9200/9300 SYSTEMS

8410 DIRECT ACCESS SUBSYSTEM

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CONTENTS

1. INTRODUCTION

The UNIVAC 8410 Disc File provides a modular direct access disc subsystem which can be used with a 9200/9300 computer with at least 12K of storage, a reader, punch, printer, and a Multiplexer channel. It provides the 9200/9300 with millisecond random or sequential access to large data files and reduces processing time for many applications.

1.1. CONFIGURATION AND STORAGE CAPACITY

The minimum 8410 configuration includes a Dual Disc File Master (2 disc drives) with Disc File Control and the Buffer and Fastband Search Feature. This provides a minimum 3.2 million bytes of online disc storage.

The basic configuration can be expanded by adding a Single Disc File Slave or Dual Disc File Slave which increases the online storage capacity by 1.6 and 3.2 million bytes respectively. When the Single Disc File Slave is added it is housed in a Dual Disc File Slave cabinet. The unused portion of this cabinet can be filled with another Disc Drive when an additional 1.6 million bytes of storage is needed. The maximum 8410 configuration consists of 4 Dual Disc Drives with an online capacity of 12.8 million bytes.

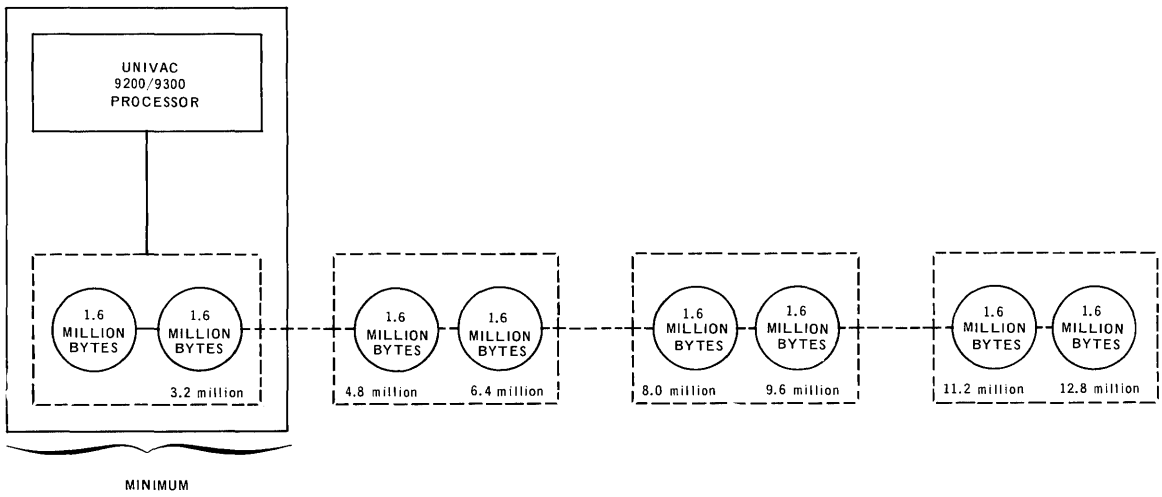


Figure 1–1. Minimum/Maximum Configuration

1.2. THE STORAGE MEDIUM

The storage medium is an aluminum disc, plated with materials having special magnetic properties. Data is stored on the surfaces of the disc in the form of tiny magnetized spots. Each disc is permanently encased in a cartridge to protect its recording surfaces. The combined weight of both the disc and the cartridge is approximately 7.5 pounds.

1.3. THE ACCESS MECHANISM

When a disc is mounted on 8410 Drive, shutters on the cartridge and read/write heads are automatically opened, exposing the disc surface to the read/write heads. The disc is rotated by the drive at a speed of 1200 revolutions per minute (50 milliseconds per revolution). The 1.6 million bytes of data located on the under side of the disc are in an online condition. The 1.6 million bytes of data on the upper disc surface are in the offline mode.

2. SYSTEM DESCRIPTION

2.1. DISC

2.1.1. Storage Design

The disc surface is divided into 10,000 identical sectors, each having a capacity of 160 bytes of data.

The sectors are arranged in circular fashion on the disc surface.

A logical track consists of 100 sectors, forming one circle on the disc surface. There are 100 logical tracks, forming 100 concentric circles on each surface. In addition there is a special track called the Fastband which will be described later.

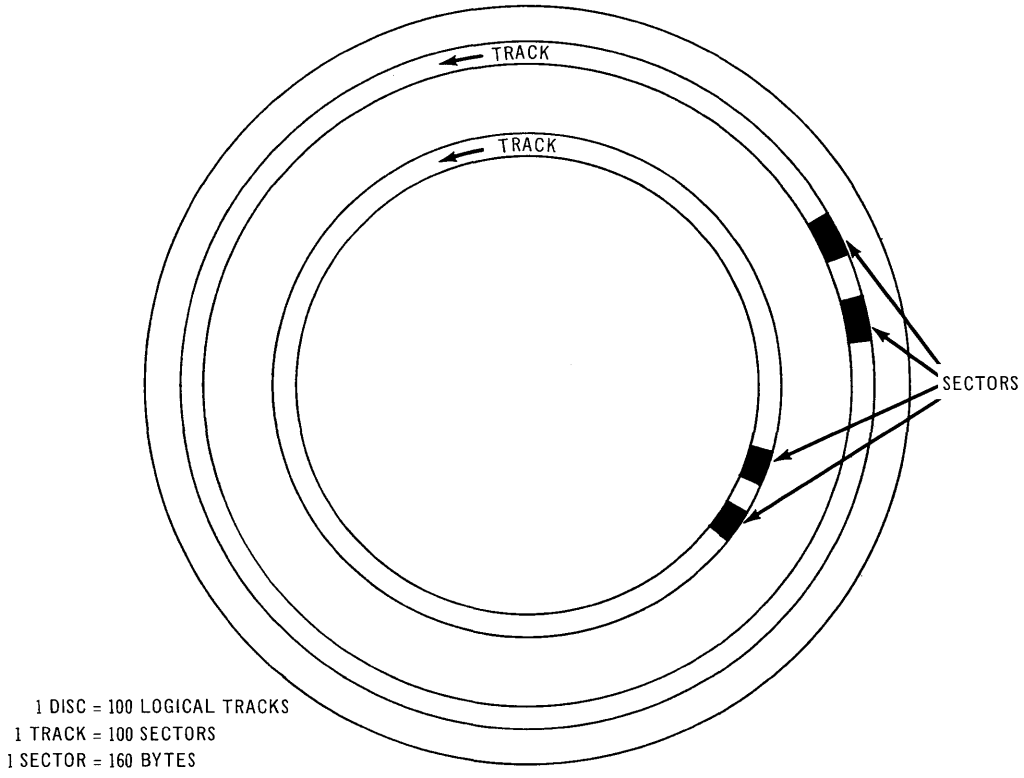


Figure 2–1. The Disc Storage Design

2.1.2. Address Structure

The 10,000 sectors are individually identified by a unique four digit number ranging from 0000 to 9999. The first two digits of the number identify each of the 100 tracks. The last two digits identify each sector within a given track. These addresses are recorded on the disc together with the data they identify.

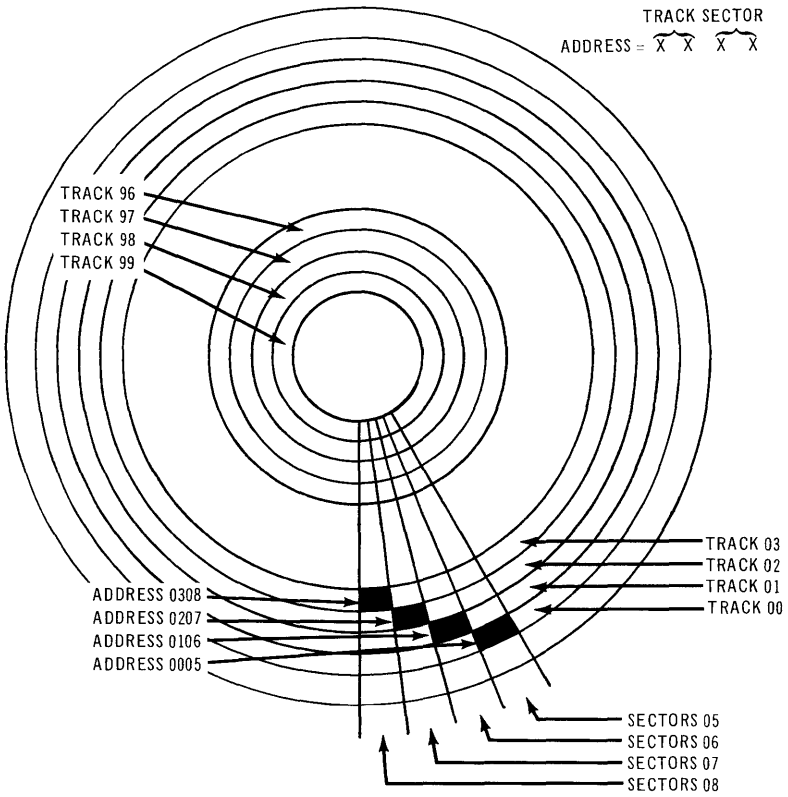


Figure 2–2. Disc Address Structure

Distinction between multiple online discs (maximum of 8) is made by the addition of a digit (0 to 7) to the left of the four digit track and sector address. The complete address is a five digit number (00000-79999) capable of uniquely identifying each of the possible 80,000 sectors.

2.1.3. Sector Format

Each sector consists of three segments, i.e., address, data, and check.

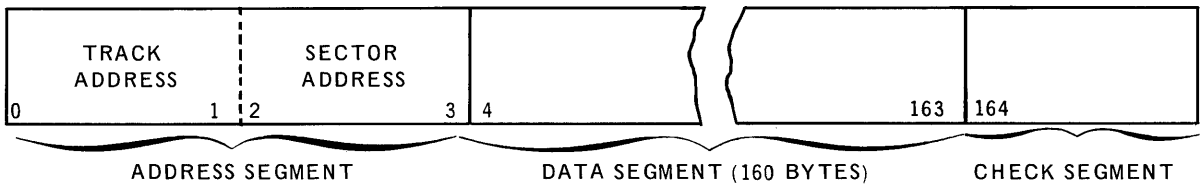


Figure 2–3. Sector Format

- Address Segment

  Track Address (bytes 0–1) consists of two bytes in unpacked format.

  Sector Address (bytes 2–3) consists of two bytes in unpacked format.

  Drive Address, which is used to select one of the several discs which may be online, is not recorded on the disc in order to provide operational flexibility.

- Data Segment

  This area (bytes 4–163) consists of 160 consecutive bytes containing data written in packed or unpacked format or both.

- Check Segment

  This area contains special check bytes computed and analyzed by circuitry to assure correct recording of both address and data.

2.1.4. Fastband

Fastband is a fast access track containing 50 sectors. Each sector has a data length of 160 bytes. It is used to implement Indexed Sequential Search or to satisfy requirements for high speed data access.

- Address Segment (See Figure 2.3.)

  Track Address (bytes 0–1) consists of two bytes providing a unique track address for the Fastband. The Fastband Track Address is hexadecimal 1000 which is beyond the address range of data tracks.

  Sector Address (bytes 2–3) consists of two bytes in unpacked format which reference each Fastband sector.

- Data Segment

  This area (bytes 4–163) consists of 160 consecutive bytes, containing data written in packed or unpacked format or both.

- Check Segment

  This area contains special check bytes computed and analyzed by circuitry to assure correct recording of both data and addresses.

2.2. DISC DRIVE

2.2.1. Track Access

The reading and writing of data are accomplished by two sets of magnetic read/write heads located in fixed positions on a movable access arm. The first read/write head is assigned to the outer portion of the disc which contains sectors 00–54 of each logical track. The second read/write head is assigned to the inner portion of the disc which contains sectors 55–99 of each logical track. The access arm moves radially across the disc with both sets of read/write heads moving in tandem. Access to tracks is made by stopping the access arm at one of 100 discrete positions. At each of these positions, one complete logical track is accessible. The availability of the complete track results from the placement of the two read/write heads exactly 100 tracks apart. When the first read/write head is positioned on sectors 00–54 of a logical track, the second is automatically in position on sectors 55–99 of the same logical track. The selection of the read/write head is made by circuitry.

Although a logical track occupies two physical tracks, the control circuitry will cause the system to respond as though the two physical tracks were continuous. Thus, for purposes of designing file layout, programming and estimating time, the organization of the disc may be assumed to provide 100 tracks of 100 sectors each as shown in Figure 2–4.

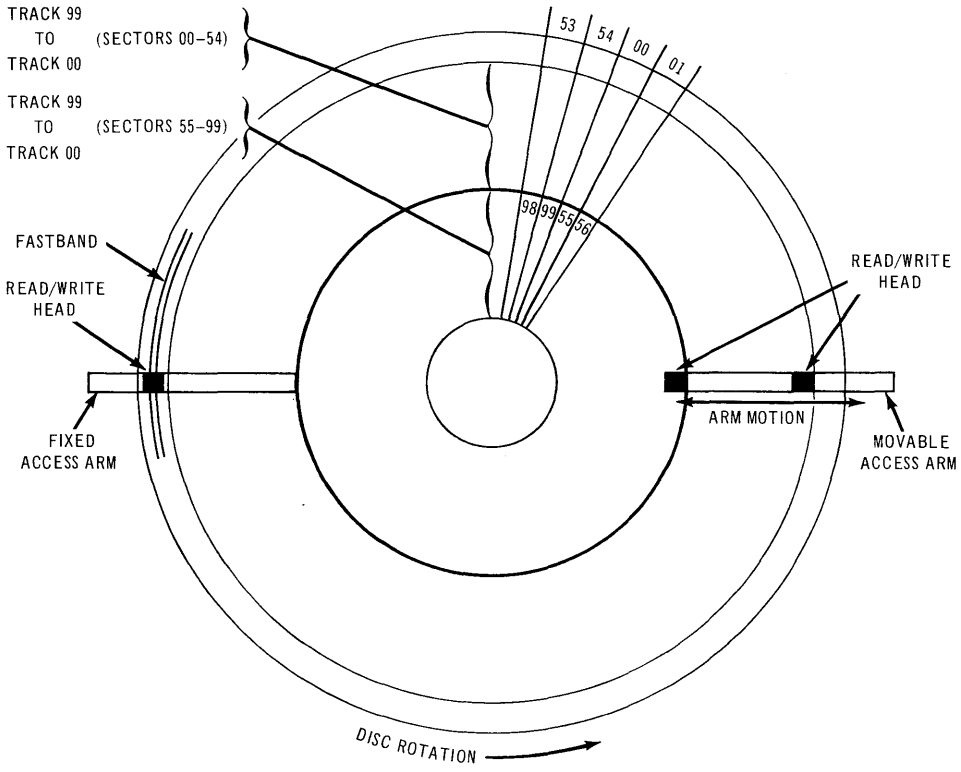


Figure 2–4.

2.2.2. Sector Selection

The positioning of the read/write heads on a track permits the selection of one of the 100 sectors on that track. The selection of a particular sector results from the rotation of the disc which causes each of the sectors to pass by the selected read/write head one at a time.

2.2.3. Fastband

The Fastband is accessed by a permanently assigned read/write head. The fast access capability of the Fastband results from the fixed nature of the read/write head. Access to the Fastband is performed with no head movement time involved.

Selection of sectors on the Fastband is a function of disc rotation as is the case with all other tracks.

2.2.4. Dual Disc File

The first Dual Disc File in a system is a master unit containing circuitry to control the operation of all other units in the subsystem. Drives, although functionally independent, are housed in pairs with separate operator controls for each of the two drives in a cabinet.

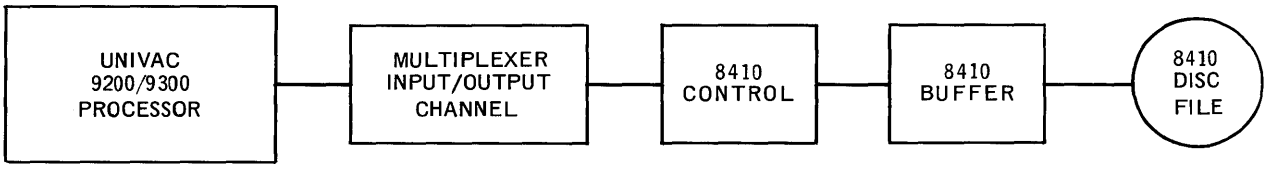
3. DATA TRANSFER

3.1. TRANSFER FACILITIES

Information is exchanged between the central processor and the disc file through the Multiplexer Input/Output Channel. The 8410 is assigned as a device on one of the subchannels.

3.2. MODE OF TRANSFER

Information is transferred between the central processor and the 8410 one byte at a time (serial). All bits of a byte are transferred at the same time (parallel). Exchange of information consists of transfers between main storage of the central processor and the 8410 Disc File via the control unit and the Multiplexer channel.



3.3. DATA VALIDATION

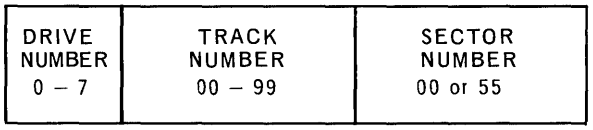
Assurance of correct data and address recording is provided by a combination of parity, bit count, and phase error checking. As entries are made, check bytes are developed and stored in each sector. Transfers from a disc sector are accompanied by verification of data and addresses. The method used is recomputation and comparison of check bytes.

The use of the Write and Check command causes the data written to be read back on the next disc revolution. At this time, check bytes are recomputed and compared to the check bytes in the sector. In addition, each character in the sector is compared to the character received from main storage.

4. DISC OPERATIONS

4.1. SEEK

A Seek function causes a read/write head to be positioned on the track specified by a five byte disc address located in main storage. Seek is a preparatory command which is followed by a Read, Write or Search function.



Seek Address Format

- Drive Number (byte 0)

  This byte will contain a number from 0 to 7 in unpacked format.

- Track Number (bytes 1 and 2)

  These bytes will contain a number from 00 to 99 in unpacked format.

- Sector Number (bytes 3 and 4)

  These bytes will contain either the code 00 or 55 in unpacked format to select zone.

Seek access motion can overlap any central processor operation, any basic input/output operation, and input/output activity on any other Multiplexer subchannel. Once a Seek has been initiated, its access motion can be overlapped with a subsequent Read or Write operation on another drive.

4.2. READ

The Read function is used to transfer data from a specified sector to the 8410 buffer for subsequent transfer to main storage. The address of the sector to be used in the operation is located in five bytes of main storage. If a read/write head is in position on the correct track, access motion will not occur. If a head is not in position, Seek circuitry will analyze the drive number and track number and then initiate access motion.

DRIVE NUMBER 0 – 7	TRACK NUMBER 00 – 99	SECTOR NUMBER 00 – 99
0	1 – 2	3 – 4

Read Address Format

- Drive Number (byte 0)

  This byte will contain a number from 0 to 7.

- Track Number (bytes 1 and 2)

  These bytes will contain a number from 00 to 99 in unpacked format.

- Sector Number (bytes 3 and 4)

  These bytes will contain a number from 00 to 99 in unpacked format.

  Reading may overlap any processor operation, any basic input/output operation, input/output activity on any other Multiplexer subchannels, and a previously initiated Seek on another drive.

4.3. WRITE

The Write function is used to transfer data from main storage to a specified disc sector via the 8410 buffer. The five byte address of the sector is transferred from main storage with the data to be recorded. If a read/write head is in position on the track, access motion will not occur. If a head is not in position, Seek circuitry will analyze the drive and track numbers and then initiate access motion.

DRIVE NUMBER 0 – 7	TRACK NUMBER 00 – 99	SECTOR NUMBER 00 – 99	DATA

Write Address and Data Format

- Drive Number (byte 0)

  This byte may contain a number from 0 to 7 in unpacked format.

- Track Number (bytes 1 and 2)

  These bytes may contain a number from 00 to 99 in unpacked format.

- Sector Number (bytes 3 and 4)

  These bytes may contain a number from 00 to 99 in unpacked format.

- Data

  Consists of 160 consecutive bytes in packed, unpacked, or mixed format, which is to be written.

A Write operation may overlap any processor operation, any basic input/output operation, any input/output operation on another subchannel and a previously initiated Seek on another drive.

4.4. WRITE AND CHECK

The Write and Check function causes a transfer of data from main storage to a specified disc sector in precisely the same manner as does the Write instruction. In addition, it will verify the Write operation by recomputing the check word and by comparing the data written to the data in the buffer. Both checks take place in one extra disc revolution.

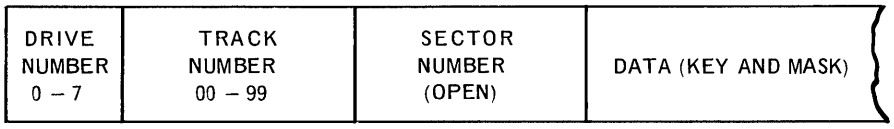
The Write and Check function employs the same address format as does the Write function.

A Write and Check operation can overlap any processor operation, any basic input/output operation, any input/output operation on another subchannel and a previously initiated Seek on another drive.

4.5. SEARCH EQUAL

Search Equal locates data on a track by comparing a 160 byte value transferred from main storage with the contents of each sector. This instruction is normally preceded by a Seek instruction to position the read/write heads on the desired track. The Seek instruction is not needed when the read/write heads are already in position.

The selection of the field or contiguous fields in a sector to be compared is under program control. A mask is set up in main storage. If the fields to be compared in the sector are preceded by other non-key fields, the bytes in these preceding fields can be ignored during the comparison by placing hexadecimal FF (all bits) in each corresponding main storage mask position. The actual value being searched for is placed in the mask in the same positions that it occupies in the sector. Place a hexadecimal FF in the mask in the byte following the last search value position to terminate the comparison for a sector. The number of positions required in the mask is equal to the number of bytes preceding the key field plus the number of bytes in the key field plus one.



Search Address Mask Format

The contents of the sector on which the equal condition occurs are transferred into the buffer for subsequent transfer to main storage.

- Drive Number (byte 0)

  This byte may contain a number from 0 to 7 in unpacked format.

- Track Number (bytes 1 and 2)

  These bytes may contain either a number from 00 to 99 in unpacked format, or the Fastband Track address

- Sector Number (bytes 3 and 4)

  For any track other than the Fastband Track, these bytes must contain 00 to permit a search of sectors 00 to 54, or 55 for a search of sectors 55 to 99. When the Fastband track is to be searched, any number from 00 to 99 may be used. In all cases, these bytes must be in unpacked format.

This operation may overlap any processor operation, any basic input/output operation, an any input/output operation on another subchannel.

4.6. MAGNITUDE SEARCH

Magnitude Search is an instruction specially designed to enhance indexed sequential file handling functions.

It compares a 160 byte mask transferred from main storage with the contents of each sector in the following manner:

1. *The comparison looks for a mask high condition.*
2. *Following a mask high condition, the first mask low (disc high or equal) will terminate the operation.*

As a result of the instruction, the address of the sector that satisfies the mask low condition is transferred to the buffer.

The selection of a field or a group of contiguous fields for comparison operates under program control. Data bytes in the sector are ignored in the comparison when the respective bytes in main storage are masked out by the presence of all one (1) bits. See 4.5.

This instruction may be used to search either a data track or Fastband.

This operation may overlap any processor operation, any basic input/output operation, or any input/output operation on another subchannel.

4.7. UNLOAD BUFFER

This instruction causes a transfer of the contents of disc buffer to main storage, following a command such as read or search.

An Unload Buffer operation can overlap any processor operation, any basic I/O operation, a previously initiated seek on another device, and activity on the multiplexor I/O channel up to the channel rate.

5. OPERATION TIMING

5.1. TIMING FACTORS

Access arm movement and disc rotation are the basic elements in timing 8410 operations.

5.1.1. Arm Motion

Access arm motion, which accomplishes track selection, consists of two distinct timing elements. First is the time required to start and stop the motion of the arm when it is instructed to move to a new track. This time is fixed at 44 milliseconds. Second is the time required for the arm to move from one track to another. Since the number of tracks crossed varies from access to access, this time will vary from a minimum of 2 milliseconds, which is the time required to cross one track, to a maximum of 198 milliseconds, which is the time required to cross 99 tracks. When a command is received for the track on which the access arm is already positioned, arm movement time will not be involved.

5.1.2. Disc Rotation

The disc rotates at a speed of 1200 revolutions per minute, or 1 revolution per 50 milliseconds. After the read/write head is positioned on the desired track, the rotation time required for the desired sector to reach the read/write head varies from 0 to 50 milliseconds (average, 25 ms.). Thus the minimum rotational delay to read, write, or search is 0 millisecond and the maximum time is 50 milliseconds. Since the write/check operation requires an additional revolution, its minimum and maximum times are 50 and 100 milliseconds, respectively.

The disc rotation time varies because the disc continues to rotate after an operation is executed. The disc rotation time depends on the time that elapses before the next operation, and on the location of the next sector desired. To transfer data from the buffer to a sector, or from a sector to the buffer, requires 1 millisecond.

5.2. TIMING EXAMPLE

The total time required to select a record in any given instance is:

start/stop time + arm travel time + disc rotation time.

To illustrate: Suppose a record has just been read from Track 1. If the next record to be read is also on Track 1, there is no start/stop time and no arm travel time. Access time therefore equals disc rotation time, or an average of 25 milliseconds. If the next record to be read is on another track, say Track 2, access time is 44 milliseconds (start/stop time) plus 2 milliseconds (arm travel time to cross one track) plus 25 milliseconds (average disc rotation time), or a total or 71 milliseconds.

5.3. TIMING AVERAGES

Since tracks are accessed at random, throughout rates for operations such as applying unsorted maintenance items to a file are determined by average times. These averages are given in the following table.

	Min.	Max.	Avg.	Avg. inc. Seek
Access Arm Positioning				
Seek	00	242	110	--
Rotational				
Read	0	50	25	135
Search (Physical Track)	0	50	25*	135
Search (Logical Track)	0	100	50*	160
Write	0	50	25	135
Write and Check	50	100	75	185
Buffer Transfer	1	1	1	--

** If the key of the record does not begin in the first data position of the sector, add 50 milliseconds to the search time given.*

6. UNIVAC 8410 PROGRAMMING AIDS

The hardware capabilities of the UNIVAC 8410 Disc File have been described in the previous sections of this manual. These capabilities are enhanced, as well as directed, by a comprehensive disc software package. A general description of the 8410 software follows.

6.1. 9200/8410 SOFTWARE

6.1.1. Disc Dispatcher

The basic ingredient for the implementation of the disc software, the dispatcher issues I/O commands, queues requests, handles error recoveries and performs the other functions of an I/O routine. The dispatcher is an integral part of the supervisor.

6.1.2. IOCS

This routine gives the user the capability of handling disc files in either sequential or random order. Like other IOCS routines it provides for OPEN and CLOSE of file and the ability to GET or PUT records. The IOCS allows the user to take full advantage of the ability to overlap seek track with disc Read or Write functions and other 9200 operations.

6.1.3. RPG

The card RPG is enhanced by the inclusion of the 8410 functions necessary to give the user complete disc file control in object programs generated with the RPG.

6.1.4. Sort

Disc file sorting can be done on the minimum 9200/8410 configuration. The programmer delivers records to the sort through First Pass Own Code. The disc work area is specified by the user and can be part or all of one or more discs. This area can be expanded following first pass to allow the input disc to be dismounted and replaced with a blank. Output can be under Last Pass Own Code control or can be left in the work area. In the latter case the sort indicates where the results can be found.

6.1.5. Library Services

6.1.5.1. System File Loader

This program loads an object program produced by either the Assembler or RPG onto a System File which is located on a disc.

6.1.5.2. Disc Loader

Locates and loads programs from the System File.

6.1.6. Indexed Sequential File Operation

This feature searches for records in sequential files, presenting desired records to the user's program when needed. Records are selected from the file by means of a key number supplied by the user's program.

This routine also provides for the addition of new records to files and the updating of the associated indices. In sum, these features provide a complete file management system.

6.2. 9300/8410 SOFTWARE

In addition to the 8410 software available for the 9200, the following packages will be available for the 9300.

6.2.1. Disc Assembler

A disc-oriented assembler utilizing discs during assembly is provided. Input is from cards or disc and output is on disc. A disc Linker is provided to complement this assembler.

6.2.2. Disc Operating System

A completely modular disc oriented Operating System is provided incorporating such features as program locate and load from an 8410 System Disc and control stream buffering using disc.

6.3. 8410 UTILITY ROUTINES

The following utility routines are available for both 9200 and 9300:

Disc Prep

Disc Print

Disc Dump and Restore (to cards, tape or disc)

7. OPERATIONAL CONTROLS AND PROCEDURES

7.1. CONTROLS

7.1.1. Power ON/OFF

This set of switches controls the application of electrical power to the drives.

7.1.2. Load

The motor which operates the disc rotation assembly is started by depression of the switch. Disc rotation will reach its maximum speed in about 30 seconds. Separate switches are provided for each drive.

7.1.3. Unload

This switch stops the motor so that disc may be exchanged by the operator. Separate switches are provided for each drive.

7.1.4. Clear

This switch clears all error indicators to a neutral (off) state.

7.1.5. Unit Select

Each drive is provided with a Unit Select dial to permit the operator to alter the internal address of each drive in the subsystem.

7.2. INDICATORS

7.2.1. Power On

This indicator is illuminated as long as power is being applied to a single or dual drive.

7.2.2. Ready

This indicator is lit when the disc reaches full rotational speed.

7.2.3. Unit Busy

This indicator is lit when the drive is executing a command.

7.2.4. Fault

This indicator is illuminated when an invalid command is received or to indicate that an abnormal condition has been detected.

7.2.5. Overtemp

This indicator provides early warning that the internal temperatures are approaching a point where the unit must be turned off. The turn-off is automatic. When the indicator is lit, the operator should immediately prepare for an orderly termination of operations.

7.3. OPERATING PROCEDURES

7.3.1. Loading

1. *Raise the cover of the drive.*
2. *Place the disc cartridge on the spindle.*
3. *Press the disc cartridge down until seated.*
4. *Place retaining cap on spindle.*
5. *Close the cover of the drive.*
6. *Depress the Load key*

7.3.2. Unloading

1. *Press the Unload key.*
2. *Raise the cover of the drive.*
3. *Remove retaining cap.*
4. *Press the release button.*
5. *Remove disc cartridge.*
6. *Close the cover of the drive.*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