per cent for mint work.

JAM RATE -- All conditions, except multiple feeds, that cause processing to be halted due to document mishandling will be counted as a jam. The jam rate will not exceed one occurrence in 1200 documents fed for live work and one occurrence in 1600 documents for mint work.

MISPLACED-PAGE RATE -- All occurrences of page misplacement (stacked out of sequence, fall from drum, etc.) will be accumulated to the misplaced page rate. This rate will not exceed one occurrence in 2000 documents for live work and one occurrence in 2500 documents for mint work.

UNDETECTED-LINE RATE -- Lines that are omitted from the reading process will not occur more frequently than one occurrence in 50,000 lines for either live or mint work. Lines must be printed in accordance with the specifications listed above in paragraphs entitled Line Spacing, Modes of Operation, Columnar Lines, and Bar Codes.

MUTILATION RATE -- Jammed or other mis-handled documents can be conveniently removed by the operator. No more than one out of every 3000 documents will be damaged so as to prevent it from being machine processed.

Input Hopper and Feeder

CAPACITY -- The input hopper has a capacity sufficient to contain a stack of pages ten inches thick (approximately 3000 pages of 16-pound paper). Pages must be placed in the hopper face up.

ALIGNMENT -- The upper right-hand edge of the paper must be aligned to within 1/4 inch in order to be properly handled.

Output Stacker

CAPACITY -- The output stacker has a capacity sufficient to contain a stack of documents ten inches thick (approximately 3000 sheets of 16-pound paper).

SEQUENCE -- Pages are stacked face down in the same sequence as they are fed.

CONTINUOUS OPERATION -- The output stacker can be emptied while the RIPPC is operating.

ALIGNMENT -- Documents stacked in the output stacker will have their upper right-hand edges aligned to within three inches.

Options

STACKER -- A second stacker, having the same capabilities as the output stacker mentioned above, can be incorporated at the time of order. The criteria that actuate this stacker are defined by program control.

LINE MARKER -- A marking device is available that can, under program control, place

a distinct red mark in the right-hand margin of a page. The vertical position of the mark with respect to the beginning of the line, subsequent to the receipt of the line mark command, is adjustable by the system engineer and is consistent for a given setting. Failure to place the distinct mark in the proper position will not occur more frequently than one out of every 100,000 attempts. The lateral position of the mark may be adjusted by the system engineer anywhere from 3/8 inch to 1-3/8 inches from the right-hand edge of the page.

Reliability

AVERAGE EFFECTIVENESS LEVEL -- This percentage figure, determined by dividing the available time by the sum of available time and down time, will not be less than 90 percent. Available time is defined as the time during which the equipment has the power on, is not under maintenance, and is known or believed to be operating correctly. Down time is defined as the interval between the time that the system engineer is notified of equipment malfunction or failure and the time that the equipment is returned to the user in proper operating condition. Hours outside the scheduled production hours, as defined by the user, cannot be counted as available time or down time except by joint consent of the user and Recognition Equipment. The time required to investigate alleged failures that prove to be other than hardware malfunction shall be counted as available time.

MEAN TIME BETWEEN FAILURE -- The average length of available time between downtime interruptions will not be less than 10 hours.

MEAN TIME TO FIX -- The average length of down time shall not exceed one hour.

Table I. RIPC Physical and Environmental Characteristics.

<u>*Weight:</u>	Main Frame -- 3,740 lbs. Control Unit -- 790 lbs.
<u>Heat Load:</u>	36,800 BTU/hr. (21,200 BTU/hr. ventable)
<u>Power:</u>	Service -- 60 ampere, 208 volt \pm 10%, 3-phase, 60 cycle \pm 1 cycle, 5-wire wye. Running -- 14.76 kva, 10.8 kw.
<u>Size:</u>	Main Frame -- Length: 80-15/16 inches Width : 33- 3/8 inches (84- 3/16 inches with feeder and stacker) Height: 67 inches Control Unit -- Length: 33- 3/8 inches Width : 26- 5/16 inches Height: 67 inches
<u>Ambient Temperature Range:</u>	50 ^o F. to 80 ^o F. (10 ^o C. to 26. 6 ^o C.)
<u>Relative Humidity:</u>	40 to 70 per cent.

*All weights listed in this manual are nominal figures and are based on uncrated units.

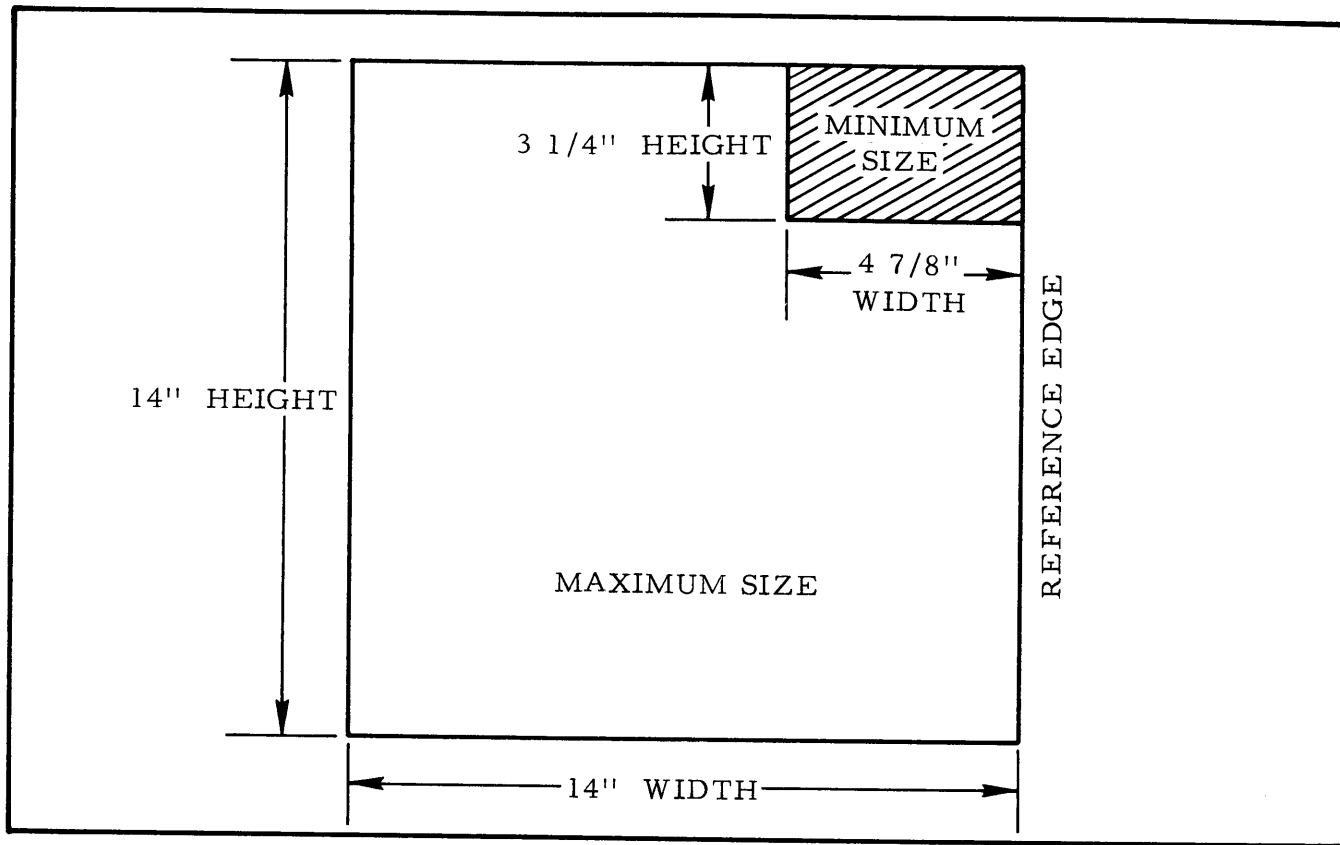


Figure 9. Page Size Range for the Rapid Index Page Carrier

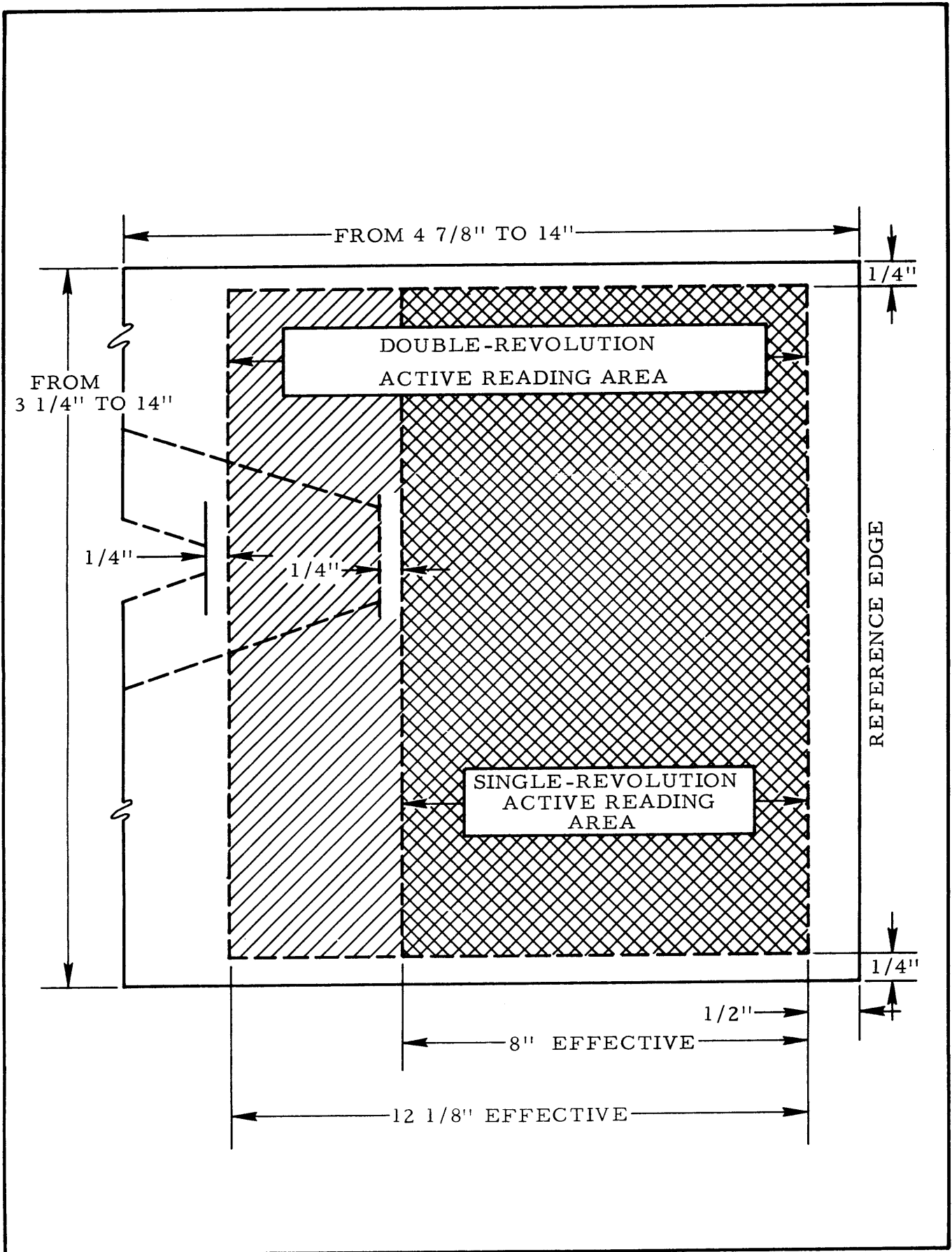


Figure 10. Page Margins and Reading Areas for the Rapid Index Page Carrier

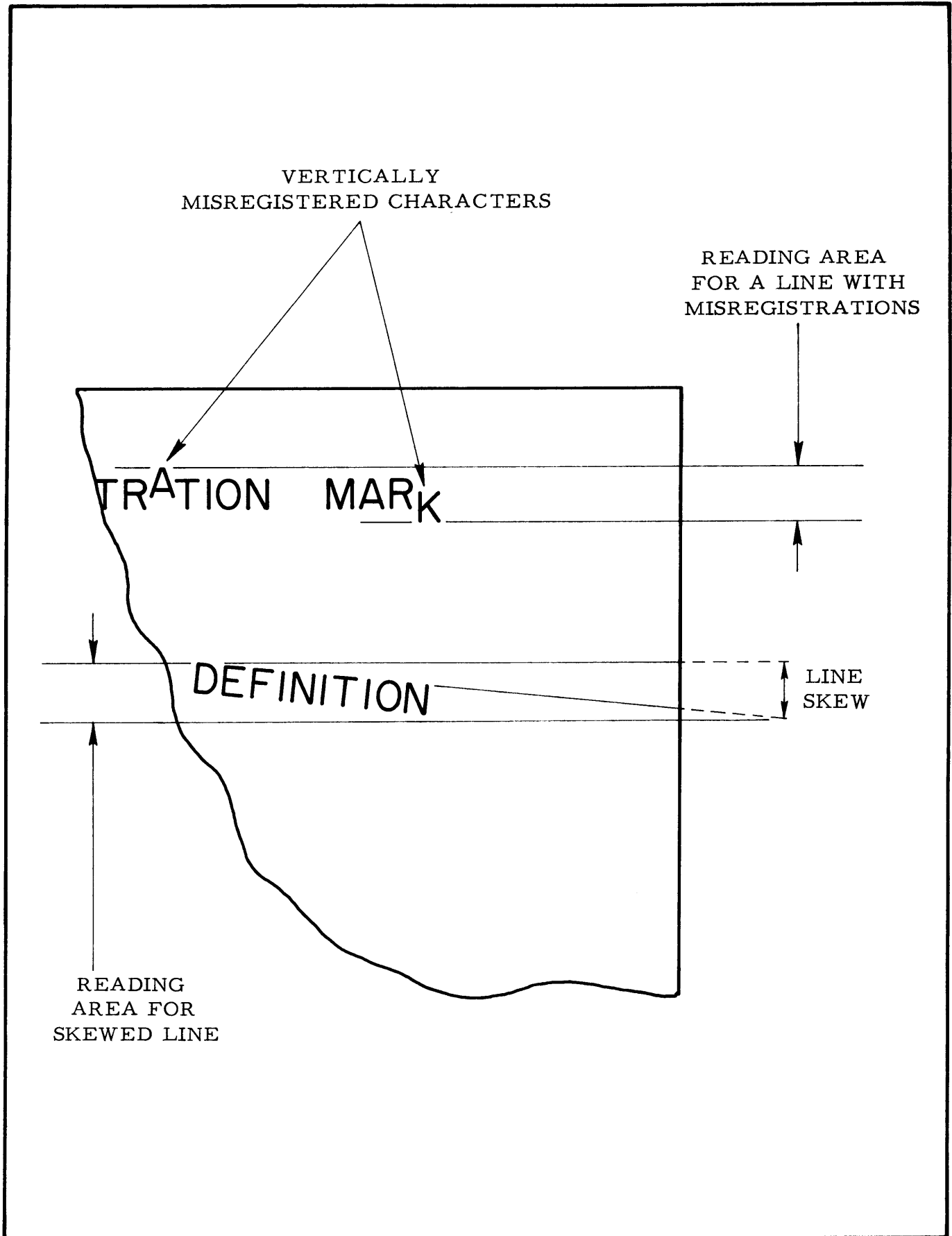


Figure 11. Line Skew and Vertical Character Misregistration

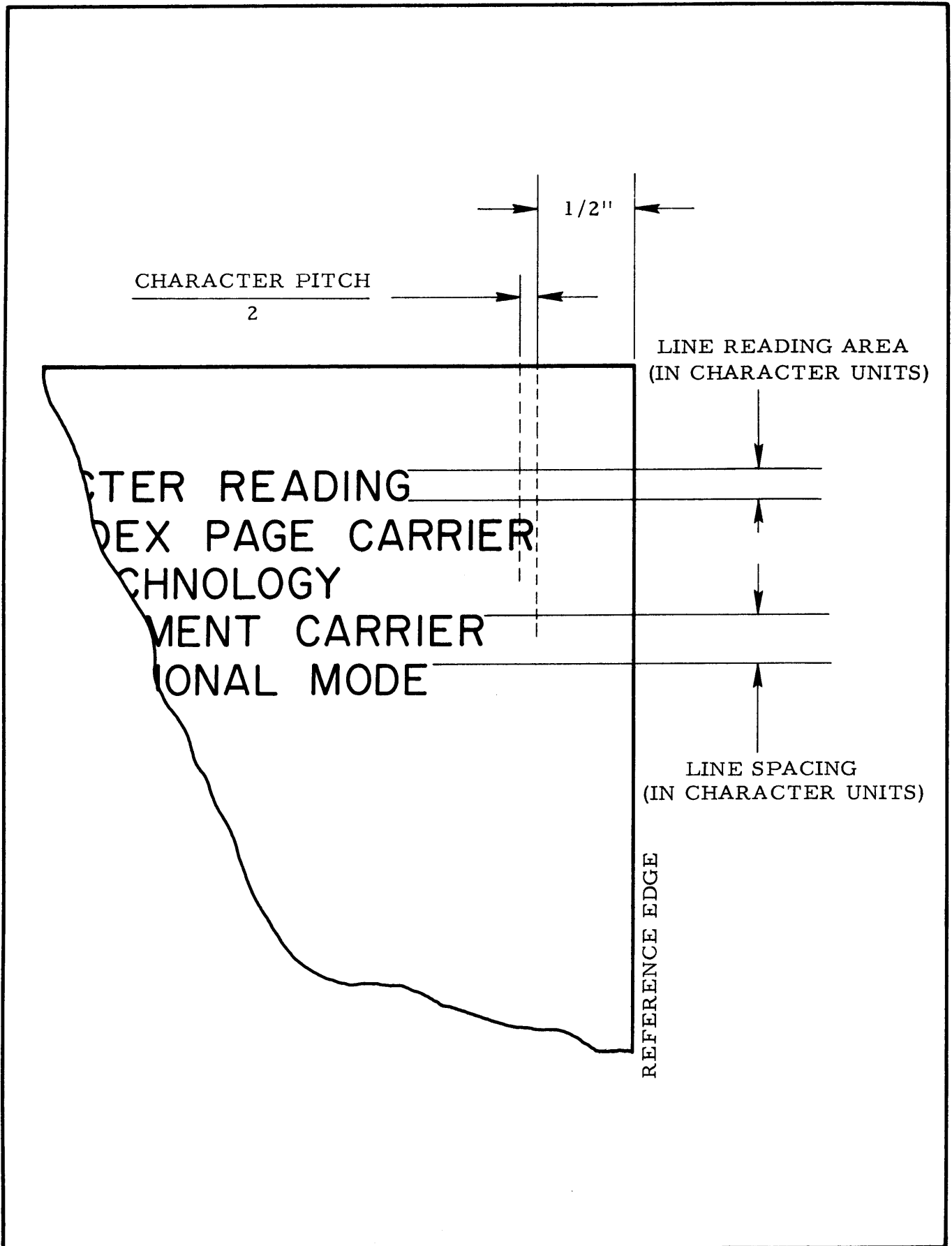


Figure 12. Line Reading Area and Spacing for the RIPC.

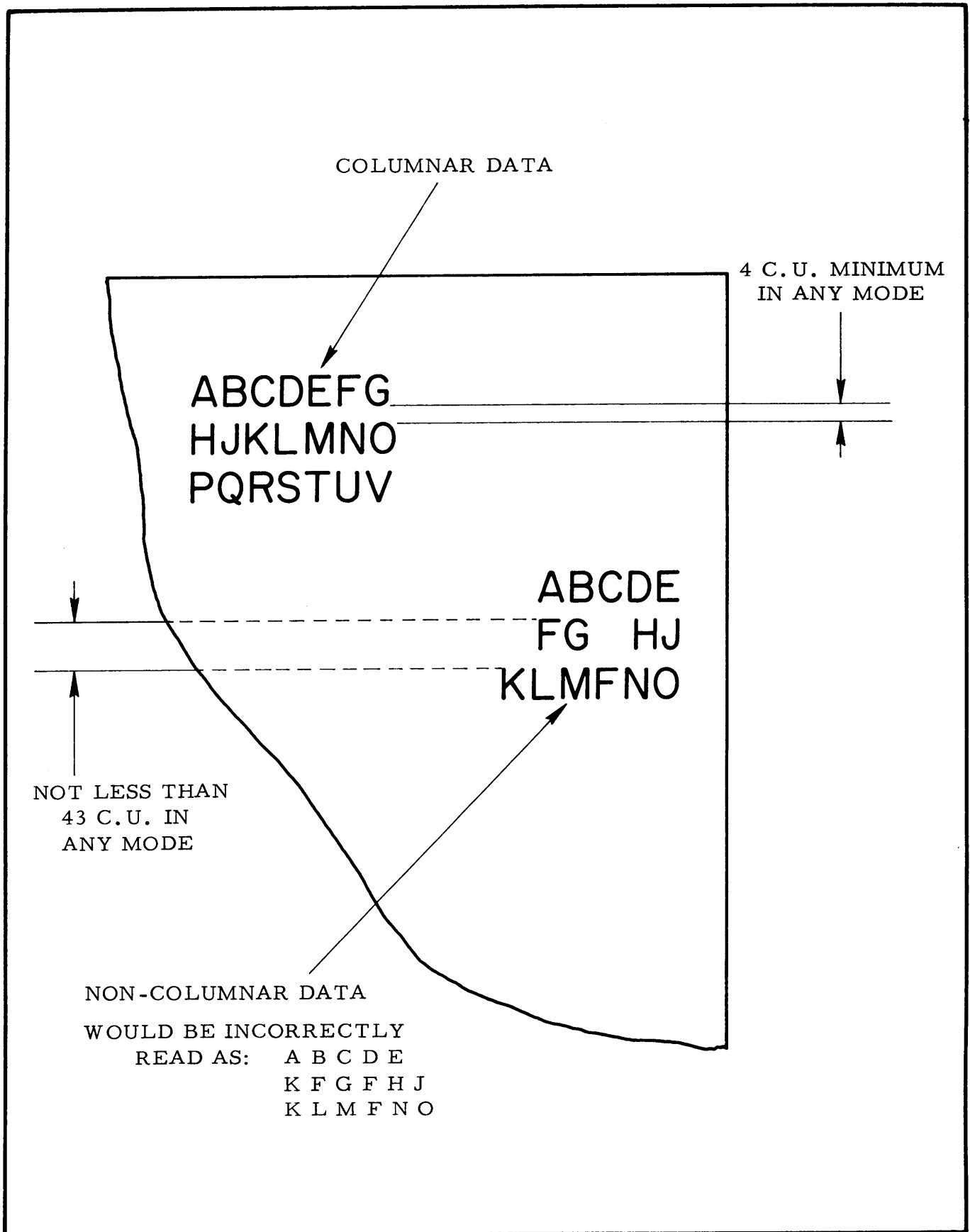


Figure 13. Columnar and Non-Columnar Lines for the RIPC.

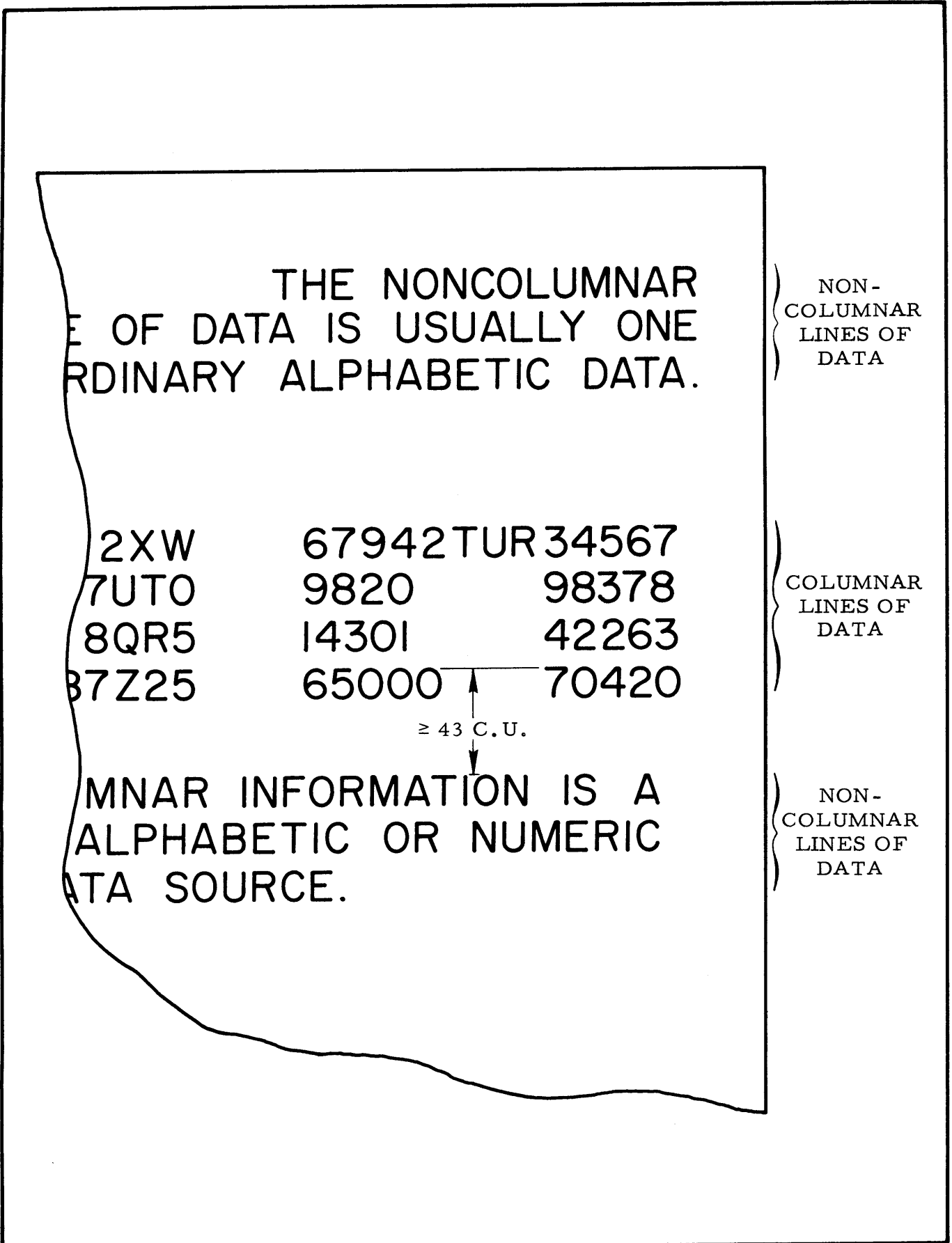


Figure 14. Discrete Areas of Columnar and Non-Columnar Data on a RIPC Form

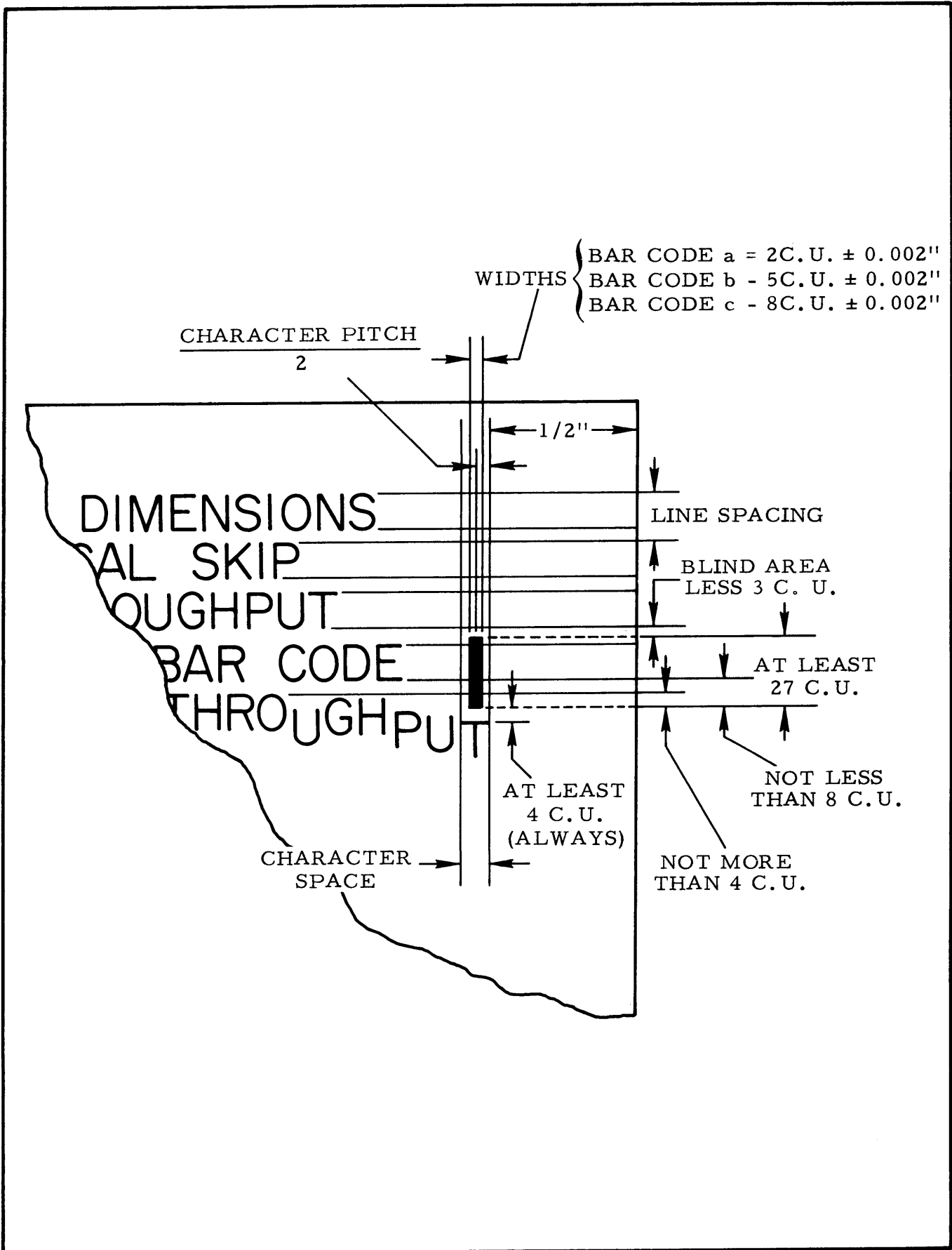


Figure 15. Bar Code Dimensions for Use With Page Copy

ERCR PRODUCTION

Date _____

Customer _____ Job _____ Analyst _____

1.0	Rapid Index Page Carrier		
1.1	Total normal-length lines per feed cycle	<u>34</u>	= <u>34</u>
1.2	Total wide lines per feed cycle	<u>0</u> x 2	= <u>0</u>
1.3	Automatic line placement adjustment		
	Total number of lines	<u>34</u> x 0.2 (round up)	= <u>7</u>
1.4	Total vertical jumps in inches	<u>2.4</u>	= <u>7</u>
1.5	Line 1.4 divided by 1/3 (round down)		= <u>2</u>
1.6	Number of vertical jumps		= <u>2</u>
1.7	Finding first line factor		= <u>0</u>
1.8	Total intentional multiple re-read		= <u>52</u>
	Total of Lines 1.1 through 1.8		= <u>52</u>
1.9	Total of Lines 1.1 through 1.8 times 0.078 seconds		= <u>4.056</u>
1.10	Index time in seconds		= <u>0.800</u>
1.11	Line 1.9 + Line 1.10		= <u>4.856</u>
1.12	Total time to read a page is Line 1.11 or 2.5 seconds, whichever is larger		= <u>4.856</u>
1.13	Pages per minute = 60 divided by Line 1.12		= <u>12.35</u>
1.14	Pages per hour = Line 1.13 times 60		= <u>741</u>
1.15	Pages per month = Line 1.14 times 200		= <u>148,200</u>
1.16	Average page volume required of ERCR by this job		= <u>10,000</u>
1.17	<u>Time to Read</u> is Line 1.16 divided by Line 1.14		= <u>13.5 hr.</u>

Figure 16. ERCR PRODUCTION Form for Use with the RIPC

DOCUMENT CARRIER (DC)

Physical Characteristics

The physical and environmental characteristics of the Document Carrier (DC) are shown in table II.

Operational Specifications

Document Specifications

SIZE -- The DC can handle documents on an intermixed basis over the range in size from 3-1/4 inches x 3-1/4 inches to 5 inches in height by 8-3/4 inches in width (figure 17). The height of any document (the dimension perpendicular to a line of print) must not exceed its width. Processing intermixed document widths is allowable as long as the width of the shortest item is at least one inch greater than one half the width of the longest item ($\frac{\text{longest width}}{2} + 1$ inch).

2

WEIGHT -- Documents that vary in weight from 12 pounds to that of punched card and postcard stock can be handled intermixed. Documents whose heights exceed four inches must be composed of paper weighing more than 20 pounds. The machine can handle long or short grain items whose weights are greater than 18 pounds. (In grain long the long dimension of the document runs parallel to the grain of the paper stock. Similarly, grain short denotes that the short dimension of the document is parallel to the grain of the paper). The presence of carbon backing on the documents does not interfere with or jeopardize the mechanical operation of the machine.

MUTILATION AND DEFACEMENTS -- Documents with pasted labels can be processed. Pasted labels may or may not affect the average throughput depending on how well the labels are attached to the documents. The DC will handle documents with staples provided neither prong of a staple is open far enough to make an angle of more than zero degrees with the base of the staple. Dog-eared and torn documents will be transported by the machine as long as such mutilations do not extend into the document any further than 1/4 inch on the leading third of the top, bottom, or leading (right) edge of a document, or one inch on the trailing (left) edge or the trailing two-thirds of the top of a document. Figure 18 illustrates

the document areas in which a dog-ear or tear can be tolerated. Documents that have been folded or crumpled and then flattened will not interfere with the mechanical transport in any way. The removal of staples and attachments will leave small holes and tears between these holes. These holes will not interfere with the transport of the document.

Data Format

MARGINS -- A viewing band on a document must be so located on the document that the edge of the band is not closer than 24 character units to the top or bottom of the document. Characters to be read must not be closer than 3/8 inch to the left or right edge of a document. Present capabilities preclude any reading in an area between 2.115 inches and 2.625 inches from the bottom of the document. Figure 19 shows the marginal limits and reading areas for documents handled by the Document Carrier.

ACTIVE READING AREA -- The basic machine contains one reading station capable of reading one line across a unit record-size document. (A second reading station is available as an option). To accommodate line skew and vertical misregistration, each reading station is capable of viewing a band, 32 character units high, across a document with the nominal vertical position of the line of characters centered in this viewing band (figure 20).

READING AREA RESTRICTIONS -- At least 16 character units of blank space must be located above and below each viewing band (figure 20). The vertical position of each reading station (corresponding to the position of the viewing band on a document) can be adjusted by the machine operator. Depending on the position of the transport belt (in upper or lower), item reading areas can vary in location, as shown in figure 21. Characters that extend outside of or that touch the edge of a viewing band may not be recognized by the system. Bar codes for a line must extend to the top of, and at least eight character units below, the viewing band and must be at least 27 character units high (figure 22).

PROGRAM CONTROL -- Horizontal format control can be accomplished by the Programmed Controller.

Throughput

PROCESSING RATES -- The Document Carrier processes intermixed document lengths within the allowable size range (figure 17) at a synchronous rate of 600 documents per minute. When equipped with an optional multispeed feeder, the DC processes documents between 3-1/4 inches and 6-1/4 inches in length, from which one line is to be read, at a rate of 1200 per minute. Documents up to 8-1/4 inches long, from which one line is to be read, can be processed at a rate of 900 documents per minute when the DC is equipped with the multispeed feeder. Documents longer than 8-1/4 inches; documents from which two lines are to be read; and some lightweight, carbon-backed documents must be processed at the 600-items-per-minute rate.

Document Handling

REJECT CRITERIA -- Representative live-work condition or mint-condition documents, with full code lines over the allowable size intermix range, will be processed through the machine once. All documents containing one or more reject characters, multiple feeds, out-of-tolerance feeds, nonrecoverable jam items, and nonstacking items will be selected out during this pass. These rejected documents will be processed through the machine a second and third time. Documents that do not reject during either the second or third pass will be counted as "first-pass rejects". Documents that do not read on any of these passes are discarded as not being machine processable. The items that were accepted during the first pass will be processed through the Document Carrier ten additional times. The rejects from each pass will remain in the reject pocket and will not be reprocessed. The total number of items rejected over the ten subsequent runs will be divided by one hundredth of the total number of items passed over the ten subsequent runs to arrive at a subsequent-pass reject rate.

FIRST-PASS REJECT RATE -- The reject rate for the machine will not exceed 1.5 per cent for the first pass with live-work documents and 0.3 per cent for the first pass with mint-condition documents.

JAM RATE -- The machine will process subsequent-pass documents with a jam rate not to exceed one occurrence out of every 40,000 documents fed for paper weights in excess of 20 pounds and one in 10,000 documents fed for paper weights of 20 pounds or less. Every jam should be counted whether the jam circuits are activated or not, as in stacking problems requiring machine stoppage.

HOLD-POCKET RATE -- Documents directed to the nonstacking, hold-pocket receptacle due to machine error (not program error) will not occur more frequently than one occurrence in 20,000 documents fed.

MISSORT RATE -- The machine will process items in a manner such that missorted items do not occur more frequently than one out of every 40,000 documents fed for paper weights in excess of 20 pounds and one in 20,000 for paper weights of 20 pounds or less. Those items placed into a sort pocket without the machine's knowledge (an undetected multiple feed) and those items that are placed in a sort pocket differing from that required by the data read from the document will be counted as missorts. (Note: Data read from the document, rather than that which is coded, will be used to determine a legitimate missort). A multiple or close feed directed to the reject pocket without an indication to the Programmed Controller will be counted as a missort.

MUTILATION RATE -- Jammed or other mishandled documents can be conveniently removed by the operator. Documents may be processed through the machine 20 times (for paper weights of less than 20 pounds) and 40 times (for paper weights greater than 20 pounds), resulting in an accumulated rate of not more than 0.1 per cent of the original documents being rendered non-processable.

Input Hopper and Feeder

CAPACITY -- The input hopper and feeder automatically positions and feeds documents one at a time into the belt transport system of the Document Carrier. The input hopper can contain a stack of documents 21 inches thick (approximately 4,450 documents of 15-pound paper).

ALIGNMENT -- The machine will handle documents placed in the input hopper such that the

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.003

lower and right-hand edges are aligned to within 1/4 inch when all documents are of the same size and to within 1/8 inch when document sizes are intermixed.

HOPPER RELOADING -- The batch of documents in the input hopper is moved forward in such a way that additional documents may be added to the hopper to accomplish limited continuous feeding.

STOP FEED -- The DC has a stop-feed capability; it can be stopped on demand from the Programmed Controller. With the machine operating at a feeding rate of 600 documents per minute, a maximum of four more documents (immediately following the document that has just been read at the reading station) will be introduced into the belt transport system when "stop feed" is generated at the first reading station.

Output Stackers

CAPACITY -- The basic Document Carrier has one output module consisting of three output pockets, or stackers. The capacity of each output stacker is sufficient to contain a stack of documents 12 inches thick (approximately 2,540 documents of 15-pound paper).

SEQUENCE -- Documents are stacked in the output stacker in the same sequence as they entered the stacking area.

WEAR -- The stacking mechanism allows documents to be processed through the machine up to 40 or more times and still be machine processable.

ALIGNMENT -- Stacking will be accomplished in such a manner that it is not necessary to joggle the documents for subsequent passes through the machine.

UNLOADING -- The output stackers are so designed that they may be unloaded while the machine is operating.

GATE FAILURE -- If a gate fails to open at the proper time to receive a document, the document will travel the length of the Document Carrier and be deposited in a nonstacking receptacle. This receptacle contains a detecting device, so that when the document enters the receptacle document feed

automatically stops and an indicator on the control panel is lighted. Document feed cannot be restarted until the document in the nonstacking receptacle is removed.

Options

OUTPUT POCKETS -- Additional output pockets (stackers), to extend the machine to 6-, 9-, or 12-pocket capacity, are optional and can be elected by the user at the time of order. Each output pocket has the same characteristics as those specified above under Output Stackers.

SECOND READING STATION -- An additional reading station, having the same capabilities as specified above under Data Format, can be elected by the user at the time of order.

MULTISPEED FEEDER -- A multispeed feeder can be elected by the user at the time of order. The feeder allows documents of less than 6-1/4 inch length to be processed at a rate of 1200 items per minute; documents of less than 8-1/4 inch length to be processed at a rate of 900 items per minute; and documents of less than 8-3/4 inch length to be processed at a rate of 600 items per minute. All documents from which two lines are to be read must be processed at a rate of 600 items per minute.

ENDORSER, NONSELECTIVE -- A nonselective endorser can be elected at the time of order. The endorser, when activated, will print a prescribed design and a six-digit number at least once on the back of every document processed. The six-digit number, ideal for date representation, can be changed manually. The endorsement image, which can be specified by the user at the time of order, must be wholly contained within an area 1/4 inch in height and 1-1/4 inches in length. The image and the six-digit number will appear at a fixed distance from the bottom of the document (normally from 2-3/4 inches to 3-1/2 inches) and is repeated every 3-1/3 inches along the length of the document. The ink supply of the endorser is sufficient to allow a minimum of four hours of continuous operation.

ENDORSER, SELECTIVE -- A selective endorser can be elected by the user at the time of order. This device will, at rates of

600, 900, or 1200 documents per minute, print a prescribed design and a six-digit number on the backs of selected documents. Selective endorsing occurs under the control of the Programmed Controller. The six-digit number, ideal for date stamping, must be set manually. The endorsement image, which must be wholly contained within an area 1/4 inch in height and 1-1/4 inches in length, can also be specified by the user at the time of order. The image and the number will appear once on the leading portion of the document and be vertically positioned not less than 2-3/4 inches from the bottom of the document. The vertical position of the endorsement will not vary more than 1/4 inch for a given setting. The horizontal position of the endorsement is adjustable by the system engineer and will not vary more than two inches for a given setting. The ink supply of the endorser is sufficient to allow a minimum of four hours of continuous operation.

SEQUENCE NUMBER UNIT, SELECTIVE -- A selective batch, or sequence, numbering unit can be elected by the user at the time of order. The numbering unit operates under the direction of the Programmed Controller and will print, at a rate of 600, 900, or 1200 items per minute, a ten-digit number on the backs of selected documents. The number may be automatically incremented (under program control) between documents and may be manually set by stylus to a given value when the Document Carrier is turned off. The value of the number is not randomly selectable under program control, but is program readable. The number will appear once on the leading 3-1/2 inches of the document at a vertically adjustable position of not less than 2-3/4 inches from the bottom of the document. The number is readable by the ERCR providing that all applicable format and printing requirements are met.

INK-JET BAR CODE PRINTER -- The Ink-Jet Bar Code Printer places a coded representation of the data read from a document on the back of that document. The code is compatible with Recognition Equipment's High-Speed Reader/Sorter, when equipped with the Fluorescent Ink Bar Code Reader. The addition of this printer does not adversely affect the performance of the Document Carrier system in any way. The printing operation is under complete control of the

Programmed Controller, assuming that an additional input-output buffer with interlace is provided for control of the printer. The user can elect, at the time of order, the side of the document (front or back) that is to be coded. The ink reservoir has a capacity sufficient to allow for ten hours of continuous operation.

Reliability

AVERAGE EFFECTIVENESS LEVEL -- The average effectiveness level for the Document Carrier will not be less than 97.5 per cent.

MEAN TIME BETWEEN FAILURES -- The average length of available time between downtime interruptions will be not less than 40 hours.

MEAN TIME TO FIX -- The average length of down time will not exceed one hour.

Table II. DC Physical and Environmental Characteristics

<u>Weight:</u>	3-pocket system -- 2,400 lbs. 6-pocket system -- 2,800 lbs. 9-pocket system -- 3,500 lbs. 12-pocket system -- 4,270 lbs. Endorser Module -- 396 lbs.
<u>Heat Load:</u>	3-pocket system --18,200 BTU/hr. 6-pocket system --19,500 BTU/hr. 9- or 12-pocket system --21,500 BTU/hr.
<u>Power:</u>	Service -- 60 ampere, 208 volt \pm 10%, 3-phase 60 cycle \pm 1 cycle, 5-wire wye. Running -- 8.2 kva, 5.4 kw.
<u>Size:</u>	Length: 3-pocket system -- 135-7/16 inches. 6-pocket system -- 142-5/8 inches. 9-pocket system -- 178-5/8 inches. 12-pocket system -- 214-5/8 inches. Endorser Module -- 20 inches. Width: 33-9/16 inches. Height: 60-1/2 inches.
<u>Ambient Temperature Range:</u>	50° F. to 80° F. (10° C. to 26.6° C.).
<u>Relative Humidity:</u>	40 to 70 per cent.

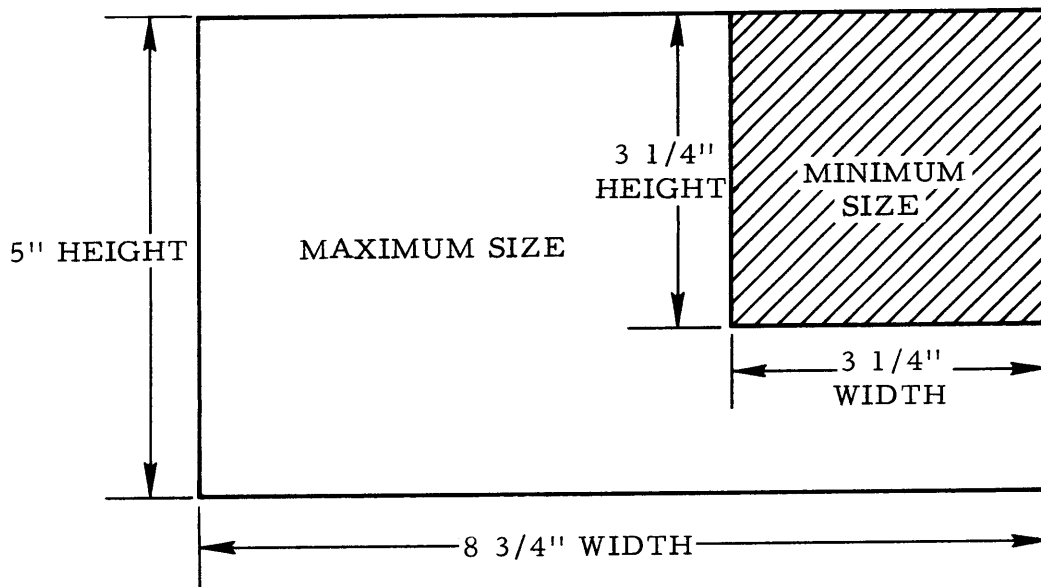


Figure 17. Document Size Range for the Document Carrier

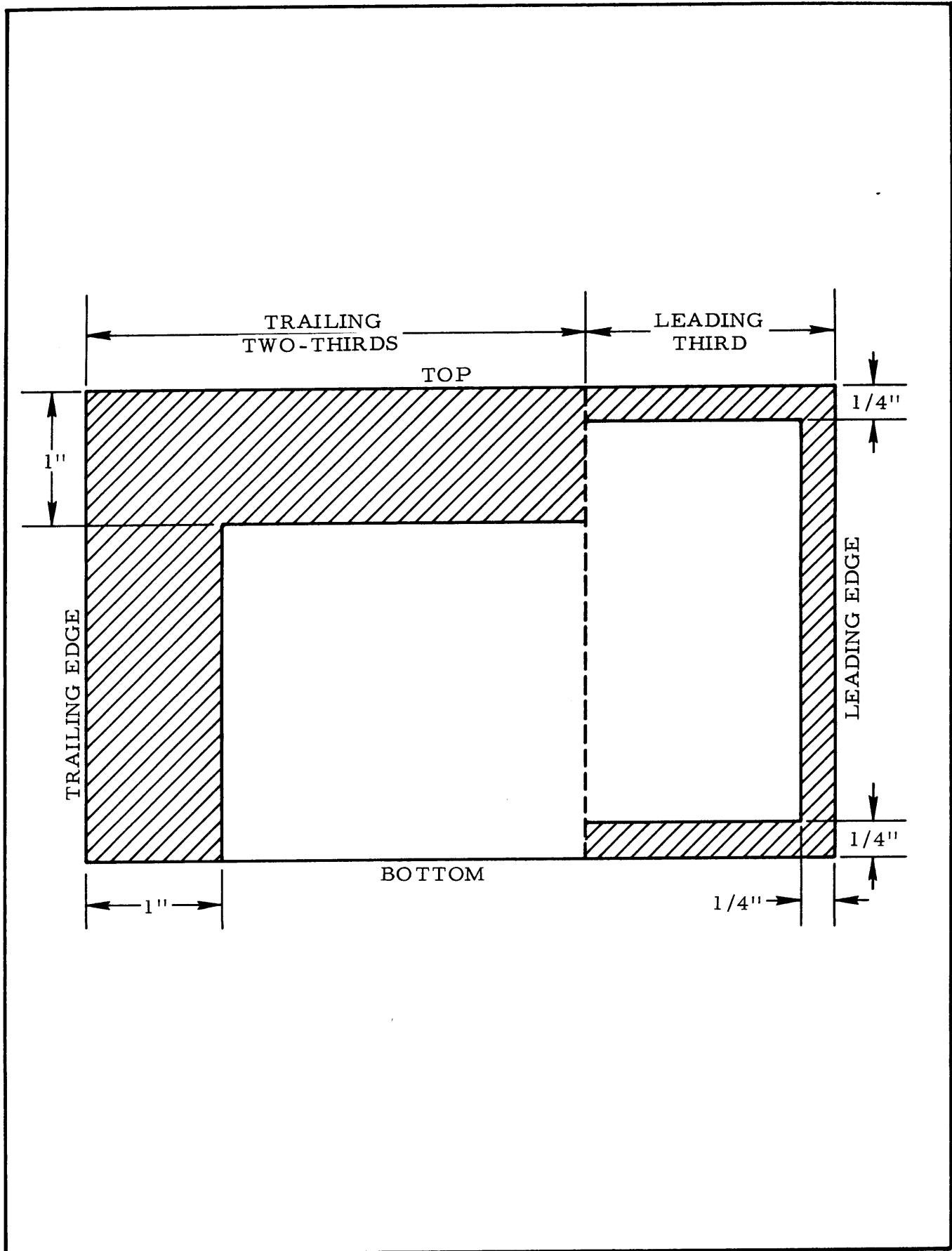


Figure 18. Document Areas (Shaded) in Which Dog-Ears and Tears Are Tolerated

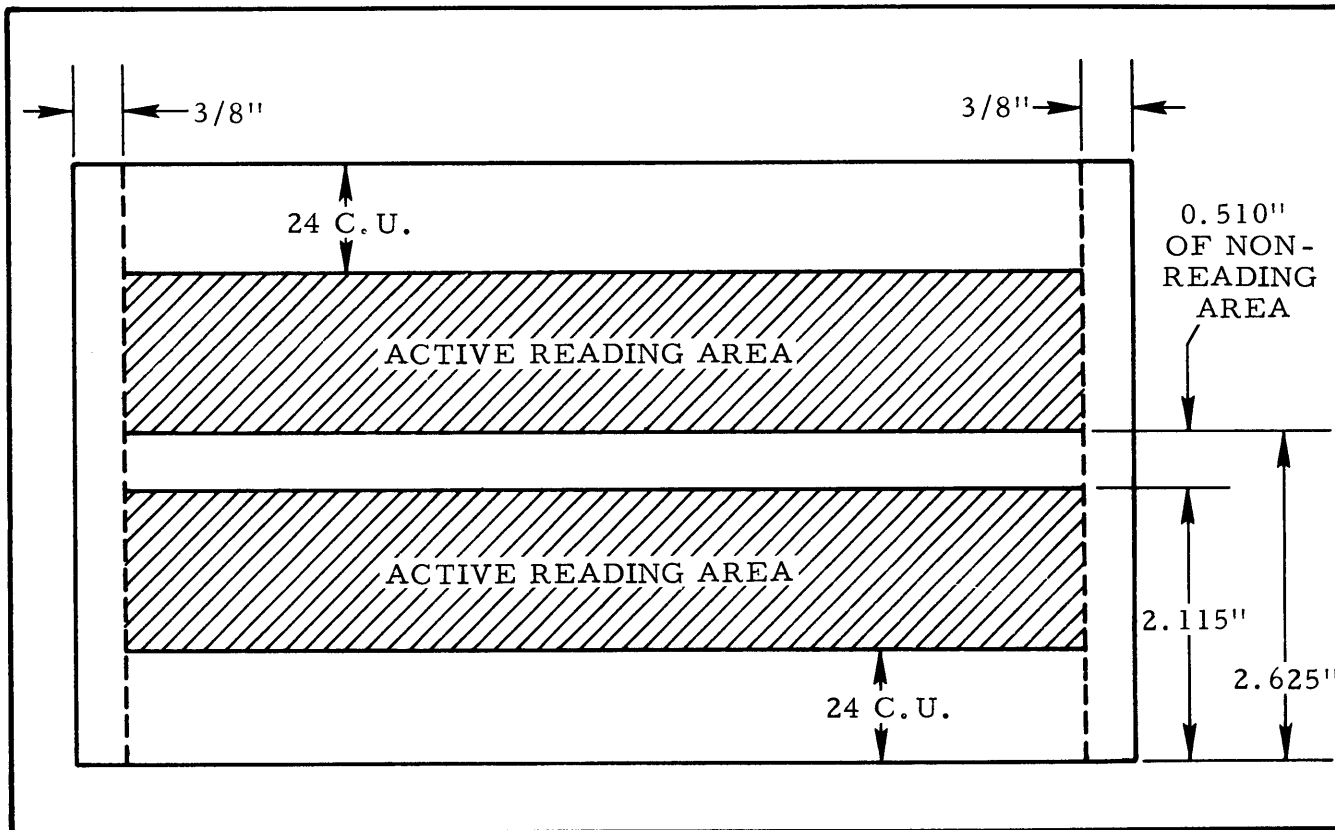


Figure 19. Margins and Active Reading Areas for the Document Carrier

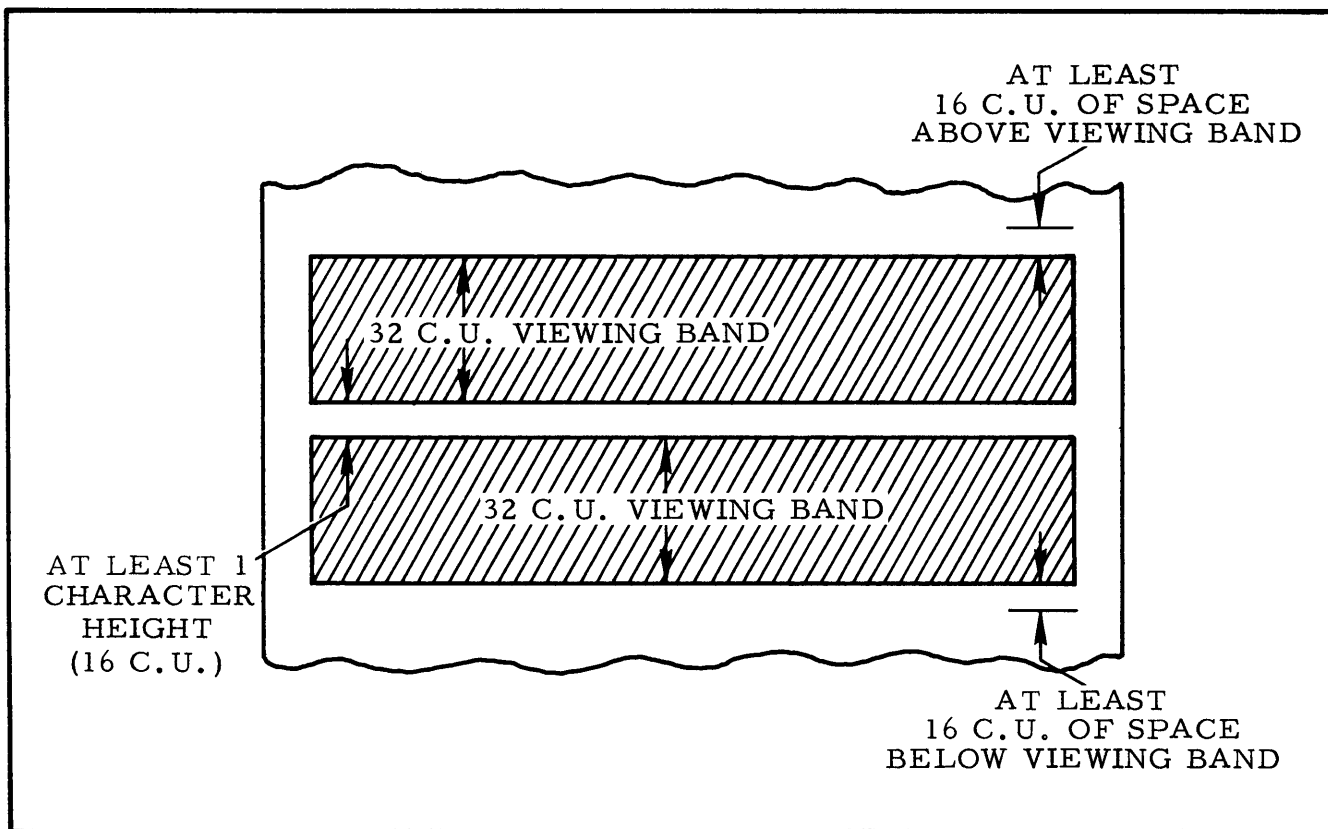


Figure 20. Viewing Band Dimensions for the Document Carrier

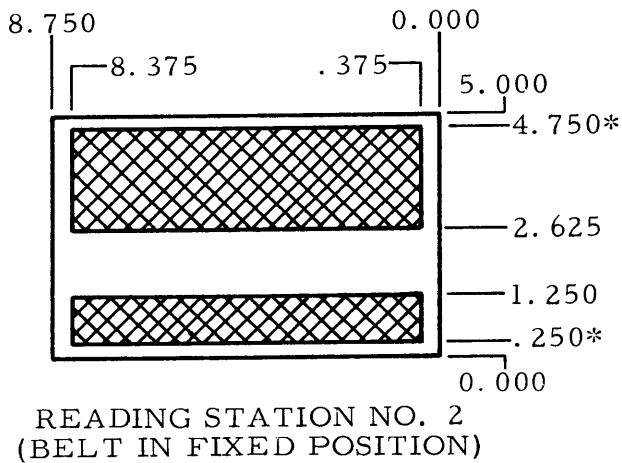
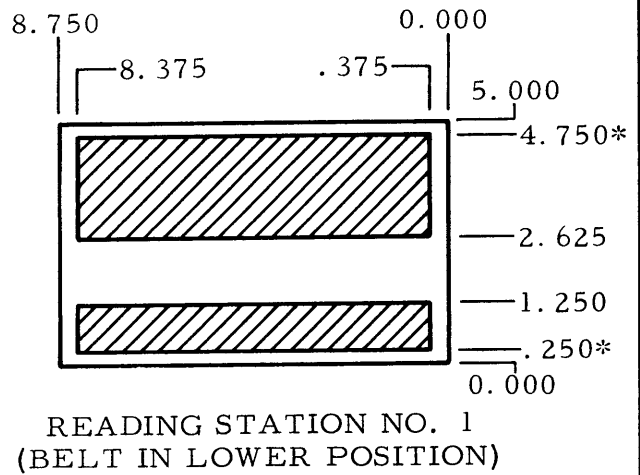
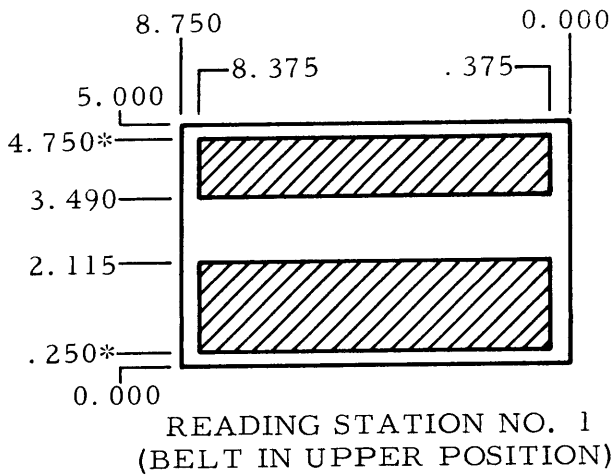
LEGEND



READABLE BY STATION NO. 1



READABLE BY STATION NO. 2



NOTE: ALL DIMENSIONS ARE IN INCHES.

*NOTE: 24 C. U. IS CONSIDERED ADEQUATE, BUT 1/4" IS RECOMMENDED.

Figure 21. Item Reading Areas for the Document Carrier

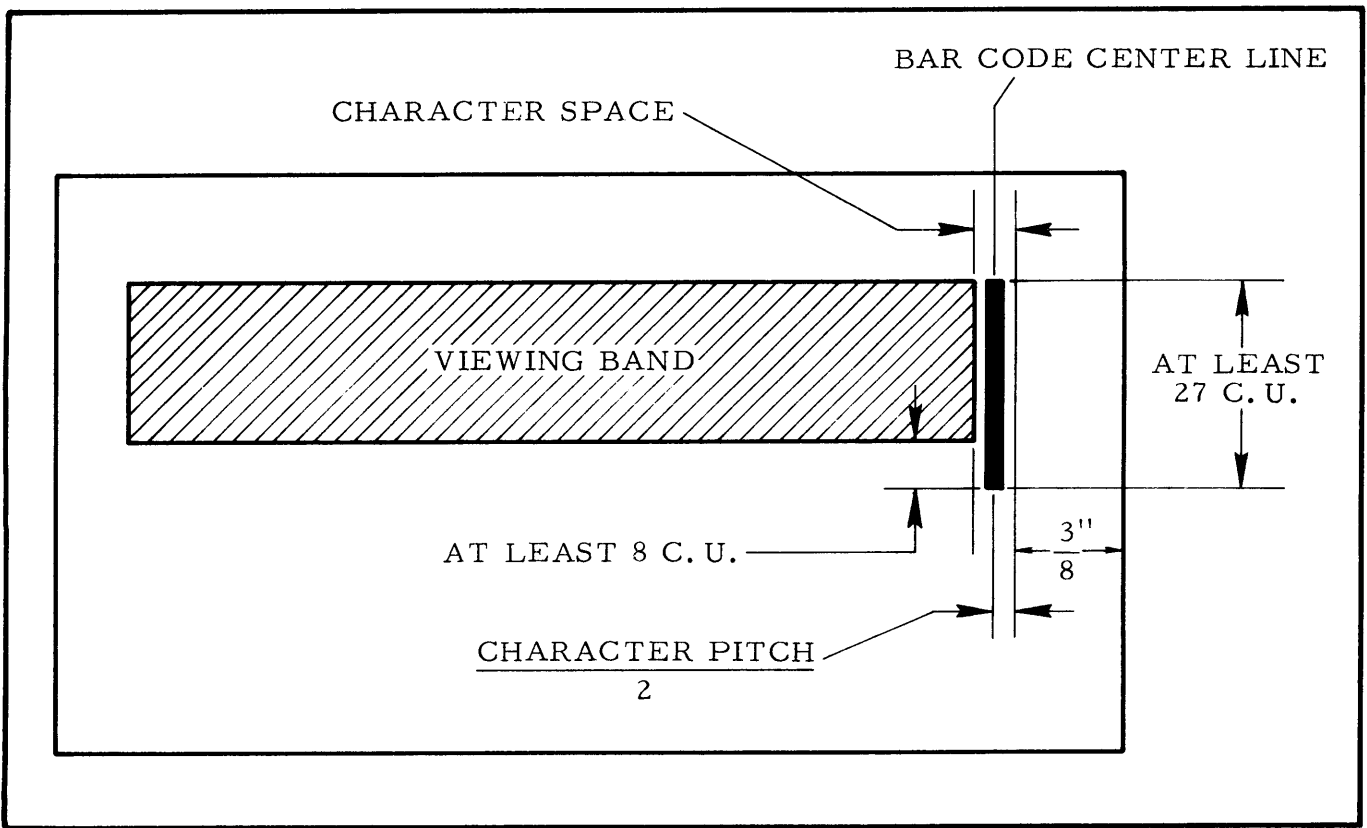


Figure 22. Bar Code Dimensions for the Document Carrier

RETINA AND RECOGNITION UNIT (RRU)

Physical Characteristics

The physical and environmental characteristics of the Retina and Recognition Unit (RRU) are shown in table III.

Operational Specifications

General Capabilities

The Retina and Recognition Unit is capable of recognizing characters or symbols that have been machine printed by conventional, fixed-pitch printing mechanisms, such as a typewriter or line printer. Since reading performance is a function of the quality of the printed material, the specifications stated here directly reflect the printing standards listed in Chapter III. In general, the ERCR reads (from right to left) all characters printed in black or dark blue on a white or nearly white background. As a multifont reading machine, the ERCR is capable of accepting up to 360 separate characters in its concurrent vocabulary. The RRU consists of the Electronic Retina and the circuitry associated with locating, analyzing, and recognizing characters. The machine's vocabulary is contained in a series of character masks, or patterns, available in 30-character modules. The particular vocabulary that the ERCR must be able to recognize is determined by the user and is prepared, in increments of 30 characters, by adding the requisite number of character masks.

Reading Rate

The RRU operates at character recognition rates that are compatible with a linear paper transport speed of 200 inches per second. This produces a maximum reading rate of 2400 characters per second (linear paper speed x character pitch).

Reading Limitations

SKEW -- Character skew of plus or minus three degrees is tolerated, except for printed bar codes, which must not be skewed more than 0.5 degree.

SIMILAR CHARACTERS -- In the event that automatic distinction between similar

characters (such as the lower case alphabetic l and the numeral 1) is not possible, the character code transmitted to the Programmed Controller will be the numeric code unless otherwise specified by the user. Automatic distinction can be made possible by modification of selected characters in the font.

DISCONTINUOUS CHARACTERS -- The recognition of vertically discontinuous characters (such as ! ; : and ?) cannot be guaranteed unless the character meets the requirements specified by Recognition Equipment.

SPACE -- An area of white space, horizontally equal to or greater than 0.7 of a character space, is required to recognize a "space". Regardless of the width of the space, only one code will result as output from the interpretation.

Reading Control Features

CHARACTER SETS -- Characters may be arranged in sets according to style, type face, or printing device. These character sets, also referred to as fonts, can be turned on (activated) separately or in combination under program control.

CHARACTER GROUPS -- Characters may also be arranged in groups according to class or function, such as alphabetic, numeric, special symbol, or mark-sense. Character groups can be turned on (activated) separately or in combination. The combination of character sets and character groups (as reading controls) permit a user to read with a complete vocabulary or, under program control, to read only a specific character type within a single font.

PITCH -- Up to six mutually exclusive lateral character pitches can be read. The user can, at the time of order, elect the particular six pitches he prefers within the range from 4-pitch to 12-pitch. Each pitch is under program control. When a particular pitch is specified by the program, all other pitches are automatically turned off (disabled).

CONFIDENCE LEVELS -- The confidence levels that a system must meet before choosing from an identification, a reject, or a substitution, can be adjusted by the resident Recognition Equipment system engineer.

Reading Performance Level

READING STANDARDS -- The following performance rates are based on the ability of the machine to recognize a standard font, or character set, printed in accordance with the specifications of Chapter 3. The standard performance character set is defined as the standard Recognition Equipment Printer Font, consisting of 1403 type style for alpha and numeric, the special symbols of the Emancipator Program typewriter, and additional special symbols from the conventional 1403 type style. The B. D. and l are alternate 1403 characters with the small serif. The actual reading performance is measured against the standard by reading the vocabulary selected by the user. At the time that the vocabulary is selected, the Engineering Department of Recognition Equipment will measure the readability of the character sets relative to the standard. The performance rates will then be judged accordingly.

REJECT RATE -- The machine will recognize the standard character set with a character reject rate not to exceed 0.02 per cent while reading from the Document Carrier and 0.01 per cent while reading from the Rapid Index Page Carrier in a maximum reread mode.

SUBSTITUTION RATE -- The machine will recognize the standard character set with a character substitution rate not to exceed 0.001 per cent while reading from either the RPC or DC. Substitution of a space code for a character is counted as a substitution.

Options

VOCABULARY -- The concurrent vocabulary of the system may be increased in increments of 30 characters up to a maximum of 360 characters. Elements of the concurrent vocabulary can be recognized intermixed. Additional sets of characters beyond 360 can be provided in groups of 30 characters; however, in order to recognize the additional characters, the printed circuit cards that represent the concurrent vocabulary must be removed and the new character masks inserted.

UPPER AND LOWER CASE -- In order to maintain the distinction between upper and lower case characters, a 90-character upper

and lower case output matrix is available. The character code structure ordinarily consists of one 6-bit code to identify each character (such as A, B, C, etc.) without regard to whether it is upper or lower case. The 90-character output matrix extends this structure to include additional 6-bit codes that not only identify the character as a particular letter, but also whether it is an upper case or lower case letter. The code presented to the Programmed Controller thereby allows lower case character identities to be maintained.

Reliability

AVERAGE EFFECTIVENESS LEVEL -- The average effectiveness level will not be less than 99 per cent.

MEAN TIME BETWEEN FAILURES -- The average length of available time between down-time interruptions will not be less than 200 hours.

MEAN TIME TO FIX -- The average length of down time will not exceed two hours.

Table III. RRU Physical and Environmental Characteristics.

<u>Weight:</u>	Retina Unit	-- 1,140 lbs.
	Recognition Unit	-- 2,460 lbs.
<u>Heat Load:</u>		20,200 BTU/hr.
<u>Power:</u>	Service	-- 60 ampere, 208 volt \pm 10%, 3-phase 60 cycle \pm 1 cycle, 5-wire wye.
	Running	-- 10 kva, 5.9 kw.
<u>Size:</u>	Retina Unit:	Length -- 34- 1/8 inches. Width -- 37- 3/4 inches. Height -- 79-15/16 inches.
	Recognition Unit:	Length -- 72- 1/4 inches. Width -- 42- 7/8 inches. Height -- 79-15/16 inches.
<u>Ambient Temperature Range:</u>		50 ^o F. to 80 ^o F. (10 ^o C. to 26.6 ^o C.).
<u>Relative Humidity:</u>		40 to 70 per cent.

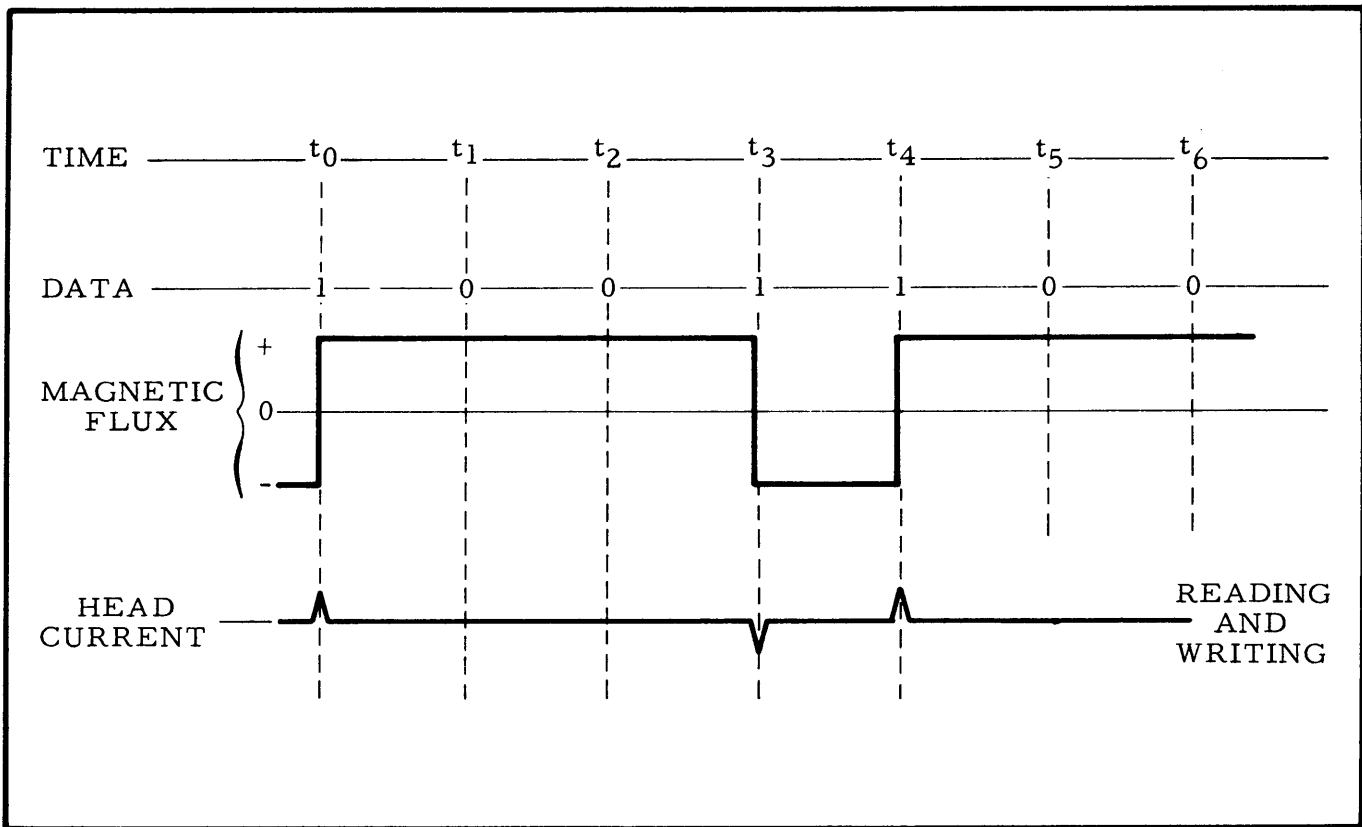


Figure 23. Non-Return-to-Zero Inverted Magnetic Recording

PROGRAMMED CONTROLLER (PC)

Physical Characteristics

The physical and environmental characteristics of the Programmed Controller (PC) are shown in table IV.

Operational Specifications

Basic Controller

MAIN FRAME -- The basic Programmed Controller main frame consists of a modified SDS 910 computer. The SDS 910 is a medium-speed, general-purpose, digital computer that uses a single-address, 24-bit word. The 910 is scientifically oriented to real-time processing, has an expandable priority-interrupt system, and lends itself readily to the simultaneous tasks of paper handling, real-time control of character recognition, and data processing.

STANDARD FEATURES -- The basic Programmed Controller is equipped with 8,192 words of core storage, a 300-character-per-second photoelectric paper tape (7-channel) reader, and a paper tape spooler.

Software-Required Optional Features

CORE STORAGE -- A total of 8,192 words of core storage will allow normal operation of the ERCR system with the standard software.

INTERLACE -- The optional interlace unit is required for the W Buffer and Y Buffer (if used).

INPUT-OUTPUT TYPEWRITER -- The input-output console typewriter is required.

PAPER TAPE PUNCH -- One 60-character-per-second paper tape punch is required.

MAGNETIC TAPE -- One magnetic tape unit is required, although two magnetic tape units or one magnetic tape unit and one line printer are recommended.

Optional Features and Peripherals

CORE STORAGE -- Core storage up to 16,384 words is available in increments of 4,096 words.

MEMORY INTERLACE CONTROL -- Memory interlace control is available for each of two input-output buffers.

MAGNETIC TAPE -- Up to four magnetic tape units can be attached to the controller. Seven-channel tapes, at all common packing densities, can presently be made available to be compatible with IBM, RCA, and Honeywell 800 magnetic tape equipment.

CARD READER -- A 200-card-per-minute reader is available.

LINE PRINTER -- Buffered line printers capable of delivering 64 unique characters in 132 print positions are available at both 300 and 1000 lines-per-minute. A buffered 1000-line-per-minute, 132-character-per-line, 90-character (upper and lower case) printer is also available.

INTERRUPTS -- Additional priority interrupts are available.

SECOND INPUT-OUTPUT BUFFER -- A second input-output character buffer is available.

OFF-LINE TYPEWRITER AND PAPER TAPE UNIT -- An off-line typewriter with paper tape reader and punch is available.

Software

Recognition Equipment has available and will deliver with each system a comprehensive library of programming systems, to include the following:

EXECUTIVE
LITERAL Assembly
FORTRAN II Compiler
META-SYMBOL
Keypunch EMANCIPATOR
REPORT GENERATOR
SORT/MERGE

Reliability

AVERAGE EFFECTIVENESS LEVEL -- The average effectiveness level for the standard Programmed Controller (as described above under Basic Controller and Software-Required Optional Features) will not be less than 98.5 per cent.

MEAN TIME BETWEEN FAILURES -- The average length of available time between down-time interruptions will not be less than 100 hours.

MEAN TIME TO FIX -- The average length of down time will not exceed 1.5 hours.

Table IV. PC Physical and Environmental Characteristics.

<u>Weight:</u>	990 lbs.
<u>Heat Load:</u>	6300 BTU/hr.
<u>Power:</u>	Service -- 30 ampere, 115 volt \pm 10%, single phase, 60 cycle, \pm 1 cycle, 3-wire. Running -- 2.3 kva, 1.9 kw.
<u>Size:</u>	Length -- 48 inches. Width -- 26 inches. Height -- 63-1/2 inches.

Note: Operator's console table is 18 inches wide by 46 inches long by 26-3/4 inches high.

Ambient Temperature Range: 50° F. to 80° F. (10° C. to 26.6° C.).

Relative Humidity: 40 to 70 per cent.

MAGNETIC TAPE UNIT (MTU)

Physical Characteristics

The physical and environmental characteristics of the Magnetic Tape Unit (MTU) are shown in table V.

Operational Specifications

General Capabilities

The normal magnetic tape unit used with the ERCR is a TM-7 Digital Tape Transport that is IBM 729 compatible. The transport moves computer-grade magnetic recording tape across a 7-track (or 9-track), magnetic, read/write head assembly in response to commands that originate from either an operator control panel or from remote equipment (such as the Programmed Controller). The tape can be moved in either the forward or reverse direction, or held at a standstill by a servo-controlled capstan. The read/write head assembly is capable of reading and writing in IBM-compatible format. Information is read by the head assembly from the tape to external equipment and written on the tape from external equipment.

Magnetic Tape Characteristics

TAPE DIMENSIONS -- The magnetic tape normally used with the MTU is 0.0015-inch, computer-grade, Mylar type, of 1/2-inch width. Tape lengths can be up to 2400 feet on standard reels (up to a maximum of 10-1/2 inches in diameter).

TAPE SPEEDS -- The read/write speed of the tape is 45 inches per second. The tape rewind speed permits a 2400-foot tape to be rewound in less than three minutes (approximately 160 inches per second).

SPEED VARIATIONS -- Long term speed variations are limited to 3 per cent, or less, of operational speed. Instantaneous speed variations are 5 per cent, or less, of operational speed, 8 milliseconds after a start command has been initiated.

TIMES AND DISTANCES -- The start and stop times for the MTU are each 8 milliseconds. At operating speed the tape start distance ranges from a minimum of 0.156

inches to a maximum of 0.234 inches. The tape stop distance ranges from a minimum of 0.133 inches to a maximum of 0.195 inches.

Information Recording

RECORDING METHOD -- The particular recording technique used by the MTU (IBM 729 compatible) is a variation of the Non-Return-to-Zero method. A binary 1 is represented (in reading or writing) by a reversal from a given condition of magnetic flux saturation to its opposite condition of flux saturation. The absence of any change in magnetic flux is taken to represent a binary 0. This method is commonly referred to as NRZ1 and, as shown in figure 23, produces a head current pulse only in writing or reading a 1-bit.

RECORDING FORMAT -- The formats in which information is recorded by the MTU are 7-channel, 6-bits-plus-parity, self-clocking, binary-coded decimal (BCD) or natural binary and 9-channel, 8-bits-plus-parity, self-clocking, ASCII or IBM 360 or natural binary.

RECORDING DENSITY -- The MTU is capable of recording data in a low density and a high density mode. Low density recording is at 200 characters per inch and high density recording is at 556 characters per inch. Also available is a low and high density combination of 556 and 800 characters per inch.

DATA TRANSFER RATE -- The data transfer rate (character read/write rate) of the MTU is a product of the tape speed in inches per second and data density in characters per inch. The data transfer rates of the TM-7 are 9000 characters per second (at a data density of 200 cpi), 25,000 (nominal) characters per second (at a data density of 556 cpi), and 36,000 characters per second (at a data density of 800 cpi).

Table V. MTU Physical and Environmental Characteristics.

<u>Weight:</u>	Tape Transport -- 350 lbs. Control Unit -- 350 lbs.
<u>Heat Load:</u>	Tape Transport -- 500 BTU/hr. Control Unit -- 1900 BTU/hr.
<u>Power:</u>	Service -- 15 ampere, 115 volt \pm 10%, single phase, 60 cycle \pm 1 cycle, 3-wire. Running -- 1 tape transport : 0.73 kva, 0.7 kw. 2 tape transports: 1.2 kva, 0.9 kw.
<u>Size:</u>	Tape Transport: Length -- 28 inches. Width -- 22 inches. Height -- 43 inches. Control Unit : Length -- 28 inches. Width -- 22 inches. Height -- 39 inches.
<u>Ambient Temperature Range:</u>	60 ^o F. to 90 ^o F. (15.5 ^o C. to 32.2 ^o C.).
<u>Relative Humidity:</u>	40 to 70 per cent.

LINE PRINTER (LP)

Physical Characteristics

The physical and environmental characteristics of the Line Printer (LP) are shown in table VI.

Operational Specifications

General Capabilities

The line printer used with the ERCR is a model DP-4300. The line printer accepts binary-coded information from a data source, such as the Programmed Controller, and produces printed copy on all standard print media at a rate of 1000 lines per minute. Printing is accomplished by means of a rotating character drum and a bank of up to 132 linear-motion print hammers. The drum passes 64 different characters, in skewed lines of up to 132 each, past the hammer bank. Upon command, the print hammers impact the paper against a ribbon and onto the appropriate character typefaces as they pass the hammers.

Character and Line Data

CHARACTERS PER LINE -- Each line of print can consist of up to 132 characters (at 10 characters to the inch).

CHARACTER TYPES -- The LP has a standard REI X03 character set (1403 style font) consisting of 64 characters on the character drum (A, B, C ... Z, \emptyset , 1, 2 ... 9, punctuation marks, and special symbols).

CHARACTER DRUM SPEED -- The character drum of the printer rotates at a minimum speed of 360 revolutions per minute (for the 300 lpm printer) and 1000 revolutions per minute (for the 64-character 1000 lpm printer).

CHARACTER SPACING -- Horizontal character spacing is measured between character centers and is 0.100 inch \pm 0.005 inch for the DP-4300 line printer. The maximum cumulative error is not more than + 0.020 inch per 132-character line.

LINE STRAIGHTNESS -- No character will deviate more than + 0.010 inch from a

straight line drawn parallel to the line of characters.

LINE DIMENSIONS -- Printed copy will consist of 6 lines per inch, with a line-to-line spacing of 0.167 inch \pm 0.015 inches.

Paper Characteristics

PAPER FEED -- The paper feed method is of tractor type, using a pair of tractors above and a pair of tractors below the print position. Paper is fed at a continuous speed of a minimum of 35 inches per second.

PAPER LINE-ADVANCE TIME -- The time required to advance paper in the printer one, two, and three lines at a time is, respectively, 15 milliseconds, 25 milliseconds, and 30 milliseconds. The given times for line advance are maximum times.

PAPER FORMAT AND DIMENSIONS -- The LP can use standard, edge-punched, 1/2-inch centers, fan-folded paper in widths from 3.5 inches to 19 inches. With the 19-inch maximum width, printing occurs on a 13.2-inch width in the center of the 19-inch form.

PAPER TYPES -- The types of paper that are usable in the line printer are up to six-part, 12-pound bond (single-copy minimum weight, 15-pound bond) or a tabulating card (0.007 inches thick) plus a second record sheet.

Table VI. LP Physical and Environmental Characteristics.

Weight: 838 lbs.

Heat Load: 4,780 BTU/hr.

Power: Service -- 25 ampere, 115 volt \pm 10%, single
phase, 60 cycle \pm 1 cycle, 3-wire
(AC, AC return, and ground).
Running -- 1.86 kva, 1.4 kw.

Size: Length -- 26 inches.
Width -- 47 inches.
Height -- 48 inches.

Ambient Temperature Range: 50^o F. to 100^o F. (10^o C. to 37.7^o C.).

Relative Humidity: 20 to 80 per cent.

III. FORMS AND PRINTING SPECIFICATIONS

PRINT STANDARDS

Introduction

Any fixed-pitch type font that is machine printed and is equal to or better than normal typewritten copy in quality, is acceptable to the Electronic Retina Computing Reader. Minimum requirements are established in this section, defining imprinted characters as they appear on the documents that are to be read.

Definitions

Character

Any upper or lower case alphabetic character, numeral, special symbol, or abstract symbol.

Average Edge

The edges of the strokes comprising a character are irregular, shaped lines that have numerous deviations from the intended edge of the stroke. The average edges are represented by a line so constructed that the area of deviation from the intended edge is equal on either side.

Mean Shape

The mean shape of any character is the locus of points that are equidistant from the average edges of the strokes representing the intended shape of the character and which lie on the shortest line between such average edges.

Stroke Width

The stroke width is the length of the shortest line between the average edges of a character at any given point. The nominal stroke width is defined as the distance between the lines described by the locus of points that are equidistant from the mean shape center line.

Reflectance

Reflectance is the measurement of diffuse reflected light only (from any angle not within 10 degrees of specularly-reflected light) when compared to magnesium oxide as a primary-white standard of 100 per cent

reflectance. Reflectance measurements shall be made using a backing of a sufficient number of paper thicknesses (of the same type as that being measured) such that doubling that number of thicknesses will not change the recorded value of the reflectance. Any device used for measurements of reflectance (of paper or print) shall have a spectral response range of 0.85 to 0.95 microns.

Void

A void is any area that is equivalent to the area of a circle with a diameter of one character unit, located wholly within the stroke width of a character, and having a reflectance greater than 50 per cent of that of the paper upon which the character is printed.

Extraneous Ink Areas

An extraneous ink area is any area that is equivalent to the area of a circle with a diameter of one character unit, located entirely outside of the strokes of a character, and having an average reflectance of less than 50 per cent of that of the paper on which the character is printed.

Reference Edge

The reference edge of a document shall be considered as the right-most edge when the document is in the normal position for human reading.

Character Boundary (Space)

A character boundary, or character space, is a lateral distance in inches, equal to the reciprocal of character pitch. For example, using 8-pitch characters results in a character space of 1/8 inch (0.125 inches) in width. The size of a rectangular character envelope which circumscribes a character is defined horizontally by the character width and vertically by the character height (figure 24). The character envelope is nominally centered within the character boundary, or space.

Character Pitch

The number of the widest equal-width character boundaries and their associated separation that will fit between two parallel lines spaced one inch apart. Pitch is stated simply as the number of characters per linear inch, as 10-pitch, 12-pitch, etc.

Character Dimension Tolerance

The nominal stroke width dimensions specified for any particular character may not vary beyond a tolerance of plus or minus one character unit. The minimum stroke width of any portion of a character must be not less than 1-1/2 character units. The maximum deviation of all strokes, including tips, from the mean shape center line for a character shall not exceed 1/3 of a character unit.

Bar Codes

Bar codes, or field-defining symbols, are vertical preprinted strokes at least 27 character units in height. Bar codes should be printed to a width tolerance of plus or minus 0.002 inches and so that skew with respect to the right, or reference, edge of a page is not more than 0.2 degrees. There are three types of bar codes presently in use; bar codes "a", "b", and "c". Nominal stroke-width dimensions for bar codes are two character units for an "a" bar code, five character units for a "b" bar code, and eight character units for a "c" bar code (figure 25). It should be noted that a bar code is a character, and like any other character, must conform to print standards (pitch, character boundaries, etc). Of particular importance is the lateral spacing associated with the use of bar codes. Characters can touch, but must never be permitted to overlap, their respective character boundaries. Character boundaries, or spaces, are defined by character pitch, so that the space for a single character will have a width equal to the reciprocal (in inches) of the pitch. For example, the character space for a character in 10-pitch printing will be 0.100 inches wide. Bar codes are laterally positioned so as to be centered within a restrictive area whose width is equal to one character space for the given pitch. As shown in ①, ②, and ③ of figure 26, an "a" bar code must be centered in a 12-pitch character space (0.083 inches in width); a "b"

bar code must be centered in a 10-pitch character space (0.100 inches in width); and a "c" bar code must be centered in an 8-pitch character space (0.125 inches in width). The centerline of a character envelope that is adjacent to a bar code can be no closer than one half a character space to the restrictive area boundary of the bar code (③, figure 26).

Character Degeneration

Character degeneration is that phenomenon which is experienced when the imprinting device, carbon, or ribbon is enough below normal in functioning to fail to imprint all of the character in the manner intended. If, for example, the type slug breaks or a hole occurs in the imprinting ribbon, thereby causing ink to be transferred to the paper from some areas of the type slug and not from others, then that character is considered to be degenerated to some degree. Large amounts of degeneration can be tolerated in some areas of a character, while small amounts of degeneration in other areas of that character can very well result in a reading reject. For the above reason, specifying a maximum allowable quantity of character degeneration is a practical impossibility and will not be attempted in these specifications. However, a character is acceptable if there is less than one void per 25 square character units of area within the nominal stroke boundaries of the character and/or there is less than one extraneous ink area per 25 square character units of area outside the nominal stroke boundaries of the character but within the character boundaries, and provided that no subarea within the character boundaries (that can be represented by a circle of three character units in diameter) shall contain more than one void and one extraneous ink area.

Character Separation

The distance between vertical boundaries of adjacent characters may be zero but must not be negative. Vertical boundaries of adjacent characters may, therefore, touch, but must never overlap.

Horizontal Spacing

The horizontal spacing of character envelopes shall be such that the number of envelopes and

their associated separations that can be placed in a linear inch is not variable.

INK CHARACTERISTICS

Color

The ERCR consists, in part, of solid-state sensing elements that are most sensitive to reflected light from the red end of the visible light spectrum. Thus, most printing done in red, or light orange, will appear to the Electronic Retina to be white, or in what is termed a "blind" color. The ink or carbon that constitutes a character and which is to be recognized by the ERCR should, therefore, be printed in black. Should black not be available, other dark pigment-based inks may be acceptable substitutes. Any preprinting, to be used on a form for typing control, as guide lines, or as instructions, and not to be recognized by the ERCR, must be printed in a blind color, such as red, pink, or light orange. Any of the conventional ink types are usable, provided they appear blind to the ERCR system. Preferred inks, always producing an adequate blind color, are the International Printer's Inks listed in table VII. Munsell No. 5R 8/4 and IPI red, San Francisco, No. 13693 are also adequate for producing blind colors. Both of the latter colors have a high reflectivity to light energy at a wave length of 950 millimicrons.

Density

Density is the degree of darkness of the ink or carbon that makes up a character and the degree to which such darkness is even throughout all the strokes of the character. This darkness is normally expressed as a contrast ratio between the ink and the background upon which it has been printed. Thus, the density of an ink is directly a function of the transfer of ink from the ribbon or carbon to the paper. Where stroke widths of characters are less than two character units, the best transfer (resulting in the greatest ink density) is experienced with carbon ribbons. If stroke widths beyond two character units are necessary, a uniform density is better achieved with a fabric ribbon. When using fabric ribbons, a very fine-weave ribbon must be used. The ribbon must also be changed whenever a cursory inspection reveals any

detectable deterioration in printing density. Although Recognition Equipment intends to supply suitable ribbons for all ERCR installations, color and stroke density (in present cases) should be tested and confirmed by Recognition Equipment personnel prior to ordering forms or purchasing imprinting devices.

PAPER CHARACTERISTICS

Background Reflectance

The measurement of average background reflectance shall be made over areas of at least 0.1 square inch. These areas will be in the shape of a circle or a regular polygon. The minimum average reflectance for any such area shall not be less than 70 per cent.

Reflectance Variations

The ratio of the maximum reflectance value to the minimum reflectance value of any two areas (one character unit in diameter) within 32 character units of each other shall not exceed 2 : 1.

Paper Opacity

Paper opacity is defined as 100 times the ratio of the diffused reflectance of a specimen backed with black (of not more than 0.5 reflectance) to the diffuse reflectance of the same specimen backed with a white body (having an absolute reflectance of 89 per cent). This ratio shall not be less than 60 per cent.

Dirt Content

The dirt count in paper may not exceed ten parts per million, as determined by TAPPI methods T 437M-43. All foreign material of 0.01 square millimeters in area and larger shall be counted.

Basic Paper Weight

A basic weight range of paper documents to be used with the RIPC is 12 pounds minimum to 30 pounds maximum. The Document Carrier, however, can handle paper ranging from 12 pound minimum to card stock maximum. The DC will also handle long grain or short grain items of weights greater than 18 pounds.

Stiffness

Strips measuring 1.5 inches in width, from the document being tested, are bent first to one side and then to the other. Readings are taken at each extreme and the results of tests on several samples of the same paper are averaged to produce the stiffness rating. (The rating is the total gram centimeters of work required to bend the strip.) The test is performed with samples cut both along and across the grain of the paper. The reading along the grain should be at least twice that of the reading across the grain. Any testing instrument that has the same capabilities as the Tabor Lee Five Instrument (Tabor Instrument Corporation) can be used to perform this test.

Tear Strength

The tear strength of the paper should be a minimum of 40 grams in both the machine and cross directions when measured against 16 sheets of paper samples cut 2.5 inches wide. The 40 grams represents the resistance-to-tear measurement. This dynamic test, directly relating the way in which a document resists mutilation in manual or machine handling, can be conducted by any test instrument capable of rendering the necessary measurements.

Smoothness

The smoothness of paper stock can be measured by using the Sheffield Tester (TAPPI T479SM). The reading should be a maximum of 200 on either side of the document. (The reading of 200 refers to 20 cubic centimeters of air escaping along the surface of enclosed paper being tested.) The smoother the paper, the less air flow and the smaller the smoothness number. Any testing instrument with the same capabilities as the Sheffield Tester can be used.

FORMS CONSIDERATION

Introduction

The degree of effectiveness of an optical character recognition (OCR) system, such as the ERCR, is influenced mainly by how well the user communicates processable

information to the system. Since the only medium for transmitting such information to the ERCR is the printed form, the design and construction of this form becomes a critical item in the linkage between man and machine. Forms should be so constructed that the ERCR reads only the desired information, while ignoring all other items of information on the form. Additionally, the user should be able to read and easily understand the same form. The capability of using a custom designed form and of processing only desired data items is a standard feature of the ERCR. Although the design of a form can greatly affect the reliability of a system and the time required to process desired data, relatively few restrictions are imposed on the forms designer, but these must be closely observed to assure the best possible results.

Physical Properties

Paper Stock

The ERCR is designed to read most conventional business forms. As previously noted, few restrictions on forms construction exist to hamper the forms designer, although decisions by the designer as to what information is to be transmitted by a form and how best to transmit that information are occasionally influenced strongly by specification limits. For example, paper of rough texture and in definitely off-white shades will not produce the maximum possible contrast between print and background. Another example would be serrations on paper edges. Serrated edges on any of the four sides of a document will not seriously impede machine efficiency, though best results are obtained if serrations are avoided on the top edge and right side of a document for the RIPC and on the bottom edge and right side for the DC. For paper specifications and paper stock dimensions, see the preceding section in this chapter and the appropriate section (RIPC or DC) in Chapter II.

Paper Color

Due to the sensitivity characteristics of the solid-state sensors used by the ERCR, red in general is recognized as white and characters printed in dark blue may be read almost as well as those printed in black. The color of the paper stock from which forms are to be

made can also be other than white. However, any time the color of the paper stock varies significantly from pure white, there will be a commensurate deterioration in the degree of contrast between the paper and the printing on that paper. If necessary, light shades of orange and yellow can be used as background, but before ordering any forms printed on off-white paper, the paper must be tested for reflectance by Recognition Equipment.

Multiple-Part Forms

Multiple-part form sets present some problems in assuring good copy for OCR systems. When several carbon copies of a single document are made simultaneously, the print quality of the original will differ from that of the copies in direct proportion to the number of carbon copies made. As the number of copies in a form set increases, one way of maintaining print quality is by reducing the weight of paper for all copies in the set. (If one-time carbon is used, the weight of the carbon paper should also be reduced.) The lighter-weight paper provides less padding between the type slug and the platen, so that as the type strikes the form, the image on the original and on the carbons will spread less. Other methods of reducing image spread are to use harder platens on the machines used to prepare multiple copies and (on electric typewriters) to change the force with which the type strikes the form. More force is required for thicker form sets and less force for thinner sets. Too much force, however, and the type will strike the paper too hard and bounce, causing an undesirable double image. In designing multiple-part forms it should be remembered that copies toward the bottom of the form set have less curvature radius around a typewriter platen than the upper copies and can be misregistered. Counteracting misregistration of this type is accomplished by designing information boxes taller on multiple-part forms than on forms used in single-copy applications. Strip carbon or carbon-backed paper yields the best results in multiple-part form sets. The first carbon copy is almost as good as the original and lower copies are superior to those in sets using interleaved one-time carbon paper. Selection of the proper carbon paper, if it is to be used to print on the OCR copy of the form set, must be considered carefully. There is a wide variety of one-time carbon

papers presently on the market and almost all brand lines contain a paper that is satisfactory for ERCCR application. In general, the requirements are that carbon transfer be as close to 100 per cent as possible, that the carbon is not excessively granular, and that shelf-life and carbon hardness is sufficient to prevent smudging or premature transfer. On request, Recognition Equipment will advise a user as to the best carbon paper within any given brand line.

Forms Printing

Quality

In the preparation of forms for the ERCCR system, modern printing equipment easily meets margin tolerances and print standards. Printing of normal commercial quality is, therefore, quite satisfactory for the production of such forms.

Blind-Color Information

It often becomes necessary to print information on a form, such as instructions or typing guide lines, which is not normally processed by the reading system. The presence of such information in black would disrupt the reading process and can, consequently, not be tolerated unless printed in a blind color. The printing of instructions and guide lines in red renders them invisible to the ERCCR while leaving the information visible to the user. Light orange and pink are also acceptable for this purpose, although red is the preferred color. In every case, the blind color should be tested and confirmed by Recognition Equipment before production of the form in quantity. Figure 27 illustrates the use of blind-color printing (shaded areas) to establish areas in which typing is permitted. The shaded areas (in red) are invisible to the ERCCR, appearing to the optical reader the same as the white background.

Bar-Code Check Points

To enable the stored program in the Programmed Controller to constantly track the viewing position of the Electronic Retina on a document, the program requires certain check points to serve as field-defining symbols. Hence, a group of characters can be set off from the rest of a line to indicate, by position,

some special meaning, such as account number or policy designator. When the character group is thus set off, the performance by the program of any necessary editing function is simplified. Check points can also be used to instruct the recognition unit to ignore, or skip over, certain areas or they can identify the page when intermixed formats are being processed by the ERCR system. The variety of check-point purposes is limited only by the ingenuity of the forms designer. Check points can be preprinted special characters or conventional characters. The most useful ones are bar codes, which are often used in place of column dividers or separators. When using bar codes, the forms designer must remember their lateral space requirements (see figure 26). Notice, in figure 27 how bar codes and blind-color printing are used in conjunction to establish bar-code spacing and typing area limits.

Vertical and Lateral Skip Spacing

When program control is used to cause the Electronic Retina to skip over a vertical distance at high speed, the earliest point down from the top of the document at which a transition from program control back to automatic (line-finding) control is to occur must be marked. Marking this point is accomplished by leaving a band of 0.35-inch height (across the document and directly above the transition point) free from any printing that is not in a blind color. This space is required to ensure that the system does not pass over any legitimate information without reading it. A 0.35-inch band is also required directly above the transition point in changing from automatic to program control when the bottom line is not continuous across a page. An analogous condition is met when lateral areas on a form, containing readable information, are to be ignored by the ERCR. In this instance, bar codes can be used to turn the system off and on again. Another technique for turning the reader off following a lateral skip is to employ program control. This again entails the use of a 0.35-inch band to provide the transition from automatic control to program control. The 0.35-inch band is vertical for lateral skips and need extend only as high as necessitated by form design and programming requirements. The vertical band again ensures that legitimate data is not overlooked. As it was

for vertical skip control, the band used for lateral skip must be free of any preprinting or postprinting not in a blind color. The horizontal 0.35-inch blank band, used in vertical skip, is shown in figure 28 as a cross-hatched area.

Mark Sensing

Optical mark sensing is a standard feature of the ERCR and is accomplished without the use of special conductive-lead pencils. Under program control, the system looks for a particular character, such as the letter "O", in a given location. If, however, a reject signal is generated instead of a recognition of the letter, this indicates that the character has been defaced, or marked. Mark sensing has a variety of uses in an OCR system, to include inventory lists, parts ordering from preprinted catalogs, turn-around documents, and student status and attendance recording (figures 28 and 29). The preprinted target used as a mark-sense symbol is shown in figure 30.

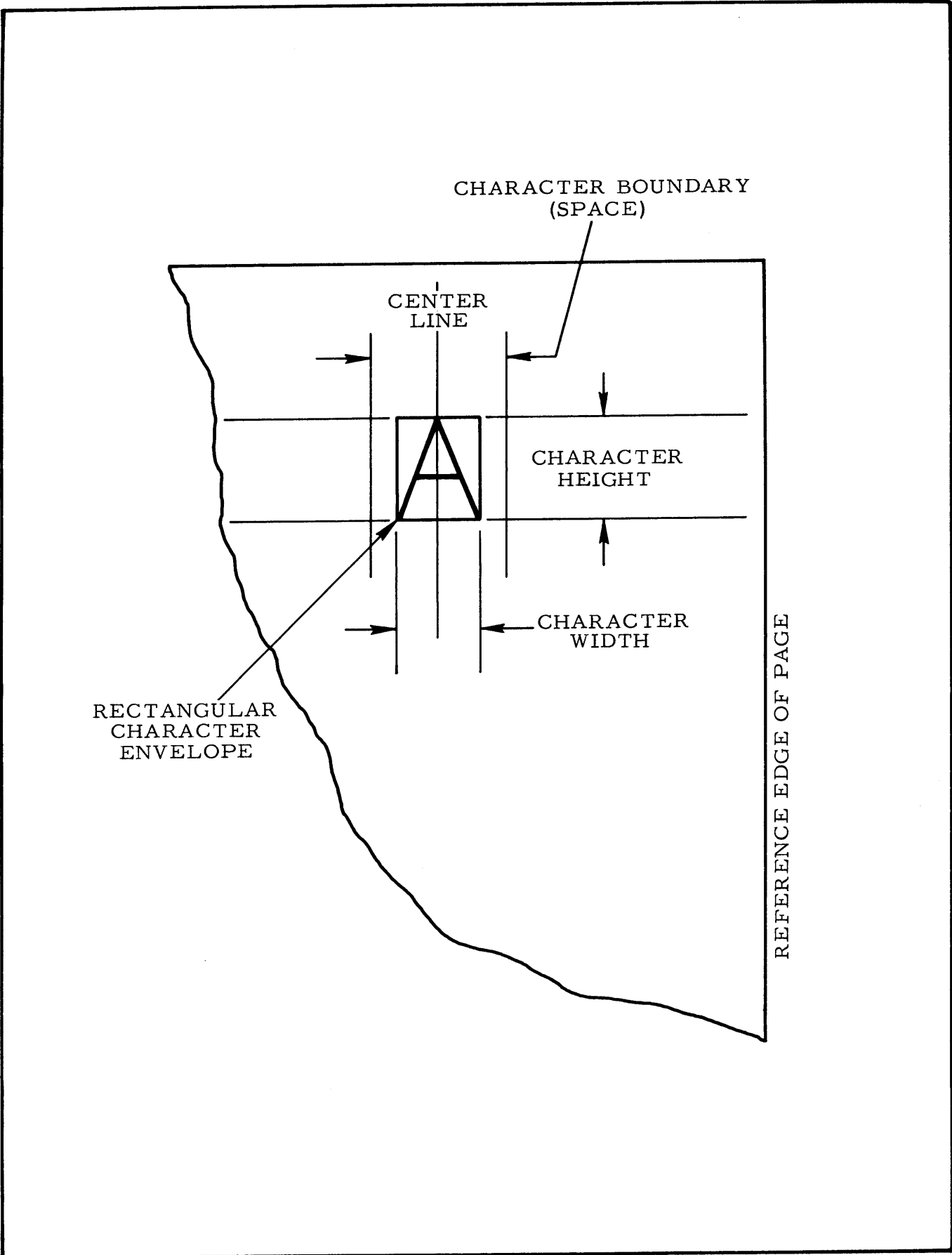


Figure 24. Character Boundary Envelope

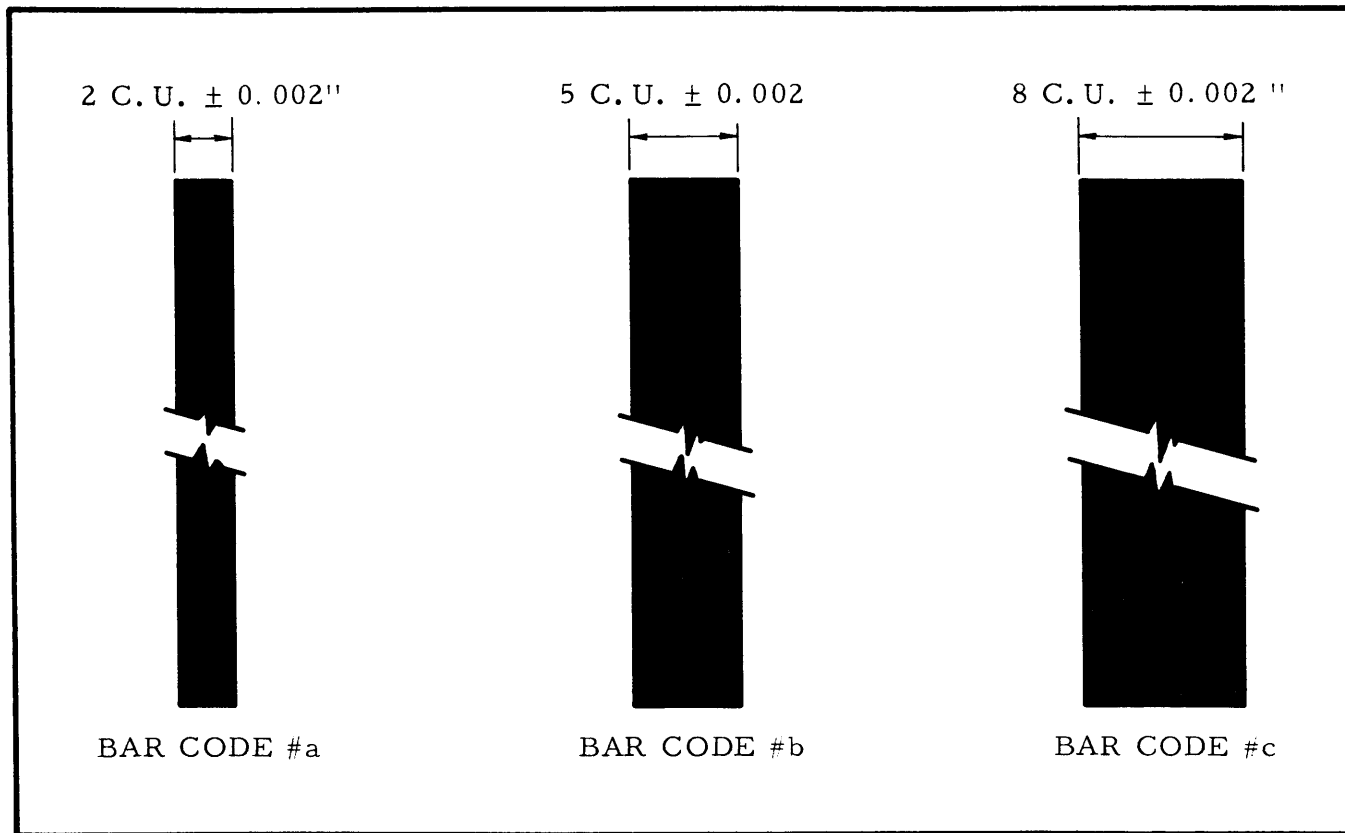


Figure 25. Bar Code Types and Dimensions

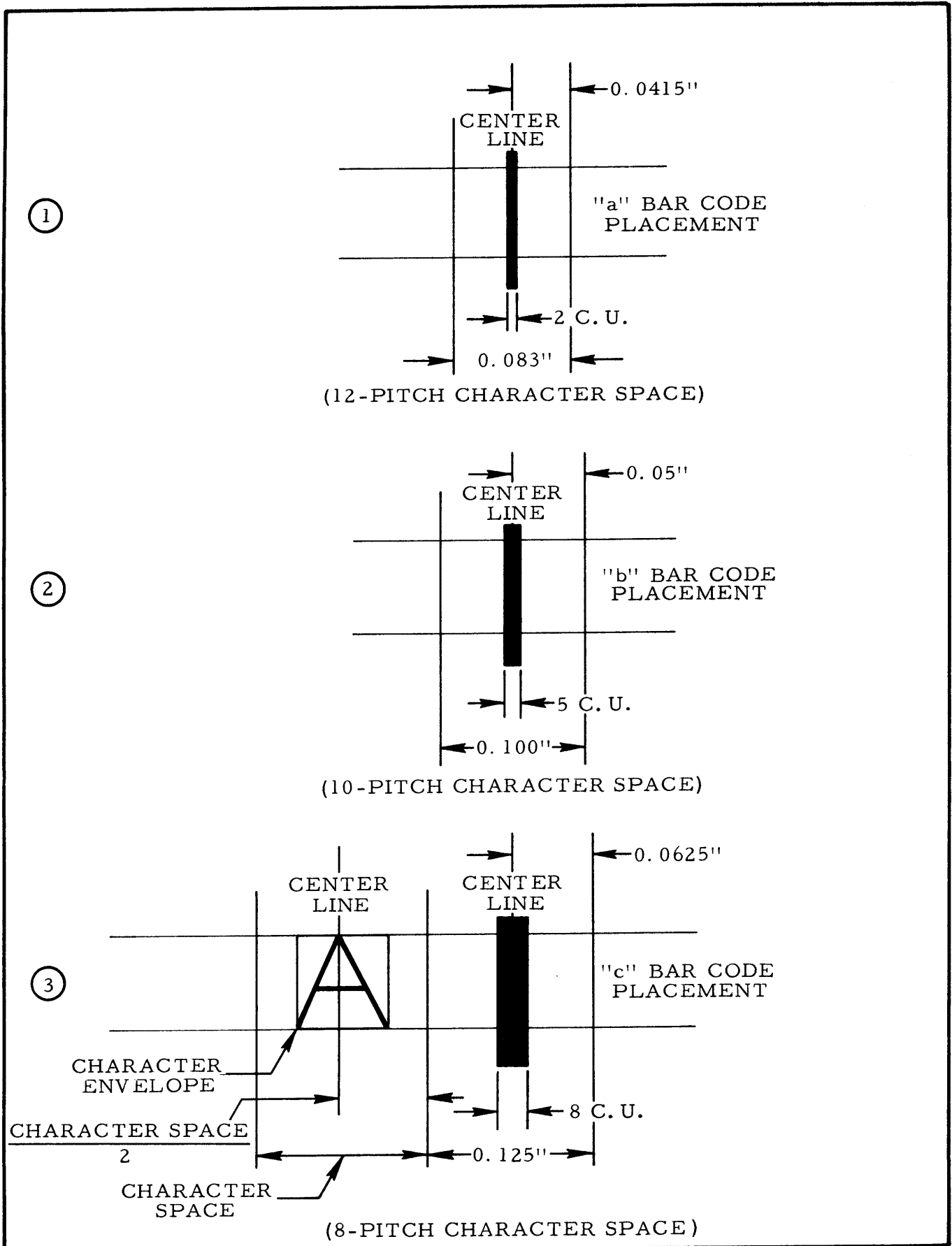


Figure 26. Bar Code - Character Spacing Requirements

Table VII. IPI Solid Colors that are Blind to the ERGR.

CF/2pm/10	CF/2oy/30
CF/2pm/20	CF/2oy/40
CF/2pm/30	CF/loy/00
CF/2pm/40	CF/loy/10
CF/2pm/20	CF/loy/20
CF/1 pm/30	CF/loy/30
CF/1pm/40	CF/loy/40
CF/2bp/ 40	CF/o/00
CF/4yg/ 40	CF/o/10
CF/3yg/ 40	CF/o/20
CF/2yg/ 30	CF/o/30
CF/2yg/ 40	CF/o/40
CF/1yg/10	CF/r/00
CF/1yg/20	CF/r/10
CF/1yg/30	CF/r/20
CF/1yg/40	CF/r/30
CF/y/00	CF/r/40
CF/y/10	CF/2mr/00
CF/y/20	CF/2mr/10
CF/y/30	CF/2mr/20
CF/y/40	CF/2mr/30
CF/1ro/20	CF/2mr/40
CF/1ro/30	CF/1mr/00
CF/1ro/40	CF/1mr/10
CF/3oy/10	CF/1mr/20
CF/3oy/20	CF/1mr/30
CF/3oy/30	CF/1mr/40
CF/3oy/40	CF/m/00
CF/2oy/00	CF/m/10
CF/2oy/10	CF/m/20
CF/2oy/20	CF/m/30
	CF/m/40

ALIGN FIRST CHARACTER
UNDER THIS ARROW

REGISTRATION FORM

CHICAGO PUBLIC SCHOOLS

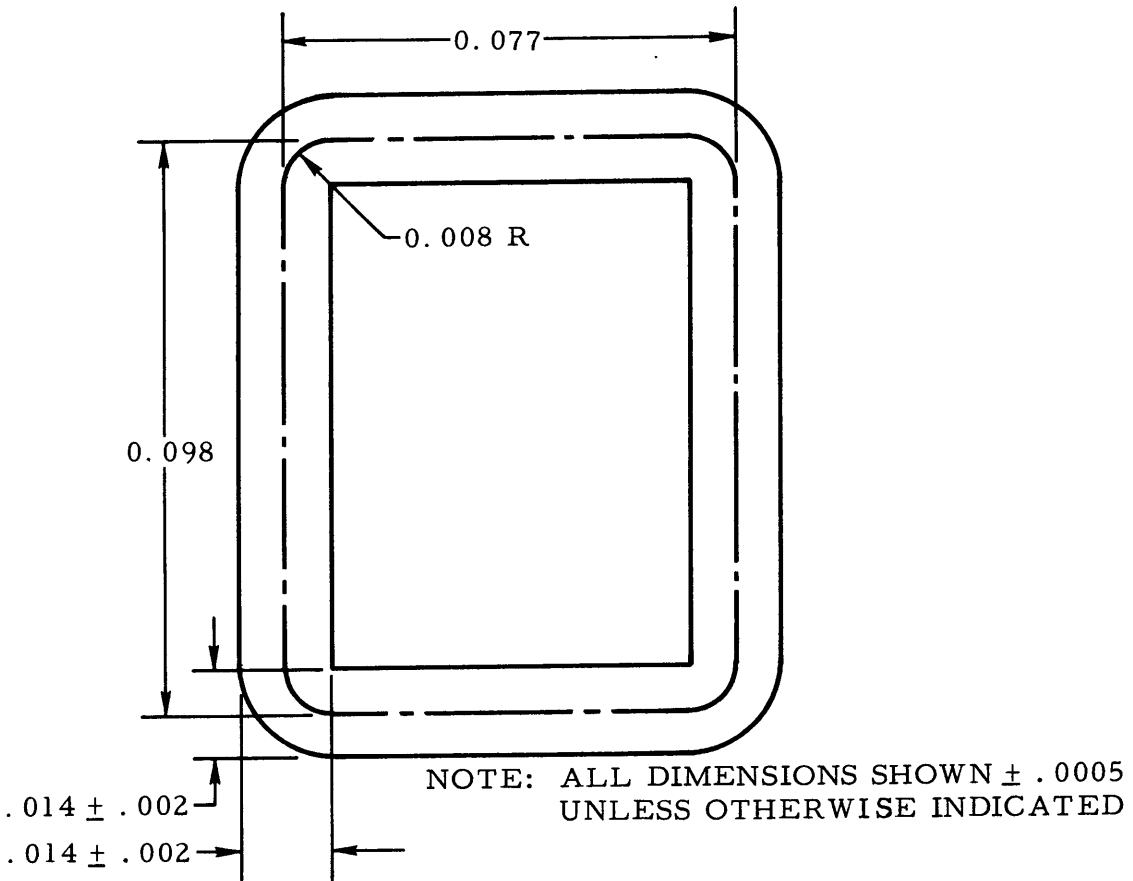
NAME OF SCHOOL											5150		
1	STUDENT NO	STUDENT NAME (LAST FIRST MIDDLE)				BIRTHDATE	BIRTHPLACE (CITY STATE)				OMIT		
	09898581	MARIO									X		
	SEX	BIRTH CERTIFICATE	GUARDIAN NAME (LAST FIRST MI)			RELA	MOTHER'S MAIDEN NAME (LAST FIRST)						
	1	BC1644				1							
	CHICAGO ADDRESS					ZONE	PHONE	E.T.	E.S.	ENTRY DATE	ROOM	GRADE	SPEC.
						10	7877117	1	3	090865	208	02	00
	LAST C SCHL	NON CHGO SCHOOL TRANSFERRED FROM											
2	STUDENT NO	STUDENT NAME (LAST FIRST MIDDLE)				BIRTHDATE	BIRTHPLACE (CITY STATE)				OMIT		
	09898581	MARINO NICHOLAS ANTHONY				032158	MONTREAL CANADA						
	SEX	BIRTH CERTIFICATE	GUARDIAN NAME (LAST FIRST MI)			RELA	MOTHER'S MAIDEN NAME (LAST FIRST)						
	1	BC1644	MARINO NICHOLAS			1	DIAZ GENEVIEVE						
	CHICAGO ADDRESS					ZONE	PHONE	E.T.	E.S.	ENTRY DATE	ROOM	GRADE	SPEC.
	1317 N SANDBURG TERR					10	7877117	1	3	090865	208	02	00
	LAST C SCHL	NON CHGO SCHOOL TRANSFERRED FROM											
	0000	HOLY NAME											
3	STUDENT NO	STUDENT NAME (LAST FIRST MIDDLE)				BIRTHDATE	BIRTHPLACE (CITY STATE)				OMIT		
	09898603	MARINO ROBERT ELIAS				042460	CANDA CANADA						
	SEX	BIRTH CERTIFICATE	GUARDIAN NAME (LAST FIRST MI)			RELA	MOTHER'S MAIDEN NAME (LAST FIRST)						
	1	BC948	MARINO NICHOLAS			1	DIAZ GENEVIEVE						
	CHICAGO ADDRESS					ZONE	PHONE	E.T.	E.S.	ENTRY DATE	ROOM	GRADE	SPEC.
	1317 N SANDBURG TERR					10	7877117	1	1	090865	101	42	00
	LAST C SCHL	NON CHGO SCHOOL TRANSFERRED FROM											
	0000												
4	STUDENT NO	STUDENT NAME (LAST FIRST MIDDLE)				BIRTHDATE	BIRTHPLACE (CITY STATE)				OMIT		
	09898611	MALLET PATSY ANN				110856	CHGO ILL						
	SEX	BIRTH CERTIFICATE	GUARDIAN NAME (LAST FIRST MI)			RELA	MOTHER'S MAIDEN NAME (LAST FIRST)						
	2		MALLET GWENDOLYN			2	MALLET GWENDOLYN						
	CHICAGO ADDRESS					ZONE	PHONE	E.T.	E.S.	ENTRY DATE	ROOM	GRADE	SPEC.
	164 W ILLINOIS					10	3373659	1	3	090865	203	04	00
	LAST C SCHL	NON CHGO SCHOOL TRANSFERRED FROM											
	4200	ST PHILIP BENIZI											
5	STUDENT NO	STUDENT NAME (LAST FIRST MIDDLE)				BIRTHDATE	BIRTHPLACE (CITY STATE)				OMIT		
	09898638	MALLET ELGINA				011852	CHGO ILL						
	SEX	BIRTH CERTIFICATE	GUARDIAN NAME (LAST FIRST MI)			RELA	MOTHER'S MAIDEN NAME (LAST FIRST)						
	2		MALLET GWENDOLYN			2	MALLET GWENDOLYN						
	CHICAGO ADDRESS					ZONE	PHONE	E.T.	E.S.	ENTRY DATE	ROOM	GRADE	SPEC.
	164 W ILLINOIS					10	3373659	1	3	090865	300	08	00
	LAST C SCHL	NON CHGO SCHOOL TRANSFERRED FROM											
	4200	ST PHILIP BENIZI											
6	STUDENT NO	STUDENT NAME (LAST FIRST MIDDLE)				BIRTHDATE	BIRTHPLACE (CITY STATE)				OMIT		
	09898646	MUSCARI JAMES				120457	CHGO ILL						
	SEX	BIRTH CERTIFICATE	GUARDIAN NAME (LAST FIRST MI)			RELA	MOTHER'S MAIDEN NAME (LAST FIRST)						
	1	711141	MUSCARI JOSEPH			1	CAROLL MARGARET						
	CHICAGO ADDRESS					ZONE	PHONE	E.T.	E.S.	ENTRY DATE	ROOM	GRADE	SPEC.
	1609 N WELLS					14	WH34102	1	2	091365	309	20	04
	LAST C SCHL	NON CHGO SCHOOL TRANSFERRED FROM											
	4420												
7	STUDENT NO	STUDENT NAME (LAST FIRST MIDDLE)				BIRTHDATE	BIRTHPLACE (CITY STATE)				OMIT		
	09898654	MILLER CHARLOTTE				021552	HUNTSVILLE ALA						
	SEX	BIRTH CERTIFICATE	GUARDIAN NAME (LAST FIRST MI)			RELA	MOTHER'S MAIDEN NAME (LAST FIRST)						
	2		CARPENTER MARY			2	EDWARDS MARY						
	CHICAGO ADDRESS					ZONE	PHONE	E.T.	E.S.	ENTRY DATE	ROOM	GRADE	SPEC.
	1022 N CLARK					10		1	6	090865	300	08	00
	LAST C SCHL	NON CHGO SCHOOL TRANSFERRED FROM											
	0000	BRADLEY											

Figure 27. Blind-Color Printing as Typing Guide Lines on an ECR Form

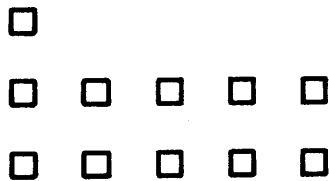
CHICAGO PUBLIC SCHOOLS ATTENDANCE ROSTER

SCHOOL NAME					PER. BEGINNING	PER.	REV.	GRADE	ROOM	UNIT																								
LAKE VIEW HI					06/10/64	L	0	09	117	1430																								
LEONG HELEN 727 W ALDINE (1) GR24068 LEONG LINTON					STUDENT NO. 00168327																													
					57																													
					ABS. A.M.																													
					ABS. P.M.																													
					TDY. A.M.																													
					TDY. P.M.																													
					SPEC. ABS.																													
HALF DAYS ABS.	TIMES TARDY	SPEC. DAYS ABS.	ENTRY DATE	LEAVE DATE	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F
LEUNG MAYTDY SANDRA 3438 N ELAINE 5257459 LEUNG SHEW M					STUDENT NO. 00168815																													
					13																													
					ABS. A.M.																													
					ABS. P.M.																													
					TDY. A.M.																													
					TDY. P.M.																													
					SPEC. ABS.																													
HALF DAYS ABS.	TIMES TARDY	SPEC. DAYS ABS.	ENTRY DATE	LEAVE DATE	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F
LEWIS JEWEL LOUISE 613 W PATTERSON NONE LEWIS DOYLE					STUDENT NO. 00133523																													
					13																													
					ABS. A.M.																													
					ABS. P.M.																													
					TDY. A.M.																													
					TDY. P.M.																													
					SPEC. ABS.																													
HALF DAYS ABS.	TIMES TARDY	SPEC. DAYS ABS.	ENTRY DATE	LEAVE DATE	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F
LOAIZA MERCEDES 3752 N FREMONT (2) FA70024 SIDDERBERG FRED					STUDENT NO. 00161144																													
					13																													
					ABS. A.M.																													
					ABS. P.M.																													
					TDY. A.M.																													
					TDY. P.M.																													
					SPEC. ABS.																													
HALF DAYS ABS.	TIMES TARDY	SPEC. DAYS ABS.	ENTRY DATE	LEAVE DATE	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F
LUKE DIANA 934 W NEWPORT 3270664 LUKE PAUL					STUDENT NO. 00168297																													
					13																													
					ABS. A.M.																													
					ABS. P.M.																													
					TDY. A.M.																													
					TDY. P.M.																													
					SPEC. ABS.																													
HALF DAYS ABS.	TIMES TARDY	SPEC. DAYS ABS.	ENTRY DATE	LEAVE DATE	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F
MALIK SHARON LOUISE 3810 N KENMORE (2) WE59753 MALIK LOUIS					STUDENT NO. 00168262																													
					13																													
					ABS. A.M.																													
					ABS. P.M.																													
					TDY. A.M.																													
					TDY. P.M.																													
					SPEC. ABS.																													
HALF DAYS ABS.	TIMES TARDY	SPEC. DAYS ABS.	ENTRY DATE	LEAVE DATE	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F
MARR CLYDE 1423 BELLE PLAINE LA58164 MARR CLYDE					STUDENT NO. 00168238																													
					13																													
					ABS. A.M.																													
					ABS. P.M.																													
					TDY. A.M.																													
					TDY. P.M.																													
					SPEC. ABS.																													
HALF DAYS ABS.	TIMES TARDY	SPEC. DAYS ABS.	ENTRY DATE	LEAVE DATE	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F
					INSTRUCTIONS: WITH A SOFT LEAD PENCIL (=2) MAKE A SMALL X IN THE TARGET BOX TO INDICATE AN ABSENCE OR A TARDY. BE SURE THE X DOES NOT EXTEND BEYOND THE BOUNDARY OF THE TARGET.																													
SIGNATURE OF TEACHER																																		

Figure 29. Mark-Sense Recording on an ERCR Form



DIMENSIONS OF PREPRINTED TARGETS



TARGETS

Figure 30. Mark-Sense Symbols Used with the ERCR.

IV. SITE REQUIREMENTS

SYSTEM LAYOUT

General

The physical layout of the ER CR system within a data processing facility is an important factor in the development of an efficient installation. The individual and differing needs of data processing installations require a high degree of flexibility in the arrangement of system components. The adaptability of ER CR components to a variety of installation configurations is illustrated by the typical system layouts shown in figures 31 through 36.

Layout Planning

Maintenance Convenience

In planning a specific system layout, sufficient space should be allowed around each system component to permit free movement of test equipment by maintenance personnel. Space must also be allowed for hinged panels to open enough to provide ready access to cabinet interiors. Figures 37 through 43 show floor plans of the individual components of the ER CR, to include necessary clearances for hinged panels. Clearances for sides without hinged panels are not shown, but a minimum of 36 inches of clearance should be allowed on these sides to permit freedom of movement and unrestricted air circulation.

Operator Convenience

Another consideration in system layout planning is the working area and accessibility to equipment provided for the system operator. An efficient layout design will minimize the operator's travel pattern to the Programmed Controller, all control panels, loading stations, unloading stations, and the various items of peripheral equipment. As an example, if the Programmed Controller, test panels, tape units, and line printer all face the same open area, the operator can move from one unit to the next more efficiently than if he must cross the room or go around other units. The layout configurations in figures 31 through 36 also show a variety of access and movement patterns for the system operator.

Plant Convenience

If the data processing equipment is located at or near the areas in which data is generated and stored, document transportation time is reduced. Some installations may provide separate entrances to system loading stations and exits from unloading stations. If at all possible, equipment should be located away from general-traffic flow areas. Few things can do more to distract operator and maintenance personnel than incidental traffic and people just passing through the area.

Area Accessibility

Another important consideration in site planning is the ability to bring equipment into the data processing area with relative ease. The accessibility of an area assumes critical proportions when the area is located in interior portions of a building and incoming units must be routed through narrow doors, down aisles, and around corners. A more efficient arrangement would be the location of a system site area as close as possible to service elevators and equipment-routing channels. Although components of the ER CR system are modular to facilitate access to an area, there are certain minimum space requirements. In a system employing a RIPC unit, for example, the length of the RIPC (approximately 81 inches) is the main length consideration in the entire system, while the two elements of the Retina and Recognition Unit provide the main height concern (79-15/16 inches). Thus, the movement of an ER CR system containing a RIPC requires entrance routes whose minimum dimensions permit the transporting of 81-inch lengths and 75-inch heights.

Expansion Plans

An often overlooked, but nonetheless important item in site planning is the possibility of future expansion of the facility. If an increase in data processing equipment, such as the addition of a second reading unit or more peripheral units, is anticipated, allowing space for such items during the design of the initial system layout will prove to be considerably more economical than a redesign or second design effort at a later time. Consider,

as an illustration, that a layout for a six-pocket Document Carrier system is being designed, but that there is also an anticipated future need for twelve pockets. Allowances, at this time, for the increased length of the anticipated unit, eliminates the possibility of difficult, and perhaps costly, add-on designing at some future date.

TEMPERATURE CONTROL

Heat Dissipation and Ventilation

Considered from the standpoint of useful equipment life, one of the most important phases of layout planning is concerned with providing proper ventilation and heat-dissipation outlets for the equipment. Though solid-state systems, such as the ERCR, generate little heat (compared to vacuum-tube systems), certain allowances must, nevertheless, be made for ventilation and air conditioning. Proper ventilation facilitates heat dissipation, thereby reducing the number and severity of breakdowns traceable to heat effect on components. Adequate space must be allowed for intake and exhaust air vents for each unit, and no units should be installed so that air vents are blocked or so that air flow around the equipment is impeded. Figures 44 through 51 show the air flow paths for each component of the ERCR.

Humidity Control

Although air conditioning is a year-round necessity at most installations, humidity control requirements will vary from location to location. The important factors in determining the devices necessary for proper control of humidity are air conditioning design (evaporative or refrigerative), geographic location (type of climate), and type of construction of the facility (brick, stone, metal, etc.) When additional moisture content is necessary, the environmental atmosphere can be humidified by atomizer, vaporizer, or steam jet. Removal of excess moisture from the air, or dehumidification, can be accomplished, when necessary, by a cooling-reheating cycle of the refrigeration equipment used for air conditioning.

POWER REQUIREMENTS

System Power

The floor plan of the complete system layout should show the locations of power cable openings for each unit in the system that requires application of power directly from the transformer supply. Some units in the system (RPC Control Unit, Recognition Unit, and Tape Transports) do not require direct application of power from the transformer supply. The Retina Unit, for example, is connected to the transformer supply while the Recognition Unit is not. Instead, the Recognition Unit receives its power indirectly, over an extension power cable from the Retina Unit. Those units that receive power indirectly (by extension power cable from another system unit) need not be considered separately by the plant electrician in planning for power delivery. The special extension power cables are supplied with the units that require them. The system units that do require transformer supply connections are shown in figures 52 through 58. Each figure includes required-power data and other pertinent information. Figure 58 shows the transformer configuration required for the system. It should be noted that all unit cabinets must be provided with an adequate ground connection, preferably a water pipe running directly to earth. As a precautionary measure, the plant or building electrician should check local ordinances and city building codes for necessary approvals and permits before installing any system-required outlets or wiring.

Supplementary Power

Convenience Outlets

In addition to the unit-required electrical outlets, extra 110/120-volt wall or floor outlets should be provided at various locations throughout the data processing facility to accommodate test and maintenance equipment (oscilloscope, multimeter, soldering gun, etc.). An adequate number of convenience outlets helps to reduce maintenance time and eliminates the hazard of extension cords in an area.

Illumination

It is axiomatic that properly located and sufficiently bright illumination goes hand in hand with operating efficiency in the data processing area. The system operator must have adequate, shadow-free lighting at all control panels and operating stations. Fluorescent lamps are suggested as the most suitable type for illuminating the general equipment area, operator positions, and maintenance locations. To insure optimum locations, the illumination points should be considered with the equipment floor plan.

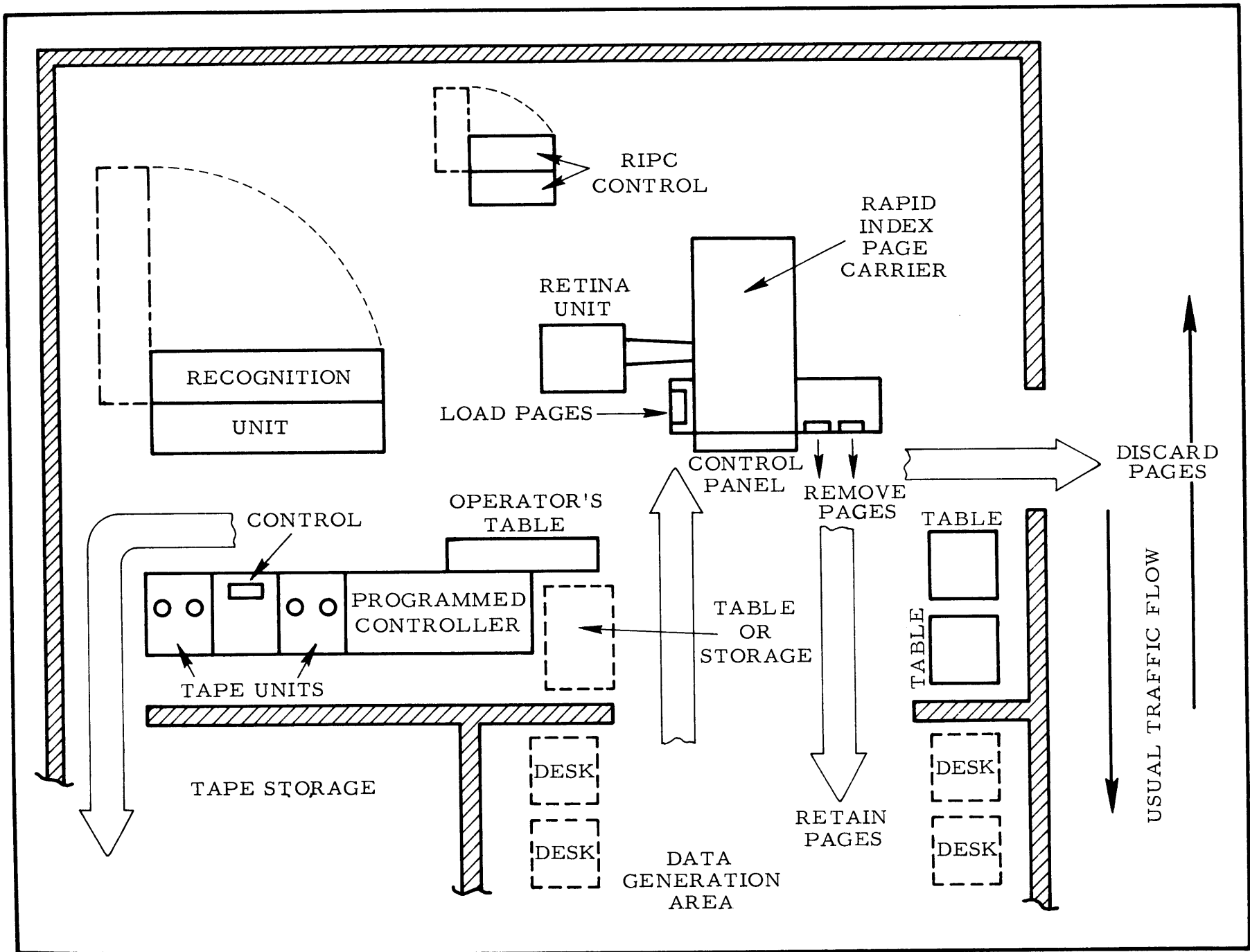


Figure 31. RIP System in a Controlled Access Installation

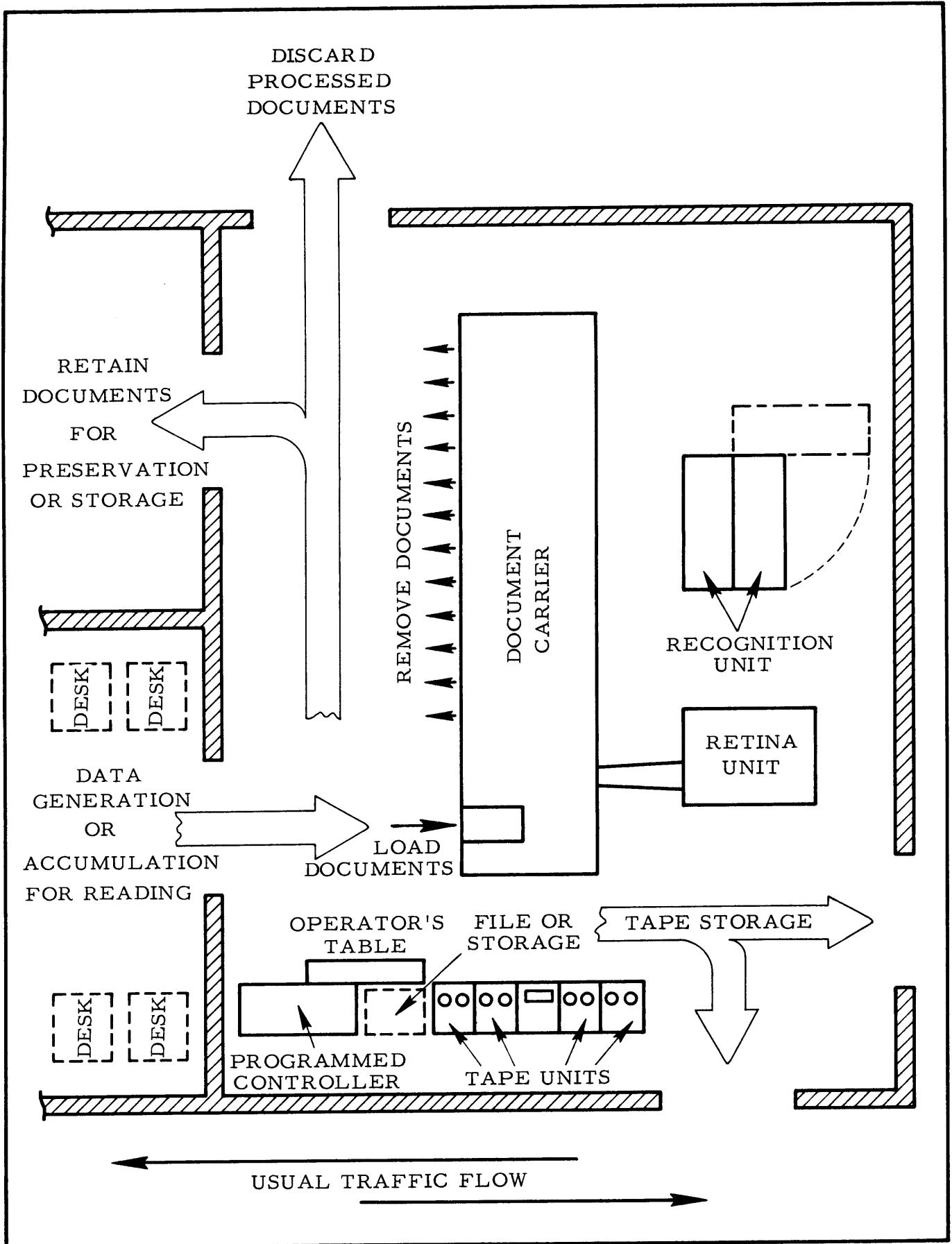


Figure 32. Document Carrier System in a Controlled Access Installation

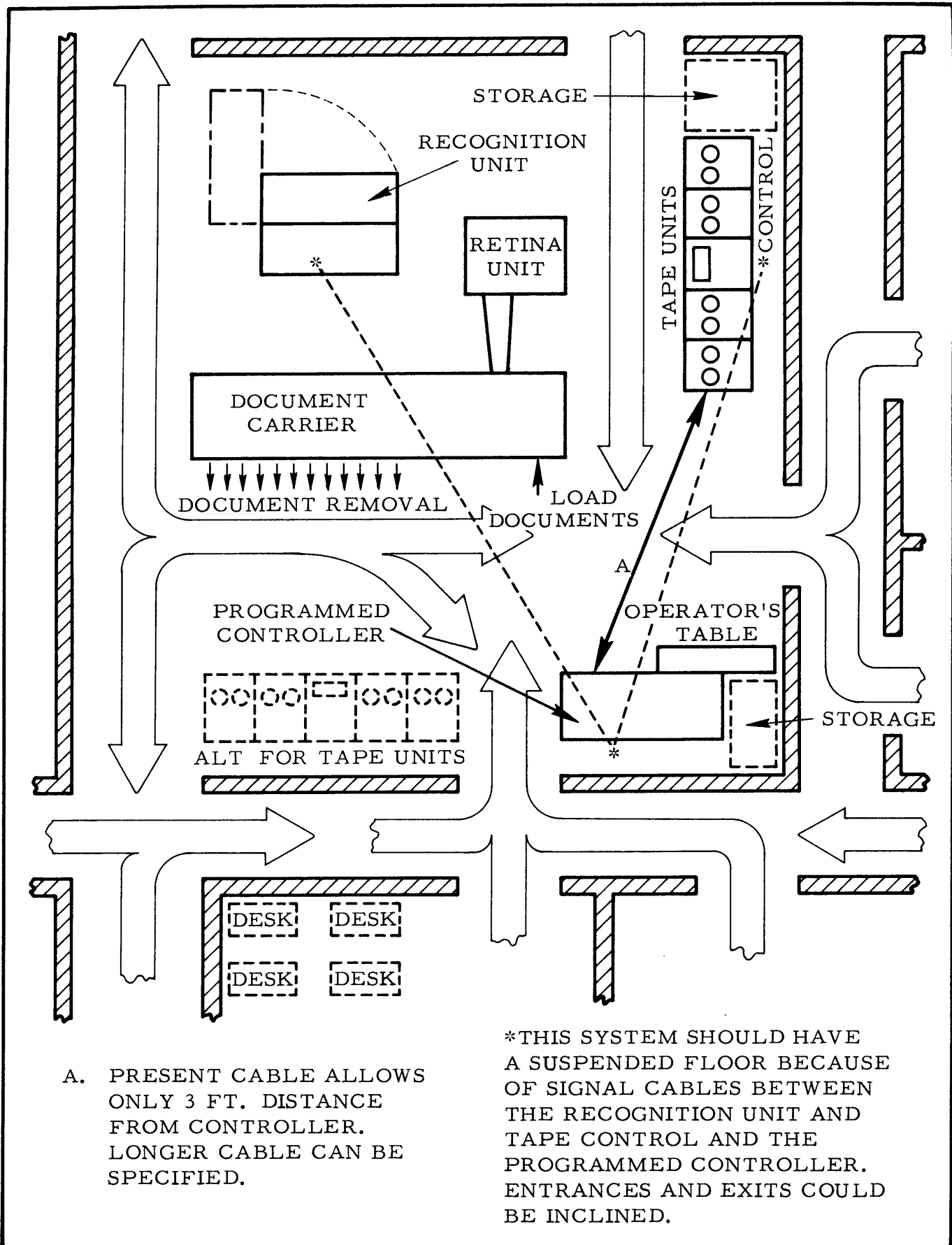


Figure 33. Multi-access Document Carrier System Configuration

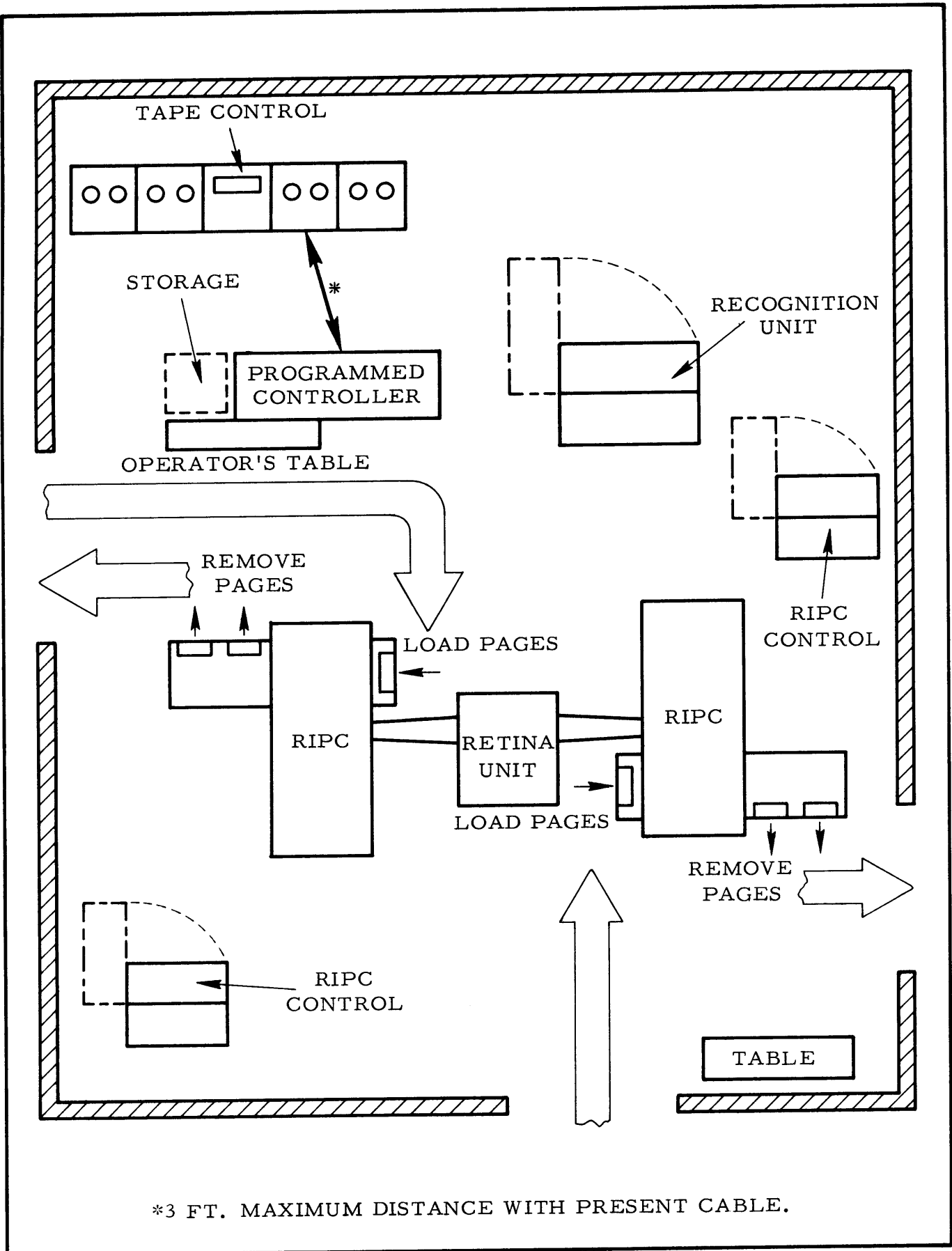


Figure 34. Dual RIPC System

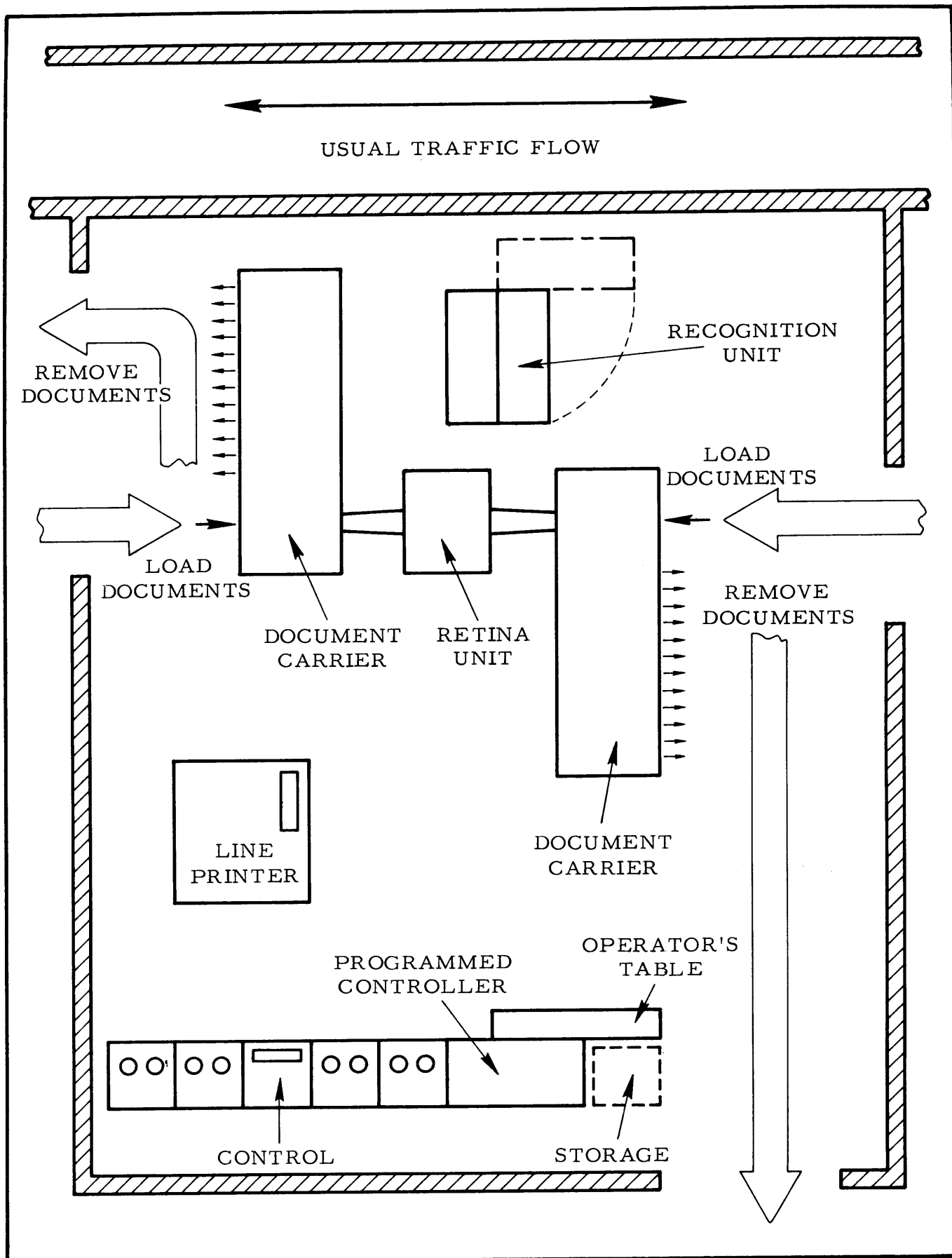


Figure 35. Dual Document Carrier System Configuration

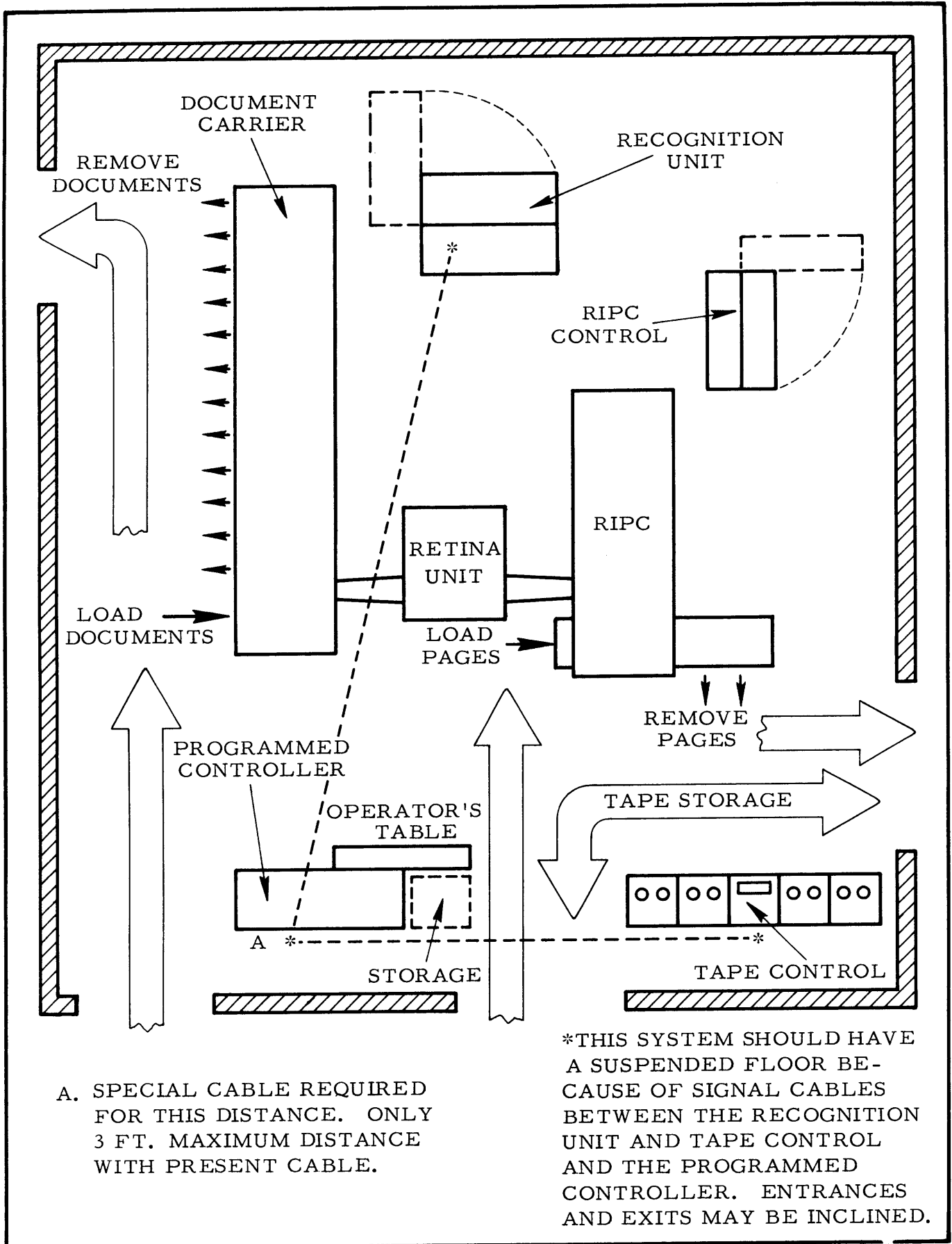


Figure 36. Dual RIPC - Document Carrier System Configuration

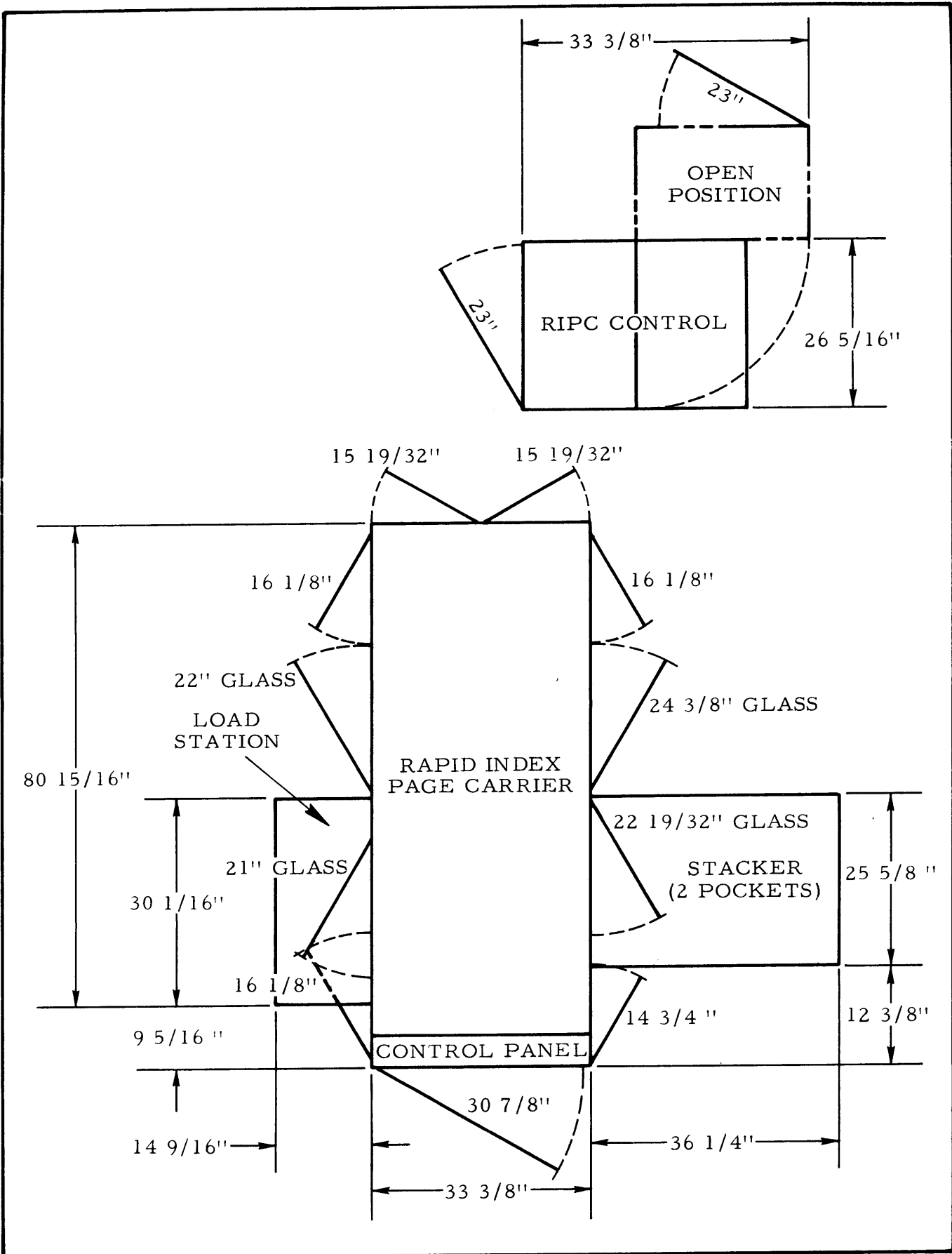


Figure 37. Rapid Index Page Carrier and RPC Control Unit Floor Plans

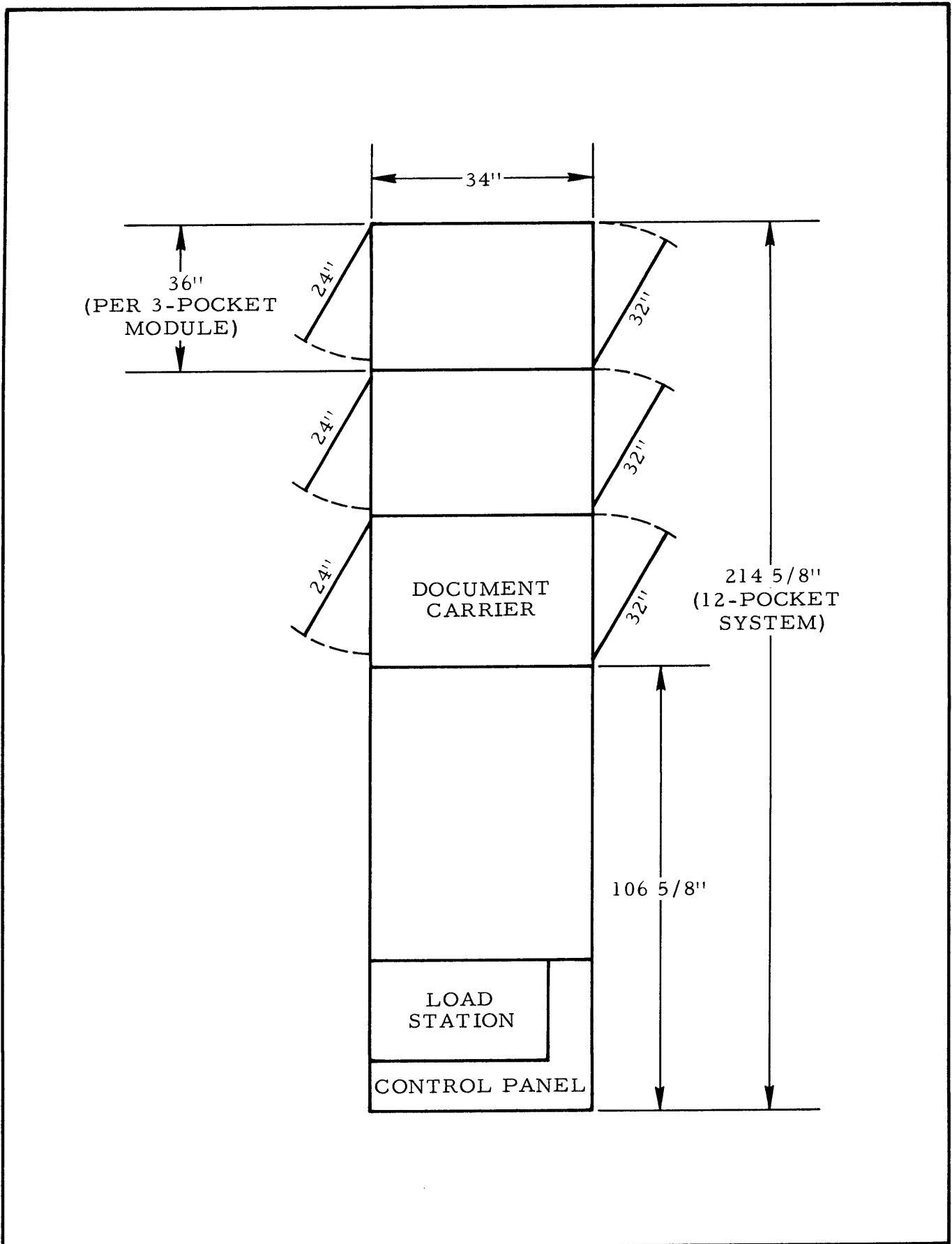


Figure 38. Document Carrier Floor Plan

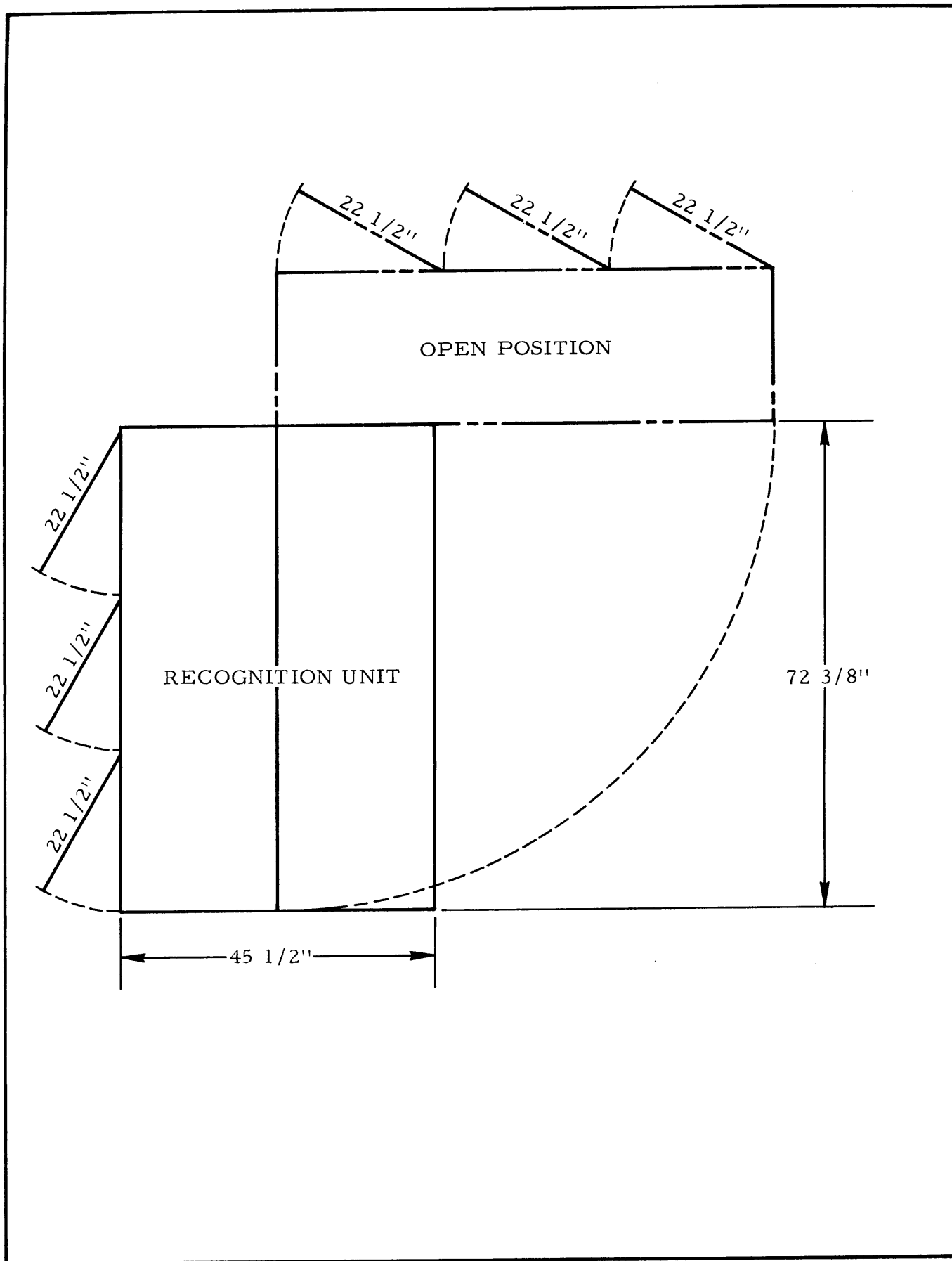


Figure 39. Recognition Unit Floor Plan

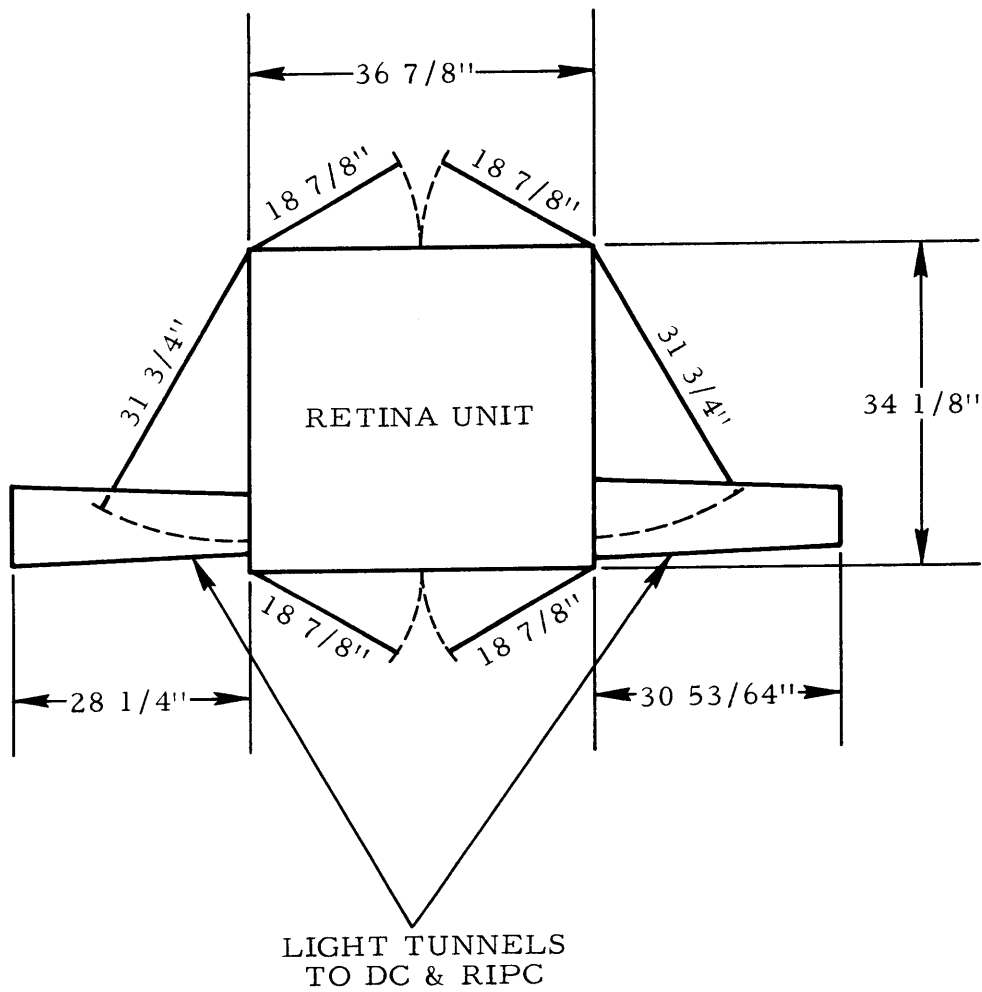


Figure 40. Retina Unit Floor Plan

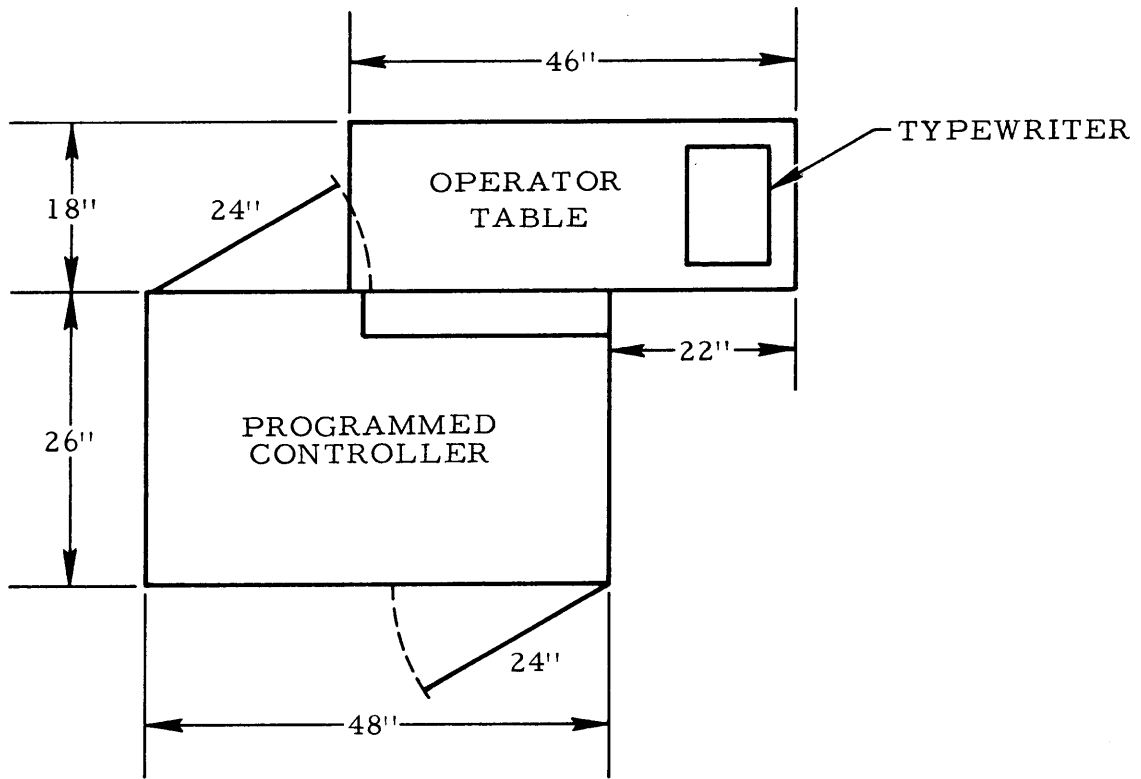


Figure 41. Programmed Controller Floor Plan

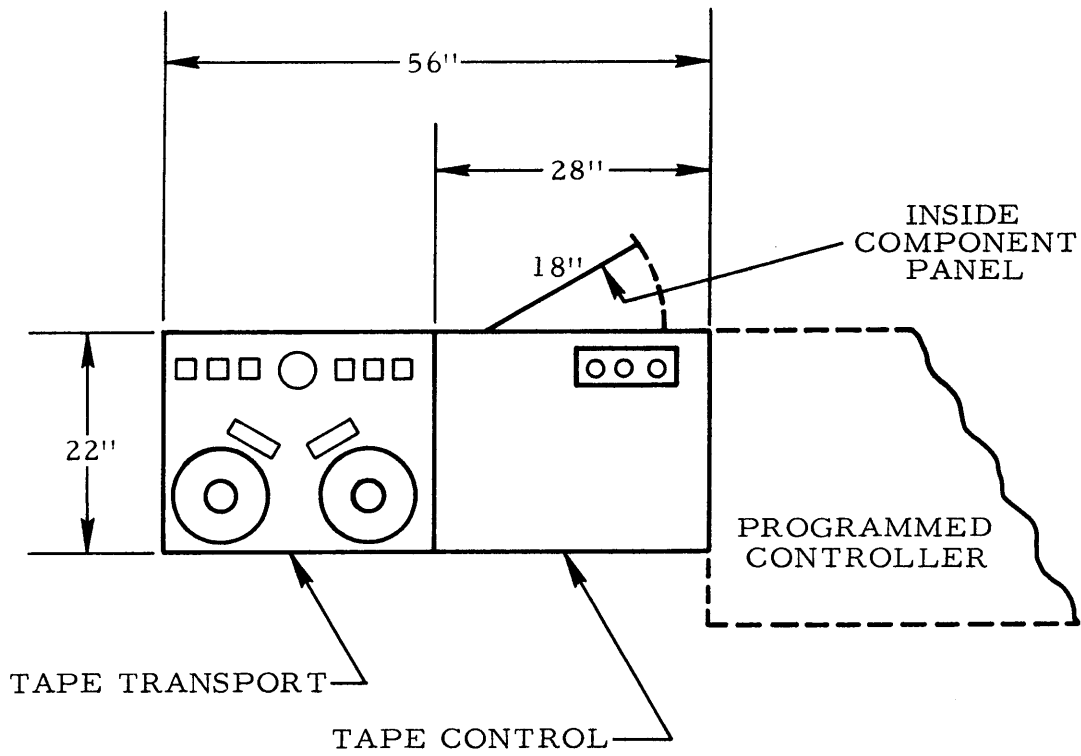


Figure 42. Magnetic Tape Transport and Control Unit Floor Plan

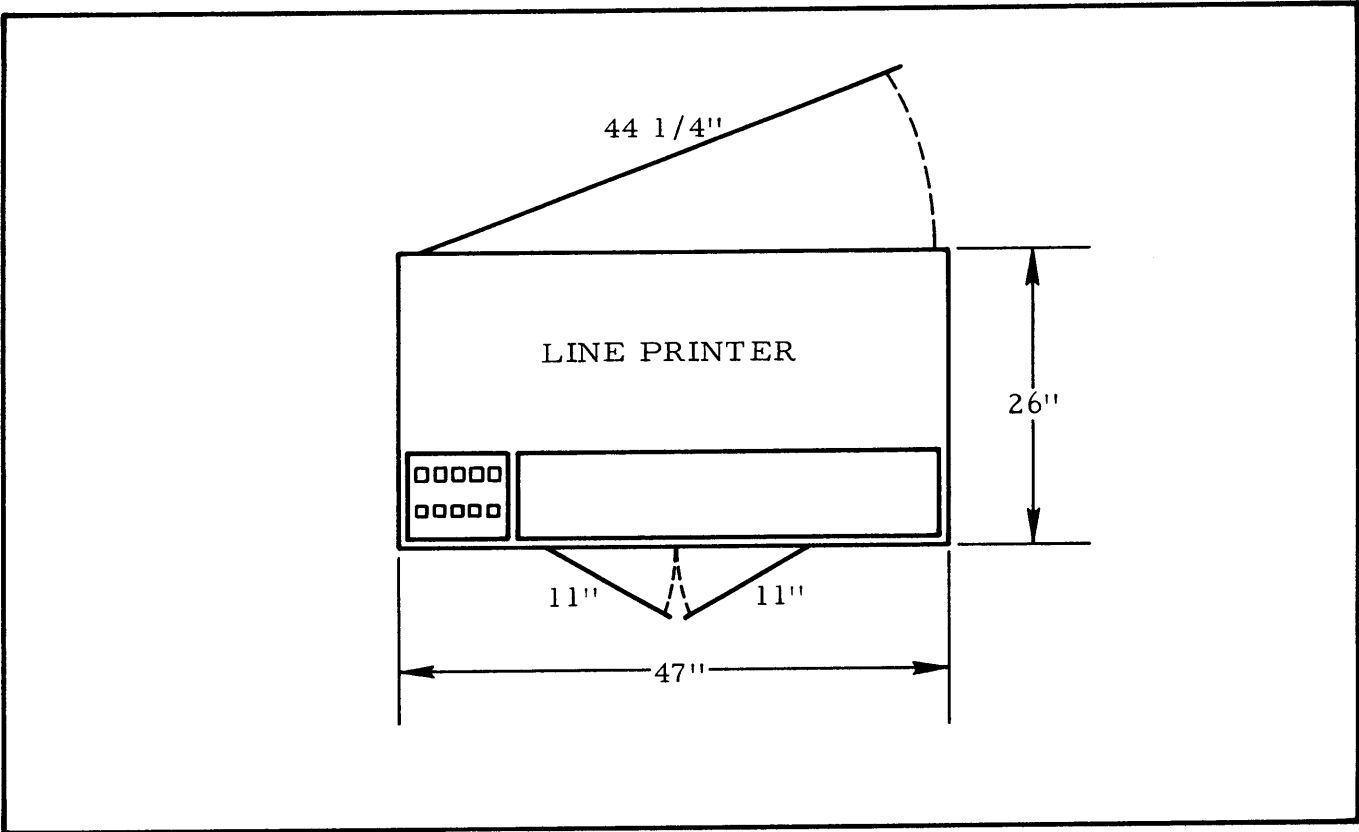


Figure 43. Line Printer Floor Plan

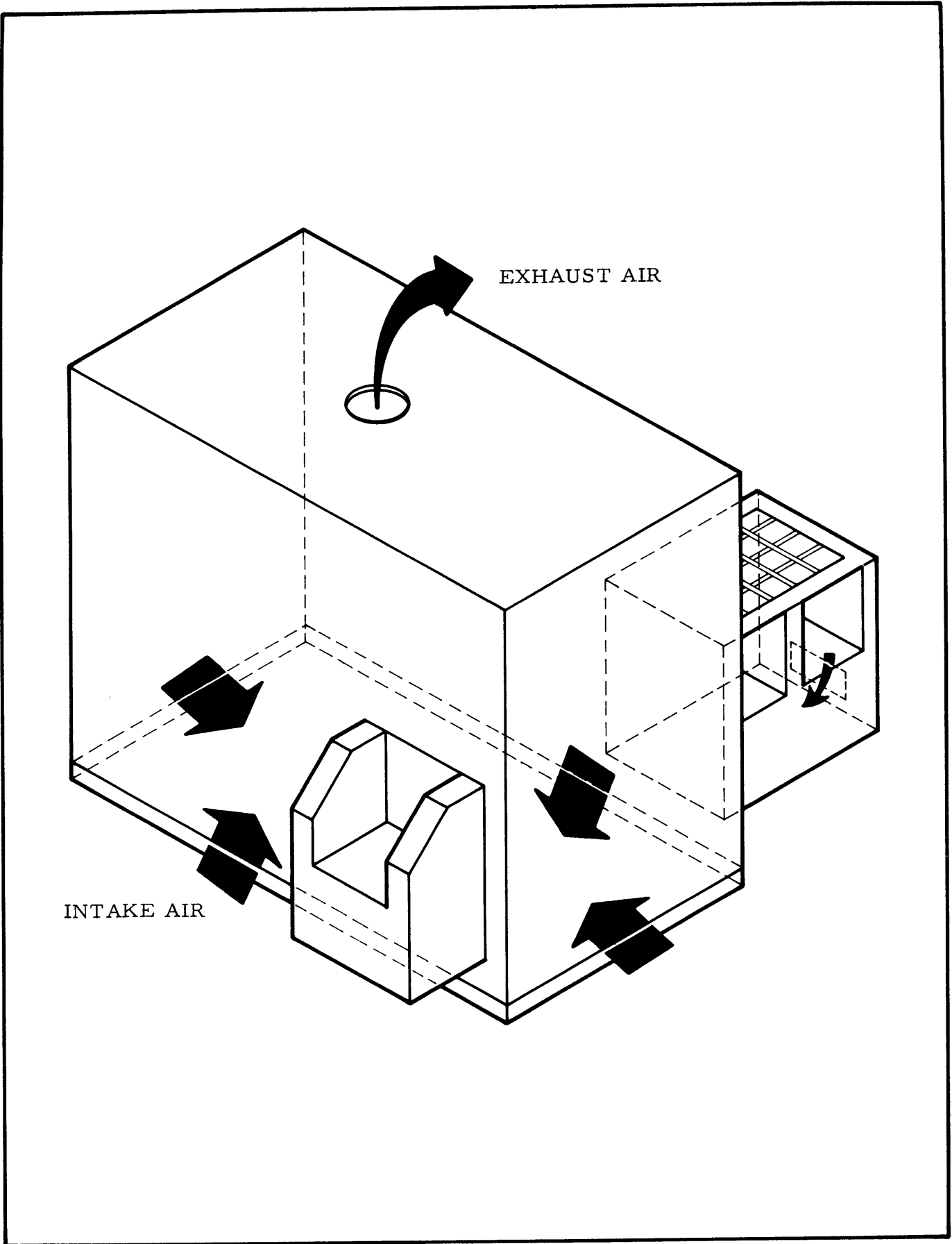


Figure 44. Air Flow Paths for the RIPC

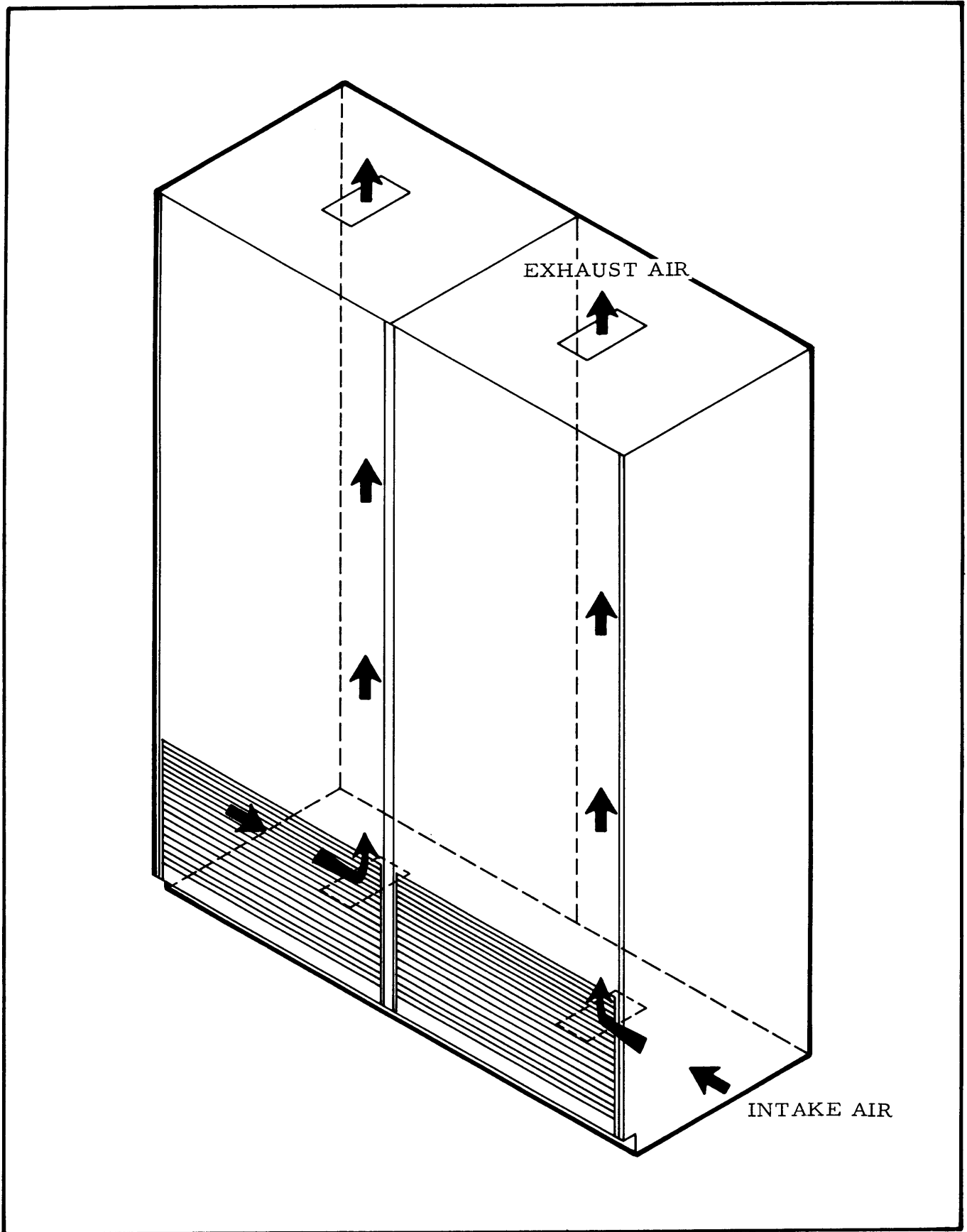


Figure 45. Air Flow Paths for the RIPC Control Unit

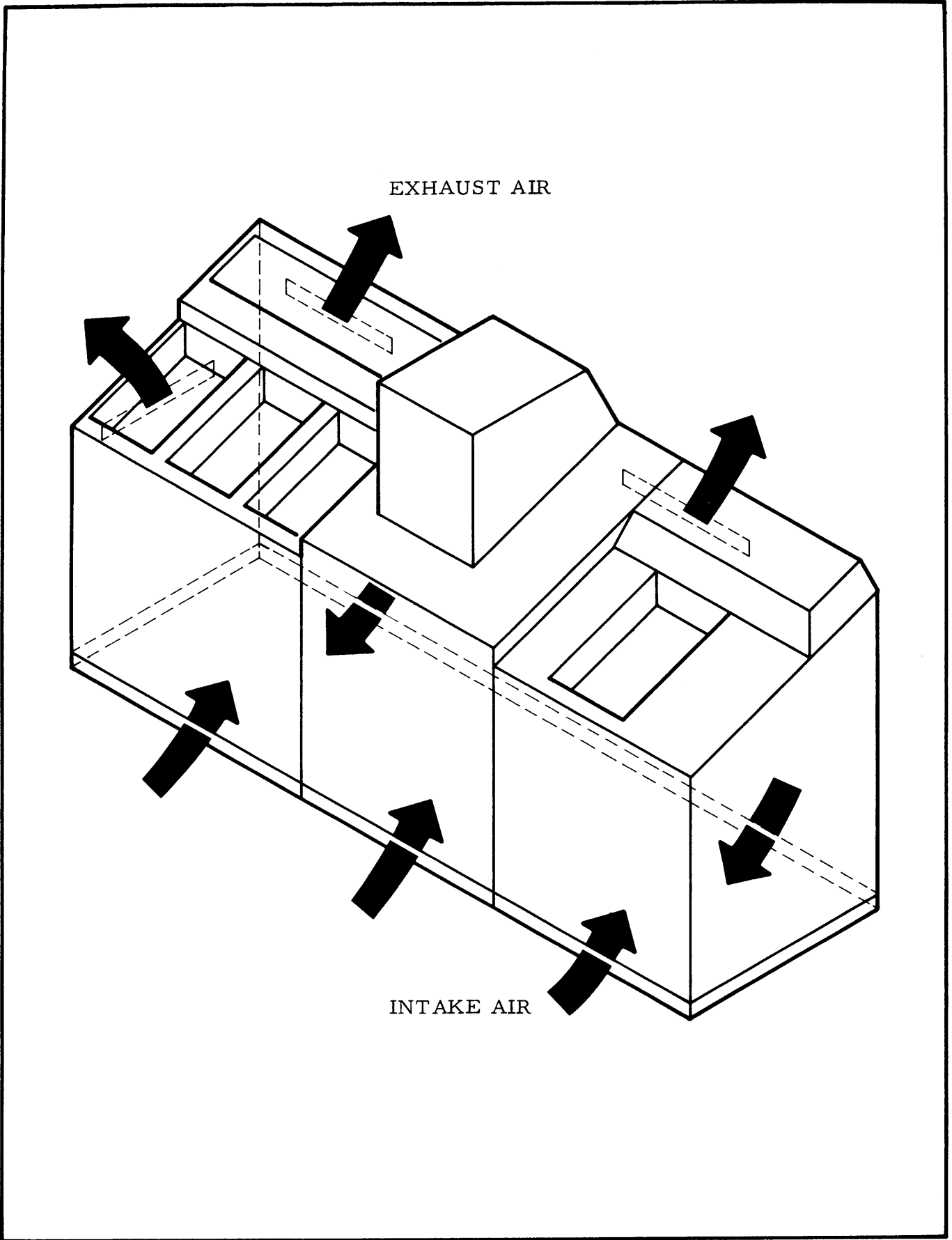


Figure 46. Air Flow Paths for the Document Carrier

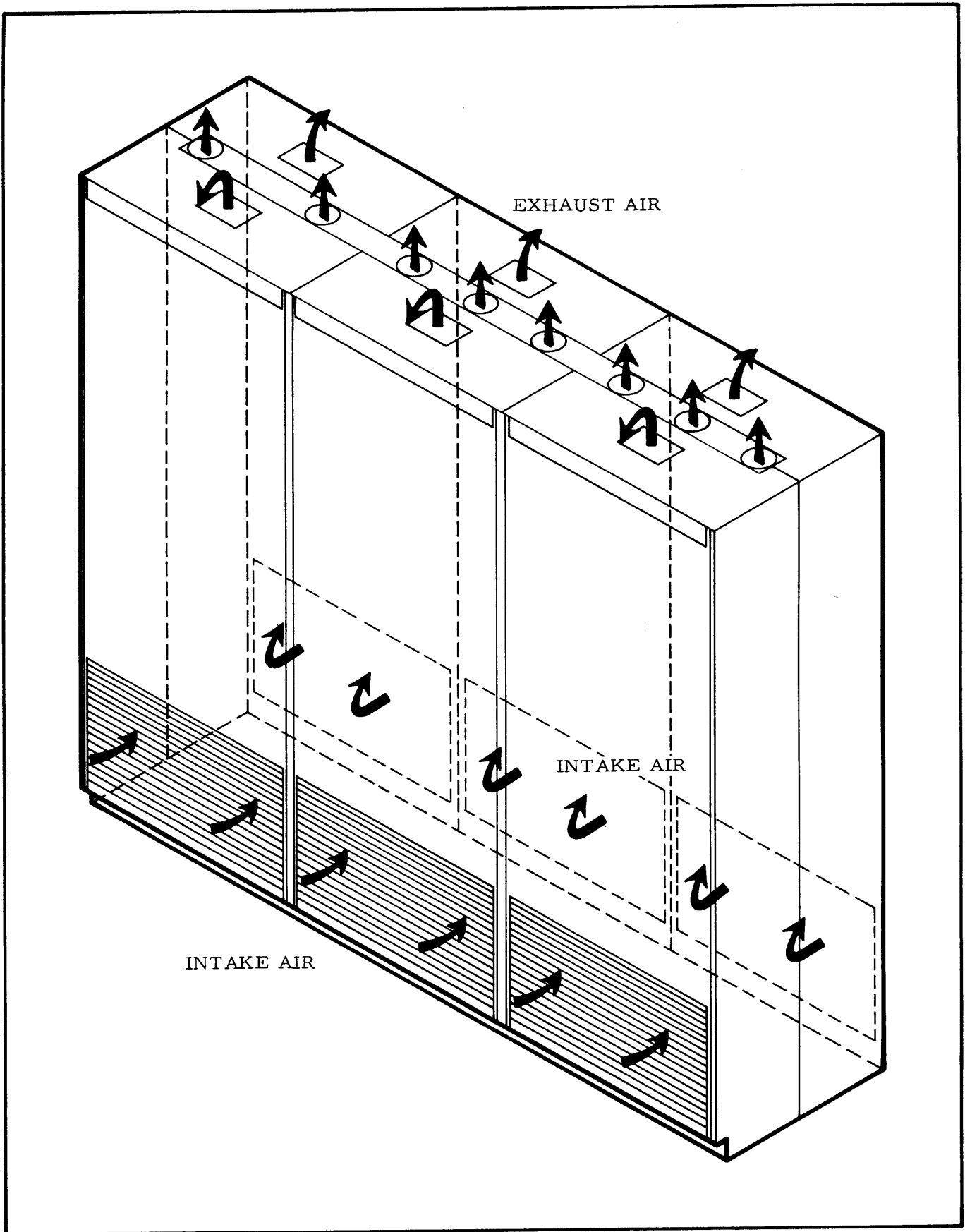


Figure 47. Air Flow Paths for the Recognition Unit

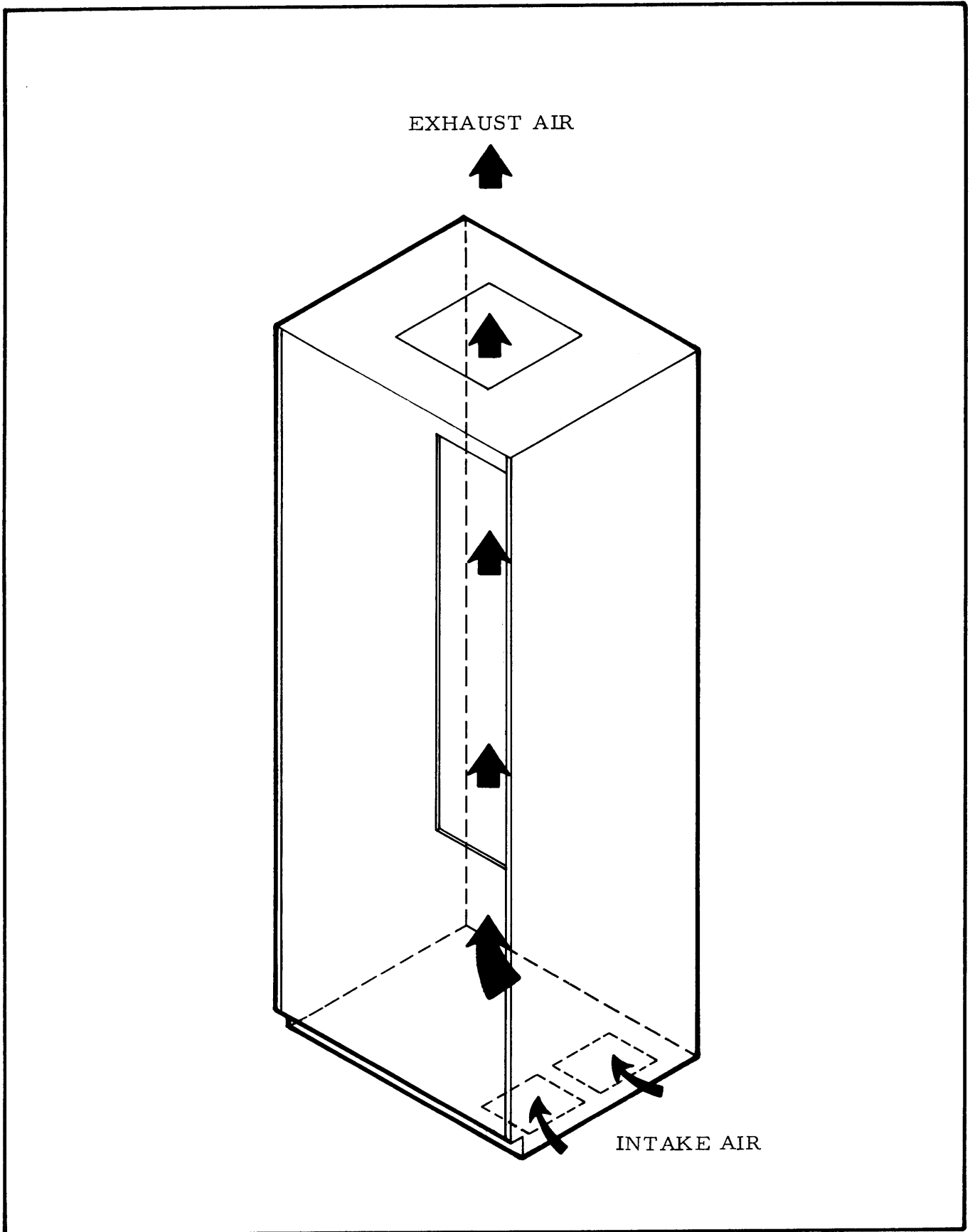


Figure 48. Air Flow Paths for the Retina Unit

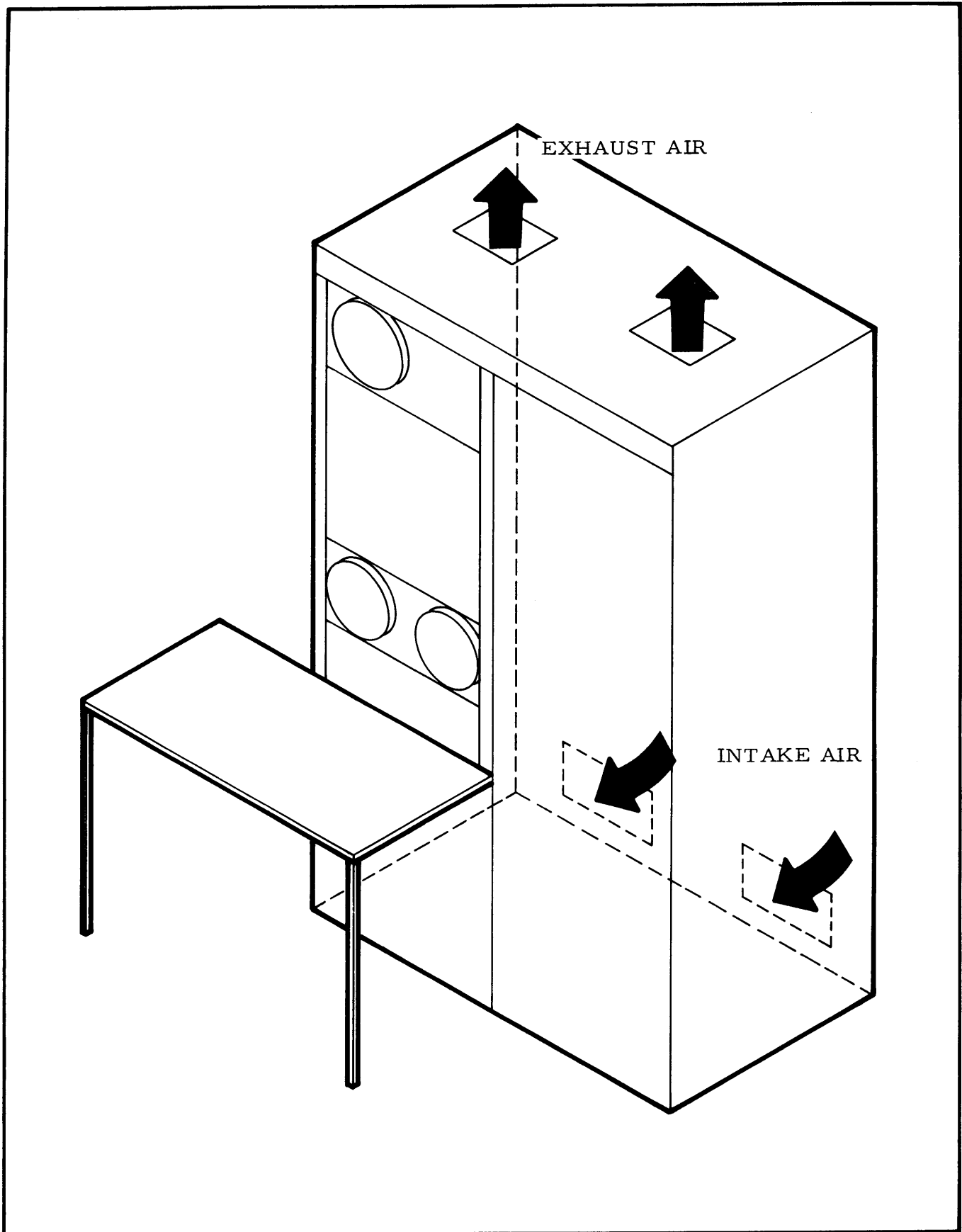


Figure 49. Air Flow Paths for the Programmed Controller

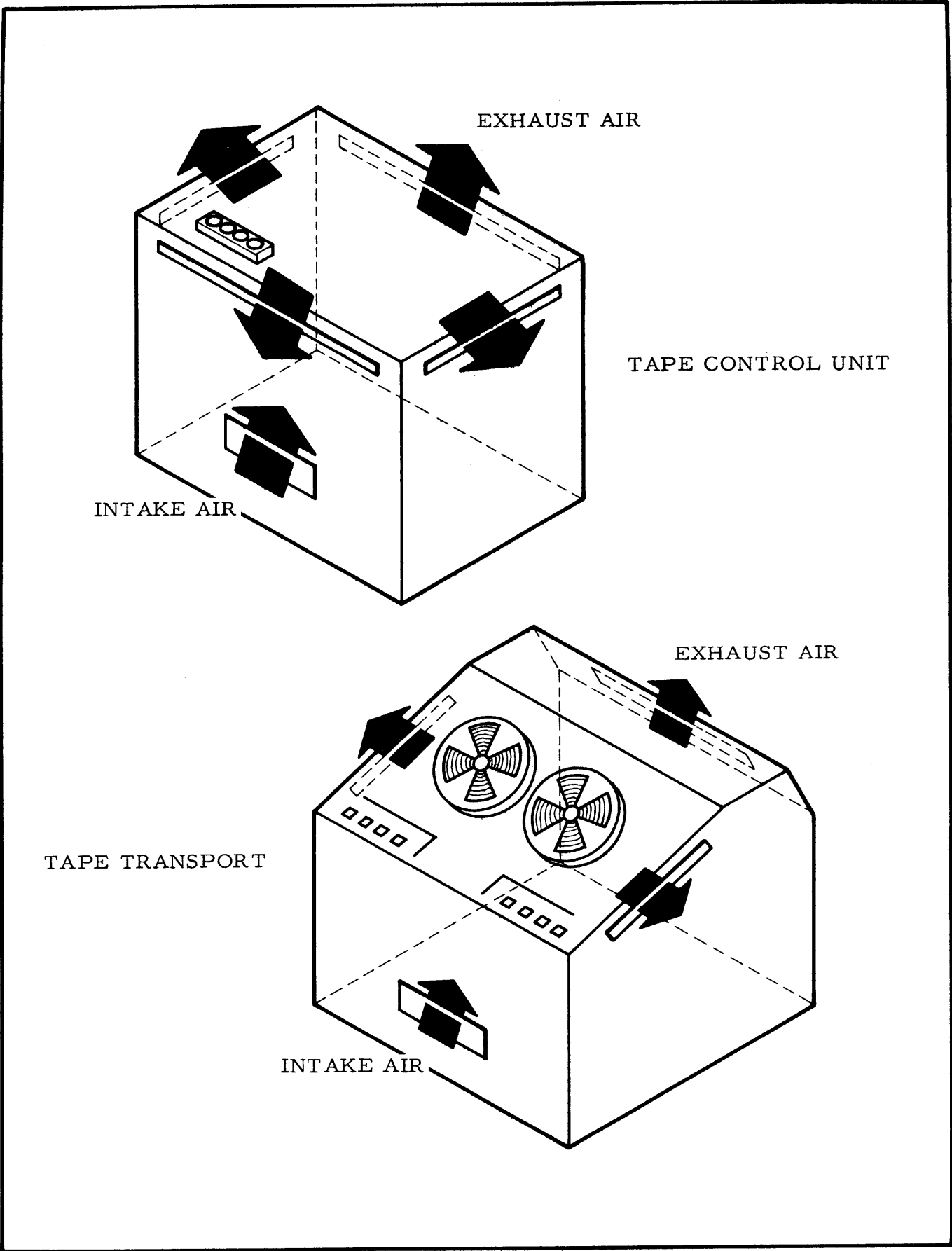


Figure 50. Air Flow Paths for the Tape Transport and Control Unit

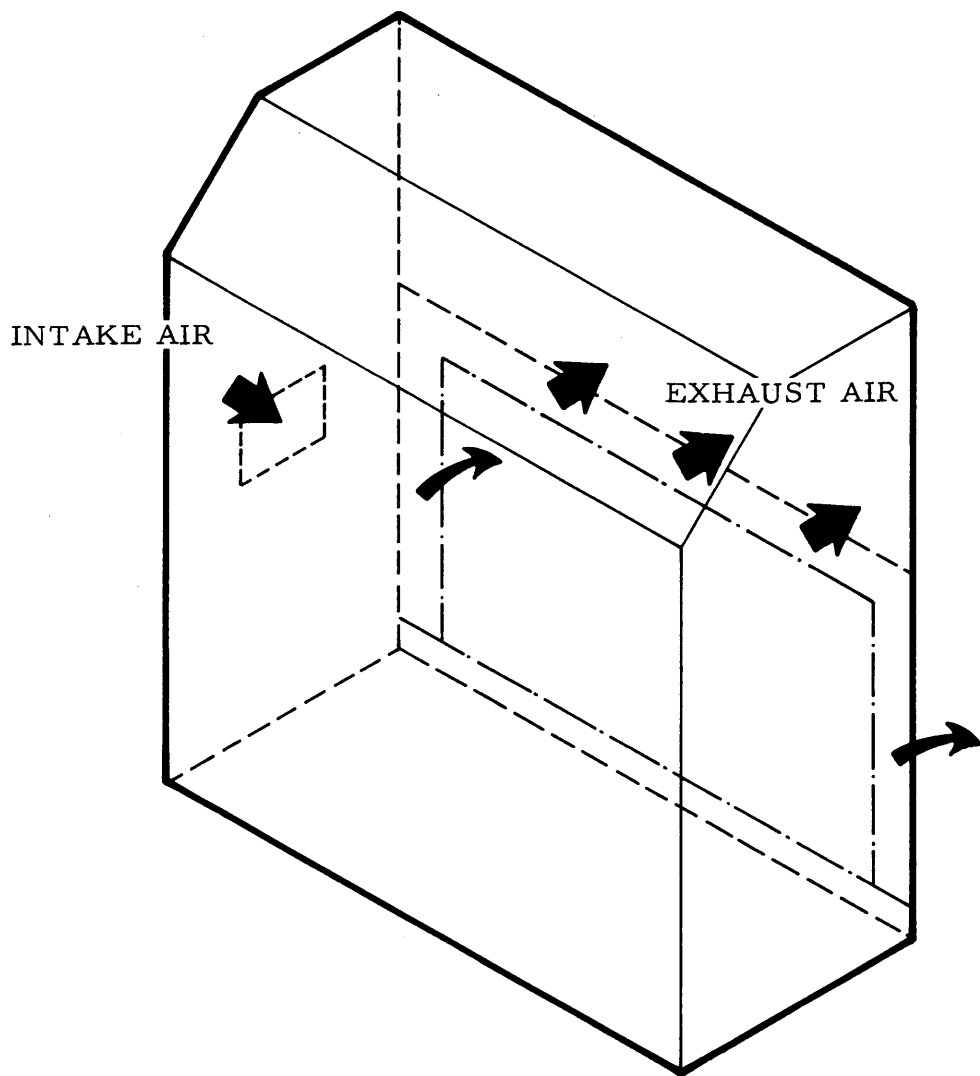
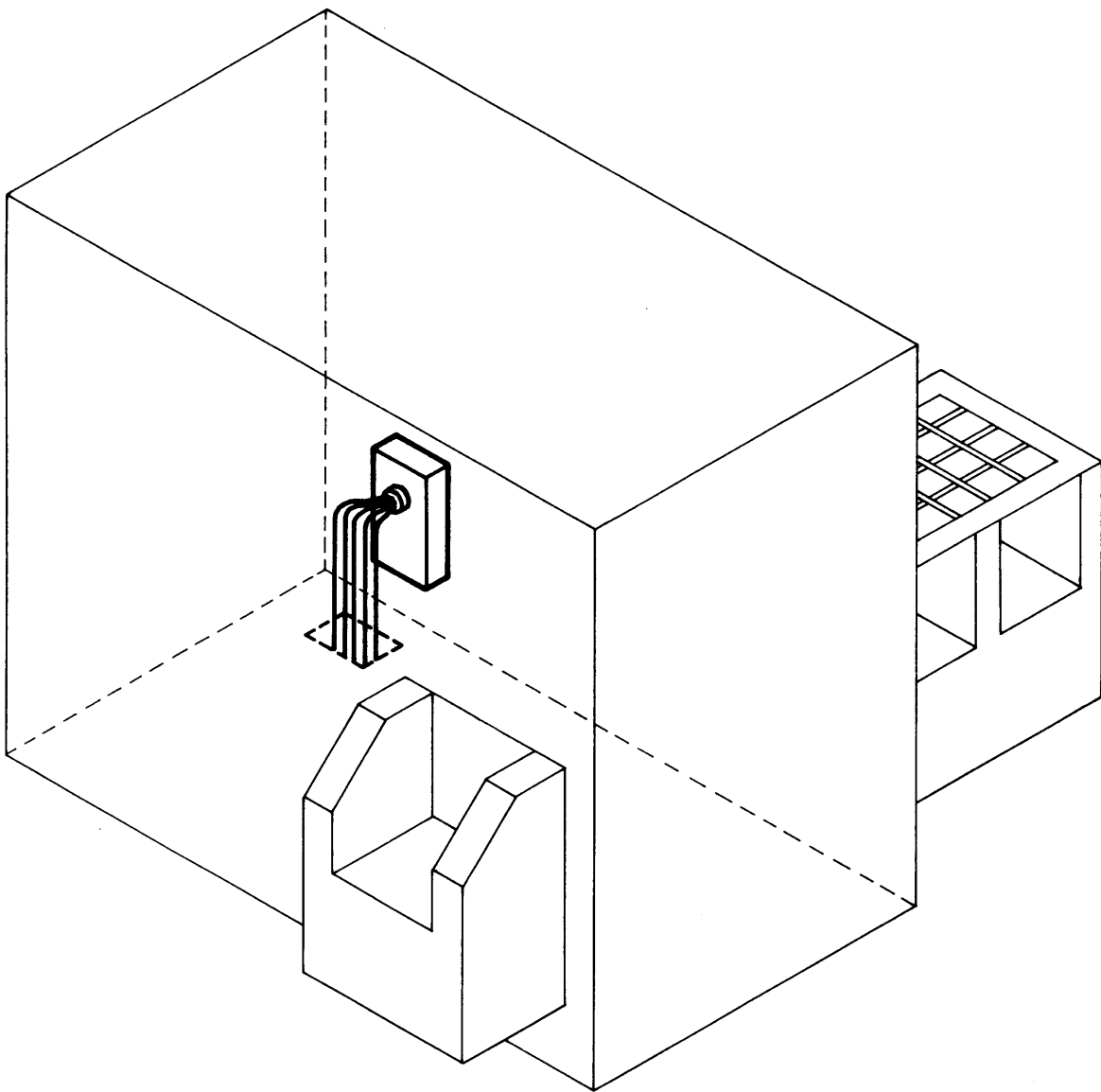


Figure 51. Air Flow Paths for the Line Printer



POWER REQUIRED

60 AMPS, 208 VOLTS, 3 PHASE, 60 CPS, 5-WIRE WYE

CONNECTOR - NONE

5-WIRE CABLE EXTENDS FOUR FEET THROUGH FLOOR
BENEATH UNIT OPENING

WIRE SIZE

7-STRAND, SIZE 0

Figure 52. Power Cable Outlet for the RIPC

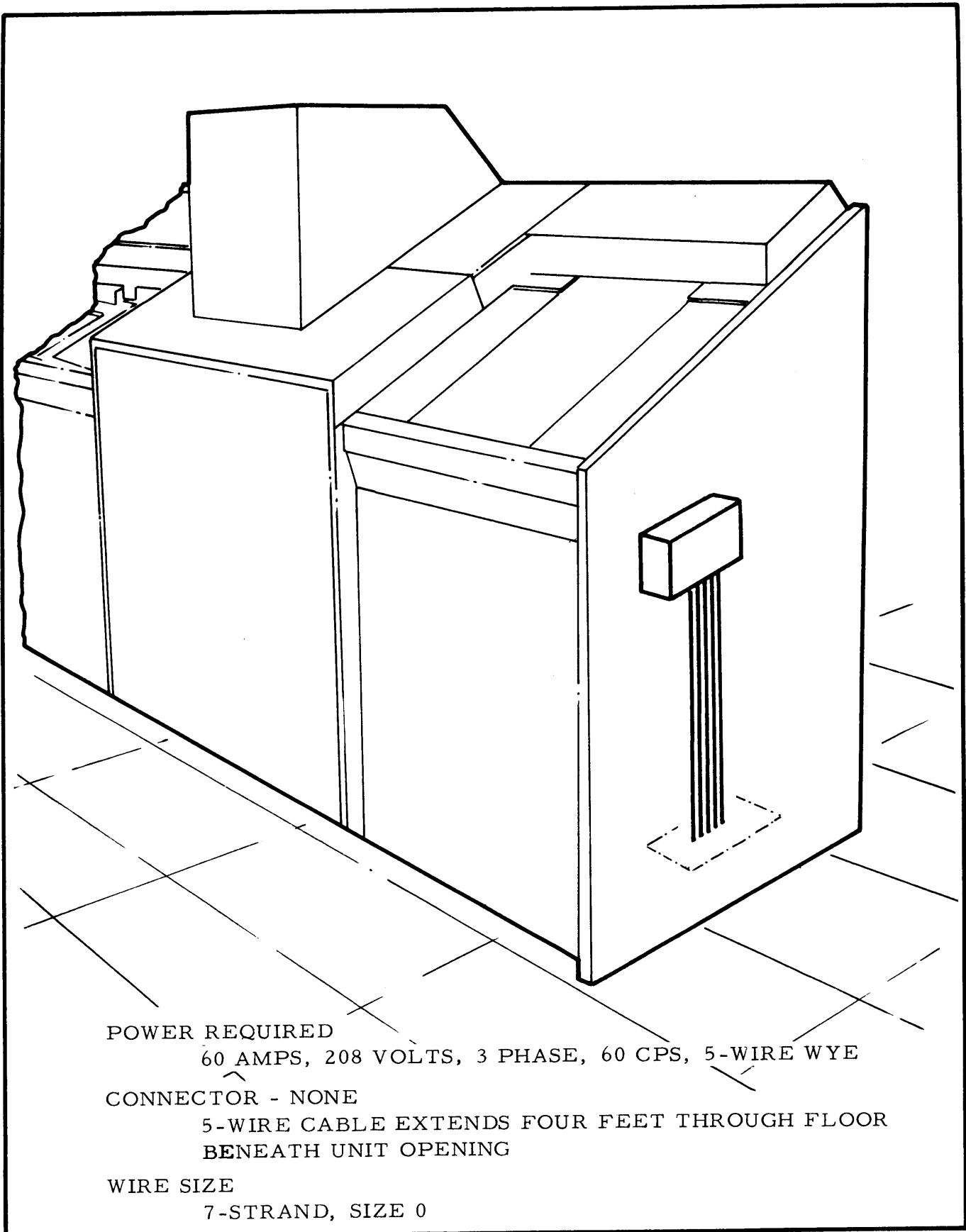
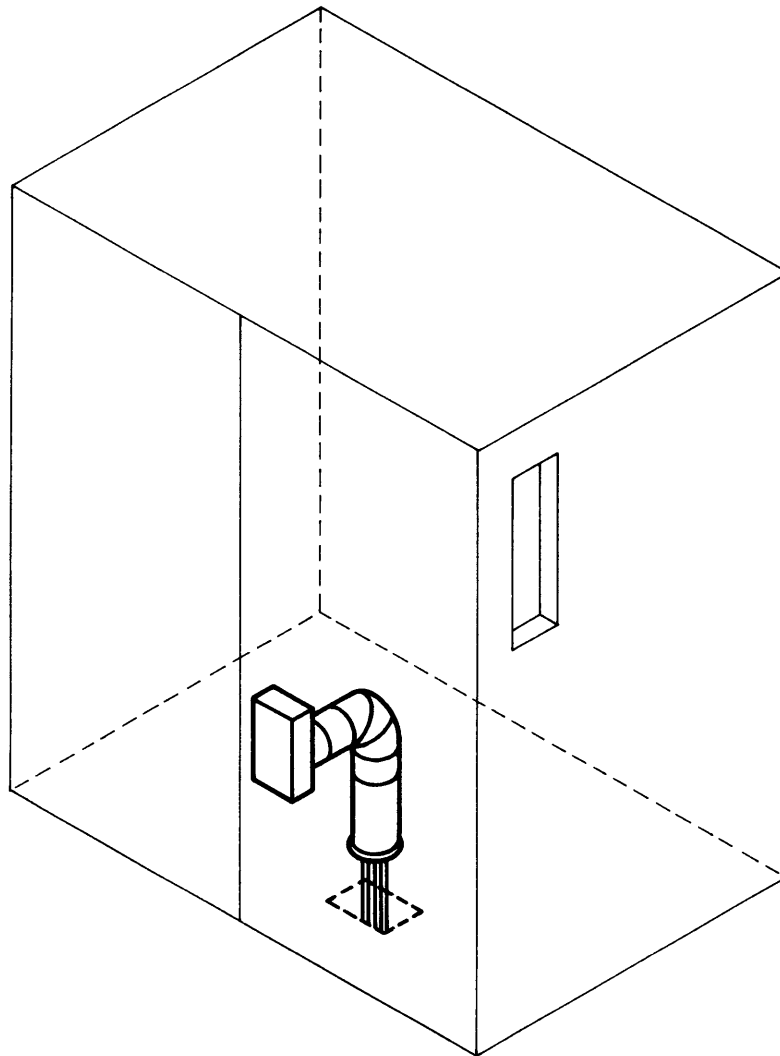


Figure 53. Power Cable Outlet for the Document Carrier



POWER REQUIRED

60 AMPS, 208 VOLTS, 3 PHASE, 60-CPS, 5-WIRE WYE

CONNECTOR - NONE

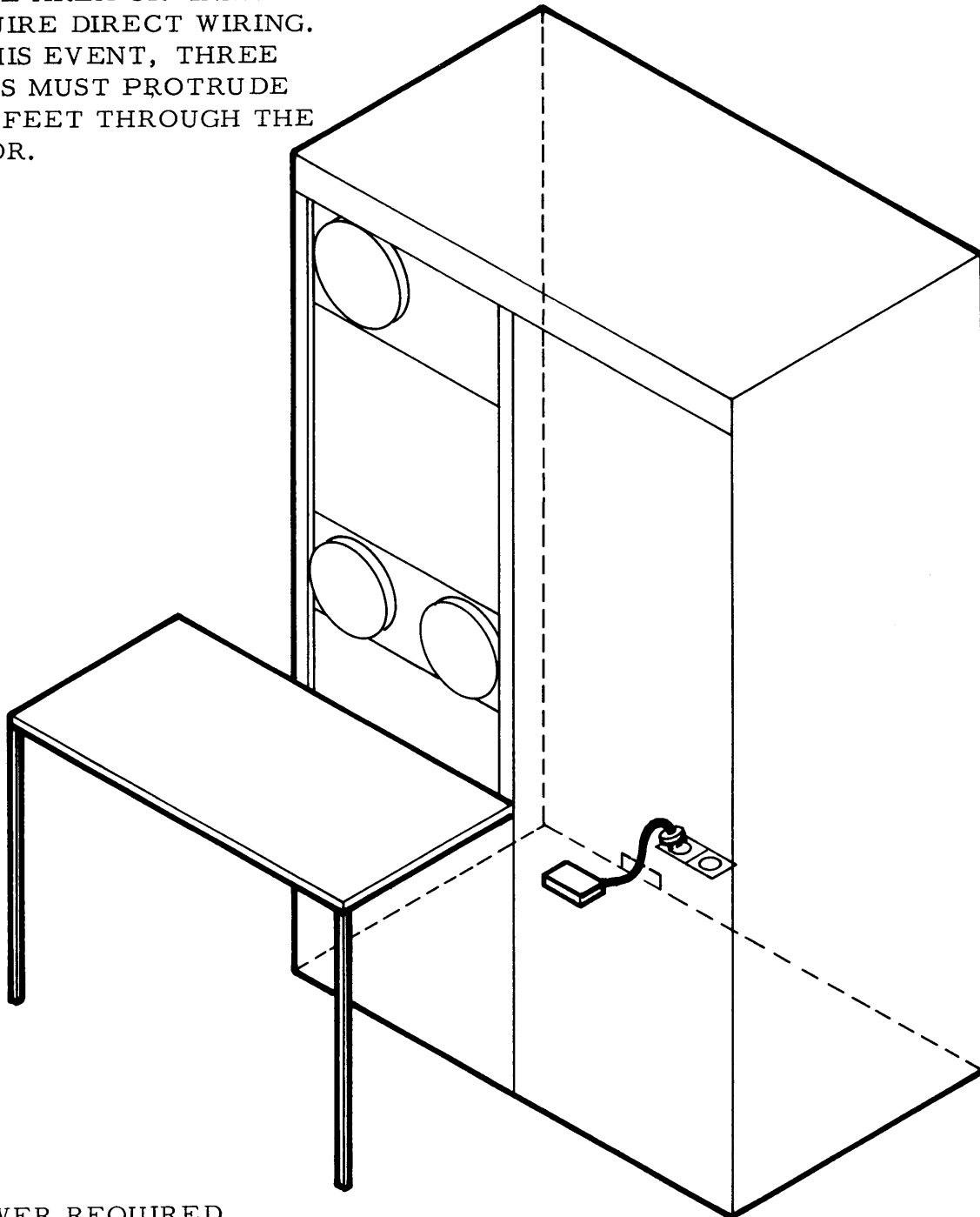
5-WIRE CABLE EXTENDS SIX FEET THROUGH FLOOR
BENEATH UNIT OPENING

WIRE SIZE

7-STRAND, SIZE 0

Figure 54. Power Cable Outlet for the Retina Unit

*SOME AREA ORDINANCES
REQUIRE DIRECT WIRING.
IN THIS EVENT, THREE
WIRES MUST PROTRUDE
TWO FEET THROUGH THE
FLOOR.



POWER REQUIRED

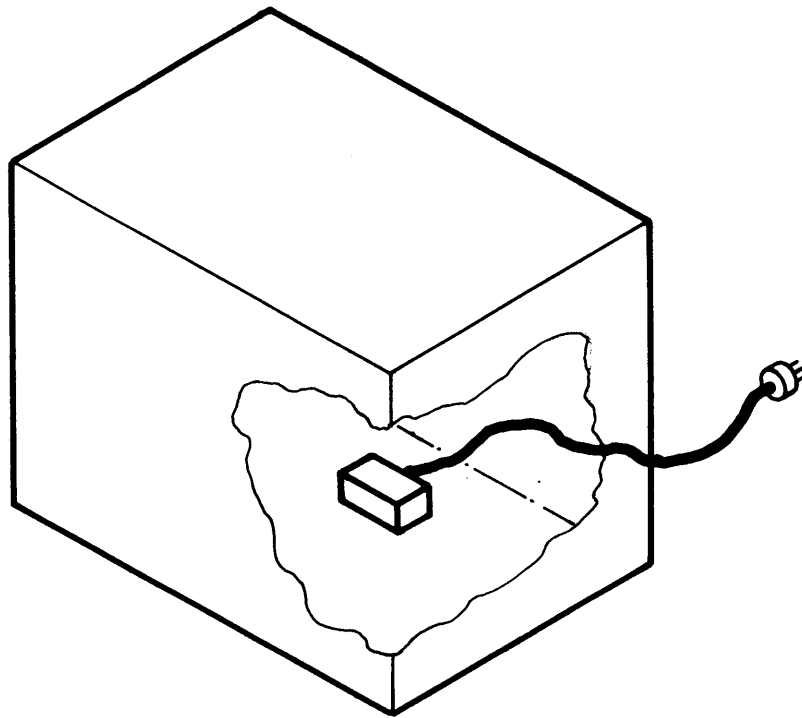
30 AMPS, 110/120 VOLTS, SINGLE-PHASE, 60-CPS, 3-WIRE

CONNECTOR

*3-SOCKET CONNECTOR, HUBBELL TWIST LOCK (OR EQUIVALENT)
REQUIRES ONE FLOOR-MOUNTED OUTLET LOCATED WITHIN ONE
FOOT BEHIND THE UNIT.

WIRE SIZE - AS REQUIRED BY LOCAL ORDINANCE

Figure 55. Power Cable Outlet for the Programmed Controller



POWER REQUIRED

15 AMPS, 115 VOLTS, SINGLE-PHASE, 60-CPS, 3-WIRE

CONNECTOR

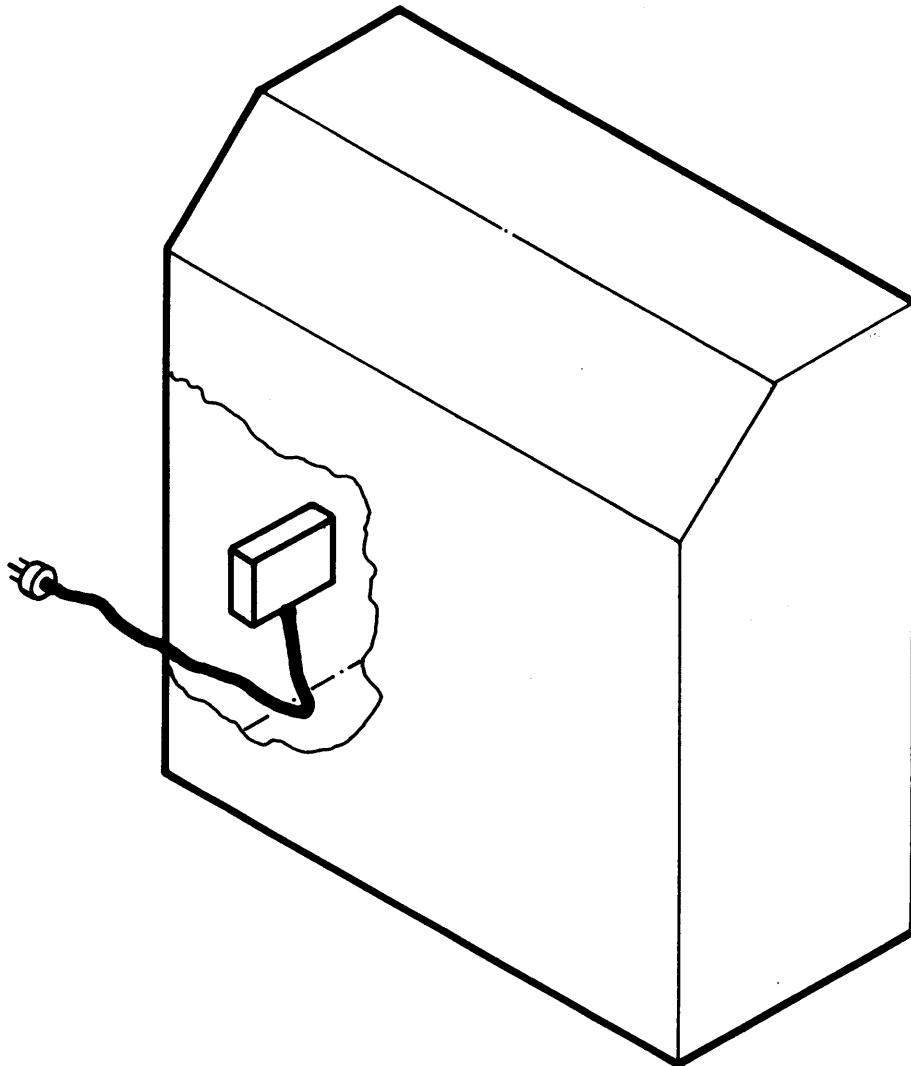
*3-SOCKET CONNECTOR, HUBBELL TWIST LOCK (OR EQUIVALENT) REQUIRES ONE OUTLET LOCATED WITHIN THREE FEET BEHIND THE UNIT. SUGGEST FLOOR MOUNTING FOR MAINTENANCE ACCESS CONVENIENCE.

WIRE SIZE - AS REQUIRED BY LOCAL ORDINANCE.

*SOME AREA ORDINANCES REQUIRE DIRECT WIRING. IN THIS EVENT, THREE WIRES MUST PROTRUDE TWO FEET THROUGH THE FLOOR AND WITHIN 6 INCHES BEHIND THE UNIT.

Figure 56. Power Cable Outlet for the Magnetic Tape Control Unit

*SOME AREA ORDINANCES REQUIRE DIRECT WIRING. IN THIS EVENT, THREE WIRES MUST PROTRUDE TWO FEET THROUGH THE FLOOR BENEATH THE UNIT OPENING.



POWER REQUIRED

25 AMPS, 115 VOLTS, SINGLE-PHASE, 60-CPS, 3-WIRE

CONNECTOR

*3-SOCKET CONNECTOR, HUBBELL TWISTLOCK (OR EQUIVALENT)-REQUIRES ONE OUTLET LOCATED WITHIN SIX FEET OF THE LEFT SIDE (FACING THE FRONT) OF THE UNIT.

WIRE SIZE - AS REQUIRED BY LOCAL ORDINANCE.

Figure 57. Power Cable Outlet for the Line Printer

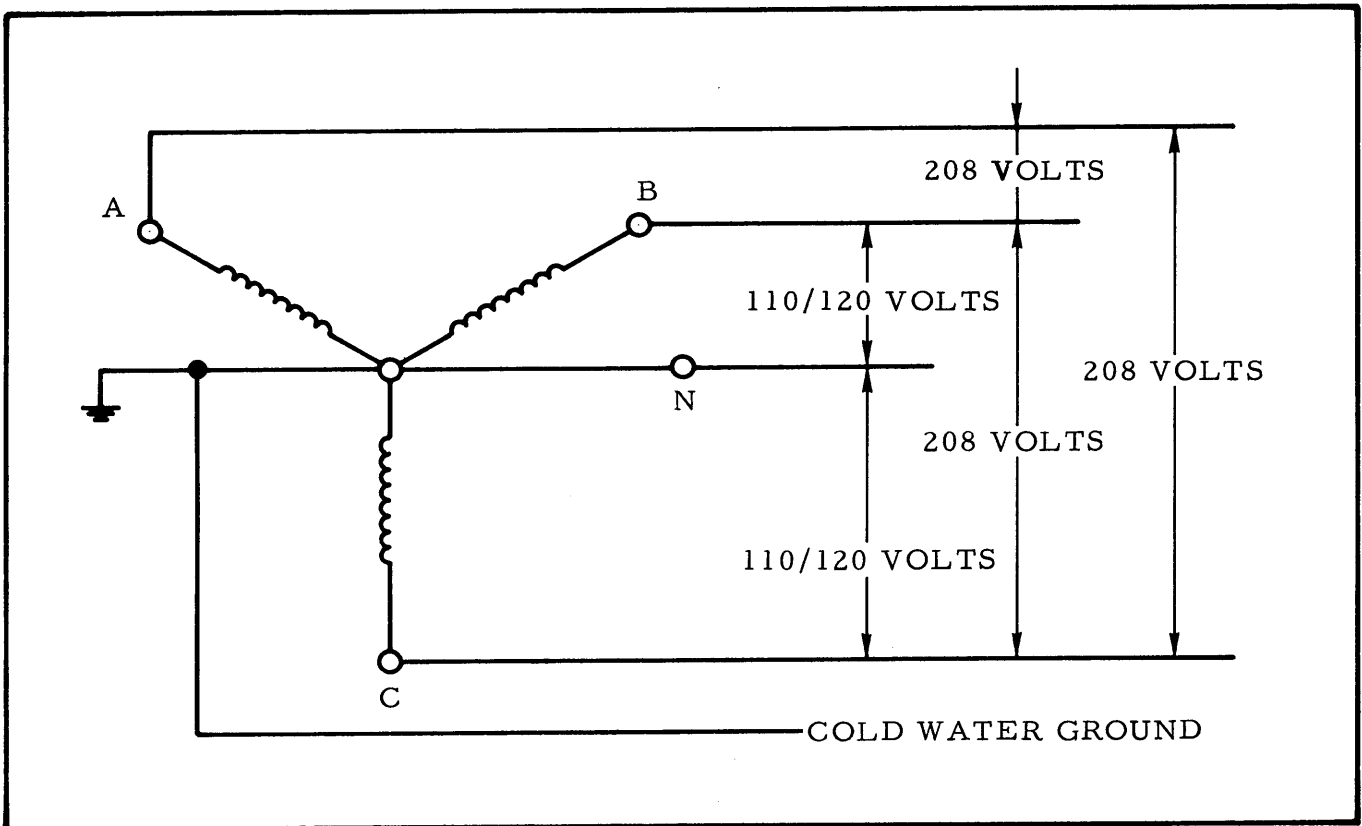


Figure 58. Power Supply Transformer Connections (5-Wire Wye) for the ERCR System

APPENDIX

GLOSSARY OF ERCR TERMINOLOGY

Active Reading Area

The maximum lateral area on a page, measured in inches, within which character recognition, or reading, can occur. Active reading areas for the RIPC are a nominal 8 inches in single-revolution reading and a nominal 12-1/8 inches in double-revolution reading.

Available Time

That time during which equipment has power on, is not under maintenance, and is known or believed to be operating normally.

Average Edge

The average edge of a stroke is represented by a line so constructed that the area of deviation from the intended edge of the stroke is equal on either side.

Average Effectiveness Level

A percentage figure, derived by dividing the available time of equipment (a system or system component) by the sum of available time and down time.

Bar Code

Bar codes are preprinted vertical strokes bordering the reading areas on a form and used by the ERCR to indicate specific functions (begin-reading, stop-reading, etc.) to be performed.

Character

Any upper- or lower-case alphabetic character, numeral, special symbol, or abstract symbol.

Character Boundary

A lateral distance in inches, usually referred to as character space, and equal to the reciprocal of character pitch.

Character Degeneration

The condition that exists when the imprinting device, carbon, or ribbon fails to imprint all of the character in the manner intended.

Character Envelope

The rectangular figure that is described by horizontal lines (perpendicular to the reference edge of a document) tangent to the top and bottom of a character and by vertical lines (parallel to the document reference edge) that are tangent to the rightmost and leftmost edges of the character.

Character Height

The difference, in inches, between two parallel lines that are perpendicular to the reference edge of a page, one line tangent to the top of the character and the other tangent to the bottom of the character. Three standard character heights are used with the ERCR; Recognition Equipment character heights 1 (0.100-inch), 2 (0.112-inch), and 3 (0.127-inch).

Character Pitch

The number of the widest equal-width character boundaries and associated separation that will fit between two parallel lines spaced one inch apart. Usually expressed as the number of characters to the linear inch, as 10-pitch, 12-pitch, etc.

Character Separation

The distance between vertical boundaries of adjacent characters. Character separation can be expressed in inches or in character units.

Character Skew

The deviation of a character from an upright position. The amount of skew is described by the angle between a line tangent and parallel to a character top or bottom and a horizontal line that is perpendicular to the reference edge of a page and tangent to the same character top or bottom.

Character Space

See Character Boundary.

Character Unit

A linear measure, in inches, equal to $1/16$ of nominal character height. Corresponding to Recognition Equipment character heights 1, 2, and 3 are character units equal to 0.00625 inches, 0.00700 inches, and 0.00797 inches, respectively.

Close Feed

A condition arising during the feeding of documents in the Document Carrier in which documents follow one another so closely as to preclude correct sorting. A close-feed condition usually results in a missort in the Document Carrier.

Columnar Line

A line in which all characters on the line are aligned vertically with respect to characters on the lines directly below and/or above.

Document Height

The dimension of a page or document that is perpendicular to a line of print.

Double-Revolution Reading

A reading mode of the RIPC in which two revolutions of the page-holding drum are required to read one line of a page on that drum. This reading mode is used for reading lines of greater than 8-inch length.

Down Time

The interval, in hours, between the time that an ERCR system engineer is notified of equipment malfunction or failure and the time that the equipment is returned to the user in proper operating condition.

Extraneous Ink Area

Any area equivalent to the area of a circle of one character unit diameter, that is located entirely outside of the strokes of a character and that has an average reflectance of less than 50 per cent of that of the paper on which the character is printed.

Grain Long Paper

A document in which the grain of the paper stock runs parallel to the long dimension of the document.

Grain Short Paper

A document in which the grain of the paper is parallel to the short dimension of the document.

Ink Density

The degree of darkness of the ink or carbon that makes up a character and the degree to which such darkness is even throughout all the strokes of the character. Density is expressed as a contrast ratio between the ink and the background upon which it has been printed.

Instantaneous Reading Rate

The rate at which characters are read from a line and expressed, in characters per second, as the product of the character pitch of the document and the lateral speed of the paper carrier transporting that document.

Jam

Any condition, other than a multiple feed, that causes processing to be halted due to document mishandling.

Lateral Skip

A condition in which the ERCR tracks laterally across a form (containing preprinted or postprinted information) without reading the information. Nonreading occurs only during the extent of the lateral skip under either bar-code control or program control.

Line Reading Area

The difference, in character units, between two parallel lines that are perpendicular to the reference edge of the paper, one line tangent to the highest character top on the line and the other tangent to the lowest character bottom on the line.

Line Reading Time

The time required to read one line of print. For lines less than 8 inches in length, line reading time is 78 milliseconds (0.078 seconds); for lines greater than 8 inches but less than 12-1/8 inches in length, line reading time is 156 milliseconds (0.156 seconds).

Line Skew

The angular deviation of a line from a horizontal reference line or edge of a page.

Line Spacing

The vertical distance, in inches or character units, between the tops of the line reading areas of any two vertically adjacent lines on a document.

Live-Work Documents

A document which, following its preparation, has received normal handling by office or plant personnel and which has been subjected to the normal wear and tear associated with everyday usage.

Mark-Sense Targets

Small circles, squares, or triangles that can be marked with a pencil or pen. Marked targets are distinguished from unmarked targets during reading.

Mean Shape

The locus of points that are equidistant from the average edges of the strokes representing the intended shape of the character and which lie on the shortest line between such average edges.

Mint-Condition Document

A document which has been specifically prepared for reading by the ERCR. The mint-condition document receives no handling of any kind before machine processing, is as close to perfect condition as can be, and will only be used by the OCR equipment.

Multiple Feed

A condition, during reading by the RIPC, in which two or more pages are placed on a reading drum at the same time.

No Feed

A condition, during reading by the RIPC, in which a feed cycle is executed without a page being placed on a reading drum.

Paper Weight

The weight, in pounds, of a stack of 500 sheets of paper of 17 inches x 22 inches size. Paper weight has a tolerance of ± 5 per cent.

Pitch

See Character Pitch.

Reference Edge

The right-most edge of a document when the document is in the normal position for human reading.

Reflectance

The measurement of diffuse reflected light only (from any angle not within 10 degrees of specularly-reflected light) when compared to magnesium oxide as a primary-white standard of 100 per cent reflectance.

Reread Time

The time required to read a line for the second or subsequent time. Reread time is the same as initial reading time, either 78 milliseconds or 156 milliseconds as determined by line length.

Single-Revolution Reading

A reading mode of the RIPC in which one line on a page is read during a single revolution of the drum that holds the page.

Stroke Width

The length of the shortest line between the average edges of a character at any given point.

Undetected Multiple Feed

A condition, during reading by the Document Carrier, in which an item is placed in a sort pocket without the machine's knowledge of this action.

Unit-Size Document

A document, no larger than 5 inches x 8-3/4 inches, containing one or two lines of information, such as utility payment stubs, airline tickets, freight bills, money orders, and travelers' checks.

Vertical Character Misregistration

A condition in which some characters on a line are higher or lower than others. Vertical character misregistration has the effect of increasing the reading area of a line and is the normal condition of documents handled by the ERCR.

Vertical Skip

A condition in which the ERCR steps vertically down a form without reading the information. Nonreading occurs under program control and only during the extent of the vertical skip. The minimum distance of a vertical skip is any line spacing of 1/3 inch or greater.

Vertical Skipping Time

The length of time required to accomplish a 1/3-inch vertical skip. Each such vertical skip requires 78 milliseconds.

Void

Any area equivalent to the area of a circle of one character unit diameter, located wholly within the stroke width of a character, and having a reflectance greater than 50 per cent of that of the paper on which the character is printed.



RECOGNITION EQUIPMENT

Incorporated

United States Headquarters, Dallas, Texas

Offices in Frankfurt, London, Milan, Paris and Stockholm