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Systems

**3350/3344 Installation
and Conversion Guide**

IBM

Systems

3350/3344 Installation and Conversion Guide

This guide describes the requirements and procedures to accomplish a successful installation of 3350 and 3344 Direct Access Storage Devices. It covers such aspects as features, compatibility modes, addressing, and hardware and programming considerations.

Special emphasis is given to the procedures for converting from different types of DASD, and several examples are explained in detail. In the same way, the checklist included in the guide will assist in the implementation of a good conversion plan.

A bibliography related to the 3350/3344 DASD is also included, as well as space utilization tables.



First Edition (February 1976)

This guide is intended for planning purposes only. It will be updated from time to time; however, the reader should remember that the authoritative sources of system information are the system library publications for the 3350/3344 and its programming support. These publications will first reflect any changes.

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| Table of Contents | 25, 26 |
| 11, 12 | 69 - 72 |
| 17, 18 | 77, 78 |
| 21 - 24 | 81 - 84 (84 added) |

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Please file this cover letter at the back of the manual to provide a record of changes.

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SECTION 1: INTRODUCTION

The purpose of the 3350/3344 Installation and Conversion Guide is to provide a reference source for the user engaged in installing the IBM 3350 and/or 3344 Direct Access Storage devices. It is assumed the reader has current knowledge of DOS/VS, OS/VS and/or VM/370 and its components. The systems engineer should have experience in installing and servicing DOS/VS, OS/VS and/or VM/370 accounts.

The objectives of the document are to provide guidance on the installation and conversion requirements for DOS/VS, OS/VS and VM/370 customers and to summarize the currently available information on the 3350/3344 DASD. The importance of a well thought-out and planned installation and conversion cannot be overemphasized. This document is not intended as a conversion plan. However, it should stimulate thought on particular account situations. The checklist included in the guide should assist in the construction of a good conversion plan.

The information in the document was current at the time of writing. However, System Reference Library manuals and subsequent programming enhancements may supersede sections of it.

The following publications are recommended for detailed information concerning the subjects covered in the manual:

- Reference Manual for IBM 3830 Storage Control Model 2, Order No. GA26-1617.
- Reference Manual for IBM Integrated Storage Control, Order No. GA26-1620.
- Introduction to IBM 3350 Direct Access Storage, Order No. GA26-1638.
- Reference Manual for IBM 3340/3344 Disk Storage, Order No. GA26-1619.

The Data Processing Glossary, Order No. GC20-1699, defines terms related to direct access storage devices.

SECTION 2: 3350/3344 BIBLIOGRAPHY

The following lists show the SRL and PLM manuals to be updated with 3350/3344 information. The updates will be available by the date indicated.

2.1 General Information (Available, November 1975)

| | |
|---|-----------|
| S/370 Principles of Operation | GA22-7000 |
| S/370 System Summary | GA22-7001 |
| S/370 I/O Configurator | GA22-7002 |
| S/370 Installation Manual Physical Planning | GC22-7004 |
| S/370 Installation Manual Physical Planning (WTC) | GC19-0004 |
| S/370 Model 145 Channel Characteristics | GA24-6962 |
| S/370 Model 158 Channel Characteristics | GA22-7012 |

2.2 SRL 3350/3344 Updated

VS1 (Available, April 1976)

| | |
|---|-----------|
| OS/VS1 Storage Estimates | GC24-5094 |
| OS/VS1 System Data Areas | SY28-0605 |
| OS/VS1 JCL Reference | GC24-5099 |
| OS/VS1 Service Aids | GC28-0665 |
| OS/VS1 Service Aids Logic | SY28-0635 |
| OS/VS1 Debugging Guide | GC24-5093 |
| OS/VS1 Access Method Services | GC26-3840 |
| OS/VS1 Data Management for System Programmers | GC26-3837 |
| OS/VS1 Planning and Use Guide | GC24-5090 |
| OS/VS1 OLTEP | GC28-0666 |
| OS/VS1 Dynamic Support System Logic | SY28-0672 |
| OS/VS1 SYS1.LOGREC Error Recording | GC28-0668 |
| OS/VS1 SYS1.LOGREC Error Recording Logic | SY28-0669 |
| OS/VS1 I/O Supervisor Logic | SY24-5156 |
| OS/VS1 Programmer's Reference Digest | GC24-5091 |
| OS/VS1 ISAM Logic | SY26-3838 |
| OS/VS1 DADSM Logic | SY26-3837 |
| OS/VS1 IPL and NIP Logic | SY24-5160 |
| OS/VS1 Supervisor Logic | SY24-5155 |

VS2 (SVS)

SVS manuals will not be updated. The information will be incorporated in the Program Directory for the ICR.

VS2 (MVS) (Available with the next general revision of OS/VS2 manuals)

| | |
|---|-----------|
| OS/VS2 System Programming Library: Storage Estimates | GC28-0604 |
| OS/VS2 JCL | GC28-0692 |
| OS/VS2 System Programming Library: Service Aids | GC28-0674 |
| OS/VS2 Service Aids Logic | SY28-0643 |
| OS/VS2 System Programming Library: Debugging Handbook | GC28-0632 |
| OS/VS2 System Programming Library: Data Management | GC26-3830 |
| OS/VS2 Message Library: VS2 System Messages | GC38-1002 |
| OS/VS2 System Programming Library: OLTEP | GC28-0675 |
| OS/VS2 System Program Library: SYS1.LOGREC Error Recording | GC28-0677 |
| OS/VS2 SYS1.LOGREC Error Recording Logic | SY28-0678 |
| OS/VS2 I/O Supervisor Logic | SY26-3823 |
| OS/VS2 System Programming Library: System Generation Reference | GC26-3792 |

| | |
|---|-----------|
| OS/VS2 Access Method Services | GC26-3841 |
| OS/VS2 Recovery Management Support Logic | SY27-7250 |
| OS/VS2 ISAM Logic | SY26-3833 |
| OS/VS2 DADSM Logic | SY26-3828 |
| OS/VS2 SPL: Initialization & Tuning Guide | GC28-0681 |
| OS/VS2 Job Management Supervisor & TSO | GC38-0682 |
| OS/VS2 Operator's Library: VS2 Reference (JES2) | GC38-0210 |
| OS/VS2 Operator's Library: VS2 Reference (JES3) | GC38-0226 |
| OS/VS2 Auxiliary Storage Management Logic | SY35-0009 |
| OS/VS2 Independent Component Access Method | GC26-3843 |
| OS/VS2 Dynamic Support System Logic | SY28-0679 |

VS1/VS2 (MVS) (Available, April 1976)

| | |
|--|-----------|
| OS/VS Data Management Services Guide | GC26-3783 |
| OS/VS Linkage Editor and Loader | GC26-3813 |
| OS/VS Utilities | GC35-0005 |
| OS/VS Utilities Logic | SY35-0005 |
| OS/VS Utilities Messages | GC38-1005 |
| OS/VS Data Management Macro Instructions | GC26-3793 |
| OS/VS Checkpoint/Restart | GC26-3784 |
| OS/VS VSAM Planning Guide | GC26-3799 |
| OS/VS Mass Storage Control Table | GC35-0013 |
| OS/VS Mass Storage Control Table Logic | SY35-0016 |
| OS/VS VSAM Programmer's Guide | GC26-3838 |

DOS/VS (Available, November 1975)

| | |
|--|-----------|
| DOS/VS Introduction to DOS/VS | GC33-5370 |
| DOS/VS System Generation | GC33-5377 |
| DOS/VS System Control Statements | GC33-5376 |
| DOS/VS Operating Procedures | GC33-5378 |
| DOS/VS Messages | GC33-5379 |
| DOS/VS System Utilities | GC33-5381 |
| DOS/VS Error Recovery and Recording Transients | SY33-8552 |
| DOS/VS System Utilities Logic | SY33-8558 |
| DOS/VS Supervisor and I/O Macros | GC33-5372 |

VM/370 (Available, June 1976)

| | |
|---|-----------|
| VM/370 Operator's Guide | GC20-1806 |
| VM/370 Command Language Guide for General Users | GC20-1804 |
| VM/370 Introduction | GC20-1800 |
| VM/370 Planning and System Generation Guide | GC20-1801 |
| VM/370 Control Program (CP) Program Logic | SY20-0880 |
| VM/370 Service Routine Program Logic | SY20-0882 |
| VM/370 Conversation Monitor System (CMS) Program Logic | SY20-0881 |
| VM/370 Virtual Machine Quick Guide | GX20-1926 |
| VM/370 Debugging Guide | GC20-1807 |
| VM/370 Virtual Master Index | GC20-1813 |
| VM/370 RSCS Program Logic | SY20-0883 |
| VM/370 Summary of CP and CMS Commands | GX20-1961 |
| VM/370 OLTSEP and Error Recording Guide | GC20-1809 |
| VM/370 System Messages | GC20-1808 |

2.3 Hardware Information (Available, April 1976)

Ref. Manual for IBM 3830 Storage Control Model 2
Reference Manual for IBM Integrated Storage Control
Introduction to IBM 3350 Direct Access Storage
Reference Manual for IBM 3340/3344 Disk Storage

GA26-1617
GA26-1620
GA26-1638
GA26-1619



SECTION 3: 3350 AND 3344 PRODUCT DESCRIPTION

The 3350 and 3344 DAS subsystems provide for the attachment of multicompatible DAS devices to systems of the System/370 Models 135 and up via attachment to the System/370 architecture. They are based upon 3340 technology, with significant enhancements which transform this technology into totally new DASD products. One key enhancement is an increase in bit and track densities which produces a 3350 spindle with capacities of 200 MB or 317.5 MB, depending upon the format selected by the customer, and a 3344 with 280 MB of capacity per spindle.* Other key enhancements for the 3350 include increased data rate, 1,198 KB/sec., 8.4 ms average latency and reduced seek time, 25 ms average. The 3344 has the same data rate, average access time and average latency as the 3340.

The 3350 and 3344 storage media consist of fixed, sealed, head/disk assembly units. The head and disk components are assembled as units and "fixed" on the drives. Proximity recording heads and the carrier are an integral part of the unit. The head/disk assembly units are removable and field replaceable *only* by customer engineers.

The 3350 consists of dual drive A, B and C units, identified as Models A2, A2F, B2, B2F and C2, C2F. The A2F, B2F and C2F units have the same functional characteristics as the A2, B2 and C2 units respectively, but in addition they feature fixed heads. Throughout this guide, the references to the Models A2, B2 and C2 will be applicable to the Model F also. When there are differences only in the fixed head characteristics, they will be designated.

The 3350 units can be configured into "strings", which are made up of one to four two-spindle disk units, the first one of which must be an A2 unit containing a controller logic module to attach the units to a storage control. Up to three B2 units, or two B2 and one C2 units, may be attached to one A2 unit in increments of two drives for a maximum of eight drives per 3350 string. Single drive units are not available, and only one C2 unit may be configured in a string. (See figure 1.)

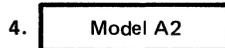
The C2 unit is equipped with a controller logic module and a "Primary/Alternate" toggle switch and indicators that allow the user to place the controller function in the C2 unit as an alternate controller to the controller in the A2 unit. The C2 unit functions as an A2 or B2 unit depending upon the setting of the manual switch on the C2 unit.

The drive functions are basically the same for the A2, B2 and C2 units. They use the 3330 command set. They have the mechanical and electronic systems necessary to drive the disks and to write and read data on them. Access operations on any drive in the string can be overlapped with access or data transfer on any other drive in the string. In addition to the drive functions, the A2 and C2 units have controller capabilities to:

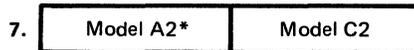
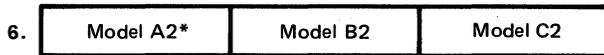
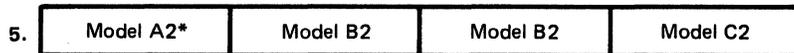
1. Interpret and execute instructions issued by the attachment.
2. Control the attachment and device interfaces.
3. Control the writing and interpretation of the track format on a field basis.
4. Clock and serialize or deserialize data as it transfers between the drive and the attachment.
5. Check the integrity of data through error detection and error correction analysis.
6. Furnish string status to the attachment.
7. Perform diagnostic evaluation of the string.

*Capacities given are approximate only.

Strings with A2 & B2 Models only:



Strings with A2, B2 and C2 Models:



*Required Primary Controller Adapter (No. 1320) on Model A2.

Figure 1. Different types of 3350 strings

All 3350 units include a Selective Format standard feature which allows users to specify 3330-1, 3330-11 or 3350 "native" mode. In 3330-1 compatibility mode, each 3350 spindle is equivalent to two 3330-1 volumes or logical devices; the first one, which has the logical cylinder 0 on real cylinder 0, is called the Primary Logical Device. Track length, cylinder size, and the number of cylinders per volume are the same as 3330-1. The fixed head storage capacity on 3330-1 compatibility mode is associated with the first of the two logical volumes. When 3330-11 compatibility mode is selected, each 3350 spindle is equivalent to a 3330-11 spindle in capacity. Track size and cylinder characteristics are the same as 3330-11. The 3330-1 and 3330-11 data sets can be mapped directly to 3350 without change in capacity when the appropriate format is selected. However, the user must be sure that old 3330-1 and 3330-11 data sets did not overfill the 3330 track capacity (13030 bytes). If the user selects 3350 native format, capacity becomes 317.5 MB per spindle, 635 MB per unit. Format must be specified by the customer when ordering, and changes in format are accomplished by customer engineering through an MES (miscellaneous equipment specifications) procedure. The user must reinitialize the disk with the appropriate utility. This selection may be made on a spindle basis.

The 3344 is a two drive unit which has basically the same drive functions as the 3350 B2 drive unit. There are two 3344 models: B2 and B2F. The second one differs in that it has fixed head capability. The 3344 units have a data rate of 885 KB/sec. 3344 B2 and/or B2F units must be attached to a standard 3340 Model A2 and may be intermixed with 3340 Model B1 and B2 units. A maximum of three B units may be attached to each 3340 Model A2. Throughout this guide, all references to 3344 Model B2 will be applicable to 3344 Model B2F.

Each of the two drives on a 3344 B2 unit is equivalent in format and capacity to that of four 3348 Model 70 Data Modules, four logical volumes, and the capacity is 280 MB per spindle, 560 MB per unit. The fixed head storage capacity on Model B2F is associated with the first of the four logical 3348 Model 70 volumes on each drive.

The 3350 and 3344 offer the Write Protection function. The file provides a switch which allows the operator to prevent writing on the data surfaces. This control is accessible on the operator panel. The function cannot be changed while the file is selected.

Write padding at unit level is provided for the 3350 subsystem. This feature frees the subsystem while the drive erases to the end of the track after a Write Format command.

The command set of the 3350/3344 subsystems is the same as the 3330, but a new command, Read Multiple Count-Key-Data, has been added allowing reading of all records on a track in a single disk revolution.

3.1 Characteristics

Table 1 illustrates the 3350 and 3344 characteristics.

Table 1. 3350/3344 Characteristics

| | 3350 | | | 3344 |
|---|--------------------------------------|---|---------------------------|---|
| | 3350 MODE (PHYSICAL & LOGICAL) | 3330-1 MODE (LOGICAL) (2 PER SPINDLE) | 3330-11 MODE (LOGICAL) | 3340 MODE (LOGICAL) (4 PER SPINDLE) |
| Data Rate (KB/sec.) | 1,198 | 1,198 | 1,198 | 885 |
| Average Latency (ms) | 8.4 | 8.4 | 8.4 | 10.1 |
| Disks/Drive | 8 | 8 | 8 | 8 |
| Data Surfaces per drive (+1 servosurface) | 15 | 15 | 15 | 15 |
| Read/Write Heads per Data Surface | 2 | 2 | 2 | 2 |
| Access Time (ms) | | | | |
| Minimum | 10 | 10 | 10 | 10 |
| Average | 25 | 25 | 25 | 25 |
| Maximum | 50 | 50 | 50 | 50 |
| Logical Cylinders per Drive | | | | |
| Data | 555 | 2x404 | 808 | 4x696 |
| Alternate | 5 | 2x7 | 7 | 4x2 |
| CE | 1 | 1 | 1 | 1 |
| Logical Cylinders per Physical Cylinder | 1 | 3/2 | 3/2 | 5 |
| Tracks (Physical or Logical per Logical Cylinder) | 30 | 19 | 19 | 12 |
| Maximum Data Capacity | | | | |
| per track (bytes) | 19,069 | 13,030 | 13,030 | 8,368 |
| per cylinder (bytes) | 572,070 | 247,570 | 247,570 | 100,416 |
| per spindle (MB) | 317.5 | 200 | 200 | 280 |
| per string (MB) | 2,540 | 1,600 | 1,600 | 1,820 |

One surface contains servo information pre-recorded in the plant for seeking, track following, data clocking, index point signal generation and rotational position signal generation. Fixed-head data is also recorded on this surface.

The 3350 file is initialized before shipment with home address and a standard eight-byte R0 on all tracks.

When ordering, the user must specify the format desired according to the following Specify Format codes:

| | <i>First Drive</i> | <i>Second Drive</i> |
|----------------------------------|--------------------|---------------------|
| 3330 Model 1 Compatibility Mode | #9731 | #9732 |
| 3330 Model 11 Compatibility Mode | #9741 | #9742 |
| 3350 Native Mode | #9751 | #9752 |

All 3350's are shipped formatted in the mode ordered by the customer. If a spindle is to operate in a mode other than ordered, the drive must be reformatting in the field. Specifications must be changed in the machine via an MES procedure that customer engineering can install. The user must run the corresponding reformatting programs. These programs read any defect flags and skip displacement (SD) information recorded during the initial factory formatting operation and then preserve it by rewriting it onto the tracks during reformatting. They also write new CCHH fields and alternate track flags appropriate to the desired mode.

In a similar manner, 3344 drives are formatted in the plant according to 3340 Mode, i.e., with four logical devices per physical drive. No reformatting utilities are needed for 3344's.

All fixed media subassemblies that are returned to the plant after field replacement are retested to original operational specifications. During this process the media is subjected to surface analysis which involves multiple rewrites of test data on all data storage surfaces. When the fixed media subassembly is returned to service, the disk surfaces contain only head and cylinder address data and pad characters.

Table 2 shows a comparison of the 3350 with other IBM DASDs.

Table 2. Device Characteristics Comparison

| PARAMETER | 3350 | 3330 | 3340-70 | 2314 |
|------------------------------|---------|------------|---------|---------|
| Access Time (ms) | | | | |
| Minimum | 10 | 10 | 10 | 25 |
| Average | 25 | 30 | 25 | 60 |
| Maximum | 50 | 55 | 50 | 130 |
| Rotation Time (MS) | 16.7 | 16.7 | 20.24 | 25.0 |
| Data Transfer Rate (KB/sec.) | 1,198 | 806 | 885 | 312 |
| MB Capacity (per spindle) | 317.5 | 100 or 200 | 70 | 29.2 |
| Cylinders (per spindle) | 555 | 404 or 808 | 696 | 200 |
| Tracks/Cylinder | 30 | 19 | 12 | 20 |
| Bytes/Track | 19,069 | 13,030 | 8,368 | 7,294 |
| Bytes/Cylinder | 572,070 | 247,570 | 100,416 | 145,880 |

3.2 Fixed-Head Models

Fixed-head capability is provided to 3350/3344 users on System/370 Virtual Storage Systems from Model 135 up.

Fixed heads are available on 3350 Models A2F, B2F and C2F and 3344 Model B2F. The characteristics of those models are the same as those of the Models A2, B2 and C2 except that cylinders 1 through 10 on 3344, cylinders 1 through 3 on 3350 in 3330-1/3330-11 compatibility mode and cylinders 1 and 2 on 3350 in native mode have been relocated to a single disk surface. These cylinders are addressed only by the fixed heads. The remaining cylinders stay in their current locations and are addressed by the movable heads. Capacity under the fixed heads is *not* additive to the total capacity.

The number of cylinders and the amount of available storage are functions of the format and/or device being utilized:

(a) 3344:

There are two logical tracks per physical track; therefore, there are a total of 120 logical tracks under the fixed heads. There are 12 tracks per logical cylinder; thus, there are 10 logical cylinders assigned to the fixed heads. They are assigned cylinders 1 through 10 of the Primary Logical Device *only*. Capacity under the fixed heads is approximately 1.0 MB per spindle or 2.0 MB per unit.

(b) 3350 in 3330-1/3330-11 Format:

There is one logical track per physical track; therefore, there are 57 logical tracks under the fixed heads. There are 19 heads per cylinder; therefore, the fixed data heads have access to three 3330 cylinders. They are assigned cylinders 1 through 3. NOTE: In 3330-1 mode, the fixed head tracks are associated with the Primary Logical Device *only*. Capacity under the fixed heads is approximately 0.74 MB per spindle or 1.48 MB per unit.

(c) 3350 Native Format:

The 3350 has one logical track per physical track. The fixed heads, therefore, record on 60 logical tracks. In 3350 format there are 30 tracks per cylinder, which yields two 3350 cylinders for fixed heads. Because of the increased track capacity with 3350, fixed head feature capacity will increase to 1.14 MB per spindle or 2.28 MB per unit.

The relocation of cylinders under fixed heads does not prohibit overlapping data sets in the fixed and movable head areas of 3350/3344. However, as a single drive can perform only one operation at a time, seek, search and data transfer cannot be overlapped between the fixed and movable heads.

The fixed data heads are mounted so as to read and write on the servo surface. This surface has a lower bit density than any area of the disk and the track width is greater than the tracks under movable heads. The probability of track defects under fixed heads is very low. Consequently, alternate tracks are not provided under fixed heads.

If, however, an unrecoverable error (hard error) is indicated on a fixed head track, it must be determined that the hard error is due to a defective track. (A write error caused by some transient condition can result in a hard error that may be misjudged as a defective track.)

To determine if a track has a permanent defect, the track should be flagged and an alternate track assigned using OS/VS system utility IEHATLAS (where data recovery is desired) or IEHDASDR, or the independent utility IBCDASDI. IEHDASDR or IBCDASDI may then be used to test the track. If the track is not defective, the flag is removed and the assigned alternate track is released. If the track is defective, the user may assign an alternate track under movable heads.

Programming support for the 3350 or 3344 with fixed heads is the same as for the 3350 or 3344 disk storage and therefore no explicit programming support is provided. Programming support does not distinguish between a device with fixed heads and one without fixed heads. The user may place system files as well as his own programs and data files in the fixed head area to take advantage of the increased device performance. It will be up to the user to utilize the fixed heads according to his application needs consistent with the capability of his operating system to allocate implicitly or explicitly the space available under the fixed heads. (See Section 6.4 for considerations on the use of this capability.)

3.3 Features

3.3.1 General

The 3350 DAS facility requires two new features, Expanded Control Store (#2151 or #2152) and Register Expansion (#6111), when attached via a 3830-2 or Integrated Storage Control (ISC). Control Store Extension (#2150) is a prerequisite for Expanded Control Store (#2151).

These features provide additional control storage and registers for microprogramming use on the 3830-2 or ISCs. The 3344 requires only Control Store Extension (#2150) and Register Expansion (#6111).

When 3350/3344 is attached to System/370 Model 168, or 165-2, Control Words (Feature #3851 or #3852) may be required on the 2880 Block Multiplexer Channel depending on the number of control units and addressing requirements (see Section 4.6).

3.3.2 Optional Features

Optional features presently supporting the 3330 and 3340 DASDs apply to 3350 and 3344.

3.3.2.1 String Switch Feature (#8150)

Throughout this document the word "string" will refer to one to four two-spindle disk drive units, one of which must contain a controller logic module to attach the drive units to a storage control.

The String Switch is an optional feature of the 3350 and 3340/3344 subsystems. When installed, a string of 3350 or 3340/3344 drives can be *attached to* and *shared between* two control interfaces on a dynamic basis under system program control. (OS/V5 provides shared DASD, i.e., uses Reserve/Release Commands.)

3.3.2.2 Primary Controller Adapter Feature (#1320)

The Primary Controller Adapter Feature provides for the manual switching of all drives in a 3350 string between controller functions of a Model A2 and a Model C2. With this feature installed on the Model A2, a string must consist of a Model A2 and a Model C2 with 0, 1 or 2 Model B2s. The C2 unit is located at the opposite end of the string from the A2 unit. The use of this feature does not affect the addressing of the string or devices therein.

A manual switch on the C2 unit allows the user to select which unit, A2 or C2, is to be the online controller. At any given time, all drives, but only one controller function, may be online running user programs. The A2 or C2 unit whose controller is not active functions as a B2 unit.

A significant advantage of the Primary Controller Adapter use is increased data availability. The user maintains access to all data in the 3350 string through the second control function if the primary becomes inoperative. Maintenance on the inoperative control function may be deferred to an appropriate time. The repair actions may be performed while the string is active. When diagnostic tests are performed, one of the drives in the string must be in customer engineering mode.

The manual switch can be activated only when power is off in both controllers and may require a re-IPL of the system. At the time of controller failure individual drive status and data may have been lost. Appropriate customer recovery actions must be taken after manually switching to the second controller. These recovery procedures will be the same as now used when a 3333 control function becomes inoperative. String Switch may be installed on both A2 and C2 units in a string and will operate in normal manner. If String Switch is on the "A Box" in a string it is recommended that it be installed on the "C Box" in that string.

3.3.3 Feature Attachment

Table 3 lists standard and optional features available with 3350 and 3340/3344 subsystems. The table is intended to indicate features available with 3350/3344 by attachment type.

Table 3. Feature Attachment

| 3350/3344 FEATURE | 135 IFA | 145, 158, 168 ISC | 3830-2 |
|---|---------|-------------------|--------|
| String Switch | Yes | Yes | Yes |
| Primary Controller Adapter* | No | Yes | Yes |
| Intermix | No | Yes* | Yes* |
| RPS | Yes | Yes | Yes |
| Two Ch. Switch | No | Yes | Yes |
| Four Ch. Switch | No | No | Yes |
| Remote Switch | No | Yes | Yes |
| Write Format Release* | No | Yes | Yes |
| *Not available when 3344 units are specified. | | | |

3.4 Model Changes

Field conversion to 3350 or 3344 from 3330 or 3340 units is not possible. Conversion from 3344 B2 units to 3350 A2 or B2 units is not possible.

Model changes between 3350 A2 or C2 and B2 units are available at time of manufacture only. Conversion between 3350 C2/C2F units and corresponding 3350 A2/A2F units is not recommended for field installation. Model changes between A2 and A2F units, B2 and B2F units or C2 and C2F units are field installable.

Following is a summary of the only possible changes:

| | <u>From 3350 Model</u> | | | <u>To 3350 Model</u> | | | |
|-----|------------------------|----|----|----------------------|-----|-----|--|
| | A2 | B2 | C2 | A2F | B2F | C2F | |
| A2 | — | TM | NR | FI | TM | NR | |
| B2 | TM | — | TM | TM | FI | TM | |
| C2 | NR | TM | — | NR | TM | FI | |
| A2F | FI | TM | NR | — | TM | NR | |
| B2F | TM | FI | TM | TM | — | TM | |
| C2F | NR | TM | FI | NR | TM | — | |

TM: Model changes available at Time of Manufacture only.
 NR: Model changes Not Recommended for field installation.
 FI: Model changes that are Field Installable.

3.5 Compatibility

The 3350 has been designed to minimize customer conversion effort. The Selective Format standard feature specifically provides format compatibility in 3330-1 or 3330-11 mode. Compatibility is provided in 3340 mode by the 3344 units at 885 KB data rate.

3330-1 Format

When the 3330-1 mode is selected, each 3350 spindle becomes logically two 3330-1 volumes. Track and cylinder capacity are the same as 3330-1. 3350 data rates and access times are the same in 3330-1 mode as in native mode, representing an enhancement to the 3330-1 function.

3330-11 Format

When 3350 is operating in 3330-11 mode, the format is identical to 3330-11. Track size, number of tracks per cylinder, and number of cylinders per volume are the same. As in 3330-1 format, other characteristics such as improved data rate and access time are the same as 3350 native.

Format conversion from 3330 mode to 3350 mode is a straightforward, uncomplicated procedure. By request of the user through an MES procedure, customer engineering will make the appropriate modifications and necessary tests on the drive and, after that, the user will initialize the drive in 3350 native format.

3344

A 3344 is similar to a standard 3340 except that each spindle has four logical volumes, each of which is equivalent to a 3348 Model 70. It may be used as if it were a standard 3340 taking advantage of increased capacity resulting from increased cylinders. There are five logical cylinders of 3340 per physical 3344 cylinder,

3.5.1 3830-2: 145, 158 168 ISC Configurations

Native Mode

When used in native mode up to four strings of 3350 can be attached to a 3830-2 or each data path of an ISC. Note: 158/168 ISC is dual path.

3330-1/3330-11 Compatibility

In situations where 3330-1 or 3330-11 format is used, the maximum number of strings remains four. Of these four, any or all strings can be in compatibility mode.

Format selection is possible on an individual spindle basis. Intermix of 3350 native and 3350 in compatibility mode is possible in the same string. But, for addressing purposes, if one spindle in a string has format set for 3330-1, the complete string is considered to be in mixed mode. (See Section 4.6.)

3344 Configuration

There are a maximum of 64 addresses per ISC path or 3830. A maximum of two strings (strings 0 and 2) may contain 3344's. Two strings of 3344 require 52 addresses. The remaining twelve addresses can be 3340 but string 3 is limited to four real 3340 spindles.

3.5.2 135 IFA Configurations

The 3344 can be attached to a 135 IFA. Unit addressing on the 135 has been expanded so that 34 logical units can be addressed. Present 3340 units utilize two logical addresses. The 3344 units use eight logical addresses, one per logical volume. Any combination of current 3340 units and 3344 units can be attached, with the limitation that *only* one string (string 0) can contain 3344 units. The maximum capacity per 135 IFA system with 3340's and 3344's comes up to approximately 2380 MB.

3.5.3 145 Configurations

Word Buffer (Feature #8810) is required when 3340 drives are attached. 3344 has the same data rate as the 3340; therefore, Word Buffer is also required in 3340/3344 configurations. It is also required for 3350 configurations.

SECTION 4: HARDWARE PLANNING CONSIDERATIONS

The successful installation of a 3350 or 3340/3344 subsystem requires careful planning.

Notify the customer engineering representative early in the planning stages of the installation. An early conference should be helpful to all concerned.

Many of the preliminary methods and procedures explained in this document will aid in developing a plan tailored to the specific installation.

4.1 Attachment

Attachment of the 3350/3344 subsystem to System/370 requires previous installation of one of the following:

- 3830-2 Storage Control
- Integrated File Adapter (Model 135)
- Integrated Storage Control (Model 145, 158, or 168)

The attachment to the different systems is shown in Table 4.

Table 4. System Attachment

| MODEL | ATTACHMENT VIA | | 3830-2 |
|--|----------------|-----|--------|
| | IFA | ISC | |
| 135 | X* | | X** |
| 145 | | X | X |
| 155-2 | | | X |
| 158 | | X | X |
| 165-2 | | | X |
| 168 | | X | X |
| *3344 only. | | | |
| **3350 only. Attachment of 3344 B2 may be requested as an RPQ. | | | |

Attachment of 3350 A2, B2 and C2 units requires Control Store Extension (#2150), Expanded Control Store (#2151), and Register Expansion (#6111) features on 158, 168 ISCs or 3830-2. Primary Controller Adapter (#1320) feature on A2 unit is corequisite to attach a C2 unit to the string.

Attachment of 3350 A2, B2 and C2 units on 145 ISC or 3345 Models 3, 4, and 5 ISCs requires Expanded Control Store (#2152) and Register Expansion (#6111). In this attachment, Control Store Extension (#2150) is not required. A 145 ISC requires Word Buffer feature (#8810) on the CPU to attach 3350's. Primary Controller Adapter (#1320) feature on A2 unit is corequisite to attach a C2 unit to the string.

The 3344 B2 must be attached to a 3340 A2 which in turn attaches to an IFA, ISC, or 3830-2. On Model 135 this is only possible through IFA. (See note at end of Table 4.) The ISC and 3830-2 require Control Store Extension (#2150) and Register Expansion (#6111).

See Section 4.5 for configuration combinations.

4.2 Power and Air Conditioning

The 3350 or 3344 requires about 44% less power per unit than the 3330-1 or 3330-11. A reduced power requirement translates to a reduced air conditioning load, which, in turn, can also reduce power consumption.

Refer to the System/370 Installation Manual—Physical Planning for detail information.

4.3 Space and Cable Requirements

Compared to 3330-1/3330-11, the 3350 or 3344 requires about 20% less space in subsystem configurations consisting of eight drives.

Table 5 illustrates the space saving capability of the 3350 over 3330-1/3330-11 assuming installation requirements of about 4800 MB online capacity.

Table 5. Space Saving Capability

| | INSTALLATION CAPACITY (MB) | FLOOR SPACE REQUIRED | | MB PER SQ. FT. | MB PER SQ.MET. | SPINDLES REQUIRED |
|-----------------|----------------------------|----------------------|------------|----------------|----------------|-------------------|
| | | (SQ. FT.) | (SQ. MET.) | | | |
| 3330-1 | 4800 | 763 | 70.5 | 6.3 | 68 | 48 |
| 3330-11 | 4800 | 382 | 35.3 | 12.6 | 136 | 24 |
| 3350/ Native | 5080 | 197 | 18.2 | 25.8 | 278 | 16 |

In terms of space, the 3350 requires about one-fourth that of the 3330-1 and one-half that of the 3330-11, assuming the above installation requirements.

A signal cable from the signal source to the unit(s) containing the controller (3350 A2 or C2) is necessary. The signal source may be the storage control or the intervening controller of the same or another string attached to the same storage control.

A maximum cumulative length of 200 feet (60.8 meters) of signal cable is available to connect up to eight controllers to a storage control data path. A maximum of four A2 units and four C2 units may be connected.

Refer to System/370 Installation Manual Physical Planning for detail information.

4.4 Acoustics

The perceived noise level of the 3350/3344 is approximately 40% less than the 3333/3330.

4.5 DASD Attachment Configurations

Current DASD subsystems contain many interdependencies between disk drive and attachments. If configuration changes are to be made concurrently with the 3350 or 3344 installation, Tables 6 and 7 should be used to check the feature and specifications requirements. These tables illustrate the device/feature combinations supported and the associated control store requirement. Full support is obtained with Expanded Control Store.

Table 6. 3350. Attachment and Function Supported

| ATTACHMENT | FUNCTION SUPPORTED | ATTACHMENT SPECIFICATIONS REQUIRED |
|---|--|--|
| 3830-2/ISC (Note 1) | 3350/3330-1 Format 3350/3330-11 Format 3350 Native Format Basic 3340 3330/3340 Intermix Fixed Head Feature (Note 2) String Switch (Note 3) Two Channel Switch Four Channel Switch* | Expanded Control Store – 8K Feature #2151 (or # 2152 for 145 ISC) and Register Expansion Feat. # 6111 (Note 4) |
| <p>*Not available on ISC.</p> <p>Note 1: The 145 ISC is available either as Feature 4660 on the 145 or as a 3345 Model 3, 4, or 5. The 158/168 ISC is available as Feature 4650. Specify Feature # 9318 must be ordered on 3830-2 or 145 ISC, 158 ISC, 168 ISC, 3345 Models 3, 4, 5.</p> <p>Note 2: 3350 Models A2F, B2F and C2F and any 3340 with Fixed Head Feature (# 4301/4302).</p> <p>Note 3: 3350 Models A2/A2F and C2/C2F must specify String Switch No. 8150 if the function is desired.</p> <p>Note 4: Control Store Extension, No. 2150 is prerequisite for Expanded Control Store # 2151.</p> | | |

Table 7. 3344. Attachment and Function Supported

| ATTACHMENT | FUNCTION SUPPORTED | ATTACHMENT SPECIFICATIONS REQUIRED |
|---|---|---|
| 3830-2/ISC (Note 1) | 3344/3340 Format Basic 3340 Fixed Head Feature (Note 2) String Switch (Note 3) Two Channel Switch Four Channel Switch* | Control Store Extension – 6K Feature # 2150 and Register Expansion Feature # 6111 |
| 135 IFA (Note 1) | 3344/3340 Format Fixed Head Feature (Note 2) String Switch Feature (Note 3) 3340/3344 Attached | Note 4. |
| <p>*Not available on ISC</p> <p>Note 1: The 145 ISC is available either as Feature 4660 on 145-2 or as a 3345 Model 3, 4, or 5. The 158/168 ISC is available as Feature 4650. The 135 IFA is Feature 4655.</p> <p>Specify feature #9317 must be ordered on the attachment.</p> <p>Note 2: 3340 with Fixed Head feature (# 4301/4302) and 3344 Model B2F only.</p> <p>Note 3: 3340-A2 must specify String Switch No. 8150 if the function is desired.</p> <p>Note 4: 3344 attachment requires 2200 bytes of control storage.</p> | | |

4.6 Addressing Considerations

In order to take advantage of existing application programs which are written for 3330 and 3340 DASD, there is provision in the storage control to emulate these devices on 3350/3344.

3350 spindles may be run in one of three different modes: 3330 Model 1 compatibility mode, 3330 Model 11 compatibility mode, or 3350 native mode.

In 3330 Model 1 compatibility mode, a single 3350 physical device is treated as two 3330 Model 1 logical devices. Each logical 3330 Model 1 volume is made equivalent to a real 3330 Model 1 volume in terms of track capacity, track format, track/cylinder ratio and pack capacity.

In 3330 Model 11 compatibility mode, the ratio is one to one; a single 3350 spindle is used as a single 3330 Model 11 drive.

In 3350 native mode, the spindle again is used as a single logical device.

4.6.1 3350 Addressing

The device address (I/O unit address) used by the system to select a particular unit is an *8-bit byte plus parity*. These bits are utilized as described below.

| STORAGE CONTROL | | DEVICE | | | | | |
|-----------------|---|------------------|--------|---|-----------------|---|---|
| | | SECONDARY DEVICE | STRING | | PHYSICAL DEVICE | | |
| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

Bits 0 and 1 are the storage control address bits. If these two bits address a nonexistent storage control, Select Out will be propagated, resulting in condition code 3 (Not Operational).

Bit 2 has a double function, depending upon the string configuration. If no 3350 in 3330 Model 1 compatibility mode is attached on the storage control unit, bit 2 functions together with bits 0 and 1 as a storage control address bit. If any 3350 drive is in 3330 Model 1 compatibility mode, bit 2 is used to select the proper "logical" device on the drive. When bit 2 is "on", the secondary logical device is addressed.

Bits 3 and 4 are the string address bits. Thus, a maximum of four strings may be attached to any given storage control. Each of these four strings may be either of two general types of strings, herein called a "mixed-mode" string and a "real" string.

The spindles of a "mixed-mode" string must all be 3350's, and they may be independently assigned to operate in any combination of 3350 mode, 3330 Model 1 compatibility mode, or 3330 Model 11 compatibility mode.

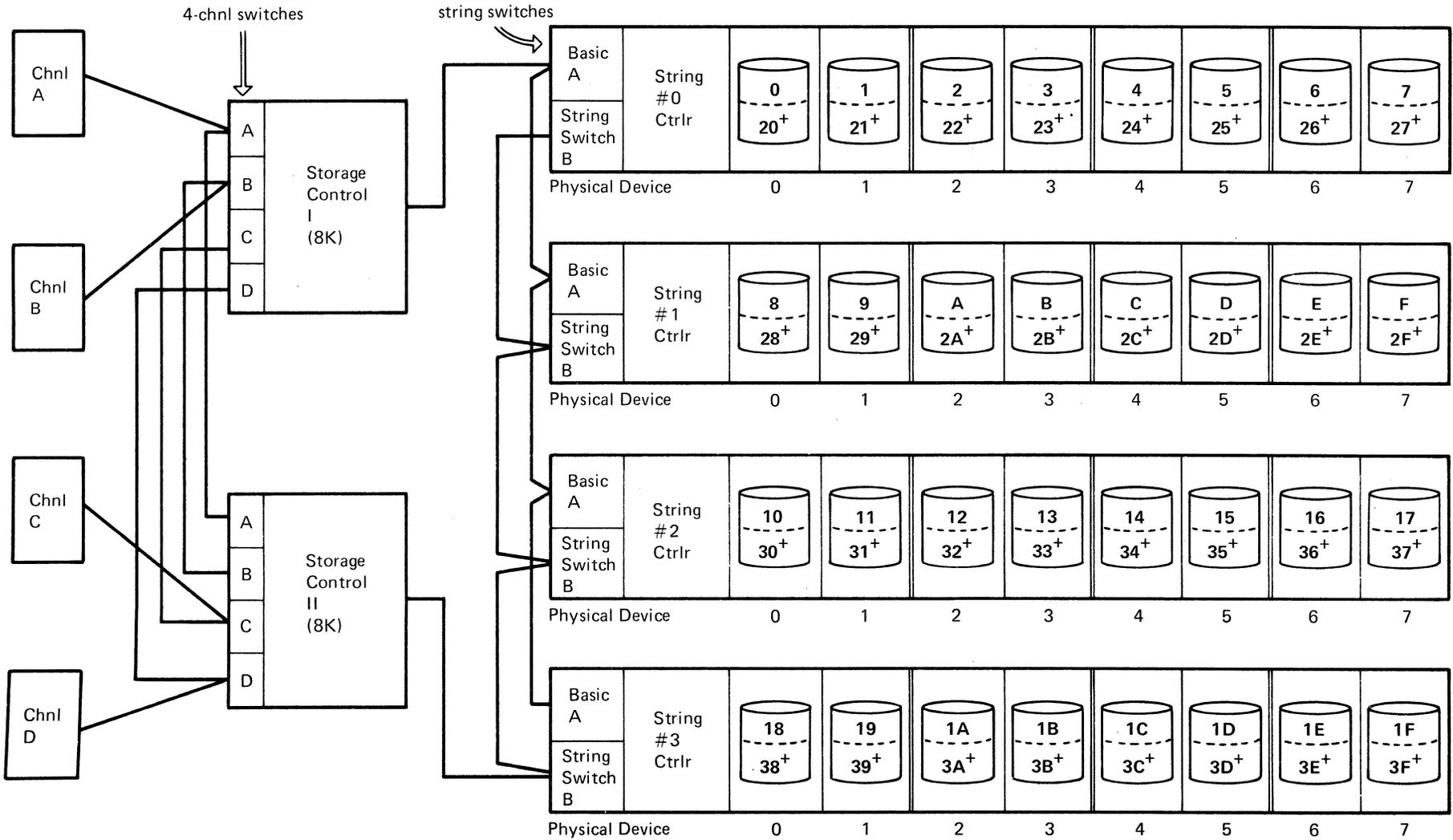
The spindles of a "real" string may not be in compatibility mode and may not be of mixed types. Each "real" string must contain only 3350's, or only 3330's, or only 3340's (not 3344's).

If these two bits refer to a string which is non-existent, is powered off, or is "disabled" by the String Switch feature, then the storage control will propagate Select Out, and a condition code 3 (Not Operational) will result.

Bits 5-7 give the physical device (i.e., drive or spindle) addresses within each string. If an addressed device within a properly selected string is nonexistent or is powered off, then Unit Check with Intervention Required will result.

Addresses of storage control units, of controllers (i.e., of string), and of individual physical units in a string are assigned by the CE at the time of installation.

Figure 2 shows the addressing requirements for the maximum configuration attachable to a storage control. The address inputs to the storage control units are left unplugged for bits 2, 3, and 4, thus allowing the complete set of 64 valid addresses to be sent to the set of strings. (See Table 8.)



+ Secondary address; is valid only if that spindle is a 3350 in 3330 Mdl. 1 compatibility mode.
 Example: Assuming the address of control unit I is X'14' (channel 1, control unit 4), the addresses of device 4 on string 2 should be: Primary Address X'154'; Secondary Address X'174'.

Figure 2. Address requirements for 3350

The following statements apply to device attachment:

1. Real and compatibility devices may attach to all four strings.
2. On a string in 3330 Model 1 compatibility mode, the lower address (e.g., 140) is primary and the higher address (e.g., 160) is secondary on the same physical spindle.
3. Real devices or 3350 in 3330 Model 11 compatibility mode attach to the primary addresses.
4. Different device types (e.g., 3330, 3340 or 3350) do not attach to the same string.

Configurations requiring a maximum of 8, 16, or 32 addresses are subsets of this maximum configuration, and they may be obtained by the selective plugging of address jumpers for bits 2, 3, and/or 4 at the inputs of the storage control and plugging a matching set at all channel inputs of the corresponding controller.

Table 8 illustrates examples of plugging that will require fewer than 64 addresses. Strings must meet the restrictions given above. Note that if either three or four strings are attached to a storage control, neither bit 3 nor 4 may be plugged.

Table 8. Device Addressing for 3350 and Related Subsystems

| NO. OF STRINGS | TYPES OF STRINGS | STRING ADDRESSES* | BIT SELECTION** | | | NUMBER OF ADDRESSES | ADDRESS RANGES |
|----------------|-------------------|-------------------|-----------------|--------|--------|---------------------|---|
| | | | BIT 2 | BIT 3 | BIT 4 | | |
| Up to 4 | At least one B | 0, 1, 2, 3 | N | N | N | 64 | 00 - 3F |
| Up to 4 | A | 0, 1, 2, 3 | 0 1 | N N | N N | 32 32 | 00 - 1F or 20 - 3F |
| Up to 2 | A | 0, 1 | 0 1 | 0 0 | N N | 16 16 | 00 - 0F or 20 - 2F |
| | | 2, 3 | 0 1 | 1 1 | N N | 16 16 | 10 - 1F or 30 - 3F |
| | | 0, 2 | 0 1 | N N | 0 0 | 16 16 | 00 - 07, 10 - 17 or 20 - 27, 30 - 37 |
| | | 1, 3 | 0 1 | N N | 1 1 | 16 16 | 08 - 0F, 18 - 1F or 28 - 2F, 38 - 3F |
| 1 | A | 0 | 0 1 | 0 0 | 0 0 | 8 8 | 00 - 07 or 20 - 27 |
| | | 1 | 0 1 | 0 0 | 1 1 | 8 8 | 08 - 0F or 28 - 2F |
| | | 2 | 0 1 | 1 1 | 0 0 | 8 8 | 10 - 17 or 30 - 37 |
| | | 3 | 0 1 | 1 1 | 1 1 | 8 8 | 18 - 1F or 38 - 3F |
| Up to 2 | A and B or only B | 0, 1 | N | 0 | N | 32 | 00 - 0F, 20 - 2F |
| | | 2, 3 | N | 1 | N | 32 | 10 - 1F, 30 - 3F |
| | | 0, 2 | N | N | 0 | 32 | 00 - 07, 10 - 17, 20 - 27, 30 - 37 |
| | | 1, 3 | N | N | 1 | 32 | 08 - 0F, 18 - 1F, 28 - 2F, 38 - 3F |
| 1 | B | 0 | N | 0 | 0 | 16 | 00 - 07, 20 - 27 |
| | | 1 | N | 0 | 1 | 16 | 08 - 0F, 28 - 2F |
| | | 2 | N | 1 | 0 | 16 | 10 - 17, 30 - 37 |
| | | 3 | N | 1 | 1 | 16 | 18 - 1F, 38 - 3F |

*A = Actual 3333/3330 string or actual 3340 string (no 3344's), or 3350 string (no drives in 3330 Model 1 compatibility mode).

B = 3350 string with one or more drives in 3330 Model 1 compatibility mode.

**N = Not set; may be zero or one.

0 = Bit set to zero on address selection card.

1 = Bit set to one on address selection card.

Important

In Table 8, the number of addresses column refers to the number of addresses that the control unit uses whether or not the physical drives are attached. For example, if the user has on the same control unit two 3330 Model 1 drives on addresses 150-151 and two 3350 Native drives on addresses 140-141, the 16 addresses 140-147 and 150-157 are preempted by that control unit and are not available to any other control unit on that channel.

Of particular significance is the fact that the Starter System recognizes only specific addresses. In some cases, this circumstance forces the choice of an address range bigger than the number of strings or drives attached to that control unit. For instance, assume an OS/VS1 user who has a 3330 Model 1 string and a 3350 Native string and desires that both strings be attached to the same control unit on addresses supported by the Starter System (150-153 for 3330 Model 1 and 148-14B for 3350). Although there are only two strings to be attached, there does not exist any valid 16-address combination which includes the 150-157 and 148-14F addresses. In this case the user must use the whole range of 32 addresses, 140-15F. These addresses will not be available to any other control unit on that channel.

Normally, the user who wants to increase storage capacity by adding 3350 in compatibility mode will have other DASDs installed. Assume a user who has 16 spindles of 3330 Model 11 installed in two strings on a 3830-2 at Starter System addresses, i.e., 150 through 15F. From 2 to 16 spindles of 3350 in 3330 Model 11 compatibility mode can be attached at 140-14F. (See Appendix A.)

The same considerations apply to the user who wants to add 3350 in 3330 Model 1 compatibility mode. There is, however, one additional requirement in this case. Since each 3350 spindle emulates two 3330 Model 1 spindles, two addresses are required. For instance, if a user has two 3330 Model 1 strings on a 3830-2 control unit at addresses 150-157 and 158-15F, he may attach to the same control unit up to two more 3350 strings in 3330 Model 1 compatibility mode at addresses 140-147 and 148-14F. Attachment of the 3350's at 140-147 also requires addresses 160-167 for the second logical devices. Attachment of the 3350's at 148-14F also requires addresses 168-16F for the second logical devices. In the same way, the address range 170-17F would be preempted even though they were not actually required for secondary addressing. All addresses in the range from 140 through 17F are unavailable for use in the system for any other devices, since the control unit preempts the entire range in the case of this maximum configuration of 3330 Model 1 compatibility.

The user wanting to add 3350's in native mode may attach the first string to either 140-147 or 148-14F. The second string will attach to the unused string position. Since the starter system supports 148-14B for VS1 and 148-14D for VS2, it is recommended that this string be attached first.

The user may increase storage capacity by replacing a string of current DASD with 3350's in a matching compatibility mode. A user who has 16 spindles of 3330 at 150-15F may reserve the first string at 150-157 and attach the 3350's at 158-15F in either 3330 Model 1 or 3330 Model 11 mode.

If the user replaced it by 3330 Model 1 compatibility mode, addresses 170-17F would have to be available to the control unit and could not be used for any other device. Note, however, that this storage control unit has not used addresses 140-14F. Consequently, the secondary addresses 160-16F have also not been preempted. As a result, these four ranges of addresses (140-147, 148-14F, 160-167 and 168-16F) could be used by other storage control units on the same channel. The user of SCP releases which support 3350 would not be required to perform an I/O GEN in the best case if the device replaced was 3330 Model 11. An I/O GEN would be required to provide the additional addresses if the replaced device was 3330 Model 1.

If the 3350's to be added were to be native mode, then they could replace either string of 3330 after an I/O GEN to provide the proper control blocks at the assigned addresses. Alternatively, if the user has planned for 3350 installation and has provided control blocks in his initial system generation at 140-14F for 3350, then he need only attach the devices.

4.6.2 3344 Addressing

The 3344 is supported in 3340 compatibility mode. Operating in this manner, a single 3344 spindle is made to look like four separate 3340 devices, each one containing a nonremovable 3348 Model 70 Data Module equivalent.

The 3344 is available in the B2 model only. As such, it attaches to the standard 3340 A2 so that the first two drives in a string containing any 3344 units are always standard 3340 devices. Within a string, there are no further restrictions; that is, 3344 B2s and 3340 B2s and B1s may be intermixed (subject to a limit of three B units maximum). From the system viewpoint, the devices in the subsystem are addressed through an eight-bit device address as follows:



For subsystems attached through a channel and storage control, bits 0 and 1 are used for the storage control address. Note that the maximum number of control unit addresses on a channel with this addressing is therefore limited to four. If these two bits address a nonexistent storage control, Select Out will be propagated, resulting in condition code 3 (Not Operational).

The remainder of the address byte, bits 2 through 7, are modifier bits used to select a particular logical device. The storage control handles the mapping of these bits into the physical string, spindle, and cylinder range appropriate to the logical device address. Thus, from the system viewpoint, there can be a maximum of 64 devices per storage control unit.

The device address transformation requires that 3344 boxes be attached to strings 0 and 2 only. Because of the upper limit of 64 device addresses, string 3 is limited to a maximum of four 3340 spindles. The maximum possible configuration using the 3830-2 or ISC attachment is shown in Figure 3. Only real 3340's and 3344's may be attached to such a storage control.

If a string is addressed which is nonexistent, is powered off, or is "disabled" by the string switch feature, then the storage control will propagate Select Out, and condition code 3 (Not Operational) will result.

The following statements apply to device attachment:

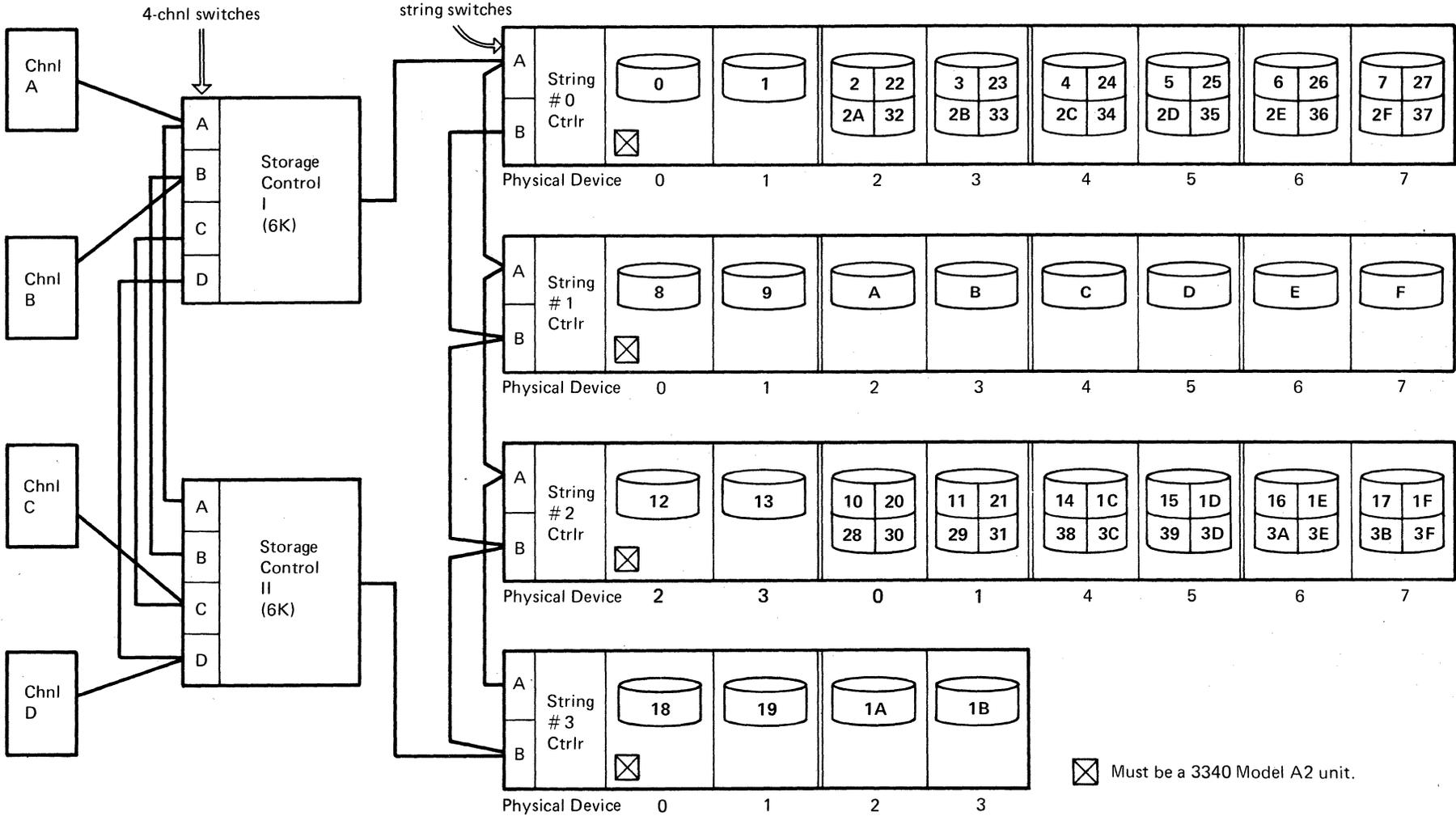
1. The first unit attached on all strings is a 3340-A2.
2. On strings 0 and 2, one, two, or three 3340-B2's or 3344 B2's may attach in any order or combination. One 3340 B1 may replace one B2 at the end of the string.
3. On string 1, one, two or three 3340's Model B1 or B2 may be attached in any combination.
4. On string 3 one 3340 Model B1 or B2 may be attached.
5. 3340/3344 precludes 3330 and 3350 attachment.

Since 3344 boxes may be intermixed with standard 3340's on the same string, it is possible for some of the logical addresses to be invalid. Where such an invalid or unused logical device (i.e., 28 through 63) is addressed, unit check with intervention required will result.

Because of the special characteristics of the address transformation algorithm, *the addresses for the 3344 are fixed and must be as shown in Figure 3.*

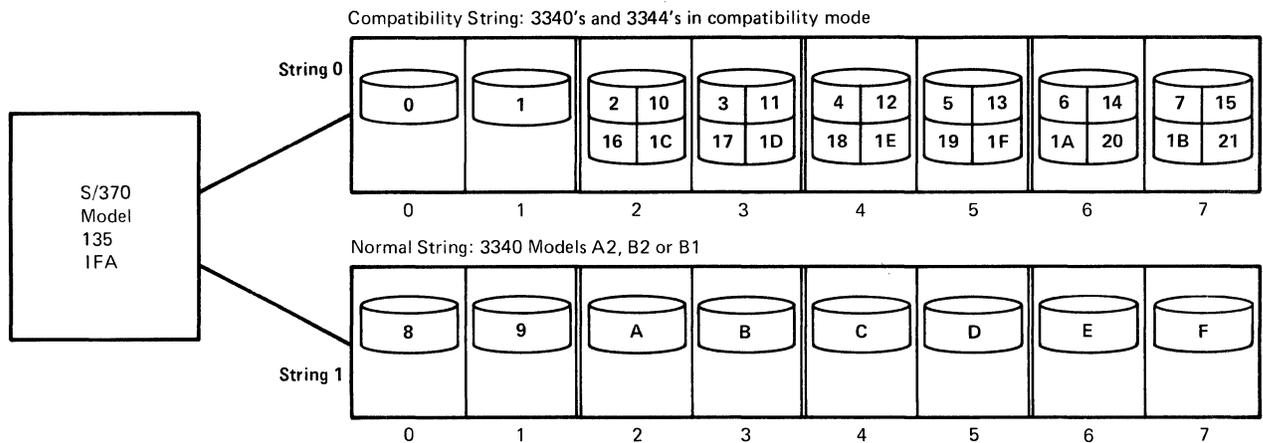
Because of the addressing requirements, the addition of the first 3344 module preempts the entire range of addresses possible on the control unit, e.g., 1C0 through 1FF. The user's current configuration may have to be changed to accommodate the address requirements, even though he does not install the maximum configuration. It may not be possible, even with careful planning, to include in his new configuration all of the addresses which he had previously, unless the maximum or near maximum configuration is installed.

Figure 4 shows the maximum configuration possible on the System/370 Model 135 IFA. Since the IFA preempts all channel 1 addresses, the number of addresses required is not pertinent.



Example: Assuming the address of control unit I is X'14', the addresses of drive 5 on string 0 should be: X'145', X'165', X'16D', and X'175'.

Figure 3. Address requirements for 3344



Example: Since the first device on string 0 is always X'1C0', the addresses of device 6 on the same string should be X'1C6', X'1D4', X'1DA' and X'1E0'.

Figure 4. Address requirements on the 135 IFA

The following statements apply to device attachment:

1. The first unit attached on each string is a 3340-A2.
2. On string 0, one, two or three 3340-B2's or 3344 B2's may attach in any order or combination. One 3340 B1 may replace one B2 at the end of the string. The eight addresses assigned to a 3344 unit are determined by its physical position in the string.
3. On string 1, one, two or three 3340-B1 or B2 units may be attached.
4. A 3330 string cannot be intermixed with a 3340 string containing the 3344.

4.6.3 Seek Addresses and Address Conversion

When a valid logical seek argument is received by the storage control, it is converted into the appropriate physical seek address according to the current selected mode of operation. These physical addresses are used to instruct the drive for seek operations. Refer to Figure 5 in connection with the following paragraphs.

In 3350 mode, the conversion mapping is one to one. That is, the logical cylinder and head address are equal to the physical cylinder and head address.

The seek limits are:

| | |
|----------------------|---------|
| Cylinders: | 0-559 |
| Heads: | 0-29 |
| Alternate Cylinders: | 555-559 |

In the Models A2F, B2F and C2F all of cylinders 1 and 2 (tracks 0-29) are located under the fixed heads.

In 3330-11 compatibility mode, the mapping is three to two. Three 3330-11 cylinders occupy two physical 3350 cylinders. The resulting 3330-11 seek limits are:

| | |
|----------------------|---------|
| Cylinders: | 0-814 |
| Heads: | 0-18 |
| Alternate Cylinders: | 808-814 |

In models with fixed heads, all 19 tracks of each (logical) cylinder 1-3 are under the fixed heads.

In 3330-1 compatibility mode, the translation is again three to two. However, there are two 3330-1 logical devices on the 3350 spindle. When the secondary 3330-1 device is addressed, an offset is added to its converted seek address. Thus, logical cylinder 0 of the secondary device is located on physical cylinder 274. The 3330-1 seek limits are:

| | |
|----------------------|---------|
| Cylinders: | 0-410 |
| Heads: | 0-18 |
| Alternate Cylinders: | 404-410 |

In models A2F, B2F and C2F, all 19 tracks of each (logical) cylinder 1-3 (on the Primary device only) are under the fixed heads.

The CE tracks are located on *physical* cylinder 560, physical tracks (heads) 0-29, either native or compatibility mode.

For 3344, the translation is five to one. Five 3340 cylinders occupy one physical 3344 cylinder. There are four 3340 logical devices on the 3344 spindle. When a seek is issued to a logical device residing on the 3344 spindle, an offset is added to the seek argument depending on the particular logical device being addressed. Thus, logical cylinder 0 of the second, third, or fourth device is located on physical cylinder 140, 280 or 420, respectively. The 3340 seek limits are:

| | |
|----------------------|---------|
| Cylinders: | 0-697 |
| Heads: | 0-11 |
| Alternate Cylinders: | 696-697 |

In model B2F, the tracks located under the fixed heads are the logical tracks 0-11 on the logical cylinders 1-10 of the primary device *only* (logical device A as shown on Figure 6).

The CE tracks are located on physical cylinder 560,

The resulting spindle mapping is shown in Figure 6.

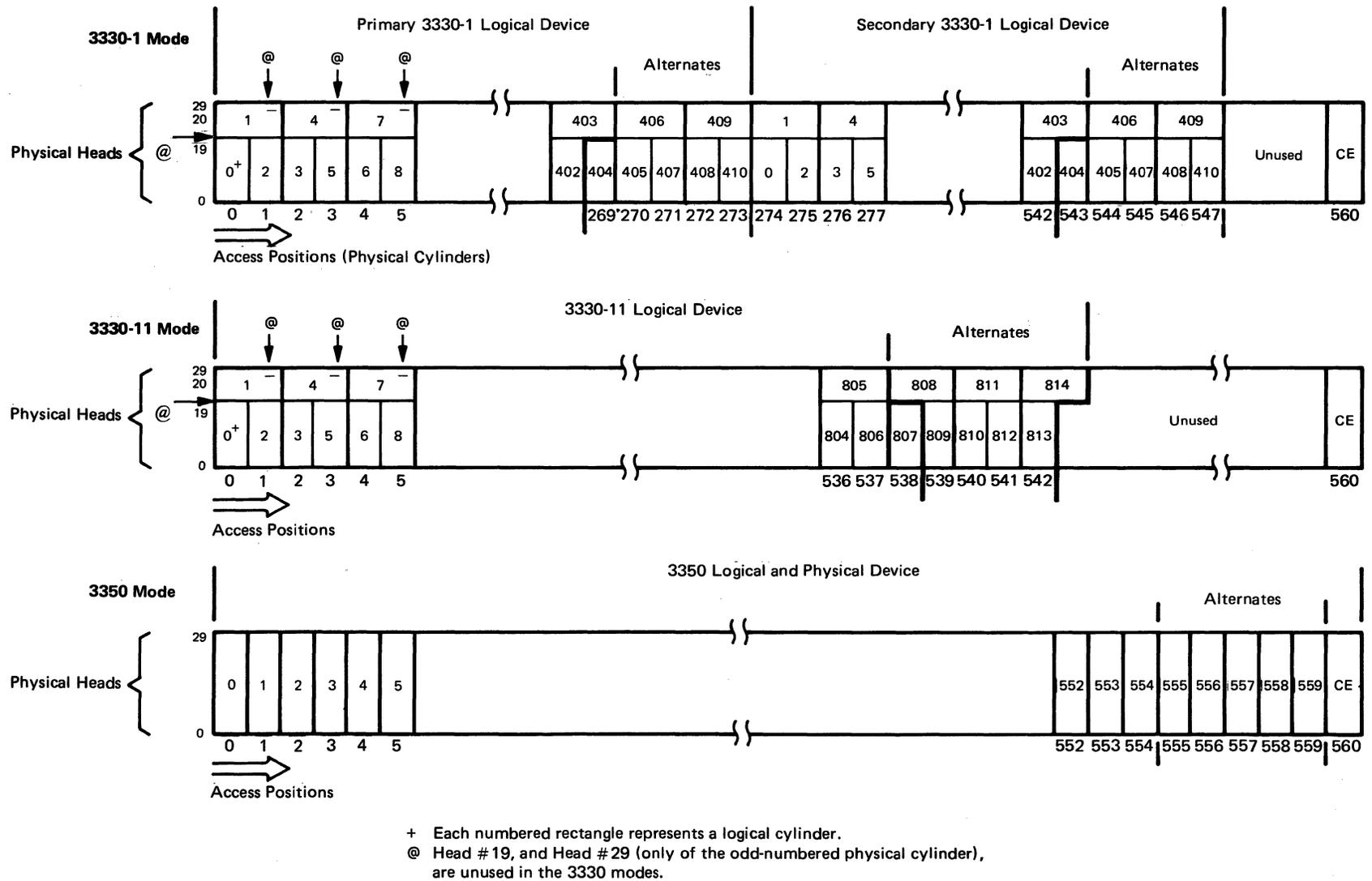
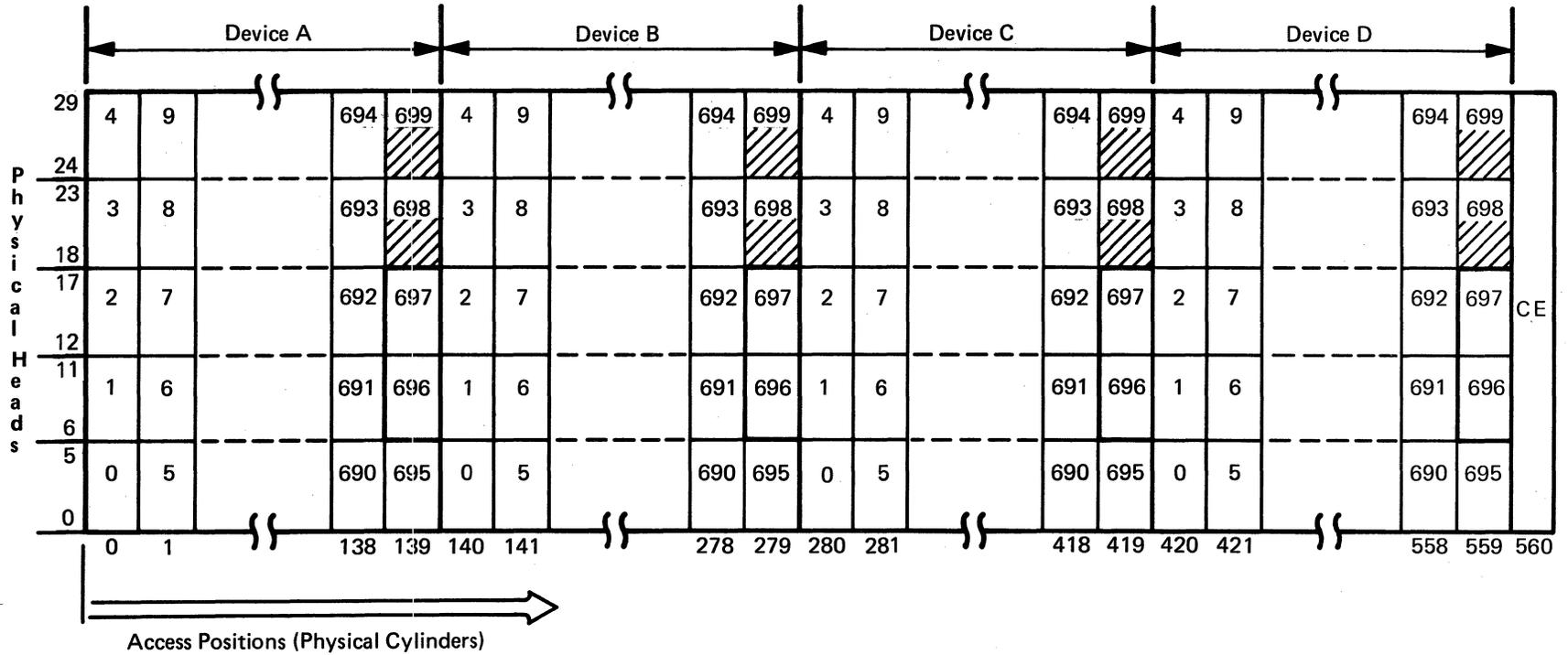


Figure 5. 3350 mapping



Numbers in boxes are logical cylinders for the corresponding logical device.
 Fixed head feature applies to "Device A", logical cylinders 1-10 only.
 Logical cylinders 696 and 697 are alternates.
 Logical cylinders 698 and 699 are unused.

Figure 6. 3344 mapping

SECTION 5: PROGRAM PLANNING CONSIDERATIONS

Support for 3350 in 3330 compatibility mode and for 3344 is an extension of existing support for the 3330 Model 1, 3330 Model 11 and 3340 devices. New device support for 3350 native mode permits use of the full machine capabilities.

5.1 DOS/VS Support

DOS supports the 3350 only in 3330 Model 1 compatibility mode, not in native or 3330 Model 11 compatibility mode. The 3344 is supported in the same manner as the 3340. In each case the emulating device appears to the programming system as the device being emulated. Since DOS/VS does not recognize the fixed media nature of the 3350 or 3344, care must be taken in using generic device assignment by device type. In this case, each logical device should be permanently assigned to dummy LUB's (Logical Unit Block) in a partition. The logical device can then be shared by all partitions but will not be eligible for MOUNT/DISMOUNT requests. If this is not done, the specific address desired or an address list should be used to avoid job cancellations due to improper MOUNT/DISMOUNT requests.

To use RPS, which is standard for the 3344, RPS must be specified for each logical 3340 device address on which it is to be used. To gain full advantage of the RPS capability all devices on a string should have the RPS capability, and its use should be specified for every device address on that string.

Before installation, order the correct level of the Disk Operating System (#5745-010), available February 1976.

5.1.1 DOS/VS Program Product and User Program Support

The 3350 in 3330 compatibility mode and the 3344 are supported by user programs that support the 3330 Model 1, 2, 3333 Model 1 and 3340 and that use DOS/VS Release 32 standard access methods VSAM, ISAM, SAM, PAM or DAM (device-independent use). Most programs can be used unmodified, except possibly those which use 3330 and are critically dependent on timing considerations.

User-written programs that create JCL should be checked for device addresses which may require changing. Because one spindle of 3350 A2, B2 or C2 appears as two volumes of 3330 Model 1, and one spindle of 3344 B2 appears as four volumes of 3340, care must be taken in placing data sets to avoid problems due to arm contention and the fixed media nature of the recorded data. (See Section 6.)

The IBM Program Products listed below support 3330 and 3340, and use only the standard access methods (VSAM, ISAM, SAM, PAM or DAM) and therefore support the 3350 in 3330 Model 1 compatibility mode and the 3344. The list is not necessarily all inclusive and changes may have been made. Ask an IBM representative if in doubt about a Program Product.

System Program Products

| <u>Program Name</u> | <u>Program No.</u> | <u>Notes</u> |
|---------------------------------|--------------------|--------------|
| DOS ANS Subset COBOL | 5736-CB1 | |
| ANS Full COBOL Version 3 | 5736-CB2 | * |
| ANS Full COBOL Library | 5736-LM2 | * |
| DOS PL/I Resident Library | 5736-LM4 | |
| DOS PL/I Transient Library | 5736-LM5 | |
| DOS PL/I Optimizing Compiler | 5736-PL1 | |
| DOS PL/I Composite Package | 5736-PL3 | |
| DOS RPG II | 5736-RG1 | |
| S/7 FORTRAN | 5736-F01 | |
| DOS/VS COBOL Compiler Library | 5746-CB1 | |
| DOS FORTRAN IV Library Option 1 | 5746-LM3 | |
| DOS/VS COBOL Object Library | 5746-LM4 | |
| DOS/VS Sort/Merge | 5746-SM1 | |
| DOS/VIDEO/370 | 5736-RC3 | |

*Not available in 3340 or 3344.

Application Program Products

| <u>Program Name</u> | <u>Program No.</u> | <u>Notes</u> |
|--|--------------------|--------------|
| DMS II DOS/VS | 5736-XC4 | |
| FAMS/DOS (Forecasting & Modeling Sys.) | 5736-XS4 | 2 |
| DBOMP CICS Feature | 5736-XX4 | |
| APT-BC DOS/VS | 5746-XN1 | 2 |
| MDAP (Machining and Display Application Program) | 5746-XN2 | 2 |
| ATMS/DOS (Advanced Text Management System) | 5746-XX4 | |
| APL/DOS | 5736-XM6 | 1 |
| BASE/DOS/VS | 5746-F31 | 1 |
| BUDPLAN/DOS/VS | 5746-F51 | 2 |
| Chained File – DL/I Bridge DOS/VS | 5748-XX3 | |
| CFO II | 5736-N13 | 2 |
| Coursewriter III DOS | 5736-E11 | 2 |
| CICS/DOS/VS | 5746-XX3 | |
| DATA LANGUAGE/I DOS/VS | 5746-XX1 | |
| EPIC:SOCRATES | 5735-E91 | 2 |
| EPIC:FAST | 5735-E92 | 2 |
| EPIC:Budget/Finance | 5735-E93 | 2 |
| EPIC:Student | 5735-E94 | 2 |
| FASTER Language Facility Feature of CICS/DOS/VS | 5746-XX3 | |
| FASTER MT DOS | 5736-G24 | 1 |
| FERST: DOS/VS Message Switching | 5795-AAG | 1 |
| FERST: DOS/VS Equipment Control | 5795-AAJ | 1 |
| FERST: DOS/VS Freight Billing | 5795-AAL | 1 |
| FERST: DOS/VS Rating/Rate Audit | 5795-AAM | 1 |
| HCS/ECG Analysis | 5736-H15 | 2 |
| HCS/Accounting System | 5746-H14 | 2 |

| <u>Program Name</u> | <u>Program No.</u> | <u>Notes</u> |
|--|--------------------|--------------|
| HCS/Lab Information System | 5746-H12 | 2 |
| Life Inquiry/Data Entry | 5746-N11 | |
| Mathematical Programming System Extended and MIP DOS/VS | 5746-XM2 | |
| GPSS V DOS/VS | 5736-XS3 | 2 |
| Data Base Design Aid (DBDA) | 5748-XX4 | 2 |
| PALIS Additional File Facility | 5736-N22 | 1,2 |
| PALIS Additional Functions | 5736-N21 | 1,2 |
| PALIS Automobile Enhancements | 5736-N24 | 1,2 |
| PALIS Homeowners Enhancements | 5736-N25 | 1,2 |
| Planning System Generator II DOS | 5736-XT1 | 2 |
| PSG II/VS DL/I Data Base Read | 5736-XT1 | |
| Purchasing DOS | 5736-XX5 | 1,4 |
| VANDL-1 | 5799-AEY | 3 |
| SL-MATH | 5736-XM7 | |
| RJE Workstation Program DOS/VS | 5799-WHX | 3 |
| PC/3600 DOS/VS | 5746-F11 | |
| DL/I Entry DOS/VS | 5746-XX7 | |

- Notes:
1. Not available in 3340 or 3344.
 2. Installation license applies.
 3. PRPQ
 4. DBOMP (5736-XX4) and the DOS PL/I Optimizing Compiler (5736-PL/1) are required to support 3330 and 3350 in 3330 Model 1 compatibility mode.

5.1.2 DOS/VS System Generation

Since 3350/3344 are supported in DOS only as transparent devices in compatibility mode, no special considerations are necessary in the system generation.

The inclusion of the 3350 or 3344 in either 3330 Model 1 or 3340 compatibility mode respectively is exactly the same as the addition of new 3330's or 3340's, except that the fixed nature of the media must be taken into account.

5.1.3 DOS/VS JCL Changes

Job control support for the 3350/3344 in either 3330 Model 1 or 3340 compatibility mode is similar to job control support for the 3330 Model 1 and 3340. No changes are required in job control except:

1. All (/) ASSGN sysnnn, x'cuu' statements must be changed if device addresses change (e.g., 3330 Model 1 x'131' to compatibility mode 3330 Model 1 x'261').
2. New (/) ASSGN sysnnn, x'cuu' statements must be built if 3350's or 3344's are added, instead of replacing old DASD's.
3. Extent information must be altered to reflect new volume labels, if any.

The user can take advantage of a field developed program (FDP 5798-AMN) DOS Data Set Conversion Aid, that may serve to reduce the manual effort involved in JCL changes for new or existing DASD installation.

This is a program that accepts control cards and produces Assembler Source statements that can be assembled to create file-to-file programs. It supports ISAM and SAM files, and although the approach is two-staged, it can help.

5.2 OS/VS1/VS2 Support

Support for 3350/3344 is provided in OS/VS1, OS/VS2 (SVS) and OS/VS2 (MVS). In these systems, the 3350 is supported in native mode and in 3330 Models 1 and 11 compatibility modes. The 3344 is supported in the same manner as the 3340. In native mode, the 3350 is supported as a fixed media device similar to the 2305. In compatibility mode, the SCP does not recognize the device as 3350 but rather as the device being emulated. The 3344 is recognized as a 3340 device. To avoid MOUNT/DEMOUNT messages, the PRESRES or VATLST options should be used.

Before installation, order the correct level of System Control Program with 3350/3344 support. OS/VS1 (#5741-030) support will be available April 1976. OS/VS2 (#5742-016) support will be available as Independent Component Release (ICR) in March 1976 for Release 3 (MVS) and in August 1976 for Release 1.7 (SVS). Support in MVS will be integrated in future releases.

The 3350 Models A2, B2 and C2 are shipped from the plant in format mode as specified when ordered. If the device is to be used in a different mode, arrangements must be made with the service representative to convert to the desired mode, either native or 3330-1 or 3330-11 compatibility mode, on an individual drive basis, and the media can then be reformatted to the correct format with IBCDASDI or with IEHDASDR if the support has been provided in your system (see Section 5.2.2).

5.2.1 OS/VS1, VS2 Program Product and User Program Support

User programs and Program Products that are not device timing dependent and which do not require pack mounting and support 3330 and 3340 and standard access methods (VSAM, ISAM, SAM, PAM, DAM), can use 3344 or 3350 in compatibility mode without modification. Care must be taken to avoid arm contention problems in 3330-1 mode and 3344 because each drive contains multiple volumes. (See Section 6.)

Subject to the above considerations, the following Program Products will run properly on 3344 and 3350 in compatibility mode.

| <u>Program Name</u> | <u>Program No.</u> |
|-----------------------------|--------------------|
| CICS/OS/VS | 5740-XX1 |
| IMS/VS | 5740-XX2 |
| GIS/2 | 5734-XX1 |
| GIS/2 DL/I Check Procedure | 5734-XX1 |
| Control System Alpha Search | 5734-F11 |
| Inquiry System | 5736-N14 |
| DMS II OS/VS | 5734-X04 |
| IQF IMS | 5740-XX2 |
| EPIC:Budget/Finance | 5735-E93 |
| EPIC:Student | 5755-E94 |
| GPSS V | 5734-X52 |
| Interactive Training System | 5734-XXC |
| Inventory Control | 5734-M52 |
| Proc. Library - Math | 5734-XM3 |
| PSG II | 5734-XT1 |
| Requirement Planning | 5734-M51 |
| SL - Math | 5736-XM7 |
| Shop Floor Control | 5734-M31 |

| <u>Program</u> | <u>Program No.</u> |
|---|--------------------|
| AML/7 | 5707-LM1 |
| APG/7 | 5734-X03 |
| VIDEO/370 | 5734-RC5 |
| COBOL Interactive Debug (TSO) | 5734-CB4 |
| FORTRAN Interactive Debug (TSO) | 5734-F05 |
| TSO Assembler Prompter | 5734-CP2 |
| TSO COBOL Prompter | 5734-CP1 |
| TSO Data Utilities | 5734-UT1 |
| TSO FORTRAN Prompter | 5734-CP3 |
| TSO ITF Basic | 5734-RC4 |
| TSO ITF PL/I | 5734-RC2 |
| Business Analysis Basic ITF (TSO) | 5734-XMB |
| MATH/BASIC ITF (TSO) | 5734-XM8 |
| STAT/BASIC ITF (TSO) | 5734-XA3 |
| CSMP III and Graphic Feature | 5734-XS9 |
| APT-BP | 5740-M51 |
| APT-IC | 5740-M52 |
| APT-AC | 5740-M53 |
| OS/VS Sort/Merge | 5740-SMI |
| Assembler H | 5734-AS1 |
| Code & Go FORTRAN | 5734-F01 |
| Full ANS COBOL - V3 | 5734-CB1 |
| Full ANS COBOL - V4 and Libr | 5734-CB2 |
| Full ANS COBOL - V4 Library | 5734-LM2 |
| FORTRAN IV G1 Compiler | 5734-F02 |
| FORTRAN IV H Ext. Compiler | 5734-F03 |
| FORTRAN IV Library M1 | 5734-LM1 |
| FORTRAN IV Library M2 | 5734-LM3 |
| S/7 FORTRAN IV S/370 Host Compiler and Library | 5734-F04 |
| PL/I Checkout Compiler | 5734-PL2 |
| PL/I Optimizing Compiler | 5734-PL1 |
| PL/I Resident Library | 5734-LM4 |
| PL/I Transient Library | 5734-LM5 |
| PL/I Optimizing Compiler & Libraries | 5734-PL3 |
| Capacity Planning – Finite | 5734-M54 |
| Capacity Planning – Infinite | 5734-M53 |
| CFO II | 5736-N13 |
| Coursewriter III – V3 | 5734-E13 |
| EPIC:SOCRATES | 5735-E91 |
| EPIC:FAST | 5735-E92 |
| COBOL to OS ANS COBOL LCP | 360C-CV-713 |
| HPPF II | 5744-AF1 (SCP) |
| MPSX | 5734-XM4 |

Program Products using VSAM, ISAM, SAM, PAM or DAM unmodified and not requiring specifications of device characteristics will operate properly on 3350 in native mode.

The following Program Products will execute properly on 3350 in native mode:

| <u>Program Name</u> | <u>Program No.</u> |
|------------------------------|--------------------|
| BASIC-VS | 5748-XX1 |
| COBOL V4 | 5734-CB2 |
| COBOL V4 Library | 5734-LM2 |
| COBOL OS/VS | 5740-CB1 |
| COBOL OS/VS Library | 5740-LM1 |
| COBOL Interactive Debug | 5734-CB4 |
| CICS/VS | 5740-XX1 |
| FORTRAN IV | 5734-F03 |
| FORTRAN Library | 5734-LM3 |
| FORTRAN IV (G2) | 5734-F02 |
| Code and Go FORTRAN | 5734-F01 |
| FORTRAN Interactive | 5734-F05 |
| GIS/VS | 5740-XX7 |
| IMS/VS | 5740-XX2 |
| PL/I Checkout Compiler | 5734-PL2 |
| PL/I Optimizing Compiler | 5734-PL1 |
| PL/I Resident Library | 5734-LM4 |
| PL/I Transient Library | 5734-LM5 |
| PL/I Optimizing Compiler | 5734-PL3 |
| OS/VS Sort Merge and Library | 5740-SM1 |
| TSO Assembler Prompter | 5734-CP2 |
| TSO COBOL Prompter | 5734-CP1 |
| TSO Data Utilities | 5734-UT1 |
| TSO FORTRAN Prompter | 5734-CP3 |
| BUDPLAN OS | 5734-F51 |
| DECTAT OS | 5734-XR2 |
| FAMS OS | 5734-XS7 |
| STAF OS | 5734-XA2 |
| GRAPHAGE OS | 5740-XM1 |
| MPSX MIP/370 OS | 5740-XM3 |
| PROJACS OS | 5740-XP1 |
| RIRMS OS | 5740-XR2 |
| STAIRS/VS | 5740-XR1 |
| MMS/V2 OS | 5707-M33 |
| CAPOSS OS | 5734-M41 |
| STEPS OS | 5740-XXB |

These lists are not comprehensive. Ask the program support representative if in doubt as to whether a specific program supports 3350 or 3344.

5.2.2 System Generation

Although the VS1 and VS2 starter systems support 3350 and 3344 in the time frame specified above, it will not be possible to restore a starter system to a 3350 drive in native mode. Depending upon the situation, one of the following procedures should be planned.

5.2.2.1 OS/VS1 Users

In this case the user must move to the OS/VS1 release with 3350/3344 support, available April 1976.

The user installing 3350 or 3344 with this release should use the corresponding starter system to perform the system generation. 3350 may be the target device for system residence. The only requirement is that 3350 be installed at the supported addresses in the starter system. The supported addresses are 148 through 14B. The corresponding addresses on channels 2 and 3 are also supported.

5.2.2.2 OS/VS2 (SVS) Users

The user desiring SVS support must move to or be using a release which is capable of performing a system generation of Release 1.7. He will apply the Release 1.7 ICR to the Release 1.7 DLIBs and perform the SYSGEN. 3350 and/or 3340/3344 may then be used for non-system data sets. If system residence on 3350 or 3340/3344 is desired, then a second SYSGEN is required using the newly created system to perform the SYSGEN with 3350 or 3340/3344 as the target device. If the user is already using Release 1.7, then application of the ICR and an I/O generation will provide 3350 and 3340/3344 support. However, a second SYSGEN must still be performed if system residence on 3350 or 3340/3344 is desired.

5.2.2.3 OS/VS2 (MVS) Users

The user desiring MVS support must move to or be using a release which is capable of performing a system generation of Release 3. He will apply the Release 3 ICR to the Release 3 DLIBs and perform the SYSGEN. 3350 and/or 3344 may then be used for non-system data sets. If system residence on 3350 is desired, then a second SYSGEN is required using the newly created system to perform the SYSGEN with 3350 as the target device. If the user is already using Release 3, then application of the ICR and an I/O GEN will provide 3350/3344 support. However, a second SYSGEN must still be performed if system residence on 3350 is desired.

Since 3350/3344 support will be provided in future releases, the user installing 3350 and/or 3344 with those releases should use the corresponding starter system to perform the system generation. Only one SYSGEN is required in this case, even if 3350 is to be the target device for system residence. The only requirement is that 3350 be installed at the supported addresses in the starter system. The supported addresses are 148 through 14D. The corresponding addresses on channels 2 through 6 are also supported.

5.2.2.4 Current DASD not in Current System

If a user requires starter system support and has only 3350 devices, he may restore the 3330 starter system to 3350 in 3330 compatibility mode, providing the 3350 to be used is attached at the addresses supported by the starter system for the 3330.

5.2.3 Job Control Language (JCL) Changes

A. 3350 Native Mode

Data Definition (DD) statements specify the I/O requirements for a job step. The DD card UNIT parameter contains the necessary information for DASD allocation. The UNIT parameter may specify:

1. Unit Address: Physical unit address, such as UNIT = 150
2. Device Type: UNIT = 3350
3. Group Name: A user-defined esoteric name, such as UNIT=DISK. At system generation, this name is equated by the UNITNAME macro to a list of device addresses.

The JCL for most data sets must be changed as a result of 3350 installation/conversion. All DD cards for data sets moved to 3350 drives which use a generic name (device type) have to be changed. Those which use a group name must be changed unless all devices in the group are changed to 3350 or the 3350 addresses to be used are added to the group at SYSGEN. DD statements specifying unit address must be changed if the device is no longer the correct type or included in the configuration. DD cards for old data sets (cataloged) do not have unit parameter and need no changes.

JCL requesting mounting or demounting (volume count greater than unit count, deferred mounting) must be changed. Likewise, parameters such as SPACE, and BLKSIZE probably must be changed if full advantage is to be taken of the incremented capacity of the 3350.

Two programs, an FDP (5798-AJU), OS/360/370 Job Control Language Device Dependent Parameter Conversion and Replacement, and an IUP (5796-PDC), Job Control Language Editor for S/360 and S/370, are available and may be useful in minimizing the manual effort involved in making the JCL changes.

The FDP converts the device-oriented arguments of the SYSOUT, UNIT, VOLUME, SPACE, SPLIT, and SUBALLOC keywords of OS JCL. Program input is the JCL deck to be converted, output is the converted deck plus a listing of the changes made and warning messages. The program was originally written to facilitate 2311/2314 to 3330 conversions, but can also be used for 3350 installation. See the Program Description (SB21-0575) and the Systems Guide (LB21-0576) for additional information.

The IUP is designed to bring a text editing capability for Job Control Language. It permits easy-to-use, fast and accurate modifications to large quantities of JCL and provides a detailed audit trail of all modifications. See the release notice (G320-1542) and the Systems Guide (LY20-2064) for additional information.

B. 3350/3344 Compatibility Mode

In this case, only slight changes relating to UNIT and VOLUME parameters may be necessary, depending upon the type of installation.

5.3 VM/370 User Programming Considerations

The 3350 is supported in native mode and in 3330 Models 1 and 11 compatibility modes. In native mode it can be used for:

- Control Program (CP) system residence device.
- Control Program (CP) paging and spooling functions.
- Conversational Monitor System (CMS) system residence device and CMS file system. Maximum CMS minidisk size is 115 cylinders.
- Remote Spooling Communications Subsystem (RSCS) system residence device.
- Dedicated device attached to a virtual machine.

The 3350 is recognized at SYSGEN time as a "target" system residence device; however, only 2314/3330/3340 starter systems are available.

In compatibility mode, the 3350 and 3344 are supported exactly like the devices being emulated, except that the 3350 is not supported as a staging device. This includes the same CP, CMS and RSCS functions provided for the 3330 and 3340 series DASD. The only consideration necessary is that when the mode of operation is being changed – for example, 3330 Model 1 compatibility mode to native – the IBCDASDI utility must be run in a non-VM environment to initialize the device before it can be used under VM/370.

VM/370 supports the 3350 for CP paging and spooling; however, performance characteristics should be carefully considered before designating a 3350 as a paging or spooling volume. The large capacity of the 3350 permits one 3350 volume to contain VM/370 paging and spooling areas and yet have much space left for other uses. The user should consider whether or not the use of this remaining space introduces significant arm contention on the 3350, before assigning paging or spooling areas to a 3350.

Support for the 3350/3344 in VM/370, DOS/VS, OS/VS1, and OS/VS2 running under VM/370 will be available in June 1976.

SECTION 6: GUIDELINES FOR CONVERSION

The primary objective initially is to complete a successful physical conversion from the existing storage media to the 3350/3344 with a minimum impact on the normal operations. Performance considerations are an important part of the overall plan for a successful conversion. However, with the many factors involved in a conversion effort, such as time constraints, scheduling, backup procedures, program and data conversion, etc., extensive tuning of the system will probably not be practical at the beginning. The efforts in the initial conversion should be to apply basic performance guidelines and to concentrate on those aspects of conversion that affect the operational impact while the conversion is actually taking place.

The 3350/3344 are conventional DASD and will be utilized (in the majority of cases) as current DASD are being utilized. The parameters have been changed (seek time, track capacity, number of tracks per cylinder, etc.) to result in significantly higher performance potential on a device basis, and provision has been made (fixed head models) for additional performance improvement on a DASD subsystem. But the device concepts are the same as current DASD with the exception that the 3350 and 3344 use fixed media.

The architecture and philosophy of the 3350 and 3344 subsystems are designed to minimize the conversion effort. Since the subsystem can work in compatibility mode, in some situations it may be easier and more economical to complete the conversion in two steps.

At first, the data sets will be copied from the actual storage media to 3344 or 3350 in compatibility mode. Once this is accomplished, the user can convert to native mode, in the case of 3350, at a convenient time. It is estimated that this migration path should reduce customer conversion costs for duplicate equipment.

Conversion to 3344 or 3350 in compatibility mode is similar to adding more spindles. A component release or new release must be applied to the SCP and new device addresses will be I/O GENed if necessary (see Section 5.0). All system and customer utilities which copy, move or dump DASD data will continue to be used.

However, the conversion to 3344 or 3350 in compatibility mode will subject the user to certain considerations imposed by the device characteristics and the programming support which is intended for the real devices. Several considerations are discussed below.

- a. Since 3350 and 3344 are fixed media devices, volumes cannot be dismounted and swaps must be avoided or rejected. Care must be taken to assure that all emulated volumes are marked as being permanently resident to avoid job cancellations where non-recoverable errors cause system initiated swaps.
- b. Execution of a DEVICE RESERVE channel command by the control unit will reserve only the logical volume addressed when that command is issued through a two- or four-channel switch. However, when issued through a string switch, all logical volumes on the same physical 3350/3344 spindle will appear reserved to a channel interface working through a different control unit. No accesses from another control unit may be made to the other logical volumes until the DEVICE RELEASE channel command is executed.

- c. It is possible to vary a logical volume offline independently of the other logical volume on the same physical spindle. However, to avoid possible problems and confusion resulting from leaving a physical spindle partly offline and partly online, it is recommended that all logical volumes of a physical spindle be varied online or offline in the same vary command.
- d. The fixed head storage is available only on the first logical volume on the physical spindle.
- e. Because the mapping of cylinders in compatibility mode is not one to one, and because various timing relationships have been altered, it is recommended that the use of 3350 in compatibility mode as a paging device be avoided, even though the function is supported.

6.1 DOS/VS Conversion

The 3350 and 3344 will be easily integrated into DOS/VS installations since each job normally specifies the spindle and cylinder addresses of the data it will access. Several DOS/VS SCP programs, program products and FDPs are now available to provide copy function. These programs are:

- DOS/VS SCP – System Utilities (see GC33-5381-1)
 - FAST COPY DISK VOLUME
 - COPY AND RESTORE DISK
 - DEBLOCK
- DOS/VS SCP – Access Method Services (see GC33-5382)
 - REPRO command
 - EXPORT/IMPORT commands
- DOS/VS SORT/MERGE (5746-SM1)
- Field Developed Programs
 - EXTENSIONS TO DOS/DITTO (5798-CAF)
 - EXTENDING SEQUENTIAL FILES FOR DOS/VS (5798-CBN)

For the DOS/VS users, the conversion process will finish after the first step; however, this may be a very good opportunity for accomplishing a better data set distribution. Data set placement can become an important consideration, not only because of space utilization, but also performance considerations. Some of the factors involved are the data set organization, the growth of the data set (dynamic and static) and the number of data sets accessed concurrently.

Since there is a great deal of interaction between these factors, the need for careful planning in this area cannot be overemphasized.

The access method used has considerable influence on how data sets should be placed on a volume. In the case of sequential access method, the user can have the data set spread across one or more non-contiguous extents or even have two or more data sets sharing the same cylinder if the split cylinder option is chosen. Because of the options offered, the user has greater flexibility in how sequential data sets can be placed to achieve more effective space utilization and throughput. For example, if two sequential data sets with high concurrent access activity have to be placed on the same volume, the split cylinder option might be best since the access arm would otherwise have to move from a cylinder in one data set to a cylinder in the other. Another example would be where only a segment of a sequential file had high activity. By splitting the file into two or more non-contiguous extents, the high activity portion could be isolated onto a volume with low activity or under the fixed heads if the unit had that capability (see Section 6.4).

Also, the ability to specify two or more extents (up to 16 on a DOS/VS volume) can allow better space utilization, particularly when the space has become fragmented.

In the case of a DAM data set, the user can also specify one or more extents. For example, in the case of a data set which can reside in one volume, if that data set is the only one being accessed when it is processed, it might be better to spread the data over more than one volume. This will reduce the average number of cylinders involved in the seek operation. However, if a sequential data set is to be processed concurrently with a randomly processed data set, it may be best to have them on two separate volumes to minimize the seek time for the sequential data set.

An ISAM data set requires more consideration than a SAM or DAM data set because the prime data area must be one contiguous extent, although it can be extended. This is also true for the independent overflow and cylinder index area. The sequence of events when processing randomly an ISAM file would be as follows: The high level indices would be searched first, followed by a seek to the track index in the prime data area, then a seek to the overflow area and finally back to the high level index area for the next record. Therefore, ideally, from a performance standpoint, it would be best to place the high level indices on one volume, the independent overflow area on a second volume and the prime data areas on a third and succeeding volumes. The next choice would be to have the high level indices, followed by the independent overflow area, placed on the same volume. The last choice would be to place the independent overflow area between the high level indices and the prime data area. If the user has fixed head units installed, the high level indices are excellent candidates to be placed on the area controlled by fixed heads.

The fact that the cylinder index, independent overflow, and prime data areas can be extended also requires careful planning for more efficient space utilization. If the independent overflow area is used and a high number of random insertions are made to the data set, the user must be careful to allow space for the upper limit to be extended. The same reasoning applies to the prime data and cylinder index areas when records are added to the end of a data set using the load extension option. It is not so critical for the cylinder index area as for the prime data area. The important point is not to allow an ISAM data set to be blocked by another data set, thus causing a premature reorganization.

Ideally, those data sets that are going to be accessed concurrently should be placed on separate physical volumes, but this may not be feasible. Those data sets that will be accessed concurrently should be grouped together in order to minimize seek time.

If system data sets are on 3330, it may be convenient to put them on 3350 in order to take advantage of the better data rate (1198 KB vs 806 KB), seek time (25 ms vs 30 ms) and enhanced reliability. However, because of fixed media, it is advisable to maintain a copy of the system residence on another 3350 or on removable media (tape or disk) in the event of a failure.

The main consideration, then, is how to use the remaining space after the system has been generated without significantly affecting performance. The first items to be considered are the libraries and the compiler work spaces. If compilations are infrequent, then the Relocatable Library (RLB), Source Statement Library (SLB) and workspaces could be allocated to the residence volume with very little degradation. (One suggested method would be to allocate the workspace between the system and the libraries.) But if compilations are frequent, or private libraries are being used in a multiprogramming environment, it would be best to allocate the libraries and especially the workspaces on a separate volume.

In that case, the next item to be considered is the user data sets. From a performance standpoint, the data sets with the least amount of use would be placed on the system residence volume, with the least active of those data sets placed in the farthest position from the residence area. If they are shared with system residence, care should be taken that the least used data sets are not highly active when they are used, because significant system degradation could result. Selecting the least active data sets also reduces backup problems. The inadvertent destruction of data on a DASD typically occurs on the system residence volume. There is, obviously, less urgency to update relatively inactive data sets than highly active ones when the volume is restored. In order to avoid updating it may be acceptable to store only libraries and workspaces on the system residence volume at some sacrifice in performance. However, the fewer drives available on the system (e.g., a four-drive system), the more likely the user is to be forced to share the system residence volume with relatively active data sets.

6.2 OS/VS Conversion: Native Mode

Conversion from current direct access devices to 3350 in native mode involves the same procedures as are required now to change from one disk device to another, e.g., from 2314 to 3330. Existing disk data sets can be moved to 3350 volumes, using an IBM-supplied utility in most cases. However, if the user requires any additional function not supported by these utilities, he can write a general purpose assembly language program that accepts control cards to perform the required functions. Writing a simple RPG, COBOL or PL/I program to perform each required function will probably be easier.

During the file conversion to 3350 DASD, sequentially organized data sets, processed by QSAM or BSAM, and partitioned data sets can be copied directly to the 3350 facility, using the IEHMOVE utility, or they can be copied to tape and then to the 3350 facility, using the same utility.

Indexed sequential data sets can be copied directly to the 3350 facility, using the IEBISAM utility. Or, they can be unloaded to tape and then loaded, using the same utility. Probably, ISAM data sets will not require new programs since the user's existing reorganization programs can be used. Minor changes to the load programs will be required because of the 3350 device characteristics (i.e., number of tracks for cylinder overflow, etc.). Changes to space allocation, etc., can be made via job control statements. Similar considerations hold for VSAM data sets using the VSAM Access Method Services.

Direct organization (BDAM) data sets can be copied on a track-to-track basis on the 3350 facility (used in the same track format as the original data set), using the IEHMOVE, or they may be copied to tape and then to the 3350 facility. If more records are to be placed on a 3350 track than are on a source device track, the existing reorganization program can be used to transfer the data to the 3350 facility. It may be necessary to reprogram the randomizing algorithm if a relative track is used as actual address reference and fewer (or more) 3350 tracks are allocated to the data set than before.

In all of the above cases, the catalog must be changed for cataloged data sets.

User-written programs that use the EXCP level to access user data sets that have been transferred to 3350 volumes may require modification to reflect the characteristics of the data set on 3350: a different number of records per track, a different number of tracks per cylinder, etc. All 2311, 2314, 3330, and 3340 CCW lists will operate on 3350 facilities except those which are device or channel time

dependent and those which support the file scan feature. User-written 2311 or 2314 error routines will not execute correctly and must be modified. RPS commands must be added by the user if this support is desired for programs that use EXCP.

Subject to the restrictions on time or device dependencies and those indicated for BDAM data sets, existing 3330 or 3340 DASD programs can be used without change to process data sets that have been transferred to 3350 volumes. Data set characteristic changes, such as block size, may be changed via JCL as well.

Assuming that data organization is not changed, consideration should be given to altering the block size used and the amount of space allocated to the data set. When replacing one type of DASD device with another, one of the major considerations is DASD space organization. This is specially true when there are significant differences in the space characteristics of the devices such as exist between the 2314, 3330, 3340 and the 3350. (Table 2 in Section 3 shows the DASD characteristics for the various devices supported by VS.)

The main objective in this area is to utilize the DASD space efficiently and maintain performance. This not only includes user data sets, but also system data sets, libraries, work areas and spooling requirements. The primary factors in effective utilization of DASD space are block sizes, organization techniques, and the size of the data sets. Consideration must also be given to the situation when data sets on two or more devices are being consolidated onto one device. This consolidation could negate to some degree the performance improvements offered by the new device.

To utilize fully the maximum capacity of the 3350, it would be necessary to record the data in one block per track without keys. As block sizes decrease, the amount of data that could be stored in a given volume would be reduced accordingly. For example, if a non-keyed block of 19,069 bytes were chosen, 16650 of these blocks could be contained on one 3350 volume or a maximum of 317,498,850 bytes. If a non-keyed block of 120 bytes were chosen, then 1,048,950 blocks could be contained on one 3350 spindle, or 125,874,000 bytes, which is about 39% of the capacity of the volume.

A further consideration is to use the maximum feasible block size within a given block size range. For example, a range of 4664-6279 allows three blocks without key to be stored on a 3350 track. In the case of a 5000-byte block (100 x 50-byte records), 300 records could be stored on a track (9000 records per cylinder). However, this utilizes only 80% of the capacity. If a block size of 6200 bytes is chosen, then 372 records can be stored on a track (11160 records per cylinder) and 96% of the space utilized. For a data set size of 500,000 records, the 5000-byte block would require 56 cylinders, while the 6200-byte block required only 45 cylinders. Reciprocally, an unlucky election may cause bad results. Figure 7 shows how a block size of 6400 bytes, which permits a good utilization of the 3330-11, about 98% of its capacity, produces a poor use of the 3350, only 67% of its total capacity. Appendix B shows the maximum number of records that can be stored on a track and a cylinder for a given size of the record.

Another aspect of the block size is the number of blocks that can be stored on a cylinder. This can easily be seen by comparing a 3330 data set of 400,000 records of 80 bytes, blocked 10 (800-byte block), to the same data set blocked 10 and 20 on the 3350. 40,000 blocks are necessary for the whole data set which requires 150 cylinders when on 3330. If no change is made in the blocking factor, 71 cylinders are required to store the same data set on the 3350 (570 blocks per cylinder). If a blocking factor of 20 is chosen, then only 67 cylinders are required

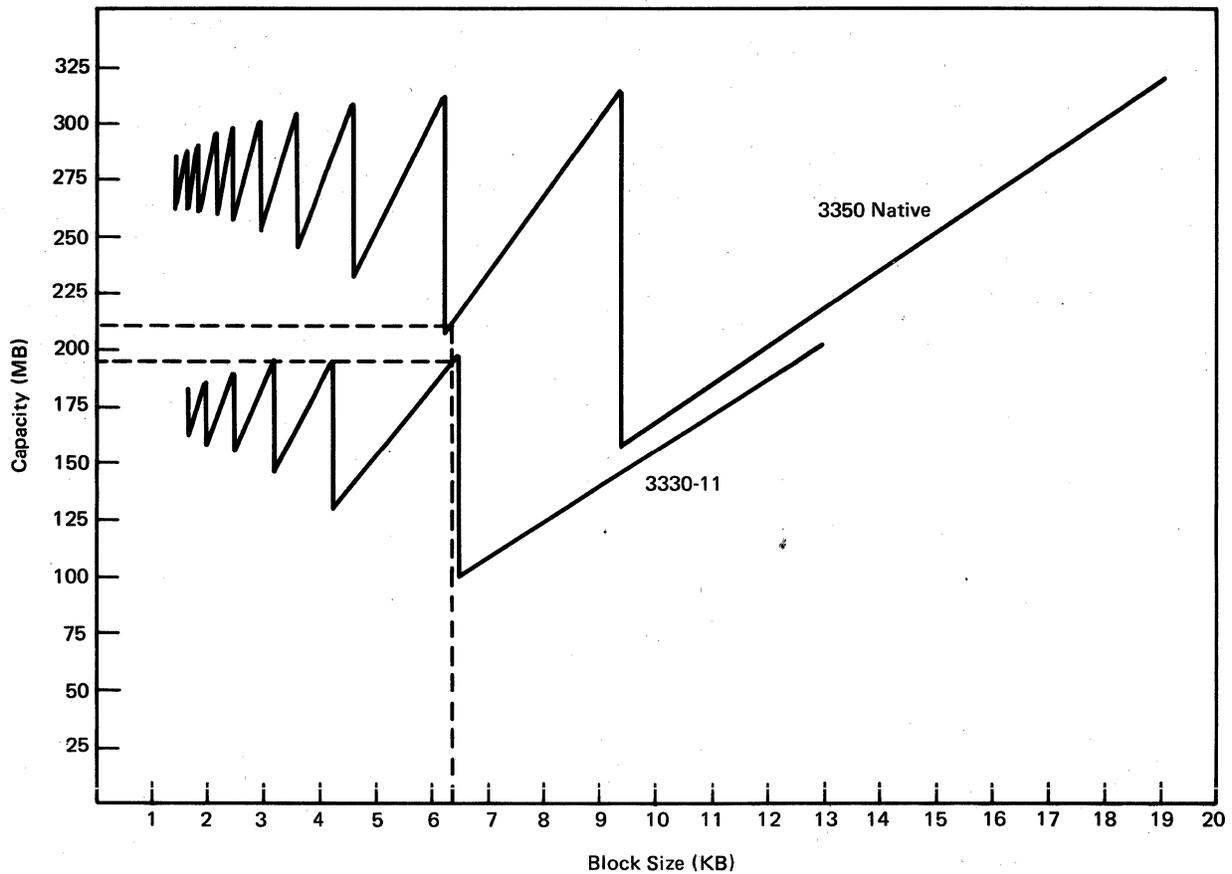


Figure 7. 3350 native and 3330-11. Space utilization vs blocksize

to store the same data set on the 3350 (300 blocks per cylinder). Incidentally, this particular case still requires 150 cylinders on the 3330 for a blocking factor of 20 (133 blocks per cylinder).

This concept is significant when converting JCL. If the SPACE parameter is given by cylinders, attention should be paid not to waste space on the 3350. A 150-cylinder allocation for a 3330 may be reduced to a 67-cylinder allocation on a 3350, as shown above.

Another factor is record size. Generally, the block sizes chosen are constrained by the record size, the amount of main storage available for I/O buffer areas, and the organization technique used. Usually the record size will not change since it is normally a constant for a given data set. A sequential data set organization should not present problems, and its block sizes are a matter of the amount of main storage available, a minor factor in a VS environment. Nor should an indexed sequential data organization generally present any problems because the block size for the prime data records can be arbitrarily chosen by the user. But the index entries and the overflow records are unblocked (set by the access method). They are influenced only by the key size for the index entries and the record length for the overflow records. In a normal environment they constitute about 20%-30% of the space required. Therefore, the user can still exercise control over the other 70%-80%.

The determining factor for ISAM block sizes is the processing method. For sequential processing, larger block sizes offer a performance improvement. For random processing, larger block sizes can cause a slight degradation in data transfer time per block but can reduce seek time because of fewer cylinders. However, the increased speed of the 3350 should more than offset any slight degradation caused by using a larger block size. Therefore, the ideal block size chosen is the one that provides an optimal balance between sequential and random processing limited by the amount of main storage provided for I/O buffers.

The DAM data set organization may present some special considerations depending upon the record string techniques used. In the most commonly used technique, which will be the only one discussed here, records are stored randomly. Other techniques usually tend to be a variation of ISAM and therefore involve the same considerations. Some of the possible solutions for better space utilization are:

- a. Work with one block per track, read the block into main storage and then scan for the desired record location in the block. (This, of course, will require more rotational time and is analogous to ISAM random retrieval of large blocks.)
- b. Choose another type of randomizing technique such as randomizing to a relative block address rather than track address.
- c. Choose another access method such as VSAM.
- d. Change nothing if performance tends to be a more pressing concern than space utilization.

For random processing, large block sizes can have the opposite effect and cause a slight performance degradation. This is because the retrieval of one record usually results in one physical read. Therefore, the more records in a block the longer the data transfer time to retrieve one record.

The biggest factor is the data retrieval time.

Where time may have been critical on a 2314 or 3330 device, it may not be on a 3350 because of the significant increase in data transfer rate and reduction in average access time. For example, consider a non-keyed record size of 80 bytes and the effect of different blocking factors on the various DASD's as shown in Table 9. It can be seen from two comparisons that:

- a. When the blocking factor is increased from 1 to 75, the average access time does increase (18.97 ms on the 2314, 7.34 ms on the 3330, and 4.94 ms on the 3350).
- b. The difference in access time between the 2314 and the 3350 is considerable (72.76 ms on a 2314 for an 80-byte block as compared to 38.40 ms on a 3350 for a 6000-byte block).
- c. If the 3350 is a fixed head model, the differences with the 2314 and 3330 DASD's become very important (the average access is almost seven times faster on 3350 than on 2314, and three and a half times faster than the 3330 for a 6000-byte block for data under the fixed heads).

This is significant when a data set is to be processed both randomly and sequentially as in the case of ISAM. The user can increase the block size of a data set considerably when converting to 3350 and still maintain an appreciable gain in DASD subsystem performance.

TABLE 9. Effects of Different Blocking Factors

| BLOCKING FACTOR OF 1 (80-BYTE BLOCK) | | | | |
|--|-----------------|---------------------------------|-----------------|----------------------------------|
| | 2314 | 3330 (MODELS 1 & 11) | 3350 | 3350 (FIXED HEAD FEATURE) |
| Blocks per Track | 40 | 61 | 72 | 72 |
| Average Rotational Delay | 12.50 ms | 8.40 ms | 8.40 ms | 8.40 ms |
| Data Transfer Time | .26 ms | .10 ms | .06 ms | .06 ms |
| Average Seek Time | <u>60.00 ms</u> | <u>30.00 ms</u> | <u>25.00 ms</u> | <u>0.00 ms</u> |
| Average Access Time | 72.76 ms | 38.50 ms | 33.46 ms | 8.46 ms |
| BLOCKING FACTOR OF 10 (800-BYTE BLOCK) | | | | |
| | 2314 | 3330 (MODELS 1 & 11) | 3350 | 3350 (FIXED HEAD FEATURE) |
| Blocks per Track | 7 | 14 | 19 | 19 |
| Average Rotational Delay | 12.50 ms | 8.40 ms | 8.40 ms | 8.40 ms |
| Data Transfer Time | 2.56 ms | .99 ms | .66 ms | .66 ms |
| Average Seek Time | <u>60.00 ms</u> | <u>30.00 ms</u> | <u>25.00 ms</u> | <u>.00 ms</u> |
| Average Access Time | 75.06 ms | 39.39 ms | 34.06 ms | 9.06 ms |
| BLOCKING FACTOR OF 20 (1600-BYTE BLOCK) | | | | |
| | 2314 | 3330 (MODELS 1 & 11) | 3350 | 3350 (FIXED HEAD FEATURE) |
| Blocks per Track | 4 | 7 | 10 | 10 |
| Average Rotational Delay | 12.50 ms | 8.40 ms | 8.40 ms | 8.40 ms |
| Data Transfer Time | 5.13 ms | 1.99 ms | 1.33 ms | 1.33 ms |
| Average Seek Time | <u>60.00 ms</u> | <u>30.00 ms</u> | <u>25.00 ms</u> | <u>.00 ms</u> |
| Average Access Time | 77.63 ms | 40.39 ms | 34.73 ms | 9.73 ms |
| BLOCKING FACTOR OF 75 (6000-BYTE BLOCK) | | | | |
| | 2314 | 3330 (MODELS 1 & 11) | 3350 | 3350 (FIXED HEAD FEATURE) |
| Blocks per Track | 1 | 2 | 3 | 3 |
| Average Rotational Delay | 12.50 ms | 8.40 ms | 8.40 ms | 8.40 ms |
| Data Transfer Time | 19.23 ms | 7.44 ms | 5.00 ms | 5.00 ms |
| Average Seek Time | <u>60.00 ms</u> | <u>30.00 ms</u> | <u>25.00 ms</u> | <u>.00 ms</u> |
| Average Access Time | 91.73 ms | 45.84 ms | 38.40 ms | 13.40 ms |

An overall DASD subsystem performance improvement can be expected if the same principles that produce good OS/VS – 3330 performance are applied to the OS/VS – 3350 environment. Some of the techniques used are as follows:

- a. Reduce the number of accesses required for a given workload.
 - Make frequently accessed data resident in processor storage at system or job step initialization time (program modules, indices, directory lists, SVC routines, access methods).
 - Increase the block size of sequential data sets.
 - Access multiple blocks for each access (PCI Fetch, OPTCD = C for sequential data sets).
- b. Minimize arm movement when accessing.
 - Separate concurrently active data sets on different physical devices when possible.
 - Place concurrently active data sets adjacent to one another when they must reside on one volume. For active permanent data sets, place the most active near the center of the pack (cylinder 277 on a 3350) to reduce the maximum length of seek outside of the data set. For data sets of about equal activity, place the smallest nearer the center. Do not allocate excessive space for a data set so that the time needed for the access arm to pass over it is reduced. Allocate small but concurrently active data sets on the same cylinder if possible (e.g., VTOC & master catalog). Cluster the most active PDS members together near the directory within the data set.

If your 3350 subsystem has the fixed head feature on all or several drives, place the smallest and most frequently used data sets under the fixed heads (VTOC, index, tables, some types of page data sets like PLPA, etc.).

- c. Minimize the time required for a given access.
 - Use the techniques in 'b' above to reduce seek time.
 - Reduce block size for data sets where direct accesses predominate.
 - Use RECFM=FS (or FBS) or OPTCD=Z (Search Direct) for sequential data sets where possible.
- d. Reduce channel busy time for each access to allow more concurrent operations to be started on the same channel in cases where more channel capacity would assist in achieving greater performance.
 - Use RECFM=FS (or FBS) or OPTCD-Z (Search Direct) for sequential data sets.
 - Reduce block size for data sets where direct accesses predominate.

Note: The most significant techniques for reducing channel busy time are already automatically done by the Operating System, such as separating or disconnecting SEEK's from data transfer channel programs and using RPS where possible in all access methods.

- e. Reduce CPU interference due to I/O operations.
 - Allocate data sets on CYLINDER boundaries to avoid getting an extent check I/O interrupt at the end of each track processed.
 - Consider using OPTCD=C (Chaining) for sequential data sets.
 - Increase the block size of sequential data sets.
 - Make frequently accessed data resident (see 'a').

Many of these known performance factors involve tradeoffs which can only be evaluated for a particular application. For example, small block sizes decrease the time required per access and permit more concurrency of operations on a channel, but reduce the effective data rate of the device, result in more CPU interference for sequential data set, and use more DASD space for a given quantity of data. As another example, chaining techniques allow a high effective data rate for sequentially accessed data sets and reduce CPU overhead for SIO (Start I/O) processing, but tie up the channel for longer periods of time, forcing other requests to wait for service. This appears reasonable for a batch environment but less desirable in an online response time-oriented system.

Since many installations will be going to a configuration with fewer access arms than in the old environment, a recommended sequence of areas to address, in order of priority, might be the following:

- Attempt to optimize system data set placement, such as Page Data Sets, JOBQUE, etc., using the techniques described in 'b'.
- Distribute other data set such as SYSIN/SYSOUT. Sort work areas, compiler and linkage editor work data sets. Careful definition of UNITNAME parameter during SYSGEN will aid greatly here.
- Review PROCLIB procedures to ensure optimum use of UNITNAMES, space allocation, and block sizes.
- Review all access method usage to take advantage of performance options not now being used (RECFM=FBS, OPTCD=Z, chaining for sequential data sets, etc.).
- Evaluate block sizes of user data sets to take advantage of 3350 track size.
- Attempt to optimize user data set placement across volumes.
- Attempt to optimize user data set placement within volumes.

Applying the techniques learned in dealing with good 2314, 3330 and 3340 installations, the 3350 can be expected to deliver increased DASD subsystem performance even during the early stages of the conversion period. The relatively modest task of converting SORT work files will probably result in a substantial performance gain immediately. The emphasis should be placed on those matters that directly affect the physical data conversion. For some installations, the very act of converting might allow an opportunity for some installation "housecleaning" (operational procedures, job scheduling, reduced use of "private packs", etc.) to effect performance gains that have little to do with the type of DASD used.

6.3 Gradual Field Conversion

When planning a lengthy field conversion to 3350 native from 3350 in 3330-1 or 3330-11 compatibility mode, where one or two drives are placed offline, converted, and returned to the system, special consideration must be given to the Operating System. The system control program must be changed so that the drives converted are available to the system at any point during the conversion.

Two procedures may be followed for this purpose:

- a. Make an I/O device generation each time a device or a device group is converted to native mode.
- b. Change, via the SUPERZAP program, several internal data areas of the system in order to reflect the new characteristics of the converted device.

The election of one of these methods depends on several considerations.

If the number of 3350's to be converted is small or if the conversion is accomplished in big groups (i.e., a string at time), so that only two or three I/O GEN are required during the whole conversion process, then the first of these methods is easier and may be more advisable.

If a large number of 3350's (two complete strings or more) are to be converted, one or two drives at a time, then it may become very laborious to perform an I/O device generation after each drive or unit is converted. In this case, it may be preferable to use the second method as detailed in sections 6.3.1 and 6.3.2. However, because this procedure modifies critical tables in the system, it is advisable to study carefully the data areas to be modified and to obtain a system backup before running the SUPERZAP program.

6.3.1 Conversion Under OS/VS1 and OS/VS2 (SVS)

If at least one 3350 native has been specified in the preliminary system generation to provide an entry in the Device Mask Table, the SUPERZAP program may be used to update the system as each device is converted. After converting a 3350 in compatibility mode, and before placing the units back online, run the SUPERZAP program to:

1. Convert the UCBTYP field to describe the new device.
2. Modify the Device Mask Table to reflect the new device in the appropriate generic and esoteric (user-defined) names entries.

The system generation process uses information supplied in the IODEVICE and UNITNAME macros to build internal tables which are used in the device allocation function. These tables are:

- Unit Control Block (UCB)
- UCB Lookup Table
- Device Mask Table

Use UNITNAME macros to include the 3350's native mode under SYSDA, DISK, etc.

Unit Control Block

One unit control block is built for each device. The UCBTYP field within the UCB describes the device type. A disk UCBTYP field contains:

```
UCB + 16 (Byte 1) IOS Flags/Model Code
      . . 1 . . . . . Burst Mode
      . . . 1 . . . . . Data Chaining
      . . . . 0 0 0 0 Model Code
```

```
UCB + 17 (Byte 2) Optional Features
      . 1 . . . . . Track Overflow
      . . 1 . . . . . Shared
      . . . 1 . . . . . RPS
```

UCB + 18 (Byte 3) Device Class
 0 0 1 0 0 0 0 0 Direct Access Storage

UCB + 19 (Byte 4) Unit Type
 0 0 0 0 1 0 0 1 3330 Model 1 (or 2) and 3333 Model 1
 0 0 0 0 1 1 0 1 3330 Model 11 and 3333 Model 11
 0 0 0 0 1 0 1 1 3350 Model B2 and A2

The UCBs are on the SYS1.NUCLEUS data set and can be located in the last system generation or I/O device generation listing.

The first two bytes of the UCBTYP field are used to describe device features. For all models of the 3333/3330, these bytes are either X'3050' or X'3070' for unshared or shared devices, respectively. The third byte describes the device class and contains X'20' for all DASD devices. The fourth byte, at UCB + 19, describes the unit type and contains X'09' for 3330/3333 Models 1 and 2, X'0D' for 3333/3330 Model 11, or X'0B' for 3350 Models A2, B2 and C2. This is the only byte in the UCB that needs to be changed.

UCB Lookup Table

One section of the UCB Lookup Table (Figure 8) has a two-byte entry for each device, built sequentially by channel and unit address, containing the address of the associated UCB. This provides the I/O Supervisor's interrupt handler routine with the ability to locate quickly the UCB for the device causing the interrupt. This lookup table is also used during allocation, together with the Device Mask Table.

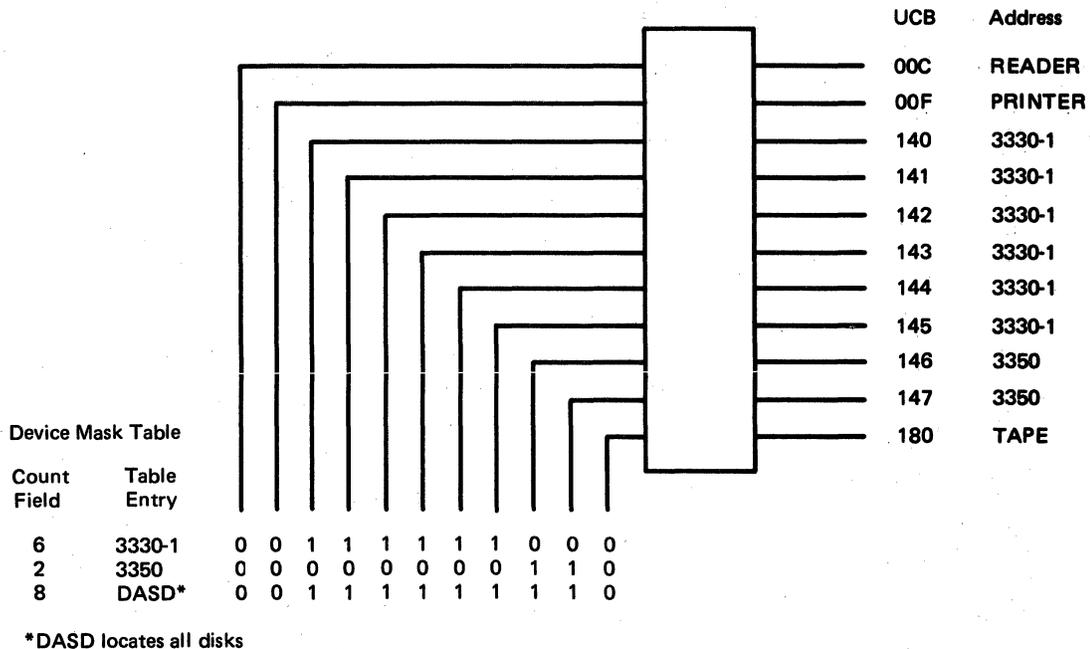


Figure 8. UCB lookup and device mask tables

Device Mask Table

The Device Mask Table (Figure 8) contains an entry for each group of units described by a generic (IBM-supplied) name and each group of units described by an esoteric name.

Each entry in the Device Mask Table contains an 8-byte header describing the device types and a count field containing the number of devices in the group. The header is followed by a bit map in which each bit corresponds to an entry in the UCB Lookup Table (see above). If the bit is on, the corresponding UCB address is for a unit (device) included in the group.

When changing a UCB from a 3350 in 3330 Model 1 or 3330 Model 11 compatibility mode to a 3350 in native mode, the appropriate bit must be turned off in the 3330 compatibility mode generic name group and turned on in the 3350 native mode generic name group. Note that two bits must be turned off and only one turned on when it is a 3330 Model 1 to 3350 native conversion. A similar change may be made to installation-defined esoteric name groups, if appropriate.

To locate the appropriate group entries:

1. Use the SUPERZAP program to dump the Device Mask Table (DEVMSK on SYS1.LINKLIB).
2. Find the 3330 entry (30502009 in bytes 4-7) or the 3330-1 entry (3050200D in bytes 4-7) and the 3350 native entry (3050200B in bytes 4-7).
3. Bytes 2 and 3 are a halfword field containing the number of UCBs for this device type. Decrement the number of UCBs for the 3330 Model 1 or 3330 Model 11 entry and increment the number of UCBs for the 3350 native entry by the number of units to be converted.

If the conversion is from 3330 Model 1 to 3350 native, the reduction is 2 to 1. (Decrement by two the number of 3330 Model 1 UCBs and increment by one the number of 3350 UCBs.)

4. The bit map starts in byte 8. The easiest way to find the correct bit(s) to alter is to find the desired UCB in the UCB Lookup Table. If the UCB address entry is the tenth entry in the UCB address portion of the UCB Lookup Table, the tenth bit in the Device Mask Table bit pattern must be updated. (The CVT offset X'28' points to the UCB address portion of the UCB Lookup Table.)

Esoteric name entries in the Device Mask Table are similar, although the contents of bytes 4-7 differ. Bytes 4 and 5 contain a number, starting from 1, which corresponds to the position of the entry's UNITNAME macro in the system generation input. The count field and bit map are in the same locations and must be incremented/decremented and the correct bits set on/off as appropriate.

Note: The conversion procedure listed above cannot be achieved when the 3350 to be converted has been selected as a paging device. In this case, a nucleus generation must be done.

- Sysgen a 3350 native to include the name in the EDT.
 - Use UNITNAME macros to include the 3350 native under SYSDA, SYSSQ, DISK, etc.
 - Define, through the DEVPREF parameter in the macro SCHEDULR, an installation device preference table with consecutive 3330 and 3350 generic names. The system will create the extended device allocation tables in the order in which the devices were specified. In order to facilitate the ZAP procedure, it is convenient if 3330 and 3350 have consecutive entries.
2. To understand the EDT, study the SYSGEN assembly of the EDTTAB CSECT with the help of Figure 9.
 3. After conversion of a 3350 in 3330 compatibility mode to 3350 native, and before placing the unit back online:
 - a. ZAP the UCB as outlined in Section 6.3.1.
 - b. ZAP EDTTAB entries in the Group Mask Table (MASKTAB).
 - Zero bits for 3350 in 3330 compatibility mode groups.
 - Set bits for 3350 native groups.
 - c. ZAP EDTTAB entries in the Generic Table (GENTAB).
 - Change UCATYPE from 3330 or 3330-1 to 3350 for the groups that were changed.
 - If this group is included under other segments, such as SYSDA, change the number of groups and the pointers to the group entry for that segment in the GENTAB.
 - d. EDTTAB entries in the Group Descriptor Table (GDTAB) must also be zapped if the conversion is from 3350 in 3330 Model 1 compatibility mode.
 - The number of devices in the converted group must be halved.

Example: Assume a system with the following configuration:

| <u>Units</u> | <u>Addresses</u> |
|--------------------|------------------------------------|
| 4 X 3330-1 strings | 140-147, 150-157, 160-167, 170-177 |
| 2 X 2305-2 | 2D0, 2D1 |
| 1 X 3340 A2 | 2C0, 2C1 |
| 1 X 3340 B2 | 2C2, 2C3 |
| 6 X 2400-4 | 280-285 |
| 2 X 1403 | 00E, 00F |
| 2 X 3211 | 002, 004 |
| 1 X 2540 | 00C |
| 1 X 2540-2 | 00D |
| 1 X 3215 | 009 |

Two 3330 Model 11 strings are changed to two 3350 strings in 3330-11 compatibility mode. The 3350 in compatibility mode strings will be gradually converted to 3350 native mode two drives at a time.

The inclusion of 3350's in the configuration requires an address reassignment on the 3330 Model 11 and 3350 strings (see Section 4.6.1). The new addresses could be:

First String: 140-147 (3350 in 3330 Model 11 compatibility mode)
 Second String: 148-14F (3350 in 3330 Model 11 compatibility mode)
 Third String: 150-157 (3330 Model 11 string)
 Fourth String: 158-15F (3330 Model 11 string)

This set of addresses has the additional advantage of being supported by the OS/VS2 Starting System (148-14D for 3350 and 158-15D for 3330 Model 11).

In order to achieve the future conversion, define a 3350 native mode in the initial system generation with an address not actually configured:

```
IODEVICE UNIT = 3350, ADDRESS = (100, 2)
```

Include under SYSDA, SYSSQ, SYSALLDA, etc., the 3350 native if 3350's in 3330-11 compatibility mode are going to be used with those names and are going to be converted later to 3350 native mode.

```
UNITNAME NAME = SYSDA, UNIT = ((140, 4), (148, 4), (150, 16), (100, 2),  
                                (2D1), (2C0, 2))
```

```
UNITNAME NAME = SYSSQ, UNIT = ((154, 4), (15C, 4), (2C2, 2))
```

```
UNITNAME NAME = SYSALLDA, UNIT = ((140, 16), (150, 16), (100, 2),  
                                   (2D0, 2), (2C0, 4))
```

Also, map the two 3350 strings into groups of two drives each which can be converted a group at a time by:

```
UNITNAME NAME = 3350A, UNIT = ((140, 141))
```

```
UNITNAME NAME = 3350B, UNIT = ((142, 143))
```

```
UNITNAME NAME = 3350H, UNIT = ((14E, 14F))
```

The DEVPREF parameter should be:

```
DEVPREF = (3350, 3330-1, 2305-2, 3340, 2400)
```

After the system generation, the Eligible Device Table, which is composed of six tables, will look as shown in Figure 9. The system generation has made a distribution of the units into groups according to the unitname and the Device Preference Table. These groups are made up as follows:

```
Group 1: 100-101  
Group 2: 140-141  
Group 3: 142-143  
Group 4: 144-145  
Group 5: 146-147  
Group 6: 148-149  
Group 7: 14A-14B  
Group 8: 14C-14D  
Group 9: 14E-14F  
Group 10: 150-153, 158-15B  
Group 11: 154-157, 15C-15F  
Group 12: 2D0  
Group 13: 2D1  
Group 14: 2C0-2C1  
Group 15: 2C2-2C3  
Group 16: 280-285  
Group 17: 002-004  
Group 18: 00E-00F  
Group 19: 00C  
Group 20: 00D  
Group 21: 009
```

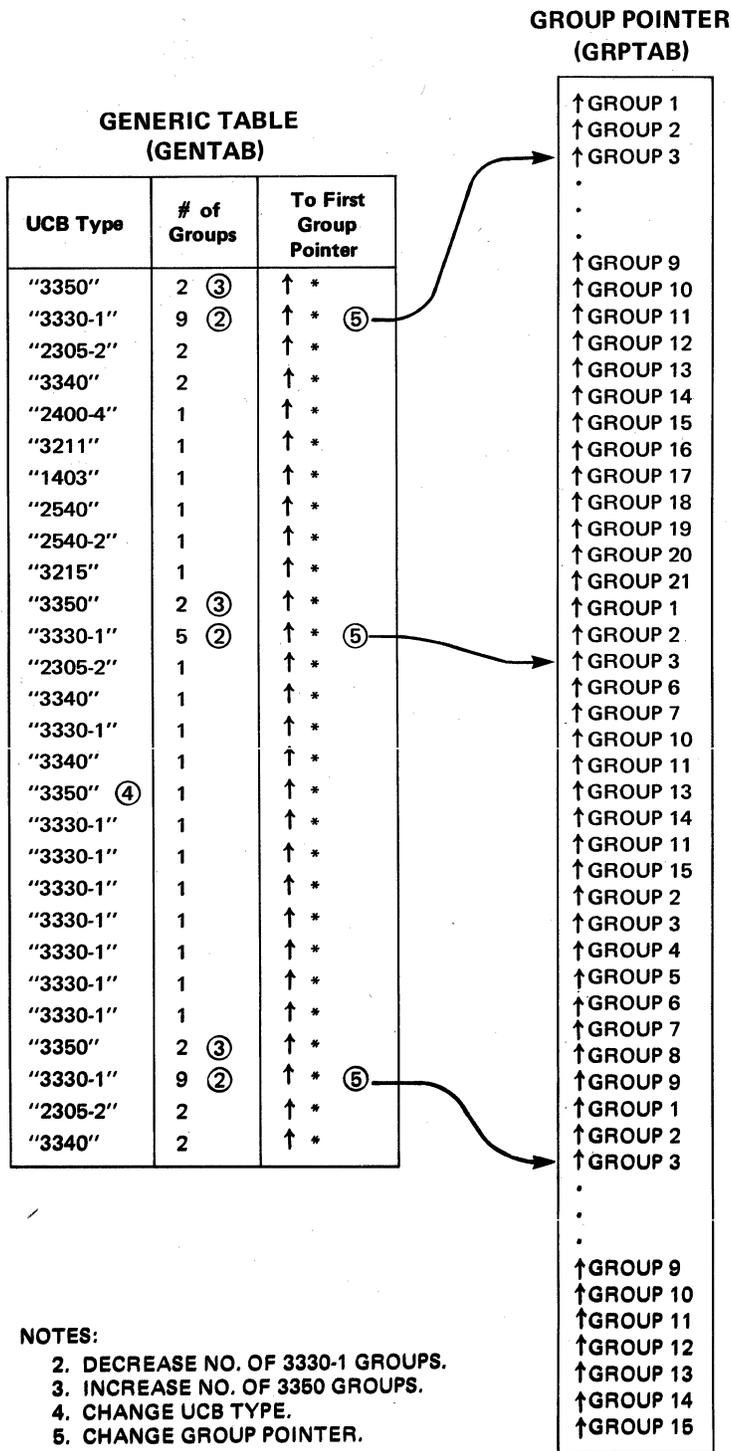



Figure 10. Generic table and group pointer table after modification

Note the Unit Name, UNIT = 3350, does not distinguish between drives with and without fixed heads. When creating a new data set on a fixed head area in a DASD subsystem with mixed drives (with and without the feature), the user must specify the volume serial number(s) and unit name with the same group name specified at SYSGEN time. It is recommended that a unique user-defined group name be assigned to 3350/3344 drives with fixed heads and another unique name to the 3350/3344 drives without them by means of a system generation or an I/O generation. The JCL should be changed for the new unit names where appropriate. Refer to Appendix C for specific examples.

6.4.1 Suggested Applications for Fixed Heads

In general, the criteria for determining candidates for fixed-head files are size and frequency of use.

The following programming components are suggested areas best suited for the fixed-head capability of the 3350/3344. System files, applications, and examples of industry applications are given. No attempt has been made to include all of the possible applications or industries, and they are not necessarily ranked by merit.

System Files

- DOS/VS Page Data Set
- Partitioned Data Set Directories
- OS/VS Pageable Line Pack Area
- System Catalog
- Volume Table of Contents (VTOC)
- DOS/VSAM Index Catalog
- JES2 Spool File

Application Files, General

- Indexes
- Tables
- Small Active Files
- Work Areas
- Transaction Logs
- SORT for Small Files
- Time Sharing Option (TSO) Data Sets
 - User Catalogs
 - User Attribute Data Sets
 - Broadcast Data Set
- TCAM Message Queue
- Video Paging Hold Files (for paging 3270 Operator)
- Video Screen in Page File (for holding constant data on 3270)
- Commonly Used Transactions

Application Files, Program Products

DBOMP

- Controller Sequential Access (CSAM) master file cylinder index
- Separate Index Access Method (SIAM) Reference file
- SIAM – body file availability and data records

DBOMP/CICS

- Recovery File

CFMS

Master file reference ISAM data set cylinder index
Master file reference data set

Industry Examples

Finance

Each of these examples illustrates the need for a file dedicated to a particular application that has rapid direct access with minimum exit/entry file delays.

Online General Ledger: If each transaction of an online application updates the general ledger, this small file may be kept under fixed heads instead of in main storage.

Teller Control Totals: When system design dictates storing teller control totals at the host system, rather than the local controller, response of the fixed-head capability is ideal.

3614 Account Number to User Security Code: The user can designate the host system to maintain a file which relates an individual's account number to his individual security code. Because of the fixed-head capability, many 3614's could be handled on a common loop.

Check Processing: The following files are small in volume and require concurrent access by several tasks:

- Directory – Mass Data Set
- Pass-to-Pass Control File – Tracer Data Set
- Kill Bundle Summary File – Cash Letter

Distribution and Finance

Credit Authorization: With an online point-of-sale terminal system, a first level positive credit check may be expedited using the 3350/3344 fixed-head capability. Besides having the credit data base (or positive file) on disk, a summary record of each customer can be located under the fixed heads. The summary record consists of the customer's account number and his credit status. The file arrangement reduces terminal response time to obtain the customer's credit status and allows a larger number of terminals to access this information with the same response time.

If the first-level check does not support an additional credit authorization, the master file can be accessed to provide additional information for a final decision.

Distribution

Online Transaction Reporting: Online transaction reporting usually consists of verifying certain header information before the permanent file is updated. Information such as store number and location is normally contained in the header and since it is frequently referenced, it is an ideal file to place under fixed heads.

Insurance

Index Files: Many insurance companies use automated alpha index systems such as the IBM Alpha Search Inquiry System program product. The alpha index file is often relatively small and has a high activity rate. Placing this file under fixed heads can improve insurance functions like inquiry and data entry by reducing time spent finding correct policy numbers when only the name is known.

Temporary Files: The Life Inquiry/Data Entry Program Product is typical of many programs that create temporary transaction files used by subsequent processing programs. Placing these files under fixed heads can speed their creation and use, and improve overall transaction performance.

Application Transaction Log: As insurance daily cycle systems are processed, files are created and updated to provide statistics and control summary information such as policy counts, premiums written, number of claims incurred, and cash received. Improved transaction performance can be realized by maintaining these files under fixed heads.

Rate Files: Rate information is necessary for most contract administration functions in insurance. Determining where the most activity occurs and placing the rates of the highest activity under fixed heads will improve daily cycle performance of application systems for online quotations and issuing of policies.

SECTION 7: CONVERSION CHECKLIST

The following checklist contains many of the items that should be considered when converting to 3350. It is not intended to answer all conversion questions but rather to identify some areas that may require attention and subsequent investigation and planning. The functions listed represent a mixture of both IBM and customer responsibilities.

1. Plan initial overall schedule
 - General task to be performed
 - Distribution of resources
 - Assignment of responsibilities
 - Preliminary PERT chart
2. Order the appropriate System Control Program release or Independent Component Release from the IBM Program Information Department (see Section 5.2).
3. Insure that lines of communication are open to all support sources
 - CE Hardware: Insure that all systems are at appropriate Engineering Change level before arrival of 3350/3344. Insure that companion features and/or Miscellaneous Equipment Specifications (MES) for disk attachments are ordered to coincide with 3350/3344 delivery.
 - CE Software: Work closely with the Program Support CE in order to utilize Customer Engineering Support systems which include Early Installation Support (EIS), Retain/370 and Field Technical Support Centers.
 - DP Account Representative.
4. Physical planning considerations
 - Consider the physical characteristics of the 3350/3344 DASD. These include heat dissipation, weight and size of the new facilities.
 - Consider the space, cabling and heat dissipation during the period when both the 3350/3344 and the facilities it will replace are on the system.

Note: The IBM Installation Planning Representative is available to provide assistance.
5. Datacenter use
 - Customer testing which must take place prior to installation may have to be scheduled at an appropriate datacenter.
 - System configuration at datacenters should be reviewed in order to ensure capability of meeting backup or test requirements.
 - Determine IBM datacenter hardware compatibility and communicate special requirements, if any.
 - Schedule datacenter time.
 - For systems being installed without 2314/3330/3340 DASD's consider scheduling SYSGEN at the datacenter.
6. Customer personnel training
 - System programming
 - Application programming
 - Operations

7. Begin detailed conversion plan and schedule

- Approach to program and data set conversion.
- Operational plans to minimize impact.
- Application of performance guidelines.
- Method of controlling and monitoring progress.
- Define checkout and acceptance criteria for release of old facilities.

Note: Checkout of customer programs and data sets when resident on 3350/3344 DASD's may require a full cycle of data processing (depending on the customer's procedures, etc.)

Procedures for verification of tests, parallel runs, etc., should be established. Extra attention to online or communications systems.

Assessment that old DASD's may be discontinued may depend upon checkout procedures.

- Define interim (parallel) operating procedures.

8. Review status of program products, Type II and Type III, currently in use for 3350 support

- Reorder if necessary.
- Define alternatives if 3350 not supported.

9. Review application programs

- EXCP/XDAP: DASD programs using 3330's may have to be rewritten (CCW's, SENSE CHECKING, etc.).
- BDAM
- Accounting routines
 - a. If accounting is based on number of tracks used, accounting routine should be modified.
 - b. If accounting is based on second SIO being issued, the routine should be modified.
- Check effective use of access methods.
- Review block size for 3350. A block size of approximately 3000 bytes in compatibility mode or 4500 in native mode will provide four records per track. If all active programs have this suggested blocking for data sets and about the same data set activity, then the channel, control unit and device load will be balanced making best use of RPS (see Section 6).
- Emphasize most critical jobs.

10. Plan SYSGEN strategy

- Note:*
- a. 3350 UCB's in the Starter System are 148-14B, 248-24B, 348-34B, for OS/VS1, and 148-14D, 248-24D, 348-34D, 448-44D, 548-54D, 648-64D for OS/VS2.
 - b. 3350 restore tape will not be available from PID. If the 2314's, 3330's or 3340's are being discontinued and a SYSGEN is planned after their removal, the DLIB should be restored to a 3330 and moved to 3350.
 - c. Support of 3350 as a starter system device is not included in the Independent Component Release (ICR).

- Apply pre-SYSGEN PTF's, if any.

11. Storage requirements

- A slight increase in resident storage (100 bytes in VS2 and 300 bytes in VS1) is required for this support. The main storage requirements for individual functional components will be available in the Storage Estimates manual, GC24-5094 (VS1) or GC28-0604 (VS2).
- Additional real storage is required if block size is increased. VS2 Release 3 defaults to chained scheduling and BUFNO = 5 for QSAM. If you use full track block on 3350 (19K Track) that means 95K of long term fixed memory for buffers. Large blocks without chained scheduling and one buffer is more efficient than short blocks with chained scheduling and multiple buffers in terms of less fixed memory and less CPU use for PCI interrupt handling.

12. Addressing requirements

- Sixty-four contiguous addresses are required for 4 strings of 3350 in 3330-1 compatibility mode and for the maximum 3344 configuration on an ISC path or 3830-2. Relocation of other devices may be necessary before installation.
- Check that the addresses conform to the scheme shown in Section 4.6.

13. PARMLIB

- PRESRES or VATLST should be updated to reflect 3350/3344 compatibility volumes. Note that in this case 3350's/3344's must be declared as permanent mounted volumes.
- System parameter and BLDL lists should be reviewed and revised, because many modules may have been split or recommended as added to residency list in the new release. See System Programmers Library: Storage Estimates.

14. DASD Initialization (Standalone and OS/VS Utilities).

- Use "Quick" DASD if the format of the 3350 (native or compatibility mode) is already correct.
- A reinitialization of the drive is required if it is desired to operate in a mode other than ordered.
- Home Address (HA) and RO will be read and rewritten on primary and alternate tracks. VTOC will be written and a surface analysis will be performed on previously defective-flagged tracks. If no errors are detected the tracks(s) will be reclaimed.
- Standalone version available in SAMPLIB of current releases.

15. DUMP/RESTORE (Standalone and OS/VS)

- Requires eight 2400' tapes (at 1600 bpi) or two 2400' tapes (at 6250 bpi) to dump entire 3350 volume.
- 2314's, 3330's and 3340's DUMPED to tape cannot be restored to 3350 native.
- Standalone version available in SAMPLIB of current releases.

16. Performance considerations

- Ensure that SPACE on direct access is allocated on cylinder boundaries either by direct CYL allocation or by using the ROUND parameter. This avoids the Extent Check Interrupt at the end of each track.
- Ensure that frequently used data sets are close to the VTOC. An example of a frequently opened system data set is the Master Catalog.

- Paging data sets are critical for system operation. The following recommendations should probably improve system performance through the careful use of paging data sets and devices:
 - a. Avoid placing more than one paging data set on any single 3350. The purpose is to reduce the contention among multiple paging data sets for the use of the device.
 - b. If the number of fast devices (2305-2, 3350) is limited, place most paging data sets on moderate speed devices, such as 3330's, to avoid overloading the fast device(s).
 - c. Set up a relatively slow device (e.g., 3330, 2314) for the data set(s) that will contain secondary copies of duplexed common areas. Secondary copies are read only some of the time for error recovery, and therefore should not occupy space on faster devices.
 - d. Specify a data set to exclusively contain the Pageable Link Pack Area (PLPA). Place the PLPA modules on the fastest available device (2305-2, 3350), since stolen real-storage pages will have to be replaced from the PLPA data set. Avoid placing other paging data sets on the same device, unless a 2305-2 or other fixed-head device is being used.

On the 3350 fixed-head models the PLPA may be structured, through the PAKLST option, so that the most active pages are on the front of the PLPA data set. Then this could be allocated under the fixed heads.
 - e. Specify overspace for all page data sets to allow the creation of additional address spaces before current ones are deleted, and to permit some reasonable increase in the number of concurrent VIO data sets.
 - f. The paging data set should be password-protected, since these data sets are critical for system operation. Use the DEFINE SPACE command to specify password protection when preallocating the data set, or use the ALTER command at a later time to add password protection.
- Consider the increment of the capacity.
 - a. The 3350 provides more storage per access mechanism than 2314's, 3330's and 3340's. Consider how more data sets on the same volume will affect performance.
 - b. Consider how fewer arms in the system will affect performance.
 - c. Remember that in a shared DASD environment the hardware RESERVE and RELEASE commands are on a device basis and not a data set basis. In the same way, when working in multivolume compatibility, if a RESERVE command is issued through string switch to one of the logical volumes (3340 or 3330-1 compatibility mode), all the volumes appear BUSY to any other interface until the RELEASE command is issued.
- Check DCB Parameters

Are DCB parameters (BLKSIZE, RECFM) hard coded in user programs (Assembler, COBOL, PL/I)? If RECFM = FB is hard coded, a compromise might be to add OPTCD = Z which is a request for Search Direct technique to the DD card rather than convert the program.

Consider record format (RECFM). All fixed blocked (F = FB) QSAM and BSAM data sets should be examined to see if fixed block standard (FS - FBS) can be used. The use of FBS could increase the effective data rate since a search direct technique is used as opposed to a search previous technique for FB.
- PROCLIB design

The above considerations are involved in converting an installation procedure library. Since procedures are used by many jobs, the performance return for careful design is great. Particular attention should be given to block sizes, RECFM = FBS and unit separation via unit name.

- Utilities
Consider use of IEBCOPY to copy partitioned data sets that have been ordered with performance in mind. IEBCOPY will not change this order while IEHMOVE will reorder alphabetically.
- UCW Assignment
System performance benefits can be achieved through proper assignment and plugging of the 370 block multiplex channel Unit Control Word (UCW).

17. Data Set Conversion

- Determine space allocation considering old usage of space and characteristics of new and old DASD. Consider rounding to a cylinder for performance.
- Determine the placement of the most active and small data sets under fixed heads.
- Determine data set conversion priorities. For example, sort work files require no effort, so SM1 using 3350 probably will save many production hours. Other work files and temporary data sets require only minimum JCL changes. IBM-supported system residence program products and application programs are pretested. Consider converting the least critical high activity customer files next. Don't forget little used data sets such as quarterly, annually, etc.
- Can data conversion be done as part of regular processing cycle? Day 1 – input old DASD (2314, 3330, etc.), output 3350/3344. Day 2 – input 3350/3344, output 3350/3344.
- Schedule machine time for one-time conversion runs.
- Consider use of utilities for data conversion. Sequential data sets directly to 3350/3344 or via tape using IEHMOVE/IEBGENER.
- Partitioned data sets directly to 3350/3344 or via tape using IEHMOVE/IEBCOPY.
- Indexed sequential data sets to 3350/3344 or via tape using IEBISAM.
- VSAM data sets to 3350/3344 or via tape using Access Method Services.
- Direct organization (BDAM) data sets to 3350/3344 or via tape using IEHMOVE.
- BDAM files deserve extra consideration.

Use of an existing reorganization program may be preferable to IEHMOVE to avoid an extra run.

Reprogramming of randomizing routine in the reorganization and all processing programs may be necessary if addressing algorithm was dependent on the old DASD device geometry (i.e., number of cylinders per module, number of tracks per cylinder, number of bytes per track).

- Check conversion schedule against program use of concatenated data sets to ensure that all concatenated data sets are converted prior to deadline to run program. Data sets concatenated across RPS and non-RPS devices default to non-RPS support. (The non-RPS device must be the first DD card in the concatenation.) This also applies to backward referenced (VOL = REF =) and multivolume data sets.

18. Backup and Recovery

- Develop two strategies – one for conversion and parallel operation and one for full production.
- Backup system or devices. How far away, time available, priority, etc.

- Time to dump/restore. Note that approximately eight 2400' reels of tape (1600 bpi) or two 2400' reels (6250 bpi) are required to dump the content of a full 3350 drive (native mode).
- Conversion and parallel operation backup is more complicated than full production backup, since old and new devices are different. This may require keeping old CATALOG, PROCEDURES, JCL and duplicate data sets.
- Close control over volume serial number usage and catalog updating is required during parallel runs, to avoid confusion and error due to duplicate volume IDs.

19. Operating Procedures

- Machine room procedures may have to be modified due to:
 - Reduced number of spindles available.
 - Reduced number of "PRIVATE" packs.
 - Data set security – more sensitive due to increased number of data sets per pack.
- Plan for operator familiarization of new machine room procedures.

SECTION 8: CONVERSION EXAMPLES

8.1 DOS/VS Compatibility Mode: 3340 to 3344 Conversion

Make the following assumptions:

Current configuration is a S370/135 Model H, 256K bytes of processor storage and DOS/VS Release 30, with IFA and two strings of 3340 (16 drives). The proposed configuration changes three 3340 Model B2's for three 3344 Model B2 units.

This conversion is similar to adding more 3340 spindles to the old configuration. However, besides the general rules given in above sections, in this particular case:

1. IFA must have Specify #9317. This feature requires 2.2K bytes of additional control storage and is mutually exclusive with IFA Conversion Feature (#4645) and with 2314/3340 Compatibility Feature (#8070).
2. Order the appropriate DOS/VS Release with 3344 Support.
3. New addresses of the 3344 devices must be on the string 0 and their addresses must be:
Spindle 2: 2, 10, 16, 1C
Spindle 3: 3, 11, 17, 1D
Spindle 4: 4, 12, 18, 1E
Spindle 5: 5, 13, 19, 1F
Spindle 6: 6, 14, 1A, 20
Spindle 7: 7, 15, 1B, 21
4. Review the job control cards and look over all generic device assignment by device type where the old 3340's were implicated. The specific address desired or an address list should be used to avoid job cancellations due to the fixed-media nature of the volumes under addresses x'n02' to x'n07' and x'n10' to x'n21'.
5. Initialize the 3344 drives. Use the standalone utility provided for VS1, VS2 and VM or the DOS utility. The drive is preinitialized at the factory with Home Address and R0 on all tracks. Therefore, only a quick initialization is necessary to write two IPL records, volume label(s) and the VTOC.

```
Example: // JOB INITIAL INITIAL 3344  
        // ASSGN SYS000, X'1C6'  
        // EXEC INTDK  
        // UID IQ  
        // VTOC STRTADR = (0695000), EXTENT = (12)  
        VOL 1333333  
        // END  
        /&
```

6. Copy data sets onto the new 3344's. Make a selective copy (data set by data set) or a full copy (volume by volume). If copying the full volume, the Fast Copy Disk Volume can be used. This program performs the copy function in considerably less time than the Copy and Restore Disk Program (about 16 minutes).

```
Example: // JOB COPY 3340 TO 3344
         // ASSGN SYS004, X' 148' (input 3340)
         // ASSGN SYS005, X' 1C6' (output 3344)
         // EXEC FCOPY, REAL
         // UDD IV = INPUT 1, OV = 333333
         / &
```

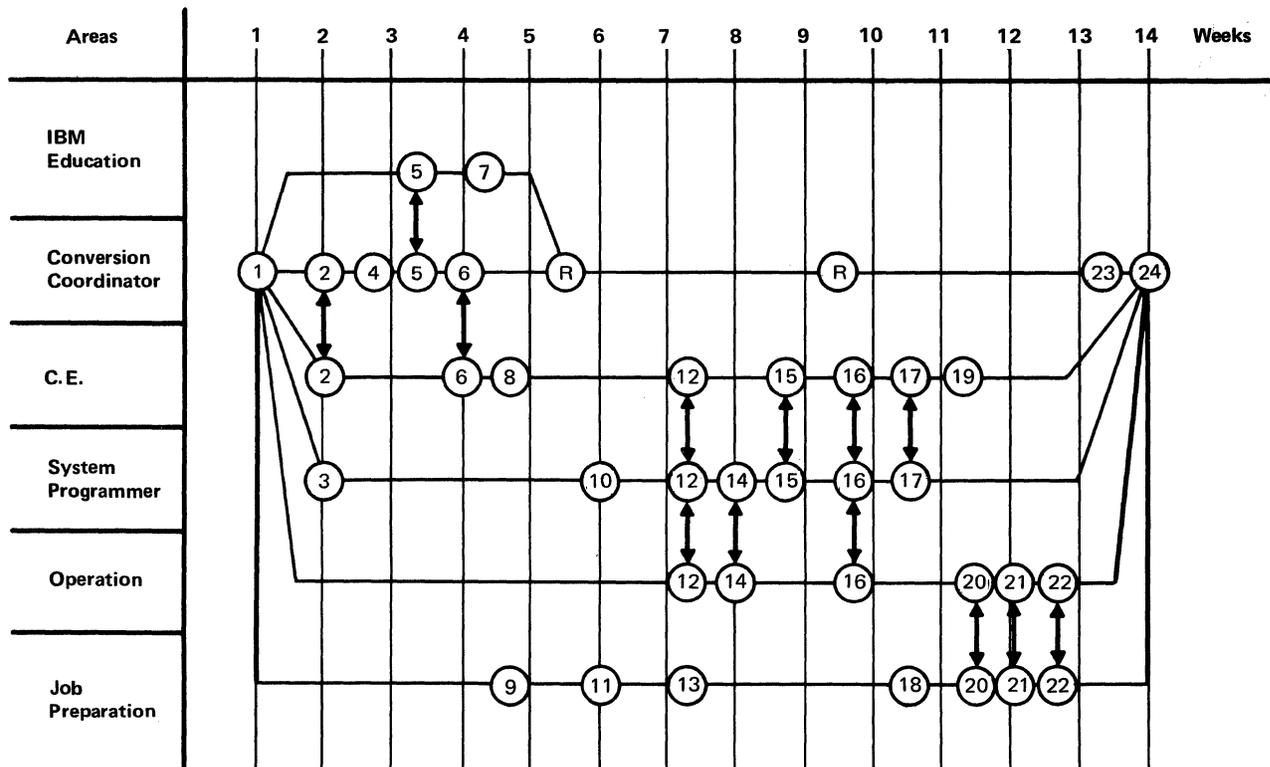
If making a selective copy, move data to 3344 according to the following guidelines:

- Maintain the highest activity files on 3340.
- Combine on 3344:
 - Active with inactive data sets.
 - Files accessed at different times during the day.
 - Files dependent upon one another.
- Maintain at least one physical spindle per active partition.

The typical sequence of events and implicated areas are shown in Table 10 and Figure 11.

TABLE 10. 3340 to 3344 Conversion: Sequence of Events

| ITEM # | EVENT OR ACTIVITY | ITEM # | EVENT OR ACTIVITY |
|--------|--|--------|--|
| 1 | Plan overall general installation schedule | 12 | Generate DOS Rel with 3344 support for present configuration (Apply PTF's pre-SYSGEN if any) |
| 2 | Review equipment specifications | 13 | Change JCL for testing |
| 3 | Order DOS Release with 3344 support | 14 | Do initial checkout of system |
| 4 | Confirm equipment delivery schedule | 15 | Apply appropriate PTF's if any |
| 5 | Establish education plan on 3344 | R | Review of the plan |
| 6 | Lay out physical plan | 16 | Generate DOS Rel with 3344 support for final configuration |
| 7 | 3344 education for customer personnel | 17 | Apply appropriate PTF's if any |
| 8 | Change physical addresses if necessary | 18 | Change JCL for production |
| 9 | Analyze and prioritize data set requirements | 19 | Physically install new devices |
| R | Review of the plan | 20 | Initialize new devices |
| 10 | Plan SYSGEN strategy | 21 | Do initial move/copy of some data sets |
| 11 | Plan placement of data sets to minimize interference | 22 | Run parallel of selected jobs |
| | | 23 | Check against acceptance criteria defined in conversion plan |
| | | 24 | Run production on 3344 system |



- Notes: 1. The position of the circle shows when the activity/event must be accomplished.
 2. Vertical arrows show relationship of different areas with common activity.

Figure 11. 3340 to 3344 – conversion schedule

8.2 DOS/VS Compatibility Mode: 3330 Model 1 to 3350 Conversion

The installation configuration is a 370/145 Model I2, 512K bytes of processor storage and DOS/VS Release 30. Actual DASD capacity is made up by two strings of 3330 Model 1, with addresses 140-147 and 150-157, attached to a 3830-2. In order to install a data base system, two strings of 3350 have been ordered in addition.

Basically, this case is very similar to the preceding, but the following must be taken into account:

1. The 3830-2 Storage Control Unit must have installed the Expanded Control Store feature (#2151), the Register Expansion Feature (#6111) and Specify #9318.
2. The new addresses for the 3350's in 3330 Model 1 compatibility mode may be (see Appendix A):
 - a. 140-14F and 160-16F, or 150-15F and 170-17F
 - b. 148-14F, 168-16F and 158-15F, 178-17F

Option "a" implies changing the addresses of one of the existing 3330 Model 1 strings.

With case "b" the new address set would be:

- First string: 140-147 (3330 Model 1 string)
- Second string: 148-14F, 168-16F (3350 in 3330-1 compatibility mode)
- Third string: 150-157 (3330 Model 1 string)
- Fourth string: 158-15F, 178-17F (3350 in 3330-1 compatibility mode)

Addresses 160-167 and 170-177 would become preempted.
 They would not be available for any other device.

8.3 OS/VS2 Native Mode: 3330 Model 11 to 3350 Conversion

Assume an installation with two 370/168's, one Model KJ with 3072K bytes of processor storage and the other, Model L and 4096 bytes. Both CPU's have OS/VS2 Release 3 as System Control Program. Every system has three 3330-11 strings (two shared between the two CPU's), with a total of 48 spindles. The installation is directed to IMS and needs to enlarge actual online DASD capacity, but the floor space is a critical problem. With this in mind, two 3350 strings with eight spindles each have been ordered to replace two 3330-11 strings, one on each system.

The conversion plan may be oriented to start in compatibility mode and gradually to convert to native mode. This will be accomplished in two phases, the first one in turn consisting of two subphases.

Phase A – Installation in Compatibility Mode:

The most important objective in this phase will be the substitution of the two 3330-11 strings by the two 3350 strings as soon as possible.

In the first subphase of this phase, users will establish the norms and general principles of the conversion, and will proceed with education on 3350. They will also dictate review and control techniques, update System Reference Library on new devices/system, and appoint the Conversion Coordinator and the responsible people in the different areas affected by the conversion.

The second subphase will relate to the physical substitution of the two 3330-11 strings. Because of the floor space problem, the substitution will take place at intervals in the following way:

1. Install first 3350 string in compatibility mode.
2. Run parallel and test selected jobs.
3. Release replaced 3330-11 string.
4. Install second 3350 string in compatibility mode.
5. Run parallel and test selected jobs.
6. Release the second 3330-11 string.

Because the conversion is volume to volume, without change in the data set organization, programs, spaces and blocksizes, the substitution should be fast and easy. Besides moving the data sets, it may only be necessary to make some slight changes in the job control cards and apply the ICR for Release 3.

Phase B – Conversion to Native Mode:

This phase requires a more careful and detailed schedule but it is possible to convert on a spindle basis while the other drives on the string are available in compatibility or native mode for use by the system. This permits accomplishment of the conversion process while the system continues with the normal work.

The implementation of this phase requires space analysis, job control changes, catalog adjustments, BDAM/EXCP analysis and move/copy data sets.

The advantage of this approach is that it permits the continuous operation of the system during the conversion process. Typically, the sequence of events and activities will develop as shown in Table 11 and Figure 12.

TABLE 11. 3330-11 to 3350 Native Conversion: Sequence of Events

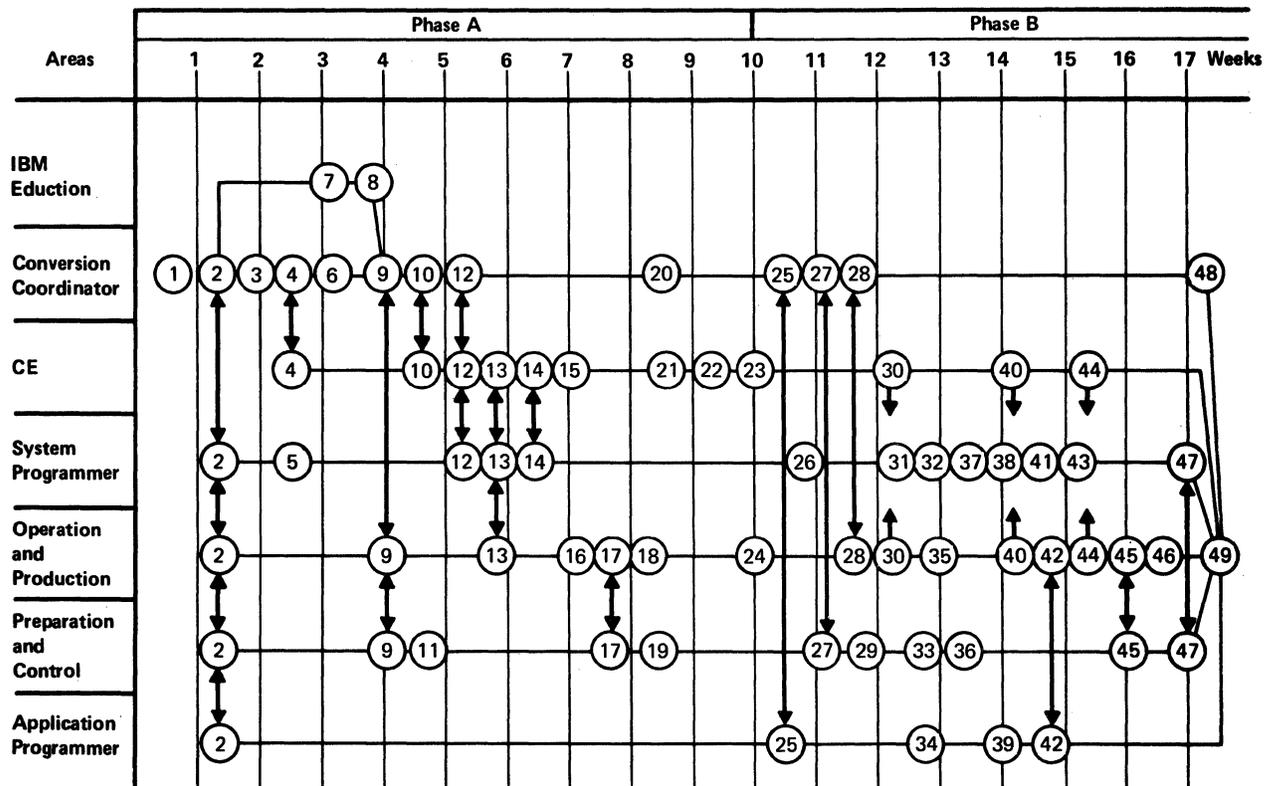
| ITEM # | EVENT OR ACTIVITY |
|--------|--|
| | PHASE A |
| 1 | Organize for the conversion – Conversion Coordinator – Review and control techniques |
| 2 | Assign responsibilities in the difference conversion areas. |
| 3 | Identify support sources – Customer engineering hardware specialist – Customer engineering software specialist – Systems Engineering support in Branch Office |
| 4 | Review equipment specifications for correctness – 3830-2 or ISC must have Expanded Control Store #2151, Register Expansion #6111 and Specify #9318. – The Specify Format of the 3350's in 3330-11 compatibility mode must be #9741 for first drives and #9742 for second drives. |
| 5 | Order Independent Component Release (ICR) for 3350 Support. |
| 6 | Confirm equipment delivery schedule. |
| 7 | Establish education plan. |
| 8 | Develop education plan. |
| 9 | Develop installation plan for phase A – Plan for parallel operation – Establish acceptance criteria for release of the 3330-11's – Develop backup plan to reflect fixed media |
| 10 | Lay out physical plan – Physical site requirements during transition phase – Floors – CE service clearance – Air conditioning – Power requirements – Cable requirements – lengths – Concurrent operation requirements |
| 11 | Identify actual volumes to reside on 3350 in 3330-11 compatibility mode. |
| 12 | Analyze the address requirements in both systems. Establish new addresses if necessary |
| 13 | Apply ICR and perform SYSGEN for both systems – Establish Sysgen parameters thinking in terms of a future gradual field conversion. See Section 6.3. |
| 14 | Apply appropriate PTF's if any. |
| 15 | Install the first 3350 string in 3330-11 compatibility mode. |
| 16 | Initialize the 3350 spindles. |
| 17 | Dump the selected volumes onto 3350 string. |
| 18 | Run selected jobs in parallel. |
| 19 | Verify results. |
| 20 | Check against acceptance criteria defined in installation plan (see item 9 above). |
| 21 | Release replaced 3330-11 string. |

TABLE 11. 3330-11 to 3350 Native Conversion: Sequence of Events (Cont)

| ITEM # | EVENT OR ACTIVITY |
|--------|---|
| 22 | Install the second 3350 string in 3330-11 compatibility mode. |
| 23 | Repeat the items 16, 17, 18, 19, 20, and 21 with the second 3350 string. |
| 24 | Run production on 3350 in 3330-11 compatibility mode system. |
| | PHASE B |
| 25 | Develop a detailed 3350 native conversion plan and schedule <ul style="list-style-type: none"> – Identify critical applications and data set requirements – Establish approach to program and data set conversion – Review manpower requirements – Establish program testing standards – Establish program documentation standards – Plan for parallel operation – Plan recovery/reconfiguration/restart for critical applications |
| 26 | Review status of program support <ul style="list-style-type: none"> – Order necessary program products (e.g., IMS) – Study the Eligible Device Table, EDTTAB CSECT, in the sysgen assembly – Prepare the SUPERZAP to UCB, and EDT (see section 6.3) |
| 27 | Plan placements of workspace and noncritical data sets to minimize interference with reconfiguration. |
| 28 | Plan sequence for data set migration. |
| 29 | Modify JCL, generics, procedures, etc., for using 3350 as workspace. |
| 30 | Convert two 3350 drives to native format <ul style="list-style-type: none"> – Procure backup of system in case system table SUPERZAPS are faulty – Apply SUPERZAP (see item 26 above) – Initialize the converted drives in native format |
| 31 | Test/Evaluate 3350 as workspace. |
| 32 | Install 3350 as workspace. |
| 33 | Change blocking/allocation for performance on 3350. |
| 34 | Analyze BDAM/EXCP situations. |
| 35 | Do initial move/copy of some data sets to 3350. |
| 36 | Adjust the catalog. |
| 37 | Test system with same job stream run on the 3330-11. |
| 38 | Evaluate test results and implement required system corrections. |
| 39 | Design data base access manager and utilities. |
| 40 | Convert two more 3350 drives to native format <ul style="list-style-type: none"> – Procure backup of system in case system table SUPERZAPS are faulty – Apply SUPERZAP (see item 26) – Initialize the converted drives in native format |
| 41 | Install IMS with 3350 support. |
| 42 | Build test data base on 3350. |
| 43 | Test data base access/utility programs. |
| 44 | Convert and initialize 3350's in native format. |
| 45 | Convert data base to 3350. |

TABLE 11. 3330-11 to 3350 Native Conversion: Sequence of Events (Cont)

| ITEM # | EVENT OR ACTIVITY |
|--------|---|
| 46 | Maintain backup data base. |
| 47 | Test new 3350 subsystem. |
| 48 | Check against acceptance criteria defined in conversion plan. |
| 49 | Run production on 3350 subsystem. |



Notes: 1. The position of the circle shows when the activity/event must be accomplished.
 2. Vertical arrows show relationship of different areas with a common activity.

Figure 12. 3330-11 to 3350 native – conversion schedule

SECTION 9: BACKUP AND RECOVERY PROCEDURES

9.1 General

The 3350 and 3344 Direct Access Storage devices have fixed media; therefore, planning backup and recovery operations now requires different considerations. The following may be advisable in order to minimize the effect of a failure on the DASD:

- Configurations. Try to have at least one "spare" drive so that it can be easily used in place of any other drive that fails. The "spare" drive can be used for scratch files, or perhaps, seldom-used read-only files.
- Backup File. Consider dumping time-critical files more frequently.
- Journaling. In case of failure, files are good only to the last checkpoint or backup. To update these files, use a journaling technique or rerun the jobs that accessed the file since the last checkpoint or backup. Each method has advantages or disadvantages and the appropriate technique must be decided upon for each file.

In case of failure, a run of the Analysis Program-1 (AP-1) will indicate whether it is a hardware or data failure. If it is neither of these, the chances are that there is an error in the program.

If there is bad data, use the IEHDASDR utility program to restore the data. Rerun the job or jobs or update from the journals. Should data in the field prove unrecoverable, data recovery assistance at the plant of manufacture will be provided. Unless this is requested by the customer, his data will not be read at the plant.

If a hardware failure exists, your service representative will isolate it. In most cases, a drive can be repaired faster than a restore/update operation. If the head/disk assembly unit must be replaced, a restore/update operation will be necessary. When a dump/restore operation is appropriate, it need not be a traumatic experience if such an eventuality has been carefully planned for.

If a drive has been designated as "spare" so that dumping is not necessary, IEHDASDR will restore the volume from backup. Depending upon the frequency with which dumps have been taken, one, two or more jobs will have to be run and restart can be made from the interrupted job.

The following outlines recovery actions for 3350 and 3344 for three categories of DASD problems: (1) drive failure, (2) head disk assembly failure, and (3) data, i.e., the hardware is functioning properly but some part of the data cannot be read. The appropriate recovery action is described for several typical environments.

9.2 Batch Environment Recovery

If this environment, data must be reconstructed by individual methods – either from journals if they are kept or by restoring data to the last checkpoint and rerunning the job. Most likely, only those data sets will be restored that will enable critical jobs to proceed.

9.2.1 Single Drive Failure

The following actions might be necessary:

- Run Analysis Program-1
- Cancel the jobs associated with data on affected drive
- Dump data from spare (May not be necessary if spare drive does not contain permanent data)
- Restore data from tape to spare drive (If journals have been kept, they may be applied against the restored data after this step)
- Restart job

9.2.2 Subsystem or Unit Failures

Failures which affect an entire unit or subsystem, although rare, are more complex and often preclude the above actions. Here the best recovery procedure is to wait for repair. However, with a 3350 C2 and the Primary Controller Adapter on 3350 A2 installed, most subsystem failures caused by controller failure can be circumvented with minimal loss of time.

9.2.3 Head Disk Assembly Failure

The recovery actions are the same as for drive failure 9.2.1.

9.2.4 Data Problem

Run Analysis Program-1 to determine that there is no hardware problem. Next, restore data from backup tape; journals, if kept, should be applied after this step. Restart the job.

9.3 General Online Environment Recovery

The situation in this environment is one of many small data sets, APL, TSO, etc., contained on a single volume and no journaling methods provided. Recovery, in this situation, consists of restoring the volume to the last checkpoint. The individual users must then resubmit their jobs.

9.3.1 Single Drive Failure

The following approach will reestablish the operation of the system:

- Run Analysis Program-1
- Cancel the jobs associated with data on affected drive
- Dump data from spare if necessary
- Restore data from backup tape to spare drive
- Bring system up and notify terminal users

Subsystem or unit failures will be recovered from by repair (see 9.2.2).

9.3.2 Head Disk Assembly Failure

The recovery action is essentially the same as in 9.2.1.

9.3.3 Data Problem

The recovery action is essentially the same as in 9.2.4.

9.4 IMS Environment Recovery

IMS recovery utility programs are designed to provide a rapid recovery of a data base data set rendered unusable by a failure.

Although these utilities will be used infrequently, judicious preplanning will enhance data base availability in the event of a failure.

9.4.1 Single Drive Failure

The recovery action may be:

- Run Analysis Program-1
- "Vary-off" spare and failing drive
- Dump data for spare if necessary
- Restore required data from tape to spare
- Run journals and update
- Vary spare online
- Restart

If the data base affected by the failure is spread across several drives, or if the failing drive has several resident data bases, recovery becomes more complex and time consuming. Here the most prudent action may be to repair the drive.

Subsystem or unit failures will be recovered from by repair (see 9.2.2).

9.4.2 Head Disk Assembly Failure

The recovery action is essentially the same as in 9.2.1.

9.4.3 Data Problem

Either a track or the data set is reconstructed using IMS recovery utilities. The time is variable and dependent upon the size of the data set, the activity and time elapsed since the last backup was taken.

9.5 Analysis Program-1 (AP-1)

AP-1 is a fast and efficient problem determination tool. It should be used whenever the 3350 or 3344 drives are suspected of causing either hardware or data errors. The operator invokes the AP-1 via his console and directs it to a specific drive. AP-1 then performs an extensive test of that drive's ability to respond to various commands, analyzing the operational status of the drive and the data and control paths for reading, writing and arm movement. More than one drive may be simultaneously tested by starting more than one AP-1 task.

If, while running AP-1, a hardware problem is detected, the message
"SUSPECTED DRIVE PROBLEM"

is written to the console. In addition, a secondary output on SYSPRINT (OS/VS) or SYSLST (DOS/VS) provides much more comprehensive information, giving the basis for decisions that lead to the primary message. This contains:

- a. A matrix showing the failing heads, if appropriate
- b. Failing CCW and associated channel status and sense data

Under this condition, the output of AP-1 should be saved and the customer engineer called for assistance. Alternatively, AP-1 may issue the message

"NO DRIVE PROBLEM FOUND"

in which case the operator will be prompted to specify whether to terminate AP-1 or to continue with the AP-1 media test.

In the media test, the entire volume is scanned for unreadable data. If AP-1 has a problem reading any of the data on the volume, it tells the operator

"ERROR READING DATA"

In this case, the operator should take the appropriate data recovery action specified by installation procedures, which may include assigning an alternate track and restoring a backup copy of the data set containing the unreadable record(s). The SYSPRINT or SYSLST output will indicate the locations of the unreadable data.

If AP-1 reads all the data on the volume successfully, it issues the message

"ALL DATA MACHINE READABLE WITHOUT ERRORS"

This message means that every record on the volume is machine readable, but this does not mean that all records have a proper data format from the point of view of the user's application program.

The AP-1 hardware and media tests are designed to correctly determine most solid drive and media problems, respectively. For example, a program may abort with a "Data Check Error." AP-1 will isolate the problem to a drive malfunction or to a "bad data" condition. The use of this program can greatly speed up the isolation of DASD-related errors and enable the operator to initiate more quickly the appropriate recovery procedures.

The AP-1 runs on CPU's that have 3350's and/or 3344's attachable, 370/135 and up. It is operational only on 3350 and 3344 DASD, and no other devices are supported.

Only those VS1, VS2 and DOS/VS releases that have 3350/3344 support provided are able to use AP-1. VM/370 is supported only through those releases. In addition, each release that is desired to run AP-1 must have an AP-1 ICR applied. Availability dates are June 1976 for OS/VS1, OS/VS2 (MVS) and DOS/VS and August 1976 for OS/VS2 (SVS).

APPENDIX A: 3350 ADDRESS ASSIGNMENT WORKSHEET

- 1 The Address Assignment Worksheet (Chart A) may be used to help understand the variety of ways that control unit addresses may be assigned. The following steps guide the use of the chart:
 - a. Use one sheet for each channel.
 - b. The 16 by 2 matrix in the lower right hand corner represents the available address space on the channel; as a control unit/device address is chosen, "X" out the appropriate boxes in the matrix.
 - c. The configurations are stated in terms of "spindles." A spindle is a physical device and for address assignment purposes, the smallest unit is a group of 8 spindles (a "string").
 - d. If any 3350 spindle on a control unit is to be used in the 3330-1 mode (two logical devices per physical spindle), then the configuration is "Emulation"; otherwise it is "Native." For addressing considerations, 3330 Model 11 compatibility mode is equivalent to "Native."
 - e. The term "Standard Control Unit" refers to control units which do not support 3350's. These are included so that the worksheet may be used to help choose addresses for, say, 2314's, 3330's, Tapes, etc., which are to share the channel.
 - f. Locate the configuration whose address is to be assigned; example: 16 Spindles, Emulation.
 - g. Choose an arrow which lies on a horizontal line (above the matrix). This indicates the range of device addresses consumed by the configuration. For the example (16 spindles, Emulation) note that there are two possibilities: either two groups of 16 addresses or four groups of 8 addresses.
 - h. Choose an arrow (or arrows) which lies on a single, vertical line (to the left of the matrix). This indicates the control unit address range consumed by the configuration. For the example (16 spindles, Emulation, two groups of 16 addresses), note that *two* arrows lie on a single vertical line — we must use the pair to determine the Control Unit Address Range, such as 5 and 7.
 - i. Now "X" out the matrix squares common to the address ranges determined in steps g and h. (This amounts to 4 squares in the example.) These may not be assigned to any other control unit.
 - j. With the help of Chart B or C of this appendix, check if the addresses obtained are valid and the number of addresses required.
 - k. Have all control unit addresses been assigned? If not, go to step f; otherwise, power up and go. . .

Example 1: Assume, hypothetically, a system in which channel 1 has assigned the following addresses:

| <u>Addresses</u> | <u>Device</u> | <u>Attachment Type</u> |
|------------------|---------------|------------------------|
| 120-12F, 130-137 | 3330 | ISC |
| 140-147 | 3330 | 3830-2 |
| 150-157 | 3330 | 3830-2 |
| 160-167 | 3330 | 3830-1 |
| 1C0-1CF, 1D0-1DF | 3340 | ISC |

Note that standard 3830-2 or ISC control units use 16 or 32 addresses regardless of the number of physical drives attached. A 3830-1 uses only 8 addresses.

Assume that one 3830-2 with 3350 capability and two 3350 strings in native mode will be attached to channel 1. To know the available addresses on the channel, you can use Chart A in the following way:

1. "X" out the matrix squares corresponding to the existing addresses.
2. Locate the configuration whose address is to be assigned: 16 spindles, native.
3. The arrow above the matrix corresponding to 16 spindles native gives two possibilities: 16 spindles native in one group of 16 consecutive addresses or in two groups of 8 addresses.
4. The arrows to the left of the matrix corresponding to 16 spindles native indicate the control unit address range. There are sixteen or eight control unit address ranges depending upon whether the configuration is in one group of 16 consecutive addresses or in two groups of 8 addresses.
5. Since the squares of device address 0-7 corresponding to the control unit address 2, 3, 4, 5, 6, C, D and the squares of device address 8-F corresponding to the control unit address 2, 3, 4, 5, C, D are crossed out by X's, only the rest are available to the 3350 strings. Therefore the addresses available are:

One group of 16 addresses

100-10F or
 110-11F or
 170-17F or
 180-18F or
 190-19F or
 1A0-1AF or
 1B0-1BF or
 1E0-1EF or
 1F0-1FF

Two groups of 8 addresses

100-107 and 110-117 or
 108-10F and 118-11F or
 168-16F and 178-17F or
 180-187 and 190-197 or
 188-18F and 198-19F or
 1A0-1A7 and 1B0-1B7 or
 1A8-1AF and 1B8-1BF or
 1E0-1E7 and 1F0-1F7 or
 1E8-1EF and 1F8-1FF

Additionally, the addresses 148-14F and 158-15F could be used if the existent 3330 strings on 140-147 and 150-157 were attached to the new control unit.

Example 2: With the same configuration as the above example, assume that two 3350 strings in 3330 Model 1 compatibility mode are to be attached.

Two possibilities are given on the chart: either two groups of 16 addresses or four groups of 8 addresses.

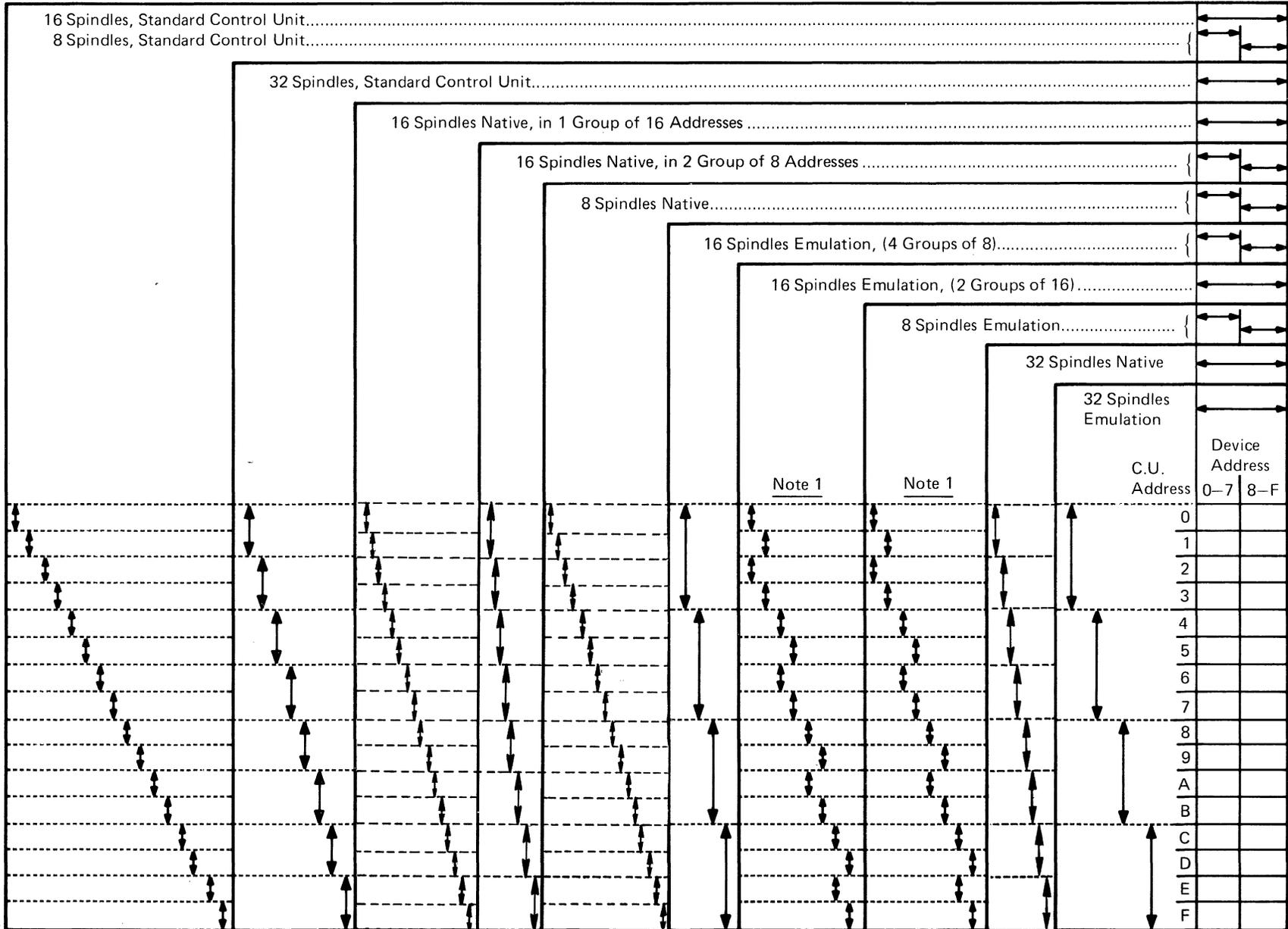
After crossing out the matrix squares corresponding to the existing addresses, only the control unit address range 8-B is available to satisfy the addressing requirements of this configuration. So, the addresses available are:

Two groups of 16 addresses

180-18F and 1A0-1AF or
 190-19F and 1B0-1BF

Four groups of 8 addresses

180-187, 190-197, 1A0-1A7, 1B0-1B7
 or
 188-18F, 198-19F, 1A8-1AF, 1B8-1BF



Note 1

Note 1

Chart A. 3350 Address Assignment Worksheet

Note 1: Take 2 Rows per Column

VALID ADDRESSES FOR 3350

| Addresses | | Number of Addresses Required | Addresses | | Number of Addresses Required |
|-----------|-----------|------------------------------|-----------|-----------|------------------------------|
| Primary | Secondary | | Primary | Secondary | |
| 00 - 07 | 20 - 27 | 16 | 80 - 87 | A0 - A7 | 16 |
| 00 - 07 | 20 - 27 | 32 | 80 - 87 | A0 - A7 | 32 |
| and | and | | and | and | |
| 10 - 17 | 30 - 37 | | 90 - 97 | B0 - B7 | |
| 00 - 0F | 20 - 2F | 32 | 80 - 8F | A0 - AF | 32 |
| 00 - 1F | 20 - 3F | 64 | 80 - 9F | A0 - BF | 64 |
| 08 - 0F | 28 - 2F | 16 | 88 - 8F | A8 - AF | 16 |
| 08 - 0F | 28 - 2F | 32 | 88 - 8F | A8 - AF | 32 |
| and | and | | and | and | |
| 18 - 1F | 38 - 3F | | 98 - 9F | B8 - BF | |
| 10 - 17 | 30 - 37 | 16 | 90 - 97 | B0 - B7 | 16 |
| 10 - 1F | 30 - 3F | 32 | 90 - 9F | B0 - BF | 32 |
| 18 - 1F | 38 - 3F | 16 | 98 - 9F | B8 - BF | 16 |
| 40 - 47 | 60 - 67 | 16 | C0 - C7 | E0 - E7 | 16 |
| 40 - 47 | 60 - 67 | 32 | C0 - C7 | E0 - E7 | 32 |
| and | and | | and | and | |
| 50 - 57 | 70 - 77 | | D0 - D7 | F0 - F7 | |
| 40 - 4F | 60 - 6F | 32 | C0 - CF | E0 - EF | 32 |
| 40 - 5F | 60 - 7F | 64 | C0 - DF | E0 - FF | 64 |
| 48 - 4F | 68 - 6F | 16 | C8 - CF | E8 - EF | 16 |
| 48 - 4F | 68 - 6F | 32 | C8 - CF | E8 - EF | 32 |
| and | and | | and | and | |
| 58 - 5F | 78 - 7F | | D8 - DF | F8 - FF | |
| 50 - 57 | 70 - 77 | 16 | D0 - D7 | F0 - F7 | 16 |
| 50 - 5F | 70 - 7F | 32 | D0 - DF | F0 - FF | 32 |
| 58 - 5F | 78 - 7F | 16 | D8 - DF | F8 - FF | 16 |

Chart B. 3330 Model 1 Compatibility Mode

| Addresses | Number of Addresses Required |
|-----------|------------------------------|-----------|------------------------------|-----------|------------------------------|-----------|------------------------------|
| 00 - 07 | 8 | 40 - 47 | 8 | 80 - 87 | 8 | C0 - C7 | 8 |
| 00 - 07 | 16 | 40 - 47 | 16 | 80 - 87 | 16 | C0 - C7 | 16 |
| and | | and | | and | | | |
| 10 - 17 | | 50 - 57 | | 90 - 97 | | D0 - D7 | |
| 00 - 0F | 16 | 40 - 4F | 16 | 80 - 8F | 16 | C0 - CF | 16 |
| 00 - 1F | 32 | 40 - 5F | 32 | 80 - 9F | 32 | C0 - DF | 32 |
| 08 - 0F | 8 | 48 - 4F | 8 | 88 - 8F | 8 | C8 - CF | 8 |
| 08 - 0F | 16 | 48 - 4F | 16 | 88 - 8F | 16 | C8 - CF | 16 |
| and | | and | | and | | | |
| 18 - 1F | | 58 - 5F | | 98 - 9F | | D8 - DF | |
| 10 - 17 | 8 | 50 - 57 | 8 | 90 - 97 | 8 | D0 - D7 | 8 |
| 10 - 1F | 16 | 50 - 5F | 16 | 90 - 9F | 16 | D0 - DF | 16 |
| 18 - 1F | 8 | 58 - 5F | 8 | 98 - 9F | 8 | D8 - DF | 8 |
| 20 - 27 | 8 | 60 - 67 | 8 | A0 - A7 | 8 | E0 - E7 | 8 |
| 20 - 27 | 16 | 60 - 67 | 16 | A0 - A7 | 16 | E0 - E7 | 16 |
| and | | and | | and | | | |
| 30 - 37 | | 70 - 77 | | B0 - B7 | | F0 - F7 | |
| 20 - 2F | 16 | 60 - 6F | 16 | A0 - AF | 16 | E0 - EF | 16 |
| 20 - 3F | 32 | 60 - 7F | 32 | A0 - BF | 32 | E0 - FF | 32 |
| 28 - 2F | 8 | 68 - 6F | 8 | A8 - AF | 8 | E8 - EF | 8 |
| 28 - 2F | 16 | 68 - 6F | 16 | A8 - AF | 16 | E8 - EF | 16 |
| and | | and | | and | | | |
| 38 - 3F | | 78 - 7F | | B8 - BF | | F8 - FF | |
| 30 - 37 | 8 | 70 - 77 | 8 | B0 - B7 | 8 | F0 - F7 | 8 |
| 30 - 3F | 16 | 70 - 7F | 16 | B0 - BF | 16 | F0 - FF | 16 |
| 38 - 3F | 8 | 78 - 7F | 8 | B8 - BF | 8 | F8 - FF | 8 |

Chart C. 3350 Native and 3330 Model 11 Compatibility Mode

APPENDIX B: 3350 SPACE UTILIZATION TABLES

The number of physical records that can be recorded on a track is a function of record size. In the following equation, basic overhead for the gap G1, the Home Address area, a standard R0 area (KL = 0, DL = 8), and space reserved for defect skipping are already accounted for.

Capacity per track: 19,254 bytes
 Bytes per record: C + KL + DL

$$\text{Number of equal length records per track} = \frac{19,254}{C + KL + DL} \quad (A)$$

where: C = 185 if key length (KL) is zero
 C = 267 if key length (KL) is not zero

The following tables give the maximum size of n equal length records on a track, where n takes on all possible values. Track, cylinder and mode capacities are given in both number of bytes and number of records. There are two tables, one for records without keys and one for records with keys. These tables are computed from the formula (A).

● 3350 Native – Records Without Keys

| Rcd Lth Bytes | Track Capacity | | Cylinder Capacity | | Module Capacity | |
|------------------|----------------|-------|-------------------|--------|-----------------|-------------|
| | Rcrds | Bytes | Rcrds | Bytes | Rcrds | Bytes |
| 19069 | 1 | 19069 | 30 | 572070 | 16650 | 317,498,850 |
| 9442 | 2 | 18884 | 60 | 566520 | 33300 | 314,418,600 |
| 6233 | 3 | 18699 | 90 | 560970 | 49950 | 311,338,350 |
| 4628 | 4 | 18512 | 120 | 555360 | 66600 | 308,224,800 |
| 3665 | 5 | 18325 | 150 | 549750 | 83250 | 305,111,250 |
| 3024 | 6 | 18144 | 180 | 544320 | 99900 | 302,097,600 |
| 2565 | 7 | 17955 | 210 | 538650 | 116550 | 298,950,750 |
| 2221 | 8 | 17768 | 240 | 533040 | 133200 | 295,837,200 |
| 1954 | 9 | 17586 | 270 | 527580 | 149850 | 292,806,900 |
| 1740 | 10 | 17400 | 300 | 522000 | 166500 | 289,710,000 |
| 1565 | 11 | 17215 | 330 | 516450 | 183150 | 286,629,750 |
| 1419 | 12 | 17028 | 360 | 510840 | 199800 | 283,516,200 |
| 1296 | 13 | 16848 | 390 | 505440 | 216450 | 280,519,200 |
| 1190 | 14 | 16660 | 420 | 499800 | 233100 | 277,389,000 |
| 1098 | 15 | 16470 | 450 | 494100 | 249750 | 274,225,500 |
| 1018 | 16 | 16288 | 480 | 488640 | 266400 | 271,195,200 |
| 947 | 17 | 16099 | 510 | 482970 | 283050 | 268,048,350 |
| 884 | 18 | 15912 | 540 | 477360 | 299700 | 264,934,800 |
| 828 | 19 | 15732 | 570 | 471960 | 316350 | 261,937,800 |
| 777 | 20 | 15540 | 600 | 466200 | 333000 | 258,741,000 |
| 731 | 21 | 15351 | 630 | 460530 | 349650 | 255,594,150 |
| 690 | 22 | 15180 | 660 | 455400 | 366300 | 252,747,000 |
| 652 | 23 | 14996 | 690 | 449880 | 382950 | 249,683,400 |
| 617 | 24 | 14808 | 720 | 444240 | 399600 | 246,553,200 |
| 585 | 25 | 14625 | 750 | 438750 | 416250 | 243,506,250 |
| 555 | 26 | 14430 | 780 | 432900 | 432900 | 240,259,500 |
| 528 | 27 | 14256 | 810 | 427680 | 449550 | 237,362,400 |
| 502 | 28 | 14056 | 840 | 421680 | 466200 | 234,032,400 |

| Red Lth | Track Capacity | | Cylinder Capacity | | Module Capacity | |
|---------|----------------|-------|-------------------|--------|-----------------|-------------|
| | Bytes | Rcrds | Bytes | Rcrds | Bytes | Rcrds |
| 478 | 29 | 13862 | 870 | 415860 | 482850 | 230,802,300 |
| 456 | 30 | 13680 | 900 | 410400 | 499500 | 227,772,000 |
| 436 | 31 | 13516 | 930 | 405480 | 516150 | 225,041,400 |
| 416 | 32 | 13312 | 960 | 399360 | 532800 | 221,644,800 |
| 398 | 33 | 13134 | 990 | 394020 | 549450 | 218,681,100 |
| 381 | 34 | 12954 | 1020 | 388620 | 566100 | 215,684,100 |
| 365 | 35 | 12775 | 1050 | 383250 | 582750 | 212,703,750 |
| 349 | 36 | 12564 | 1080 | 376920 | 599400 | 209,190,600 |
| 335 | 37 | 12395 | 1110 | 371850 | 616050 | 206,376,750 |
| 321 | 38 | 12198 | 1140 | 365940 | 632700 | 203,096,700 |
| 308 | 39 | 12012 | 1170 | 360360 | 649350 | 199,999,800 |
| 296 | 40 | 11840 | 1200 | 355200 | 666000 | 197,136,000 |
| 284 | 41 | 11644 | 1230 | 349320 | 682650 | 193,872,600 |
| 273 | 42 | 11466 | 1260 | 343980 | 699300 | 190,908,900 |
| 262 | 43 | 11266 | 1290 | 337980 | 715950 | 187,578,900 |
| 252 | 44 | 11088 | 1320 | 332640 | 732600 | 184,615,200 |
| 242 | 45 | 10890 | 1350 | 326700 | 749250 | 181,318,500 |
| 233 | 46 | 10718 | 1380 | 321540 | 765900 | 178,454,700 |
| 224 | 47 | 10528 | 1410 | 315840 | 782550 | 175,291,200 |
| 216 | 48 | 10368 | 1440 | 311040 | 799200 | 172,627,200 |
| 207 | 49 | 10143 | 1470 | 304290 | 815850 | 168,880,950 |
| 200 | 50 | 10000 | 1500 | 300000 | 832500 | 166,500,000 |
| 192 | 51 | 9792 | 1530 | 293760 | 849150 | 163,036,800 |
| 185 | 52 | 9620 | 1560 | 288600 | 865800 | 160,173,000 |
| 178 | 53 | 9434 | 1590 | 283020 | 882450 | 157,076,100 |
| 171 | 54 | 9234 | 1620 | 277020 | 899100 | 153,746,100 |
| 165 | 55 | 9075 | 1650 | 272250 | 915750 | 151,098,750 |
| 158 | 56 | 8848 | 1680 | 265440 | 932400 | 147,319,200 |
| 152 | 57 | 8664 | 1710 | 259920 | 949050 | 144,255,600 |
| 146 | 58 | 8468 | 1740 | 254040 | 965700 | 140,992,200 |
| 141 | 59 | 8319 | 1770 | 249570 | 982350 | 138,511,350 |
| 135 | 60 | 8100 | 1800 | 243000 | 999000 | 134,865,000 |
| 130 | 61 | 7930 | 1830 | 237900 | 1015650 | 132,034,500 |
| 125 | 62 | 7750 | 1860 | 232500 | 1032300 | 129,037,500 |
| 120 | 63 | 7560 | 1890 | 226800 | 1048950 | 125,874,000 |
| 115 | 64 | 7360 | 1920 | 220800 | 1065600 | 122,544,000 |
| 111 | 65 | 7215 | 1950 | 216450 | 1082250 | 120,129,750 |
| 106 | 66 | 6996 | 1980 | 209880 | 1098900 | 116,483,400 |
| 102 | 67 | 6834 | 2010 | 205020 | 1115550 | 113,786,100 |
| 98 | 68 | 6664 | 2040 | 199920 | 1132200 | 110,955,600 |
| 94 | 69 | 6486 | 2070 | 194580 | 1148850 | 107,991,900 |
| 90 | 70 | 6300 | 2100 | 189000 | 1165500 | 104,895,000 |
| 86 | 71 | 6106 | 2130 | 183180 | 1182150 | 101,664,900 |
| 82 | 72 | 5904 | 2160 | 177120 | 1198800 | 98,301,600 |
| 78 | 73 | 5694 | 2190 | 170820 | 1215450 | 94,805,100 |
| 75 | 74 | 5550 | 2220 | 166500 | 1232100 | 92,407,500 |
| 71 | 75 | 5325 | 2250 | 159750 | 1248750 | 88,661,250 |
| 68 | 76 | 5168 | 2280 | 155040 | 1265400 | 86,047,200 |
| 65 | 77 | 5005 | 2310 | 150150 | 1282050 | 83,333,250 |
| 61 | 78 | 4758 | 2340 | 142740 | 1298700 | 79,220,700 |
| 58 | 79 | 4582 | 2370 | 137460 | 1315350 | 76,290,300 |
| 55 | 80 | 4400 | 2400 | 132000 | 1332000 | 73,260,000 |

| <u>Rcd Lth</u> <u>Bytes</u> | <u>Track Capacity</u> | | <u>Cylinder Capacity</u> | | <u>Module Capacity</u> | |
|--------------------------------|-----------------------|--------------|--------------------------|--------------|------------------------|--------------|
| | <u>Rcrds</u> | <u>Bytes</u> | <u>Rcrds</u> | <u>Bytes</u> | <u>Rcrds</u> | <u>Bytes</u> |
| 52 | 81 | 4212 | 2430 | 126360 | 1348650 | 70,129,800 |
| 49 | 82 | 4018 | 2460 | 120540 | 1365300 | 66,899,700 |
| 46 | 83 | 3818 | 2490 | 114540 | 1381950 | 63,569,700 |
| 44 | 84 | 3696 | 2520 | 110880 | 1398600 | 61,538,400 |
| 41 | 85 | 3485 | 2550 | 104550 | 1415250 | 58,025,250 |
| 38 | 86 | 3268 | 2580 | 98040 | 1431900 | 54,412,200 |
| 36 | 87 | 3132 | 2610 | 93960 | 1448550 | 52,147,800 |
| 33 | 88 | 2904 | 2640 | 87120 | 1465200 | 48,351,600 |
| 31 | 89 | 2759 | 2670 | 82770 | 1481850 | 45,937,350 |
| 28 | 90 | 2520 | 2700 | 75600 | 1498500 | 41,958,000 |
| 26 | 91 | 2366 | 2730 | 70980 | 1515150 | 39,393,900 |
| 24 | 92 | 2208 | 2760 | 66240 | 1531800 | 36,763,200 |
| 22 | 93 | 2046 | 2790 | 61380 | 1548450 | 34,065,900 |
| 19 | 94 | 1786 | 2820 | 53580 | 1565100 | 29,736,900 |
| 17 | 95 | 1615 | 2850 | 48450 | 1581750 | 26,889,750 |
| 15 | 96 | 1440 | 2880 | 43200 | 1598400 | 23,976,000 |
| 13 | 97 | 1261 | 2910 | 37830 | 1615050 | 20,995,650 |
| 11 | 98 | 1078 | 2940 | 32340 | 1631700 | 17,948,700 |
| 9 | 99 | 891 | 2970 | 26730 | 1648350 | 14,835,150 |
| 7 | 100 | 700 | 3000 | 21000 | 1665000 | 11,655,000 |
| 5 | 101 | 505 | 3030 | 15150 | 1681650 | 8,408,250 |
| 3 | 102 | 306 | 3060 | 9180 | 1698300 | 5,094,900 |
| 1 | 103 | 103 | 3090 | 3090 | 1714950 | 1,714,950 |

● 3350 Native – Records With Keys

| <u>Rcd Lth</u> <u>Bytes</u> | <u>Track Capacity</u> | | <u>Cylinder Capacity</u> | | <u>Module Capacity</u> | |
|--------------------------------|-----------------------|--------------|--------------------------|--------------|------------------------|--------------|
| | <u>Rcrds</u> | <u>Bytes</u> | <u>Rcrds</u> | <u>Bytes</u> | <u>Rcrds</u> | <u>Bytes</u> |
| 18987 | 1 | 18987 | 30 | 569610 | 16650 | 316,133,550 |
| 9360 | 2 | 18720 | 60 | 561600 | 33300 | 311,688,000 |
| 6151 | 3 | 18453 | 90 | 553590 | 49950 | 307,242,450 |
| 4546 | 4 | 18184 | 120 | 545520 | 66600 | 302,763,600 |
| 3583 | 5 | 17915 | 150 | 537450 | 83250 | 298,284,750 |
| 2942 | 6 | 17652 | 180 | 529560 | 99900 | 293,905,800 |
| 2483 | 7 | 17381 | 210 | 521430 | 116550 | 289,393,650 |
| 2139 | 8 | 17112 | 240 | 513360 | 133200 | 284,914,800 |
| 1872 | 9 | 16848 | 270 | 505440 | 149850 | 280,519,200 |
| 1658 | 10 | 16580 | 300 | 497400 | 166500 | 276,057,000 |
| 1483 | 11 | 16313 | 330 | 489390 | 183150 | 271,611,450 |
| 1337 | 12 | 16044 | 360 | 481320 | 199800 | 267,132,600 |
| 1214 | 13 | 15782 | 390 | 473460 | 216450 | 262,770,300 |
| 1108 | 14 | 15512 | 420 | 465360 | 233100 | 258,274,800 |
| 1016 | 15 | 15240 | 450 | 457200 | 249750 | 253,746,000 |
| 936 | 16 | 14976 | 480 | 449280 | 266400 | 249,350,400 |
| 865 | 17 | 14705 | 510 | 441150 | 283050 | 244,838,250 |
| 802 | 18 | 14436 | 540 | 433080 | 299700 | 240,359,400 |
| 746 | 19 | 14174 | 570 | 425220 | 316350 | 235,997,100 |
| 695 | 20 | 13900 | 600 | 417000 | 333000 | 231,435,000 |
| 649 | 21 | 13629 | 630 | 408870 | 349650 | 226,922,850 |
| 608 | 22 | 13376 | 660 | 401280 | 366300 | 222,710,400 |
| 570 | 23 | 13110 | 690 | 393300 | 382950 | 218,281,500 |
| 535 | 24 | 12840 | 720 | 385200 | 399600 | 213,786,000 |

| Rcd Lth Bytes | Track Capacity | | Cylinder Capacity | | Module Capacity | |
|------------------|----------------|-------|-------------------|--------|-----------------|-------------|
| | Rcrds | Bytes | Rcrds | Bytes | Rcrds | Bytes |
| 503 | 25 | 12575 | 750 | 377250 | 416250 | 209,373,750 |
| 473 | 26 | 12298 | 780 | 368940 | 432900 | 204,761,700 |
| 446 | 27 | 12042 | 810 | 361260 | 449550 | 200,499,300 |
| 420 | 28 | 11760 | 840 | 352800 | 466200 | 195,804,000 |
| 396 | 29 | 11484 | 870 | 344520 | 482850 | 191,208,600 |
| 374 | 30 | 11220 | 900 | 336600 | 499500 | 186,813,000 |
| 354 | 31 | 10974 | 930 | 329220 | 516150 | 182,717,100 |
| 334 | 32 | 10688 | 960 | 320640 | 532800 | 177,955,200 |
| 316 | 33 | 10428 | 990 | 312840 | 549450 | 173,626,200 |
| 299 | 34 | 10166 | 1020 | 304980 | 566100 | 169,263,900 |
| 283 | 35 | 9905 | 1050 | 297150 | 582750 | 164,918,250 |
| 267 | 36 | 9612 | 1080 | 288360 | 599400 | 160,039,800 |
| 253 | 37 | 9361 | 1110 | 280830 | 616050 | 155,860,650 |
| 239 | 38 | 9082 | 1140 | 272460 | 632700 | 151,215,300 |
| 226 | 39 | 8814 | 1170 | 264420 | 649350 | 146,753,100 |
| 214 | 40 | 8560 | 1200 | 256800 | 666000 | 142,524,000 |
| 202 | 41 | 8282 | 1230 | 248460 | 682650 | 137,895,300 |
| 191 | 42 | 8022 | 1260 | 240660 | 699300 | 133,566,300 |
| 180 | 43 | 7740 | 1290 | 232200 | 715950 | 128,871,000 |
| 170 | 44 | 7480 | 1320 | 224400 | 732600 | 124,542,000 |
| 160 | 45 | 7200 | 1350 | 216000 | 749250 | 119,880,000 |
| 151 | 46 | 6946 | 1380 | 208380 | 765900 | 115,650,900 |
| 142 | 47 | 6674 | 1410 | 200220 | 782550 | 111,122,100 |
| 134 | 48 | 6432 | 1440 | 192960 | 799200 | 107,092,800 |
| 125 | 49 | 6125 | 1470 | 183750 | 815850 | 101,981,250 |
| 118 | 50 | 5900 | 1500 | 177000 | 832500 | 98,235,000 |
| 110 | 51 | 5610 | 1530 | 168300 | 849150 | 93,406,500 |
| 103 | 52 | 5356 | 1560 | 160680 | 865800 | 89,177,400 |
| 96 | 53 | 5088 | 1590 | 152640 | 882450 | 84,715,200 |
| 89 | 54 | 4806 | 1620 | 144180 | 899100 | 80,019,900 |
| 83 | 55 | 4565 | 1650 | 136950 | 915750 | 76,007,250 |
| 76 | 56 | 4256 | 1680 | 127680 | 932400 | 70,862,400 |
| 70 | 57 | 3990 | 1710 | 119700 | 949050 | 66,433,500 |
| 64 | 58 | 3712 | 1740 | 111360 | 965700 | 61,804,800 |
| 59 | 59 | 3481 | 1770 | 104430 | 982350 | 57,958,650 |
| 53 | 60 | 3180 | 1800 | 95400 | 999000 | 52,947,000 |
| 48 | 61 | 2928 | 1830 | 87840 | 1015650 | 48,751,200 |
| 43 | 62 | 2666 | 1860 | 79980 | 1032300 | 44,388,900 |
| 38 | 63 | 2394 | 1890 | 71820 | 1048950 | 39,860,100 |
| 33 | 64 | 2112 | 1920 | 63360 | 1065600 | 35,164,800 |
| 29 | 65 | 1885 | 1950 | 56550 | 1082250 | 31,385,250 |
| 24 | 66 | 1584 | 1980 | 47520 | 1098900 | 26,373,600 |
| 20 | 67 | 1340 | 2010 | 40200 | 1115550 | 22,311,000 |
| 16 | 68 | 1088 | 2040 | 32640 | 1132200 | 18,115,200 |
| 12 | 69 | 828 | 2070 | 24840 | 1148850 | 13,786,200 |
| 8 | 70 | 560 | 2100 | 16800 | 1165500 | 9,324,000 |
| 4 | 71 | 284 | 2130 | 8520 | 1182150 | 4,728,600 |

APPENDIX C: FILE DEFINITION EXAMPLES UNDER FIXED HEADS

Disk Operating System/ Virtual Storage (DOS/VS)

Application Files

To allocate data sets appropriate EXTENT statements are required. Following are some examples:

DAM (Direct Access Method) or SAM (Sequential Access Method)

For DAM or SAM data sets to be located on cylinders 1 through 10 (3344 in 3340 emulation mode).

Example:

```
// EXTENT SYSxxx, xxxxxx, 1, 1, 012, 120
```

| <u>JCL</u> | <u>Meaning</u> |
|------------|-----------------------------------|
| SYSxxx | Symbolic Unit |
| xxxxxx | Volume Serial Number |
| 1 | Extent Type (prime data) |
| 1 | Extent Sequence |
| 012 | Starting Track (relative address) |
| 120 | Number of Tracks |

ISAM (Index Sequential Access Method) (3350 Compatibility Mode)

For the ISAM cylinder index use:

```
// EXTENT SYSxxx, xxxxxx, 1, 019, 57
```

VSAM (Virtual Storage Access Method) (3344 in 3340 Compatibility Mode)

The user can place his critical data under fixed heads using the UNIQUE option of the AMS DEFINE command together with absolute space allocation in the job control statement for the DEFINE. The index component of a keyed-sequence data set (or any data) can be placed under fixed heads.

The following example shows the JCL and the DEFINE for a keyed-sequence data set (KSDS), the index component of which is on the fixed-head cylinders.

Example:

```
// JOB FIXED HEAD INDEX
// ASSGN SYS001, X'130'
// DLBL INDEX, , ,VSAM
// EXTENT SYS001, 3344FH, , ,12, 48
// EXEC IDCAMS, SIZE = 26K
/* CONTROL CARDS TO DEFINE A KSDS,
   THE INDEX COMPONENT WHICH IS
   PLACED ON THE FIXED HEAD CYLINDERS
   OF A 3344 */
DEFINE CLUSTER
  (NAME (MY.SPECIAL.CLUSTER)
   INDEXED KEYS (6 20) REPLICATE
   NOIMBED)
DATA
  (NAME (DATA.PART.OF.CLUSTER)
   VOLUMES (VOL001 VOL002)
   SUBALLOCATION TRACKS (40 20)
   RECORDSIZE (200 512)
   FREESPACE (20 10))
INDEX
  (NAME (FIXED.HEAD.INDEX.ON. 3344FH)
   FILE (INDEX) VOLUMES (3344FH)
   UNIQUE TRACKS (48) WRITECHECK)
/*
/ &
```

JCL: allocates
INDEX on tracks
12-59

- AMS DEFINE:
- The UNIQUE
- option in the
- INDEX declaration
- allows for
- absolute space
- allocation;
- the FILE
- parameter refers
- to the appropriate
- DLBL card.

It should be understood that any restrictions for use of unique data sets also apply when using the fixed-head capability.

Although the VSAM catalog cannot be defined as a unique data set, it can be placed on the fixed-head cylinders since the space for the catalog must be specified with DEFINE. Making the initial space allocations for the VSAM catalog equal to the total amount of space allocated ensures that the catalog occupies all the space specified in the job control statements. The following example demonstrates how to place the VSAM catalog on the fixed-head cylinders.

Example:

```
// JOB FIXED HEAD CATALOG
// ASSGN SYSCAT, X'135'
// DLBL CATALOG, , ,VSAM
// EXTENT SYS010, 3344FH, , ,12, 120
// EXEC IDCAMS, SIZE = 26K
/* CONTROL CARDS TO DEFINE A VSAM
   MASTER CATALOG WHICH RESIDES ON
   THE FIXED HEAD CYLINDERS OF
   A 3344 */
DEFINE MASTER CATALOG
  (NAME (VSAM.MASTER.CATALOG)
   FILE (CATALOG)
   VOLUMES (3344FH) TRACKS (120 12))
/*
/ &
```

JCL; provides space
for VSAM catalog
on the fixed-head
cylinder of the
3344

AMS DEFINE: The FILE
Parameter refers to the
appropriate DLBL card:
*/ the initial allocations
- are chosen so that the
- whole space defined by
- the JCL is occupied
by the catalog

**DBOMP (Data Base
Organization and
Maintenance Processor)**

**CSAM (Controlled Sequential Access Method) Master File Cylinder Index
(3350 Compatibility Mode)**

If it is desirable to select the option that places the cylinder index in main storage (CXINCORE), a performance enhancement can be obtained by specifying the cylinder index on one of the fixed-head cylinders. Cylinder boundary alignment is not required for the cylinder index. It is then possible to place the cylinder indexes for several files in the fixed-head cylinders. No advantage is gained by placing the CSAM file master index on the fixed-head cylinders, because the master index is always resident in main storage.

Note: The master index is not used for CXINCORE.

The following label-set example shows three CSAM master files located on the same spindle. The master indexes are loaded on cylinder 4 and the cylinder indexes are loaded on fixed-head cylinders 1, 2, and 3. The prime data areas are loaded starting at cylinders 5, 105, and 205, respectively.

Example:

```
// ASSGN SYS010, X'264'  
// DLBL FILE1, 'CSAMFILE1', 99/365, DA  
// EXTENT SYS010, 111111, 1, 0, 76, 2  
// EXTENT SYS010, 111111, 1, 1, 20, 19  
// EXTENT SYS010, 111111, 1, 2, 95, 1900  
  
// DLBL FILE2, 'CSAMFILE2', 99/365, DA  
// EXTENT SYS010, 111111, 1, 0, 78, 2  
// EXTENT SYS010, 111111, 1, 1, 39, 19  
// EXTENT SYS010, 111111, 1, 2, 1995, 1900  
  
// DLBL FILE3, 'CSAMFILE3', 99/365, DA  
// EXTENT SYS010, 111111, 1, 0, 80, 2  
// EXTENT SYS010, 111111, 1, 1, 57, 19  
// EXTENT SYS010, 111111, 1, 2, 3895, 1200
```

**SIAM (Separate Index Access Method) Reference File (3344 in 3340
Compatibility Mode)**

The SIAM reference file is the lowest level of index in the SIAM organization. The reference-file cylinder index is always resident in main storage so no advantage is gained by locating it on fixed-head cylinders. However, the reference file itself could be located on the fixed-head cylinders to great advantage. Assuming an 8-byte key and a reference file blocking factor of 60, the ten fixed-head cylinders could store 39,880 records.

Note: This figure assumes one cylinder is reserved for heavy file additions activity and one track per cylinder for cylinder overflow.

The following label-set example shows how to specify this file:

Note: The reference-file cylinder index is located on cylinder 11 because it is always resident in main storage. The file is located on the same drive in this example, but the fixed-head location of the reference file eliminates the access movement that occurs on a 3344 Model B2 (without fixed-head capability).

Example:

```
// DLBL SIAMFIL, 'SIAM MASTER FILE', 99/365, DA
// EXTENT SYS010, 111111, 1, 0, 132, 4
// EXTENT SYS010, 111111, 1, 1, 12, 120
// EXTENT SYS010, 111111, 1, 2, 144, 1200
```

SIAM Body File Availability and Data Records (3350 Compatibility Mode)

Because the SIAM body file availability record (located on the first cylinder of the body file) is written back to disk every master file add (and delete), great advantage could be derived from locating this record on a fixed-head cylinder.

If the most active records in a file can be identified, another advantage can be gained. The most active records would be located in the file create run. Because the file create run requires sequential input, the less active records must be omitted and added later in a maintenance run. This approach accomplishes the loading of the most active records in the first cylinders of the body file.

The following label-set example shows the reference file cylinder index and the reference file located on another module. The reference file is located on cylinders 1 through 3. The cylinder index is located on cylinder 4. (The cylinder index could be loaded on the cylinder following the reference file if the reference file exceeded three cylinders.) The body file is located on the second volume in cylinders 1 through 100. This put the master file availability record(s) on cylinder 1. If an activity load was performed, the most active records would be in the first three cylinders. Assuming 320 records blocked 3 with an 8-byte key, space would be available in the first three cylinders for 4,275 records.

Example:

```
// DLBL SIAMFIL, 'SIAM MASTER FILE', 99/365, DA
// EXTENT SYS010, 111111, 1, 0, 76, 4
// EXTENT SYS010, 111111, 1, 1, 19, 57
// EXTENT SYS010, 222222, 1, 2, 19, 1900
```

DBOMP/CICS

Note: DBOMP/CICS users should refer to manufacturing newsletter, MFG-73-046, dated December 10, 1973.

Recovery File

The recovery file contains a BEFORE copy of every record affected in any given maintenance transaction. For a chain file with four subordinate master files, a transaction could cause as many as 20 recovery records to be written.

If the recovery file were located on a fixed-head cylinder, an advantage would exist at the time the records were written in the online environment and at batch recovery time. The recovery file is written with CICS file control and may reference the 3350 in native mode.

Operating System/ Virtual Storage (OS/VS)

Page Data Set (3350 Native Format)

This example is valid only for VS1 and VS2 Release 1.7 (SVS). VS2 Rel 3 uses Access Method Services DEFINE, which does not support ABSTR allocation. Allocating the page data set to fixed-head cylinders requires the following JCL command:

Example:

```
// PAGE 1 DD DSN = SYS 1.PAGE, DISP = (NEW, KEEP),  
// VOL = SER = XXXXXX, UNIT = 3350,  
// SPACE = (ABSTR, (60, 30))  
// PAGE 2 DD DSN = SYS1.PAGE, DISP = (NEW, KEEP),  
// VOL = SER = YYYYYY, UNIT = 3350,  
// SPACE = (ABSTR, (60, 30))
```

Note: The absolute track (ABSTR) option of the SPACE parameter specifies cylinders 1 and 2. The 60 indicates the required track quantity; the 30 signifies the first track of cylinder 1.

If the PAGE macro is used at SYSGEN time to specify the page parameters in PARMLIB, the following example is given:

Example:

```
PAGE 1 PAGE DEV = 3350, VOLNO = XXXXXX, SIZE = (CYL, 2)  
PAGE 2 PAGE DEV = 3350, VOLNO = YYYYYY, SIZE = (CYL, 2)
```

The PAGE macroinstructions provide the Nucleus Initialization Program (NIP) with the information needed to allocate space to the page data sets. Up to eight page data sets may be defined. The user must specify a PAGE macro for each data set required.

Application Files

Allocation of application files follows the same format as the JCL statement that illustrates the SPACE parameter in the Page Data Set example.

Note: VSAM applications are only recommended under DOS/VS.

CFMS

Master File Reference ISAM Data Set Cylinder Index (3350 Native Format)

If the master file is large and a master index is used, the master index would probably be specified as resident in main storage (HINDXINCRE). An advantage is derived by loading the cylinder index in the fixed-head cylinders. The cylinder indexes of several files could share fixed-head cylinders. The following DD card example shows how it can be done:

Example:

```
// FILENAMI DD DSN = REF.FILE (INDEX), DCB = (OPTCD = WYL,  
// DSORG = IS), UNIT = 3350,  
// DISP = (NEW, KEEP), VOL = SER = PACK01, SPACE = (ABSTR,  
// (60, 30))  
// DD DSN = REF.FILE (PRIME), DCB = (DSORG = IS, OPTCD = WYL,  
// CYLOFL = 1), UNIT = 3350  
// DISP = (NEW, KEEP), VOL = SER = PACK01, SPACE = (CYL, (50))
```

Master File Reference Data Set (3350 Native Format)

The following example shows how to specify a small reference file to the fixed-head cylinders:

Example:

```
// FILENAMI DD DSN = REF.FILE, DCB = (DSORG = IS, CYLOFL = 1,  
    OPTCD = WYL),  
// UNIT = 3350, DISP = (NEW, KEEP), VOL = SER = PACK01,  
    SPACE = (ABSTR, (10, 80))
```

READER'S COMMENT FORM

3350/3344 Installation and Conversion Guide
Systems Guide

GC20-1780-0

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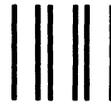
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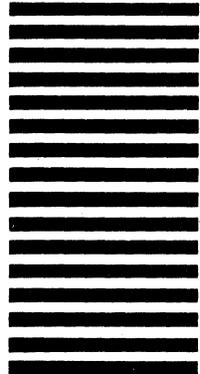
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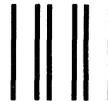
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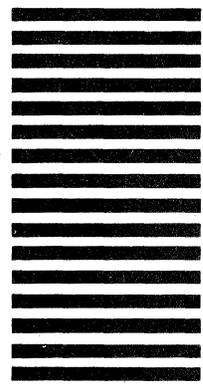
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