IBM z/VSE
Version 6 Release 2

VSE/VSAM User's Guide and Application Programming

SC34-2704-01

Note !

Before using this information and the product it supports, be sure to read the general information under “Notices” on page 351.

This edition applies to Version 6 Release 2 of IBM® z/Virtual Storage Extended (z/VSE), Program Number 5686-VS6, and to all subsequent releases and modifications unless otherwise indicated in new editions.

This edition replaces SC34–2704–00.

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About This Publication

This publication contains guidance information for using the functions that are available with the *IBM VSE/Virtual Storage Access Method (VSE/VSAM)*. It describes the major facilities of the program and how to use them efficiently.

This publication explains *concepts* of VSE/VSAM. Furthermore, it includes information about:

- Planning for VSE/VSAM.
- Using various diagnosis tools.
- Using VSE/VSAM macros.

Who Should Use This Publication

This publication is intended for the VSE/VSAM application programmer and for the end user.

How to Use This Publication

- *Conceptual Information*:

  If you want *basic information* about VSE/VSAM, refer to Chapter 1, “Introduction to IBM VSE/VSAM,” on page 1.
- *Requirements and Planning*:

  If you need to know about *VSE/VSAM requirements*, or want to *plan* and calculate storage space, refer to Chapter 2, “Planning Information,” on page 13.

  If you are responsible for planning the *protection of data* at your installation, you should acquaint yourself with Chapter 8, “Data Protection and Data Recovery,” on page 111.
- *For information on VSE/VSAM macros:*

  Chapter 11, “Using VSE/VSAM Macros,” on page 171 describes how to use the VSE/VSAM macros.

  Chapter 12, “Descriptions of VSE/VSAM Macros,” on page 183 shows the format for each VSE/VSAM macro and the meaning of each parameter.

  Appendix A, “Operand Notation and Parameter Lists for VSE/VSAM Macros,” on page 285 shows how to specify operands and how to use parameter lists of the various VSE/VSAM macros.

VSAM for VM

As of z/VSE release 3.1, the component VSE/VSAM for VM operating system (Program Number 5686-081) was discontinued and is no longer available as an optional product. Consequently, all references to it have been removed from the VSE/VSAM technical documentation. However, customers having a need for running VSE/VSAM in the VM environment must keep the reference publications titled VSE/VSAM User's Guide and Application Programming, VSE Central Functions 6.4, and VSE/VSAM Commands, VSE Central Functions 6.4, as well as VSE/ESA documentation up to release 2.7.

Where to Find More Information

- VSE/VSAM Commands

  gives an overview of and detailed information on the *IDCAMS utility program* (how to create and maintain files).
- z/VSE Messages and Codes Volume 1, z/VSE Messages and Codes Volume 2, z/VSE Messages and Codes Volume 3

lists VSE/VSAM messages and their explanations.

z/VSE IBM Documentation

IBM Documentation is the new home for IBM's technical information. The z/VSE IBM Documentation can be found here:

https://www.ibm.com/docs/en/zvse/6.2

You can also find VSE user examples (in zipped format) at

https://public.dhe.ibm.com/eserver/zseries/zos/vse/pdf3/zVSE_Samples.pdf

Abbreviations

The following abbreviations are used in this publication:

ACB
Access control block

ACF
Advanced Communications Function

AIX®
Alternate index

ASA
American Standards Association

ASCII
American National Standard Code for Information Interchange

ASI
Automated system initialization

BG
Background

BSM
Basic Security Manager

CA
Control area

CCDS
Compression control data set

CCW
Channel command word

CI
Control interval

CIDF
Control information definition field

CKD
count-key-data (device)

CP
Control program

CPU
Central processing unit

DFSMSdfp
Data Facility Storage Management Subsystem Data Facility Product

DLBL
Disk label

DLF
Define lock file

DOS
Disk Operating System

DSF
Device Support Facilities

DTF
Define the file

EBCDIC
Extended binary coded decimal interchange code

ECKD
Extended count key data

EOF
End of file

EOV
End of volume

ESA
Enterprise Systems Architecture

ESCON
Enterprise systems connection

ESS
Enterprise Storage Server®

ESDS
Entry-sequenced data set

EXCP
Execute channel program

FBA
Fixed-block-architecture (device)

HALCRBA
High allocated relative byte address

ICCF
Interactive Computing and Control Facility

ICF
Integrated Catalog Facility

ID
Identifier

IIP
ISAM Interface Program

IPL
Initial program load

ISAM
Indexed-sequential access method

ISO
International Standards Organization

JCL
Job control language

JIB
Job information block

KB
Kilobyte (1024 bytes)

KSDS
Key-sequenced data set

LSR
Local shared resources

LU
Logical unit

MB
Megabyte (1,048,576 bytes)

MSHP
Maintain system history program

MVS™
Multiple Virtual Storage

NSR
Non-shared resources

RBA
Relative byte address

RDF
Record definition field

RL
Record length

RRDS
Relative record data set

SAM
Sequential Access Method

SCSI
Small Computer Systems Interface

SDL
System directory list

SEOF
Software end-of-file

SIO
Start I/O

SP
System Package

SVA
Shared virtual area

UPSI
Use program switch indicator

VM
Virtual machine

VRDS
Variable-length relative-record data set

VSAM
Virtual Storage Access Method

VSE
Virtual Storage Extended

VTAM®
Virtual Telecommunications Access Method

VTOC
Volume Table of Contents

XA
Extended Architecture

z/VSE®
z/Virtual Storage Extended

Summary of Changes

This publication has been updated to reflect enhancements and changes that are implemented with VSE/VSAM 9.2. It also includes terminology, maintenance, and editorial changes.

- Support of the CISIZE parameter of DLBL statement was added for VSE/VSAM Implicit Cluster Definitions. Refer to “Format of the DLBL Statement” on page 26.
- Starting with z/VSE V5.1, the SHOWCB macro also provides the following information:
  - LSR (Local Shared Resources) matrix which contains string statistics information, information about each buffer pool defined for the specified LSR pool, and LSR string and buffer statistics for each cluster within a specified share pool.
  - Extent matrix which contains characteristics of physical devices where the specified cluster and information about all extents for the specified cluster resides.

  Nine new keywords for the FIELDS parameter were added. For more details, refer to “The SHOWCB Macro” on page 235.
- Resource Access Control Facility interface for IDCAMS commands has been implemented to integrate VSAM into the overall z/VSE BSM concept. Access control on the level of IDCAMS has been added. Refer to “IDCAMS Commands Security” on page 114.

What is New With z/VSE 5.2?

For a complete overview of the functions that are new with z/VSE 5.2, refer to the z/VSE Release Guide.

Chapter 1. Introduction to IBM VSE/VSAM

This Chapter...

- Summarizes the **advantages** of using the *IBM VSE/Virtual Storage Access Method (VSE/VSAM)*.
- Highlights the use of programs and *functions* of VSE/VSAM.
- Provides you with **conceptual information** on physical file organization, and the elements that are used in managing and processing the files.
- Gives you an outline on the various means for **communicating** with VSE/VSAM.

For information on requirements and compatibility of VSE/VSAM, refer to Chapter 2, “Planning Information,” on page 13.

Overview

IBM VSE/VSAM is an access method for the indexed or sequential processing of records on direct access devices. Records can be of fixed-length or variable-length.

VSE/VSAM is the preferred file management system for VSE environments.

Note: If you presently have SAM or ISAM files, you can convert such files to the VSE/VSAM format.

VSE/VSAM can handle:

- Batch and online processing
- Direct and sequential access
- Access by key, record number, or address
- Intermixed types of processing in a common data base

VSE/VSAM provides the following means of communication:

- The *IDCAMS utility program*. You use IDCAMS commands to create and maintain VSE/VSAM files on disk, independently of a specific program.
- The *VSE/VSAM macros*. You use the macros for processing such created files from a program.

Advantages

Central Control

You can centrally control all the VSE/VSAM files at your installation, because all information about files and their storage space is collected in VSE/VSAM catalogs. In the catalogs, you can define and delete files, and you can change information about the files.

Data Protection and Integrity

You can control the access to data by assigning passwords to various objects (for example, to files and catalogs).

Also, you can protect your data from accidental loss or destruction by using the *VSE/VSAM Backup/Restore Function*. This function allows you to easily store data on tape or disk and call it back.

Device Independence

You simply set aside an area of space to be used exclusively by VSE/VSAM. From this space, VSE/VSAM selects whatever space is needed for a file when it is defined. Space allocation is dynamic; if a file or catalog must be extended, VSE/VSAM allocates more space to it.

Portability of Data Between Systems

VSE/VSAM uses a record format that is common to the IBM operating systems z/VSE and z/OS® [1]. Therefore, but with some exceptions, VSE/VSAM files are portable to MVS/VSAM. You can get full portability for files and volumes by using only those commands, file types, devices, and programming interfaces that are supported by all environments (z/VSE and z/OS). For information on portability requirements, refer to Appendix D, “Compatibility With Other Products,” on page 319.

To move files between different operating systems, you can use the EXPORT/IMPORT commands of the *IDCAMS utility program*. Communication with VSE/VSAM is essentially the same for the z/VSE and z/OS operating systems, except for job control.

Ease of Conversion from SAM or ISAM to VSE/VSAM

To take advantage of VSE/VSAM processing capabilities, you can convert SAM (sequential access method) files and ISAM (indexed sequential access method) files to VSE/VSAM format:

- If you have SAM files, you can use the *VSE/VSAM Space Management for SAM Function* to convert the files. Then, you can use commands of the *IDCAMS utility program* to manipulate the converted files. For an overview, see below; for more details, refer to Chapter 9, “VSE/VSAM Support for SAM Files,” on page 137.
- Your existing ISAM programs can use the *ISAM Interface Program (IIP)* to process the files. For further considerations, refer to Appendix C, “Advantages of the ISAM Interface Program (IIP),” on page 311.

Functions of IBM VSE/VSAM

With VSE/VSAM, the following functions are included:

- *VSE/VSAM Space Management for SAM Function*
- *VSE/VSAM Backup/Restore Function*

VSE/VSAM Space Management for SAM Function

You can use this function to manage your SAM files, including most system work files.

Use the function to convert a SAM file into a SAM ESDS file by placing the SAM ESDS file into VSE/VSAM space. Then, the SAM ESDS files can be accessed by SAM macros as well as by VSE/VSAM macros.

The *VSE/VSAM Space Management for SAM Function* allows you to:

- Define and delete a SAM ESDS file in VSE/VSAM space. Use IDCAMS commands, or define/delete implicitly at OPEN/CLOSE time.
- Access a SAM ESDS file.

  For files in CI-format, use DTFSD and DTFCP with DISK=YES.

  For files that are either in CI-format or non-CI-format, use DTFPH for disk with MOUNTED=SINGLE.

  SAM access is provided for all CKD and FBA devices that are supported by VSE/VSAM.
- Allocate dynamic secondary space during creation or extension of a SAM ESDS file.
- Access a SAM ESDS file through the VSE/VSAM macro ACB (that is, native VSE/VSAM) for files in CI-format.

[1] The principal component of z/OS is MVS; references to MVS in this publication should be understood as meaning the MVS element of the z/OS operating system.

An existing VSE/VSAM program that processes a VSE/VSAM ESDS file can access a SAM ESDS without change (except for extending the file).

VSE/VSAM Backup/Restore Function

You can use this function to back up VSE/VSAM files to magnetic tape or disk devices, and restore the files again into a VSE/VSAM data set. You can use the two IDCAMS commands BACKUP and RESTORE.

Use the function to:

- Write and read data sets as follows:
  - Write from disk to magnetic tape or disk (BACKUP).
  - Read from magnetic tape or disk to disk (RESTORE).

  You can perform these operations for the following VSE/VSAM objects:
  - KSDS files
  - ESDS files
  - RRDS files
  - VRDS files
  - Alternate indexes
  - SAM ESDS files in CI format
  - Paths
- Handle several VSE/VSAM files with a single command, either with a generic name or as files of one catalog.
- Restore VSE/VSAM files to locations, volumes, and device types that are different from those where the files were before.
- Exclude files from a collective back up or restore operation.
- Tune the performance of VSE/VSAM by specifying the size of the buffers in the BACKUP command, and the number of buffers in both the BACKUP and RESTORE commands.

Also, the *VSE/VSAM Backup/Restore Function* allows you to:

- Back up and restore empty objects, where an empty object may be either a:
  - VSE/VSAM object defined with NOALLOCATION (such as a default model or a dynamic file), or
  - VSE/VSAM cluster that has not been loaded since being defined or reset.
- Change the allocation size for the data component of a file at restoration. You can specify allocation size in device-independent units by using the RECORDS parameter when the cluster is defined to facilitate restoration of objects.
- Change the index CI-size at restoration.

Note: You cannot process magnetic tape files that were created by the EXPORT command with RESTORE, or magnetic tape files that were created by BACKUP with the IMPORT command. REPRO files can only be processed by using REPRO.

Concepts of Data Organization

The following provides you with basic information (terminology and concepts) with which you have to be familiar to understand the information in other parts of this publication.

File Types

IBM VSE/VSAM supports four types of physical file organization:

- ESDS (Entry-sequenced data set)
- KSDS (Key-sequenced data set)
- RRDS (Relative-record data set)
- VRDS (Variable-length relative-record data set)

These files differ in the record lengths they allow and in the sequence in which they contain the records:

Type	Record Length	Sequence by
ESDS	Fixed or variable	Entry
KSDS	Fixed or variable	Key field
RRDS	Fixed only	Record number or entry
VRDS	Fixed or variable	Record number or entry

Formats of Files

The following figures show the file organization (or file format) for the different file types:

Table 1. ESDS File Format: Records Stored as Received					
First Record	**Second Record**	**Third Record**	**Forth Record**	**Fifth Record**	**...**

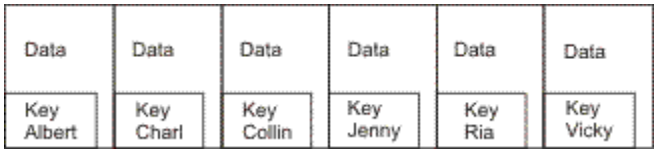


Figure 1. KSDS File Format: Records Stored in Key Field Sequence

Table 2. RRDS File Format: Fixed-Length Records Stored by Record Number. RRDS records are entered in one of two ways: Either you give the records a sequence number explicitly, or you just enter them one by one and they get their sequence number automatically.					
Relative Record 1		**Relative Record 3**	**Relative Record 4**		**Relative Record 6**

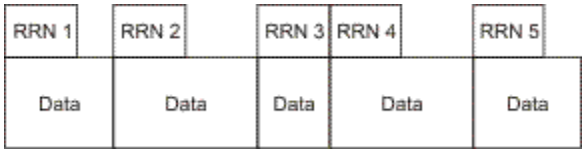


Figure 2. VRDS File Format: Variable-Length Records Stored by Record Number

Elements of Organization

Data Space

For the data that you want to include in VSE/VSAM files, you have to define *VSE/VSAM data space*. You define the space on a disk volume for exclusive use by VSE/VSAM. From this space, VSE/VSAM selects whatever room (control area) is needed for a file when it is defined. VSE/VSAM allocates space dynamically; that is, if a file or a catalog must be extended, VSE/VSAM allocates the space as required.

The VSE/VSAM data space you define is owned by a catalog. You establish the ownership when defining a catalog or data space.

Control Area (CA)

For a definition of "control area", refer to the “Glossary” on page 357.

A file occupies one or more control areas (CAs). Note that:

- For count-key data (CKD) devices, a CA cannot be larger than a cylinder and not smaller than a track. For details, refer to Table 18 on page 80.
- For every type of fixed block architecture (FBA) device, specific maximum and minimum CA-sizes exist. For details, refer to Table 19 on page 81.

VSE/VSAM determines the CA-size for a file, but you can influence it through the space allocation parameters of the IDCAMS command DEFINE CLUSTER.

Control Interval (CI)

For a definition of "control interval", refer to the “Glossary” on page 357.

Control intervals (CIs) are fixed-length parts of a CA. They are the unit of transfer between processor and external storage. You specify a CI-size for the file in the IDCAMS command DEFINE CLUSTER; however, if your specification is inappropriate, VSE/VSAM determines the correct CI-size.

Spanned Records

VSE/VSAM allows records to extend across, or span, CI boundaries. Such records are called spanned records. Spanned records can be used only in KSDS and ESDS files.

A spanned record must always begin on a CI boundary; such a record occupies two or more CIs within a given CA. The CI with the last portion of a spanned record may contain unused space that can be used only to extend the spanned record.

Clusters

Every type of VSE/VSAM file has a cluster name and a data component name; the cluster name must be different from the data component name.

Depending on the type of file, a *cluster* consists of a data component and corresponding index component, or just the data component. This is illustrated in Figure 3 on page 5:

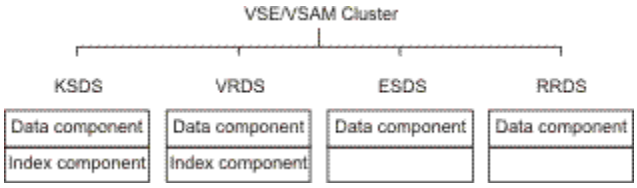


Figure 3. VSE/VSAM File Type Structures

KSDS and VRDS Files

The file types KSDS and VRDS have two components: a data component and an index component (as indicated in Figure 3 on page 5).

The index component of KSDS and VRDS files are built and used by VSE/VSAM to locate the records in the data component. You can either treat the data and index components separately or together as a single unit. If you treat the two components as a single unit, it is called a "cluster".

ESDS and RRDS

The file types ESDS and RRDS have a data component, but no index component (as indicated in Figure 3 on page 5). Nevertheless, these file types are also referred to as "clusters".

Catalogs with VSE/VSAM

A catalog is a central file that holds information about data spaces and files. VSE/VSAM uses catalogs for space and file management.

For a given environment, you have a *master catalog*, and you can have one or more *user catalogs*. VSE/VSAM creates such catalogs from the information you provide through IDCAMS commands.

Space Management

When you define a VSE/VSAM data space on a volume, you set up a relationship between that data space and a catalog. The data space is owned by the catalog. You can define other data spaces on that same or a different volume in the same catalog.

Thus, a catalog describes where and how much data space is available, the number and device characteristics of the volume, and other values. Whenever data space is allocated to a file, VSE/VSAM automatically updates the data space information in the catalog.

File Management

For each of your VSE/VSAM files, an entry must exist in a catalog. Making an entry in a catalog for a file is called "defining the file". Unless you have defined the file, you cannot, for example, load records into the file.

The entry in the catalog describes the location and attributes (for example, record size and key location) of the file.

Also kept in the catalog are dynamic statistics about the file (such as the number of records inserted since the file was created), and the number of CIs that have been split. This information provides you with the information you need in making a decision to reorganize your files, or for changing the current type of processing so as to improve performance.

Master and User Catalogs

As mentioned above, VSE/VSAM allows you to define several catalogs. This can have significant advantages for performance as well as for data security. Every catalog exists on a single volume; it is independent of other catalogs and controls exclusively its own data spaces and files.

In an environment with several catalogs, one of the catalogs is the *master catalog*. All other catalogs are *user catalogs* and are defined in the master catalog. By placing information about your files and storage volumes into user catalogs, you decentralize control and reduce the time required to search a given catalog. Note that you can have only one user catalog per volume.

Using several catalogs also allows you to:

- Transfer files between the IBM operating systems z/VSE and z/OS. You can do so by using the EXPORT/IMPORT commands. ESDS, KSDS, and RRDS files are compatible between these operating systems. VRDS files are incompatible.
- Specify that one of the user catalogs is to be used as a *job catalog*. The job catalog will then be used to reference all VSE/VSAM files in the current job. You have the option of overriding the job catalog reference to a file through a VSE/VSAM job control statement.

Indexes with VSE/VSAM

For KSDS and VRDS files, VSE/VSAM builds an index. This index is called the *prime index*.

For KSDS and ESDS files, you optionally can specify that VSE/VSAM builds an *alternate index* (AIX).

Alternate Indexes - Their Advantages

An alternate index provides you with another way of gaining access to the records in a given KSDS or ESDS file. It eliminates the need for you to keep several copies of the same information organized in different ways for different applications. For example, you can take a KSDS payroll file that is indexed by employee name, and using the same base data, index it according to department number or social security number (Figure 4 on page 7). You can use any field in the records of the file as an alternate-index key field, as long as the field has a fixed length and fixed position in the record.

Paths to Base Clusters

To gain access from an alternate index to the file with its prime index (base cluster), you must define a path to it. The path sets up an association between the alternate index and the base cluster (Figure 4 on page 7). The two alternate indexes shown make the records of the base cluster available to you in different orders.

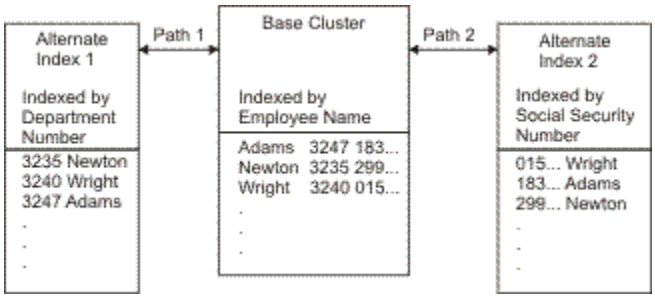


Figure 4. Example: Two Alternate Indexes for a Key-Sequenced File

How to Communicate with VSE/VSAM

To make your wants known to VSE/VSAM, you use:

- Commands of the IDCAMS utility program.
- VSE/VSAM macros.
- Job control (JCL) parameters.
- Dialogs of the z/VSE Interactive Interface.

IDCAMS Commands

The *IDCAMS utility program* is part of IBM VSE/VSAM. Use IDCAMS commands to define VSE/VSAM files, catalog such files, and request many other IDCAMS functions:

- Establish catalog(s)
- Create data spaces
- Create VSE/VSAM files and load records into the files
- Build an alternate index for a file
- Create backup copies of files and their associated catalog entries
- Print, copy, or reorganize files
- Delete files, data spaces, and catalogs
- Alter file definitions and file attributes
- Print catalog entries
- Move catalogs and files from one system to another
- Convert nonVSAM files to VSE/VSAM files
- Map a VSE/VSAM cluster to a relational structure, and later maintain the associated map or view

- Recover from damage to files or catalogs
- Copy entire volumes to support offline backup to tape from the target volume, for example
- Verify command syntax
- Merge two VSE/VSAM files

For details on the *IDCAMS utility program* and its commands, refer to the VSE/VSAM Commands.

The IDCAMS utility program supports two types of IDCAMS commands:

- *Functional commands*

  Used for requesting the actual work (for example, defining a file or moving a catalog).
- *Modal commands*

  Used for the conditional execution of functional commands.

Functional Commands

The functional IDCAMS commands can be grouped according to the following user tasks.

To Define, Alter, and Delete Objects

DEFINE
to define catalogs, files, clusters, alternate indexes, paths, and data spaces.

ALTER
to change previously-defined attributes of an object.

DELETE
to delete catalogs, clusters, and data spaces.

BLDINDEX
to build an alternate index for an existing file.

To Move Data

REPRO
to copy, convert, merge, and reorganize files.

EXPORT
to create a copy of a file on tape or disk for back up, or transport to another system.

IMPORT
to read a copy of a file into a system, and make it available for use in that system.

BACKUP
to create a backup copy of a file.

RECMAP
to map a VSE/VSAM cluster to a relational structure and later maintain the associated map or view. For details on the RECMAP command, refer to VSE/VSAM Commands.

RESTORE
to restore a file backed up via the BACKUP command.

SNAP
to snap (copy) a given set of source volumes within an IBM Enterprise Storage Server (ESS).

To Print Objects

LISTCAT
to list entries from a catalog, or only certain information from every entry.

PRINT
to print all, or a specified range of records of a file. Several output formats are available: every byte printed as a single character, or every byte printed as two hexadecimal digits, or both side by side.

To Correct a Problem, To Cancel a Job or Job Step

VERIFY
to prepare a file for the next access if it was not closed successfully the last time it was processed.

CANCEL
to cancel either a job or the current job step.

Modal Commands

The modal IDCAMS commands control command execution and establish options.

IF
to test a condition code and run according to the results of the test. IF is followed by THEN and ELSE clauses which specify alternative actions.

DO, END
to denote the beginning and end of a functional command sequence (normally within a THEN or ELSE clause).

SET
to change condition codes.

PARM
to specify diagnostic aids and printed output options and change input record margins. With PARM, you can verify the syntax of your IDCAMS commands before running them.

VSE/VSAM Macros

Once you have defined your VSE/VSAM files with IDCAMS commands, you can load data into the files and process the records. Use VSE/VSAM macros in your programs to process VSE/VSAM files.

You can load the data by use of any programming language. The programs can use VSE/VSAM, SAM, or ISAM macros, but only the assembler language supports all VSE/VSAM functions.

For details on the macros, refer to Chapter 11, “Using VSE/VSAM Macros,” on page 171 and Chapter 12, “Descriptions of VSE/VSAM Macros,” on page 183.

To Relate the Program and the Data (Declarative Macros)

ACB
specifies the file to be processed and the access type.

EXLST
specifies a list of user-supplied exit routines.

RPL
specifies information for a particular request.

To Handle Declarative Macros

GENCB
specifies declarative parameters during program execution.

MODCB
changes declarative parameters.

SHOWCB
displays declarative parameters in effect.

TESTCB
checks declarative parameters (or their error codes) and sets the condition code accordingly.

To Display Data

SHOWCAT
displays data from the catalog in a buffer you have supplied.

To Connect/Disconnect a Program to/from a File

OPEN
connects a program to a file.

CLOSE
prepares the separation and disconnects a program from a file.

TCLOSE
prepares the separation but leaves program and file connected.

To Share Resources Between Several Files (LSR)

BLDVRP
builds a VSE/VSAM pool of buffers, control blocks, and channel programs.

DLVRP
deletes such a resource pool.

WRTBFR
writes waiting buffer contents to satisfy a GET request.

To Handle Records

GET
retrieves a record from a file for processing.

PUT
inserts a record in a file.

ERASE
deletes a record in a file.

POINT
positions control to a specific address in the file.

ENDREQ
ends processing of a GET or POINT request.

Job Control Parameters to Access VSE/VSAM Files

Use job control parameters to complete or override the file information already stored in the catalog.

As most of the information normally coded with job control statements is available to VSE/VSAM in the catalog, you need to specify only a minimum of job control parameters with any one job. In most cases, only the DLBL statement has to carry VSE/VSAM information.

z/VSE Interactive Interface

The following highlights the functions and use of the *z/VSE Interactive Interface* as applicable to VSE/VSAM. For more information about the interactive interface, refer to the z/VSE Administration.

To use the interface, start with the panel entitled *z/VSE Function Selection*. On this panel select:

- *Resource Definition* if you want to manage files or catalogs.
- *Operations* if you want to back up or restore VSE/VSAM objects, or transfer files.

If you select *Resource Definition* and then *File and Catalog Management*, you can make further selections to:

- Display or process a file
- Define a new file
- Define a library
- Define an alternate index (AIX) or name
- Display or process a catalog, or space
- Define a new user catalog.

For example, if you select to define a new file, you can specify elements such as the file ID and name, file organization (for example SAM ESDS organization), and space allocation. You can then select how the job is to be run.

If you select *Operations* and then *Backup/Restore VSE/VSAM Objects*, you can make further selections to export, import, back up, or restore VSE/VSAM files, and back up or restore master and user catalogs.

Chapter 2. Planning Information

This Chapter...

Provides information on **storage requirements** for IBM VSE/VSAM and related programs and utilities. It explains how to calculate the required **partition virtual storage** for your files.

Compatibility with IBM VSE/VSAM Version 2

IBM VSE/VSAM Version 7 is compatible with IBM VSE/VSAM Version 2. Files, programs, and jobs that were created under IBM VSE/VSAM Version 2 can be used without changes.

Overview of Environment and Requirements

IBM VSE/VSAM operates on any:

- IBM processor supported by any operating system under which it runs.
- IBM disk device supported by both VSE/VSAM and the operating system under which it runs.

IBM VSE/VSAM, which is part of VSE Central Functions Version 7 Release 1, 5686-CF7, runs under IBM z/VSE Version 3 Release 1.

What to Consider

Before IBM VSE/VSAM is used, you should plan for the storage needs of VSE/VSAM. Consider storage requirements for:

- IBM VSE/VSAM routines loaded automatically into the SVA during IPL. The routines occupy about 300KB in the SVA (shared virtual area).
- Routines that are not eligible for the SVA.

  See “Partition Space for Non-SVA-Eligible Routines” on page 13, below. For information on the *ISAM Interface Program*, see “Storage for the ISAM Interface Program (IIP)” on page 18.
- Running VSE/VSAM in real mode.

  See “Space for Running in Real Mode” on page 14.
- VSE/VSAM buffers and control blocks.

  See “Partition Requirement for Buffers and Control Blocks” on page 14.
- The IDCAMS utility program.

  See “Storage for IDCAMS Including the VSE/VSAM Backup/Restore Function” on page 18.

Partition Space for Non-SVA-Eligible Routines

Most VSE/VSAM routines are automatically loaded into the SVA during IPL. Routines that are not reentrant are *not* eligible for SVA (non-SVA-eligible). Therefore, such routines require space in the partition GETVIS area. For example, modules of the *ISAM Interface Program* are non-SVA-eligible and must be loaded into every partition where they are used.

The partition where the non-SVA-eligible VSE/VSAM routines are loaded must have at least 128KB plus the partition GETVIS area. Add to this 28KB for the IDCAMS root modules, plus the extra space for every IDCAMS command, which varies between 2KB and 100KB depending on the command.

Device Dependencies

See Chapter 6, "Device Dependencies," on page 71 for information on special functions, restrictions, and exceptions when using certain devices.

Storage for VSE/VSAM

Space for Running in Virtual Mode

Many VSE/VSAM phases run in the SVA. This means that one copy of the VSE/VSAM modules is shared by all partitions.

Space for Running in Real Mode

If you specify REAL in the // EXEC statement, the system loads VSE/VSAM modules that normally reside in SVA into your partition. Your partition must have sufficient storage to accommodate these VSE/VSAM SVA modules.

Running programs in real mode in one partition can degrade the performance in other partitions. For more information, refer to "Format of the EXEC Statement" on page 36 (see REAL).

Partition Requirement for Buffers and Control Blocks

The partition in which VSE/VSAM files are to be processed must allow for a GETVIS area to accommodate VSE/VSAM buffers and control blocks; the user program resides in the same partition, below the GETVIS area.

The size of the partition GETVIS area depends on the number of VSE/VSAM files that are accessed, and on their CI sizes. The minimum requirement is 64KB.

For your files, you need to calculate the total required *partition virtual storage*. You have to consider that:

- Every open catalog needs 14KB for basic buffers and control blocks.
- During open and close processing, an additional 50KB is required for open control blocks and catalog check routines that are used in error analysis.
- Every file needs the partition virtual storage shown in:

  Table 3 on page 15 if *non-shared resources* (NSR) is specified.
  Table 4 on page 16 if *local shared resources* (LSR) is specified.

The following applies to both Table 3 on page 15 and Table 4 on page 16:

- To calculate the requirements for one file, add the values given in *one* column (according to the applicable path/input/output conditions). Complete this calculation for every file; then, add the individual results to obtain the total requirements.
- The buffer space (*n* in the figures) depends on the CI size(s) and on the buffer specifications. If upgrade is done, one set of buffers serves all alternate indexes in the upgrade set. This set of buffers includes two data buffers and one index buffer. (Buffer space can be specified in the IDCAMS command DEFINE, in the DLBL statement, or in the VSE/VSAM macro ACB. For more information, see "Buffer Specification" on page 87.)
- If *data set name sharing* is used, only the *first* cluster of a DSN structure uses the partition GETVIS space as calculated in Table 3 on page 15 or Table 4 on page 16.

  All the *subsequent* opens to ACBs (for those clusters that are connected to the existing DSN structure) need a minimum GETVIS space of 128 bytes per 28 ACBs.

If NSR is Specified

Table 3. Partition Requirements for Control Blocks and Buffers (with NSR)				
	No Path Specified		**Path Specified**	
Item	**Input**	**Output**	**Input**	**Output***
Basic requirement (minimum)	7KB	7KB	9KB	9KB
Upgrade set (minimum)	0	(u+1) x 2KB	0	u x 2KB
Buffers for base cluster	n	n	n	n
Buffers for alternate index	0	0	n**	n**
Upgrade buffers***	0	n	0	n
For every string	(S - 1) x 1KB		(S - 1) x 2KB	

* The file must be opened for output only,
or for both output and input.
** Always two data buffers and one index buffer.
*** If there is an upgrade set.

u = Number of alternate indexes in the upgrade set.
n = Buffer space.
S = Number of strings.

A file may exceed *minimum requirements* under any of these conditions:

- If the file has key ranges associated with it.
- If the file has several extents for data or for index.
- If SHAREOPTIONS(4) is used.
- If the length of the key field is very long.
- If the ACB or RPL is not created by GENCB, with the space allocation left up to VSE/VSAM, or if the GENCB requests are not done in the following sequence: 1. GENCB ACB, 2. GENCB RPL.
- If CCW areas are insufficient (see below).

Additional space is required for CCW areas for a) output files that use RECOVERY mode, and b) KSDS files in case of CA split. The size can be calculated by this formula:

```
(CI/CA)÷40
and rounded down to the next 2KB value
```

For example:

```
CI/CA = 450
450÷40 = 11.25
and rounded down = 10

That is, the required additional
GETVIS space is 10KB.
```

If LSR is Specified

If LSR is used to share control blocks among some files, the requirement for the VSE/VSAM resource pools must be taken into account. Refer also to “The BLDVRP Macro” on page 194.

For LSR, virtual storage is equal to the working set.

Table 4 on page 16 shows the partition virtual storage requirements when LSR is used.

Table 4. Partition Requirements for Control Blocks and Buffers (with LSR)				
	No Path Specified		Path Specified	
Item	Input	Output	Input	Output*
Basic requirement (minimum)	3.25KB	3.25KB	5.25KB	5.25KB
Upgrade set (minimum)	0	u x 2KB	0	(u-1) x 2KB
Buffers for base cluster	0	0	0	0
Buffers for alternate index	0	0	0	0
Upgrade buffers**	0	0	0	0
For every string	(S - 1) x 1KB		(S - 1) x 2KB	

* The file must be opened for output only,
  or for both output and input.
** If there is an upgrade set.

u = Number of alternate indexes in the upgrade set.
n = Buffer space.
S = Number of strings.

To these values, add the requirement for the LSR pool, which consists of:

```
n          The total space specified for buffers.
72p        The space for subpools, where p is the number of subpools.
104b       The number of Buffer Control Blocks; b = number of buffers
s(920 + k) The space for ACB strings, where:
             s = the number of strings.
             k = the maximum key length for files
                 sharing the resource pool.

2048       Space for the channel program area.  Dynamically increase
           this value by 2048 if the resource pool is very active.
```

Round the result to the next page boundary. If you build a large resource pool, the VSE/VSAM working set will be somewhat reduced when resource pool activity is light.

Buffer Allocation above the 16MB Line of Storage

To keep the use of the GETVIS space below the 16MB line as little as possible, VSE/VSAM tries to allocate buffers *above* the 16MB line whenever possible.

The allocation depends on whether sufficient partition GETVIS space is available above the line. If no partition GETVIS space is available above the line, VSE/VSAM allocates all buffers below the line. This means that buffer handling in partitions residing below the 16MB line is fully compatible with previous buffer handling.

Table 5 on page 16 shows the buffer allocation relative to the 16MB line. If you have:

- NSR, refer to the entries for the ACB specifications.
- LSR, refer to the entries for the BLDVRP specifications.

Table 5. How VSE/VSAM Allocates Buffers			
Specification in ACB or BLDVRP	Object	Allocation	
		Below	Any
ACB RMODE31=ALL	All buffers		X

Table 5. How VSE/VSAM Allocates Buffers (continued)			
Specification in ACB or BLDVRP	**Object**	**Allocation**	
		Below	**Any**
ACB RMODE31=NONE	All cluster/path NSR data buffers All cluster/path NSR index buffers[1] All upgrade set NSR buffers[1]	X	X X
BLDVRP RMODE31=ALL	All buffers		X
BLDVRP RMODE31=NONE	All cluster/path NSR data buffers All cluster/path NSR index buffers[1] All upgrade set NSR buffers[1]	X X X	

Note:

1. The buffers are not accessible by user applications.

Storage for the VSE/VSAM Space Management for SAM Function

SAM Access Routines

The working set is the same as for unmanaged-SAM access. VSE/VSAM does not need additional work storage for managed-SAM access.

Space for Running in Real Mode

If you specify REAL in the // EXEC statement, the system loads VSE/VSAM modules that normally reside in SVA into your partition. Your partition must have an additional 340KB to accommodate these SVA modules.

Running programs in real mode in one partition can degrade the performance in other partitions. For more information, refer to “Format of the EXEC Statement” on page 36 (see REAL).

Partition Requirement for Control Blocks and Buffers

Specify additional work storage:

- 2KB for control blocks. The buffer must equal CISIZE.

The working set for DTFPH is determined by the user program.

Partition Virtual Storage

Add to the virtual storage requirements for VSE/VSAM:

- During open processing, additional 4KB is needed for open control blocks.
- For every file, the amount of virtual storage required is equal to the working set, except for DTFPH access, in which case the virtual storage requirement is determined by the user program.

GETVIS Requirements for Managed-SAM Access to SAM ESDS Files

When you run programs that issue SAM imperative macros to access managed-SAM files, the default GETVIS size of 48KB is inadequate. For more information, refer to “Note to Users of the VSE/VSAM Space Management for SAM Function” on page 35.

For programs that are invoked by using the EXEC statement, you must specify the SIZE parameter of the EXEC statement to provide adequate GETVIS storage.

For job control routines that process an INCLUDE statement when IJSYSLN has been defined as a managed-SAM file, both the minimum partition size of 128KB and the default GETVIS size of 48KB are too small. Proceed as follows:

1. Use the ALLOC command to adjust the partition size to provide the required GETVIS space, plus 80KB non-GETVIS space for job control routines.
2. Set aside adequate default GETVIS space in the partition with the SIZE command. GETVIS space for file OPEN and catalog handling is the same as for VSE/VSAM. See “Storage for VSE/VSAM” on page 14.

Storage for the ISAM Interface Program (IIP)

IIP modules are *non-SVA-eligible* and must be loaded into every partition where they are used.

To accommodate interface translation modules, add 6KB to the working set previously determined for VSE/VSAM record management modules. Also add approximately 6KB for the IIP phases. This is in addition to the storage required for buffers and control blocks,

Storage for IDCAMS Including the VSE/VSAM Backup/Restore Function

IDCAMS must be used for file definitions, catalog manipulation, and other functions. Because IDCAMS modules cannot be loaded into the SVA, their partition requirement depends on the functions required for the current job.

The required partition GETVIS area can be provided by specifying the job control statement:

```
// EXEC IDCAMS,SIZE=AUTO ...
```

For more information, refer to “// EXEC Statement” on page 35.

To operate efficiently, IDCAMS needs a working set of about 72KB.

In addition to the basic allocation for VSE/VSAM, IDCAMS needs up to 256KB of virtual storage in the partition in which it is to run.

VSE/VSAM Backup/Restore Function

Note: To use the function with a user-generated supervisor, you must generate the supervisor with the option RPS=YES.

Loading VSE/VSAM Backup/Restore into the SVA

At IPL, provide:

10 entries in the SDL
122KB of storage in the SVA

The VSE/VSAM Backup/Restore Function may be loaded into the SVA. Simply store the following statements in the job control procedure for the background partition (in procedure $0JCL):

```
SET SDL
   IDCBP01,SVA
   IDCBP03,SVA
   IDCCDBP,SVA
   IDCTSBP0,SVA
   IDCRT01,SVA
   IDCCDRT,SVA
   IDCBPDNC,SVA
   IDCBPDNT,SVA
   IDCRTDDC,SVA
```

```
      IDCRTDDT,SVA
   /*
```

Note that you can use the skeleton SKJCL0 to update the job control procedure $0JCL. For more information on $0JCL and skeletons, refer to the z/VSE Administration.

Partition Virtual Storage

In addition to basic VSE/VSAM and IDCAMS virtual storage requirements, you must provide sufficient virtual storage in the partition to accommodate the BACKUP or RESTORE command:

```
  BACKUP:   42KB + n * b           If COMPACT parameter is not used.
            42KB + (2n + 1) * b    If COMPACT parameter is used.



  RESTORE:  52KB + n * b           If restoration from a
                                   non-compacted backup file.

            52KB + (2n + 1) * b    If restoration from a
                                   compacted backup file.

where: n = Number of buffers.
       b = Size of one buffer in bytes.
           A buffer size of 32KB is recommended.
           In most cases, there is no advantage
           in providing larger buffers.
```

Chapter 3. Operation and Job Control

This Chapter...

- Describes **operating procedures** that are unique to VSE/VSAM. You may also need to refer to the z/VSE Operation, SC33-8309, for example, for details on exporting VSE/VSAM files.
- Describes **job control commands** whose meaning for VSE/VSAM is different as compared to the meaning they have with other access methods.

  The information supplements the job control information is contained in the z/VSE System Control Statements, SC34-2679.

IPL Command Specifications for VSE/VSAM

The IPL commands described here are part of the pre-defined *automated system initialization* (ASI) procedure for z/VSE. The following specifications are important for VSE/VSAM:

- Assign a device to the master catalog (DEF command).
- Define the lock file (DLF command).
- Specify the number of supervisor buffers (SYS command, BUFSIZE operand).

Assigning a Device to the Master Catalog

To assign a device to the VSE/VSAM master catalog, you must first ready the device. Then use the IPL command DEF with the LU name of the master catalog, which is always SYSCAT:

```
DEF SYSCAT=cuu...

where: cuu = the device number of the
             assigned disk device.
```

The assignment is valid until the next IPL. The DEF command must follow the (optional) SET and precede the DPD command.

Defining the Lock File

If you are using the *z/VSE DASD Sharing facility*, you must define the *lock file* (the cross-system communication file) by specifying the DLF command at IPL.

The number of resources that can be locked by a lock file depends on the device type on which the lock file resides. For detail information, refer to a description of the DLF command in the publication z/VSE System Control Statements, SC34-2679.

Lock File Requirements

VSE/VSAM determines its lock requirements according to this formula:

```
n = Px(2xU+1) + 5C + (2xS3) + (3xS4) + O + P + 5

where:
  n  = number of lock table entries (optimal upper limit).
  C  = number of catalogs open concurrently.
  O  = number of VSE/VSAM components that are open but not
       accounted for by S3 and S4.
  P  = number of partitions.
  S3 = number of share option 3 VSE/VSAM components
       concurrently open for output.
  S4 = number of share option 4 VSE/VSAM components (for
```

```
           example, key component or data component) concurrently
           open for output.
      U  = number of user catalogs open concurrently.
```

All these values should reflect the situation that exists when n is at its maximum value. The value for n (calculated in the above manner) will cause sufficient space to be reserved for the variable resources to be used. Depending on the application, however, the number of resources actually required most of the time might be much lower.

Note: If the value substituted for n is too small and the pool of named resources gets exhausted, the VSE/VSAM partition is canceled and an error message is displayed.

Specifying the Number of Supervisor Buffers for Channel Programs

You must specify the number of supervisor buffers for channel programs. You do this in the BUFSIZE=n operand of the IPL command SYS. For details on this operand, see a description of the SYS command in the z/VSE System Control Statements, SC34-2679 publication. After you have determined a value, add 40 for the use by VSE/VSAM.

Volume Mounting

To access VSE/VSAM files, the appropriate volume or volumes must be mounted on a device. There are two approaches that allow you to mount one or more required volumes.

Mounting a Volume Through Job Control Specifications

If full job control describes the file (DLBL, EXTENT, and ASSGN statements), the required volume must be mounted on the device specified in the job control.

If the requested volume (except for a catalog volume) is *not* mounted on the requested device, VSE/VSAM issues a message to inform you; then, you can correct the situation.

You should take advantage of job control simplification (by omitting a LU on an EXTENT statement), because it gives VSE/VSAM greater flexibility in providing the required volume. In this case, VSE/VSAM is free to use any device on which the required volume (as indicated by the VSE/VSAM catalog) is mounted or can be mounted.

Mounting a Volume Through Automatic Assignment

If the Volume is Mounted

If the required volume is already mounted on some device, VSE/VSAM attempts to automatically assign that device (if successful, it avoids the need for operator intervention).

For the automatic assignment to be successful, ensure that devices are up before mounting volumes, and do not reserve devices unnecessarily. Refer to the z/VSE System Control Statements, SC34-2679, , and for information about DVCUP, FREE, and RESERV commands.

If the Volume is Not Mounted

If the required volume is not yet mounted, VSE/VSAM prompts you to mount it. If possible, VSE/VSAM recommends a device and reserves it while the mount is pending.

If you choose to use a device other than the recommended device (or if VSE/VSAM did not recommend one), you must ensure that the device you use is up and operational, and that mounting the required volume does not interfere with other users in the system.

To hold a device while a mount is pending, use the RESERV command. When the volume is mounted, the device becomes ready and the reserved status is reset to free. Your reply to the mount message allows VSE/VSAM to verify the volume mount and continue processing the file.

Use of z/VSE Job Control Statements for VSE/VSAM

In many jobs, you can omit from your job control the following z/VSE job control statements: **// DLBL**, **// EXTENT,** and **// ASSGN**. Under certain circumstances, however, you may have to explicitly specify EXTENT or ASSIGN statements for the catalogs, (for example, if your program uses CHECKPOINT/RESTART).

Table 6 on page 24 shows under which circumstances you have to specify *// DLBL* statements for *job catalogs* and *user catalogs*.

Table 7 on page 25 shows under which circumstances you have to specify job control statements for *files* when you want to run VSE/VSAM applications and want to use IDCAMS commands.

For a detailed explanation of the z/VSE job control, refer to the z/VSE System Control Statements, SC34-2679.

Job Control Statements for Catalogs

VSE/VSAM Application Programs

All VSE/VSAM application programs must specify a // DLBL statement for the master catalog; no // EXTENT statement is necessary. This also applies to ISAM programs that access VSE/VSAM through the *ISAM Interface Program* (IIP), and SAM programs that access SAM ESDS files through DTFs.

The // DLBL statement may be in the job stream, or in the system or partition standard label area.

If the program accesses a file in a user catalog, you must supply a file // DLBL statement for the VSE/VSAM file. You can refer to the user catalog by either:

- The CAT=filename parameter pointing to that user catalog,

  Or

- A job catalog // DLBL IJSYSUC statement pointing to that user catalog.

Irrespective of which way you specify, you do not need to supply // EXTENT and

// ASSGN statements.

Note that if an application program accesses files in several catalogs, you must supply a *user catalog // DLBL* for all files not in the job's default catalog.

IDCAMS Commands

From the job control that you specify to identify the catalog you are using, you may omit // EXTENT and // ASSGN statements. VSE/VSAM handles the distribution of logical units (LUs) to physical disk addresses in an optimized way. You do not need to reserve one logical unit for every file. However, when you run out of LUs, use // ASSGN statements, or cut the single job into several jobs.

For the master catalog (with filename IJSYSCT), you *always* require a // DLBL statement. Include the statement in the job stream, or in the system or partition standard label area.

For certain operations (for example, to alter file attributes in catalog entries), you can omit the // DLBL statement. You can do so if you specify the name of the catalog through IDCAMS commands. Depending on which IDCAMS command you issue, you have to specify the CATALOG, WORKCAT, or MODEL parameter; in the parameter, specify the name in the subparameter *catname*. Table 6 on page 24 shows when you must specify a // DLBL statement for a job catalog (IJSYSUC) and, when applicable, for a user catalog (*not* a IJSYSUC).

Table 6. // DLBL Statement Required for Job Catalogs and User Catalogs

ALTER	**No job catalog // DLBL statement is required, but you must specify CATALOG(*catname*) in the command if the catalog referenced is not the master catalog, or if a password is required.**						
BACKUP	A job catalog // DLBL (IJSYSUC) is required if the catalog to be referenced is not the master catalog.						
BLD-INDEX	Location of Alternate index = = > Work file = = >	MCAT MCAT	UCAT1 MCAT	MCAT UCAT1	UCAT1 UCAT2	MCAT none	UCAT none
	Specify job cat // DLBL?	No	Yes	No	Yes (UCAT1)	No	Yes
	Specify BLDINDEX catalog parameter?	No *	Yes (MCAT) **	Yes (UCAT1) **	Yes (UCAT2) **	No *	No *

(*) Unless a password is required, in which case you must specify the CATALOG parameter.

(**) Specify the WORKVOLUMES parameter, because it does not require a // DLBL for the work file. If you specify the WORKFILES parameter, you must also specify CAT= in the // DLBL statement.

Table 6. // DLBL Statement Required for Job Catalogs and User Catalogs

CANCEL	**A job catalog // DLBL is not applicable.**
DEFINE AIX CLUSTER or PATH	No job catalog // DLBL is required, but you must specify CATALOG(*catname*) and MODEL(*catname*) (if applicable) in the command whenever the catalog to be referenced is not the master catalog, or if a password is required.
DEFINE NONVSAM or SPACE	No job catalog // DLBL is required, but you must specify CATALOG(*catname*) in the command if the catalog to be referenced is not the master catalog, or if a password is required.
DELETE	No job catalog // DLBL is required, but you must specify CATALOG(*catname*) in the command if the catalog to be referenced is not the master catalog, or if a password is required.
EXPORT	A job catalog // DLBL (IJSYSUC) is required if the catalog to be referenced is not the master catalog.
IMPORT	No job catalog // DLBL is required, but you must specify CATALOG(*catname*) in the command if the catalog to be referenced is not the master catalog, or if a password is required.
LISTCAT	No job catalog is required, but you must specify CATALOG*(catname)* in the command if the catalog to be referenced is not the master catalog, or if a password is required.
PRINT	INFILE in master catalog: Do not specify a user catalog // DLBL or a job catalog // DLBL. INFILE in user catalog: Specify either a user catalog // DLBL (CAT=parameter) or a job catalog // DLBL (IJSYSUC). INFILE is nonVSAM: A user catalog // DLBL or a job catalog // DLBL statement is not applicable.
RECMAP	No job catalog // DLBL is required, but you must specify CATALOG(*catname*) in the command.

Table 6. // DLBL Statement Required for Job Catalogs and User Catalogs (continued)	
CANCEL	**A job catalog // DLBL is not applicable.**
REPRO	INFILE and OUTFILE in same catalog: Master catalog: Do not specify a user catalog // DLBL or a job catalog // DLBL. User catalog: Specify either a user catalog // DLBL(CAT=parameter) or a job catalog // DLBL(IJSYSUC). INFILE and OUTFILE in different catalogs: Specify a user catalog // DLBL for every catalog that is not the default catalog.
RESTORE	No job catalog // DLBL is required, but you must specify CATALOG(*catname*) in the command if the catalog to be referenced is not the master catalog, or if a password is required.
SNAP	A job catalog // DLBL (IJSYSUC) is required if the catalog to be referenced is not the master catalog.
VERIFY	A job catalog // DLBL (IJSYSUC) is required if the catalog to be referenced is not the master catalog, or if a password is required.

Job Control Statements for Files

In specifying job control statements for user files, // DLBL, // EXTENT, and // ASSGN statements may or may not be required. Table 7 on page 25 indicates when you should specify these statements.

Table 7. Job Control Statements Required for Files			
File Job Control			
Type of Processing	**DLBL Required**	**EXTENT Required**	**ASSGN Required**
Files to be implicitly opened. (For example, accessing a file through AIX or path during which VSE/VSAM must open index files without user specification.)	No	No	No
Files to be explicitly opened. (The // DLBL *filename* must match the ACB DDNAME parameter, or the ACB name if DDNAME is omitted, and the *file-ID* must be the name of the object opened.)	Yes	No	No
ISAM programs accessing VSE/VSAM files through the ISAM Interface Program	Yes	No	No
SAM programs accessing SAM ESDS files through DTFs. (The // DLBL *filename* must match the DTFxx name field.)	Yes	No [1]	No
IDCAMS Commands			
ALTER	No	No	No
BACKUP to tape	No	No	Yes
BACKUP to disk	Yes	Yes	Yes
BLDINDEX	No	No	No
CANCEL	No	No	No
DEFINE AIX/CLUSTER UNIQUE	Yes	Yes	No
DEFINE AIX/CLUSTER not unique	No	No	No
DEFINE MASTERCATALOG	Yes	No	No

Table 7. Job Control Statements Required for Files (continued)

File Job Control			
Type of Processing	**DLBL Required**	**EXTENT Required**	**ASSGN Required**
DEFINE NONVSAM/PATH/SPACE	No	No	No
DEFINE USERCATALOG	No	No	No
DELETE	No	No	No
EXPORT OUTFILE (SAM file on disk)	Yes	Yes	Yes
EXPORT all others	No	No	No
IMPORT INFILE (SAM file on disk)	Yes	Yes	Yes
IMPORT OBJECTS FILE UNIQUE unless predefined	Yes	Yes	No
IMPORT all other	No	No	No
LISTCAT	No	No	No
PRINT VSAM file	Yes	No	No
Print nonVSAM file (SAM or ISAM file on disk)	Yes	Yes	Yes
RECMAP	No	No	No
Repro VSAM file	Yes	No	No
REPRO nonVSAM file (SAM or ISAM file on disk)	Yes	Yes	Yes
RESTORE from tape	No	No	Yes
RESTORE from disk	Yes	Yes	Yes
SNAP	Yes	No	No
VERIFY	No	No	No

Note:

[1] Exception: An EXTENT statement *is* required for the implicit definition of an output or work file for which no implicit model exists.

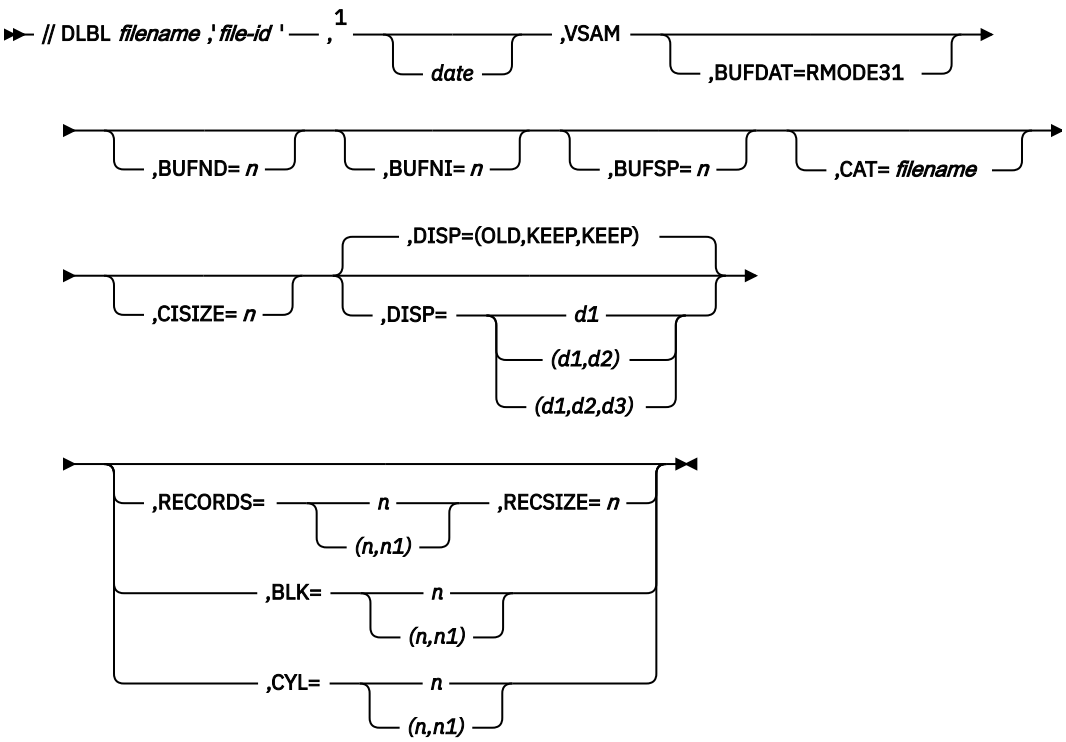
// DLBL Statement

To determine when you must supply a // DLBL statement, refer to "Use of z/VSE Job Control Statements for VSE/VSAM" on page 23.

If you specify many // DLBL parameters, you may need to use a continuation statement. If so, column 72 (on the first statement) must contain a continuation character. The columns between the last comma and the continuation character must be blank, and the continuation statement must start in column 16 (no // in columns 1 and 2).

Format of the DLBL Statement

The following describes the // DLBL statement and its operands in the context of VSE/VSAM.



Notes:

[1] This comma and the following comma are positional, they must be used even if the operands are omitted.

BLK=n|(n,n1)
Indicates the number of blocks on an FBA device that are used for space allocation. BLK is only valid for VSE/VSAM managed-SAM clusters. **n** specifies the number of blocks used for the primary allocation, **n1** the number used for secondary allocation. VSE/VSAM accepts values up to 16,777,215 for **n** and **n1**.

BUFDAT=RMODE31
Indicates that data buffers will be allocated in the 31-bit GETVIS area of the partition, if sufficient space is available. Otherwise, the 24-bit GETVIS area of the partition will be used, without an error return code or message being issued.

BUFND=n
Specifies the number of I/O buffers to hold control intervals containing data records. Each buffer is the size of one data control interval. This specification overrides the value given for BUFND in the ACB macro.

BUFNI=n
Specifies the number of I/O buffers to hold control intervals containing index records. Each buffer is the size of one index control interval. This specification overrides the value given for BUFNI in the ACB macro.

BUFSP=n
This operand specifies the number of bytes of virtual storage (0-9999999) to be allocated as buffer space for a VSE/VSAM cluster. It overrides the values specified for BUFSP in the ACB macro and for BUFFERSPACE in the DEFINE command. See "I/O Buffer Space (Using Non-Shared Resources)" on page 86 for further details on buffer spaces.

VSE/VSAM uses the maximum of the following:

- The BUFFERSPACE value specified in the IDCAMS command DEFINE CLUSTER
- The BUFSP parameter specified in the ACB macro
- The BUFSP parameter specified in the DLBL statement

When you access a cluster using an alternate index, the DLBL BUFSP value applies only to the alternate index.

CAT=filename

This operand specifies the filename (1 to 7 alphanumeric characters) of the DLBL statement for the catalog owning this VSE/VSAM cluster. The system searches only this catalog for the file-id when the VSE/VSAM cluster is to be opened. Specify this operand only if you want to override the system's assumption that the job catalog or, if there is no job catalog, that the master catalog owns the cluster.

The only Access Method Services commands that use the CAT operand to specify a private user catalog are the PRINT, REPRO, VERIFY, and DELETE ERASE commands.

CISIZE=n

For VSE/VSAM this parameter specifies a control interval size for SAM ESDS dataset. The size overrides that specified (or defaulted) in the respective DTF macro. The specified size must be a number from 1 to 32,768. VSAM will round the value up to the multiple of 512 bytes or multiple of 2K (if specified value is greater then 8K) but greater than the SAM logical block length.

CYL=n|(n,n1)

Indicates the number of cylinders on an CKD device that are used for space allocation. CYL is only valid for VSE/VSAM managed-SAM clusters. **n** specifies the number of cylinders used for the primary allocation, **n1** the number used for secondary allocation. VSE/VSAM accepts values up to 16,777,215 for **n** and **n1**.

date

With one exception, this parameter is ignored for VSE/VSAM clusters.

Normally, the expiration date used is that specified in the IDCAMS DEFINE command. The only case in which the // DLBL date parameter applies to a VSE/VSAM cluster is for implicit definition of VSE/VSAM managed-SAM clusters. VSE/VSAM clusters (that have been explicitly defined) or data spaces can only be deleted through the DELETE command, even though the expiration date has been reached. For details on the possible formats of the *date* parameter, please refer to the description of the DLBL statement for non-VSAM files in the z/VSE System Control Statements, SC34-2679.

DISP=disposition

This parameter is valid only in a DLBL statement for a VSE/VSAM cluster. It permits specification of the data set disposition. Table 8 on page 28 shows the possible disposition values, applicability and their meaning. The default is DISP=(OLD,KEEP,KEEP).

Table 8. DLBL Statement Disposition Values

	Possible value	**Indicates the file is:**	**Applies when the file is:**
d1	NEW	reset at OPEN	opened
	OLD	not reset at OPEN	
d2	DELETE	made inaccessible at CLOSE	regularly closed
	KEEP	kept at CLOSE	
	DATE	kept at CLOSE, if the expiration date has not been reached	
		made inaccessible at CLOSE, if the expiration date has been reached	
d3	DELETE	made inaccessible at CLOSE	abnormally terminated
	KEEP	kept at CLOSE	

If you use the parenthesis syntax, each keyword (but not the separating commas) can be omitted. For example, the following three specifications are equivalent:

- DISP=NEW
- DISP=(NEW,)
- DISP=(NEW,,)

Specifying DISP=(,) or DISP=(,,) is the same as if the whole DISP parameter is omitted.

For additional information about these keywords, see “File Disposition” on page 29.

‘file-id’

For VSE/VSAM, **'file-id'** is mandatory when a file is being processed. The file-id is identical to the name of the cluster that was specified in the DEFINE command of IDCAMS and listed in the VSE/VSAM catalog. For VSE/VSAM, the file-id must be coded according to the following rules:

- One to 44 characters long, enclosed in quotes (');
- Characters must be alphanumeric (A-Z, 0-9, @, $, or #) or hyphen (-) or plus zero (+0);
- After each group of eight or fewer characters, a period (.) must be inserted;
- No embedded blanks are allowed;
- The first character of the file-id and the first character following a period must be alphabetic (A-Z) or @, $ or #.

For details on the VSE/VSAM partition/processor unique file-id (%%), see “VTOC Label Processing” on page 325.

filename

This can be from one to seven alphanumeric characters, the first of which must be alphabetic, @, # or $. This unique filename is identical to the symbolic name of the program DTF that identifies the file.

Note: Do not use the same filename for both a DLBL and a TLBL statement.

For VSE/VSAM, filename is identical to the **DDNAME=filenam**e parameter of the access method control block (ACB) in the processing program that identifies the cluster. If the DDNAME parameter is omitted, the filename must be contained in the symbolic name (label) field of the ACB.

RECORDS=n|(n,n1)

This operand is only valid for VSE/VSAM managed-SAM clusters. It permits specification of the number of records for the primary and secondary data set allocation. The operand can be specified in one of two formats:

- RECORDS=n
- RECORDS=(n,n1)

where **n** indicates the number of records for the primary allocation, and **n1** the number of records for the secondary allocation. **n** must not be zero; **n1** can be larger or smaller than **n**. VSE/VSAM accepts values up to 16,777,215 for **n** and **n1**.

The RECORDS and RECSIZE operands must either both be specified or both be omitted.

RECSIZE=n

This operand is only valid for VSE/VSAM managed-SAM clusters. It specifies the average record length of the file. The value specified for n must not be zero. The RECSIZE and RECORDS operands must either both be specified or both be omitted.

VSAM

This parameter is required for all Virtual Storage Access Method clusters.

For details on the RECORDS and RECSIZE parameters, see “Defining a SAM ESDS File” on page 143.

File Disposition

Disposition processing applies to reusable files only. Implicitly defined SAM ESDS files are always reusable.

For *VSE/VSAM access*, the options available at OPEN and the disposition of the file at CLOSE depend on the DISP parameter of the // DLBL statement or the MACRF/CLOSDSP parameters of the ACB macro. Options specified for DISP override those specified for MACRF/CLOSDSP. The default for the DISP parameter depends on the file opened or closed. For VSE/VSAM access, the default is:

```
DISP=(OLD,KEEP,KEEP)

where:
  OLD is the default when the file is opened.
  The first KEEP is the default when the file is normally closed.
  The second KEEP is the default when the job is abnormally ended.
```

For *managed-SAM* access, the options available at OPEN and the disposition of the file at CLOSE depend on the DISP parameter of the // DLBL statement and options specified in the DTF.

Each option of the DISP parameter has a corresponding option in the MACRF/CLOSDSP parameters that causes the same function to be performed. The NEW, OLD, RST, and NRS options apply when the file is opened; KEEP, DELETE, and DATE apply when the file is closed. VSE/VSAM allocates space, resets the file, or implicitly defines a file (for managed-SAM access of a SAM ESDS file that is not already defined in the catalog) when the ACB/DTF for the file is opened. At close, VSE/VSAM keeps, resets, deallocates, or deletes the file, depending on which function has been specified.

Table 9 on page 31 through **Table 13 on page 34** list the VSE/VSAM actions when opening and closing different kinds of files. The following definitions apply to the figures:

- **Keep** means to retain a file's data and accessibility.
- **Reset** means to set a file to empty and release its secondary extents.
- **Deallocate** means to set a file to empty and release its primary and secondary extents.
- **Allocate** means to provide primary disk space, as specified by the user at DEFINE time.
- **Define** means to place information describing the file into the VSE/VSAM catalog.
- **Delete** means to remove all references to the file from the catalog, and release the file's space.

OPEN Disposition

A file may appear in one of the following four states when it is opened for output:

Unallocated

A file is unallocated if its catalog records have no information of suballocated space. This happens for one of two reasons. Either the file was defined as a dynamic file (NOALLOCATION, REUSE) and it has never been opened, or the file was defined as a dynamic file (NOALLOCATION, REUSE) and it has been closed with DISP and/or MACRF/CLOSDSP options that caused deallocation.

All open options cause space to be suballocated for the file, providing enough space is available. If enough space is not available, the open fails. The ACB user is informed by an ACB return code; the DTF user's job is canceled.

Allocated for Native VSE/VSAM Access

The options DISP=NEW and/or MACRF=RST cause the file to be reset to its primary allocation; its secondary extents are released. Although the file records are not erased, the file is considered empty. The options DISP=OLD and/or MACRF=NRS do not cause the file to be reset to empty and allow updating and extension of the file.

Allocated for Managed-SAM Access of a SAM ESDS File

Same as for *Allocated for Native VSE/VSAM Access*, above.

Undefined for Managed-SAM Access

All options of the DISP parameter cause the file to be implicitly defined. The native VSE/VSAM user cannot implicitly define a file.

When a file with suballocated space is opened for input, the options DISP=NEW and/or MACRF=RST are invalid, and the options DISP=OLD and/or MACRF=NRS cause the file to be opened without resetting the file to empty.

Table 9 on page 31 shows the action performed by VSE/VSAM when you try to open a file that is allocated for *VSE/VSAM access*.

Table 9. VSE/VSAM Access: OPEN Disposition

Files with REUSE Attribute			
OPEN (ACB)	**File Status**	**DISP on DLBL or MACRF on ACB**	
		NEW/RST	**OLD/NRS**
OUTPUT	Unallocated	Allocate space for the file.	Allocate space for the file.
	Allocated	Reset the file. (DISP=NEW prevents access to any data that exists prior to open.)	File is not reset. Output operations allow updating and extension of the file.
	Undefined	Open fails.	Open fails.
INPUT	Allocated	Open fails.	File is not reset. If the file is already empty, open fails.

Table 10 on page 31 and **Table 11 on page 32** show the action performed by VSE/VSAM when you try to open a file that is allocated for *managed-SAM access*. For explanations to the "See ( )" references in the two figures, refer to the explanations below the tables.

Table 10. Managed-SAM Access: OPEN Disposition -- OUTPUT/INPUT

Files with REUSE Attribute				
OPEN (DTF)	**File Status**	**DISP is NOT specified. See (A)**	**DISP on DLBL. See (B)**	
			NEW	**OLD**
OUTPUT	Unallocated SAM ESDS file. See (1)	Allocate space for the file. (DISP=NEW)	Allocate space for the file.	Allocate space for the file.
	Allocated for SAM ESDS file. See (1) (2)	Reset the file. Position to the beginning of the file. (DISP=NEW) See (B)	Reset the file. Position to the beginning of the file.	File is not reset. Position to the end of the file for extension.
	Undefined.	Implicitly define a SAM ESDS file. (DISP=NEW)	Implicitly define a SAM ESDS file.	Implicitly define a SAM ESDS file.
INPUT	Allocated for SAM ESDS file.	File is not reset. Position to the beginning of the file for input. (DISP=OLD)	Invalid. File is not reset. Open fails.	File is not reset. Position to the beginning of the file for input.

Table 11. Managed-SAM Access: OPEN Disposition -- WORKxxxx				
Files with REUSE Attribute				
OPEN (DTF)	**File status**	**DISP is NOT specified See (A)**	**DISP on DLBL See (B)**	
			NEW	**OLD**
WORK	Unallocated SAM ESDS file. See (1)	Allocate space for the file. (DISP=NEW).	Allocate space for the file.	Allocate space for the file.
	Allocated for SAM ESDS file. See (1)	Reset the file. Position to the beginning of the file. (DISP=NEW).	Reset the file. Position to the beginning of the file.	File is not reset. Position to the beginning of the file. The file may be read.
	Undefined.	Implicitly define a SAM ESDS file. (DISP=NEW).	Implicitly define a SAM ESDS file.	Implicitly define a SAM ESDS file.
WORK-IN See	Unallocated SAM ESDS file.	Invalid. Open fails. (DISP=OLD).	Invalid. Open fails.	Invalid. Open fails.
	Allocated for SAM ESDS file.	File is not reset. Position to the beginning of the file. The file may be read. (DISP=OLD).	File is not reset. Position to the beginning of the file. The file may be read.	File is not reset. Position to the beginning of the file. The file may be read.
	Undefined.	Invalid. Open fails. (DISP=OLD).	Invalid. Open fails.	Invalid. Open fails.
WORK-INUP See	Unallocated SAM ESDS file.	Invalid. Open fails. (DISP=NEW).	Invalid. Open fails.	Invalid. Open fails. .
	Allocated for SAM ESDS file.	File is not reset. Position to the beginning of the file. The file may be read. (DISP=NEW).	File is not reset. Position to the beginning of the file. The file may be read.	File is not reset. Position to the beginning of the file. The file may be read.
	Undefined.	Invalid. Open fails. (DISP=NEW).	Invalid. Open fails.	Invalid. Open fails.

Table 11. Managed-SAM Access: OPEN Disposition -- WORKxxxx (continued)				
Files with REUSE Attribute				
OPEN (DTF)	**File status**	**DISP is NOT specified See (A)**	**DISP on DLBL See (B)**	
			NEW	**OLD**
WORK-MOD	Unallocated SAM ESDS file. See (1).	Allocate space for the file. See (1). (DISP=NEW).	Allocate space for the file.	Allocate space for the file.
	Allocated for SAM ESDS file.	Reset the file. Position to the beginning of the file. (DISP=NEW).	Reset the file. Position to the beginning of the file.	File is not reset. Position to the end of the file. The file may be read.
	Undefined.	Implicitly define a SAM ESDS file. (DISP=NEW).	Implicitly define a SAM ESDS file.	Implicitly define a SAM ESDS file.

Explanations

In Table 10 on page 31 and Table 11 on page 32:

(A) The default value is given in parentheses, for example (DISP=NEW).

(B) Do not specify the DISP parameter for IJSYSLN (SYSLNK file).

(1) If the characteristics of the file do not match those specified in the DTF, open fails and the file cannot be implicitly deleted. In particular, the maximum logical block that may be written (DTF BLKSIZE) must not be greater than the maximum allowed in the file (DEFINE maximum RECORDSIZE). If DTFSD is used, the file must be in CI format.

(2) DISP=NEW prevents access to any data existing prior to open.

CLOSE Disposition

Close disposition takes effect only after the file has been successfully opened. If you open a file but do not close it, close disposition takes effect during automatic close at the end of the job step.

VSE/VSAM Access

If you specify DELETE as the only disposition at CLOSE, VSE/VSAM always deletes the data by deallocation or resetting the file. The contents of the file is lost. The next open for INPUT will fail because the file is empty. If any other DTF (or ACB) is open for the same file, the close is completed, but the file is not reset, deallocated, or deleted; the operator and the invoking program are notified by a return code.

If you specify a *second* close disposition in the // DLBL DISP parameter, this specification takes over the function of the first close disposition if the job is canceled by the operator or is ended abnormally for any other reason before the file was closed.

Note: A nonzero job return code is *not* an abnormal end of job. This means:

- The *first* close disposition will be performed.
- The *second* close disposition will *not* be performed.

If, for example, you open a reusable file through a // DLBL statement with the close disposition specified as ...DELETE,KEEP then this file is only deleted if the job comes to a *normal* end. In any other case the file is not deleted and you can rerun the job without reloading the file.

Table 12 on page 34 shows the action performed by VSE/VSAM when you try to close a file that is allocated for *VSE/VSAM access*.

Table 12. VSE/VSAM Access: CLOSE Disposition				
Files with REUSE Attribute				
CLOSE (ACB)	**DISP on DLBL or MACRF on ACB**			
	KEEP	**DELETE**	**Date**	
			Expired	**Unexpired**
File was explicitly defined (NOALLOCATION)	Keep	Deallocate	Deallocate	Keep
REUSABLE (suballocated)	Keep	Reset	Reset	Keep
File was implicitly defined	Keep	Reset	Reset	Keep

Managed-SAM Access

If you specify DELETE as the only disposition at CLOSE, VSE/VSAM always deletes the data by deallocation, resetting, or implicit deletion. To avoid sharing-problems, however, if any other DTF (or ACB) for the same file is open at the same time, no deletion occurs; the operator is notified by a message with a warning return code, and close processing continues. With DELETE specified at CLOSE, the contents of the file is lost. The next open for OUTPUT WORK will write new data. If the file has been deallocated or reset, an OPEN for INPUT will be successful, but the first GET will cause control to be passed to the EOFADDR routine because the file is empty.

If you specify a *second* close disposition in the // DLBL DISP parameter, this specification takes over the function of the first close disposition if the job is canceled by the operator or is ended abnormally for any other reason before the file was closed.

Note: A job return code of *not 0* is *not* an abnormal end of job. That means:

- The *first* close disposition will be performed.
- The *second* close disposition will *not* be performed.

If, for example, you open a reusable file through a // DLBL statement with the close disposition specified as ...DELETE,KEEP then this file is only deleted if the job comes to a *normal* end. In any other case the file is not deleted and you can rerun the job without reloading the file.

Table 13 on page 34 shows the action performed by VSE/VSAM when you try to close a file that is allocated for *managed-SAM access*.

Table 13. Managed-SAM Access: CLOSE Disposition					
Files with REUSE Attribute					
CLOSE (DTF)	**DISP not specified**	**DISP on DLBL. See (A)**			
		KEEP	**DELETE**	**Date**	
				Expired	**Unexpired**
File was explicitly defined (NOALLOCATION)	Keep. See (1)	Keep	Deallocate	Deallocate	Keep
REUSABLE (suballocated)	Keep. See (1)	Keep	Reset	Reset	Keep
File was implicitly defined	Keep. See (1)	Keep	Delete	Delete	Keep
(A) Do not specify the DISP parameter for IJSYSLN (SYSLNK file). (1) DISP is DELETE if TYPEFILE=WORK and DELETFL is specified.					

Additional Considerations

- Specifying DISP=NEW in the // DLBL statement overrides MACRF=NRS in the ACB, such that the result is as if MACRF=RST were specified. Because MACRF=RST is mutually exclusive with MACRF=IN and MACRF=LSR, open fails if DISP=NEW is specified for a file opened through DTF TYPEFLE=INPUT, or ACB MACRF=IN, or MACRF=LSR.
- If the close disposition specified for the file results in the resetting or deallocation of the file, and if the file is password-protected, the ACB must specify (or the operator will be prompted for) the update- or higher-level password of the file at open. If the close disposition specified for the file results in the implicit deletion of the file, there is no prompting for the entry password because an implicitly defined file cannot be password-protected. If the catalog itself is password-protected, the operator is prompted for the master password of the catalog at CLOSE.

  Using DISP could eliminate data inadvertently if the wrong parameter is specified. You may want to use an entry password to protect against inadvertent destruction of data. A catalog password may also provide protection for files owned by the catalog. If the file is accessed through DTF, the password must be supplied by the operator. If the file is accessed through ACB, the password may be supplied in the ACB, by the operator, or through IDCAMS commands.

// EXEC Statement

To run a job or job step, enter the EXEC command with the SIZE parameter.

Note to Users of the VSE/VSAM Space Management for SAM Function

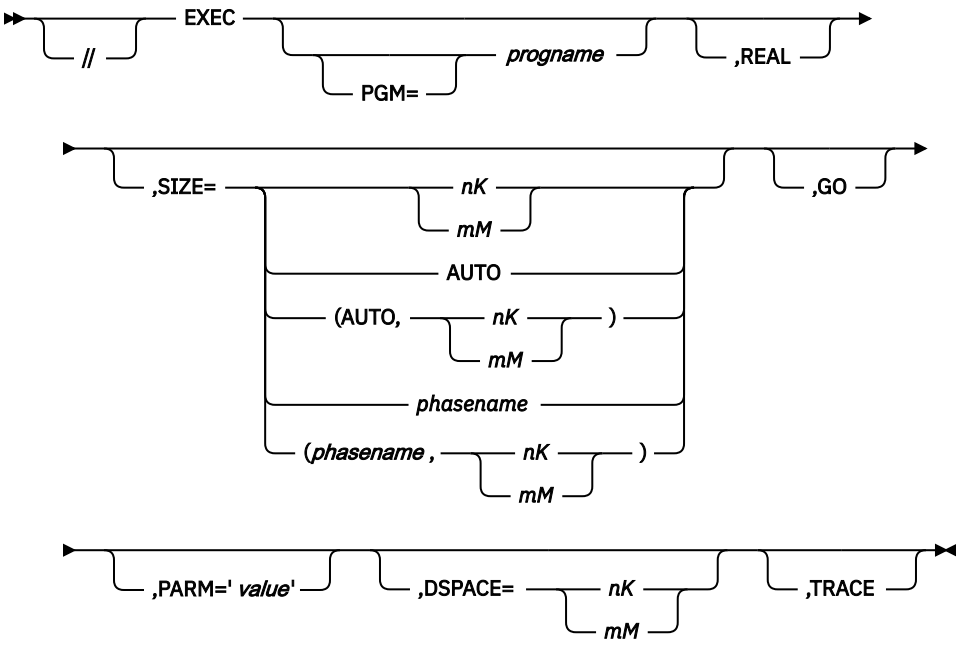
When job control routines process linkage editor control statements (such as ACTION, ENTRY, INCLUDE, or PHASE) with IJSYSLN defined as a managed-SAM file, both the minimum partition size of 128KB and the default GETVIS space of 48KB are too small. Before attempting to run the linkage editor with a managed-SAM IJSYSLN file, tell the system operator to issue the ALLOC command to adjust partition size to provide the required GETVIS space, plus 80KB non-GETVIS space for job control routines. The operator must then issue the SIZE *command* to set aside an adequate amount of default GETVIS space in the partition.

To determine how much GETVIS space is adequate, consider the following:

- You must provide enough storage to access the catalog(s) to locate the SAM ESDS file(s). For every catalog required, provide at least 40KB of GETVIS space.
- For every SAM ESDS file you wish to have open at any given time, you should provide at least an additional 20KB of GETVIS space.

For example, to use 4 work files cataloged in the same user catalog, provide 40KB (user catalog) + 40KB (master catalog) + 80KB (4 SAM ESDS files) = 160KB of GETVIS space. This is in addition to the space for the program you intend to run in that partition.

Format of the EXEC Statement



For information about parameters not described here, refer to the description of the EXEC statement in the , z/VSE System Control Statements, SC34-2679.

PARM='value'

REAL

Tells the system to execute the program in real storage, without paging. In VSE/VSAM, use of this parameter causes the system to load VSE/VSAM modules that normally reside in the SVA into your partition. Your partition must have an additional 300KB to accommodate these VSE/VSAM SVA modules. To run the *VSE/VSAM Space Management for SAM Function* in real mode, add another 40KB (340KB total) to your partition.

There are only a few cases (for example, time-dependent applications) in which VSE/VSAM should run in real mode instead of virtual mode. Running programs in real mode in one partition can significantly degrade performance in other partitions, so you should use real mode sparingly. Do *not* specify REAL on the // EXEC IDCAMS invoke statement, because the partition cannot accommodate both VSE/VSAM and IDCAMS modules at the same time.

SIZE=size

Specifies how much storage is needed for loading the specified program. For ease of use, specifying SIZE=AUTO is recommended. This indicates that the program size, as calculated by the system, is to be taken as the value for SIZE. For other possible specifications of SIZE, see the description of the EXEC statement in the z/VSE System Control Statements, SC34-2679.

You must specify SIZE for VSE/VSAM programs (including IDCAMS), ISAM programs using the *ISAM Interface Program* (IIP), and SAM files using the *VSE/VSAM Space Management for SAM Function*. SIZE specifies the size of that part of the partition that is directly available to the program to be executed. The remainder of the partition may be used as GETVIS storage area.

The non-SVA-eligible VSE/VSAM phases and IDCAMS must be accommodated in the partition GETVIS area. The partition GETVIS area must contain at least 40KB for VSE/VSAM buffers and control blocks for every catalog that is open, plus 12KB for every KSDS and 10KB for every ESDS or RRDS (assuming a CI size of 2KB or less). Additional space for modules, buffers, and control blocks is required if you use any non-SVA-eligible VSE/VSAM phases (for example, the *ISAM Interface Program*) or IDCAMS. For exact storage requirements, see "Storage for VSE/VSAM" on page 14.

To **invoke** IDCAMS through job control, specify:

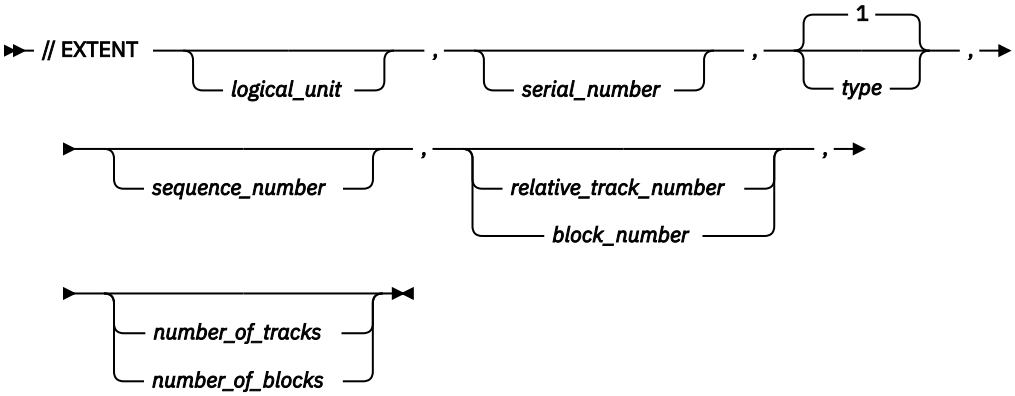
```
// EXEC IDCAMS,SIZE=AUTO,PARM='value'
```

If you do not specify the SIZE parameter, IDCAMS terminates your job immediately. When you specify SIZE=AUTO, the system determines the amount of storage required for the IDCAMS root segment and leaves the rest of the partition free for the GETVIS area.

// EXTENT Statement

To determine when you must supply a // EXTENT statement, refer to "Use of z/VSE Job Control Statements for VSE/VSAM" on page 23.

Format of the EXTENT Statement



logical_unit
Specifies a six-character field indicating the logical unit (SYSxxx) of the volume on which this extent resides. VSE/VSAM does not require this parameter; if you do not specify a LU, VSE/VSAM will assign one.

If you specify this parameter, you must supply full job control statements (// DLBL, // EXTENT, and // ASSGN) for *all* volumes (including candidate volumes) for the file and its associations.

number_of_tracks | number_of_blocks
This parameter indicates the number of tracks (CKD), or number of blocks (FBA) to be allocated to the file or space. You must specify it when a file with the UNIQUE option is created (DEFINE or IMPORT command).

This parameter is ignored when a VSE/VSAM file is created within an existing data space, because VSE/VSAM suballocates the space for the file from direct-access extents it already owns. This parameter is not required for VSE/VSAM input files, because the extents are obtained from the VSE/VSAM catalog.

For an implicitly defined SAM ESDS file that does not specify RECORDS (and RECSIZE), or CYL or BLK (on the // DLBL statement), VSE/VSAM uses the number of tracks | blocks parameter to determine the primary allocation size. A secondary allocation size equal to 20% of the primary size is used.

This parameter and the relative track | block parameter must either both be present or both be omitted.

relative_track_number | block_number
This parameter indicates the number of the track (CKD), or number of block (FBA) on which the extent is to begin. You must specify it when a file with the UNIQUE option is created (DEFINE or IMPORT command).

This parameter is not required (and is ignored) if it is specified for a VSE/VSAM file that is created within an existing data space. In this case, VSE/VSAM suballocates the space for the file from direct-access extents it already owns. You are not required to specify this parameter for a VSE/VSAM input file, because the extents are obtained from the VSE/VSAM catalog.

This parameter and the number of tracks | blocks parameter must either both be present or both be omitted.

sequence_number
This parameter is ignored for VSE/VSAM users, but if it is specified incorrectly, it is flagged by job control.

serial_number
VSE/VSAM users are required to specify the serial number of the volume this extent is on. For data integrity reasons, do not have two volumes with the same serial number in your system (even if one of the volumes contains no VSE/VSAM space).

type
For VSE/VSAM, a value of 1 is assumed.

Using Job Control for Catalog Definition

Overview of Catalogs

VSE/VSAM catalog(s) are central information points for files and volumes. A catalog contains the information VSE/VSAM needs to allocate space for files, verify authorization to gain access to files, compile use statistics on files, and relate relative byte addresses (RBAs) to physical locations. Each VSE/VSAM catalog also contains entries that describe the catalog itself. Figure 5 on page 38 shows the *relationship* between a *master catalog* and *user catalogs*, as well as their relationships with VSE/VSAM and nonVSAM files.

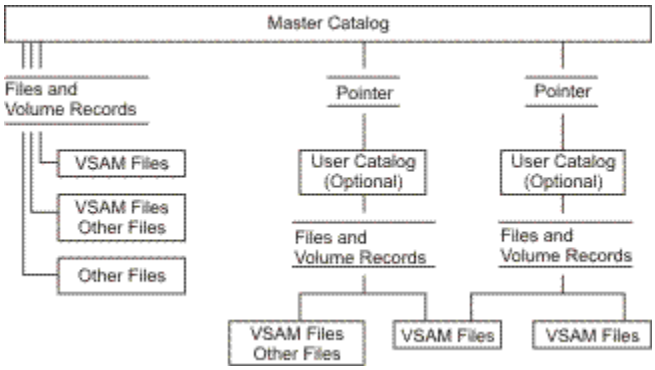


Figure 5. Relationship of Catalogs and Files

Master Catalogs

This type of catalog is mandatory. A master catalog *must* be defined in your system. Defining a master catalog is the first job that needs to be done after you have installed VSE/VSAM in your system. You can have several master catalogs at your installation; however, only one can be connected to the system at a time.

The master catalog volume must always be mounted whenever a VSE/VSAM file or catalog is to be processed. If the VSE/VSAM file to be processed is defined in a user catalog, the user catalog volume must be mounted also.

The master catalog volume is connected to the system at IPL (initial program load) by the DEF SYSCAT=cuu command. It is always on a LU named SYSCAT.

User Catalogs

This type of catalog is optional. A user catalog has the same structure and function as the master catalog. If defined, a user catalog is pointed to by the master catalog.

One or more user catalogs can be defined in your system. They are used to increase data integrity and security, improve performance, and provide volume portability.

Files and Catalogs

All VSE/VSAM files (except implicitly defined SAM ESDS files) *must* be defined (have an entry) in a catalog. To make such an entry, or to perform other actions on a file, you do *not* act on the file, but on a VSE/VSAM catalog. For example: to establish a file, you have to create an entry in a catalog by using the IDCAMS command DEFINE; to delete a file involves removing an entry from the catalog; to move a file from one system to another involves moving an entry from one system's catalog to another system's catalog.

Note that VSE/VSAM either:

- Uses a catalog to *access a file* (as in the PRINT command, where VSE/VSAM locates the file to be printed through the catalog), or
- Accesses the catalog information only and does not access a file (as in the ALTER command, where VSE/VSAM changes an entry in the catalog).

Catalog Volumes

Several catalogs can own space on a volume, but with the restriction that only one catalog can *reside* on a volume.

If a VSE/VSAM file resides on several volumes, every one of those data spaces must be owned by the same catalog.

Note that information requests to a catalog might be answered more quickly if the information is distributed across several catalogs. For example, if the master catalog primarily contains pointers to user catalogs, which in turn contain entries for most files and volumes, catalog search time can be reduced, and the effect of an inoperative or unavailable catalog is minimized.

The following discussion (except where noted) pertains to the accessing of a file.

Specifying the Master Catalog

To define a master catalog you must supply a *master catalog // DLBL* statement, and you must specify extent information, either in the form of an // EXTENT statement or by DEFINE command parameters.

```
// DLBL    IJSYSCT,'VSAM.MASTER.CATALOG',,VSAM
```

The // DLBL statement in the above example identifies:

- The filename: must be IJSYSCT.
- The file-ID: VSAM.MASTER.CATALOG

  This can be any name you choose (it must match the NAME parameter in the DEFINE MASTERCATALOG command).
- The access method.

You can omit the master catalog // DLBL statement from the job stream if you place the statement in the system or partition standard label area. You do this by preceding it with *one* of the following job control statements:

```
// OPTION   STDLABEL=ADD
// OPTION   PARSTD=ADD
```

Another way of referring to the master catalog (after its initial specification) is by coding the CAT=filename parameter in a VSE/VSAM file's // DLBL statement. For further explanation to the CAT=filename parameter, see below.

Specifying a User Catalog

To *define* a user catalog you supply a // DLBL statement for the *master* catalog only. But to *access* files in a user catalog, specify a user catalog // DLBL statement. (For information on // DLBL requirements for IDCAMS commands, refer to Table 6 on page 24.) No // EXTENT statement is required.

Specifying a Job Catalog

With VSE/VSAM, you can designate one (but only one) of your user catalogs as a *job catalog*.

You specify a job catalog by coding the filename, IJSYSUC, in the // DLBL statement that specifies the user catalog; for example:

```
// DLBL    IJSYSUC,'JOBCAT',,VSAM
```

When you specify a job catalog, VSE/VSAM will always use that one catalog for all catalog and file access in the current job, unless it is specifically overridden by:

- The CAT=filename parameter of a VSE/VSAM file's // DLBL statement.
- The CATALOG or WORKCAT parameter of an IDCAMS command.

Using a Job Catalog

The following example makes use of the REPRO command (data is to be copied from one file to another) to show how you use a job catalog. It is assumed that the input file, PAY, and the output file, PAYROLL, were already defined (cataloged) in the job catalog. It is also assumed that the // DLBL statement for the master catalog has been placed in the system or partition standard label area and so need not be included in the example.

Example:

```
     // JOB      Specify a job catalog
(a)  // DLBL     IJSYSUC,'USER1',,VSAM
(b)  // DLBL     VSAMIN,'PAY',,VSAM
(c)  // DLBL     VSAMOUT,'PAYROLL',,VSAM
     // EXEC     IDCAMS,SIZE=AUTO
        REPRO    INFILE(VSAMIN) OUTFILE(VSAMOUT)
     /*
     /&
```

In this example, VSE/VSAM finds a // DLBL statement with a filename of IJSYSUC (a). VSE/VSAM interprets this to mean that files PAY (b) and PAYROLL (c) have their respective entries in the job catalog. It, therefore, searches the job catalog to locate the entry for input file PAY and output file PAYROLL.

Assume that you want to process a file, but the file is not cataloged in the job catalog. In this case, you can override the job catalog by using either:

- The // DLBL CAT=filename parameter, or
- The CATALOG parameter of an IDCAMS command.

The following explains these two methods of explicit catalog specifications.

Explicit Catalog Specification (With a VSE/VSAM File's // DLBL CAT Parameter)

The following example directs VSE/VSAM to search a catalog other than the job catalog (specified in the previous example). Assume that the input file PAY was defined in job catalog USER1 as before, but output

file PAYROLL was defined in user catalog USER2. Also assume, as before, that the // DLBL statement for the master catalog has been placed in the system or partition standard label area.

Example:

```
     // JOB      USING the // DLBL CAT PARAMETER
(a)  // DLBL     IJSYSUC,'USER1',,VSAM
(b)  // DLBL     VSAMIN,'PAY',,VSAM
(c)  // DLBL     VSAMOUT,'PAYROLL',,VSAM,CAT=PRIVCAT
(d)  // DLBL     PRIVCAT,'USER2',,VSAM
     // EXEC     IDCAMS,SIZE=AUTO
        REPRO    INFILE(VSAMIN) OUTFILE(VSAMOUT)
     /*
     /&
```

VSE/VSAM encounters the filename IJSYSUC in a // DLBL statement (a), but it also finds CAT=PRIVCAT in a file's // DLBL statement (c). CAT=PRIVCAT directs VSE/VSAM to search catalog (d) USER2 (rather than the job catalog) for PAYROLL's file entry. (Filename PRIVCAT links the CAT parameter to the appropriate // DLBL user catalog statement.)

VSE/VSAM locates the entry of file PAY (b) in the job catalog as before because, in this case, you have not overridden the job catalog specification.

The // DLBL CAT=filename parameter is used with the PRINT and REPRO commands. (Each of these commands is used to access data.) The // DLBL CAT=filename parameter can also be used for VSE/VSAM application program access.

Explicit Catalog Specification (With the IDCAMS CATALOG Parameter)

Master Catalog

A master catalog // DLBL statement is always required. You may include it in the job stream or in the partition or standard label area.

User Catalog

If you specify the CATALOG parameter in an IDCAMS command, generally no // DLBL is needed for a user catalog. Only the PRINT and REPRO commands require a user catalog // DLBL because they are used with nonVSAM files. For information on the requirement of // DLBL for IDCAMS commands, see Table 6 on page 24.

```
The format of the CATALOG parameter is:

   CATALOG  (catname/password)
```

Specify `password` only if needed.

Search Sequence of Catalogs

VSE/VSAM follows a certain order in searching for the catalog of a file. The established hierarchy that determines the specific catalog to be searched is as follows:

1. Explicitly specified user or master catalog.

   This is the catalog that is specified by the IDCAMS CATALOG parameter or by the CAT=filename parameter of a VSE/VSAM file's // DLBL statement.

2. Job catalog.

   If the above catalog is not specified, the job catalog (IJSYSUC) specified as the filename of a // DLBL statement is searched.

3. Master catalog.

If the above catalogs are not specified, the master catalog (IJSYSCT) is searched.

Table 14 on page 42 shows which catalog is searched, depending on your // DLBL specification.

The *default catalog* is the catalog that VSE/VSAM searches if you do not specify CAT=filename in the // DLBL statement, or if you do not use the CATALOG parameter in an IDCAMS command.

Normally, the default catalog is specified by the // DLBL IJSYSUC statement (also referred to as *job catalog*). If not specified, the default catalog is the master catalog (// DLBL IJSYSCT).

Table 14. // DLBL Specifications and Search Sequence of Catalogs

// DLBL IJSYSUC specified?	// DLBL CAT=filename	CATALOG Parameter Specified? See (1)	Catalog to be Searched
Yes	None	No	Job Catalog
Yes	Filename of User Catalog // DLBL	No	User Catalog
Yes	'IJSYSCT'	No	Master Catalog
Yes	'IJSYSUC'	No	Job Catalog
Yes	None	Yes	CATALOG(catname)
No	None	No	Master Catalog
No	Filename of User Catalog // DLBL	No	User Catalog
No	'IJSYSCT'	No	Master Catalog
No	'IJSYSUC'	No	Master Catalog. See (2)
No	None	Yes	CATALOG(catname)

Note:

1. For more information on the CATALOG parameter, see Table 6 on page 24.
2. If the filename for the job catalog is specified but not a job catalog, VSE/VSAM defaults to the master catalog.

Chapter 4. Tasks under VSE/VSAM

This Chapter...

Explains the **relationship** between a catalog, the data space on a volume, and VSE/VSAM files.

The chapter includes **"how to"** information for:

- Defining data space and files, and handling ownership of space and volumes.
- Transporting files.
- Migrating catalogs and files.
- Modeling a new object from existing definitions.

Data and Space Management

About the VSE/VSAM Catalog

When you define a catalog under VSE/VSAM, the catalog is the first object contained on a volume, and VSE/VSAM allocates a specific amount of data space to the catalog. This data space is "owned" by the catalog, and it is managed by VSE/VSAM. Of this data space, you can make portions available to other VSE/VSAM objects; that is, you can *suballocate* space.

Information Contained in the Entries of a Catalog

The VSE/VSAM catalog is a key-sequenced file composed of a *data part* and an *index part*. The data part of the catalog consists of:

- *Cluster entries* that describe files.

  Cluster entries contain the information that VSE/VSAM requires to properly access a file, verify access authorization (if required), and provide statistics on operations performed on a file.
- *Volume entries* that describe direct-access volumes in terms of the allocation of data spaces and the location of available space.

  Volume entries in a catalog enable VSE/VSAM to keep track of data spaces and free storage areas.

The index part of the catalog allows VSE/VSAM to find the *cluster entry* through its 44-byte name (file-ID), and to find the *volume entry* through the volume serial number.

The information contained in VSE/VSAM catalogs is sufficient to enable VSE/VSAM to suballocate and deallocate space for files on the available volumes. Because these volumes need *not* be mounted on a device of the system, file management is less dependent on job control information, or on information specified in processing programs. In certain cases, however, volumes must be mounted; refer to “Volume Mounting Needs” on page 46.

Except for clusters that have been defined with the UNIQUE attribute, VSE/VSAM can allocate and deallocate space for files on cataloged volumes that are not mounted.

Defining VSE/VSAM Data Spaces on a Volume

To define VSE/VSAM data space on a volume, and to identify the volumes that will contain the VSE/VSAM clusters, you use the IDCAMS command DEFINE SPACE.

The space you define will be:

- Identified in the *volume table of contents* (VTOC) of the volume.

- Controlled entirely by the VSE/VSAM catalog in which it is defined.

Note that the volumes that will contain VSE/VSAM files must be mounted.

Defining VSE/VSAM Files

VSE/VSAM files (or clusters) are stored in VSE/VSAM data spaces. Usually, you first define a data space, then you define the files.

All VSE/VSAM files of an installation must be cataloged in a VSE/VSAM catalog. You *catalog* a file by *defining* it through the IDCAMS command DEFINE CLUSTER. IDCAMS, then, enters the name of the file and other characteristics into the catalog.

When you define VSE/VSAM files, you normally do not need any // DLBL and // EXTENT statements. This is because VSE/VSAM automatically allocates space for the files from existing data spaces.

When you define a file with the UNIQUE attribute (to enable the file to be allocated a space of its own), you do not define the data space beforehand. Instead, you provide extent information. You do this through // DLBL and // EXTENT statements in the IDCAMS job stream that defines that file. The data space is then set up at the same time as the entry for the file is created. The volume(s) must be mounted, as in defining a data space.

Note that you can also identify nonVSAM files in a VSE/VSAM catalog, but you cannot suballocate nonVSAM files within VSE/VSAM data space.

About Volumes and VTOCs

Volume Ownership

A given catalog controls (*owns*) any space that is defined in it. This includes the space in which the catalog resides, as well as the VSE/VSAM data space occupied by VSE/VSAM files.

The VSE/VSAM data space occupied by VSE/VSAM files is recorded in the *volume entries* in a catalog. The *ownership* of the volume, and the *use* of VSE/VSAM data space on a volume are indicated by label entries in the VTOC of the volume.

VSE/VSAM volume ownership does not affect nonVSAM files that reside on the volume. NonVSAM files can exist on a volume owned by a catalog but can be cataloged as nonVSAM entries in a catalog that does not own the volume. (NonVSAM files do not have to be defined in a VSE/VSAM catalog.)

Label Entries in the VTOC

The *data secure file bit* in the format-1 VTOC (identifier) label of every VSE/VSAM data space on the volume is set to indicate both read and write protection.

The *ownership bit* in the format-4 VTOC label is set to 1 if the volume contains a VSE/VSAM data space, or if the volume is a candidate volume for a VSE/VSAM object. The ownership bit indicates that the volume is owned by one or more catalogs, but does not identify the volumes.

Volume Entries in a Catalog

Every catalog contains a *volume entry* for every volume it owns. The volume entry describes:

- The characteristics of the direct-access volume
- Every extent of the VSE/VSAM data space
- Every VSE/VSAM object that uses the space of the volume

Note that volumes with duplicate volume serial numbers cannot be owned by the same catalog.

Handling Ownership

Removing Volume Ownership

To remove a volume ownership from a catalog, you must delete all VSE/VSAM objects and data spaces owned by that catalog on the volume.

If you cannot use the DELETE command because IDCAMS can no longer access the volume (due to the damage that resulted from a system or hardware failure), you can reset the ownership bit by using the IKQVDU program.

Note: Do not use IKQVDU if more than one catalog owns space on the volume. This is because IKQVDU resets the ownership bit even if other catalogs own space on the volume. For more information on the IKQVDU program, see "Maintaining VTOC and VOL1 Labels on Disk (IKQVDU)" on page 343.

Releasing Space from Ownership

To release space from ownership by a catalog, you must delete all VSE/VSAM objects that reside in that space. The catalog contains a volume entry, which describes the volume and its VSE/VSAM data spaces.

After deleting the VSE/VSAM objects, you must issue the DELETE SPACE command. The DELETE SPACE command deletes the VSE/VSAM data spaces owned by that catalog, removes the volume entry from the catalog, deletes the format-1 label, and revises the format-4 label in the VTOC (if no other catalogs own space on that volume).

The following fields in the format-4 VTOC label are reset only when all catalogs have released their VSE/VSAM space on the volume:

```
Offset  Length  Description
  77      8     VSE/VSAM time stamp 1 is set to the system's time of day
                when VSE/VSAM acquires volume ownership in a catalog.  This
                time stamp is modified whenever physical space allocated to
                VSE/VSAM is acquired, either by allocation of an extent
                or any time VSE/VSAM physical space is returned to the
                VTOC by VSE/VSAM catalog management routines.

  85      1     VSE/VSAM indicators:
                  Bit 0 set to 1 = One or more VSE/VSAM catalogs owns space
                                   on the volume.
                  Bit 1 set to 1 = No significance for VSE.
                  Bits 2 - 7     = Reserved (set to binary zeros).

  86-87         Not used

  88      8     VSE/VSAM time stamp 2 is the VSE/VSAM-only timestamp.  (Set
                only for MVS compatibility and not used by VSE.)
```

Recognizing VSE/VSAM Data Space Names in the VTOC

VSE/VSAM generates *names* for data spaces and enters the names in the VTOC of the applicable volume. You want to be able to recognize the names that relate to VSE/VSAM when you list the volume's VTOC, when you reinitialize the volume, or when you dump the volume to a magnetic tape.

The VTOC contains the:

- Name of every VSE/VSAM data space on the volume, and
- For unique files, the names for the data and index components of a cluster or alternate index (the format-1 VTOC label is identified with the object's entry name).

The names generated by VSE/VSAM have the following format:

- For a data space containing suballocated VSE/VSAM objects, the VSE/VSAM-generated name is:

```
Z999999n.VSAMDSPC.Taaaaaaa.Tbbbbbbb

where:
  n=2 if no catalog resides in the data space
  n=4 if a user catalog resides in the data space
  n=6 if the master catalog resides in the data space
  aaaaaaabbbbbbb is the time stamp value
```

- For a unique data space (defined as a data space that cannot contain more than one cataloged VSE/VSAM object), the VSE/VSAM-generated name is:

```
VSAMDSET.DFDyyddd.Taaaaaaa.Tbbbbbbb

where:
  yyddd is the date (year and Julian day)
  aaaaaaabbbbbbb is the time stamp value
```

Relating Names Created for Unique Data Spaces

When you define a VSE/VSAM file with the UNIQUE attribute, VSE/VSAM creates a unique data space. If you specify a name for the data and/or index component, VSE/VSAM places the name you specify in the format-1 VTOC label rather than generating a name.

To relate the VSE/VSAM-generated name with a VSE/VSAM cluster, alternate index, catalog, or data space, you have to list the catalog that owns the volume. Issue a LISTCAT command to list the content of the catalog. The LISTCAT output, then, relates the VSE/VSAM-generated names with user-assigned entry names for cataloged objects.

Time Stamps

Every volume owned by a catalog contains a time stamp that is written in the VTOC when the volume is first cataloged. Both time stamps, the one in the VTOC and the one in the volume entry in the catalog, are updated whenever the catalog is updated in response to the following IDCAMS commands:

DEFINE SPACE
DEFINE CLUSTER (with UNIQUE attribute)
DEFINE ALTERNATEINDEX (with UNIQUE attribute)
DEFINE MASTERCATALOG
DEFINE USERCATALOG
DELETE SPACE
DELETE CLUSTER (with UNIQUE attribute)
DELETE ALTERNATEINDEX (with UNIQUE attribute)
DELETE MASTERCATALOG
DELETE USERCATALOG
EXPORT PERMANENT a cluster or alternate index with the UNIQUE attribute. (The cluster or alternate index is deleted.)
IMPORT a cluster or alternate index with the UNIQUE attribute. (Any old copy, if present, is deleted, and a new version is defined.)

If the time stamp of the volume is earlier than the time stamp of the catalog, the volume is considered down-level. IDCAMS will not open a file on a down-level volume.

Volume Mounting Needs

Volumes *must* be mounted in the following cases:

- If it is the owning VSE/VSAM catalog.
- If a volume contains a *unique* file.
- If there is not enough unused data space to contain a file, you must mount one or more volumes to allocate new data space, or you have to assign to the file other volumes that contain unused data space.
- In all cases where files are actually accessed (for example, VSE/VSAM application programs, PRINT, REPRO, DELETE ERASE, work files, EXPORT, IMPORT), you have to mount the volumes.
- In all cases where a VTOC update is necessary (for example, DEFINE or DELETE SPACE, DEFINE or DELETE a UNIQUE file, ALTER NEWNAME NONVSAM, ALTER NEWNAME UNIQUE), you have to mount the volume(s) for the affected VTOC(s).

Work Files on Virtual Disk

Work files may reside on real disk devices, but also on *virtual disks*, that is: in virtual storage that has been reserved for z/VSE data spaces. If a work file resides on virtual disk, data is moved to or from data space (instead of being written to or from a real disk device).

Virtual disk processing should only be used in conjunction with temporary work files, because the information in a z/VSE data space is lost whenever the system is restarted.

Preparations for Use

To prepare for the use of virtual disk, in general proceed as follows:

1. At IPL time, add one or more virtual disks by using the ADD command, FBAV operand.
2. Define z/VSE data space by using the SYSDEF command.
3. After IPL, define the layout of the virtual disk(s) by using the VDISK command.

   (Using the VDISK command makes the virtual disk available automatically.)

For information on these commands, refer to the , z/VSE System Control Statements, SC34-2679.

To use the virtual disk support for VSE/VSAM:

1. Define one or more user catalogs on the prepared virtual disks by using the IDCAMS command DEFINE USERCATALOG.

   A catalog can own VSE/VSAM space on one or more virtual disks (up to 123 volumes).
2. Catalog the VSE/VSAM objects in the defined catalog by using the DEFINE commands of IDCAMS.

For an example of definitions, refer to the VSE/VSAM Commands, SC34-2707.

Restrictions

Files residing on virtual disk are managed by VSE/VSAM as if they resided on real devices. However, note the following restrictions:

- Master catalogs must *not* reside on virtual disk.
- If the user catalog resides on a:
  - Virtual disk, and if defining an object on a real disk, the define will fail.
  - Real device, and if defining an object on a virtual disk, the define will fail.

  That is, cataloging an object to a user catalog is only successful if both - object and catalog - are either on real volumes or virtual volumes.
- Whenever virtual disks are lost for VSE/VSAM (for example, on re-IPL or detach), you have to EXPORT DISCONNECT the corresponding user catalog(s) before defining a new user catalog of the same volume serial name.

Transporting Files between Systems

Transporting Catalog Information

Because all VSE/VSAM files must be cataloged, moving a file from one system (or set of systems if in a disk sharing environment) to another requires that catalog information be moved along with it or that the copy of the file moved be cataloged in the receiving system. If the catalog information is copied with the file, it must be in a format that both systems can process.

Transporting Files between VSE/VSAM and DFSMSdfp VSAM or DFSMS/MVS

Use EXPORT and IMPORT to copy VSE/VSAM files and their catalog information to DFSMSdfp VSAM (which uses the Integrated Catalog Facility - ICF). The only way you can move MVS files cataloged with the new catalog format to VSE/VSAM is to export those files to tape while running on DFSMSdfp VSAM. Then you can import the tape files to VSE/VSAM. You cannot mount a DFSMSdfp VSAM format volume on a z/VSE system. VSE/VSAM cannot process DFSMSdfp ICF catalog information.

Do not use BACKUP and RESTORE to transport files from z/VSE to MVS, because MVS does not have BACKUP and RESTORE commands.

Transporting Files between VSE/VSAM and MVS/VSAM (not DFP)

Use EXPORT and IMPORT to transfer files and their catalog information between systems. Files and volumes are portable between VSE/VSAM and MVS/VSAM "old" catalog format systems.

You can use BACKUP and RESTORE to back up MVS "old" catalog format files on z/VSE and restore them on z/VSE. This procedure is recommended only for a one-time move of files from MVS to z/VSE. The only way you could move the files back to MVS is to use EXPORT/IMPORT, because MVS does not support BACKUP and RESTORE.

The description under “Transporting Files between z/VSE Systems” on page 48 also applies to transferring files between z/VSE and MVS "old" catalog format systems.

Transporting Files between z/VSE Systems

You can move individual files and user catalogs from one z/VSE system to another by using the EXPORT and IMPORT commands. When you move a user catalog from one system (or set of systems) to another, its VSE/VSAM volume ownership moves along with it. Thus, a VSE/VSAM volume (without compressed data sets) is portable between systems together with all VSE/VSAM data spaces and files contained on the volume(s). Any VSE/VSAM volume including compressed data sets is portable between z/VSE systems.

The entire VSE/VSAM master catalog and the VSE/VSAM volumes owned by the master catalog can be moved from one z/VSE system (or set of systems) to another.

To use a VSE/VSAM master catalog from another system, you need only assign it by use of the DEF SYSCAT=cuu command during initial program load. All VSE/VSAM volumes owned by that catalog are then available to the receiving system. In addition, a // DLBL statement for the master catalog must be provided either in the job stream or in the label area.

Catalog and File Migration

The following explains how to proceed if you want to migrate VSE/VSAM catalogs and files from one device type to another. This includes movement from one CKD device type to another, one FBA device type to another, or from a CKD device to an FBA device (and vice versa). Note that a catalog on an FBA device can own CKD volumes (and their VSE/VSAM files), and a CKD catalog can own FBA volumes.

There are two ways to migrate objects and their catalog information from one device type to another. The simpler method is to use the VSE/VSAM Backup/Restore Function, but there are some restrictions; the other way is to use a combination of EXPORT/IMPORT and DEFINE commands. For a description of the methods, refer to “Migrating Catalogs” on page 49.

Definitions for Catalog Migration

Defining a Catalog

The following applies to both master and user catalogs. Whenever you use BACKUP/RESTORE or EXPORT/IMPORT for migration, you must first define the catalog that will own the VSE/VSAM objects after migration.

VSE/VSAM defines a VSE/VSAM data space from which the catalog is suballocated. This is done on CKD devices using the DEDICATE, ORIGIN, CYLINDERS, TRACKS, or RECORDS subparameter of DEFINE MASTERCATALOG|USERCATALOG. FBA devices require the same process, except that the DEDICATE, ORIGIN, BLOCKS or RECORDS subparameter must be specified. (CYLINDERS or TRACKS is not accepted.) Therefore, you must convert a CYLINDERS or TRACKS value to a BLOCKS or RECORDS quantity.

If you specify DEDICATE for the CKD device, no conversion is necessary.

Convert the number of tracks or cylinders into the number of bytes, using LISTCAT to determine the number of bytes per track and tracks per cylinder. Divide the number of bytes by 512 to determine the BLOCKS value. Adjust it accordingly if you want more or less space allocated.

The beginning-block-number specification in the ORIGIN parameter depends on where you want the data space to be on the volume (VSE/VSAM always rounds it to the next minimum CA boundary). Use the LVTOC utility program to determine what space is available on the volume. The catalog will be located at the beginning of the defined data space. In VSE/VSAM Commands, SC34-2707, refer to

- the description of the NAME|VOLUME... parameter in the description of the LISTCAT command,
- the description for special fields BLKS/MAX-CA.

You may wish to change other subparameters of MCAT or UCAT (for instance, the volume serial number), but there are no special considerations for FBA devices.

Specify the actual space to be suballocated for your catalog using the BLOCKS or RECORDS subparameters of DATA and INDEX. Do *not* try to directly convert a CKD catalog size definition to a fixed block definition. Instead, calculate the desired values; refer to the instructions in the VSE/VSAM Commands, SC34-2707. To avoid an overly small, inefficient CA size, make the secondary allocation value at least as large as the desired CA size.

Defining a VSE/VSAM Data Space

The considerations for data space definition are essentially the same as for catalog definition. Differences are:

- A catalog is not suballocated from the data space.
- Both BACKUP/RESTORE and EXPORT/IMPORT assume that you have already defined a VSE/VSAM data space on the new volume.

If CANDIDATE is specified with DEFINE SPACE, fixed block data space definition is the same as CKD data space definition.

Defining a Non-Unique Cluster or Alternate Index

Because these files (or their components) are suballocated from VSE/VSAM data spaces, there are no job control considerations for FBA devices. For FBA devices, you must convert the TRACKS or CYLINDERS subparameters to BLOCKS or RECORDS. (The RECORDS subparameter does not require conversion.) This conversion is the same as described above for catalog conversion.

Defining a Unique Cluster or Alternate Index

If a cluster or alternate index contains both a non-unique component and a unique component, conversion considerations for the non-unique component are as described above.

For every unique component (data and, if present, index), you must convert EXTENT statement parameters and the TRACKS|CYLINDERS subparameters. Both conversions are required because a unique component occupies its own VSE/VSAM data space. If the component is to be on more than one volume, specify a new EXTENT statement for every volume.

Migrating Catalogs

Catalog Migration Using BACKUP/RESTORE

You cannot actually back up and restore catalogs under BACKUP/RESTORE, but when you back up and restore objects (including empty objects), their catalog information is backed up and restored too. This makes it possible for you to use BACKUP and RESTORE to copy objects and their catalog information into a different catalog. If the new catalog already contains an entry name for the object restored, the original object is deleted, and the restored object is added to the new catalog.

Catalog Migration Using DEFINE/REPRO/ALTER

Although you cannot copy a user catalog itself the following procedure can be used to migrate (move to another volume) a user catalog and the required files using DEFINE/REPRO/ALTER commands.

1. Define the new user catalog (procedure described above) on a new volume using a temporary catalog name that is not already in the system.
2. Define any VSE/VSAM data spaces required for the new volumes. Note that the define catalog operation has already defined a data space on the catalog volume. Any space to be occupied by unique files should be left unallocated.
3. Define all the files, alternate indexes and paths using the old names from the source catalog.
4. REPRO every file and its alternate index onto the new volume.
5. Delete and disconnect the source catalog entry from the system.
6. Change a temporary catalog name of the new catalog to the source catalog name using ALTER NEWNAME USERCATALOG.

Although this method might be slower than Backup/Restore, it allows to move the user catalog and files to the new device type as well as perform the data reorganization during the move.

Catalog Migration Using EXPORT/IMPORT

Moving a Master Catalog to Another Volume:

1. Using EXPORT, create portable copies of all files that are to be in the new catalog (procedure described below). For EXPORT, DISCONNECT any user catalogs to be reconnected to the new catalog.
2. IPL with the master catalog assigned to the new volume, using the IPL DEF SYSCAT=cuu command.
3. Define the new master catalog (procedure described above).
4. Define any VSE/VSAM data spaces required for the volumes. (You need not delete files and catalogs belonging to another catalog.) Note that the define catalog operation has already defined a data space on the catalog volume. Any space to be occupied by unique files should be left unallocated.
5. Using IMPORT, copy VSE/VSAM files to volumes belonging to the new catalog. (For considerations on moving to a different device type, refer to “Migrating VSE/VSAM Files to Another Device” on page 50.) If IMPORT was used, you can IMPORT CONNECT user catalogs.

Moving a User Catalog to Another Volume:

1. Using EXPORT, create portable copies of all files that are to be in the new catalog (procedure described below).
2. Delete or disconnect the previous user catalog entry unless it is owned by a different master catalog.
3. Define the new user catalog (procedure described above).
4. Define any VSE/VSAM data spaces required for the volumes. (You need not delete files and catalogs belonging to another catalog.) Note that the define catalog operation has already defined a data space on the catalog volume. Any space to be occupied by unique files should be left unallocated.
5. Using IMPORT, copy VSE/VSAM files to volumes belonging to the new catalog. (For considerations on moving to a different device type, refer to “Migrating VSE/VSAM Files to Another Device” on page 50.)

Migrating VSE/VSAM Files to Another Device

File Migration Using BACKUP and RESTORE

Note: VSAM will tolerate the use of IDCAMS BACKUP/RESTORE for migration from a non-SCSI device to a SCSI device, or vice versa. However, not every cluster can be migrated in this manner. In these cases, IDCAMS EXPORT/IMPORT must be used instead. EXPORT/IMPORT is the recommended method of data migration.

The VSE/VSAM Backup/Restore Function can back up the following objects and their catalog information onto tape or disk volumes:

- Key-sequenced data sets (KSDS)
- Entry-sequenced data sets (ESDS)
- Relative-record data sets (RRDS)
- Variable-length relative record data sets (VRDS)
- Alternate indexes (AIX)
- SAM ESDS files in CI format

Empty objects can be backed up and restored. An empty object is an object that was defined using the NOALLOCATION parameter, an object that has never been loaded with data, or an object that has not been loaded since reset. Although they cannot be specified in the command, paths are backed up and restored automatically when their respective path entry clusters are backed up or restored.

VSE/VSAM Backup/Restore supports backing up onto tape and disk, and restoring from tape and disk; this support applies to all tape and disk devices that are supported by z/VSE.

You can back up and restore multiple objects with a single command. If you specify BACKUP (*), all objects defined in a specific catalog will be backed up. If you specify RESTORE (*), all objects residing in a specific backup file are restored. You can also specify generic names representing groups of related objects to be backed up or restored. Because the generic specification may include objects you do not want backed up or restored, you can exclude objects by specifying either their entry names or other generic names. For information on the use of generic names for back up and restore, refer to the VSE/VSAM Commands, SC34-2707 under:

- "Using BACKUP and RESTORE"
- "Generic Names"

To copy objects from one volume to another volume of a different device type, specify the *volser* representing the new volume in the RESTORE command.

Other Methods of File Migration

In addition to Backup/Restore, there are three ways to move VSE/VSAM files from one volume to another. They may or may not require moving from one catalog to another.

- **DEFINE/REPRO**:
  - To move files between two volumes owned by different catalogs, DEFINE every file on the new volume, using its old name. REPRO every file onto the new volume, and delete it from the old one.
  - To move files between two volumes owned by the same catalog, DEFINE every file on the new volume, using a temporary name that is not already in the catalog. REPRO every file onto the new volume, and delete it from the old volume. Using ALTER, rename the new copy with the name the file had on the old volume.

  In both cases, alternate indexes can be copied. You must redefine all paths for the new copy.
- **EXPORT/IMPORT**:

  With EXPORT/IMPORT, every file to be migrated is first exported to a temporary SAM file (tape or disk). For EXPORT PERMANENT, this frees the space (and volumes if all files on them are exported) that is potentially reusable during the IMPORT phase.

To ensure the desired space allocation, DEFINE the files importing them. If files are imported but not defined, too much or too little space may be allocated to them. Then IMPORT the files.

Unique files require extent values specified on an EXTENT statement. Path definitions are implicitly transferred.

NonVSAM Migration

Catalog entries can be moved also into catalogs on FBA devices (as described above) through DEFINE NONVSAM and DELETE, but they cannot have fixed block specified as their device type.

Space Allocation through Modeling

If a user catalog, cluster, or alternate index migrated from one device type to another had its space allocation defined by modeling, you should consider changing to explicit specification, or modeling it on a catalog, cluster, or alternate index on the new device type. Otherwise, you will allocate space based on the track and/or cylinder capacity of the old device type rather than the new device type. This can cause wasted space, excessive secondary allocation, and inefficient or even invalid CA or CI sizes.

For further information about modeling, see “Using an Object as a Model” on page 52.

Using an Object as a Model

You can use the entry of an already-defined alternate index, catalog, cluster, or path as a *model* for the definition of another object of the same type. When one entry is used as a model for another, its attributes are copied as the new entry is defined.

Modeling permits you to set your own parameter defaults to override system defaults. Once defaults are established, you need not specify them every time you define new objects. An explicit parameter specification, however, overrides defaults established by you (through modeling) and by the system.

The normal IDCAMS DEFINE CLUSTER or DEFINE ALTERNATEINDEX procedure is greatly simplified by reducing the numbers of parameters required. This in turn can reduce the number of errors that are likely to occur, and the number of parameters to which the user needs to be exposed. At the same time, it permits application- and installation-associated standards.

There are three kinds of models; they are referred to as:

- Explicit Allocation (Example in Figure 6 on page 53)
- Explicit NOALLOCATION (Example in Figure 8 on page 54)
- Implicit NOALLOCATION (Example in Figure 9 on page 55)

With *explicit* modeling, you have to specify the name of the model you wish to use. With *implicit* modeling, VSE/VSAM chooses a default model based on the kind of object you are trying to define.

About the MODEL Subparameter

You can specify the MODEL parameter in the DEFINE commands ALTERNATEINDEX, CLUSTER, PATH, and USERCATALOG.

Using the MODEL parameter, you can easily define files that are identical, except for their names and security attributes. When you use the MODEL parameter, ensure that your job is not terminated because of allocation problems when you explicitly do any of the following:

- Specify a different type of device with the VOLUMES parameter.
- Change the length or position of the keys with the KEYS parameter.
- Change the size of records, buffer space, or CIs with the RECORDSIZE, BUFFERSPACE, or CONTROLINTERVALSIZE parameters.

- Change the type of cluster (that is, entry-sequenced, key-sequenced, or relative-record), the type of alternate index (that is, key-pointer or RBA-pointer), or the allocation-type of the object (that is, unique or non-unique).
- Change the *unit of allocation* with the BLOCKS, TRACKS, CYLINDERS, or RECORDS parameters.

When you explicitly specify any of the above parameters for your to-be-defined object, you might have to make corresponding changes to other related parameters.

Explicit Allocation Models

Figure 6 on page 53 shows an explicit model that occupies data space and can be used as a normal VSE/VSAM object. You must explicitly specify the *entryname* subparameter of the MODEL parameter to identify the object to be used as a model. This is the only form of modeling that is valid for paths and user catalogs. If MODEL is specified as a parameter of PATH:

- The attributes of the model are used for the path defined.
- Any attributes explicitly specified as parameters of the defined path are defined and override those of the model.

Figure 6. Explicit Allocation Model

Figure 7 on page 54 shows how parameters are merged from a *Model Cluster* and an *Explicit Specification* into *New Cluster*. Once the merge is completed, *New Cluster* contains a new list of cluster parameters which VSE/VSAM uses to create a cluster.

In the figure, it is assumed that MODEL is specified at the *cluster level* in the DEFINE CLUSTER command. It is also assumed that MODEL is *not* specified at the *data component level* and *index component level* of the command.

The following explains the step numbers shown in the figure:

- (1) The non-propagating cluster level attributes (entryname, passwords, AUTHORIZATION, ATTEMPTS, CODE, OWNER, TO, FOR, and allocation attributes) of the model are used for the defined user catalog, cluster, or alternate index.
- (2) Any non-propagating cluster level attributes *explicitly specified* as parameters of the defined object are applied to and override those of the model.
- (3) The attributes of the model are used for the data and index components of the alternate index, cluster, or user catalog.
- (4) Attributes explicitly specified at the cluster level are propagated to the data and index components of the cluster.
- (5) Attributes that are explicitly specified for the data and index components of the object (that is, specified as subparameters of the DATA or INDEX parameter) are defined.

Note that attributes specified for every step (n) override the attributes specified by the previous step.

If MODEL is Specified in DATA or INDEX Parameter

(not applicable to a user catalog):

- Attributes explicitly specified at the cluster level are propagated to the data and index components of the object.
- Attributes of the model specified for the data or index component are defined (that is, the model specified with the MODEL subparameter of the DATA or INDEX parameter).

- Attributes explicitly specified for the data and index components are defined (that is, the attributes specified with subparameters of the DATA or INDEX parameter).

Attributes specified for every step override the attributes specified by the previous step.

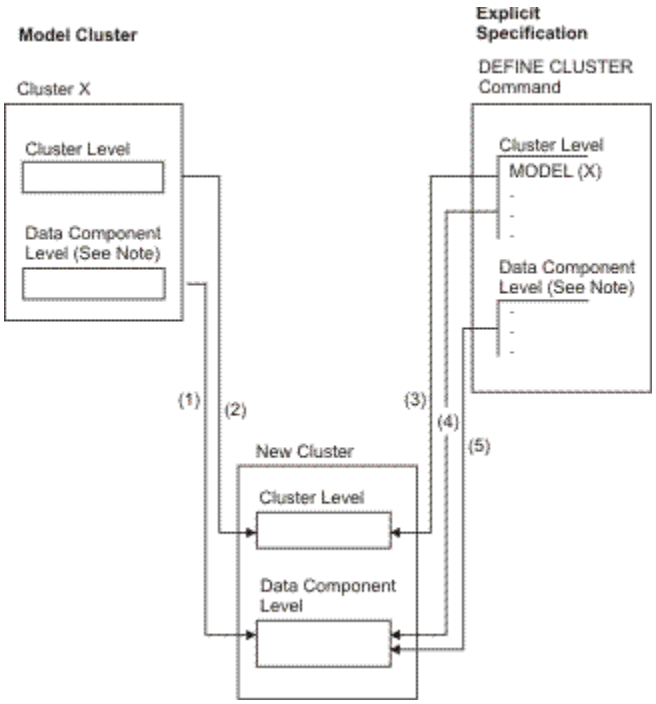


Figure 7. Specifying the MODEL Parameter at the CLUSTER Level Only

Note: The DATA and INDEX component levels have similar rules; for simplicity, only the DATA component is shown in this figure.

Explicit Noallocation Models

Using explicit noallocation and default models, the defined object exists *only* as a model; no space is suballocated to it. The model is represented by entries in the VSE/VSAM catalog.

Figure 8 on page 54 is an *explicit* model because you must specify MODEL(entryname) for the cluster you wish to use as a model. It is a *NOALLOCATION* model because no storage is allocated to it.

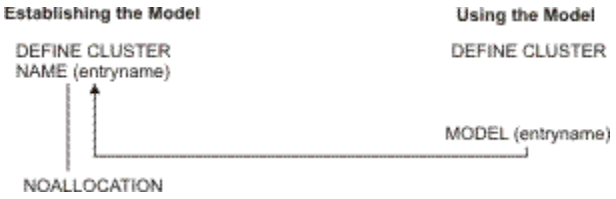


Figure 8. Explicit NOALLOCATION Model

Implicit NOALLOCATION Models (Default Models)

In the case of an *implicit* model, you do not have to specify the name of the model in order to reference it. It is a *NOALLOCATION* model because no storage is suballocated to it.

The *implicit model* is a default model.

When you define the model, specify the entryname subparameter of the NAME parameter as one of the following:

DEFAULT.MODEL.KSDS
(key-sequenced file)

DEFAULT.MODEL.ESDS
(VSAM entry-sequenced file)

DEFAULT.MODEL.ESDS.SAM
(managed-SAM file)

DEFAULT.MODEL.RRDS
(relative-record file)

DEFAULT.MODEL.VRDS
(variable-length relative record file)

DEFAULT.MODEL.AIX
(alternate index)

Every catalog may have six implicit models, one of every type.

As shown in Figure 9 on page 55, you need only specify INDEXED, NONINDEXED, RECORDFORMAT(...)NONINDEXED, NUMBERED, or AIX for VSE/VSAM to locate the appropriate model.

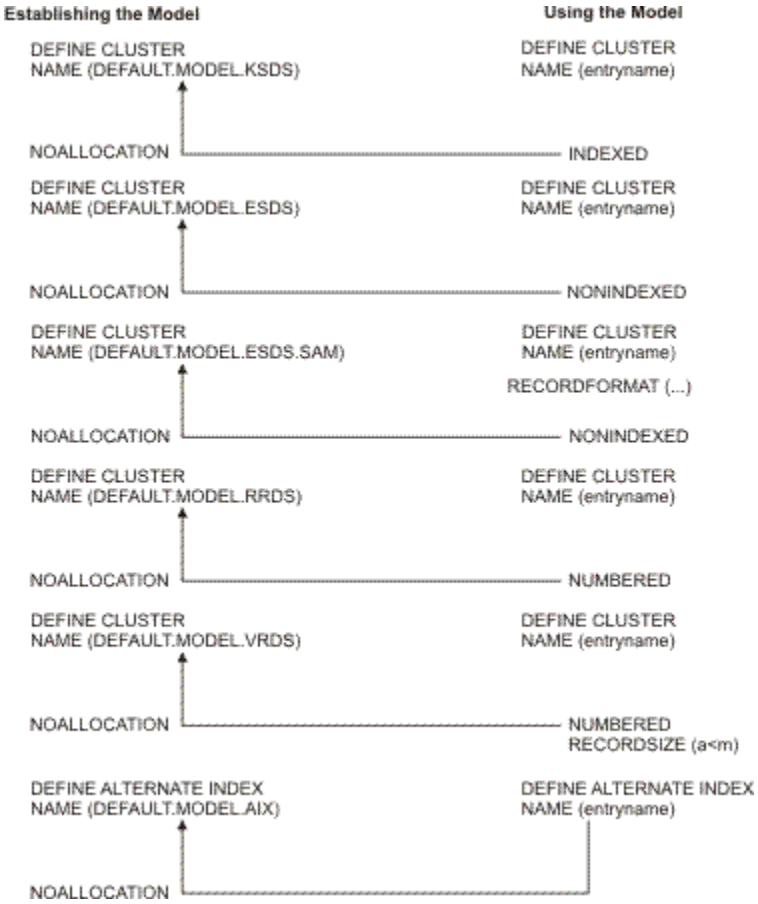


Figure 9. Implicit NOALLOCATION Models

How VSE/VSAM Determines Which Parameters to Use

VSE/VSAM goes through the following sequence in determining which parameter to use in the definition of a cluster or alternate index.

1. Did you explicitly specify a parameter in the define? If yes, VSE/VSAM uses it. (If you explicitly specify a space allocation parameter (CYLINDERS, TRACKS, BLOCKS, or RECORDS) at *any* level of DEFINE CLUSTER/AIX, the space allocation parameter(s) in your model are ignored.)
2. Did you specify MODEL parameter in the define (refer to Figure 6 on page 53)? If yes, go to step 4, below; VSE/VSAM creates a file using the parameters specified in MODEL(entryname).

3. Did you specify the NOALLOCATION parameter with a DEFAULT.MODEL.xxxx in a previous DEFINE command, thereby creating a default model (refer to Figure 9 on page 55)? If yes and the file organization matches the entryname, VSE/VSAM uses the parameters specified in the default model.
4. If none of the above apply, VSE/VSAM uses the system default (if one exists).

Restrictions

The following restrictions exist for modeling of VSE/VSAM objects.

- If you specify DEFINE CLUSTER or DEFINE ALTERNATEINDEX and the cluster name begins with DEFAULT.MODEL., VSE/VSAM assumes that you are establishing a model. The rest of the name must be KSDS, ESDS, ESDS.SAM, RRDS, VRDS or AIX. It is not possible to open a file or component whose name begins with DEFAULT.MODEL.. DEFINE CLUSTER and DEFINE ALTERNATEINDEX ignores user-specified DATA and INDEX component names for clusters that have the DEFAULT.MODEL. prefix. Instead, these components are implicitly assigned a name constructed from the cluster or alternate index name with the additional qualifier of DATA or INDEX. A message will tell you any data/index names that have been generated in this way.
- If space parameters (CYLINDERS, TRACKS, RECORDS, or BLOCKS) are specified at any level of DEFINE CLUSTER or DEFINE ALTERNATEINDEX, they override any modeled defaults.
- You can model the USECLASS parameter only if one of the following is true:
  - If space parameters (CYL, TRK, REC, BLK) are *not* specified
  - If space parameters are specified at a different level

  You cannot model USECLASS if both specifications, USECLASS and space parameter, are at the same level (that is, both specifications are at cluster, data, or index level). If you do specify the same level, VSE/VSAM cannot model from a default model.

  However, you can, for example, model the USECLASS at cluster level if space parameters are specified at the data or the index level.
- You cannot rename (through ALTER NEWNAME or IMPORT NEWNAME) any catalog entry such that the name is changed to or from DEFAULT.MODEL.xxxx. An attempt to do so causes the command to terminate with an error message.
- When a file is defined *implicitly* (through managed-SAM access) and if you have not provided volume information in an EXTENT statement, VSE/VSAM attempts to construct a volume list of up to 16 volumes from the DEFAULTVOLUMES parameter in a managed-SAM ESDS default model (DEFAULT.MODEL.ESDS.SAM). No other parameters from the SAM ESDS default model are used for an implicit define.
- When a VRDS has to be defined through a default model, and to indicate a VRDS, you have to define the recordsize (a<m). If recordsize is not defined, an RRDS is assumed.
- The use of this utility in a VSE/VSAM environment requires special considerations, because both the volume VTOC and the catalog contain space mapping information about the volume which has to be synchronized to insure accessibility and to avoid damage to data.

Table 15 on page 56 lists the various DEFINE parameters and shows for each one if it can be modeled explicitly with 'MODEL(entryname)' and implicitly with 'DEFAULT.MODEL.xxxx'.

Table 15. Modeling of DEFINE Parameters

Parameter	Modeling		System Default if Parameter Not Modeled	Notes
	Explicit	Implicit		
ATTEMPTS	Yes	Yes	Yes	Not propagated to other levels.
AUTHORIZATION	Yes	Yes*	No	Not propagated to other levels.

Table 15. Modeling of DEFINE Parameters (continued)

Parameter	Modeling		System Default if Parameter Not Modeled	Notes
	Explicit	Implicit		
BLOCKS	Can model only if not explicitly specified at any level.		No	Propagated via algorithm from cluster or data levels.
BUFFERSPACE	Yes	No	Yes	
CLASS	No	No	Yes	See USECLASS Parameter.
CODE	Yes	Yes*	No	Not propagated to other levels.
COMPRESSED	n/a	n/a	No	Must not be used with a model data set.
CONTROL INTERVALSIZE	Yes	No	Yes	
CYLINDERS	Can model only if not explicitly specified at any level.		No	Propagated via algorithm from cluster or data levels.
DEDICATE	No	No	No	
DEFAULTVOLUMES	No	No	Yes	
ERASE	Yes	Yes	Yes	Propagated to data level only; NOERASE is the default.
EXCEPTIONEXIT	Yes	Yes	No	
EXTRALARGE	No	No	No	
FILE	No	No	No	
FOR	Yes	Yes	Yes	Specified at cluster level only; propagated to data or index.
FREESPACE	Yes	Yes	Yes	(0 0) is the default.
INDEXED	See last column.	No	Yes	KSDS is created if nothing or INDEXED is specified.
KEYRANGES	Yes	Yes	No	
KEYS(AIX)	Yes	Yes	Yes	
KEYS (cluster)	Yes	Yes	Yes	Not specified or modeled for INDEX.
NOALLOCATION	Yes	No	Yes	SUBALLOCATION is the default.
NOERASE	Yes	Yes	Yes	NOERASE is the default.
NONINDEXED	See last column.	No	Yes	ESDS or SAM ESDS.
NONSPANNED	Yes	Yes	Yes	NONSPANNED is the default.
NONUNIQUEKEY	Yes	Yes	Yes	NONUNIQUEKEY is the default.
NOREUSE	Yes	Yes	Yes	NOREUSE is the default.
NOUPGRADE	Yes	Yes	Yes	UPGRADE is the default.
NOWRITECHECK	Yes	Yes	Yes	NOWRITECHECK is the default.

Table 15. Modeling of DEFINE Parameters (continued)

Parameter	Modeling		System Default if Parameter Not Modeled	Notes
	Explicit	Implicit		
NUMBERED	See last column.	No	Yes	RRDS is created if recordsize (a=m), VRDS is created if recordsize (a<m).
ORDERED	Yes	Yes	Yes	UNORDERED is the default.
OWNER	Yes	Yes	No	Not propagated to other levels.
Passwords	Yes	No	No	No propagation from cluster level, but lower level password is propagated to master if no master password is specified.
RECORDFORMAT	Yes	n/a	Yes	For SAM ESDS models only.
RECORDS	Can model only if not explicitly specified at any level.		No.	Propagated via algorithm from cluster or data levels.
RECORDSIZE	Yes	No	Yes	
RECOVERY	Yes	Yes	Yes	
RELATE	No	No	n/a	
REUSE	Yes	Yes	Yes	NOREUSE is the default.
SHAREOPTIONS	Yes	Yes	Yes	
SPANNED	Yes	Yes	Yes	NONSPANNED is the default.
SPEED	Yes	Yes	Yes	
SUBALLOCATION	Yes	No.	Yes	SUBALLOCATION is the default.
TO	Yes	Yes	Yes	Specified at cluster level only; propagated to data and index.
TRACKS	Can model only if not explicitly specified at any level.		No	Propagated via algorithm from cluster or data levels.
UNIQUE	Yes	No	Yes	SUBALLOCATION is the default.
UNIQUEKEY	Yes	Yes	Yes	NONUNIQUEKEY is the default.
UNORDERED	Yes	Yes	Yes	UNORDERED is the default.
UPGRADE	Yes	Yes	Yes	UPGRADE is the default.
USECLASS	Only if space parms are specified at different level, or if space parms are not specified.		Yes	
VOLUMES	Yes	Yes	No	
WRITECHECK	Yes	Yes	Yes	NOWRITECHECK is the default.

(*) To implicitly model this parameter, the object must be defined with at least one password, and the master catalog password must be specified in the CATALOG parameter.

Default Volumes

Default volume lists are derived from the volumes list of a default model that is of the same type as the object defined. For example, if a VSE/VSAM ESDS cluster is defined without a VOLUMES parameter, an ESDS default model (DEFAULT.MODEL.ESDS.DATA) is used to build the volumes list for the ESDS. Because volume selection from the default volume list is done randomly for every component, the data and index components of a KSDS or AIX could reside on different volumes and even different device types. You can eliminate the possibility of different device types by including devices of only one type when defining the KSDS or AIX model.

When a file is defined implicitly (through managed-SAM) and if you have not provided volume information in an EXTENT statement, VSE/VSAM attempts to construct a volumes list of up to 16 volumes from a managed-SAM ESDS default model (DEFAULT.MODEL.ESDS.SAM). No other information is used (from the SAM ESDS default model) for an implicit define.

DEFAULTVOLUMES forces a default model to override an explicit model for purposes of determining the volumes list. There are three sources of volumes lists:

1. Explicit specification (VOLUMES parameter)
2. Explicit model (MODEL parameter)
3. Default model (DEFAULT.MODEL.xxxx plus VOLUMES parameter)

These sources are listed in order of precedence. 1 overrides 2, and 3 takes effect if 1 and 2 are missing. If only 2 and 3 are present, however, specifying DEFAULTVOLUMES causes the volumes list in 2 to be bypassed in favor of the volumes list in 3. You cannot specify the DEFAULTVOLUMES parameter to bypass 2 if 3 does not exist. (At least one of these options (1, 2, or 3) must be specified or modeled.)

DEFAULTVOLUMES cannot be explicitly modeled because it is not retained as an attribute in the catalog. Do not try to use default volume lists with KEYRANGES, because VSE/VSAM does not order the volumes in any way when allocating space to them.

Chapter 5. Working With Compressed Files

This Chapter...

- Introduces you to data compression.
- Describes how it works internally.
- Explains what you need to do to work with compressed data.
- Differentiates the files for which data compression works and under which circumstances.
- Describes the IKQCPRED tool, which examines VSE/VSAM data for its suitability and calculates how well it would compress.

Introduction to VSE/VSAM Compression

If a cluster is defined with the COMPRESSED attribute, VSE/VSAM attempts to minimize the external storage needs by compressing each record written to the file. The compression algorithm is compatible with the zSeries and ESA/390 hardware compression facility, that is if the processor supports the CMPSC instruction, then this hardware instruction is used to compress or expand data. The ESA/390 compression facility is further described in *Enterprise Systems Architecture/390: Data Compression* SA22-7208. On processors without the ESA/390 compression facility, an equivalent software emulation is performed. See also the *Principles of Operation* publication for your processor.

The compression facility compresses and expands data using a *dictionary*. This dictionary contains the information which substrings of the data are to be encoded and how to expand the encoded strings. When data is loaded into a compressed cluster, VSE/VSAM attempts to build a dictionary that can compress that data. As soon as this dictionary is built, all records written to the file are compressed using this dictionary, and all records read from the file are expanded using this dictionary. The information on what the dictionary looks like is stored in the VSE/VSAM *Compression Control Data Set (CCDS)*, which needs to exist in each catalog that holds compressed data sets.

Advantages

Working with compressed files has several advantages. The reduction in DASD space is the most obvious one, but not the only one:

- Since records in a compressed file are smaller, the resulting relative byte address (RBA) is smaller. While the maximum size of a VSE/VSAM data set (excluding extended-addressed KSDS data sets) is still 4GB (x'FFFFFFFF'), more user data can be stored within a single data set.
- More data can be stored per control interval or buffer. The advantages are:
  - For sequential workloads, a new buffer is required less often. This reduces the number of I/O requests.
  - For random access workloads, the control interval size might be decreased, which in turn might speed up the data transfer time.

Activating VSE/VSAM Data Compression

This involves the following steps:

1. Identify which data sets are eligible for compression and which ones you want to have compressed.
2. Define the Compression Control Data Set (CCDS)

   While the CCDS is *required* for those catalogs that contain compressed clusters, it is recommended to have a CCDS defined for each catalog.

Catalogs that were newly defined using the VSE/VSAM Interactive Interface already have a CCDS defined for them. Otherwise, see "How to Define the Compression Control Data Set" on page 64 on how to define a CCDS or use the skeleton SKVSAMDC in the ICCF library 59.

3. Define the cluster with the COMPRESSED attribute.
4. Load data into the file.

   It is necessary to use *load mode* since VSE/VSAM can determine the dictionary only during the initial load mode. You could use, for example, IDCAMS REPRO to load the data from an existing file to DASD or tape.

How VSE/VSAM Data Compression Works Internally

As mentioned previously, the ESA/390 compression facility, as well as its software emulation, requires a *dictionary* to compress and expand data. The dictionary is the key to an effective compression.

Dictionary Creation

Unfortunately there is no dictionary that is able to compress all kinds of data effectively. The dictionary is data-dependant and needs to be constructed by the actual data, or, to be more precise, by a subset of data that should be representative for the total data. On the other hand, the vast majority of data would actually consists of certain elements that are likely to re-occur. Thinking of an English text, such elements could be English suffices (-ion, -ing) or character sequences such as a comma followed by a space. Of course there are many and not just text-related elements that are likely to re-occur, and hence might be good candidates for a compression. For each of these elements it is known how to compress them, this information is contained in a data structure called *dictionary building block (DBB)*. Each DBB can be viewed as a small, very specialized dictionary. VSE/VSAM has several hundred of them.

VSE/VSAM determines the dictionary for each compressed cluster by examining the first set of data loaded into the cluster. This examination consists of two phases:

1. Interrogation: In this phase VSE/VSAM examines the data written to the file and attempts to find out which elements make up the data, that is it identifies a number of DBBs that might be fit to compress the data.
2. Sampling: Eventually the DBBs selected in the interrogation phase are used to compress the encountered data. Those that perform best are selected and a real dictionary is then assembled from all the selected DBBs.

If the interrogation and sampling phase successfully ends with the creation of a dictionary, then all records written subsequently to the file are compressed with this dictionary. The dictionary remains associated ('mated') with the cluster for the lifetime of the cluster.

The information about which DBBs make up the dictionary is stored in the CCDS. Each record in the compression control data set identifies one compressed cluster and holds information about the compression state of the cluster, and usually which DBBs constitute the dictionary for the cluster.

Compression States

A compressed cluster always assumes one of four possible compression states, as outlined in Figure 10 on page 63. These states are reported in the LISTCAT output.

States
Explanation

CMPPENDING
If a compressed cluster is newly defined by the IDCAMS command DEFINE CLUSTER 1, nothing is known about the data that will be loaded into it. When records are loaded into the file, VSE/VSAM interrogates the data in order to create a dictionary for it.

CMP-ACTIVE
If VSE/VSAM has successfully determined how to compress the data 2, the compression state changes to ACTIVE. From now on all records written to the file are compressed.

CMP-REJECT
If VSE/VSAM cannot compress the data, the compression state is changed to REJECTED 3. You can access a cluster in this state just like any other compressed cluster; the only difference is that the records are not compressed. Possible reasons for rejection are:

- The data is already in some compressed format.
- You closed the file before the interrogation phase completed, that is you did not write enough data during the initial load mode.

CMP-UNDET
If the information how to compress and expand a cluster is lost 4, then the compression state is undeterminable. In this case the compression control data set might be deleted or become inaccessible.

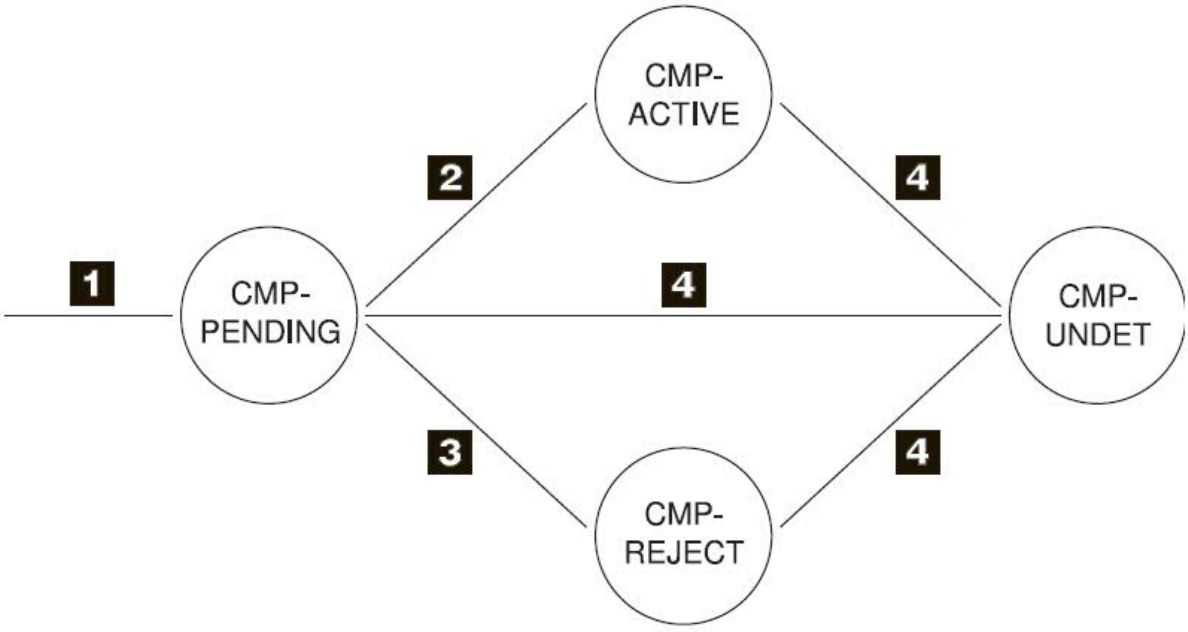


Figure 10. The Four Compression States of a Compressed Cluster

Data Format of Records

In general, the format of data records in compressed and nocompressed format is very similar. The control area and the RDF (record descriptor field) in the control interval is identical. However, the record as stored within the control interval has a different format. Each record can consist of the following parts:

1. The compressed record prefix. This prefix has a length of 3 bytes for nonspanned records, and a length of 5 bytes for spanned records. Its format is:

Offset Dec	Hex	Bytes	Hex Digit	Description
0	0	1		Flags
			X'40'	Record is compressed
1	1	2		Length of expanded record (nonspanned)
1	1	4		Length of expanded record (spanned)

1. The non-compressed part of the record. This applies only to files with a key, it is the first part of the record, up to (and including) the prime key.
2. The compressed part of the record.

How to Define the Compression Control Data Set

The VSE/VSAM Compression Control Data Set (CCDS) is an indexed cluster called `VSAM.COMPRESS.CONTROL`. A cluster with this name is always used as a CCDS, hence no other data set of this name must exist in any catalog. The compression control data set must be defined for each catalog into which compressed clusters are defined. It is recommended, however, to define a compression control data set for every catalog.

The "Define a New User Catalog" dialog of the z/VSE Interactive Interface defines a CCDS for each newly defined catalog.

You can also define a CCDS manually using the IDCAMS `DEFINE CLUSTER` command, as outlined below. Once the compression control data set is defined, compressed clusters can be defined or restored.

```
// JOB DEFINE CLUSTER
// EXEC IDCAMS,SIZE=AUTO
      DEFINE CLUSTER                          -
         (NAME(VSAM.COMPRESS.CONTROL)         - 1
          VOLUME(volser)                      - 2
          RECORDS(200 100)                    - 3
          KEYS(44 0)                          -
          RECSZ(128 500)                      -
          SHR(4 4)                            - 4
          NOREUSE                             -
         )                                    -
         DATA (NAME(VSAM.COMPRESS.CONTROL.@D@)) -
         INDEX(NAME(VSAM.COMPRESS.CONTROL.@I@)) -
         CAT(catalog.id)                        5
/*
/&
```

Explanation:

1
The name identifies this cluster as a compression control data set.

2
The compression control data set should reside on the same volume as the catalog to which it is defined.

3
The compression control data set contains one record per compressed cluster. Specify a number that is sufficiently large to accommodate the number of compressed files you anticipate.

4
The CCDS is always defined with the SHAREOPTIONS(4 4) attribute.

5
Specify the name of the catalog for which you want to define the CCDS. Alternatively, you could identify the catalog using a `DLBL IJSYSUC` statement.

Which Data Set Types Are Eligible

The following types of data sets can be defined with the COMPRESSED attribute:

- KSDS files, i.e. clusters with the INDEXED attribute, under the following condition:
  - The maximum record length must be greater than the following sum: `key_offset + key_length + 40`.
- ESDS files, i.e. clusters with the NONINDEXED attribute, under the following conditions:

  - The maximum record length must be greater than 40.
  - The RECORDFORMAT attribute must not be specified (this implies that SAM files in VSE/VSAM-managed space cannot be compressed).
  - The file is not defined for use as a virtual tape.

- VRDS files, i.e. clusters with the NUMBERED attribute, under the following conditions:
  - The average record size is not equal to the maximum record size.
  - The maximum record length must be greater than 40.

The following types of data sets **cannot** be defined with the COMPRESSED attribute:

- Alternate index files
- Relative Record Data Sets (RRDS)

  If you would like to use VSE/VSAM data compression with your existing relative record data sets, you could attempt the following approach: change the `DEFINE CLUSTER` for the RRDS to specify a maximum record size that is larger than the average record size. This actually defines a VRDS rather than a RRDS, but the VRDS is eligible for data compression and offers a user interface that is almost identical to the user interface of a RRDS.
- SAM ESDS files
- ESDS files defined for use as virtual tapes.

Restrictions

The following restrictions apply to compressed data sets:

1. In a compressed file, you cannot update existing records using addressed access (RPL OPTCD=ADR). This implies that records of an entry-sequenced file cannot be replaced.
2. An application must not compute record positions (RBA) itself. Rather use `SHOWCB RPL=…,FIELDS=(RBA),…` instead.
3. A compressed file cannot be opened in control interval mode (MACRF=CNV in the ACB), except if the ACB also specifies MACRF=CMP. In this case all data passed to the application and expected from the application is in compressed (not expanded) format.
4. The data or index component of a compressed cluster cannot be opened by itself. VSE/VSAM would allow, however, an input open of a compressed data component.

The VSE/VSAM Compression Prediction Tool (IKQCPRED)

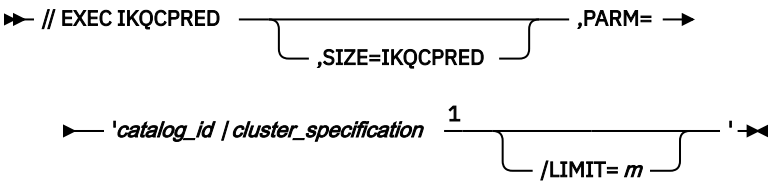
Before you compress data, you may want to know which of your VSE/VSAM data sets are suitable candidates for compression. IKQCPRED is a program that examines VSE/VSAM data and calculates how well it would compress.

A measure for compressibility is the *compression ratio*, which is the ratio of the length of the data in uncompressed format to the length in compressed format.

IKQCPRED can compute the anticipated compression ratio for one or more data sets residing in the same VSE/VSAM catalog on a z/VSE or VSE/ESA Version 2 system.

Using IKQPRED

Invoke IKQCPRED with the following JCL statement:



Notes:

[1] The last or only character of *cluster_specification* can be the wild-card character *, indicating all clusters with a matching name up to the asterisk.

The parameters for IKQCPRED are specified on the PARM parameter of the EXEC IKQCPRED statement, and are separated by slashes(/):

- The first parameter is the target catalog name. This is mandatory, and must be fully qualified.
- The second parameter is the cluster specification. You can specify cluster names generically with an asterisk (*). IKQCPRED can process up to 400 clusters.
- The third, optional parameter LIMIT=*m*, where *m* is an integer greater than 0, specifies an upper limit (in megabytes) to the amount of data to be examined per cluster.

  Where *m* is 0, no upper limit is set, and each cluster is examined completely.

For performance reasons, IKQCPRED should be run in a relatively large partition. **2MB GETVIS(any)** should be sufficient. Specifying SIZE=IKQCPRED on the EXEC statement allows for maximum use of the partition GETVIS.

IKQCPRED Examples

Here are some typical uses for IKQCPRED, with examples of the control statements you could use, and a short description of what these statements would result in:

- Examine all files in a catalog

```
// JOB IKQCPRED PREDICT VSAM DATA COMPRESSION RATIO
// EXEC IKQCPRED,PARM='VSESP.USER.CATALOG/*/LIMIT=2'
/&
```

  IKQCPRED scans *all* the data sets in catalog VSESP.USER.CATALOG. Up to 2 megabytes of data per cluster are scanned.

- Examine a group of files in a catalog

```
// JOB IKQCPRED PREDICT VSAM DATA COMPRESSION RATIO
// EXEC IKQCPRED,SIZE=IKQCPRED,PARM='VSESP.USER.CATALOG/TST*'
/&
```

  IKQCPRED scans all data sets in catalog VSESP.USER.CATALOG whose names begin with 'TST'.

- Examine a single file

```
// JOB IKQCPRED PREDICT VSAM DATA COMPRESSION RATIO
// EXEC IKQCPRED,PARM='VSESP.USER.CATALOG/TST.KSDS3/LIMIT=8'
/&
```

  IKQCPRED scans only the cluster TST.KSDS3 in catalog VSESP.USER.CATALOG. A maximum of 8 megabytes of data is scanned.

Method of Operation

IKQCPRED works internally in three phases:

1. IKQCPRED searches the specified catalog, and selects all cluster entries matching the specification on the PARM statement.

2. Clusters with inappropriate data-set attributes, such as NOCIFORMAT files (VSE libraries), are excluded from examination.
3. Each of the remaining data sets is opened, and each record fed into the VSE/VSAM data compression routines for interrogation and compression. The process ends at the end of a data set, or when the threshold specified in LIMIT=*m* is exceeded.

   The length of time required for this step depends on the amount of data to be scanned.

IKQCPRED prints the results for each examined cluster to SYSLST. The output is described in "Interpreting IKQCPRED Results" on page 67.

Interpreting IKQCPRED Results

This section explains the output of the IKQCPRED program with reference to the sample output in Figure 11 on page 67:

```
// EXEC IKQCPRED,PARM='VSESP.USER.CATALOG/TST.*/LIMIT=5'


                       VSE/VSAM Data Compression Prediction -        (Copyright IBM , 1995, 1996)
IKQ5000I Computing compression ratios for files in catalog VSESP.USER.CATALOG
07/16/96
IKQ5003I This processor supports hardware data compression

Cluster Name                    Type     CmpStatus Ratio AvgLRECL  # Records Open  FDBK   Close (HU-)RBA
TST.KSDS1                       KSDS     CmpActive  1.38      256       3949 00/00 000000 00/00 0024C000
TST.SAM.ESDS1                   SAMESDS  CmpActive  7.88      256      12067 00/00 000000 00/00 0035E000
TST.ESDS1                       ESDS     CmpActive  1.01      256        300 00/00 000000 00/00 00015800
TST.ESDS2                       ESDS     CmpActive  7.42      256      12067 00/00 000000 00/00 0035E000
TST.ESDS3                       ESDS-CMP CmpActive  8.69      256      12107 00/00 000000 00/00 00056000
TST.ESDS4                       ESDS     CmpReject   .92       80        875 00/00 000000 00/00 00011800
TST.KSDS2                       KSDS-CMP CmpActive  1.30      256       1236 00/00 000000 00/00 00150000
TST.SAM.ESDS.IMPLICIT           SAMESDS  CmpActive  2.69      256        120 00/00 000000 00/00 00009000
TST.VRDS                        VRDS     CmpActive 12.36      256          * 00/00 000000 00/00 00E38000

1S55I  LAST RETURN CODE WAS 0000
EOJ CMPRATIO  MAX.RETURN CODE=0000                      DATE 07/16/96,CLOCK 09/56/06,DURATION   00/00/41
```

Figure 11. Sample IKQCPRED Output

Message IKQ5000I tells you which catalog was examined. Message IKQ5003I, as shown in the example, states that the processor supports the CMPSC instruction (**hardware** data compression).

If the processor does not support this instruction, you will see the message:

```
IKQ50004I This processor does not support hardware data compression
```

This indicates that software emulation has been used instead of hardware data compression. Performance is slower than on a processor that supports hardware data compression.

The results of the data compression prediction tool, arranged into several columns, show:

Cluster Name
The names of the clusters that were examined. Only cluster entries can be examined; other objects, such as AIXs, are not eligible for VSE/VSAM data compression.

Type
The type of the data set being examined. The following types may appear:

Type
Remarks

ESDS
Entry sequenced (flat) file. ESDS files are eligible for VSE/VSAM data compression, but with one restriction: Existing records must not be updated. When you have compressed an ESDS, you can only append new records to it.

KSDS
Key sequenced (indexed) file. Only the part of the record following the prime key can be compressed, and only if it has a length of at least 40 bytes. Consequently, placing the key near the beginning of the record allows optimum compression.

RSDS
Relative record (numbered) file. RSDS files are NOT eligible for VSE/VSAM data compression. IKQCPRED examines them because it might be possible to define them as VRDS files, which can be compressed.

SAMESDS
CIFORMAT SAM file in VSE/VSAM managed space. SAMESDS files are NOT eligible for VSE/VSAM data compression. IKQCPRED examines them because it might be possible to define them as native ESDS files, which can be compressed.

VRDS
Variable length relative record file. Only records longer than 40 bytes can be compressed.

-CMP
The suffix -CMP indicates that the examined file was already defined with the COMPRESSED attribute.

CmpStatus
The compression status anticipated for the file:

CmpActive
Actual compression will achieve a significant result.

Pending
There is not enough data in the file to determine whether compression will achieve results. If possible, load more data into the file and rerun IKQCPRED.

CmpReject
The data set is expected to be compression-rejected, because the data is not suited for VSE/VSAM data compression.

Ratio
The **compression ratio**. IKQCPRED computes the approximate compression ratio as:

```
          (sum of lengths of uncompressed data records)
Ratio =  ---------------------------------------------
           (sum of lengths of compressed data records)
```

The larger the value of `Ratio`, the better the file will compress. In other words, the file is expected to shrink to `1/Ratio` of the size of the uncompressed file.

Because of rounding effects and the way the records happen to fit into the control intervals, the computed compression ratio may differ from the compression ratio that could actually be achieved. However, this effect should be significant only for SPANNED data sets with relatively short records. Each record in a spanned data set begins in a new control interval.

AvgLRECL
The average record length of the file. This is the *actual* average record length, *not* the value specified on the DEFINE CLUSTER command.

 # Records
The number of records in the data set. This column shows an asterisk (*) if data interrogation ended at the threshold specified by LIMIT=*m*.

Open
The VSE/VSAM return and reason code, if an OPEN error occurred. It would be normal to see some errors in this column. For example, 08/6E would indicate that this cluster is empty, or 08/A8 would indicate that the cluster cannot be opened because it has been opened from another partition.

FDBK
The VSE/VSAM feedback information, if a record management error occurred while reading the data set. Under certain circumstances, record management errors can be tolerated when processing SAM files in VSE/VSAM managed space. This is the case when, for example, the SAM files have been written using non-VSAM (that is, DTFSD) access.

Close
The VSE/VSAM return and reason codes, if a CLOSE error occurred

(HU-)RBA
This column normally shows the hexadecimal number of bytes in the high-used-RBA of the data set. However, if a record management error occurred, it shows the current RBA for which the error indicated in the FDBK column was posted.

The IKQCPRED return code is the highest return code encountered during processing. If, for example, one or more data sets could not be examined because they were empty, the return code would be 4.

Chapter 6. Device Dependencies

This topic discusses special functionality, restrictions, and exceptions applying to specific types of devices.

IBM System Storage® DS8000® / DS6000™ 64K cylinder support: z/VSE 4.1 is designed to exploit the Large Volume Support (LVS) of IBM System Storage DS8000, DS6000, and TotalStorage™ ESS. z/VSE 4.1 will support disks that are defined as 3390 ECKD with a size of up to 64K cylinders.

VSE/VSAM Support of Large DASD

VSE/VSAM supports DASD with a capacity exceeding 65535 (64K) tracks, referred to in this publication as *Large DASD*. (Accordingly, DASD with a capacity of 64K tracks or less is referred to as *Small DASD*.) This support provides a capacity of up to 10017 cylinders (150255 tracks), which corresponds to the capacity of an IBM 3390 Model 9.

VSAM recognizes two types of ECKD DASD:

- Small DASD have less than 64K tracks per volume and are reported in a LISTCAT as "3390" .
- Large DASD:
  - BIG DASD, have a capacity of more than 64K tracks and are reported in a LISTCAT as "BIG-3390". VSAM supports up to 10017 cylinders on this device.
  - FAT DASD supports a device with more than 64K tracks up to 64K cylinders. LISTCAT reports this device as "FAT-3390".

If you try to define a VSE/VSAM catalog or space on a DASD volume that exceeds the limit of 10017 cylinders without the parameter FATDASD, then you will receive the following message:

```
IDC0055I  VOLUME SPACE EXCEEDS MAXIMUM VSAM CAPABILITY. MAXIMUM WILL BE USED.
```

BIG-DASD implementation does not change the mapping of free and used tracks of the space map in the catalog. However, using BIG-DASD, the number of space map segments and catalog records used will increase. One catalog record can hold one segment of the space map, which describes 3520 tracks. For Small DASD, the maximum number of space map segments is 19 (this means that 19 catalog records are required to map 65535 tracks on one disk). For the IBM 3390 Model 9, which has 10017 cylinders and 150255 tracks, the catalog will map the tracks of this disk device type with 43 catalog records.

FAT-DASD implementation does change the mapping of free and used tracks of the space map in the catalog. One catalog record can hold one segment of the space map, which describes 3520 cylinders instead of tracks.

Making Use of the Support

The following IDCAMS DEFINE commands can be used for defining space allocation:

```
   DEFINE MASTERCATALOG
   DEFINE USERCATALOG
   DEFINE SPACE
   DEFINE CLUSTER UNIQUE
   DEFINE ALTERNATEINDEX UNIQUE
```

The above commands internally check the disk capacity. They use either:

- The "Small DASD" model: using up to 65535 tracks of the disk (the support prior to Large DASD) when:
  - the disk has up to 65535 tracks, or
  - the current catalog owns VSAM space on this disk and it was defined before VSE/ESA 2.6.
- The "Large DASD" model:

  - BIG-DASD uses up to 10017 cylinders of the disk, when the disk has more than 65535 tracks, and the current catalog does *not* own VSAM space on that disk, that was defined before VSE/ESA 2.6.
  - FAT-DASD: uses up to 65520 cylinders of the disk, when the disk has more than 65535 tracks, the parameter FATDASD is explicitly specified and the current catalog does *not* own VSAM space on that disk, that was defined before z/VSE 4.1.

For an IBM 3390-9 or other Large DASD, this means that either:

- VSAM space was already allocated on this disk for the current catalog from a previous VSE/ESA release. The disk will therefore not have Large DASD support, and will only be supported as a "64K track disk".
- Space was not used by VSE/VSAM before VSE/ESA 2.6. The disk will therefore have Large DASD support, and in addition to the "Large DASD" in the Catalog Volume Record, a new flag bit will indicate a "FAT DASD" and the volume (up to 64K cylinders) could be used by VSAM.

In addition, for an IBM 3390-9 or other Large DASD:

- Where possible, allocations other than CYLINDERS (for example, TRACKS or RECORDS) will be translated internally to multiples of CYLINDERS. Or, if track allocation is required by VSE/VSAM for Large DASD, allocations of tracks or records (for example) will be translated internally to multiples of tracks-per-cylinder. For example, a VSE/VSAM cluster with a primary (and secondary) allocation of one track will have a primary (and secondary) allocation of one cylinder. Direct allocation in CYLINDERS is recommended.
- Track boundaries of extents will be rounded to cylinder boundaries.
- If a catalog resides on a Large DASD, the minimum allocation for the catalog is 5 cylinders (4 cylinders for the data component plus 1 cylinder for the index component).

Migrating to Large DASD Using IDCAMS Backup/ Restore

Most files that have been defined using a CI size of 512 *cannot* be migrated using IDCAMS Backup / Restore to a Large DASD device (this is due to internal restrictions). Backup/Restore is intended to transfer files with high performance, and is based on the CI Size.

Any file defined with IMBED option cannot be restored to or defined on a Large DASD.

If you want to use files that have been defined with a CI size of 512 on a Large DASD, you must follow these general steps:

1. Restore the files that have a CI size of 512, to a previously supported Small DASD type. You use the IDCAMS RESTORE command to do this.
2. Export the files from the previously supported Small DASD type using the IDCAMS EXPORT command.
3. Import the files to a Large DASD using the IDCAMS IMPORT command.

For further details about using the above IDCAMS commands, refer to VSE/VSAM CommandsSC34-2707.

Performance Considerations (KSDS Only)

The performance of KSDS access may change if the data control area size (data CA) changes. One index control interval (index CI) controls one data control area. The larger the data control area together with a large index control interval, the better the keyed access performance. This is because less index I/O is required for keyed-direct and keyed-sequential access. VSE/VSAM calculates the control area size from the smaller of the primary or secondary allocation. The minimum is one track, and the maximum is one cylinder (15 tracks).

Note: A control area size of one cylinder is recommended.

Where possible, a VSE/VSAM KSDS on a Large DASD will have a control area size of one cylinder. Primary and secondary allocations are rounded up to cylinder multiples and cylinder boundaries, even if they have been defined as TRACKS or RECORDS. To also get a control area size of one cylinder for long keys (up to 255 bytes), VSE/VSAM calculates the minimum data control interval size (CI size) of a KSDS and increases it where required. The following key lengths require the following minimum control interval sizes:

Table 16. Minimum CI Sizes Depending on Key Length	
Key Length in Bytes	**Minimum CI Size**
7 - 35	1024
36 - 55	2048
> 55	4096

BUFFERSPACE Parameter

The BUFFERSPACE parameter could force a smaller data control area size, and must have a size that is at least two data control intervals plus one index control interval. It is recommended not to use this parameter with DEFINE CLUSTER. Large DASD support ensures that the BUFFERSPACE parameter will not reduce the CA size.

Increased Size of the Catalog Index

As a result of Large DASD support, the index primary allocation of a catalog on *all* DASD (large or small) will be at least 4% of the primary catalog data allocation. The catalog index secondary allocation will have the same size as the index primary allocation.

Restrictions for VSE/VSAM Support of Large DASD

The following restrictions apply when using Large DASD with VSE/VSAM:

- No support for imbedded indices:
  - The definition of imbedded indices for catalogs, alternate indices, and clusters is not supported. If the keyword IMBED is used in existing IDCAMS DEFINE jobs, it will be ignored or rejected with an error message.
- Per default VSAM handles a DASD with more than 64K tracks as a BIG-DASD, if no FATDASD parameter is specified.
- The catalog default is NOIMBED:
  - For Large DASD support, the default value for DEFINE MASTERCATALOG and DEFINE USERCATALOG is NOIMBED.
  - Newly defined catalogs (MASTERCATALOG and USERCATALOG) will never have an imbedded index.

New or Changed Fields in LISTCAT Output

The LISTCAT output reflects Large DASD support in the field DEVTYPE. Either the Volume Group (DATA, INDEX) or the Volume Entry has a prefix:

- "BIG-" in case of a Large DASD with space bitmap in tracks (Example: `DEVTYPE-----BIG-3390`)
- "FAT-" in case of a Large DASD with space bitmap in cylinders (Example: `DEVTYPE-----FAT-3390`)
- The field TRACKS in the Volume Group (DATA, INDEX) is replaced by CYLINDERS for a Large DASD.
- The field SPACE-MAP in the Volume Entry is replaced by CYL-SPC-MAP, which indicates cylinder mapping instead of track mapping for a Large DASD.

Support for FBA Disk Devices (FBA and SCSI)

z/VSE 3.1 is designed to allow IBM eServer™ zSeries servers to attach industry-standard Small Computer System Interface (SCSI) disk devices via zSeries Fibre Channel Protocol (FCP) channels.

User-written programs use VSE's existing Fixed Block Architecture (FBA) support (512 byte blocks) to access SCSI disks. User programs cannot use SCSI commands directly. z/VSE 3.1 is designed to support SCSI disk volume sizes from 8 MB to 24 GB. Because z/VSE itself uses the first 4 MB for internal

purposes, the available user space is equal to the defined size of the disk minus 4 MB. z/VSE 3.1 limits VSE/VSAM to the first 16 GB of any SCSI volume.

Special migration considerations apply:

- It is not possible to use the Fast Service Upgrade (FSU) process to move from a VSE/ESA 2.6 or 2.7 system to a z/VSE 3.1 system with SCSI system residence disks.
- Not every cluster can be migrated using Backup/Restore. In some cases, Export/Import must be used.

Similar restrictions apply to FBA to SCSI migration.

z/VSE SCSI-FCP disk support complements SCSI support in z/VM® Version 5 and Linux® for zSeries. The individual z/VSE maximum SCSI volume size limits do not apply to z/VM minidisks backed by SCSI disks. When operating as a guest under z/VM (using SCSI disks not directly attached to z/VSE), z/VM presents SCSI disks as 9336-20 FBA disks. In this case, z/VSE sees them as FBA, not SCSI disks.

The maximum size of a z/VSE 3.1 FBA volume is 2 GB. Of course, multiple 2 GB minidisks can be assigned within the limits of a single physical SCSI disk volume controlled by z/VM. For SCSI disks directly attached to z/VSE under z/VM, the normal z/VSE limits described above apply.

Technical Considerations

VSE/VSAM extends the existing FBA logic to support SCSI disks. VSAM implements a SCSI disk as a generic FBA device and uses its own "virtual characteristics" for mapping and building channel programs for optimized VSAM performance and space utilization.

Except as noted, all commands, parameters, and requirements for FBA devices are valid for SCSI as well.

Several FBA configurations are supported. The generic FBA model is used to:

- simulate an FBA device in virtual storage; for example, the user can defined in CP:

  ```
  CP DEF VFB-512 AS 152 BLK 100000
  ```

  This virtual disk will be presented to the user under VSE as an FBA disk after the initialization with ICKDSF:

  ```
  volume 152
  AR 0015 CUU  CODE DEV.-TYP   VOLID  USAGE   SHARED    STATUS    CAPACITY
  AR 0015 152  90   9336-10   FBA001  UNUSED                        99960 BLK
  AR 0015 1I40I
  READY
  ```

- access a VM minidisk (as part of a real SCSI device). VSAM can address only 2 GB. (z/VM 5.1 and later releases allows defining VM FBA minidisks with a larger size, but VSE/VSAM can only handle a 2 GB FBA disk in this case.)

  The nature of this 2 GB limit can be explained as follows: VSE/VSAM supports so-called Generic FBA Devices with a virtual FBA disk device characteristic of 64 FBA blocks per track and 15 tracks per cylinder, that is: 960 FBA blocks per cylinder = 4,194,240 bytes per cylinder.

  A space map in the catalog maps each track of a particular disk device with 1 bit (0 = track used, 1 = track free). Additional catalog fields and control blocks map the number of tracks and the start/end track of data spaces and data set extents in 2-byte-fields, which limits the maximum capacity of one DASD device to X'FFFF' = 65,535 tracks (64K - 1).

  Therefore, the current maximum FBA disk capacity is 65,535 tracks * 64 FBA blocks = 4,194,240 FBA blocks = 2,147,450,880 bytes = 2 gigabytes.
- directly access the SCSI device as an FBA-SCSI device (via FCP). The limit for an FBA-SCSI device is 24 GB, and VSAM can use up to 16 GB on this device by using a different device model (different min-CA and max-CA) as shown in the following table:

Table 17. Minimum and Maximum CA for Generic FBA Devices

FBA Device	Blocks per Minimum CA	Minimum CA per Maximum CA	Blocks per Maximum CA
Generic Virtual FBA	64	15	960
Generic FBA as VM Minidisk	64	15	960
FBA-SCSI	512	60	30720

The new device model for SCSI significantly improves the performance (due to fewer CI/CA splits, for example) but requires the system programmers to review, re-calculate, and possibly adapt the space definitions of the JCLs (for example, the minimum size for a catalog (6 min-CAs) and the size for space sub-allocation are different).

Restrictions

The following notes and restrictions apply to VSAM structures on SCSI disks:

- The minimum CA (min CA) is 512 blocks, which implies that the minimum file size for VSAM on such a device is 512 blocks. Space specifications will be rounded up to a multiple of 512 blocks (for example, 10000000 blocks will effectively become 10000384).

  Note: Due to different rounding values (different min CA values on FBA and SCSI), it is not guaranteed that the same JCLs will run on generic FBA and SCSI devices.
- The absolute minimum space specified for primary allocation is 2561 blocks, which is rounded to 3072.
- If the ORIGIN option is used during cluster definition, the minimum specified must be 3072, because rounding will not be performed in this case.
- The maximum CA (max CA) on a SCSI disk is 30720 (60*512) blocks, i.e., the min CA per max CA is 60.
- Any cluster defined in blocks with a key length >38 requires a minimum CISIZE of 1024.
- If no key length is specified, the default will be used, which in most cases is 64. In this case, any cluster definition with a CISIZE of 512 (smallest possible value under VSAM) will be rejected by VSAM with a corresponding error code
- Migration to any cluster defined on a SCSI device must be done using REPRO or EXPORT/IMPORT. The use of IDCAMS BACKUP/RESTORE is not recommended for long-term recovery or data migration and is not supported.
- VSAM data can be transferred to SCSI using IDCAMS BACKUP/RESTORE. For certain files that cannot be restored with IDCAMS RESTORE because of file definition restrictions for SCSI, IDCAMS REPRO should be used. This includes, but is not limited to, all files defined with the SPANNED option and some files defined with very small allocations or CI sizes.
- The parameters IMBED, REPLICATE, and RECOVERABLE are no longer supported and are either ignored or rejected with an error message.

  Migration of older clusters defined with any of these options should be performed using IDCAMS REPRO.
- The entire SCSI device can be made available to VSAM if SPACE is defined with option DEDICATE. Otherwise, up to X'FFFFFF' (16,777,215) blocks can be specifed (this is the same restriction as for the current RECORDS parameter).
- The hardware architecture of Large DASD and SCSI devices imposes minimum allocation requirements in VSAM device support (1 cylinder, 512 block minimum CA size).

VSAM detects and reports the SCSI disk as device type 'FBA' on LISTCAT output:

```
     CHARACTERISTICS
       BLKS/MIN-CA----------512      DEVTYPE---------FBA
       BLKS/MAX-CA--------30720      VOLUME-TIMESTAMP:
```

IUI dialogs for FILE AND CATALOG MANAGEMENT under RESOURCE DEFINITION assist the user in generating the JCLs for IDCAMS jobs to support SCSI devices.

Virtual Tapes

Local virtual tapes are implemented as standard VSAM ESDS files. One restriction, however, is that they must not be compressed. Information on using virtual tapes is provided in z/VSE Planning, SC34-2681.

Chapter 7. Optimizing the Performance of VSE/VSAM

This Chapter...

Explains the following VSE/VSAM **options** that affect **performance**:

For an outline on **file statistics** that are available to you for evaluating possible performance improvements, refer to "Performance Measurement" on page 108.

Most of the options are specified in the IDCAMS command DEFINE when creating a file, and in the VSE/VSAM macros ACB and GENCB when a processing program prepares to open a file.

Because of the great number of variables, not everything presented in this chapter is true for all installations and under all conditions.

Number of Files Defined in a Catalog

The number of files defined in a catalog can have a direct impact on the performance of most VSE/VSAM activities. Generally, it is recommended that files on a single volume be defined in a unique user catalog.

A large number of files in a single catalog (for example, a thousand files) can significantly increase the run time for most IDCAMS functions. This includes DEFINE, DELETE, and LISTCAT functions. It also impacts open and close performance.

The exact number of files at which the impact on performance becomes noticeable depends on several factors (for example, DASD access speed and file name pattern). As the number of files in a single catalog increases, you should carefully monitor the performance of the indicated IDCAMS functions.

Data Space Classification

To direct the suballocation of data space to VSE/VSAM objects, you can assign a *class value* to VSE/VSAM data space; it allows you to optimize performance. Specify the value in the CLASS(value) parameter of the command DEFINE SPACE, DEFINE MASTERCATALOG, or DEFINE USERCATALOG. You can specify a value from 0 to 7.

After you have assigned a value to a data space, you can request that it will be available for suballocation to an alternate index or cluster (or their components). Make the request in the USECLASS parameter of the command DEFINE CLUSTER, DEFINE ALTERNATEINDEX, or IMPORT.

The class values and their meaning are:

0
: General use and default. (Data spaces defined under MVS/VSAM are treated as class-0.)

1
High performance (specifically suggested for fixed-head areas).

2-7
User-defined classes (for example, data space in the middle of a volume).

Figure 12 on page 78 illustrates the classification of data space and the use of classified data space.

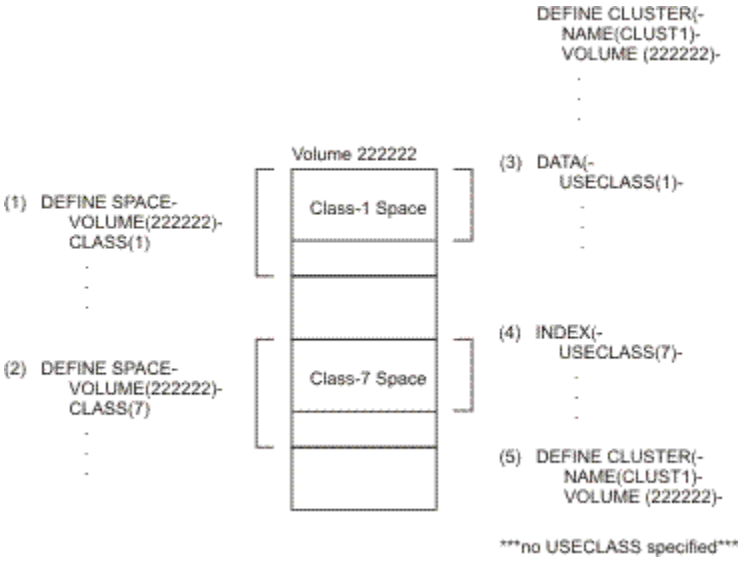


Figure 12. Classification of Data Space

Explanation:

1. Class–1 data space defined
2. Class–7 data space defined
3. Class–1 data space suballocated to the data component of CLUST1
4. Class–7 data space suballocated to the index component of CLUST1
5. This DEFINE command fails, because the default class (0) is not available on volume 222222

The definition of VSE/VSAM catalogs involves the implicit allocation of data space and the suballocation of some (or all) of that data space to the catalog itself. Because of this, you need only specify the CLASS parameter if you want to assign a catalog's data space to a certain performance class. You do not have the option of specifying the USECLASS parameter. The catalog is automatically suballocated from the same data space and the same performance class.

You can request a new class through the USECLASS parameter in the IMPORT command when an object is implicitly defined through this command.

The following restriction applies:

- Classes other than 0 are not permitted for unique objects.

For the DEFINE command, you must specify USECLASS concurrently (at the same level) with the space parameters (TRACKS, BLOCKS, and so on). For example, if you specify USECLASS in DEFINE CLUSTER at the data level, you must also specify CYLINDERS, TRACKS, BLOCKS, or RECORDS at the data level. If you do not do so, the USECLASS specification will be ineffective. The following are the three possible combinations of levels at which space may be specified for DEFINE CLUSTER or DEFINE ALTERNATEINDEX:

(a) Cluster level only or alternate index level only
(b) Data component level only
(c) Data component and index component levels

Therefore, these are also the levels that are effective for USECLASS.

In case **(a)**, the USECLASS specified (or defaulted to) is also applied to the data and index components.

In case **(b)**, the USECLASS specified, defaulted to, or modeled for the data component level is also applied to the index component level. This permits you to apply the same class of data space to both components while leaving the calculation of the index allocation to VSE/VSAM.

In case **(c)**, the data and index components may be assigned (or modeled or defaulted) to a separate or to the same class of data space, depending on the values chosen.

For information on *assigning* classes of data space, refer to the USECLASS parameter in the index of the VSE/VSAM Commands, SC34-2707, for example, for a description of the DEFINE ALTERNATEINDEX command.

Control Area (CA) Size

Minimum and Maximum CA Sizes

The terms *minimum control area size (min CA)* and *maximum control area size (max CA)* are device independent terms. For CKD devices, the term:

- *minimum CA* relates to *track size*
- *maximum CA* relates to *cylinder size*

For FBA devices, however, the terms *tracks* and *cylinders* (as used for CKD) are not meaningful, because FBA devices store data on *fixed-size blocks* (where the blocks are not associated with tracks or cylinders).

The terms of minimum CA and maximum CA, however, are common to both CKD and FBA devices.

For applicable values for the various IBM CKD and FBA devices, refer to Table 18 on page 80 and Table 19 on page 81.

For CKD devices, the CA allocation limits depend on the:

- Index CI size you indicate, if the BUFFERSPACE parameter prevents an increase of the index CI size.
- Primary or secondary allocation.

Note: If VSE/VSAM runs in an environment where simulated devices are used, VSE/VSAM depends on the characteristics provided by the simulating system. These device characteristics may be different from those of the simulated device type. Therefore, VSE/VSAM may use unexpected device characteristics.

Performance Implications

In the case of a key-sequenced file, the size of a CA can affect the size of the CI of the index component. If there is not enough room for index entries in the sequence set record, VSE/VSAM increases the CI size to accommodate more entries.

CA size has significant performance implications. When a whole number of CAs occupies a maximum CA (cylinder), performance is better than when CAs cross maximum CA (cylinder) boundaries. If you allocate space in a DEFINE command using the CYLINDERS parameter, or if a CKD file is defined as *unique* (that is, the file is the only one in its data space), IDCAMS sets the CA size to one maximum CA (cylinder). If a CA is smaller than a maximum CA (cylinder), its size will be an integral multiple of minimum CAs (tracks), and it can cross maximum CA (cylinder) boundaries. However, a CA can never cross the extent boundaries of a file; that is, an extent of a file is made up of a whole number of CAs.

Aside from specifying space in terms of maximum CAs (cylinders) or defining a CKD file as unique, you do not have a direct way of specifying that a whole number of CAs will occupy a maximum CA (cylinder). But, you can provide values in the DEFINE command that will influence the CA size as computed by IDCAMS.

IDCAMS checks the smaller of the primary and secondary space values against the maximum CA (cylinder) size of the specified device. If the smaller space quantity is less than or equal to the device's maximum CA (cylinder) size, the size of the CA is set equal to the smaller space quantity. If the smaller

space quantity is greater than the device's maximum CA (cylinder) size, the CA size is set equal to the maximum CA (cylinder) size.

You specify space in number of tracks, cylinders, blocks, or records; the system then preformats space in CAs (except for DEFINE CLUSTER/AIX SPEED). By calculating the size of a CA as it does, IDCAMS is able to meet your primary and secondary space requirements without over committing space for this file.

An index record must be large enough to address all of the CIs in a CA. The more CIs an index record addresses, the fewer reads for index records are required for sequential access. Generally, the greater the size of the CA, the better the performance and space utilization.

Disk Storage Sizes

Table 18 on page 80 lists values for cylinders, tracks, and other capacities for IBM CKD devices.

Table 18. Disk Storage Sizes for IBM CKD Devices

IBM CKD Device	Cylinders (Max CA) per Volume	Tracks (Min CA) per Cylinder	Bytes per Track (1)	Maximum Total Capacity (Bytes)
3375	959	12	19,456 -33,280	382,986,240
3380 ADJ	885	15	23,552 - 45,056	570,931,200
3380 E	1770	15	23,552 - 45,056	1,141,862,400
3380 K	2655	15	23,552 - 45,056	1,712,793,600
3390-1	1113	15	25,088 - 55,296	846,236,160
3390-2	2226	15	25,088 - 55,296	1,692,472,320
3390-3	3339	15	25,088 - 55,296	2,538,708,480
3390-1 (2)	1113	15	23,552 - 45,056	718,018,560
3390-2 (2)	2226	15	23,552 - 45,056	1,436,037,120
3390-3 (2)	3339	15	23,552 - 45,056	2,154,055,680
3390-9 (3)	10017	15	56,664	8,514,049,320
3390-9 (4)	65520	15	56,664	55,689,379,200

Note:

1. Depending on the physical block size (see Table 20 on page 83)
2. When in 3380 track compatibility mode.
3. Large DASD (BIG-DASD)
4. Large DASD (FAT-DASD)

VSE/VSAM treats the IBM 3995 Model 151 Optical Library Dataserver as an IBM 3390 Model 2 direct access storage device.

An Enterprise Storage Server (ESS) is reflected as a 3390-3 or 3390-9 depending on the number of cylinders available.

Table 19 on page 81 lists values for minimum and maximum CA, and 512-byte blocks for IBM FBA devices.

Table 19. Disk Storage Sizes for IBM FBA (and SCSI) Devices

IBM FBA Device	Max CA per Volume	Min CA per Max CA	Blocks* per Min CA	Blocks* per Max CA	Total Blocks
0671	See (1)	8	63	504	See (1)
3370-1	750	12	62	744	558,000
3370-1	958				712,752
9332-1 (2)	1,233	4	73	292	360,036
9332-2 (3)	1,900	4	73		554,817
9335	1,890	6	71	426	805,140
Other FBA (4)	See (1)	15	64	960	See (1)
SCSI (5)	See (1)	60	512	30720	See (1)

Note:

1. Configuration or device dependent.
2. Models 200, 400, 402.
3. Models 300, 600, 602.
4. For example, IBM 9336 and virtual disk.
5. Appears as device type FBA.

(*) 1 block = 512 bytes.

Control Interval (CI) Size

How to Specify

You can let IDCAMS select the size of a CI for a data or index component, or you can specify CI size in the DEFINE command. CI size should be specified at both DATA and INDEX levels. If the CI size is specified at the CLUSTER or ALTERNATEINDEX level, this size applies to the data component and also to the index component.

The CI size you specify is checked for being within *acceptable limits*. IDCAMS tries to modify an unacceptable value. If it cannot, the DEFINE fails. If you specify a CI size that is not a proper multiple, IDCAMS increases it to the next multiple. For example, 2050 is increased to 2560.

Data CI and Block Sizes

The limits (mentioned above) depend on the maximum (nonspanned) or average (spanned) *record size* that you specify in the RECORDSIZE parameter of the DEFINE command.

Note that a CI is always a multiple of the physical block size.

Physical Block Size for Data Component

A physical block (or physical record) is any multiple of:

- 512 bytes up to 8,192 bytes
- 2048 bytes from 8,193 bytes to 30,720 bytes

Figure 13 on page 82 shows how VSE/VSAM computes physical block size, using DEFINE attributes and device type. The following explains the numbers shown in the figure:

1. Maximum record size can be specified as 1 through 32761; the default is 4089 bytes.
2. The CONTROLINTERVAL size of the data component can be specified as 512 through 32768; the default is:
   - 2048 bytes if RECORDSIZE is specified
   - 4096 bytes if RECORDSIZE is not specified
3. The control area size chosen by VSE/VSAM is never larger than one max CA (cylinder).
4. BUFFERSPACE(size) must provide enough space to accommodate:
   - two control intervals, and
   - one index control interval if the file is key-sequenced.

   This is also the default. If you specify less than the default, the command is terminated.
5. The physical block size chosen by VSE/VSAM depends on the device type that is being used, and on the size of the control interval. The physical block size chosen by VSE/VSAM is:
   - For CKD devices:
     - 512 bytes up to 8,192 bytes
     - 2048 bytes from 8,193 bytes to 30,720 bytes
   - For FBA devices: always 512 bytes.

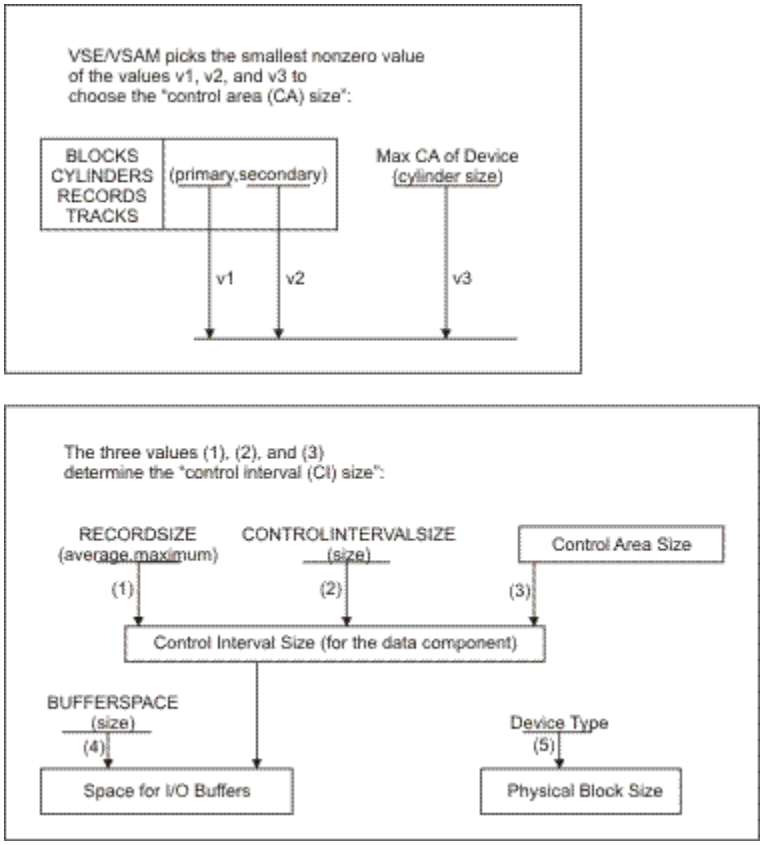


Figure 13. How VSE/VSAM Computes Physical Block Size

CI Size in a Data Component

The size of a CI in the data component can be any multiple of 512, up to 32,768. If it is over 8,192 bytes, it must be a multiple of 2048.

For nonspanned records, the CI must be at least seven bytes larger than the largest record in the data component.

For spanned records, the CI must be at least ten bytes larger than the average record in the data component.

Average and largest record are specified in the RECORDSIZE parameter.

CI size affects space utilization because of the way VSE/VSAM chooses physical block sizes on CKD devices. (There are no similar considerations for FBA devices.) For a given CI size, VSE/VSAM chooses the physical block size that results in the most efficient use of track capacity.

Note: A file with a data physical block size or index CI size other than .5, 1, 2, or 4KB cannot be directly processed by MVS. (File portability between VSE/VSAM and MVS via EXPORT/IMPORT is not impacted by data physical block size, but it does require an MVS-compatible CI size.)

Table 20 on page 83 shows the physical block size that VSE/VSAM uses for a data CI, and the number of KB (kilobyte) of user data that can be accommodated on the track (the values depend on the specified CI size and the device that is used). For example, given a CI size of 6KB on a 3380, VSE/VSAM chooses a physical block size of 6KB that results in 42KB (plus overhead) of data on a 43008-byte track.

VSE/VSAM treats the IBM 3995 Model 151 Optical Library Dataserver as an IBM 3390 Model 2 direct access storage device.

Table 20. Relationship of CI Size to Physical Block Size for Data Component

CI Size	Physical Block Size (in KB)				Track Space Used (in KB)			
	3375	3380	3390	9345	3375	3380	3390	9345
0.5	0.5	0.5	0.5	0.5	20	23	24.5	20.5
1	1	1	1	1	25	31	33	28
1.5	1.5	1.5	1.5	1.5	27	34.5	39	31.5
2	2	2	2	2	28	36	42	34
2.5	2.5	2.5	2.5	2.5	30	37.5	42.5	35
3	3	3	3	3	30	39	45	36
3.5	3.5	3.5	3.5	3.5	31.5	38.5	45.5	38.5
4	4	4	4	4	32	40	48	40
4.5	4.5	4.5	4.5	4.5	31.5	40.5	45	36
5	5	5	5	5	30	40	45	40
5.5	5.5	5.5	5.5	5.5	27.5	38.5	49.5	38.5
6	6	6	6	6	30	42	48	36
6.5	6.5	6.5	6.5	6.5	32.5	39	45.5	39
7	3.5	7	7	7	31.5	42	49	42
7.5	7.5	7.5	7.5	7.5	30	37.5	45	37.5
8	8	8	8	8	32	40	48	40
10	5	10	10	10	30	40	50	40
12	4	6	12	4	32	42	48	40
14	3.5	14	7	14	31.5	42	49	42
16	16	8	16	8	32	40	48	40
18	4.5	6	18	18	31.5	42	54	36
20	4	20	10	20	32	40	50	40

Table 20. Relationship of CI Size to Physical Block Size for Data Component (continued)

CI Size	Physical Block Size (in KB)				Track Space Used (in KB)			
	3375	3380	3390	9345	3375	3380	3390	9345
22	2	22	5.5	22	28	44	49.5	44
24	8	6	24	8	32	42	48	40
26	6.5	6.5	26	6.5	32.5	39	52	39
28	4	14	7	14	32	42	49	42
30	7.5	6	10	10	30	42	50	40
32	16	8	16	8	32	40	48	40

Performance Considerations

For performance improvement, consider the following rules.

- The larger the data CI, the better the *sequential* performance. EXPORT and IMPORT are sequential applications.
- As the size of your *nonspanned data records* increases, you may need larger data CIs.
- As data and index CI size increases and record size remains unchanged, more buffer space is required in storage for every CI.
- Free space will probably be used more efficiently as data CI size increases relative to data record size, especially with variable-length records.

  Free space in a *nonspanned data CI* is not used if there is not enough free space for a complete data record. In any event, free space in the last CI of a spanned record is never used for any other record, even if there is room enough to hold a complete data record.
- Direct processing is less sensitive to data CI size. But smaller data CIs generally improve performance.
- When you process input that already has been sorted, on the other hand, large data CIs may be better.
- If you have a choice between a large index CI or a large data CI for direct processing, choose the combination that yields the smallest buffer space value. This combination needs the least active storage and the least data transfer time.

CI Size in an Index Component

The CI size in the index component can be any multiple of 512, up to 8,192 bytes. Generally a 512-byte index CI is adequate if:

- The number of data CIs per CA is small,
- The full key size is not too large, and
- The key compresses well (usually when the data CI is 4KB or greater).

IDCAMS might adjust your specifications. To find the values actually set in a defined file, you can issue the IDCAMS LISTCAT command or, while your program is executed, the SHOWCB macro.

Considerations

Generally, you should specify the smallest index CI size that still is adequate.

You may want to specify the smallest value, that is 512. To find out if a 512-byte index CI size is adequate, do the following experiment:

- Use your chosen data CI size and a 512-byte index CI.

- Do not allow free space.
- Load enough records to equal one CA.
- At the end of the run, perform a LISTCAT.

  If there is only one level of index, a 512-byte index CI is large enough. For n CAs, there should be two levels of index with the number of index CIs equal to n + 1.

A smaller data CI may require a large index CI. The sequence set index CI contains pointers to the data CIs in a CA. If the data CI is made smaller (when the CA stays the same size), there will be more data CIs per CA, and therefore more entries in the sequence set. As an example, assume a one cylinder CA size on an IBM 3380. Using 4096-byte data CIs, one CA can contain 150 data CIs. If the data CI size were changed to 1024 bytes, the CA could contain 465 data CIs. The sequence set would now require 465 pointers instead of 150.

What IDCAMS Calculates and Adjusts

For a key-sequenced file, after CI size has been set, IDCAMS determines the number of bytes to be reserved for free space, if any. For example, if the CI size is 4096, and the percentage of free space in a CI is twenty, 820 bytes are reserved (4096 x 20% = 820.)

If you do not specify a size for:

- Data CIs, IDCAMS uses 2048, if possible.
- Index CIs, IDCAMS uses 512, if possible.

To determine a suitable index CI size, IDCAMS uses the following formula:

```
(DCI x AES) + (2 x 'DCI) + 31
```

where:

- DCI = number of data CIs per CA
- AES = average entry size:

If Key Length is	Then AES is
>64	28
30-64	3 + (key length/3)
10-29	13
0-9	3 + key length

If the result of the calculation is an odd value, VSE/VSAM rounds it to the next higher even value.

After IDCAMS determines the number of CIs in a CA (see “Control Area (CA) Size” on page 79), it estimates whether one index CI is large enough to handle all of the data CIs in a CA. If the index CI is not large enough, its size is increased, if possible. If not possible, the number of CIs in a CA is decreased. This calculation may result in IDCAMS overriding the specified index CI size. For example, for a file without an index, if CI size space is not specified and the maximum record size is specified to be 200 bytes, IDCAMS sets the data CI size to 2048 bytes. For a key-sequenced file, IDCAMS additionally sets the index CI size to 512 bytes.

If spanning is not specified and the maximum data record size specified in RECORDSIZE is 2500 bytes, and 2500 is also specified for the data CI size, the system adjusts the 2500-byte CI size to the next higher multiple of 512: 2560.

Key Compression

The following information relates to the KEYRANGES parameter/subparameter of the IDCAMS commands DEFINE and IMPORT.

VSE/VSAM increases the number of entries that an index record can hold by key compression. Compression makes an index smaller by reducing the size of the keys in the index entries. VSE/VSAM eliminates from the front and back of a key those characters that are not needed to distinguish it from the adjacent keys. For example, the keys in the sequence 1110, 1230, 1450 would compress to 11, 23, 45 respectively.

Front compression works best when the keys of the last records of every CI run in a series (for example, 100, 101, 102, 106). When several high keys have the same leading characters, those characters can be compressed.

Rear compression works best when adjacent keys have large differences at the back of the key.

If keys compress poorly, more room is required in the index CI to store the compressed key. The index CI may be too small for the data. If it is too small, more CAs are needed. When VSE/VSAM has no more room to insert compressed keys from the data CIs into the index CI, it continues to load data into the next CA, using its associated sequence set CI. The previous CA contain fewer "filled" data CIs than if the index CI had been adequate.

Poor key compression can occur under the following conditions:

- The key is comprised of multiple fields.
- Changes occur in the front of the key and the back of the key, but not in the middle.
- If the number of keys in a group is less than the number of keys in a data CI, the high key in every data CI does not repeat the high-order characters. Therefore, front compression is almost non-existent.
- If the last field of the key is long and very dense, poor rear compression results.

Single field keys *do* compress well. Larger keys (20 - 30 bytes) can compress to 8 or 9 bytes (including control information). Smaller keys (5 - 15 bytes) can compress to 3 - 5 bytes (including control information).

Example of a Key that Compresses Poorly

```
NNN0000000000SS

where: NNN -- changes every 4 or 5 records; there are more
              than 4 or 5 records per data CI.
       0000000000 -- changes rarely.
       SS -- changes in every record.
```

The key would compress well if:

- NNN changed every 20 - 25 records;
- SS is seldom changed;
- SS were located next to NNN (NNNSS0000000000) and changed frequently; or
- The entire key were one field and the bytes changed randomly.

I/O Buffer Space (Using Non-Shared Resources)

VSE/VSAM transmits the contents of a CI to a buffer in main or virtual storage. Therefore, the CI size affects the use and size of I/O buffers, and the amount of storage space for I/O buffers.

If you do not specify buffer space, VSE/VSAM allocates buffer space for two data CIs and (if the file is indexed) one index CI. You may not specify less space, but to optimize performance, you may want to provide additional buffer space.

If you specify a buffer space that is *not* large enough to contain:

Two data CIs, and
One index CI for KSDS and for VRDS,

the DEFINE command terminates.

Considerations

Sequential Processing

Increasing the space to hold three or more data CIs generally improves performance due to I/O command chaining. More than four or five data buffers may cause excessive paging.

If there is an index component, the buffer space must be large enough to hold an index CI also.

Direct Processing

Any remaining buffer space beyond that required for two data CIs is used for index CIs. To optimize performance, specify enough buffer space to accommodate one index CI for every level of index. If the index CI size or the number of index levels is not known, specify 2KB of buffer space for the index (default BUFFERSPACE, which rounds to a 2KB boundary, may in some cases accomplish this for you), and check the result with LISTCAT output. Make adjustments with ALTER, if necessary.

Buffer Specification

You can specify buffer space through the:

- IDCAMS command DEFINE,
- ACB macro, or
- // DLBL statement.

The buffer space entry in the catalog was either specified or defaulted to when the cluster was defined or modified with the ALTER command.

Specifying through DEFINE Command

Using DEFINE, you can specify the BUFFERSPACE parameter at the cluster or data level, but not both. The default buffer space allocation is two data buffers and one index buffer (key-sequenced data sets only). For ESDS and RRDS, the default is two data buffers.

Specifying through ACB Macro

You can specify buffer space values or cause a default buffer space through the ACB macro:

```
ACB   .
      .
      .
      BUFSP=n
      BUFNI=n
      BUFND=n
```

To use the ACB buffer space, the value selected must be larger than the catalog entry buffer space. The use of ACB parameters is explained under “Buffer Allocation” on page 88.

Specifying through // DLBL

At run time, you may require more than the buffer space specified in the catalog or ACB. The minimum requirements for run time buffers are as follows (default STRNO=1):

```
Data buffers  = ACB STRNO + 1
Index buffers = ACB STRNO
```

If STRNO = 2 (that is, you require concurrent file positioning), the minimum buffer space required for output is three data CIs and two index CIs.

Examples

1. Specifying Buffer Space

   You can specify buffer space through the use of the // DLBL statement:

   ```
   // DLBL filename,'file-ID',,VSAM,BUFSP=size
   ```

   To be effective, the value specified for the DLBL buffer space must be larger than the catalog entry buffer space.

   VSE/VSAM rounds the buffer space value (obtained from the DLBL, ACB, or DEFINE) so that it is a multiple of either the index CI size or the data CI size, whichever is smaller.

   If the amount of buffer space specified is greater than the minimum required, VSE/VSAM uses the remainder for additional index buffers (direct processing) or additional data buffers (sequential or skip sequential processing).

2. Specifying Number of Buffers

   You can specify the number of buffers through the use of the // DLBL statement:

   ```
   // DLBL filename,'file-ID',,VSAM,BUFND=m,BUFNI=n
   ```

   Note that BUFND and BUFNI represent the *total* number of buffers, independent of the number of strings. That is, if the value for BUFND, respectively BUFNI, is lower than the required minimum, the default values are used.

Buffer Allocation

The following explains how VSE/VSAM allocates buffer space according to ACB specification. The following ACB parameters relate to buffer allocation:

```
ACB  MACRF=(IN|OUT,SEQ|DIR|SKP)
     STRNO=n
     BUFSP=n
     BUFND=n
     BUFNI=n
```

Minimum Buffer Allocation

Data Buffers

If you specify:

```
MACRF=(...,IN,...)
```

then, the number of data buffers for:

ESDS and RRDS is the greater of BUFND or STRNO.
KSDS is the greater of BUFND or STRNO + 1.

If you specify:

```
MACRF=(...,OUT,...)
```

then, the number of data buffers is the greater of BUFND or STRNO + 1.

Index Buffers

If the number of index buffers is the greater of BUFNI or STRNO, then OPEN calculates the remainder as follows:

```
Remainder = BUFSP - ((NDB*DCI) + (NIB*ICI))

   where: NDB = number of data buffers
          DCI = size of a data CI
          NIB = number of index buffers
          ICI = size of an index CI
```

If the remainder ≤ 0, then OPEN allocates the number of data buffers and index buffers and increases BUFSP to hold them.

If the remainder > 0, and to calculate additional buffers, refer to the section below.

Note that you get no indication if the BUFSP used for the minimum allocation is greater than that specified in DEFINE, DLBL, or ACB.

If Remainder > 0

1. MACRF=(...,SEQ,OUT,...)

   VSE/VSAM allocates data buffers until there is a remainder that is less than the data CI size; then it allocates more index buffers. (This is only possible when the index CI size is less than the data CI size. If the index CI size is larger, see item 2 below.)

   Example:

   ```
   BUFSP=13824
   data CI size=4096
   index CI size=512
   STRNO=1
   MACRF=(...,SEQ,OUT,...)
   ```

Allocation	Cumulative Totals
Minimum = 2 data buffers 8192 1 index buffer 512	8704
Additional = 1 data buffer 4096 2 index buffers 1024*	12800 13824
* Resulting from MACRF specification.	

2. MACRF=(...,DIR,OUT,...)

   VSE/VSAM allocates more index buffers until there is a remainder that is less than the size of one index CI; then it allocates more data buffers. (This is possible only when the data CI size is less than the index CI size.)

   Example:

   ```
   BUFSP=13824
   data CI size=4096
   index CI size=512
   STRNO=1
   MACRF=(...,DIR,OUT,...)
   ```

Allocation	Cumulative Totals
Minimum = 2 data buffers 8192 1 index buffer 512	8704
Additional = 10 index buffers 5120 *	13824
* Resulting from MACRF specification.	

3. MACRF=(...,SEQ,DIR,OUT,...)

   VSE/VSAM increases the number of index buffers to twice STRNO. (If this is not possible, VSE/VSAM uses the procedure described in item 2 above.) If there is still a remainder, VSE/VSAM uses the procedure described in item 1 above to allocate the remainder.

   Example:

```
BUFSP=13824
data CI size=4096
index CI size=512
STRNO=1
MACRF=(...,SEQ,DIR,OUT,...)
```

Allocation	Cumulative Totals
Minimum = 2 data buffers 8192 1 index buffer 512	8704
Additional* = 1 index buffer 512 = 1 data buffer 4096* = 1 index buffer 512*	9216 13312 13824
* Resulting from MACRF specification.	

   Later modifications of RPLs do not change buffer allocations.

Buffer Allocation for a Path

Path Entry for Alternate Index (AIX)

If the path entry is not a member of the upgrade set, buffers are allocated in the same manner as for a normal KSDS. Your ACB is used for the path entry.

If the path entry is a member of the upgrade set, then buffers are allocated as for a normal KSDS, but minimum allocations are increased by one for both the number of data buffers and the number of index buffers. Your ACB is used for the path entry.

Buffer Allocation for Path Entry when the Base Cluster is a KSDS

Buffers are allocated in the same manner as for a normal KSDS with the following ACB specifications:

```
BUFND=0
BUFNI=0
STRNO=number of strings specified in the ACB
```

You can influence buffer allocation only through the BUFFERSPACE parameter of DEFINE CLUSTER or through DLBL BUFSP= ,BUFND= ,BUFNI=.

If you open the path for *input* only, the base cluster uses MACRF=(...,DIR,IN,...). If you open the path for *output*, the base cluster uses MACRF=(...,DIR,OUT,...).

Buffer Allocation for a Base Cluster of an Alternate Index

You can influence buffer allocation through the path DLBL BUFND=, BUFNI=. If the base cluster is a KSDS, the minimum index buffer allocation is one buffer per index level per string.

Buffer Allocation for an Upgrade Set

The buffer allocation is always two data buffers and one index buffer. You cannot influence buffer allocation for the upgrade set.

Miscellaneous Notes on Buffer Allocation (NSR)

- Data and index buffers are acquired and allocated only at OPEN time. Buffer space is freed at CLOSE time.
- The data buffers will be allocated in 24-bit partition GETVIS, unless “RMODE31=BUFF” is specified in the ACB definition, or “BUFDAT=RMODE31” is specified on the DLBL at run-time. If there is insufficient storage available to satisfy this request, processing will terminate with an appropriate OPEN error code.
- Buffer space is aligned on page boundaries. Data buffers are allocated first, then the index buffers.
- Writing a buffer does not free buffer space. The CI is still in storage, so if you again reference that CI, VSE/VSAM does not reread the CI. Because VSE/VSAM checks to see if the CI is in storage, processing directly in a limited key range may increase throughput if extra data buffers are provided.
- The POINT macro does not cause read ahead because its purpose is to position for subsequent sequential retrieval. It fills only one data buffer.
- When processing *directly*, VSE/VSAM reads only one data CI. It does not reread data or index CIs if they reside in storage, except when SHAREOPTIONS(4) is specified. VSE/VSAM will immediately write a data buffer if PUT (UPD,DIR) or PUT (NUP,DIR) was issued. VSE/VSAM will write immediately for a sequential PUT if PUT (SEQ) follows GET (DIR) for the same RBA.
- Although VSE/VSAM does not read index buffers ahead, the effect is similar. Index buffers are loaded when referenced. If multiple index buffers are provided, index CIs are not reread because there is room for the CIs in storage. VSE/VSAM reuses buffers on a least-recently-used basis.
- For SHAREOPTIONS(4) processing, VSE/VSAM usually reads data and sequence-set CIs on every request. Exceptions are:
  - Consecutive retrievals, not for update, from the same CI do not cause a reread in sequential or skip-sequential mode.
  - Consecutive inserts or retrievals for update, in sequential or skip-sequential mode, do not cause rereads, unless the SHAREOPTIONS(4) lock has been held for a period longer than about 0.5 seconds. (The SHAREOPTIONS(4) lock is for a CA.)
- High-level index CIs are not reread unless they are out of date.
- Read-ahead is not done under SHAREOPTIONS(4); therefore extra data buffers are of no benefit.

I/O Buffer Space (Using Local Shared Resources)

Using the Shared Resources facility of VSE/VSAM, you can manage I/O buffers. This includes:

- Deferring write operations for direct PUT requests.
- Correlating deferred requests by transaction ID.
- Writing out buffers whose writing has been deferred.

For more information, refer to “Sharing Resources Among Files and Displaying Catalog Information” on page 178.

Miscellaneous Notes on Buffer Allocation (LSR)

- Read-ahead is not done under LSR. Therefore, extra buffers are of no advantage.
- Writing a buffer does not free buffer space. The CI is still in storage, so if you again reference that CI, VSE/VSAM does not reread the CI. Because VSE/VSAM checks to see if the CI is in storage, processing directly in a limited key range may increase throughput if extra data buffers are provided.
- When processing *directly*, VSE/VSAM reads only one data CI. It does not reread data or index CIs if they reside in storage, except when SHAREOPTIONS(4) is specified. VSE/VSAM will immediately write a data buffer if PUT (UPD,DIR) or PUT (NUP,DIR) was issued. VSE/VSAM will write immediately for a sequential PUT if PUT (SEQ) follows GET (DIR) for the same RBA.

- Although VSE/VSAM does not read index buffers ahead, the effect is similar. Index buffers are loaded when referenced. If multiple index buffers are provided, index CIs are not reread because there is room for the CIs in storage. VSE/VSAM reuses buffers on a least-recently-used basis.
- For SHAREOPTIONS(4) processing, VSE/VSAM usually reads data and sequence-set CIs on every request. Exceptions are:
  - Consecutive retrievals, not for update, from the same CI do not cause a reread in sequential or skip-sequential mode.
  - Consecutive inserts or retrievals for update, in sequential or skip-sequential mode, do not cause rereads, unless the SHAREOPTIONS(4) lock has been held for a period longer than about 0.5 seconds. (The SHAREOPTIONS(4) lock is for a CA.)

  High-level index CIs are not reread unless they are out of date.

LSR Buffer Hashing

Large VSAM LSR buffer pools can improve response time and reduce I/O operations. However, searching the pool to find the right buffer takes time. Benefits were often reduced due to the increased CPU time needed to search large buffer pools. To overcome this reduction in performance, VSAM buffer hashing has been implemented, in which a VSAM hashing algorithm allows direct access to the required buffer. Using VSAM buffer hashing, you can take advantage of very large buffer pools without the disadvantage of additional processor load. VSAM buffer hashing is a function introduced with VSE/ESA 2.5. This buffer management technique provides the following improvements over the existing sequential buffer management:

- The time required to perform buffer searches is reduced, since the need to do sequential searches through the buffer pool is removed. The search technique uses a hashing algorithm. Using this hashing algorithm, the path length of the search is significantly shortened. The I/O rate is therefore reduced.
- The path length does not depend upon the number of buffers (therefore the search time is independent of the buffer pool size).

How Does Buffer Hashing Work?

Using VSAM buffer hashing, you can take advantage of using very large buffer pools, without the disadvantage of additional processor load.

VSAM Buffer Hashing uses a:

- Hash Table – A table in main storage in which each table entry is used as a pointer to a BCB (Buffer Control Block). A BCB contains the address of the buffer (for data or index), and information about the buffer itself. There is one BCB for each buffer in the LSR buffer pool.
- Synonym – When using a hashing technique, synonyms may occur when two or more entities hash to the same anchor point. In VSAM Buffer Hashing, synonyms are chained together in the BCB. However, the possibility that synonyms occur is very small, and the chain is usually very short.
- Hash Algorithm, which is calculated as follows:
  - **X = remainder of (RBA/2 + DSID1/2 + DSID2/2) / DIM**

    where:

    X
    The remainder of the above calculation, and is used as the index to the hash table.

    RBA
    The Relative Byte Address, used by VSAM to identify a certain buffer in the LSR buffer pool.

    DSID1 and DSID2
    The Data Set Identifiers (DSIs), which are unique identifications of a certain opened VSAM data set component, either a data or an index component.

    DIM
    The number of entries in the Hash Table. DIM = (2N-1).

N
The number of buffers in the subpool.

Here is a "simple" example:

"Simple" in this case means that the values of this example were simplified to decimal values (not hexadecimal) to give a better understanding of the technique.

1. Let us assume that we have an LSR pool with 10 buffers. The Hash Table will have (2 * 10 -1) = 19 entries. Therefore:

   DIM = 19
2. A VSAM GET operation reads a data record from a certain VSAM data set with the internal data set identifications DSD1 and DSD2 into a data buffer. Therefore:

   DSID1 = 220, DSID2 = 32

   The BCB pointing to that data buffer is at storage location '640000'. The RBA (Relative Byte Address) of the VSAM data buffer is 800. Therefore:

   RBA = 800
3. The hash algorithm `X = remainder of (RBA/2 + DSID1/2 + DSID2/2) / DIM` therefore calculates the following index for the hash table:

   (800/2 + 220/2 + 32/2) /19 = 27, **remainder = 13 = X**

   "13" will be used as index into the hash table.
4. The BCB pointer **'640000'** will be stored in the **13th position** of the hash table.
5. Whenever another request is searching for a data buffer with RBA **800** from this certain dataset, the hash algorithm can calculate easily the index of **13** into the hash table and use the BCB at address **'640000'** and its related data buffer without a long pool search. This hashing technique also works, of course, with very large buffer pools (for example, 32767 buffers).

Preventing Deadlock in Buffer Contention

Contention for VSE/VSAM data (the contents of a CI) can lead to deadlocks, in which a processing program is stopped because its request for data cannot be satisfied.

Your processing program gets exclusive control of a buffer (CI) whenever you issue a GET for update (RPL option OPTCD=UPD) to retrieve a record from that buffer. You are responsible for preventing a deadlock by releasing as soon as possible the buffer for which another request may be waiting. Two requests, for example, A and B, may engage in four different contests:

1. A wants exclusive control, but B has exclusive control (OPTCD=UPD). VSE/VSAM refuses A's request. A must either do without the data or retry its request.
2. A wants exclusive control, but B has read-only access to the data (OPTCD=NUP). VSE/VSAM gives A a separate copy of the data.
3. A wants read-only access to the data (NUP), but B has exclusive control. VSE/VSAM refuses A's request. A must either do without the data or retry its request.
4. A has read-only access to the data, and B has read-only access. VSE/VSAM gives A a separate copy of the data.

VSE/VSAM's action in a contest for data rests on the assumptions that, if a processing program has exclusive control of the data (OPTCD=UPD), it will (or at least might) update or delete it and that, if a processing program is updating or deleting the data, it has exclusive control of it.

In contests 1 and 3, B is responsible for giving up exclusive control of a CI by way of an ENDREQ or a request for access to a different CI. (The RPL that defines the ENDREQ or request is the one that was used to acquire exclusive control in the first place.)

Multiple Volume Support

Key Ranges

The records of a key-sequenced file, including alternate indexes, can be grouped on volumes according to key ranges. A payroll file, for example, could have employee records beginning with A, B, C, and D on one volume, with E, F, G, H, and I on a second volume, and so on. Every portion of a multivolume file can be on a separate volume. Every key range of a file, as well as the end of the file, is preformatted. Multiple volume support is affected by the following DEFINE parameters: VOLUMES, ORDERED | UNORDERED, CYLINDERS | RECORDS | TRACKS | BLOCKS, and KEYRANGES.

The first allocation made on every volume is always the primary allocation.

Your CLASS specification in the DEFINE command can affect suballocation. For further information, see “Data Space Classification” on page 77.

Space Allocation

Space Allocation without Key Range Specified

Primary space is acquired from the first volume at define time. If VSE/VSAM needs more space during loading or processing of the file, and if secondary allocation was specified, VSE/VSAM uses the secondary extents on the first volume. When VSE/VSAM has acquired all the secondary space it can on the first volume and still needs more space, then primary space from the second volume is acquired, even if no secondary allocation was specified. If more space is needed, secondary space is acquired on the second volume.

Space Allocation with Key Range Specified

Primary space is acquired from every volume at define time. Every key range is assigned to a volume. There is a primary allocation for every key range. If there are fewer volumes than key ranges, the extra key ranges are grouped together on the last volume. If there are more volumes than the number of key ranges, the excess volumes become overflow volumes. A key range is associated with the primary allocation volume and can extend to any overflow volumes.

A key range is extended first by acquiring secondary extents on its volume of primary allocation, next by acquiring primary allocation on the first overflow volume, then secondary extents on the first overflow volume. Primary allocation is then acquired on the second overflow volume, followed by acquiring secondary extents on the second overflow volume. If there is not enough room on an overflow volume to acquire primary space for that key range, VSE/VSAM does not acquire any secondary space for that key range. VSE/VSAM just skips that overflow volume and goes to the next overflow volume to try to obtain primary space.

VSE/VSAM searches for space on volumes in the order they were specified in the VOLUMES parameter. This does not mean that the volumes are allocated or suballocated in that order. Allocation depends on whether ORDERED or UNORDERED was specified.

Unordered Space Allocation

If no Key Range was Specified

UNORDERED means VSE/VSAM must find a primary allocation (or the DEFINE command will fail), but not necessarily on the first volume listed in the VOLUMES parameter. If there is no room for a primary allocation on the first volume, successive volumes are checked for primary space.

If Key Range was Specified

UNORDERED means that VSE/VSAM must find room for a primary allocation for every key range, but not necessarily the first key range on the first volume, the second key range on the second volume, and so on.

Ordered Space Allocation

ORDERED means VSE/VSAM must suballocate space on the volumes in the order in which the volumes are listed in the VOLUMES parameter.

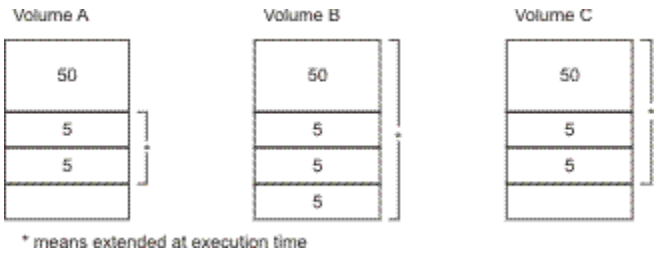
If secondary allocation is specified, space for a component can be expanded to include a maximum of 123 extents. Every primary and every secondary allocation can be made up of up to five non-contiguous areas (extents).

Examples: Allocation of Space on Multiple Volumes

The following examples show various combinations of ORDERED and UNORDERED space allocation, VOLUMES, and primary versus secondary allocations.

Example 1

```
VOLUMES(A B C)
ORDERED
CYLINDERS(50 5)
SUBALLOCATION
```



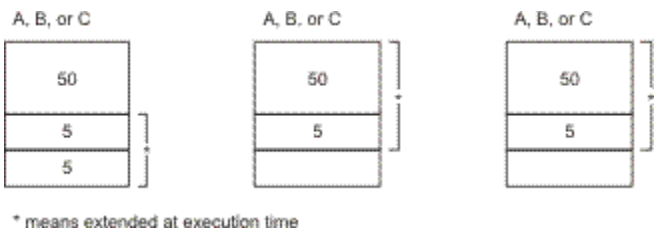
Volume A is the primary volume; volumes B and C are overflow volumes. Fifty cylinders of primary space must be available on volume A, or the DEFINE command will fail.

If the file is extended, a 5-cylinder secondary allocation is made on volume A, providing volume A has enough available VSE/VSAM space of the required class. Otherwise, an allocation of 50 cylinders (primary amount) is made on volume B. If volume B does not have enough data space for this allocation, the request for extension is rejected.

If volume B has 50 cylinders for allocation (primary amount) and the file needs to be extended further, secondary allocations are made from volume B. Volume B must have enough space available of the required class. Otherwise, a 50-cylinder allocation is made on volume C.

Example 2

```
VOLUMES(A B C)
UNORDERED
CYLINDERS(50 5)
SUBALLOCATION
```



Fifty cylinders of primary allocation must be made on one volume. It may be volume A, B, or C. If it is not possible to allocate all 50 cylinders a single volume, the DEFINE fails.

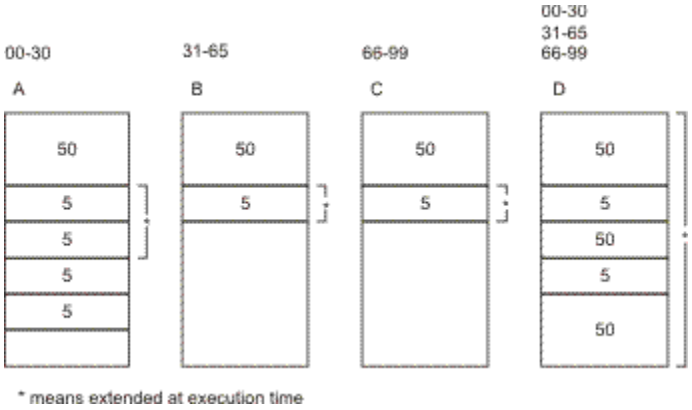
Volumes are searched in the order they are specified. If both A and B have 50 cylinders available, allocation is made on A because it was specified first.

When the file is extended, VSE/VSAM attempts to make the 5-cylinder secondary allocations on the same volume the primary allocation was made on. This continues until all data space of the required class is used.

To further extend the file, VSE/VSAM searches the volumes for space in the same order specified for primary allocation. If VSE/VSAM cannot acquire the primary amount of space (50 cylinders), an error code is issued.

Example 3

```
VOLUMES(A B C)
KEYRANGES((00 30) (31 65) (66 99))
ORDERED
CYLINDERS(50 5)
SUBALLOCATION
```

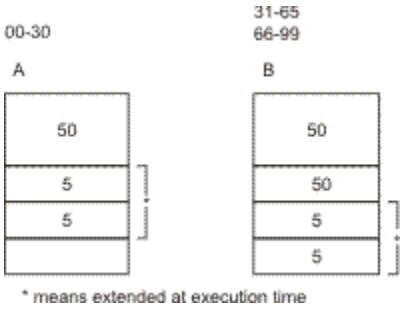


A primary allocation of 50 cylinders is made for every key range. The first key range is on volume A, the second on volume B, the third on volume C. If 50 cylinders cannot be allocated on every volume, the DEFINE fails. The 5-cylinder secondary allocations are made as needed.

A key range can be extended only on the volume it occupies or on an overflow volume. If volume D were added to the VOLUMES list, all key ranges would be extended on volume D if the volume initially assigned to the key range became full: first a primary allocation amount of 50 cylinders for a key range on volume D, then secondary allocations of 5 cylinders.

Example 4

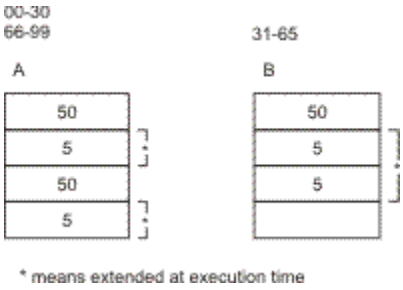
```
VOLUMES(A B)
KEYRANGES((00 30) (31 65) (66 99))
ORDERED
CYLINDERS(50 5)
SUBALLOCATION
```



If only volumes A and B are specified, the first key range is allocated on volume A, and the second and third key ranges are allocated on volume B. Volume A has one 50-cylinder primary allocation, and volume B has two 50-cylinder primary allocations. This can occur only for a file with the SUBALLOCATION attribute specified. If both UNIQUE and KEYRANGES are specified, every key range must reside on a separate volume.

Example 5

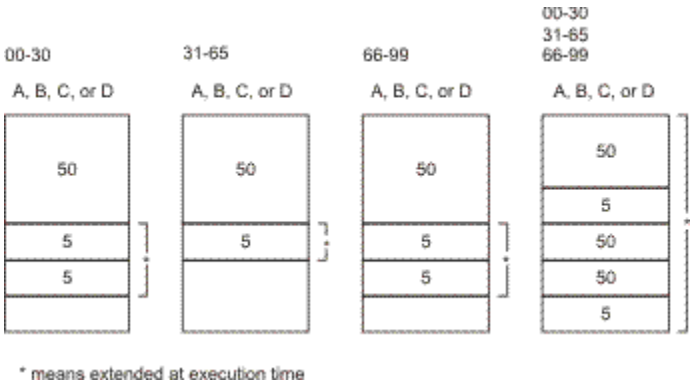
```
VOLUMES(A B A)
KEYRANGES((00 30) (31 65) (66 99))
ORDERED
CYLINDERS(50 5)
SUBALLOCATION
```



A primary allocation of 50 cylinders is made for every key range. The second key range is on volume B; the first and third key ranges are on volume A. This can occur only for a file with the SUBALLOCATION attributed specified. If both UNIQUE and KEYRANGES are specified, every key range must reside on a separate volume.

Example 6

```
VOLUMES(A B C)
KEYRANGES((00 30) (31 65) (66 99))
UNORDERED
CYLINDERS(50 5)
SUBALLOCATION
```



A primary allocation of 50 cylinders is made for every key range. VSE/VSAM attempts to put one key range on every volume. If volume A does not have 50 cylinders available, the first key range is put on volume B, and the second and third key ranges are put on volume C. If neither A nor B has 50 cylinders, all three key ranges are placed on volume C.

VSE/VSAM first extends a key range on the volume it is on before trying to extend it on any overflow volume. If volume D were added to the VOLUMES list, every key range would be extended on volume D, if no more spaces were available on the volume of its primary allocation.

If volume D were listed in the VOLUMES parameter, it would not necessarily be an overflow volume. If 50 cylinders of primary allocation were available on A, B, and C, then D would be an overflow volume. If volume A does not have 50 cylinders available, but B, C, and D have 50 cylinders each, the first key range is put on volume B, the second on volume C, and the third on volume D. Volume A becomes the overflow volume.

An Exercise

Assume that you have a 600-cylinder file that you want to have reside on two volumes: 400 cylinders on volume A, and 200 cylinders on volume B. How would you specify this allocation requirement in the DEFINE command?

Do **not** specify:

```
VOL(A B)
CYL(600)
```

This request would be rejected because the amount of primary space to be allocated on every volume is greater than that available on one volume.

Do **not** specify:

```
VOL(A B)
CYL(400,200)
```

This request would obtain 400 cylinders of primary allocation on volume A and 400 cylinders of primary allocation on volume B.

Do specify:

```
VOL(A B)
CYL(200,200)
```

This request obtains:

200 cylinders primary allocation on volume A,
200 cylinders secondary allocation on volume A, and
200 cylinders primary allocation on volume B.

The mounting requirements with multiple volumes are simple. All volumes must be mounted (except with sequential KSDS, ESDS, and RRDS). A primary allocation amount will be acquired on *every* volume.

Space Allocation

Possible Options

The CYLINDERS | RECORDS | TRACKS | BLOCKS parameters of the DEFINE command determine how VSE/VSAM allocates space. You may specify allocation at the CLUSTER/AIX level, DATA level, DATA and INDEX levels, and CLUSTER/AIX and DATA levels. Considerations in choosing allocation parameters are:

- If you specify allocation at the CLUSTER/AIX level only, the amount needed for the index is subtracted from the specified amount. The remainder of the specified amount is assigned to data.

- If you specify allocation at the DATA level only, the specified amount is assigned to data. The amount needed for the index is in addition to the specified amount.
- If you specify allocation at both the DATA and INDEX levels, the specified data amount is assigned to data, and the specified index amount is assigned to the index.
- If you specify *secondary* allocation at the DATA level, secondary allocation must be specified at the INDEX level unless you specify allocation at the CLUSTER level.
- A CA can never cross an extent boundary. A cluster extent consists of a whole number of CAs.
- A CA is never larger than one cylinder (CKD) or one maximum CA (FBA). Optimum performance is obtained when an integral number of CAs occupy a cylinder (or maximum CA).
- IDCAMS checks the smaller of primary and secondary space allocation values against the specified device's cylinder (or maximum CA for FBA devices) size. If the smaller quantity is greater than the device's cylinder (or maximum CA) size, the CA is set equal to the cylinder (or maximum CA) size. If the smaller quantity is less than or equal to the device's cylinder (or maximum CA) size, the size of the CA is set equal to the smaller space quantity. For FBA, this value is then rounded up to a multiple of minimum CA size.

  For example:

```
CYL(5 10)     results in a 1-cylinder CA
TRK(100 3)    results in a 3-track CA
REC(2000 5)   results in a 1-track CA (assuming 10 records
              per track - minimum CA is 1 track)
TRK(3 100)    results in a 3-track CA
```

  For a device with 64 blocks per minimum CA and 960 blocks per maximum CA:

```
BLK(1100 1000)  results in a 960-block CA
BLK(900 400)    results in a 448-block CA
BLK(100 40)     results in a  64-block CA
```

For CKD to force IDCAMS to select cylinder CAs, specify CYLINDERS or UNIQUE. When defining through the RECORDS | TRACKS parameters, specify the smaller of primary or secondary allocation as a value of at least one cylinder.

- If you specify secondary allocation, space for a component can be expanded to a maximum of 123 extents (if there is sufficient data space) with a limit of 16 extents per volume if REUSE is specified.
- A UNIQUE file can have a maximum of 16 extents per volume, but it can not be extended; no secondary allocations are permitted for UNIQUE files.
- A spanned record cannot be longer than a CA minus the control information (10 bytes per CI). Do not specify large spanned records with small primary or secondary allocation.
- VSE/VSAM acquires space in increments of CAs. For example, if the allocation amount is 20 tracks and the device is an IBM 3380, the CA size is one cylinder. Two cylinders of space (two CAs) are allocated, because a 3380 has 15 tracks per cylinder.
- LISTCAT gives information in increments of CA size. If you specify either TRACKS or RECORDS and the allocation is less than one cylinder, LISTCAT reflects the allocation as TRACKS. If the specification results in a one-cylinder CA, LISTCAT reflects the allocation as CYLINDERS. If you specify BLOCKS, the allocation is given in multiples of blocks.

NOALLOCATION

NOALLOCATION allows you to define a file into a catalog without suballocating any space to it. This parameter can be useful in two ways:

- Creating default models. (For a discussion of default models, see “Using an Object as a Model” on page 52.)
- Creating *dynamic* files for which space is not actually suballocated until the file is opened.

Dynamic Files

Formerly, files that were used for brief periods of time (for example, work files) occupied disk space from the time they were defined until they were deleted. If they were required again, they had to be redefined.

Using the DEFINE CLUSTER command with NOALLOCATION and REUSE parameters makes it possible to define a file for which no space is suballocated until the file is to be opened; this file is called a *dynamic* file. The catalog entry for a dynamic file contains only the allocation *size* specified at define. Information about the suballocated space is added to the catalog when the file is opened.

When you try to delete a dynamic file, VSE/VSAM determines if space is currently allocated to it. If it is, VSE/VSAM deletes it as if it were a normal VSE/VSAM cluster. If space is not allocated, only the catalog entry of the file is removed.

Dynamic files may be entry-sequenced (including SAM ESDS supported by the *VSE/VSAM Space Management for SAM Function*), key-sequenced, or relative-record files.

Dynamic File Restrictions

The following restrictions apply to dynamic files:

- A path (but not an alternate index) may be built over a dynamic file, except for a SAM ESDS file.
- A dynamic file that does not have space allocated to it cannot be printed (PRINT), copied (REPRO), or exported through EXPORT. EXPORT only supports non-empty dynamic files
- A default model cannot be opened. If you specify NOALLOCATION, you must also specify REUSE if you plan to open the file.
- Normally, parameters such as CYLINDERS, TRACKS, and USECLASS control space allocation. However, for noallocation models (other than reusable files), these attributes are recorded only for modeling purposes.
- If you specify the VOLUMES parameter when you define a file as NOALLOCATION, VSE/VSAM records those volumes in the catalog as candidate volumes.
- The NOALLOCATION attribute exists in the catalog entry, but it cannot be implicitly modeled. It can be explicitly modeled (MODEL parameter of DEFINE).
- You cannot specify NOALLOCATION on the ALTER command.
- You cannot ALTER REMOVEVOLUMES for the last existing volume on the candidate list for NOALLOCATION files.

Data Protection and Integrity Options

When considering performance, you must also consider the data protection and integrity options you are using. VSE/VSAM performance is affected by the following:

- Share options.

  For more information, see “Protecting Shared Data” on page 116.
- Write check.

  If you specify WRITECHECK in the DEFINE command, it means you wish to have your records checked as they are written. After a record is written, it is then read without data transfer to test for a data check condition. If applicable, VSE/VSAM uses the bypass cache option when writing to write check files. If NOWRITECHECK is specified (and this is the default), a record is written but no checking occurs. That is, you will get better performance with the NOWRITECHECK option.
- Recovery versus Speed.

  The RECOVERY and SPEED parameters in the DEFINE command control the preformatting of CAs before records are inserted. RECOVERY|SPEED applies only to initial loading. Specifying RECOVERY means that space allocated to the data component is preformatted. Specifying SPEED means that space will *not* be preformatted.

Specifying SPEED gives you better performance, whereas specifying RECOVERY enables you to recover from certain system failures.

Consider the following:

- If you specify SPEED in a file's DEFINE command, and a system failure occurs, the file must be deleted, redefined, and reloaded. RECOVERY is only useful if you have a recovery procedure that allows you to resume loading the file after a system failure. RECOVERY formats every CA before loading records into it. It allows you to find the software end-of-file if an abnormal termination occurs during initial creation. After the initial creation of the file, RECOVERY is always in effect.
- RECOVERY works in conjunction with the IDCAMS VERIFY command. If a system failure occurs before a file is closed (CLOSE or TCLOSE), VERIFY can prevent your having to reload the file by updating the catalog with the current high RBA. This ensures that your data will not be overwritten inadvertently at a later time, and that you may continue the load at the point of interruption (load-extend). If the SPEED option was in effect while the file was loaded, VERIFY cannot help because no preformatting was done and no high RBA exists until the file is closed.

Distributed Free Space

Free space can occur in files as a result of:

- your FREESPACE specifications in the commands DEFINE ALTERNATEINDEX and DEFINE CLUSTER, or
- CI/CA splits.

For more information and examples on CI and CA splits that result from record inserts during direct and sequential processing, refer to “CI/CA Splits” on page 103.

You can specify free space only for key-sequenced data sets (KSDSs), variable-length relative-record data sets (VRDSs), or alternate indexes. The CI free space should be as large as the design insertion level. Determine the free space required by estimating the percentage of additions to be made between file reorganizations. Also, consider the size of your records. If there are to be no additions, or if records will not be lengthened, there is no need for free space.

Loading a File

Specifying Free Space

You specify free space for both the CI and the CA as a percentage of the total space for the respective unit. For example:

```
FREESPACE (20 10)
```

indicates that:

20% of every CI is to be initially empty, and
10% of every CA is to be initially empty.

If you specify the minimum CA free space of 1%, free space for one CI in every CA will be provided. The system default for free space is (0 0).

Altering Free Space

You can change the free space after the file is loaded. To take full advantage of mass insertion, specify FREESPACE(0 0) in the ALTER command after the file has been loaded.

Considerations for Loading a File

- If additions occur only in a specific part of the file:

Load those parts that will have no additions with a free space specification of (0 0). Alter the free space to (n n) to load those parts of the file that will receive the additions.

If SPEED is specified, it is in effect for loading the initial portion only. Any subsequent portions are loaded with RECOVERY, regardless of the DEFINE specification.

- If additions occur throughout the file, but are unevenly distributed:

  Specify a small amount of free space when you define the file. Then, increase the percentage after loading the file. As new CIs and CAs are required, they are created with the increased free space specification.

  Additional splits (after the first split) in the part of the file with the most growth will be minimized. CIs that have little or no growth will contain only a small amount of unneeded free space.

- If there are few additions to the file:

  Consider a free space specification of (0 0) for loading the file and subsequent processing.

  When records are added, new CAs are created to provide room for additional insertions. In this case, unused free space is not provided.

- For direct insertions:

  Make the CI free space larger than the CA free space, unless the frequency of insertions is very low. In that case, zero CI free space and average CA free space might be indicated.

- For sequential processing:

  The greater the free space specification, the more disk space is required.

  For *sequential* processing, more I/O operations (with more system overhead) are required to process the same number of records. A bad combination of CI-size/record-size/free-space can cause poor sequential performance if much of the free space is unusable.

Performance with Too Much or Too Little Free Space

Too much free space could increase the number of index levels, which could increase run time for *direct* processing.

Too little free space can cause an excess of (time-consuming) CI/CA splits:

- For *sequential* processing - and after a split occurred - extra time is required because the records are not in physical sequence.
- For *direct* processing, CA splits can increase seek time.

Another factor is the additional VSE/VSAM overhead to do the split. (If insertions are truly random, ideally all CAs would split at approximately the same time.) It is recommended to monitor CA splits and to reorganize the file when the splits become prevalent. To monitor CA splits, use LISTCAT or the ACB JRNAD exit.

Where VSE/VSAM Places the Records

Records are loaded or mass inserted at the end of a CI until the free space threshold is passed. The free space threshold is the point at which free space becomes less than the amount specified in the DEFINE command.

VSE/VSAM ensures that at least one record (or one segment of a spanned record) is placed into a CI. Also, if the CA free space specified in the DEFINE command is not zero but is less than one CI, the result is one free CI in the CA.

Specifying Free Space in a CI and CA

You specify free space in a CI as a percentage of bytes in the CI. Generally you should specify a value equal to at least one record, because VSE/VSAM does not round up the free space to hold a whole number of records.

The amount of *unused space* in the CI, however, may be more than the *free space* you requested. For example:

> If you specify (33 0) free space, you are in effect telling VSE/VSAM to put as many records as possible into 67% of the CI. If the CI can contain four logical records, the first two records will fit into 50% of the CI. This leaves 17% unallocated space. The unallocated space is added to the 33% free space, for a total of 50% free space available for allocation. In this case, where the amount of unused space is greater than the amount of requested free space, the value you requested is stored in the catalog.

For this same CI, if you specify (25 0) free space, the CI would contain three logical records and 25% free space. If (20 0) free space is specified, the result is three logical records and 25% free space. If (80 0) free space is specified, the result is one logical record and 75% free space. Specifying *free space in a CA* is somewhat different. If you specify any value greater than zero, VSE/VSAM will round up the value so that you get at least 1 free CI per CA. As in CI free space allocation, however, you may get additional space due to the combination of requested free space plus unallocated space.

Note:

1. Remember that a CI contains logical records, free space, and control information (CIDF and RDF). A 4KB CI cannot contain four 1KB logical records. A 4KB CI with (25 0) free space specified will contain at least 1KB of free space; only two 1KB fixed length logical records could be loaded into the CI. Only one more 1KB logical record could be added before a CI and/or CA split would be required.
2. If you specify FREESPACE(100 100), the CIs and CAs are not left empty. VSE/VSAM writes one record per CI and one CI per CA; the rest is free space.
3. If ten CIs fit into one CA and (0 5) free space is specified, the CA will have one free CI.

Reclaiming Space

You can use the ERASE macro to delete records. The space that was occupied by the deleted record is returned to the free space.

If a CI is emptied by ERASE, it can be reclaimed later as a free CI if it is needed.

Note: Space that becomes free within a CI because of records deleted or shortened may remain unused even though the space is available. This situation occurs when new records to be added to the file do not have key-field values that match the range of the freed area within the CI. For example:

> A record with key-field value 250 cannot be inserted between records with key-field values 22 and 70.

Depending on the amount of unusable space, you may want to reorganize the file (using EXPORT and IMPORT) to make the available free space useable.

The same problem can exist on a CA level. If all records in all CIs (in one CA) are deleted, the CA is not reused unless space is required in its key range. To reclaim unused CAs, use BACKUP and RESTORE to reorganize the file.

CI/CA Splits

The following explains the rules for CI and CA splits.

Sequential Processing

- CI Split

  If the insert is in the middle of the CI, the records with higher keys are moved to the free CI. The insert and the records with lower keys remain in the old CI. If the insert is at the logical end of the CI, the inserted record goes to the free CI.

- CA Split

  If the insert is *not* in the last logical CI, all CIs after the split CI are moved to the new CA. If the insert is within the last logical CI, that CI is moved to the new CA. If the insert is at the end of the last logical CI, the inserted record is placed into the new CA.

Direct Processing

- CI Split

  Half the records (those with the higher keys) in the CI are moved into the new CI. The new record is inserted (in key sequence) into the CI to which it belongs.

- CA Split

  Half the CIs (those with the higher keys) are moved to the new CA. Insertion then occurs through regular CI split processing, using the newly-created free space CIs.

  Updates can cause CI/CA splits when:

  – The record length is increased, and there is not enough free space in the CI, or
  – The record length is decreased and additional RDFs are required. If the space required for the RDFs is more than the amount by which the record is shortened, and there is insufficient free space, the CI must be split.

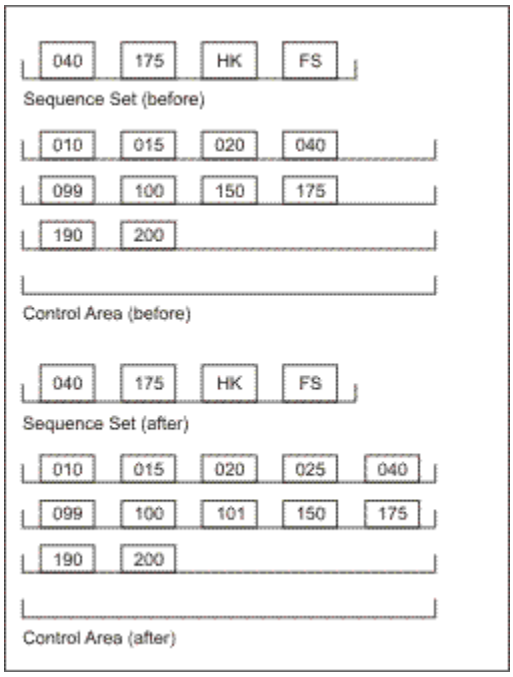
Examples: CI/CA Splits

In the examples:

HK means High Key
FS means Free Space

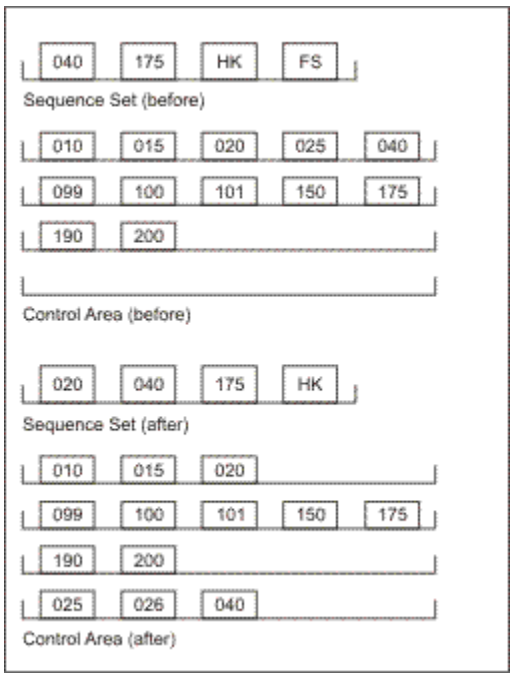
Example 1

shows the CA after direct and sequential insertion of records 025 and 101.



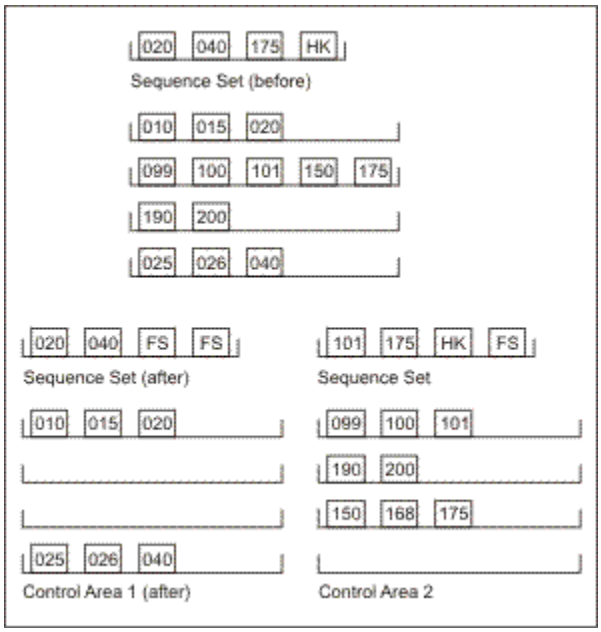
Example 2

shows the CA after direct insertion of record 026, causing a CI split.



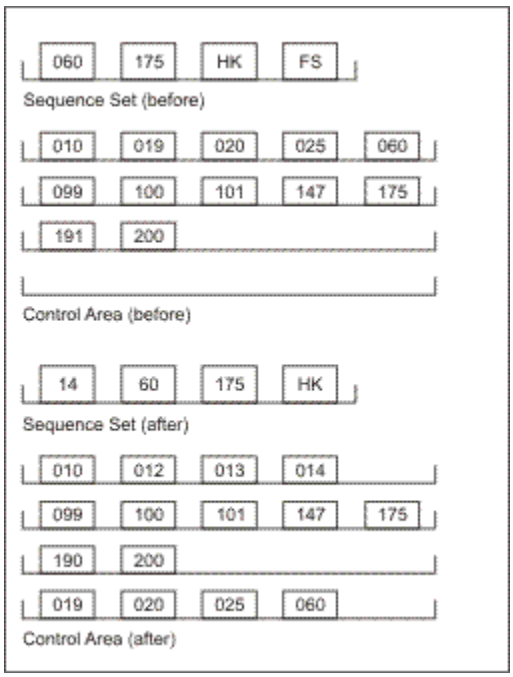
Example 3

shows a CA split and CI split caused by the direct insertion of record 168.



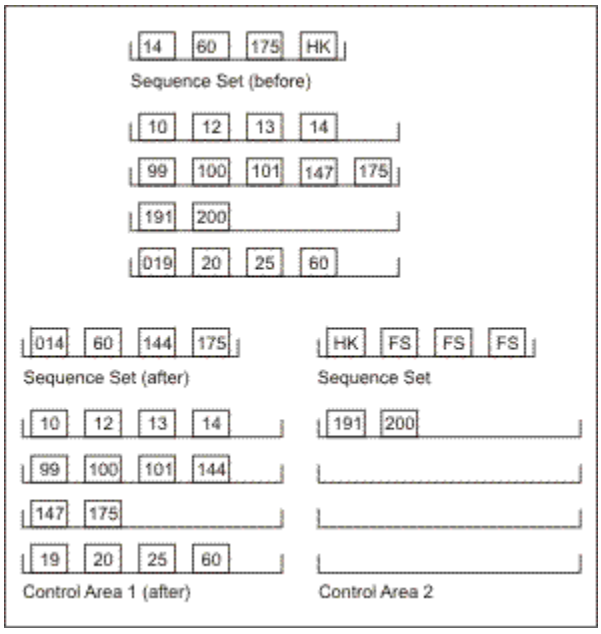
Example 4

shows the CA after sequential insertion of records 12, 13, and 14. Record 12 causes a new CI split. Note that the key associated with the old CI is one number less than the low key in the new CI. This permits mass insertion to take advantage of the newly-created free space.



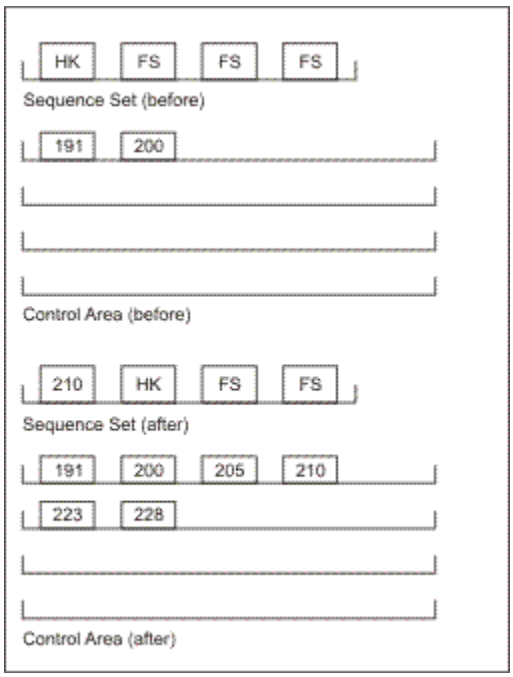
Example 5

shows a CA split and CI split caused by the sequential insertion of record 144. Note that the key associated with the old CI is one less than the low key in the new CI. This permits mass insertion into the newly-created free space.



Example 6

shows a CA after a sequential insertion of records 205, 210, 223, and 228, during load extend processing. Note that the free space is preserved.



Index Options

Number of Index Records in Virtual Storage

For keyed access, VSE/VSAM needs to examine the index of a file. Performance improves if a large number of index records can be held in virtual storage.

Before the processing program begins to process the file, it must specify, either explicitly or by default, the amount of space VSE/VSAM can use to buffer index records. Enough space for one index record is the minimum. However, when the space is large enough for only one or two index records, an index record may be continually deleted from virtual storage to make room for another and then retrieved again later when it is required anew. Ample space in which to buffer index records can improve performance by preventing this situation, provided that the buffer allocation does not cause excessive paging by z/VSE. Remember that VSE/VSAM searches only the sequence set for sequential access but every index level for direct access.

You can ensure that an acceptable number of index records is in virtual storage by specifying enough space for I/O buffers for index records through one of the following parameters when you open the file:

- BUFFERSPACE parameter of the DEFINE CLUSTER command for a file
- BUFNI and BUFSP parameters of the ACB macro
- BUFNI and BUFSP parameter of the DLBL statement

VSE/VSAM keeps as many index set records in virtual storage as the space will hold. Whenever an index record must be retrieved to locate a record, VSE/VSAM makes room for it by deleting another index record from the space.

Consideration for ECKD Devices

For extended count key data (ECKD) devices (such as the IBM 3390), special considerations apply. Especially in conjunction with cached devices, performance will usually be best if the index is as compact as possible.

Key Ranges

The records of a key-sequenced file and an alternate index can be grouped on different volumes according to key ranges. For example, a payroll file could have employee records beginning with A, B, C, and D on one volume, with E, F, G, H, and I on a second volume, and so on. You can then process the records of every volume, or you can process as many volumes together as your program(s) requires. For more information and examples, refer to “Multiple Volume Support” on page 94.

Performance Measurement

VSE/VSAM keeps statistical information about a file in its catalog record. Some statistics, such as number of extents in a file, number of records retrieved, added, deleted, and updated, and number of CI splits, can help you decide when to take action to improve performance. Appropriate actions could be, for example, reorganizing a file or altering the type of processing.

You can list the entire catalog record, the statistics, and the parameters selected when the file was defined, by using the LISTCAT command. For an explanation of the output produced by the LISTCAT command, refer to the VSE/VSAM Commands, SC34-2707 . You can use the SHOWCB and TESTCB macros in a processing program to display or test one or more file statistics and parameters. These statistics and parameters include:

- CI size
- Percentage of free CIs per CA
- Number of bytes of available space at the end of the file
- Length and displacement of the key
- Maximum record length
- Number of buffers
- Usage of LSR buffer pools
- Number of records See Note 1, below.
- Password
- A time stamp that indicates if either the data or the index has been processed separately
- Number of levels in the index
- Number of extents
- Number of records retrieved, inserted, deleted, and updated See Note 1, below.
- Number of CI splits in the data and in the sequence set of the index
- Number of EXCPs that VSE/VSAM has issued for access to a file

Note:

1. VSE/VSAM does not update these statistics when a file is processed in control interval access (that is, MACRF=CNV is specified in the ACB macro).
2. When a cluster or alternate index is exported, that is, named in an EXPORT command, the statistics are reset in the exported catalog record due to the redefinition of the imported cluster or alternate index in another catalog.
3. SAM ESDS statistics are not updated when the file is accessed via DTF.

Displaying Statistics About Buffer Pools

You can use the SHOWCB macro to obtain statistics about the use of buffer pools. These statistics help you to determine how to improve both a previous definition of a resource pool and a mix of data sets that use it.

The statistics are available through an ACB that describes an open data set that is using the buffer pool. They reflect the use of the buffer pool from the time it was built to the time SHOWCB is issued. All but one

of the statistics are for a single buffer pool (subpool). To get statistics for the whole resource pool, issue SHOWCB for each of its buffer pools.

The statistics cannot be used to redefine the resource pool while it is in use. You have to make adjustments the next time you build the resource pool.

For information on the use of SHOWCB, refer to "The SHOWCB Macro" on page 235.

For buffer pool statistics, the keywords described below are specified in the FIELDS operand. These fields may be displayed only after the data set described by the ACB is opened. Each field requires one fullword in the display work area.

Field	Description
BFRFND	The number of requests for retrieval that could be satisfied without an I/O operation (the data was found in a buffer).
BUFRDS	The number of I/O operations to bring data into a buffer.
NUIW	The number of nonuser–initiated writes. Applies only for DFR. Writes that VSE/VSAM was forced to do because no buffers were available for reading.
STRMAX	The maximum number of place holders currently active for the resource pool (for the whole resource pool).
UIW	The number of user–initiated writes. For DFR only.

Chapter 8. Data Protection and Data Recovery

This Chapter...

- Explains which VSE/VSAM options and z/VSE utilities you can use to protect your data. **Data protection** includes:
  - **data security**, the safety of data from theft or intentional destruction.
  - **data integrity**, the safety of data from accidental loss or destruction.
- Includes procedures to **analyze problems** with files, catalogs, and volumes, and shows how to **recover** from error conditions.

For an overview of available **tools**, refer to "Tools for Data Integrity, Backup, and Recovery" on page 125.

Data Protection

VSE/VSAM provides options to protect files against unauthorized use and loss of data. These options allow you to specify passwords and the use of a *user security-verification routine* (USVR), and allow you to control file sharing and data set name sharing. Using IDCAMS commands, you specify the options when you define a file or catalog.

Passwords to Authorize Access

Password Levels

You can optionally define passwords for clusters, alternate indexes, components (data and index), paths, and catalogs. To gain access to password-protected objects, a program or the operator must provide the appropriate password. Password levels differ for various degrees of security. These levels are (from low to high):

- *Read access* (READPW parameter). This is the read-only password, which allows you to retrieve data records and catalog entries, but not to add, update, or delete them, nor to see password information in a catalog entry.
- *Update access* (UPDATEPW parameter). This password authorizes you to retrieve, update, add, or delete records in a file. Specifying a catalog's update password authorizes you to define files in it.
- *CI access* (CONTROLPW parameter). This password authorizes you to retrieve and store the contents of an entire CI (rather than a logical record).
- *Full access* (MASTERPW parameter). This is the master password, which allows you to perform all operations (retrieving, updating, adding, and deleting) on a file and on the catalog entry or any index associated with it. Using this password to gain access to a catalog entry allows you to delete an entire file and to alter any catalog information (including passwords) about data, index, or catalog. The master password allows all operations and bypasses any additional verification checking by a user security-verification routine (USVR).

Every higher-level password allows all operations permitted by lower levels. Any level may be null (not specified), but if a low-level password is specified, the master level password must also exist. The DEFINE and ALTER commands accomplish this by propagating the value of the highest password specified to all the higher password levels. For example, if you specify only a read-level password, that password becomes the update, control-interval, and master level passwords as well. If you specify a read password and a control-interval password, the control-interval password becomes the master level password as well. However, the update level password is not affected (it remains null).

Password Submission

A password, if required, is normally supplied by the processing program in a field pointed to by the ACB or through IDCAMS parameters. If neither of these are supplied, the password must be supplied by the operator. VSE/VSAM prompts the operator for every entry password.

Two options can be specified in the DEFINE command for use when the operator supplies a password: the ATTEMPTS option and the CODE option.

- The ATTEMPTS option specifies how many times, 0 through 7, the operator can attempt to supply the correct password. If 0 is specified, passwords cannot be supplied by the operator. If ATTEMPTS is not specified in the DEFINE command, the default (2) allows the operator to attempt to supply the password twice.
- The CODE option specifies a one-to-eight character name, other than the name (file-ID) of the file, to which the operator responds with a password. This *prompting code* helps keep data secure by not allowing the operator to know both the name of the file and its password. If the CODE option is not specified, the name of the job and the name (file-ID) of the file are supplied to the operator.

If the processing program omits the password or supplies the wrong password, and the operator cannot supply the correct password in the allowed number of attempts, OPEN is terminated. An error code is set in the ACB indicating that the file cannot be opened because the correct password was not supplied.

Password Relationships

Catalogs may have passwords. If you define passwords for any files in a catalog, you *must also* define passwords for the catalog so that the file passwords can take effect. If you do not define passwords for the catalog, no password checking takes place during operations on the file's catalog entry. For some operations (for example, listing all of a catalog's entries with their passwords, or deleting catalog entries), the password of the catalog may be used instead of the password of the file's catalog entry. Thus, if the master catalog is protected, its update or higher-level password is required when defining a user catalog because all user catalogs have an entry in the master catalog. When deleting a protected user catalog, the user catalog's master password must be specified.

Password Checking

VSE/VSAM does password checking only for files that are password-protected. Operations on a catalog may be authorized by the catalog's appropriate password or, in some cases, by the appropriate password of the file whose definition in the catalog is operated on. For example:

- If you want to delete a protected file from a password-protected catalog, you must specify the catalog's or file's master password.
- If you want to alter a file definition in a password-protected catalog, and if the file is password-protected also, you must specify the catalog's or the file's master password.
- If you want to list a file's catalog definition in a password-protected catalog, and if the file is password-protected also, you must specify the catalog's or the file's read (or higher) password. If you want to list the passwords themselves, you must provide the master password.
- If you want to list a file's catalog definition in a password-protected catalog, and if the file is *not* password-protected, you do not have to specify a password.

Because a user catalog defines itself, it may be password-protected without the master catalog being password-protected. To delete an empty user catalog, you must give its master password, whether the master catalog is password-protected or not.

Passwords and IDCAMS Operations

Some IDCAMS operations may involve more than one password authorization. For example, importing a file involves defining the file and loading records into it. If the catalog into which the file is imported is password-protected, its update (or higher) password is required for the definition; if the file is password-

protected, its update (or higher) password is required for the load. In these cases, the master password of the catalog satisfies both requirements.

Every VSE/VSAM file is represented in a catalog by two or more entries: a cluster entry and a data entry or, if the file is a key-sequenced file, a cluster entry, a data entry, and an index entry. Of the entries, the *cluster entry* is the controlling entry. Each entry can have its own set of four passwords; the passwords you assign need have no relationship to one another. One reason for this separate password-protection is to prevent access to the index of a key-sequenced file (because an index can be opened independently of the cluster). For example, if you password-protect a cluster but do not password-protect the cluster's data component, another user could issue LISTCAT to determine the name of your cluster's data component, then open the data component and access records in it even if the cluster itself is password-protected.

The following protection considerations and precautions should be observed when using IDCAMS commands that refer to a catalog without using the files defined by the catalog:

- To gain access to passwords in a catalog (for example to list or change passwords), you must specify the master password of either the entry or the catalog. If both the password of the entry and the password of the catalog are supplied, the password of the catalog is used. Similarly, a master password must be specified with the DEFINE command if you want to model the entry's passwords (with the MODEL parameter).
- To delete a protected file entry from a catalog requires the master password of the entry or the master password of the catalog containing the entry. To delete a non-empty VSE/VSAM data space, the master password of the catalog is required, if the catalog is password-protected; to delete an empty VSE/VSAM data space, the update password of the catalog is sufficient. When a catalog entry is created (with a DEFINE command), the catalog's update or higher-level password is required.
- You can list catalog entries that are password-protected by specifying the read passwords of the entries or the catalog's read password. You can list unprotected entries without specifying the catalog's read password. If you wish to list the passwords associated with a catalog entry, you must specify either the master password of the entry or the master password of the catalog.
- If the proper password is not specified with an IDCAMS command, a password prompt occurs. Unless you have specified the CODE parameter on either the DEFINE or ALTER command, the prompt includes the *file-ID* of the file; if you specify CODE, the prompt includes the code name you specified.

  In some circumstances, more than one prompt occurs. For example, when an ALTER or DELETE request is processed, the catalog must be referred to twice, once to locate the information, and again to perform the requested function. Again, incorrect password specification when you want to list catalog entries may cause numerous prompts. To avoid unnecessary prompts, specify the catalog's master password, which allows access to all entries contained in that catalog.

  An unprotected file can be deleted without a password, even if the catalog is protected. This is important during IMPORT and RESTORE processing, because the old, unprotected version of the file is deleted, but a new version is not defined.
- Specification of a password where none is required is always ignored.

The following protection considerations and precautions should be observed when using commands that cause access to a VSE/VSAM file:

- To access a VSE/VSAM file by using its cluster name instead of a data or index name, you must specify the proper level of password for the cluster. The proper level password for the cluster is required even if the data or index passwords are null (that is, no password was assigned).
- To access a VSE/VSAM file by using its data or index name instead of its cluster name, you must specify the proper level data or index password. If cluster passwords are defined, however, the master password of the cluster may be specified instead of the proper data or index password.
- If a cluster is not password-protected, you can access the file by using the cluster name without specifying passwords. This is true even if the data and index entries of the cluster have passwords defined. This allows unrestricted access to the VSE/VSAM file as a whole, but protects against unauthorized modification of the data or index as separate components.

- An update password is required at OPEN for MACRF=IN files when DLBL DISP or ACB CLOSDSP is: DELETE or DATE.

IDCAMS Commands Security

IDCAMS tool provides a number of backup/restore, define/delete, and catalog maintenance commands which can be destructive to data. To prevent cases of data destruction, system administrators can restrict the usage of IDCAMS commands with the help of a security manager, for example the Basic Security Manager (BSM) provided with z/VSE. For more information on BSM and the BSTADMIN utility used to issue BSM commands or the dialog support (fastpath 28) refer to "Part 3. BSM Security" in z/VSE Administration, SC34-2692. Descriptions of specific IDCAMS commands can be found in VSE/VSAM Commands, SC34-2707.

The administrator can control access to IDCAMS commands by using the BSM resource profile of the resource class FACILITY called IDCAMS.GENERAL.

If batch security is not active, or if it is active but the profile IDCAMS.GENERAL was not defined to the BSM, then IDCAMS commands are executed as requested without warnings. Refer to z/VSE Administration, SC34-2692 under "Activating Security for Batch Resources" . Same happens in the case when IDCAMS function is executed in ICCF pseudo partition since IDCAMS commands access control is designed for batch processing only.

If batch security is active and the corresponding IDCAMS.GENERAL profile in the resource class FACILITY is defined, then an ID statement has to be supplied in the job to authenticate a user.

IDCAMS commands are permitted depending on user's authorization level in the IDCAMS.GENERAL profile: ***read***, ***update***, or ***alter***. Users having ***read*** authorization level are permitted to perform the following set of IDCAMS commands:

- LISTCAT - lists entries contained in a catalog
- PRINT - lists a part or the whole VSAM file
- BACKUP - produces a backup copy of one or more VSAM objects

Users having ***update*** authorization level are permitted to perform commands for the read authorization level plus the set of IDCAMS commands listed below.

- DEFINE CLUSTER|AIX|PATH|NONVSAM - defines cluster, alternate index, path, or nonVSAM file
- DELETE CLUSTER|AIX|PATH|NONVSAM - deletes cluster, alternate index, path, or nonVSAM file
- EXPORT/IMPORT - exports/imports cluster or alternate index
- REPRO - copies data from one dataset to another
- RESTORE - defines cluster (if required) and fills it with the data from the backup medium
- BLDINDEX - builds one or more alternate indexes
- VERIFY - verifies and corrects (if required) end-of-file information

Note:

1. The scope of using of the DEFINE and DELETE commands is limited to cluster, alternate index, path, and nonVSAM file.
2. EXPORT CONNECT and IMPORT DISCONNECT are not allowed for this authorization level.

Users having ***alter*** authorization level are permitted to perform commands for the read and update authorization levels plus the following set of IDCAMS commands:

- DEFINE MASTERCATALOG|USERCATALOG|SPACE - defines master catalog, user catalog, or space
- DELETE MASTERCATALOG|USERCATALOG|SPACE - deletes master catalog, user catalog, or space
- IMPORT DISCONNECT - disconnects user catalog from master catalog
- EXPORT CONNECT - connects user catalog to master catalog
- ALTER - changes attributes of catalog entries

If the user's authorization level to IDCAMS.GENERAL profile is enough to execute a specific IDCAMS function, then the command is executed without any extra messages.

Otherwise, if the user's authorization level to IDCAMS.GENERAL profile is **not** enough to execute a specific IDCAMS function, IDCAMS function is interrupted and the following message pair is displayed in SYSLST:

```
    IDC32240I RACROUTE (AUTH) FAILED WITH RETURN CODE nn REASON mm
    IDC32241I SAF RETURN CODE nn FOR RACROUTE (AUTH)
```

For description of the return codes, refer to z/VSE Messages and Codes Volume 1, SC34-2682 under "RACROUTE REQUEST=AUTH" . At the same time message BST120I from BSM is displayed on the console. It shows which BSM resource class and resource profile are affected. The example of the BST120I message is given below.

```
BG 0000 BST120I USER(OPER    )
            BST120I   IDCAMS.GENERAL CL(FACILITY)
            BST120I   INSUFFICIENT ACCESS AUTHORITY
            BST120I   FROM IDCAMS.GENERAL
            BST120I   ACCESS INTENT(UPDATE  ) ACCESS ALLOWED(READ    )
```

Job is not cancelled, IDCAMS processing continues with the next command specified.

Note:

1. IDCAMS RECMAP command is not under control of BSM resource profile since is does not affect any VSAM data directly. Commands like CANCEL and other modal commands (IF-THEN-ELSE, SET, PARM) are not covered by security manager as well.
2. IDCAMS SNAP command is controlled by a separate BSM resource profile of the BSM resource class FACILITY. Refer to Chapter 10, “Performing an IDCAMS SNAP (FlashCopy),” on page 165.

The JCL sample below shows how to use BSTADMIN utility for defining the IDCAMS.GENERAL profile in BSM. This sample profile allows everyone to use the 'read-only' commands and grants user USR1 update authorization level and user USR2 alter authorization level to the IDCAMS.GENERAL profile.

```
// JOB BSTADMIN SETUP
* Define IDCAMS.GENERAL security profile and setting user permissions
// EXEC BSTADMIN
   ADD FACILITY IDCAMS.GENERAL UAC(READ)
   PERMIT FACILITY IDCAMS.GENERAL ID(USR1) ACCESS(UPD)
   PERMIT FACILITY IDCAMS.GENERAL ID(USR2) ACCESS(ALT)
   PERFORM DATASPACE REFRESH
/&
```

Instead of BSTADMIN, you can also use the Interactive Interface dialogs (fastpath 28) for security maintenance.

User Security-Verification Routine

If you specify password-protection when you define a file or catalog, you can also supply your own routine to double-check the authority of a processing program to access the file. To use this routine, specify the name of *your* user security-verification routine (USVR) in the AUTHORIZATION parameter of the DEFINE or ALTER command.

The verification routine must be a phase residing in the library (LIBDEF=). VSE/VSAM transfers control to the verification routine only after the program that tries to open the file gives a correct password other than the master password. (The verification routine is always bypassed whenever a correct master password is specified.) The authorization option can also include a maximum of 255 bytes of information which will be passed to the authorization routine when it is called. The verification routine receives control in AMODE24. Therefore, the routine must reside below the 16MB line of address space. When the authorization routine gets control from VSE/VSAM, the registers are set as shown in Table 21 on page 116.

Table 21. Register Settings on Passing Control to Authorization Routine

Register	Content
0	Unpredictable.
1	Address of a parameter list with the following format: 44 bytes: File-ID. 8 bytes: Prompting code (specified by the CODE parameter), or zero. 8 bytes: Owner-ID (specified by the OWNER parameter), or zero. 8 bytes: Password that has already been verified. 2 bytes: Length of the authorization string (next field). Up to 255 bytes: Authorization string (specified in the AUTHORIZATION parameter) of DEFINE or ALTER.
2-12	Unpredictable.
13	Address of save area. Note: This address must not be destroyed by the USVR.
14	Return address to VSE/VSAM.
15	Entry point to verification routine.

The USVR should *not* issue any VSE/VSAM macros because they will cause VSE/VSAM to loop. The USVR should return control to the program for any VSE/VSAM requests.

When the authorization routine returns to VSE/VSAM, register 15 should be set to zero if the processing program is authorized to access the file or catalog. If register 15 is not zero, VSE/VSAM does not allow the processing program to open the file.

Protecting Shared Data

Files can be shared among partitions, among tasks in a partition, or among z/VSE systems. File sharing is controlled by the use of the SHAREOPTIONS parameter in the DEFINE command, and the type of processing (input or output) for which the file was opened.

For sharing among systems, you must establish the DASD sharing environment through the correct system generation and IPL commands. You are also responsible for ensuring that the volume containing the file is mounted on a *shared device*.

In determining the level of sharing you intend to allow, you must evaluate the consequences of a loss of *read integrity* (reading the correct information) to the processing program, and a loss of *write integrity* (writing the correct information) to the file owner.

The degree of sharing to be allowed for the file is specified, when the file is defined, in the SHAREOPTIONS parameter of the DEFINE command. The SHAREOPTIONS parameter can be changed by the ALTER command (if the file is not concurrently open for another program). A file cannot be deleted or reset if it is currently open for another program, regardless of the share option specified.

During the initial load of a file (and regardless of the share option values specified), VSE/VSAM treats the share option specification as if it were *share option 1* (see below). After the file is loaded and successfully closed, VSE/VSAM uses the specified share option value.

One of the following file share options can be specified, where every open ACB counts as one request:

- Share option 1: The file may be opened by any number of requests for input processing (retrieve records), or it can be opened by one request for output processing (update or add records). This option ensures full (read and write) integrity. Every open ACB counts as one request.
- Share option 2: The file may be opened by more than one request for input processing and, at the same time, it may be opened by one request for output processing. This option ensures write integrity but, because the file might be modified while records are retrieved from it, read integrity must be ensured individually by every user.

- Share option 3: The file can be opened by any number of requests (ACBs) for both input and output processing. VSE/VSAM does nothing to ensure either the integrity of information written in the file or the integrity of the data retrieved from the file. VSE/VSAM does ensure, however, that an open file is not deleted or reset.
- Share option 4: A key-sequenced or relative-record file can be opened by any number of requests (ACBs) for both input and output processing by users in the first system requesting output to the file. Once a file has been opened for output by one system, VSE/VSAM accepts only open for input requests from another system.

  VSE/VSAM ensures write integrity by using the z/VSE LOCK facility. Read integrity is ensured by VSE/VSAM only when records are retrieved for update. If records are *not* retrieved for update, VSE/VSAM may miss or skip some of the records in CIs that are updated concurrently by more than one program. In this case, read integrity is not ensured, because every program might retrieve a different copy of the CI. If one task makes multiple GET/PUT requests (through two or more ACBs) to the same file, VSE/VSAM cannot resolve the integrity conflict and issues an error code. The requestor must resolve the conflict and retry the request.

Note: If you specify share option 4 for an ESDS file, VSE/VSAM treats the specification as if it were share option 2.

If a file cannot be shared for the type of processing you specify, your request to open a file is denied.

If a file is fully sharable (share options 3 and 4), more than one request can open it at the same time to update or add records. If the file is not sharable, only one request at a time can open it to update or add records. With share options 2, 3, or 4, any number of requests can retrieve records from the file regardless of whether it is sharable or not. With share option 1, data retrieval is prevented by the OPEN macro if the file is already opened for output.

If an alternate index is defined with the UPGRADE attribute and share option 1 or 2, keep in mind the restrictions on the number of requests that can open it for input and/or output processing. For example, if you specify share option 2 for an alternate index that is a member of an upgrade set, you cannot open another update path over the base cluster, or the base cluster itself, for output. This is because share option 2 does not allow a file to be opened twice for output.

Cross-Systems Sharing

VSE/VSAM allows the sharing of catalogs and files across z/VSE systems. To this end, the catalogs and files must reside on *shared devices* that have been defined to the supervisor at IPL.

Each shared devices must have a unique volume identifier across all systems, because all locks are done using the volume of the catalog and the CI number within the catalog. Thus, if two catalogs are defined on DASDs with a duplicate VOLID in two different z/VSE systems, a lock from one system may interfere with a lock on another system and cause a catalog corruption.

You do not specifically invoke cross-system sharing when opening catalogs and files, because:

- Catalogs are automatically shared if they reside on shared devices.
- Files are automatically shared if they are owned by a shared catalog.

To ensure data protection, the degree of *file sharing* that is to be allowed can be specified in the SHAREOPTIONS parameter of the IDCAMS commands: ALTER, DEFINE CLUSTER, and DEFINE ALTERNATEINDEX. The following explains various options and their results.

- Specifying SHAREOPTIONS(4)

  This specification provides:

  – *Input OPEN function* for all the systems that participate in cross-system sharing, and

  – *Output OPEN function* only for the first system that requests it.

  If you ignore this behavior, VSE/VSAM issues an OPEN error message with the error code 168 (X'A8') when trying to open a file. The error code means that the file is already opened for output from a

different processor, and that only one processor may write output to the file at a time. In this case the OPEN error message is accompanied by the explanatory message:

```
FILE ALREADY OPEN IN ANOTHER PARTITION, RC X'rc_value' TASK X'task_id'
```

which shows the owning task ID as X'FFFF'. The actual task ID will appear here only if the file is opened in another partition of the same processor.

- Specifying SHAREOPTIONS(4 4)

  This specification provides OPEN functions for input *and* output processing for all the systems that participate in cross-system sharing. It provides full read and write integrity for a file that is accessed from:

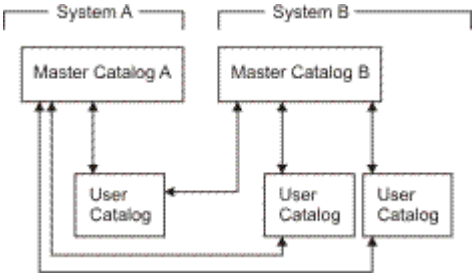
  – Different partitions of a particular CPU, or

  – Different CPUs.

  Note: With SHAREOPTIONS(4 4) specified, the lock file activity (with regard to z/VSE DASD sharing) increases. This may have an effect on performance.

- Defining Shared User Catalogs

  You may wish to have a non-shared master catalog on every system, and shared user catalog(s) that connect to every master catalog as illustrated in the following diagram:



  To do this, define the user catalog under one master catalog, then IMPORT CONNECT the user catalog to another master catalog. The shared (user) catalog(s) must contain entries for all shared files.

Data Integrity

To protect your VSE/VSAM data from accidental loss or destruction, you can use the IDCAMS commands and command options listed below, and you can use the following IBM utility programs:

- VSE/Fast Copy

  The use of this utility in a VSE/VSAM environment requires special considerations, because both the volume VTOC and the catalog contain space mapping information about the volume which has to be synchronized to insure accessibility and to avoid damage to data.

  With VSE/VSAM, data can be flexibly distributed among many DASD volumes (minidisks) of different device types and capacity. However, some rules need to be followed:

  – A catalog resides on a single volume.

  – Only one catalog can exist per volume.

  – A catalog may own space on any number of DASDs of different device types, sizes, and architectures.

  – Several catalogs can own space on the same volume, but then the recovery may become quite complex.

  – Each component of a cluster must reside on the same DASD type. The DASDs can have different sizes.

- VSE/VSAM VTOC Utility (**IKQVDU**)

For brief explanations on when to use which command, option, or utility, refer to Table 22 on page 125. The figure also shows where to find more detailed explanations and procedures.

IDCAMS Commands and Command Options for Data Integrity

BACKUP/RESTORE commands
DEFINE CLUSTER allocation option (See Note)
DEFINE CLUSTER RECOVERY|SPEED option
DEFINE CLUSTER DATA WRITECHECK option
DEFINE CLUSTER WRITECHECK option
DEFINE USERCATALOG command (See Note)
DEFINE SPACE command (See Note)
DELETE SPACE FORCE option
EXPORT/IMPORT commands
LISTCAT command
REPRO command
SNAP command
VERIFY command

Note: Though not specifically designed for the purpose of data integrity, the commands and options DEFINE SPACE, DEFINE CLUSTER, and DEFINE USERCATALOG can be used for that purpose as explained below.

Using the DEFINE SPACE Command

The DEFINE SPACE command and its DEDICATE parameter can be used to easily dedicate an entire volume to VSE/VSAM by defining a space that occupies the whole volume. Other volumes can be used exclusively for nonVSAM files. This allows recovery on a volume basis to be strictly VSAM or nonVSAM. If the volumes are mixed, two different approaches are needed for integrity. For example, a copy of the data on tape is needed to back up the nonVSAM data, but several exports may be all that is necessary for VSE/VSAM files. Both a COPY run with VSE/Fast Copy and the EXPORT command are necessary on the mixed volumes. If the volumes are segregated, only one of the integrity measures is necessary.

Using the DEFINE CLUSTER Allocation Subparameter

Secondary allocation that occurs after the last catalog backup results in new catalog records that are not available to the backup catalog. The allocation subparameter of the DEFINE CLUSTER command can be used to improve file integrity and reduce this exposure by eliminating or minimizing secondary allocation. An entry-sequenced file is extended only by adding new CAs to the end of the file. Thus, the effect of addition is predictable and the problem is eased. If it is impractical to allocate enough primary space to accommodate additions, the secondary allocation quantity should be large enough so that extension is infrequent.

When secondary allocation is done, a new back up of the catalog or file (or both) can be made. By monitoring the file statistics in the catalog, either by way of a LISTCAT command or by way of a SHOWCB macro against an open ACB (to inspect the number of bytes of available space), you can predict when secondary allocation will occur. You can determine if a secondary allocation took place with a SHOWCB or TESTCB for the RPL feedback information after every PUT request.

For a key-sequenced file the problem is much more complicated. If existing records are not lengthened and all additions are made to the logical end of the file, the situation is similar to that of an entry-sequenced file, except that the index must also be checked. The other patterns of insert and update activity are limitless. Some of them are specific and dictate specific back up strategies, but discussion here assumes a random distribution of activity against the file.

There are reasons, other than recovery, to design a key-sequenced file to minimize extensions. A control-area split takes a relatively long time. For many online systems this can be a serious disruption. A characteristic of key-sequenced files is that, assuming a random insert pattern, all CAs tend to split at roughly the same time. Because every split results in two CAs created from the original one, the file's physical size doubles in a short period of time.

For these reasons it is advisable to design free-space percentages to minimize the probability of a split for a given insert level, rather than to allow extra primary allocation for expansion. The file should be reloaded (reorganized) when its insert level approaches the design point. For further information, see “Distributed Free Space” on page 101.

Using the DEFINE USERCATALOG Command

The DEFINE USERCATALOG command can be used to create many user catalogs (as many as one per volume) and reduce the number of files per catalog. If a catalog becomes unusable and has, for example, only ten files cataloged in it, access to only those ten files has to be recovered.

Note that once a catalog has been destroyed, the data it controls can no longer be accessed. Thus, if a system contains only one (master) catalog and that catalog is destroyed, the resources of the whole system are lost and must be restored by the use of backup copies.

Catalogs with *only nonVSAM entries* can be backed up with VSE/Fast Copy. After the volume is restored, only those jobs that updated the files since the backup was made would have to be rerun.

When several user catalogs are involved, only the resources controlled by the destroyed catalog are affected, and it can be rebuilt while processing on other data continues. Because user catalogs (like the master catalog) are self-describing, you need only rebuild the master catalog and the resources directly connected to it. This applies even if the master catalog has been destroyed. No files in a user catalog connected to that master catalog can be accessed until the user catalog is again connected to a master catalog.

Protecting VSE/VSAM Files and Volumes

You must plan in advance how much and what kind of protection you need. You need to consider questions such as:

- Does it take less time, effort, or expense to recreate lost data than it does to maintain backup copies?
- Should I segregate VSAM and nonVSAM files and make maximum use of recoverability, or is it sufficient to use VSE/Fast Copy plus the file update reruns necessary to make the file current?

The following explanations should help you answer such questions.

Backup Considerations

In choosing methods of back up and recovery, you need to consider the physical matters of accomplishing the work, and the need for back up, operational characteristics, and security and integrity of the backup medium.

- *Necessity for Back Up*: If the file can be recreated from the original input or from records or journals you kept, perhaps there is no need for back up. Considering the time required for regular backup procedures and the relative infrequency of recovery, many files may fit into this category.
- *Operational Factors*: You should consider frequency of back up and possible frequency of recovery, time required for back up and recovery, and the ease or difficulty of the backup and recovery technique used.
- *Frequency Factors*: In deciding for the best method for back up and recovery, you have to find a good balance between the *frequency* of, and the *time required* for making back ups and recoveries. You may find some methods are considerably easier to use than others but may require more time to accomplish. Thus, a method that might be suitable for one file because of its relative infrequency of backing up might be unacceptable for another file that must be backed up frequently.
- *Time Required Factor*: The time required for back up and recovery may be a deciding factor in the choice of method, particularly for real-time systems where recovery must be accomplished quickly. A method that takes longer may have other characteristics that are more desirable. Time required for recovery may also necessitate that a backup technique be used that takes longer.
- *Ease of Use*: The alternatives for back up and recovery vary widely in relative ease of use. Complicated methods that are difficult to use may cause errors, which makes recovery much more time consuming

than estimated. If recovery is infrequent, a difficult method may require more time to reason out than another method would require to do the actual recovery.

- *Physical Security and Integrity*: Security and integrity of the backup medium are often neglected. Measures used while data is on the system are of no use for a backup copy that is stored elsewhere. Security and integrity factors may also need to be reviewed as the nature of data changes in an installation.

Relationship of Catalog Entries to VSE/VSAM Files and Volumes

The VSE/VSAM catalog contains information essential to accessing and controlling its files and volumes. Note the following:

- All VSE/VSAM files must be cataloged. Because the physical and logical description of a file is contained in its catalog entries, VSE/VSAM requires up-to-date catalog entries to be able to access files.
- For multivolume files, the same catalog must own space on all current and candidate volumes.
- Logical and physical mapping information is contained in the catalog entries. For files defined in nonunique VSE/VSAM data spaces, the catalog contains the only record of the physical extents allocated to the file. For unique files, entries in the VTOC also contain a record of physical extents. In both cases, only the catalog contains the logical-to-physical mapping information (the relationship of the RBA ranges of the file to the physical extents).

All other types of data access must use catalog information.

Creating Backup Copies of VSE/VSAM Files

Several methods of back up and recovery can be used for VSE/VSAM files. Usually, it is not possible to use only one method for all files in an installation. You should consider individual files or groups of files, and then determine the most suitable method for each.

- Use the BACKUP command to create a copy of the file on tape or disk. The command backs up empty objects, including catalog entries.

  Note: The file you are backing up must be available for an INPUT OPEN. The OPEN *might* fail if the file is currently opened for input or output by another partition or system. Because the OPEN might not *always* fail, it is strongly recommended that the file which is being backed up should not be opened for output by any other partition or system. Otherwise, the resulting backup copy might not represent the actual state of the original file.

  Use the RESTORE command to create - from the backup copy - an object that is equivalent to the original one. You can also use the RESTORE command to move the files to a different disk device type, or to increase the allocation size of a file.

  You can back up (or restore) all the objects owned by one catalog (or contained on the backup file) with a single command. Generic names let you include or exclude subsets of objects from the backup or restore operation.

  Note that the format of the file produced by BACKUP is different from the format produced by EXPORT. Therefore:

  – RESTORE cannot process files created by EXPORT, and

  – IMPORT cannot process files created by BACKUP.

  Recommendation: Because of their performance advantage, BACKUP and RESTORE should be used for regular back up of files, with restoration as necessary. EXPORT and IMPORT should be used for migration between VSE/VSAM and MVS, and for reorganization on record-level or CI-level. For optimum performance a COMPRESSED file is stored by BACKUP. A compressed file can only be restored on a system with support for VSE/VSAM data compression (that is VSE/VSAM Version 2 or later).
- Use the EXPORT command to create an unloaded, portable copy of the file. The operation is simple. There are options that offer protection, and most catalog information is exported along with the data, easing the problem of redefinition. You can prevent the exported file from being updated until the

IMPORT command reestablishes its accessibility. A COMPRESSED file is backed up by EXPORT in an uncompressed format, hence the IMPORT can be done by any system supporting the IMPORT command. IMPORT defines the file as a NOCOMPRESS file, unless the target file is a pre-defined, empty file with the COMPRESS attribute.

For more information and examples, refer to the VSE/VSAM Commands, SC34-2707 .

- Use the REPRO command to create either a SAM file, or a duplicate VSE/VSAM file for back up. The advantage in using REPRO (instead of EXPORT) is the accessibility of the backup copy. A DEFINE command is required before reloading, but this is a relatively minor inconvenience, particularly if the original DEFINE statements can be used. A COMPRESSED file is copied by REPRO in an uncompressed format.

  For more information and examples, refer to the VSE/VSAM Commands, SC34-2707.
- User-written programs for back up are usually appropriate when the data has some characteristic that does not allow you to take advantage of a generalized backup method. Files for which not all records have to be saved for back up might fit into this category. Also, keyed sequential files which have to be processed sequentially on a regular basis could be backed up by creating a sequential file as a by-product.

You must keep in mind that any backup procedure that does not involve an image copy of the file (for example, the BACKUP, EXPORT, and REPRO commands do not provide an image copy of the file) will result in data reorganization and the re-creation of the index for a key-sequenced file. Therefore, any absolute references by way of RBA may become invalid.

Creating Backup Copies of Volumes

You can use VSE/Fast Copy to create a backup copy of an entire volume and to restore that copy on a volume. However, the use of this utility in a VSE/VSAM environment requires special considerations, because both the volume VTOC and the catalog contain space mapping information about the volume that has to be synchronized to ensure accessibility and to avoid damage to data. Therefore, it is generally recommend that every volume should have its own user catalog. This can make the problem of synchronizing data and catalog information much simpler.

For details on how to use VSE/Fast Copy, refer to the z/VSE System Utilities, SC34-2675.

For information on how to solve problems relating to catalogs and volumes, refer to “Procedures for VSE/VSAM Recovery” on page 128.

Protecting VSE/VSAM Catalogs

Because of the importance of the VSE/VSAM catalog, you should consider to back up catalogs as well as files and volumes. If all of the files owned by a catalog are backed up individually, it is possible to recover from destruction of the catalog by carrying out recovery procedures for every file. The probability of losing an entire catalog is very low. However, to speed recovery or minimize exposure in the case of catalog damage or destruction, three backup methods are available:

- Use the REPRO command to create a backup copy of either a master catalog or user catalog, and to reestablish that backup copy as a catalog. Use the command to unload the catalog to a VSAM or nonVSAM file.

  This set of functions is referred to as catalog *unload* and *reload*. The REPRO command requires no special parameters to perform the function. The unload function is triggered when the REPRO source is a catalog. The reload function is triggered when the REPRO target is a catalog. When a new catalog is defined, an unloaded catalog file may be reloaded into the newly defined catalog, or the unloaded catalog can be reloaded into a version or the original catalog.

  Before using *REPRO unload/reload* as the method for catalog recovery, refer to the VSE/VSAM Commands, SC34-2707 for a description on how to use REPRO for catalog backup and file reorganization.
- Use VSE/Fast Copy to back up the entire catalog volume.

The following explains how to proceed if integrity problems occur with catalogs, files, or volumes.

Creating Backup Copies of Catalogs

You should protect catalogs by backup procedures against:

- Loss of data.
- Unusable catalog.

Protect Against Loss of Data, and Recover

The only way to safeguard against loss of data is to have a copy of the data in another form or place. The usual method of doing this is to use the BACKUP command of the VSE/VSAM Backup/Restore Function to copy the volume to tape or to another disk volume.

If you have lost a file and if you do have a backup copy, use the RESTORE or IMPORT command to copy the volume to disk. Then reprocess any updates made since the backup copy was made. If you do *not* have a backup copy of the file, you must recreate the file by redefining, loading, and updating the file.

Before you restore a volume, consider the following:

- If the information on the restored volume is downlevel, (your original volume has been updated since the back up was made), you must apply the updates to the restored level of the volume to bring it to the level of the original volume.
- If the volume is not the catalog volume, you have information about the volume in the catalog that may not match what is actually on the volume. It would be helpful to have a LISTCAT listing of the catalog at the time you created the backup copy to compare with a present listing. The data spaces and file extents may be different if any file updates have been made since the back up was made. See “Volume is Inaccessible” on page 134 for a complete recovery procedure.
- If the volume is the catalog volume, all of the volumes owned by the catalog may have file and data space extents that do not match the catalog information. Again, LISTCAT listings of the backup copy and the original catalog can be of help. Every volume must be handled as if the volume was just restored. See “Volume is Inaccessible” on page 134.

Protect Against Unusable Catalog, and Recover

If there is *no* loss of data, but the catalog is partially or totally unusable, you can use (depending on prevailing conditions) one or the other of the following methods:

- If REPRO has been used to periodically copy your catalog, perform the following steps:
  1. BACKUP or EXPORT those files that have been updated (and that can still be accessed through the catalog) since the catalog copy was made.
  2. Reload the catalog using the catalog REPRO copy.
  3. RESTORE or IMPORT the files copied in step 1.
  4. If there are files that were updated but could not be copied by BACKUP or EXPORT, recreate the files from back level copies by reprocessing updates.

  If you do not have a REPRO unload copy, you have to restore a volume backup as explained under “Volume is Inaccessible” on page 134.
- If you do *not* have a copy of the catalog, perform the following steps:
  1. BACKUP or EXPORT those files that have been updated (and that can still be accessed through the catalog) since the last backup.
  2. Delete the data spaces from the volume.
  3. Redefine the catalog and data spaces.
  4. RESTORE or IMPORT the files copied in step 1.

5. RESTORE or IMPORT the files not copied in step 1 from the backup tape.
6. If there are files that could not be processed in step 1, recreate them from back level copies by reprocessing updates.

Rebuilding a Catalog

You may have to rebuild your catalog if it gets damaged. Use the following procedure:

1. Run a LISTCAT command to determine which files own space on the volume. Assuming that you want to save the contents of these files, determine if an acceptable back level copy exists of each. If not, save the contents of these files by running either BACKUP or REPRO.

   The BACKUP command is preferable, because it automatically saves any alternate indexes built over the cluster backed up. (If REPRO is used, you must rebuild these alternate indexes at restoration.) If there is catalog damage, it may not be possible to recover all files.
2. Issue a DELETE command for every object in the catalog. (alternate indexes and paths associated with the file are automatically deleted.)
3. Issue a DELETE SPACE command for all volumes owned by the catalog.
4. Delete the catalog itself.
5. Define the catalog.
6. Issue a DEFINE SPACE command for any volumes on which the catalog will own space.
7. Define a compression control data set.
8. If any files (and associated alternate indexes or paths) were deleted in step 1, reintroduce them into the catalog in one of the following ways:
   - If you used BACKUP in step 1, use the RESTORE command to define and restore objects saved in step 1.
   - If you used REPRO in step 1, DEFINE every object that was deleted in step 2. Then use REPRO to restore the objects saved in step 1. Also DEFINE any alternate indexes or paths deleted in step 2. Recreate any associated alternate indexes using the BLDINDEX command.

Guide to VSE/VSAM Recovery

About Data Organization and Recovery

Questions and considerations on *VSE/VSAM recovery* have a very close relationship to how you organize the VSE/VSAM data so that it can be recovered more easily, and on how you provide for backup data. For information on these topics, refer to:

"Data Integrity" on page 118
"Protecting VSE/VSAM Files and Volumes" on page 120
"Protecting VSE/VSAM Catalogs" on page 122

If the time required for recovery is the governing factor, follow the preparation and recovery steps explained under "Quick Recovery" on page 135.

About the Recovery Process

VSE/VSAM recovery is the process of regaining access to lost VSE/VSAM data. To regain access to lost data, you can use a combination of functions from VSE/VSAM, IDCAMS, and z/VSE system utilities.

Levels of Recovery

The types of VSE/VSAM data recovery, in terms of the currency of the recovered data, are: *current* and *downlevel*.

The *current* type of data recovery operation restores addressability and access to the most recent version of the data. Operations that recover current data are generally used to correct problems such as read and write errors associated with the data itself or with the data description.

The *downlevel* type of data recovery operation restores addressability and access to a version of the data other than the most recent. Operations that recover downlevel data are generally used to correct logical problems such as a programming error or faulty transactions. This is the most common type of recovery, probably because of the types of problems encountered and the level of data available for recovery. An example of a downlevel recovery is the restore of a volume.

Note: Some of the utilities (listed in Table 22 on page 125) can only recover data that currently is not *downlevel*. Further processing is necessary to make the file, volume, or catalog current.

Tools for Data Integrity, Backup, and Recovery

Table 22 on page 125 lists the integrity options, backup programs and commands, and recovery tools. In the figure, the column headings that are not self-explanatory have the following meaning:

TOOL TYPE indicates where the tool is supported: in VSE/VSAM, in IDCAMS, or in z/VSE. For more information on *current* and *downlevel*, refer to "Levels of Recovery" on page 125.

FILE TYPE indicates what is recovered:

FILE means VSE/VSAM file.
VOL means volume.
CAT means VSE/VSAM catalog.

TOOL CLASS indicates the command or program class:

INT is any tool that is a VSE/VSAM integrity option.
BKP is a backup command or program other than recovery, and other than recovery-type tools.

(X) in the last column means that you have to refer to the VSE/VSAM Commands, SC34-2707. There, you find the discussion under the quoted title.

Table 22. Tools for Integrity, Backup, and Recovery

Tool Name	Tool Type	File Type	Tool Class	Application	Where Discussed
VSE/Fast Copy	z/VSE Utility	VOL	BKP	Use the *VSE/Fast Copy* system utility to create a backup copy of an entire volume and to restore that copy on a volume. The use of this utility in a VSE/VSAM environment requires special considerations, because both the volume VTOC and the catalog contain space mapping information about the volume which has to be synchronized to insure accessibility and to avoid damage to data.	• In the z/VSE System Utilities.

Table 22. Tools for Integrity, Backup, and Recovery (continued)

Tool Name	Tool Type	File Type	Tool Class	Application	Where Discussed
BACKUP/ RESTORE	IDCAMS	CAT or FILE	BKP	Use BACKUP and RESTORE for high-speed data recovery operations, or to move files to a different disk device type, or to change the allocation size of the file. Besides, you can just print the contents of the tape or disk without restoring objects.	• **(X)** VSE/VSAM Commands • "Creating Backup Copies of VSE/VSAM Files" on page 121, and "Creating Backup Copies of Catalogs" on page 123.
EXPORT/ IMPORT	IDCAMS	FILE	BKP	Use the EXPORT command to create backup copies of data and associated catalog entries. The catalog entries can be reestablished in the catalog from which they were extracted or into a different catalog using IMPORT command. The data file is reestablished by IMPORT without redefining it.	• **(X)** VSE/VSAM Commands • "Creating Backup Copies of VSE/VSAM Files" on page 121, and "Creating Backup Copies of Catalogs" on page 123.
LISTCAT	IDCAMS	FILE, VOL, CAT	REC	Use the LISTCAT command to list the contents of a catalog after a recovery operation. Visually compare this list with a copy of the LISTCAT list most recently done before the recovery. For a description of the out-of-synchronization condition you may find, see "Catalog Entry Mismatches" on page 132.	• **(X)** VSE/VSAM Commands • "Catalog Entry Mismatches" on page 132.
REPRO	IDCAMS	CAT	BKP	The REPRO command is used to create a backup copy of catalog. The unloaded or backup copy can be reloaded into a newly defined catalog or a version of the original if the backed up catalog becomes unusable.	• **(X)** VSE/VSAM Commands • "Creating Backup Copies of Catalogs" on page 123.
SNAP	IDCAMS	VOL	BKP	Use the SNAP command to copy entire ESS volumes so that a backup operation can be performed on the target volumes involved. Access to SNAP can be restricted by using RACROUTE security.	• Chapter 10, "Performing an IDCAMS SNAP (FlashCopy)," on page 165 • **(X)** VSE/VSAM Commands
VERIFY	IDCAMS	FILE	INT	Use the VERIFY command if you want to compare the file's catalog information with the EOF indicator in the file.	• **(X)** VSE/VSAM Commands

Table 22. Tools for Integrity, Backup, and Recovery (continued)

Tool Name	Tool Type	File Type	Tool Class	Application	Where Discussed
VTOC Utility (IKQVDU)	VSE/VSAM Utility Program	VOL	BKP	Use the VSE/VSAM VTOC utility program IKQVDU to initialize a VSE/VSAM-owned volume when the owning catalog is not available. VSE/VSAM volume ownership can be given up and VSE/VSAM space can be returned to the VTOC as available space. All data in that space is lost. Caution. The owning catalog is not modified.	• “Maintaining VTOC and VOL1 Labels on Disk (IKQVDU)” on page 343.
DEFINE SPACE	IDCAMS	VOL, CAT	INT	Use the DEFINE SPACE command to dedicate use of volumes for VSE/VSAM files in order to segregate VSE/VSAM and non-VSE/VSAM recovery. You can dedicate a volume by defining a VSE/VSAM data space that occupies the whole volume, or by specifying the DEDICATE parameter.	• **(X)** VSE/VSAM Commands. • “Data Integrity” on page 118.
DEFINE USER-CATALOG	IDCAMS	VOL, CAT	INT	Use the DEFINE USERCATALOG command to maximize the use of user catalogs and to limit the use of the master catalog. Compare the effect of the loss of a catalog when 10 files are cataloged and 50 files are cataloged in every of two catalogs. The fewer the catalogs the greater the disruption of daily operations in the event of loss of a catalog.	• **(X)** VSE/VSAM Commands.
DEFINE option WRITE-CHECK	IDCAMS	FILE	INT	Use the optional WRITECHECK parameter of the DEFINE command to verify every write operation when writing data to auxiliary storage. (See the WRITECHECK parameter for an explanation.)	• **(X)** VSE/VSAM Commands. • **(X)** VSE/VSAM Commands.

Table 22. Tools for Integrity, Backup, and Recovery (continued)

Tool Name	Tool Type	File Type	Tool Class	Application	Where Discussed
DELETE SPACE FORCE	IDCAMS	VOL	INT	Use the DELETE SPACE FORCE command to remove information from both the VTOC and the catalog. When space is deleted by using FORCE option, the VTOC's VSE/VSAM volume ownership is given up (if no other catalogs own space on that volume), the catalog's VSE/VSAM space is returned to the VTOC, the space definition in the catalog for that volume is deleted, and VSE/VSAM files on that volume are marked as unusable in the catalog. If you want to redefine the files, you must first delete them.	• **(X)** VSE/VSAM Commands.
DEFINE CLUSTER RECOVERY SPEED	IDCAMS	FILE	INT	When you define a cluster, you can indicate that VSE/VSAM is to preformat every CA as records are loaded into the cluster (RECOVERY) or is not to preformat them in interest of performance (SPEED). As records are loaded into a preformatted area there is always a following end-of-file indicator that indicates how far loading has progressed. If an error occurs that prevents loading from continuing, you can readily identify the last successfully loaded record and resume loading from that point.	• **(X)** VSE/VSAM Commands. • "Data Protection and Integrity Options" on page 100.
DEFINE CLUSTER ALLO-CATION	IDCAMS	FILE	INT	Minimize or eliminate secondary allocations for files to overcome the difficulty in catalog recovery stemming from secondary extents.	• "Using the DEFINE CLUSTER Allocation Subparameter" on page 119.

Procedures for VSE/VSAM Recovery

You can use the following procedures to analyze and to recover from the following conditions:

- "File is Not Properly Closed" on page 129, below
- "File is Inaccessible" on page 130
- "Catalog is Unusable" on page 131
- "Volume is Inaccessible" on page 134

Because the two activities *backup* and *recovery* overlap, read also the explanations under:

"Creating Backup Copies of VSE/VSAM Files" on page 121
"Creating Backup Copies of Volumes" on page 122
"Creating Backup Copies of Catalogs" on page 123

Several of the following procedures use volume restore. If this is indicated, one or the other of the following must be true:

- The volume restored does not contain multivolume files.
- If a volume does contain a portion of a multivolume file, all volumes that contain portions of those multivolume files are treated as a single unit. That is, if a volume is required, the entire set is restored.

File is Not Properly Closed

Cause of Failure

VSE/VSAM files are not properly closed when they are opened for output and a system failure occurred, or automatic CLOSE was not activated. This condition is reflected in the catalog and is communicated to the next program that does an OPEN of the file. There is a possibility that the failure occurred after the load or update of the file was complete. In this case, the file itself and the file's catalog entry are correct.

Error Conditions:

- Incorrect high RBA in catalog
- Incomplete write to direct access device
- Duplicate data

Overview

The warning "file not properly closed" may indicate an error in a VSE/VSAM file. This condition can generally be corrected by using the VERIFY command. If other errors are encountered or suspected, they can generally be corrected by using either the IMPORT command or the REPRO command.

Recovery for Incorrect High RBA in Catalog

This is the error most likely to occur. If you are running in RECOVERY mode, all you need to do is reopen the file, and the automatic VERIFY function of VSE/VSAM will correct the error and update the catalog with the correct high RBA. However, VSE/VSAM cannot correct the following:

- If an ESDS file opened for control interval (CI) access.
- If a SAM ESDS file is in non-CI format.
- If a SAM ESDS file is in CI format. VSE/VSAM cannot update the EOF indicator, because the file is always loaded and extended in SPEED mode.

Recovery for Incomplete Write to a Disk Device

The file must be restored from a backup copy. You can use either an exported or sequential backup copy created by the REPRO command.

Use the IMPORT command to put a previously exported copy into the catalog, or:

1. Delete the file that failed.
2. Redefine the file with the DEFINE command.
3. Load the new file with the sequential backup file by using the REPRO command.

The restored file is downlevel and all updates since the back up was made must be reapplied to make the file current.

Recovery for Duplicate Data in a Key-Sequenced File, Alternate Index, or Catalog

This can result from a failure during a CI or CA split. One of two possible situations can exist for a duplicate data error conditions, depending on the type of processing done.

For addressed or control interval (CI) processing, you correct the error condition by using the REPRO command to copy the current version of data to a temporary file and then copy it back into the original file. This gives you a reorganized file without duplicate data.

For keyed or sequential processing, VSE/VSAM automatically detects and corrects the duplicate data condition. (VSE/VSAM erases the original versions of the copied records.) Duplicate records caused by a failure during a CI split may cause an error if the file is processed by z/VSE.

File is Inaccessible

Cause of Failure

A VSE/VSAM file may become inaccessible due to damage to the file itself, damage to related information in the catalog, or both. Depending on the extent of damage and prior actions, it may be possible to gain access to either the current or a downlevel version of the data.

Error Conditions:

- The file cannot be opened
- The file is partially unreadable (but can be opened)
- The file is totally unreadable (but can be opened)
- The compression status of the file is CMP-UNDET

Overview

The inaccessibility of a VSE/VSAM file can be analyzed by using the LISTCAT command, and the extent of file damage can be determined. Based on the analysis, you can recover the data by using BACKUP/RESTORE, EXPORT/IMPORT, and REPRO.

Recovery for a File that Cannot Be Opened

The problem is probably due to catalog damage. Determine the extent of this damage. If the damage is relatively minor (that is, relatively few catalog file entries are affected):

1. Use the analysis tool LISTCAT to determine the extent of damage. This can be done by comparing a previous LISTCAT list with one of the damaged catalog.
2. For a *catalog*, if a back level copy of the file is available, you can RESTORE or IMPORT the file to gain access to the file.

Recovery for a File that is Partially Unreadable

The problem is either confined to the file itself, or to an entire physical extent of the file.

1. Use an analysis tool as outlined in “Recovery for a File that Cannot Be Opened” on page 130 to determine if there is a mismatch in the number of extents. If the catalog indicates one or more extents than there are on the volume, it may be caused by a volume restored independent of the catalog.
2. For a catalog, you can import a previously exported copy. See “Recovery for a File that Cannot Be Opened” on page 130 for use of these tools.

3. If there is no catalog mismatch, a backup copy of the file must be restored, using BACKUP/RESTORE, EXPORT/IMPORT, or REPRO.

Recovery for a File that is Completely Unreadable

Either the file has been destroyed, or the catalog and volume are not synchronized.

1. Analyze the catalog with LISTCAT to determine if the damage is in the file or in the catalog.
2. Regain access to data
   - If the damage is to the file or a catalog, use IMPORT or REPRO to restore the file. This gives you access to a downlevel copy of the data.
   - If the file has a CMP-UNDET compression status, the backup copy of the file must be restored, using BACKUP/RESTORE, EXPORT/IMPORT, or REPRO.

Catalog is Unusable

Cause of Failure

A catalog may become unusable because of physical damage to the catalog. Depending on the extent of the damage and prior actions, it may be possible to gain access to current level catalog entries or to downlevel catalog entries.

Error Conditions:

- Catalog can be opened, but many VSE/VSAM files cannot be opened.
- The catalog cannot be opened.
- The catalog volume is unusable.

Overview

An unusable catalog can be reestablished, provided certain backup procedures made possible by the system copy utility and the REPRO command are followed. This provides a downlevel version recovery when a file or volume is damaged or unusable.

Recovery for a Catalog that Can Be Opened, but Many VSE/VSAM Files Cannot Be Opened

A problem with the catalog probably exists. This can be determined by using an analysis tool. If I/O errors are encountered or mismatches are detected, some form of catalog recovery is required. If not, the problem is confined to the files themselves and the procedures given for “Recovery for a File that Cannot Be Opened” on page 130 can be used.

1. Use the analysis tool LISTCAT to determine if a problem exists in the catalog. This can be done by comparing a previous LISTCAT list with one of the suspect catalog.
2. If the problem is with the catalog, recovery depends on the availability of backup copies of the catalog, volumes, and files.

   Proceed as follows:

   a. Delete each VSE/VSAM file that cannot be opened.
   b. Redefine these files in the catalog, or use the IMPORT command to load backup copies created by the EXPORT command.
   c. If backup copies created by the EXPORT command are not available, load the files with backup REPRO copies, if available.

Recovery for a Catalog that Cannot Be Opened

You must have either:

- Backups of all data sets of this damaged catalog, or
- A copy of the whole volume.

For *catalogs*, proceed as follows:

1. As applicable:
   - Reload the backups of the data sets into a newly defined catalog.
   - Restore the copy of the whole volume.
2. Use LISTCAT listings of backup files and current files to determine if there are mismatches. If entry mismatches are detected, see "Catalog Entry Mismatches" on page 132.
3. For those files with other than an RBA or general mismatch, delete the file and reestablish with a backup copy of the file created by the IMPORT command or the REPRO command.

Recovery for a Catalog Volume that is Unusable

- See the procedure "Recovery for a Catalog that Cannot Be Opened" on page 132.

Catalog Entry Mismatches

Whenever a catalog is used out of synchronization with the volumes it owns, there is the possibility that the information in the catalog does not match the physical characteristics of the volumes or files that it describes. Catalog entry mismatches may indicate that the data is inaccessible, partially accessible or completely accessible.

The descriptions of catalog mismatches are meant to guide you through a comparison of two LISTCAT listings that you have produced:

One listing of a catalog taken *before* the catalog is restored.
One listing of a catalog taken *after* the catalog is restored.

If you notice a difference in the entries of the two listings:

1. For the description of LISTCAT keyword fields, consult the VSE/VSAM Commands, SC34-2707.
2. Determine what mismatch has occurred by following the descriptions given under "Determination of Mismatches" on page 132 below.

This method is for the analysis of catalogs for out of synchronization conditions that may occur when the catalog is restored to a previous level.

Determination of Mismatches

By comparing the LISTCAT runs that were made when the catalog was backed up with those when the catalog is restored, critical changes can be detected.

Volume Mismatches

- Mismatched Space Map

  This mismatch indicates that the catalog does not correctly reflect the tracks (Min CAs) on the volume occupied by its VSE/VSAM files. Files wholly contained in space correctly indicated as allocated can be accessed if their file descriptions in the catalog are correct.
- Mismatched Data Space Group

This mismatch shows that the catalog does not correctly reflect the VSE/VSAM files that it owns on the volume. Files wholly contained within data spaces that are accurately described are accessible if their file descriptions in the catalog are correct.

- Mismatched File Directory

  This mismatch shows that the catalog does not correctly reflect the files it owns on the volume. Files known from the file directory are accessible if their descriptions are correct.

File Mismatches

- Mismatched Statistics

  These mismatches do not affect accessing of a file.

- Mismatched High RBA

  This mismatch indicates that the catalog does not correctly reflect the end of data in a file. Correct this condition by reopening the file, which causes automatic VERIFY to reset the high RBA.

- Mismatched Extents

  This mismatch indicates that the file has acquired additional extents that are not reflected in the catalog. The data contained in the extents that are correctly identified may be accessed. For a key-sequenced file it may be necessary to treat the data portion as an entry-sequenced file 0n order to access the data.

- Mismatched Volume or Key Range

  This mismatch indicates that the file:

  – Was extended to a volume which is unknown to the catalog's file record, or
  – On the volume has the same name as the catalog, but it is not the same file that is described in the catalog.

  If the file was extended to a volume not known in its catalog record, the extents of the file on that volume are not accessible. The extents of the file on known volumes may be accessible.

Actions that Cause Catalog Mismatches

There are several actions that cause mismatches from a backup catalog. Some of these are overt actions such as the use of the DEFINE and DELETE commands to create files or data spaces. Others are automatic system actions, such as acquiring additional extents.

- Define/Delete/Extend Data Space

  Any of these actions cause the data space group set of fields for a data space to be invalid in a backup catalog.

- Define/Delete Files

  Either of these actions cause the file directory in the volume record and some of the file entries to be invalid in a backup catalog. The use of the EXPORT command may cause a deletion. The use of the IMPORT command always causes an entry definition.

- Add/Remove Volumes

  The ALTER ADDVOLUMES command is used to add a volume to a file as a candidate. The ALTER REMOVEVOLUMES command is used to remove a volume from a file as a candidate.

- File Extension through Suballocation

  Extension causes the volume space map in the backup catalog to be invalid as well as the entry for the file.

Minimization of Catalog Mismatches

The possible catalog mismatches described above, which cause files to be wholly or partially inaccessible, are all caused by the DEFINE, DELETE, and ALTER commands, or by the extension of VSE/VSAM files or data spaces. Because DEFINE, DELETE, and ALTER are always known to you, a backup copy of the catalog can be made every time one of these commands is used. Therefore, the only action that invalidates a backup catalog without you being aware is the extension of space. Thus, the minimization of space extension tends to minimize critical catalog changes. To prevent any VSE/VSAM object from extending, you can define VSE/VSAM objects with no secondary extent value. As long as a VSE/VSAM object does not extend, it remains totally accessible from a backup copy of the catalog.

Volume is Inaccessible

Cause of Failure

A given volume may become wholly or partially unusable because of physical damage to the volume, or because the catalog that owns the volume was restored to a state that is not synchronized with the volume.

If the problem is because of a catalog restore operation, the procedure outlined under "Catalog is Unusable" on page 131 can be used to correct the condition.

If the problem is because of physical damage to the volume, recovery depends on the availability of backup copies of the catalogs, volumes, and files.

Error Conditions

- Volume is totally unusable.
- Volume is partially unusable.

Overview

A given volume that is wholly or partially unusable can be reestablished if backup copies of the data are available. In certain cases, the current version of the data can be extracted from the unusable volume and reestablished in the system.

Recovery for Volume that is Totally Unusable

You can recover only if you have a volume backup and a catalog volume backup created at the same time (that is, at the same level), or if you have copies of the files created by the REPRO command or by the EXPORT command.

If you have backup volumes:

1. Restore the damaged volume(s).
2. Compare the LISTCAT listing from the backup level with the current LISTCAT listing for possible mismatches.
3. Use the EXPORT command or the REPRO command to move the downlevel copies recovered to temporary files.
4. Initialize the volume and reestablish nonVSAM files.
5. If there is a volume mismatch which requires the use of the EXPORT command or the REPRO command, use the DELETE command with the FORCE option to clean up the volume and to remove the volume entry from the catalog (file entries are marked unusable); then, define space on the volume.
6. Use the IMPORT command or the REPRO command to reestablish the files. These files are downlevel and any update applied after the backup was made has to be reapplied to make the file current.
7. If reestablished nonVSAM files are cataloged, delete and redefine the nonVSAM entries.

If you do not have volume backup, but you do have a file backup:

1. Initialize the volume and reestablish the nonVSAM files.
2. Use DELETE FORCE to clean up the volume of VSE/VSAM ownership and data spaces. This will also remove the volume entry from the catalog and mark file entries unusable.
3. Reestablish files
   - If copies created by the EXPORT command of VSE/VSAM files are available, use the IMPORT command to reestablish them.
   - If backup files created by the REPRO command exist, delete the unusable files and redefine them using the DEFINE command and then load the backup copies into the newly created files with the REPRO command.
   - If reestablished nonVSAM files were cataloged, delete and redefine the nonVSAM entries.

Recovery for Volume that is Partially Unusable

If the VSE/VSAM files are partially or totally unusable, but the nonVSAM files are accessible, use the above procedure. If the VSE/VSAM files are accessible, but the nonVSAM files are not, proceed as follows:

1. Recover the VSE/VSAM files on the volume using the EXPORT command.
2. Initialize the volume and reestablish the nonVSAM files.
3. Using the IMPORT command, reestablish the VSE/VSAM files.
4. If the reestablished nonVSAM files were cataloged, delete and redefine the nonVSAM entries.

Quick Recovery

There are some applications (such as online teleprocessing systems) which require that file recovery be done as quickly as possible. In this type of situation, normal VSE/VSAM recovery procedures may be too time consuming to be of much use. For quick recovery, you have to:

- Implement certain "restrictions".
- Ensure data integrity.
- Recover lost objects.

Procedure for Quick Recovery

1. Implement "restrictions":
   - Define all files so that they *cannot* acquire additional extents.
   - Allocate sufficient extents (overallocate).

   These definitions ensure that the backup catalog stays in synchronization with the files that the catalog controls.

   Explanation to "overallocate extents": The restriction that files cannot acquire additional extents does not mean that CA splits will not be allowed. As long as there is sufficient unused space in the current extent, CA splits can still occur.

   To provide sufficient space for CA splits, overallocate your extents. For example, an overallocation of 20 cylinders for any VSE/VSAM file allows that at least 20 CA splits may occur.

   Note: Overallocate for the index also, because at least one new index record will be created whenever a CA split occurs.
2. Create a backup of the catalog *whenever* any file is defined, deleted, or altered. To do so, use the REPRO command.
3. Create a backup of the compression control data set *whenever* a compressed file is defined, deleted, altered, or loaded. To do so, use the REPRO command.
4. Recover objects:

If the catalog controlling the files is lost, do the following:

a. REPRO the backup catalog into the existing catalog.
b. Run VERIFY against all files controlled by the catalog.

If a volume is lost, do the following:

a. Restore the backup copy of the lost volume.
b. If the volume is the catalog volume, REPRO the corresponding backup catalog into the existing catalog, and if applicable, REPRO the corresponding backup of the compression control data set into the existing CCDS.
c. Run VERIFY against all files on this volume. (The files may also belong to other catalogs.)

   If the volume is a catalog volume, also run VERIFY against all files of this catalog (where the files may reside also on other volumes).
d. Update restored files from journaled records.

Chapter 9. VSE/VSAM Support for SAM Files

This Chapter...

Explains how you can prepare your existing **SAM files** and programs so as to take advantage of the functions provided by VSE/VSAM.

The chapter highlights the optional and required steps and definitions, and includes examples for loading and defining SAM ESDS files.

Overview

About SAM ESDS Files

A SAM file that can be processed within VSE/VSAM data space is called a *SAM ESDS file*.

You can move/convert your SAM files to:

- *SAM ESDS files*, or
- *VSE/VSAM ESDS files*.

Note:

1. A SAM ESDS file is not identical to a VSE/VSAM ESDS file. For more information, refer to "Differences Between VSE/VSAM ESDS and SAM ESDS File Format" on page 161.
2. SAM ESDS files can only be created and used if the *VSE/VSAM Space Management for SAM Function* is effective. This is always true for the z/VSE environment.

SAM files that have been converted can take full advantage of the processing capabilities of VSE/VSAM. You can use SAM with VSE/VSAM for data and work files, and you can move data and programs from SAM control to VSE/VSAM control.

The *full* conversion of SAM files involves the three steps explained under "Levels of Migrating Data and Programs from SAM to VSE/VSAM Control" on page 141. You have the option to stop at any level of the conversion. Depending on the level that you implement, you can use specific VSE/VSAM functions and capabilities for processing the files.

To indicate a SAM ESDS file and provide SAM record format information, specify the RECORDFORMAT parameter in the IDCAMS DEFINE CLUSTER command for a NONINDEXED (ESDS file). During VSE/VSAM access of a SAM ESDS file, SAM records are processed according to your specifications in the RECORDFORMAT parameter. To the VSE/VSAM program, a SAM ESDS file appears as though it is in VSE/VSAM ESDS file format.

SAM ESDS files can be accessed by VSE/VSAM (ACB) access if the files are formatted with control intervals (CIs).

About the VSE/VSAM Space Management for SAM Function

VSE/VSAM offers the *VSE/VSAM Space Management for SAM Function*. The function allows you to:

- Define and process your SAM files within VSE/VSAM data space.
- Request quantities of disk space rather than absolute locations.

To define and process your SAM files in VSE/VSAM data space, you use a DTF, and SAM imperative macros (for example, OPEN, GET, PUT). You indicate your intention to use a SAM file in VSE/VSAM data space by opening a DTF that specifies a file name described in a VSE/VSAM DLBL statement. This tells OPEN that

the file to be accessed is a SAM ESDS file. Then, managed-SAM OPEN retrieves file information from the VSE/VSAM catalog rather than from the VTOC.

Data is written in a format similar to a VSE/VSAM ESDS file. The control interval (CI) format is used; where the CI is the basic unit of information that is transmitted to or from a direct-access device. This format allows:

- VSE/VSAM access (through ACB) to SAM files in VSE/VSAM data space.
- Disk independence (for example, maximum DTF BLKSIZE is not limited to disk track size, but only to CI size minus 7).

You need not specify absolute extent limits for the file, because VSE/VSAM determines the location of the file.

Advantages in Using SAM ESDS Files

If you move unmanaged-SAM files into SAM ESDS files, you can take advantage of many of the functions available in VSE/VSAM, including IDCAMS commands. The following are the functions that are available after you complete the first step explained under “Levels of Migrating Data and Programs from SAM to VSE/VSAM Control” on page 141.

Dynamic Allocation

With VSE/VSAM managing your space, you can take advantage of VSE/VSAM's dynamic allocation. The allocation of file space is simpler because you do not have to specify extent limits. You need only request a quantity of space. This space is allocated when it is needed. If more space is subsequently needed, a secondary quantity is allocated.

VSE/VSAM's dynamic file capability allows you to define a file in the VSE/VSAM catalog without allocating space for it. Space is allocated at OPEN and deleted at CLOSE under control of the DLBL DISP parameter. This dynamic file capability applies to SAM ESDS files.

Simplified Job Control

This improvement is available to the SAM user through the *VSE/VSAM Space Management for SAM Function*. The information required by the system to check the location and characteristics of files is stored in the VSE/VSAM catalog. The need for DLBL statements is also removed for many of the IDCAMS commands. Because VSE/VSAM user catalogs are programmer logical units, they too are eligible for automatic assignment. Operator communications are also simplified because the operator may mount a requested volume on an available drive without the need to assign the drive.

Default Modeling

Default modeling allows you to select your own parameter defaults in place of the usual system defaults during explicit define. The ability to specify default parameters for the IDCAMS DEFINE CLUSTER command through default modeling is available for SAM ESDS files as well as for VSE/VSAM files.

Implicit File Definition

SAM ESDS files do not have to be explicitly defined (by way of the IDCAMS DEFINE command) prior to the time they are opened. An implicit define of a reusable SAM ESDS file occurs during managed-SAM OPEN if the file has not yet been explicitly defined.

Generally, when a file is implicitly defined, it may be implicitly deleted during managed-SAM CLOSE. This depends on the disposition parameters specified on the DTF or DLBL statement. For more information, refer to “Implicit Deletion of a SAM ESDS File” on page 156.

Device Independence

You do not have to be concerned with different track and cylinder sizes for various types of devices. (The DTF DEVICE and DEVADDR parameters are ignored by managed-SAM OPEN so that the file may reside on any disk device type.) Allocation sizes may be requested in terms of number of records and average record length rather than tracks, cylinders, or blocks which are device-dependent. This may be specified in the DEFINE CLUSTER command for explicitly defined files, or in the DLBL RECORDS and RECSIZE parameters for implicitly defined files. For implicitly defined files, a default secondary allocation size of twenty percent of the primary allocation size (rounded up) is assumed if none is specified.

The control interval (CI) is the basic unit of information that VSE/VSAM transmits to or from a direct-access device. Because the CI size has no relation to the track and cylinder size of a particular device, this makes the processing of files disk independent.

IDCAMS Commands

You do not need to use different utility programs to manipulate files. With the *VSE/VSAM Space Management for SAM Function* effective, you can use IDCAMS commands to print, copy, alter, delete, and move files from one system to another. For special considerations in using the commands, refer to "The IDCAMS Commands for a SAM ESDS File" on page 153.

Security and Integrity of Data

VSE/VSAM ensures the security and integrity of data through a combination of VSE/VSAM facilities:

- The share options support for SAM ESDS files.
- Password-protection to prevent unauthorized access.
- Automatic CLOSE facility for files not closed before the end of job.

Data Recovery

Data recovery is supported for a SAM ESDS file through various IDCAMS commands. As a basis for reconstruction (if the original file becomes inaccessible), you can use the EXPORT and IMPORT commands in the same way as for a VSE/VSAM file. That is, you can create a portable copy of a SAM ESDS file by using the EXPORT command, and introduce the copy of the file into the system by using the IMPORT command

Additional Functions Available for Managed-SAM Access

In addition to the specific functions mentioned above, the following additional functions are available to facilitate processing of SAM ESDS files:

- Multiple extents and multiple volumes are supported, unless:
  - During definition of the file there was no secondary allocation size specified, or a single volume was specified, *or*
  - The program accessing the file does not support multiple extents (for example, DTFPH with EXCP access).
- A SAM ESDS file can be extended through the request in the DISP parameter of the DLBL statement.

Planning for Files

Note that all the functions described in this chapter apply also to work files, but you may find some of them as being inappropriate (for example, password-protection and data recovery).

Work Files

Automatic Space Management

Work files may need varying amounts of space for different jobs. For some jobs only a small quantity of space is needed. At other times, a great deal of space is needed.

VSE/VSAM provides automatic space management. That is, you do *not* need to:

- Ensure that enough space is available for jobs that require large quantities of space.
- Keep large amounts of space tied up. The space needed for work files can be smaller.

You can think in terms of the average size of space needed rather than the maximum size needed. This is because VSE/VSAM provides *dynamic secondary allocation*. You can make your primary allocation nearer to the average size of space needed; if more is needed, VSE/VSAM gets the necessary space by using the secondary allocation. In addition to dynamic secondary allocation, VSE/VSAM provides *dynamic primary allocation*. This allows you to define a file that does not need space until it is opened. (A file defined in this way is called a *dynamic file*.) When a dynamic file is opened, the needed space is provided by VSE/VSAM. The options available at OPEN and the disposition of the files at CLOSE depend on what you code in the DISP parameter of the DLBL statement, or what is specified in the DTF (for example: DELETFL=NO).

Partition/Processor Independence

VSE/VSAM provides for partition/processor independence through the *implicit define* or *explicit define* with the dynamic data set capability. This VSE/VSAM support eliminates the tasks of:

- Assigning different work files to different disk locations for every partition.
- Specifying those disk locations in your job control statements.

The file-ID is chosen according to the partition in which the job is running, and space is assigned as needed. Work-space can also be shared between processors. The same job can be processed in any partition of a number of different processors without conflict in the catalog. When the file is closed, it may be deleted or deallocated. The space the file occupied is reclaimed and made available for use by other files.

Disposition

The disposition of a reusable file (REUSE) can be controlled through the DLBL DISP parameter. A file can be allocated, reset, or implicitly defined at OPEN according to these specifications. Whatever you specify in the DLBL DISP parameter overrides whatever was specified in the DTF. Pertinent information from the disposition parameters and the DTF is saved for closing of the file. At that time, the file is kept, reset, deallocated, or deleted according to the disposition that is specified in the DTF and DLBL statement. When you do not specify the DISP parameter, a default is chosen according to the type of file opened or closed. The default disposition is the same as would occur for unmanaged-SAM files. For example, the default disposition for:

- DTFSD OUTPUT data file is DISP=(NEW,KEEP)
- DTFSD INPUT data file is DISP=(OLD,KEEP)
- DTFSD work file is DISP=(NEW,DELETE).

  If DELETFL=NO, then DISP=(NEW,KEEP).

For disposition parameter specifications and their results, see Table 10 on page 31 and Table 12 on page 34. Disposition processing for VSE/VSAM (ACB) access of a SAM ESDS file is the same as for a VSE/VSAM ESDS file.

Extending Existing SAM ESDS Files

With VSE/VSAM support you can also extend existing SAM ESDS files through the use of the DLBL DISP parameter. For example, to extend a SAM ESDS file during output processing using SAM access, DISP=OLD would position the file to end-of-file to allow for extension. Refer also to Table 10 on page 31.

Space for extension of a file is allocated (if necessary) according to the secondary space allocation specified at definition time. SAM ESDS files are always extended in SPEED mode. See “Example 4: Define a Dynamic SAM ESDS File and Access” on page 160.

This support is not provided for SAM ESDS work file access.

Levels of Migrating Data and Programs from SAM to VSE/VSAM Control

Moving from SAM-control to VSE/VSAM-control consists of up to three steps:

- **Step 1**: Move unmanaged-SAM data (files) into SAM ESDS files.

  This allows managed-SAM access.

- **Step 2**: Change managed-SAM access programs to VSE/VSAM access programs.

  SAM ESDS files are accessible by VSE/VSAM.

- **Step 3**: Convert data (files) from SAM ESDS files to VSE/VSAM ESDS files.

  Files are accessible by VSE/VSAM only.

Depending on the VSE/VSAM functions you want to be able to use, you can simply implement only the first step, or you can complete the other steps as well.

Figure 14 on page 141 illustrates the relationship of the migration levels and steps.

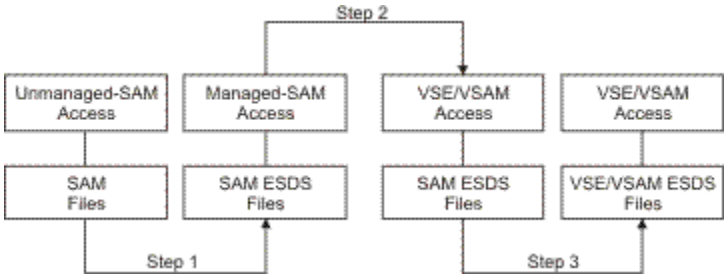


Figure 14. Migration from SAM Control to VSE/VSAM Control

Table 23 on page 141 lists the valid combinations of access modes and file types that can be used when the *VSE/VSAM Space Management for SAM Function* is effective.

Table 23. Valid Combinations of Access Methods and File Types

File Type	Access Mode	
	VSE/VSAM Access	Managed-SAM Access
SAM ESDS	Valid	Valid
VSE/VSAM ESDS	Valid	Invalid

Functions Available at the Various Migration Levels

1. Step 1: Move SAM Files to SAM ESDS Files

   After you completed this step, you get all the functions described under “Advantages in Using SAM ESDS Files” on page 138.

   Before you can move your SAM files, you have to create SAM ESDS files as explained under “Creating a SAM ESDS File” on page 142.
2. Step 2: Change Managed-SAM Access Programs to VSE/VSAM Programs

After you completed this step, you get the following additional access functions (they are provided by VSE/VSAM access):

- VSE/VSAM provides a single ACB/RPL format and a single set of request macros for all file types. You can generate the ACB or the RPL by specifying the GENCB macro.
- The file can be accessed in a direct manner through access by RBAs.
- The file can be processed in a skip sequential manner or sequentially backwards.
- Access statistics are maintained; they can be displayed through LISTCAT.
- Multiple (CI) buffers may be used in support of VSE/VSAM's read-ahead capability.
- A password may be specified in the ACB so that the operator is not involved with passwords.
- The job is not canceled due to logical or physical errors as is done in SAM. Rather, a return code and error code are passed back to the user to allow diagnosis of the failure within the user's program.
- Multiple strings and chained RPL support are provided by VSE/VSAM.

3. Step 3: Convert SAM ESDS Files to VSE/VSAM ESDS Files

   After you completed this step, you get the following additional capabilities:

   - You can build alternate indexes or paths. It allows you other ways of gaining access to your files, thereby eliminating the need to keep multiple copies of the same information sorted differently for different applications.
   - You can specify RECOVERY in the DEFINE CLUSTER statement. This parameter will help ensure data integrity by preformatting every CA before records are loaded into it. In case of load or extend failure, the IDCAMS VERIFY command can be used to recover data written, and your program may resume writing data from the last correctly-written data record.
   - Records can be spanned (SPANNED) records, eliminating the need for very large CIs.
   - You might be able to define the file with the COMPRESSED attribute to save DASD space.
   - Generally, a VSE/VSAM ESDS file is portable to MVS and can be accessed by way of MVS/VSAM. See Appendix D, “Compatibility With Other Products,” on page 319 for specific cases when files are not portable.

   To copy data from SAM ESDS files to VSE/VSAM ESDS files, you can use the IDCAMS command REPRO; refer to page REPRO Command.

Creating a SAM ESDS File

To **create** a SAM ESDS file, you have to:

1. Set up a quantity of space (see below).
2. Define a SAM ESDS file (see below).

After you created a SAM ESDS file, you can:

- *Access* the file by using:
  - DTF and SAM imperative macros with VSE/VSAM DLBL
  - ACB and VSE/VSAM imperative macros with VSE/VSAM DLBL
  - IDCAMS commands with VSE/VSAM DLBL

  For explanations, refer to “Access to a SAM ESDS File” on page 149.
- *Delete* the file either:
  - Explicitly (through IDCAMS), or
  - Implicitly (through managed-SAM CLOSE).

    For explanations, refer to “Implicit Deletion of a SAM ESDS File” on page 156.

Setting Up a Quantity of Space

Space for a SAM ESDS file may be suballocated by VSE/VSAM from data space that was previously defined for VSE/VSAM files. You need not assign separate space for SAM ESDS files. The size and boundaries of the suballocated space are communicated to the managed-SAM access routines at OPEN and secondary allocation time. You define this space (ideally entire volumes) in the usual way by using one or more of the following IDCAMS commands:

- DEFINE MASTERCATALOG
- DEFINE SPACE
- DEFINE USERCATALOG

These commands are described in the VSE/VSAM Commands, SC34-2707.

Defining a SAM ESDS File

After sufficient space is defined, you can define a SAM ESDS file in one of two ways:

- *Explicitly*. That is, by using the IDCAMS command DEFINE CLUSTER.
- *Implicitly*. That is, by providing the required file information in the job control statements so that the file can be defined at managed-SAM OPEN.

Besides these defines, you can do the following with a file that already has been explicitly or implicitly defined and used:

extend it, or
reset it to empty, or
reuse it.

Note: If the catalog is password-protected, implicit define will request the update or higher level password of the catalog, and implicit delete will request the master password of the catalog.

The following explains explicit and implicit define.

Explicit Define Cluster (Using the DEFINE CLUSTER Command)

You define a SAM ESDS file explicitly by specifying parameters in the IDCAMS command DEFINE CLUSTER.

The following is not a complete list of the parameters that are eligible to be specified. However, for SAM ESDS files, you need to evaluate the applicability of these particular parameters:

- NAME -- Cluster level (Required parameter)
- NAME -- Data component level (Optional parameter unless you wish to request single extent primary allocation, in which case it is required)
- NONINDEXED -- (Required parameter)
- RECORDFORMAT -- (Required parameter)
- RECORDSIZE -- (Required parameter if RECORDFORMAT is in fixed format; for example, FIXUNB or FIXBLK. Optional for V, VB, or U format.)
- RECORDS or

  TRACKS or

  CYLINDERS or

  BLOCKS

  (One of these parameters is required unless a default model exists for a SAM ESDS file.)
- VOLUMES -- (Required parameter unless a default model exists for a SAM ESDS file.)

DEFINE CLUSTER Command -- Explanations of Parameters

NAME(entryname)
Specifies the file-ID of the SAM ESDS file.

For a single extent primary allocation you must specify both the cluster name and the data component name. (See "Single Extent Primary Allocation" on page 145.) Otherwise, the data component name is optional and if specified, can be any name.

Also, you can specify that a file be partition independent, or both partition independent and processor independent (see "Partition/Processor Independence Specification" on page 145.) Specifying file names at both levels (cluster and data) gives you the capability to access data under two different file IDs.

NONINDEXED
Specifies that the file defined is an ESDS file.

RECORDFORMAT(format)
Establishes a NONINDEXED file as a SAM ESDS file.

Note: This parameter is required to explicitly define a SAM ESDS file. You can specify it either at the cluster level or data component level.

format For *format*, substitute one of the following values:

Format	Abbreviation	Meaning	Type of Access
FIXUNB	F	Fixed, unblocked	Managed-SAM/VSAM
FIXBLK	FB	Fixed, blocked	Managed-SAM/VSAM
VARUNB	V	Variable, unblocked	Managed-SAM/VSAM
VARBLK	VB	Variable, blocked	Managed-SAM/VSAM
UNDEF	U	Undefined	Managed-SAM/VSAM
NOCIFORMAT	NCIF	See below	See below

FIXUNB, FIXBLK(*logicalrecordsize*), VARUNB, VARBLK, and UNDEF indicate that data records are stored in CI format and therefore are accessible and managed by VSE/VSAM.

NOCIFORMAT indicates that data is not stored in CI (VSE/VSAM) format. Therefore, DTFPH with physical I/O (EXCP) must be used to access the data records. (Do not use managed-SAM access or VSE/VSAM access.) The DTFPH method of access should only be used for local (work) files. Other SAM programs will not be able to read or write to the file (except for other programs that have been written specifically for NOCIFORMAT access; for example, EXCP). You cannot specify NOCIFORMAT together with any of the following parameters: CONTROLINTERVALSIZE, ERASE, BUFFERSPACE, EXCEPTIONEXIT, or WRITECHECK.

logicalrecordsize indicates the length of the SAM logical record. This value must always be specified when using FIXBLK format.

RECORDSIZE(average maximum) and RECORDS(primary)
When you specify the RECORDFORMAT parameter with the FIXUNB or FIXBLK subparameter, you must specify the *maximum* SAM logical block size in the RECORDSIZE(maximum) parameter.

Note: This parameter specifies the largest SAM logical block size that may be used. If a DTF is opened for OUTPUT or WORK and specifies a BLKSIZE larger than the maximum SAM logical block size allowable in the file, the OPEN fails and the job is canceled. You must be careful to specify the maximum RECORDSIZE that a system program or program product will use during explicit define of the file. If multiple system programs or program products are to use the same (work) file, the maximum RECORDSIZE should be equal to the largest record that any of the programs will use.

If the RECORDFORMAT parameter is specified as VARUNB, VARBLK, or UNDEF and the RECORDSIZE parameter is omitted, the RECORDSIZE defaults to 4089 for the average and 4089 for the maximum

(that is, RECORDSIZE (4089 4089)). (Note that RECORDSIZE(maximum) is used in calculating the CI size and therefore has no meaning when NOCIFORMAT is specified.)

Whether or not you specify the NOCIFORMAT subparameter, you can use the RECORDSIZE(average) and RECORDS parameters for the suballocation of space. When using the RECORDSIZE and RECORDS parameters together, they must be consistent in units of reference (either both refer to SAM logical records or both refer to SAM logical blocks). Note that both the average and maximum record size must be specified in the RECORDSIZE parameter when one is specified.

For V, VB, or U records, the RECORDSIZE parameter is optional. For F or FB records, the RECORDSIZE parameter is required. For FB records, the RECORDSIZE must be a multiple of the SAM logical record size specified in the RECORDFORMAT parameter. For V or VB records, the maximum RECORDSIZE parameter must include room for the control information for variable length records (the record length field is four bytes and the block length field is four bytes) because the control information is part of the SAM logical block.

TRACKS|CYLINDERS|BLOCKS(primary)
The rules involved in the use of these parameters are the same for a SAM ESDS file as for a VSE/VSAM file. For information concerning the TRACKS, CYLINDERS, and BLOCKS parameters, search the index of the VSE/VSAM Commands, SC34-2707; they exist, for example, for the DEFINE ALTERNATEINDEX command.

VOLUMES(volser)
Specifies the volume(s) to contain the SAM ESDS file. Every volume that you specify must be owned by the catalog that is to own the SAM ESDS file. If not specified during define of a SAM ESDS file, VSE/VSAM picks a set of volumes for you if you have a default model (DEFAULT.MODEL.ESDS.SAM) defined. For information on the VOLUMES parameter, search the index of the VSE/VSAM Commands, SC34-2707; they exist, for example, for the DEFINE ALTERNATEINDEX command.

Additional Considerations

- The RECORDFORMAT attributes can be modeled by means of the MODEL parameter.
- You should specify REUSE when a SAM ESDS file is used mainly for work files. You should additionally specify NOALLOCATION in the DEFINE CLUSTER command to provide the dynamic file capability to work files.
- Do not specify RECOVERY. (VSE/VSAM defaults to SPEED for a SAM ESDS file.) You cannot build an alternate index or define a path over a SAM ESDS file.

Note: For work files, a zero retention period is the default and is normally appropriate to avoid operator communications during a subsequent OPEN if the file was not deleted at CLOSE.

Single Extent Primary Allocation

NAME(DOS.WORKFILE.SYSentryname) - data component level

Some programs that access data through DTFPH with EXCP may require that disk space for the file be allocated as a single extent. You can specify that you want the primary space allocated as a single extent by specifying the data component name as above. (Normally, VSE/VSAM may obtain an allocation in as many as five extents.) The cluster name is still chosen in the same manner as before, but DOS.WORKFILE.SYS *must* prefix the *data* component name to ensure that space is allocated within a single extent.

VSE/VSAM will deny the allocation request if it cannot obtain the primary allocation in a single extent.

Partition/Processor Independence Specification

NAME(%entryname) - Partition independent file-ID.

You specify a partition-unique file-ID by using the prefix "%" in the cluster name parameter of the DEFINE CLUSTER command. (The file-ID is limited to twenty-seven characters in this case.)

If your system also has the *Interactive Computing and Control Facility* (ICCF) installed, you are allowed only one partition-independent file for every ICCF real-partition. (ICCF pseudo-partitions do not have unique partition IDs, so there can be only one partition-independent file per partition.)

NAME(%%entryname) - Partition and processor independent file-ID.

To specify both a partition-unique and processor-unique file-ID together with a single extent primary allocation, the cluster name must be prefixed with "%%" (the file-ID is limited to twenty-seven characters in this case) and the data component name must be prefixed with "%%DOS.WORKFILE.SYS" (the file-ID is limited to an additional eleven characters in this case).

Implicit Define Cluster

A SAM ESDS file can be defined implicitly through managed-SAM OPEN when TYPEFLE=OUTPUT or TYPEFLE=WORK is specified in the DTF. An implicit define cluster occurs as a result of the following two conditions:

- The SAM ESDS file (to be opened through the DTF and written to) is currently undefined in the VSE/VSAM catalog, or the characteristics of the file were not compatible with the DTF and the file has been implicitly deleted by OPEN.
- Enough information has been provided for the implicit define to occur. VSE/VSAM gathers the necessary information from three sources:
  - It makes several assumptions about the file.
  - It extracts information from the DTF specifications.
  - It extracts information from the job control statements.

  The following explains the assumptions made by VSE/VSAM, and the information gathered by VSE/VSAM from the DTF and from job control statements.

Assumptions Made by VSE/VSAM

For an implicit define, VSE/VSAM always makes the following assumptions:

Parameter
Assumption

NONINDEXED
An ESDS file is defined.

NONSPANNED
The maximum length of a SAM logical block must not be greater than the CI size minus 7.

NOWRITECHECK
VSE/VSAM access will not check for correct data transfer for records written to the file. (In managed-SAM access, checking for correct data transfer is controlled by the DTF VERIFY=YES or NO parameters. The NOWRITECHECK specification has no meaning for the managed-SAM user. It is used only during VSE/VSAM access.)

REUSE
It is possible for a user to reset an already existing file back to empty and reuse it.

SHAREOPTIONS(1 3)
Either any number of users are permitted for input processing, or one user is permitted for output processing.

SPEED
Direct access storage is not preformatted.

SUBALLOCATION
VSE/VSAM data space for the file was previously defined and a primary allocation is suballocated at define.

UNORDERED
The volumes need not be used in the order specified in the EXTENT job control statements or the default model if EXTENT statements are omitted.

USECLASS(0 P)
The file occupies class-0 data space.

Information Obtained from the DTF

VSE/VSAM extracts information either from the:

- DTFSD or
- DTFPH MOUNTED=SINGLE

to determine the following:

- CI size.
- Length of the maximum VSE/VSAM logical record (SAM logical block).
- Record format of the records in the file.
- SAM logical record size for FIXBLK.

From DTFSD Specifications (for Data files)

- CI size — derived from the CISIZE=nnnnn parameter. VSE/VSAM rounds this value up to a valid CISIZE before defining the file. If zero or no value was specified, VSE/VSAM chooses a CI size. If IOAREA2 is specified and CI size is not specified, VSE/VSAM attempts to choose a CI size that ensures that at least 2 logical blocks will fit into a CI. If no CI size was specified, VSE/VSAM computes the size on the base of the maximum record size.
- Maximum record size — derived from the BLKSIZE=nnnn parameter. This value (minus 8 for data OUTPUT DTFs) specifies the file's maximum RECORDSIZE.
- Record format — derived from the RECFORM=xxxxxx parameter. Specifies the RECORDFORMAT of the file. If the RECFORM=FIXBLK, the SAM logical record size is derived from the DTF RECSIZE=nnnnn parameter.

From DTFSD Specifications (for Work Files)

- CI size — derived from the CISIZE=nnnnn parameter. VSE/VSAM rounds this value up to a valid CISIZE before defining the file. If zero or no value was specified, VSE/VSAM chooses a CI size. If no CI size was specified, VSE/VSAM computes the size on the base of the maximum record size.
- Maximum record size — derived from the BLKSIZE=nnnn parameter. This value specifies the file's maximum RECORDSIZE.
- Record format — derived from the RECFORM=xxxxxx parameter. Specifies the RECORDFORMAT of the file; FIXUNB and UNDEF are the only valid subparameters that you can specify for work files.

From DTFPH MOUNTED=SINGLE (for Disk)

- CI size — derived from the CISIZE=nnnnn parameter If a non-zero value is specified, VSE/VSAM rounds this value up to a valid CISIZE before defining the file. Specifying zero is the same as not specifying a CI size. In this case, VSE/VSAM indicates that the file is non-CI format; it is accessible only by EXCP (not by VSE/VSAM or managed-SAM).
- Maximum record size —
  - If CI format, maximum equals the DTF CISIZE minus 7.
  - If non-CI format, this parameter does not apply.
- Record format —

- If CI format, the RECORDFORMAT is UNDEF.
- If non-CI format, the RECORDFORMAT is NOCIFORMAT.

Note: DTFPH (with a CISIZE of zero specified or no CISIZE specified) is the only possible way you can implicitly define a non-CI format file. Also, if a nonzero value is specified for the CISIZE parameter, it must be greater than seven in order to choose a valid maximum record size.

Information Obtained from the Job Control Statements

Certain parameters in the VSE/VSAM DLBL and EXTENT job control statements provide the information that VSE/VSAM needs to implicitly define a file.

Information from the DLBL Statement

The DLBL statement provides the following information for implicit define:

- file-ID — This parameter provides the unique name associated with the file.

  To request single extent allocation through an implicit define, DOS.WORKFILE.SYS must prefix the file-ID.

  A partition/processor unique file-ID may also be specified. In this case the DLBL file-ID must be specified with a prefix of "%" (partition-unique) or "%%" (partition- and processor-unique) with a limit of twenty-seven characters. For both partition/processor uniqueness and single extent primary allocation, the DLBL file-ID prefix may be specified as "%%DOS.WORKFILE.SYS" (with a limit of eleven additional characters).

  If your system also has Interactive Computing and Control Facility (ICCF) installed, you are allowed only one partition-independent file for every ICCF real-partition. ICCF pseudo-partitions do not have unique partition IDs, so there can be only one partition-independent file per partition.
- date — This parameter indicates either the retention period in days or the actual expiration date. If this parameter is not present the normal default applies.

  Note: For work files, specify a zero (retention period) to avoid operator communications during a subsequent OPEN if the file was not deleted at CLOSE.
- CAT=filename — This parameter indicates the catalog that owns the file. If this parameter is not present the normal default applies.
- RECORDS=(primary,secondary) — This parameter designates the number of SAM logical records for allocation purposes. If no secondary amount is specified, twenty percent of the primary allocation is assumed. Zero can be specified for the secondary amount. If RECORDS is specified, RECSIZE=n must also be specified.
- RECSIZE=n — This parameter indicates the average SAM logical record size; it must be specified together with the RECORDS=(primary,secondary) parameter. The value n is only used for space calculation; it does not influence the CI size.

  Note: You may alternatively specify the average SAM logical *block* size in the RECSIZE parameter. If you do this, you should also specify the number of SAM logical *blocks* in the RECORDS parameter.
- CYL=(primary,secondary) — This parameter designates the number of cylinders for allocation purposes. If no secondary amount is specified, twenty percent of the primary allocation is assumed. Zero can be specified for the secondary amount. This parameter is correct only for CKD disks.
- BLK=(primary,secondary) — This parameter designates the number of blocks for allocation purposes. If no secondary amount is specified, twenty percent of the primary allocation is assumed. Zero can be specified for the secondary amount. This parameter is correct only for FBA disks.
- CISIZE=n — For VSE/VSAM this parameter specifies a control interval size for SAM ESDS dataset. The size overrides that specified (or defaulted) in the respective DTF macro. The specified size must be a number from 1 to 32,768. VSAM will round the value up to the multiple of 512 bytes or multiple of 2K (if specified value is greater then 8K) but greater then the SAM logical block length.

Note: One of the parameters RECORDS|CYL|BLK must be specified if the “number of tracks or blocks” is omitted in the EXTENT statement.

Information from the EXTENT Statement

The EXTENT statement provides the following information for implicit define:

- Volume serial number — This indicates the volume that this file resides on. There must be one EXTENT statement for every volume that the file is eligible to reside on. If EXTENT statements are specified, this parameter is required on every EXTENT statement.
- Number of tracks or blocks (specified in the first EXTENT statement if multiple EXTENT statements are specified) — This indicates the number of tracks (CKD) or blocks (FBA) to be allocated to this file. A secondary allocation size of twenty percent of the primary allocation size (rounded up) is assumed. Whether it is tracks or blocks is determined by the device type of the volume serial number specified. This parameter is ignored on subsequent EXTENT statements, or if the RECORDS/RECSIZE, or CYL, or BLK parameters are specified in the DLBL.

Note: The EXTENT statement is not required for implicit define if a default model for a SAM ESDS file was previously defined (providing VOLUME information) and RECORDS/RECSIZE are specified in the DLBL statement (providing allocation information). When an implicit DEFINE is done, only the VOLUMES parameter is allowed to be modeled.

Resetting and Reusing a Previously-Defined File

You can specify that a file is to be reset and reused by specifying the NOALLOCATION parameter together with the REUSE parameter in the DEFINE CLUSTER command. This specification indicates that data space is not to be suballocated to the file at DEFINE, but that it is to be suballocated as needed. This type of file is called a *dynamic file*.

A file may be implicitly defined at OPEN and implicitly deleted at CLOSE. However, performance is not as good as for an explicitly defined dynamic file.

Using a SAM ESDS File

Access to a SAM ESDS File

Managed-SAM access to a SAM ESDS file is provided so that you can:

- Open it through DTF
- Access it through the SAM imperative macros
- Close it through DTF

Support is also provided for DTFPH and EXCP access; in this case, it is space management support only. The data formats that can be written and read by the EXCP program are entirely under control of the EXCP program itself.

Dynamic secondary allocation is supported according to the access method or EXCP program's constraints and the allocation sizes for the file contained in the VSE/VSAM catalog.

Managed-SAM Access: Differences to (Unmanaged) SAM Access

Considerations Relating to DEFINE CLUSTER Specifications

RECORDSIZE

If the SAM ESDS file is defined *explicitly*, the maximum RECORDSIZE parameter is an important consideration. At OPEN, this maximum record size is compared to the BLKSIZE parameter in the DTF (for TYPEFLE=OUTPUT or WORK only). If the DTF BLKSIZE (minus eight for output) is greater than

the maximum record size in the file's catalog entry, VSE/VSAM denies the OPEN and cancels the job. VSE/VSAM does not allow you to write a larger SAM logical block than the maximum VSE/VSAM record size specified during definition. If the SAM ESDS file is defined *implicitly*, the maximum VSE/VSAM record size for define is determined from the DTF BLKSIZE parameter so that the file's catalog entry is consistent.

If the DLBL RECORDS/RECSIZE parameters are used for allocation parameters (during implicit define), the RECSIZE parameter specifies the average record size in the file's catalog entry. VSE/VSAM DEFINE does not allow the average record size (from the DLBL RECSIZE parameter) to be greater than the maximum record size (from the DTF BLKSIZE parameter). Therefore, if the average record size is larger than the maximum record size, a VSE/VSAM implicit define sets the average RECSIZE equal to the maximum RECSIZE, and the RECORDS value is increased by the same factor that the RECSIZE was decreased by.

RECORDFORMAT
The record format specified during the explicit define of a SAM ESDS file need not match the DTF RECFORM specification. The only exception is that VSE/VSAM does not allow a non-DTFSD to access a NOCIFORMAT SAM ESDS file. Either the file is implicitly redefined or the job is canceled.

VOLUMES
The volume(s) specified during define determine the candidates eligible for file allocation. If EXTENT statements are specified with symbolic units during access to the file, there must be an EXTENT statement and a corresponding ASSGN statement for every volume specified during define, even if all of the volumes are not written to or read from. However, EXTENT statements with symbolic units are not required and should not be specified.

SHAREOPTIONS
The share options specified during define affect the sharing characteristics of the file. For example, if SHAREOPTIONS(1) is specified for a SAM ESDS file (allowing one output or many input users), and if you are updating the file and then want to open the file for input to read it back in, you must close the file. Otherwise, the INPUT OPEN will be denied due to the SHAREOPTIONS specification.

If you want to allow multiple INPUT with UPDATE users to access a SAM ESDS file (in conjunction with the DTF HOLD=YES parameter, for example), explicitly define the file with SHAREOPTIONS(3) to allow concurrent OPENs for update (that is, OUTPUT). VSE/VSAM does not support SHAREOPTIONS(4) for an ESDS (SHAREOPTIONS(4) is treated as SHAREOPTIONS(2) during OPEN).

Regardless of the SHAREOPTIONS specification, if you have a file open for load or extension, all other attempts to open that file are denied for reasons of data integrity. Conversely, you would be denied access if you attempted to open a file for load or extension and another user had already opened that file. (A *software end-of-file* - SEOF - does not normally exist until a file is closed. If concurrent access was not denied there would be a chance that an input user would read past the end of the file.)

Considerations for Access to Files

Considerations for all Types of Files

Many of the considerations on CI format that relate to unmanaged-SAM on FBA devices are also considerations for managed-SAM access (on both FBA and CKD devices). For example, if an I/O error occurs during access, it concerns an entire CI of information rather than a single logical block. Also, logical blocks are not necessarily written to a device until a CI is full (refer also to the description of the PWRITE parameter of the DTFSD macro in the http://publibfp.dhe.ibm.com/epubs/pdf/iesmfe81.pdf).

Empty Files

VSE/VSAM does not distinguish between a file that:

- Has just been defined (empty and never written to),
- Has been opened and closed with no records written into it, or

- Has been loaded but deallocated or reset at CLOSE.

A file in any of these states is considered empty (that is, the high-used RBA is zero). In any of these cases, if the file is opened for input through DTFSD TYPEFLE=INPUT, the OPEN will be successful and control will be passed to the EOFADDR on the first GET. This DTF OPEN is actually simulated because VSE/VSAM OPEN (ACB) will not open an empty file for input. However, this is transparent to the DTFSD user.

If other DTF types (such as DTFPH) are opened for INPUT on an empty file, VSE/VSAM cannot simulate the end of file condition. This OPEN cannot be allowed because the file has not been opened by VSE/VSAM and the file extents have not been located. (The file may not even be allocated in the case of a dynamic file.) Therefore, such an OPEN will be cancelled if the file is empty.

Assignments and Files Ignored

If EXTENT statements with symbolic units and ASSGN statements are used, and if any one (or more) of the assignments is ignored (IGN), then the entire file is ignored. That is, the DTF is not opened and DTF+X‘10’, bit 2 (X‘20’) will be set.

Disk-Independence

In general, you should attempt to be as disk-independent as possible. You should make no assumptions about the track size (or CI size), the size or the number of extents or even the number of volumes that the file will reside on. You should not attempt to choose a BLKSIZE that will maximize disk utilization because CI format is used and also, your program cannot know what disk device type will be used for the file before OPEN. It is better to use a smaller BLKSIZE that will be reasonable for any disk device type -- it enables to process on any disk device type. You should not assume that a particular symbolic unit will be used. This will allow you to take advantage of VSE/VSAM's job control simplifications. Note that (unmanaged) SAM now provides for disk independence by ignoring the DTF DEVICE= parameter during OPEN.

GETVIS Space

Sufficient GETVIS space must be provided for managed-SAM access; enter the specifications in the SIZE parameter of the EXEC job control statement, or in the SIZE job control command. The partition GETVIS area must contain at least 40KB for the VSE/VSAM catalog, plus 10KB for every SAM ESDS file, plus storage for the CI buffer for every SAM ESDS file.

Work Files

- The format of NOTE/POINT IDs for a managed-SAM CKD file is similar to unmanaged SAM FBA NOTE/POINT ID format. That is, for all devices, the managed-SAM NOTE/POINT ID format is CCCN rather than (as for unmanaged SAM) CCHR for CKD and CCCN for FBA. Therefore, you should not generate or modify a NOTE/POINT ID. Also, do not move or modify the DTF between OPEN and CLOSE.
- The DELETFL=NO parameter of DTFSD TYPEFLE=WORK is determined at OPEN. Modifying this indicator after OPEN will have no effect on the CLOSE disposition. Note that DLBL DISP specification overrides the DTF DELETFL indicator. If there are any other DTFs or ACBs currently open for this file at CLOSE, the file is not deleted. If the DTF is not closed by the end of job step, automatic CLOSE attempts to close the file.
- Files accessed through DTFSD TYPEFLE=WORK are normally reset at OPEN. If you wish to read a file using a work file DTF, specify DISP=OLD in the DLBL to avoid losing the data due to reset.

Using SAM ESDS Files: Restrictions

Device-Dependent SAM Functions

The following device-dependent SAM functions are not supported:

- Split cylinders

- FEOVD (ignored)
- CNTRL (ignored)
- Subsetting of the input file through EXTENT statement specifications.

SAM ESDS Files

The following restrictions apply:

- SAM ESDS files are limited to 16 extents per volume, unless they are explicitly defined as non-reusable (NOREUSE).
- If SAM ESDS file is implicitly defined, DLBL allocation parameters (RECORDS, CYL, BLK) are limited to 16,777,125 as a maximum value.
- DSF (data secured file) is not supported (it is ignored) in the VSE/VSAM DLBL control statement. (VSE/VSAM password-protection may be used.)
- SAM ESDS files are not portable and cannot be imported (through IMPORT) to MVS SAM or VSE/VSAM.
- IJSYSxx file restrictions:
  - The only system data file that is supported is SYSLNK (IJSYSLN). The job is canceled if any other system data files are specified at OPEN.
  - System work files (IJSYSnn) are supported unless restricted by the program accessing the system work file.
- Some system programs or program products may have restrictions on the use of managed-SAM files. (For example, the files may be limited to a single extent, or managed-SAM files may not be supported.) Please consult the appropriate VSE/VSAM or Program Product publication for planning and support considerations.

DTF Specifications

The following restrictions apply to specifications in the DTF:

- User labels are not supported. The LABADDR specification of the DTF is ignored.
- Because managed-SAM records are in CI format, SAM spanned records are not supported. VSE/VSAM maximum record size (32KB minus 7) is not limited by the device track size. The job is canceled if RECFORM=SPNUNB or RECFORM=SPNBLK is specified in the DTF.

DTFPH Specifications

The following restrictions apply to the use of DTFPH:

- A file created with DTFPH with CISIZE=0 is not supported by managed-SAM request macros (GET,PUT, and so on). That is, the file can only be read with DTFPH and EXCP. The managed-SAM request macro routines support CI format only. The job is canceled if a non-DTFPH OPEN is issued against a NOCIFORMAT SAM ESDS file (unless the file can be implicitly deleted and defined by OPEN).
- Conversely, if a file is created with DTFSD and is to be read through DTFPH with EXCP, the EXCP routine must support it in CI format. If the DTFPH is a "version 3 DTF", OPEN stores the CISIZE in the version 3 extension and the OPEN is successful. You must reference this CISIZE when you read the file. If the DTFPH is not a version 3 DTF, OPEN has no means of indicating the CISIZE and the job is canceled.
- There is no way to restrict a DTFPH EXCP user from opening a password-protected SAM ESDS file for input (requiring a read password) and then writing to the file. A DTFPH user may also violate SHAREOPTIONS integrity protection in this same manner.

VSE/VSAM Access of SAM ESDS Files: Considerations

VSE/VSAM access of a SAM ESDS file processes SAM logical records. It uses the RECORDFORMAT information in the catalog to block SAM logical records into SAM logical blocks and de-block SAM logical

blocks into SAM logical records. Therefore, it is important that the RECORDFORMAT information in the catalog matches the actual SAM record format of the data.

The valid SAM logical record formats are:

- Fixed unblocked
- Fixed blocked (logical record size)
- Variable unblocked
- Variable blocked
- Undefined

SAM access (through DTF) of V or VB records returns the RL (record length field) at the beginning of the record. VSE/VSAM access (through ACB) does not return it. Correspondingly, for a PUT for V or VB records, no RL should be at the beginning of the record when it is passed to VSE/VSAM because VSE/VSAM prefixes the RL. A program using VSE/VSAM access (through ACB) for sequential processing can process a VSE/VSAM ESDS file or a SAM ESDS file.

Differences between the VSE/VSAM access of a VSE/VSAM ESDS file and the VSE/VSAM access of a SAM ESDS file are:

- VSE/VSAM always loads and extends a SAM ESDS file in SPEED mode.
- VSE/VSAM does not build an alternate index over a SAM ESDS file.
- VSE/VSAM does not support path entries over a SAM ESDS file.
- VSE/VSAM does not support VSE/VSAM SPANNED records for a SAM ESDS file.

The following applies to VSE/VSAM access of a SAM ESDS file:

- TCLOSE and ENDREQ do not imply TRUNC or RELSE. VSE/VSAM continues processing from the last SAM logical record.
- For direct requests or POINT, the ARG parameter of the RPL always specifies the RBA (relative byte address) of the SAM logical record. The RL (record length) and the BL (block length) fields are not included; however, they are accounted for by VSE/VSAM. On a direct retrieval, you must supply to VSE/VSAM the same RBA as returned during a VSE/VSAM load of a SAM ESDS file.
- For both the RPL and control block manipulation macros, RECLEN is always the SAM logical record length. It is not the SAM block length (that is, VSE/VSAM record length), and does not include any RL or BL fields.
- When issuing a SHOWCB or TESTCB macro, the following apply:
  - NLOGR refers to logical records. For blocked record files, NLOGR could be greater than the number of VSE/VSAM records.
  - NRETR and NUPDR have similar meanings; they are the number of retrieved and updated SAM logical records, respectively.

When a SAM ESDS file is extended through managed-SAM access, managed-SAM always starts with a new CI. When a SAM ESDS file is extended through VSE/VSAM access, VSE/VSAM attempts to continue storing records into the last CI of the file. Additionally, the number and method of blocking records in a SAM logical block may differ between managed-SAM access and VSE/VSAM access. The following parameters will cause differences:

- Logical record size comes from the LRECL in "RECORDFORMAT".
- Block size comes from the maximum record size in "RECORDSIZE".
- Average record size in "RECORDSIZE" is only used together with the "RECORDS" parameter.

The IDCAMS Commands for a SAM ESDS File

The following lists only those commands (and parameters) that need *special consideration* when used with the *VSE/VSAM Space Management for SAM Function*. The commands are listed in alphabetical order.

For the complete set of the parameters available with the commands, see the VSE/VSAM Commands, SC34-2707.

ALTER Command

```
entryname/password
BUFFERSPACE(size)
ERASE|NOERASE
EXCEPTIONEXIT(mname)
WRITECHECK|NOWRITECHECK
```

The ALTER command is used to change attributes in catalog entries. The subparameters and their use for a SAM ESDS file are explained here.

entryname/password
is a required parameter that names the SAM ESDS file to be altered and supplies its master password if it is password-protected. For a NOCIFORMAT SAM ESDS file, the specification of BUFFERSPACE, ERASE, EXCEPTIONEXIT (except as a subparameter of NULLIFY), or WRITECHECK causes the ALTER command to terminate.

BUFFERSPACE(size)
specifies the minimum space to be provided for buffers. For a NOCIFORMAT SAM ESDS file, the specification of BUFFERSPACE causes the ALTER command to terminate.

ERASE|NOERASE
specifies whether the SAM ESDS file is to be erased when its entry in the catalog is deleted. For a NOCIFORMAT SAM ESDS file, the specification of ERASE causes the ALTER command to terminate.

EXCEPTIONEXIT(mname)
specifies the name of the user module to be given control when an exception occurs during the processing of the SAM ESDS whose entry is altered. For a NOCIFORMAT SAM ESDS file, the specification of EXCEPTIONEXIT causes the ALTER command to terminate. (EXCEPTIONEXIT can be specified as a subparameter of NULLIFY.)

WRITECHECK|NOWRITECHECK
specifies whether to check the data transfer of records written in the SAM ESDS through VSE/VSAM (ACB) access. For a NOCIFORMAT SAM ESDS file, the specification of WRITECHECK causes the ALTER command to terminate.

DEFINE CLUSTER Command

For the applicable DEFINE CLUSTER parameters, see “Explicit Define Cluster (Using the DEFINE CLUSTER Command)” on page 143.

DELETE Command

You can use the DELETE command as described in the VSE/VSAM Commands, SC34-2707, except that the ERASE parameter is not valid for a NOCIFORMAT SAM ESDS file.

An implicitly defined SAM ESDS file may be deleted by way of the DELETE command in the same manner as an explicitly defined SAM ESDS file. Refer also to “Implicit Deletion of a SAM ESDS File” on page 156.

EXPORT Command

If you are exporting a CI-format SAM ESDS file, VSE/VSAM treats it as an ESDS file. If you attempt to export a NOCIFORMAT SAM ESDS file, VSE/VSAM issues an error message and terminates the command.

You cannot use a SAM ESDS file as the portable file (OUTFILE parameter).

IMPORT Command

IMPORT provides full import support for those SAM ESDS files which can be exported. When attempting to import a SAM ESDS file into a predefined empty file, IMPORT ensures that the exported file and the predefined file have fully consistent RECORDFORMAT parameter values and that the maximum record size of the predefined file is not less than that of the file originally exported. Any mismatch causes an error message and command termination.

LISTCAT Command

You can display space for a SAM ESDS file by specifying LISTCAT SPACE. You can display all files that have been defined for a particular catalog by using the LISTCAT command; this includes all SAM ESDS files defined either explicitly or implicitly.

The ATTRIBUTES portion of LISTCAT output is modified as follows for ESDS:

- CISIZE indicates 0 if RECORDFORMAT(NOCIFORMAT) was specified on either an explicit or implicit define.
- CI/CA indicates 0 if RECORDFORMAT was specified on either an explicit or implicit define.
- SAMLRECL indicates the SAM logical record length (listed for SAM ESDS files only). This value is the user-supplied record length for FIXBLK SAM files and is zero for all other record format SAM files.
- RECORDFORMAT indicates the SAM record format (listed for SAM ESDS files only). FIXBLK, FIXUNBLK, VARBLK, VARUNBLK, UNDEFINED, or NOCIFMT are the possible values for this attribute.
- IMP-DEFINE is listed if the SAM ESDS file has been implicitly defined; otherwise EXP-DEFINE is listed (applies to SAM ESDS files only).
- SAMDATASET is listed if the ESDS is a managed-SAM file; otherwise VSE/VSAMDATASET is listed.

The Statistics Group (data) is listed for a SAM ESDS file. However, it should be noted that these statistics are maintained during VSE/VSAM access only and not during managed-SAM access. For more information on the statistics, refer to the VSE/VSAM Commands, SC34-2707.

PRINT Command

You can print a CI-format SAM ESDS file by way of managed-SAM access or VSE/VSAM access. The output is always SAM logical records. You cannot print a NOCIFORMAT ESDS file through either managed-SAM or VSE/VSAM access.

For managed-SAM access:

- Specify the ENVIRONMENT parameter.
- The output format is the same as unmanaged SAM (no RBA display, record length field at the beginning of the record for format V and VB).
- The SKIP and COUNT parameters can be used and the value always indicates the number of SAM logical records to be skipped or listed.

(For an example of printing a SAM ESDS file by retrieving the SAM logical records with managed-SAM, see “Example 4: Define a Dynamic SAM ESDS File and Access” on page 160.)

For VSE/VSAM access:

- Omit the ENVIRONMENT parameter.
- The output format is a VSE/VSAM ESDS file (RBA display, no record length field at the beginning of format V and VB RECORDS. VSE/VSAM uses the RECORDFORMAT information recorded in the catalog to determine the SAM record format for access). Note that the record or block size and format has not been changed through DTF-ACCESS.
- The SKIP and COUNT parameters can be used and the value always indicates the number of SAM logical records to be skipped or listed.
- The FROMADDRESS and TOADDRESS parameters can be used. (The RBA value for FROMADDRESS must be the exact beginning of a SAM logical record.)

REPRO Command

CI-format SAM ESDS files can be used as input or output files in a REPRO command wherever SAM files or VSE/VSAM ESDS files are currently allowed. (Do not specify a NOCIFORMAT SAM ESDS as an input or output file.) You can use the REPRO command to convert an unmanaged-SAM file to a SAM ESDS file by using the following specifications:

- INFILE(dname,ENVIRONMENT(subparameters))

  Indicates the unmanaged SAM file to be used as the input file.

- OUTFILE(dname/password ENVIRONMENT(subparameters))

  Indicates the CI-format SAM ESDS to be used as the output file. If the output file is a managed-SAM file that is to be created by way of managed-SAM access, and it has not been previously defined, it will be implicitly defined if the job control statements meet the requirements of implicit define.

  – For both the INFILE and OUTFILE parameters, *dname* specifies the *filename* of the DLBL job control statement that identifies the file to be copied. The ENVIRONMENT parameter is not always required. Coding the ENVIRONMENT (...) parameter instructs IDCAMS to use SAM access, that is, access through a DTF control block. Without the ENVIRONMENT parameter VSAM access will be used (ACB). The ENVIRONMENT parameter is required in one of the following cases:

    - To access an unmanaged SAM file
    - To allow an implicit definition of an output file

    password is not allowed for SAM access.

- FROMADDRESS(address) TOADDRESS(address)

  You can specify FROMADDRESS and TOADDRESS for VSE/VSAM access (not managed-SAM access). The RBA value for FROMADDRESS must be the exact beginning of a SAM logical record.

- SKIP(count) COUNT(count)

  You can specify SKIP and COUNT (for both VSE/VSAM and managed-SAM access) and the value always indicates the number of SAM logical records to be skipped or copied.

VERIFY Command

If the VERIFY command is executed on a CI-format SAM ESDS file, you can discover whether the file was successfully closed (warning messages are issued), but you cannot cause the end-of-file indicator in the catalog entry to be updated. This is because a SAM ESDS file is always loaded and extended in SPEED mode. A SAM ESDS file cannot be accessed for input by VSE/VSAM unless it was successfully closed after initially loaded. (If the file is accessed for input by managed-SAM without closed, an OPEN in a subsequent job step will be successful and the first GET will cause the user to be sent to the EOFADDR routine.) The file can only be accessed by VSE/VSAM up to the data written by the last successful CLOSE if extended. After extension, a SAM ESDS file can be accessed by managed-SAM even if the CLOSE was unsuccessful; however, the file may not terminate with an SEOF.

The VERIFY command terminates due to an OPEN error if it is executed on a NOCIFORMAT SAM ESDS file.

Implicit Deletion of a SAM ESDS File

An implicitly defined SAM ESDS file may be deleted by way of the DELETE command in the same manner as an explicitly defined SAM ESDS file.

You can use the DELETE command as described in the VSE/VSAM Commands, SC34-2707, except that the ERASE parameter is not valid for a NOCIFORMAT SAM ESDS file.

An implicit delete of a SAM ESDS file occurs if all the following conditions are true for any of the following cases:

1. Case 1

   During OPEN of DTF (implicit delete followed by implicit define)

   - The catalog entry has been implicitly defined.
   - The DTFSD maximum logical block size exceeds the VSE/VSAM catalog maximum RECORDSIZE of the SAM ESDS file or the RECORDFORMAT of the file is NOCIFORMAT.
   - DTFSD TYPEFLE=OUTPUT, WORK, or WORKMOD.
   - The file is unexpired and the operator has responded "delete" to message 4233A EQUAL FILE-ID IN CATALOG, or the file is expired.
   - DISP=OLD is not specified.

2. Case 2

   During CLOSE of DTF

   - The catalog entry has been implicitly defined.
   - DISP=(,delete)

     Note: The job control statement overrides the DTF.

3. Case 3

   During CLOSE of DTF

   - The catalog entry has been implicitly defined.
   - DISP=(,date)

     Note: The job control statement overrides the DTF.
   - The expiration date has passed.

   In all cases, if another user has the same file open for access, the file is not deleted.

Sample Programs and Job Streams

- Example 1 loads a SAM ESDS file by way of managed-SAM access (source code).
- Examples 2, 3, and 4 use this program assuming that it is cataloged under the phase name SDOUTPUT.

Example 1: Load a SAM ESDS File by Way of Managed-SAM Access

```
Col.        Col.    Col.                                                Col.
1           10      16                                                  72

// JOB SDOUTPUT
// OPTION CATAL,NODUMP
   PHASE SDOUTPUT,*
// EXEC ASSEMBLY,SIZE=120K,PARM='XREF'
SDOUTPUT    START   X'200078'
            BALR    2,0
            USING   *,2
            OPEN    SDOUT,PRINT
            LA      5,1             INITIAL COUNT TO 1
            L       6,MAXRCDS       LOAD NO. OF RECORDS TO WRITE
LOOP        CR      5,6             WRITTEN LAST RECORD YET
            BH      CLOSE           YES
STORE       ST      5,RECNO         NO, STORE RECORD NUMBER
            CVD     5,DWB           CONVERT KEY TO DECIMAL
            UNPK    NUM(15),DWB(8)  UNPACK KEY
            TM      UNPKSIGN,X'10'   SEE IF NUMBER WAS NEGATIVE
            BO      NEG1             YES, NEGATIVE
            MVI     SIGN,C'+'        MAKE OUTPUT SHOW POSITIVE
            B       CONTINUE
NEG1        MVI     SIGN,C'-'        MAKE OUTPUT SHOW NEGATIVE
CONTINUE    OI      UNPKSIGN,X'F0'   MAKE LAST BYTE A NUMBER
            PUT     PRINT           PRINT KEY
            PUT     SDOUT,WORKAREA  PUT FROM WORKAREA
            LA      5,1(5)          INCR RECORD NO.
            B       LOOP            GO BACK
CLOSE       CLOSE   SDOUT,PRINT     CLOSE THE FILE
            EOJ
            EJECT
*
SDOUT       DTFSD   BLKSIZE=2008,[1]                                    X
                    DEVADDR=SYS007,[2]                                  X
                    IOAREA1=OUTPUT1,                                    X
                    DEVICE=2314,[3]                                     X
                    RECFORM=FIXBLK,[4]                                  X
                    RECSIZE=80,                                         X
                    TYPEFLE=OUTPUT,[5]                                  X
                    WORKA=YES
            EJECT
PRINT       DTFDI   DEVADDR=SYSLST,                                     X
                    IOAREA1=IOAREA,                                     X
                    RECSIZE=17
```

```
*
            EJECT
DWB         DC      D'0'              USED TO CVD INTO
*
IOAREA      DC      0CL17' '
            DC      C' '              PRINT CONTROL
OUT         DC      0CL16' '
SIGN        DC      C' '              PRINTED SIGN
NUM         DC      0CL15' '          PRINTED KEY
            DC      CL14' '
UNPKSIGN    DC      C' '              LAST BYTE OF UNPACKED NUMBER
*
MAXRCDS     DC      F'400'                NO. OF RECORDS TO WRITE
*
WORKAREA    DC      0CL80' '
RECNO       DC      F'0'                  CURRENT RECORD NO.
            DC      CL76' '
OUTPUT1     DC      CL8' '                AREA FOR COUNT
            DC      25CL80' '
            EJECT
*           SDMODFOB[6]
            DIMOD TYPEFLE=OUTPUT
            END SDOUTPUT
/*
// IF $MRC GT 0 THEN
// GOTO ERRORS
// LIBDEF PHASE,CATALOG=USER.LIB
// EXEC LNKEDT
/*
/. ERRORS
// EXEC LISTLOG
/&
```

Explanations for Example 1:

1

The BLKSIZE specifies the logical block size of the SAM file. The extra eight bytes specified include the count area required for DTFSD OUTPUT data files.

2

This symbolic unit is ignored. The symbolic unit either comes from the EXTENT statement or is dynamically chosen by VSE/VSAM.

3

The device type specified is ignored. VSE/VSAM determines the device type from the volume serial of the volume that the file resides on. The volume serial is specified either in the EXTENT statement during implicit define, or in the VOLUMES parameter of the DEFINE CLUSTER command, or is chosen by VSE/VSAM from a default model during explicit or implicit define.

4

The RECFORM along with the BLKSIZE and RECSIZE information is used to determine the record format and size characteristics of the file to be written. In addition, if the file is implicitly defined, this information is stored into the VSE/VSAM catalog to be used if the file is accessed through VSE/VSAM (ACB).

5

An output file normally implies reset. That is, the file is set to empty before the records are written into the file. This may be overridden by the DLBL DISP parameter. If DISP=OLD is specified, the file will not be reset and an existing file will have this data added to the end of the file. (If the file does not exist or is empty, DISP=OLD or NEW has no effect.)

6

No SD logic module needs to be assembled or included. (Note that it is a comment.)

Note: If IOAREA2 is specified in the DTFSD (in combination with either IOREG or WORKA) and implicit define occurs, VSE/VSAM will attempt to choose a CI size that will hold at least two SAM logical blocks.

Example 2: Implicit Define of a SAM ESDS File

A job that loads a SAM ESDS file through managed-SAM access (execution). This job implicitly defines a SAM ESDS file.

```
// JOB LOAD A MANAGED SAM FILE (400 RECORDS)
// DLBL SDOUT,'MANAGED.SAM.FILE1',0,VSAM,RECORDS=400,RECSIZE=80[1]
// EXTENT ,VSER01[2]
// LIBDEF *,SEARCH=(USER.LIB)
// EXEC SDOUTPUT,SIZE=AUTO[3]/&
```

Explanations for Example 2:

1

The information from the DLBL and the EXTENT statement (together with the DTF information) provides the information to do an implicit define.

- The DLBL specifies VSE/VSAM indicating that the SAM file is to be a SAM ESDS file.
- A retention period of 0 indicates that the file can be deleted at any time (assuming it is not in use).
- RECORDS and RECSIZE specify that the primary allocation size should be large enough to hold four hundred records of eighty bytes each. The secondary allocation size is assumed to be twenty percent of the primary allocation size.
- The default disposition for an OUTPUT DTFSD data file is (NEW,KEEP).

2

The EXTENT statement specifies that the file is to reside on volume VSER01 and that the logical unit is to be dynamically assigned by VSE/VSAM. (This assumes, of course, that there is VSE/VSAM data space available on volume VSER01.)

3

A SAM ESDS file needs about 52KB of GETVIS space for access (12KB for the file and CI buffers, and a one-time requirement of 40KB for the catalog). SIZE=AUTO will ensure that the maximum GETVIS space is available to VSE/VSAM.

Example 3: Define a Default Model SAM ESDS File

A job stream that loads a SAM ESDS file through SAM access (execution). This job stream defines a default model for a SAM ESDS file and then implicitly defines a SAM ESDS file, using the default model to obtain a volume list (to allow elimination of the EXTENT statement).

```
// JOB DEFINE DEFAULT MODEL FOR SAM ESDS FILE
// EXEC IDCAMS,SIZE=AUTO
                  DEFINE CLUSTER                    -
                   (NAME(DEFAULT.MODEL.ESDS.SAM)    -[1]
                    VOLUMES(VSER02)                 -[2]
                    RECORDS(100 25)                 -
                    RECORDSIZE(2000 2000)           -
                    RECORDFORMAT(UNDEF)             -
                    REUSE                           -
                    NOALLOCATION                    -[3]
                    NONINDEXED)
                  LISTCAT                           -
                    ENTRIES(DEFAULT.MODEL.ESDS.SAM) -
                    ALL
/*
/&
// JOB LOAD A MANAGED SAM FILE (400 RECORDS)
// DLBL SDOUT,'MANAGED.SAM.FILE2',0,VSAM,RECORDS=400,RECSIZE=80[4]
// LIBDEF *,SEARCH=(USER.LIB)
// EXEC SDOUTPUT,SIZE=AUTO
/&
```

Explanations for Example 3:

1

This is the required file-ID for a default model for a SAM ESDS file.

2

This is the volume that will be used for any SAM ESDS file implicitly defined with no EXTENT statement specified (or explicitly defined with no VOLUMES parameter specified).

3

NOALLOCATION is required for default model.

4

The same DLBL information is specified as in Example 2, but the volume that the file is to reside on is retrieved from the default model rather than an EXTENT statement. (The file will reside on VSER02.) Also, the symbolic unit is dynamically chosen and assigned by VSE/VSAM. Note that allocation size and retention period are still obtained from the DLBL statement. The only information retrieved from the default model during implicit define is the volume list.

Example 4: Define a Dynamic SAM ESDS File and Access

A job stream that loads a SAM ESDS file through managed-SAM access (execution). This job stream defines a dynamic SAM ESDS and then accesses the defined file allowing elimination of the EXTENT statement.

```
// JOB ESDS DEFINE FOR SAM ESDS FILE
// EXEC IDCAMS,SIZE=AUTO
                 DEFINE CLUSTER               -
                  (NAME(MANAGED.SAM.FILE3)    -
                   VOLUMES(VSER03)            -
                   RECORDS(16 4)              -1
                   RECORDSIZE(2000 2000)      -2
                   RECORDFORMAT(FIXBLK(80))   -3
                   REUSE                      -4
                   NOALLOCATION               -
                   NONINDEXED)5
                 LISTCAT                      -
                   ENTRIES(MANAGED.SAM.FILE3) -
                   ALL
/*
/&
// JOB LOAD A MANAGED SAM FILE (400 RECORDS)
// DLBL SDOUT,'MANAGED.SAM.FILE3',,VSAM,DISP=(NEW,KEEP)6
// LIBDEF *,SEARCH=(USER.LIB)
// EXEC SDOUTPUT,SIZE=AUTO
/&
// JOB EXTEND A MANAGED SAM FILE (ANOTHER 400 RECORDS)
// DLBL SDOUT,'MANAGED.SAM.FILE3',,VSAM,DISP=(OLD,KEEP)7
// LIBDEF *,SEARCH=(USER.LIB)
// EXEC SDOUTPUT,SIZE=AUTO
/&
// JOB ESDS PRINT A MANAGED FILE WITH SAM
// DLBL ESDS1,'MANAGED.SAM.FILE3',,VSAM,DISP=(OLD,DELETE)8
// EXEC IDCAMS,SIZE=AUTO
                 PRINT INFILE(ESDS1           -
                   ENVIRONMENT                -9
                       (BLOCKSIZE(2000)       -
                       RECORDFORMAT(FIXBLK)   -
                       RECORDSIZE(80)))
/*
/&
```

Explanations for Example 4:

1

This specifies the number of VSE/VSAM logical records (SAM logical blocks) for primary and secondary allocation. Sixteen is specified for the primary allocation since sixteen 2000-byte logical blocks will be written to hold four hundred 80-byte SAM logical records.

2

This specifies the average and maximum VSE/VSAM logical record size (SAM logical block size) for the file.

3

This specifies the SAM logical record size for the file.

4

REUSE in connection with NOALLOCATION makes the file a dynamic file.

5

NONINDEXED is required for a SAM ESDS file.

6

The DISP parameter specifies that the file is to be reset at OPEN, and kept at CLOSE. The file resides on volume VSER03 as specified in the define cluster. A symbolic unit will be dynamically assigned.

7

The DISP parameter specifies that the file is *not* to be reset at OPEN, that is, the file will be extended with the records written by JOB EXTEND. The file is to be kept at CLOSE.

8

The DISP parameter specifies that the file is *not* to be reset at OPEN. (A specification of DISP=NEW would be an error in this case since the file will be opened for input.) When the file is closed, it will be deleted (that is, deallocated since this file was defined as a dynamic file).

9

The file is read by way of managed-SAM access by way of the ENVIRONMENT parameter. The ENVIRONMENT subparameters specify the information required to generate a DTF. The file may be accessed through VSE/VSAM by omitting the ENVIRONMENT parameter. In that case, VSE/VSAM gets the SAM file characteristics from the VSE/VSAM catalog entry for the file.

Differences Between VSE/VSAM ESDS and SAM ESDS File Format

How CIs are Formatted into CAs

Figure 15 on page 162 and **Figure 16 on page 162** illustrate the way in which CIs are physically formatted into CAs for VSE/VSAM ESDS files as compared to SAM ESDS files.

For values for CI size and tracks, refer to Table 20 on page 83.

VSE/VSAM ESDS Files

A VSE/VSAM ESDS file formats CIs into CAs in CA format. This means that CIs cannot be written across CA boundaries. If there is not sufficient space at the end of a CA to write a complete CI, an area of unusable space is left and the CI to be formatted is written at the beginning of the next CA. This is illustrated in Figure 15 on page 162.

Assumptions

```
Device type=3390
Allocation specified=TRK(3 1)
CI size=14KB
Physical block size=7KB
1 track=7 blocks (PR)
11 CIs of data are written
CA=Min (primary (3 TRKs), secondary (1 TRK), Max-CA(1 CYL))
```

Therefore: CA=1 track

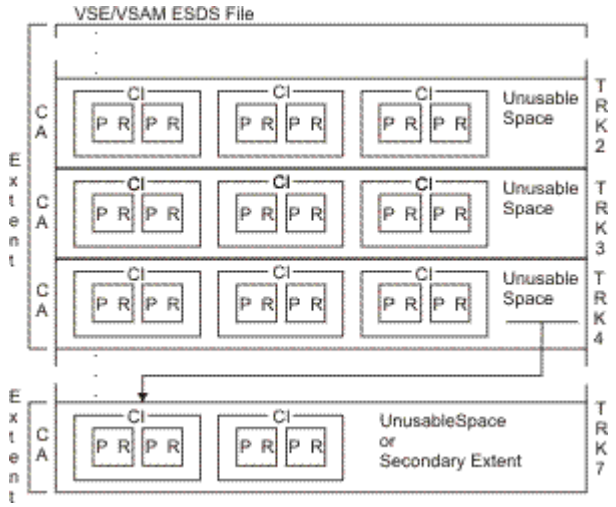


Figure 15. Example of CA Format Using a VSE/VSAM Entry-Sequenced File

SAM ESDS Files

A SAM ESDS file formats CIs into CAs in non-CA format. This means that a CI can be written across a CA boundary (tracks 2 and 3) but not across an extent boundary. If there is not sufficient space at the end of the CA to write a complete CI, the CI will be written across a CA boundary causing the CI to have part of its contents in one CA and the rest of its contents in another. This is illustrated in Figure 16 on page 162.

Assumptions:

```
Device type=3390
Allocation specified=TRK(3 1)
CI size=14KB
Physical block size=7KB
1 track=7 blocks (PR)
11 CIs of data are written
CA=Min (primary (3 TRKs), secondary (1 TRK), Max-CA(1 CYL))
```

Therefore: CA=1 track

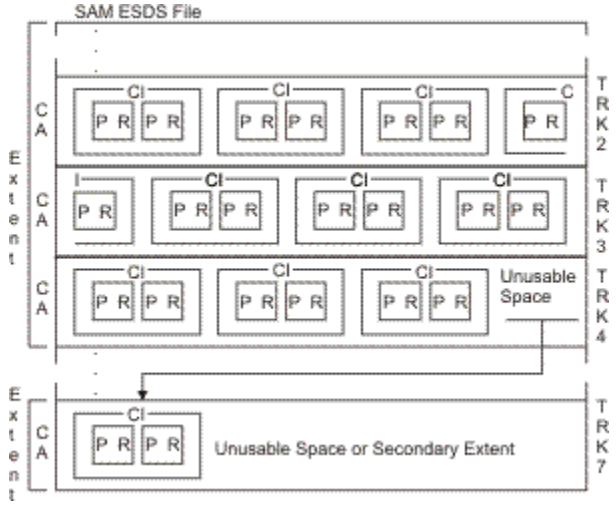


Figure 16. Example of Non-CA Format Using a SAM ESDS File

Relationship of Physical and Logical Layout

Figure 17 on page 163 shows the construction of a CI and how records are physically and logically laid out for a VSE/VSAM ESDS file and a SAM ESDS file. It explains the relationship between *VSE/VSAM logical records* and *SAM logical blocks*.

When you have defined a VSE/VSAM ESDS file, the CI is made up of VSE/VSAM logical records and their related control information. When you define a SAM ESDS file, the VSE/VSAM logical records become SAM logical blocks. The CI size is a multiple of the VSE/VSAM block size and normally determined by VSE/VSAM, not by you, at DEFINE time. Control information in a CI consists of a CIDF and RDFs. There is an RDF for every SAM logical block (VSE/VSAM logical record) indicating its length, except in the case of consecutive logical blocks of equal length, in which case the first RDF (right-most of the pair) describes the length of the logical blocks and the second RDF (left-most of the pair) tells how many logical blocks the first RDF describes.

The SAM logical block consists of SAM logical records. In the case of VB format, every logical record is prefixed with an RL (record length) field which indicates the length of the record. The SAM logical block begins with a BL (block length) field which indicates the length of the block. During managed-SAM (DTF) access of V or VB records, the RL is returned at the beginning of the record. For VSE/VSAM (ACB) access, it is not. A program using VSE/VSAM (ACB) access for sequential processing can process a SAM ESDS file or a VSE/VSAM ESDS file.

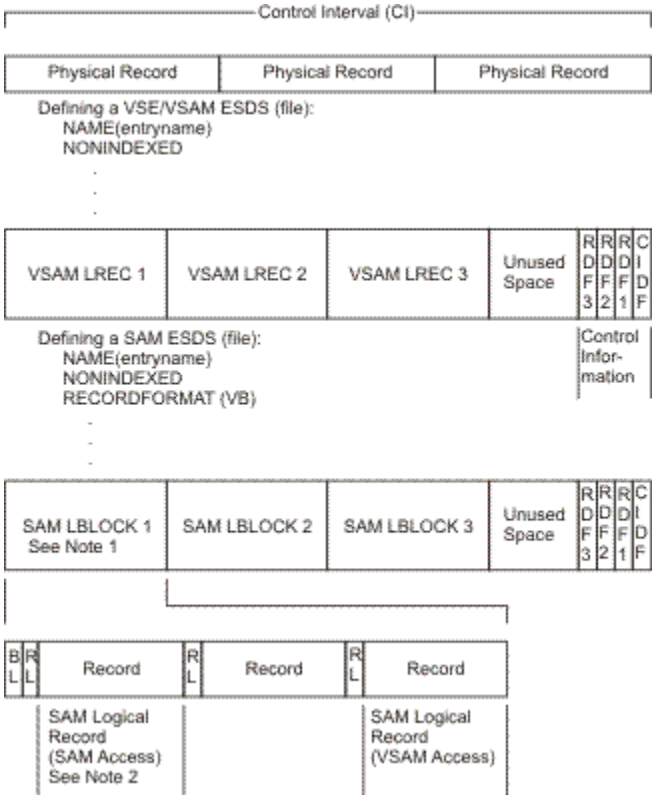


Figure 17. Comparison of a VSE/VSAM Block to a SAM Logical Block

Note:

1. The SAM LOGICAL BLOCK size is what you specify in the RECORDSIZE parameter when you DEFINE a SAM ESDS file, and define in the BLKSIZE parameter of the DTF.
2. The SAM LOGICAL RECORD size is what you specify in the SIZE parameter of the DTF.

Chapter 10. Performing an IDCAMS SNAP (FlashCopy)

This Chapter...

describes how you can backup VSE/VSAM datasets using an **IDCAMS SNAP** command:

Related Topics:

For details of ...	Refer to ...
how FlashCopy® is used within z/VSE	z/VSE Administration, SC34-2692
the IDCAMS SNAP and IDCAMS BACKUP commands (syntax diagram and parameters)	VSE/VSAM Commands, SC34-2707
the IXFP SNAP command (syntax diagram and parameters)	z/VSE System Control Statements, SC34-2679
how to backup VSE/VSAM data to tape using FlashCopy	z/VSE Operation, SC33-8309

Overview of the IDCAMS SNAP Command

The IDCAMS SNAP command provides an interface to the *FlashCopy* feature that produces a snapshot of specified *source volumes* onto *target volumes*. The snapshot that is produced:

- Represents a copy of the source volumes that is "frozen" at the moment when SNAP was invoked.
- Is *immediately* available for use, by referencing to the target volumes.
- Can be used before the physical copying to the target volumes is completed.

When SNAP is issued with the NOCOPY parameter, the physical copying of data to the target volumes is not performed. Instead:

- The snapshot on the target volumes is "simulated" until a SNAP command with the DDSR parameter has been issued.
- Both real and simulated "frozen" copies of VSE/VSAM data can be safely used for archiving, while the source volumes are updated by other applications.

To support the "frozen" state of the snapshot, ESS utilizes its internal resources, like ESS cache, for tracking possible updates of the source volumes that may be done while copying is performed. When copying is finished, ESS resources are freed automatically. However if you use SNAP with the NOCOPY parameter, you should later free the ESS resources by the SNAP DDSR command. To prevent wasting of the ESS resources, access to the SNAP command can be restricted. For more information on this, refer to "Controlling Access to the IDCAMS SNAP Command" on page 169.

The SNAP command is especially helpful when ordinary copy or backup may cause problems with data integrity because of updates done to source volumes by other applications. For the format of the SNAP command, refer to VSE/VSAM Commands, SC34-2707.

Avoiding Incorrect Usage of Volumes and Catalogs

If you use FlashCopy to directly backup VSE/VSAM data, VSAM cannot access the copies of VSAM catalogs and clusters on the *target volumes* in the way it does for volumes for which a FlashCopy was not made. This is because the standard VSAM search path (`master-catalog -> [user-catalog ->] cluster`) will point to the *original* version of the VSAM data that is stored on the *source volumes*.

You can use the IDCAMS IMPORT CONNECT command to connect the copied catalog on the target volume to the master catalog. This results in the copied catalog being included in the search path. However, the connected catalog is of limited use. This is because:

- To avoid duplication of names, the catalog on the target volume will be connected via its new name (the synonym catalog name SYNONYMCATALOG). However, the original name of the catalog is still stored internally in the catalog and will be used by VSAM operations.
- VSAM catalogs retain the information about the VOLIDs on which the catalogs and clusters were originally created. After this information has been copied to the target volumes, it is therefore *no longer valid*. **Note:** VSAM does not allow duplicate VOLIDs (that is, different volumes having the *same* VOLID).

VSAM only supports a BACKUP using a synonym list (SYNONYMLIST) when backing up VSAM data from target volumes of the IDCAMS SNAP (see “Example of Running IDCAMS SNAP / BACKUP With a Synonym List” on page 168). However, this processing method makes these copies very safe.

Note: Before initiating the IXFP SNAP command, the target volumes must be DOWN (DVCDN). This is the *opposite* to the situation when performing an IDCAMS SNAP (where the volumes are UP by default).

Advantages in Creating a Snapshot of Entire Disk Volumes

These are the advantages in using IDCAMS SNAP together with a synonym list, to produce "snapshots" of volumes:

1. After a snapshot of disk volumes is complete, backup processing *can be started immediately* and can run *during online processing*.
2. During the very short “copy-time” of the snapshot (which may be minutes, or even **seconds**), online systems only have to be shut down for a very short time.
3. There is no risk of losing data.
4. There is faster access to the target datasets.
5. There are no catalog changes to the catalog-copy that is stored on the target volume.
6. Error-prone and time-consuming catalog changes are not required on the target catalog. The target catalogs remains 100% unchanged. The target catalogs and the datasets could then be used for disaster recovery (for example, to replace one or more complete disk volumes).
7. When the snapshot is made, the content of the target volumes remain identical to the content of the source volumes. This is very important if you must carry out a disaster recovery.
8. Any BACKUP jobs that you run after the snapshot, will use “frozen” data on the target volumes. This data is independent of any data changes that take place on the online systems.
9. Running IDCAMS SNAP and IDCAMS BACKUP using a synonym list significantly reduces the time during which your system is unavailable.

Using IDCAMS SNAP and BACKUP With a Synonym List

These are the steps you should follow:

1. **Run IDCAMS SNAP using the Synonym List.**

Use the IDCAMS SNAP command to create a snapshot of all entire disk volumes where the catalog and all its datasets reside. Give the target volumes different VOLIDs than the source volumes. **Note:** The target volumes will then be online after the IDCAMS SNAP has run.

This is an extract of the syntax of the IDCAMS SNAP command:

```
SNAP
      [COPY|NOCOPY]
      SOURCEVOLUMES(volser[ volser...])
      TARGETVOLUMES(volser[ volser...])
      [NOPROMPT|PROMPT]
```

where:

COPY
This keyword specifies that both the temporary and permanent snapshots of the source volumes on the target volumes are to be created. The temporary snapshots are available immediately by referencing the target volumes and are created by establishing the IXFP FlashCopy relation supported with internal ESS resources.

NOCOPY
This keyword specifies that only temporary snapshots of the source volumes on the target volumes are to be created by establishing the IXFP FlashCopy relation between the source and target volumes. The real copying to the target volumes normally is not performed because of using internal ESS resources to track out any changes done to the source volumes.

SOURCEVOLUMES(volser[volser...]) TARGETVOLUMES(volser[volser...])
Are a pair of lists indicating from which volumes, and to which volumes, the snapshot is to be done. ***Please Note:*** The target device must be set UP (DVCUP command) prior to initiating the IDCAMS SNAP function. For the target, this is the *opposite* to what you would set for the IXFP SNAP command.Abbreviations: SVOLUME or SVOL, TVOLUME or TVOL

NOPROMPT
This keyword prevents decision-type messages from being issued.

PROMPT
This keyword allows decision-type messages to be issued.

2. **Run IDCAMS IMPORT CONNECT.**

You run IDCAMS IMPORT CONNECT to inform the z/VSE system that a copy of the User Catalog now exists on the *target volume*, and that this copy of the User Catalog now has a *synonym name*.

Note:

a. The catalog that has a synonym name now exists (including its datasets), but *cannot be accessed* by normal applications.

b. You use a target Master Catalog in the same way as you use a target User Catalog.

3. **Run IDCAMS BACKUP using the Synonym List.**

IDCAMS BACKUP uses the parameters contained in the synonym list:

- The synonym list is used to route the VSAM OPEN and BACKUP functions to the target volumes.
- The BACKUP works in the same way as before, *except* that it uses the synonym list to access the target volumes. Therefore, you can use all features of IDCAMS BACKUP.
- You can use the output from this IDCAMS BACKUP (that uses a synonym list) in the same way as before (for IDCAMS RESTORE).

This is an extract of the syntax of the IDCAMS BACKUP command:

```
BACKUP  ..........
        SYNONYMLIST(
        SOURCEVOLUMES(volser[ volser...])
        TARGETVOLUMES(volser[ volser...])
        CATALOG(catname[/password])
        SYNONYMCATALOG(catname[/password]) )
```

where:

SYNONYMLIST
Indicates that this backup uses a synonym list of target VSAM volumes. Abbreviations: SYNLIST or SYNL

SOURCEVOLUMES(volser[volser...]) TARGETVOLUMES(volser[volser...])
Are a pair of lists indicating from which volumes, and to which volumes, a FlashCopy has to be performed. Abbreviations: SVOLUME or SVOL, TVOLUME or TVOL

CATALOG(catname[/password])
Specifies the name and the password of the source catalog, which is the original catalog from which a FlashCopy was done. Abbreviation: CAT

SYNONYMCATALOG(catname[/password])
Specifies the synonym name and password of the target catalog which was created by a FlashCopy to the target volume. You must ensure that the synonym name of the catalog has been imported using IMPORT CONNECT, before running the IDCAMS BACKUP. The password is identical to the password of the source catalog.

Note: You must provide the synonym name of the catalog in a DLBL statement containing filename IJSYSUC.

Abbreviation: SYNCAT

Example of Running IDCAMS SNAP / BACKUP With a Synonym List

The following job-stream example shows how to:

1. Create a snapshot of the *source* volumes *SOURCE1* and *SOURCE2* to the *target* volumes *TARGET1* and *TARGET2*.
2. Run an IDCAMS IMPORT CONNECT to inform the z/VSE system that a copy of the User Catalog (VSESP.USER.CATALOG on SYSWK1 and DOSRES) now exists on the target volume, and that this copy of the User Catalog now has a *synonym name* (VSESP.SNAP.CATALOG).
3. Run an IDCAMS BACKUP that uses the parameters contained in the synonym list.

Input

```
// JOB SNAP and BACKUP from target volumes
// ASSGN SYS005,180
// DLBL IJSYSUC,'VSAM.SNAP.CATALOG',,VSAM
// EXEC IDCAMS,SIZE=AUTO
 /* First: do the SNAP  */                          -
  SNAP COPY                                        -
     SOURCEVOLUMES(SOURCE1 SOURCE2 )               -
     TARGETVOLUMES(TARGET1 TARGET2 )
 /* Second: Synonym name for the target catalog  */
  IMPORT CONNECT OBJECTS((VSAM.SNAP.CATALOG        -
     VOLUMES(UCATVOL) DEVT(3390)))                 -
     CATALOG(VSAM.MASTER.CATALOG)
 /* Third: BACKUP from target volumes  */          -
  BACKUP (*)                                       -
     SYNONYMLIST(                                  -
     SOURCEVOLUMES(SOURCE1 SOURCE2 )               -
     TARGETVOLUMES(TARGET1 TARGET2 )               -
     CATALOG(VSAM.USER.CATALOG)                    -
     SYNCATALOG(VSAM.SNAP.CATALOG)     )
/*
/&
```

You can also use the option *Flashcopy VSAM Catalog/Files* in the *BACKUP/RESTORE VSAM OBJECTS* dialog (Fast Path 3719) to create such a job stream. For details, refer to "Using the FlashCopy Dialog to Backup VSE/VSAM Data" on page 169.

Output

The output from using IDCAMS BACKUP (with a synonym list) is any normal backup media (tape or disk). This is the same as any other IDCAMS BACKUP output.

Using the FlashCopy Dialog to Backup VSE/VSAM Data

The *Flashcopy VSAM Catalog/Files* dialog provides a fast backup function from disk to **tape** for VSE/VSAM data. It does so by creating a job stream that includes three IDCAMS commands: IDCAMS SNAP (including the DDSR function), IDCAMS IMPORT CONNECT, and IDCAMS BACKUP.

Note: The IDCAMS BACKUP requires the availability of the catalog and of **all** the related disk volumes holding data of the VSAM files owned by the catalog.

To access the dialog, start with the *z/VSEFunction Selection* panel and select:

- **5** (Backup/Restore)
- **1** (Backup/Restore VSAM Objects)
- **9** (FlashCopy VSAM Catalog/Files (ESS only)

You can either:

- Copy a whole catalog and *all* its related files.
- Select *individual* files from the catalog for backup (IDCAMS BACKUP).

For further details about using FlashCopy to backup VSE/VSAM data, refer to the z/VSE Operation, SC33-8309.

Controlling Access to the IDCAMS SNAP Command

The IDCAMS SNAP command creates a snapshot of source volumes on the IBM TotalStorage Enterprise Storage Servers (ESS). ESS resources are used to ensure that the snapshot is not affected by any updates done to the source volumes. Therefore, inappropriate usage of the SNAP command can waste the internal ESS resources and decrease the overall performance. For example, this would occur if the SNAP NOCOPY command is not followed by the SNAP DDSR for a long time.

To prevent cases of this kind, system administrators can restrict the usage of the IDCAMS SNAP command by using a security manager, for example the *Basic Security Manager* (BSM) provided by z/VSE. For more information on BSM and the BSTADMIN (fastpath 28) utility used to issue BSM commands or the dialog support refer to z/VSE Administration, SC34-2692. A description of the IDCAMS SNAP command can be found in VSE/VSAM Commands, SC34-2707.

You can control access to the IDCAMS SNAP command with the following BSM profile names of the resource class FACILITY:

- VSAMSNAP.COPY for IDCAMS SNAP COPY
- VSAMSNAP.NOCOPY for IDCAMS SNAP NOCOPY
- VSAMSNAP.DDSR for IDCAMS SNAP DDSR

If no batch security is enabled in the z/VSE system (SYS SEC=NO) or it is enabled but the profiles VSAMSNAP.COPY, VSAMSNAP.NOCOPY, and VSAMSNAP.DDSR in class FACILITY were not defined to the BSM, then the IDCAMS SNAP [COPY|NOCOPY|DDSR] statements are executed as requested but with a warning:

```
IDC32204I RACROUTE RESOURCE NOT PROTECTED OR BATCH SECURITY=OFF
```

If batch security is enabled and the corresponding profiles VSAMSNAP.xxx in class FACILITY are defined, then an ID statement has to be supplied in the job to identify the user. To use the IDCAMS SNAP function one of the following access conditions must be set:

1. The user has at least READ access to the VSAMSNAP.xxx profile related to the issued IDCAMS SNAP command.

2. The VSAMSNAP.xxx profile is defined with at least universal access of READ.
3. The supplied user ID is an administrator's ID and, therefore, the user has access to all the BSM protected resources.

Then the appropriate IDCAMS SNAP function is executed as requested and is accompanied by the following message:

```
IDC32200I RACROUTE (AUTH) SUCCESSFUL
```

In all other cases the requested IDCAMS SNAP function is suspended and the following message pair is displayed:

```
IDC32240I RACROUTE (AUTH) FAILED WITH RETURN CODE  xx REASON xx
IDC32241I SAF RETURN CODE  xx FOR RACROUTE (AUTH)
```

The example below shows how to define profiles in BSM to allow everyone to use the SNAP COPY and SNAP DDSR commands and how to completely forbid usage of the SNAP NOCOPY command.

```
 r rdr,pausebg
 AR 0015 1C39I COMMAND PASSED TO VSE/POWER
 F1 0001 1R88I  OK : 1 ENTRY PROCESSED BY R RDR,PAUSEBG
 BG 0001 1Q47I   BG PAUSEBG 000XX FROM (SYSA) , TIME=15:10:27
 BG 0000 // JOB PAUSEBG
         DATE 12/27/2007, CLOCK 15/07/27
 BG-0000 // PAUSE
 BG 0000 // ID (PARAMETERS SUPPRESSED)
 BG-0000
 0 exec bstadmin
 BG 0000 1S54I  PHASE BSTADMIN IS TO BE FETCHED FROM IJSYSRS.SYSLIB
 BG-0000 BST901A ENTER COMMAND OR END
 0 add facility vsam.snap.copy uacc(read)
 BG 0000 BST904I RETURN CODE OF ADD IS 00
 BG-0000 BST901A ENTER COMMAND OR END
 0 add facility vsam.snap.ddsr uacc(read)
 BG 0000 BST904I RETURN CODE OF ADD IS 00
 BG-0000 BST901A ENTER COMMAND OR END
 0 add facility vsam.snap.nocopy uacc(none)
 BG 0000 BST904I RETURN CODE OF ADD IS 00
 BG-0000 BST901A ENTER COMMAND OR END
 0 end
 BG-0000
 0
```

Instead of BSTADMIN, you can also use the Interactive Interface dialogs for security.

Chapter 11. Using VSE/VSAM Macros

This Chapter...

- Documents Programming Interface information. See “Notices” on page 351.
- Explains the use of the VSE/VSAM macros. VSE/VSAM macro instructions are coded in an assembler program to access the data.
- Assigns the macros to various tasks, there are macros for:
  - Relating a program to the data. They identify the file and describe the kind of processing to be done. They are ACB, EXLST, RPL, and GENCB.
  - Connecting and disconnecting the program to the file. They are OPEN, CLOSE, and TCLOSE.
  - Displaying and changing the information relating a program to the data and thus changing the type of processing. They are SHOWCB, TESTCB, and MODCB.
  - Initiating transfer of data between disk storage and processor storage, positioning within the file, or deletion of records. They are GET, PUT, POINT, ERASE, WRTBFR, and ENDREQ.
  - Sharing I/O Buffers and control blocks among files, and to write out buffers. They are BLDVRP, DLVRP, and again WRTBFR. Also ACB, RPL, and the macros of the second group have been extended for sharing resources and managing I/O buffers.
  - Displaying catalog information: SHOWCAT.

Groups of Macros

The VSE/VSAM macros can be grouped according to main tasks and the relationship between the various macros. The following shows the groups and outlines the purpose of the individual macro.

Declarative VSE/VSAM macros:

- ACB specifies the file to be processed and the access type.
- EXLST specifies a list of user-supplied exit routines.
- RPL specifies information for a request to access a particular record.

Macros to Share Resources Between Several Files

- BLDVRP builds a VSE/VSAM pool of buffers, control blocks, and channel programs.
- DLVRP deletes such a resource pool.
- WRTBFR writes waiting buffer contents to satisfy a GET request.

Request Macros

- GET retrieves a record from a file for processing.
- PUT inserts a record in a file.
- POINT positions control on a specific address in the file.
- ERASE deletes a record in a file.
- ENDREQ ends processing of a GET or POINT request.

Control Block Manipulation Macros

- GENCB specifies declarative parameters, but during execution of a program.

- MODCB changes declarative parameters.
- SHOWCB displays declarative parameters in effect.
- TESTCB checks declarative parameters (or their error codes) and branches accordingly.
- SHOWCAT displays data from the catalog in a buffer you have supplied.

OPEN/CLOSE Macros

- OPEN connects a program to a file.
- CLOSE prepares the separation and disconnects a program from a file.
- TCLOSE prepares the separation but leaves program and file connected.

Relating a Program and the Data

The ACB macro specifies the file to be processed and the types of access you want to use.

The EXLST macro specifies a list of user-supplied exit routines.

The RPL macro specifies information for a request to access a particular record in the file.

These declarative macros are used while assembling or compiling an assembler program.

The GENCB macro can be used in place of the ACB, EXLST, or RPL macros to generate processing specifications while the processing program is running.

ACB: Specifying the Access Method Control Block

Every VSE/VSAM file has an ACB (Access Control Block) that contains information about it. The file name of the DLBL job control statement that describes the file is included, so that the Open routine can connect a program to the data.

The other information that you specify enables OPEN to prepare the kind of processing to be done by your program.

Exit Routines

The address of a list of exit-routine names that you supply (EXLST parameter). You use the EXLST macro, described next, to construct the list.

I/O Buffers

The amount of space for I/O buffers (BUFSP parameter) and the number of I/O buffers (BUFND and BUFNI parameters) that VSE/VSAM will use to process data and index records. The minimum number of buffers allowed depends on how much buffer space is allocated, the number of concurrent requests to be allowed, and whether processing will be direct or sequential.

Password

The password, if required, indicates the level of authorization to access the file: read, read and update, and so on (PASSWD parameter).

Processing Options

The processing options to be used (MACRF parameter): keyed or addressed access, or both; sequential, direct, or skip sequential processing, or a combination; retrieval, storage, or update (including deletion), or a combination; whether to use the shared resource pool and to defer the writing of updated records.

Concurrent Requests

For processing concurrent requests (STRNO parameter), the number of requests that are defined for processing the file (see the discussion of the RPL macro following EXLST).

Error Messages

Address and length of an area for error messages from OPEN, CLOSE, or TCLOSE (MAREA and MLEN parameters).

EXLST: Specifying the Exit List

The EXLST macro specifies the addresses of optional exit routines that you can supply for analyzing physical errors and logic errors, for end-of-file processing, for overlapping I/O operations, and for writing a journal. Any number of ACBs in a program can indicate the same exit list, and an exit routine can be used for several files.

Analyzing Physical Errors (SYNAD)

When VSE/VSAM encounters an error in an I/O operation that the z/VSE error recovery routines cannot correct, it exits to the physical-error analysis (SYNAD) routine. VSE/VSAM sets a code in the RPL to indicate whether the I/O error occurred during reading or writing the data or the index.

Analyzing Logic Errors (LERAD)

Errors not directly associated with an I/O operation, such as an invalid request, cause VSE/VSAM to exit to the logic error analysis (LERAD) routine. VSE/VSAM sets a code in the RPL that indicates the type of logic error.

End-of-File Processing (EODAD)

When your program requests a record beyond the last record in the file during sequential access, your end-of-file (EODAD) routine is given control. The last record is the highest-addressed record for addressed or control-interval access or the highest-keyed record for keyed access. If an EODAD exit routine is not available, control is given to the LERAD exit routine.

Overlapping I/O Operations (EXCPAD)

When VSE/VSAM starts an I/O operation caused by a request macro, the execute-channel-program (EXCPAD) exit routine is given control. The EXCPAD routine must return control to VSE/VSAM, which continues your mainline routine at the instruction following the request macro. The EXCPAD exit is intended for use by programmers of utilities and systems.

Writing a Journal (JRNAD)

You can use the JRNAD routine to journal the transactions made against your file and to keep track of RBA changes.

For recording transactions, VSE/VSAM exits to the JRNAD routine every time your processing program issues a GET, PUT, or ERASE. For keeping track of RBA changes, VSE/VSAM takes the JRNAD exit every time data is shifted within a CI or moved to another CI. To process a key-sequenced file with addressed access, you need to know whether any RBAs have changed during keyed processing. VSE/VSAM takes the JRNAD exit before transmitting to direct-access storage the contents of a CI in which there was an RBA change.

RPL: Specifying the Request Parameter List

The RPL macro produces a Request Parameter List (RPL) which contains all the information needed by a request macro to access a record in the file. The request macros are GET, PUT, POINT, ERASE, and WRTBFR. The RPL identifies the file to which the request is directed by naming the ACB of the file.

You can use a single RPL to define parameters that apply to several requests. With the MODCB macro (described below) you can modify some of the parameters to change the type of processing, such as from direct to sequential or from update to non-update.

For concurrent requests, which require VSE/VSAM to keep track of more than one position in a file, any number of RPL macros may be used asynchronously by a processing program or its subtasks to process a file. The requests can be sequential or direct or both, and they can be for records in the same part or different parts of the file. You need specify only the RPL parameters appropriate to a given request, as follows:

Processing Options for a Request (OPTCD)

A request is for keyed, addressed, or control-interval access. The processing can be sequential, skip sequential (keyed access only), or direct. For keyed and addressed access and for sequential or direct processing, records may be retrieved in backward direction. A request may be for updating or not updating a record. A non-update direct request to retrieve a record can optionally cause positioning at the following record for subsequent sequential access.

For a keyed request, you specify either a generic key or a full key to which the key field of the record is to be matched. A generic key can match several records while a full key matches only one record. You can also specify that, if the key does not match the key of any record in the file, the record with the next greater key will be processed.

For retrieval, a request is either for a data record to be placed in a work area in the processing program (move mode) or for the address of the record within VSE/VSAM's I/O buffer to be passed to the processing program (locate mode).

Address of the Work Area for, or Pointer to, a Data Record (AREA)

For retrieval, update, insertion, or addition of a record, you must provide a work area in which the record is to be processed (move mode). For retrieval, you can have VSE/VSAM give you the address of the record within VSE/VSAM's I/O buffer (locate mode) in this field.

Size of the Work Area for a Data Record (AREALEN)

This parameter specifies either the length of the work area in which a record is placed (for move mode) or the four-byte address of the record in VSE/VSAM's I/O buffer (for locate mode). Having a work area that is too small is considered a logic error.

Length of the Data Record Being Processed (RECLEN)

For storage, your processing program indicates the length to VSE/VSAM; for retrieval, VSE/VSAM indicates it to your program.

Length of the Key (KEYLEN)

This parameter is required only for processing by generic key. For ordinary keyed access, the full key length is available from the catalog.

Address of the Area Containing the Search Argument (ARG)

The search argument is either a key (including a relative-record number) or an RBA. If the OPTCD parameter indicates a generic key, the KEYLEN parameter tells how many high-order (leftmost) bytes of the search argument will be used.

Address of the Next RPL in a Chain (NXTRPL)

You can process several records with a single GET or PUT by chaining RPLs together. For example, every RPL in a chain could contain a unique search argument and point to a unique work area. A single GET macro would retrieve a record for every RPL in the chain. A chain of RPLs is processed as a single request. (Chaining RPLs is not the same as issuing concurrent requests that require VSE/VSAM to keep track of multiple positions in a file.)

Transaction-ID (TRANSID)

With this parameter you can create a logical relationship between I/O requests issued for different VSE/VSAM files.

GENCB: Generating Control Blocks and Lists

You can use the GENCB macro to generate an ACB, EXLST, or RPL during the execution of your processing program, rather than to assemble it with the corresponding macro. GENCB is coded in the same way as the other macros, but it generates one or more copies of a control block or list and allows you to code parameter values in more ways.

Connecting and Disconnecting a Processing Program and a File

OPEN connects a processing program to a file, so that VSE/VSAM can satisfy the program's request for data. CLOSE completes processing and frees resources that were obtained by the Open routine. TCLOSE causes buffers to be written out and the catalog to be updated.

OPEN: Connecting a Processing Program to a File

The OPEN macro calls the Open routine, which verifies that the processing program has authority to process the file, constructs VSE/VSAM control blocks and establishes linkages to VSE/VSAM routines. By examining the DLBL statement indicated by the DDNAME operand in the ACB macro and the volume information in the catalog, Open verifies that the necessary volumes have been mounted. When you are opening a key-sequenced file or an alternate index, VSE/VSAM issues an error code to warn you if the data has been updated separately from its index.

CLOSE: Disconnecting a Processing Program from a File

The Close routine completes any I/O operations that are outstanding when a processing program issues a CLOSE macro for a file. It writes any output buffers that have not been stored.

Close updates the catalog entries for any changes in the attributes of a file; it also updates the statistics on file processing (such as number of records inserted). The addition of records to a file may cause its end-of-file indicator to change, in which case Close updates the end-of-file indicator in the catalog. These end-of-file indicators help ensure that the entire file is accessible. If an error prevents VSE/VSAM from updating the indicators, the file is flagged as not properly closed. When a processing program subsequently issues an OPEN macro, it is given an error code indicating the failure.

Because it is essential for the integrity of a file that it is closed properly, z/VSE automatically attempts to close all open VSE/VSAM files within the partition at both normal and abnormal termination of a job step. If any control blocks for a file have been destroyed through an error in your program, this file cannot be closed and a message is issued to the operator. EXLST routines are not entered during automatic CLOSE.

Close restores control blocks to the status that they had before the file was opened, and frees the virtual storage space that Open used to construct VSE/VSAM control blocks.

TCLOSE: Securing Records Added to a File

The TCLOSE macro performs the functions of CLOSE, except that it leaves the program and the file connected so that you can continue processing without reopening the file. You can use the TCLOSE macro to protect data while the file is loaded or extended. Positioning is lost when a TCLOSE is issued.

Manipulating and Displaying the Information Relating Program and Data

The MODCB, SHOWCB, and TESTCB macros are used for modifying, displaying, and testing the contents of an ACB, EXLST, or RPL.

MODCB: Modifying the Contents of Control Blocks and Lists

The MODCB macro is used to specify new values for fields in an ACB, EXLST, or RPL. For example, to use a single RPL to retrieve directly the first record having a certain generic key and then to retrieve sequentially the rest of the records having that generic key, you would use MODCB to alter the RPL to change from direct to sequential access.

SHOWCB: Displaying Fields of Control Blocks and Lists

SHOWCB allows you to examine the contents of fields in an ACB, EXLST, or RPL. VSE/VSAM displays the requested fields in an area you provide. You can also display fields in addition to those defined in the macros. For example, when a file is open, you can display various counts, such as number of CI splits, number of deleted records, and number of index levels. The RBA of the last record accessed and the error codes set in the ACB or RPL after macro execution can also be displayed.

TESTCB: Testing the Contents of Control Blocks and Lists

The TESTCB macro enables you to test the contents of a field or combination of fields in an ACB, EXLST, or RPL for a particular value and to alter the sequence of your processing steps as a result of the test. Thus, TESTCB is similar to a branch instruction. You can test the error codes set in the ACB or the RPL, for instance, or the attributes of a file, such as record length.

Requesting Data Transfer, Positioning, and Deletion of Records

All of the preceding macros prepare to process a file. The request macros (GET, PUT, POINT, ERASE, and WRTBFR) initiate an access to data. Another request macro, ENDREQ, is provided to (1) terminate processing of a request when completion is not required, or (2) free VSE/VSAM from having to keep track of a position in the file. Each of these macros is associated with an RPL (or chain of RPLs) that fully defines the request. The only parameter that is needed with a request macro is the address of the RPL that defines the request.

Displaying Catalog Information. SHOWCAT

With the SHOWCAT macro, you can retrieve information from a catalog about any non-open file defined in the catalog.

The entries in a catalog are related. Several entries are required to describe an object and its associated objects (for example, a cluster and its data and index components); one entry points to one or more other entries, which point to yet others. Figure 18 on page 177 shows the relationship of entries that describe the following *types of objects*:

- Alternate index (G)
- Cluster (C)
- Data component (D)

- Index component (I)
- Path (R)
- Upgrade set (Y)

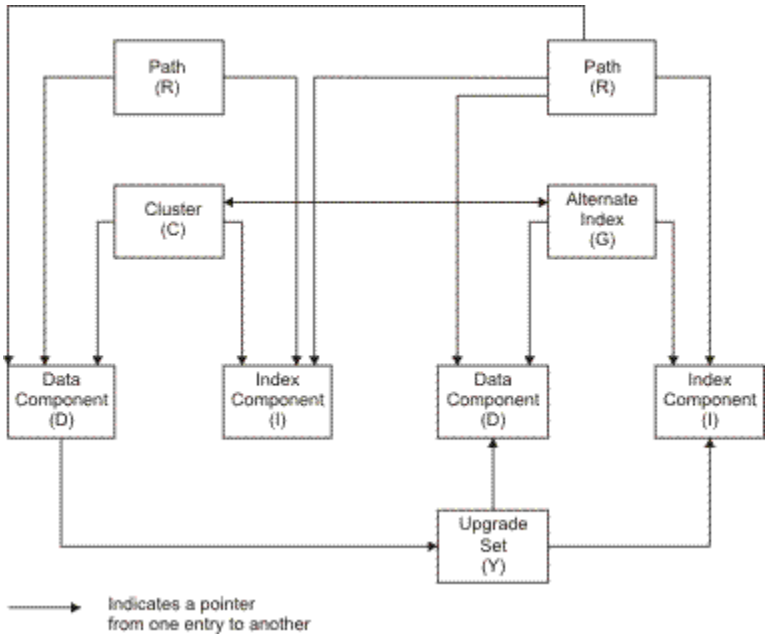


Figure 18. Relationship of Catalog Entries

For example, an *alternate index entry* points to the entries of its data and index components, its base cluster, and its path. SHOWCAT enables you to follow the arrows pictured in Figure 18 on page 177. You first issue SHOWCAT by specifying the name of the object you want to display. The information VSE/VSAM returns to you (only if EXTOPT is not specified) includes the CI numbers of the catalog entries that describe any associated objects. You then issue subsequent SHOWCATs to retrieve information from these associated entries by specifying the CI numbers that VSE/VSAM has returned. The first time you issue SHOWCAT, VSE/VSAM searches catalogs (in the following order) to locate the entry that describes the object to be displayed:

1. The catalog identified by the SHOWCAT CATDSN parameter, if specified.
2. The catalog identified by the DLBL CAT parameter for the VSE/VSAM file.
3. The job catalog identified by the IJSYSUC DLBL statement, if supplied.
4. The master catalog (IJSYSCT).

You must provide DLBL cards for:

- The master catalog – if the entry is in the master catalog.
- The master and the job catalogs – if the entry is in the job catalog.
- The master catalog – if the entry is in a user catalog specified by either the SHOWCAT CATDSN parameter or the DLBL CAT parameter for the VSE/VSAM file.

VSE/VSAM returns to you the address of the ACB that defines the catalog containing the entry to be displayed. The subsequent times you issue SHOWCAT, you can specify that address, which causes VSE/VSAM to search only the corresponding catalog.

Sharing Resources Among Files and Displaying Catalog Information

Normally, buffers and control blocks are allocated statically to a file at the time the file is opened; they are freed when the file is closed. As long as the file is open, these buffers and control blocks cannot be used by any other file.

The Shared Resources facility, however, allows you to share buffers, I/O control blocks, and channel programs among several VSE/VSAM files within a partition, and to manage I/O buffers. These buffers and control blocks are allocated out of a common resource pool at the time you issue an I/O request for a file. When the request is satisfied, the same buffers and control blocks can be assigned to another file (for direct requests).

Sharing these resources optimizes their use and also reduces the amount of virtual storage required (the working set) per partition. The facility is especially useful in an environment in which (a) many VSE/VSAM files are open and it is therefore difficult to predict the amount of activity that will occur at a given time, or (b) every transaction may refer to several files.

Managing I/O buffers includes:

- Deferring write operations for direct PUT requests, thus reducing the number of I/O operations.
- Correlating deferred requests by a transaction ID.
- Writing out buffers whose writing has been deferred.

Managing I/O buffers should enable you to speed up direct processing of VSE/VSAM files whose activity is unpredictable.

When you share resources for sequential access, you have to establish positioning before you can issue your initial retrieval request, because with shared resources VSE/VSAM does not automatically position itself at the beginning of a file opened for sequential access. Also note that you may not use shared resources to load records into an empty file.

The macros you use to share resources and write I/O buffers are:

- BLDVRP (build VSE/VSAM resource pool)
- DLVRP (delete VSE/VSAM resource pool)
- WRTBFR (write buffer)

In addition, the SHOWCAT macro is provided to display, for non-open files, the catalog information needed for the proper specification of some of the BLDVRP operands.

The ACB, RPL, SHOWCB, MODCB, and TESTCB macros have been extended to provide for sharing resources and managing I/O buffers.

Data Set Name Sharing

Normally, VSE/VSAM handles data sets that are opened through different access method control blocks (ACBs) always as different data sets; this applies even if such ACBs point to the same data set. Thus, when a file is opened through different ACBs, the *read integrity* may be impaired. Also, for non-shared resources (NSR), individual buffers with different copies of the same data and index records are in virtual storage, but cannot be shared. This results in unnecessary input/output operations, and negatively affects read/write integrity.

VSE/VSAM provides the processing option *data set name sharing*. Using this option:

- Improves data integrity when opening a file through different ACBs.
- Does not violate data integrity when writing to base clusters directly, or when writing through paths or alternate indexes simultaneously.
- Allows local shared resources (LSR) or non-shared resources (NSR) to share I/O buffers and control blocks of a file that has been opened through different ACBs.

ACBs that are created by VSE/VSAM internally can also access shared buffers; this, however, does not apply to catalogs.

To use *Data Set Name Sharing*, you essentially have to make entries in the ACB macro; in the:

- MACRF operand -- you have to specify DSN and DDN.
- BSTRNO operand -- you have to consider additional requirements for handling the base cluster of an alternate index (AIX).

The VSE/VSAM control block (CB) manipulation macros GENCB, MODCB, SHOWCB, and TESTCB are available to manipulate the ACB.

The following ACB specifications are MVS compatible:

```
MACRF=(DDN|DSN) and BSTRNO=number
```

Considerations

If you use *Data Set Name Sharing*, note that:

- The first opening ACB has to define the *total number of strings* for the first and all following ACBs. (This is similar to processing LSR resource pools.)
- All buffers have to be defined with the first ACB.
- All ACBs that are to be opened for a specific file must use the same resource pool. That is, you have to specify the *same* SHRPOOL number in each ACB.
- VSE/VSAM ignores the definition of STRNO, BSTRNO, BUFSP, BUFNI and BUFND for the second and further data set name shared ACBs.
- VSE/VSAM rejects an open to a reusable data set if ACB MACRF=(....DSN,RST...) is specified.
- VSE/VSAM rejects an open if ACB MACRF=(....DSN,UBF...) is specified.
- Before issuing TCLOSE, issue ENDREQ to the ACB-related RPLs. This avoids unpredictable results that could be caused by outstanding input/output processing.
- For DSN shared ACBs, VSE/VSAM ignores the share option specified in the IDCAMS commands ALTER and DEFINE. That is, if you specify *data set name sharing*, and whenever VSE/VSAM has opened a file, all data integrity within the DSN structure is handled internally by VSE/VSAM without the z/VSE LOCK facility. Additional OPENs to this file without *data set name sharing* are handled by VSE/VSAM depending on the specifications in the share option.
- It is *not* possible to share a path through an alternate index and a *single alternate index* (either opened as a key sequenced file, or opened through a path specified wit ACB MACRF=(AIX)). The reason for this is: there is a possibility that buffers containing base cluster records and alternate index records are mixed.

Processing

The sharing of buffers and control blocks of a data set is initiated at OPEN time through the operands MACRF=(DSN) and BSTRNO=number.

If a mix-up of input/output ACBs occurs, VSE/VSAM issues a warning message; nevertheless, opening of the file will be successful. VSE/VSAM handles a mix-up as follows:

- The first opening ACB designates whether the whole structure is for input or output. After the first open, you cannot change the structure anymore.
- If the first ACB is opened with MACRF=(...OUT,DSN...), and if one of the *following ACBs* is opened with MACRF=(...IN,DSN...), each insert/update request through such *following ACB* is rejected.
- If the first ACB is opened with MACRF=(...IN,DSN...), each insert/update request through this or each following ACB is rejected, even if the following ACB has been opened with MACRF=(...OUT,DSN).

Specifying Manipulation Macros

The VSE/VSAM control-block manipulation macros GENCB, MODCB, SHOWCB, and TESTCB are available to manipulate the ACB.

The following outlines the use of MACRF operand and the BSTRNO value:

GENCB ACB

```
,MACRF=(..,DSN),BSTRNO=number ...
```

This generates an ACB with MACRF=DSN, and sets the ACB field BSTRNO to the additional base cluster string number.

MODCB ACB

```
,MACRF=(..,DDN|DSN),BSTRNO=number ...
```

This modifies the ACB to MACRF=DSN or DDN, and sets the ACB field BSTRNO to the additional base cluster string number.

SHOWCB ACB

```
,FIELDS=(BSTRNO) ...
```

This shows the value of the ACB field BSTRNO.

TESTCB ACB

```
,MACRF=(..,DDN|DSN) ...
,BSTRNO=number ...
```

This tests the ACB for MACRF=DDN or DSN, and tests for the value of the ACB field BSTRNO.

Buffers and LSR Pools above 16MB Line of Storage

VSE/VSAM allows to allocate virtual storage for I/O buffers and for multiple local shared resources (LSR) pools *above* or *below* the 16MB line of address space.

The option can be specified through the parameter RMODE31 that is available in the macros ACB and BLDVRP. Refer to "The ACB Macro" on page 184 and "The BLDVRP Macro" on page 194. For information on how VSE/VSAM allocates buffers, refer to "Buffer Allocation above the 16MB Line of Storage" on page 16.

Note that a *program check* may occur if:

- A program uses a 24-bit address and if you attempt to reference control blocks, I/O data buffers, or LSR pools that are located above the 16MB line of storage.
- You attempt to use LOCATE mode:

  While in 24-bit mode, and
  RMODE31=ALL was specified.

When you use 31-bit addresses in your programs, note the following:

- All VSE/VSAM control blocks that have fields defined as 31-bit addresses *must* contain 31-bit addresses.

  Do not use the high-order byte of a 31-bit address field as a user-defined flag field. This applies to 24-bit and 31-bit addressing.
- You may obtain I/O data buffers from above or below the 16MB line as follows:
  - Below the 16MB line by taking the default (=NONE) in the ACB or BLDVRP macro.
  - Above the 16MB line by specifying RMODE31=ALL in the ACB or BLDVRP macro.

- The parameter list that is passed to your exit routine resides below the 16MB line.
- You must recompile the portion of your program that contains the ACB, BLDVRP, and DLVRP macro specifications, including control block manipulation requests.

Chapter 12. Descriptions of VSE/VSAM Macros

This Chapter...

- Documents Programming Interface information. See “Notices” on page 351.
- Describes the macros in *alphabetical* order. For each macro, you find an explanation of the format and operands, and other related details. When details apply to *macro groups*, the information is organized as follows:
  - Declarative Macros (ACB, EXLST, RPL):
    - “Examples: ACB, EXLST, and RPL Macros” on page 260.
  - Request Macros (GET, PUT, and so on):
    - “Examples of Request Macros” on page 262.
    - “Return Codes of Request Macros” on page 281.
  - Control Block Manipulation Macros (GENCB, MODCB, and so on):
    - “List, Execute, and Generate Forms of the Control Block Manipulation Macros” on page 283.
    - “Return Codes from the Control Block Manipulation Macros” on page 282.
  - OPEN/CLOSE Macros:
    - “OPEN/CLOSE/TCLOSE Message Area” on page 191.
- For information on the various *macro groups*, refer to Chapter 11, “Using VSE/VSAM Macros,” on page 171.

Syntax of VSE/VSAM Macros

For the general command description conventions, refer to the VSE/VSAM Commands, SC34-2707 under "Understanding Syntax Diagrams".

In the VSE/VSAM macros, you can code **address** as a symbolic name. Except for the ACB, EXLST, and RPL macros, you can also code an address as a register, using either ordinary register notation (with registers 2 through 12) or, if shown in the format description as a decimal number in parentheses, special register notation. For example:

```
RPL=address|(1)
```

means that you can specify either a symbolic address, any of the registers 2 to 12, or Register 1.

The use of Registers 0, 1, 13, 14, and 15 is the same as for z/VSE macros. VSE/VSAM does not save the contents of registers 0, 1, 14, 15 before using them. The highest order part of register 13 can be changed, depending on the caller's AMODE. If you use these registers, you must either save their contents yourself (and reload them later) or finish with them before VSE/VSAM uses them. For additional information about the use of registers, see the z/VSE System Macros Reference, SC34-2708.

You can code a **value** (number) as any absolute expression, except for a self-defining character term. You can code a **name** according to the rules of the assembler. The control block manipulation macros (GENCB, SHOWCB, MODCB, and TESTCB) can be coded in even more ways as shown in “Operand Notation for VSE/VSAM Macros” on page 285.

Some operands of the VSE/VSAM macros can have more than one parameter. These operands are shown with parentheses around the parameters (for example, the MACRF operand of the ACB macro). This

means that you can code the operand, if it has only one parameter, with or without parentheses around the parameter:

```
MACRF=option
MACRF=(option)
```

However, if the operand is coded with two or more parameters, enclosing parentheses are required:

```
MACRF=(option,option)
```

VSAM Executable Macros and Their Mode Dependencies

Table 24. VSAM Macros and Their Mode Dependencies

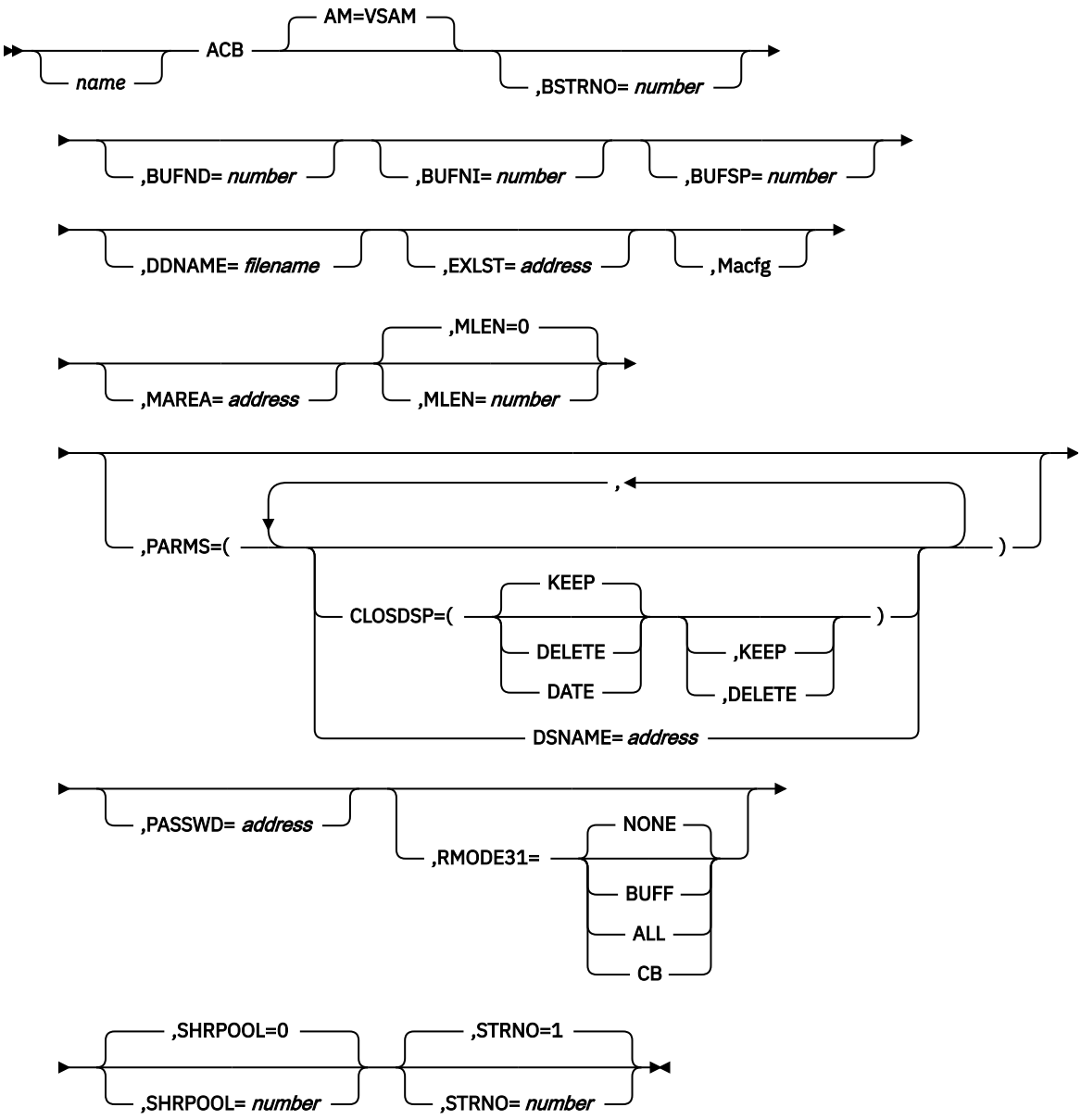
Macro	AMODE	RMODE	Comment
CLOSE	31	ANY	
OPEN	31	ANY	
TCLOSE	31	ANY	
GET(RPL)	31	ANY	
PUT(RPL)	31	ANY	
ENDREQ	31	ANY	
POINT	31	ANY	
GENCB	31	ANY	All parameters and control blocks can be allocated either above or below 16MB
SHOWCB	31	ANY	All parameters and control blocks can be allocated either above or below 16MB
MODCB	31	ANY	All parameters and control blocks can be allocated either above or below 16MB
TESTCB	31	ANY	All parameters and control blocks can be allocated either above or below 16MB
SHOWCAT	31	ANY	All parameters and control blocks can be allocated either above or below 16MB
BLDVRP	31	ANY	
DLVRP	31	ANY	
WRTBFR	31	ANY	

The ACB Macro

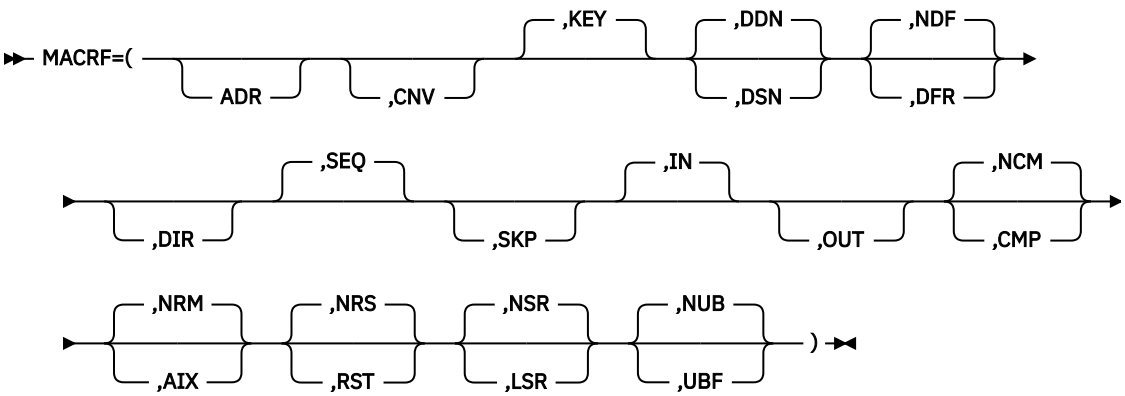
You specify most information (such as key length or record format) about the file in the DEFINE command of IDCAMS. That information then resides in the VSE/VSAM catalog and is brought into virtual storage when the ACB is opened.

You code the values for the ACB macro operands as absolute numeric expressions, character strings, codes, and expressions that generate valid relocatable A-type address constants. Ordinary register notation cannot be used for address.

Format of the ACB Macro



Macfg



This macro specifies the kind(s) of processing you will do with the file. The options must be meaningful for the file. For example, if you specify keyed access for an entry-sequenced file, you will not be able to

open the file. You must specify all of the types of access you are going to use, whether you use them concurrently or by switching from one to the other.

For information on the interaction between the DLBL DISP parameter and the ACB MACRF specification when a file is opened, refer to “File Disposition” on page 29.

Mutually exclusive options are:

```
AIX and NRM       NDF and DFR
IN and RST        LSR and UBF
NRS and RST       LSR and RST
NUB and UBF       NSR and DFR
NSR and LSR       NCM and CMP
```

The following restrictions apply to a SHAREOPTIONS 4 key-sequenced output file:

- One ACB cannot specify both KEY and ADR (or both KEY and CNV). Attempts to do this result in an OPEN failure.
- If the file is open for output under one ACB for keyed access, an attempt to open it under another ACB with MACRF=(OUT,ADR) or MACRF=(OUT,CNV) will fail.
- If the file is open for output under one ACB for addressed or CI access, an attempt to open it under another ACB with MACRF=(OUT,KEY) will fail.

If an application chooses to place a VSE/VSAM ACB in 31-bit partition GETVIS, the Open macro can be used to open only that one ACB in a single invocation (Open List). No DTFs can be included in an Open List containing an ACB residing in 31-bit partition GETVIS.

name
one through eight characters that provide a symbolic address for the ACB that is assembled. If you omit the DDNAME parameter, the specified name serves as the file name that you must specify in the DLBL JCL statement. In that case, the name you use must not exceed seven characters, and its first character must be a letter (A - Z).

AM=VSAM
specifies that this is a VSE/VSAM control block. You may want to specify this operand for documentation purposes if your installation also uses VTAM.

BSTRNO=number
specifies additional buffers and strings that are required whenever a path is opened to handle the base cluster of an alternate index (AIX). It specifies the number of strings that VSE/VSAM is to allocate internally for access to the base cluster of a path.

BSTRNO applies only in conjunction with *data set name sharing*.

If you omit the operand or specify BSTRNO=0, the number of internally created strings is twice that specified in STRNO.

No dynamic increase of string numbers is possible under VSE/VSAM.

If the value specified in BSTRNO is insufficient, requests could fail. BSTRNO is accepted if the sum of the values in STRNO and BSTRNO does *not* exceed 255; this applies even if the opened ACB does not belong to the path.

It is important to define a reasonable value with the *first* ACB that opens for data set name (DSN) sharing. This is necessary, because VSE/VSAM ignores the BSTRNO values of subsequently opened ACBs with DSN sharing to the same data set.

For further information and considerations, refer to “Data Set Name Sharing” on page 178.

BUFND=number
specifies the number of I/O buffers to be used to hold CIs containing data records. Every buffer is the size of one data CI. The allowable minimum specification (and also the default) is the number specified for STRNO, plus one. (The default for STRNO is one.) If you specify the BUFND operand, but your specification is less than the minimum, VSE/VSAM overrides your specification and uses the minimum. However, VSE/VSAM issues no message to inform you of this.

These buffers will be allocated in 24-bit partition GETVIS, unless “RMODE31=BUFF” is specified, or “BUFDAT=RMODE31” is specified on the DLBL statement at run-time. If there is insufficient storage available to satisfy this request, processing will terminate with an appropriate OPEN error code.

VSE/VSAM increases the number of data buffers you specify if the amount of virtual storage available for buffers differs from the storage requirements indicated by the BUFND and BUFNI operands. See the BUFSP operand for an explanation. For examples of BUFND use, see “Buffer Specification” on page 87.

BUFNI=number

specifies the number of I/O buffers to be used to hold index CIs (index records). Every buffer is the size of one index CI. The minimum number you can specify is the number specified for the STRNO operand. (If you omit STRNO, BUFNI must be at least one, because the default for STRNO is one.) If BUFNI is omitted, the default is the number specified for STRNO, because the smallest number of index buffers allowed is one for every string. If you specify the BUFNI operand, but your specification is less than the minimum, VSE/VSAM overrides your specification and uses the minimum. However, VSE/VSAM issues no message to inform you of this.

VSE/VSAM increases the number of index buffers you specify if the amount of virtual storage available for buffers differs from the storage requirements indicated by the BUFND and BUFNI operands. See the BUFSP operand for an explanation. For examples of BUFNI use, see “Buffer Specification” on page 87.

BUFSP=number

specifies the size, in bytes, of an area for data and index I/O buffers. VSE/VSAM issues a GETVIS macro to obtain the buffer area in your processing partition. It must be at least as large as the buffer space size recorded in the catalog entry for the file. If your specification is too small, VSE/VSAM overrides it and uses the value recorded in the catalog for buffer space size. However, VSE/VSAM issues no message to inform you of this.

If you do not specify the BUFSP operand, the buffer space size will be the larger of (1) the size recorded in the catalog or (2) the size determined from the values specified for BUFND and BUFNI. (The size recorded in the catalog was specified by the BUFFERSPACE parameter in the DEFINE command of IDCAMS. If that parameter was omitted when the file was defined, a default value was set in the catalog. This default value, the minimum amount of buffer space allowed by VSE/VSAM, is enough space for two data CIs and one index CI.)

You can also specify buffer space by means of the BUFSP=number operand on the DLBL statement that identifies the file to be processed. This value overrides the BUFSP operand in the ACB macro. It also overrides the BUFFERSPACE parameter in the DEFINE command if it is greater than the BUFFERSPACE parameter value.

The data buffers will be allocated in 24-bit partition GETVIS, unless “RMODE31=BUFF” is specified, or “BUFDAT=RMODE31” is specified on the DLBL statement at run-time. If there is insufficient storage available to satisfy this request, processing will terminate with an appropriate OPEN error code.

If the values you code for BUFND, BUFNI, and BUFSP are not consistent with each other, VSE/VSAM increases the number of buffers to conform to the size of the buffer area.

If BUFSP is greater than the minimum requirements and greater than the BUFND and BUFNI requirements, the extra space will be allocated between data and index buffers as follows:

- If the ACB MACRF operand indicates direct processing only:

  First, BUFND and BUFNI are allocated as specified. Then, all additional space is allocated to index buffers.

- If the ACB MACRF operand indicates sequential processing:

  First, BUFND and BUFNI are allocated as specified. Then, one additional buffer is allocated to the index and the remaining space is allocated to data buffers. Any space remaining, but insufficient for a single data buffer, is allocated to an index buffer.

If BUFSP is greater than the minimum requirements, but less than the BUFND and BUFNI requirements, the buffer space will be changed to conform to the BUFND and BUFNI requirements.

If you provide your own pool of I/O buffers for CI (CNV) access (MACRF=UBF), the BUFND, BUFNI, and BUFSP operands have no effect. The AREA and AREALEN parameters in the RPL macro then define the area for user buffers.

For examples of BUFSP use, see "Buffer Specification" on page 87.

DDNAME=filename
specifies a character string of up to seven bytes and is the same as the filename parameter specified in the DLBL statement that identifies the VSE/VSAM file or path to be processed.

If the 'file ID' in the DLBL statement indicates a path, but you want to process only the alternate index of the path, you must specify MACRF=AIX (see the discussion of the MACRF operand). If the file ID does not indicate a path, the AIX option is ignored.

If you omit the DDNAME operand, you must specify the DLBL filename as the name (label) of the ACB macro.

EXLST=address
specifies the address of a list of user exit-routine addresses. The list is generated by the EXLST macro (or the GENCB macro). If you use the EXLST macro, you can specify its name (label) here as the address of the exit list. If you use the GENCB macro, you can specify the address of the EXLST returned by GENCB in Register 1. Omitting this operand indicates that you have no user exit routines.

MACRF=
see the beginning of this section.

MAREA=address
specifies the address of an optional OPEN/CLOSE/TCLOSE message area. (See "OPEN/CLOSE/TCLOSE Message Area" on page 191.)

MLEN=number
specifies the length of an optional OPEN/CLOSE/TCLOSE message area. The default is 0, the maximum value can be 32,768 bytes.

PARMS=(CLOSDSP=options DSNAME=address)

CLOSDSP=options
specifies the CLOSE disposition for a reusable file. Options specified in the DLBLs DISP=(,option) JCL statement override the options specified in this parameter.

If a second option (either KEEP or DELETE) is specified, this indicates whether the file should be kept or deleted if it was opened during a job that ended abnormally. For example, if you open a file with PARMS=(CLOSDSP=(DELETE,KEEP)) specified, then this file is deleted only if the job comes to a *normal* end. In any other case, the file is kept so that you can rerun the job without reloading the file.

DATE
indicates that disposition depends on the current system date and the file's expiration date. If the expiration date is yet future relative to the system date, the file is treated as though KEEP were specified. Otherwise the file is treated as though DELETE were specified. DISP=(,DATE) on the DLBL statement is equivalent to PARMS=(CLOSDSP=DATE) and will override any CLOSDSP specified in the ACB.

DELETE
indicates that the file and its contents need not be preserved. VSE/VSAM is free to release resources associated with the file. DISP=(,DELETE) on the DLBL statement is equivalent to PARMS=(CLOSDSP=DELETE) and will override any CLOSDSP specified in the ACB.

KEEP
indicates that the file and its contents are to be preserved. DISP=(,KEEP) on the DLBL statement is equivalent to PARMS=(CLOSDSP=KEEP) and will override any CLOSDSP specified in the ACB.

If disposition parameters indicate that file resources can be freed, VSE/VSAM releases as many resources as allowed by the sharing status and by the characteristics defined for the file. For details, refer to "File Disposition" on page 29.

DSNAME=address
specifies the address of a 88 byte area that contains the data set names of the cluster and the catalog that contains the data set. The DSNAME operand allows to open a file without referring to a matching label (DLBL). The format of the area pointed to by `address` is:

Offset Dec	Hex	Bytes	Description
0	0	44	Entry name of cluster or component to be used
44	2C	44	Entry name of the catalog

PASSWD=address
specifies the address of a field that contains the highest-level password required for the type(s) of access indicated by the MACRF operand. The first byte of the field pointed to contains the length (in binary) of the password (maximum of 8 bytes). A zero in the length byte indicates that no password is supplied. If the file is password-protected and you do not supply a required password in the ACB, VSE/VSAM gives the console operator the opportunity to supply it when opening the file.

RMODE31=NONE | BUFF | ALL | CB
specifies whether VSE/VSAM OPEN is to obtain virtual storage for I/O buffers above or below the 16MB line of address space. The default is NONE. Another option to accomplish the same effect as 'RMODE31=BUFF', would be to specify 'BUFDAT=RMODE31' on the DLBL statement at run-time.

Note: The internal VSE/VSAM buffers and control blocks are not affected by the RMODE31 parameter. If possible, VSE/VSAM places such buffers and control blocks above the 16MB line.

(Internal VSE/VSAM buffers are, for example, NSR index buffers, path buffers, and upgrade set buffers.)

NONE (**CB**)specifies that VSE/VSAM I/O buffers must be obtained from *below* the 16MB line.

BUFF (**ALL**) specifies that VSE/VSAM I/O buffers may to be obtained from *above* the 16MB line.

ALL and **CB** are implemented for reasons of z/OS (DFSMSdfp) compatibility.

SHRPOOL=number
identifies which LSR pool is to be connected to the ACB. This parameter is only valid when MACRF=LSR is also specified. For *number* specify the identification number of the shared pool; it can be a number from 0 through 15. The default is 0.

STRNO=number
indicates how many concurrent active requests VSE/VSAM is to handle. The maximum value is 255. The default is one.

During initial load of a file, VSE/VSAM ignores your specification and sets the value to one because a file can be loaded by one string only. After the file is loaded and successfully closed, it can be reopened and processed by as many strings as specified under STRNO.

Several requests, with the corresponding RPLs pointing to the same ACB, can be active at the same time. Thus, you can access simultaneously (a) different parts of a file, and (b) in different modes of operation (sequential and direct, or keyed and addressed, for example). You may, for example, process one part of a file sequentially (forward or backward) and intermix sequential processing with direct requests to any part of the file, without affecting the sequential positioning.

Every request is activated by its own RPL and action (GET, PUT, etc.) macro. Positioning information is maintained separately for every RPL, so that every request can be processed independently from all other requests.

A request is defined either by a single RPL or by a chain of RPLs (see “RPL: Specifying the Request Parameter List” on page 174). Specify for STRNO the total number of RPLs or chains of RPLs that you will use to define requests. For a chain of RPLs VSE/VSAM needs to remember only one position. However, every position beyond the minimum number that VSE/VSAM needs to remember requires additional virtual-storage space for:

- A minimum of one data I/O buffer and, for keyed access, one index I/O buffer (the size of an I/O buffer is the CI size of a file).
- Internal control blocks and other areas.

VSE/VSAM remembers its position in the file for any sequential or update request. For example, sequential access depends on VSE/VSAM being able to determine the location of the next record from the location of the present record. Updating or deleting a record depends on VSE/VSAM remembering its location after you retrieve it. Also, processing a record in the I/O buffer requires VSE/VSAM to remember its location in the buffer.

Note: If the number of concurrent requests (RPLs or chain of RPLs) exceeds the number you have specified in the ACB STRNO operand, you must disconnect a request from its RPL by means of the ENDREQ macro before you can issue another concurrent request. The ENDREQ macro is discussed under "The ENDREQ Macro" on page 200.

Options of the MACRF Parameter

The following explains the MACRF parameter options. The options are arranged in groups, where every group has a default value (highlighted). You can specify options in any order. You may specify both DIR and SEQ; with keyed access, you may specify SKP as well. If you specify OUT and want simply to retrieve some records as well as update, delete, or insert others, you need not also specify IN. You may specify both ADR and KEY to process a key-sequenced file.

ADR
Addressed access (for key-sequenced and entry-sequenced files).

CNV
CI access.

KEY
Keyed access (for key-sequenced or relative-record files).

DDN
specifies to open the data set according to the DDNAME specification.

DSN
specifies that VSE/VSAM handles the first ACB that is opened as if you specified DDN. However, VSE/VSAM also:

- Remembers that a *DSN structure* was built.
- Connects the second and all following ACBs that open the first data set to the structure of the first ACB.

If DSN is specified, VSE/VSAM shares control blocks and I/O buffers.

For further information and considerations, refer to "Data Set Name Sharing" on page 178.

DFR
Write operations are to be deferred when possible.

NDF
Write operations are not to be deferred.

DIR
Direct processing.

SEQ
Sequential processing.

SKP
Skip sequential processing (for key-sequenced or relative-record files).

IN
Retrieve records only.

OUT
Retrieve, insert, add-to-end, or update records (keyed access); retrieve, update, or add-to-end (addressed access).

NCM
All data records exchanged between VSE/VSAM and the application are in uncompressed (expanded) format. If the file is in COMPRESSED format, MACRF=CNV must not be specified.

CMP
If the file is in COMPRESSED format, all data (records or control intervals) exchanged between VSE/VSAM and the application are in compressed format. The record includes the compressed record prefix (see "Data Format of Records" on page 63). SHOWCB and TESTCB also take the prefix length into account for the LRECL, RKP, and RECLEN keywords, if MACRF=CMP is specified.

NRM
The file (or path) named in the DDNAME operand or in the DLBL statement is to be processed.

AIX
The alternate index of the path specified in the DDNAME operand is to be processed. If no path is specified there, this option is ignored. The AIX option causes the path restrictions (that is, the restrictions limiting the access through a path) to be ignored so that the alternate index can be processed like a key-sequenced file. The alternate index of the path can be opened for input (IN), output (OUT), or it can be reset (RST), provided it was defined with the REUSE attribute (in the DEFINE ALTERNATEINDEX command).

NRS
The Open routine does not reset the file to 'empty'. Output operations will cause updating or extension of the existing record. DISP=OLD on the DLBL statement is equivalent to MACRF=NRS and will override MACRF=RST.

RST
The Open routine resets the catalog information about the file (cluster or alternate index) to its original status, that is, to the status it had before it was opened for the first time. The file must have been defined with the REUSE attribute for RST to be effective. Although the file is not erased, you can handle it like a new file and use it as a work file. After the Open routine has performed the reset operation, the RST option is equivalent to the OUT option. DISP=NEW on the DLBL statement is equivalent to MACRF=RST and will override MACRF=NRS.

NSR
Non-shared resources (normal operation).

LSR
Local shared resources (LSR).

When you specify LSR in the ACB, VSE/VSAM ignores the BUFND, BUFNI, BUFSP, and STRNO operands, because it uses the BUFFERS and STRNO values specified in the BLDVRP macro.

For more information, see "Sharing Resources Among Files and Displaying Catalog Information" on page 178.

NUB
No user buffers; VSE/VSAM supplies buffers for I/O operations (KEY, ADR, and CNV access).

UBF
User buffers (only CNV access can be specified). VSE/VSAM will read and write CIs in a buffer you supply. It is pointed to by the AREA parameter of the RPL.

OPEN/CLOSE/TCLOSE Message Area

Providing the Area

After you have issued an OPEN, CLOSE, or TCLOSE macro, the ACB error code is either zero, indicating that the files were opened or closed successfully, or non-zero, indicating that a warning or error condition

occurred. You can examine this code by specifying the ERROR keyword in the SHOWCB or TESTCB macro. However, during an OPEN, CLOSE, or TCLOSE more than one warning or error condition may be detected, in which case the error code which you get when you specify the ERROR keyword reflects only the warning or error condition which occurred last. The error code does not indicate any other (earlier) conditions which might have occurred during the OPEN, CLOSE, or TCLOSE.

In order to save such multiple warning or error conditions, you can provide a message area in which those conditions are to be stored, together with additional information. This message area is connected to the ACB when you specify the following parameters in the ACB macro:

```
MAREA=address,MLEN=length
```

If MAREA or MLEN are not specified or a length of zero has been specified for MLEN, no area is provided and the ACB error code is then the only indication for errors or warnings which occurred during OPEN, CLOSE, or TCLOSE. If you have specified both MAREA and MLEN (with a non-zero value) and error or warning conditions are detected, appropriate messages are stored into the message area.

The OPEN/CLOSE/TCLOSE message area is also used by VSE/VSAM record management if resources such as buffers and control blocks are shared among files. If a GET request is issued for a file using the common resource pool, it can happen that (owing to deferred write operations for PUT requests) the resource pool is filled up with modified buffers forcing VSE/VSAM to write a buffer for another file before it can satisfy the GET request. If an error occurs in writing out such a buffer, this is indicated in the message area, together with the ACB name of the affected file.

The message information provided by VSE/VSAM consists of the message area header and the message list.

The message area header contains statistical, pointer, and general information. Its contents are unrelated to the individual messages.

Format of the Message Area Header

The format of the message area header is:

Byte
Meaning

0
Flag byte

Bit 0=1:
At least one warning or error condition has occurred and the complete header is stored.

Bit 0=0:
Either no warning or error condition has occurred or the message area is too short for the complete header. No further header information and no messages are stored.

Bits 1-7
Reserved (set to binary zero)

1-2
Length of message area header

3
Request type code:

X‘01’
OPEN

X‘02’
CLOSE

X‘03’
TCLOSE

X‘04’
GET (for shared resources only)

4-11
Filename used for ACB

12-13
Total number of error or warning conditions issued by OPEN, CLOSE, TCLOSE, or (for shared resources only) by record management

14-15
Number of messages stored into message area

16-19
Address of message list, that is, of first message in the message area

Apart from the flag byte, message area header information is stored only when a warning or error condition was detected (the ACB or RPL error code is non-zero) and the length of the message area (MLEN) is large enough to accommodate the full message area header. Thus, before accessing bytes 1-19 of the message header information, you should test byte 0 to see whether further information was stored at all.

The message list contains the individual messages corresponding to the warning or error conditions detected. It is pointed to by bytes 16-19 of the message area header. Within the message list, the individual messages are stored continuously one after another in the form of variable-length records. The number of messages stored is contained in the message area header (bytes 14-15). Before investigating the message list, you should check whether the stored-message count is zero or greater than zero. The format of a message is as follows:

Byte
Contents

0-1
Total length of message (including length bytes).

2
ACB error code corresponding to error or warning condition represented by this message, or (for shared resources) RPL error code indicating write error.

3
Function-type code (indicates the component which produced the error or warning condition and the state of the upgrade set):

X‘00’
Condition occurred during accessing the base cluster. Upgrade set is correct.

X‘01’
Condition occurred during accessing the base cluster. Upgrade set may be incorrect as a consequence of this request.

X‘02’
Condition occurred during accessing the AIX over a base cluster. Upgrade set is correct.

X‘03’
Condition occurred during accessing the AIX over a base cluster. Upgrade set may be incorrect as a consequence of this request.

X‘04’
Condition occurred during upgrade processing. Upgrade set is correct.

X‘05’
Condition occurred during upgrade processing. Upgrade set may be incorrect as a consequence of this request.

X‘06’
Condition occurred during writing of a buffer which does not belong to the file for which the GET request was issued (for shared resources only).

4-nn
File ID of the component indicated by the function-type code (up to 44 bytes), or (for shared resources) name of the ACB identifying the file for which the buffer write error occurred.

Exceptional Conditions for the Message Area

- Message area (MLEN) is too small to contain the complete message area header:

  Byte 0, bit 0=0: The whole message area is overwritten with binary zeros.

- Message area is too small to contain a complete message:

  Byte 0, bit 0=1: The header exists.
  Bytes 12-13 not equal to 0: Warning or error conditions have occurred.
  Bytes 14-15=0: No message stored.

- Message area is too small to contain all messages:

  Byte 0, bit 0=1: The header exists.
  Bytes 12-13 not equal to 0: Warning or error conditions have occurred.
  Bytes 14-15 not equal to 0: If the value in bytes 14-15 is lower than in bytes 12-13, then not all messages have been stored.

The BLDVRP Macro

To share resources, you must provide a resource pool which you build by issuing the BLDVRP (build the VSE/VSAM resource pool) macro. Issuing BLDVRP causes VSE/VSAM to share the I/O buffers, I/O control blocks, and channel programs of those files whose ACBs indicate the local shared resource (LSR) option. Control blocks and channel programs are shared automatically; you can control the sharing of buffers.

When issuing BLDVRP, you must specify one or more *buffer pools* within the resource pool, and also the size and number of buffers in every buffer pool. A file uses the buffer pool whose buffer size exactly matches the file's CI size or, if this CI size is not available, the buffer pool with the next-larger buffer size. The file uses only the one buffer pool.

To share resources, you must do all of the following:

- Issue the BLDVRP macro to build a resource pool.
- Code the LSR option in the MACRF operand in the ACBs of your files.
- Issue OPEN to connect these files to the resource pool.

When you issue a BLDVRP macro, Register 13 must contain the address of a 72-byte save area that you are providing. When you issue a BLDVRP macro from within one of your exit routines such as LERAD or SYNAD, your program must provide a second 72-byte save area for use by VSE/VSAM, because the original save area is still in use by the external VSE/VSAM routine.

Deciding How Big a Pool to Provide

You have to provide a resource pool before any clusters or alternate indexes are opened to use it. Specifying the BUFFERS, KEYLEN, and STRNO operands of the BLDVRP macro requires knowledge of the size of the CIs, data records (if spanned), and key fields in the components that will use the resource pool and knowledge about the way the components are processed.

Displaying Information about an Unopened File

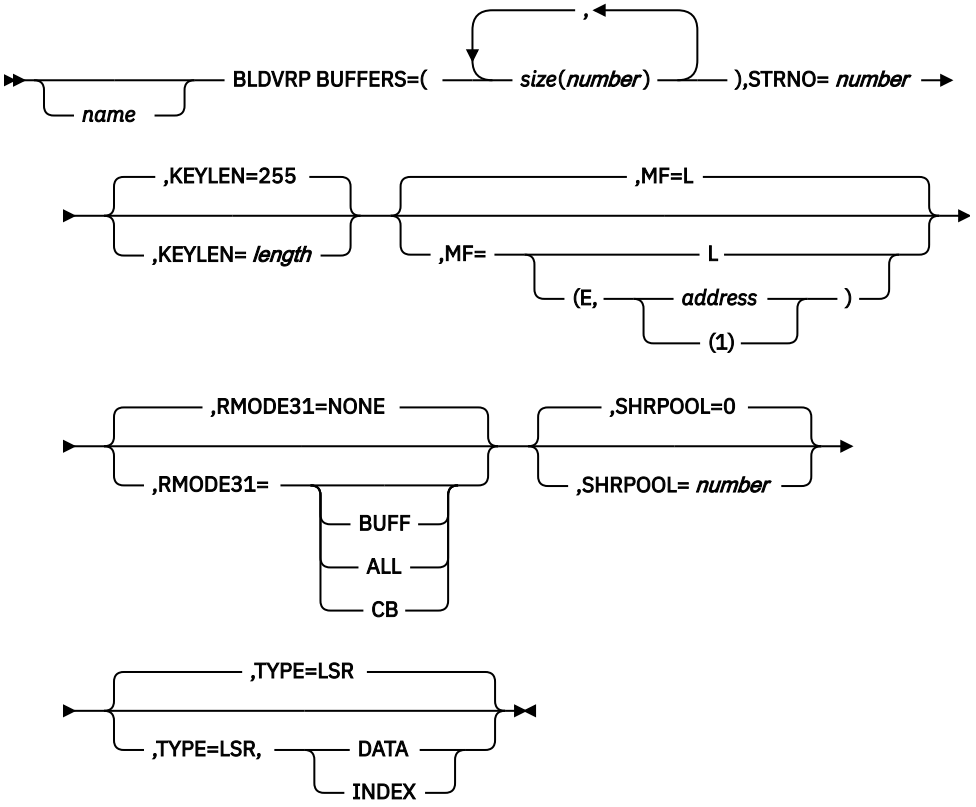
The SHOWCAT macro enables you to get information about a component before its cluster or alternate index is opened. The program that is to issue BLDVRP can issue SHOWCAT on all of the components to find out the sizes of CIs, records, and keys. This information enables the program to calculate values for the BUFFERS and KEYLEN operands of BLDVRP.

Displaying Statistics about a Buffer Pool

You can get statistics about the use of buffer pools to determine how you could improve a previous definition of a resource pool and the mix of files that use it. The SHOWCB macro enables you to get statistics about a buffer pool. The statistics are available from an ACB that describes an open file that is using the buffer pool. They reflect the use of the buffer pool from the time it was built to the time SHOWCB is issued. All of the statistics except one are for a single buffer pool. To get statistics for the whole resource pool, issue SHOWCB for every buffer pool in it.

The statistics cannot be used to redefine the resource pool while it is in use. You have to make adjustments the next time you build it.

Format of the BLDVRP Macro



name
one to eight characters that provide a symbolic name.

BUFFERS=size(number)
specifies the size and the number of buffers in every buffer in the resource pool. The number of buffer pools in the resource pool is implied by the number of **size(number)** pairs you specify. The buffer sizes should normally be set equal to the CI sizes of the files to be processed. (You can find out the CI size of a file by issuing the SHOWCAT macro for that file.) If you do not specify the exact buffer (=CI) size for a file, VSE/VSAM will use buffers from the buffer pool with the next larger buffer size. All buffers and control blocks are automatically defined in 31-bit storage, if available.

When you process a key-sequenced file, the index component, as well as the data component, shares the buffers of a buffer pool. When you use an alternate index to process a base cluster, the components of the alternate index and the base cluster share buffers. The components of alternate indexes in an upgrade set share buffers. Buffers of the appropriate size and number must be provided for all of these components, each of which uses the buffer pool whose buffers are exactly the right size or the next-larger size.

size is 512, 1024, 2048, 4096, or so on in increments of 4096 to a maximum of 32KB.

number is at least 3 but must not exceed 32767.

KEYLEN=length
specifies the maximum key length of the files that are to share the resource pool. The default is 255.

The keys whose lengths must be provided for are the prime key of every KSDS and the alternate key of every alternate index that is used for processing or is upgraded. The key length (relative record number) of a relative record file is 4. If the buffer pool is to contain for entry-sequenced files only, specify KEYLEN=0. (You can find out the key length of a file by issuing the SHOWCAT macro for that file.)

MF=L
indicates that this is the list form of BLDVRP. The list form builds a parameter list when the macro is assembled. It is not executable. If you do not specify STRNO in the list form of BLDVRP, you must specify it in the execute form.

The list form of the BLDVRP macro is especially useful when the buffer sizes of the VSE/VSAM files are not known. In that case you can first retrieve from the VSE/VSAM catalog the CI sizes of the files to be processed via the SHOWCAT macro and then enter these values in the BLDVRP parameter list.

The format of the BLDVRP parameter list is described in "The BLDVRP Parameter List" on page 302.

MF=(E)
indicates that this is the execute form of BLDVRP. address is the address of the parameter list built by the list form of BLDVRP.

If you use register notation, you may use Register 1, as well as any register from 2 through 12. The execute form puts the address of the parameter list in Register 1 and passes control to VSE/VSAM to process the list. You may, however, first change the values for STRNO and/or KEYLEN (which are both optional in the execute form of BLDVRP). BUFFERS may not be specified in the execute form of BLDVRP, because this operand affects the length of the parameter list.

If the MF operand is omitted, the standard form of the BLDVRP macro is assumed, which builds a parameter list, puts its address in Register 1, and passes control to VSE/VSAM to process the list.

RMODE31=NONE | BUFF | ALL | CB
specifies where the I/O buffers for the LSR pool are to reside. (The pools are identified in the SHRPOOL keyword.) The default is NONE.

NONE (**CB**) specifies that the buffers must reside *below* the 16MB line.

[BUFF] (**ALL**) specifies that the buffers may reside *above* the 16MB line.

ALL and **CB** are implemented for reasons of z/OS (DFSMSdfp) compatibility.

SHRPOOL=number
specifies the identification number of a shared resources pool that is to be build. Specify a number from 0 through 15. The default is 0.

STRNO=number
specifies the maximum number of requests that may be issued concurrently for all of the files that are to share the resource pool. The number must be at least one and no more than 255.

If you want to find out how effectively your resource pool is utilized during execution, you can display the maximum number of requests which were concurrently active because the resource pool was built by issuing a SHOWCB ACB=...,FIELDS=(STRMAX) in your processing program. Depending on the result, you may want to redefine STRNO=number the next time you build your resource pool. (You cannot redefine the pool while it is in use.)

The ACB specified in the SHOWCB macro can be any ACB that describes an open file that is using the resource pool.

TYPE=LSR(,DATA | INDEX)
Allows definition of separate LSR pools for data and index. If only LSR is specified, there is one LSR pool for both data and index. Definition of an INDEX LSR pool requires a previous definition of a DATA

LSR pool. The form "TYPE=LSR" is implemented for compatibility with z/OS (DFSMSdfp). No type other than LSR (such as GSR on z/OS) is accepted by VSE/VSAM.

Return Codes from BLDVRP

When VSE/VSAM returns to your processing program after a BLDVRP request, Register 15 contains one of the following return codes:

Return Dec	Code Hex	Meaning
0	X‘00’	VSE/VSAM completed the request.
4	X‘04’ No new pool was build.	The resource pool already exists in the partition.
12	X‘0C’	The request was not executed because an error was encountered while VSE/VSAM routines were loaded (for example, CDLOAD failed), or there was insufficient GETVIS space for the partition that uses the BLDVRP macro.
20	X‘14’	STRNO is less than one or greater than 255.
24	X‘18’	BUFFERS is specified incorrectly: size or number is invalid.
28	X‘1C’	SHRPOOL is less than 0 or greater than 15.
32	X‘20’	BLDVRP was issued to build an index resource pool, but the required corresponding data resource pool does not exist.

Connecting a File to a Resource Pool

After having built a resource pool, you cause a file to use that pool by specifying the SHRPOOL=number and MACRF=(LSR) operands of the file's ACB before you open the file, thus:

```
ACB   SHRPOOL=number,MACRF=(LSR)
```

When you have specified LSR in the ACB, VSE/VSAM ignores the BUFND, BUFNI, BUFSP, and STRNO operands, because it uses the BUFFERS and STRNO values that you have specified in the BLDVRP macro.

Restrictions

UBF (user buffering) may not be specified together with LSR. LSR may not be specified in the ACB of an empty file (which implies that the file is to be loaded).

Apart from the standard error codes from the Open routine, you may get additional error codes in the ACB ERROR field when you try to open a file with the LSR option. These error codes are listed in the z/VSE Messages and Codes Volume 2, SC34-2683.

The CLOSE Macro

After your last request for access to the file, you will normally issue a CLOSE macro to complete processing of that file and disconnect your program from the file. If you have not issued a CLOSE macro before end-of-job or if your job terminates abnormally, your file might not be closed properly and subsequent processing of that file might cause errors.

Because it is essential for the integrity of a file that it is closed properly, z/VSE automatically attempts to close all open VSE/VSAM files in the partition at both normal and abnormal termination of a job step. If any control blocks for a file have been destroyed through an error in your program, this file cannot be closed and a message is given to the operator. EXLST routines are not entered during an automatic CLOSE.

The TCLOSE macro performs the functions of CLOSE, except that it leaves the program and the file connected so that you can continue processing without reopening the file.

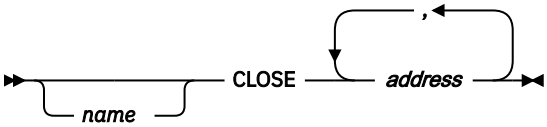
The Close routine completes any I/O operations that are outstanding when a processing program issues a CLOSE macro for a file. It writes any output buffers that have not been stored.

The Close routine updates the catalog entries of the file, including pointers to the end of the file and statistics on file processing (such as number of records inserted). If the file was loaded and the SPEED option was specified (in the DEFINE command), the Close routine formats the last CA in the file to ensure that the entire file is accessible.

The Close routine restores the ACB to the status that it had before the file was opened and frees the virtual storage that the Open routine used to construct VSE/VSAM control blocks.

You must specify a CLOSE macro to change from loading a file to retrieving records from that file in the same run.

Format of the CLOSE Macro



name
one through eight characters that provide a symbolic name.

address
specifies up to 16 addresses of ACBs and DTFs that define the file(s) to be closed.

If an application chooses to place VSE/VSAM ACBs in 31-bit partition GETVIS, the OPEN and CLOSE macros can be used to open or close only one ACB in a single invocation (Open or Close List). No DTFs can be included in an Open or Close List containing an ACB residing in 31-bit partition GETVIS.

You can specify address:

- In register notation, using a register from 1 through 12. Specify within parentheses.

  Or

- With an expression that generates a valid relocatable A-type address constant.

A return code is set in Register 15 to indicate whether the ACBs were closed successfully. ACBs should be coded together (following the DTFs) to apply to all of them. If, for example, you coded:

```
    CLOSE  ACB1,DTF1,ACB2
```

the return code will apply to ACB2 only. If ACB2 closed successfully and ACB1 did not, the return code will still be X‘00’. (The Close routine sets Register 15 to zero when it receives control after a DTF has been closed.) To ensure that the return code is valid and applies to both ACBs, write the macro in the following way:

```
    CLOSE  DTF1,ACB1,ACB2
```

The Close routine sets one of the following return codes in Register 15:

Return Code
Meaning

X‘00’
All ACBs were closed successfully.

X‘04’
One or more ACBs were not closed successfully.

X‘08’
One or more Close routines could not be loaded because there was not enough virtual storage space, or the modules could not be found. Processing cannot continue.

If Register 15 contains X‘04’, an error code is set in one or more ACBs. You can use the ERROR keyword of the SHOWCB or TESTCB macro to examine the error code. For an explanation of the VSE/VSAM CLOSE (and TCLOSE) error codes, refer to z/VSE Messages and Codes Volume 2, SC34-2683.

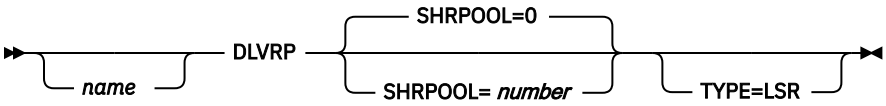
The DLVRP Macro

After all the files using the resource pool have been closed, you must delete the resource pool by issuing the DLVRP (delete VSE/VSAM resource pool) macro.

If you do not delete the resource pool with the DLVRP macro, it will automatically be deleted at the end of the job step, because it resides in virtual storage, which is invalidated at the end of a job step.

When you issue a DLVRP macro, Register 13 must contain the address of a 72-byte save area that you are providing. When you issue a DLVRP macro from within one of your exit routines such as LERAD or SYNAD, your program must provide a second 72-byte save area for use by VSE/VSAM, because the original save area is still in use by the external VSE/VSAM routine.

Format of the DLVRP Macro



name
one to eight characters that provide a symbolic name.

SHRPOOL=number
specifies the identification number of a shared resources pool that is to be deleted. Specify a number from 0 through 15. The default is 0.

TYPE=LSR
This parameter is accepted by VSE/VSAM for compatibility with zOS. It is ignored, however, since no type other than LSR is available under VSE/VSAM. See also BLDVRP. Separate deletion of data and index LSR pools is not possible because they form a unit and must not be deleted individually.

Return Codes from DLVRP

When VSE/VSAM returns to your processing program after a DLVRP request, following return codes:

Return Dec	Code Hex	Meaning
0	X‘00’	VSE/VSAM completed the request.
4	X‘04’	There is no resource pool to be deleted.
8	X‘08’	There is at least one other open file using the resource pool.
12	X‘0C’	The request was not executed because an error was encountered while VSE/VSAM routines were loaded (for example, CDLOAD failed).
28	X‘1C’	SHRPOOL is less than 0 or greater than 15.

The ENDREQ Macro

When you issue an ENDREQ macro, Register 13 must contain the address of a 72-byte save area that you are providing. When you issue the macro from within one of your exit routines such as LERAD or SYNAD, you must provide a second 72-byte save area for use by VSE/VSAM.

This macro causes VSE/VSAM to end a request, that is, to forget its position for the specified RPL and to release its associated buffers for use by another RPL. Before you can issue a request specifying an RPL for which an ENDREQ macro was executed, you have to reposition VSE/VSAM.

An ENDREQ macro is required in your program whenever you have already issued as many concurrent active requests as you have specified for STRNO operand of the ACB and you want to issue yet another request. (Refer to the discussion under “VSE/VSAM is Not Yet Positioned” on page 212.)

If an I/O operation was started, it will be allowed to complete. Also, I/O operations required to maintain the integrity of the file will be performed.

If the request involves a chain of RPLs, all records specified by the request may not be processed. For example, two RPLs are chained in a PUT request to add two new records to the file and an ENDREQ is issued after VSE/VSAM started the I/O operation to add the first record. That I/O operation will be completed and, if it causes a CI split, subsequent I/O operations will be performed to complete the split and update the index. However, VSE/VSAM will then return control to the processing program without adding the second record.

The ENDREQ macro causes VSE/VSAM to cancel the position in the file established for that request and also invalidates data and index buffers to force refreshing of all requests subsequent to the end request. There is, however, *no* buffer invalidation for:

- SHAREOPTION 1 files
- SHAREOPTION 2 files opened for output
- Higher level index buffers (only sequence set invalidation).

Format of the ENDREQ Macro

name
one through eight characters that provide a symbolic name.

RPL=address | (1)
specifies the address of the RPL (or first RPL in a chain of RPLs) that defines the request to be terminated. You can specify address:

- In register notation, using a register from 2 through 12. Specify within parentheses, or
- With an expression that generates a valid relocatable A-type address constant.

The ERASE Macro

When you issue an ERASE macro, Register 13 must contain the address of a 72-byte save area that you are providing. When you issue the macro from within one of your exit routines such as LERAD or SYNAD, you must provide a second 72-byte save area for use by VSE/VSAM.

This macro deletes the record previously retrieved for update (with the GET macro, OPTCD=UPD). You can delete records in a key-sequenced file by keyed or addressed access, but you cannot delete records in an entry-sequenced file. You can delete records in a relative-record file by keyed access. You cannot delete CIs (OPTCD=CNV).

Format of the ERASE Macro

name
one through eight characters that provide a symbolic name.

RPL=address|(1)
specifies the address of the RPL (or the first RPL in a chain of RPLs) that defines the ERASE request. You can specify address:

- In register notation, using a register from 2 through 12. Specify within parentheses.

  Or

- With an expression that generates a valid relocatable A-type address constant.

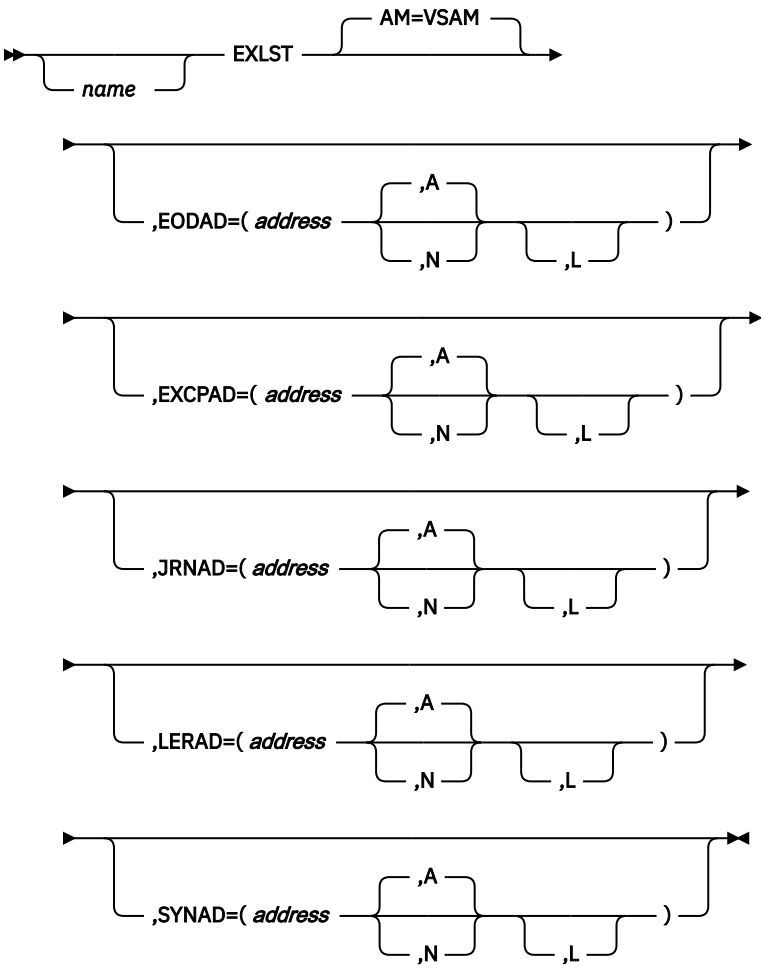
The EXLST Macro

Assembly of the EXLST (exit list) macro produces an optional list of addresses of user exit routines. An exit routine is entered when VSE/VSAM detects the condition (such as an I/O error) that the routine is supposed to handle. The exit list is associated with an ACB by the EXLST operand of the ACB macro. Two or more ACBs can refer to the same exit list.

The number of exit addresses in a list is variable and depends on the number of operands you code. You cannot add addresses to the list after it is generated, but you can change an address or the indication of whether or not an exit is active (with the MODCB macro).

Values for EXLST macro operands can be specified as codes and expressions that generate valid relocatable A-type address constants. Do not use register notation.

Format of the EXLST Macro



name
one through eight characters that provide a symbolic address for the exit list that is established.

AM=VSAM
specifies that this is a VSE/VSAM control block. You may want to specify this operand for documentation purposes if your installation also uses VTAM.

EODAD
specifies that an exit is provided for special processing when the end of a file is reached by sequential or skip sequential access.

EXCPAD
specifies that an exit is provided to receive control from VSE/VSAM when an I/O operation is started or when a task can be forced to wait for an SHR(4) lock.

JRNAD
specifies that an exit is provided for journalizing as you process data records.

LERAD
specifies that an exit is provided for analyzing logic errors.

SYNAD
specifies that an exit is provided for analyzing physical errors.

address
is the address of a user-supplied exit routine. The address must always be specified first.

A | **N**
specifies that the exit routine is active (A) or not active (N). VSE/VSAM does not enter a routine whose exit is marked not active.

L
specifies that the address is the address of an eight-byte field that contains the name of a phase that VSE/VSAM is to load for exit processing. If L is omitted, the address gives the entry point of the exit routine in virtual storage. L can precede or follow the A or N specification.

EODAD Exit Routine to Process End-of-File

An EODAD routine finishes the processing of a file when VSE/VSAM reaches the end of the file. VSE/VSAM exits to this routine when: (1) you attempt to sequentially retrieve or point to a record beyond the last record in the file, that is, the record with the highest key or the highest relative-record number (for keyed access), or with the highest RBA (for addressed access); (2) during sequential backward retrieval when the records in reverse sequence are exhausted or; (3) when you have specified CI access and user buffers and there is no more data after a GET request or a PUT for update request.

If your program retrieves records sequentially with a request defined by a chain of RPLs, your EODAD routine must determine whether the end of the file was reached for the first RPL in the chain. If not, then one or more records have been retrieved but not yet processed by your program.

If you do not have this exit routine, VSE/VSAM exits to the routine for analyzing logic errors (see the LERAD operand). If you do not have the LERAD exit routine, VSE/VSAM returns to your processing program at the instruction following the last executed instruction. In that case, Register 15 contains X‘08’, and register 1 contains the address of the RPL. Your program can examine the feedback field in the RPL with the SHOWCB or TESTCB macro to see whether VSE/VSAM has reached the end of the file.

When the exit receives control, it is in the same AMODE that was in effect when the request was issued.

When VSE/VSAM exits to the EODAD routine, the contents of the registers (**Reg**) are as follows:

Reg
Contents

0
Unpredictable.

1
Address of the request parameter list that defines the request that occasioned VSE/VSAM's reaching the end of the file. The register must contain this address if you return to VSE/VSAM.

2-13
Same as when the request macro was issued. Register 13, by convention, contains the address of your processing program's 72-byte save area, which may not be used as a save area by the EODAD routine if it returns control to VSE/VSAM.

14
Return address to VSE/VSAM.

15
Entry address to the EODAD routine.

If the EODAD exit routine returns to VSE/VSAM and you issue another GET macro, VSE/VSAM enters the EODAD exit routine again. This can cause your program to loop. If, however, you reach end-of-file during keyed access and then change to addressed access, additional records may be retrieved provided they are physically after the last record in key sequence (because of a CI or control-area split).

EXCPAD Exit Routine

An EXCPAD routine receives control from VSE/VSAM when an I/O operation is started or when a task can be forced to wait for an SHR(4) lock. By supplying an EXCPAD exit routine, you can overlap VSE/VSAM I/O or SHR(4) locking operations with the execution of your processing program.

The exit routine must return to VSE/VSAM, so that VSE/VSAM can return to your processing program at the instruction following the I/O request macro.

TheVSE/VSAM EXCPAD exit is used by CICS® TS to overlap VSE/VSAM I/O and CICS task processing. When a CICS task issues a VSE/VSAM request and physical I/O is required, the CICS EXCPAD exit places the CICS task into an internal wait state and CICS is free to dispatch another task. When the physical I/O is complete, the task is made dispatchable again.

Note: EXCPAD routine is called in AMODE 31 (31-bit addressing) only. Thus, if the caller's application AMODE is not 31-bit, EXCPAD exit is skipped and VSE/VSAM is just waiting for I/O to complete.

When VSE/VSAM exits to the EXCPAD routine, the contents of the registers (**Reg**) are as follows:

Reg
Contents

0
Unpredictable.

1
Address of a parameter list with the following contents:

Offset

X'00'
Address of the RPL.

X'04'
Address of the IORB or DTL ECB.

X'08'
EXCPAD lock word.

X'0C'
116 bytes available to the user.

2-13
Same as when the request macro was issued. Register 13, by convention, contains the address of the user's 72-byte save area, which must not be used as a save area by the EXCPAD routine (because EXCPAD must return control to VSE/VSAM).

14
Return address to VSE/VSAM.

15
Address of EXCPAD routine.

If the exit routine uses Register 1, it must restore that register with the parameter-list address before returning to VSE/VSAM. (The routine must return for completion of the request that caused VSE/VSAM to exit.)

The EXCPAD routine can test the traffic bit of the IORB or DTL ECB to determine whether the VSE/VSAM I/O operation has been completed or if the SHR(4) lock is now available. However, the routine must not change the contents of the IORB or DTL because these control blocks are used by VSE/VSAM.

The EXCPAD lock word normally contains zero, in which case the routine may issue any other VSE/VSAM request with another RPL to the same file, except a CLOSE. When a CI split, control-area split or spanned record update occurs, the lock word contains the address of the RPL for the request. In that case, the EXCPAD routine must either complete the request because a second (simultaneous) request in the same file results in a system deadlock, or issue a request against another file. A split or spanned record update may occur during UPGRADE processing of an AIX. If this happens, no other UPGRADE request may be issued through *any* path to the same base cluster. EXCPAD lock words are not used for EXCPADs for SHR(4) locks.

The EXCPAD exit routine may be entered more than once for a VSE/VSAM request because a request may require more than one I/O operation. The EXCPAD routine is not entered in the following cases:

- When the I/O operation completes before VSE/VSAM is ready to wait on it.

- When caller's application (processing program), which issues the request macro, runs in AMODE 24.
- During processing to complete pending I/O at CLOSE time.
- During Upgrade processing.
- When VSE/VSAM is forced to do a PUT because of insufficient buffers available (that is, when VSE/VSAM writes a buffer to be able to use this buffer for other data).

JRNAD Exit Routine to Journal Transactions

A JRNAD routine records transactions made against a file and keeps track of RBA changes. VSE/VSAM exits to this routine every time the processing program issues a GET, PUT, or ERASE and every time data is shifted right or left in a CI or is moved to another CI (because one or more records have been inserted, deleted, shortened, or lengthened). VSE/VSAM takes the JRNAD exit before transmitting to direct-access storage the contents of a CI in which there was an RBA change. (You need to know whether RBAs have changed during keyed processing if later on you want to process your key-sequenced file with addressed access.)

VSE/VSAM also takes the JRNAD exit whenever a segment of a spanned record is transmitted to or from direct-access storage. This allows you to keep track of the CIs occupied by a spanned record.

The JRNAD exit must return to VSE/VSAM for completion of the request that caused VSE/VSAM to exit.

When the exit receives control, it is in the same AMODE that was in effect when the request was issued.

When VSE/VSAM exits to the JRNAD routine, the contents of the registers (**Reg**) are as follows:

Registers	**Contents**
0	Unpredictable.

<table>
<tr><th>Registers</th><th colspan="4">Contents</th></tr>
<tr><td rowspan="15">1</td><td colspan="4">Address of a parameter list with the following format:</td></tr>
<tr><td>Displ</td><td>Length</td><td colspan="2">Description</td></tr>
<tr><td>0</td><td>4 bytes</td><td colspan="2">Address of RPL of the request that caused the exit.</td></tr>
<tr><td>4</td><td>4 bytes</td><td colspan="2">Address of the address pointing to the dataset ACB.</td></tr>
<tr><td>8</td><td>4 bytes</td><td colspan="2">For RBA changes, the RBA of the first byte of data that is shifted or moved. For a GET or PUT request against a spanned record segment, the RBA of the first byte of the segment.</td></tr>
<tr><td>12</td><td>4 bytes</td><td colspan="2">For RBA changes, the number of bytes of data that is shifted or moved. (The number of bytes does not include free space (if any), or control information - except for a control-area split, when the whole contents of a CI are moved to a new CI).
For a GET or PUT request against a spanned record segment, the number of bytes in the segment.</td></tr>
<tr><td>16</td><td>4 bytes</td><td colspan="2">For RBA changes only, the RBA of the first byte to which data is shifted or moved.</td></tr>
<tr><td>20</td><td>1 byte</td><td colspan="2">Request type causing VSE/VSAM to exit to JRNAD routine:</td></tr>
<tr><td></td><td></td><td>X'00'</td><td>GET request</td></tr>
<tr><td></td><td></td><td>X'04'</td><td>PUT request</td></tr>
<tr><td></td><td></td><td>X'08'</td><td>ERASE request</td></tr>
<tr><td></td><td></td><td>X'0C'</td><td>RBA change</td></tr>
<tr><td></td><td></td><td>X'10'</td><td>GET request against a spanned record segment</td></tr>
<tr><td></td><td></td><td>X'14'</td><td>PUT request against a spanned record segment</td></tr>
<tr><td rowspan="7"></td><td>21</td><td>1 byte</td><td colspan="2">Reserved</td></tr>
<tr><td>22</td><td>1 byte</td><td colspan="2">Version Flag
X'00' indicates z/VSE Version 4.3
X’01’ indicates z/VSE Version 5.1</td></tr>
<tr><td>23</td><td>1 byte</td><td colspan="2">Reserved</td></tr>
<tr><td>24</td><td>4 bytes</td><td colspan="2">Address of the ACB</td></tr>
<tr><td>28</td><td>1 byte</td><td colspan="2">Component type
X’01’ indicates Data
X’02’ indicates Index</td></tr>
<tr><td>29</td><td>3 bytes</td><td colspan="2">Reserved</td></tr>
<tr><td>2-13</td><td colspan="4">Unpredictable</td></tr>
<tr><td>14</td><td colspan="4">Return address to VSE/VSAM</td></tr>
</table>

Registers	Contents
15	Entry address to the JRNAD routine.

If, in your exit routine, you intend to issue the GENCB, MODCB, SHOWCB, or TESTCB macros, make sure that you save the contents of Register 14 before you issue the macro and restore these contents in Register 14 before your exit routine returns to VSE/VSAM. The same applies accordingly if, in your exit routine, you intend to use registers. Your exit routine must return to VSE/VSAM for completion of the request that caused VSE/VSAM to exit.

For journalizing transactions (when VSE/VSAM exits because of a GET, PUT, or ERASE), you can use the SHOWCB macro, for example, to display information in the RPL about the record that was retrieved, stored, or deleted by specifying:

```
    FIELDS=(AREA,KEYLEN,RBA,RECLEN)
```

You can also use the TESTCB macro to determine whether a GET or a PUT was for update (OPTCD=UPD).

You cannot use the keywords RBA or RECLEN to display the RBA or length of a spanned record segment retrieved or stored. Instead, this information is given in the parameter list at offsets 8 and 12, respectively.

For recording RBA changes, you must calculate how many records there are in the data shifted or moved, so you can keep track of the new RBA for every one. With fixed-length records, you calculate the number by dividing the record length into the number of bytes of data shifted. With variable-length records, you could calculate the number by using a table that not only identifies the records (by associating a record's key with its RBA), but also gives their lengths.

Some CI splits cause data to be moved to two new CIs, and control-area splits normally cause the contents of many CIs to be moved. In these cases, VSE/VSAM exits to the JRNAD routine for every separate movement of data to a new CI.

If your JRNAD routine only journals transactions, it should ignore calls with the reason code X‘0C’ and return to VSE/VSAM; conversely, if it only records RBA changes, it should ignore all calls with reason codes other than X‘0C’.

The only journaling you can do during processing of a path is to record transactions made against the base cluster; access to the alternate index during retrieval of a base record or during upgrading cannot be journaled. Journaling for path processing is triggered by the specification of the JRNAD exit in the EXLST of the ACB identifying the base cluster.

The JRNAD exit must be indicated as active before the file for which the exit is to be used is opened, and the exit must not be made inactive during processing. If you define more than one ACB for a file and if you want to have a JRNAD routine, the first ACB you open for the file must specify the exit list that identifies the routine.

LERAD Exit Routine to Analyze Logic Errors

A LERAD routine analyzes logic errors and all other error conditions except I/O errors encountered by VSE/VSAM during execution of a GET, PUT, POINT, ENDREQ or ERASE macro. The routine determines what error has occurred by issuing a SHOWCB or TESTCB macro to examine the feedback (FDBK) field in the RPL. The contents of FDBK will be 0000xx, where xx is the error code indicating the type of error.

If the routine cannot correct the error, it should either:

- Close the file, or
- Return to VSE/VSAM (which will return to your processing program at the instruction following the last executed instruction).

If you do not have the LERAD exit routine and VSE/VSAM encounters a logic error, VSE/VSAM returns to your processing program at the instruction following the last executed instruction. Register 15 then contains X‘08’, and Register 1 contains the address of the RPL. Your program can examine the feedback field in the RPL with the SHOWCB or TESTCB macro to identify the logic error.

When the exit receives control, it is in the same AMODE that was in effect when the request was issued.

When VSE/VSAM exits to the LERAD routine, the contents of the registers are:

Register
Contents

0
Unpredictable.

1
Address of the RPL that contains the feedback field the routine should examine. The register must contain this address if you return to VSE/VSAM.

2-13
Same as when the request macro was issued. Register 13, by convention, contains the address of your processing program's 72-byte save area, which may not be used as a save area by the LERAD routine if the routine returns control to VSE/VSAM.

14
Return address to VSE/VSAM.

15
Entry address to the LERAD routine. The register does not contain the logical-error indicator.

SYNAD Exit Routine to Analyze Physical Errors

A SYNAD routine can analyze physical I/O errors that were detected by VSE/VSAM during execution of a GET, ENDREQ, PUT, POINT, ERASE, or CLOSE macro and that the system error routine was unable to correct. The exit routine determines what error has occurred (reading or writing either the data or the index component) by issuing a SHOWCB or TESTCB macro to examine the feedback (FDBK) field in the RPL. The contents of FDBK will be 0000xx, where xx is the error code indicating the type of error.

If your exit routine cannot correct or bypass the error, it is recommended that the routine (1) issues the PDUMP macro to obtain a dump of the contents of all pertinent control blocks, including the IORB involved in the failing I/O operation; (2) closes the files used by your program; and (3) ends the job. If the error occurred while VSE/VSAM was closing the file or index, and if another error occurs after the exit routine issues a CLOSE macro, VSE/VSAM does not exit to the routine a second time.

If the exit routine returns to VSE/VSAM, whether the error was corrected or the file closed, VSE/VSAM drops the request and returns to your processing program at the instruction following the last executed instruction.

If you do not have this exit routine and VSE/VSAM detects a physical error, VSE/VSAM returns to your processing program at the instruction following the last executed instruction. Register 15 then contains X‘0C’, and Register 1 contains the address of the RPL. Your program can examine the feedback field in the RPL with the SHOWCB or TESTCB macro to identify the physical error.

An I/O error that occurs when processing a data CI during the execution of a sequential GET request positions VSE/VSAM at the next CI in key sequence for keyed access or in entry sequence for addressed access. The next GET after the error will return the first record from the CI following the index CI, VSE/VSAM is not positioned at the next index control in further.

Errors that occur while VSE/VSAM writes a CI cause the loss of positioning.

When the exit receives control, it is in the same AMODE that was in effect when the request was issued.

When VSE/VSAM exits to the SYNAD routine, the contents of the registers are:

Register
Contents

0
Unpredictable.

1
Address of the RPL that contains a feedback return code and the address of a message area, if any. If you issued a request macro, the RPL is the one pointed to by the request macro; if you issued a CLOSE macro, the RPL was built by VSE/VSAM to process the close request. Register 1 must contain this address if the SYNAD routine returns to VSE/VSAM

2-13
Same as when the request macro or CLOSE macro was issued. Register 13, by convention, contains the address of your processing program's 72-byte save area, which may not be used by the SYNAD routine if it returns control to VSE/VSAM.

14
Return address to VSE/VSAM.

15
Entry address to the SYNAD routine. The register does not contain the physical-error indicator.

The GENCB Macro

The GENCB macro generates an ACB, an EXLST, or an RPL when it is executed. You can use it in place of the ACB, EXLST, and RPL macros to avoid (1) reassembling your programs should the format or length of the control block or list change, and (2) generating more than one copy of a control block or list.

VSE/VSAM returns, in Register 1, the address of the first (or only) control block and, in Register 0, the total length of the control block(s) built. You can find out the length of every control block by dividing the length of the area by the number of copies. The address of every control block can then be calculated by this offset from the address in Register 1.

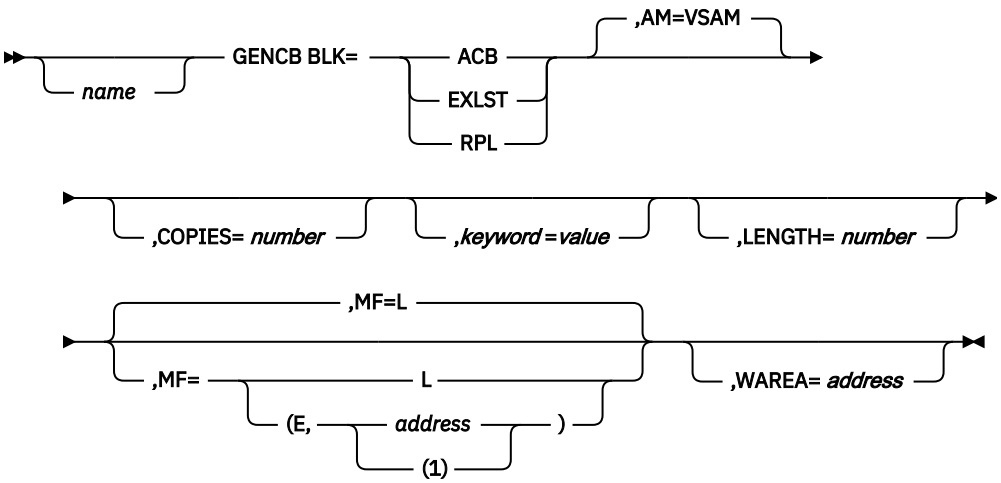
GENCB generates the control block(s) or list(s) either in an area you specify or, if you do not specify an area, in an area obtained by VSE/VSAM in your partition. GENCB is sensitive to the current AMODE, if it is AMODE 31, then GENCB first attempts to allocate the area above the 16MB line. The area obtained by VSE/VSAM can contain other control blocks too. It will not be freed at closing time but at end-of-job or end-of-job step only.

When you issue a GENCB macro, Register 13 must contain the address of a 72-byte save area that you are providing. When you issue a GENCB macro from within one of your exit routines (such as LERAD or SYNAD), your program must provide a second 72-byte save area for use by VSE/VSAM, because the original save area is still in use by the external VSE/VSAM routine.

The operands of the GENCB macro are specified as absolute numeric expressions, as character strings, as codes, as expressions that generate valid relocatable A-type address constants, in register notation, as S-type address constants, and as indirect S-type address constants. “Operand Notation for VSE/VSAM Macros” on page 285 gives all the ways of coding every operand for the macros that work at execution.

If you use register notation to specify specific addresses in your GENCB macro, be sure that these registers contain the correct addresses before you issue the GENCB macro. This is necessary because the assembler-generated instructions for this macro store the addresses contained in the specified registers in the appropriate control fields.

Format of the GENCB Macro



name
one through eight characters that provide a symbolic name.

AM=VSAM
specifies that this is a VSE/VSAM control block. You may want to specify this operand for documentation purposes if your installation also uses VTAM.

BLK=ACB | EXLST | RPL
specifies whether you want to generate an ACB, an EXLST, or an RPL.

COPIES=number
specifies the number of control blocks or lists you want VSE/VSAM to generate. The default is 1. If you generate two or more, they are generated next to each other. They are identical, so you must use MODCB to tailor them for a particular file or request.

VSE/VSAM returns, in Register 1, the address of the first (or only) control block and, in Register 0, the total length of the control block(s) built. You can find out the length of every control block by dividing the length of the area by the number of copies. The address of every control block can then be calculated by this offset from the address in Register 1.

keyword=value
The operands you code are identical to those of the ACB, EXLST, and RPL macros, except that you can code them in more ways, as described in "Operand Notation for VSE/VSAM Macros" on page 285. If you do not code any operands, VSE/VSAM builds:

- For BLK=ACB, an ACB with default values provided by VSE/VSAM when you open the file. You must supply the DDNAME=filename operand before the file is opened.
- For BLK=EXLST, a complete EXLST with zeros for addresses and all entries flagged inactive.
- For BLK=RPL, an RPL with default values.

LENGTH=number
specifies the length of the area, if any, you provided by the WAREA operand. You can determine the length required for a control block or list by using the SHOWCB macro.

MF=
For information on specifying this operand, refer to "List, Execute, and Generate Forms of the Control Block Manipulation Macros" on page 283.

WAREA=address
specifies the address of an area in which you want VSE/VSAM to generate the control block(s) or list(s). The area must begin on a fullword boundary. If WAREA is specified, the LENGTH operand must also be specified. If you do not specify WAREA, VSE/VSAM obtains an area in your processing partition in which to generate the control block(s) or list(s). When control is returned to you, Register 1 contains

the address of the control block or list and Register 0 contains the total length of the control block(s) or list(s).

Examples of the GENCB Macro

Figure 19 on page 211 shows examples of how to specify VSE/VSAM control blocks by using the GENCB macro. With GENCB, the control blocks are created dynamically during execution of the program. The same parameters are specified in this example as are specified in the example of ACB, EXLST, and RPL macros shown in Figure 26 on page 261. VSE/VSAM obtains space for every control block in your partition. The address of every control block is set in Register 1 after the GENCB is executed.

```
*       GENERATE VSE/VSAM CONTROL BLOCKS
        GENCB  BLK=EXLST,EODAD=(ENDUP,N),
               LERAD=LOGERR,
               SYNAD=(IOERR,L)
        LTR    15,15                            GENCB successful?
        BNZ    GENERR                           No, go to error routine
        LR     3,1                              Yes, save EXLST address
        GENCB  BLK=ACB,EXLST=(3),PASSWD=PASS,
               BUFND=4,BUFNI=3,BUFSP=11064,
               MACRF=(KEY,SEQ,DIR,OUT),
               DDNAME=VFILENM
        LTR    15,15                            GENCB successful?
        BNZ    GENERR                           No, go to error routine
        LR     2,1                              Yes, save ACB address
*
*
        GENCB  BLK=RPL,AREA=WORK,
               AREALEN=125,OPTCD=(DIR,NSP),
               ARG=SEARCH,ACB=(2)
        LTR    15,15                            GENCB successful?
        BNZ    GENERR                           No, go to error routine
        LR     4,1                              Yes, save RPL address
*
*       PROCESSING ROUTINES
*
        GET    RPL=(4)
*
*       CONSTANTS AND WORK AREAS
*
PASS    DC     FL1'6',C'CHANGE'
WORK    DS     CL125
SEARCH  DS     CL4
```

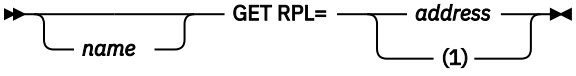
Note: The continuation characters required in column 72 are not shown.

Figure 19. GENCB Macro Examples

The GET Macro

When your program issues a request macro, its processing does not continue until VSE/VSAM completes the request. At that time, VSE/VSAM sets a return code in Register 15. If end-of-file is reached or an error or other special condition occurs during the request, VSE/VSAM sets a code containing additional information in the feedback (FDBK) field of the RPL and takes any required exit. The return codes and codes set in the feedback field of the RPL are described later in this section.

Format of the GET Macro



name
one through eight characters that provide a symbolic name.

RPL=address | (1)
specifies the address of the RPL (or the first RPL in a chain of RPLs) that defines the GET request.

You may specify the address in register notation (using a register from 1 through 12, enclosed in parentheses) or specify it with an expression that generates a valid relocatable A-type address constant.

When you issue a GET macro, Register 13 must contain the address of a 72-byte save area that you are providing. When you issue the macro from within one of your exit routines such as LERAD or SYNAD, you must provide a second 72-byte save area for use by VSE/VSAM.

This macro retrieves the next record in key sequence or the record with the next higher relative-record number with RPL operand OPTCD=(KEY,SEQ), and the next record in entry sequence with OPTCD=(ADR,SEQ). It retrieves the record specified by the key or relative record number in the search-argument field with OPTCD=(KEY,SKP) or OPTCD=(KEY,DIR), and by the RBA in the search-argument field with OPTCD=(ADR,DIR). With skip sequential retrieval, every key or relative-record number that you specify must be greater by number or alphabet than the key or relative-record number of the previous record retrieved.

GET retrieves the next CI with OPTCD=(CNV,SEQ) and the CI specified by the RBA in the search-argument field with OPTCD=(CNV,DIR).

You must issue a GET with OPTCD=UPD to update (PUT with OPTCD=UPD) or to delete (ERASE) a record. You can have the record moved to your work area (OPTCD=MVE) or you can have VSE/VSAM leave the record in its I/O buffer and pass you the address of the record (OPTCD=LOC). The AREA operand of the RPL macro points to your work area or to a field in which VSE/VSAM will place a record address.

You can also keep VSE/VSAM positioned for subsequent sequential or skip sequential processing when you issue a direct GET request with OPTCD=(DIR,NSP) or OPTCD=(DIR,UPD). With OPTCD=(DIR,UPD) however, positioning is canceled when you issue a PUT for update or an ERASE following the GET for update.

VSE/VSAM is Not Yet Positioned

If VSE/VSAM does not already have positioning for the RPL (or chain of RPLs) for which the GET request is to be issued, then you may have to issue an ENDREQ macro for a different RPL. An ENDREQ must be issued to free a position if the number of positions that VSE/VSAM must remember is already the same as the value specified in the STRNO=number operand of the pertinent ACB macro. At any particular time, VSE/VSAM will remember positions for any request macro in process by VSE/VSAM, and for a succeeding request for any RPL (or chain of RPLs) for which the preceding request was one of the following:

GET	**DIR,LOC**
GET	DIR,MVE,NSP
GET	DIR,MVE,UPD
GET	SEQ
GET	SKP
POINT	any
PUT	DIR,NSP
PUT	SEQ
PUT	SKP
ERASE	SEQ
ERASE	SKP

The MODCB Macro

The MODCB macro modifies the addresses, values, options, and names that you can establish with the ACB, EXLST, RPL, and GENCB macros in an ACB, EXLST, or RPL.

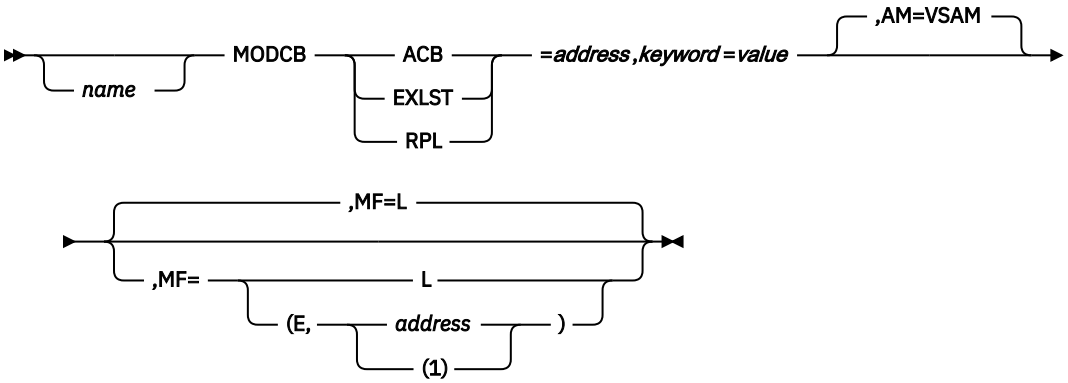
The operands of the MODCB macro are specified as absolute numeric expressions, as character strings, as codes, as expressions that generate relocatable A-type address constants, in ordinary z/VSE register notation, as S-type address constants, and as indirect S-type address constants. "Operand Notation for VSE/VSAM Macros" on page 285 gives all the ways of coding every operand for the macros that work at execution.

When you issue a standard MODCB macro (not the short form described below), Register 13 must contain the address of a 72-byte save area that you are providing. When you issue a MODCB macro from within one of your exit routines such as LERAD or SYNAD, your program must provide a second 72-byte save area for use by VSE/VSAM because the original save area is still in use by VSE/VSAM.

If you want to modify only the length of a data record (the value of the RECLEN field of the corresponding RPL), you can do so without any call to a VSE/VSAM routine by issuing the MODCB macro in the following short form: **MODCB RPL=(1),RECLEN=(0)**

The address of the RPL must be contained in Register 1 (short form only). The record length, stored in Register 0, will be placed into the RPL. No parameter list is created. For other MODCB functions, you must use the standard form of the MODCB macro.

Format of the MODCB Macro



name
one to eight characters that provide a symbolic name.

AM=VSAM
specifies that this is a VSE/VSAM control block. You may want to specify this operand for documentation purposes if your installation uses also VTAM.

ACB | EXLST | RPL=address
specifies whether you want to modify an ACB, an EXLST, or an RPL and specifies its address. Do *not* use the MODCB macro to:

- Modify an open ACB
- Activate or deactivate a JRNAD exit if the ACB to which the EXLST is connected is already open. (See the discussion of JRNAD in the EXLST macro.)
- Add entries to or delete entries from a field in an EXLST. (You can modify a field in an EXLST at any time.)
- Modify an active RPL, that is, one that defines a request that has been issued but not completed.

With the execute form of MODCB, you can change the address of the block or list to be modified, but not the type.

keyword=value
The operands you code are identical to those for the ACB, EXLST, and RPL macros, except that:

- You can code them in more ways, as shown in "Operand Notation for VSE/VSAM Macros" on page 285.
- There are no defaults for the options of the ACB MACRF operand or the RPL OPTCD operand. With OPTCD, when you set on a new option with the MODCB macro, the old option is automatically turned off, because you can specify only one option in every one of its groups (see "The RPL Macro" on page 218).
- You can make an address in an EXLST active or not active without specifying the address by coding: keyword=(,A|N).
- When you specify an address for an entry in an EXLST that previously contained zeros (possible if you generated a default list with the GENCB macro), you must code keyword=(addr,A) to make the address active, because A is not a default for the MODCB macro.

MF=
For information on specifying this operand, refer to "List, Execute, and Generate Forms of the Control Block Manipulation Macros" on page 283.

The MODCB macro cannot be used to reset a MACRF option which was set in an ACB unless this option is mutually exclusive with the new intended option. For example, if the options

```
KEY,SEQ,OUT
```

were set and you wish to have the options

```
ADR,SEQ,OUT
```

instead, then specifying MACRF=ADR in a MODCB macro results in options

```
KEY,ADR,SEQ,OUT
```

being set in the pertinent ACB.

Examples of the MODCB Macro

Figure 20 on page 214 shows two examples of modifying VSE/VSAM control blocks by using the MODCB macro.

The MODCB (short form) is used to place the length of a record in the RPL when variable-length records are added to a file:

```
MODCB  RPL=(1),RECLEN=(0)       Current length in register 0
LTR    15,15                    MODCB successful?
BNZ    MODERR                   No, go to error routine
PUT    RPL=(1)                  Yes, write record
```

The MODCB is used to activate the EODAD exit specified in the GENCB example of Figure 19 on page 211.

```
MODCB  EXLST=(3),EODAD=(,A)
LTR    15,15                    MODCB successful?
BNZ    MODERR                   No, go to error routine
```

Figure 20. MODCB Macro Examples

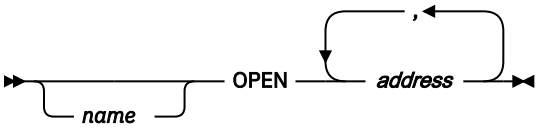
The OPEN Macro

The information you have specified in the ACB and EXLST macros must be connected with the file to be processed so that you can gain access to the data. To this purpose, you must supply, in the job stream, job control statements defining the file and issue, in your program, an OPEN macro for the ACB you have set up for the file.

The OPEN macro calls the Open routine, which verifies that the processing program has authority to process the file. The Open routine constructs VSE/VSAM control blocks and establishes linkages to those VSE/VSAM routines that are needed to process your file(s).

By examining the DLBL statement indicated by the DDNAME operand in the ACB macro and the volume information in the catalog, the Open routine verifies that the necessary volumes have been mounted. If a key-sequenced file is opened, VSE/VSAM issues an error code to warn you if the data has been updated separately from its index.

Format of the OPEN Macro



name
one through eight characters that provide a symbolic name.

address
specifies the address of the ACB or DTF for the file(s) to be opened.

If an application chooses to place VSE/VSAM ACBs in 31-bit partition GETVIS, the Open and Close macros can be used to open or close only one ACB in a single invocation (Open or Close List). No DTFs can be included in an Open or Close List containing an ACB residing in 31-bit partition GETVIS.

You can specify address:

- In register notation, using a register from 1 through 12. Specify within parentheses.

  Or

- With an expression that generates a valid relocatable A-type address constant.

  You can specify up to 16 addresses of ACBs and DTFs that define the files to be opened.

Return Codes from OPEN

A return code is set in Register 15 to indicate whether the ACBs were opened successfully. ACBs should be coded together to ensure that the return code will apply to all of them. If, for example, you coded:

```
    OPEN  ACB1,DTF1,ACB2
```

the return code will apply to ACB2 only. If ACB2 opened successfully and ACB1 did not, the return code will still be X‘00’. (The Open routine sets Register 15 to zero when it receives control after a DTF has been opened.) To ensure that the return code is valid and applies to both ACBs, the macro should be coded in the following way:

```
    OPEN  DTF1,ACB1,ACB2
```

The Open routine sets one of the following return codes in Register 15:

Return Code
Meaning

X‘00’
All ACBs were opened successfully.

X‘04’
All ACBs opened successfully, but one or more ACBs had a warning message.

X‘08’
One or more ACBs were not opened successfully. The entries with errors are restored to their pre-open status.

If Register 15 contains X‘04’, an error code is set in one or more ACBs to indicate a warning message. All ACBs are open and, unless you prevent it, processing will continue on the file that the message applies to. You can use the ERROR keyword of the SHOWCB or TESTCB macro to examine the code.

If Register 15 contains X‘08’, an error code is set in one or more ACBs. Again, you can use the ERROR keyword of the SHOWCB or TESTCB macro to examine the code. Note that Register 15 contains the maximum (worst) return code encountered while opening a list of ACBs. This means that some of the ACBs in the list may have been opened successfully, even though Register 15 contains X‘04’ or X‘08’.

For an explanation of the VSE/VSAM OPEN error codes, refer to z/VSE Messages and Codes Volume 2, SC34-2683.

The POINT Macro

When you issue a POINT macro, Register 13 must contain the address of a 72-byte save area that you are providing. When you issue the macro from within one of your exit routines such as LERAD or SYNAD, you must provide a second 72-byte save area for use by VSE/VSAM.

When OPTCD=KEY was specified in the pertinent RPL, this macro positions VSE/VSAM at the record whose key or relative-record number you specify in the search argument field. You can use the macro to position VSE/VSAM for subsequent sequential or skip sequential processing, either forward or backward in the file.

When OPTCD=ADR or OPTCD=CNV was specified in the pertinent RPL, the POINT macro positions VSE/VSAM at the record or CI whose RBA you specify in the search argument field. You can cause the macro to position VSE/VSAM for subsequent sequential processing, either forward or backward in the file.

Note: You cannot issue the POINT macro in one mode of access, change to another mode of access, and then request VSE/VSAM to continue processing the file sequentially. This will result in termination of the request with an error. For example, you cannot change from the mode OPTCD=ADR to another mode such as OPTCD=KEY.

VSE/VSAM can also be positioned for sequential processing by either a direct GET or a direct PUT as described in the preceding sections on the GET and PUT macros.

You may have to issue an ENDREQ macro before you can issue a POINT request in your program. Information about this possible requirement is given at the end of the discussion of the GET macro.

Format of the POINT Macro

name
one through eight characters that provide a symbolic name.

RPL=address|(1)
specifies the address of the RPL (or the first RPL in a chain of RPLs) that defines the POINT request. You can specify address:

- In register notation, using a register from 2 through 12. Specify within parentheses.

  Or

- With an expression that generates a valid relocatable A-type address constant.

The PUT Macro

When you issue a PUT macro, Register 13 must contain the address of a 72-byte save area that you are providing. When you issue the macro from within one of your exit routines such as LERAD or SYNAD, you must provide a second 72-byte save area for use by VSE/VSAM.

This macro stores a new record in key sequence or relative-record sequence if one of the following combinations of options is set in the RPL:

OPTCD=(KEY,DIR,NSP)
OPTCD=(KEY,SKP,NUP)
OPTCD=(KEY,DIR,NUP)
OPTCD=(KEY,SEQ,NUP)
OPTCD=(KEY,SEQ,NSP)

If you specify OPTCD=(KEY,DIR,NSP), VSE/VSAM is kept positioned at the next record in key sequence or relative-record sequence for subsequent sequential processing.

PUT stores a new record at the end of an entry-sequenced file with OTPCD=ADR. (You cannot store a new record in a key-sequenced file with addressed access.)

With skip sequential storage, OPTCD=(KEY,SKP), the key or relative-record number of every record that you store must be greater by number or alphabet than the key or relative-record number of the previous record stored.

With CI access, OPTCD=(CNV,NUP), PUT stores a new CI at the end of an entry sequenced file.

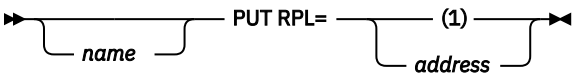
When loading or extending a file with the PUT macro, you must specify sequential or skip sequential processing (OPTCD=SEQ or OPTCD=SKP).

To store a changed record or CI, you must have previously retrieved it with option OPTCD=UPD set in the RPL for both the GET and the PUT. You cannot change the length of a record in either a relative record file or an entry-sequenced file.

The record to be added or updated with a PUT macro must be in your work area (OPTCD=MVE); you cannot use OPTCD=LOC with the PUT macro. The AREA operand of the RPL macro points to your work area.

You may have to write an ENDREQ macro before you can issue a PUT NUP or PUT NSP request in your program. Information about this possible requirement is given at the end of the discussion of the GET macro.

Format of the PUT Macro



name
one through eight characters that provide a symbolic name.

RPL=address | (1)
specifies the address of the RPL (or the first RPL in a chain of RPLs) that defines the PUT request. You can specify address:

- In register notation, using a register from 2 through 12. Specify within parentheses.

  Or

- With an expression that generates a valid relocatable A-type address constant.

The RPL Macro

You define a request with the RPL macro, which produces a 'request parameter list' (RPL). Every request macro (GET, PUT, POINT, ERASE, and ENDREQ) has one and only one operand, the address of the request parameter list that defines the request. Thus, the information a request macro needs to access a record in a file (such as the ACB of the file to which the request is directed, or the search argument for the record) is always in the RPL instead of in the request macro itself.

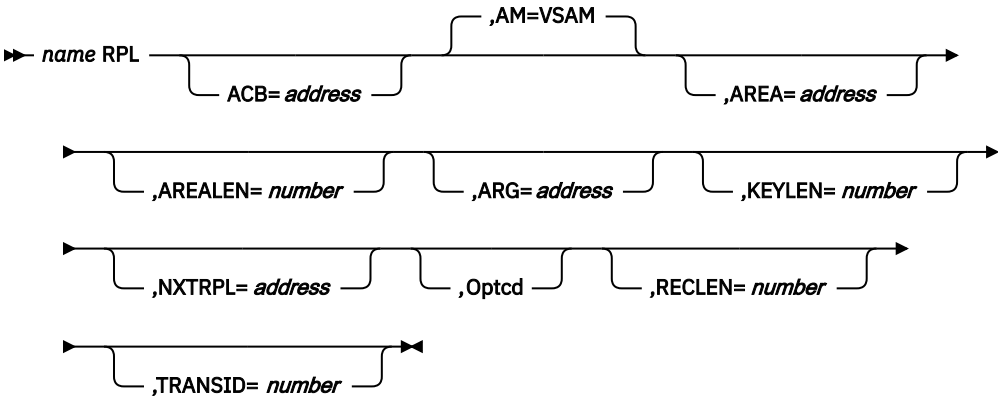
The RPL does not indicate a specific request, such as GET or PUT, for example; you can use a single RPL, without modification, for several requests. However, if you want to use the same RPL for different types of processing (for both direct and sequential processing, for example), you must modify the RPL (with the MODCB macro) every time you change from one type of processing to another.

As was pointed out in the discussion of the STRNO operand of the ACB macro, several requests, with the corresponding RPLs pointing to the same ACB, can be active at the same time. You may specify any number of RPLs for requests requiring concurrent positioning, provided you do not exceed the maximum number of concurrent active requests you have specified in the STRNO operand. The requests can be for sequential or direct retrieval or both, and they can be for records in the same part of the file or in different parts.

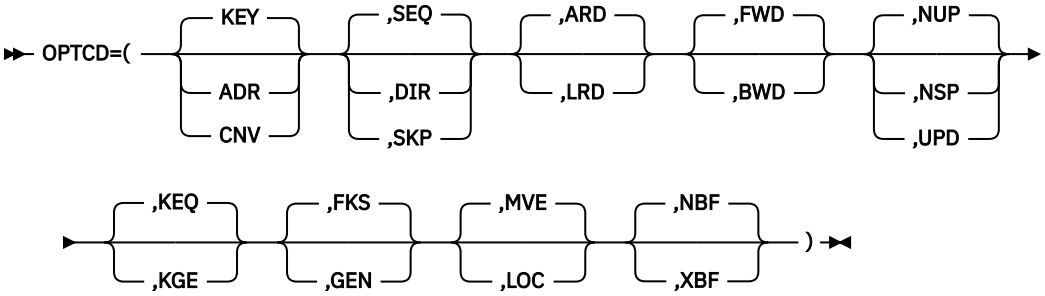
Values for RPL macro operands can be specified as absolute numeric expressions, character strings, codes, and expressions that generate valid relocatable A-type address constants. Register notation cannot be used for *addresses*.

If a customer application or vendor product uses the RPL OPTCD=LOC to access records directly in VSE/VSAM data buffers, and if these data buffers are now placed in 31-bit partition GETVIS, the application or product must be running in AMODE(31). VSE/VSAM Record Management will reject a GET request with OPTCD=LOC if the application does not have AMODE(31) enabled.

Format of the RPL Macro



Optcd



name
one through eight characters that provide a symbolic address for the request parameter list that is generated. You can use it in the request macros to give the address of the list. You can also use it in

the NXTRPL operand of the RPL macro, when you are chaining request parameter lists, to indicate the address of the next list.

ACB=address
specifies the address of the access method control block that identifies the file to which access will be requested. If you used the ACB macro to generate the control block, you can specify the label of that macro for the address. If you omit this operand you must issue a MODCB macro to specify the address of the file's ACB before you can issue a request against the RPL.

AM=VSAM
specifies that this is a VSE/VSAM control block. You may want to specify this operand for documentation purposes if your installation also uses VTAM.

AREA=address
specifies the address of your I/O work area to and from which VSE/VSAM moves the record (OPTCD=MVE) for GET and PUT requests. You process the record in this work area. If you process the records in VSE/VSAM's I/O buffer (OPTCD=LOC), VSE/VSAM puts into this work area the address of the record in the I/O buffer (GET only).

If you omit this operand you must issue a MODCB macro to specify the address of the request against the RPL.

When you specify user buffers (MACRF=UBF in the ACB) for CI (CNV) access, AREA specifies the address of a single I/O buffer. VSE/VSAM uses the buffer to read and write CIs.

AREALEN=number
specifies the length, in bytes, of the work area. For OPTCD=MVE, the work area must be large enough to contain the largest record in the file. For OPTCD=LOC, the work area must be at least 4 bytes long to contain the address of the record in the I/O buffer. For OPTCD=CNV, the work area must be at least the size of a CI.

If you omit this operand, you must issue a MODCB macro to specify the length of the request against the RPL.

ARG=address
specifies the address of a field that contains the search argument for:

- Direct or skip sequential retrieval (GET)
- Sequential positioning (POINT)
- Direct or skip sequential storage (PUT) for a relative-record file

For keyed access (OPTCD=KEY), the search argument may be a:

- Full key (OPTCD=FKS)
- Generic key (OPTCD=GEN) In this case you must also indicate its size in the KEYLEN operand.
- Relative-record number (which is treated as a key of 4 bytes length)

For addressed access (OPTCD=ADR), the search argument is always an RBA (relative byte address of a length of 4 bytes). To determine the RBA of a record to which you have gained access sequentially or directly by key, you can use the SHOWCB macro to display the RBA of the last record processed. (See “The SHOWCB Macro” on page 235).

Note: Addressed access is not available with an extended-addressed KSDS, and an RBA does not apply.

For CI access with user buffering and user-supplied RBA, the record is written only to this RBA if positioning is not established by a previous request.

When records are inserted (sequentially or directly) into a key-sequenced file, VSE/VSAM obtains the key from the record itself. When records are sequentially inserted into, or retrieved from, a relative-record file, VSE/VSAM returns the assigned relative-record number in the ARG field (as a four-byte binary number).

KEYLEN=number

When a generic key is used as a search argument (OPTCD=GEN), this operand specifies the length of the generic key in number of bytes. KEYLEN can be any value from 1 to 255.

If, for example, the full key is 50 bytes long and KEYLEN=10 is specified, VSE/VSAM uses the leftmost 10 bytes of the 50-byte key field for comparison with the search argument. The length of the full key is in the catalog. It can be obtained through the KEYLEN parameter of the SHOWCB macro. You place the key (full or generic) in a field pointed to by the ARG parameter.

NXTRPL=address

indicates the address of the next RPL in a chain of RPLs; it is required when you chain several RPLs together.

The standard request for access to a file retrieves, stores, or deletes a single record by means of one RPL specified in the request macro. If you want to retrieve or store more than one record with a single GET or PUT, you can chain several RPLs together so that every RPL indicates a different data record. For example, every RPL in the chain could contain a unique search argument and point to a unique work area. For a GET against such a chain of RPLs, VSE/VSAM retrieves a record for every RPL in the chain.

The positioning information, normally maintained for every RPL, is maintained only once for the total chain, so a chain of RPLs is processed as a single request. (Chaining RPLs is not the same as processing concurrent requests, where every request requires that VSE/VSAM keep track of a position in the file.) See the discussion of the STRNO operand under “The ACB Macro” on page 184.

Figure 21 on page 220 shows how to build a chain of RPLs by specifying the NXTRPL operand. When you issue a request that is defined by a chain of RPLs, specify in the request macro the address of the first RPL in the chain. This request macro determines the request type for the whole chain, and the same major operation, GET for example, is performed for all RPLs in the chain. However, other options such as the request options, which you specify in the OPTCD operand of the RPL macro, may vary from one RPL to another. Thus, an RPL with the option SEQ may be followed by an RPL with the option DIR.

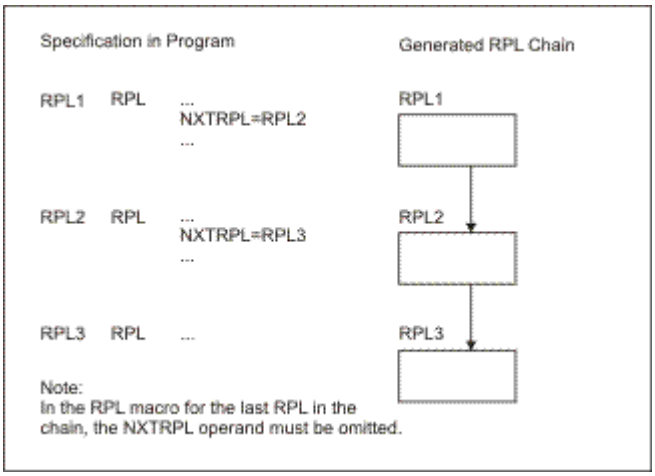


Figure 21. Example of an RPL Chain Built by Specifying the NXTRPL Operand

You cannot process records in VSE/VSAM's I/O buffer with chained RPLs (OPTCD=LOC is invalid for chained RPLs).

With chained RPLs, the following types of requests cause VSE/VSAM to position itself at the record following the one identified by the last RPL in the chain:

- POINT
- Sequential or skip sequential GET
- Direct GET with positioning requested (OPTCD=NSP)

VSE/VSAM will execute the chain of RPLs as a *single request*, thereby attempting to execute the requests with as few I/O requests as possible. All control intervals residing in the same control area

will usually be processed in a single I/O. For a description of extended user buffering see "How to Use Extended User Buffering: GET and PUT Macros" on page 279.

RECLEN=number
specifies the length, in bytes, of a data record stored by a PUT request. For fixed length records, the length need only be set once. For GET requests, VSE/VSAM indicates the length of the record in this field. To process a file with records of different lengths you can examine the field with the SHOWCB or TESTCB macro and modify it with the MODCB macro.

TRANSID=number
specifies a number that relates modified buffers in a buffer pool for a subsequent write operation (with the WRTBFR macro). It is used in shared resource applications and is described under "Sharing Resources Among Files and Displaying Catalog Information" on page 178.

RPL Processing Options

Specifies the type of access to be gained to the file through the requests defined by this RPL. Options are arranged in groups, and every group has a default value. You can specify only one option in every group; therefore, if your ACB indicates both sequential and direct processing for example, you must modify the RPL when you switch from one to the other. In other words you can use the same RPL for different types of request (GET, PUT, POINT, for example) by modifying the RPL. Because VSE/VSAM ignores inapplicable option groups, there is no need for you to zero out options that are not required before you go from one type of request to another. For more information about modifying an RPL, see "The MODCB Macro" on page 213. The following list gives the options; they are arranged in groups, and every group has a default value (indicated by underlining):

KEY
Keyed access (for key-sequenced and relative-record files). For a key-sequenced file, you can change from keyed to addressed access without positioning. If you change from keyed to CI access, the results are unpredictable and no error code will be issued.

ADR
Addressed access (for key-sequenced and entry-sequenced files, not for relative-record files). If you change from addressed to keyed access, you must reestablish positioning or the request will terminate with an error. If you change from addressed to CI access, the results are unpredictable and no error code will be issued.

Note: Addressed access is not available for extended-addressed KSDS files. For more information, refer to VSE/VSAM Commands, SC34-2707.

CNV
CI access (provided for special applications such as utilities). If you change from CI to keyed access, you must reestablish positioning or the request will terminate with an error. If you change from CI to addressed access, the results are unpredictable and no error code will be issued.

Note: CI access is not available for extended-addressed KSDS files. For more information, refer to VSE/VSAM Commands, SC34-2707..

SEQ
Sequential processing.

DIR
Direct processing.

SKP
Skip sequential processing (for keyed access only).

FWD
Forward processing of a file.

BWD
Backward processing of a file (see "Specifying Processing Options for a Request" on page 222). Backward processing is only allowed for keyed (KEY) or addressed (ADR) access and for sequential (SEQ) or direct (DIR) processing.

ARD
The search argument given in your argument (ARG) field determines the record to be located, retrieved, or stored.

LRD
The last record of the file is to be located (POINT) or retrieved (GET direct). LRD can only be used in conjunction with OPTCD=BWD.

NUP
Request is not for update (you will not update or delete a record you are retrieving; a record you are storing is new). For a direct request, positioning will be released.

NSP
For direct processing only, request is not for update, and VSE/VSAM will be positioned at the next record for subsequent sequential processing.

UPD
Request is for update; you must issue a GET for update before you can issue a PUT for update or an ERASE. However, if you supply your own buffers for CI access, you can issue a PUT for update without a preceding GET.

KEQ
The search argument must equal the key of the data record (for keyed direct or skip sequential retrieval or keyed sequential pointing).

KGE
If the search argument does not equal the key of a record the request applies to the record with the next greater key (for keyed direct or skip sequential retrieval or keyed sequential pointing). If the search argument is a relative-record number, KEQ and KGE apply to a POINT request only. KGE is ignored if BWD is specified.

FKS
The entire key is to be used for a search argument (for keyed direct or skip sequential retrieval or keyed sequential pointing).

GEN
A generic key is to be used for a search argument (for keyed direct or skip sequential retrieval or keyed sequential pointing). You must specify the length of the generic key in the KEYLEN operand. GEN is ignored for relative-record files and if BWD is specified.

MVE
For retrieval and storage, VSE/VSAM moves a data record between the I/O buffer and your work area. MVE must also be specified when you supply your own buffers for CI access.

LOC
For retrieval, you can process the record in VSE/VSAM's I/O buffer. VSE/VSAM will pass you a pointer to the record in the buffer. If you want to update the record, you will have to move it to your work area before issuing a PUT macro (OPTCD=MVE). Do not specify LOC when processing spanned records.

NBF
Normal user buffering.

Each request as identified by an RPL is executed serially and independently. This is the conventional processing of user buffering and remains the default.

XBF
Extended user buffering.

For more details on the options you can specify in the OPTCD operand of the RPL macro, refer to the section "Specifying Processing Options for a Request" on page 222.

Specifying Processing Options for a Request

The following deals mainly with keyed and addressed access as applied to the different types of processing (sequential, skip sequential, direct) and types of files. CI access and move/locate mode are described at the end of this section. See also "Examples of Request Macros" on page 262.

Keyed and Addressed Access

You can gain access to a record in:

- A KSDS file by keyed or addressed access.

  Note: Access to an extended-addressed KSDS file (> 4 GB) is keyed only. For more information, refer to VSE/VSAM Commands, SC34-2707..
- An RRDS file only by keyed access.
- An ESDS file only by addressed access.
- A VRDS file only by keyed access.

An alternate index or a path is treated like a KSDS, except that addressed access is not allowed for an alternate-index path. All key references in the RPL are to the alternate key (instead of the base cluster's prime key).

You can process spanned records in a KSDS by keyed (direct or sequential) access, and in an ESDS by addressed (direct or sequential) access. In either case, the entire record is returned. You cannot process spanned records in a KSDS file by addressed access, because the CIs that contain the spanned record may not be physically contiguous. You may process a file in backward direction by keyed or addressed access.

Table 25 on page 223 summarizes the use of keyed and addressed access to retrieve, add (insert), update, or erase records in KSDS, ESDS, RRDS, and VRDS files. Sequential BWD means that the previous, instead of the next record in sequence (FWD) is to be accessed (see the BWD option of the OPTCD operand). Direct backward (BWD) is mainly used to prepare for a following GET sequential backward.

Table 25. Summary of Processing Options for Keyed and Addressed Access

Type of File	Type of Access	Type of Processing	Records			
			Retrieve	Add	Update	Delete
key sequenced	keyed	sequential FWD sequential BWD skip sequential direct (FWD or BWD)	yes yes yes yes	yes no yes yes**	yes yes yes yes	yes yes yes yes
	addr***	sequential FWD sequential BWD direct (FWD or BWD)	yes yes yes	no no no	yes* yes* yes*	yes yes yes
entry sequenced	addr	sequential FWD sequential BWD direct (FWD or BWD)	yes yes yes	to end no to end**	yes* yes* yes*	no no no
relative record	keyed	sequential FWD sequential BWD skip sequential direct (FWD or BWD)	yes yes yes yes	yes no yes yes**	yes* yes* yes* yes*	yes yes yes yes
variable relative record	keyed	sequential FWD sequential BWD skip sequential direct (FWD or BWD)	yes yes yes yes	yes no yes yes**	yes yes yes yes	yes yes yes yes

Table 25. Summary of Processing Options for Keyed and Addressed Access (continued)

Type of File	Type of Access	Type of Processing	Records			
			Retrieve	Add	Update	Delete
* The length of the record cannot be changed. ** 'no' for backward (BWD) processing. *** Not available for extended-addressed KSDS files (> 4 GB).						

Sequential and Direct Processing

VSE/VSAM allows both sequential and direct processing for every of its types of files.

Sequential processing of a record depends on the position, with respect to the key, relative-record number, or address of the previously processed record; direct processing does not. With sequential access, records retrieved by key are in key sequence, records retrieved by relative-record number are in numerical order, and records retrieved by address are in entry (RBA) sequence. To retrieve or store records sequentially after initial positioning, you do not need to specify a key, relative-record number, or RBA. VSE/VSAM automatically retrieves or stores the next record in order. Apart from OPEN's positioning to the first record of a file, initial positioning can be established by:

- Pointing to the desired record, or
- Inserting a record into the file (keyed access with FWD only), or
- Using direct processing and:
  - Retrieving a record for update (UPD) or
  - Specifying OPTCD=NSP.

A variation of normal sequential retrieval is sequential backward processing. Instead of retrieving the next record in relation to current positioning in the file, the previous record is retrieved. Sequential backward processing is available for keyed and addressed access.

With direct processing, the retrieval or storage of a record is not dependent on the key, relative-record number, or address of any previously retrieved record. You must identify the record to be retrieved by key, or relative-record number, or RBA.

Keyed Access

Keyed access is for key-sequenced and relative-record files. The relative-record numbers of the records in a relative-record file are treated as keys. Keys or relative-record numbers are specified and returned in the area pointed to by the ARG operand of the RPL macro.

Keyed access provides for retrieval, update (including lengthening or shortening a record in a key-sequenced file, as well as altering its contents, except for the key), insertion, addition, and deletion. Each of these actions can be sequential, skip sequential, or direct.

With sequential processing, records are retrieved or stored in ascending key or relative-record sequence, starting from the beginning of the file or another position that you select. You do not have to supply a search argument for VSE/VSAM to process the records.

When you specify SEQ and BWD in the OPTCD operand of the RPL macro, VSE/VSAM returns the previous, instead of the next record in the file (in relation to current positioning). The previous record is the one which has the next lower key (or relative-record number). With the SEQ and BWD options, you can retrieve, update, or erase records, but you cannot insert or add records.

With direct processing, records are retrieved by the search argument (key or relative-record number) you supply. Records can be processed in any order, without regard to the sequence of records processed before or after.

With skip sequential processing, records are retrieved by search argument, but in *ascending* key or relative-record sequence (no backward processing). Thus, skip sequential combines functions of both sequential and direct processing.

The subject is discussed below in more detail for keyed retrieval, storage, and deletion.

Sequential (SEQ) Retrieval

If you specify KEY and SEQ for a *key-sequenced file*, the record to be retrieved depends on where VSE/VSAM is positioned in the file. When your program opens the file, VSE/VSAM is positioned at the first record in the file to begin sequential processing. However, if sequential processing is not to begin with the first record of the file, you can issue a POINT macro to position VSE/VSAM at the record whose key you specify. (If the specified key is generic, that is, a leading portion of the key field, then VSE/VSAM is positioned to the first of the records that have the same generic key.) A subsequent GET macro retrieves the record VSE/VSAM is positioned at and, at the same time, positions VSE/VSAM at the record with the next higher key. In the POINT macro you can also indicate the direction in which the file is to be processed subsequently, by specifying either FWD or BWD.

When you are accessing a base cluster through a *path*, records from the base cluster are returned according to ascending or, if you are retrieving the previous record, descending alternate key values. If several records contain the same (non-unique) alternate key, these records are retrieved in the order in which they were entered into the alternate index (even if BWD was specified). In addition, although Register 15 contains X‘00’, a warning code (duplicate key) is set in the FDBK field of the RPL if there is at least one more data record with the same alternate key value. For example, if there are three data records with the alternate key "1234", the error code would be set during the retrieval of records one and two, and would be reset during retrieval of the third record.

Besides the error code, a function code is set in the RPL indicating whether the condition occurred during accessing the alternate index or the base cluster of a path or during upgrade processing (for a description of the function code, see “Return Codes of Request Macros” on page 281).

If a base cluster is accessed in a partition, once using a path and once not using a path, "a no record found" or "duplicate key error" can occur. These errors can be avoided by using Local Shared Resources (LSR).

The example in Table 26 on page 225 illustrates backward sequential retrieval through a path with non-unique alternate keys.

Table 26. Example of Backward Sequential Retrieval through a Path with Non-Unique Alternate Keys

Alternate Index	Pointer	Record
CI 1: Alternate Key 10	1 2 3	T U E
CI 2: Alternate Key 20	1 2 3 4	S D A Y
Backward sequential retrieval results in the sequence: S, D, A, Y, T, U, E		

Keyed sequential retrieval for a *relative-record file* causes the records to be returned in ascending or, if you are retrieving the previous record, descending numerical order, based on the positioning for the file. Positioning is established in the same way as for a key-sequenced file, the relative-record number always treated as a full 4-byte key. If one or more empty slots are encountered during sequential retrieval, they are skipped and the next (or previous) record is retrieved. The relative-record number of the retrieved record is returned in the ARG field of the RPL.

Sequential Backward (SEQ BWD) Retrieval

To process a file in backward direction or to switch from forward to backward processing or vice versa, you must position VSE/VSAM and, at the same time, indicate the direction of subsequent processing. Open always establishes forward processing direction so that a GET sequential backward immediately after Open results in a positioning error.

To position VSE/VSAM to the end of the file, issue a POINT macro with OPTCD=(BWD,LRD) specified in the RPL. A subsequent GET sequential backward retrieves the last record of the file. To locate and retrieve any other record in the file and establish backward processing direction at the same time, issue a POINT with OPTCD=(BWD,ARD) and a subsequent GET sequential backward (or a direct GET with OPTCD=(BWD,NSP)).

A read error during a GET with:

```
OPTCD=(SEQ,BWD)
```

does not cause the positioning to be lost. An immediately following GET with OPTCD=(SEQ,BWD) will cause VSE/VSAM to skip the next logical record in backward direction that can be retrieved without a read error.

Direct (DIR) Retrieval

Keyed direct retrieval for a *key-sequenced file* does not depend on previous positioning; VSE/VSAM searches the index from the highest level down to the sequence set to retrieve a record. You must specify the record to be retrieved by supplying, in the ARG field of the RPL, one of the following:

- The exact key of the record (OPTCD=KEQ)
- A key less than or equal to the key field of the record (OPTCD=KGE)
- A leading portion of the key, or generic key (OPTCD=GEN)

You can specify OPTCD=KGE when you do not know the exact key. If a record actually has the specified key, VSE/VSAM retrieves it; otherwise, it retrieves the record with the next higher key. Generic-key specification for direct processing causes VSE/VSAM to retrieve the first record with a key whose leading portion is identical with the key in the ARG field. If you want to retrieve all the records with the generic key, specify NSP for your direct request, which causes VSE/VSAM to position itself at the next record in key sequence. You can then retrieve the remaining records with the same generic key sequentially.

If you use *generic keys* in conjunction with *direct* requests there is an additional aspect to consider. VSE/VSAM has to read a data CI to determine that it is empty. So the performance of direct requests with a generic key will decrease if you have many deleted records that match your generic key and precede the first existing record.

To retrieve a record in the file and indicate backward processing direction for a subsequent GET sequential backward, issue a direct GET with OPTCD=(BWD,NSP,ARD), or LRD instead of ARD if you want to retrieve the last record in the file. The search argument must always be a full key (FKS) and must be the same as that of the data record (KEQ); KGE and GEN are ignored. A direct GET or a POINT with OPTCD=(BWD,LRD) against an empty file results in a no-record-found condition.

When you are accessing a base cluster through a *path* with direct access, a record from the base cluster is returned according to the alternate key value you have specified in the ARG field of the RPL macro. If the alternate key is not unique, the record which was first entered with that alternate key is returned and a warning code (duplicate key) is set in the FDBK field of the RPL. To retrieve the remaining records with the same alternate key, specify the NSP option when retrieving the first record and then change to sequential processing.

If a base cluster is accessed in a partition, once using a path and once not using a path, a "no record found" or "duplicate key" error can occur. These errors can be avoided by using Local Shared Resources (LSR).

When you are processing a *relative-record file* with direct access, you must supply the 4-byte relative record number of the desired record in the ARG field of the RPL macro. If you request a deleted or non-existent record, the request will result in a no-record-found condition.

Skip Sequential (SKP) Retrieval

For skip sequential retrieval for a *key-sequenced file*, when you indicate the key of the next record to be retrieved, VSE/VSAM skips to its index entry by using horizontal pointers in the sequence set to get to the appropriate sequence-set index record to scan its entries. SKP is similar to direct processing, except that the key of the next record must always be higher in sequence than the key of the preceding record.

A *relative-record file* has no index. When you indicate the number of the next record to be retrieved, VSE/VSAM calculates the CI containing the requested record and the position of the requested record within that CI. As for a key-sequenced file, the relative-record numbers you specify must be ascending sequence for skip sequential retrieval.

For a *path*, skip sequential access is the same as direct access, except that the alternate key values have to be in ascending sequence. If a base cluster is accessed in a partition, once using a path and once not using a path, a "no record found" or "duplicate key" error can occur. These errors can be avoided by using Local Shared Resources (LSR).

Backward processing is not allowed for skip sequential retrieval.

Keyed Insertion

VSE/VSAM stores a record whenever you issue a PUT request against an RPL. A PUT request for update following a GET for update stores the record that the GET retrieved. To update a record, you must previously have retrieved it for update.

When you store records sequentially beyond the highest key in the file, VSE/VSAM automatically extends the file as though you were continuing to load records. VSE/VSAM does not use distributed free space for these records, but establishes new control areas at the end of the file. Free space is left in the new control areas and CIs according to the file's FREESPACE specification in the catalog.

To store records in key (or relative-record) sequence throughout the file, you can use sequential, skip sequential, or direct access.

When you insert records into a key-sequenced file, you never have to specify a search argument; VSE/VSAM always obtains the key from the record itself. With sequential insertion or skip sequential insertion of consecutive records, VSE/VSAM creates new CIs and control areas and free space is left in them according to the file's FREESPACE specification in the catalog. With direct insertion or skip sequential insertion of non-consecutive records, VSE/VSAM uses the free space.

For a *relative-record file*, sequential insertion causes a record to be inserted into the next slot (provided it is empty). The slot number is returned in the ARG field of the RPL. If the slot is not empty, a duplicate-record error condition will occur.

Direct or skip sequential insertion of a record into a relative-record file causes the record to be placed as specified by the relative-record number in the ARG field. You must insert the record into a slot which does not contain a record; otherwise, a duplicate-record error condition will occur.

If you insert a record after the current end-of-file of a relative-record file, the file is preformatted from the current end-of-file up to and including the control area that is to contain the inserted record. Preformatting mainly consists of inserting control information in the control areas and indicating that the slots are empty.

You can update and insert base data records via a *path*, provided the PUT request does not result in non-unique alternate-key values in an alternate index (in the upgrade set) which you have defined with the UNIQUEKEY parameter. The alternate indexes in the upgrade set are modified automatically when you insert or update a data record in the base cluster. When you update a previously retrieved base record via a path, you must not change the alternate key by which that record was retrieved or its prime key. If the updating of the alternate index results in an alternate index record with no pointers to the base cluster, that alternate index record is erased.

PUT insert requests with OPTCD=NUP or NSP are not allowed in backward direction.

Keyed Deletion

An ERASE macro instruction following a GET for update deletes the record that the GET retrieved. A record is physically erased in the file when you delete it. The space the record occupied is then available as free space.

You can erase a record from the base cluster of a *path* only if the base cluster is a key-sequenced file. The alternate indexes of the upgrade set are modified automatically when you erase a record. If the alternate key value of the erased record is unique, the alternate index data record with that alternate key is also deleted.

You can erase a record from a *relative-record file* after you have retrieved it for update. The record will be set to binary zeros and the control information for the slot will be updated to indicate an empty slot. You can reuse the vacated space by inserting another record of the same length in that location.

Addressed Access

Addressed access is the only form of access for an entry-sequenced file, using the RBA determined for a record when it was stored in the file. This form of access is also allowed for a key-sequenced file, but not for a path or for a relative-record file. For both key-sequenced and entry-sequenced files, addressed access allows processing in backward direction (by specifying OPTCD=BWD in the RPL macro). Positioning is established as for keyed retrieval. You cannot add or insert records in backward direction.

Addressed access can be either sequential or direct for both key-sequenced and entry-sequenced files, but the processing allowed for a key-sequenced file is different from that allowed for an entry-sequenced file.

With a key-sequenced file, addressed access can be used to retrieve records, update their contents, and delete records, but the length of a record and the contents of its key field cannot be changed. Records cannot be added because VSE/VSAM does not allow changes to the file which could cause the index to change. With an entry-sequenced file, addressed access can be used to retrieve records and to update their contents, but not to change their lengths. New records can be added to the end of the file. Records cannot be physically deleted because that would change the entry sequence of the records in the file (the RBAs of the records).

Keyed insertion, deletion, or update (length changing) of records can change the RBAs of these records. Therefore, to use addressed access to process a key-sequenced file, you may have to keep track of RBA changes. For this purpose VSE/VSAM passes back the RBA of every record retrieved, added, updated, or deleted. (See also “JRNAD Exit Routine to Journal Transactions” on page 205.)

Note: Addressed access is not available for extended-addressed KSDS files (> 4 GB). For more information, refer to VSE/VSAM Commands, SC34-2707.

Addressed Retrieval

Positioning for addressed sequential retrieval is done by RBA rather than by key. When a processing program opens a file for addressed access, VSE/VSAM is positioned at the first record in the file in entry sequence to begin addressed sequential processing. A POINT positions VSE/VSAM for sequential access beginning at the record whose RBA you have indicated. A sequential GET causes VSE/VSAM to retrieve the data record at which it is positioned and positions VSE/VSAM at the next or previous record in entry sequence depending on whether you have specified forward (FWD) or backward (BWD) processing in the RPL. If you use addressed sequential retrieval for a key-sequenced file, records will not be in their key sequence if there have been CI or control-area splits.

Addressed direct retrieval requires that the RBA of every individual record be specified, because previous positioning is not applicable. The address specified for a GET or a POINT must correspond to the beginning of a data record; otherwise, the request is invalid.

With direct processing, you may optionally specify that GET position VSE/VSAM at the next record in forward (FWD,NSP) or backward (BWD,NSP) sequence. Your program can then process the following or preceding records sequentially.

Addressed Deletion

You can use the ERASE macro with a key-sequenced file to delete a record that you have previously retrieved for update.

With an entry-sequenced file, you are responsible for marking a record you want to delete. In other words, as far as VSE/VSAM is concerned, the record is not deleted. You can reuse the space occupied by a record marked for deletion by retrieving the record for update and storing in its place a new record of the same length.

Addressed Insertion

VSE/VSAM does not insert new records into the middle of an entry-sequenced file, but adds them at the end. With addressed access of a key-sequenced file, VSE/VSAM does not insert or add new records. You cannot add or insert new records in backward direction.

When you store records sequentially beyond the highest key in the file, VSE/VSAM automatically extends the file as though you were continuing to load records.

A PUT macro instruction stores a record. A PUT for update following a GET for update stores the record that the GET retrieved. To update a record, you must previously have retrieved it for update. You can update the contents of a record with addressed access, but you cannot alter the record's length. Neither can you alter the key field of a record in a key-sequenced file. To change the length of a record in an entry-sequenced file, you must store it either at the end of the file (as a new record) or in the place of a deleted record of the same length (as an update). You are responsible for marking the old version of the record as deleted.

CI Access

VSE/VSAM provides programmers of utilities and systems with CI access. They retrieve and store the contents of a CI, rather than a single record, by specifying CI access in the macros and (for direct processing) giving the RBA of the CI. They are responsible for maintaining the control information at the end of the CI. The format of this information may change in future releases of VSE/VSAM.

CI access is allowed for relative-record files, provided the size of the file is not changed by insertions or additions. CI access is not allowed when you process an alternate-index path or access records in backward direction (with the BWD option).

Note: CI access is not available for extended-addressed KSDS files. For more information, refer to VSE/VSAM Commands, SC34-2707..

Processing a Record in a Work Area or in a Buffer

When your processing program retrieves a record, VSE/VSAM reads into virtual storage the contents of the entire CI in which the record is stored. VSE/VSAM de-blocks the records and either places the requested record in your program's work area (OPTCD=MVE) or leaves the record in VSE/VSAM's I/O buffer and gives you, in the AREA field, the address of the record in the buffer (OPTCD=LOC). VSE/VSAM indicates the length of the record to your program (in the RECLEN field) in both move mode and locate mode. You need not concern yourself with any physical attributes of stored records. Spanned records cannot be accessed in locate mode.

The SHOWCAT Macro

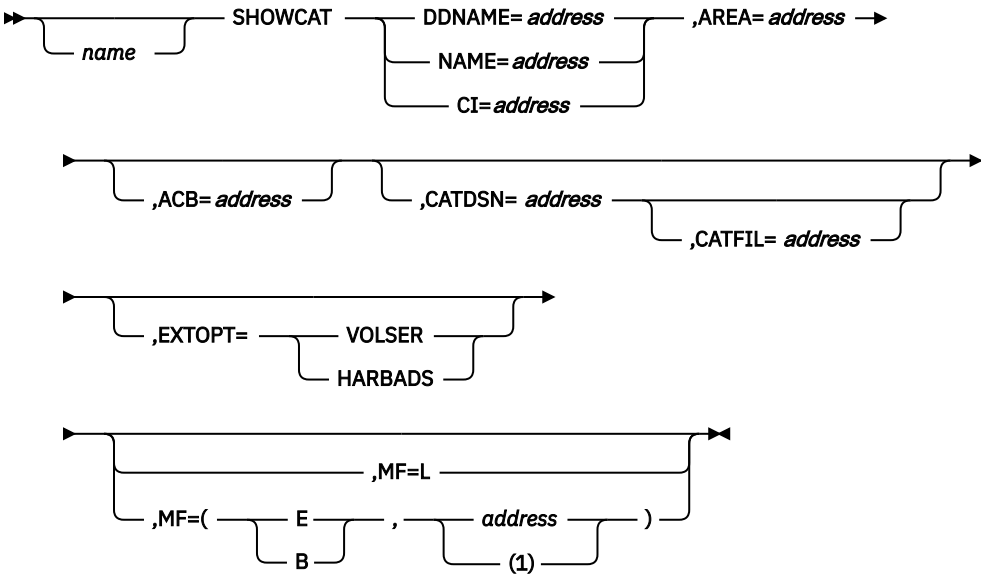
With the SHOWCAT macro, you can retrieve information from a catalog about any non-open file defined in the catalog.

For explanations on the *relationship* of the information that you can retrieve, refer to “Displaying Catalog Information. SHOWCAT” on page 176 (Figure 18 on page 177).

Format of the SHOWCAT Macro

When you issue a SHOWCAT macro, Register 13 must contain the address of a 72-byte save area that you are providing. When you issue a SHOWCAT macro from within one of your exit routines, such as LERAD or SYNAD, your program must provide a second 72-byte save area for use by VSE/VSAM, because the original save area is still in use by the external VSE/VSAM routine.

The SHOWCAT macro has the following format:



name
one to eight characters that provide a symbolic name.

DDNAME | NAME | CI=address
specifies the address of an area that identifies the catalog entry that contains the desired information.

DDNAME=address
specifies the address of a seven-byte area containing the file name of the object to be displayed. The object can be a cluster (C), an alternate index (G), or a path (R). Using the indicated file name, SHOWCAT first retrieves the corresponding name (file ID) of the object from the label cylinder and then the desired information from the catalog.

Either this parameter or the NAME or CI parameter must be provided. However, when issuing the first SHOWCAT for an object, specify DDNAME or NAME. VSE/VSAM then supplies the CI numbers of any associated objects for subsequent SHOWCATs (in the work area supplied through the AREA operand). See “Format of the SHOWCAT Work Area” on page 233.

NAME=address
specifies the address of a 44-byte area containing the name (file ID) of the object to be displayed. The name is left-justified and padded with blanks on the right. The type of object named must be C, G, R, D, or I.

Either this parameter or the DDNAME or CI parameter must be specified. However, when issuing the first SHOWCAT for an object, specify DDNAME or NAME. VSE/VSAM then supplies the CI numbers of any associated objects for subsequent SHOWCATs (in the work area supplied through the AREA operand). See “Format of the SHOWCAT Work Area” on page 233.

CI=address
specifies the address of a three-byte area that contains the CI number of the catalog entry for the object to be displayed. The entry type of the object must be C, G, R, D, I, or Y. (Y can only be retrieved via CI).

Either this parameter or the DDNAME or NAME parameter must be specified. However, when you have already issued a SHOWCAT request for an object (with the DDNAME or NAME parameter), you then issue any subsequent SHOWCATs for its associated objects by specifying their CI numbers (as returned to you via the previous SHOWCAT DDNAME or NAME request).

The three-byte area must be separate from the work area specified by the AREA operand, even though VSE/VSAM returns a CI number in the work area.

AREA=address
specifies the address of a work area in which the catalog information is to be displayed. The first two bytes of this area must contain the length of the area, including these two length bytes.

The minimum size of the area is 64 bytes, unless EXTOPT is specified. With EXTOPT, the minimum size is 28 bytes. If it is smaller than the minimum size, you get a return code of 4 in Register 15 and you can reissue the SHOWCAT macro with a larger size. The format of the work area is described in "Format of the SHOWCAT Work Area" on page 233.

ACB=address
specifies the address of the ACB that defines the catalog containing the entry to be displayed. You issue the first SHOWCAT without ACB specified; VSE/VSAM searches for the specified objects and returns to you (in the work area supplied through the AREA operand) the address of the ACB that defines the correct catalog. The catalogs are searched in the following order: the catalog specified by the CATDSN parameter, the catalog specified by the CAT parameter of the VSE/VSAM file, the job catalog, or if none of these exist, the master catalog. When you subsequently issue SHOWCAT, you can specify that ACB address, which causes VSE/VSAM to go directly to the correct catalog without searching other catalogs first. You should always include the ACB parameter when you specify CI instead of NAME.

CATDSN=address and CATFIL=address
CATDSN specifies the address of a 44-byte area containing the name (file ID) of the catalog to be searched.

CATFIL specifies the address of an 8-byte area containing the file name of the catalog to be searched. File ID and file name must be the same as those specified in the DLBL statement (if one is provided) for the catalog. CATDSN must always be specified if CATFIL is specified. CATFIL is always optional. You use these parameters to override the established order in which catalogs are searched. (VSE/VSAM always searches only one catalog for a specific entry.) That is, you must specify CATDSN if the object to be displayed is (1) not specified by the CAT parameter on the DLBL statement for the file, (2) not in the job or master catalog, or (3) in the master catalog and not the job catalog (if IJSYSUC and IJSYSCT are both specified).

EXTOPT=VOLSER|HARBADS
indicates that either the volume serial number of the file's primary allocation volume (VOLSER) or the high allocated RBA for the file (HARBADS) is to be returned to you. This operand can only be issued for a D or I type catalog record.

The data returned for the EXTOPT operand replaces the associated object information in the user return area. If you need the associated object information as well as the EXTOPT data, you must issue separate SHOWCAT macros.

MF=L
specifies that the list form of the SHOWCAT macro is required. The list form builds a parameter list when the macro is assembled; it is not executable. AREA and DDNAME|CI|NAME are optional in the list form; if you do not specify them in the list form they must be specified in the execute form. In the list form, the operand addresses cannot be expressed in register notation. The format of the SHOWCAT parameter list is described in "Parameter Lists for VSE/VSAM Macros" on page 294.

MF=(E|B,address|(1))
specifies that the execute form of the SHOWCAT macro is required.

E indicates that the parameter list, whose address is given in address or in a register, is to be passed to VSE/VSAM for processing.

B indicates that the parameter list is to be built or modified, but is not to be passed to VSE/VSAM. This form of the macro is similar to the list form, except that it works at execution time and can modify a parameter list, as well as build it.

To build a parameter list, first issue SHOWCAT with only MF=(B) specified, to zero out the area in which it will be built.

address gives the address of the parameter list. If you use register notation, you may use Register 1, as well as a register from 2 through 12. Register 1 is used to pass the parameter list to VSE/VSAM (if MF=E).

If the MF operand is omitted, the standard form of the SHOWCAT macro is assumed, which builds the parameter list, puts its address in Register 1, and passes control to VSE/VSAM to process the list.

Return Codes from SHOWCAT

When VSE/VSAM returns to your processing program after a SHOWCAT request, Register 15 contains one of the following return codes:

Return Code	Meaning
0 (0)	VSE/VSAM completed the request.
4 (4)	The area specified in the AREA operand is less than the minimum required (64 bytes) or is too small to display all associated objects (as many objects as possible are displayed).
8 (8)	Either the ACB address is invalid or the VSE/VSAM master catalog does not exist or could not be opened.
12 (0C)	The request was not executed because an error was found while VSE/VSAM routines were loaded (see Note).
20 (14)	The named object or CI does not exist (see Note).
24 (18)	An I/O error occurred in gaining access to the catalog (see Note).
28 (1C)	The specified CI number is invalid.
32 (20)	The specified object is not a C, D, G, I, R, or Y type (see Note).
40 (28)	An unexpected error code was returned from catalog management to the SHOWCAT processor (see Note).
44 (2C)	An error occurred in searching the label area for the file ID corresponding to the specified file name (See Note).
48 (30)	EXTOPT field name is not valid for SHOWCAT.
52 (34)	EXTOPT specified, but record type not D or I.

If a return code of 0 was passed in Register 15, the requested catalog information is returned in the work area which you have supplied through the AREA operand. The format is shown below.

Note: In case the SHOWCAT return code in Register 15 is 12, 20, 24, 28, 36, 40, 44, or 52, the work area contains the return code and reason code issued by VSE/VSAM catalog management as well as the module ID of the catalog management module in which the error was detected. The format of the work area is then as follows:

Offset	Length	Description
0	2	Length of work area
2	2	VSE/VSAM catalog return code[1] or (for return code 44) VSE/VSAM error code

Offset	Length	Description
4	2	VSE/VSAM catalog reason code[1]
6	2	VSE/VSAM catalog management module ID

[1] For the codes, refer to z/VSE Messages and Codes Volume 2, SC34-2683 .

Format of the SHOWCAT Work Area

Offset Length
Description

0(0) 2
Length of the work area, including the length of this field (provided by you).

2(2) 2
Length of the work area actually used by VSE/VSAM, including the length of this field and the preceding field.

4(4) 4
The address of the ACB that defined the catalog that contains the entry which is to be displayed.

8(8) 1
Type of object about which information is returned:

C
Cluster

D
Data component

G
Alternate index

I
Index

R
Path

Y
Upgrade set

The following fields contain one set of information for C, G, R, and Y types, and another set for D and I types.

For C, G, R, and Y types:

9(9) 1
For Y type: Reserved.

For C type:

x... ....
The SHOWCAT output for the D type record will provide the VSAM file type (1).

.xxx xxxx
Reserved.

For G type:

x... ....
The alternate index might (1) or might not (0) be a member of an upgrade set. The way to find out for sure is to display information for the upgrade set of the base cluster and check whether

it contains CI numbers of entries that describe the components of the alternate index. Figure 18 on page 177 shows you how to get from the alternate index's catalog entry to the entries that describe its components (G to C to D to Y to D and I).

.xxx xxxx
Reserved.

For R type:

x... ....
The path is (1) or is not (0) defined with the UPDATE attribute (for upgrading alternate indexes).

.xxx xxxx
Reserved.

10(A) 2
The number of pairs of fields that follow. Every pair of fields identifies another catalog entry that describes an object associated with this C, G, R or Y object. The possible types of associated objects are:

With C: D, G, I, R.
With G: C, D, I, R.
With R: C, D, G, I.
With Y: D, I.

Figure 18 on page 177 shows how the catalog entries for all these objects are related.

12(C) 1
Type of associated object the entry describes.

13(D) 3
The CI number of its first record.

16(10)
Next pair of fields, and so on. If the area is too small to display a pair of fields for every associated object, VSE/VSAM displays as many pairs as possible and returns a code of 4 in Register 15.

Every pair of fields occupies 4 bytes, except Y-type entries which require 8 bytes (4 for the data component and 4 for the index component of the alternate index in the upgrade set).

For D and I types:

9(9) 1
For I type: Reserved.

For D type:

..xx ....
.1x. -> The file is a SAM file (NOCIFORMAT data set, DTFPH access only). .01. -> The file is a SAM ESDS file (ACB access allowed). .00. -> The file is a native VSAM file, defined as:

.x00 x...
0000 -> ESDS (Entry-Sequenced Data Set) 1000 -> KSDS (Key-Sequenced Data Set) 0001 -> RRDS (Relative Record Data Set) 1001 -> VRDS (Variable-length Relative Record Data Set)

For SAM ESDS (invalid for native VSE/VSAM file):

x... ....
File definition by implicit (1) or explicit (0) DEFINE

.... .x..
The SAM record format is blocked (1)

.... ..x.
The SAM record format is variable records (1)

....x
The SAM record format is fixed records (1)

10(A) 2
Relative position of the prime key in records in the data component. For the data component of an entry-sequenced or a relative record file there is no prime key, and this field is 0.

12(C) 2
Length of the prime key, or length of logical record for fixed-blocked SAM files.

14(E) 4
CI size of the data or index component.

18(12) 4
Maximum record size of the data or index component, or block size for blocked SAM files.

22(16) 2
The number of pairs for fields that follow. Every pair of fields identifies another catalog entry that describes an object associated with this D or I object. The possible types of associated objects are:

With D: C, G, Y.
With I : C, G.

Figure 18 on page 177 shows how the catalog entries for all these objects are related.

24(18) 1
Type of associated object the entry describes.

25(19) 3
The CI number of its first record.

28(1C)
Next pair of fields, and so on. Fields for all associated objects can always be displayed (with the minimum AREA size specified).

The SHOWCB Macro

The SHOWCB macro displays fields in an ACB, EXLST or RPL. VSE/VSAM places these fields in an area that you provide. They are independent of the format of the control block or list you are displaying. The fields are displayed in the order that you specify the keywords for them.

The operands of the SHOWCB macro are specified as absolute numeric expressions, as character strings, as codes, as expressions that generate valid relocatable A-type address constants, in ordinary z/VSE register notation, as S-type address constants, and as indirect S-type address constants. “Operand Notation for VSE/VSAM Macros” on page 285 gives all the ways of coding every operand for the macros that work at execution.

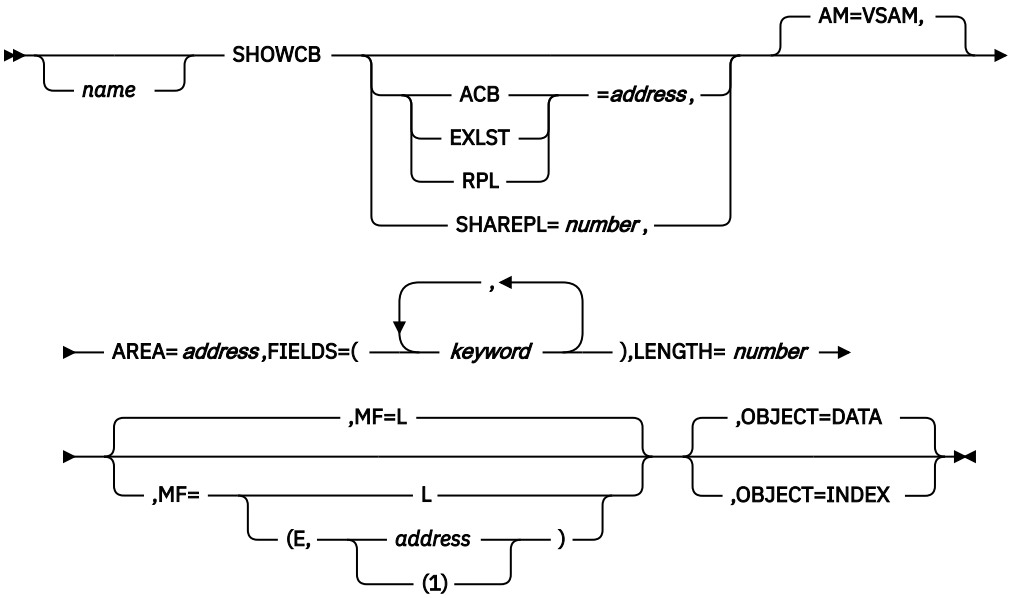
When you issue a standard SHOWCB macro (not the short form described below), Register 13 must contain the address of a 72-byte save area that you are providing. When you issue a SHOWCB macro from within one of your exit routines such as LERAD or SYNAD, your program must provide a second 72-byte save area for use by VSE/VSAM because the original save area is still in use by the external VSE/VSAM routine.

If you want to display only the length of a data record (the RECLEN field of the corresponding RPL), you can do so without any call to a VSE/VSAM routine by issuing the SHOWCB macro in the following short form:

SHOWCB RPL=(1),RECLEN=(0)

The address of the RPL must be contained in Register 1. The record length will be put into Register 0. No parameter list is created. For other SHOWCB functions, you must use the standard form of the SHOWCB macro.

Format of the SHOWCB Macro



name
one to eight characters that provide a symbolic name.

ACB | EXLST | RPL=address|SHAREPL=number
This operand specifies whether you want to display an ACB, an EXLST, an RPL and its address, or information about an LSR share pool.

In the standard and list forms of SHOWCB, you can omit this operand if you are displaying only the standard length of a control block or list (see "Length of a Control Block or List" on page 238). With the execute form of SHOWCB, you can change the address of the block or list to be displayed, but not the type.

AM=VSAM
specifies that this is a VSE/VSAM control block. You may want to specify this operand for documentation purposes if your installation also uses VTAM.

AREA=address
specifies the address of the area in virtual storage that you are providing for VSE/VSAM to display the items you specify in the FIELDS operand. The items are in the area in the order you specify the keywords. The area must begin on a fullword boundary.

FIELDS=(keywords)
There are five groups of keywords you can code for the FIELDS operand of the SHOWCB.

- The keywords that you can code with the ACB, EXLST, RPL, and GENCB macros. For details, refer to "Keywords of the ACB, EXLST, and RPL Macros" on page 237.
- The length of an ACB, RPL, or EXLST. For details, refer to "Length of a Control Block or List" on page 238.
- The attributes of an open file or index indicated by the ACB. For details, refer to "Attributes of an Open File" on page 238.
- The matrix of LSR statistics LSRINF. To retrieve this matrix into the user's area, LSRINF must be the only keyword in the FIELDS parameter. If SHAREPL=number is specified, OBJECT parameter is ignored. For details, refer to "LSR Matrix" on page 244.
- The extent matrix EXTINF. To retrieve this matrix into the user's area, EXTINF must be the only keyword in the FIELDS parameter. For details, refer to "Extent Matrix" on page 247.

LENGTH=number
specifies the length of the display area you are providing (by way of the AREA operand). Every field in the ACB and RPL takes a fullword, except for DDNAME, STMST, and ATRB in the ACB, which take two fullwords. Every EXLST operand takes only one fullword, because you cannot display the codes A, N, and L.

MF=
For information on specifying this operand, refer to "List, Execute, and Generate Forms of the Control Block Manipulation Macros" on page 283.

OBJECT=DATA|INDEX
specifies, for the open ACB of a key-sequenced file, whether the fields displayed are for the data or the index. VSE/VSAM will display the same values for KEYLEN regardless of your specification in the OBJECT operand. The same is true for field RKP.

If you specify INDEX, VSE/VSAM's display is all zeros for the following fields:

FS	NRETR	LNDELR	LNUPDR
NCIS	NSSS	LNINSR	
NDELR	NUPDR	LNRETR	
NINSR	LNCIS	LNSSS	

SHAREPL=number
specifies the identification number of a Local Shared Resources (LSR) pool to be displayed. Specify a number from 0 through 15.

Keywords of the ACB, EXLST, and RPL Macros

The keywords in this group require one fullword every for display, except DDNAME which requires two fullwords. The keywords are identical to those of the ACB, EXLST, and RPL macros, except that:

- You can code the operands in more ways, as shown in "Operand Notation for VSE/VSAM Macros" on page 285.
- You do not code the address, value, option, or name to which the keyword is equal.
- In relation to the ACB macro, you cannot display the MACRF options and the RMODE31 keyword.

  With the keyword **ERROR**, you can display the error code (in the rightmost byte of the display word) from the Open or Close routine (see the OPEN and CLOSE macros); you can test the **MACRF** options with the TESTCB macro.

  Also in relation to the ACB macro, you cannot display the ABEND CLOSE disposition, that is, the second KEEP or DELETE keyword of the PARMS= parameter.
- In relation to the EXLST macro, you cannot display the codes that indicate whether an exit address is active or not active or is the address of the name of a routine to be loaded; you can test them with the TESTCB macro.
- In relation to the RPL macro, you cannot display the OPTCD options, but you can code the keyword **FDBK** to display error codes (in the rightmost byte of the display word) from the request macros and the keyword **RBA** to display the relative byte address of the last record processed; you can test the **OPTCD** options with the TESTCB macro.

  You can code the keyword **AIXPC** to display the number of key or RBA pointers in the most recently processed alternate index record.

  You can code the keyword **FTNCD** to display, after a logical or physical error, the *function code* which indicates whether the respective condition occurred during processing of the base cluster or the alternate index of a path or during upgrade processing. (For details, see "Return Codes of Request Macros" on page 281.)

Length of a Control Block or List

You can code the keyword **ACBLEN**, **EXLLEN**, or **RPLLEN** to display either the standard length of an ACB, EXLST, or RPL, or the actual length of a particular block or list. You display a standard length by omitting the ACB | EXLST | RPL operand and coding only one (or more) of these length keywords and no other keywords. You display the actual length of a block or list by specifying the ACB | EXLST | RPL operand and the corresponding length keyword.

Attributes of an Open File

After a file is opened, the ACB contains information that it does not contain before it is opened or after it is closed. Whether you are displaying the attributes of the data or the index of a key-sequenced file is determined by the OBJECT operand. Every item displayed requires one fullword in your work area, except STMST which require two fullwords. You can display the following items:

Note: If specified ACB is designated to the PATH, then the following keywords refer to the values related to the corresponding alternate index (not the base cluster): LRECL, HALCRBA, STRMAX, ATRB, ASTRNUM, STRTOT, SYMU.

Attribute
Meaning

ATRB
An eight-byte field, the first four bytes of which contain the current AMDSB attribute bytes. The fifth byte contains SAM ESDS RECFM INFO, and the remaining three bytes are reserved for future use. Refer to “Structure of the ATRB” on page 241.

ASTRNUM
Number of currently active requests in the resource pool.

AVSPAC
Number of bytes of available space in the data or index component from all previous sessions.

LAVSPAC
Local number of bytes of available space in the data or index component, that is, the number calculated during the current work session. When the file is closed, this number is added to AVSPAC and LAVSPAC starts at zero for the next session.

BFREE
Number of unassigned buffers.

BFRFND
Number of requests for retrieval that could be satisfied without an I/O operation; that is, the data was found in the buffer. Applies for LSR only.

BLREC
The record length of a SAM ESDS file.

BUFNO
Number of buffers used for the data or index component.

BUFRDS
Number of requests for retrieval that required I/O operation; that is, the data was *not* found in the buffer. Applies for LSR only.

CDBUF
Number of data buffers.

CIBUF
Number of index buffers.

CINV
Size of a CI in the data or index component.

CIPCA
Number of control intervals per control area.

CNAME
Name of the cluster (44 bytes).

ENDRBA
Ending (high used) RBA of the space used by the data component or the index component.

EXTINF
Refer to "Extent Matrix" on page 247.

FS
Number of free control intervals per control area of a key-sequenced file.

IDACB
The ACB identifier is equal to x'A0'.

IDDOS
The DOS identifier is equal to x'28'.

KEYLEN
Full length of the prime key or alternate key field in every logical record (depending on whether or not you access the base cluster via a path).

HALCRBA
High allocated RBA. The relative byte address (1 fullword) of the end of the data component (OBJECT=DATA) or the index component (OBJECT=INDEX) of the cluster opened by the related ACB.

LNEST
Local number of index levels.

LRECL
Maximum length of a logical record, or for an index, the index CI size minus seven bytes.

NCIS
Number of CI splits in the file from all previous sessions.

LNCIS
Local number of CI splits in the file, that is, the number calculated during the current work session. When the file is closed, this number is added to NCIS and LNCIS starts at zero for the next session.

NDELR
Number of data records deleted from the file from all previous sessions.

LNDELR
Local number of data records deleted from the file, that is, the number calculated during the current work session. When the file is closed, this number is added to NDELR and LNDELR starts at zero for the next session.

NEXCP
Number of times EXCP was issued by VSE/VSAM I/O routines from all previous sessions.

LNEXCP
Local number of EXCP issued by VSE/VSAM I/O routines, that is, the number calculated during the current work session. When the file is closed, this number is added to NEXCP and LNEXCP starts at zero for the next session.

NEXT
Number of logical extents, data spaces, or portions of data spaces, now allocated to the data or index component.

NINSR
Number of data records inserted into the file from all previous sessions. For a relative-record file, number of valid records (non-empty slots in the file). For a key-sequenced file, number of records inserted between the records, not records initially loaded or added to the end of the file.

LNINSR
Local number of data records inserted into the file, that is, the number calculated during the current work session. For a relative-record file, number of valid records (non-empty slots in the file). For a key-sequenced file, number of records inserted between the records, not records initially loaded or added to the end of the file.

When the file is closed, this number is added to NINSR and LNINSR starts at zero for the next session.

NIXL
Number of index levels in a key-sequenced file, including recent updates to the referenced ACB.

NLOGR
Number of data records in the file from all previous sessions. For a relative-record file, total number of slots (empty or non-empty) in the used CIs.

LNLOGR
Local number of data records in the file, that is, the number calculated during the current work session. For a relative-record file, total number of slots (empty or non-empty) in the used CIs. When the file is closed, LNLOGR number is added to NLOGR and LNLOGR starts at zero for the next session.

NRETR
Number of data records retrieved from the file from all previous sessions.

LNRETR
Local number of data records retrieved from the file, that is the number calculated during the current work session. When the file is closed, this number is added to NRETR and LNRETR starts at zero for the next session.

NSLOT
Number of relative record slots within each data control interval.

NSSS
Number of data control-area splits in a key-sequenced file from all previous sessions.

LNSSS
Local number of data control-area splits in a key-sequenced file, that is, the number calculated during the current work session. When the file is closed, this number is added to NSSS and LNSSS starts at zero for the next session.

NUIW
Number of write requests that VSE/VSAM was forced to do because buffers were not available for reading the contents of a control interval (CI). (NUIW is the number of write requests that were *not* initiated by the user.) Applies for LSR with DFR only.

NUPDR
Number of data records updated in the file from all previous sessions.

LNUPDR
Local number of data records updated in the file, that is, the number calculated during the current work session. When the file is closed, this number is added to NUPDR and LNUPDR starts at zero for the next session.

OPENOBJ
AMS flag byte. With the AMS flag you can determine whether the opened object is a path, a base cluster, or an alternate index:

- x'80'=alternate index
- x'40'=access via path
- x'20'=access via base cluster

RKP
Displacement of the prime key or alternate key field from the beginning of a data record (depending on whether or not you access the base cluster via a path); the same value is displayed whether the object is index or data.

SHAREOP
Share options byte.

SSRBA
RBA of the sequence-set index record which points to the logical beginning of the data component.

STMST
System time stamp; the time and day (in microseconds) when the data or index component was last closed. Bits 52 through 63 of the field are unused.

STRMAX
Maximum number of requests which were concurrently active since the resource pool was built. Used in shared resource applications (see "The BLDVRP Macro" on page 194).

STRTOT
Total number of open ACB strings administered by the resource pool.

SYMU
Symbolic unit name of the volume.

UIW
Number of all other write requests (those that are not counted in NUIW). Applies for LSR only.

Structure of the ATRB

The first attribute byte includes the following options:

EQU X'80'	Indexed Dataset (KSDS or VRDS)
EQU X'40'	WRITECHECK attribute
EQU X'20'	IBMED attribute (obsolete)
EQU X'10'	REPLICATE attribute (obsolete)
EQU X'08'	ORDERED attribute
EQU X'04'	KEYRANGE attribute
EQU X'02'	Relative record data set
EQU X'01'	SPANNED attribute

The second attribute byte includes the following options:

EQU X'80'	For internal use
EQU X'40'	Load mode
EQU X'20'	SPEED attribute
EQU X'10'	This is an index component.
EQU X'08'	Sharing
EQU X'04'	Key range processing
EQU X'02'	Component is mixed architecture (both FBA and CKD). This bit is set only when a mixed architecture index is opened by itself.
EQU X'01'	This is a catalog.

The third attribute byte includes the following options:

EQU X'80'	For alternate index only: 0=UNIQUEKEY, 1=NONUNIQUEKEY
EQU X'40'	Expiration date
EQU X'20'	EXTRALARGE attribute
EQU X'10'	COMPRESSED attribute
EQU X'08'	FAT-DASD attribute
EQU X'04'	For internal use
EQU X'02'	VRDS dataset

EQU X'80'	For alternate index only: 0=UNIQUEKEY, 1=NONUNIQUEKEY
EQU X'01'	Reserved

The forth attribute byte includes the following options:

EQU X'80'	If this AMDSB is for data component, this bit indicates component is on FBA. If this AMDSB is for index component (when both components are opened together), this bit indicates that high-level index is on FBA.
EQU X'40'	Used only when this AMDSB is for index component (when both components are opened together). Indicates that sequence set in on FBA.
EQU X'20'	Reserved
EQU X'10'	If this AMDSB is for data component, this bit indicates component is on ECKD. If this AMDSB is for index component (when both components are opened together), this bit indicates that high-level index in on ECKD.
EQU X'08'	Used only when this AMDSB is for index component (when both components are open together). Indicates that sequence set in on ECKD.
EQU X'04'	Component is mixed architecture (both CKD and ECKD). This bit is set only when a mixed architecture index is opened by itself.

SAM ESDS RECFM INFO byte includes the following options:

EQU X'80'	Implicitly defined file
EQU X'40'	Reserved
EQU X'20'	Non-CI format (for example, RECFM(NOCIFORMAT))
EQU X'10'	Non-CA format (SAM ESDS)
EQU X'08'	Reserved
EQU X'04'	SAM blocked
EQU X'02'	SAM variable
EQU X'01'	SAM fixed

Examples: The SHOWCB Macro

Figure 22 on page 243 is an example of how to display information from VSE/VSAM control blocks using the SHOWCB macro. Continuation characters required in column 72 are not shown in the example.

The SHOWCB macro is used to display statistics about an open file:

```
          SHOWCB ACB=(2),AREA=DISPLAY,LENGTH=12,                      x
                 FIELDS=(KEYLEN,LRECL,RKP)
          LTR    15,15                        SHOWCB successful?
          BNZ    SHOWERR                      No, go to error routine
          .
          .
DISPLAY   DS     0F                           Align on fullword boundary
KEYLEN    DS     F
LRECL     DS     F
RKP       DS     F
```

The SHOWCB macro is used to display the length and RBA of a record that has been retrieved:

```
         GET     RPL=(4)
         LTR     15,15
         GNZ     GETRR
         SHOWCB  RPL=(4),AREA=DISPLAY,LENGTH=8,                      x
                 FIELDS=(RECLEN,RBA)
         LTR     15,15                        SHOWCB successful?
         BNZ     SHOWERR                      No, go to error routine
         .
         .
DISPLAY  DS      0F                           Align on fullword boundary
RECLEN   DS      F
RBA      DS      F
```

Figure 22. SHOWCB Macro Example

```
         SHOWCB ACB=ACB1,AREA=AREA1,LENGTH=100,FIELDS=(IDACB,IDDOS, x
                CDBUF,CIBUF,CIPCA,LNEST,BFREE,OPENOBJ,CNAME)
         LTR    15,15
         BNZ    SHOWERR
         .
         .
AREA1    DS     0F
IDACB    DS     F
IDDOS    DS     F
CDBUF    DS     F
CIBUF    DS     F
CIPCA    DS     F
LNEST    DS     F
BFREE    DS     F
OPENOBJ  DS     F
CNAME    DS     44CL
```

Figure 23. Example of a SHOWCB Call

Example: Statistics on Use of LSR Buffer Pools

This example shows what to specify in SHOWCB to obtain statistics about the usage of buffer pools for local shared resources (LSR). The information can help you to determine how to improve both, a previous definition of a resource pool, and the mix of data sets that use a pool.

The statistics:

- Are available through an ACB that describes an open data set that uses a buffer pool.
- Reflect the use of the buffer subpool from the time it was built up to the time you issue SHOWCB.
- Are for a single buffer subpool. To get statistics for all buffer subpools, issue a SHOWCB for each of the subpools.

The example specifications for displaying the statistics are:

```
   SHOWCB ACB=(R6),AREA=SHOW,FIELDS=(BFRFND,BUFRDS,NUIW,UIW),  x
          LENGTH=16,OBJECT=INDEX
```

Figure 24. SHOWCB Macro Example

where:

- R6 must point to an ACB for an open data set.
- SHOW must be 16 bytes long. After processing of SHOWCB, the field SHOW will contain all four counters (each being four bytes long).
- INDEX specifies that the statistics are to be taken from the LSR sub-pool that is used by the index component of the data set.

LSR Matrix

Returned LSR matrix consists of three parts:

1. Header.
2. Share Pool Statistics Area. Includes string statistics area, which contains the total number of LSR strings, and buffer matrix, which contains buffer statistics for the requested share pool.
3. Cluster Matrix. Includes LSR string and buffer statistics for each VSE/VSAM cluster assigned to a specified share pool.

Header

Header has a fixed size of 32 bytes and contains the following fields:

Field	Length
Length of area supplied by user	4 bytes
Total length used (or required) by VSAM	4 bytes
Length of string statistics area	4 bytes
Number of rows in buffer matrix	4 bytes
Length of rows in buffer matrix	2 bytes
Number of rows in cluster matrix	4 bytes
Length of rows in cluster matrix	2 bytes
(reserved)	4 bytes
(reserved)	4 bytes

Length of area supplied by user
length of the area passed by the user in the Length parameter of the macro call in bytes.

Total length used (or required) by VSAM
length of the area actually used by or needed for VSAM to display string statistics, buffer matrix, and cluster matrix, including length of the header, in bytes.

Length of string statistics area
length of fixed string statistics area (first part of share pool statistics area) in bytes.

Number of rows in buffer matrix
number of fixed size rows that are displayed in user's area. This number also indicates the number of subpools in a specified share pool.

Length of rows in buffer matrix
length of each row in buffer matrix in bytes.

Number of rows in cluster matrix
number of fixed size rows that are passed to the user. This number also indicates the number of clusters in a specified share pool, including base clusters opened via a path.

Length of rows in cluster matrix
length of each row in cluster matrix in bytes.

Share Pool Statistics Area

Share pool statistics area contains string statistics area and buffer matrix. String statistics area includes the following data:

Field	Length
Share pool number	2 bytes
Total number of strings	2 bytes
Number of active strings	2 bytes
Number of free strings	2 bytes
(reserved)	2 bytes
(reserved)	2 bytes
(reserved)	2 bytes
(reserved)	2 bytes

Buffer matrix includes the following data:

Field	Length
Size of buffer	2 bytes
Type of buffer	1 byte
Flags	1 byte
Number of buffers	4 bytes
Number of modified buffers	4 bytes
Number of free buffers	4 bytes
Number of buffer reads	4 bytes
Number of retry requests without I/O	4 bytes
Number of user-initiated writes	4 bytes
Number of non-user-initiated writes	4 bytes

Size of buffer
the size of every buffer in the resource pool. See “The BLDVRP Macro” on page 194 for how to define size of buffers, type of buffers, and number of buffers in the resource pool.

Type of buffer
'D' means data, 'I' means index.

Flags
reserved field.

Number of buffer reads
number of requests for retrieval that required I/O operation, that is, the data was not found in the buffer. Refer to a description of the BUFRDS attribute in “Attributes of an Open File” on page 238.

Number of retry-requests without I/O
number of requests for retrieval that did not require I/O operation, that is, the data was found in the buffer. Refer to a description of the BFRFND attribute in “Attributes of an Open File” on page 238.

Number of non-user-initiated writes from buffer pool
number of write requests that VSE/VSAM was forced to do because buffers were not available for reading the contents of a control interval (CI). This is the number of write requests that were not

initiated by the user. Refer to a description of the NUIW attribute in “Attributes of an Open File” on page 238.

Number of user-initiated writes
number of all other write requests, those that are not counted in non-user-initiated write requests. Refer to a description of the UIW attribute in “Attributes of an Open File” on page 238.

Cluster Matrix

LSR string and buffer statistics for each cluster within a specified share pool. This part contains fixed size rows, number of which equals number of clusters associated with a specified share pool. The length of a row and the current number of rows are contained in the header.

Field	Length
DDNAME	8 bytes
Type of cluster	1 byte
Flags	1 byte
Number of active strings for this cluster	2 bytes
Size of data buffers	4 bytes
Number of data buffers used	4 bytes
Size of index buffers	4 bytes
Number of index buffers used	4 bytes
(reserved)	4 bytes
(reserved)	4 bytes

DDNAME
name of cluster in a specified share pool. Specifies a character string of up to eight bytes and is the same as the file name parameter specified in the DLBL statement that identifies the VSE/VSAM file or path to be processed.

Type of cluster
'B' means a base cluster, '00' means path.

Number of active strings for this cluster
number of active strings for a cluster with the name DDNAME.

Size of data buffers
size of data buffers in the resource pool.

Number of data buffers used
number of data buffers in the resource pool specified via BLDVRP Macro.

Size of index buffers
contains the size of index buffers in the resource pool.

Number of index buffers used
number of index buffers in the resource pool specified via BLDVRP Macro.

LSR Matrix Usage

The header is 32 bytes length. If the value specified for length is large enough, VSE/VSAM returns:

- header;
- string statistics area;
- all rows of buffer matrix. Their number can be checked in the "Number of rows in buffer matrix" field of the header;

- all rows of cluster matrix. Their number can be checked in the "Number of rows of cluster matrix" field of the header.

If length is not large enough for the whole output but more than 32 bytes, VSE/VSAM returns as much information as fits, the return code 4, and the reason code 9. Check the field "Total length used (or required) by VSAM" in the header for the required space length and issue another SHOWCB call specifying length large enough to contain all the matrix information.

In case user specifies length less than 32 bytes, VSE/VSAM will reject the request, issue the return code 4 and the reason code 21. Recompile the program with length bigger than 32 bytes.

Extent Matrix

The output matrix consists of the three parts:

1. Header.
2. Physical Device Characteristics Area which contains information about the extents allocated for the specified cluster (ACB). Note that VSAM requires that all extents for a specific cluster component reside on the same type of DASD. For KSDS and VRDS clusters, the data and index can reside on different types of DASD, so there will be two sets of physical device characteristics, one set used for data and the other used for index.
3. Extent Information Area which contains information about each extent for the requested VSAM cluster. Data extents will be listed first, marked with 'D', followed by the index extents, marked with 'I'.

Header

Header has a fixed size of 32 bytes and contains the following fields:

Field	Length
Length of area supplied by user	4 bytes
Total length used (or required) by VSAM	4 bytes
Length of physical device characteristics area	4 bytes
Number of data extents	4 bytes
Length of data extents row	2 bytes
Number of index extents	4 bytes
Length of index extents row	2 bytes
(reserved)	4 bytes
(reserved)	4 bytes

Length of area supplied by user
length of the area passed by user in the Length parameter of macro call in bytes.

Total length used (or required) by VSAM
length of the area actually used by or needed for VSE/VSAM to display physical device information and extent information, including length of the header, in bytes.

Length of physical device information area
length of this area in bytes.

Number of data extents
number of data extents for the specified cluster (ACB). It also indicates the number of fixed size rows that are displayed in the user's area.

Length of data extents row
length of each row, which describes data extent, in the extent area in bytes.

Number of index extents
number of index extents for the specified cluster (ACB). This number also indicates the number of fixed size rows that are displayed in the user's area.

Length of index extents row
length of each row, which describes index extent, in the extent area in bytes.

Physical Device Characteristics Area

This part contains the physical device characteristics for the indicated cluster. Data volume information is displayed first and is followed by index, if applicable. Each 48 bytes contain the following fields:

Field	Length
Volume ID	6 bytes
Type of extent	1 byte
Flags	1 byte
Physical block size	4 bytes
Number of bytes per track	4 bytes
Number of bytes per control area	4 bytes
Number of physical blocks per control interval	4 bytes
Number of physical blocks per track	4 bytes
Number of tracks per control area	4 bytes
Number of tracks per cylinder	4 bytes
Number of physical blocks per control area	4 bytes
(reserved)	4 bytes
(reserved)	4 bytes

Volume ID
identifier of the volume where extents of the current cluster reside.

Type of extent
'D' if data, 'I' if Index.

Flags
reserved.

Number of bytes per track

for ECKD this number actually shows the number of bytes per track.

for FBA:

- first 2 bytes contain the number of replications of the control interval that fit on a track.
- last 2 bytes contain number of the total 'logical' blocks per control area.

Number of tracks per control area

for ECKD this number actually shows number of tracks per control area.

for FBA this field shows the total number of physical blocks per control area.

Number of tracks per cylinder for ECKD
for FBA this field is undefined.

Extent Information Area

This part shows information about all extents for a specified file. This part consists of fixed size rows, number of which equals the number of extents associated with a specified cluster. The length of each row and the current number of rows can be found in the header. The length of each row is calculated as number of data extents plus number of index extents.

Field	Length
Volser	6 bytes
Type of extent	1 byte
Flags	1 byte
Low extent (CCHH)	4 bytes
(reserved)	4 bytes
High extent (CCHH)	4 bytes
(reserved)	4 bytes
Low RBA	8 bytes
High RBA	8 bytes
(reserved)	4 bytes
(reserved)	4 bytes

Volser
serial number of volume on which the extent resides. This is a label assigned when a volume is prepared for use in a system.

Type of extent
'D' if data, 'I' if index.

Flags

X'80'	**Data RBA with sequence set**
X'40'	Sequence set RBA with data
X'20'	Index replication
X'10'	Volume mount flag
X'08'	Device contains more than 256 cylinders
X'04'	Index for RPS device
X'02'	Extent is located on FBA
X'01'	Extent is located on an ECKD device

Low extent (CCHH)
device address (that is, CC = cylinder and HH = track) of the beginning of the extent.

High extent (CCHH)
device address (that is, CC = cylinder and HH = track) of the end of the extent.

Low RBA
hexadecimal field containing the RBA (relative byte address) of the beginning of the extent. For an extended-addressed KSDS, this field contains the first CI in the extent.

High RBA
hexadecimal field containing the RBA (relative byte address) of the end of the extent. For an extended-addressed KSDS, this field contains the last CI in the extent.

Extent Matrix Usage

The header is 32 bytes in length. If the value specified for length is large enough, VSE/VSAM returns:

- header;
- physical device characteristics area;
- all rows of Extent Information Area. Their number is calculated as "Number of data extents" plus "Number of index extents" fields of the header.

If length is not large enough for the whole output but more than 32 bytes, VSE/VSAM returns as much information as fits, the return code 4, and the reason code 9. Check the field "Total length used (or required) by VSAM" in the header for the required space length, and issue another SHOWCB call specifying length large enough to contain all the matrix information.

In case user specifies length less than 32 bytes, VSE/VSAM will reject the request, issue the return code 4 and the reason code 21. Recompile the program with length bigger than 32 bytes.

Example of an LSR Matrix Call

```
SHOWCB AREA=USER_AREA, LENGTH=800, SHAREPL=1, FIELDS=(LSRINF)
```

The following figure shows LSR input information. For information on ACB, RPL, and BLDVRP macros, refer to Chapter 12, “Descriptions of VSE/VSAM Macros,” on page 183.

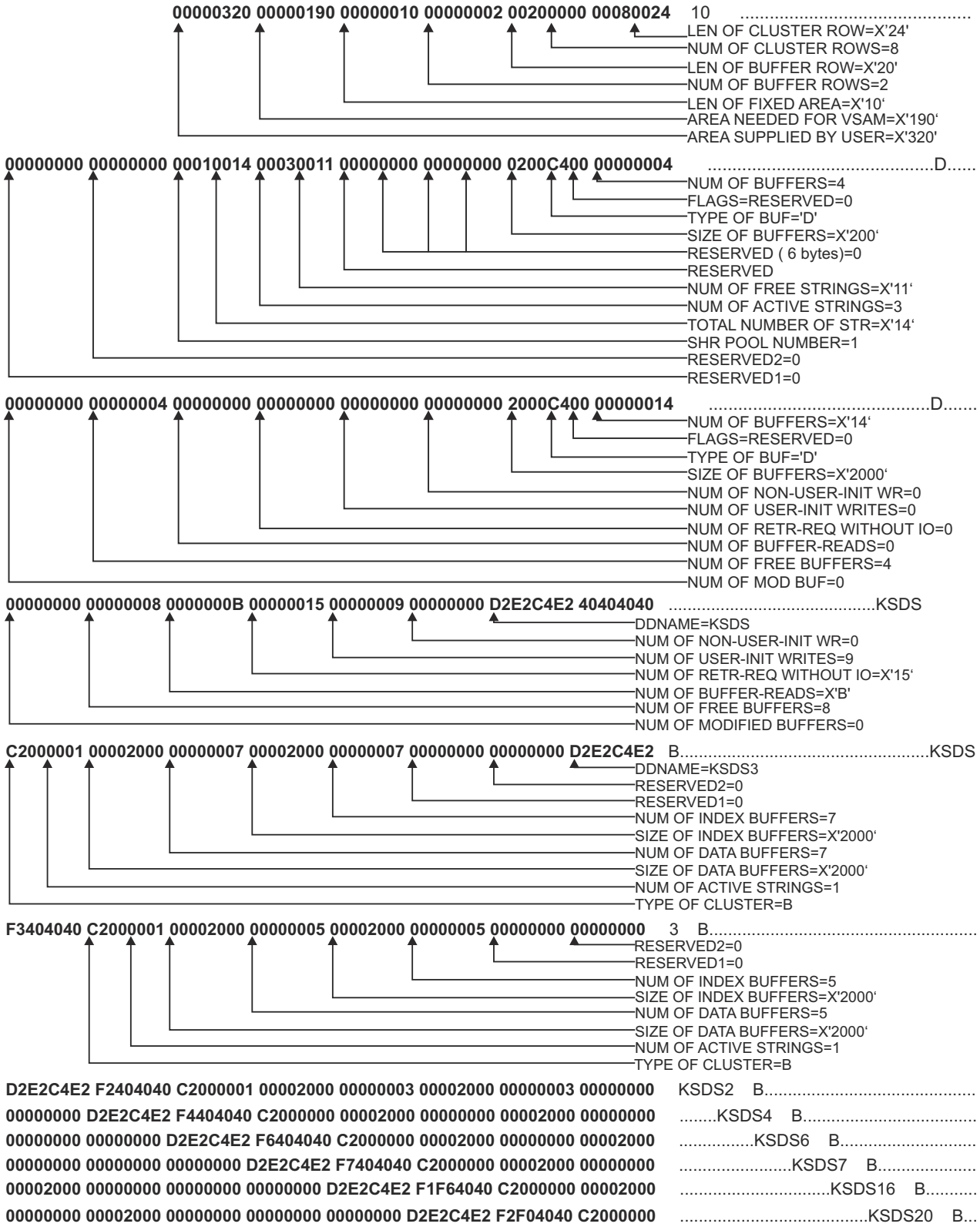
```
         LA     R2,BLDVRPA
         BLDVRP MF=(E,(R2))
------------------------------------------------------------------------------
LSREA    DS 0F
BLDVRPA  BLDVRP KEYLEN=16,                                                   x
               BUFFERS=(8192(20),512(4)),                                    x
               STRNO=20,                                                     x
               MF=L,                                                         x
               SHRPOOL=1
------------------------------------------------------------------------------
ACB1     ACB   DDNAME=KSDS,MACRF=(KEY,SEQ,OUT,LSR),                          x
              STRNO=9,SHRPOOL=1,BUFND=03,BUFNI=03
RPL11    RPL   ACB=ACB1,AREA=REC1,AREALEN=40,RECLEN=40,ARG=KEY1,             x
              OPTCD=(KEY,SEQ,NSP,KEQ,MVE)

ACB2     ACB   DDNAME=KSDS2,MACRF=(KEY,SEQ,OUT,LSR),                         x
              STRNO=2,SHRPOOL=1,BUFND=02,BUFNI=02
RPL21    RPL   ACB=ACB2,AREA=REC2,AREALEN=40,RECLEN=40,ARG=KEY2,             x
              OPTCD=(KEY,SEQ,NSP,KEQ,MVE)

ACB3     ACB   DDNAME=KSDS3,MACRF=(KEY,SEQ,OUT,LSR),                         x
              STRNO=2,SHRPOOL=1,BUFND=02,BUFNI=02
RPL31    RPL   ACB=ACB3,AREA=REC3,AREALEN=40,RECLEN=1000,ARG=KEY3,           x
              OPTCD=(KEY,SEQ,NSP,KEQ,MVE)

ACB41    ACB   DDNAME=KSDS4,MACRF=(KEY,SEQ,OUT,LSR),                         x
              STRNO=2,SHRPOOL=1,BUFND=03,BUFNI=03
ACB61    ACB   DDNAME=KSDS6,MACRF=(KEY,SEQ,OUT,LSR),                         x
              STRNO=2,SHRPOOL=1,BUFND=03,BUFNI=03
ACB71    ACB   DDNAME=KSDS7,MACRF=(KEY,SEQ,OUT,LSR),                         x
              STRNO=2,SHRPOOL=1,BUFND=03,BUFNI=03
ACB16    ACB   DDNAME=KSDS16,MACRF=(KEY,SEQ,OUT,LSR),                        x
              STRNO=2,SHRPOOL=1,BUFND=03,BUFNI=03
ACB20    ACB   DDNAME=KSDS20,MACRF=(KEY,SEQ,OUT,LSR),                        x
              STRNO=2,SHRPOOL=1,BUFND=03,BUFNI=03
```

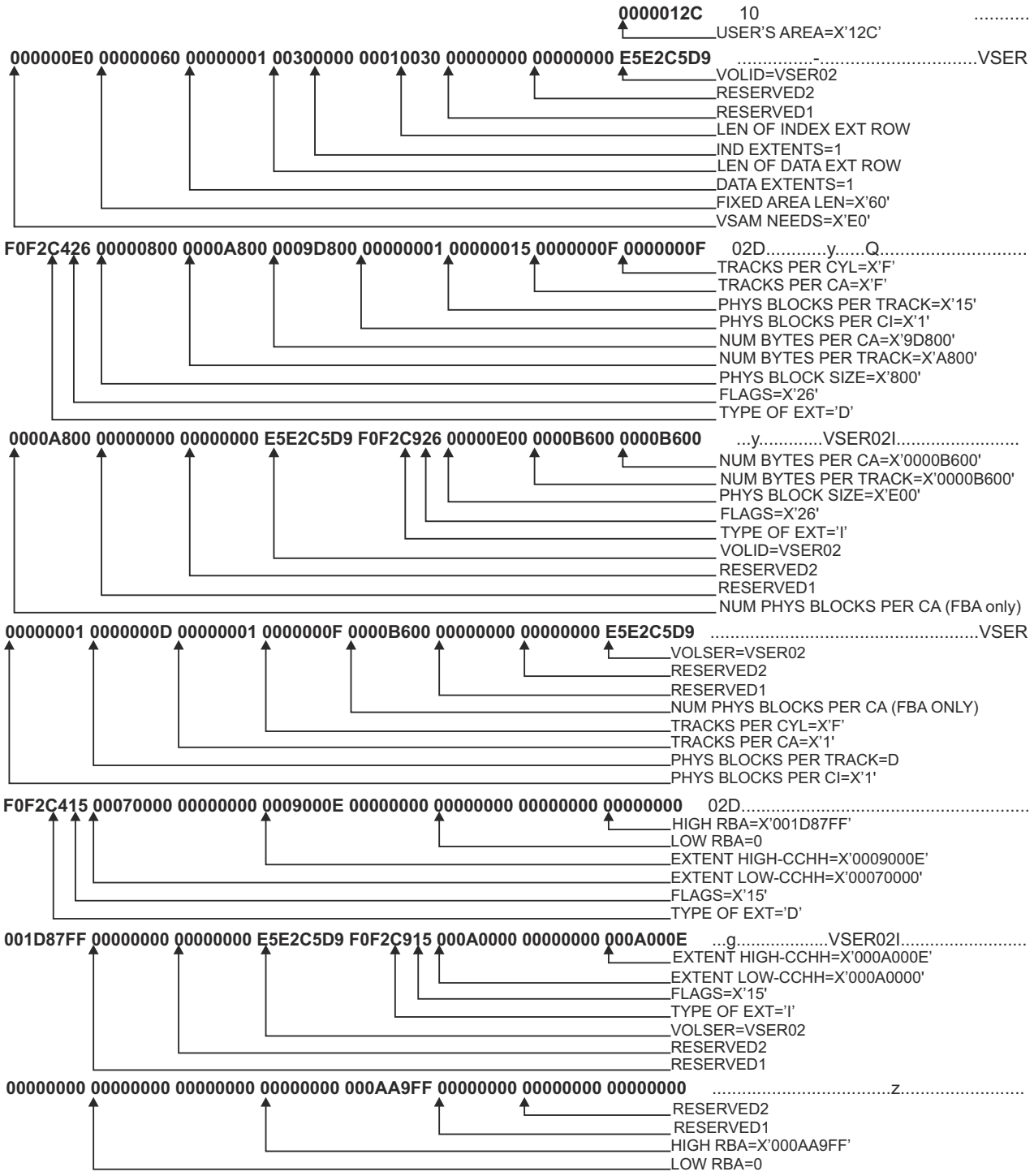
LSR matrix output will look as follows:



Example of an Extent Matrix Call

```
SHOWCB AREA=USER_AREA, LENGTH=300, ACB=ACB1, FIELDS=(EXTINF)
```

Extent matrix output will look as follows:



The TCLOSE Macro

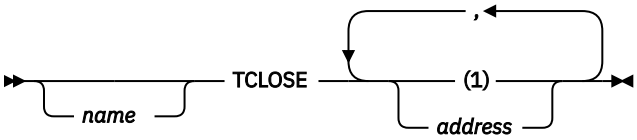
A TCLOSE macro completes outstanding I/O operations and updates the catalog. Processing can continue without reopening the file. You use the TCLOSE macro to protect data while the file is loaded or extended and the SPEED option was specified when the file was defined. When TCLOSE is issued, the close routine formats the last CA in the file to ensure that all of the data that has been loaded is accessible.

The TCLOSE macro cannot be used to change the processing mode for a file from sequential load to retrieve in the same run.

The TCLOSE macro has no effect when the local shared resources (LSR) option is in the ACB macro together with DFR (deferred write).

The return codes and error codes are identical to those of the CLOSE macro.

Format of the TCLOSE Macro



name
one through eight characters that provide a symbolic name.

address
specifies up to 16 addresses of ACBs.

If an application chooses to place VSE/VSAM ACBs in 31-bit partition GETVIS, the Open and Close macros can be used to open or close only one ACB in a single invocation (Open or Close List). No DTFs can be included in an Open or Close List containing an ACB residing in 31-bit partition GETVIS.

You can specify address:

- In register notation, using a register from 1 through 12. Specify within parentheses.

  Or

- With an expression that generates a valid relocatable A-type address constant.

You cannot specify the address of DTFs with TCLOSE.

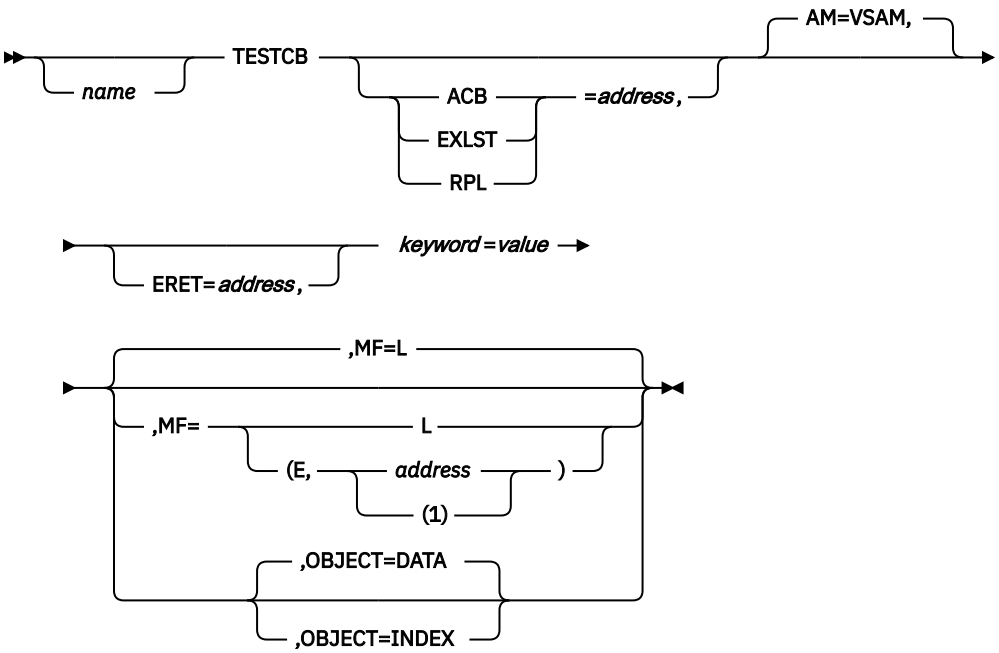
The TESTCB Macro

The TESTCB macro tests values in an ACB, EXLST, or RPL against values that you specify in the macro.

You can examine the condition code after issuing a TESTCB macro and examining the return code in Register 15. For keywords specified as an option (such as A for an operand of the EXLST macro), a test is for an equal or unequal comparison; for keywords specified as an address or value, a test is for an equal, unequal, high, low, not-high, or not-low comparison. In the comparison, A to B, B is the address, value, or option that you specify in the TESTCB macro. For example, if you test for a value in an ACB, a high comparison means the value in the block is higher than the value you specified in the TESTCB macro.

When you issue a TESTCB macro, Register 13 must contain the address of a 72-byte save area that you are providing. When you issue a TESTCB macro from within one of your exit routines such as LERAD or SYNAD, your program must provide a second 72-byte save area for use by VSE/VSAM because the original save area is still in use by the external VSE/VSAM routine.

Format of the TESTCB Macro



name
one to eight characters that provide a symbolic name.

ACB | EXLST | RPL=address
This operand specifies whether you want to test an ACB, an EXLST, or an RPL and specifies its address.

In the standard and list forms of TESTCB, you can omit this operand if you are testing only the standard length of a control block or list (see "Length of a Control Block or List" on page 255). With the execute form of TESTCB, you can change the address of the block or list to be tested, but not the type.

AM=VSAM
specifies that this is a VSE/VSAM control block. You may want to specify this operand for documentation purposes if your installation also uses VTAM.

ERET=address
specifies the address of a user-written routine that VSE/VSAM gives control if, because of an error, it is unable to test for the condition you specified (return code in Register 15 is not X'00'). When the ERET routine receives control, it should inspect the return code. If the return code is X'04', an error code will be tested in Register 0. See "Return Codes from the Control Block Manipulation Macros" on page 282 for the error codes that can be tested by TESTCB.

After completing its processing, the ERET routine can terminate the job or pass control to a point in the processing program that it determines. It cannot return to VSE/VSAM.

keyword=value
specifies a field and a value. The contents of the field are compared with the value and the condition code is set. You can specify only one keyword at a time. There are THREE groups of operands that you can code with the TESTCB macro:

- The addresses, values, options, and names that you can code with the ACB, EXLST, RPL, and GENCB macros
- The length of a control block or list
- The attributes of an open file or index indicated by the ACB.

If you code more than one operand, every one of them must compare equal to the corresponding value in the block or list for you to get an equal condition.

For details, refer to:

- "Operands of the ACB, EXLST, and RPL Macros" on page 255
- "Length of a Control Block or List" on page 255
- "Attributes of an Open File or Index" on page 256

MF=
For information on specifying this operand, refer to "List, Execute, and Generate Forms of the Control Block Manipulation Macros" on page 283.

OBJECT=DATA|INDEX
specifies, for the open ACB of a key-sequenced file, whether the field tested is for the data or the index. KEYLEN and RKP will contain the same value, no matter whether the data or the index is tested. FS, NCIS, NDELR, NINSR, NIXL, NLOGR, NRETR, NSSS, and NUPDR will contain zeros if the index is tested.

Operands of the ACB, EXLST, and RPL Macros

The operands in this group are identical to those of the ACB, EXLST, and RPL macros.

- You can code the operands in more ways, as shown "Operand Notation for VSE/VSAM Macros" on page 285.
- In relation to the ACB macro, you can test for error codes from the Open and Close routines by coding ERROR=*code* (as any absolute expression, except for a self-defining character term). When an ACB is opened for a path, the base cluster ACB is tested. However, you can test the alternate index ACB by specifying MACRF=AIX in the ACB macro. For the ACB, you cannot test the RMODE31.
- In relation to the EXLST macro, you can test whether an EXLST has an exit of a certain type by coding keyword=0.
- In relation to the EXLST macro, you can test whether an address in an EXLST is active or not active or is the address of the name of a routine to be loaded by coding: keyword=,A|N or keyword=,A|N,L.
- In relation to the RPL macro, you can code the operand **FDBK=code** (as any absolute expression, except for a self-defining character term) to test for error codes from the request macros (see "Return Codes of Request Macros" on page 281). You can code the operand RBA=number to test the relative byte address of the last record processed.
- In relation to the RPL macro, you can code the operand **AIXPC=number** to find out the number of key or RBA pointers in the most recently processed alternate index record.
- You can code the operand **AIXFLAG=AIXPKP** to test whether the alternate index record just processed contains prime key pointers (or, if not, RBA pointers).
- You can code the operand **FTNCD=number** to test (after a logical or physical error) the *function code*. The function code indicates whether the respective condition occurred during processing of the base cluster or the alternate index of a path or during upgrade processing. (For details, see "Return Codes of Request Macros" on page 281.)

Length of a Control Block or List

You can code the operand EXLLEN=length, ACBLEN=length, or RPLLEN=length to test either the standard length of an EXLST, ACB, or RPL; or the actual length of a particular ACB, RPL, or EXLST. You test for a standard length by omitting the ACB|EXLST|RPL operand and coding only one (or more) of these length operands and no other operands. You can test the actual length of a control block or list by specifying the ACB|EXLST|RPL operand and the corresponding length operand.

Attributes of an Open File or Index

After a file is opened, the ACB contains information that it does not contain before it is opened or after it is closed. Whether you are testing for the attributes of the data or the index of a key-sequenced file is determined by the OBJECT operand. By coding **OFLAGS=OPEN**, you can test whether the file is open.

Note: If specified ACB is designated to the PATH, then the following keywords refer to the values related to the corresponding Alternate Index (not the Base Cluster): LRECL and ATRB.

You can test the following fields:

Attribute
Meaning

AVSPAC
Number of bytes of available space in the data or index component.

BUFNO
Number of buffers used for the data or index component.

CINV
Size of a CI in the data or index component.

ENDRBA
Ending (high used) RBA of the data component or the index component.

FS
Percent of free CIs in every data CA of a key-sequenced file.

KEYLEN
Full length of the prime key or alternate key field in every logical record (depending on whether or not you access the base cluster via a path).

LRECL
Maximum length of a logical record or, for an index, the index CI size minus seven bytes.

NCIS
Number of CI splits in the file.

NDELR
Number of data records deleted from the file.

NEXCP
Number of EXCP commands issued since the data or the index was opened.

NEXT
Number of logical extents, data spaces or portions of data spaces, now allocated to the data or index component.

NINSR
Number of records inserted into the file. For a relative-record file, number of valid records, that is, non-empty slots in the file.

NIXL
Number of levels in the index of a key-sequenced file.

NLOGR
Number of data records in the file. For a relative-record file, total number of slots (empty or non-empty) in the used CIs.

NRETR
Number of data records retrieved from the file.

NSSS
Number of control-area splits in a key-sequenced file.

NUPDR
Number of data records updated in the file.

RKP
Displacement of the prime key or alternate key field from the beginning of a data record (depending on whether or not you access the base cluster via a path); the same value is displayed whether the object is index or data.

STMST
System time stamp; the time and day (in microseconds) when the data or index component was last closed. Bits 52 through 63 of the fields are unused.

You can also test for these attributes:

Specification
Meaning

ATRB=COMP
File is defined with the COMPRESSED attribute

ATRB=ESDS
Entry-sequenced file

ATRB=KSDS
Key-sequenced file

ATRB=RRDS
Relative-record file

ATRB=VRDS
Variable-length Relative record Data Sets

ATRB=WCK
VSE/VSAM is verifying write operations

ATRB=SSWD
Sequence set of the index is adjacent to the file

ATRB=REPL
Index records are replicated

ATRB=SPAN
File contains spanned records

ATRB=UNQ
Unique alternate keys in alternate index

ATRB=XLKSDS
Extended-addressed KSDS

Furthermore, you can determine whether the opened object is a path, a base cluster, or an alternate index by coding:

OPENOBJ=PATH
Alternate index/base cluster pair (path)

OPENOBJ=BASE
Base cluster

OPENOBJ=AIX
Alternate index

Examples of the TESTCB Macro

Figure 25 on page 258 shows examples of how the TESTCB macro can be used to test values in a VSE/VSAM control block.

Continuation characters required in column 72 are not shown in the example.

Example 1: Uses TESTCB to determine whether or not a file is open.

```
            TESTCB ACB=(2),OFLAGS=OPEN,
                   ERET=TESTERR
            BE     OPEN
            B      UNOPEN
            .
TESTERR     .....
```

Example 2: Uses TESTCB to determine whether the LERAD exit routine was entered because of an end-of-file condition or a processing error. (The example assumes that no EODAD exit routine was provided.)

```
LOGERR      TESTCB RPL=(4),FDBK=4,
                   ERET=TESTERR
            BE     EODATA
            B      ERROR
            .
TESTERR     ......
```

Figure 25. TESTCB Macro Examples

The WRTBFR Macro

Managing I/O Buffers

Managing I/O buffers includes:

- Deferring writes for direct PUT requests, which reduces the number of I/O operations
- Writing buffers that have been modified by related requests.
- Writing out buffers whose writing has been deferred.

Deferring Write Requests

VSE/VSAM normally writes out the contents of a buffer immediately for direct PUT requests. With shared resources, however, you can cause write operations for direct PUT requests to be deferred. Buffers are finally written out:

- When you issue the WRTBFR macro.
- When VSE/VSAM needs a buffer to satisfy a GET request.
- When a file using a buffer pool is closed. (Temporary CLOSE is ineffective against a file that is sharing buffers; nor does ENDREQ cause buffers in a resource pool to be written.)

Deferring writes saves I/O operations in cases where subsequent requests can be satisfied by the data in the buffer pool. Processing speed improves if CIs are updated several times.

You indicate that writes are to be deferred by coding the MACRF DFR option in the ACB, along with MACRF=LSR:

```
ACB  MACRF=(LSR,DFR,...)
```

NDF, the default, indicates that writes are not to be deferred for direct PUTs.

The DFR option is incompatible with SHAREOPTIONS(4). (SHAREOPTIONS is a parameter of the IDCAMS command DEFINE.) A request to open a file with SHAREOPTIONS(4) for deferred writes is rejected.

Relating Deferred Requests by Transaction ID

You can relate action requests (GET, PUT, etc.) according to transaction by specifying the same ID in the RPLs that define the requests.

The purpose of relating the requests that belong to a transaction is to enable WRTBFR to cause all of the modified buffers used for this transaction to be written out together. When the WRTBFR request is complete, the transaction is physically complete. To relate requests, specify:

```
RPL TRANSID=number
```

TRANSID=number
specifies a number from 0 to 31. A number from 1 to 31 relates the request(s) defined by this RPL to the requests defined by other RPLs with the same transaction ID. The number 0, which is the default, indicates that the request defined by this RPL is not associated with other requests.

You can find out what transaction ID an RPL has by issuing

SHOWCB or TESTCB:

```
SHOWCB   FIELDS=(TRANSID)
```

TRANSID requires one fullword in the display work area.

```
TESTCB   TRANSID=number
```

You can also change the transaction ID of an RPL by issuing the MODCB macro:

```
MODCB   TRANSID=number
```

Writing Buffers Whose Writing Has Been Deferred

If DFR is specified in the ACB of any file that is using a resource pool, you can use the WRTBFR (write buffer) macro to write:

- All modified buffers for a given file
- All modified buffers in the resource pool
- The least recently used modified buffers in every buffer pool in the resource pool
- All buffers that have been modified by requests with the same transaction ID. (See “Relating Deferred Requests by Transaction ID” on page 258).

You can specify the DFR option in an ACB without using the WRTBFR to write buffers. A buffer will be written when VSE/VSAM needs one to satisfy a GET request, or all modified buffers will be written when the last of the files that uses them is closed.

Using WRTBFR can improve performance, if you schedule WRTBFR to overlap other processing.

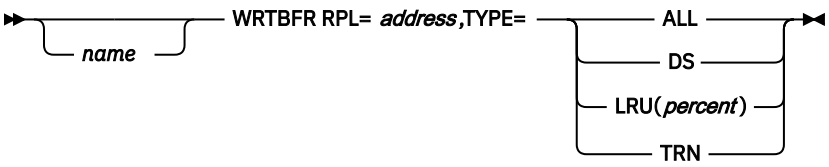
VSE/VSAM notifies the processing program when there are no more unmodified buffers into which to read the contents of a CI. (VSE/VSAM would be forced to write buffers when another GET or PUT request required an I/O operation.) VSE/VSAM sets Register 15 to 0 and puts 12 (X‘0C’) in the feedback (FDBK) field of the RPL that defines the request that detects the condition.

VSE/VSAM also notifies the processing program when there are no buffers available to process your request. This is a logic error. Register 15 contains 8, unless an exit is taken to a LERAD routine. The feedback (FDBK) field in the RPL contains 152 (X‘98’). You may retry the request and it will get a buffer if one has been freed.

In addition, VSE/VSAM will notify the processing program when the number of active requests exceeds the STRNO value specified in the BLDVRP macro (Register 15=X‘08’; RPL FDBK=X‘40’).

Format of the WRTBFR Macro

When you issue a WRTBFR macro, Register 13 must contain the address of a 72-byte save area that you are providing. When you issue a WRTBFR macro from within one of your exit routines such as LERAD or SYNAD, your program must provide a second 72-byte save area for use by VSE/VSAM, because the original save area is still in use by the external VSE/VSAM routine.



name
one to eight characters that provide a symbolic name.

RPL=address
specifies the address of the request parameter list that defines the WRTBFR request. An RPL need not be built especially for the WRTBFR; WRTBFR may use an inactive RPL that defines other request(s) (GET, PUT, etc.) for a file that is using the resource pool.

Only the ACB and the TRANSID operands of the RPL are meaningful for WRTBFR; all other RPL operands are ignored. Unlike the other action macros (GET, PUT, etc.), WRTBFR assumes that RPLs are not chained.

TYPE=ALL | DS | LRU(percent) | TRN
specifies what buffers are to be written.

ALL
specifies that all modified buffers in every buffer pool in the resource pool are to be written. (Closing all of the files that use a resource pool has the same effect.)

DS
specifies that, for the file defined by the ACB to which the WRTBFRs RPL is related all modified buffers are to be written.

LRU(percent)
specifies the percentage of the total number of buffers in every buffer pool in the resource pool that are to be examined for possible writing. The least recently used buffers are examined. (If percent is coded in register notation, only Registers 1 and 13 may not be used.)

When using the DFR option it is possible for the buffer pool to become filled with modified buffers. VSE/VSAM would then be forced to write out a buffer before satisfying any other GET or PUT request. To ensure that buffers are always available for GET or PUT requests (without having to wait for buffers to be written) you can periodically force out the least recently used part of every buffer pool through the LRU option. To help determine when to do this, VSE/VSAM sets a non-error return code of 12 (X‘0C’) in the FDBK field of the RPL whenever it is forced to write out a deferred buffer because of insufficient free buffers.

TRN
specifies that all buffers in a buffer pool are to be written that have been modified by requests with the same transaction ID as the one specified in the WRTBFR's RPL. Transaction IDs are no longer associated with these buffers.

Examples: ACB, EXLST, and RPL Macros

Specifying VSE/VSAM Control Blocks

Figure 26 on page 261 shows an example of how you can specify VSE/VSAM control blocks by using the ACB, EXLST, and RPL macros. These control blocks are generated during assembly of your program. Default values will be provided for those parameters that are omitted.

```
// JOB ABCADR
// OPTION CATAL,NODUMP
   PHASE ABCADR,*
// EXEC ASSEMBLY,SIZE=120K,PARM='XREF'
ACBADR        ACB         EXLST=EXITS,
                          PASSWD=PASS,
                          BUFND=4,BUFNI=3,
                          BUFSP=11264,
                          MACRF=(KEY,SEQ,
                          DIR,OUT),
                          STRNO=2
EXITS         EXLST       EODAD=(ENDUP,N),
                          LERAD=LOGERR,
                          SYNAD=(IOERR,L),
                          EXCPAD=(OVERLP,A)
RETRVE        RPL         ACB=ACBADR,
                          AREA=WORK,
                          ARG=SEARCH,
                          AREALEN=125,
                          OPTCD=(DIR,NSP)
              .
              .
PASS          DC          FL1'6',C'CHANGE'
WORK          DS          CL125
SEARCH        DS          CL4
IOERR         DC          C'PHYSICAL'
ENDUP                     End-of-file routine
              .
              .
LOGERR                    Logical-error routine
              .
              .
OVERLP                    I/O-overlap routine
              .
              .
/*
// IF $MRC GT 0 THEN
// GOTO ERRORS
// LIBDEF PHASE,CATALOG=USER.LIB
// EXEC LNKEDT
/*
/. ERRORS
// EXEC LISTLOG
/&
```

Figure 26. Example of Specifying Control Blocks for a File

Explanations to Figure 26 on page 261:

ACB Macro

Because the DDNAME operand is not specified, VSE/VSAM uses the name, ACBADR, of the ACB as the name (file name) of the associated file.

BUFND:
Four I/O buffers for data CIs.

BUFNI:
Three I/O buffers for index CIs.

BUFSP:
The size of the buffer space is sufficient to accommodate four data control intervals of 2048 bytes each and three index CIs of 1024 bytes each.

EXLST:
Specifies that the label of the exit list associated with this ACB is named EXITS.

PASSWD:
Specifies the location of the password. The DC at PASS gives the password's length in the first byte and the password itself in the subsequent six bytes.

MACRF:
Specifies keyed-sequential and keyed-direct processing for both insertion and update.

STRNO:
Specifies that two requests will require concurrent positioning.

EXLST Macro

EODAD:
The end-of-file routine is located at ENDUP and is not active.

LERAD:
The logic error routine is located at LOGERR and is active.

SYNAD:
The physical I/O error routine's name is located at IOERR.

EXCPAD:
The I/O-overlap routine is located at OVERLP and is active.

RPL Macro

ACB:
Associates the RPL with the ACB named ACBADR.

AREA:
Address of work area is WORK.

AREALEN:
Length of work area is 125 bytes.

ARG:
The search argument is defined at SEARCH. Because the KEYLEN operand is omitted, VSE/VSAM uses the full key as search argument.

OPTCD:
Specifies direct processing with positioning at the next record for subsequent sequential processing.

JCL to Open and Process a File

Figure 27 on page 262 shows the JCL needed to open and process a file identified in an ACB macro (file ACBADR in the example). Continuation characters required in column 72 are not shown in the example.

```
// JOB
// DLBL IJSYSCT,'AMASTCAT',,VSAM
// DLBL ACBADR,'FILE1',,VSAM
// EXEC progname,SIZE=AUTO
   .
   .
   .
   OPEN ACBADR
   .
   .
   .
   GET RPL=RETRVE
   .
   .
   .
   CLOSE ACBADR
   .
   .
   .
/*
/&
```

FILE1 is the name of the file under which it is entered in the VSE/VSAM master catalog.

Figure 27. Example of JCL Needed to Open and Process a File

Examples of Request Macros

The following examples show the essential macros and operands required to perform the operations indicated in the headings of the examples. The examples illustrate the relationship between the ACB

MACRF operand, the RPL OPTCD operand, and the request macros themselves. They show how to use the other operands as required by the assumptions for every example.

For your convenience in reading them, the examples show macros that generate control blocks at assembly (ACB, EXLST, and RPL) at the beginning of the example rather than at the end where they would normally be placed with program constants. Every example assumes that the file has been opened and that it will be closed. Only nominal checks for errors are shown. Exit routines to analyze errors are not indicated.

Note: The continuation characters required in column 72 are not shown in the examples, nor are the asterisks required in column 1 of the comment cards shown.

The examples relate to:

- "How to Retrieve a Record: GET Macro" on page 263
- "How to Position for Subsequent Sequential Access: GET and POINT Macros" on page 267
- "How to Chain Request Parameter Lists and Terminate a Request: ENDREQ Macro" on page 270
- "How to Store a Record: PUT Macro" on page 271
- "How to Update a Record: GET and PUT Macros" on page 275
- "How to Delete a Record: GET and ERASE Macros" on page 277

Errors

If extended user buffering was incorrectly used the request will be rejected as logical error (R15=8) with error code 106 (X'6A').

How to Retrieve a Record: GET Macro

Examples 1, 2, 3, 4, and 5 illustrate keyed and addressed, direct sequential, and skip sequential retrieval.

Example 1: Keyed-Sequential Retrieval

Assumptions

Records moved to a work area. Fixed-length records, 100 bytes. Control blocks generated at assembly.

```
INPUT    ACB     MACRF=(KEY,SEQ,IN)       All MACRF and OPTCD options
                                          specified are defaults and
                                          could have been omitted.
RETRVE   RPL     ACB=INPUT,
                 AREA=IN,AREALEN=100,
                 OPTCD=(KEY,SEQ,NUP,MVE)
         .
         .
         .
LOOP     GET     RPL=RETRVE               This GET or identical GETs
                                          can be issued, with no change
                                          in the request parameter list,
                                          to retrieve subsequent records
                                          in key sequence.
         LTR     15,15
         BNZ     ERROR
         .
         .
         .
         B       LOOP
ERROR    ...                              Request was not accepted or
         .                                failed.
         .
         .
IN       DS      CL100                    IN contains a data record
                                          after GET is completed.
```

Figure 28. Request Macro Example 1: Keyed-Sequential Retrieval

Discussion

The records are retrieved in key sequence. No search argument has to be specified; VSE/VSAM is positioned at the first record in key sequence when the file is opened, and the next record is retrieved automatically as every GET is issued. The branch to ERROR will also be taken if the end of the file is reached.

Example 2: Skip-Sequential Retrieval

Assumptions

Variable-length records: they are processed in the I/O buffer. The search argument is a full key, compared greater than or equal. Control blocks are generated at the time of execution. Key length is eight bytes.

```
         GENCB       BLK=ACB,                VSE/VSAM gets an area in virtual
                     DDNAME=INPUT,           storage to generate the
                     MACRF=(KEY,SKP,IN)      access method control block
                                             and returns the address in
                                             Register 1.
         LTR         15,15
         BNZ         CHECKO
         LR          2,1                     Address of ACB
         GENCB       BLK=RPL,ACB=(2),
                     AREA=RCDADDR,AREALEN=4,
                     ARG=SCRHKEY,
                     OPTCD=(KEY,SKP,NUP,KGE,FKS,LOC)
         LTR         15,15
         BNZ         CHECK0
         LR          3,1                     Address of the request
         .                                   parameter list.
         .
         .
LOOP     MVC         SRCHKEY,table           Search argument for
                                             retrieval, moved in from
                                             a table or a
                                             transaction record.
         GET         RPL=(3)
         LTR         15,15
         BNZ         ERROR
         LR          1,3                      Put RPL address in Register 1.
         SHOWCB      RPL=(1),                 Display the length of the
                     RECLEN=(0)               record.
         LTR         15,15
         BNZ         CHECK0
         ST          0,RCDLEN                 Save the record length.
         .
         .
         .
         B           LOOP
ERROR    ...                                  Request was not accepted
                                              or failed.
CHECKO   ...                                  Generation or display failed
         .
         .
         .
RCDADDR  DS          F                        Work area into which VSE/VSAM
                                              puts the address of a data
                                              record within the I/O buffer
                                              (OPTCD=LOC).
SRCHKEY  DS          CL8                      Search argument for
                                              retrieval.
RCDLEN   DS          F                        For retrieving variable
                                              record lengths.
```

Figure 29. Request Macro Example 2: Skip-Sequential Retrieval

Discussion

The records are retrieved in key sequence, but some records are skipped. Skip sequential retrieval is very similar to keyed direct retrieval (see Example 4), except that you must retrieve records in ascending sequence (with skips) rather than in a random sequence.

Internally, with skip sequential retrieval, VSE/VSAM uses only the sequence set of the index to skip ahead; with direct retrieval it searches the index from top to bottom to locate a record.

Example 3: Addressed-Sequential Retrieval

Assumptions

Many records are retrieved with one GET request. Records are moved to work areas (only option); they are of fixed length, 20 bytes long. Chain of RPLs is generated during execution.

```
BLOCK    ACB      DDNAME=INPUT,
                  MACRF=(ADR,SEQ,IN)
         .
         .
         .
         GENCB    BLK=RPL,
                  COPIES=10,
                  ACB=BLOCK,
                  OPTCD=(ADR,SEQ,NUP,MVE)
         LTR      15,15
         BNZ      CHECKO
         LA       5,WORKAREA             Address of the first
                                         work area.
         LA       3,10                   Number of lists(10).
         LR       2,1                    Address of the first list.
         LR       1,0                    Length of all of the lists.
                                         Registers 0 and 1 contain
                                         length and address of the
                                         generated control blocks when
                                         VSE/VSAM returns control after
                                         GENCB.
         SR       0,0                    Prepare for following
                                         division.
         DR       0,3                    Divide number of lists into
                                         length of all the lists.
         LR       3,1                    Save the resulting length of a
                                         sing le list for an offset.
         LR       4,2                    Save address of the first list.
```

Do the following 6 instructions 10 times to set up all of the request parameter lists. The tenth time register 4 must be set to 0 to indicate the last request parameter list in the chain.

```
         AR       4,3                    Address of the next list.
         MODCB    RPL=(2),               In every request parameter
                  NXTRPL=(4),            list, indicate the address
                  AREA=(5),AREALEN=20    of the next list and the
                                         address and length of the
                                         work area.

         LTR      15,15
         BNZ      CHECKO
         AR       2,3                    Address the next line.
         LA       5,20(5)                Address the next work area.
         .                               Restore Register 2 to address
         .                               the first list before
         .                               continuing to process.
LOOP     GET      RPL=(2)
         LTR      15,15
         BNZ      ERROR
         .                               Process the ten records that
         .                               have been retrieved by the
         .                               GET.
         B        LOOP
CHECKO   ...
ERROR    ...                             Display the feedback field
                                         (FIELDS=FDBK) of every
                                         request parameter list to
                                         find out which one had an
                                         error.
WORKAREA DS       CL200                  Space for a work area for
                                         each of the 10 request
                                         parameter lists.
```

Figure 30. Request Macro Example 3: Addressed-Sequential Retrieval

Discussion

The records are retrieved in entry sequence. In a key-sequenced file that has had CI or control-area splits, it is likely that the entry sequence of the records is no longer the same as their key sequence. Each of the ten RPLs in the chain identifies a record to be retrieved by the GET. VSE/VSAM moves every record into the work area provided for the request parameter list that identifies the record.

If an error occurred for one of the RPLs in the chain and you have supplied error analysis routines, VSE/VSAM takes a LERAD or SYNAD exit before returning to your program. Register 15 indicates the status of the request. A code of 0 indicates that no error was associated with any of the RPLs. Any other code indicates that an error occurred for one of the RPLs. Issue a SHOWCB for every RPL in the chain to find out which one had an error. VSE/VSAM does not process any of the RPLs beyond the one with an error.

Example 4: Keyed-Direct Retrieval

Assumptions

Fixed-length records are processed in the I/O buffer. Key length is 15 bytes. The search argument is a 5-byte generic key, compared equal. Control blocks are generated during assembly.

```
INPUT    ACB      MACRF=(KEY,DIR,IN)

RETRVE   RPL      ACB=INPUT,              You specify all parameters
                  AREA=IN,AREALEN=4       for the request in the RPL
                  OPTCD=(KEY,DIR,         macro.
                  NUP,KEQ,GEN,LOC),
                  ARG=KEYAREA,KEYLEN=5
         .
         .
         .
LOOP     MVC      KEYAREA,table           Search argument for retrieval,
                                          moved in from a table or a
                                          transaction record.
         GET      RPL=RETRVE              This GET or identical GETs can
                                          be issued with no change in the
                                          RPL: just specify every new
                                          search argument in the field
                                          KEYAREA.
         LTR      15,15
         BNZ      ERROR
         .
         .                                Process the record.
         .
         B        LOOP
ERROR    ...                              Request was not accepted
         .                                or failed.
         .
         .
IN       DS       CL4                     VSE/VSAM stores the address
         .                                of the record here.
         .
         .
KEYAREA  DS       CL5                     You specify the search
                                          argument here.
```

Figure 31. Request Macro Example 4: Keyed-Direct Retrieval

Discussion

The generic key specifies a class of records. For example, if you search on the first third of employee number, you get the first of presumably several records that start with the specified characters. To retrieve all of the records in that class, either switch to sequential access (see Example 7) or to a full-key search with greater-than-or-equal comparison (Example 2), increasing the key of every record you retrieve to the next possible key value.

Example 5: Addressed-Direct Retrieval

Assumptions

Fixed-length records, 20 bytes long, are moved to a work area.

```
BLOCK    ACB      DDNAME=INPUT,           Access-method control block
                  MACRF=(ADR,DIR,IN)      generated at assembly.
         GENCB    BLK=RPL,COPIES=1,       Request parameter list
                  ACB=BLOCK,              generated at execution.
                  OPTCD=(ADR,DIR,
                  NUP,MVE),
                  ARG=SRCHADR,
                  AREA=IN,AREALEN=20
         LTR      15,15
         BNZ      CHECKO
         LR       2,1                     Address of the list.
         .
         .
         .
LOOP     MVC      SRCHADR,table           Search argument for retrieval,
                                          calculated or moved in from a
                                          table or a transaction record.
         GET      RPL=(2)
         LTR      15,15
         BNZ      ERROR
         .
         .                                Process the record.
         .
         B        LOOP
CHECKO   ...                              Generation failed.
ERROR    ...                              Request was not accepted
         .                                or failed.
         .
         .
IN       DS       CL20                    VSE/VSAM puts a record here
                                          for every GET request.
SRCHADR  DS       CL4                     You specify the RBA search
                                          argument here for every request.
```

Figure 32. Request Macro Example 5: Addressed-Direct Retrieval

Discussion

The RBA provided for a search argument must match the RBA of a record. Keyed insertion and deletion of records in a key-sequenced file will probably cause the RBAs of some records to change. Therefore, if you process a key-sequenced file by addressed direct access (or by addressed sequential access using POINT), you need to keep track of changes. You can use the JRNAD exit for this purpose.

How to Position for Subsequent Sequential Access: GET and POINT Macros

Examples 6 and 7 illustrate positioning both with the POINT macro and with direct access followed by sequential access.

Example 6: Keyed Positioning with POINT

Assumptions

Sequential access. The search argument (for positioning) is a full key of 5 bytes, compared equal. Records are 50 bytes long. Control blocks are generated during assembly.

```
BLOCK    ACB      DDNAME=10               Default MACRF options
                                          sufficient.
POSITION RPL      ACB=BLOCK,              ARG operand and KEQ and
                  AREA=WORK,AREALEN=50,   FKS OPTCD options define
                  ARG=SRCHKEY,            the POINT request.
                  OPTCD=(KEY,SEQ,
                  KEQ,FKS)
         .
         .
         .
LOOP     MVC      SRCHKEY,table           Search argument for
                                          positioning, moved in from a
                                          table or transaction record.
         POINT    RPL=POSITION
         LTR      15,15
         BNZ      ERROR
LOOP1    GET      RPL=POSITION
         LTR      15,15
         BNZ      ERROR
         .                                Process the record.  Decide
         .                                whether to skip another
         .                                position (forward or
                                          backward).
         BE       LOOP                    Yes, skip.
         B        LOOP1                   No, continue in consecutive
                                          sequence.
ERROR    ...                              Request was not accepted or
         .                                failed.
         .
         .
SRCHKEY  DS       CL5                     Search-argument field for
                                          POINT request.
WORK     DS       CL50                    VSE/VSAM puts a record here
                                          for every GET request.
```

Figure 33. Request Macro Example 6: Keyed Positioning with POINT

Discussion

No access is gained to a record with POINT. POINT causes VSE/VSAM to be positioned ahead or back to the specified record for a subsequent sequential GET request, which retrieves the record. If, after positioning, you issue a direct request by way of the same RPL, VSE/VSAM does not remember the position established by the POINT. VSE/VSAM would then either be positioned somewhere else or not positioned at all, depending on whether OPTCD=NSP or UPD was specified or OPTCD=NUP (see Example 7).

Positioning by address is identical to positioning by key, except that the search argument is an RBA, which must match with the RBA of a record in the file.

Example 7: Switching from Direct to Keyed-Sequential Retrieval

Assumptions

Records are moved to a work area. The search argument (for the direct request preceding sequential requests) is a generic key, 8 bytes long, compared equal. Records are of fixed-length, 100 bytes long. Positioning is requested for direct requests. Control blocks are generated during assembly.

```
INPUT    ACB      MACRF=(KEY,DIR,          Both direct and sequential
                  SEQ,IN)                  access specified.
RETRVE   RPL      ACB=INPUT,
                  AREA=IN,AREALEN=100,
                  OPTCD=(KEY,DIR,
                  NSP,KEQ,GEN,MVE),        NSP specifies that VSE/VSAM is
                  ARG=KEYAREA,KEYLEN=8     to remember its position.
         .
         .
         .
LOOP     MVC      KEYAREA,table            Search argument for direct
                                           retrieval, moved in from a
                                           table or transaction record.
LOOP1    GET      RPL=RETRVE
         LTR      15,15
         BNZ      ERROR
         .                                 Decide whether to switch from
         .                                 one type of access to the
         .                                 other.  If now sequential:
                                           To remain sequential, branch
                                           to LOOP1
                                           To switch to direct, branch
                                           to DIR
                                           If now direct:
                                           To remain direct, branch
                                           to LOOP
                                           To switch to sequential,
                                           branch to SEQ
SEQ      MODCB    RPL=RETRVE,              Alter request parameter list
                  OPTCD=SEQ                for sequential access.
         LTR      15,15
         BNZ      CHECKO
         B        LOOP1                    No search argument required.
DIR      MODCB    RPL=RETRVE,              Alter request parameter list
                  OPTCD=DIR                for direct access.
         LTR      15,15
         BNZ      CHECK0
         B        LOOP                     Prepare new search argument.
ERROR    ...                               Request was not accepted or
                                           failed.
CHECKO   ...                               Modification failed.
         .
         .
         .
IN       DS       CL100                    VSE/VSAM puts retrieved records
                                           here.
KEYAREA  DS       CL8                      Specify the generic key for
                                           a direct request here.
```

Figure 34. Request Macro Example 7: Switching from Direct to Keyed-Sequential

Discussion

Positioning is associated with an RPL; thus to switch from direct to sequential access without independently establishing positioning for the sequential access, modify a single RPL that alternately defines requests for both types of access rather than use a different RPL for every type.

With direct retrieval, VSE/VSAM does not remember its position for subsequent retrieval unless you explicitly requested this (OPTCD=NSP). After a direct GET for update (OPTCD=UPD), VSE/VSAM is positioned for a subsequent PUT,ERASE, or sequential GET (if you modify OPTCD(DIR,UPD) to OPTCD=(SEQ,UPD)). If you modify OPTCD=(DIR,NUP) to OPTCD=SEQ, you must issue a POINT to get VSE/VSAM positioned for sequential retrieval, as NUP indicates that no positioning is desired with a direct GET.

If you have chained many RPLs together, one position is remembered for the whole chain. For example, if you issue a GET that gives the address of the first RPL in the chain, the position of VSE/VSAM when the GET request is complete is at the record following the one defined by the last RPL in the chain. Therefore, modifying OPTCD=(DIR,NSP) in every RPL in a chain to OPTCD=SEQ implies continuing with sequential access relative to the last of the direct RPLs.

How to Chain Request Parameter Lists and Terminate a Request: ENDREQ Macro

Example 8 illustrates how to chain RPLs. Example 9 illustrates the use of ENDREQ to cause VSE/VSAM to give up its position for a request to be able to remember its position for another request.

Example 8: Chaining Request Parameter Lists

Assumptions

Records are 50 bytes long. Retrieved records are moved to a work area. Three RPLs are chained.

```
FIRST    RPL      ACB=BLOCK,
                  AREA=AREA1,AREALEN=50,
                  NXTRPL=SECOND

SECOND   RPL      ACB=BLOCK,
                  AREA=AREA2,AREALEN=50,
                  NXTRPL=THIRD
THIRD    RPL      ACB=BLOCK               Last list does not indicate
                  AREALEN=50              a next list.
                  AREALEN=50
         .
         .
         .
LOOP     GET      RPL=FIRST               Request gives the address of
                                          the first request parameter
                                          list.
         LTR      15,15
         BNZ      ERROR
         .                                Process the three records
         .                                retrieved by the GET.
         .
         B        LOOP
ERROR    ...                              Display the feedback field
                                          (FIELD=FDBK) of every request
                                          parameter list to find out
                                          which one had an error.
AREA1    DS       CL50                    A single GET request causes
                                          VSE/VSAM to put a record in
                                          each one of AREA1, AREA2,
                                          and AREA3.
AREA2    DS       CL50
AREA3    DS       CL50
```

Figure 35. Request Macro Example 8: Chaining Request Parameter Lists

Discussion

If an error occurred for one of the RPLs in the chain and you have supplied error-analysis routines, VSE/VSAM takes a LERAD or SYNAD exit before it returns control to your program. Register 15 is set to indicate the status of the request. A code of 0 indicates that no error was associated with any of the RPLs. Any other code indicates that an error occurred for one of the RPLs. You should issue a SHOWCB macro for every RPL in the chain to find out which one had an error. VSE/VSAM does not process any of the RPLs beyond the one with an error.

Example 9: Giving up Positioning for Another Request

Assumptions

There are three RPLs, all of which require VSE/VSAM to remember its position, one only temporarily and two until VSE/VSAM is explicitly requested to forget its position. VSE/VSAM can remember only two positions concurrently (STRNO=2).

```
BLOCK    ACB      MACRF=(SEQ,DIR),
                  STRNO=2
SEQ      RPL      ACB=BLOCK,              VSE/VSAM must remember its
                  OPTCD=SEQ               position.
DIRUPD   RPL      ACB=BLOCK,              VSE/VSAM must remember its
                  OPTCD=(DIR,UPD)         position until explicitly
                                          requested to forget it by
                                          PUT or ENDREQ.
DIRNUP   RPL      ACB=BLOCK,              VSE/VSAM must be able to
                  OPTCD=(DIR,NUP)         temporarily remember its
         .                                position.
         .
         .
LOOP     GET      RPL=SEQ                 VSE/VSAM now remembers its
                                          position for this request.
         LTR      15,15
         BNZ      ERROR
         GET      RPL=DIRNUP              VSE/VSAM remembers its position
                                          for this request only while
                                          it is processing the request.
         LTR      15,15
         BNZ      ERROR
         GET      RPL=DIRUPD              VSE/VSAM can therefore remember
                                          its position for this request,
                                          even that STRNO=2.
         LTR      15,15
         BNZ      ERROR
         .
         .                                Decide whether to update the
         .                                record.
         BE       UPDATE
         B        FORGET                  No.
UPDATE   PUT      RPL=DIRUPD              Yes, update the record,
                                          causing VSE/VSAM to forget its
                                          position for DIRUPD.
         LTR      15,15
         BNZ      ERROR
         B        LOOP
FORGET   ENDREQ   RPL=DIRUPD              Cause VSE/VSAM to forget its
                                          position for DIRUPD.
         LTR      15,15
         BNZ      ERROR
         B        LOOP
ERROR    ...                              Request was not
                                          accepted or failed.
```

Figure 36. Request Macro Example 9: Giving up Positioning for Other Request

Discussion

The use of ENDREQ illustrated here is to cause VSE/VSAM to forget its position for one RPL so a request defined by another RPL can be issued. When PUT is issued after a GET RPL=DIRUPD request, ENDREQ need not be issued, because PUT causes VSE/VSAM to forget its position (the next GET with RPL=DIRUPD does not depend on VSE/VSAM's remembering its position). You need to cause VSE/VSAM to forget its position when you have issued requests for as many RPLs requiring concurrent positioning as the number you specified for STRNO (in the ACB macro) and you want to issue a request for yet another RPL. In the example, a GET with RPL=DIRNUP cannot be reissued unless VSE/VSAM is freed from remembering its position for either SEQ or DIRNUP. VSE/VSAM must be allowed to remember its position for SEQ because requests against this RPL are sequential and depend on VSE/VSAM's remembering its position.

To cause VSE/VSAM to give up its position associated with a chain of RPLs, specify the first RPL in the chain in your ENDREQ macro.

Because VSE/VSAM remembers its position after a direct GET with OPTCD=UPD, if no PUT or ENDREQ follows, you can switch to sequential access (OPTCD=(SEQ,UPD) or OPTCD=SEQ) and use the positioning for a GET.

How to Store a Record: PUT Macro

Examples 10, 11, 12, and 13 illustrate the storage of records: keyed and addressed, sequential, skip sequential, and direct.

Example 10: Keyed-Sequential Insertion

Assumptions

Records of variable length are moved from a work area (only option). These records are up to 250 bytes long. Key length is 15 bytes. Some records are inserted between existing records, others are added at the end of the file.

```
BLOCK    ACB      DDNAME=OUTPUT,
                  MACRF=(KEY,SEQ,OUT)

LIST     RPL      ACB=BLOCK,
                  AREA=BUILDRCD,AREALEN=250,
                  OPTCD=(KEY,SEQ,NUP,MVE)
         .
         .
LOOP     L        0,length               Put length of record to be
                                          inserted into Register 0.
         LA       1,LIST                 Put RPL address into Register 1.
         MODCB    RPL=(1),               Modify record length in
                  RECLEN=(0)             request parameter list.
         LTR      15,15
         BNZ      CHECKO
         PUT      RPL=LIST
         LTR      15,15
         BNZ      ERROR
         B        LOOP
CHECKO   ...                            Modification failed.
ERROR    ...                            Request was not accepted
         .                              or failed.
         .
         .
BUILDRCD DS      CL250                  Work area for building record.
```

Figure 37. Request Macro Example 10: Keyed-Sequential Insertion

Discussion

Sequential insertion does not require VSE/VSAM to be positioned at the point of insertion. VSE/VSAM automatically skips ahead (never back) to that point, as though you were using skip sequential insertion (see Example 11). The difference between sequential and skip sequential insertion is that sequential insertion leaves free space in CIs and CAs according to the file's FREESPACE specification in the catalog (which is entered by the IDCAMS command DEFINE). Skip sequential insertion (and direct insertion) uses the free space.

You must use sequential storage (as opposed to skip sequential or direct storage) when you load records into a file for the first time. Thereafter, you may use skip sequential and direct storage, but you should use sequential storage when you are inserting large numbers of records between two existing records or at the end of the file.

When you store records sequentially beyond the highest key in the file, VSE/VSAM automatically extends the file as though you were continuing to load records. VSE/VSAM does not use distributed free space for these records, but establishes new CAs at the end of the file.

Example 11: Skip-Sequential Insertion

Assumptions

Several records are inserted with one PUT request. The records are moved from a work area (only option). They are fixed-length, 100 bytes long.

```
OUTPUT   ACB      MACRF=(KEY,SKP,OUT)
         .
         .
         .
         GENCB    BLK=RPL,COPIES=5,       Generate 5 request parameter
                  ACB=OUTPUT,             lists at execution.
                  AREALEN=100,
                  OPTCD=(KEY,SKP,NUP,MVE)
         LTR      15,15
         BNZ      CHECKO
```

Calculate the length of every list and use register notation with the MODCB macro to complete each list. See Example 3.

```
         MODCB    RPL=(2),
                  AREA=(3),
                  NXTRPL=(4)
         LTR      15,15
         BNZ      CHECKO
```

Increase the value in every register and repeat the MODCB until all five requests have been completed. The last time, Register 4 must be set to 0.

```
         .
         .
         .
LOOP     ...                              Restore address of first list
                                          Register 2.  Build 5 records
                                          in WORK.
         PUT      RPL=(2)                 Register 2 points to the first
                                          request parameter list in the
                                          chain.  The five records in
                                          WORK are stored with this one
                                          PUT request.
         LTR      15,15
         BNZ      ERROR
         .
         .
         .
         B        LOOP
CHECKO   ...                              Generation or modification
                                          failed.
ERROR    ...                              Display the feedback field
                                          in every request parameter
                                          list to find out if it had
                                          an error (see discussion
                                          for Example 8).
WORK     DS       CL500                   Contains 5 100-byte work
                                          areas.
```

Figure 38. Request Macro Example 11: Skip-Sequential Insertion

Discussion

You give no search argument for storage. VSE/VSAM knows the position of the key field in every record and extracts the key from it. Skip sequential insertion differs from keyed direct insertion in the sequence in which records may be inserted (ascending non-consecutive sequence versus random sequence) and in performance. With skip sequential insertion, VSE/VSAM uses only the sequence set of the index to find the point of insertion; with keyed direct insertion, VSE/VSAM searches from the top level of the index down to the sequence set.

With skip sequential insertion, if you insert two or more records into a CI, VSE/VSAM does not write the contents of the buffer to direct-access storage until you have inserted all records. With direct insertion, VSE/VSAM writes the contents of the buffer after you have inserted each record.

Example 12: Keyed-Direct Insertion

Assumptions

Records are moved from a work area (only option.) They have a fixed length of 100 bytes.

```
OUTPUT   ACB      MACRF=(KEY,DIR,OUT)

DIRECT   RPL      ACB=OUTPUT,
                  AREA=WORK,AREALEN=100,
                  OPTCD=(KEY,DIR,NUP,MVE),
                  RECLEN=100
         .
         .
         .
LOOP     PUT      RPL=DIRECT
         LTR      15,15
         BNZ      ERROR
         .
         .
         .
         B        LOOP
ERROR    ...                              Request failed
         .
         .
         .
WORK     DS       CL100                   Work area
```

Figure 39. Request Macro Example 12: Keyed-Direct Insertion

Discussion

VSE/VSAM extracts the key from every record's key field. You give no search argument. Using keyed direct access is very similar to using skip sequential access. About the only differences are specifying DIR instead of SKP in the MACRF and OPTCD operands and being able to process records randomly instead of in ascending key sequence (with skips).

Example 13: Addressed-Sequential Addition

Assumptions

Records are moved from work area (only option). They are of variable-length, up to 100 bytes long.

```
BLOCK    ACB      MACRF=(ADR,SEQ,OUT)

LIST     RPL      ACB=BLOCK,
                  AREA=NEWRCD,AREALEN=100,
                  OPTCD=(ADR,SEQ,MVE)
         .
         .
         .
LOOP     ...                              Build the record.
         L        0,length                Put the length of the record
                                          into Register 0.
         LA       1,LIST                  Put RPL address into Register 1.
         MODCB    RPL=(1),                Indicate length of new record.
                  RECLEN=(0)
         LTR      15,15
         BNZ      CHECKO
         PUT      RPL=LIST
         LTR      15,15
         BNZ      ERROR
         B        LOOP
CHECKO   ...                              Modification failed.
ERROR    ...                              Request was not accepted
         .                                or failed.
         .
         .
NEWCRD   DS       CL100                   Build record in this work
                                          area.
```

Figure 40. Request Macro Example 13: Addressed-Sequential Addition

Discussion

With addressed access, you cannot insert records into or add records to a key-sequenced file, because the index is not used and VSE/VSAM cannot locate the CI into which to insert the record. You can add records to, but not insert records into, an entry sequenced-file. Every record is stored in the next position after the last record in the file. You do not have to specify an RBA or do any explicit positioning (with the POINT macro). Addressed addition of records is always identical to loading a file. When the last CA is filled up, VSE/VSAM extends the file and establish new CAs.

Actually, there is no difference between addressed sequential and addressed direct addition. Every method stores a record in the next position after the last record in the file. However, you cannot use direct processing to load records into a file for the first time; you must use sequential processing.

How to Update a Record: GET and PUT Macros

Examples 14, 15, and 16 illustrate updating a record by first retrieving it and then storing it back with changes. (You cannot update a record without first retrieving it for update.)

Example 14: Keyed-Sequential Update

Assumptions

Records are updated in a work area (only option). They are fixed-length, 50 bytes long. Not every record retrieved is also updated.

```
UPDATA   ACB      MACRF=(KEY,SEQ,OUT)

LIST     RPL      ACB=UPDATA,             UPD indicates the record
                  AREA=WORK,AREALEN=50,   may be stored back(or
                  OPTCD=(KEY,SEQ,         deleted).
                  UPD,MVE)
         .
         .
         .
LOOP     GET      RPL=LIST
         LTR      15,15
         BNZ      ERROR
         .                                Decide whether to update
         .                                the record.
         .
         BE       UPDATE
         B        LOOP                    Do not update it; retrieve
                                          another.

UPDATE   .                                Update the record and store
         .                                it back.
         .
         PUT      RPL=LIST
         LTR      15,15
         BNZ      ERROR
         B        LOOP
ERROR    ...                              Request was not accepted
         .                                or failed.
         .
         .
         .
WORK     DS      CL50                     VSE/VSAM places the retrieved
                                          record here.
```

Figure 41. Request Macro Example 14: Keyed-Sequential Update

Discussion

A GET update (OPTCD=UPD) must precede a PUT for update. Besides retrieving the record to be updated, GET positions VSE/VSAM at the record retrieved in anticipation of the succeeding update (or deletion). It is not necessary to store back (or delete) the record that you retrieved for update. VSE/VSAM's position at the record previously retrieved allows you to issue another GET to retrieve the following record

(OPTCD=(SEQ,UPD) or OPTCD=SEQ). Then, however, the position for update was not maintained because of the following GET.

This example requires the use of a work area because you cannot update a record in the I/O buffer. Skip sequential retrieval (with OPTCD=UPD) can be used to update. Compare this example with Example 2.

Example 15: Keyed-Direct Update

Assumptions

Records are moved to and from a work area (only option). They are of variable-length, up to 120 bytes (with some lengths changed by update). The search argument is a full key of five bytes, compared equal.

```
INPUT    ACB      MACRF=(KEY,DIR,OUT)

UPDATE   RPL      ACB=INPUT,              UPD indicates the record
                  AREA=IN,AREALEN=120,    may be stored back (or
                  OPTCD=(KEY,DIR,         deleted).
                  UPD,KEQ,FKS,MVE),
                  ARG=KEYAREA,KEYLEN=5
         .
         .
         .
LOOP     GET      RPL=UPDATE
         LTR      15,15
         BNZ      ERROR
         LA       1,UPDATE                Put RPL address in Register 1.
         SHOWCB   RPL=(1),                Display the length of the
                  RECLEN=(0)              record.
         LTR      15,15
         BNZ      CHECKO
         ST       0,RLNGTH                Save the record length.
         .                                Update the record.  Does the
         .                                update change the record's
         .                                length?

         B        STORE                   No, length not changed.
         L        0,length                Yes, load new length into
                                          Register 0.
         LA       1,UPDATE                Put RPL address in Register 1.
         MODCB    RPL=(1),                Modify length indication in
                  RECLEN=(0)              the request parameter list.
         LTR      15,15

          BNZ      CHECKO
STORE    PUT      RPL=UPDATE
         LTR      15,15
         BNZ      ERROR
         B        LOOP
ERROR    ...                              Request was not accepted
                                          or failed.
CHECKO   ...                              Display or modification
         .                                failed.
         .
         .
IN       DS       CL120                   Work area for retrieving,
                                          updating, and storing a
                                          record
KEYAREA  DS       CL5                     Search argument for
                                          retrieving a record.
RLNGTH   DS       F                       Area for displaying the
                                          length of a retrieved record.
```

Figure 42. Request Macro Example 15: Keyed-Direct Update

Discussion

You cannot update records in the I/O buffer. A direct GET for update positions VSE/VSAM at the record retrieved, in anticipation of storing back (or deleting) the record. This positioning also allows you to switch to sequential access to retrieve the next record.

You do not have to store back a record that you retrieve for update, but if you do another retrieval, (using the same RPL). Or else, use two RPLs with STRNO=2. One RPL is used solely for GET DIR with UPD.

Example 16: Addressed-Sequential Update

Assumptions

Entry-sequenced file. Records are processed in a work area. They are of variable-length, up to 200 bytes long (lengths are not changed by updates; the length of a record can never be changed if addressed access is used).

```
ENTRY    ACB      MACRF=(ADR,SEQ,OUT)

ADRUPD   RPL      ACB=ENTRY,              UPD indicates update
                  AREA=WORK,              (or deletion).
                  AREALEN=200,
                  OPTCD=(ADR,SEQ,UPD,MVE)
         .
         .
         .
LOOP     GET      RPL=ADRUPD
         LTR      15,15
         BNZ      ERROR
         LA       1,ADRUPD                Put RPL address in Register 1.
         SHOWCB   RPL=(1),                Find out how long the record is.
                  RECLEN=(0)
         LTR      15,15
         BNZ      CHECKO
         ST       0,RLNGTH                Save the record length.
         PUT      RPL=ADRUPD
         LTR      15,15
         BNZ      ERROR
         B        LOOP
ERROR    ...                              Request was not accepted
                                          or failed.
CHECKO   ...                              Display failed.
         .
         .
         .
WORK     DS       CL200                   Record-processing work area.
RLNGTH   DS       F                       Display area for length of
                                          records.
```

Figure 43. Request Macro Example 16: Addressed-Sequential Update

Discussion

The RBAs of records in an entry-sequenced file are fixed and free space is not distributed. Therefore, it is not possible to change the length of records in an entry-sequenced file.

If you have inactive records in your entry-sequenced file, you may reuse the space they occupy by retrieving the records for update and restoring a new record in their place.

With a key-sequenced file, it is also impossible to change the length of records by addressed update because the index is not used and VSE/VSAM could not split a CI if required because of changing record length.

Addressed direct update differs from sequential update in the specification of an RBA for a search argument.

How to Delete a Record: GET and ERASE Macros

Examples 17 and 18 illustrate deleting a record from a key-sequenced file.

Example 17: Keyed-Direct Deletion

Assumptions

Records are processed in a work area (only option). They are fixed-length, 50 bytes long. Not every record retrieved for deletion is deleted. The search argument is a full key, 5 bytes long, compared equal.

```
DELETE   ACB      MACRF=(KEY,DIR,OUT)
LIST     RPL      ACB=DELETE,             UPD indicates deletion.
                  AREA=WORK,AREALEN=50,
                  ARG=KEYFIELD,
                  OPTCD=(KEY,DIR,UPD,MVE,FKS,KEQ)
         .
         .
         .
LOOP     MVC      KEYFIELD,table          Search argument for retrieval,
                                          from a table or transaction
                                          record.
         GET      RPL=LIST
         LTR      15,15
         BNZ      ERROR
         .
         .
         .                                Decide whether to delete
                                          the record.
         BE       DELET
         B        LOOP                    No, retrieve the next record.
DELET    ERASE    RPL=LIST                Yes, delete the record.
         LTR      15,15
         BNZ      ERROR
         B        LOOP
ERROR    ...                              Request was not accepted
                                          or failed.
WORK     DS       CL50                    Examine the data record here.
KEYFIELD DS       CL5                     Search argument.
```

Figure 44. Request Macro Example 17: Keyed-Direct Deletion

Discussion

When you retrieve a record for deletion (OPTCD=UPD, same as retrieval for update), VSE/VSAM is positioned at the record retrieved, in anticipation of a following ERASE (or PUT) request for that record. You are not required to issue such a request, however. Another GET request nullifies any previous positioning for deletion or update.

Keyed sequential retrieval for deletion varies from direct in not using a search argument (except for possible use of the POINT macro). Skip sequential retrieval for deletion (OPTCD=(SKP,UPD) has the same effect as direct, but it is faster or slower depending on the number of CIs separating the records to be retrieved.

Example 18: Addressed-Sequential Deletion

Assumptions

Records are processed in a work area. They are fixed-length, 100 bytes long. Not every record that is retrieved is deleted. Skipping is effected by issuing the POINT macro.

```
DELETE   ACB      MACRF=(ADR,SEQ,OUT)

REQUEST  RPL      ACB=DELETE,             UPD indicates deletion.
                  AREA=WORK,
                  AREALEN=100,
                  ARG=ADDR,
                  OPTCD=(ADR,SEQ,UPD,MVE)
         .
         .
         .
LOOP     ...                              Decide whether you need to
                                          skip to another position
                                          (forward or backward).
         B        RETRIEVE                No, bypass the POINT.
         MVC      ADDR,RBA value          Yes, move search argument for
                                          POINT into search-argument
                                          field.
         POINT    RPL=REQUEST             Position VSE/VSAM to the record
                                          to be retrieved next.
         LTR      15,15
         BNZ      ERROR
RETRIEVE GET      RPL=REQUEST
         LTR      15,15
         BNZ      ERROR
         .
         .
         .                                Decide whether to delete
                                          the record.
         BE       DELET
         B        LOOP                    No, skip ERASE.
DELET    ERASE    RPL=REQUEST             Yes, delete the record.
         LTR      15,15
         BNZ      ERROR
         B        LOOP
ERROR    ...                              Request was not accepted
         .                                or failed.
         .
         .
ADDR     DS       F                       RBA search argument for
                                          POINT.
WORK     DS       CL100                   Work area.
```

Figure 45. Request Macro Example 18: Addressed-Sequential Deletion

Discussion

Addressed deletion is allowed only for a key-sequenced file. The records of an entry-sequenced file are fixed, both in their existence and in their location.

How to Use Extended User Buffering: GET and PUT Macros

User buffering is mostly used by database systems such as DL/I and SQL/DS. Extended user buffering reduces the number of I/O requests and contributes to an increase in performance. Extended user buffering is provided for VSE/VSAM ESDS files and can be requested via the VSE/VSAM RPL control block. The support became available for the first time with VSE/ESA 2.1.2.

Current User Buffering Support

User buffering is only possible in conjunction with the *control interval mode*, that is, the ACB specifies: `MACRF=(CNV,UBF,MVE,FWD)`. With user buffering, the RPL identifies the buffer address via the `AREA=` parameter and, in case of direct access, the RBA of the control interval to be read or written via the RPL `ARG=` parameter.

Since a READ request needs to be processed immediately and (on a PUT request) the buffer cannot be copied from the user buffer, each VSE/VSAM request with user buffering results in an immediate I/O for each single control interval.

If several RPLs are chained via the `NXTRPL=` option of the RPL, the situation is unchanged, because each request as identified via each RPL is executed independently. In addition, certain restrictions exist for use with RPL chaining.

Extended User Buffering Support

Extended user buffering improves performance by handling related I/O requests, as far as possible, as a **single** I/O request. This reduces the number of I/O requests required by a factor that is usually the number of buffers per extended user buffering request.

To support extended user buffering, the options NBF and XBF are added to the RPL macro OPTCD options:

```
OPTCD=(...,NBF,...)
OPTCD=(...,XBF,...)
```

NBF and XBF are also added as operands to the macros GENCB, MODCB, and TESTCB.

OPTCD
Meaning

NBF
Normal user buffering.

Each request as identified by an RPL is executed serially and independently. This is the conventional processing of user buffering and remains the default.

XBF
Extended user buffering.

VSE/VSAM will execute the chain of RPLs as a *single request*, thereby attempting to execute the requests with as few I/O requests as possible. All control intervals residing in the same control area will usually be processed in a single I/O.

Using Extended User Buffering

When using extended user buffering, the following must be observed:

1. OPTCD=UBF and OPTCD=XBF can be used interchangeably.
2. To perform an actual request, an application must:
   a. Set up a chain of as many RPLs as control intervals are to be read or written.
   b. Store the RBA and buffer address (AREA, AREALEN) information for **each** control interval into the associated RPL.
   c. Execute the appropriate request macro against the first RPL of the chain.
3. With OPTCD=XBF, the following request macros are valid:

   GET
   PUT

4. All requests will be executed as if OPTCD=(DIR,NUP,MVE) were specified. OPTCD=SEQ is allowed but it would only affect the cache handling (DEFINE EXTENT, global attributes) for ECKD devices. OPTCD=SEQ should only be set for an application that has to process large portions of data sequentially in forward direction.
5. There is no *exclusive control* handling. The consequences are:
   - It is possible to update a control interval without having it read previously.
   - There is no protection by VSE/VSAM that different strings update a control interval concurrently.
6. With OPTCD=XBF, it is not possible to extend a data set. Hence pre-formatting would still need to be done with either OPTCD=NBF, or with VSE/VSAM buffering (MACRF=NUB).

Return Codes of Request Macros

When VSE/VSAM returns to your processing program, a return code in Register 15 indicates what happened. If an error occurred, the RPL contains additional information. Your processing program can examine the feedback field of the RPL with the SHOWCB or TESTCB macro. Register 1 contains the address of the RPL which defines the request that caused the error.

Control is returned to the instruction following your action macro when:

1. The request was completed normally
2. The request was not accepted because another request was using the RPL
3. An error occurred and you did not have an active exit routine
4. An error occurred and you had an active exit routine.

   The routine returns control to VSE/VSAM after processing the error. VSE/VSAM then returns control to the instruction following the action macro.

When you gain control after a request, Register 15 contains one of the following return codes:

Return Code
Meaning

X‘00’
Request completed successfully; the RPL might contain additional (non-error) information about the request.

X‘04’
The request was not accepted because a request from another task is active on the same RPL; no additional information is in the RPL.

X‘08’
Logic error; the error code in the RPL identifies the specific error. End-of-file is considered a logic error (error code X'04').

X‘0C’
Uncorrectable I/O error; the error code in the RPL identifies the specific error.

Note: For information on return and error codes, refer to z/VSE Messages and Codes Volume 2, SC34-2683.

As applicable, also refer to the descriptions of the request macros (GET, PUT, POINT, ERASE, and ENDREQ).

Depending on the return code in Register 15 and your specification in the EXLST macro, VSE/VSAM takes one of the following actions:

- When the RPL is in use (return code X'04'), retry the request.
- If the request is completed with a logic error (return code X'08') other than end-of-file, your LERAD exit routine is entered if you specified the LERAD exit in the EXLST and if it is active. If no LERAD exit routine is specified or if it is inactive, control is returned to the instruction following the request macro that raised the logic error condition with return code X'08' set.

  When you reach end-of-file, your request completes with a logic error (return code X'08' and error code X'04') and your EODAD exit routine is entered. If you have no EODAD exit routine or if it is inactive, your LERAD exit routine is entered. If no LERAD exit routine is specified or if it is inactive, control is returned to the instruction following the request macro that raised the end-of-file condition with return code X'08' set. Note, too, that if the EODAD exit is taken, the LERAD exit is not.
- If the request completed with an I/O (physical) error (return code X'0C'), your SYNAD exit routine is entered if you specified the SYNAD exit in the EXLST and if it is active. If no SYNAD exit routine is specified or if it is inactive, control is returned to the instruction following the request macro that raised the I/O error condition with return code X'0C' set.

After your EODAD, LERAD, or SYNAD exit returns to VSE/VSAM, VSE/VSAM returns control to the instruction following the request macro that raised the error condition with a non-zero return code set.

The feedback field in the RPL (FDBK operand in SHOWCB and TESTCB) is a three-byte field with the following format:

```
0000xx
```

where:

xx
is an error code that describes the error or, if the return code is zero, additional information about the request.

Besides the return code (set in Register 15) and the error code (which you may obtain by specifying FDBK in the SHOWCB macro) a function code is provided for alternate-index processing. This function code is set on logical or physical errors detected by VSE/VSAM and indicates whether the respective error condition occurred during accessing the base cluster or the alternate index. In addition, the function code indicates whether or not the upgrade set is still correct after the request that failed. The function codes and their meanings are:

Function Code
Meaning

X'00'
Condition occurred during accessing the base cluster. Upgrade set is correct.

X'01'
Condition occurred during accessing the base cluster. Upgrade set may be incorrect as a consequence of this request.

X'02'
Condition occurred during accessing the AIX over a base cluster. Upgrade set is correct.

X'03'
Condition occurred during accessing the AIX over a base cluster. Upgrade set may be incorrect as a consequence of this request.

X'04'
Condition occurred during upgrade processing. Upgrade set is correct.

X'05'
Condition occurred during upgrade processing. Upgrade set may be incorrect as a result as a consequence of this request.

You can display or test the function code by specifying the keyword FTNCD in the SHOWCB or TESTCB macro, respectively.

Return Codes from the Control Block Manipulation Macros

When VSE/VSAM returns to your processing program after a GENCB, MODCB, SHOWCB, or TESTCB request, Register 15 contains one of the following return codes:

Return Code
Meaning

X'00'
Operation successfully completed.

X'04'
An error occurred.

X'08'
The execute form of the macro was used in an attempt to change a non-existent entry in the referenced parameter list.

X'0C'
Request was not executed because an error was encountered while VSE/VSAM routines were loaded.

If Register 15 contains X'04', an error code is set in Register 0, which indicates the type of error. Make sure that, before issuing the macro, you save the contents of Register 0 if you want to use its contents later on. For an explanation of the error codes, refer to z/VSE Messages and Codes Volume 2, SC34-2683.

List, Execute, and Generate Forms of the Control Block Manipulation Macros

The list and execute forms of the control block manipulation macros (GENCB, MODCB, SHOWCB, and TESTCB) allow you to save virtual storage by using one parameter list for two or more macros. You can also make your program reenterable, that is, executable by more than one task at a time. While the generate form of the macros enables you to make programs reenterable it does not allow shared parameter lists.

List and Execute Forms

The list form of GENCB, MODCB, SHOWCB, and TESTCB has the same parameters as the standard form, except that it includes the parameter MF=L or MF=(L,adress...).

The parameter list of the macro is created inline when MF=L is coded. This version is not reenterable and register notation cannot be used for macro parameter addresses.

When MF=(L,address...) is coded, the parameter list of the macro is created in the area specified by address. This form is reenterable. You must supply the area by a GETVIS macro when your program is executed. You can determine the size of the parameter list by coding the third operand label. VSE/VSAM equates label to the length of the list.

The execute form produces the executable code of the macros. The execute form is also identical to the standard form, except that it includes the operand MF=(E,address), where address points to the parameter list created by the list form of the macro. All of the other operands of the macro are optional and are coded only to change entries in the parameter list before the list is used. However, you cannot use the execute form to add or delete entries from the parameter list or to change the type of list.

Generate Form

The generate form of the macros allows you to make your program reenterable, but it does not create shared parameter lists. The generate form is the same as the standard form, except that you code MF=(G,address...). The parameter list is created in an area pointed to by address. To ensure that the parameter list is reenterable, address should be coded in register notation. You must obtain this area by a GETVIS macro when the program is executed. You can determine the size of the parameter list by coding the third operand label. VSE/VSAM equates label to the length of the list.

Examples of the List, Execute, and Generate Forms

Figure 46 on page 284 and Figure 47 on page 284 show the use of the list, execute, and generate forms of the control block manipulation macros.

In Figure 46 on page 284, MODCB is used to place the length of a record in the RPL before the record is written. The list and execute forms are used so that only one parameter list is created (though the macro is issued several times). This list form is not reenterable.

In Figure 47 on page 284, the generate form is used to create an ACB. It is reenterable because both the ACB itself and the parameter list of the GENCB macro are created in areas obtained through a GETVIS macro.

Continuation characters required in column 72 are not shown in the examples.

```
        MODCB  MF=(E,LENMOD),RECLEN=(7)      Current length in register 7
        LTR    15,15                         MODCB successful?
        BNZ    MODERR                        No, go to error routine
        PUT    RPL=LIST                      Yes, write record
        .
        .
        .
        MODCB  MF=(E,LENMOD)                 Length is 100 bytes
        LTR    15,15                         MODCB successful?
        BNZ    MODERR                        No, go to error routine
        PUT    RPL=LIST                      Yes, write record
        .
        .
        .
LENMOD  MODCB  RPL=LIST,RECLEN=100,MF=L      List form has default
```

Figure 46. Examples of the List and Execute Form

```
         LA     10,PARMLEN                   Load length for GETVIS
         GETVIS ADDRESS=(8),LENGTH=(10)      Get area for parm, list
         LTR    15,15                        GETVIS successful?
         BNZ    VISERR                       No, go to error routine
         GENCB  BLK=ACB,MF=(G,(8),PARMLEN),
                 EXLST=(3),BUFND=4,BUFNI=3,
                 DDNAME=VFILENM,
                 MACRF=(KEY,SEQ,DIR,OUT),
                 PASSWD=PASS
         LTR    15,15                        GENCB successful?
         BNZ   GENERR                        No, go to error routine
         LR    2,1                           Yes, save ACB address
         .
         .
         .
PASS     DC    FL1'6',C'CHANGE'
```

Figure 47. Example of the Generate Form

Appendix A. Operand Notation and Parameter Lists for VSE/VSAM Macros

This Appendix...

- Documents Programming Interface information. For a definition of this category of interface information refer to "Notices" on page 351.
- Lists the macro operands and parameter lists for VSE/VSAM macros.

Operand Notation for VSE/VSAM Macros

The addresses, names, numbers, and options required with operands in GENCB, MODCB, SHOWCB, TESTCB, BLDVRP, WRTBFR, and SHOWCAT can be expressed in a variety of ways:

- An absolute numeric expression, for example, RECLEN=400, as in the following sample job stream:

```
          LA     1,RPL                Set RPL address in register 1.
          MODCB  RPL=(1),RECLEN=400   Set record length field in
*                                     RPL to value of 400.
```

- A character string, for example, DDNAME=DATASET
- A code or a list of codes separated by commas and enclosed in parentheses, for example, OPTCD=KEY or OPTCD=(KEY,DIR,IN)
- A register from 2 through 12 that contains an address or numeric value. Equated labels can be used to designate a register, for example, SYNAD=(ERR), where the following equate statement has been included in the program: ERR EQU 3.

  Example of register notation for an operand taking numeric value:

```
          LA     6,400                Set length desired in register 6.
          MODCB  RPL=RPL,RECLEN=(6)   Set record length field in RPL
*                                     to value specified in register 6.
```

  Example of register notation for an operand that takes an address value:

```
          LA     2,RCDAREA            Set address of record area in
*                                     register 2.
          MODCB  RPL=RPL,AREA=(2)     Set area operand in RPL according
*                                     to contents of register 2.
          .
          .
          .
RCDAREA   DS   CL400
```

- An expression of the form (S,scon), where scon is any expression valid for an S-type address constant, including the base-displacement form.

  The use of the S-type notation for numeric-value operands is usually equivalent to either absolute-numeric-expression notation or register notation (see the following example).

  Example of S-type address notation for an operand that takes a numeric value:

```
          MODCB  RPL=RPL,RECLEN=(S,400)  Set record length field
*                                        in RPL to value of 400.
```

Example of S-type address notation for an operand that takes an address value:

```
          MODCB  RPL=RPL,RECLEN=(S,RCDAREA1)  Set area operand in RPL
*                                            to address of RCDAREA1.
          .
          .
          .
RCDAREA1  DS   CL400
```

- An expression of the form (*,scon); where scon is any expression valid for an S-type address constant, including the base-displacement form. The address specified by scon is indirect, that is, it points to the location that contains the value of the keyword.

  If indirect S-type address notation is used, the value it points to must meet either of the following criteria:

  – If the value is a numeric quantity, a bit string representing codes, or a pointer, it must occupy a fullword of storage.
  – If the value is an alphameric character string, it must occupy two words of storage, be left aligned, and be padded on the right with blanks, if necessary.

  Example of indirect S-type address notation for an operand that takes a numeric value:

```
          MODCB  RPL=RPL,RECLEN=(*,RECLEN1)   Set record length field
*                                             in RPL to value specified
*                                             in the fullword RECLEN1.
          .
          .
          .
RECLEN1   DC   F'400'
```

  Example of indirect S-type address notation for an operand that takes a name value:

```
          MODCB  ACB=ACB,DDNAME=(*,DDNAME1)   Set ddname field in ACB
*                                             to value specified in the
*                                             8-byte field DDNAME1.
          .
          .
          .
DDNAME1   DC   CL8'FILENAME'
```

  Example of indirect S-type notation for an operand that takes an address value:

```
          MODCB  RPL=RPL,AREA=(*,ARCDAREA)    Set area operand in RPL
*                                             to the address pointed to
*                                             be the pointer ARCDAREA.
          .
          .
          .
ARCDAREA  DC   A(RCDAREA1)
```

  Example of an expression valid for a relocatable A-type address constant:

```
          MODCB  RPL=RPL,AREA=RCDAREA    Set area operand in RPL
*                                        to address of RCDAREA.
```

  The expressions that can be used depend on the keyword specified. Register and S-type address notations cannot be used when MF=L is specified.

GENCB Macro Operands

Table 27. GENCB Keywords

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
AM	-	x	-	-	-	-	-
BLK	-	x	-	-	-	-	-
COPIES	x	-	-	x	x	x	-
LENGTH	x	-	-	x	x	x	-
WAREA	-	-	-	x	x	x	x

Table 28. ACB Keywords (BLK=ACB)

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
BSTRNO	x	-	-	x	x	x	-
BUFND	x	-	-	x	x	x	-
BUFNI	x	-	-	x	x	x	-
BUFSP	x	-	-	x	x	x	-
DDNAME	-	-	x	-	-	x	-
EXLST	-	-	-	x	x	x	x
MACRF	-	x	-	-	-	-	-
MAREA	-	-	-	x	x	x	x
MLEN	x	-	-	x	x	x	-
PARMS= CLOSDSP	-	x	-	-	-	-	-
PASSWD	-	-	-	x	x	x	x
RMODE31	-	x	-	-	-	-	-
SHRPOOL	x	-	-	x	x	x	-
STRNO	x	-	-	x	x	x	-

Table 29. EXLST Keywords (BLK=EXLST)

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
EODAD	-	-	-	x	x	x	x
EXCPAD	-	-	-	x	x	x	x
JRNAD	-	-	-	x	x	x	x

Table 29. EXLST Keywords (BLK=EXLST) (continued)

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
LERAD	-	-	-	x	x	x	x
SYNAD	-	-	-	x	x	x	x

Table 30. RPL Keywords (BLK=RPL)

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
ACB	-	-	-	x	x	x	x
AREA	-	-	-	x	x	x	x
AREALEN	x	-	-	x	x	x	-
ARG	-	-	-	x	x	x	x
KEYLEN	x	-	-	x	x	x	-
NXTRPL	-	-	-	x	x	x	x
OPTCD	-	x	-	-	-	-	-
RECLEN	x	-	-	x	x	x	-
TRANSID	x	-	-	x	x	x	-

MODCB Macro Operands

Table 31. MODCB Keywords

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
ACB	-	-	-	x	x	x	x
AM	-	x	-	-	-	-	-
EXLST	-	-	-	x	x	x	x
RPL	-	-	-	x	x	x	x

Table 32. ACB Keywords

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
BSTRNO	x	-	-	x	x	x	-
BUFND	x	-	-	x	x	x	-
BUFNI	x	-	-	x	x	x	-

Table 32. ACB Keywords (continued)

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
BUFSP	x	-	-	x	x	x	-
DDNAME	-	-	x	-	-	x	-
EXLST	-	-	-	x	x	x	x
MACRF	-	x	-	-	-	-	-
MAREA	-	-	-	x	x	x	x
MLEN	x	-	-	x	x	x	-
PARMS= CLOSDSP	-	x	-	-	-	-	-
PASSWD	-	-	-	x	x	x	x
RMODE31	-	x	-	-	-	-	-
SHRPOOL	x	-	-	x	x	x	-
STRNO	x	-	-	x	x	x	-

Table 33. EXLST Keywords

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
EODAD	-	-	-	x	x	x	x
EXCPAD	-	-	-	x	x	x	x
JRNAD	-	-	-	x	x	x	x
LERAD	-	-	-	x	x	x	x
SYNAD	-	-	-	x	x	x	x

Table 34. RPL Keywords

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
ACB	-	-	-	x	x	x	x
AREA	-	-	-	x	x	x	x
AREALEN	x	-	-	x	x	x	-
ARG	-	-	-	x	x	x	x
KEYLEN	x	-	-	x	x	x	-
NXTRPL	-	-	-	x	x	x	x
OPTCD	-	x	-	-	-	-	-

Table 34. RPL Keywords (continued)							
					Address		
Keyword	Absolute Numeric	Code	Character String	Register	S-Type	Indirect S-Type	A-Type
RECLEN	x	-	-	x	x	x	-
TRANSID	x	-	-	x	x	x	-

SHOWCB Macro Operands

Table 35. SHOWCB Keywords							
					Address		
Keyword	Absolute Numeric	Code	Character String	Register	S-Type	Indirect S-Type	A-Type
ACB	-	-	-	x	x	x	x
AM	-	x	-	-	-	-	-
AREA	-	-	-	x	x	x	x
EXLST	-	-	-	x	x	x	x
FIELDS*	-	x	-	-	-	-	-
LENGTH	x	-	-	x	x	x	-
OBJECT	-	x	-	-	-	-	-
RPL	-	-	-	x	x	x	x
SHAREPL	x	-	-	-	-	-	-

* For a list of the operands you can specify in the FIELDS parameter, see "The SHOWCB Parameter List" on page 298.

TESTCB Macro Operands

Table 36. TESTCB Keywords							
					Address		
Keyword	Absolute Numeric	Code	Character String	Register	S-Type	Indirect S-Type	A-Type
ACB	-	-	-	x	x	x	x
AM	-	x	-	-	-	-	-
ERET	-	-	-	x	x	x	x
EXLST	-	-	-	x	x	x	x
OBJECT	-	x	-	-	-	-	-
RPL	-	-	-	x	x	x	x

Table 37. ACB Keywords

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
ACBLEN	x	-	-	x	x	x	-
ATRB	-	x	-	-	-	-	-
AVSPAC	x	-	-	x	x	x	-
BSTRNO	x	-	-	x	x	x	-
BUFND	x	-	-	x	x	x	-
BUFNI	x	-	-	x	x	x	-
BUFNO	x	-	-	x	x	x	-
BUFSP	x	-	-	x	x	x	-
CINCV	x	-	-	x	x	x	-
DDNAME	-	-	x	-	-	-	-
ERROR	x	-	-	x	x	x	-
EXLST	-	-	-	x	x	x	x
FS	x	-	-	x	x	x	-
KEYLEN	x	-	-	x	x	x	-
LRECL	x	-	-	x	x	x	-
MACRF	-	x	-	-	-	-	-
MAREA	-	-	-	x	x	x	x
MLEN	x	-	-	x	x	x	-
NCIS	x	-	-	x	x	x	-
NDELR	x	-	-	x	x	x	-
NEXCP	x	-	-	x	x	x	-
NEXT	x	-	-	x	x	x	-
NINSR	x	-	-	x	x	x	-
NIXL	x	-	-	x	x	x	-
NLOGR	x	-	-	x	x	x	-
NRETR	x	-	-	x	x	x	-
NSSS	x	-	-	x	x	x	-
NUPDR	x	-	-	x	x	x	-
OFLAGS	-	x	-	-	-	-	-
OPENOBJ	-	x	-	-	-	-	-
PARMS= CLOSDSP	-	x	-	-	-	-	-

Table 37. ACB Keywords (continued)

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
PASSWD	-	-	-	x	x	x	x
RKP	x	-	-	x	x	x	-
SHRPOOL	x	-	-	x	x	x	-
STMST	-	-	-	-	-	x	-
STRNO	x	-	-	x	x	x	-

Table 38. EXLST Keywords

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
EODAD	-	-	-	x	x	x	x
EXCPAD	-	-	-	x	x	x	x
EXLLEN	x	-	-	x	x	x	-
JRNAD	-	-	-	x	x	x	x
LERAD	-	-	-	x	x	x	x
SYNAD	-	-	-	x	x	x	x

Table 39. RPL Keywords

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
ACB	-	-	-	x	x	x	x
AIXFLAG	x	-	-	-	-	-	-
AIXPC	x	-	-	x	x	x	-
AREA	-	-	-	x	x	x	x
AREALEN	x	-	-	x	x	x	-
ARG	-	-	-	x	x	x	x
FDBK	x	-	-	x	x	x	-
FTNCD	x	-	-	x	x	x	-
KEYLEN	x	-	-	x	x	x	-
NXTRPL	-	-	-	x	x	x	x
OPTCD	-	x	-	-	-	-	-
RBA	x	-	-	x	x	x	-
RECLEN	x	-	-	x	x	x	-

Table 39. RPL Keywords (continued)

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
RPLLEN	x	-	-	x	x	x	-
TRANSID	x	-	-	x	x	x	-

BLDVRP Macro Operands

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
BUFFERS	x	-	-	x	-	-	-
KEYLEN	x	-	-	x	-	-	-
RMODE31	-	x	-	-	-	-	-
SHRPOOL	x	-	-	x	-	-	-
STRNO	x	-	-	x	-	-	-
TYPE	-	x	-	-	-	-	-

DLVRP Macro Operands

Table 40. EXLST Keywords

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
SHRPOOL	x	-	-	x	-	-	-
TYPE	-	x	-	-	-	-	-

SHOWCAT Macro Operands

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
ACB	-	-	-	x	-	-	x
AREA	-	-	-	x	-	-	x
CI	-	-	-	x	-	-	x
CATDSN	-	-	-	x	-	-	x
CATFIL	-	-	-	x	-	-	x
DDNAME	-	-	-	x	-	-	x
NAME	-	-	-	x	-	-	x

WRTBFR Macro Operands

Keyword	Absolute Numeric	Code	Character String	Register	Address		
					S-Type	Indirect S-Type	A-Type
percent	x	-	-	x	-	-	-
RPL	-	-	-	x	-	-	x
TYPE=ALL	-	x	-	-	-	-	-
TYPE=DS	-	x	-	-	-	-	-
TYPE=LRU	-	x	-	-	-	-	-
TYPE=TRN	-	x	-	-	-	-	-

Parameter Lists for VSE/VSAM Macros

The VSE/VSAM control block (CB) manipulation macros (GENCB, MODCB, SHOWCB, and TESTCB) use an internal parameter list to describe the actions that you specify when you code the macros. The BLDVRP macro (for building a VSE/VSAM resource pool) and the SHOWCAT macro (which displays catalog information) also use an internal parameter list to indicate the addresses and values that you specify when you code the macros.

Depending on the *form* of the macro, the *internal parameter list* is built as follows:

- The *standard* form of these macros builds a parameter list in-line and processes it.
- The *list* form builds a parameter list in an area you specified.
- The *execute* form processes a previously built parameter list.
- The *generate* form (not for BLDVRP and SHOWCAT) builds a parameter list in an area you specify and also processes it.

(Use of the different forms are discussed under “List, Execute, and Generate Forms of the Control Block Manipulation Macros” on page 283.)

For special purposes, such as developing high-level programming languages, you may want to build and process parameter lists without using the macros. The following describes the format of the parameter lists and gives the codes used for the operands of each of the macros. The formats and codes are fixed, so that you can build and alter them by your own methods. For the control block manipulation macros, a parameter list contains a variable number of entries of three types:

Type 1: At the beginning of the list, *addresses* of entries of Type 2 and Type 3. The addresses are fullwords, and the high-order bit of the last fullword is 1.

Type 2: A *header* entry containing general information about the block or list that you want to generate, modify, display or test.

Type 3: At the end of the list, *keyword entries* describing each field that you want to generate, modify, display, or test.

In the following, entries of *Type 2* and *Type 3* are described separately for GENCB, MODCB, SHOWCB, and TESTCB. When VSE/VSAM receives control, register 1 must point to your parameter list.

The format of the BLDVRP and SHOWCAT parameter lists is different from the above scheme. Refer to “The BLDVRP Parameter List” on page 302 and “The SHOWCAT Parameter List” on page 303.

The GENCB Parameter List

Header Entry

Offset Dec	Offset (HEX)	0	1	2
0	(0)	Block or list See "(1) list"	X'01'	Number of copies
4	(4)	Address of the area you are providing, or zeros		
8	(8)	Length of the area, or zeros		(reserved)

(1) list explanation:

X‘A0’ indicates ACB
X‘B0’ indicates EXLST
X‘C0’ indicates RPL

Keyword Entries

The parameter list for GENCB contains no keyword entries if you are generating a default ACB, EXLST, or RPL.

Offset Dec	Offset (HEX)	0	2
0	(0)	Keyword code See "(1) keyword code"	(reserved)
4	(4)	(value|address|option|name) of the keyword See "(2) option"	
8	(8)	(Required for some keywords) See "(3) keywords"	

(1) keyword code explanation: Defined by AL2(value).

For an ACB		For an EXLST		For an RPL	
Keyword	**Value**	**Keyword**	**Value**	**Keyword**	**Value**
BUFND	4	EODAD	37	ACB	43
BUFNI	5	EXCPAD	38	AREA	44
BUFSP	7	JRNAD	39	AREALEN	45
DDNAME	9	LERAD	40	ARG	46
EXLST	12	SYNAD	41	KEYLEN	48
MAREA	14			NXTRPL	51
MLEN	15			OPTCD	52
MACRF	18			RECLEN	53
PASSWD	30			TRANSID	95
STRNO	32				
BSTRNO	36				
SHRPOOL	129				
CLOSDSP	151				
MACRF3	163				

(2) option explanation: Indicates the options for MACRF, MACRF3, OPTCD, and CLOSDSP with a 1 in a bit of the fullword:

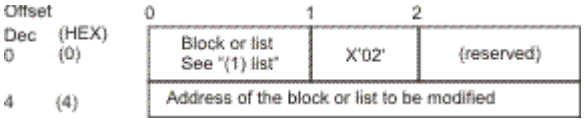
MACRF Option	Bit	MACRF3 Option	Bit	OPTCD Option	Bit	CLOSEDSP Option	Bit
KEY	0	DDN	0	KEY	0	First CLOSDSP Option:	
ADR	1	DSN	1	ADR	1		
CNV	2	NCM	8	CNV	2		
SEQ	3	CMP	9	SEQ	3	KEEP	0
SKP	4	RMODE31	15	DIR	4	DELETE	1
DIR	5			SKP	5	DATE	2
IN	6			NUP	8	Second CLOSDSP Option:	
OUT	7			UPD	9		
NUB	8			NSP	10		
UBF	9			KEQ	11	KEEP	3
NRM	15			KGE	12	DELETE	4
AIX	16			FKS	13		
NSR	17			GEN	14		
LSR	18			MVE	15		
NDF	22			LOC	16		
DFR	23			FWD	17		
RST	28			BWD	18		
NRS	29			ARD	19		
NFY	30			LRD	20		
VFY	31						

(3) keywords explanation: The third fullword is required for the ACB operand DDNAME, and for all of the EXLST operands, for which the third fullword indicates A, N, and L:

Bit	Meaning when Set to 1
0	Address is active (A).
1	Address is not active (N).
2	Address is of a field containing the name of an exit routine to be loaded (L).
3	Address is specified in the preceding fullword of this entry.
4-31	Unused.

The MODCB Parameter List

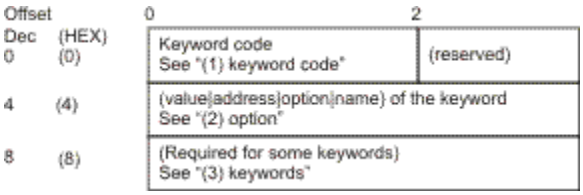
Header Entry



(1) list explanation:

X‘A0’ indicates ACB
X‘B0’ indicates EXLST
X‘C0’ indicates RPL

Keyword Entries



(1) keyword code explanation: Defined by AL2(value):

For an ACB		For an EXLST		For an RPL	
Keyword	**Value**	**Keyword**	**Value**	**Keyword**	**Value**
BUFND	4	EODAD	37	ACB	43
BUFNI	5	EXCPAD	38	AREA	44
BUFSP	7	JRNAD	39	AREALEN	45
DDNAME	9	LERAD	40	ARG	46
EXLST	12	SYNAD	41	KEYLEN	48
MAREA	14			NXTRPL	51
MLEN	15			OPTCD	52
MACRF	18			RECLEN	53
PASSWD	30			TRANSID	95
STRNO	32				
BSTRNO	36				
SHRPOOL	129				
CLOSDSP	151				
MACRF3	163				

(2) option explanation: Indicates the options for MACRF, MACRF3, OPTCD, and CLOSDSP with a 1 in a bit of the fullword:

MACRF Option	Bit	MACRF3 Option	Bit	OPTCD Option	Bit	CLOSEDSP Option	Bit
KEY	0	DDN	0	KEY	0	First CLOSDSP Option:	
ADR	1	DSN	1	ADR	1		
CNV	2	NCM	8	CNV	2		
SEQ	3	CMP	9	SEQ	3	KEEP	0
SKP	4	RMODE31	15	DIR	4	DELETE	1
DIR	5			SKP	5	DATE	2

MACRF Option	Bit	MACRF3 Option	Bit	OPTCD Option	Bit	CLOSEDSP Option	Bit
IN	6			NUP	8	Second CLOSDSP Option:	
OUT	7			UPD	9		
NUB	8			NSP	10		
UBF	9			KEQ	11	KEEP	3
NRM	15			KGE	12	DELETE	4
AIX	16			FKS	13		
NSR	17			GEN	14		
LSR	18			MVE	15		
NDF	22			LOC	16		
DFR	23			FWD	17		
RST	28			BWD	18		
NRS	29			ARD	19		
NFY	30			LRD	20		
VFY	31						

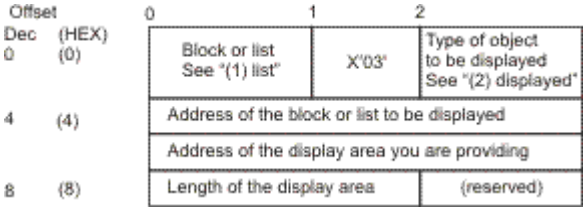
With the MODCB macro, there are no defaults for these options. When you code a bit for the OPTCD operand, the contrary bit that was previously set is turned off. For example, if KEY was previously set, and you set ADR, KEY is turned off, because a request parameter list can be set for only one type of access.

(3) keywords explanation: The third fullword is required for the ACB operand DDNAME, and for all of the EXLST operands, for which the third fullword indicates A, N, and L:

Bit	Meaning when Set to 1
0	Address is active (A).
1	Address is not active (N).
2	Address is of a field containing the name of an exit routine to be loaded (L).
3	Address is specified in the preceding fullword of this entry.
4-31	Unused.

The SHOWCB Parameter List

Header Entry



(1) list explanation:

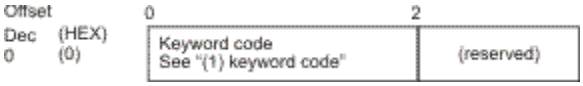
X‘00’ indicates that no block or list is specified
to display the standard length of the block(s)

or list(s) specified by the keywords
ACBLEN, EXLLEN, or RPLLEN
X‘A0’ indicates ACB
X‘B0’ indicates EXLST
X‘C0’ indicates RPL

(2) displayed:

AL2(0) indicates the data of a file
AL2(1) indicates the index of a file

Keyword Entries

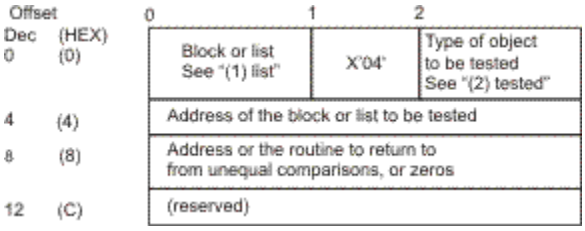


(1) keyword code explanation: Defined by AL2(value):

For an ACB				For an EXLST		For an RPL	
Keyword	**Value**	**Keyword**	**Value**	**Keyword**	**Value**	**Keyword**	**Value**
AVSPAC	2	STRNO	32	EODAD	37	ACB	43
ACBLEN	3	STMST	35	EXCPAD	38	AREA	44
BUFND	4	BSTRNO	36	JRNAD	39	AREALEN	45
BUFNI	5	BFRFND	124	LERAD	40	ARG	46
BUFNO	6	BUFRDS	125	SYNAD	41	KEYLEN	48
BUFSP	7	NUIW	126	EXLLEN	42	NXTRPL	51
CINV	8	UIW	127			RECLEN	53
DDNAME	9	STRMAX	128			RPLLEN	55
ENDRBA	10	SHRPOOL	129			FDBK	56
ERROR	11	HALCRBA	148			RBA	57
EXLST	12	SHAREOP	161			AIXPC	58
FS	13	ATRB	164			TRANSID	95
MAREA	14	BLREC	165			FTNCD	99
MLEN	15	NSLOT	166				
KEYLEN	16	SSRBA	167				
LRECL	17	ASTRNUM	168				
NCIS	19	STRTOT	169				
NDELR	20	SYMU	170				
NEXCP	21	LNCIS	171				
NEXT	22	LNEXCP	172				
NINSR	23	LNINSR	173				
NIXL	24	LNUPDR	174				
NLOGR	25	LNRETR	175				
NRETR	26	LNSSS	176				
NSSS	27	LAVSPAC	177				
NUPDR	28	LNDELR	178				
PASSWD	30	LNLOGR	179				
RKP	31						

The TESTCB Parameter List

Header Entry



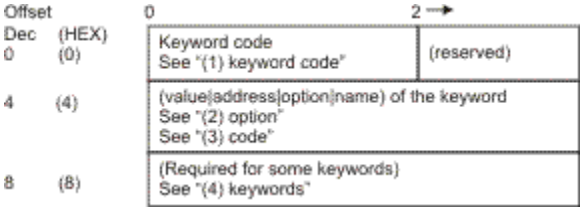
(1) list explanation:

X‘00’ indicates that no block or list is specified to test the standard length of the block(s) or list(s) specified by the keywords ACBLEN, EXLLEN, or RPLLEN
X‘A0’ indicates ACB
X‘B0’ indicates EXLST
X‘C0’ indicates RPL

(2) tested explanation:

AL2(0) indicates the data of a file
AL2(1) indicates the index of a file

Keyword Entries



(1) keyword code explanation: Defined by AL2(value):

For an ACB				For an EXLST		For an RPL	
Keyword	**Value**	**Keyword**	**Value**	**Keyword**	**Value**	**Keyword**	**Value**
ATRB	1*	NEXT	22	EODAD	37	ACB	43
ATRB	162**	NINSR	23	EXCPAD	38	AREA	44
AVSPAC	2	NIXL	24	JRNAD	39	AREALEN	45
ACBLEN	3	NLOGR	25	LERAD	40	ARG	46
BUFND	4	NRETR	26	SYNAD	41	KEYLEN	48
BUFNI	5	NSSS	27	EXLLEN	42	NXTRPL	51
BUFNO	6	NUPDR	28			OPTCD	52
BUFSP	7	OFLAGS	29			RECLEN	53
CINV	8	PASSWD	30			RPLLEN	55
DDNAME	9	RKP	31			FDBK	56
ERROR	11	STRNO	32			RBA	57
EXLST	12	OPENOBJ	33			AIXPC	58
FS	13	STMST	35			AIXFLAG	59

For an ACB				For an EXLST		For an RPL	
Keyword	**Value**	**Keyword**	**Value**	**Keyword**	**Value**	**Keyword**	**Value**
MAREA	14	BSTRNO	36			FTNCD	99
MLEM	15	SHRPOOL	129			XRBA	184
KEYLEN	16	CLOSEDSP	151				
LRECL	17	MACRF3	163				
MACRF	18						
NCIS	19						
NDELR	20						
NEXCP	21						

*) Option bits 0 to 7 only (see (2)).

**) Option bits 8 to 15 only (see (2)).

(2) option explanation: Indicate the options for MACRF, MACRF3 OPTCD, CLOSDSP, ATRB, OFLAGS, AIXFLAG, and OPENOBJ: with a 1 in a bit of the fullword:

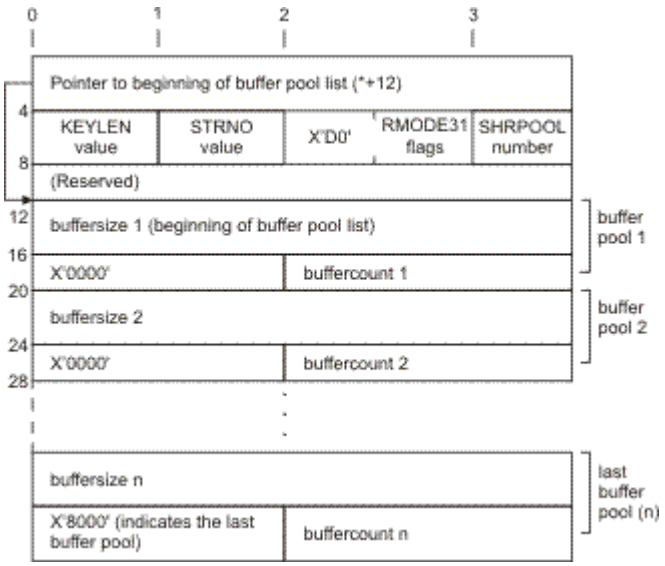
MACRF Option	Bit	MACRF3 Option	Bit	OPTCD Option	Bit	CLOSEDSP Option	Bit
KEY	0	DDN	0	KEY	0	First CLOSDSP Option:	
ADR	1	DSN	1	ADR	1		
CNV	2	NCM	8	CNV	2		
SEQ	3	CMP	9	SEQ	3	KEEP	0
SKP	4	RMODE31	15	DIR	4	DELETE	1
DIR	5			SKP	5	DATE	2
IN	6			NUP	8	Second CLOSDSP Option:	
OUT	7			UPD	9		
NUB	8			NSP	10		
UBF	9			KEQ	11	KEEP	3
NRM	15			KGE	12	DELETE	4
AIX	16			FKS	13		
NSR	17			GEN	14		
LSR	18			MVE	15		
NDF	22			LOC	16		
DFR	23			FWD	17		
RST	28			BWD	18		
NRS	29			ARD	19		
NFY	30			LRD	20		
VFY	31						

ATRB Option	Bit	OPENOBJ Option	Bit	AIXFLAG Option	Bit	OPENOBJ Option	Bit
KSDS	0	OPEN	0	AIXPKP	0	AIX	0
ESDS	1					PATH	1
WCK	2					BASE	1
SSWD	3						
REPL	4						
RRDS	5						
SPAN	6						
UNQ	7						
COMP	8						
XLKSDS	11						
VRDS	14						

(3) code explanation: The codes for ERROR and for FDBK are documented with the appropriate macro instructions. **(4) keywords** explanation: The third fullword is required for the ACB operands DDNAME and STMST, and for all of the EXLST operands, for which the third fullword indicates A, N, and L:

Bit	Meaning when Set to 1
0	Address is active (A).
1	Address is not active (N).
2	Address is of a field containing the name of an exit routine to be loaded (L).
3	Address is specified in the preceding fullword of this entry.
4-31	Unused.

The BLDVRP Parameter List



The SHOWCAT Parameter List

Header Entry

Dec	(HEX)			
0	(0)	Type of entry See "(1) entry"	X'80'= EXTOPT spec	X'0000'
4	(4)	Address of filename, file ID, or CI that identifies the catalog entry to be displayed		
		Address of catalog ACB (or zero)		
		Address of return area in which catalog information will be displayed		
		Address of 44-byte catalog file-ID		
		Address of 7-byte catalog file name		
		Name of EXTOPT field		

(1) entry explanation:

X‘80’ = The field at offset X'04' points to a 44-byte file ID
X‘40’ = The field at offset 'X04' points to a 7-byte file name
X‘00’ = The field at offset X'04' points to a 3-byte CI number

Appendix B. Invoking IDCAMS from a Program

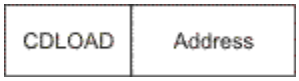
This Appendix...

Shows how IDCAMS can be invoked by a program through the use of the CDLOAD macro instruction.

Describes how the dynamic invocation of IDCAMS enables re-specification of selected processing defaults as well as the ability to manage input/output operations for selected files.

Invoking Macro Instructions

IDCAMS may be invoked from a program by loading the root segment of IDCAMS into virtual storage and then doing a branch entry to the module. To load IDCAMS, the program should be invoked with the SIZE=AUTO parameter on the EXEC statement, and should issue a CDLOAD macro of the form:



where address specifies the address of an 8-byte left-justified character string 'IDCAMS'.

CDLOAD returns the starting address of the module in Register 1.

The invoking program should branch to the address returned by CDLOAD plus 6.

Because IDCAMS uses MVS linkage conventions, the invoking program must provide an 18 fullword area to be used as a save area by IDCAMS. On entry to IDCAMS, Register:

- 1 should point to the argument list described in Figure 48 on page 306.
- 13 should point to the save area.
- 14 must contain the return address.
- 15 must contain the address of IDCAMS plus 6.

On return, all registers except Register 15 are restored by IDCAMS. Register 15 contains the final return code from the processor. The following table contains the possible values of Register 15:

Code
Meaning

0
The function was executed as directed and expected. Informational messages may have been issued.

4
Some disturbance in executing the complete function was met, but it was possible to continue. The results might not be exactly what the user wants, but no permanent harm appears to have been done by continuing. A warning message was issued.

8
A function could not perform all that was asked of it. The function was completed, but specific details were bypassed.

12
The entire function could not be performed.

16
Severe problem encountered. Remainder of command stream is not flushed but processor returns code 16 to the system.

Figure 48 on page 306 describes the argument list as it exists in the user's area that is passed to the IDCAMS processor.

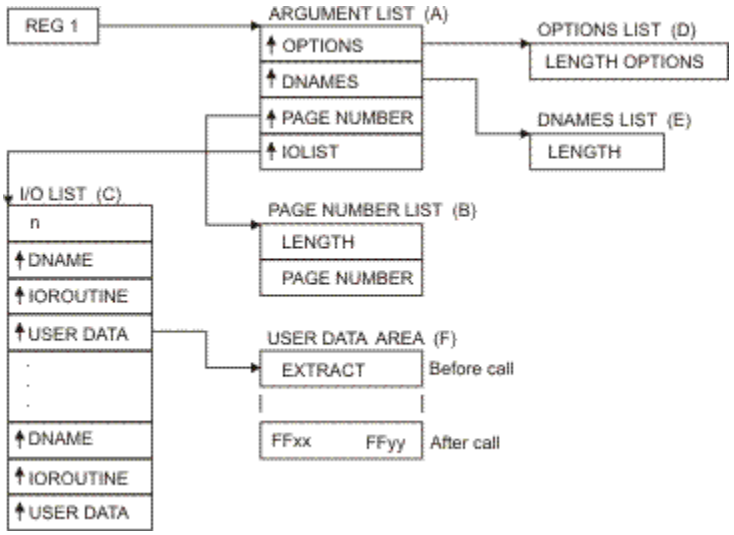


Figure 48. Processor Invocation Argument List from a Program

Explanation

The following explains Figure 48 on page 306.

- **(A) The Argument List**

  A maximum of four fullword addresses pointing to the various arguments. The high-order bit of the last address must be set to one. Any argument you do not wish to specify that precedes an argument you are specifying must be an address pointing to a half word of binary zeros. If you do not specify IOLIST, turn on the high-order bit in PAGE NUMBER.

- **(B) The Page Number List**

  - LENGTH: Halfword that specifies the number of bytes in the PAGE NUMBER field.
  - PAGE NUMBER; Optional: Provides a way to specify the starting page number for system output listing. If you do not wish to specify a starting page number, you must set the length field to binary zeros.

    PAGE NUMBER is a 1-4 byte character string that may specify the starting page number of system output listing. This value is reset to the current page number upon completion of the present invocation of the IDCAMS processor.

- **(C) The Input/Output List**

  Optional. Provides the means of identifying those files for which the invoker wishes to manage all I/O operations.

  n: A fullword that specifies the number of groups of three fields that follows. Every group consists of a DNAME address, an IOROUTINE address, and a USER DATA address.
  DNAME: Address of a character string that identifies a file that causes the invocation of the associated IOROUTINE for all I/O operations (including OPEN and CLOSE) against the file. The character string identifies the data set as follows: A 10-byte character string, the first two characters are 'DD', the next 8 characters are the DNAME field left-justified (padded with blanks if necessary), which may appear in the FILE, INFILE, or OUTFILE parameters of any IDCAMS command. The SYSIPT (DDSYSIPT) and SYSLST (DDTSYSLST) DLBL names may also appear if the Invoker wishes to manage these files.
  IOROUTINE: Address of the program that is to be invoked to process I/O operations upon the file associated with DNAME. This routine, instead of the processor, is invoked for all operations against the file. For information on linkage and interface conventions between the IOROUTINE and IDCAMS, see “User I/O Routines” on page 307, below.
  USER DATA: Address of a data area that the user may use for any purpose.

- **(D) The Options List**

  Required. Provides a way to specify processing options. If you do not wish to specify any options, you must set the length field to binary zeros.

  LENGTH: Halfword that specifies the number of bytes in the options field.

  OPTIONS: Character string that contains the processing options of the Access Method Services (AMS) PARM command. The options must comply to the parameter syntax of the IDCAMS PARM command.

- **(E) The DNAMES List**

  Optional. This value must be a halfword of binary zeros.

- **(F) USER DATA AREA**

  As long as no return or reason codes are inserted, the *user data area* (8 bytes) contains the character string **EXTRACT**.

  If return or reason codes are inserted, the meaning is as follows:

  FF = Valid return or reason code follows.
  xx = Catalog return code in hexadecimals.
  yy = Catalog reason code in hexadecimals.

User I/O Routines

User I/O routines enable a user to perform all I/O operations for a file that would normally be handled by the IDCAMS processor. This makes it possible, for instance, to control the command input stream by providing an I/O routine for SYSIPT.

A user I/O routine is invoked by IDCAMS for all operations against the selected files. The identification of the files and their associated I/O routines is via the Input/Output list of the processor invocation parameter list (Figure 48 on page 306).

When writing a user I/O routine, the user must be aware of three things. First, the processor handles the user file as if it were a nonVSAM file that contains undefined records (maximum record length is 32760 bytes) with a physical sequential organization. The processor does not test for the existence of the file. Second, the user must know the data format so that the user's routine can be coded to handle the correct type of input and format the correct type of output. Third, every user routine must handle errors encountered for files it is managing and provide to the processor a return code in register 15. The processor uses the return code to determine what to do next.

The permissible return codes are:

- 0 – operation successful
- 4 – end of data for a GET operation
- 8 – error encountered during GET/PUT operation, but continue processing
- 12 – do not allow any further calls (except CLOSE) to this routine

Figure 49 on page 308 shows the argument list used in communication between the user I/O routine and the IDCAMS processor. The user I/O routine is invoked by the processor for OPEN, CLOSE, GET and PUT routines. The type of operation to be performed is indicated via the IOFLAGS. The IOINFO field indicates, for OPEN and CLOSE operations, the filename of the DLBL or TLBL statements for the file. For GET and PUT operations, the IOINFO field is used to communicate the record length and address.

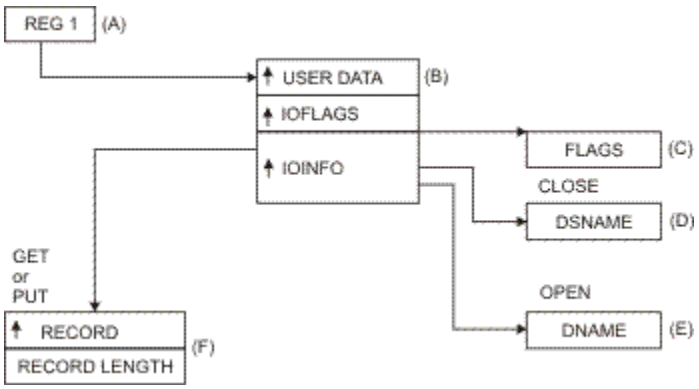


Figure 49. Arguments Passed to and from a User I/O Routine

Explanation

The following explains Figure 49 on page 308.

- **(A) Register 1**

  When IDCAMS gives control to the PUT I/O routine pointed to by the IOROUTINE, Register 1 points to an IDCAMS argument list. Refer to Figure 48 on page 306.

- **(B) User Data**

  The user data pointer is obtained from the input/output list of the processor invocation parameter list. The user data area contains the character string EXTRACT, or return or reason codes. Refer to Figure 48 on page 306.

- **(C) Flags**

  The following explains the fullword of FLAGS:

Byte	Value or Bit Pattern	Meaning
1*	0	OPEN
	4	CLOSE
	8	GET
	12	PUT
2	1.....	OPEN for Input
	.1....	OPEN for Output
	..1...	On OPEN, indicates that IOINFO contains the address of a DLBL or TLBL file name.
3, 4**	0	A normal data record is to be written.
	N	If an IDC message is to be written, the message serial number converted to binary.

  * Operation only.

  ** Record type for PUT only.

- **(D) DSNAME**

  A 44-byte field, left justified, and padded with blanks if necessary. It contains the name of the data set to be closed.

- **(E) DNAME**

An 8-byte field, left justified, and padded with blanks if necessary. It contains the DLBL or TLBL file name.

- **(F) RECORD and RECORD LENGTH**
  - For a GET: The information is returned to the processor by the user's I/O routine in the 8-byte area passed to the routine. Where:

    RECORD: Address of the retrieved record.
    RECORD LENGTH: Fullword length of the retrieved record.

  - For a PUT: The processor gives the information to the user's I/O routine. Where:

    RECORD: Address of the record to be written.
    RECORD LENGTH: Fullword length of record to be written.

Appendix C. Advantages of the ISAM Interface Program (IIP)

This Appendix ...

Is for users of ISAM who want to **convert** from ISAM to VSE/VSAM.

The information helps you to decide whether your existing ISAM processing programs can use the *ISAM Interface Program (IIP)* to process files that have been converted from ISAM format to VSE/VSAM format.

The IIP minimizes your conversion costs and scheduling problems by permitting ISAM programs to process VSE/VSAM files. Also, through IIP, ISAM programs can process ISAM files and VSE/VSAM files concurrently.

Comparison of VSE/VSAM and ISAM

In most cases, you can get better performance with VSE/VSAM while achieving essentially the same results that can be achieved with ISAM. Furthermore, VSE/VSAM can achieve results that cannot be achieved with ISAM.

The extent to which you can use your existing ISAM processing programs to process key-sequenced files relates to the similarities between ISAM and VSE/VSAM, as well as to limitations of the IIP.

The following describes the similarities and differences between VSE/VSAM and ISAM in the areas that you are familiar with from using ISAM, and outlines the functions of VSE/VSAM that have no counterpart in ISAM.

Differences Between ISAM and VSE/VSAM

A number of things that ISAM does are done differently or not at all by VSE/VSAM, even though similar results are achieved. The following describes the areas in which VSE/VSAM and ISAM differ.

Index Structure

Both a VSE/VSAM key-sequenced file and an indexed-sequential file have an index that consists of levels, with a higher level controlling a lower level. In ISAM, either all or none of the index records of a higher level can be kept in storage. VSE/VSAM keeps individual index records in storage during processing, the number depending on the amount of buffer space provided.

Relation of Index to Data

The relation of a VSE/VSAM index to the direct access storage space whose records it controls is quite different from the corresponding relation for ISAM, in particular with regard to overflow areas for record insertion.

ISAM keeps a two-part index entry for every primary track on which a file is stored. The first part of the entry indicates the highest-keyed record on the primary track. The second part indicates the highest-keyed record from that primary track that is in the overflow area, and gives the physical location in the overflow area of the lowest-keyed overflow record from that primary track. All the records in the overflow area from a primary track are chained together, from the lowest-keyed to the highest-keyed, by pointers that ISAM follows to locate an overflow record. Overflow records are unblocked, even if primary records are blocked.

VSE/VSAM does not distinguish between primary and overflow areas. A control interval (CI), whether used or free, has an entry in the sequence set, and after records are stored in a free CI, it is processed

in exactly the same way as other used CIs. Data records are blocked in all CIs and addressed, without chaining, by way of an index entry that contains the key (in compressed form) of the highest-keyed record in a CI.

Defining and Loading a File

All VSE/VSAM files are defined in a catalog. Records are loaded into a file with IDCAMS or with the processing program, in one execution or in stages. When loading new records into an empty key-sequenced file, the index is built automatically. IDCAMS does not merge input files. For a key-sequenced file, however, input records are merged in key sequence with existing records of the output file.

Deletion of Records

With ISAM, records cannot be deleted until the file is reorganized; you must mark the records you want to delete.

VSE/VSAM automatically reclaims the space in a key-sequenced file and combines it with any existing free space in the affected CI. VSE/VSAM's use of distributed free space for insertions and deletions requires less file reorganization than ISAM does.

VSE/VSAM Functions That Go Beyond ISAM

VSE/VSAM Functions Available through IIP

Secondary Allocation of Storage Space

When you define a VSE/VSAM file, you can specify the amount of direct access storage space that is to be allocated automatically, when required, beyond the primary space allocation. You can specify the amount of secondary space in number of data records, or in number of blocks (for FBA), or tracks or cylinders (for CKD).

Automatic File Reorganization

VSE/VSAM partially reorganizes a key-sequenced file by splitting a control area (CA) when it has no more free control intervals (CIs) and if one is needed to insert a record. VSE/VSAM allocates a new CA and gives it the contents of approximately half of the CIs of the old CA; about half of the CIs of every CA are then free.

Key Range Allocation

With a multiple volume key-sequenced file, you can assign data to various volumes according to the ranges of key values in the data records. For example, for a file that resides on three volumes, you might assign keys A-E to the first volume, F-M to the second volume, and N-Z to the third.

Automatic CLOSE

Because it is essential for the integrity of a file that it be closed properly, VSE/VSAM attempts to close all open VSE/VSAM files within the partition at both normal or abnormal termination of the job step. It also restores control blocks to their status before the file was opened, and it frees storage that open routines used for VSE/VSAM control blocks.

Job Control

ASSGN or EXTENT statements are not required for file access. The IIP supports disposition processing (DISP parameter on DLBL statement) for reusable and dynamic files.

VSE/VSAM Functions Requiring Conversion from ISAM

If you convert your ISAM programs to VSE/VSAM, the following additional VSE/VSAM functions become available to you.

Addressed Sequential Access

With VSE/VSAM, you can retrieve and store the records of a key-sequenced file by relative byte address (RBA), as well as by key. With ISAM you can position by physical address, but you must retrieve in a separate request.

Direct Retrieval by Generic Key

With VSE/VSAM, you can retrieve a record directly, not only with a full-key search argument, but also with a generic search argument. ISAM can only position a record by generic argument; you must retrieve the record separately.

Concurrent Request Processing

A processing program can issue concurrent requests for a single ACB. The requests can be sequential or direct, or both, for the same part or different parts of the file. VSE/VSAM maintains a position in the file for every concurrent request.

No Abnormal Terminations by OPEN

The VSE/VSAM OPEN routine does *not* abnormally terminate the user program, but returns an explanatory message in all cases where it cannot carry out a request to open a file.

Alternate Indexes for Key-Sequenced and Entry-Sequenced Files

Instead of only one index, you can build several indexes (called alternate indexes) for a single data file. Every index can access the file in a different way so that you need not keep multiple copies of the same information organized differently for different applications.

Variable-Length and Spanned Records

In addition to fixed-length records, VSE/VSAM supports variable-length and spanned records.

Skip Sequential Access

You can process a key-sequenced file sequentially and skip records automatically, as though you were using direct access.

Preparations and Using the ISAM Interface Program

Before you can use the IIP, you have to:

- Consider restrictions in the use of the IIP and VSE/VSAM
- Convert ISAM files to VSE/VSAM files, that is:
  - Define a VSE/VSAM file
  - Load ISAM files into the VSE/VSAM file

  For a summary on converting files and processing them, refer to Figure 50 on page 316.
- Change ISAM job control statements

Step 1: Consider Restrictions in the Use of IIP and VSE/VSAM

Most programs that use ISAM require little or no modification for using the IIP to process VSE/VSAM files. It is suggested that you evaluate your existing ISAM programs in terms of your requirements, and in terms of their suitability to use the IIP.

The following lists prerequisites for using the IIP, and those ISAM functions for which there is no VSE/VSAM equivalent or which cannot be simulated by the IIP.

- The program must run successfully under ISAM. IIP does not check for parameters that are invalid for ISAM.
- The program must use standard ISAM interfaces.
- Record ID processing of ISAM cannot be used because VSE/VSAM does not use the record ID functions.
- VSE/VSAM does not return device-dependent information or the storage or disk address of the record containing the error in the ERREXT parameter list.
- VSE/VSAM always assumes EXTEND mode when loading a file. If you try to reload an existing file, VSE/VSAM returns a sequence error code to you. You must DELETE and DEFINE the file (or specify DISP=NEW to reset a reusable file) before reloading it.
- The ISAM program cannot open a DTF while another ISAM DTF or VSE/VSAM ACB is already open for output processing for the same file unless VSE/VSAM SHAREOPTIONS(3) was specified for the file. If you select SHAREOPTIONS (3), you must accept the responsibility of maintaining file integrity. SHAREOPTIONS(4) may also be valid if the records accessed concurrently are not in the same CA.
- Files defined with SHAREOPTIONS(4) cannot be shared between IIP users in different systems because IIP always opens a file for output. Note that another system can open the file for input using native VSE/VSAM access.

Ensure that your existing ISAM programs comply with the restrictions described above. If they comply, there is no need to assemble or link-edit these programs again.

Step 2: Define a VSE/VSAM File

Define a key-sequenced VSE/VSAM file by using the IDCAMS command DEFINE CLUSTER, described in the publication VSE/VSAM Commands, SC34-2707. Note the following information for specifying the command:

Data Space

You may define the file on a volume that already contains enough free VSE/VSAM data space for it, or you may define data space when you define the file (unique file).

Buffer Space

The BUFFERSPACE parameter in the DEFINE command specifies how much space VSE/VSAM will have for I/O buffers. If you do not specify the BUFFERSPACE parameter, the default is at least two data buffers and one index buffer. For better performance, however, you can specify space for more than two data buffers and one index buffer.

Reusable File

If you have a file that requires rebuilding, initially specify the REUSE parameter in the DEFINE command. When reloading the file, specify DISP=NEW in the DLBL statement.

DTFIS Parameters and DEFINE Command Relationship

For VSE/VSAM, some of the information given in the DTFIS parameters must be specified correctly in the DEFINE command, because the value specified in the command overrides the DTF. These parameters and the corresponding DEFINE command options are:

DTFIS Parameter	DEFINE Option
HOLD=YES	SHAREOPTIONS(4).
KEYLEN=n and KEYLOC=n	KEYS (length, offset) • length should always be set to KEYLEN. • offset should be set to: – KEYLOC-1 if DTFIS RECFORM=FIXBLK – 0 if RECFORM=FIXUNB
RECSIZE=n	RECORDSIZE (average, maximum). The average and maximum values must be equal. If (in the DTFIS): • RECFORM=FIXBLK, you should set RECORDSIZE to RECSIZE. • RECFORM=FIXUNB, you should set RECORDSIZE to RECSIZE + KEYLEN.
VERIFY=YES	WRITECHECK.

The IIP uses the following DTFIS parameters (all other parameters are ignored):

```
ERREXT=YES   (for a description of the ERREXT parameter
              with IIP, see Table 41 on page 317)
IOAREAL=name (used when IOROUT=LOAD)
IOAREAS=name (used if SETL BOF is issued)
IOREG=(r)
IOROUT=LOAD, ADD, RETRVE, ADDRTR
KEYARG=name
RECFORM=FIXUNB, FIXBLK
WORKL=name
WORKR=name
WORKS=YES
```

Step 3: Load the VSE/VSAM File

After you have defined the VSE/VSAM file, load the file by copying your existing ISAM file into it. To do so, you may use one of the following:

- Your ISAM load program, by way of the IIP
- The IDCAMS command REPRO, described in the publication VSE/VSAM Commands, SC34-2707.

Note:

1. Do not move files from ISAM to tape and then from tape to VSE/VSAM.
2. The REPRO procedure must be from disk to disk.
3. If you have records marked for deletion in the ISAM file and do not want them copied into the VSE/VSAM file, you should use your ISAM load program, because the REPRO command copies all records from the ISAM file, including those marked for deletion.
4. REPRO of a fixed, unblocked ISAM file creates records consisting of the original record preceded by its key. The IIP strips this leading key when a program that specifies fixed unblocked ISAM is executed, and returns only the original record to you. The leading key is returned with the record, however, when the file is accessed in native VSE/VSAM mode.

Step 4: Changing ISAM Job Control Statements

To satisfy the requirements of VSE/VSAM, you have to replace the job control statements for ISAM by job control statements for VSE/VSAM.

The following is an example of VSE/VSAM job control statements used with an ISAM program:

```
// JOB    PROCESS A VSE/VSAM FILE
// DLBL   IFN,'MSTRFILE',,VSAM
// EXEC   ISAMPGM,SIZE=nK
  .
  .   SYSIPT data for the program ISAMPGM
  .
/*
/&
```

One DLBL statement is required for the file; it connects the ISAM filename (IFN) to the VSE/VSAM cluster name (MSTRFILE) stored in the catalog. The DLBL type code parameter (VSAM) causes the *ISAM Interface Program* to be called. The same VSE/VSAM job control statements are required regardless of the type of ISAM program.

What the ISAM Interface Program Does

When a processing program that uses ISAM opens a VSE/VSAM file, the VSE open routine detects the need for the IIP by the type code "VSAM" specified in the DLBL statement. The processing program calls the IIP OPEN routine to:

- Build control blocks required by VSE/VSAM
- Load the ISAM command processor
- Flag the DTFIS for the IIP to intercept ISAM requests

Figure 50 on page 316 summarizes the steps required to convert indexed sequential files to key-sequenced files and processing them either with programs that have been converted from ISAM to VSE/VSAM, or with programs that still use ISAM.

Most existing processing programs that use ISAM can process VSE/VSAM files through the *ISAM Interface Program* (IIP) with little or no change.

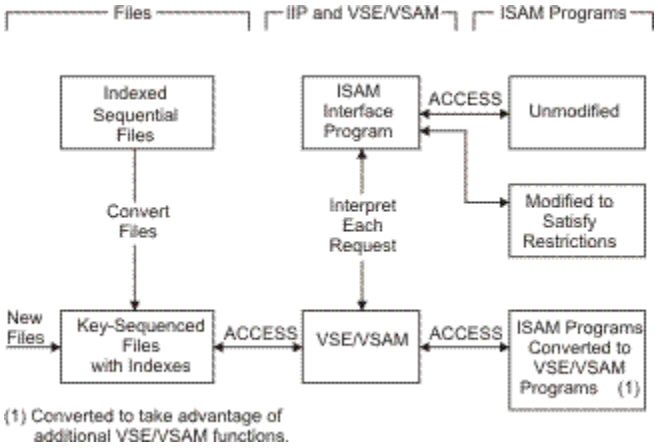


Figure 50. Using the ISAM Interface Program

The IIP intercepts every subsequent ISAM request, analyzes it to determine the equivalent keyed VSE/VSAM request, which it defines in the RPL constructed by OPEN, and then initiates the request.

The IIP interprets VSE/VSAM's return codes and, if the VSE/VSAM condition corresponds to an ISAM condition, turns on the respective bit in the filenameC byte in the DTFIS. For irrecoverable errors that cannot be posted in the filenameC byte, the IIP prints a message, closes the VSE/VSAM file (by the VSE/VSAM CLOSE routine), and ends the job. If a physical I/O error occurs and ERREXT=YES was specified in the DTFIS, the IIP transfers additional error information to the processing program. Table 41 on page 317 shows the format of the ERREXT parameter list.

Table 42 on page 317 and Table 43 on page 317 show the formats of the filenameC byte for ISAM processing through the IIP.

Table 41. ERREXT Parameter List for ISAM Programs with IIP

Bytes	Bits	Contents
0-3	-	DTF address
4-15	-	Not supported by the IIP
16	0	Data
	1	VSE/VSAM sequence set
	2	VSE/VSAM index set
	3-5	Not used
	6	Read operation
	7	Write operation
17	-	Not supported by the IIP

Table 42. FilenameC with IIP when IOROUT=ADD, RETRVE, or ADDRTR

Bit	Cause in ISAM	Cause in IIP/VSAM
0	Disk error	Disk error
1	Wrong length record	Not set
2	End of file	End of file
3	No record found	No record found
4	Illegal ID specified	Not supported by IIP
5	Duplicate record	Duplicate record
6	Overflow area full	No more VSE/VSAM data space available
7	Overflow	Not set

Table 43. FilenameC with IIP when IOROUT=LOAD

Bit	Cause in ISAM	Cause in IIP/VSAM
0	Disk error	Disk error
1	Wrong length record	Not set
2	Prime data area full	No more VSE/VSAM data space
3	Cylinder index area full	No more VSE/VSAM data space
4	Master index full	No more VSE/VSAM data space
5	Duplicate record	Duplicate record
6	Sequence check	Sequence check
7	Prime data area overflow	Not set **Note:** If there is no more VSE/VSAM data space, bits 2 through 4 are set.

Appendix D. Compatibility With Other Products

This Appendix...

Describes what to avoid so as not to endanger the portability of VSE/VSAM files to other systems.

Describes similarities between VSE/VSAM and ACF/VTAM.

Portability of VSE/VSAM Files to DFSMSdfp VSAM

You can port files and volumes to MVS if you avoid the use of device types, file types, and functions that are not supported by MVS.

The following functions are not supported by DFSMSdfp VSAM:

- *VSE/VSAM Space Management for SAM Function*
- EXTOPT parameter of the SHOWCAT macro
- IDCAMS CANCEL command
- SYNCHK parameter of the PARM command
- IGNOREERROR parameter of the DELETE command
- %%-function in the NAME parameter of the DEFINE CLUSTER command that gives a certain partition- or processor independence to the cluster.

Other critical functions are listed below and explained afterwards.

- FBA support
- Dedicated VSE/VSAM volume
- Data space classification
- Default models
- Default volumes
- Multiple volume ownership
- Catalog check services
- VSE/VSAM Backup/Restore Function
- Device Dependency
- VSE/VSAM data compression

FBA Support

Files on an FBA device cannot be processed by MVS. This does not affect the processing of catalog entries or files for a CKD device.

Files on an FBA device can be transferred (through EXPORT and IMPORT) from VSE/VSAM to a CKD device on an MVS system and vice versa.

Dedicated VSE/VSAM Volume

The DEDICATE parameter in the DEFINE commands is not supported by MVS. However, a volume allocated to VSE/VSAM with the DEDICATE parameter can be processed by MVS.

Data Space Classification

Space class specifications are not supported by MVS, but a file, data space, or volume with space classes under VSE/VSAM can be processed by MVS/VSAM.

MVS/VSAM files can be transported to VSE/VSAM volumes defined with classes.

Default Models

They allow users of IDCAMS to choose their own parameter defaults. Default models are not supported by MVS/VSAM; however, the resultant file and catalog data can be processed by MVS.

Default Volumes

They allow users to omit explicit volume lists in the DEFINE CLUSTER and DEFINE ALTERNATEINDEX commands. Also, the parameter DEFAULTVOLUMES is provided in the IMPORT command to allow users to override the exported volumes list. The required volumes are selected from the volumes list associated with the default model.

The command functions are not supported by MVS; however, the resulting file and catalog data can be processed by MVS.

Multiple Volume Ownership

Multiple catalogs can own space on the same disk volume, providing that only one catalog resides on that volume.

After you use VSE/VSAM to define, on one volume, several spaces belonging to different catalogs, you can perform the following activities while running on MVS:

- Define or delete a file in the space belonging to any one of the catalogs.
- Access any file.
- Define additional space belonging to any one of the catalogs.
- Define a UNIQUE file belonging to any one of the catalogs.
- Delete a UNIQUE file.

Do not issue a DELETE SPACE, DELETE MASTERCATALOG, or DELETE USERCATALOG whenever spaces belonging to different catalogs reside on the volume. If you were to do this, the spaces belonging to other catalogs would be deleted from the volume, but their catalog entries would remain.

Catalog Check Services

Automatic Catalog Check

This service examines VSE/VSAM catalogs containing DFSMSdfp files (alias and generation data group), but it can validate only their horizontal and vertical extension chains. It does not check associations or volume information for DFSMSdfp files.

Backup/Restore

Backup/Restore first verifies that an MVS/VSAM file to be backed up can be successfully restored. In cases where restoration is not possible, VSE/VSAM ignores the backup request and, instead, issues a message.

The IDCAMS commands BACKUP and RESTORE are not supported by IDCAMS under MVS/VSAM.

Device Dependency

VSE/VSAM treats the IBM 3995 Model 151 Optical Library Dataserver as an IBM 3390 Model 2 direct access storage device. However, a VSE/VSAM catalog that resides on an IBM 3995 Model 151 Optical Library Dataserver cannot be shared with a DFSMSdfp system.

VSE/VSAM Data Compression

VSE/VSAM compressed files can be ported to an MVS system using the EXPORT and IMPORT or REPRO functions. The portable data set will be in uncompressed format.

Compatibility of VSE/VSAM with DFSMSdfp VSAM

ICF catalogs created under DFSMSdfp VSAM are incompatible with the VSE/VSAM catalog, and VSE/VSAM cannot process them. Compatibility of files, IDCAMS job streams, and VSE/VSAM user programs is unchanged.

Similarities between VSE/VSAM and ACF/VTAM

IBM VTAM is an access method for teleprocessing. There is considerable similarity between the two access methods (VSE/VSAM and ACF/VTAM) regarding control block names and fields, control block manipulation, and general approach to request handling.

Both access methods use an ACB. The VSE/VSAM ACB represents the file. In VTAM, however, the ACB essentially represents an application program. Both types of ACBs are objects of the OPEN macro instruction, and VSE/VSAM and VTAM ACBs can be opened with one macro instruction.

Both types of ACBs can contain pointers to an exit list. Both VSE/VSAM and VTAM exit lists contain addresses of routines to be entered when error conditions occur (LERAD and SYNAD exit routines) and addresses of routines to be entered when special situations occur.

Both access methods follow the same general I/O-request procedure. An I/O macro instruction is issued that indicates an RPL. The RPL in turn contains information about the request, such as the location of the I/O work area or whether the request is to be handled synchronously or asynchronously.

Finally, both access methods use the same macro instructions (GENCB, MODCB, TESTCB, and SHOWCB) to generate and manipulate their respective ACB, EXLST, and RPL control blocks.

To make control blocks unique, a special parameter is used when the control block is generated. By specifying AM=VTAM on the ACB, EXLST, or RPL macro instruction, the control block is generated in VTAM form. Omitting this parameter causes a VSE/VSAM control block to be built. A VSE/VSAM control block will also be built if AM=VSAM is specified. If an installation uses both of these access methods, it may be desirable to have AM=VSAM specified in VSE/VSAM programs for documentation purposes.

Appendix E. VSE/VSAM Labels

This Appendix ...

Provides **conceptual** information on the **labels** that are used with VSE/VSAM for identifying volumes, data space, and files. It explains how the labels are processed, and includes **definition examples** relating to job control and IDCAMS commands.

Types of VSE/VSAM Labels

VSE/VSAM maintains identifying information for its files in a central location called the VSE/VSAM catalog. Volumes that contain VSE/VSAM files have the same internal labels as other volumes. Most of the identifying information for VSE/VSAM files, however, is in the VSE/VSAM catalog.

VSE/VSAM uses a:

- Volume label (VOL1)
- Data space label and its continuation (format-1 and format-3)
- VTOC label (format-4)

User-standard labels are not supported. Neither is the F-5 label, but space is reserved for it on the VTOC for the purpose of MVS/SP compatibility.

Volume Label

The *volume label* (VOL1) is generally written during initialization. At that time, a permanent volume number is written on the volume as part of the label to give the volume a permanent ID.

Data Space Label

The VSE/VSAM *format-1 VTOC label* describes direct access space; the characteristics of the logical files that occupy that space are described in the VSE/VSAM catalog.

There is a format-1 label for every VSE/VSAM data space that is on the volume. Every data space consists of one or more separate extents:

- Up to three extents are described in the format-1 label.
- Extents additional to the first three extents are described in a format-3 label; the format-3 label is pointed to by the format-1 label. (Refer to “Space Continuation Label” on page 323.)

Usually, you do not name a VSE/VSAM data space, because VSE/VSAM automatically assigns a name to the data space. This name is placed into byte 1 through 44 of the key area (called the *44-byte key area*). However, if you allocate a data space to contain the data or the index of only one specific VSE/VSAM file (called a *unique* file), the 44-byte key area will contain the name given to the data or the index when you define it.

When a new VSE/VSAM data space is created (IDCAMS command DEFINE), existing format-1 and format-3 labels are read and checked, and new labels are created by the catalog and space management routines.

Space Continuation Label

A *format-3 VTOC label* is written whenever a VSE/VSAM data space occupies more than three separate areas (extents) of a volume. It is used to supply the limits (starting and ending addresses) of the

additional extents. Thirteen separate extents can be defined by one format-3 label. This label is pointed to by the format-1 label.

VTOC Label

A *format-4 VTOC label* defines the *volume table of contents* (VTOC). Also, if a volume contains VSE/VSAM spaces, the label defines the volume as a *VSE/VSAM volume*.

The format-4 label is always the first record in the VTOC. The record is written when you initialize your disk pack by using the *IBM Device Support Facilities (ICKDSF)*. For details, refer to the Device Support Facilities (ICKDSF) User's Guide and Reference.

The OPEN/CLOSE routines refer to the format-4 label to determine the extent of the VTOC.

The format-1 and format-3 labels are stored in the VTOC and are processed as described under "VTOC Label Processing" on page 325.

Location of Labels

Volume Layouts

Each volume has a VTOC that contains labels for the data spaces.

Figure 51 on page 325 shows two volumes that contain VSE/VSAM data spaces (1, 2, and 3). The figure illustrates the relationship between volumes, VSE/VSAM data spaces, and labels in the VTOC. Specifically:

- The two volumes contain the VSE/VSAM data spaces 1, 2, and 3. Each volume has a VTOC that describes the data spaces owned by VSE/VSAM. The files are described in the VSE/VSAM catalog.
- *Data Space 2* is occupied by *File A*; this file is assumed to be a *unique* file. If a unique file occupies a data space, no other file can be suballocated in the data space, and File A cannot be extended to any other data space.
- The 44-byte name field of the label for Data Space 2 contains the name (the file-ID) of file A. The 44-byte name fields of the other data spaces contain the data space name that is automatically generated by VSE/VSAM

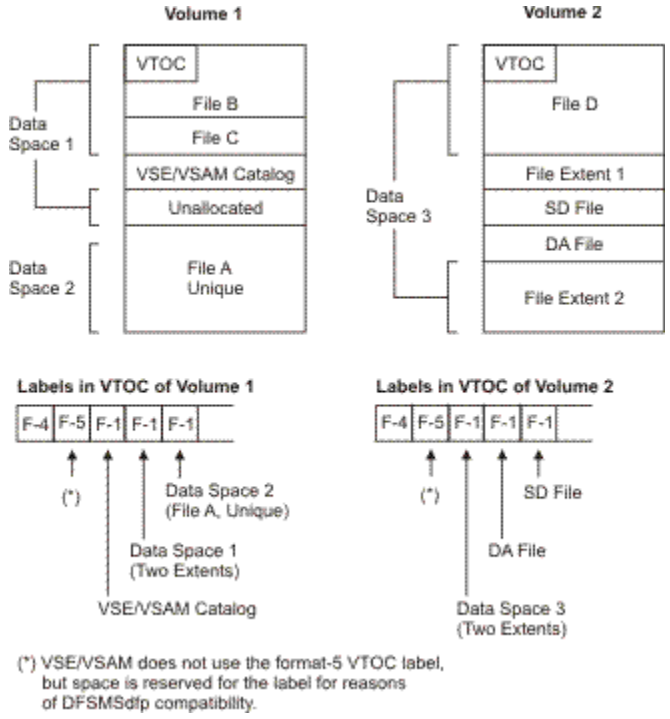


Figure 51. Volume Layouts of VSE/VSAM Files

Label Information Area

VSE/VSAM file label information, and standard labels for a user catalog, can be submitted following // OPTION STDLABEL=ADD or // OPTION PARSTD=ADD. VSE/VSAM searches the partition temporary user label area (USRLABEL), the partition standard label area (PARSTD), and the system standard label area (STDLABEL), in that order. Thus, it is possible to override permanent label sets for a single job by submitting the new label set under

// OPTION USRLABEL. The default is // OPTION USRLABEL and can be omitted.

VTOC Label Processing

VSE/VSAM Data Spaces

The format-1 and format-3 VTOC labels describe VSE/VSAM data spaces. A data space consists of one or more extents on a single volume allocated to VSE/VSAM and controlled by a VSE/VSAM catalog. VSE/VSAM files are written in data spaces.

Even if it does not contain any files, a data space is owned by VSE/VSAM and is not available for files of other access methods.

Label processing is done when data spaces (including catalogs and unique files) are created or deleted, and during ALTER NEWNAME for unique files.

The format-1 and (if needed) format-3 VTOC labels are created and checked (for overlap or duplicate name) only when data spaces are created (including data spaces for unique files). If data spaces are deleted, their format-1 and format-3 labels are removed from the VTOC. Labels are also altered during RESETCAT processing if the data in the label and the catalog do not agree. When VSE/VSAM files are processed, the VSE/VSAM catalog is used for checking the location and characteristics of the files.

VSE/VSAM Files

VTOC label processing takes place only for *unique* VSE/VSAM files that are defined, deleted, or renamed.

VSE/VSAM files are normally defined after data spaces have been defined. The direct access space for the files is suballocated by VSE/VSAM from one or more data spaces. You may select the volume or volumes the file will reside on. You tell VSE/VSAM how much space to suballocate to the file initially and, optionally, how much additional space to suballocate when the file must be extended. VSE/VSAM decides which data spaces or portions of data spaces to suballocate to a file.

You can, however, specify the size and exact location of the file when you define it. In this case, the file is called *unique* and occupies its own data space which is defined when the file is defined. No other files can occupy that data space. If the file extends across more than one volume, it occupies one data space on every volume. The format-1 and format-3 labels still describe the data space(s) occupied by the unique file. A key-sequenced unique file requires separate data spaces for the data and the index components.

The *file-ID* parameter of the // DLBL statement (if specified) indicates the file you want to process. It is the same as the name of the file, stored in the catalog, which was specified in the NAME(entryname) parameter of the DEFINE statement. For VSE/VSAM data spaces, the format-1 label contains a data space name that is generated by VSE/VSAM.

VTOC Labels for FBA Devices

The physical block is the basic unit of storage on an FBA device. A disk address is a physical block number relative to the beginning of the volume.

A VTOC for an FBA is divided into control intervals (CIs) of the VSE/VSAM relative record format; the VTOC labels reside in these CIs. There is a slot for the VTOC label and its corresponding RDF in the CI. The CI size is a multiple of FBA block size; a CI always starts on a block boundary. Specify VTOC size through the DSF program.

The VOL1 label contains the VTOC CI size, the number of blocks per CI, and the number of labels per CI. VTOC labels are referenced according to relative record number (beginning with 1).

VSE/VSAM Data Space

VOL1 Label Processing

The VSE/VSAM VOL1 label fields are the same as for the other access methods.

The standard volume label (VOL1) must be located as follows:

- For CKD: on cylinder 0, track 0, record 3 (CKD).
- For FBA: in physical block 1.

  This block is called the *volume label block*.

If the VOL1 label is not located correctly, the job is cancelled.

The VOL1 label, written by the IBM Device Support Facilities (ICKDSF) program, contains a permanent volume number.

If any additional volume labels follow the VOL1 label, VSE/VSAM ignores them.

From the VOL1 label, VSE/VSAM determines the location of the VTOC.

Format-1 VTOC Label Processing for Unique Files

You must supply one // DLBL statement when creating a unique file and one // EXTENT statement for every separate extent on the volume that the data space will occupy. A multivolume unique file requires only one // DLBL statement, even though it occupies a data space on every volume.

// DLBL Statement

The // DLBL statement for defining a data space under VSE/VSAM requires only the filename parameter and the VSE/VSAM code. The // DLBL *filename* is identical to the *dname* specified in the FILE parameter of the DEFINE command.

The *file-ID* parameter is not required and is ignored if you specify it. The *date* parameter can be specified, but it has no real function. VSE/VSAM data spaces and files can be deleted only by using the DELETE command of IDCAMS.

// EXTENT Statement

An // EXTENT statement defines a continuous extent of the volume that is to be allocated to VSE/VSAM. There can be up to 16 extents in a data space, and a data space is contained entirely on one volume.

The // EXTENT statement provides the starting address (relative address) and the number of tracks (CKD) or blocks (FBA), which indirectly give the ending address. The // EXTENT statement also provides the order in which this extent should be processed in a multiple-extent unique file.

VSE/VSAM validates the // EXTENT specifications by checking the extent limits against the limits of the format-4 label, and every format-1 and format-3 label already written in the VTOC. If the new extent overlaps an existing extent, VSE/VSAM issues a message to the operator. If the overlapped extent is part of a file of another access method (expired or unexpired), the operator can delete the file or terminate the job. If the overlapped extent is part of a VSE/VSAM data space (or unique file), the operator can only cancel the job. VSE/VSAM data spaces or files (expired or unexpired) can only be deleted through the IDCAMS command DELETE.

If all extents of the new unique file are valid, VSE/VSAM writes one (or two, for a KSDS) format-1 label, and (if necessary) the format-3 label into an available location in the VTOC.

For the data or the index of a unique file, you may specify a data space name in the DEFINE command. If specified, this name is entered in the catalog and in the label. Remember that even though the name of a unique file is entered in the labels of the data space it occupies, the information describing the file is in the catalog.

Bytes 45-60, 63-75, 83-84, and 94 are written in the format-1 label for VSE/VSAM. This information is for compatibility with the format-1 labels of other access methods; during processing, VSE/VSAM uses the catalog, rather than using information from the VTOC.

Bytes 106-115 define the first (or only) extent allocated to the unique file component. If there is more than one extent, bytes 116-125 define the second extent, and bytes 126-135 define the third extent. These fields are written from the // EXTENT statements you supply.

If you have included more than three // EXTENT statements, VSE/VSAM writes a format-3 label and writes the address of that label in the pointer field (bytes 136-140) of the format-1 label.

If the unique file is deleted, the format-1 label (and if present, the format-3 label) is removed from the VTOC.

Format-3 VTOC Label Processing

The VSE/VSAM format-3 label fields are the same as for the other access methods, but a VSE/VSAM data space can have only one format-3 label.

If more than three extents are required for the data space (or unique file), VSE/VSAM sets up a format-3 label for the additional extents. A data space can consist of up to 16 extents, so only one format-3 label is allowed. VSE/VSAM processes the extent fields of the format-3 labels in the same manner as those of the format-1 label.

If the data space is deleted, the format-3 label is removed from the VTOC, along with the format-1 label.

Format-4 VTOC Label Processing

The format-4 label describes the VTOC (it does *not* describe the files or data spaces of individual access methods). However, a VSE/VSAM *indicator field* (bytes 77-87) is written in the format-4 label of any volume that contains VSE/VSAM data spaces or unique files. This field (volume time stamp) indicates the date and time the most recent VSE/VSAM data space was added to or deleted from the volume. For MVS compatibility reasons, this time stamp is repeated in bytes 88-95.

The same date and time are entered in the catalog. VSE/VSAM OPEN routines check if the volume time stamp matches the time stamp for it in the catalog. If they do not match, processing continues, but an error code is issued to indicate that the VTOC might not agree with the data space information in the volume's catalog entry.

Bit 0 of byte 85 indicates that this volume is owned by a VSE/VSAM catalog. Either VSE/VSAM space was defined on the volume, or the volume was listed as a CANDIDATE volume in the DEFINE SPACE command.

If all VSE/VSAM data space is deleted from a volume, the VSE/VSAM indicator field (bytes 77-87) is erased. The deleted space can be used by other z/VSE access methods.

VSE/VSAM Files

Defining a File: Suballocating Data Space (Non-Unique Files)

When a *non-unique* file is defined, the space for it can be *suballocated* from one or more existing data spaces on one or more volumes. This is illustrated in Figure 53 on page 332. VTOC label processing is not performed for the following reasons:

- Information needed to set up the file is in the DEFINE command.
- Information about data spaces to be suballocated to the file is in the VSE/VSAM catalog.

The resulting description of the file is entered in the catalog. The // DLBL and // EXTENT statements are not required; they are ignored if specified for a catalog.

You indicate the volume(s) on which the file will reside, the amount of space to be initially suballocated to the file and, optionally, the amount of space to be suballocated if the file must be extended. VSE/VSAM selects the extent(s) on the volume on which to write the file. If you specify more volumes than necessary for the primary space, the additional volumes can be used when the file is extended, if they contain free data space.

If none of the volumes contains free data space, new data spaces must be defined, or volumes with free data space can be made available to the file through the IDCAMS command ALTER. You can indicate in which order the volumes should be used. You can also decide to place certain portions of the file (key ranges) on certain volumes. If the file must be extended, VSE/VSAM can use only the volumes you indicated. For further information, refer to “Multiple Volume Support” on page 94.

Volume Mounting

The volume containing the catalog must be mounted, but the volumes on which the file is defined need not be mounted. Additional information about volume mounting requirements appears in “Using an Object as a Model” on page 52.

File Loading

Loading a file is a separate step from defining it. Records can be loaded into a file by a VSE/VSAM processing program by using the PUT macro, or the IDCAMS command REPRO.

Defining a File: Unique

A unique file occupies space described in the VTOC through // DLBL and // EXTENT statements (all this is similar to unique files with other access methods). Defining a unique file is illustrated in Figure 54 on page 332.

The data space for a unique file is defined (implicitly) in the same DEFINE command as the file itself. Characteristics of the file (such as logical record length) are specified in the command, just as with a suballocated file. Space information is taken from // DLBL and // EXTENT statements instead of from the DEFINE command.

The data and index of a unique key-sequenced file or alternate index require separate data spaces, and hence, separate // DLBL and // EXTENT statements.

A unique file cannot be extended. The extents of the file are the same as the extents of the data spaces and, because they are described in the VTOC, cannot be changed without deleting the file.

Label processing is performed for the data spaces of a unique file as described under “VSE/VSAM Data Space” on page 326. The only difference is that the 44-byte names of the data and index are placed in the labels and in the file's catalog entry. The data spaces of unique files are described in the VSE/VSAM catalog as well as in the VTOC.

Processing a File

When a previously defined file is processed by a VSE/VSAM application program or by a PRINT or REPRO command, a // DLBL statement is required for the file.

The statement is retrieved by VSE/VSAM OPEN from the label area. OPEN obtains the // DLBL statement from the file name specified in the IDCAMS macro ACB in the processing program. All the information required to process the file is in the VSE/VSAM catalog or the label area; no VTOC processing is performed (see Figure 55 on page 332).

// DLBL Statement

The // DLBL statement is used to find the 44-byte name of the file in the catalog. The 44-byte name matches the file-ID parameter. For PRINT and REPRO and VSE/VSAM application programs, the CAT parameter is required only if you want to override the system's assumption that the job catalog, or, if there is none, the master catalog, owns the file. The function of the job catalog is explained under “Specifying a Job Catalog” on page 40.

Volume Mounting

If the volumes allocated to the file are not mounted, messages are issued to the operator to mount the required volumes or cancel the job. A file can span a maximum of 16 volumes. If a multivolume file is opened for direct or keyed-sequential processing, all volumes must be mounted. If it is opened for addressed-sequential processing, only one volume at a time need be mounted.

The first allocation made on every volume is always the primary allocation. VSE/VSAM extends a suballocated file if:

- Secondary space allocation was specified when the file was defined.
- No secondary space allocation was specified, but overflow volumes are specified in the VOLUMES parameter of the DEFINE CLUSTER command. In that case, the primary allocation is taken.
- A volume that contains or can contain part of the file has unused data space of the required class.

Use the IDCAMS command ALTER to make more volumes available to the file after it has been defined.

The VOL1 label is checked to verify that the correct volume is mounted (volume serial number), and the format-4 label is checked to verify that the catalog is at the proper level (volume time stamp). Processing for these labels is described under “VSE/VSAM Data Space” on page 326.

Job Stream Examples

In the following, **Figure 52 on page 331** through **Figure 55 on page 332** show examples of the job streams you must supply to:

- Define a data space
- Define a file in a catalog
- Define a unique file
- Process a file

Note:

1. In Figure 53 on page 332 through Figure 54 on page 332, further parameters are required in the DEFINE command to specify the characteristics (such as logical record length) of the VSE/VSAM file. These parameters are not shown, because they do not affect space allocation and label processing.
2. For the description of the IDCAMS command DEFINE, refer to the VSE/VSAM Commands , SC34-2707. More information about the job control statements required for VSE/VSAM is in “Use of z/VSE Job Control Statements for VSE/VSAM” on page 23.

Example - Define Data Spaces

Figure 52 on page 331 shows "samples" of the job streams you must supply to define data spaces. The figure shows allocation of an entire volume to VSE/VSAM (as a single data space), and allocation of a data space that is smaller than a single volume.

"Sample 3" and "Sample 6" show allocation of data spaces on different volumes of the same device type.

DEFINE command parameters supply the data space information.

For the master catalog, a // DLBL statement is required. In the samples, assume that the statement is in the label information area.

```
==== Sample 1: ====================================================
        // JOB      ALLOCATE A VOLUME TO VSE/VSAM
        * VOLUME IS OWNED BY MASTER CATALOG
        * ALL UNALLOCATED SPACE IS GIVEN TO VSE/VSAM
        // EXEC     IDCAMS,SIZE=AUTO
           DEFINE   SPACE(DEDICATE                  -
                    VOLUME(PAY001))
        /*
        /&

==== Sample 2: ====================================================
        // JOB      DEFINE A VSE/VSAM DATA SPACE
        * SPACE IS OWNED BY MASTER CATALOG
        // EXEC     IDCAMS,SIZE=AUTO
           DEFINE   SPACE(ORIGIN(760) TRACKS(570     -
                    VOLUME(PAY002))
        /*
        /&

==== Sample 3: ====================================================
        // JOB      DEFINE VSE/VSAM DATA SPACES ON SEVERAL VOLUMES
        * SPACES ARE OWNED BY USER CATALOG MYUCAT
        // DLBL IJSYSUC,'MYUCAT',,VSAM
        * DEFAULT ORIGIN USED FOR DATA SPACE ALLOCATION
        // EXEC     IDCAMS,SIZE=AUTO
           DEFINE   SPACE(TRACKS(190)               -
                    VOLUME(PAY003))
        /*
        /&
```

```
==== Sample 4: ====================================================
        // JOB      ALLOCATE A VOLUME TO VSE/VSAM
        * VOLUME IS OWNED BY MASTER CATALOG
        * ALL UNALLOCATED SPACE IS GIVEN TO VSE/VSAM
        // EXEC     IDCAMS,SIZE=AUTO
           DEFINE   SPACE(DEDICATE                  -
                    VOLUME(INV001))
        /*
        /&

==== Sample 5: ====================================================
        // JOB      DEFINE A VSE/VSAM DATA SPACE ON A VOLUME
        * SPACE IS OWNED BY MASTER CATALOG
        // EXEC     IDCAMS,SIZE=AUTO
           DEFINE   SPACE(ORIGIN(960) BLOCKS(2240)   -
                    VOLUME(INV002))
        /*
        /&

==== Sample 6: ====================================================
        // JOB      DEFINE VSE/VSAM DATA SPACES ON SEVERAL VOLUMES
        * SPACES ARE OWNED BY USER CATALOG MYUCAT
        // DLBL IJSYSUC,'MYUCAT',,VSAM
        * DEFAULT ORIGIN USED FOR DATA SPACE ALLOCATION
        // EXEC     IDCAMS,SIZE=AUTO
           DEFINE   SPACE(BLOCKS(3100)              -
                    VOLUME(DEV001))
        /*
        /&

==== Sample 7: ====================================================
        // JOB      DEFINE SPACES ON A VOLUME BELONGING TO TWO CATALOGS
        // EXEC IDCAMS,SIZE=AUTO
           DEFINE SPACE(VOLUME(SCRTC1) /* SPACE BELONGING TO MASTER CATALOG */  -
                  CYLINDERS(40) ORIGIN(171)) /* CYLINDERS 9-48               */
           DEFINE SPACE(VOLUME(SCRTC1) /* SPACE BELONGING TO USER CATALOG   */  -
                  DEDICATE )   /* THE REST OF THE SPACE AVAILABLE           */ -
                  CATALOG (MYUCAT)
        /*
        /&
```

Figure 52. Examples: Defining VSE/VSAM Data Spaces

Example - Define a File in a Catalog

Figure 53 on page 332 shows the job stream you must submit to define a file that is suballocated from an existing data space. This file is recorded in the master catalog.

```
// JOB     SUB-ALLOCATE VSE/VSAM FILE
// EXEC    IDCAMS,SIZE=AUTO
   DEFINE  CLUSTER                  -
           NAME(MSTRFIL1)           -
           VOLUME(PAY002)TRACKS(285 19))
/*
/&
```

Figure 53. Example: Defining a VSE/VSAM File Suballocated from a Data Space

Example - Define a Unique File

Figure 54 on page 332 shows the job stream for defining a unique file. The data space information is supplied in // EXTENT statements. IDCAMS requires the VOLUMES and CYLINDERS (BLOCKS, TRACKS, or RECORDS) parameters in the DEFINE command if no MODEL is used.

```
// JOB     ALLOCATE A UNIQUE VSE/VSAM FILE
// DLBL    VDATANM,,,VSAM
// EXTENT  ,338002,1,,1330,380
// DLBL    VINDXNM,,,VSAM
// EXTENT  ,338002,1,,1710,190
// EXEC    IDCAMS,SIZE=AUTO
   DEFINE  CLUSTER(NAME(MSTRFIL3)UNIQUE                    -
           DATA(FILE(VDATANM)VOLUMES(PAY002)CYLINDERS(20))  -
           INDEX(FILE(VINDXNM)VOLUMES(PAY002)CYLINDERS(10))
/*
/&
```

Figure 54. Example: Defining a Unique VSE/VSAM File (File-ID MSTRFILE)

Example - Process a File

Figure 55 on page 332 shows the job stream for processing a VSE/VSAM file. The CAT parameter of the // DLBL statement indicates the file name of the user catalog in which the file is recorded. The CAT parameter is written into the label information area. For details on the use of this parameter, see “Use of z/VSE Job Control Statements for VSE/VSAM” on page 23.

```
// JOB      PROCESS A VSE/VSAM FILE
// DLBL     VFILENM,'MSTRFILE',,VSAM,CAT=PRIVCAT
            (for the file)
// DLBL     PRIVCAT,'MYUCAT',,VSAM
// EXEC     USERPGM,SIZE=20K
   CSECT
     .
     .
     .
   ACB  DDNAME=VFILENM,...
     .
     .
     .
   END
/*
/&
```

Figure 55. Example: Processing a VSE/VSAM File with an Assembler Program

Appendix F. Diagnosis Tools

This Chapter...

Contains Diagnosis, Modification, or Tuning Information.

Describes the **VSE/VSAM tools** summarized in Table 44 on page 333, below. The information is primarily for system administrators. The descriptions emphasize **running** the tools, rather than interpreting the output.

Under certain conditions, the *IBM support representative* might ask you to supply the output of diagnosis tools.

Table 44. VSE/VSAM Diagnosis Tools

Tool	Purpose
Catalog Check Service Aid (IKQVCHK)	To identify erroneous catalog records. Under certain conditions, VSE/VSAM automatically invokes the tool, or you can invoke it yourself.
SNAP Trace Facility (IKQVEDA)	To print an error symptom infromation. You can invoke a SNAP trace to provide an error code trace during program processing.
Maintain VTOC and VOL1 Utility (IKQVDU)	To assists you in maintaining the VTOC and VOL1 labels on disk devices.

For information on other diagnosis tools available in the z/VSE environment (for example, for producing various types of dumps), refer to the z/VSE Guide for Solving Problems, SC34-2605.

Catalog Check Service Aid (IKQVCHK)

The *Catalog Check Service Aid* (IKQVCHK) helps you to determine whether a catalog has been damaged and, if damaged, the type and extent of the damage.

IKQVCHK is called under the following circumstances:

- If a file was *not* closed on a previous OPEN for update. In this case, VSE/VSAM OPEN tries to VERIFY the file before opening it. If the VERIFY is successful, VSE/VSAM calls IKQVCHK to examine the catalog records that describe the file. Note that only the records pertaining to that file are checked. The rest of the catalog is not examined.

  OPEN error codes might tell you to run IKQVCHK yourself for additional information.
- If the DELETE command with IGNOREERROR specified is issued. In this case, IDCAMS calls IKQVCHK, and the entire catalog is checked to ensure catalog integrity.

Furthermore, you should run IKQVCHK to assess catalog integrity in the following circumstances:

- After a system failure.
- When a file or catalog does not behave as expected.
- As part of regular system maintenance.

In Case of Errors

IKQVCHK issues error messages that identify missing or inconsistent information.

Perform the corrective action documented in z/VSE Messages and Codes Volume 2, SC34-2683.Take the action before contacting IBM for support. If the problem persists, report it. Make IKQVCHK output available so that the system administrator or your IBM support representative can assess the extent of catalog damage and how much rebuilding is required.

How to Run a Check

Issue the following job control statement:

```
// EXEC IKQVCHK,SIZE=AUTO,PARM='aaaa...a/bbbbbbbb'
```

where:

```
aaaa      is the name (up to 44 characters) of
          the catalog that is to be checked.
          The entire catalog is checked.

bbbbbbbb  is the master, control, or update password of
          the catalog that is to be checked.
```

If you omit the PARM parameter, the default catalog is checked. (The default catalog is the job catalog if the IJSYSUC DLBL statement is specified. Otherwise, it is the master catalog.)

Examples of Error Messages

The following examples show a few of the problems that IKQVCHK can diagnose and the kinds of error messages that it produces. These examples are for users who want a deeper understanding of IKQVCHK.

Catalog errors are difficult to understand, because they involve internal catalog records, data, and control blocks which most users do not see. The *programmer action* associated with every message, however, does not require a full knowledge of the error condition. Similarly, you do not have to understand the listing of catalog records and the 512-byte catalog record dump that accompany the messages.

For the full documentation of all error messages issued by IKQVCHK, refer to the "IKQ-Prefix" in z/VSE Messages and Codes Volume 2, SC34-2683.

Example: Key-Range Names Not Matching

Figure 56 on page 335 shows the output associated with message IKQ0016I. In this example, the problem is that the low-key-range name for a particular object does not match the high-key-range name for that object, where the:

- Low-key-range name is XXXS1.INDEX
- High-key-range name is KSDS1.INDEX (identified by the submessage ASSOCIATED HKR REC FOLLOWS)

To correct this problem, run a DELETE command, specifying IGNOREERROR for KSDS1.INDEX. VSE/VSAM will delete the name KSDS1.INDEX from the catalog.

```
IKQ0016I DATA SET NAME NOT SAME IN HIGH AND LOW KEY RANGE RECORDS
LKR REC WITH INVALID DATA :
0000  0000002E 01000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
0020  00000000 00000000 00000000 C9015700   8FE7E7E7 E2F14BC9 D5C4C5E7 40404040
*............I....XXXS1.INDEX    *
0040  40404040 40404040 40404040 40404040   40404040 40404040 40404040 40FFFFFF
*                             ...*
0060  FFFFFFFF FF92057F 00000F20 F000FFFF   FFFF0000 01000001 80000010 000000A0
*............0...................*
0080  00FFFFFF FF0000FF FFFFFFFF FFFFFF00   00000000 05000000 C0000000 00010100
*................................*
00A0  00620201 00006803 01000000 44010062   60000060 00040000 000A0000 000A0000
*................................*
00C0  00000000 00001000 00000FF9 00000000   00000000 00000000 00000000 00000000
*...........9....................*
00E0  A54E6475 B838FE02 00010001 00000001   00000000 00000000 00000000 00000000
*................................*
0100  00009000 00000000 00000000 0000000F   0006C300 002C0327 3010200E F1F1F1F1
*..................C.........1111*
0120  F1F10000 80010000 00000000 10000000   A0000000 1000000A 00010000 02000000
*11..............................*
0140  00001400 11000000 01000000 01000100   00000000 009FFF00 00000000 00000000
*................................*
0160  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
0180  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
01A0  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
01C0  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
01E0  00000000 00000000 00000000 00000000   00000000 00000000 000001F9 01F90000
*............................9.9..*
ASSOCIATED HKR REC FOLLOWS:
NAME = KSDS1.INDEX                              CI = 00002E
```

Figure 56. Example: Key-Range Names not Matching

Example: Erroneous Association Group Occurrence

Figure 57 on page 336 shows a problem in which two error messages are produced, IKQ0027I and IKQ0028I. The first hex dump shows the association group occurrence at X‘08B’. The third byte of the association group occurrence indicates the record type (D).

The contents of CI 2 are printed just below the submessage ASSOC WITH UNEQUAL TYPE. Field X‘2C’ of a catalog record always tells what type of catalog record it is. In this case, the record type is X‘C3’ or C, meaning a cluster record, which does not match the record type (D) in the group occurrence (the first record).

To correct this error, issue a DELETE IGNOREERROR command for KSDS2 (specified in NAME).

```
IKQ0027I RECORD TYPE IN ASSOCIATION GROUP OCCURRENCE NOT EQUAL TO RECORD TYPE IN RECORD IT REFERENCES
IKQ0028I AFFECTED GROUP OCCURRENCE AT DISPLACEMENT 135 (X'087')
REC WITH ERRONEOUS GO FOLLOWS:
0000  0000002F 01000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
0020  00000000 00000000 00000000 C3008D00   6CD2E2C4 E2F24040 40404040 40404040
*............C....KSDS2          *
0040  40404040 40404040 40404040 40404040   40404040 40404040 40404040 40FFFFFF
*                              ...*
0060  FFFFFFFF FF92057F 00000F00 00000000   00030000 00020100 00060202 00000044
*................................*
0080  010006C4 00003000 06C90000 31000000   00000000 00000000 00000000 00000000
*...D.....I.....................*
00A0  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
00C0  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
00E0  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
0100  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
0120  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
0140  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
0160  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
0180  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
01A0  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
01C0  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
01E0  00000000 00000000 00000000 00000000   00000000 00000000 000001F9 01F90000
*.........................9.9..*
ASSOC REC WITH UNEQUAL TYPE:
0000  00000031 01000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
0020  00000000 00000000 00000000 C3015700   8FD2E2C4 E2F24BC9 D5C4C5E7 40404040
*............C....KSDS2.INDEX    *
0040  40404040 40404040 40404040 40404040   40404040 40404040 40404040 40FFFFFF
*                              ...*
0060  FFFFFFFF FF92057F 00000F00 6000FFFF   FFFF0000 03000003 80000008 000001B0
*................................*
0080  00FFFFFF FF0000FF FFFFFFFF FFFFFF00   00000000 05000000 C0000000 00010100
*................................*
00A0  00620201 00006803 01000000 44010062   60080060 000C0000 000A0000 00120000
*................................*
00C0  00000000 00000800 000007F9 00000000   00000000 00000000 00000000 00000000
*...........9....................*
00E0  A54E6DEF 570E8C04 00010001 00000001   00000000 00000000 00000000 00000000
*................................*
0100  0001A800 00000000 00000000 00000005   0006C300 002F0327 3010200E F1F1F1F1
*................C.........1111*
0120  F1F10000 80010000 00000000 08000001   B0000000 08000012 00010000 02000000
*11..............................*
0140  00001400 01000100 01000100 03000300   00000000 01AFFF00 00000000 00000000
*................................*
0160  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
0180  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
01A0  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
01C0  00000000 00000000 00000000 00000000   00000000 00000000 00000000 00000000
*................................*
01E0  00000000 00000000 00000000 00000000   00000000 00000000 000001F9 01F90000
*.........................9.9..*
ASSOCIATED HKR REC FOLLOWS:
NAME = KSDS2                                        CI = 00002F
```

Figure 57. Example: Incorrect Association Group Occurrence

Output of a Check

Figure 58 on page 337 shows catalog data that was produced by a run of IKQVCHK against a catalog named VSAM.MCAT.

```
 DATA ABOUT VSAM CATALOG - VSAM.MCAT
=====================================================
 THIS CATALOG CONTAINS    USED HKR-RECORDS          60    See 1.
                          FORMATTED RECORDS         87    See 2.
                          - CCR RECORDS          L    1
                          - FREE RECORDS         F    2
                          - GDG BASE ENTRIES     B    0
                          - CLUSTER RECORDS      C   14
                          - INDEX RECORDS        I   11
                          - DATA RECORDS         D   21
                          - VOLUME RECORDS       V    1
                          - VOLUME EXT. RECORDS  W    4
                          - NONVSAM RECORDS      A    0
                          - EXTENSION RECORDS    E   14
                          - AIX RECORDS          G    7
                          - PATH RECORDS         R    7
                          - ALIAS RECORDS        X    0
                          - UPGRADE RECORDS      Y    4
                          - USER-CAT RECORDS     U    1
                          - UNAVAILABLE RECORDS  *    0
  =====================================================
   NO ERRORS WERE FOUND IN THIS CATALOG                  See 3.
```

Figure 58. Example: Output from the Catalog Check Service Aid (IKQVCHK)

Note:

1. **High-Key-Range Catalog Records**

   Each *USED HKR-RECORD* is a 47-byte "true name record". It relates the NAME (as specified in DEFINE CLUSTER or AIX), or the volume number (as specified in DEFINE SPACE) to the CI number of the catalog record that describes the object.

2. **Low-Key-Range Catalog Records**

   The output line *FORMATTED RECORDS* shows the sum of formatted records in the low-key range of the catalog (it equals the total of all fields below the output line). Every low-key-range record occupies a full CI.

   For explanations to the *formatted records*, refer to Table 45 on page 337.

3. Depending on the circumstances, one of the following summary statements appears at the bottom of the catalog data:

   NO ERRORS WERE FOUND IN THIS CATALOG
   MINOR ERRORS WERE FOUND AND CORRECTED IN THIS CATALOG
   SERIOUS ERRORS WERE FOUND IN THIS CATALOG

   The statement is preceded by messages that identify the catalog errors that were found.

Record Types and Catalog Identifiers

In the output of IKQVCHK (shown in Figure 58 on page 337), every record type is followed by its one-letter catalog ID.

Table 45. Low-Key-Range Catalog Records and Codes

Record Type	Code	Description
CCR RECORDS	L	Catalog control records keep track of which CIs are allocated. When VSE/VSAM needs space for a catalog record, the CCR indicates that space will be taken from the unformatted section or from a list of CIs that are no longer in use.
FREE RECORDS	F	Free record; the CI in which it resides can be reused by another kind of catalog record on subsequent DEFINEs. Free records are records that have been used and made available again. Records that have not yet been used are not free records.
GDG BASE ENTRIES	B	Generation data group; applies to MVS objects only.

Table 45. Low-Key-Range Catalog Records and Codes (continued)

Record Type	Code	Description
CLUSTER RECORDS	C	There is one cluster record for every cluster defined in the catalog.
INDEX RECORDS	I	An index record describes the index component of a cluster or AIX. There is one index record for every KSDS cluster or AIX defined in the catalog.
DATA RECORDS	D	A data record describes the data component of a cluster or AIX. There is one data record for every cluster or AIX defined in the catalog. The number of data records should equal the number of cluster records (C) plus the number of AIX (G) records.
VOLUME RECORDS	V	A volume record describes the following: • VSE/VSAM data space on the volume; • Every component residing in VSE/VSAM data space on the volume; • Any available space in that data space. There is one volume record for every volume owned by the catalog.
VOLUME EXTENSION RECORDS	W	A volume extension record provides the same data as a volume record. When a volume record becomes full, a volume extension record is created for it. There are as many volume extension records as necessary to contain overflow information.
NONVSAM RECORDS	A	A nonVSAM record describes a nonVSAM file. There is one nonVSAM record for every nonVSAM file defined in the catalog.
EXTENSION RECORDS	E	An extension record contains overflow information from another catalog record (except type V or F). There are as many extension records as necessary to contain overflow information.
AIX RECORDS	G	An AIX record describes an alternate index. There is one AIX record for every alternate index defined in the catalog.
PATH RECORDS	R	A path record describes a path. There is one path record for every path defined in the catalog.
ALIAS RECORDS	X	Alias; applies to DFSMSdfp objects only.
UPGRADE RECORDS	Y	An upgrade record describes a set of alternate indexes that are to be upgraded (kept up to date) when their base cluster is modified.
USER-CAT RECORDS	U	A user cat record describes a user catalog. The master catalog contains one user cat record for every user catalog defined in it.
UNAVAILABLE RECORDS		An unavailable record is one that exists but is inaccessible because one or more pointers to it were destroyed.

SNAP Trace (IKQVEDA)

The IBM support representative may ask you to run a SNAP trace to provide information for problem diagnosis. You can enable any of the following *types* of SNAP trace:

Type:
Enables:

0001
Catalog management error code trace

0002
Buffer manager trace

0003

- OPEN control block trace (when OPEN processing is complete)
- OPEN error trace (prints control blocks if an error occurs during OPEN processing)
- CLOSE control block dump (at the beginning of CLOSE processing)
- Managed-SAM OPEN and CLOSE control block trace (when OPEN processing is complete and at the beginning of CLOSE Processing)

0004
VSE/VSAM I/O trace

0005
I/O error trace

0006
Available for future development

0007
Available for future development

0008
Catalog management I/O trace (prints all I/O operations done by VSE/VSAM catalog management)

0009
Record management error trace (prints control blocks for any error detected by VSE/VSAM record management)

0010
Redirector trace

0011
Available for future development

0012
Reserved for diagnostic purposes

0013
In-core wrap trace for trace points within VSE/VSAM Record Management

0014
Level2 SNAP013 Trace (I/O, EXCPAD and z/VSE Lock Activity)

0015
Level3 SNAP013 Trace (Buffer Management)

0016
Produce a printout (PDUMP) each time the SNAP013 Trace Table wraps.

Note: Depending on which SNAP013 level was selected and the amount of system activity, this might produce a lot of SYSLST output. Consider using the DDNAME= parameter to limit the number of files traced. The DDNAME= parameter is not supported by SNAP Traces 0001 and 0008.

SNAP Trace Number	Output
0001	To Console
0002 - 0005	To SYSLST
0006, 0007	Future Development
0009, 0010	To SYSLST
0011	Future Development
0012	Reserved
0013 - 0015	In-core
0016	To SYSLST

With the MSHP PATCH command, the trace output can be limited to specific elements. Your IBM support representative can give you further details.

How to Run a SNAP Trace

Activating a SNAP Trace

To activate IKQVEDA from the system console (SYSLOG) or SYSRDR, enter:

```
// EXEC IKQVEDA,PARM='SYSnnn'
```

where SYSnnn specifies the LU from which the SNAP commands are entered:

```
SYSLOG - SNAP commands are entered from the system console
         (this is the default if PARM is omitted)
SYSIPT - SNAP commands are read from SYSIPT
```

PARM is optional. If the input is to be entered from the console, the system responds with:

```
ENTER FUNCTION ENABLE | DISABLE | END | HELP
```

Enabling a SNAP Trace

To enable the SNAP trace, enter:

```
ENABLE SNAP=00nn,PART=yy,DDNAME=(list of filenames)
```

where yy is the partition (BG or Fn) in which the SNAP is to be enabled. If PART is omitted, the SNAP is enabled for the issuing partition. SNAP013 has an additional parameter: SIZE=nnK, which specifies the size of the in-core wrap trace.

Note that the SNAP trace becomes effective immediately (without re-IPL), and only for the partition which you have specified (or defaulted).

Then the system prints:

```
SNAP 00nn ENABLED IN PARTITION yy
ENTER FUNCTION ENABLE | DISABLE | END | HELP
```

To keep the SNAP option that you just selected (ENABLE) in effect, and to go on to run your program, enter:

```
END
```

If you want to activate the HELP function (which produces explanatory messages on the console), enter:

```
HELP
```

Note that for a *dynamic* partition, the trace must be enabled while the VSE/POWER job that is to be traced is already active. At the end of the VSE/POWER job, the SNAP traces will be lost.

Notes:

1. Input from SYSIPT: If the input is to be read from SYSIPT, you must prepare your input records in advance and place them on SYSIPT before the EXEC command is entered (either on SYSLOG or SYSRDR). The format of these records must be the same as described above for the console input. The last command must be END. All messages are issued on SYSLOG.
2. After *enabling* or *disabling* a SNAP trace, the message IKQ0082I is issued. The message lists all SNAP traces that are currently enabled for the partition.

Disabling a SNAP Trace

1. To disable the SNAP trace after the program is finished, enter:

```
// EXEC IKQVEDA,PARM='SYSnnn'
```

   where SYSnnn is either SYSLOG (default) or SYSIPT. PARM is optional.

   The system responds with:

```
ENTER FUNCTION ENABLE | DISABLE | DISABLE | END | HELP
```

2. Enter:

```
DISABLE SNAP=00nn,PART=yy
```

   PART is optional. The system responds with:

```
SNAP 00nn DISABLED IN PARTITION yy
ENTER FUNCTION ENABLE | DISABLE | END | HELP
```

3. Enter:

```
END
```

Example: SNAP Trace 0001

The following example shows the use of IKQVEDA to enable SNAP 0001 as a batch job in the BG partition.

Input (from SYSIN):

```
// JOB EXAMPLE
// EXEC IKQVEDA,PARM='SYSIPT'
ENABLE SNAP=01
END
/*
/&
```

Output (on SYSLOG):

```
// JOB EXAMPLE ...
IKQ0082I SNAP 0001 ENABLED IN PARTITION BG
EOJ EXAMPLE ...
```

Activating

You must now activate SNAP 0001 in your program. Do this by including one of three UPSI statements in your job stream.

The UPSI job control statement specifies under which conditions the SNAP code should be executed. Because user programs can also use the UPSI byte, make sure that there is no conflict between the UPSI setting for SNAP and the UPSI requirements for any program running in the same partition. Using UPSI, you can specify that the error symptom message be printed under one of the following conditions. If you do not specify an UPSI value, 00000000 is the default.

// UPSI 0
When the catalog management return code is not 0, 40, 68, or 160, or if LISTCAT issued a return code not equal to 8. (These codes occur during normal processing.)

// UPSI 1
When the catalog management return code is not zero.

// UPSI 11
For all catalog management return codes, including zero.

// UPSI 01
Same as 1 but with operator reply required.

// UPSI 011
Same as 11 but with operator reply required.

// UPSI 0111
Same as 0 but with operator reply required.

// UPSI 00001
Compression control services trace requires operator reply when a request failed.

// UPSI 000011
Compression control services trace requires operator reply.

SNAP 0001 Output

SNAP 0001 prints the following *error symptom string* at the console (SYSLOG):

```
nnn,mn,rrr,ffff,ccc
```

The error symptom string is preceded by the partition identifier (for example, BG, F1, F2).

The meaning of the string elements:

nnn
Is the Catalog Management return code (decimal).

mn
Are the last two characters of the name of the module that encountered the error (IGG0CLmn).

rrr
Is the Catalog Management reason code (decimal). The return and reason codes are documented in z/VSE Messages and Codes Volume 2, SC34-2683.

ffff
Indicates which of the following functions was processed:

ALT
- alter

DEF
- define VSE/VSAM object

DEFA
- define nonVSAM file

DEFC
- define catalog

DEFS
- define space

DEL
- delete VSE/VSAM object or nonVSAM file

DELC
- delete catalog

DELS
- delete space

LOC
- locate

LSTC
- list catalog

UPD
- update or update-extend

ccc
Is one of the following:

- The number of the CI associated with the function (decimal)
- The object name, full length
- The volume number in EBCDIC

Figure 59 on page 343 is an example of the console listing for a job in which a cluster and two alternate indexes are defined:

```
Control Statement                    Meaning
================================================================================
// UPSI 11000000                     Print error symptom string for all VSE/VSAM
                                     return codes.
// EXEC IDCAMS,SIZE=AUTO


Error Symptom String                    Meaning
================================================================================
BG  000,  ,000,LOC ,000000              Locate for CI 000000.
BG  000,  ,000,LOC ,MASTER              Locate for master catalog volume.
BG  000,  ,000,LOC ,000001              Locate for CI 000001.
BG  000,  ,000,LOC ,000001
BG  008,CG,006,DEL ,V3V003.KSDS         Before defining V3V003.KSDS, user
                                        issues a DELETE to make sure that the
                                        object does not already exist (it doesn't).
BG  008,CG,006,LOC ,DEFAULT.MODEL.KSDS  Before attempting to define the new
                                        cluster, VSE/VSAM looks for an optional
                                        default model.  No default model exists.
BG  000,  ,000,DEF ,V3V003.KSDS         VSAM defines the new cluster.
BG  008,CG,006,LOC ,DEFAULT.MODEL.AIX   Before attempting to define the new AIX,
                                        VSE/VSAM looks for an optional
                                        default model.  No default model exists.
BG  000,  ,000,DEF ,V3V003.KSDS.AIX1    VSAM defines the first AIX.
BG  008,CG,006,LOC ,DEFAULT.MODEL.AIX
BG  000,  ,000,DEF ,V3V003.KSDS.AIX2    VSAM defines the second AIX.
```

Figure 59. Example: SNAP Trace Output

Maintaining VTOC and VOL1 Labels on Disk (IKQVDU)

The utility IKQVDU assists in maintaining the VTOC and VOL1 labels on disk devices.

Note: This utility changes information in the VTOC only; it does not change catalog entries. If you want to redefine a VSE/VSAM data space or UNIQUE file, you must first issue a DELETE command to erase the file's catalog information.

If you want conceptual information on labels, refer to Appendix E, “VSE/VSAM Labels,” on page 323.

How to Run the IKQVDU

The following procedures should be followed to use IKQVDU at the *system console* for such maintenance. The key difference in the three procedures is the presence or absence of a // UPSI job control statement.

PROCEDURE 1 **Type in the following, then press ENTER**	**Explanation**
1. // ASSGN SYS000,X'cuu'	For *cuu*, type in the address of the disk drive whose volume is to be accessed.

PROCEDURE 1 Type in the following, then press ENTER	Explanation
2. // UPSI 1	This job control statement is optional. If it is included, the following events take place on the volume that was assigned to SYS000: • The VSE/VSAM volume ownership bit in the F4 VTOC label is reset. The ownership bit is reset regardless of how many catalogs own space on the volume. • The entire VTOC is scratched, that is, empty VTOC labels are written over existing F1, F2, and F3 labels, except for labels that have names starting with the characters "DOS.", "VSE.", or "PAGE". • An operator authorization prompt is issued if the VTOC label to be scratched is security protected.
3. // EXEC IKQVDU,SIZE=AUTO	Start execution of the IKQVDU phase. Then run an IDCAMS DELETE SPACE command to delete the catalog information for the volume you just scratched. Specify the FORCE parameter if necessary.

PROCEDURE 2 Type in the following, then press ENTER	Explanation
1. // ASSGN SYS000,X'cuu'	For *cuu*, type in the address of the disk drive whose volume is to be accessed.
2. // UPSI 11	This job control statement is optional. If it is included, the following events take place on the volume that was assigned to SYS000: • The VSE/VSAM volume ownership bit in the F4 label are reset. The ownership bit is reset regardless of how many catalogs own space on the volume. • The entire VTOC is scratched, that is, F0 labels are written over existing F1, F2, and F3 labels, except for labels that have names starting with the characters "DOS.", "VSE.", or "PAGE".
3. // EXEC IKQVDU,SIZE=AUTO	Start execution of the IKQVDU phase. Then run an IDCAMS DELETE SPACE command to delete the catalog information for the volume you just scratched. Specify the FORCE parameter if necessary.

PROCEDURE 3 Type in the following, then press ENTER	Explanation
1. // ASSGN SYS000,X'cuu'	For *cuu*, type in the address of the disk drive whose volume is to be accessed.

PROCEDURE 3 **Type in the following, then press ENTER**	**Explanation**
2. // EXEC IKQVDU,SIZE=AUTO	Start execution of the IKQVDU phase.
SPECIFY FUNCTION OR REPLY '?' FOR OPTIONS READY	• You can specify the functions listed in Table 46 on page 345. If you specify a function, the list shown in Figure 60 on page 345 is *not* displayed. • You can enter the character **?** This displays (at the system console) a list of the functions that IKQVDU can perform; refer to Figure 60 on page 345.

```
TO SET THE VOLUME OWNERSHIP FLAG REPLY 'SET OWNERSHIP'
TO RESET THE VOLUME OWNERSHIP FLAG REPLY 'RESET OWNERSHIP'
TO SET THE SECURITY FLAG IN A F1 LABEL REPLY 'SET
    SECURITY'
TO RESET THE SECURITY FLAG IN A F1 LABEL REPLY 'RESET
    SECURITY'
TO REMOVE A LABEL FROM THE VTOC REPLY 'SCRATCH'
TO RENAME A LABEL REPLY 'RENAME'
TO ALLOCATE A LABEL REPLY 'ALLOCATE'
TO REINITIATE PROCESSING REPLY 'RESTART'
TO ALTER OR DISPLAY A disk VOL1 LABEL
REPLY 'CLIP LABEL=SER=N..N' OR 'CLIP LABEL=DISPLAY'
TO TERMINATE PROCESSING REPLY 'END'
READY
```

Figure 60. Display of IKQVDU Functions

Table 46. Explanation to IKQVDU Functions

Function **Enter one of the following, then press ENTER**	**Explanation**
SET OWNERSHIP	Causes the VSE/VSAM ownership bit to be set in the F4 VTOC label.
RESET OWNERSHIP	Causes the VSE/VSAM ownership bit to be reset in the F4 VTOC label. The ownership bit is reset regardless of how many catalogs own space on the volume.
SET SECURITY	Causes the security bit to be set in the F1 VTOC label. When the console responds with ENTER DSN, reply with the data set name of the VTOC label to be modified.
RESET SECURITY	Causes the security bit in the F1 label to be reset. When the console responds with ENTER DSN, reply with the data set name of the VTOC label to be modified.
SCRATCH DSN=dsname	Causes the VTOC label with the specified file name to be scratched. If the file is a VSE/VSAM data space or a UNIQUE VSE/VSAM file, run an IDCAMS DELETE SPACE or DELETE CLUSTER command to delete the catalog information for the object(s) you just scratched. Specify the FORCE parameter if necessary.

Table 46. Explanation to IKQVDU Functions (continued)

Function Enter one of the following, then press ENTER	Explanation
SCRATCH VTOC	Causes the entire VTOC to be scratched except for file names starting with the characters "DOS.", "VSE.", and "PAGE". In addition, an operator-authorization prompt will be issued if the VTOC label is security-protected or describes a catalog. If the VTOC contained VSE/VSAM data spaces, run an IDCAMS DELETE SPACE command to delete the catalog information for the volume you just scratched. Specify the FORCE parameter if necessary.
RENAME	Causes the DSNAME portion of the F1 VTOC label to be changed. When the console responds with ENTER OLD DSN, reply with the file name of the VTOC label to be changed. Be sure to enter the correct OLD DSN. No error checking is performed if an invalid name is specified. When the console responds with ENTER NEW DSN, reply with the new file name.
ALLOCATE	Causes a new label to be created and written in the VTOC. To use this function, a DLBL/EXTENT job control statement must be provided. When the console responds with ENTER FILENAME, reply with the same file name as that in the DLBL statement referred to above. When the console responds with ENTER NEW DSN, reply with the file name of the file to be created. When the console responds with DO YOU WISH TO SECURITY PROTECT THIS DATA SET? reply YES or NO. A reply of YES causes the data security bit to be set in the F1 VTOC label. A reply of NO causes the data security bit to be reset.
RESTART	Causes processing to be reinitiated with a READY prompt. This keyword can be used as a response to any operator prompt.
CLIP LABEL=DISPLAY	Causes the volume serial number to be displayed on the system console.
CLIP LABEL=SER=n..n	Causes the existing volume serial number to be changed to the one specified as n..n.
END	Causes processing to terminate.

Error Message and Codes (from IKQVDU)

If an error occurs during execution of IKQVDU, a message of the following format is displayed at the system console:

```
ERROR** DADSM RETURN CODE IS nnn condition

where:
   nnn        is the code (for example: 020)
   condition  describes the problem (for example: VTOC FULL)
```

The following shows the code (nnn), the associated condition, and the action required to correct the condition.

004 I/O ERROR WHILE READING VOLUME LABEL
Action: If the problem was not caused by a hardware error, restore the volume.

008 VOLUME NOT MOUNTED
Action: Mount the correct volume.

012 I/O ERROR ON VTOC
Action: If the problem was not caused by a hardware error, restore the volume.

016 DUPLICATE NAME ON VOLUME
Action: Choose another file name or scratch the original file from the volume. If duplication is because of key ranges, ensure every UNIQUE key range is on a separate volume.

020 VTOC FULL
Action: Delete any nonVSAM files or VSE/VSAM data spaces no longer needed from the volume to make additional Format 1 labels available, or reinitialize the volume with a larger VTOC.

024 EXTENT OVERLAPS EXPIRED FILE
Action: Examine the VTOC listing to determine where the overlap occurred. Correct the EXTENT statement causing the error. To delete the expired file, open a DTF using the same file-ID as that of the expired file, and instruct the operator to reply DELETE to message 4n33A when it is issued.

028 EXTENT OVERLAPS UNEXPIRED FILE
Action: Compare the high and low extent limits on the EXTENT statement or LSERV output with the file or data space limits on the VTOC display. If the extents overlap, correct the EXTENT statement in error.

032 EXTENT OVERLAPS PROTECTED UNEXPIRED FILE
Action: Examine the VTOC to determine where the overlap occurred. Correct the EXTENT statement causing the error. If necessary, use another volume.

036 EXTENT OVERLAPS VTOC
Action: Execute LVTOC. The Format 4 label (the first label in the VTOC display) contains the extent limits of the VTOC. If the program executed uses a temporary label set and overlaps the VTOC, correct the EXTENT statements that overlap. If the job uses standard or partition standard labels, use the LSERV output to correct the extents of the overlapping file, VSE/VSAM data space, or UNIQUE VSE/VSAM file. Then rebuild the appropriate label tracks.

040 REQUIRED EXTENTS MISSING
Action: If temporary labels were used, match the extents on the incoming EXTENT card with the extents in the LVTOC output. If standard (permanent) labels were used, match the extents in the LSERV output with those in the LVTOC output.

044 LABEL NOT FOUND
Action: Use the LVTOC output to check for all file labels used in OPEN macros. If the file has been destroyed, it was probably because of deletion of overlapping extents on an unexpired file, and the file must be rebuilt.

048 INVALID LABEL ADDRESS
Action: Examine the VTOC for a label having an invalid forward chain pointer, and delete it. If no invalid labels are found, just rerun the job.

056 EXTENT OVERLAPS PROTECTED EXPIRED FILE
Action: Examine the VTOC listing to determine where the overlap occurred. Correct the EXTENT statement causing the error. If it is not necessary to save the expired file, open a DTF using the same file-ID as that of the expired file, and instruct the operator to reply DELETE to message 4n33A when it is issued.

064 GETVIS FAILURE ENCOUNTERED
Action: Allocate GETVIS area. If VSE/VSAM is running in the SVA, re-IPL and specify a new value for SET SVA. If VSE/VSAM is running in a partition, rerun the job in a larger partition.

072 CDLOAD FAILURE ENCOUNTERED
Action: Either the CDLOAD directory or the GETVIS area is full. Allocate more space.

080 OVERLAP AMONG NEW EXTENTS
Action: If DLBL and EXTENT statements are included in the program, determine the conflicting extents and correct them. If a standard label set is used, use the LSERV output to locate and correct the conflicting file extents, and rebuild the standard label tracks.

088 FORMAT 4 LABEL NOT FOUND
Action: Reinitialize the VTOC to create a format-4 label.

092 VOL1 LABEL NOT FOUND
Action: Reinitialize the volume to create a VOL1 label.

096 JIB PROCESSING FAILURE
Action: Rerun the job when more JIBs are available.

Appendix G. Using the VSAM Redirector Connector

This Appendix ...

Describes the *VSAM Redirector Connector*, which enables you to use your existing applications (for example COBOL programs) *without any changes* to work with data on any Java-enabled platform (for example, *Linux on System z*).

Related Topics:

For details of ...	Refer to ...
how the VSAM Redirector Connector works (including diagrams and examples)	z/VSE e-business Connectors User's Guide, SC34-2693
how to map VSE/VSAM data to a relational structure	z/VSE e-business Connectors User's Guide, SC34-2693
how to use the IDCAMS RECMAP command	VSE/VSAM Commands, SC34-2707

Overview of the VSAM Redirector Connector

The VSAM Redirector Connector enables VSE programs to work with:

- VSAM data that is synchronized with a remote database or file system.
- VSAM files, all of whose data has been moved to a remote platform.

Using the VSAM Redirector Connector:

- VSAM data can be migrated to other file systems or databases.
- Data can be synchronized on different systems with VSE VSAM data.
- VSE programs can work transparently with data on other file systems or databases.
- Changes made to VSAM data can be captured and temporarily stored on your z/VSE system for further processing.

The VSAM Redirector Connector consists of:

- The *VSAM Redirector Client* for *synchronous* redirection (which is installed on your z/VSE host).
- The *VSAM Capture Exit* for *asynchronous* redirection (which is installed on your z/VSE host).
- A *VSAM Redirector Server* which can be installed on most Java™ platforms.
- *VSAM Redirector Loaders*, which are Java programs running on the remote platform, and which are used to load and process VSAM data.

Using the VSAM Redirector Client For Synchronous Data Redirection

Using synchronous data redirection, you can migrate or synchronize your VSAM data for example with DB2® tables residing on a remote system, and your VSE programs will then work with this data, without requiring any changes to these VSE programs. On the remote system, a *Java handler* provides access to the specific file system or database on the remote system. For example, you can migrate your VSAM data into DB2 tables residing on a remote system, and your VSE programs will then work with this data, without requiring any changes to these VSE programs.

The VSAM Redirector Connector handles requests to VSAM datasets and redirects them to a different:

- Java platform (for example Linux on System z, Windows NT, Windows 2000, Windows XP).

- file system (for example DB2 or flat files).

Your existing z/VSE host programs that are:

- written in any language (COBOL, PL/I, ASSEMBLER)
- batch or CICS programs

can therefore work with migrated VSAM data without the need to amend and recompile these z/VSE host programs. The VSAM Redirector Connector manages all connections and data conversions.

Using the VSAM Capture Exit For Asynchronous Data Redirection

Asynchronous redirection of VSAM data is provided by the **VSAM Capture Exit**, which allows you to:

- Capture changes made to a particular VSAM file.
- Store these changes for further processing.

There are two options you can use:

- Save changes in a VSAM cluster (the VSAM delta cluster).
- Save changes in an MQSeries® queue.

Captured changes are written as "delta records" or messages. They contain:

- The data of the changed record.
- Information about *when* (the timestamp) and *by whom* (the partition, phase name, origin value, and so on) the record was changed.

The saved changes can later be accessed via the Java-based connector by Java programs running on the remote platform. Loader programs are also provided to load and process the captured data from the VSAM delta cluster (for example, to apply the changes to a database).

EXCPAD for The Redirector

Usually the Redirector runs in the same z/VSE subtask as VSAM. However, when the EXCPAD exit routine is used, the Redirector call is performed in a separate subtask. VSAM will return to the EXCPAD exit routine, while the Redirector task waits for a remote connection. This allows the application to perform other processing concurrently until the remote activity is complete. For an EXCPAD description, refer to “EXCPAD Exit Routine” on page 203.

This capability is primarily implemented for CICS transactions. The Redirector EXCPAD is not used for VSAM files opened by CICS/VSE.

The EXCPAD user exit is enabled automatically under the following conditions:

1. a VSE/VSAM cluster is enabled for the Redirector,
2. the EXCPAD exit is defined during the OPEN request.

VSAM will attach only one Redirector subtask per partition even if multiple redirected files are opened in the partition with an active EXCPAD.

If the EXCPAD exit is not active within the user’s application exit list, then the Redirector will function in a normal way within the same running task as the application.

The Redirector call is performed through the IKQVEX01 module’s exit logic. If you provide your own IKQVEX01 exit, then the EXCPAD function support is applicable to this exit as well.

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Accessibility features help a user who has a physical disability, such as restricted mobility or limited vision, to use software products successfully. The major accessibility features in z/VSE enable users to:

- Use assistive technologies such as screen readers and screen magnifier software
- Operate specific or equivalent features using only the keyboard
- Customize display attributes such as color, contrast, and font size

Using Assistive Technologies

Assistive technology products, such as screen readers, function with the user interfaces found in z/VSE. Consult the assistive technology documentation for specific information when using such products to access z/VSE interfaces.

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This glossary includes terms and definitions related primarily to VSE/VSAM. If you do not find the term you are looking for, refer to the index of this publication, or to the *IBM Dictionary of Computing* , SC20-1699.

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The part of speech being defined is indicated by the opening words of the descriptive phrase: "To ..." indicates a verb and "Pertaining to ..." indicates a modifier. Any other wording indicates a noun or noun phrase.

31-bit addressing
Provides addressability for address spaces of up to 2 gigabytes.

access method
A program (such as VSE/VSAM or VTAM) that allows the user to define files and addresses, and to move data to and from them. It is a technique for moving data between main storage and input/output devices.

address
1. The location in the storage of a computer where data are stored.

2. In data communication, the unique code assigned to every device or work station connected to a network.

addressing mode (AMODE)
A program attribute that refers to the address length that a program is prepared to handle on entry. Addresses may be either 24 bits or 31 bits in length. In 24-bit addressing mode, the processor treats all virtual addresses as 24-bit values; in 31-bit addressing mode, the processor treats all virtual addresses as 31-bit values.

address space
A range of up to two gigabytes of contiguous virtual storage addresses that the system creates for a user. Unlike a data space, an address space contains user data **and** programs, as well as system data and programs, some of which are common to all address spaces. Instructions execute in an address space (not a data space).

AIX
See *alternate index*.

alternate index (AIX)
In systems with VSE/VSAM, the index entries of a given base cluster organized by an alternate key, that is, a key other than the prime key of the base cluster. For example, a personnel file primarily ordered by names can be indexed also by department number.

*** alternate tape**
A tape drive to which the operating system switches automatically for tape read or write operations if the end of the volume has been reached on the originally used tape drive.

alternate track
On a direct access storage device, a track designated to contain data in place of a defective track.

AMODE
See *addressing mode*.

application program
A program written for or by a user that applies to the user's work, such as a program that does inventory control or payroll.

ASI
See *automated system initialization*.

assemble
To translate a program from assembler language into object code.

assembler
A computer program that converts assembly language instructions into object code.

*** assembler language**
A source language that includes symbolic machine language statements in which there is a on-to-one correspondence with the instruction formats and data formats of the computer.

*** automated system initialization (ASI)**
A function that allows control information for system startup to be cataloged for automatic retrieval during system startup.

*** autostart**
In z/VSE, a facility that starts-up VSE/POWER with little or no operator involvement.

*** auxiliary storage**
All addressable storage, other than main storage, that can be accessed by an input/output channel; for example, storage on magnetic tape or direct access storage devices. Synonymous with external storage and with secondary storage.

*** backup copy**
A copy of information or data that is kept in case the original is changed or destroyed.

batch processing
1. Serial processing of computer programs. 2. Pertaining to the technique of processing a set of computer programs in such a way that each is completed before the next program of the set is started. (A)

batch program
A program that is processed in series with other programs and therefore normally processes data without user interaction.

BIG-DASD
A subtype of Large DASD that has a capacity of more than 64K tracks and uses up to 10017 cylinders of the disk.

block
Usually, a block consists of several records of a file that are transmitted as a unit. But if records are very large, a block can also be part of a record only. On an FBA disk, a block is a string of 512 bytes of data. In the (E)CKD environment, blocks are called records. See also *control block*.

buffer
An area of storage temporarily reserved for input or output operations; an area into which data is read or from which data is written. Synonymous with I/O area.

byte
Eight adjacent binary digits that are operated upon as a unit and that constitute the smallest addressable unit of information within a computer system. Normally, it represents a stored character.

catalog
A directory of files and libraries, with reference to their locations. A catalog may contain other information such as the types of devices in which the files are stored, passwords, and blocking factors. (I) (A)

See also *VSE/VSAM master catalog*.

channel program
One or more channel command words that control a sequence of data channel operations. Execution of this sequence is initiated by a single start I/O (SIO) instruction.

CA
See *control area*.

CI
See *control interval*.

CKD
See *count-key-data (CKD) device*.

close
The function that ends the connection between a file and a program, and ends the processing. Contrast with open.

cluster
In systems with VSE/VSAM, a named structure consisting of a group of related components; for example, a data component with its index component.

component
1. Hardware or software that is part of a computer system. 2. A functional part of an operating system, for example: job control program, VSE/POWER. 3. In VSE/VSAM, a named, cataloged group of stored records, such as the data component or index component of a key-sequenced file or alternate index.

conditional job control
The capability of the job control program to process or to skip one or more statements based on a condition that is tested by the program.

configuration
The devices and programs that make up a system, subsystem, or network.

control area (CA)
In VSE/VSAM, a group of control intervals (CIs) used as a unit for formatting a data set before adding records to it. Also, in a key-sequenced data set, the set of control intervals pointed to by a sequence-set index record (which, for example, is used by VSE/VSAM for distributing free space).

control block
An area within a program or a routine defined for the purpose of storing and maintaining control information.

control interval (CI)
A fixed length area of disk storage where VSE/VSAM stores records and creates distributes free space. It is the unit of information that VSE/VSAM transfers to or from disk storage.

count-key-data (CKD) device
A disk storage device that stores data in the record format: count field, key field, data field. The count field contains, among others, the address of the record in the format: cylinder, head (track), record number and the length of the data field. The key field, if present, contains the record's key (search argument). CKD disk space is allocated by tracks and cylinders. Contrast with fixed-block-architecture (FBA) device.

DASD
See *direct access storage device*.

Data Facility Product (DFP)
See *DFSMSdfp*.

data import
The process of reformatting data that was used under one operating system (for example, IBM System/3) such that it can subsequently be used under a different operating system (for example, the IBM z/VSE system).

data management
A major function of the operating system. It involves organizing, storing, locating, and retrieving data.

data set
The major unit of data storage and retrieval, consisting of a collection of data in one or several prescribed arrangements and described by control information to which the system has access.

See also *file*.

*** default value**
A value assumed when no value has been specified. Synonymous with assumed value.

device
A hardware component of a computer system with a specific purpose.

device address
1. The identification of an input/output device by its channel and unit number. 2. In data communication, the identification of any device to which data can be sent or from which data can be received.

*** device class**
The generic name for a group of device types, for example, all display stations belong to the same device class. Contrast with device type.

*** device type**
The name of a particular kind of device; for example, 9345 (IBM DASD module), 3420 (IBM magnetic tape unit). Contrast with device class.

DFP
See *DFSMSdfp*.

DFSMSdfp
DFSMSdfp (formerly known as DFP) provides data management, device support, program library management, utility functions, and support for the z/OS operating system.

direct access
Accessing data on a storage device using their address and not their sequence. This is the typical access on disk devices as opposed to magnetic tapes. Contrast with sequential access.

*** direct access storage**
A storage device that provides direct access to data. (1)

*** direct access storage device (DASD)**
A device in which access time is effectively independent of the location of the data. See also *fixed-block-architecture (FBA) device*.

directory
1. A table of identifiers and references to the corresponding items of data. (I) (A) 2. In z/VSE, an index that is used by the system to locate one or more sequential blocks of program information that are stored on direct access storage.

disk
Synonymous for magnetic disk.

diskette
A thin, flexible magnetic disk and a semi-rigid protective jacket, in which the disk is permanently enclosed.

disk sharing
An option that lets independently operating computer systems to jointly use common data residing on shared disk devices.

dump
1. To record, at a particular instant, the contents of all or part of one storage device in another storage device. Dumping is usually for the purpose of debugging. (T) 2. Data that has been dumped. (T) 3. To copy data in a readable format from main or auxiliary storage onto an external medium such as tape, diskette, or printer. 4. To copy the contents of all or part of virtual storage for the purpose of collecting error information.

Enterprise Storage Server (ESS)
An IBM disk storage system designed for performance, automation, integration, and continuous data availability. It supports advanced copy functions, which can be critical for increasing data availability by providing important disaster recovery and backup protection.

*** entry-sequenced file**
A VSE/VSAM file whose records are loaded without respect to their contents and whose relative byte addresses cannot change. Records are retrieved and stored by addressed access, and new records are added to the end of the file.

entry-sequenced data set (ESDS)
An entry-sequenced file under VSE/VSAM. Its records are loaded without respect to their contents, and whose relative byte addresses cannot change. Records are retrieved and stored by addressed access, and new records are added to the end of the file. See also *SAM ESDS file*.

exit
1. To execute an instruction within a portion of a computer program in order to terminate the execution of that portion. 2. See *user exit routine*.

exit routine
1. Either of two types of routines: installation exit routines or user exit routines. Synonymous with exit program. 2. See *user exit routine*.

extended-addressed KSDS
A KSDS exceeding 4 GB in size.

extent
Continuous space on a disk or diskette that is occupied by or reserved for a particular file or VSE/VSAM data space.

*** external storage**
Storage that is accessible to a processor only through input-output channels. An external storage may sometimes be considered as peripheral equipment. Synonymous with auxiliary storage. (T)

FAT-DASD
A subtype of Large DASD, it supports a device with more than 4369 cylinders (64K tracks) up to 64K cylinders.

FBA
See *fixed-block-architecture (FBA) device*.

FBA block
A unit of data that is transported as a unit on FBA disk devices.

Fibre Channel Protocol (FCP)
A combination of hardware and software conforming to the Fibre Channel standards and allowing system and peripheral connections via FICON® and FICON Express® feature cards on IBM zSeries processors. In z/VSE, zSeries FCP is employed to access industry-standard SCSI disk devices.

file
A named set of records stored or processed as a unit. (T) Synonymous with data set.

fixed-block-architecture (FBA) device
A disk storage device that stores data in blocks of fixed size. These blocks are addressed by block number relative to the beginning of the particular file. Contrast with count-key-data (CKD) device.

generation
See *macrogeneration*.

generic name
The initial characters common to names, that can be used to identify a group of items. A generic name usually ends with an *; for example, ORD* identifies all items whose names begin with the characters ORD.

index
1. A table used to locate records in an indexed sequential data set or an indexed file. 2. In VSE/VSAM, an ordered collection of pairs, each consisting of a key and a pointer, used by VSE/VSAM to sequence

and locate the records of a key-sequenced data set or file; it is organized in levels of index records. See also *alternate index*.

initial program load (IPL)
The process of loading system programs and preparing the system to run jobs.

input
1. Pertaining to a functional unit or channel involved in an input process, or to the data involved in such process. 2. Loosely, input data, input process. 3. Information or data to be processed.

input/output (I/O)
See *input* and *output*.

IPL
See *initial program load*.

JCL
See *job control language*.

job
One program, or a group of related programs called job steps, complete with the JCL statements necessary for a particular run. A job is identified in the job stream by a JOB statement followed by one EXEC statement for each of the programs or job steps.

job catalog
A catalog made available for a job by using the file name IJSYSUC in the respective DLBL statement.

job control language (JCL)
A language that serves to prepare a job or each job step of a job to be run. Some of its functions are: to identify the job, to determine the I/O devices to be used, set switches for program use, log (or print) its own statements, and fetch the first phase of each job step.

job control statement
A particular statement of JCL.

job step
One of a group of related programs complete with the JCL statements necessary for a particular run. Every job step is identified in the job stream by an EXEC statement under one JOB statement for the entire job.

job stream
The sequence of jobs as submitted to an operating system.

*** KB (kilobyte)**
1024 bytes of storage.

key
In VSE/VSAM, one or several characters taken from a certain field (key field) in data records for identification and sequence of index entries or of the records themselves.

key sequence
The collating sequence of either records themselves or of their keys in the index, or the collating sequence of records and keys. The key-sequence is alphanumeric.

key-sequenced data set (KSDS)
Under VSE/VSAM, a key-sequenced file. See *key-sequenced file*.

key-sequenced file
A VSE/VSAM file whose records are loaded in key sequence and controlled by an index. Records are retrieved and stored by keyed access or by addressed access, and new records are inserted in the file in key sequence.

KSDS
See *key-sequenced data set*.

*** label**
A record that identifies a volume on tape, disk, or diskette, or that identifies a file on the volume.

Large DASD
A DASD device that (1) has a capacity exceeding 64K tracks and (2) does not have VSAM space created prior to VSE/ESA 2.6 that is owned by a catalog.

local shared resources (LSR)
1. An option for sharing I/O buffers, I/O-related control blocks, and channel programs among VSE/VSAM data sets in a resource pool that serves one partition or address space. 2. A VSE/VSAM option activated by the macros BLDVRP, DLVRP, and WRTBFR to share control blocks among files.

logical record
A user record, normally pertaining to a single subject and processed by data management as a unit. Contrast with physical record which may be larger or smaller.

LSR
See *local shared resources*.

macro
See *macroinstruction*.

macrodefinition
A set of statements and instructions that defines the name of, format of, and conditions for generating a sequence of assembler statements and machine instructions from a single source statement.

macroexpansion
See *macrogeneration*.

macrogeneration
An operation in which an assembler produces a sequence of assembler language statements by processing a macrodefinition called by a macroinstruction. Macrogeneration takes place before assembly. Synonymous with macroexpansion.

macroinstruction
In assembler programming, an assembler language statement that causes the assembler to process a predefined set of statements called a macrodefinition. The statements normally produced from the macrodefinition replace the macroinstruction in the program.

magnetic tape
A tape with a magnetizable layer on which data can be stored. (T)

maximum (max) CA
A unit of allocation equivalent to the maximum control area size on a count-key-data or fixed-block device. On a CKD device, the max CA is equal to one cylinder.

*** MB (megabyte)**
One megabyte equals 1,048,576 bytes.

message
In z/VSE, a communication sent from a program to the operator or user. It can appear on a console, a display terminal, or in a printout.

*** migrate**
To move to a changed operating environment, usually to a new release or version of a system.

minimum (min) CA
A unit of allocation equivalent to the minimum control area size on a count-key-data or fixed-block device. On a CKD device, the min CA is equal to one track.

module
A program unit that is discrete and identifiable with respect to compiling, combining with other units, and loading; for example, the input to, or output from an assembler, compiler, linkage editor, or executive routine. (A)

online processing
Processing by which the input data enters the computer directly from a display station and the output data is transmitted directly to the display station.

open
To connect a file or a library to a program for processing. Contrast with close.

*** operating system**
Software that controls the execution of programs and that may provide services such as resource allocation, scheduling, input/output control, and data management. Although operating systems are predominantly software, partial hardware implementations are possible. (T)

*** operator command**
A statement to a control program, issued via a console or terminal. It causes the control program to provide requested information, alter normal operations, initiate new operations, or end existing operations.

output
1. Pertaining to a functional unit or channel involved in an output process, or to the data involved in such process. 2. Loosely, output data, output process. 3. Information or data that has been processed.

*** partition**
In z/VSE, a division of the virtual address area that is available for program execution.

*** password**
In computer security, a string of characters known to the computer system and a user. The user must specify it to gain full or limited access to the system and to the data stored in it.

path
1. In ACF/VTAM, the intervening nodes and data links connecting a terminal and an application program in the host processor. 2. In VSE/VSAM, a named logical entity providing access to the records of a base cluster either directly or through an alternate index.

*** physical record**
The amount of data transferred to or from auxiliary storage. Synonymous with block.

processor
The hardware component that interprets and executes instructions.

*** processor storage**
1. The storage provided by one or more processing units. 2. In virtual storage systems, synonymous with real storage.

*** random processing**
1. The treatment of data without respect to its location in external storage, and in an arbitrary sequence governed by the input against which it is to be processed. 2. The processing of records in an order other than the order in which they exist in a file.

*** read**
To acquire or interpret data from a storage device, from a data medium, or from another source. (I) (A)

*** real storage**
The main storage in a virtual system. Physically, real storage and main storage are identical. Conceptually however, real storage represents only part of the range of addresses available to the user of a virtual storage system. Traditionally, the total range of addresses available to the user was provided by the main storage. (I) (A)

record
A collection of related data or words, treated as a unit. See *logical record* and *physical record*.

*** recover**
After an execution failure, to establish a previous or new status from which execution can be resumed. (T)

relative-record data set (RRDS)
A VSE/VSAM file whose records are loaded into fixed-length slots and accessed by the relative-record numbers of these slots.

residency mode (RMODE)
A program attribute that refers to the location where a program is expected to reside in virtual storage.

restore
To write back on disk data that was previously written from disk to an intermediate storage medium such as tape.

RMODE
See *residency mode*.

routine
A program, or part of a program, that may have some general or frequent use. (T)

*** RPG II**
A commercially oriented programming language suitable specifically designed for writing application programs intended for business data processing.

RRDS
See *relative-record data set*.

run
1. A performance of one or more jobs or programs. (I) (A) 2. To cause a program, utility, or other machine function to be performed.

SAM
See *sequential access method*.

SAM ESDS file
A SAM file managed in VSE/VSAM space, so it can be accessed by both SAM and VSE/VSAM macros.

SCSI
A peripheral interface originally introduced for small computers. IBM Enterprise Storage Server (ESS) disks can be accessed via a SCSI interface implemented via zSeries Fibre Channel Protocol (FCP) channels.

SDL
See *system directory list*.

sequential access
The serial retrieval of records in their entry sequence or serial storage of records with or without a premeditated order. Contrast with direct access.

sequential access method (SAM)
A data access method that writes to and reads from an I/O device record after record (or block after block). On request, the support performs device control operations such as line spacing or page ejects on a printer, or skip a certain number of tape marks on a tape drive.

sequential file
A file in which records are processed in the order in which they are entered and stored.

service program
A program in general support of computer processes, for example, a diagnostic program, a trace program, or a sort program. (T)

*** shared virtual area (SVA)**
In z/VSE, a high address area of virtual storage that contains a system directory list (SDL) of frequently used phases, resident programs that can be shared between partitions, and an area for system support.

*** spanned record**
A logical record contained in more than one block.

split
To double a specified unit of storage space (CI or CA) dynamically when the specified minimum of free space gets used up by new records.

*** standard label**
A fixed-format record that identifies a volume of data such as a tape reel or a file that is part of a volume of data.

startup
The process of performing IPL of the operating system and of getting all subsystems and application programs ready for operation.

storage
A device, or part of a device, that can retain data. See also *auxiliary storage, processor storage, virtual storage*.

*** suballocated file**
A VSE/VSAM file that occupies a portion of an already defined data space. The data space may contain other files. Contrast with unique file.

SVA
See *shared virtual area*.

system directory list (SDL)
A list containing directory entries of frequently-used phases and of all phases resident in the SVA. The list resides in the SVA.

track
A circular path on the surface of a disk or diskette. Smallest unit of physical disk space.

*** unique file**
A VSE/VSAM file that occupies a data space of its own. The data space is defined at the same time as the file and cannot contain any other file. Contrast with suballocated file.

unit of transfer
The amount of data that can be transferred between virtual storage and an I/O device in response to a read or write request.

user exit routine
A user-written routine that receives control at predefined user exit points.

*** utility program**
1. A computer program in general support of computer processes; for example, a diagnostic program, a trace program, or a sort program. (T) Synonymous with service program. 2. A program that performs an everyday task such as copying data from one storage device to another.

variable-length relative-record data set (VRDS)
A VSE/VSAM relative-record data set with variable-length records. See also *relative-record data set*.

*** virtual address**
The address of a location in virtual storage. A virtual address must be translated into a real address in order to process the data in processor storage.

*** virtual address area**
The area available as a program address range.

virtual address space
In z/VSE, a subdivision of the virtual address area available to the user for the allocation of private, non-shared partitions.

virtual disk
A range of up to two gigabytes of contiguous virtual storage addresses that a program can use as workspace. Although the virtual disk exists in storage, it appears as a real FBA disk device to the user program. All I/O operations directed to a virtual disk are intercepted and the data to be written to, or read from, the disk is moved to or from a data space.

Like a data space, a virtual disk can hold only user data; it does not contain shared areas, system data or programs. Unlike an address space or a data space, data is not directly addressable on a virtual disk. To manipulate data on a virtual disk, the program has to perform I/O operations.

virtual storage
Addressable space image for the user from which instructions and data are mapped into processor storage locations.

virtual storage access method (VSAM)
An access method for indexed or sequential processing of fixed and variable length records on direct access devices. The records in a VSE/VSAM data set or file can be organized: in logical sequence using a key field (key sequence); in physical sequence in which they are written on the data set or file (entry sequence); by using relative record numbers.

These and other functions are provided by the IBM product VSE/VSAM.

volume
A data carrier mounted and demounted as a unit; for example, a reel of magnetic tape, a disk pack. (I) Some disk units have no demountable packs. In that case, a volume is the portion available to one read/write mechanism.

volume identifier
The volume serial number, which is a number in a volume label assigned when a volume is prepared for use by the system. See *volume serial number*.

*** volume serial number**
A number in a volume label assigned when a volume is prepared for use in a system.

volume table of contents (VTOC)
A table on a disk volume that describes every file on it.

VRDS
See *variable-length relative-record data set*.

VSE/VSAM
Virtual Storage Extended/Virtual Storage Access Method. See *virtual storage access method*.

VSAM
See *virtual storage access method*.

*** VSE/VSAM managed space**
A user-defined space on disk that is under the control of VSE/VSAM.

*** VSE/VSAM master catalog**
A key-sequenced data set or file with an index containing extensive data set and volume information that VSE/VSAM requires to locate data sets or files, allocate and deallocate storage space, verify the authorization of a program or operator to gain access to a data set or file, and to accumulate use statistics for data sets or files.

*** VSE/VSAM user catalog**
An optional VSE/VSAM catalog used in the same way as the master catalog and pointed to by the master catalog. Use of user catalogs lessens the contention for the master catalog and facilitates volume portability.

VSE
Virtual Storage Extended. 1. Synonym for VSE/Advanced Functions. 2. An operating system that is an extension of Disk Operating System/Virtual Storage (DOS/VSE).

VSE/Advanced Functions
The basic operating support needed for a VSE-controlled installation. Synonymous with VSE.

VTOC
See *volume table of contents*.

work file
A file used to for temporary storage of data being processed.

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