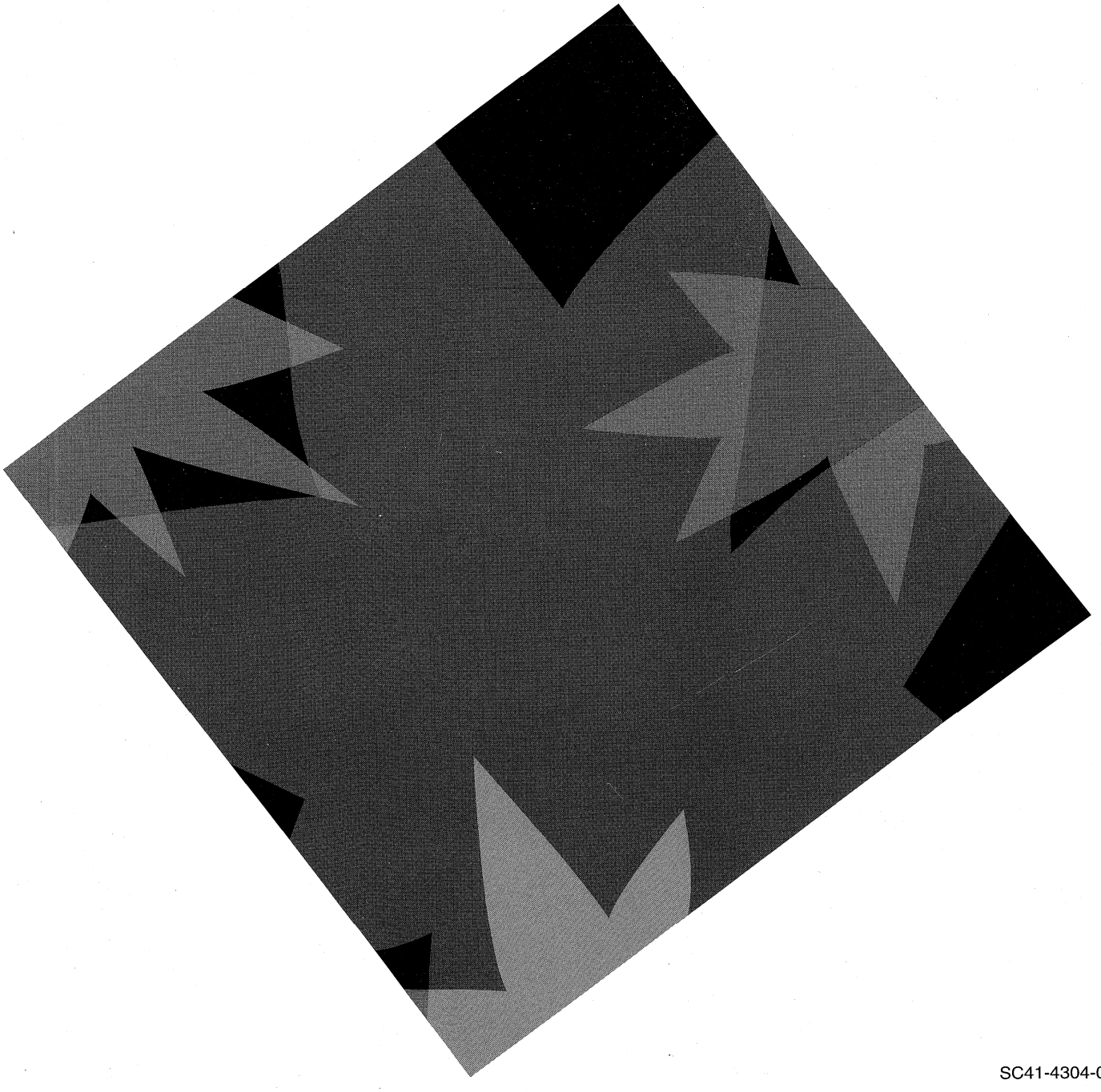
AS/400 Advanced Series

Backup and Recovery – Basic

Version 3



SC41-4304-00

AS/400 Advanced Series

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Version 3

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Take Note!

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

First Edition (December 1995)

Make sure you are using the proper edition for the level of the product.

This edition applies to the licensed program Operating System/400, (Program 5716-SS1), Version 3 Release 6 Modification 0, and to all subsequent releases and modifications until otherwise indicated in new editions. Make sure you are using the proper edition for the level of the product.

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Refer to the “Summary of Changes” on page xiii for a summary of changes made to the Operating System/400 and how they are described in this publication.

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About Backup and Recovery – Basic, SC41-4304

This book provides general information about backup, recovery, and availability options for the AS/400 business computing system. It describes the options available on the system, compares and contrasts them, and tells where to find more information about them.

This book provides:

- Information to plan a backup and recovery strategy.
- Procedures for saving information on your system.
- Information to select the right recovery strategy.
- Procedures for restoring information to your system.

This book is intended for someone who is assigned the responsibilities of backup and recovery planning and recovering the system after a failure. You should be familiar with the information contained in the *System Operation* book, and the *System Operation for New Users* book, before using this book. If you know how to operate the system, you should be ready to use this book.

See the *Backup and Recovery – Advanced* book, SC41-4305, for more information about the following topics:

- Journal management and database recovery
- Commitment control
- Device parity protection
- Mirrored protection
- Save-while-active function
- Uninterruptible power supply
- Backup and recovery programming techniques
- Backup and recovery performance
- Saving and restoring to different releases of OS/400

If you currently have an AS/400 system that is running Version 3 Release 1 Modification 0 or an earlier version of the OS/400 licensed program and you want to move all of your information to a RISC-based AS/400 system, consult the *AS/400 Road Map for Changing to PowerPC Technology* book.

You may need to refer to other IBM manuals for more specific information about a particular topic. The *Publications Reference*, SC41-4003, provides information on all the manuals in the AS/400 library.

For a list of related publications, see the "Bibliography."

Summary of Changes

Changes have been made to the *Backup and Recovery – Basic* book for these reasons:

- New and enhanced function has been added to the Operating System/400 licensed program for Version 3 Release 6 Modification 0 (V3R6M0). This additional function affects backup, recovery, and availability.
- Differences in architecture between RISC-based systems and CISC-based systems affect the way that you recover your system. In particular, this affects the way that you install or restore your Licensed Internal Code and the way that you start your system after it stops unexpectedly.

Recovering Licensed Internal Code: The procedures for recovering Licensed Internal Code have been simplified for V3R6M0. The procedure can be done primarily by selecting menu options instead of using the control panel on the processor. The new procedures are described in Chapter 10. The recovery checklists in Chapter 9 have been updated to reflect the new procedures.

Continuously Powered Main Store: When your system has the continuously powered main store feature, it can preserve the content of memory for a period of time after a power outage. This can reduce the amount of time it takes to perform an initial program load (IPL) after a power outage. "What Are the Common Failure Types?" on page 2-1 gives an overview of the continuously powered main store feature.

Main Store Dump Manager: Because of the large amount of main memory that is available for the system, the facility for storing and working with main store dumps has been enhanced. Chapter 12 provides some information about the Main Storage Dump Manager facility. The *AS/400 Service Functions* book has more information about the Main Storage Dump Manager facility.

Damaged Database Objects: To avoid an IPL that is unexpectedly long, the procedure for recovering certain types of damage to database objects has been changed. Prior to V3R6M0, the system automatically performed an analysis of all disk segments during the next IPL if certain types of database damage were detected. Beginning with V3R6M0, you can control whether the special IPL phase occurs. "Recovering Damaged Database Files" on page 12-9 describes the procedures.

ObjectConnect: The ObjectConnect function provides a set of commands to easily and quickly move objects between AS/400 systems. "ObjectConnect–Overview" on page 1-5 provides a brief description. Chapter 5 has information about the specific save and restore (SAVRSTxxx) commands. "How to Use the ObjectConnect/400 Function" on page 5-17 provides general information about setting up and using the ObjectConnect function.

Support for New Media: Licensed programs from IBM are now distributed on CD-ROM. Chapter 11, "Restoring the Operating System" includes changes to displays for CD-ROM support.

Save and restore commands will provide support for optical media. Information about this support is included in "How to Choose Your Save Media" on page 3-5.

System Object Model: Tools are available on the AS/400 system to work with SOMobjects. "How to Restore System Object Model Objects" on page 15-25 describes special considerations for saving and restoring SOMobjects.

Feedback from Users: This book has many audiences and users:

System operators and managers
Software support
Business partners
Business recovery services
Availability consultants

Information has been clarified and steps have been changed or added to the recovery checklists based on feedback from all of these groups.

Designing Backup, Recovery, and Availability

Chapter 1. Options for Backup, Recovery, and Availability–Overview

Today, computer systems and the applications and information that they provide are at the heart of most businesses. Without the critical functions they support–customer service, sales, order processing, distribution, manufacturing– business quickly comes to a halt. You need to plan backup, recovery, and system availability to protect your ability to maintain crucial business functions no matter what happens. Planning can mean the difference between business success and business failure.

AS/400 business computing systems offer a wide range of recovery and availability options. Some options are included with your hardware or software. Others are ordered separately. They are intended to help you do the following:

- Make your save operations faster and more efficient.
- Keep your system available for your users.
- Plan and manage your backup and recovery.

This chapter provides an overview of the options. Chapter 2 provides comparisons of the options. Use this information to decide what other options beyond the basics might be useful, affordable, and practical for your situation. The overview of each option tells you where you can find more information if that option appeals to you.

The remaining parts of this book describe the basics:

- Planning your save strategy.
- Saving information from your system.
- Recovering your system.

Save and Restore Operations–Overview

Save and restore commands and menus are provided with the Operating System/400* (OS/400*) licensed program. You can use the save operations and restore operations on the system to do the following:

- Recover from a program or system failure.
- Exchange information between AS/400 business computing systems.
- Store infrequently used objects offline.

Normally, objects are frequently saved and infrequently restored.

You can use commands and menu options to save individual objects and groups of objects. You can use some save and restore operations while your system is active. Other save and restore operations require that no other activity is occurring on the system.

You can save and restore objects using diskette, magnetic tape, optical media, or a save file. You can also use communications capabilities or an optical connection to save and restore objects with another system.

If your system is busy most of the time, you can use the save-while-active function to reduce the time period that the system is unavailable while you are performing save operations.

You can read more about save procedures in Chapter 3 of this book. You can read more about restore procedures in Chapter 8 of this book. You can read more about the save-while-active function in "Save-While-Active Function" in the *Backup and Recovery – Advanced* book.

Tape Units–Overview

The AS/400 business computing system offers many different types of tape units to meet a variety of requirements for performance, capacity, and cost. In many cases, you can attach enough tape drives with sufficient media capacity to save your entire system without operator intervention. This allows a complete unattended save operation.

For more information about the tape units that are available to attach to your system, call 1-800-IBM-CALL. You can read about tape performance and capacity in "Tape Performance Considerations" in the *Backup and Recovery – Advanced* book.

Automated Tape Library Systems –Overview

Automated tape library systems are a combination of hardware and software that store, catalog, and load large numbers of tapes without operator intervention. On AS/400 business computing systems, Backup Recovery and Media Services for OS/400 software supports the use of an automated tape library system.

You can read more about using automated tape library systems with the AS/400 business computing system in the *Automated Tape Library Planning and Management* book.

Optical Media Support–Overview

Some of the save and restore commands support optical devices and optical media. The primary purpose for this support is to provide the capability to archive and retrieve information from optical media. For example, you may want to save folders that have old documents to optical media. If a user needs an archived document, the document can be retrieved from the optical media. Similarly, you can archive history files, spooled files of month-end reports, or a copy of accounting files at the end of a fiscal year.

Optical media is not intended to be a primary save and restore media for the AS/400 system. Currently, you cannot

save your entire system, or even all of your user data, to optical media. The *Optical Support* book provides more information about using optical media.

Journal Management–Overview

You can use journal management to recover the changes to database files or other objects that have occurred since your last complete save.

You use a **journal** to define what files and access paths you want to protect with journal management. This is often referred to as **journaling** a file or an access path. A **journal receiver** contains the entries (called **journal entries**) that the system adds when events occur that are journaled, such as changes to database files, changes to other journaled objects, or security-relevant events.

The main purpose of journal management is to assist in recovery. You can also use the information stored in journal receivers for other purposes, such as:

- An audit trail of activity that occurs for database files or other objects on the system.
- Assistance in testing application programs. You can use journal entries to see the changes made by a particular program.

You can read more about planning and setting up journal management in "Planning and Setting Up Journaling" in the *Backup and Recovery – Advanced* book.

Access-Path Protection–Overview

An **access path** describes the order in which records in a database file are processed. A file can have multiple access paths, if different programs need to see the records in different sequences. If your system ends abnormally when access paths are in use, the system may have to rebuild the access paths before you can use the files again. This is a time-consuming process. To perform an IPL on a large, busy AS/400* that has ended abnormally can take many hours.

You can use journal management to keep a record of changes to access paths. This greatly reduces the amount of time it takes the system to perform an IPL after it ends abnormally.

Two methods of access-path protection are available:

System-managed access-path protection
Explicit journaling of access paths

System-Managed Access-Path Protection: You can allow the system to determine which access paths to protect. You specify target recovery times for access paths for the entire system or for auxiliary storage pools (ASPs). When your system is shipped, it has a default recovery time for access paths for the entire system of 150 minutes. You can use the Edit Recovery for Access Paths (EDTRCYAP) command to see and change the target recovery times for access paths and to see how much space the system is using for system-managed access-path protection (SMAPP).

SMAPP provides a simple method to reduce your recovery time after an abnormal system end. SMAPP manages the required environment for you. You do not need to use any type of journal management to use SMAPP.

Explicit Journaling of Access Paths: When you use SMAPP, the system decides which access paths to protect, based on overall target recovery times for access paths. You may want to make sure that certain access paths are protected because they are critical to your business. You can use journal management to explicitly protect access paths on your system.

You can use a combination of SMAPP and explicit journaling of access paths. The system evaluates the protected and unprotected access paths to develop its strategy for meeting your recovery targets for access paths.

You can read more about SMAPP in "Protecting Access Paths Using System-Managed Access-Path Protection" in the *Backup and Recovery – Advanced* book. Also in the same book, "Planning and Setting Up Journaling" describes explicit journaling of access paths.

Commitment Control–Overview

Commitment control is an extension of journal management that assists you in keeping your database files synchronized. A single transaction on your system may update more than one database file. If your system is in a network, a single transaction may update files on more than one system.

Commitment control helps ensure that:

- All changes within a transaction are completed for all files affected.
- All changes within a transaction are removed if processing is interrupted before the transaction is completed.
- Changes made during a transaction can be removed when the user program determines that it is necessary to do so. This is called a rollback operation.

Without commitment control, recovering data for a complicated program requires detailed application and program knowledge. Programs that are interrupted cannot easily be started again. To restore the data to the last completed transaction, you may need to write a user program or use data file utility (DFU) to reverse the database updates that are not complete.

The commit (COMMIT) and rollback (ROLLBACK) operations are available in several AS/400* programming languages including ILE RPG/400*, ILE COBOL/400*, ILE C/400*,

control language (CL), and Structured Query Language (SQL).

You can read more about commitment control in "Commitment Control" in the *Backup and Recovery – Advanced* book.

Auxiliary Storage Pools–Overview

Your system may have many disk units attached to it for auxiliary storage of your data. To your system, they look like a single unit of storage. The system spreads data across all disk units. You can use auxiliary storage pools to separate your disk units into logical subsets.

An **auxiliary storage pool (ASP)** is a group of units defined from all the disk units that make up auxiliary storage. It is a software definition of how the disk units are arranged. An ASP does not necessarily correspond to the physical arrangement of disks.

ASPs allow you to isolate objects on one or more specific disk units. This may reduce the loss of data due to a disk media failure. In most cases, only data stored on disk units in the affected ASP is lost. However, when a disk unit fails, the entire system is unusable until the disk unit is repaired, unless the failed unit is protected by device parity protection or mirrored protection.

ASPs are used to manage system performance and backup requirements:

- You can create an ASP to provide dedicated resources for frequently used objects, such as journal receivers.
- You can create an ASP to hold save files. Objects can be backed up to save files in a different ASP. It is unlikely that both the ASP containing the object and the ASP containing the save file will be lost.
- You can create different ASPs for objects with different recovery and availability requirements. For example, you can put critical database files or documents in an ASP that has mirrored protection or device parity protection.
- You can create an ASP to place infrequently used objects, such as large history files, on disk units with slower performance.
- You can use ASPs to manage recovery times for access paths for critical and noncritical database files using system-managed access-path protection.

Two types of ASPs are available on the system:

- The **system ASP** (ASP 1) is created by the system and is always configured. It contains the Licensed Internal Code, licensed programs, system libraries, and temporary system work space. The system ASP also contains all other configured disk units that are not assigned to a user ASP.
- A **user ASP** is created by grouping together a physical set of disk units and assigning them a number (2 through 16). ASP 1 is always reserved as the system ASP.

You can read more about ASPs in "Working with Auxiliary Storage Pools" in the *Backup and Recovery – Advanced* book.

Mirrored Protection–Overview

Mirrored protection is intended to prevent data from being lost if a disk failure occurs. Mirrored protection is a software function that uses duplicates of disk-related hardware components to keep your system available if one of the components fails. It can be used on any model of the AS/400 system and is a part of the Licensed Internal Code.

Different levels of mirrored protection are possible, depending on what hardware is duplicated. You can duplicate:

Disk units
Disk controllers
Disk I/O processors
A bus

If a failing component and the hardware components attached to it are duplicated, the system remains available during the failure.

You can read more about mirrored protection in "Working with Mirrored Protection" in the *Backup and Recovery – Advanced* book.

Device Parity Protection–Overview

Device parity protection is intended to prevent data from being lost if a disk failure occurs. In many cases, device parity protection can also prevent your system from stopping when a disk unit fails. Device parity protection provides the following:

- Technology similar to the RAID-5 (redundant array of independent disks) technique
- Redundant power
- Concurrent maintenance for single disk failures
- Concurrent maintenance for power supply failures for the 9337 Disk Array Subsystem

Device parity protection is a hardware function that is available for some disk unit subsystems and input/output processor features. This includes the 6502 or 6512 Input/Output Processor and the 9337 Disk Array Subsystem.

The models with device parity protection use a data redundancy technique to protect the data. The parity information in the disk unit subsystems with device parity protection is spread across multiple units to improve performance.

When a failure occurs on a disk unit subsystem that has device parity protection, the data is reconstructed. The disk subsystem controller automatically reconstructs the data from the active units in the disk unit subsystem. The system continues to run while the data is being reconstructed.

When a failure occurs on a disk unit subsystem that does not have device parity protection or mirrored protection, you cannot use the system until the disk unit is repaired or replaced.

If possible, you should protect all the disk units on your system with either device parity protection or mirrored protection. This prevents the loss of information when a disk failure occurs. In many cases, you can also keep your system running while a disk unit is being repaired or replaced.

You can read more about device parity protection in "Working with Device Parity Protection" in the *Backup and Recovery – Advanced* book.

Comparison of Disk Protection Options

Table 1-1 compares the disk protection options:

Table 1-1. Comparison of Disk Protection Options. Yes *indicates the component is protected. The system does not stop when that component fails.*

Disk Component	Device Parity Protection	Mirrored Protection	Checksum Protection[3]
Bus	No	Yes[2]	No
IOP	No	Yes[2]	No
Controller	No	Yes[2]	No
Power supply	Yes[1]	Yes[2]	No
Disk drive	Yes	Yes	No

1 Only on the 9337 Disk Array Subsystem.

2 Mirrored protection protects this component if your system has sufficient redundant hardware.

3 Checksum protection is no longer available, beginning with V3R6M0 of the OS/400 licensed program. It is included for comparison purposes.

Uninterruptible Power Supply–Overview

An uninterruptible power supply provides auxiliary power to the processing unit, disk units, system console, and other devices that you choose to protect. When you use an uninterruptible power supply with the AS/400 system, you can:

- Continue operations during brief power interruptions.
- Provide normal ending of operations to reduce the recovery time when the system is restarted. If the system ends abnormally before completing a normal ending of operations, the recovery time can be significant.
- Protect the system from voltage peaks.

Normally, an uninterruptible power supply does not provide power to all work stations. You should design your interactive applications to handle the loss of communications with a workstation. Otherwise, system resources are used to attempt to do error recovery for workstations that have lost power.

The programming language reference manuals provide examples of how to use the error feedback areas to handle workstations that are no longer communicating with the application. The part of the *Backup and Recovery – Advanced* book called "Description of Power Loss Recovery" describes how to develop programs to handle an orderly shutdown of the system when the uninterruptible power supply unit takes over.

Continuously Powered Main Store–Overview

Many systems are equipped with a feature called System Power Control Network. This feature provides a function called Continuously Powered Main Store. If your system has this feature, a battery provides sufficient power to shut down the system and maintain the contents of memory for up to 2 days after a power loss. In many cases, this can significantly reduce the amount of time the system requires to perform an initial program load (IPL) after a power loss.

You can use the continuously powered main store feature along with an uninterruptible power supply. If the system detects that the uninterruptible power supply can no longer provide sufficient power to the system, the continuously powered main store feature takes control, shuts down the system, and preserves the contents of memory for up to 2 days.

When you have this feature, the system automatically initiates an IPL after power is restored.

Dual Systems–Overview

Installations with very high availability requirements use a dual-systems approach. Some or all data is maintained on two systems. The secondary system can take over critical application programs if the primary system fails.

The most common method for maintaining data on the secondary system is through the use of journaling. Journal entries from the primary system are transmitted to the secondary system. A user-written program on the secondary system receives the journal entries and uses them to update files and other journaled objects.

Another method is to copy journal receivers to tape regularly. The journal receivers are then restored to the secondary system. A user-written program uses the journal entries to update the files on the secondary system.

Several software packages are available from independent software vendors to support dual systems on the AS/400 system.

ObjectConnect–Overview

The ObjectConnect function provides the ability to move entire objects between systems using an optical connection, a communications line, or a local area network (LAN). The ObjectConnect function provides a set of save and restore (SAVRSTxxx) commands. For example, you can use the SAVRSTLIB command to save one or more libraries, send the libraries over an optical connection to a specified system, and restore the libraries.

The ObjectConnect support is provided at a low level in the operating system. It provides better performance than other methods of transferring objects, such as using save files. You can read more about ObjectConnect in "How to Use the ObjectConnect/400 Function" on page 5-17.

OptiConnect/400–Overview

OptiConnect/400 support provides the capability of linking AS/400 systems with a fiber-optic bus. You can use OptiConnect/400 with ObjectConnect to move objects between systems quickly and efficiently. You can read more about OptiConnect/400 in the *OptiConnect/400 Guide*.

Backup Recovery and Media Services/400–Overview

The Backup Recovery and Media Services/400 (BRMS for OS/400*) licensed program offers a set of services for defining and performing these tasks:

- Backup
- Recovery
- Archiving
- Retrieval
- Media management

You can use BRMS for OS/400 to simplify and automate your backups and to manage your tape library. BRMS for OS/400 keeps track of what you have saved, when you saved it, and where it is saved. When you need to do a recovery, BRMS for OS/400 helps ensure that the correct information is restored from the correct tapes in the correct sequence.

You can read more about BRMS for OS/400 in the *Backup Recovery and Media Services for OS/400* book.

ADSTAR Distributed Storage Manager/400–Overview

You can use the ADSTAR Distributed Storage Manager/400* licensed program to protect data on your workstations and LAN file servers. ADSTAR Distributed Storage Manager can automatically back up critical LAN and workstation data and archive files that are used infrequently. It provides a disaster recovery solution for LANs and workstations.

ADSTAR Distributed Storage Manager/400 is administered from a client workstation attached to an AS/400 business computing system. It can back up data from a variety of workstation platforms. You can use ADSTAR Distributed Storage Manager/400 with the BRMS for OS/400 program to back up an entire AS/400 client/server environment.

You can read more about ADSTAR Distributed Storage Manager/400 in *ADSTAR Distributed Storage Manager General Information*, GH35-0114.

Report Data Archive and Retrieval System/400–Overview

The Report Data Archive and Retrieval System/400 (R/DARS) is a service offering. You can use R/DARS to create search criteria and a search index for large volumes of data, such as history reports or files, that you want to archive. You can archive the data either to a folder or to optical media. You can retrieve specific archived data that meets your search criteria.

For more information about R/DARS, call 1-800-426-9402.

Work with Auxiliary Storage Pools–Overview

Work with Auxiliary Storage Pools (WRKASP) is an offering by the Availability Support Center. The WRKASP utility provides functions to help you plan and manage multiple auxiliary storage pools on your system. It includes the following information:

- The capacity and status of user ASPs
- The contents of ASPs
- Whether they have disk protection (mirrored protection)

For more information about the WRKASP utility, call 1-800-IBM-IBM-0.

Business Recovery Services–Overview

IBM Business Recovery Services (BRS) offers an extensive portfolio of services to help you design, set up, and manage a comprehensive, enterprise-wide AS/400 business recovery strategy. BRS can help you minimize the effects of network and system outages and plan for their efficient recovery. BRS consultants can help you do the following:

- Evaluate critical business functions and applications.
- Assess your system environment.
- Design a recovery plan to keep your business running in the event of an extended outage.

BRS recovery centers are equipped with the latest AS/400 business computing system technologies. They are staffed with technical experts to assist you in testing your recovery plan and performing a recovery in the event of a disaster.

For more information about Business Recovery Services, please call 1-800-599-9950, extension 206.

Availability Support Center–Overview

The AS/400 Availability Support Center provides consulting services in the following areas:

- Availability management
- Recovery readiness
- Operational reviews
- Systems management

The center supports several tools for backup and recovery and regularly conducts education sessions. The topics that follow describe some of the service and education offerings from the Availability Support Center.

For more information about the Availability Support Center, please call 1-800-365-4426, extension 200.

Recovery Readiness Examination–Overview

The AS/400 Recovery Readiness Examination (RRE) is a service offering designed to help you to determine the most cost-effective way to reduce the frequency and duration of unplanned outages on your system. The RRE consultant uses the following to gather information about your system:

- A tool that runs on your system and collects data.
- Interviews.
- Questionnaires.

The results include the following:

- Backup and recovery procedures.
- The amount of data to be saved and restored.
- Recovery time objectives.
- The estimated outage time and the cost for the major failure types.

For more information about the Recovery Readiness Examination, please call 1-800-IBM-IBM-0.

Data Migration Service Offerings–Overview

The AS/400 DASD Migration Service Offering (GIGMIG) is a service offering to migrate the disk (DASD) on your AS/400 business computing system to different disk technology without reloading your entire system. GIGMIG offerings include the following:

- Replacing all disks on the system.
- Adding new disks and removing some existing disks.
- Moving disks between ASPs.

SYSMIG is a service offering to migrate your data from one AS/400 system to another AS/400 system.

For more information about GIGMIG and SYSMIG, please call 1-800-IBM-IBM-0.

Chapter 2. Planning Strategies for Saving and Availability

The objective of this chapter is to provide you with the knowledge to decide the following at a high level:

- What you need to save.
- How often you need to save it.
- What availability strategies you can use to reduce the amount of time it takes to recover.

This chapter discusses strategy, not procedures and implementation. How you perform save operations and set up availability options are discussed later in this book and in the *Backup and Recovery – Advanced* book.

In making decisions about your strategies for saving and availability, you need to balance the cost of a failure with the cost of protection against the failure. To decide how much time, effort, and money you are willing to spend on backup and availability, you must attempt to answer and quantify some difficult questions:

- What is the cost of being without the system during an unplanned outage?
- How much data can you afford to lose?
- What is the cost of being without the system on a scheduled basis for backups?

Why Do You Need a Save Strategy?

Saving the information on your system is time-consuming and requires discipline. Why should you do it? Why should you spend time planning and evaluating it?

Because you may have a problem. You will need to use your backup copies of information. Every system needs to restore some or all of its information at some point in time.

Figure 2-1 shows a sample time line. It begins when you save information and ends when your system is fully recovered after a failure.

Refer to this chart as you read and make decisions. Your strategies for saving and availability determine these things:

- Whether you can successfully complete each step in the chart
- How long it will take you to complete each step

As you read, use the chart to develop specific examples. What if the known point (1) is Sunday evening and the failure point (2) is Thursday afternoon? How long will it take to get back to the known point? How long will it take to get to the current point (6)? Is it even possible with the save strategy you have planned?

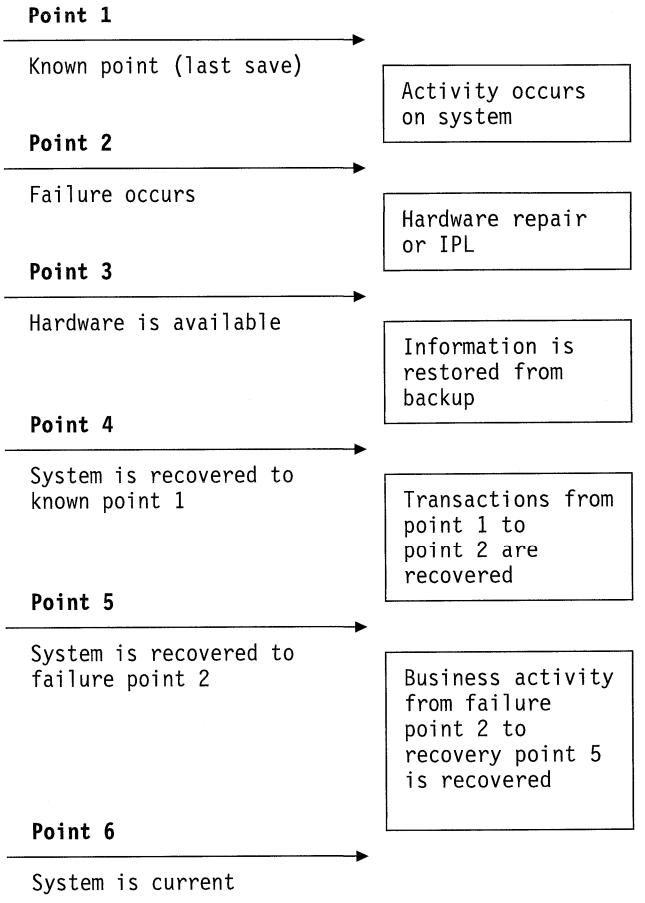


Figure 2-1. Sample Time Line for Recovery

What Are the Common Failure Types?

Five basic types of failures can occur on a system. Some are more likely to occur than others. You should have a save strategy that prepares you to recover from all of them. Chapter 9, "Selecting the Right Recovery Strategy" describes the procedures for recovering from each type of failure.

Disk Failure: If a disk unit on your system fails, in most cases the data on that disk unit is destroyed. This requires recovering all the data in the auxiliary storage pool (ASP) that contains the failed unit.

The single-level storage architecture makes the AS/400 system a very productive system to program and to manage. However, the architecture makes recovering from a disk failure somewhat more difficult. The system spreads information across all the disk units in an ASP to provide good performance and storage management. If a unit in an ASP is lost, you cannot determine what data was on that unit because objects are spread across the ASP. You must recover all the data in the ASP.

The disk protection tools–mirrored protection and device parity protection–are designed to reduce the recovery time if

a disk unit fails or, in some cases, to eliminate the need for the recovery of data.

System Failure: A system failure means that some part of your system hardware, other than the DASD subsystems, fails. Some system failures, such as processor problems, cause your system to stop without warning. This is called an **abnormal end**.

When your system ends abnormally, problems can occur:

- Files may be partially updated.
- Access paths for files may be incomplete.
- Objects that are in use may be damaged.
- Relationships between files may be partially validated.

When you restart (IPL) your system after the failed component is repaired, the system analyzes the possible damage, rebuilds or recovers access paths, tries to verify file relationships, and attempts to synchronize files to transaction boundaries. The first IPL after the system ends abnormally can take a long time.

Power Failure: Loss of power also causes your system to end abnormally. You may experience the same types of problems that occur with a system failure. Many systems are equipped with a feature called System Power Control Network. This feature provides a function called Continuously Powered Main Store. If your system has this feature, a battery provides sufficient power to shut down the system and maintain the contents of memory for up to 2 days after a power loss. In many cases, this can significantly reduce the amount of time the system requires to perform an initial program load (IPL) after a power loss.

Program Failure or Human Error: Sometimes programs are not adequately tested before they are put into production. Or a condition occurs that was not anticipated by the software developers. A program error can cause incorrect information in some of your data files.

People using the system can make mistakes, too. An operator might run a month-end program twice. A data entry person might enter the same batch of orders twice. A system manager might delete a file by mistake.

When these types of errors occur, you need to correct or restore the data that has been damaged.

Complete System Loss: A fire, flood, or other natural disaster could destroy your entire system. To rebuild your entire system, you should have a complete set of save tapes and documentation stored off-site at a secure, accessible location.

What Do You Need to Save and How Often?

What you need to save is easy: everything. To be prepared for a site loss or certain types of disk failures, you need to be able to recover everything on your system. Saving the right things determines whether you can recover to point 4 (the last save) shown in Figure 2-1 on page 2-1.

In an ideal world, how often you need to save is also an easy question. Every week, save the parts of your system that do not change very much. Every day, save the parts of your system that change often. Saving the right things at the right time determines how much information you need to recover to get from point 4 to point 5 in Figure 2-1.

Table 2-1 describes the parts of the system, whether they are supplied by IBM or created by users, and how often they change:

Table 2-1 (Page 1 of 2). Overview of Parts of the System

Item Description	IBM-Supplied?	When Changes Occur
Parts of the System That Do Not Change Often:		
Licensed Internal Code	Yes	PTFs or new release of the operating system
Operating system objects in QSYS library	Yes	PTFs or new release of the operating system
OS/400 optional libraries (QHLPSYS, QUSRTOOL)	Yes	PTFs or new release of the operating system
Licensed program libraries (QRPG, QCBL, Qxxxx)	Yes	Updates to licensed programs
Licensed program folders (Qxxxxxxx)	Yes	Updates to licensed programs
Licensed program directories (/Qxxxxxxx)	Yes	Updates to licensed programs
Parts of the System That Change Often:		
Security information (user profiles, private authorities, authorization lists)	Some	Regularly as new users and objects are added or authorities are changed[1]
Configuration objects in QSYS	No	Regularly, when device descriptions are added or changed or when you use the Hardware Service Manager function to update configuration information[1]
IBM-supplied libraries that contain user data (QGPL, QUSRSYS)	Yes	Regularly

Table 2-1 (Page 2 of 2). Overview of Parts of the System

Item Description	IBM-Supplied?	When Changes Occur
User libraries that contain user data and programs	No	Regularly
Folders and documents	Some	Regularly, if you use these objects
Distributions	No	Regularly, if you use the distribution function
Directories	Some	Regularly, if you use these objects

1 These objects may also change when you update licensed programs.

Realistically, when you run save procedures, how you run save procedures, and what you save depend on the size of your **save window**. Your save window is the amount of time that your system can be unavailable to users while you perform your save operations. To simplify your recovery, you need to save when your system is at a known point and your data is not changing.

When you select a save strategy, you should balance what your users think is an acceptable save window with the value of the data you might lose and the amount of time it may take to recover.

Choose one of the save strategies described in the topics that follow, based on the size of your save window. Then reevaluate your decision based on how your save strategy positions you for a recovery.

Save Window	Description	Save Strategy
Long	An 8- to 12-hour block of time available daily with no system activity (including batch work).	Simple
Medium	A shorter block of time (4 to 6 hours) available daily with no system activity.	Medium
Short	Little or no time available when the system is not being used for interactive or batch work.	Complex

Simple Save Strategy

The simplest save strategy is to save everything every night (or off-shift hours). You can use option 21 (Entire system) from the Save menu to do this. You can schedule option 21 to run without an operator (unattended) beginning at a certain time. "Using Save Menu Options 21, 22, and 23" on page 4-2 describes using option 21 on the Save menu.

You can also use this method to save your entire system after you upgrade to a new release or apply program temporary fixes (PTFs).

You may find that you do not have enough time or enough tape unit capability to run option 21 without an operator. You can still employ a simple strategy:

Daily Save everything that changes often.

Weekly Save the things that do not change often.

Table 2-1 on page 2-2 shows how the system can be viewed by what changes often and what does not. Option 23 (All user data) on the Save menu saves the things that change regularly. Option 23 can be scheduled to run unattended. "Using Save Menu Options 21, 22, and 23" on page 4-2 describes using option 23. To run unattended, you must have enough online backup media capacity.

If your system has a long period of inactivity on the weekend, your save strategy might look like this:

Friday night	Save menu option 21
Monday night	Save menu option 23
Tuesday night	Save menu option 23
Wednesday night	Save menu option 23
Thursday night	Save menu option 23
Friday night	Save menu option 21

Medium Save Strategy

You may find you do not have a long enough save window to use a simple save strategy. Perhaps you run large batch jobs on your system at night. Or, you have very large files that take a long time to save. If this is the case, you may need to develop a medium save strategy, which means the complexity for saving and for recovery is medium.

When developing a medium save strategy, apply this principle: the more often it changes, the more often you should save it. You just need to be more detailed in evaluating how often things change than when you use a simple strategy.

Several techniques are available to use in a medium save strategy. You may use one of them or a combination.

- Saving changed objects
- Journaling database files and saving the journal receivers
- Saving groups of libraries

Saving Changed Objects: You can use several commands to save only information that has changed since the last save operation or since a particular date and time.

You can use the Save Changed Objects (SAVCHGOBJ) command to save only those objects that have changed since a library or group of libraries was last saved. This can be particularly useful in a situation where programs and data files are in the same library. Typically, data files change frequently and programs change infrequently. You can use the SAVCHGOBJ command to save only the files that change.

You can use the Save Document Library Object (SAVDLO) command to save only documents and folders that have

changed. You can use the SAVDLO command for all user ASPs or for a specific user ASP.

You can use the Save (SAV) command to save objects in directories that have changed since a particular point.

You might also choose to save changed objects if your batch workload is heavier some nights. For example:

Day	Batch Workload	Save Operation
Friday night	Light	Save menu option 21
Monday night	Heavy	Save changes only[1]
Tuesday night	Light	Save menu option 23
Wednesday night	Heavy	Save changes only[1]
Thursday night	Heavy	Save changes only[1]
Friday night	Light	Save menu option 21

1 Use a combination of the SAVCHGOBJ, SAVDLO, and SAV commands.

Journaling Database Files: If your save operations take too long because your files are large, saving changed objects may not help you. If you have a file member with 100 000 records and 1 record changes, the SAVCHGOBJ command saves the entire file member. In this situation, journaling your database files and saving journal receivers regularly may be a better solution, even though recovery is more complex.

When you journal a database file, the system writes a copy of every changed record to a journal receiver. When you save a journal receiver, you are saving only the changed records in the file, not the entire file.

If you journal your database files and have a batch workload that varies, your save strategy might look like this:

Day	Batch Workload	Save Operation
Friday night	Light	Save menu option 21
Monday night	Heavy	Save journal receivers
Tuesday night	Light	Save menu option 23
Wednesday night	Heavy	Save journal receivers
Thursday night	Heavy	Save journal receivers
Friday night	Light	Save menu option 21

Notes:

1. To take advantage of the protection that journaling provides, you should detach and save journal receivers regularly. How often you save them depends on the number of journaled changes that occur. Saving journal receivers several times during the day may be appropriate for you. How you save journal receivers depends on whether they are in a separate library. You might use the Save Library (SAVLIB) command or the Save Object (SAVOBJ) command. See "How to Save Journals and Journal Receivers" on page 5-6 for more information.
2. You must save a new member of a database file before you can apply journal entries to the file. If your applications regularly add new file members, you should consider using the SAVCHGOBJ strategy either by itself or in combination with journaling.

The chapter in the *Backup and Recovery – Advanced* book called "Planning and Setting Up Journaling" provides more information about setting up and managing journaling.

Saving Groups of Libraries: Many applications are set up with data files in different libraries from application programs. Data files change frequently. On most systems, application programs change infrequently. If your system is set up like this, you may want to save only the libraries with data files on a daily basis.

You can use option 1 (Change daily backup options) on the Set Up Backup (SETUPBCKUP) menu to create a list of libraries to be backed up daily. You can use option 1 (Run daily backup) from the Run Backup (RUNBCKUP) menu to save this list of libraries. Or you can schedule a job to run daily backup using option 20 (Change backup schedule) on the SETUPBCKUP menu. Chapter 6, "Using Operational Assistant to Save Information" provides more information about using the backup menus.

Your save strategy using Operational Assistant backup might look like this:

Friday night	RUNBCKUP menu option 11
Monday night	RUNBCKUP menu option 1
Tuesday night	RUNBCKUP menu option 1
Wednesday night	RUNBCKUP menu option 1
Thursday night	RUNBCKUP menu option 1
Friday night	RUNBCKUP menu option 11

Should You Use the Backup Menu or the Save Menu?: You can use options 21, 22, and 23 on the Save menu to ensure that you have saved everything on your system. Recovery using these save tapes is straight-forward. However, you must have a long enough save window to be able to save all user libraries (option 23) on a regular basis.

You can use the Backup menu if you want to save a list of libraries or changed objects only. It provides a simple method for doing a partial backup on a regular basis. If you use the Backup menu, you may be able to complete your daily save operations in less time with less media. However, recovery from the media created by using the Backup menu can be more complex.

Select either the Save menu or the Backup menu for your save strategy. Do not mix backup options from the two menus. If you use backup options from both menus, you may have incomplete save media and your recovery may be more difficult.

Check Your Strategy Often!!

If your situation requires a strategy of medium complexity, it also requires regular review:

- Are you saving everything occasionally?
- What do you need to do to recover to the known point (4) on Figure 2-1 on page 2-1?
- Are you using options like journaling or saving changed objects to help you recover to the failure point (5)? Do you know how to recover using those options?
- Have you added new applications? Are those libraries being saved?
- Are you saving the IBM-supplied libraries that contain user data (QGPL and QUSRSYS)?
- Have you tested your recovery?

Complex Save Strategy

A very short save window requires a complex strategy for saving and for recovery. You use the same tools and techniques described for a medium save strategy, but at a greater level of detail. For example, you may need to save specific critical files at specific times of the day or week.

Saving your system while it is active is often necessary in a complex save strategy. The save active (SAVACT) parameter is supported on these commands:

Save Library (SAVLIB)
Save Object (SAVOBJ)
Save Changed Objects (SAVCHGOBJ)
Save Document Library Object (SAVDLO)
Save (SAV)

If you use save-while-active support, you can significantly reduce the amount of time that files are made unavailable. When the system has established a checkpoint for all objects being saved, the objects can be made available for use. Save-while-active support should be used in combination with journaling and commitment control to simplify the recovery procedure. Commitment control also improves save-while-active performance.

If you choose to use save-while-active support, make sure you understand the process and monitor how well checkpoints are being established on your system. The part of the *Backup and Recovery – Advanced* book called "Save-While-Active Function" describes using save-while-active support. The *AS/400 System Availability and Recovery for V2R2* book, GG24-3912, describes recovering when save-while-active support is used for the save procedures.

Check Your Strategy Often!!

If your situation requires a complex strategy, it also requires regular review:

- Are you saving everything occasionally?
- What do you need to do to recover to the known point (4) on Figure 2-1 on page 2-1?
- Are you using options like journaling or saving changed objects to help you recover to the failure point (5)? Do you know how to recover using those options?
- Have you added new applications? Are those libraries being saved?
- Are you saving the IBM-supplied libraries that contain user data (QGPL and QUSRSYS)?
- Are you getting good checkpoints if you use the save-while-active function?
- Have you tested your recovery?

If your system is so critical to your business that you do not have a manageable save window, you probably cannot afford an unscheduled outage either. You should seriously evaluate all the availability options of the AS/400 system, including dual systems.

Testing Your Strategy for Saving and Recovering

The best way to test your strategy for saving is to test a recovery. Although you can test a recovery on your own system, doing so can be risky. If you have not saved everything successfully, you may lose information when you attempt to restore.

A number of organizations offer recovery testing as a service. IBM Business Recovery Services is one organization that can assist you with recovery testing.

Availability Options

Availability options are a complement to a good save strategy, not a replacement. Availability options can significantly reduce the time it takes you to recover after a failure. In some cases, availability options can prevent you from having to perform a recovery.

To justify the cost of using availability options, you need to understand:

- The value your system provides.
- The cost of a scheduled or unscheduled outage.
- What your availability requirements are.

These terms are often used to discuss system availability:

Outage
A period when the system is not available to users. During a **scheduled outage**, you deliberately make your system unavailable to users. You might use a scheduled outage to run batch work, save your system, or apply program temporary fixes (PTFs). An **unscheduled outage** is usually caused by a failure of some type.

High availability
The system has no unscheduled outages.

Continuous operations
The system has no scheduled outages.

Continuous availability
The system has no scheduled or unscheduled outages.

Benefits, Costs, and Limitations of Availability Options

Table 2-2 summarizes the benefits and costs of the AS/400 availability options. Planning, setting up, and managing availability options is described in the *Backup and Recovery – Advanced* book.

Table 2-2 (Page 1 of 2). Benefits, Costs, and Limitations of Availability Functions

Function	Benefits	Costs and Limitations
Journaling files	• Can reduce the frequency and amount of data saved. • Improves ability and speed of recovery from known point to failure point. See Figure 2-1 on page 2-1. • Provides file synchronization if the system ends abnormally.	• Increases auxiliary storage requirements. • May impact performance due to increased disk and processing unit activity. • Requires file and application knowledge for recovery.
Access path protection	• Avoids rebuilding access paths after most abnormal system ends. • If SMAPP is active, manages the required environment and makes adjustments as the system changes. • Successful even if main storage cannot be copied to storage unit 1 of the system ASP during an abnormal system end. • Generally faster and more dependable than forcing access paths to auxiliary storage for the files (FRCACCPTH parameter).	• Same as journaling files, plus some small additional processor overhead if *RMVINTENT is specified for the RCVSIZOPT parameter for user-created journals. However, the increase in storage requirments for access path journaling is reduced by using *RMVINTENT. • Normally requires a significant increase in the storage requirements for journaling files. The increase with SMAPP is less than when access paths are explicitly journaled.
Auxiliary storage pools	• Reduces amount of data loss if a disk unit failure occurs. • Allows separation of information by availability needs. You can assign critical or highly used objects to protected, high-performance disk units. You might assign large, low-usage files, like history files, to unprotected, low-performance disk units. • Allows specifying different target recovery times for access paths. • May improve performance. If you do extensive journaling, you can place a journal receiver in a user ASP that can be used exclusively for journaling. • Can significantly reduce the number of transactions lost since you last saved the system. ASPs allow you to separate your files and journal receivers. Your files can be placed in the system ASP or a user ASP, and your journal receivers can be placed in a different user ASP, reducing the chances that both will be lost.	• System cannot directly recover lost data from a disk unit media failure. Requires operations by user to recover. • Can require additional disk devices. • Requires user effort to manage the amount of data in an ASP and avoid an overflowed ASP. • Requires special recovery steps if an ASP overflows. • Requires managing related objects. Some related objects, such as journals and journaled files, must be in the same ASP.

Table 2-2 (Page 2 of 2). Benefits, Costs, and Limitations of Availability Functions

Function	Benefits	Costs and Limitations
Checksum protection [1]	• Lost data is automatically reconstructed after a disk failure in the ASP. • Reduces the number of objects that are damaged by read errors.	• Requires additional processing unit resources. • Requires additional main storage. • Can require additional disk units to prevent slower performance. • System stops if a disk fails.
Device parity protection	• Lost data is automatically reconstructed by the disk controller after a disk failure. • System continues running after a single disk failure. • A failed disk unit can be replaced without stopping the system. • Reduces the number of objects that are damaged.	• Can require additional disk units to prevent slower performance. • Restore operations take longer.
Mirrored protection	• System continues to operate with disk unit failures and with some failures in controllers, input/output processors (IOPs), and buses. • On the 9406 system unit, most failed disk units can be replaced while the system continues to run.	• Requires additional disk units. • May require additional controllers, IOPs, and buses.
Dual systems	• Backup system continues to operate if failure occurs on the primary system. • If systems are at different locations, can prevent lengthy recovery after site loss.	• Additional hardware costs. • Additional software costs. • Communications costs, if systems are on different sites.

Table 2-3 compares several characteristics of these recovery and availability options:

Physical File Journaling
Checksum protection [1]
Mirrored protection
Device parity protection

Table 2-3 (Page 1 of 2). Comparison of Availability and Recovery Options

Attribute	Physical File Journaling	Checksum Protection [1]	Mirrored Protection	Device Parity Protection
Data loss after a single disk failure	Minimal loss to file data if good backups are available.	None of the data is lost.	None of the data is lost.	None of the data is lost.
Recovery time after a single disk unit failure	Potentially many hours. After the disk unit is repaired or replaced, files must be restored and journaled changes must be applied.	A few hours. After the disk unit is repaired or replaced, the system rebuilds the lost data using the checksum information.	None to a few hours. In some cases, the system does not stop. After mirrored protection is resumed, the system recovers the data on the mirrored pair while the system is running normally.	None to a few hours. In some cases, the system does not stop. Performance degrades until the failed unit is replaced and data is rebuilt from the parity information.
Performance impact	Varies from minimal to significant.	Varies from minimal to significant.	Minimal. In some cases, performance improves.	Minimal, except for the performance of restore operations, which can be considerably slower.

[1] Checksum protection is no longer available, beginning with V3R6M0 of the OS/400 licensed program. It is included for comparison purposes.

Table 2-3 (Page 2 of 2). Comparison of Availability and Recovery Options

Attribute	Physical File Journaling	Checksum Protection [1]	Mirrored Protection	Device Parity Protection
Planning complexity – Hardware	Minimal. Additional disk capacity may be required because of the storage required for journal receivers. A user ASP may need to be set up for the journal receivers.	Careful planning is necessary to determine the size of the unprotected area. Additional disks may be needed.	Careful planning is necessary to determine the hardware configuration to provide the best possible protection. Mixing mirrored protection with device parity protection must be analyzed.	Careful planning is necessary to determine the restore time. Additional disks may be needed. Mixing device parity protection with mirrored protection must be analyzed.
Planning complexity – Software	Significant. Detailed application knowledge is required to determine what files to journal and how to assign them to journals.	Minimal. Some application knowledge is required to correctly place objects in user ASPs.	Minimal. Some application knowledge is required to determine whether user ASPs are needed and to correctly place objects in user ASPs.	Minimal. Some application knowledge is required to determine whether user ASPs are needed and to correctly place objects in user ASPs.
Setup complexity and time required.	Minimal.	Significant. New disk units and other hardware must be installed. Disk units must be assigned to ASPs. The protected and unprotected storage must be defined for all disks in the ASP.	Minimal. New disk units and other hardware must be installed. The disk units must be added to an ASP. Starting mirrored protection is a simple operation that takes a maximum of a few hours on the largest systems.	Minimal. New disk units and other hardware must be installed. Device parity protection must be started, which can take about an hour. The disk units must be added to an ASP.
Operational and management complexity.	Average. Journal receivers must be detached and saved regularly. New applications must be evaluated for journaling needs.	Minimal, unless the checksum configuration or the boundary for protected and unprotected storage must be changed.	Minimal.	Minimal.
Additional hardware required.	Additional disk capacity may be required because of the storage required for journal receivers. A user ASP may need to be set up for the journal receivers.	One additional storage unit for each checksum set. This means a minimum of one storage unit for each seven existing storage units.	Twice as many storage units. Other redundant hardware, such as controllers and IOPs, based on availability requirements.	One or two disk units for each parity set. This depends on the number of disk units in the parity set.

Table 2-4 on page 2-9 shows which availability options can reduce the time it takes to recover from a failure. The number of pluses (+'s) in a column indicates that option's impact compared to the other options. An option with more pluses has greater relative impact.

Table 2-4. Summary of Availability Options by Failure Type–Recovery Time

This Save or Availability Option:	Has This Relative Impact on the Recovery Time for These Failure Types: DASD	System	Power Loss	Program Failure	Site Loss
Save Operations	+	+	+	+	+
File Journaling	++	++	++	+	
Access Path Protection	++	++	++		
Uninterruptible Power Supply			+++		
User ASPs	++				
Checksum Protection [1]	++				
Device Parity Protection	+++				
Mirrored Protection	+++				
Dual Systems	+++	+			++

Table 2-5 shows whether availability options can have an effect on how often certain types of failures cause a recovery situation. The number of pluses (+'s) in a column indicates that option's impact compared to the other options.

Table 2-5. Summary of Availability Options by Failure Type–Frequency

This Save or Availability Option:	Has This Relative Impact on the Frequency of Failures That Cause a Recovery for These Failure Types: DASD	System	Power Loss	Program Failure	Site Loss
Save Operations					
File Journaling					
Access Path Protection					
Uninterruptible Power Supply			+		
User ASPs					
Checksum Protection [1]					
Device Parity Protection	+				
Mirrored Protection	++				
Dual Systems	+	+			+

Chapter 3. Save Procedure–General Information

Chapter 2 discusses how you decide what your strategies should be for backing up information and for availability. This chapter discusses the operational decisions you must make about your save operations and things that apply to all save procedures:

- What menu options or commands to use.
- Choosing your save media.
- How to manage your tapes.
- Freeing storage when saving.
- Locking objects when saving.
- Size limitations when saving objects.
- Save file restrictions.
- How to verify your save operations.
- Recovering from problems during a save procedure.
- Things that affect the performance of save operations.
- Managing IBM-supplied journals.

What the Save Commands and Menu Options Do

Figure 3-1 shows the system from the perspective of the different file systems available. It shows which SAVxxx commands you can use to save each file system that you use.

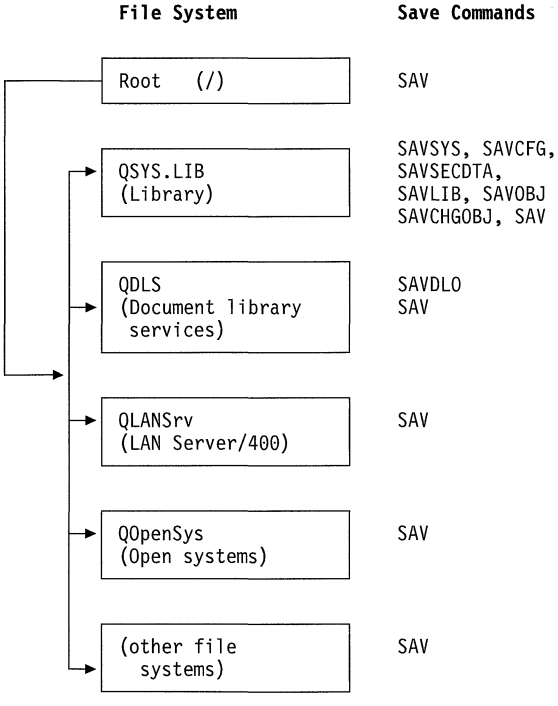


Figure 3-1. File Systems–Save Commands

Figure 3-2 illustrates the commands and menu options you can use to save the parts of the system and the entire system.

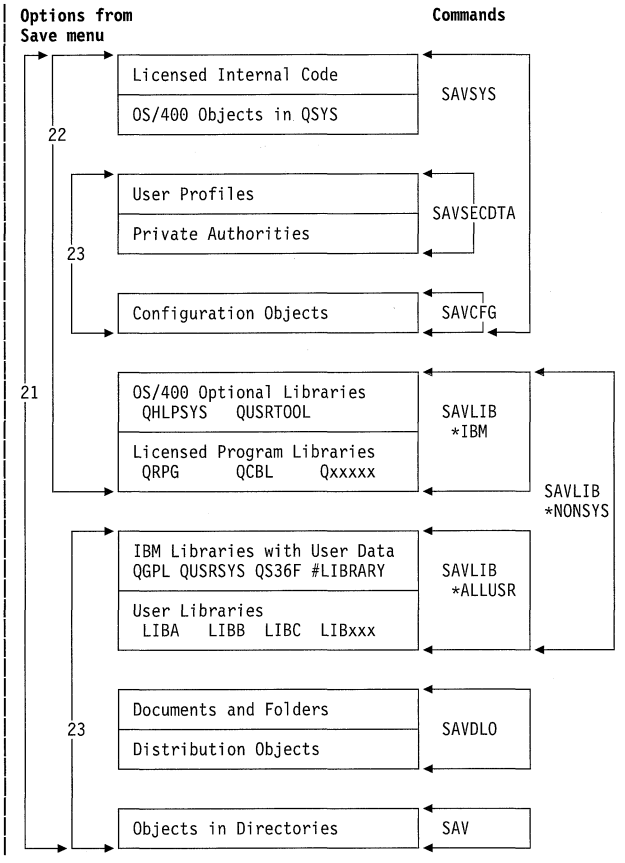


Figure 3-2. Save Commands and Menu Options

If you have chosen to use a simple save strategy, review Figure 3-2 to see what parts of your system are saved when you use options 21, 22, and 23 from the Save menu. Then skip to the topic "How to Manage Your Tapes" on page 3-6.

If you have chosen to use a medium or complex save strategy, do this:

1. Draw a picture of your system similar to the one in Figure 3-2. In your picture, break the section called "User Libraries" into smaller segments that match the way you plan to save user libraries.
2. Study the information in Figure 3-2 and Table 3-1 on page 3-2. Determine how and when you plan to save each part of your system.

Table 3-1 on page 3-2 groups the items that need to be saved on the system. It shows how often they are changed and the most common methods for saving them.

Table 3-1 (Page 1 of 3). Options for Saving Parts of the System

Item Description	When Changes Occur	Common Save Method	Requires Restricted State?[1]	Contains User Data or Changes?	IBM-Supplied?
Licensed Internal Code	When PTFs are applied or a new release of the operating system is installed.	SAVSYS	Yes	No	Yes
		Save menu option 21	Yes		
		Save menu option 22	Yes		
		Backup menu option 11	Yes		
Operating system objects in QSYS library	When PTFs are applied or a new release of the operating system is installed.	SAVSYS	Yes	No[2]	Yes
		Save menu option 21	Yes		
		Save menu option 22	Yes		
		Backup menu option 11	Yes		
System information, such as system values and access path recovery times	Regularly	SAVSYS	Yes	Yes	Yes
		Save menu option 21	Yes		
		Save menu option 22	Yes		
		Backup menu option 11	Yes		
Security information (user profiles, private authorities, authorization lists)	Regularly as new users and objects are added, authorities changed[3]	SAVSYS[4]	Yes	Yes	Some
		SAVSECDTA[4]	No		
		Save menu option 21	Yes		
		Save menu option 22	Yes		
		Save menu option 23	No[6]		
		Backup menu option 11	Yes		
		Backup menu option 1, 2, 3[5,6]	No		
Configuration objects in QSYS	Regularly, when configuration information is added or changed by using commands or by using the Hardware Service Manager function[4].	SAVSYS	Yes	Yes	No
		SAVCFG	No		
		Save menu option 21	Yes		
		Save menu option 22	Yes		
		Save menu option 23	No[6]		
		Backup menu option 11	Yes		
		Backup menu option 1, 2, 3[7]	No		
OS/400 optional libraries (QHLPSYS, QUSRTOOL)	When PTFs are applied or a new release of the operating system is installed.	SAVLIB *NONSYS	Yes	No[2]	Yes
		SAVLIB *IBM	No[11]		
		SAVLIB *library-name*	No		
		Save menu option 21	Yes		
		Save menu option 22	Yes		
		Backup menu option 11	Yes		
		Backup menu option 10	No		
Licensed program libraries (QRPG, QCBL, Qxxxx)	When licensed programs are updated	SAVLIB *NONSYS	Yes	No[2]	Yes
		SAVLIB *IBM	No[11]		
		SAVLICPGM	Yes		
		Save menu option 21	Yes		
		Save menu option 22	Yes		
		Backup menu option 11	Yes		
		Backup menu option 10	No		

Table 3-1 (Page 2 of 3). Options for Saving Parts of the System

Item Description	When Changes Occur	Common Save Method	Requires Restricted State?[1]	Contains User Data or Changes?	IBM-Supplied?
Q libraries that contain user data include QGPL, QUSRSYS, QDSNX[7] [8]	Regularly	SAVLIB *NONSYS	Yes	Yes	Yes
		SAVLIB *ALLUSR	No		
		SAVLIB *library-name*	No		
		SAVCHGOBJ	No		
		Save menu option 21	Yes		
		Save menu option 23	No[6]		
		Backup menu option 11	Yes		
		Backup menu option 1, 2, 3[5]	No		
User libraries	Regularly	SAVLIB *NONSYS	Yes	Yes	No
		SAVLIB *ALLUSR	No		
		SAVLIB *library-name*	No		
		SAVCHGOBJ	No		
		Save menu option 21	Yes		
		Save menu option 23	No[6]		
		Backup menu option 11	Yes		
		Backup menu option 1, 2, 3[5]	No		
IBM-supplied document library objects and folders (usually start with Q, used by Client Access for OS/400 and InfoSeeker)	When licensed programs are updated.	SAVDLO	No	No[2]	Yes
		Save menu option 21	Yes		
		Save menu option 23	No[6]		
		Save menu option 30	Yes		
		Save menu option 32	Yes		
		Backup menu option 11	Yes		
		Backup menu option 1, 2, 3[5]	No		
User document library objects and folders	Regularly	SAVDLO	No	Yes	Some
		Save menu option 21	Yes		
		Save menu option 23	No[6]		
		Save menu option 30	Yes		
		Save menu option 32	Yes		
		Backup menu option 11	Yes		
		Backup menu option 1, 2, 3[5]	No		
Distribution objects (in QUSRSYS)	Regularly	SAVDLO	No	Yes	No
		Save menu option 21	Yes		
		Save menu option 23	No[6]		
		Save menu option 30	Yes		
		Save menu option 33	Yes		
		Backup menu option 11	Yes		
		Backup menu option 1, 2, 3[5]	No		

Table 3-1 (Page 3 of 3). Options for Saving Parts of the System

Item Description	When Changes Occur	Common Save Method	Requires Restricted State?[1]	Contains User Data or Changes?	IBM-Supplied?
Network server storage spaces for the LAN Server for OS/400 licensed program (QFPNWSSTG directory)	Regularly	SAV[5]	No	Yes	Yes
		Save menu option 21[9]	Yes		
		Save menu option 23[9]	No[7]		
		Backup menu option 11[9]	Yes		
Directories in the QLANSrv file system (QLANSrv directory)	Regularly	SAV[10]	No	Yes	Some
		Save menu option 21[10]	Yes		
		Backup menu option 11[10]	Yes		
Directories in the *Root* and QOpenSys file system	Regularly	SAV	No	Yes	Some
		Save menu option 21	Yes		
		Save menu option 23	No[6]		
		Backup menu option 11	Yes		

1 For procedures where the system does not require a restricted state, you must ensure that the system can get the locks necessary to save the information. A restricted state is recommended whenever you are saving multiple libraries, documents, or directories, unless you are using the save-while-active function.

2 You should not change objects or store user data in these IBM-supplied libraries or folders. These changes may be lost or destroyed when you install a new release of the operating system. If you make changes to objects in these libraries, note them carefully in a log for future reference.

3 These objects may also change when you update licensed programs.

4 SAVSYS and SAVSECDTA do not save authority information for objects in the QLANSrv file system. Authority information is saved with the LAN Server for OS/400 objects.

5 If you select the item on the backup options.

6 When you use option 23 from the Save menu, the default is to place your system in a restricted state. If you choose the prompting option, you can cancel the display that puts your system in a restricted state.

7 To save the system directory files, you must end the QSNADS subsystem before saving the QUSRSYS library.

8 If you have the LAN Server for OS/400 licensed program, you must vary off the network server descriptions before saving the QUSRSYS library. This allows the system to obtain the necessary locks on the server storage spaces in the library.

9 The network server descriptions must be varied off.

10 The network server descriptions must be varied on.

11 A restricted state is not required, but it is recommended.

How the System Performs a Save Operation

When you run a save command, the system processes your request in several stages. The processing for these stages overlaps to provide better performance.

Figure 3-3 on page 3-5 shows an example of the overlapping processing that occurs:

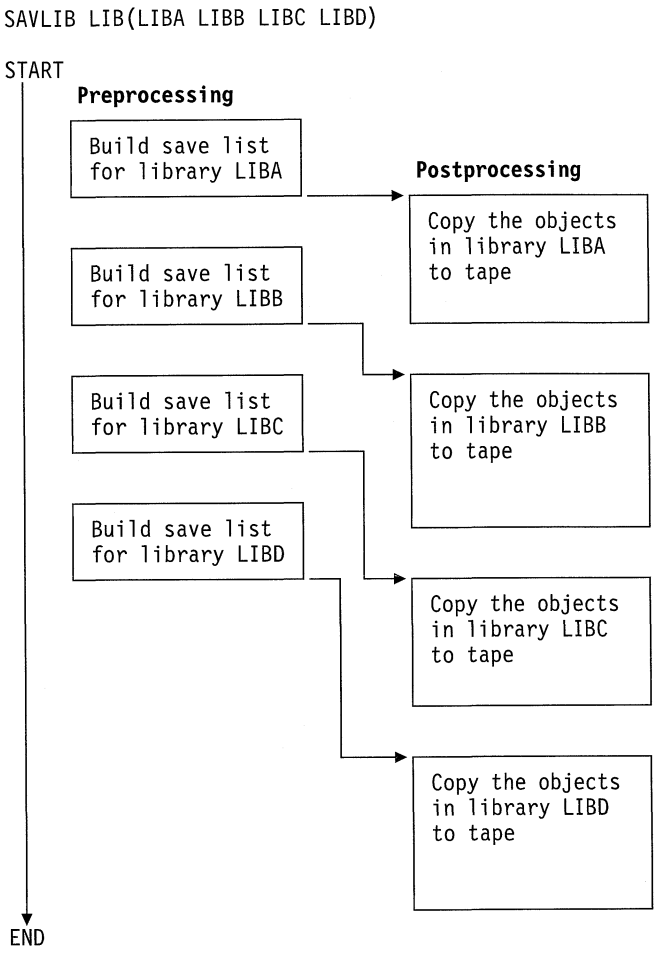


Figure 3-3. How the System Performs Save Processing

During the preprocessing phase for a library, the system creates a list of all the objects to be saved, called a **save list**, before the system starts actually copying data to the media. While data is being copied to media during the postprocessing phase for that library, the system works on creating the save list for the next library or libraries to be processed.

If a library has any database files with members, the system creates a recovery object to keep track of those members during the preprocessing phase. When this object is created, the *Date last changed* field for the library itself is updated because an object is added to the library.

In some cases, the overlapping processing during a save operation can be confusing for system operators. Messages that relate to preprocessing for one library may be intermixed with messages that relate to postprocessing for another library. For example, assume the system encounters a damaged object while creating the save list for LIBD. The object was not previously marked as damaged. The system sends a message to the operator whose only option is to cancel the save operation. However, data is still being written to tape after the operator responds to the message because the system is still writing libraries LIBB and LIBC. The operator might assume, incorrectly, that the save operation completed normally because the system continued to write to tape after the cancel option was taken.

How to Use the Pre-Check Option

You can use the pre-check (PRECHK) parameter when you save objects to ensure that all the objects you intend to save can be successfully saved. If you specify PRECHK(*YES), the system verifies, on a library-by-library basis, the following conditions for each object that you are saving:

- The object can be allocated during the save operation. No other job has a conflicting lock on the object.
- The object exists.
- The object is not marked as damaged. The pre-check process looks only for damage that has already been detected. It does not detect new damage to the object header or damage to the contents.
- If the object is a database file, all its members can be allocated.
- The person requesting the save operation has sufficient authority to save the object.

When you specify PRECHK(*YES), all the objects you are saving in a library must meet the conditions, or no objects in the library are saved. If you specify more than one library on the save command, the failure of one library to meet the PRECHK tests does not prevent the system from saving other libraries, unless you also specify SAVACT(*SYNCLIB). When you specify SAVACT(*SYNCLIB), the entire save operation stops if one object fails the pre-check process.

When you specify PRECHK(*NO), the system performs the checking on an object-by-object basis. Any object that does not meet the conditions is bypassed, but the save operation continues with other objects in the library.

How to Choose Your Save Media

Tape is the most common media used for save and restore operations. Table 3-2 shows which save and restore commands also support using diskettes, optical media, or save files. Support for optical media is provided so that you can archive information. It is not intended to provide backup and recovery capability.

Table 3-2 (Page 1 of 2). Media Used with the Save Commands

	Type of Media			
Command	**Tape**	**Diskette**	**Save File**	**Optical Media**
SAVSYS	Yes	No	No	No
SAVCFG	Yes	No	Yes	No
SAVSECDTA	Yes	No	Yes	No
SAVLIB	Yes	Yes	Yes	Yes[1]
SAVOBJ	Yes	Yes	Yes	Yes
SAVCHGOBJ	Yes	Yes	Yes	Yes

Table 3-2 (Page 2 of 2). Media Used with the Save Commands

	Type of Media			
Command	**Tape**	**Diskette**	**Save File**	**Optical Media**
SAVDLO	Yes	Yes	Yes	Yes[2]
SAVSAVFDTA	Yes	Yes	No	No
SAVLICPGM	Yes	No	Yes	No
SAVSTG	Yes	No	No	No
SAV	Yes	Yes	Yes	Yes
RUNBCKUP	Yes	No	No	No

1 You cannot specify SAVLIB LIB(*ALLUSR), SAVLIB LIB(*IBM), or SAVLIB LIB(*NONSYS) when you use optical media.

2 Usually you cannot save document library objects from more than one ASP on a single command. However, SAVDLO DLO(*ALL) FLR(*ANY) saves DLOs from all ASPs.

The topic "How to Manage Your Tapes" discusses general considerations for using tapes. The chapter of the *Backup and Recovery – Advanced* book called "Tape Performance Considerations" shows the performance and capacity characteristics of the tapes available for the AS/400 system. The chapter in the *Backup and Recovery – Advanced* book called "Techniques and Programming Examples for Backup and Recovery" describes considerations when using save files.

The *Optical Support* book provides more information about using optical media. If you want to substitute optical media for tape in some of your existing procedures, you need to evaluate how to assign saved objects to directories on the optical media and how to name the media.

How to Manage Your Tapes

Managing your tapes is an important part of your save operation. If you cannot easily locate tapes that are correct and undamaged when you need to do a recovery, the time spent creating the save tapes was wasted.

Make decisions about your procedures for managing tapes, write down those decisions, and monitor the procedures regularly.

Tape management requires these things:

- Rotating tapes
- Naming and labeling tapes
- Preparing tapes and tape drives
- Verifying tapes
- Storing tapes
- Monitoring for tape errors

The Backup Recovery and Media Services/400 (BRMS for OS/400) program provides a set of tools to help you manage your tape library. BRMS for OS/400 is particularly useful if you have a library of more than 100 tapes.

Rotating Tapes: An important part of a good save procedure is to have more than one set of tapes. When you perform a recovery, you may need to go back to an old set of save tapes if one of the following is true:

- Your most recent set is damaged.
- You discover a programming error that has affected data on your most recent save tapes.

At a minimum, rotate three sets of tapes:

```
Save 1          Set A
Save 2          Set B
Save 3          Set C
Save 4          Set A
Save 5          Set B
Save 6          Set C
```

and so on.

Many installations find the best approach is to have a different set of tapes for each day of the week. This makes it easy for the operator to know which tapes to mount.

Naming and Labeling Tapes: Initializing each tape volume with a name helps ensure that your operators load the correct tapes for the save operation. Choose tape names that help determine what is on the tape and which tape set it belongs to. Table 3-3 shows an example of how you might initialize tapes and label them externally if you use a simple save strategy. For the internal label created by the INZTAP command, each tape has a prefix that indicates the day of the week (A for Monday, B for Tuesday, and so on) and the operation.

Table 3-3. Tape Naming for Simple Save Strategy

Volume Name (INZTAP)	External Label
B23001	Tuesday–Save menu option 23–Tape 1
B23002	Tuesday–Save menu option 23–Tape 2
B23003	Tuesday–Save menu option 23–Tape 3
E21001	Friday–Save menu option 21–Tape 1
E21002	Friday–Save menu option 21–Tape 2
E21003	Friday–Save menu option 21–Tape 3

Your tape names and labels for the save strategy shown in "Medium Save Strategy" on page 2-3 might look like those in Table 3-4:

Table 3-4. Tape Naming for Medium Save Strategy

Volume Name	External Label
E21001	Friday–Save menu option 21–Tape 1
E21002	Friday–Save menu option 21–Tape 2
AJR001	Monday–Save journal receivers–Tape 1
AJR002	Monday–Save journal receivers–Tape 2
ASC001	Monday–Save changed objects–Tape 1
ASC002	Monday–Save changed objects–Tape 2
BJR001	Tuesday–Save journal receivers–Tape 1
BJR002	Tuesday–Save journal receivers–Tape 2
B23001	Tuesday–Save menu option 23–Tape 1
B23002	Tuesday–Save menu option 23–Tape 2

Put an external label on each tape. The label should show the name of the tape and the most recent date it was used for a save operation. Color-coded labels can help for locating and storing tapes: yellow for Set A, red for Set B, and so on.

Preparing Tapes and Tape Drives: Tape units must be cleaned on a regular basis. The read and write heads collect dust and other material that can cause errors when reading or writing to tape. In addition to your regular cleaning cycle, you should also clean the tape unit if you are going to be using it for an extended period of time or you are using new tapes. New tapes tend to collect more material on the read and write heads of the tape unit. For more specific recommendations, refer to the manual for the specific tape unit.

Tapes must be initialized using the Initialize Tape (INZTAP) command. The command allows you to control writing to tape by clearing files on the tape. You can also specify the density or bits per inch (bpi) before writing to tape by using parameters on the INZTAP command when the tape is initialized.

You can use option 21 (Prepare tapes) on the Backup menu. This provides a simple method of initializing tapes with a naming convention like the ones described here.

Verifying Tapes: Good save procedures include verifying that the correct tapes are being used. Depending on the size of your installation, you may choose to rely on the operators to verify tapes manually or you may have the system verify tapes.

Manual Checking
: You can use the default for the volume (VOL) parameter on the save or restore commands that tell the system to use the tape that is loaded. It is up to the operator to load the correct tapes in the correct order.

System Checking
: You specify a list of volume identifiers on the save or restore commands. The system makes sure that the tapes loaded by the operator are the correct volumes and in the order specified on the command. If an error occurs, a message is sent to the operator requesting the correct tape volume. The operator can either load another tape or override the request.

Another method for verifying that the correct tapes are used is by specifying an expiration date for the files on the tape. If you rely on your operators to verify tapes, you might specify an expiration date (EXPDATE) of *PERM (permanent) for your save operations. This prevents someone from writing over a file on the tape unintentionally. When you are ready to use the tape again, specify CLEAR(*ALL) for the save operation. You can also set up a system to initialize tapes. The Operational Assistant backup menus provide this function.

If you want the system to verify tapes, specify an expiration date (EXPDATE) that ensures that the tapes are not used again too soon. For example, if you rotate 5 sets of tapes for daily saves, specify an expiration date of the current day plus 4 on the save operation. Specify CLEAR(*NONE) on save operations so the system does not write over unexpired files.

Avoid situations where the operator must regularly respond to (and ignore) messages such as "Unexpired files on the tape." If operators get in the habit of ignoring routine messages, they might miss important messages.

Storing Tapes: Store tapes where they are safe but accessible. Make sure they have external labels and are organized so they can be easily located. Store a complete set of backup tapes at a safe, accessible location away from your system. When choosing your off-site storage, consider how quickly you can retrieve the tapes and whether you could retrieve them on weekends and holidays. Off-site backup is essential in the case of a site loss.

Handling Tape Errors: When reading from or writing to tape, it is normal for some errors to occur. Three types of tape errors can occur during save and restore operations:

Recoverable errors
: Some tape devices support recovering from media errors. The system repositions the tape automatically and tries the operation again.

Unrecoverable errors–processing can continue
: In some cases, the system cannot continue to use the current tape, but can continue processing on a new tape. The system requests you to load another tape. The tape with the unrecoverable error can be used for restore operations.

Unrecoverable errors–processing cannot continue
: In some cases, an unrecoverable media error causes the system to stop the save process. "Recovering from a Media Error During a SAVLIB Operation" on page 3-11 describes what to do when this type of error occurs.

The tape units that do not support automatic recovery are the 6341, 6346, 6366, and 9346.

Tapes physically wear out after extended use. You can determine if a tape is wearing out by periodically printing the error log. Use the Print Error Log (PRTERRLOG) command and specify TYPE(*VOLSTAT). The printed output provides statistics about each tape volume. If you use unique names (volume identifiers) for your tapes, you can determine which tapes have excessive read or write errors and should be removed from the media library.

If you suspect that a tape has problems and you want to check the integrity of saved information, use the Display Tape (DSPTAP) or the Duplicate Tape (DUPTAP) command. These commands read the entire tape and detect objects on the tape that cannot be read.

How to Free Storage When Saving

Normally, saving an object does not remove it from the system. However, you can use the storage (STG) parameter on some save commands to free some of the storage used by saved objects.

If you specify STG(*FREE), the object description and search values remain on the system. The object's contents are deleted. You can perform operations such as moving and renaming an object whose storage has been freed. However, the object must be restored to be used.

Using STG(*FREE) is supported for the object types in Table 3-5:

Table 3-5. Object Types That Support Freeing Storage

Object Type	Description
*FILE[1,2]	Files, except save files
*JRNRCV[3]	Journal receivers
*PGM[4]	Programs
*DOC	Documents
*SQLPKG	SQL packages
*SRVPGM	Service programs
*MODULE	Modules

1 When a database file is freed, the member information is discarded. If you save a database file and free its storage, the object cannot be saved again if it still exists with its storage freed.

2 The storage occupied by logical file access paths is not freed.

3 You can free storage for a journal receiver if it is detached and all previous journal receivers are deleted or have their storage freed. If you are using dual receivers, you can free storage for one of the detached receivers in a pair of dual receivers if the other receiver is undamaged and has the same entries or additional entries.

4 Do not specify STG(*FREE) for a program that is running. This causes the program to end abnormally. For ILE programs, the program does not end abnormally. A message is sent to indicate that the ILE program was not saved.

You can also specify STG(*DELETE) on the Save Document Library Object (SAVDLO) command. This deletes any filed documents after they are saved, including the object description, the document description, search values, and document contents.

How Object Locking Affects Save Operations

In general, an object is locked to prevent an update operation while it is being saved. If the system cannot obtain a lock on an object within the specified time, that object is not saved and a message is sent to the joblog. The save-while-active function shortens the time during which the system locks an object while saving.

Table 3-6 shows the type of lock the system must obtain successfully to save an object or to establish a checkpoint for the object for save-while-active processing. The part of the *Backup and Recovery – Advanced* book called "Save-While-Active Function" provides more information about locking during save-while-active processing.

Table 3-6. Lock Type Needed for Save Operation

Object Type	Lock Type Needed for Save Operation
Most object types	*SHRNUP
Object, if STG(*FREE) is specified	*EXCL
Object in QLANSrv file system	*SHRNUP[1]
Journal	*SHRRD
Journal receiver	*SHRRD
Job queue	*SHRRD
Output queue	*SHRRD
Configuration object	No lock needed
System resource management object	*SHRNUP
User profiles, authorization lists, and authority holders	*SHRRD
Library, when the library or an object in it is being saved	*SHRUPD
Data area	*SHRRD, if save-while-active function used.
Database members	*SHRRD, if save-while-active function used.

1 In PC terminology, this lock is called "read/deny-write." This lock may conflict with client workstations accessing files using the LAN Requester program, unless the access is to read only.

When you specify multiple libraries for a save procedure, the libraries specified are locked and unavailable for use during the save operation. Some or all of the libraries may be unavailable for use at any given moment.

Size Limitations When Saving Objects

When you perform a save operation, the system creates a list of the objects being saved and their descriptions. This list is saved with the objects for use when displaying the save media or restoring the objects. The list is an internal object that is not accessible to user programs. It does not appear in the count of objects saved.

A single list of saved objects is limited to 32766 object names and 16MB of description data. Because multiple lists can be created for each library that you save, the limits are rarely exceeded.

On V2R3 or later, you cannot save more than 349000 objects from a single library. Before V2R3, the limit is 250000 objects. Because DLOs are nominally stored in libraries, this limit applies to the QDOC library in the system ASP and the QDOCnnnn libraries in user ASPs.

The system requires that certain objects be grouped together in the same save list. If you exceed the limit for the size of a save list, it is because of this requirement. The following objects must be grouped together on the save list:

- All objects in a library when the save device is a diskette unit.
- All database file objects in a library that are related to each other by dependent logical files.
- All database file objects in a library that are journaled to the same journal when you use the save-while-active function.

If your save operation fails because you have exceeded the size limit for the save list, you need to save objects using separate save commands instead of saving them with a single command.

Restrictions When Using Save Files

You can specify only one library when your output media for the save procedure is a save file. When saving DLOs, you can specify only one ASP when your output media is a save file.

Table 3-7 shows the size limits for save files:

Table 3-7. Size Limitations for Save Files

Release of OS/400	Number of 528-Byte Records	Gigabytes
Version 2 Release 2 and subsequent releases	536854528	256.0
Version 2 Release 1	5865293	2.8
Version 1 Release 3 and earlier	3997574	1.9

Verifying What Is Saved

Verify and audit how effective your save strategy and procedures are by determining:

- Which objects are being saved.
- Which objects are not being saved.
- When specific objects were last saved.

How to Determine Objects That Are Saved

You can use the joblog or an output file to determine which objects are saved successfully.

Information Messages in the Joblog: The SAVLIB and SAVOBJ commands send these messages:

CPC3701	Sent for each library saved to media.
CPC3722	Sent for each library saved to a save file.
CPC9410	Completion message for SAVDLO command to media.
CPC9063	Completion message for SAVDLO command to save file.
CPC370C	Completion message for SAV command to media.
CPC370D	Completion message for SAV command to save file.

These messages tell the number of objects saved. The message help of the completion message includes the volume identifiers of the first 75 volumes used (for media). These identifiers are used to update the status information of each object saved. The message data contains this information, the last volume ID, and either the last device used or the save file used.

Note: Overlap processing is performed during normal save operations. Some libraries can be written to the media while other libraries are being preprocessed. This may cause the preprocessing and completion messages in the job log to appear in a different order than the order in which the libraries were written to the media. See "How the System Performs a Save Operation" on page 3-4.

If multiple libraries are saved in a single command, a final completion message (CPC3720 or CPC3721) also contains the last device used.

Information in Output Files: Most save commands create output that shows what was saved. Depending on which command you use, you can direct this output to a printer (OUTPUT(*PRINT)), a database file (OUTPUT(*OUTFILE)), a stream file, or a user space. The default for save commands is not to create output. You must request it each time you run the save command. You can change the default for the OUTPUT parameter for save commands using the Change Command Default (CHGCMDDFT) command.

You can print the output and store it with your media, or you can create a program to analyze and report on the information in the output file.

You can use the OUTPUT parameter with these commands:

SAV	SAVDLO	SAVSAVFDTA
SAVCFG	SAVLIB	SAVSECDTA
SAVCHGOBJ	SAVOBJ	SAVSYS

The SAVCHGOBJ, SAVLIB, SAVOBJ, and SAV commands have an information type (INFTYPE) parameter to specify how much detail you want in the output.

The SAV command does not support sending output to an output file. You can send output from the SAV command to a stream file or to a user space. The topic "How to Create and Use Output from the SAV and RST Commands" in the *Backup and Recovery – Advanced* book shows the layout for the stream file or user space.

The online information for the save commands tells the names of the model database outfiles they use for output.

Note: The output file you specify is in use throughout the save operation. Therefore, the system cannot save it as part of the operation. Depending on how you perform your save operation, you may see a CPF379A message in the joblog for the output file. If you want to save the output file after your save operation has completed, use the SAVOBJ command.

How to Determine Objects That Are Not Saved

Determining the objects that are not saved is just as important as determining the objects that are saved. An object may not be saved for two basic reasons:

- The object is missing from your save plan. For example, you are saving libraries individually. You add a new application with new libraries but forget to update your save procedures. The topic in the *Backup and Recovery – Advanced* book called "Techniques and Programming Examples for Backup and Recovery" describes how to locate objects that are not being saved.
- The object is in your plan but was not saved successfully. An object may not be saved because of any of the following:
  - It is in use. If you are using the save-while-active function, the system waits a certain amount of time to obtain a lock on the object. If you are not using the save-while-active function, the system does not wait.
  - It is marked as damaged.
  - You do not have the necessary authority to the object.

  When an object cannot be saved, the system skips that object and writes an entry to the job log. Verifying the job logs created by your save procedures is very important. If you have very large save operations, you may want to develop a program that copies the job log to a file and analyzes it.

How to Determine When An Object Was Last Saved

The description information for every object in the QSYS.LIB file system and the QDLS file system includes the date and time when the object was last saved. For most objects, this information is updated when the object is saved, unless you specify UPDHST(*NO) on the save command. The following commands do not update the *date last saved* field for the individual objects that are saved:

- Save System (SAVSYS)
- Save Security (SAVSECDTA)
- Save Configuration (SAVCFG)
- Save Save File Data (SAVSAVFDTA)
- Save (SAV), when saving objects in these file systems:
  QLANSrv
  QOpenSys
  Root

The system uses the *Date last saved* field when you are saving objects that have changed since the last save operation. See "How to Save Only Changed Objects" on page 5-3 for more information.

For some save operations, the system updates history information in a data area. In some cases, the data area is updated instead of updating the individual objects. In other cases, the data area is updated in addition to the individual objects. Table 3-8 shows these commands and the associated data areas:

Table 3-8. Data Areas That Contain Save History

Command	Associated Data Area	Individual Objects Updated?
SAVCFG	QSAVCFG	No
SAVDLO DLO(*ALL) FLR(*ANY)	QSAVDLOALL	Yes
SAVLIB *ALLUSR	QSAVALLUSR	Yes[1]
SAVLIB *IBM	QSAVIBM	Yes[1]
SAVLIB *NONSYS	QSAVLIBALL	Yes[1]
SAVSECDTA	QSAVUSRPRF	No
SAVSTG	QSAVSTG	No
SAVSYS	QSAVSYS, QSAVUSRPRF, QSAVCFG	No

[1] If you specify UPDHST(*NO), the system does not update the *date last saved* field in either the object or the data area.

You can use the Display Object Description (DSPOBJD) command to find out when a specific object was saved. You can also use the DSPOBJD command to display the data areas shown in Table 3-8.

For document library objects, the save history for the QSAVDLOALL data area shows when this command was run: `SAVDLO DLO(*ALL) FLR(*ANY) ASP(*ANY)`. The contents of the QSAVDLOALL data area have information for each user ASP that contains DLOs, showing when this command was run: `SAVDLO DLO(*ALL) FLR(*ANY) ASP(n)`. You can use the Display Data Area (DSPDTAARA) command to display this information.

You can use the output from the SAV command to maintain save history information for objects in the QLANSrv file system, the QOpenSys file system, and the *Root* file system.

Recovering from a Media Error During a SAVLIB Operation

If an unrecoverable media error occurs when you are saving multiple libraries, you can restart the procedure using the Start Library (STRLIB) parameter on the SAVLIB command. The STRLIB parameter is valid only when *NONSYS, *ALLUSR, or *IBM is specified for the SAVLIB or SAVCHGOBJ command.

The basic recovery steps for a save operation are:

__ **Step 1** Check the job log to determine the library where the previous SAVLIB LIB(*NONSYS, *IBM, or *ALLUSR) failed. Find the last library saved, which is indicated by a successful save completion message.

__ **Step 2** Load the next tape and ensure the tape is initialized. If you were using menu option 21, 22, or 23 when the save operation failed, skip to step 4.

__ **Step 3** Type the SAVxxx command you were using with the same parameter values. Add the STRLIB and OMITLIB parameters and specify the last library that was saved successfully. For example, if you were running a SAVLIB *ALLUSR and CUSTLIB was the last library saved successfully, you would type:

```
SAVLIB LIB(*ALLUSR) DEV(tape-device-name)
       STRLIB(CUSTLIB) OMITLIB(CUSTLIB)
```

This starts the save operation on the library after the last successfully saved library. You have completed restarting the SAVLIB operation.

__ **Step 4** If you were using a menu option, select that menu option again.

__ **Step 5** On the Specify Command Defaults display, type `Y` for the *Prompt for commands* prompt. When you are shown prompts for commands you have completed successfully, press F12 (cancel). When you are shown the prompt for the SAVLIB command, specify the STRLIB and OMITLIB parameters as shown in step 3.

Note: Restoring the system using this set of media requires two RSTLIB SAVLIB(*NONSYS, *ALLUSR, or *IBM) commands to restore the libraries.

How the System Handles Damaged Objects During a Save Operation

The system's action when it encounters a damaged object during a save operation depends on when the damage is detected:

Object marked as damaged before save operation
An object marked as damaged cannot be saved, but the save operation continues with the next object. The operation completes with an indication of how many objects were saved and how many were not. Diagnostic messages describe the reason each object was not saved.

Object detected as damaged by save operation
The object is marked as damaged, and the save operation ends. Diagnostic messages are sent.

Object not detected as damaged
In some unusual cases, a save operation does not detect damage. The save operation may detect physical damage on the disk, but it may not detect all damage. For example, the system does not attempt to determine if all bytes within an object are valid and consistent (logical damage). For some cases, you will not be able to determine a damage condition unless you attempt to use the object (such as calling a program object). If this type of damage exists, the object is restored normally.

What Affects the Performance of Save Operations

The following factors affect the performance of your save operations. In some cases, the performance relationship is obvious. For example, a faster processor or a faster tape unit improves performance. A large amount of data takes longer to save than a small amount of data. Where the relationships are not as obvious, they are noted in the list:

- Size and activity level of the storage pool.
- Run priority of the save or restore job.
- Size of the system, processor, and memory.
- Size of the machine pool.
- Size of the data being saved.
- Type of data being saved. Some types of objects are more complex and take longer per megabyte to save.
- Number of objects saved. Saving many small objects takes longer than saving a few large objects, even if you are saving the same number of megabytes of data.

- Restricted state. Having the system in a restricted state improves performance because the system does not need to check object locking or compete with other users for resources.
- Authority of user running the job. If the user has *SAVSYS or *ALLOBJ special authority, the system does not need to check authority for each object.
- Speed of save device.
- Other activity on the system. This can cause the system to compete for resources and to wait for locks to be released.
- Save-while-active. Using the save-while-active function increases the total time the save operation requires but decreases the amount of time that the objects being saved are unavailable.
- Output (OUTPUT) parameter. Creating output while saving takes longer.
- Software data compression. It degrades performance because it requires more processor cycles. It reduces the amount of media that is used, however.
- Hardware data compression. It improves performance.

Performance Considerations for Using Tapes: The AS/400 system supports streaming tape drives and start-stop tape drives. For example, the 3430, 3422, 3480, and 6341 are start-stop tape drives. The 9348, 9347, 9346, and 6346 are streaming tape drives. The 2440 can be both a start-stop drive and a streaming tape drive.

A **start-stop tape drive** has the ability to stop and restart movement of the tape between reading or writing each block of tape data. A **streaming tape drive** cannot stop and start between blocks of data. If the next request does not reach the device fast enough, the tape drive overruns its position on the tape and must stop and backup before it can run the next command. This repositioning takes time and can cause additional stress to the device and the tape.

Save and restore operations are designed to keep the tape in streaming mode as much as possible. On heavily used systems, the ability of the system to maintain streaming mode is reduced. This increases the time required for the save or restore operation. When possible, limit save and restore operations on streaming tape drives to times of lower system activity.

Data Compaction and Data Compression: The AS/400 system offers three types of data compression and data compaction to save more data to the media:

- Software data compression is performed by the OS/400 licensed program.
- Hardware data compression is performed by the AS/400 adapter (attachment feature).
- Hardware data compaction is performed by the tape unit. It is supported on only the 3480 and 3490 tape units if the tape unit has the compaction feature. It is also supported on the 7208 Model 12 tape unit when using the 5GB format.

The chapter in the *Backup and Recovery – Advanced* book called "Tape Performance Considerations" provides more information about data compression and data compaction.

Managing IBM-Supplied Journals

The operating system and some licensed programs use journals to provide audit trails and assist with recovery. Table 3-9 lists some of the IBM-supplied journals:

Table 3-9 (Page 1 of 2). IBM-Supplied Journals

Journal Name	Library Name	Description
QACGJRN	QSYS	Keeps job accounting information. The *Work Management* book describes using this optional journal.
QAOSDIAJRN	QUSRSYS	Provides recovery for the document library files and the distribution files. Used by Client Access for OS/400 and OfficeVision for OS/400.
QAUDJRN	QSYS	Keeps an audit record of security-relevant activity on the system. The *Security – Reference* book describes using this optional journal.
QCQJMJRN	QSVMSS	Provides an audit trail for Managed System Services for OS/400.
QDSNX	QUSRSYS	Provides an audit trail for DSNX activity.
QLYJRN	QUSRSYS	Keeps a log of transactions made to the Application Development Manager for OS/400 datastore files. Used by the system if recovery is necessary. The *ADTS/400: Application Development Manager/400 User's Guide* provides more information about this journal.
QLYPRJLOG	QUSRSYS	Keeps the project logs for the Application Development Manager for OS/400 licensed program. Used by the system if recovery is necessary. The *ADTS/400: Application Development Manager/400 User's Guide* book provides more information about this journal.
QLZALOG	QUSRSYS	Used by the licensed management program to log requests that exceed the usage limit of a license.

Table 3-9 (Page 2 of 2). IBM-Supplied Journals

Journal Name	Library Name	Description
QPFRADJ	QSYS	Keeps a log of dynamic performance tuning information. The *Work Management* book describes using this optional journal.
QSNADS	QUSRSYS	Provides an audit trail for SNADS activity.
QSNMP	QUSRSYS	Provides an audit trail for network management information. The *Simple Network Management Protocol (SNMP) Support* book describes using this journal.
QSXJRN	QUSRSYS	Provides a log of the activity that occurs in the database files for service-related activity. The information in this journal should be kept for 30 days.
QZMF	QUSRSYS	Provides an audit trail for the mail server framework. The *AnyMail/400 Mail Server Framework Support* book provides more information about this journal.

If you are using licensed programs or system functions that require these journals, you should consult the documentation for those functions for instructions on how to manage the journals and journal receivers.

In general, you should use the Change Journal (CHGJRN) command to detach the journal receiver and create and attach a new receiver on a regular basis. You may need to save detached receivers before deleting them, or you may be able to delete them without saving them. This depends on how the journal receivers are being used and whether the journal is defined as MNGRCV(*SYSTEM).

In some cases, you can use the automatic cleanup function of Operational Assistant to remove detached journal receivers that are no longer needed. The *System Operation* book describes using the automatic cleanup function.

Following is a description of the procedure for changing journal receivers. See "Working with Journal Entries, Journals, and Journal Receivers" in the *Backup and Recovery – Advanced* book for more information about managing journals and journal receivers.

__ **Step 1** Type `CHGJRN JRN(`*`library-name/journal-name`*`) JRNRCV(*GEN)`. This command:

a. Detaches the currently attached receiver.
b. Creates a new receiver with a name and attributes that follow the conventions established by the function that uses the journal.
c. Attaches the new receiver to the journal.

__ **Step 2** Use the Save Object (SAVOBJ) command to save the detached journal receiver. Specify object type *JRNRCV.

__ **Step 3** Use the Delete Journal Receiver (DLTJRNRCV) command to delete the receiver. If you try to delete the detached receiver without saving it, you receive a warning message.

Chapter 4. The Save Menu

The Save menu provides many options for saving information. To display the menu, type GO SAVE from any command line. Figure 4-1 shows the options on the menu. The options that are marked with a single plus sign (+) place your system in a restricted state if you run the menu option without prompting. If you select prompting, you can cancel the display that places the system in a restricted state. However, your save operation may run more slowly and some objects may not be saved.

The options that are marked with a double plus sign (++) require your system to be in a restricted state. When your system is in a restricted state, that does not prevent client workstations from attempting to access information. If you have directories managed by the LAN Server for OS/400 program, you should vary off the network server descriptions.

```
SAVE                                  Save

Select one of the following:

  Save Data
     1. Files
     2. Libraries
     3. Documents and folders
     4. Programs
     5. Other objects
     6. Changed objects only
     7. Licensed programs
     8. Security data
++   9. Storage
    10. Configuration
    11. Objects in directories
```

Figure 4-1. Save Menu–First Display

You can page down on the Save menu to see additional options:

Save System and User Data

++	21	Entire system
++	22	System data only
+	23	All user data

Save Document Library Objects

	30	All documents, folders, and mail
	31	New and changed documents, new folders, all mail
	32	Documents and folders
	33	Mail only
	34	Calendars

Save Libraries

++	40	All libraries other than the system library
	41	All IBM libraries other than the system library
	42	All user libraries
	43	All changed objects in user libraries

Save for Different Systems

	50	Save in System/36 format

What the Save Menu Options Do

Following are the commands the system runs for the menu options that save multiple libraries, documents, or directories. In parentheses () following the description is the name of the program for the menu option, if the menu option has a program. You may want to change this program if you need different values than the system-supplied default values for the program. Figure 3-2 on page 3-1 shows which parts of the system are saved by the special values of the SAVLIB commands.

Option Number	Description and Commands

21	Entire system (QMNSAVE):
	`ENDSBS SBS(*ALL) OPTION(*IMMED)`
	`CHGMSGQ QSYSOPR *BREAK`
	`SAVSYS`
	`SAVLIB LIB(*NONSYS) ACCPTH(*YES)`
	`SAVDLO DLO(*ALL) SAVFLR(*ANY)`
	`SAV DEV('/QSYS.LIB/TAPxx.DEVD')`
	`OBJ(('/*') ('/QSYS.LIB' *OMIT)`
	`('/QDLS' *OMIT))`[1] `UPDHST(*YES)`
	`STRSBS SBS(controlling-subsystem)`
	where *xx* is the name of the tape drive.

22	System data only (QSRSAVI):
	`ENDSBS SBS(*ALL) OPTION(*IMMED)`
	`CHGMSGQ QSYSOPR *BREAK`
	`SAVSYS`
	`SAVLIB LIB(*IBM) ACCPTH(*YES)`
	`STRSBS SBS(controlling-subsystem)`

23	All user data (QSRSAVU):
	`ENDSBS SBS(*ALL) OPTION(*IMMED)`
	`CHGMSGQ QSYSOPR *BREAK`
	`SAVSECDTA`
	`SAVCFG`
	`SAVLIB LIB(*ALLUSR) ACCPTH(*YES)`
	`SAVDLO DLO(*ALL) SAVFLR(*ANY)`
	`SAV DEV('/QSYS.LIB/TAPxx.DEVD')`
	`OBJ(('/*') ('/QSYS.LIB' *OMIT)`
	`('/QDLS' *OMIT))`[1] `UPDHST(*YES)`
	`STRSBS SBS(controlling-subsystem)`
	where *xx* is the name of the tape drive.

40	All libraries other than the system library (QMNSAVN):
	`ENDSBS SBS(*ALL) OPTION(*IMMED)`
	`CHGMSGQ QSYSOPR *BREAK`
	`SAVLIB LIB(*NONSYS) ACCPTH(*YES)`
	`STRSBS SBS(controlling-subsystem)`

41	All IBM libraries other than the system library: `SAVLIB LIB(*IBM)`
42	All user libraries : `SAVLIB LIB(*ALLUSR)`
43	All changed objects in user libraries: `SAVCHGOBJ LIB(*ALLUSR)`

Using Save Menu Options 21, 22, and 23

This topic describes the procedure for saving information using option 21, 22, or 23 from the Save menu. The basic steps are the same for each menu option. Which option or options you use depends on the decisions you have made about your save procedures. This is discussed in "What the Save Commands and Menu Options Do" on page 3-1.

Do These Things Before You Begin:

__ Make sure you have enough tapes initialized as standard-labeled tapes. Use the Initialize Tape (INZTAP) command or option 21 (Prepare tapes) on the Backup menu.

__ Clean the read and write head of the tape unit.

Task 1–Printing System Documentation and Preparing to Save

In this task, you print information that is helpful if you need to perform a recovery. You may not need to print all this information every time you save. You should print it at least monthly.

__ **Step 1** Print your current disk configuration. This is essential if you plan to do a model upgrade and you are using mirrored protection. Do the following:

- __ **Step a.** Sign on with a user profile that has *SERVICE special authority.
- __ **Step b.** Type `STRSST` on a command line and press the Enter key.
- __ **Step c.** Select option 3 (Work with disk units) on the System Service Tools (SST) display.

[1] The QSYS.LIB file system is omitted because it is saved by the SAVSYS command and the SAVLIB LIB(*NONSYS) command. The QDLS file system is omitted because it is saved by the SAVDLO command.

__ **Step** **d.** Select option 1 (Display disk configuration) on the Work with Disk Units display.

__ **Step** **e.** Select option 3 (Display disk configuration protection) on the Display Disk Configuration display.

__ **Step** **f.** Print the displays (there may be several) using the PRINT key for each display.

__ **Step** **g.** Press F3 until you see the Exit System Service Tools display.

__ **Step** **h.** On the Exit System Service Tools display, press the Enter key.

__ **Step** **2** Sign on with a user profile that has *ALLOBJ special authority. The system lists information only if you have the proper authority. If you sign on as a user with less than *ALLOBJ authority, some of the listings in these steps may not be complete. You must also be enrolled in the system directory to print a list of all the folders on the system.

__ **Step** **3** If you use the history log or are required to keep it, do the following:

__ **Step** **a.** Display the system log QHST. This automatically brings it up to date. Type:

```
DSPLOG LOG(QHST) OUTPUT(*PRINT)
```

__ **Step** **b.** Display all copies of the system log:

```
WRKF FILE(QSYS/QHST*)
```

Look at the list to verify that you saved all copies of the log that will be needed later.

Note: To get more information about the history (QHST) log, such as date created and the last change date and time, select option 8 (Display file description) on the Work with Files display.

__ **Step** **c.** To prevent confusion about the date of the log, select the `Delete` option on the Work with Files display to delete all but the current copies of the system log. This step improves the performance of the SAVSYS command.

__ **Step** **4** Print a list of all the user libraries on the system. This list shows when the library was saved and whether anything in the library has changed since then. You can use the list later if you need to restore a single library:

```
DSPBCKUPL BCKUPL(*LIB) OUTPUT(*PRINT)
```

__ **Step** **5** Print a list of folders. This list shows all the first-level folders on the system, when they were last saved, and whether they have changed since then:

```
DSPBCKUPL BCKUPL(*FLR) OUTPUT(*PRINT)
```

__ **Step** **6** Print a list of the current system values:

```
WRKSYSVAL OUTPUT(*PRINT)
```

__ **Step** **7** Print a list of the current network attributes:

```
DSPNETA OUTPUT(*PRINT)
```

__ **Step** **8** Print a list of the current configuration lists:

```
WRKCFGL
```

Select option 6 (Print) for each configuration list.

Note: If no configuration lists appear on your display, continue to the next step.

__ **Step** **9** Print a list of any user-defined edit descriptions currently on the system by doing the following:

__ **Step a.** Type:

```
DSPEDTD EDTD(5) OUTPUT(*PRINT)
```

__ **Step b.** Repeat step 9a for each of the following:

```
EDTD(6)
EDTD(7)
EDTD(8)
EDTD(9)
```

__ **Step 10** Print a list of all the PTFs currently on the system:

```
DSPPTF LICPGM(*ALL) OUTPUT(*PRINT)
```

__ **Step 11** Print a list of all reply list entries currently on the system:

```
WRKRPYLE OUTPUT(*PRINT)
```

__ **Step 12** Print your settings for access path recovery times:

```
DSPRCYAP OUTPUT(*PRINT)
```

__ **Step 13** Display the service attributes for your system:

```
DSPSRVA
```

Either use the Print key or write down the settings on the display.

__ **Step 14** If you use the power schedule to automatically power your system off and on, print the schedule:

```
DSPPWRSCD OUTPUT(*PRINT)
```

__ **Step 15** Print the automatic cleanup options by doing the following:

__ **Step a.** Type `CHGCLNUP` and press F4.

__ **Step b.** On the Change Cleanup (CHGCLNUP) display, press the Print key.

__ **Step c.** Press F12 (Cancel).

__ **Step 16** Print your hardware configuration by doing the following:

__ **Step a.** Type WRKHDWPRD and press the Enter key. You are shown the Work with Hardware Products menu.

__ **Step b.** Select option 4 (Display description label locations).

__ **Step c.** From the Display Description Label Locations display, press F17 (Print).

__ **Step d.** Retrieve the output from the printer.

__ **Step e.** Press F3 (Exit) until you return to a menu with a command line.

__ **Step f.** Type:

```
DSPHDWRSC TYPE(*CMN) OUTPUT(*PRINT)
```

__ **Step g.** Repeat step 16f for each of the following:

```
TYPE(*CSA)
TYPE(*LAN)
TYPE(*LWS)
TYPE(*PRC)
TYPE(*STG)
```

Note: You may not have all these types of hardware configured on your system.

__ **Step 17** Retrieve a record of your configuration (such as devices and controllers) in a CL source member by typing the following:

```
RTVCFGSRC CFGD(*ALL) CFGTYPE(*ALL) SRCFILE(QGPL/QCLSRC)
   SRCMBR(IMPICFG)
```

__ **Step 18** If you use Remote Job Entry (RJE) on your system, print your RJE configurations:

```
DSPRJECFG SSND(*ALL) OUTPUT(*PRINT)
```

__ **Step 19** Print your SNADS configuration:

```
DSPDSTSRV OUTPUT(*PRINT)
```

__ **Step 20** Print a list of the IBM-supplied subsystem descriptions that you have changed. If you are not sure which ones you have changed, print all IBM-supplied subsystem descriptions. Do the following:

__ **Step a.** Type the following:

```
WRKSBSD SBSD(*ALL)
```

You are shown the Work with Subsystem Descriptions display.

__ **Step b.** Type a 5 (Display) in the option column for each subsystem description that you want to print. (Do not press the Enter key yet.)

__ **Step c.** On the command line at the bottom of the display, type:

```
OUTPUT(*PRINT)
```

__ **Step d.** Press the Enter key.

__ **Step 21** Print a list of the licensed programs that are installed:

```
DSPSFWRSC OUTPUT(*PRINT)
```

__ **Step 22** If you use journaling or have applications that use journaling, print information about your journaling environment. Do the following:

__ **Step a.** Type:

```
DSPOBJD OBJ(*ALL/*ALL) OBJTYPE(*JRN)
   OUTPUT(*PRINT)
```

and press the Enter key. This prints a list of all the journals on the system.

__ **Step b.** For each journal on the list, type:

```
WRKJRNA JRN(library-name/journal-name)
   OUTPUT(*PRINT)
```

This prints a list of all files and access paths that are journaled to this journal and the attributes of the journal.

__ **Step 23** Print any IBM-supplied objects that you have modified, such as the QSYSPRT print file.

__ **Step 24** Keep this information with your backup log or your save system tapes for future reference. If you choose not to print the lists, use the Copy Spooled File (CPYSPLF) command to copy them to database files. See "How to Save Spooled Files" on page 5-8 for information on how to do this. Make sure the database files are in a library that is saved when you perform the menu option.

Task 2–Using the Menu Option

__ **Step 1** Sign on with a user profile that has *SAVSYS and *JOBCTL special authority, such as QSECOFR. This ensures you have the authority that you need to place the system in the necessary state and to save everything.

__ **Step 2** Make sure that Client Access for OS/400 is not active at your workstation. To deactivate Client Access for OS/400:

a. From the PC workstation, double-click on the AS/400 Workstation icon.

b. Double-click on the Connections icon.

c. Click on the Disconnect pushbutton.

__ **Step 3** If you plan to run the save procedure immediately, make sure that no jobs are running on the system: `WRKACTJOB`.

If you plan to schedule the save procedure to run later, send a message to all users that informs them when the system will be unavailable.

__ **Step 4** If you use the LAN Server for OS/400 licensed program, you must vary off the network server descriptions before beginning the save procedure. Use the Vary Configuration (VRYCFG) command. If you are going to do an unattended save operation, you can use the job scheduler to submit a job to vary off the network server descriptions before the save procedure begins.

__ **Step 5** Display the Save menu: `GO SAVE`

__ **Step 6** If you want to do an *attended save* operation, skip to step 7. If you want to do an *unattended save* operation, do the following steps. This prevents your save operation from stopping because of unanswered messages:

__ **Step a** Display the reply list sequence numbers to find what numbers are available for use:

```
WRKRPYLE
```

__ **Step b** If MSGID(CPA3708) is not already in your reply list, add it. For *xxxx*, substitute an unused sequence number from 1 through 9999:

```
ADDRPYLE SEQNBR(xxxx) MSGID(CPA3708) RPY('G')
```

__ **Step c** Change your job to use the reply list:

```
CHGJOB INQMSGRPY(*SYSRPYL)
```

__ **Step 7** Select the option (21, 22, or 23) from the Save menu and press the Enter key.

You are shown a display that describes the function of the menu option that you selected.

__ **Step 8** After reading the display, press the Enter key to continue. You are shown the Specify Command Defaults display:

```
                        Specify Command Defaults

Type choices, press Enter.

  Tape devices . . . . . .   TAP01       Names
                             _____
                             _____
                             _____

  Prompt for commands  . . . . .   Y          Y=Yes, N=No

  Check for active files . . . .   Y          Y=Yes, N=No

  Message queue delivery . . . .   *BREAK     *BREAK, *NOTIFY

  Start time . . . . . .   *CURRENT   *CURRENT, time
```

__ **Step 9** Type your choices for the *Tape device* prompt. You can specify as many as four tape device names. If you specify more than one device, the system automatically switches to the next tape device when the current tape is full.

The first tape device for options 21 and 22 should be your alternate IPL device. If you are creating tapes to install on another system, the tape device must be compatible with the alternate IPL device for that system. This ensures that the system can read the SAVSYS tapes if you need to restore your Licensed Internal Code and the operating system.

__ **Step 10** Type your choice for the *Prompt for commands* prompt. Specify N (No) if you want to run an unattended save. Specify Y (Yes) if you want to change the defaults on the SAVxxx commands.

Note: If Y is specified to change the LABEL parameter on the save commands, then Y must be specified if you use these tapes to restore the system.

__ **Step 11** Type your choice for the *Check for active files* prompt. Specify Y (Yes) if you want the system to warn you if active files exist on the save tapes. The warning you receive gives the following choices:

- Cancel the save operation.
- Insert a new tape and try the command again.
- Initialize the current tape and try the command again.

Specify N (No) if you want the system to write over any active files on the save tapes without warning you.

__ **Step 12** Type your choice for the *Message queue delivery* prompt. Specify *NOTIFY if you want to do an unattended save. This prevents communications messages from stopping the save operation. If you specify *NOTIFY, severity 99 messages that are not associated with the save operation are sent to the QSYSOPR message queue without interrupting the save process. For example, messages that request a new volume to be loaded interrupt the save operation because they are associated with the job. You cannot continue until you reply to these messages.

Specify *BREAK, if you want to be interrupted for severity 99 messages that require a reply.

__ **Step 13** Type your choice for the *Start time* prompt. You may schedule the start of the save operation up to 24 hours later. For example, assume the current time is 4:30 p.m. on Friday afternoon. If you specify 2:30 for the start time, the save operation begins at 2:30 a.m. on Saturday morning.

Notes:

a. The system uses the Delay Job (DLYJOB) command to schedule the save operation. Your workstation will be unavailable from the time you request the menu option until the save operation completes.

b. **Make sure your workstation is in a secure location**. Your workstation remains signed on, waiting for the job to start. If the system request function is used to cancel the job, your workstation displays the Save menu and is still signed on with your user profile and your authority.

c. If you specify a delayed start and want your save operation to run unattended, be sure you have done the following:

- Set up the system reply list.
- Specified *NOTIFY on message queue delivery.
- Responded `N` to *Prompt for commands*.
- Responded `N` to *Check for active files*.

__ **Step 14** After you type your choices on the display, press the Enter key. If you chose a later start time, your display shows message CPI3716. The message tells when the save operation was requested and when it will start. You cannot use the display until the save operation completes. The input-inhibited indicator should appear. You have completed the steps for setting up the save operation.

If you did not choose a later start time, continue with step 15. **If the QSYSOPR message queue delivery is set to *BREAK with a severity level of 60 or lower, you must respond to the ENDSBS messages, even if you plan to run an unattended save operation specifying a start time of *CURRENT**.

__ **Step 15** If you responded `Y` to the *Prompt for commands* prompt, you are shown the End Subsystem display. Type any changes and press the Enter key. While the system is ending subsystems, you see the following messages and must respond to them if the QSYSOPR message queue is set to *BREAK with a severity level of 60 or lower. Each message appears at least twice.

__ **Step a.** `CPF0994 ENDSBS SBS(*ALL) command being processed`
Press the Enter key.

__ **Step b.** `CPF0968 System ended to restricted condition`
Press the Enter key.

If you responded `N` to the *Prompt for commands* prompt, skip to step 17 on page 4-9.

__ **Step 16** When the system is ready to perform each major step in the save operation, you are shown the prompt display for that step. The time between displays may be quite long.

For option 21 (Entire system) you are shown these displays:

- `ENDSBS SBS(*ALL) OPTION(*IMMED)`
- `SAVSYS`
- `SAVLIB LIB(*NONSYS) ACCPTH(*YES)`
- `SAVDLO DLO(*ALL) FLR(*ANY)`
- `SAV OBJ(('/*') ('/QSYS.LIB' *OMIT) ('/QDLS' *OMIT)) UPDHST(*YES)`
- `STRSBS SBSD(controlling-subsystem)`

For option 22 (System data only) you are shown these displays:

- `ENDSBS SBS(*ALL) OPTION(*IMMED)`
- `SAVSYS`
- `SAVLIB LIB(*IBM) ACCPTH(*YES)`
- `STRSBS SBSD(controlling-subsystem)`

For option 23 (All user data) you are shown these displays:

- ENDSBS(*ALL) OPTION(*IMMED)
- SAVSECDTA
- SAVCFG
- SAVLIB LIB(*ALLUSR) ACCPTH(*YES)
- SAVDLO DLO(*ALL) FLR(*ANY)
- SAV OBJ(('/*') ('/QSYS.LIB' *OMIT) ('/QDLS' *OMIT)) UPDHST(*YES)
- STRSBS SBSD(controlling-subsystem)

Type your changes when each display is shown and press the Enter key.

__ **Step 17** When the system sends a message that asks you to load the next volume, load the next tape and respond to the message. For example, if the message is the following:

```
Device was not ready or next volume was not loaded (C R)
```

load the next volume and then enter R.

If a media error occurs...

If an unrecoverable media error occurs during the SAVLIB procedure, see "Recovering from a Media Error During a SAVLIB Operation" on page 3-11.

__ **Step 18** If you have network server descriptions on your system, vary them back on after the save operation completes.

__ **Step 19** When the save operation completes, print the job log. It contains information about the save operation. Use it to verify that all objects were saved. Type one of the following:

```
DSPJOBLOG * *PRINT
```

Or

```
SIGNOFF *LIST
```

You have completed the save operation. Make sure all your tapes are marked and stored in a safe, accessible place.

Chapter 5. How to Save Specific Types of Information

This chapter describes how to save specific types of information on the system. It includes special considerations that apply when you save certain types of information either by using commands or by using menu options.

The information in this chapter is arranged by commands that are most often used. For example, it is more common to save libraries (SAVLIB) than it is to save licensed programs (SAVLICPGM).

If you are building your own CL programs to save information on your system, save information in the same order that it is saved when you use option 21 or option 23 from the Save menu:

- If your program includes SAVSYS, this must be first. The files created by SAVSYS must be the first files on the tape.
- If you perform SAVSECDTA or SAVCFG, you should do these before you save any libraries or objects. This simplifies a restore procedure because you restore these objects before you restore libraries.

For information about how to save objects when you are moving them between AS/400 business computing systems running different releases of the operating system, see the chapter of the *Backup and Recovery – Advanced* book called "Release-to-Release Support."

How to Save Libraries

You can use the SAVLIB command or option 2 on the Save menu to save from 1 to 300 libraries. Specifying multiple libraries allows overlap processing, which can improve performance.

Note: You can only specify one library if you save to a save file.

The SAVLIB command allows you to use special values to specify groups of libraries: *NONSYS, *ALLUSR, and *IBM. If you specify one of the these special values, you can exclude from 1 to 300 libraries using the OMITLIB parameter. Libraries you exclude are not saved.

When you specify libraries by name on the SAVLIB command, they are saved in the order in which you list them. When you use a special value to save libraries, the libraries are saved in alphabetical order by name.

| You can use the Save/Restore Library (SAVRSTLIB) command to save one or more libraries, send them to another system, and restore them. The SAVRSTLIB command supports the same options as the SAVLIB command. You use the Remote Location Name (RMTLOCNAME) parameter to specify where the saved libraries are to be restored. The system determines the method (communications line or optical connection) for transferring data to that location. See "How to Use the ObjectConnect/400 Function" on page 5-17 for more information. ObjectConnect cannot run in restricted state.

When you save a large group of libraries, you should place your system in a restricted state to ensure that all important objects are saved. For example, if subsystem QSNADS or directory shadowing is active, files whose names begin with QAO are not saved in library QUSRSYS. The QAO* files in library QUSRSYS are very important files. If the QAO* files are not saved, you should end the QSNADS subsystem (ENDSBS command) or directory shadowing (ENDDIRSHD command) and then save the QAO* files.

| Be sure that you regularly save the QGPL library and the QUSRSYS library. These IBM-supplied libraries contain information that is important to your system and changes regularly. For example, the QGPL library is often the default library for new objects, such as job descriptions. The QUSRSYS library contains some configuration information for communications and for tape subsystems. It also contains exit registration information.

Table 5-1 shows which IBM-supplied libraries are saved for each special value:

Table 5-1 (Page 1 of 2). Comparison of Special Values for SAVLIB Command–LIB Parameter. Libraries marked with an X are saved.

Library Name	*NONSYS	*IBM	*ALLUSR
QDOCnnnn[1]			
QDSNX	X		X
QGPL	X		X
QGPLTEMP	X	X	
QGPL38	X		X
QPFRDATA	X		X
QRCL	X		X
QRECOVERY[3]			
QRPLOBJ[3]			
QSPL[3]			
QSRV[3]			
QSSP	X	X	
QSYS[2]			
QSYS2	X	X	
QS36F	X		X
QTEMP[3]			
QUSER38	X		X
QUSRINFSKR	X		X
QUSRSYS	X		X
QUSRTEMP	X	X	
QUSRVxRxMx[4]	X		X
QXZ1	X	X	
Qxxxxxx[5]	X	X	
#LIBRARY	X		X
#CGULIB	X	X	
#COBLIB	X	X	

Table 5-1 (Page 2 of 2). Comparison of Special Values for SAVLIB Command–LIB Parameter. Libraries marked with an X are saved.

Library Name	*NONSYS	*IBM	*ALLUSR
#DFULIB	X	X	
#RPGLIB	X	X	
#SDALIB	X	X	
#SEULIB	X	X	
#DSULIB	X	X	

1 A QDOCnnnn library exists for each user auxiliary storage pool (ASP) that contains document library objects (DLOs). The library for the system ASP is QDOC. The library for ASP 2 is QDOC0002, the library for ASP 3 is QDOC0003, and so on. Use the SAVDLO command to save DLOs in the QDOCnnnn library.

2 Use the SAVSYS command to save information in the QSYS library.

3 These libraries contain temporary information. They are not saved or restored.

4 A different library name, format QUSRVxRxMx, may have been created by the user for each previous release supported by IBM. This library contains user commands to be compiled in a CL program for a previous release. For the QUSRVxRxMx user library, the VxRxMx is the version, release, and modification level of a previous release that IBM continues to support.

5 Qxxxxxx refers to any other library that starts with the letter Q. These libraries are intended to contain IBM-supplied objects. They are not saved when you specify *ALLUSR. For a complete list of IBM libraries that start with the character Q, see the *CL Reference* book.

How to Save Objects

You use the Save Object (SAVOBJ) command to save one or more objects. Objects are not affected by this command (other than having the change history updated) unless you specify that storage is to be freed.

You can use the Save/Restore Object (SAVRSTOBJ) command to save one or more objects, send them to another system, and restore them. The SAVRSTOBJ command supports the same options as the SAVOBJ command. You use the Remote Location Name (RMTLOCNAME) parameter to specify where the saved objects are to be restored. The system determines the method (communications line or optical connection) for transferring data to that location. See "How to Use the ObjectConnect/400 Function" on page 5-17 for more information. ObjectConnect cannot run in restricted state.

Ways to Save Multiple Objects

You can use the parameters of the SAVOBJ command to specify multiple objects in many ways, including the following:

- The object (OBJ) parameter can be *ALL, a generic name, or a list of as many as 300 specific names and generic names. A **generic name** is the starting characters for a name. For example, you specify OBJ(CUST*) to get all the objects whose names begin with CUST.
- The object type (OBJTYPE) parameter can be *ALL or a list of types. For example, you can save all job descriptions and subsystem descriptions by specifying OBJ(*ALL) and OBJTYPE(*JOBD *SBSD).
- The library (LIB) parameter can be a single library or a list of as many as 300 library names.

When you are saving from more than one library, you can specify one or more object types, but you must specify OBJ(*ALL) for the object name.

Libraries are processed in the order specified in the library (LIB) parameter. Specifying more than one library allows overlapping processing, which can improve performance.

You can also use the Save Objects from a List (QSRSAVO) application programming interface (API) to save multiple objects. The QSRSAVO API is similar to the SAVOBJ command, except that you can associate a specific object type with each object name that you specify. This provides more granularity in what you save with a single command. The *System API Reference* book provides more information about the QSRSAVO API.

Objects Whose Contents Are Not Saved

For some object types, the system saves only object descriptions, not the contents of the objects. Table 5-2 on page 5-3 shows these object types:

Table 5-2. Object Types Whose Contents Are Not Saved

Object Type	Contents Not Saved
Data queues (*DTAQ)	Data queue entries
Job queues (*JOBQ)	Jobs
Journals (*JRN)	List of currently journaled objects. List of associated journal receivers.
Logical files (*FILE)	Physical files making up logical files are not saved when the logical file is saved. Access paths owned by logical files are saved with the physical file if access path (*YES) is specified on the save command.
Message queues (*MSGQ)	Messages
Output queues (*OUTQ)	Spooled files
Save file (*SAVF)	When SAVFDTA(*NO) is specified.
User Queue (*USRQ)	User queue entries

How to Save Only Changed Objects

You can use the Save Changed Objects (SAVCHGOBJ) command to save only objects that have changed since a specified time. Saving changed objects is often used to reduce the amount of media and to complete save processing in a shorter period of time.

| You can use the Save/Restore Changed Objects (SAVRSTCHG) command to save one or more changed objects, send them to another system, and restore them. The SAVRSTCHG command supports most of the same options that make sense as the SAVCHGOBJ command. You use the Remote Location Name (RMTLOCNAME) parameter to specify where the saved changed objects are to be restored. The system determines the method (communications line or optical connection) for transferring data to that location. See "How to Use the ObjectConnect/400 Function" on page 5-17 for more information. ObjectConnect cannot run in restricted state. You might use the SAVRSTCHG command to maintain duplicate sets of files on two different systems.

| The default for the commands is to save objects that have changed since the library was last saved using the SAVLIB command. You can specify a different reference date and time by using the reference date (REFDATE) and reference time (REFTIME) parameters on the SAVCHGOBJ command. However, this degrades the performance of the save operation and makes recovery more complicated.

The system compares the reference date and time with the date and time of the last change in the object description to determine when an object was changed.

The options for specifying objects, object types, and libraries are similar to those for the SAVOBJ command:

- You can specify up to 300 different libraries on the SAVCHGOBJ command.
- You can specify *ALLUSR for the library. If you specify *ALLUSR, you can omit up to 300 libraries using the OMITLIB parameter.

If saving changed objects is an important part of your save strategy, you must ensure that any save activity that occurs between your full save operations does not affect what is saved when you use the SAVCHGOBJ command. If users save individual objects occasionally, you may want them to specify UPDHST(*NO). That prevents their save activity from having an impact on the overall SAVCHGOBJ strategy.

Note: The most common way to use the SAVCHGOBJ command is to specify REFDATE(*SAVLIB). If you have a new library that has never been saved, it is not saved when you specify SAVCHGOBJ REFDATE(*SAVLIB).

Using SAVCHGOBJ–Examples: In a typical environment, you might use the SAVLIB command once a week and the SAVCHGOBJ command every day. Because the default for SAVCHGOBJ is from the last SAVLIB operation, the media produced by SAVCHGOBJ tends to grow during the week.

Table 5-3 shows an example of using SAVCHGOBJ during a typical week. Assume the entire library is saved on Sunday night and the SAVCHGOBJ command is used each evening during the week:

Table 5-3. SAVCHGOBJ Command–Cumulative

Day	Files That Changed That Day	Media Contents
Monday	FILEA, FILED	FILEA, FILED
Tuesday	FILEC	FILEA, FILEC, FILED
Wednesday	FILEA, FILEF	FILEA, FILEC, FILED, FILEF
Thursday	FILEF	FILEA, FILEC, FILED, FILEF
Friday	FILEB	FILEA, FILEB, FILEC, FILED, FILEF

If a failure occurred on Thursday morning, you would:

1. Restore the library from Sunday evening.
2. Restore all the objects from Wednesday's SAVCHGOBJ tapes.

When you use this technique of saving everything that changed since the last SAVLIB, recovery is easier. You need to restore only the tapes from the most recent SAVCHGOBJ operation.

You can use the REFDATE and REFTIME to save only objects that have changed since the last SAVCHGOBJ operation. This may reduce the amount of media and the time for the save operation. Table 5-4 on page 5-4 shows an example:

Table 5-4. SAVCHGOBJ Command–Not Cumulative

Day	Files That Changed That Day	Media Contents
Monday	FILEA, FILED	FILEA, FILED
Tuesday	FILEC	FILEC
Wednesday	FILEA, FILEF	FILEA, FILEF
Thursday	FILEF	FILEF
Friday	FILEB	FILEB

The recovery steps are more complicated if you use this technique. You can restore the SAVCHGOBJ media from earliest to latest. Or you can display each tape and restore only the latest version of each object.

For information about using the SAVDLO command to save changed DLOs, see "How to Save Changed Document Library Objects" on page 5-9. For information about using the SAV command to save changed objects, see "How to Save Changed Objects in Directories" on page 5-13.

How to Save Changed Objects When You Use Journaling

When you journal database files, the system uses one or more journal receivers to keep a record of changes that have occurred to the journaled files. The chapter of the *Backup and Recovery – Advanced* book called "Planning and Setting Up Journaling" describes how to set up journaling.

If you journal database files, you probably do not want to save those physical files when you save changed objects. You should save the journal receivers rather than the physical files.

The journaled objects (OBJJRN) parameter of the SAVCHGOBJ command controls whether journaled files are saved. If you specify *NO, which is the default, a physical file is not saved if both these conditions are true:

- The file was being journaled at the time specified for the REFDATE and REFTIME parameters on the SAVCHGOBJ command.
- The file is currently being journaled.

How the System Updates Changed Object Information

The changed object information kept by the system is a date and timestamp. When an object is created, the timestamp is placed in the changed field. Any change to the object causes the date and timestamp to be updated.

Use the DSPOBJD command and specify DETAIL(*FULL) to display the date and time of the last change for a specific object. Use the Display File Description (DSPFD) command to display the last change date for a database member.

To display the last change date for a document library object, do the following:

1. Use the Display DLO Name (DSPDLONAM) command to display the system name for the DLO and the ASP where it is located.
2. Use the DSPOBJD command, specifying the system name, the name of the document library for the ASP (such as QDOC0002 for ASP 2), and DETAIL(*FULL).

Some common operations that result in a change of the date and time are:

- Create commands
- Change commands
- Restore commands
- Add and remove commands
- Journal commands
- Authority commands
- Moving or duplicating an object

These actions do not cause the system to update the change date and time:

- *Message queue.* When a message is sent or received.
- *Data queue.* When an entry is sent or received.

An IPL causes all job queues and output queues to be changed.

Change Information for Database Files and Members: For database files, SAVCHGOBJ saves the file description and any members that have changed.

Some operations change the change date and time of the file and all of its members. Examples are the CHGOBJOWN, RNMOBJ, and MOVOBJ commands. If you save a file with 5 or more members, the system updates the change date for the library because it creates a recovery object in the library to improve save performance.

Operations that affect only the content or attributes of a member change only the member's date and time. Examples are:

- Using the Clear Physical File Member (CLRPFM) command
- Updating a member using source entry utility (SEU)
- Updating a member with a user program.

The SAVCHGOBJ command can be useful for backing up typical source files. Normally, a source file has many members, and only a small percentage of members is changed every day.

How to Save Database Files

Use the SAVOBJ command to save individual database files. You can use the FILEMBR (file member) parameter to save:

- A list of members from one database file.
- The same group of members from multiple files.

The online information for the SAVOBJ command describes how to use the FILEMBR parameter.

The SAVCHGOBJ command saves only changed members of physical files.

Table 5-5 shows what the system does when you save a database file:

Table 5-5. Saving Database Files

Type of File	What Is Saved	Restrictions
Physical file, TYPE(*DATA), keyed access path[1]	Description, data, access path	No more than 16 000 members
Physical file, TYPE(*DATA), access path not keyed	Description, data	No more than 32 000 members
Physical file, TYPE(*SRC), keyed access path	Description, data	No more than 32 000 members
Logical file [2]	Description	

1 The following types of access paths are included as keyed access paths: keyed access paths, primary key constraints, unique constraints, referential constraints.

2 To save the access path for a logical file, save the associated physical files using the SAVLIB, SAVOBJ, or SAVCHGOBJ command. Specify ACCPTH(*YES).

The description for a file may include the following:

- Definitions of triggers and the programs that are associated with the file, but not the programs themselves. The programs must be saved separately.
- Definitions of any constraints for the file.

Special considerations apply when restoring a file that has trigger programs or constraints defined. See "How the System Restores Files with Triggers" on page 15-15 and "How the System Restores Files with Referential Constraints" on page 15-14.

The save operation saves all records in the file, but does not save unused storage at the end of the file.

Considerations When Saving Database Files That Are Journaled: When you save a file that is being journaled, the system writes an entry to the journal for each member that is saved.

You can use the OBJJRN parameter of the SAVCHGOBJ command to omit journaled files. See "How to Save Changed Objects When You Use Journaling" on page 5-4.

How to Save Access Paths

Saving access paths can significantly reduce the amount of time it takes you to recover. When you restore a database file and the access path has not been saved, the system rebuilds the access path. However, saving access paths increases the time for the save operation and the amount of media used.

When you save a physical file that is not a source file, the system saves the following types of access paths with it, whether or not you specify ACCPTH(*YES):

- Keyed access paths owned by the physical file
- Primary key constraints
- Unique constraints
- Referential constraints

To save access paths owned by logical files, specify ACCPTH(*YES) on the SAVCHGOBJ, SAVLIB, and SAVOBJ commands when you save the physical files. Access paths are saved when you save the physical file because the physical file contains the data associated with the access path. When you save the logical file, you are saving only the description of the logical file.

Access paths that are owned by logical files and are not used for referential constraints are saved if **all** of the following are true:

- ACCPTH(*YES) is specified on the save command for the physical files.
- All based-on physical files under the logical file are in the same library and are being saved at the same time on the same save command.
- The logical file is MAINT(*IMMED) or MAINT(*DLY).

In all cases, an access path is saved only if it is valid and not damaged at the time of the save operation.

If the based-on physical files and the logical files are in different libraries, the access paths are saved. However, these access paths may not be restored. See "How the System Restores Access Paths" on page 15-13.

Saving a File Network–Example

Figure 5-1 on page 5-6 shows a physical file, FILEA in the LIB1 library. Logical file FILEB in LIB1 and logical file FILEC in LIB2 have access paths over physical file FILEA in LIB1.

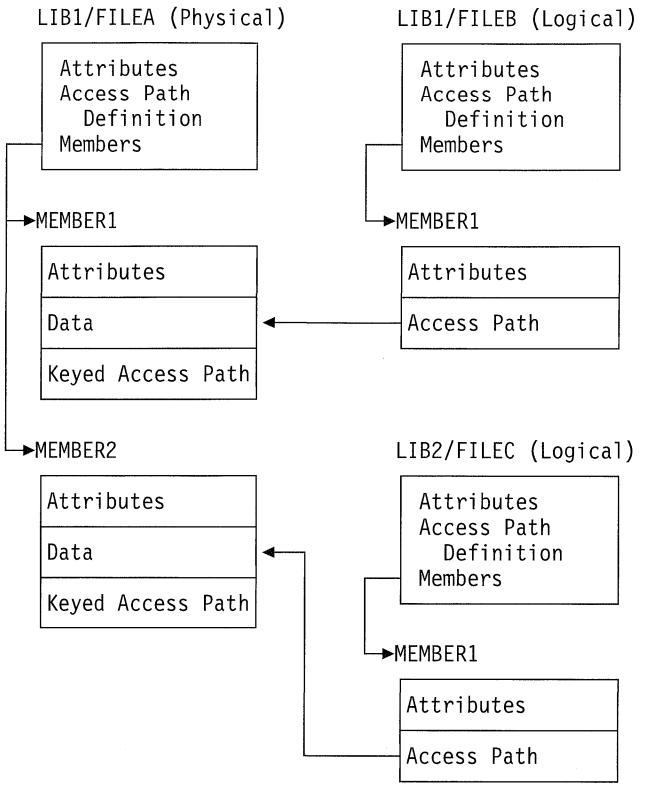


Figure 5-1. Saving Access Paths

Table 5-6 shows which parts of this file network are saved using different commands:

Table 5-6. Saving a File Network

Command	What Is Saved
`SAVLIB LIB(LIB1) ACCPTH(*YES)`	FILEA: description, data, keyed access path FILEB: description, access path FILEC: access path
`SAVOBJ OBJ(FILEA) LIB(LIB1) ACCPTH(*YES)`	FILEA: description, data, keyed access path FILEB: access path FILEC: access path
`SAVLIB LIB(LIB2) ACCPTH(*YES)`	FILEC: description

How to Save Files with Referential Constraints

Referential constraints link multiple files together in a network, similar to the network for access paths. You might think of this as a relationship network. If possible, you should save all the files in a relationship network in a single save operation.

If files in a relationship network are restored in separate operations, the system must verify that the relationships are still valid and current. You can avoid this process and improve restore performance if you save and restore relationship networks in a single operation.

"How the System Restores Files with Referential Constraints" on page 15-14 has more information about the considerations when restoring relationship networks.

How to Save Journals and Journal Receivers

Use the SAVOBJ, SAVCHGOBJ, or SAVLIB command to save journals and journal receivers that are in user libraries. Use the SAVSYS command to save the journals and journal receivers that are in the QSYS library.

You can save a journal or journal receiver even when files are being journaled to it. The save operation always starts at the beginning of the journal receiver. If you save a journal receiver that is currently attached, you receive a diagnostic message.

If you specified MNGRCV(*USER) for a journal on the CRTJRN command or the CHGJRN command, save the detached receiver immediately after running the CHGJRN command.

If you specified MNGRCV(*SYSTEM), do one of the following:

- Set up a regular procedure for saving detached receivers. Use this procedure to determine which detached journal receivers need to be saved:
  1. Type `WRKJRNA JRN(`*`library-name/journal-name`*`)`
  2. On the Work with Journal Attributes display, press F15 (Work with receiver directory).
- Create a program to monitor for message CPF7020 in the threshold message queue for the journal. This message is sent when the receiver is detached. Save the receiver identified in the message.

The chapter of the *Backup and Recovery – Advanced* book called "Planning and Setting Up Journaling" provides more information about managing journals and journal receivers.

How to Save Save Files

You can save the contents of a save file by:

- Using the Save Save File Data (SAVSAVFDTA) command. Objects saved with this command appear on the media as if they were saved directly to the media. For example, assume that you use the following commands to save a library:
  1. `SAVLIB LIB(LIBA) DEV(*SAVF) SAVF(LIBB/SAVFA)`
  2. `SAVSAVFDTA SAVF(LIBB/SAVFA) DEV(TAP01)`

  You can restore library LIBA either from the tape or from the save file by using the RSTLIB command. When you

use the SAVSAVFDTA command, the save file object itself is not saved.

You cannot save to diskette by using the SAVSAVFDTA command if the save file contains data from the SAVSECDTA command or the SAVCFG command.

- Using the save file data (SAVFDTA) parameter on the SAVLIB, SAVOBJ, or SAVCHGOBJ command. When you specify SAVFDTA(*YES), the save file and its contents are saved to media. You cannot restore individual objects that are in the save file from the media copy of the save file. You must restore the save file and then restore the objects from the save file.

  The following restrictions apply when specifying SAVFDTA(*YES):

  - If you are saving the save file for a system at a previous release, the system saves the save file in a previous release format. The objects within the save file remain in the release format that was specified when they were saved to the save file.
  - If the save media for the save operation is the same save file, only the description of the save file is saved. Message CPI374B, `SAVFDTA ignored for file &1 in library &2`, is sent and the save operation continues.
  - The SAVACT parameter does not affect saving save file data. The save file is locked during the entire save operation.

How to Save Configuration Information

Use the Save Configuration (SAVCFG) command or the SAVSYS (Save System) command to save configuration objects. The SAVCFG command does not require a restricted state. However, if your system is active, these configuration objects are bypassed by the SAVCFG command:

- A device that is being created.
- A device that is being deleted.
- A device if the associated system resource management object is in use.

| You can use the Save/Restore Configuration (SAVRSTCFG) | command to save one or more configuration objects, send | them to another system, and restore them. The | SAVRSTCFG command supports the most of the options | and parameters as the SAVCFG and RSTCFG commands. | You use the Remote Location Name (RMTLOCNAME) | parameter to specify where the saved configuration objects | are to be restored. The system determines the method | (communications line or optical connection) for transferring | data to that location. See "How to Use the | ObjectConnect/400 Function" on page 5-17 for more information. ObjectConnect cannot run in restricted state.

| When you save your configuration by using the SAVCFG | command or the SAVSYS command, the system saves the | following object types:

*CFGL	*DEVD	*NTBD
*CNNL	*IPXD	*NWID
*COSD	*LIND	*NWSD
*CTLD	*MODD	*SRM

| When you copy your configuration by using the SAVRSTCFG | command, the system saves and restores the following | object types:

*CFGL	*COSD	*NTBD
*CNNL	*MODD	*TRA

Note: You might think of system information, such as system values and network attributes, as configuration information. However, this type of information is not contained in configuration objects. System information is not saved by the SAVCFG command. It is saved by the SAVSYS command because it is stored in the QSYS library.

How to Save Security Information

Use the SAVSYS command or the Save Security Data (SAVSECDTA) command to save this security information:

- User profiles
- Private authorities
- Authorization lists
- Authority holders

This security information is stored with the object and saved when the object is saved:

- Public authority
- Owner and owner authority
- Primary group and primary group authority
- Authorization list linked to object

Saving security information does not require a restricted state. However, you cannot delete user profiles while security information is being saved. If you change user profiles or grant authority while you are saving security information, your saved information may not reflect the changes.

The system can save up to 16MB of authority information for a single user profile. If this limit is exceeded, a diagnostic message (CPD373D) is sent. The profile is bypassed and the save operation continues with the next user profile.

To reduce the size of a large user profile, do one or more of the following:

- Transfer ownership of some objects to another user profile.
- Remove the user profile's private authority to some objects.

Authority information for objects in the QLANSrv file system is stored differently. The *LAN Server for OS/400 Adminis-*

tration book describes how to save security information for LAN Server for OS/400.

How to Save Spooled Files

When you save an output queue, you are saving its description but not its contents (the spooled files). To save spooled files, including all the advanced function attributes associated with the spooled files, use the following APIs:

- Open Spooled File (QSPOPNSP)
- Create Spooled File (QSPCRTSP)
- Get Spooled File (QSPGETSP)
- Put Spooled File (QSPPUTSP)
- Close Spooled File (QSPCLOSP)
- User Spooled File Attributes (QUSRSPLA)

The *System API Reference* book provides information about these APIs. You can find an example and a tool for using these APIs in the QUSRTOOL library in the TSRINFO member of the QATTINFO file.

To copy only the data from a spooled file, do the following:

1. Use the Copy Spooled File (CPYSPLF) command to save the spooled files to a database file.
2. Save the database file.

Because it copies textual data only and not advanced function attributes such as graphics and variable fonts, the CPYSPLF command may not provide a complete solution for saving your spooled files.

How to Save Licensed Programs

You can use the SAVLIB command or the Save Licensed Program (SAVLICPGM) command to save licensed programs. These methods are intended for two different purposes:

- If you are saving licensed programs in case they are needed for a recovery, use the SAVLIB command. You can save just the libraries that contain licensed programs by specifying SAVLIB LIB(*IBM). Or, you can save the libraries that contain licensed programs when you save other libraries by specifying SAVLIB LIB(*NONSYS).
- If you are saving licensed programs to distribute them to other systems in your organization, use the SAVLICPGM command. If you have V3R1 or later, you can use a save file as the output for the SAVLICPGM command. You then have the option of sending the save file over your communications network.

  Refer to the *Central Site Distribution* book for more information about saving licensed programs to distribute to other systems.

Note: The system needs additional work space in auxiliary storage when you use the SAVLICPGM command to save the following programs:

- Client Access for OS/400 for Windows** 3.1 (5716-XC1)
- Client Access for OS/400 Optimized for OS/2* (5716-XG1)

To save the programs in a format that allows them to be restored using the RSTLICPGM command, the system must copy PC files from the *Root* file system to the QDLS file system. The amount of additional space is approximately the same as the space required to install the licensed program initially.

How Documents and Folders Are Stored and Used

The AS/400 system provides the capability to store documents and folders in a hierarchy (documents within a folder within another folder). Documents and folders are called document library objects (DLOs).

To simplify storage management, all DLOs are stored nominally in one or more libraries. The library in the system ASP is called QDOC. Each user ASP that contains DLOs has a document library called QDOCnnnn, where nnnn is the number assigned to the ASP. From a user perspective, DLOs are not in libraries; they are filed or reside in folders. You manipulate DLOs using DLO commands and menus.

Note: The topic in the *Backup and Recovery – Advanced* book called "ASPs with Document Library Objects–Planning" describes how to set up and manage DLOs in user ASPs.

Several licensed programs, including Client Access for OS/400, OfficeVision for OS/400*, and Image WAF/400, use DLO support. For example, Client Access for OS/400 for most workstation platforms uses shared folders, which are DLOs. The online documentation that is available through InfoSeeker is also stored in folders. The folder names begin with the characters QBK. If you choose to install the bookshelves for online information and you usually save all DLOs, your save operation will take more media and more time than it did for releases before V3R1.

Within the integrated file system, DLO support is called the QDLS (Document Library Services) file system.

The system uses a set of search index files in the QUSRSYS library to keep track of all the DLOs on the system. The names of these database files begin with the characters QAOSS. Other QAO* files in the QUSRSYS library are used to track distributions and support text search capabilities. These files in QUSRSYS should be saved periodically. Options 21 and 23 from the Save menu save both library QUSRSYS and all the DLOs on the system.

How to Save Document Library Objects

You can use the Save Document Library Object (SAVDLO) command to save one or more documents. Documents are not affected by this unless you specify that storage is to be freed or deleted. You can save a single document or more than one document.

| You can use the Save/Restore Document Library Object (SAVRSTDLO) command to save one or more document library objects, send them to another system, and restore them. The SAVRSTDLO command supports the same options as the SAVDLO command. You use the Remote Location Name (RMTLOCNAME) parameter to specify where the saved document library objects are to be restored. The system determines the method (communications line or optical connection) for transferring data to that location. See "How to Use the ObjectConnect/400 Function" on page 5-17 for more information. ObjectConnect cannot run in restricted state.

Ways to Save Multiple Documents

You can save multiple documents in several ways:

- All documents by typing: `SAVDLO DLO(*ALL) FLR(*ANY)`.
- All documents in an ASP by typing: `SAVDLO DLO(*ALL) FLR(*ANY) ASP(n)`.

  You may want to move the folders that contain user documents to user ASPs. You can save the DLOs in those ASPs regularly and not save the system ASP. This eliminates the extra time and media for saving the bookshelf folders for InfoSeeker and the system folders for Client Access for OS/400, which change infrequently.

  | **Note:** When saving Client Access for OS/400 you must also run the SAV command. The following shows all the parameters needed to save everything in the integrated file system which picks up Client Access.

  ```
  SAV DEV('/QSYS.LIB/TAPxx.DEVD')
      OBJ(('/*') ('/QSYS.LIB' *OMIT)
      ('/QDLS' *OMIT))[1] UPDHST(*YES)
  ```

- A list of documents, by user-defined name or by system object name.
- All documents that meet certain search criteria. You can use these parameters if you specify DLO(*SEARCH):

FLR	Folder
CHKFORMRK	Marked for offline storage
CHKEXP	Document expiration date
CRTDATE	Creation date
DOCCLS	Document class
OWNER	Owner
REFCHGDATE	Document last changed date
REFCHGTIME	Document last changed time
SRCHTYPE	*ALL, for all folders meeting the search criteria

- All distribution objects (mail) by typing: `SAVDLO DLO(*MAIL)`.
- All distribution objects, new folders, new documents, and changed documents by typing: `SAVDLO DLO(*CHG)`.

  Only changed DLOs. This is another method for reducing the effect of online information on the amount of time and media that it takes to save DLOs. "How to Save Changed Document Library Objects" provides more information about specifying `DLO(*CHG)`.

The online information for the SAVDLO command describes how to use all the options.

When you save DLOs from more than one ASP with the same operation, the system creates a separate file on the media for each ASP. When you restore DLOs from the media, you must specify the sequence numbers to restore the DLOs from more than one ASP.

Authority Required for the SAVDLO Command: The following parameter combinations for the SAVDLO command requires either *ALLOBJ special authority, *SAVSYS special authority, or *ALL authority to the documents and enrollment in the system directory:

- DLO(*ALL) FLR(*ANY)
- DLO(*CHG)
- DLO(*MAIL)
- DLO(*SEARCH) OWNER(*ALL)
- DLO(*SEARCH) OWNER(user-profile-name)

Note: You can always save your own DLOs. You must have the authorities specified to specify another user profile for the owner parameter.

How to Save Changed Document Library Objects

You can use the Save Document Library Object (SAVDLO) command to save DLOs that have changed since a particular time. When you specify `SAVDLO DLO(*CHG)`, the default is to save DLOs that have changed since you saved all DLOs for that user ASP (SAVDLO DLO(*ALL) FLR(*ANY)). When you save changed DLOs, the system also saves the distribution objects in the QUSRSYS library, which are called **unfiled mail**.

Note: Documents that are referenced by a distribution (unfiled mail) are saved if they have changed since they were last saved. If you have Version 3 Release 1 Modification 0 or later, these documents are not saved when you specify `DLO(*MAIL)`.

"How to Save Document Library Objects" provides more information about saving DLOs.

Ways to Reduce Disk Space Used by Documents

Documents tend to accumulate and require more and more storage. You can manage the disk space used for documents by:

- Saving documents and deleting them (STG(*DELETE)). These documents no longer appear when you search for documents.
- Saving documents and freeing storage (STG(*FREE)). These documents appear when you search and are marked as offline.
- Moving documents to a user ASP. You can establish different backup and recovery strategies for these user ASPs.
- Using the Reorganize Document Library Object (RGZDLO) command.

When you save documents, you can use search criteria, such as the storage mark on the document or the document expiration date, to specify which documents should have their storage freed. The *Office Services Concepts and Programmer's Guide* book provides more information about marking and managing documents.

Output from the SAVDLO Command

You can use the OUTPUT parameter on the SAVDLO command to show information about the saved documents, folders, and mail. You can either print the output (OUTPUT(*PRINT)) or save it to a database file (OUTPUT(*OUTFILE)).

If you print the output, you should be aware of device dependencies:

- The heading information in the output is device-dependent. All information does not appear for all devices.
- The print file for the SAVDLO command uses a character identifier (CHRID) of 697500. If the printer you are using does not support this character identifier, you will receive message CPA3388. To print the SAVDLO output and not receive message CPA3388, specify the following before specifying *PRINT on the SAVDLO command:

  ```
  CHGPRTF FILE(QSYSOPR/QPSAVDLO) CHRID(*DEV)
  ```

  For more information about character identifiers (CHRID), see the *Printer Device Programming* book.

If you use an output file, the system uses the file format QSYS/QAOJSAVO.OJSDLO. The file layout is described in the *Office Services Concepts and Programmer's Guide* book.

How to Save Office Services Information

Office services information includes database files, distribution objects, and DLOs. Figure 5-2 shows how these objects are organized and the common methods for saving them:

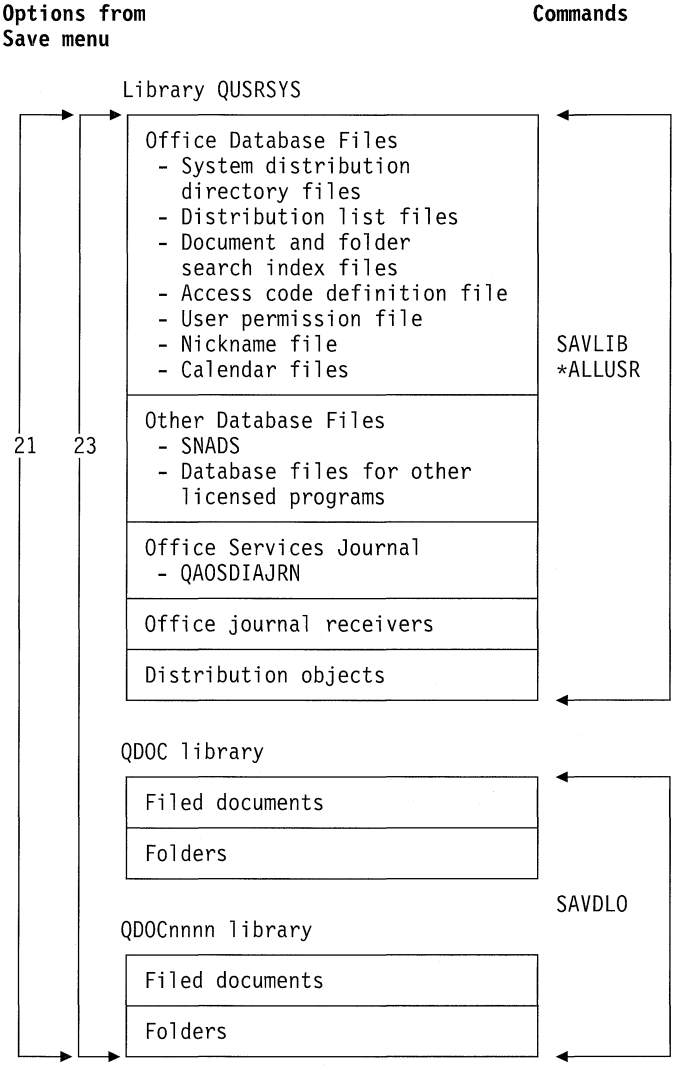


Figure 5-2. How Office Services Objects Are Saved

To save your office information completely, you must save both documents and the QUSRSYS library. The documents you save must include users' mail. "How to Save Mail Objects" on page 5-11 describes how to save mail.

To ensure that all the system directory files in QUSRSYS are saved, you must end the QSNADS subsystem. If QSNADS is active, the system cannot get the necessary locks on the directory files.

How to Save Mail Objects

Mail objects are internal objects created and managed by document distribution services. For a description of these objects, see the *Office Services Concepts and Programmer's Guide*.

Use the Save Document Library Object (SAVDLO) command to save mail.

Following are versions of the SAVDLO command that save mail:

- SAVDLO DLO(*ALL) FLR(*ANY).
- SAVDLO DLO(*CHG). This saves all mail, not just changed mail.
- SAVDLO DLO(*MAIL).

When you save mail, remember the following:

- *ALLOBJ or *SAVSYS special authority is required to save mail.
- Mail changes frequently and should be saved regularly.
- Mail cannot be saved to a previous release.
- Mail cannot be saved for only one user.

Saving Files for Text Search Services

The text index database files are a part of the Text Search Services. For more information about Text Search Services, see *Office Services Concepts and Programmer's Guide*.

Before you save the text index files, update the index using the Start Update Index (STRUPDIDX) command to finish any outstanding requests.

Running one of the following commands removes records from the index when the next STRUPDIDX command is run.

- The SAVDLO with STG(*DELETE) specified.
- The SAVDLO with CHKFORMRK(*YES) specified and the document is marked for save and delete.
- The DLTDLO command.

You must make sure that the STRUPDIDX command or the
| Start Reorganize Index (STRRGZIDX) command is not running during the save operation. Use the End Index Monitor (ENDIDXMON) command to end the automatic administration monitor and then select option 8 (Display all status) on the Work with Text Index (WRKTXTIDX) display to verify that the update function and the reorganize function are not running.

File Systems–Save Methods Available

The **integrated file system** is a part of the OS/400 program that supports stream input/output and storage management similar to personal computers and UNIX** operating systems. The integrated file system also provides an integrating structure over all information stored in the AS/400 system.

All objects on the system can be viewed from the perspective of a hierarchical directory structure. However, in most cases, objects are viewed in the way that is most common for a particular file system. For example, objects in the QSYS.LIB file system are usually viewed from the perspective of libraries. Objects in the QDLS file system are usually viewed as documents within folders.

Similarly, objects should be saved using the methods that are designed for a particular file system. Figure 5-3 shows the association between save commands and file systems.

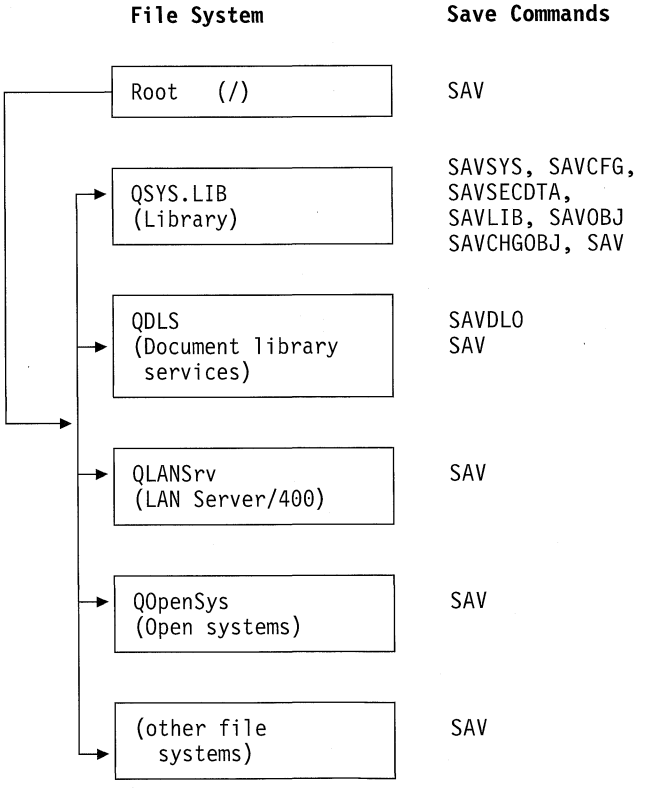


Figure 5-3. Integrated File System and Save Commands

How to Save Objects in Directories

Use the SAV (Save) command to save objects in directories. The SAV command is most commonly used to save objects in the QLANSrv file system, the QOpenSys file system, and the *Root* file system.

| You can use the Save/Restore (SAVRST) command to save
| one or more objects in directories, send them to another
| system, and restore them. It can also save entire directories
| (not to be confused with entire systems). The SAVRST

command supports the same options as the SAV command. You use the Remote Location Name (RMTLOCNAME) parameter to specify where the saved objects in directories are to be restored. The system determines the method (communications line or optical connection) for transferring data to that location. See "How to Use the ObjectConnect/400 Function" on page 5-17 for more information. ObjectConnect cannot run in restricted state.

When you use the SAV command, you use a pathname to specify objects to be saved. The pathname consists of a sequence of directory names followed by the name of the object. You also use the pathname for the values of other parameters, such as the device (DEV) parameter. For example, on the SAVLIB command, you specify `DEV(TAP01)`. On the SAV command, you specify `DEV('/QSYS.LIB/TAP01.DEVD')`

You may want to create symbolic links for devices that you specify with the SAV command to simplify keying and to reduce errors. For example, you can create a symbolic link for the tape device description called `tap01`.

You can use the SAV command to save:

- A specific object
- A directory or subdirectory
- An entire file system
- Objects that meet search criteria

The object (OBJ) parameter on the SAV command supports the use of wildcard characters and the directory hierarchy. Online information and the *Integrated File System Introduction* book provide more information about how to specify object names when you use integrated file system commands.

When you specify on the SAV command to save the current directory—SAV OBJ('*')— and the current directory is empty (it has no files or subdirectories), nothing is saved. The command does not save the one *DIR object that represents the current directory. However, when you explicitly specify the directory by name—SAV OBJ('/mydir')— the *DIR object is included in your save. The same applies to the home directory.

How to Save Objects That Have More Than One Name:

You can give more than one name to objects on the system. An additional name for an object is sometimes called a link or an alias. Some links, referred to as hard links, point directly to the object. Other links are more like a nickname for an object. The nickname does not point directly to the object. Instead, you can think of the nickname as an object that contains the name of the original object. This type of link is referred to as a soft link, a symbolic link, or an alias.

If you create links or aliases for objects, study the examples that follow to ensure that your save strategy saves both the contents of objects and all their possible names.

Figure 5-4 shows an example of a hard link:

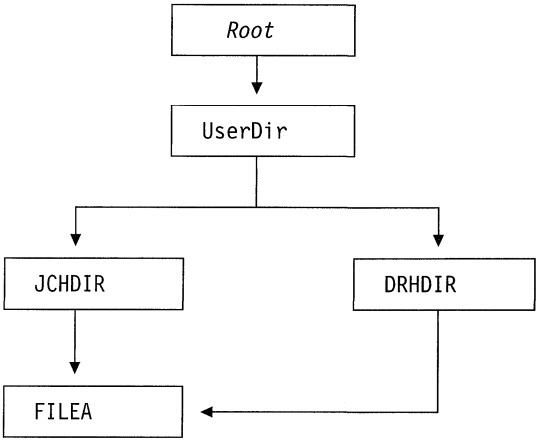


Figure 5-4. An Object with Hard Links–Example

You can save FILEA with either of the following commands. For both commands, you get the description of FILEA and the data:

- `SAV OBJ('/UserDir/JCHDIR/FILEA')`
- `SAV OBJ('/UserDir/DRHDIR/FILEA')`

If you use only the first command (JCHDIR), you have not saved the fact that FILEA is also named in the DRHDIR directory.

You can use the following commands to get the data once and both names (hard links) for the file:

- `SAV OBJ(('/UserDir'))`
- `SAV OBJ(('/UserDir/JCHDIR') ('/UserDir/DRHDIR'))`
- `SAV OBJ(('/UserDir/JCHDIR/FILEA') ('/UserDir/DRHDIR/FILEA'))`

Figure 5-5 shows an example of a symbolic link:

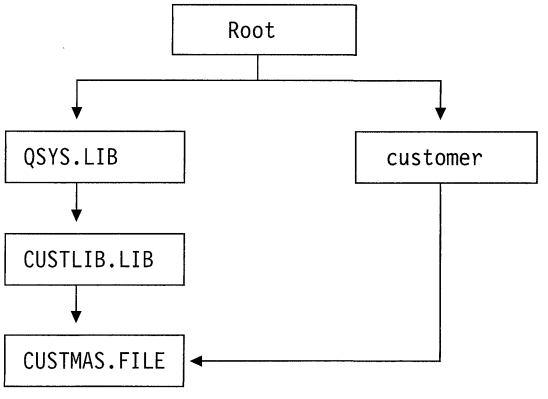


Figure 5-5. An Object with a Symbolic Link–Example

Following are several commands you can use to save the CUSTMAS file (both description and data):

- `SAVLIB LIB(CUSTLIB)`
- `SAVOBJ OBJ(CUSTMAS) LIB(CUSTLIB)`
- `SAV ('/QSYS.LIB/CUSTLIB.LIB/CUSTMAS.FILE')`

None of these commands saves the fact that the CUSTMAS file has a "nickname" of `customer` in the root directory.

If you specify SAV OBJ('/customer'), you have saved the fact that customer is a nickname for the CUSTMAS file. You have not saved the description of the CUSTMAS file or its contents.

How to Save Changed Objects in Directories

For objects in the QOpenSys file system and the *Root* file system, the system keeps a record of when the object was last changed and whether it has been changed since it was last saved. The system does not store when the object was last saved.

For objects in the QLANSrv file system, the system keeps a record of when the object was last changed.

You can use the change period (CHGPERIOD) parameter on the Save (SAV) command to save objects that have changed since a specified time. For objects in the QLANSrv file system, you must specify a date and time. For objects in the QOpenSys file system and the *Root* file system, you can specify `CHGPERIOD(*LASTSAVE)`.

If you specify `CHGPERIOD(*LASTSAVE)`, you get any object that has changed since any save operation was performed for that object with UPDHST(*YES) specified. If you use this method several times during a week, the resulting media will look like Table 5-4 on page 5-4.

To perform a save operation that includes all objects that have changed since the last complete save of a directory (similar to what is shown in Table 5-3 on page 5-3), do one of the following:

- Specify a date and time for the CHGPERIOD parameter.
- Specify UPDHST(*YES) for a complete save operation. Specify UPDHST(*NO) and CHGPERIOD(*LASTSAVE) when you save changed objects.

You can also use the SAV command to save objects that have not changed since a particular time by specifying `CHGPERIOD(*ALL *ALL date time)`. This might be useful in archiving old information before removing it.

"How to Save Objects in Directories" on page 5-11 provides more information about using the SAV command.

How LAN Server for OS/400 Information Is Stored and Saved

Personal systems can be attached to an AS/400 business computing system using the File Server I/O Processor (File Server IOP). The File Server IOP provides the personal systems with fast access to information that is stored on the AS/400 system in the QLANSrv file system. The LAN Server for OS/400 licensed program provides the interface to manage the QLANSrv file system.

Information stored by LAN Server for OS/400 appears in several different directories on the system:

/QLANSrv
The logical representation of access to the information. Use the /QLANSrv directory to retrieve, save, or restore specific files and directories managed by the File Server IOP. Figure 5-6 on page 5-14 shows how LAN Server for OS/400 information appears from the perspective of the AS/400 user.

/QFPNWSSTG
The physical storage of LAN Server for OS/400 information. In the /QFPNWSSTG directory, each logical PC drive appears as one large object to the AS/400 system. The directories within the /QPFNWSSTG directory are called **network server storage space**, or simply **storage space**. Use the directories with the /QFPNWSSTG directory to save entire virtual drives. Individual files and directories cannot be restored from saved copies of the directories within the /QFPNWSSTG directory.

/QSYS.LIB/QXZ1.LIB
This holds licensed program information that does not change. From a library perspective, this is the QXZ1 library. The QXZ1 library is saved when you specify *IBM for the SAVLIB command.

/QSYS.LIB/QUSRSYS.LIB
This holds copies of server storage spaces. Most of this information does not change regularly. But a few files change when users are active on the File Server IOP. From a library perspective, this is the QUSRSYS library. The QUSRSYS library is saved when you specify *ALLUSR for the SAVLIB command.

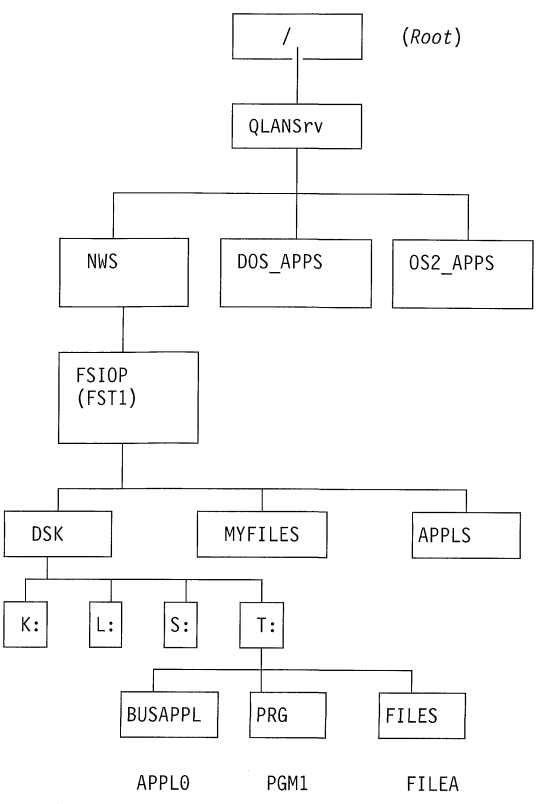


Figure 5-6. View of the /QLANSrv Directory

Tips for Saving LAN Server for OS/400 Information:

This topic provides a general description of saving LAN Server for OS/400 information. For more about saving LAN Server for OS/400 information, see the *LAN Server for OS/400 Administration* book.

- When you use option 21 or option 23 from the Save menu or option 11 from the Backup menu, the system attempts to save the directories within the QLANSrv directory and the directories within the QFPNWSSTG directory. The contents of the save media depend on whether a network server description is varied on or off. If a network server description is varied on, your save media contains the information from the /QLANSrv directories associated with that File Server IOP. If a network server description is varied off, your save media contains the information from the directories within the /QFPNWSSTG directory. Individual files and directories cannot be restored from a saved copy of a directory within the /QFPNWSSTG directory.

  The time that it takes to save the /QFPNWSSTG directory is significantly less than the time that it takes to save the /QLANSrv directory. To take advantage of this performance difference, consider the following save strategy:

  - When you perform a regular full backup, such as option 21 or option 23 on the Save menu, make sure that the File Server IOP is varied off. The /QFPNWSSTG directory will be saved.
  - Put objects that change frequently, such as files, in one or two sub-directories in the /QLANSrv directory. Save those directories frequently with the File Server IOP varied on. This enables you to restore individual files if you need to do a partial recovery or to recover changed objects.

- When you save a directory within the /QFPNWSSTG directory, specify SUBTREE(*ALL), which is the default. These directories contain files that must be saved and restored as a group.
- Put your system in a restricted state, if possible, when you save either the /QFPNWSSTG directory or the /QLANSrv directory. This is the only way to ensure that everything is saved.
- The network server description must be varied off to save the /QFPNWSSTG directory. The network server description must be varied on to save objects using the /QLANSrv directory.
- *SAVSYS special authority applies when you save information using the /QFPNWSSTG directory. *SAVSYS special authority does not apply when saving objects using the /QLANSrv directory. To save objects from the /QLANSRV directory, you must have the necessary permission (authority) to the object or LAN administrator authority.
- Authority information for LAN Server for OS/400 objects is stored with the objects, not with the user profiles that have the authority. The SAVSECDTA command and the SAVSYS command do not save authority information for LAN Server for OS/400 objects. The authority information is saved when you save the object, if you have sufficient authority. If you do not have sufficient authority to the object to save the authority information, the object is saved without the authority information.
- *ALLOBJ special authority gives enough authority to save /QLANSrv objects and their authority information if both of the following are true:
  - You are a defined user in the LAN domain.
  - The domain controller is a File Server IOP on the local AS/400 system.

Saving LAN Server for OS/400 Objects with Multiple Names: When LAN Server for OS/400 objects have multiple names, the additional names are called **aliases** and **netnames**. Netnames are temporary and are defined during a session. Definitions for aliases are stored in the LAN Server domain controller data base (DCDB). They are similar to symbolic links in the QOpenSys file system.

When you vary on the first network server description in the domain, the LAN Server for OS/400 program creates directories for each of the aliases that is defined. When you vary on a network server description or a remote LAN server, the LAN Server for OS/400 program creates directories for each of the netnames that is currently defined.

In Figure 5-6, all the actual files and directories are in the path /QLANSrv/NWS/FSI1/DSK. The directories /DOS_APPS and /OS2_APPS contain aliases. The directories MYFILES and APPLS contain netnames.

Objects are marked to ensure that you save the contents of an object only once, even if the object has more than one name. If you save the entire /QLANSrv directory, you are saving each file and directory only once, even if it has aliases. To save the nicknames (aliases) that have been set up on your system, you must save the DCDB. See "Saving the Domain Controller Database."

Saving the Domain Controller Database: If one of the network servers on your AS/400 business computing system is the domain controller, you need to save the domain controller database (DCDB). Do one of the following to save the DCDB:

- Use the DCDB Replicator service to replicate the DCDB to a backup domain controller.
- Save the server storage space that contains the DCDB directories. Type: SAVOBJ OBJ(QUSRSYS/*server3*) OBJTYPE(*SRVSTG). For *server3*, substitute the name of the network server description followed by a 3. For example, if the network server description is called MYSERVER, type OBJ(QUSRSYS/MYSERVER3).

Saving Specific LAN Server for OS/400 Objects–Examples: The following example shows how to save a specific directory on a local AS/400 system. You can save a file with the same command.

```
SAV OBJ('/QLANSrv/NWS/FSI1/DSK/T/FILES')
    DEV('/QSYS.LIB/TAP01.DEVD')
```

The following example shows how to save a specific file on a remote system.

```
SAV OBJ('/QLANSrv/NWS/SERVER1/DSK/T/FILES/FILEA.TXT')
    DEV('/QSYS.LIB/TAP01.DEVD')
    SYSTEM(*RMT)
```

Saving the Directory for a File Server I/O Processor–Example: When you save an entire directory, it is like saving a library. You want to stop any update activity against objects in the directory to ensure that everything is saved successfully. Put your system in a restricted state to save one or more File Server IOP directories. This ensures that no AS/400 jobs or client users are updating any data.

The network server description must remain varied on during the save procedure. Its services are necessary to access the data that you are saving.

Use this command to save all local File Server IOP directories:

```
SAV OBJ('/QLANSrv/*')
    DEV('/QSYS.LIB/TAP01.DEVD')
```

Use this command to save the directory for a specific File Server IOP:

```
SAV OBJ('/QLANSrv/NWS/iop-name')
    DEV('/QSYS.LIB/TAP01.DEVD')
```

Saving Network Server Storage Space–Examples: You can save a storage space (in the /QFPNWSSTG directory) to move it to another system. You can also save it for faster recovery in a disaster. You cannot recover individual objects from a saved copy of a network server storage space.

When you save storage space, the network server descriptions must be varied off. Use the Vary Configuration (VRYCFG) command to vary off a File Server IOP.

Use this command to save a specific storage space:

```
SAV OBJ('/QFPNWSSTG/drive-name')
    DEV('/QSYS.LIB/TAP01.DEVD')
```

Use this command to save all storage spaces:

```
SAV OBJ('/QFPNWSSTG/*')
    DEV('/QSYS.LIB/TAP01.DEVD')
```

Output from the SAV Command

When you use the SAV command, you can specify OUTPUT(*PRINT) to receive a report of what was saved. You can also specify that the output be directed to a stream file or to a user space. The topic in the *Backup and Recovery – Advanced* book called "How to Create and Use Output from the SAV and RST Commands" describes this output. The SAV command does not provide the option to create an output file.

Restrictions When Using the SAV Command

The SAV command can be used to save objects from any file system. The topics that follow describe restrictions that apply when using the SAV command.

Restrictions When Saving Across Multiple File Systems: When you use the SAV command to save objects from more than one file system at the same time, the following restrictions apply:

- Different file systems support different types of objects and different methods of naming objects. Therefore, when you save objects from more than one file system with the same command, you cannot specify object names or object types. You can save all objects from all file systems, or you can omit some file systems. These combinations are valid:
  - Saving all objects on the system: OBJ('/*')

    Note: Using this command is not the same as using option 21 from the Save menu. Following are the differences between SAV OBJ('/*') and option 21:

- SAV OBJ('/*') does not put the system in a restricted state.
- SAV OBJ('/*') does not start the controlling subsystem when it finishes.
- SAV OBJ('/*') does not provide prompting to change default options.

– Saving all objects in all file systems except the QSYS.LIB file system and the QDLS file system: `OBJ(('/*') ('/QSYS.LIB' *OMIT) ('/QDLS' *OMIT))`

– Saving all objects in all files systems except the QSYS.LIB file system, the QDLS file system, and one or more other file systems: `OBJ(('/*') ('/QSYS.LIB' *OMIT) ('/QDLS' *OMIT) ('/other values' *OMIT))`

- Values for other parameters of the SAV command are supported only for some file systems. You must choose values that are supported by all file systems. Specify the following parameters and values:

CHGPERIOD	Default
PRECHK	*NO
UPDHST	*YES
LABEL	*GEN
SAVACT	*NO
OUTPUT	*NONE
SUBTREE	*ALL
SYSTEM	*LCL
DEV	Must be a tape device

- The following are required when you specify SAV OBJ('/*'):
  – The system must be in a restricted state.
  – You must have *SAVSYS or *ALLOBJ special authority.
  – You must specify VOL(*MOUNTED).
  – You must specify SEQNBR(*END).

  Note: SAV OBJ('/*') is not the recommended method for saving the entire system. Use option 21 from the Save menu to save the entire system.

Restrictions When Saving Objects from the QSYS.LIB File System: When you use the SAV command to save objects from the QSYS.LIB (library) file system, the following restrictions apply:

- The OBJ parameter must have only one name.
- The OBJ parameter must match the way that you can specify objects on the SAVLIB command and the SAVOBJ command:
  – You can save a library: `OBJ('/QSYS.LIB/library-name.LIB')`.
  – You can save all the objects in a library: `OBJ('/QSYS.LIB/library-name.LIB/*')`.
  – You can save all objects of a particular type in a library: `OBJ('/QSYS.LIB/library-name.LIB /*.object-type')`
  – You can save a specific object name and object type in a library: `OBJ('/QSYS.LIB/library-name.LIB /object-name.object-type')`
  – You can save all the members in a file using either of the following:
    - `OBJ('/QSYS.LIB/library-name.LIB /file-name.FILE/*')`
    - `OBJ('/QSYS.LIB/library-name.LIB /file-name.FILE/*.MBR')`
  – You can save a specific member in a file: `OBJ('/QSYS.LIB/library-name.LIB /file-name.FILE /member-name.MBR')`
- You can specify only object types that are allowed on the SAVOBJ command. For example, you cannot use the SAV command to save user profiles, because OBJTYPE(*USRPRF) is not allowed on the SAVOBJ command.
- Some libraries in the QSYS.LIB file system cannot be saved with the SAVLIB command because of the type of information they contain. Following are examples:
  – The QDOC library, because it contains documents
  – The QSYS library, because it contains system objects.

  You cannot use the SAV command to save these entire libraries:

QDOC	QSRV
QDOCnnnn	QSPL
QRECOVERY	QSYS
QRPLOBJ	QTEMP

- Other parameters must have these values:

SUBTREE	*ALL
SYSTEM	*LCL
OUTPUT	*NONE
CHGPERIOD	Start date cannot be *LASTSAVE End date must be *ALL End time must be *ALL Default, if a file member is specified

Restrictions When Saving Objects from the QDLS File System: When you use the SAV command to save objects from the QDLS (document library services) file system, the following restrictions apply:

- The OBJ and SUBTREE parameters must be one of the following:
  – `OBJ('/QDLS/path/folder-name') SUBTREE(*ALL)`
  – `OBJ('/QDLS/path/document-name') SUBTREE(*OBJ)`
- Other parameters must have these values:

SYSTEM	*LCL
OUTPUT	*NONE
CHGPERIOD	Start date cannot be *LASTSAVE End date must be *ALL End time must be *ALL

	Default, if OBJ('/QDLS/*path-name*/*document-name*') SUBTREE(*ALL) specified
PRECHK	*NO
UPDHST	*YES
SAVACT	Cannot be *SYNC
SAVACTMSGQ	*NONE

How to Save System/36 Information in a Multiple-Operating-System Environment

See the Operator Tasks – Multiple Operating Systems book, SC21-8384, for information on saving in a multiple-operating-system environment.

How to Use the ObjectConnect/400 Function

ObjectConnect/400 is a set a CL commands for moving objects between AS/400 systems simply and efficiently. ObjectConnect/400 is included with the operating system. You install it by selecting it on the Install Licensed Program display.

When you use an ObjectConnect command, the system moves the object directly to the target system without using save files or distribution queues. ObjectConnect provides better performance than other methods for moving objects between systems, and ObjectConnect does not require additional disk space to store an intermediate copy of the object that is being moved.

ObjectConnect commands are closely related to the SAVxxx and RSTxxx commands. The ObjectConnect commands support most of the same parameters. Table 5-7 shows a list of the ObjectConnect commands and the associated AS/400 save and restore commands. The *CL Reference* book describes the parameters for each command.

Table 5-7. ObjectConnect/400 and Associated AS/400 Save and Restore Commands

ObjectConnect Commands	AS/400 Save and Restore Commands
Save/Restore Integrated File System (SAVRST)	Save (SAV), Restore (RST)
Save/Restore Object (SAVRSTOBJ)	Save Object (SAVOBJ), Restore Object (RSTOBJ)
Save/Restore Changed Object (SAVRSTCHG)	Save Changed Object (SAVCHGOBJ), Restore Object (RSTOBJ)
Save/Restore Library (SAVRSTLIB)	Save Library (SAVLIB), Restore Library (RSTLIB)
Save/Restore Document Library Object (SAVRSTDLO)	Save Document Library Object (SAVDLO), Restore Document Library Object (RSTDLO)
Save/Restore Configuration (SAVRSTCFG)	Save Configuration (SAVCFG), Restore Configuration (RSTCFG)

To use the ObjectConnect functions, you must have ObjectConnect installed on both the source and target systems. The systems must be connected with one of the following methods:

- Local area network (LAN) or remote communications line with APPC and APPN*.
- Local area network (LAN) or remote communications line with TCP/IP with AnyNet* support.
- Fiber optic bus with OptiConnect/400.

Components of ObjectConnect/400

The basic components of ObjectConnect/400 are outlined below:

QSR library
This library contains all ObjectConnect objects.

QCMN subsystem
If the source and target systems are connected with a communications line or a LAN, ObjectConnect jobs run in the QCMN subsystem.

QSOC subsystem
If the source and target systems are connected with OptiConnect/400, ObjectConnect jobs run in the QSOC subsystem.

QSVRSRA job description
This job description is installed with ObjectConnect and is used for ObjectConnect jobs.

QSOCCT mode description
ObjectConnect uses the IBM-supplied default mode description, QSOCCT. You must start this mode description before you use ObjectConnect commands by specifying the following:

```
STRMOD RMTLOCNAME(target) MODE(QSOCCT)
   LCLLOCNAME(*NETATR) RMTNETID(*NETATR)
```

QSOCCT user profile
This IBM-supplied user profile is used by ObjectConnect jobs.

How to Set Up Your System to Use ObjectConnect/400

After you have installed ObjectConnect, you must set up your systems to run ObjectConnect. You perform some tasks only once. You perform other tasks regularly to prepare for ObjectConnect commands.

Do These Things Initially: If your systems are connected with a communications line or a LAN, add a communications entry to the QCMN subsystem. Type the following on both systems:

```
ADDCMNE SBSD(QCMN) DEV(*ALL) DFTUSR(QSOCCT)
   MODE(QSOCCT)
```

If you are using a fiber-optic bus, see the *OptiConnect for OS/400* book, SC41-4414.

Do These Things Before You Run ObjectConnect Commands: Whenever you start your system, you must also start the ObjectConnect environment. You can include these tasks in your startup procedures, or you can perform them manually.

If your systems are connected with a communications line or a LAN, do the following:

- Ensure that the subsystem is started.
- Ensure that the connection is varied on and active.
- Start the mode description by typing the following:

```
STRMOD RMTLOCNAME(target) MODE(QSOCCT)
   LCLLOCNAME(*NETATR) RMTNETID(*NETATR)
```

If your systems are connect with OptiConnect/400, do the following:

How the System Runs an ObjectConnect Command

When you issue an ObjectConnect command, the system starts an ObjectConnect job and establishes a conversation with the target system. Figure 5-7 shows the flow of the job:

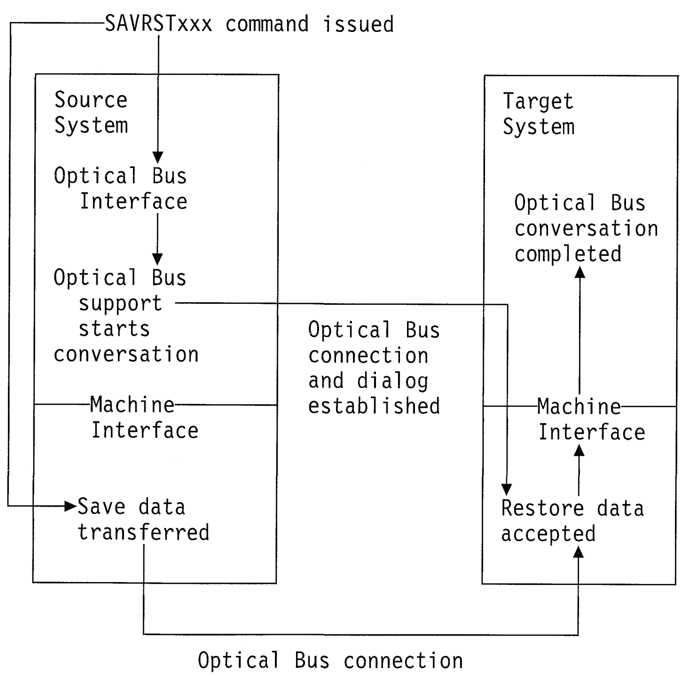


Figure 5-7. ObjectConnect Job Flow

You can view the ObjectConnect job by working with the subsystem. Type `WRKACTJOB SBS(QCMN)` if your systems are linked with communications support. Type `WRKACTJOB SBS(QSOC)` if your systems are linked with OptiConnect/400. You are shown the Work with Active Jobs display:

```
                         Work with Active Jobs                    AS009
                                                               03/31/95
CPU %   .0    Elapsed time:   00:00:00        Active Jobs 60

Type options, press Enter.
  2=Change  3=Hold  4=End  5=Work with    6=Release  7=Display mes
  8=Work with spooled files  13=Disconnect ...

Opt  Subsystem/Job  User       Type  CPU % Function        Status
 _    QCMN          QSYS       SBS      .0                 DEQW
 _     ENDCTL1      QCMN       BCH      .0                 DEQW
 _     RCHCTL2      QCMN       ASJ      .0 PGM-QYYCMGR     DEQW
```

You can use the Work with Configuration Status (WRKCFGSTS) command to see the activity on the communications or LAN link:

```
                     Work with Configuration Status                AS009
                                                                03/31/95
Position to  . . . . .  ________    Starting characters

Type options, press Enter.
  1=Vary on   2=Vary off   5=Work with job    8=Work with description
  9=Display mode status ...

Opt  Description         Status                 -------------Job-----
 _    WWGLOCAL           ACTIVE
 _      WWGLOC1          ACTIVE
 _        QSOCCT         ACTIVE/DETACHED        QPADEV0023  GREEN
 _        QSOCCT         ACTIVE/SOURCE          QPADEV0024  GREEN
```

How to Investigate ObjectConnect Problems

If all ObjectConnect commands are failing, do the following:

- Ensure the correct subsystem is active.
- Ensure the connection between systems is active.
- Ensure the correct remote location name is specified.
- Ensure the QSR library is in the library list.

If you suspect a more specific problem, do the following:

1. Locate the failing job or job log on both the source and target system. An informational message may exist between the save completion message and the restore completion message. This message ID is CPFAD87. If this message exists, use F1 to display the detailed message to determine the name of the job log on the target system.
2. Display the job log information on the target system and find the following message:

   `Corresponding source information from location &1.`
3. Use F1 to display the detailed message. The detailed information indicates the job name and number for the source job.
4. Inspect the job log information on both systems to locate any messages. The messages each include secondary

text that describes the recommended course of action if any is needed.

If problems are identified as OptiConnect/400 or communications problems, see the *OptiConnect/400 Guide* or the *Communications Configuration* book.

If you receive a CPFAD84 message on either the source or target system, use the Analyze Problem (ANZPRB) command to report the problem.

Chapter 6. Using Operational Assistant to Save Information

This chapter describes how to use options from the Operational Assistant* menus to save information on your system. Operational Assistant provides a simple, menu-driven approach to saving information on your system regularly. Figure 6-1 provides a general view of how the Operational Assistant menus and commands can be used to save information.

To see how Operational Assistant compares with other commands and menu options for saving information, review Figure 3-2 on page 3-1. "Should You Use the Backup Menu or the Save Menu?" on page 2-4 discusses the differences between using the Save menu and the Backup menus.

Notice that when you use the Operational Assistant backup functions, you only save objects in directories when you save the entire system. If you are using applications that have objects in directories, read "How to Save Objects in Directories" on page 5-11 and "Tips for Saving LAN Server for OS/400 Information" on page 5-14 to help you decide what strategy you should use.

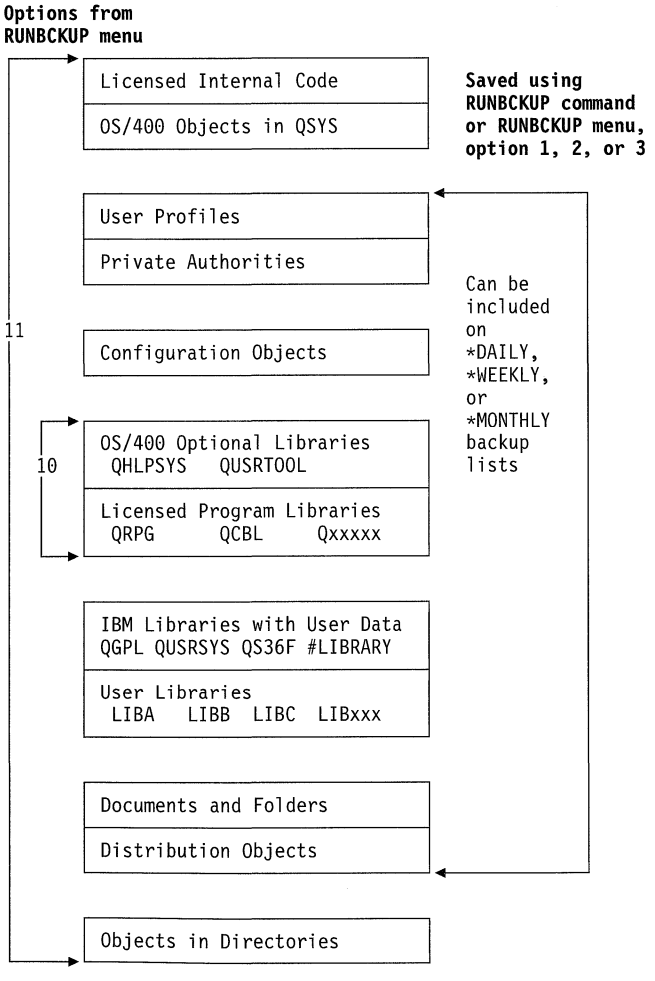


Figure 6-1. Operational Assistant Save Options

When you use the Operational Assistant backup functions, referred to as Operational Assistant backup, you can set up three backup definitions: daily, weekly, and monthly. A backup definition includes information about what will be saved, when it will be saved, and how it will be saved.

Defining What Should Be Saved

Operational Assistant maintains two lists for backup:

- All user libraries on the system
- All folders on the system

For each item in the list, you can specify when it is to be saved:

- Monthly only
- Weekly and monthly
- Daily, weekly, and monthly
- Not at all

For each of the three backup periods, you can specify whether all libraries and folders on the list are to be saved, or only those libraries and folders that have changed since the last backup. The topic "Defining How Backup Operations Are Run" on page 6-2 describes how to specify this.

For example, you might specify that all user libraries on your system be saved monthly. If your application programs do not change very often, you might specify that only those libraries containing database files be saved weekly. You can omit the libraries that contain programs from your weekly backup. Your daily backup might include the same libraries, but it might specify that only changed objects are saved. You could use a similar approach for saving folders.

To change the backup lists, do the following:

__ **Step 1** Type `GO SETUPBCKUP`.

__ **Step 2** From the Set Up Backup menu, select option 10 to change the library backup list or option 11 to change the folder backup list. You are shown a list of all the libraries or folders on your system:

```
                          Change Library Backup List
                                                              System:   SYSTEM01
Find library . . . . . _________  Starting characters

Type options below, then press Enter.
  2=Change backup   5=Display library contents   8=Display details

                  ----------Backup----------  Last
Opt  Library      Daily     Weekly    Monthly   Backup    Changed
 _    #LIBRARY    Yes       Yes       Yes       01/01/9x  No
 _    AMES        Yes       Yes       Yes       01/01/9x  No
 _    BALYLE      Yes       Yes       Yes       01/01/9x  No
 _    BETH        Yes       Yes       Yes       01/01/9x  No
 _    BURT        Yes       Yes       Yes       01/01/9x  No
```

The display shows when each library is scheduled to be saved, when it was last saved, and whether it has changed since it was saved.

__ **Step 3** Type your changes on the display and press the Enter key.

Defining How Backup Operations Are Run

Each of the three schedules for Operational Assistant backup has a set of options associated with it. These options define how that backup is to be run. For example, you can specify whether the system saves only changed libraries or whether the system prints a report of what was saved.

To change the backup options, do the following:

__ **Step 1** Type `GO SETUPBCKUP`. You see the Set Up Backup menu:

```
SETUPBCKUP                    Set Up Backup

To select one of the following, type its number below and press Enter:

     1. Change daily backup options
     2. Change weekly backup options
     3. Change monthly backup options

    10. Change library backup list
    11. Change folder backup list

    20. Change backup schedule
```

__ **Step 2** From the Set Up Backup menu, select option 1, 2, or 3 for the options that you want to change. You see one of the change options displays, such as the Change Daily Backup Options display:

```
                        Change Daily Backup Options

Type choices below, then press Enter.

Where to back up:
  Backup device . . . . . . . . . . . . .   TAP01

  Tape sets to rotate . . . . . . . . . .   BBBB




  Erase tape before backup . . . . . . . .  Y
```

__ **Step 3** Type any changes that you want on this display and page forward to see additional options:

```
                        Change Daily Backup Options

Type choices below, then press Enter.

What to back up:
  User libraries . . . . . . . . .  1          1=Selected from list
                                                2=All
                                                3=None
  Folders . . . . . . . . . . . . .  1          1=Selected from list
                                                2=All
                                                3=None
  Security data . . . . . . . . .   N           Y=Yes, N=No
  Configuration . . . . . . . . .   N           Y=Yes, N=No
  OfficeVision/400 mail . . . . .   Y           Y=Yes, N=No
  OfficeVision/400 calendars . . .  Y           Y=Yes, N=No

How to back up:
  Save changed objects only . . .   Y           Y=Yes, N=No
  Submit backup as a batch job . .  Y           Y=Yes, N=No
  Print detailed report . . . . .   Y           Y=Yes, N=No
```

__ **Step 4** Type any additional changes and press the Enter key.

Note: You can also use the Change Backup Options (CHGBCKUP) command to change the backup options.

How the System Saves Changed Objects Using Operational Assistant Backup

You can use backup options displays or the CHGBCKUP command to specify that one or more of the backups saves only changed objects. If you intend to use the Operational Assistant support for saving changed objects, you must save all libraries and folders regularly using Operational Assistant backup.

Following is what the system does when you use Operational Assistant to save changed objects in libraries. The process is similar when you save changed objects in folders by using Operational Assistant backup.

1. The system retrieves the date and time when you last saved all libraries using Operational Assistant. This information is stored in an internal object used by Operational Assistant. It is updated every time you run an Operational Assistant backup and specify 2 (All libraries) for the *User libraries* prompt on a backup options display. This becomes the reference date and time.
2. The system runs the Save Changed Object (SAVCHGOBJ) command for each library in the backup list that you are saving. For the reference date and reference time parameters, the system uses the date and time from step 1.

For example, assume that the monthly backup saves all libraries. The weekly backup list saves entire libraries, not just changes. It includes the following libraries:

- LIBA
- LIBB
- LIBC
- LIBD

The daily backup saves changes only. It includes these libraries:

- LIBA
- LIBC

The tape contents for this example look like this:

Date	Procedure	Contents
October 3	Monthly backup	All user libraries (SAVLIB LIB(*ALLUSR))
October 10	Weekly backup	LIBA, LIBB, LIBC, LIBD
October 11	Daily backup	Any objects in LIBA and LIBC that have changed since October 3.

Defining When Backup Operations Are Run

You can run a backup with Operational Assistant by using the Run Backup (RUNBCKUP) command or by selecting an option from the Run Backup menu. You can also set up a schedule for when daily, weekly, and monthly backups are to be run. Jobs to run the backups are placed on the job scheduler to be started at certain times and days. You can also request that the system send a message to mount the backup tapes a specified number of hours before the job is scheduled to begin.

To change the backup schedule, do the following:

__ **Step 1** Type `GO SETUPBCKUP`.

__ **Step 2** From the Set Up Backup menu, select option 20 to change the backup schedule. You are shown the Change Backup Schedule display:

```
                        Change Backup Schedule

Type choices below, then press Enter. Press F4 for list of backups.

  Run backup using this schedule  . . . . . .   Y   Y=Yes, N=No

                           Backup            Backup Time

  Sunday  . . . . . .
  Monday  . . . . . .      *DAILY              22:00:00
  Tuesday . . . . . .      *DAILY              22:00:00
  Wednesday . . . . .      *DAILY              22:00:00
  Thursday  . . . . .      *DAILY              22:00:00
  Friday  . . . . . .      *DAILY              22:00:00
  Saturday  . . . . .      *WEEKMONTH          22:00:00

  Occurrence of day in month to run monthly
    backup . . . . . .                          1

  Hours before backup to send load tape
    message  . . . . . .                        5
```

__ **Step 3** Type your choices and press the Enter key.

In the example shown, the system runs the daily backup on week days (Monday through Friday). It uses the daily backup list and the daily backup options. The backup job is on the job scheduler and is scheduled to begin at 10 p.m. A message is sent to the system operator at 5 p.m.

In the example, monthly backup is run on the first Saturday of the month. Weekly backup is run every Saturday except the first Saturday of the month.

Note: When you use the backup schedule, the system places jobs whose names begin with the following characters on the job scheduler:

QEZBKTM
QEZBKMG

Do not change these entries using the job scheduling commands.

Getting Started with Operational Assistant Backup

Operational Assistant backup is intended to be simple and to run without much attention. However, you still need to plan and to monitor backup procedures regularly to ensure that they are working as you intended. Do the following when you are setting up your backups using Operational Assistant:

__ **Step 1** Start by saving the entire system using option 11 from the Run Backup menu. This menu option is the same as option 21 from the Save menu. It ensures that you have a base set of tapes that has everything on it, in case you need to restore your entire system.

__ **Step 2** Save all libraries and folders using Operational Assistant by doing the following:

__ **Step a.** Initialize tapes, if necessary, using option 21 from the Backup Tasks menu. To access this menu, type `GO BACKUP`.

__ **Step b.** Type `GO SETUPBCKUP`.

__ **Step c.** Select the option from the Set Up Backup menu to change the monthly backup options.

__ **Step d.** Page down to the second page of the display and fill in the options as shown in Figure 6-2 on page 6-4:

```
                    Change Monthly Backup Options

Type choices below, then press Enter.

What to back up:
  User libraries . . . . . .  2          1=Selected from list
                                         2=All
                                         3=None
  Folders  . . . . . . . . .  2          1=Selected from list
                                         2=All
                                         3=None
  Security data  . . . . . .  Y          Y=Yes, N=No
  Configuration  . . . . . .  Y          Y=Yes, N=No
  OfficeVision/400 mail  . .  Y          Y=Yes, N=No
  OfficeVision/400 calendars  Y          Y=Yes, N=No

How to back up:
  Save changed objects only  .  N        Y=Yes, N=No
  Submit backup as a batch job  N        Y=Yes, N=No
  Print detailed report  . . .  N        Y=Yes, N=No
```

Figure 6-2. Change Monthly Backup Options Display

__ **Step e.** Mount the tapes and press the Enter key.

Before you can use a strategy of saving changed objects with Operational Assistant backup, you must save all the libraries using Operational Assistant backup. When you save changed objects using Operational Assistant, the system looks at information maintained by Operational Assistant. It does not look at the *Date last saved* field in the object description.

__ **Step 3** After you run each type of backup (daily, weekly, and monthly) for the first time using Operational Assistant, display the tapes to ensure that you are saving what you think you are saving.

__ **Step 4** If you are using applications that have objects in the QOpenSys directory or the *Root* directory, you must save those objects outside of Operational Assistant backup using the Save (SAV) command.

Summary of Operational Assistant Commands and Menu Options for Backup

You can perform Operational Assistant backup tasks using either menu options or commands. Table 6-1 provides a summary of the options available. Online information for both the commands and the menu options provides detailed information about the parameters that you can specify.

Table 6-1. Summary of Operational Assistant Backup Options

Menu Option	Equivalent Operational Assistant Command
Backup Tasks Menu:	
1. Run backup	Go BACKUP
2. Display backup status	DSPBCKSTS
10. Set up backup	GO SETUPBCKUP
20. Initialize a tape	
21. Initialize a tape set	
Run Backup Menu:	
1. Run daily backup	RUNBCKUP BCKUPOPT(*DAILY)
2. Run weekly backup	RUNBCKUP BCKUPOPT(*WEEKLY)
3. Run monthly backup	RUNBCKUP BCKUPOPT(*MONTHLY)
10. Back up IBM-supplied libraries	SAVLIB LIB(*IBM)
11. Back up the entire system	Option 21 from Save menu
Set Up Backup Menu	
1. Change the daily backup options	CHGBCKUP BCKUPOPT(*DAILY)
2. Change the weekly backup options	CHGBCKUP BCKUPOPT(*WEEKLY)
3. Change the monthly backup options	CHGBCKUP BCKUPOPT(*MONTHLY)
10. Change the backup library list	EDTBCKUPL BCKUPL(*LIB)
11. Change the backup folder list	EDTBCKUPL BCKUPL(*FLR)
20. Change the backup schedule	
Commands not on menus:	
	RTVBCKUP (Retrieve Backup Options)
	DSPBCKUP (Display Backup Options)
	DSPBCKUPL (Display Backup List)

Table 6-1. Summary of Operational Assistant Backup Options

Chapter 7. Saving Storage

The save storage process copies the Licensed Internal Code and all of the disk unit data to tape. The tape produced is a sector-by-sector copy of all permanent data on configured disk units. You cannot restore individual objects from the save storage media.

Attention

The save and restore storage processes are intended for disaster backup and recovery and are to be used along with the standard commands for saving and restoring. They are not intended for copying or distributing to other systems. IBM does not support using the processes for saving and restoring storage as a means to distribute the Licensed Internal Code and the operating system to other systems.

Saving Storage–Planning

When planning to use the process for saving storage, consider the following:

- The purpose of saving storage
- Hardware considerations
- Operational considerations
- Error recovery
- Performance considerations

Saving Storage–Purpose

- The processes for saving and restoring storage provide the fastest method for backing up and recovering an entire system. The restore storage process is the fastest method for restoring the entire system. The performance difference is greater on faster tape units for both processes.
- The save storage media is intended for disaster recovery and cannot be used to restore individual objects. You must complement a save storage approach with the SAVSYS, SAVLIB, SAVDLO, and SAV commands.
- To properly implement a save storage approach, you should have multiple levels of your backup media.
- The save storage operation does not save disk sectors that are not used or that contain temporary data.

Saving Storage–Hardware Considerations

- If the tape unit supports hardware data compression, then hardware data compression is used. If device data compression is not supported, then programming data compression may be used. In general, if the device operates at a faster rate than data compression can be performed, then data that is not compressed is written to the device.
- Only one tape unit can be used.
- The save storage process does not start unless all of the configured disk units are operating.
- If the tape unit used for the save operation cannot be used as an alternate IPL device, the same tape unit cannot be used to restore the Licensed Internal Code and the Licensed Internal Code PTFs from the save storage tape.

Saving Storage–Operational Considerations

- The save storage process can be run only when the system is in a restricted state.
- The user must have save system (*SAVSYS) special authority to use the Save Storage (SAVSTG) command.
- The SAVSTG command causes the system to power down and starts the system again as if PWRDWNSYS RESTART(*YES) was specified. An initial program load (IPL) of the system occurs after the command completes. The save storage function implicitly occurs during the IPL of the system from the dedicated service tools (DST) function.
- The first tape can be saved without an operator being present. After the first tape is saved, DST messages appear asking for the next tape so the save operation can continue.
- As the amount of storage on the system increases, the chance of an unrecoverable media error increases. Clean the tape unit frequently.
- A device name must be specified on the command. Expiration date (EXPDATE) and clear (CLEAR) parameters are optional. No volume ID can be specified.
- The save storage process does not start unless the system console is available. If the console is not available, a system reference code is displayed on the control panel.
- When the save storage operation completes successfully, a normal IPL occurs.

Saving Storage–Error Recovery

If a tape error occurs, the system attempts to recover from the error by automatically trying the operation again. If the system cannot recover, you can resume the save storage operation on a new tape volume. The operation continues from the last completed tape volume that was saved.

Saving Storage with Mirrored Protection

If the system is using mirrored protection, only one copy of the data from each mirrored pair is saved. When you restore your system by using the SAVSTG tapes, mirrored protection will not be active.

Steps for Saving Storage

This topic describes how to run the SAVSTG command.

Do These Things Before You Begin

__ Initialize at least three more tapes than you think you will need to complete the save operation. Initialize them as standard-labeled tapes and specify the maximum density for the tape unit you are using. The number of tapes required depends on the size of the system, the number of objects being saved and the capacity of the tape.

Each tape should have a volume ID of SAVEDS and an external label that allows you to easily identify the tape. Ensure that each of the tapes support the same density.

__ Clean the read/write heads of the tape unit.

__ Apply any program temporary fixes (PTFs).

__ Print a list of all the PTFs currently on the system. Type the following and press the Enter key.

```
DSPPTF LICPGM(*ALL) OUTPUT(*PRINT)
```

__ Ensure you have a recent SAVSYS media. The Hardware Configuration information from that SAVSYS tape may be needed in the event a Restore Storage is required and any hardware on the system has been moved or added since the Save Storage function was performed.

Task 1–Starting the Save Storage Procedure

__ **Step 1** Sign on at the system console with a user profile that has *SAVSYS special authority.

__ **Step 2** Notify users that the system will be unavailable.

__ **Step 3** Change the QSYSOPR message queue to break mode:

```
CHGMSGQ MSGQ(QSYSOPR) DLVRY(*BREAK) SEV(60)
```

__ **Step 4** Type the following to bring the system to a restricted state:

```
ENDSBS SBS(*ALL) OPTION(*CNTRLD) DELAY(600)
```

Note: For the delay parameter, specify a number of seconds that allows your system time to bring most jobs to a normal end. On a large, busy system, you may need a longer delay.

Messages are sent to the QSYSOPR message queue. These messages indicate that the subsystems ended and the system is in a restricted state. When the subsystems have ended, continue with the next step.

__ **Step 5** Load the first tape of the SAVSTG media, and make the tape unit ready.

__ **Step 6** Check the control panel on your processor to ensure the system is in normal mode.

__ **Step 7** Enter the save storage command, such as:

```
SAVSTG DEV(TAP01) CLEAR(*ALL)
```

You can also enter an expiration date (EXPDATE(mmddyy)).

__ **Step 8** Press the Enter key. The system will power down with a restart IPL. This is similar to PWRDWNSYS OPTION(*IMMED) RESTART(*YES). This means that when the command is entered, the system will power down and perform an automatic IPL.

When the IPL occurs, a dedicated service tools (DST) function starts saving storage. The operator does not need to be present for the first tape if it is positioned correctly and the expiration date checking does not cause an error.

If the tape is loaded correctly, the following save status display continually displays the progress of the save operation.

```
                    Function Status

You selected to save storage.



                                  1 % Complete
```

The *Percent saved* field on the display indicates what part of the total amount of disk sectors has been saved. However, this estimate cannot be used to accurately predict either the time it will take or the number of tapes needed to complete the save operation because unused sectors are not saved.

Task 2–Responding to Messages

While the SAVSTG procedure is running, you may see either the Handle Tape or Diskette Intervention display:

```
                  Handle Tape or Diskette Intervention

Device:
   :
I/O manager code . . . . . . . . . . . . . :       _______
   :
Type choice, press Enter.

  Action  . . . . . . . . . . . . . . . . . . . . 1=Cancel
                                                  _____________________
                                                  3=Continue
                                                  _____________________

F3=Exit            F12=Cancel
End of tape encountered.  Load next volume.
```

When one of these displays appears, look for messages at the bottom of the display or for an I/O manager code on the display. Respond to the display using the information in Table 7-1:

Table 7-1 (Page 1 of 2). Handling SAVSTG Messages

Message or Code	Your Action
End of tape encountered. Load next volume.	Load the next tape volume. Select option 3 (Continue), and press the Enter key.
Active files exist on media.	To continue the save operation to tape, select option 2 (Ignore) to ignore the active files. Press the Enter key.
Tape unit not ready.	Make the tape unit ready, select option 3 (Continue), and press the Enter key.
Media is write protected.	Replace the tape with a tape that is not write-protected and select option 3 (Retry). Press the Enter key.

Table 7-1 (Page 2 of 2). Handling SAVSTG Messages

Message or Code	Your Action
Device is not able to process the media format.	Select option 4 (Format), and press the Enter key.
Tape or diskette loaded is blank.	Select option 4 (Format), and press the Enter key.
I/O manager code 8000 0001C.	Replace the tape with a tape that can be formatted to the requested density and select option 3 (Retry). Press the Enter key.

If an unrecoverable tape media error occurs, do the following:

__ **Step 1** Remove the failing tape from the tape device. Do not put the failing tape with the other tapes that have already been saved during the save storage operation. The failing tape cannot be used during the restore storage operation.

__ **Step 2** Load a different tape in the tape device.

__ **Step 3** Press the F3 key to return to the Use Dedicated Service Tools menu.

__ **Step 4** Go to "Procedure for Resuming the Save Storage Operation."

Task 3–Completing the SAVSTG Process

When the last tape is complete and no errors have occurred, the tape automatically rewinds and a normal IPL occurs. Do the following:

__ **Step 1** The data area QSAVSTG in library QSYS is updated to show the date and time of the save operation. Use the Display Object Description (DSPOBJD) command to display the date and time of the save storage operation.

__ **Step 2** Ensure that the save operation completed successfully. Use the Display Log (DSPLOG) command to display the history (QHST) log:

```
DSPLOG QHST
```

or use the Display Message (DSPMSG) command to display the QSYSOPR messages:

```
DSPMSG QSYSOPR
```

Look for a save storage completion message or diagnostic messages indicating that some sectors could not be read. If any sectors were found damaged and could not be read, this means that your tapes may not be complete. If you use them to restore storage, the operation may fail. Contact your service representative for assistance. Then repeat the save storage operation.

This completes the save storage procedure. If you do not want the system to perform an automatic IPL, you can use an autostart job, which powers down the system.

Procedure for Resuming the Save Storage Operation

You can use this procedure only if the following conditions are true:

- The save storage operation has finished saving the Licensed Internal Code.
- The save storage operation has completed writing to at least one tape during the save storage operation.
- All disk units are attached and operating.

If an error occurs that causes the save storage operation to end (for example, system power loss, operator error, or tape drive error), the save storage operation can be started again.

Do the following to resume the save storage operation:

__ **Step 1** Select manual mode on the control panel of your processor.

__ **Step 2** Power on the system by using the Power switch or the Power button. The IPL or Install the System menu is shown.

__ **Step 3** Select option 3 (Use Dedicated Service Tools (DST)) and press the Enter key.

__ **Step 4** Sign on DST using the password assigned to your system for full DST authority. The Use Dedicated Service Tools (DST) menu is shown.

__ **Step 5** From the Use Dedicated Service Tools (DST) menu, select option 9 (Work with save storage and restore storage) and press the Enter key.

__ **Step 6** Select option 4 (Resume save storage) and press the Enter key.

If resuming the save storage operation is not allowed, a display with an explanation is shown.

__ **Step 7** If you are shown the Resume Save Storage display, load the tape that was being written to when the save storage operation was interrupted and press the Enter key.

```
                              Resume Save Storage

You have selected to resume the save storage.

Do the following:

 1.  Locate the set of tapes created during the save storage
     which was interrupted.  The last tape which was completely
     written before the save storage was interrupted has the
     following identification:
         Volume identifier  . . . . . . . . :  _______
         Sequence number  . . . . . . . . . :  ___

 2.  Ensure that an initialized and write-enable tape is
     loaded and ready in the tape device.  Follow the
     procedures described in the tape device operator's
     guide.

 3.  Press Enter to resume the save storage.
```

__ **Step 8** If the volume identifier of the tape that is loaded is different from the volume identifier of the first save storage tape, you are shown the Device Intervention Required display. The message at the bottom says **Wrong volume loaded**.

To continue the save operation, type SAVEDS on the "New volume" line and select option 4 to format the tape.

Recovering Information on Your System

Chapter 8. Restore Procedures–General Information

Figure 8-1 on page 8-2 shows the menu options and commands that are available for restoring information. It also shows the normal sequence for restoring information, working from top to bottom. Figure 8-2 on page 8-3 shows what restore commands can be used for information in the different file systems.

Compare these figures with Figure 3-2 on page 3-1 and Figure 3-1 on page 3-1 to see the relationship between how things are saved and how they are restored. Use them to gain a general understanding of what you need to restore and how you might do it. Use the information in Chapter 9, "Selecting the Right Recovery Strategy" to plan the correct recovery strategy for your situation.

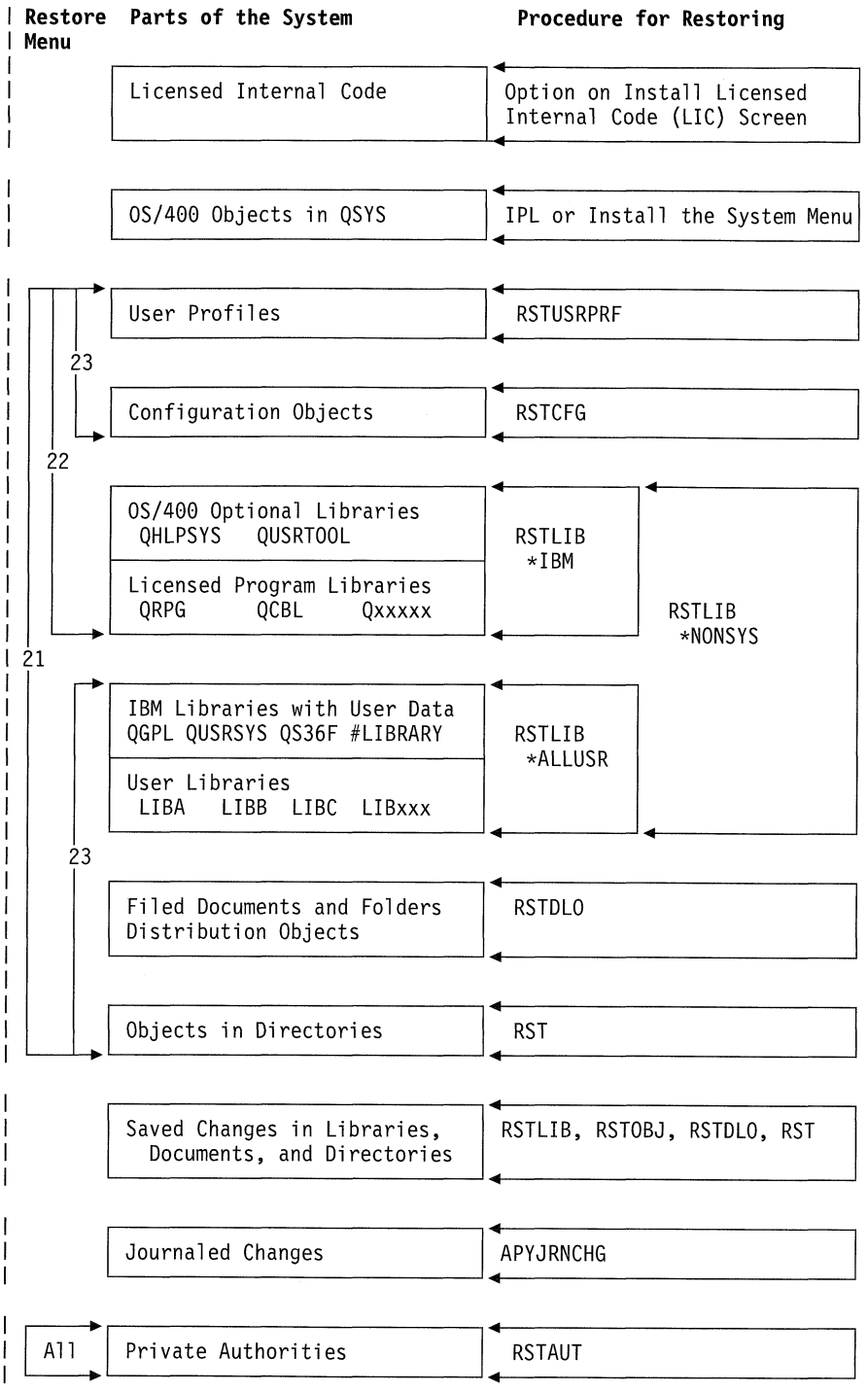


Figure 8-1. Restore Procedures

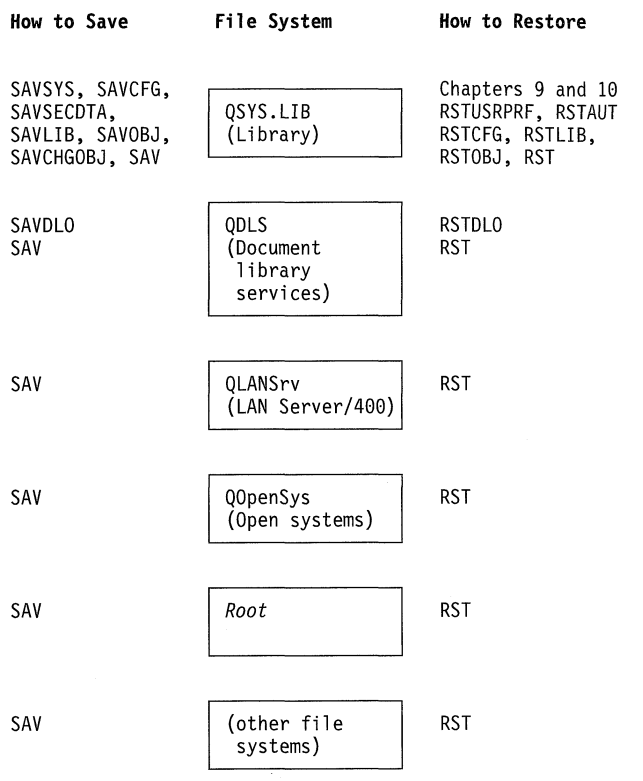


Figure 8-2. Save Procedures and Restore Procedures for File Systems

The Relationship Between Save and Restore Commands

Table 8-1 shows which restore commands can be used, based on how the objects were saved.

Table 8-1. Relationship Between Save and Restore Commands

Save Command Used	Possible Restore Command
SAVOBJ	RSTOBJ RST
SAV	RST
SAVLIB LIB(*NONSYS)	RSTLIB SAVLIB(*NONSYS) RSTLIB SAVLIB(*IBM) RSTLIB SAVLIB(*ALLUSR) RSTLIB SAVLIB(*library-name*) RST
SAVLIB LIB(*ALLUSR)	RSTLIB SAVLIB(*ALLUSR) RSTLIB SAVLIB(*library-name*) RST
SAVLIB LIB(*IBM)	RSTLIB SAVLIB(*IBM) RSTLIB SAVLIB(*library-name*) RST
SAVLIB LIB(*library-name*)	RSTLIB SAVLIB(*library-name*) RST
SAVSECDTA	RSTUSRPRF RSTAUT[1]
SAVCFG	RSTCFG
SAVDLO	RSTDLO RST

1 The RSTUSRPRF command restores authority information to temporary tables. The RSTAUT command rebuilds private authorities from those tables.

What Happens When You Restore Objects

An object on this system is like a container. The object has information about the container itself, such as the owner of the object and the last time it was saved. This is the information you see when you display the object description (DSPOBJD command). The object also has contents, such as the records in a database file or the instructions in a program.

When you restore an object, the system takes different actions depending on the following:

- Whether the object to be restored already exists.
- The allow object differences (ALWOBJDIF) parameter on the save command.
- Whether the object was saved on a different system (serial number of the processor).

With a few exceptions that relate to security, the contents of the object are always restored. If the object exists, the system compares the object description information on the system copy and the media copy and then makes decisions. For most information, the media version of the information is restored. For security-relevant information, such as the public authority and the object owner, the system version is left unchanged. In a few cases, such as the size of the object and the date it was saved, the system determines a value when the object is restore.

The allow object differences (ALWOBJDIF) parameter on the restore commands is primarily for security protection and integrity protection. For example, if system security is important to you, you may want to take special action if someone attempts to restore an object whose owner has been changed. Or, if the member information about a database file does not match, you may have problems with the integrity of your data. You can use the ALWOBJDIF parameter to prevent this.

The default value for the ALWOBJDIF parameter is *NONE. This means that if important differences exist between the media version and the system version of an object, you want

the system to take special action. Normally, you should use the default value. However, when you are restoring your information to a different system, such as during a disaster recovery, you should specify ALWOBJDIF(*ALL). Table 8-2 shows examples of the effect of the ALWOBJDIF parameter:

Table 8-2. Restoring Existing Objects. Affect of ALWOBJDIF parameter when the value on the media and on the system are different.

	Value for Object after Restore Operation	
Object Characteristic That Differs	**ALWOBJDIF(*NONE) Specified**	**ALWOBJDIF(*ALL) Specified**
Object owner	Object is not restored	Existing value
Object auditing	Existing value	Existing value
Database files:		
Creation date for file	File is not restored	File is renamed on the system; copy is restored from media with media creation date; message is sent to user.
Creation date for member	Member is not restored	Member is renamed on the system; copy is restored from media with media creation date; message is sent to user.

The following topics provide more information about the effect of the ALWOBJDIF parameter:

- "How the System Establishes Ownership for Restored Objects" on page 15-3
- "How the System Establishes the Authorization List for a Restored Object" on page 15-3
- "Comparing File Attributes during a Restore Operation" on page 15-10
- "How the System Restores Programs" on page 15-19

Sequence for Restoring Related Objects

Some objects depend on other objects. When related objects are in the same library, the system restores them in the correct order. If related objects are in different libraries, you must restore them in the correct order or perform additional recovery steps after they are restored.

If possible, restore objects in this sequence:

- Journals before journaled files. If you restore a journaled file when the journal is not on the system, you must start journaling again after the journal is restored. Use the STRJRNPF command or the STRJRNAP command. See "How to Restore Files That Are Journaled" on page 15-16 for more information.
- Journals before journal receivers. If you restore a journal receiver when the journal is not on the system, you must associate the journal receivers with the journal after it is is restored. Use the WRKJRN command. See "How to Restore Journals and Journal Receivers" on page 15-17 for more information.
- Physical files before logical files. You cannot restore a logical file if the based-on physical files are not on the system. "How the System Restores Access Paths" on page 15-13 describes how to restore logical files and based-on physical files that are in different libraries.

Putting Your System in a Restricted State

Many recovery procedures require that your system have no other activity on it. When no subsystems except the controlling subsystem are active on your system, it is in a **restricted state**.

Use the End Subsystem (ENDSBS) command to put your system in a restricted state. You specify how you want the subsystems to end:

Possible Values for the OPTION Parameter of the ENDSBS Command:

***CNTRLD**	Allow active jobs to end themselves (if they are checking to see if the job is being ended). If you specify *CNTRLD, you can use the delay parameter to set a time for the system to wait before ending subsystems immediately.
***IMMED**	End the subsystem immediately. Use this option if there are no users on the system and no batch jobs running.

Note: Even if you have no activity on the system, jobs may be running under a few system-provided subsystems, such as the QSYSWRK (subsystem monitor) subsystem and the QCALSRV (calendar server) subsystem. You can end all subsystems immediately without first ending these jobs. You will receive messages that these subsystems ended abnormally. Do the following to put your system in a restricted state:

__ **Step 1** Before putting your system in a restricted state, ensure that all users are signed off and all jobs are ended.

__ **Step 2** To receive notification that the subsystems have ended, type the following and press the Enter key:

```
CHGMSGQ MSGQ(QSYSOPR) DLVRY(*BREAK)
   SEV(60)
```

__ **Step 3** To end all subsystems, type the following:

```
ENDSBS SBS(*ALL) OPTION(*CNTRLD) DELAY(600)
```

Note: For the delay parameter, specify a number of seconds that allows your system time to bring most jobs to a normal end. On a large, busy

system, you may need a longer delay.

A message is sent that indicates that the procedure for ending subsystems is in progress. A final message is sent when the system is in a restricted state.

Reclaiming Storage

Use the reclaim storage procedure (RCLSTG command) to recover the addressability of lost or damaged objects. This allows you to identify and then restore those objects that were damaged. If an authorization list is found damaged during reclaim storage, the objects secured by the damaged authorization are associated with the system authorization list QRCLAUTL. See the *Security – Basic* book to find out how to recover from damaged authorization lists.

Note: The RCLSTG procedure requires auxiliary storage. If you are already using a very high percentage of auxiliary storage, the RCLSTG procedure may not complete successfully.

To reclaim storage, do the following:

__ **Step 1** Sign on the system with a user profile that is authorized to the RCLSTG command. Either sign on at the console or use the Transfer Job (TFRJOB) command to transfer your job to the controlling subsystem.

__ **Step 2** Type `DSPSYSVAL QALWUSRDMN`. If the current value does not include the QRCL (Reclaim Storage) library or does not specify *ALL, use the CHGSYSVAL command to add QRCL to the list of libraries for this system value.

__ **Step 3** Ensure your system is in a restricted state. If it is not, follow the procedure in "Putting Your System in a Restricted State" on page 8-4.

__ **Step 4** Start the reclaim storage process by typing:

```
RCLSTG
```

What Happens When You Reclaim Storage: The purpose of the RCLSTG command is to ensure the following:

- Objects that reside permanently in auxiliary storage can be accessed.
- All auxiliary storage either is used properly or is available for use.

The system checks every object that resides permanently in auxiliary storage for loss or damage. It does the following:

- If an object does not address a library or directory, it is placed in an IBM-supplied library or directory based on the object type. The system may not be able to retrieve description information for the object, such as:
  - Program temporary fix (PTF) status.
  - Save and restore information.
  - Object attributes and text description.
- For objects that normally reside in libraries (the QSYS.LIB file system), the system does the following:
  - If a lost object with the same name and object type is already in the Recovery (QRCL) library, the system gives the object that it has just encountered a new name. The name has the format `QRCLnnnnnn`, where *nnnnnn* is a unique number. The original object name is placed in the text description for the object in the QRCL library.

    Note: You cannot rename journals and journal receivers. If the system encounters two journals (or journal receivers) with the same name and they both need to be placed in the QRCL library, the system renames one of them. You cannot rename that journal or journal receiver back to its original name. You must restore a previous version with the correct name or re-create the journal or journal receiver. For this reason, you should use a naming convention for journals and journal receivers that is unique for the entire system, not just for a library.
  - If data exists for a lost or damaged physical file, the system attempts to rebuild the file and place it in the QRCL library. The text description for the object in the QRCL library indicates that it has been rebuilt.

    To use the physical file, create it again in the correct library with the correct attributes. Then copy the data from the rebuilt file in the QRCL library to the new physical file. The data in the file may not be complete because the RCLSTG procedure cannot recover from all types of damage.
  - A user domain object can be placed in the QRCL library only if the QALWUSRDMN system value includes QRCL or specifies *ALL. Otherwise, a lost user domain object is deleted. Most objects are system domain objects. User domain objects have type *USRSPC, *USRIDX, or *USRQ.
  - If an object does not have an owner, it is assigned to an IBM-supplied user profile based on the object type. Most objects are assigned to the QDFTOWN user profile.
  - If descriptions for objects in a library cannot be accessed, the library is rebuilt.
  - If an object is secured by a damaged authorization list or authority holder, the system makes QRCLAUTL the authorization list for the object. You can use the Display Authorization List Objects (DSPAUTLOBJ) command to determine which objects are secured by the QRCLAUTL authorization list.
- If a lost object was in the *Root* file system, the object is placed in the /QReclaim directory.

- If a lost object was in the QOpenSys file system, the object is placed in the /QOpenSys/QReclaim directory.
- For objects in the *Root* file system and the QOpenSys file system, the system takes actions for duplicate names or for unidentified object owners similar to the actions taken for objects in the QSYS.LIB file system.

What To Do After Running the RCLSTG Procedure

__ **Step 1** Do the following to determine what the system has done:

__ **Step a.** Display the QSYSOPR message queue by using the Display Message (DSPMSG) command.

Note: You may see a message indicating that objects were deleted by the reclaim storage procedure. These are internal system objects that are no longer needed.

__ **Step b.** Display the history (QHST) log by using the Display Log (DSPLOG) command.

__ **Step c.** Display the QRCL library by using the Display Library (DSPLIB) command.

Note: If the reclaim storage procedure did not place any objects in the QRCL library, you may receive a message that the library is not found. Ignore the message and continue with the next step.

__ **Step d.** Display the /QReclaim directory by using the Display Link (DSPLNK) command.

Note: If the reclaim storage procedure did not place any objects in the /QReclaim directory, you may receive a message that the object is not found. Ignore the message and continue with the next step.

__ **Step e.** Display the /QOpenSys/QReclaim directory by using the Display Link (DSPLNK) command.

Note: If the reclaim storage procedure did not place any objects in the /QOpenSys/QReclaim directory, you may receive a message that the object is not found. Ignore the message and continue with the next step.

__ **Step f.** Display objects owned by the QDFTOWN user profile by using the Work with Objects by Owner (WRKOBJOWN) command.

__ **Step g.** Display objects secured by the QRCLAUTL authorization list by using the Display Authorization List Objects (DSPAUTLOBJ) command.

Note: If the reclaim storage procedure did not assign any objects to the QRCLAUTL authorization list, you may receive a message that the authorization list is not found. Ignore the message and continue with the next step.

__ **Step 2** Do the following to restore your system to normal:

__ **Step a.** Delete unusable objects by using the appropriate DLTxxx command. Restore them by using the Restore Object (RSTOBJ) command.

__ **Step b.** Move objects from the QRCL library to the correct library by using the Move Object (MOVOBJ) command.

__ **Step c.** Move objects from the /QReclaim directory or the /QOpenSys/QReclaim directory to the correct directory by using the Move (MOV) command. Rename the objects if necessary by using the Rename Object (RNMOBJ) command or the Rename (RNM) command.

__ **Step d.** Transfer ownership of objects by using the Work with

Objects by Owner (WRKOBJOWN) command.

__ **Step e.** Correct the authority for objects, if necessary, by using the Edit Object Authority (EDTOBJAUT) command.

__ **Step f.** Copy data from rebuilt files to new files by using the Copy File (CPYF) command.

__ **Step 3** If IBM-supplied objects are in the QRCL library, contact software support for assistance.

Controlling Restoration of Security-Sensitive Objects

For Version 3 Release 1 Modification 0 and later, the QALWOBJRST system value determines whether objects that are security-sensitive may be restored to your system. You can use it to prevent anyone from restoring a system state object or an object that adopts authority. The QALWOBJRST system value affects programs, service programs, modules, and SQL packages.

When your system is shipped, the QALWOBJRST system value is *ALL. This value is necessary to install your system successfully.

Warning: It is important to set the QALWOBJRST value to *ALL before performing some system activities, such as:

- Installing a new release of the OS/400 licensed program.
- Installing new licensed programs.
- Applying PTFs.
- Recovering your system.

These activities may fail if the QALWOBJRST value is not *ALL.

To ensure system security, return the QALWOBJRST value to your normal setting after completing the system activity. Make sure the entire restore operation has completed before changing the QALWOBJRST system value, or some objects may not restore successfully.

You may specify multiple values for the QALWOBJRST system value, unless you specify *ALL or *NONE.

Possible Values for the QALWOBJRST System Value:

***ALL**	Any object may be restored to your system by a user with the proper authority.
***NONE**	Security-sensitive objects, such as system state programs or programs that adopt authority, may not be restored to the system.
***ALWSYSST**	System state objects may be restored to the system.
***ALWPGMADP**	Objects that adopt authority may be restored to the system.

Setting the QALWOBJRST System Value to Allow Complete Recovery

__ **Step 1** Type `WRKSYSVAL QALWOBJRST` and press the Enter key.

__ **Step 2** You are shown the Work with System Values display. Type `5` (Display) in the Opt column next to QALWOBJRST and press the Enter key.

__ **Step 3** You are shown the Display System Value display. Write down the current setting for use after you complete your recovery. If the value is *ALL, you do not need to change it for your recovery. Skip to step 6.

__ **Step 4** Press F12 to return to the Work with System Values display. Type `2` (Change) in the Opt column next to QALWOBJRST and press the Enter key.

__ **Step 5** You are shown the Change System Value display. Type *ALL for the value and press the Enter key.

__ **Step 6** Press F12 to cancel the Work with System Values display.

Setting the QALWOBJRST System Value to Restrict Restore Operations

__ **Step 1** Type `WRKSYSVAL QALWOBJRST` and press the Enter key.

__ **Step 2** You are shown the Work with System Values display. Type `2` (Change) in the Opt column next to QALWOBJRST and press the Enter key.

__ **Step 3** You are shown the Change System Value display. Type the value you wrote down in step 3 of "Setting the QALWOBJRST System Value to Allow Complete Recovery." Press the Enter key.

__ **Step 4** Press F12 to cancel the Work with System Values display.

Locked Objects While Restoring

In general, an object is locked to prevent a read operation while it is being restored. If the system cannot obtain a lock on an object within the specified time, that object is not restored and a message is sent to the job log.

Table 8-3 on page 8-8 shows the type of lock required to restore objects:

Table 8-3. Lock Type Needed for Restore Operation

Object Type	Lock Type Needed for Restore Operation
Most object types	*EXCL
Job queue	*SHRRD
Output queue	*SHRRD
Message queue	*EXCLRD
Library, during RSTLIB command	*EXCLRD
Library, when object is being restored to it	*SHRUPD

If you restore a program that is running, the program ends abnormally because the one in use by the system is deleted. The system does not allow you to restore an ILE program that is running.

How to Verify That Objects Are Restored Successfully

You can use the joblog or an output file to determine which objects are restored successfully.

Note: The system does not restore files to libraries QGPL and QUSRSYS if the file names begin with QAPZ. No diagnostic message is sent indicating these files are not restored.

How to Use the Job Log: The RSTLIB and RSTOBJ commands send these messages:

CPC3703 Sent for each library that is restored.

CPF3773 Tells the number of objects restored and not restored.

CPF3839 Completion message for RST command from media.

CPF383E Completion message for RST command from a save file.

CPF9003 Completion message for RSTDLO command from media.

CPF909B Completion message for RSTDLO command from a save file.

These messages tell the number of objects restored and the number of objects not restored. An object is counted only if it fits the selection values you specified. For example, assume library LIB1 has 75 objects. The names of 74 of those objects begin with the characters ORD. You specify RSTOBJ OBJ(ORD*) OBJTYPE(*ALL) SAVLIB(LIB1). If all objects restored successfully, the completion message would say that 74 objects were restored to library LIB1. You would not be notified that 1 object was not restored.

A diagnostic message is sent if:

An object could not be restored.
When the system cannot restore an object successfully, it is usually because:

- The object exists on the system and is being used. Restoring an object requires an exclusive lock.
- The object on the media is damaged.
- The user does not have the necessary authority to restore the object.

Security information was changed.
Under some conditions, the system may:

- Revoke public and private authority
- Change object ownership.
- Change the object's primary group.
- Not link to the authorization list.

See "Sequence for Restoring Security Information" on page 15-1 for more information.

An integrity change occurred.

- Journaling could not be started for an object that was being journaled at the time of the save operation.
- A logical file is restored over a deleted and re-created physical file.
- The QAUDJRN (audit) journal was created by the system. You receive message CPF7088. If you restore the operating system and the QAUDLVL system value is not *NONE, the system creates the QAUDJRN if it does not exist. This ensures that security auditing is restarted for your system.

How to Use An Output File: Most restore commands create output that shows what was restored. You can direct this output to a printer (OUTPUT(*PRINT)), a database file (OUTPUT(*OUTFILE)), a stream file, or a user space. The default for restore commands is not to create output. You must request it each time you run the restore command. Or you can change the default for the OUTPUT parameter for restore commands using the Change Command Default (CHGCMDDFT) command.

You can print the output and save it. Or you can create a program to analyze and report on the information in the output file.

You can use the OUTPUT parameter with these commands:

RST	RSTDLO	RSTOBJ
RSTCFG	RSTLIB	RSTUSRPRF

The RST command places output in a stream file or a user space, rather than an output file. The chapter of the *Backup and Recovery – Advanced* book called "How to Create and Use Output from the SAV and RST Commands" provides the layouts. The RSTLIB, RSTOBJ, and RST commands have an information type (INFTYPE) parameter to specify how much detail you want in the output file.

The online information for the restore commands tells the names of the model database outfiles they use for output.

Note: The output file you specify is in use throughout the restore operation. Therefore, the system cannot restore it as part of the operation. Depending on how you perform your restore operation, you may see a CPF379D message in the joblog for the output file. If you want to restore the output file after your restore operation completes, use the RSTOBJ command.

Recovery from an Unsuccessful Restore Operation

A restore operation can be unsuccessful either because an error was encountered when trying to restore an object or because the operation was interrupted. If the object existed on the system before the restore operation, it may be damaged by the unsuccessful restore operation.

An object is not restored when an error is encountered. The error is either recoverable or not.

Restore Operation Error Is Recoverable: If an object cannot be restored and the error is recoverable, the following occurs:

- A diagnostic message is sent to the job log for each object that is not restored. The message ID can vary, depending on why the object was not restored.
- Each object associated with the errors is not restored. However, other objects not associated with the errors but involved in the same restore operation are restored.
- Only the save and restore status information for the objects that were successfully restored is updated.
- A count of the number of objects successfully restored and a count of the number of objects not restored are sent to the user in a diagnostic message.

Restore Operation Error Is Not Recoverable: If the error is not recoverable, the following occurs:

- Diagnostic messages are sent to the job log for each object.
- The save and restore status information for each object is not updated.
- A diagnostic message identifying the error condition is sent to the user.
- The restore command ends immediately. No other objects are restored.

Recovering from an Error While Restoring Libraries

Some errors that occur during a restore operation stop the operation. Following are a few examples of this type of error:

- An unrecoverable media error.
- Exceeding the maximum storage specified in the user profile of the user running the restore operation or in a user profile that owns objects that are being restored.

If an error stops the restore operation, you can correct the error condition and then start the restore operation where it ended. For example, if the maximum storage is exceeded, you can increase the MAXSTG parameter in the user profile.

You can use the STRLIB parameter on the RSTLIB command to restart the restore operation. The STRLIB parameter is valid only when *NONSYS, *ALLUSR, or *IBM is specified for the restore operation,

The basic recovery steps for a restore operation are:

__ **Step 1** Check the job log to determine the library where the previous RSTLIB SAVLIB(*NONSYS, *IBM, or *ALLUSR) failed. Find the last library restored which is indicated by a successful restore completion message.

__ **Step 2** Load the first tape of the SAVLIB LIB(*NONSYS, *ALLUSR, or *IBM) media.

__ **Step 3** Type the following and press the Enter key:

```
RSTLIB SAVLIB(*NONSYS, *IBM or *ALLUSR)
   DEV(tape-name) ENDOPT(*LEAVE)
   STRLIB(library-name)
   OMITLIB(library-name)
```

- If the restore operation stopped because of a media error that you cannot correct, the *library-name* for the STRLIB and the OMITLIB parameters should be the library where the restore operation failed. This causes the operation to start with the library after that library.
- If the failure was not related to a media error, the *library-name* for the STRLIB and the OMITLIB parameters should be the name of the last library that was successfully restored. This causes the operation to start with the library that caused the error.

__ **Step 4** You will be asked to load the volume containing the starting library.

__ **Step 5** After the restore operation is complete, restore the library that failed using the media from a previous save operation.

Note: Consider eliminating the tape with the media error from the next save

Recovering from an Error While Restoring DLOs

Some errors that occur during a restore operation stop the operation. Following are a few examples of this type of error:

- An unrecoverable media error.
- Exceeding the maximum storage specified in the user profile of the user running the restore operation or in a user profile that owns objects that are being restored.

If an error occurs that stops the restore operation, you can correct the error condition and then start the restore operation where it ended. For example, if the maximum storage is exceeded, you can increase the MAXSTG parameter in the user profile.

If an unrecoverable error occurs when running the RSTDLO DLO(*ALL) SAVFLR(*ANY) command, you must determine where the failure occurred and continue the restore operation step-by-step. Do the following:

__ **Step 1** Check the job log to determine if the failure occurred on a distribution object or a folder. The job log may identify where the failure occurred.

__ **Step 2** If the failure occurred on a distribution object, the restore operation failed when the system was restoring mail. Go to "Recovering Mail."

__ **Step 3** If the failure occurred on a folder, go to "Recovering Documents and Folders."

Recovering Mail: To recover, do **one** of the following:

- If you have daily save (SAVDLO DLO(*CHG or *MAIL)) tapes to restore later, mail will be restored during the restore of these tapes.
- Restore the mail from the next most current SAVDLO DLO(*ALL, *CHG, or *MAIL) FLR(*ANY) tapes. Type the following to restore the mail:

  ```
  RSTDLO DLO(*MAIL) DEV(tape-device-name)
  ```

- If you do not have any tapes from SAVDLO DLO(*ALL, *CHG, or *MAIL) FLR(*ANY), run the following program:

  ```
  CALL PGM(QSYS/QOHFIXIX) PARM(Y)
  ```

  Run this command so that the mail that was restored is usable. Some of your mail may not have been restored.

If you need to restore the documents and folders from this set of save media, continue with "Recovering Documents and Folders."

Recovering Documents and Folders: If an unrecoverable error occurs during the RSTDLO procedure, you can restart the procedure using the SAVFLR parameter on the RSTDLO command.

The basic recovery steps for a restore operation are:

1. Check the job log to determine where the previous RSTDLO DLO(*ALL) command failed. The job log identifies which folder failed to restore.

   Note: If the failure occurred during the restore of mail, you need to restore all documents and folders.

2. Find the first folder after the folder that failed to restore. Use the list that was created during the last SAVDLO OUTPUT(*PRINT or *OUTFILE) operation or use the DSPTAP DATA(*SAVRST) command to determine which first-level folder is next. To find the first-level folders, find the object type *FLR. Look at the *Document or Folder Information* column. The name of a first-level folder does not contain a forward slash (/).
3. Load the first tape of the SAVDLO DLO(*ALL) media.

   Note: You must always start with the first volume of the SAVDLO media for each set of 300 first-level folders. Each volume in the set of SAVDLO tapes must be loaded in sequence.

4. For each first-level folder, type the following and press the Enter key:

   ```
   RSTDLO DLO(*ALL) SAVFLR(folder-name-list)
       DEV(tape-device-name)
   ```

   where the *folder-name-list* has the names of the first-level folders identified from the list described in step 2. A limit of 300 first-level folders can be specified.

   Repeat this step for each set of 300 first-level folders.

Performing a Normal IPL

You should perform a normal IPL at the end of any recovery before allowing users to resume normal activity. Do the following:

__ **Step 1** Place the system in Normal mode.

__ **Step 2** Ensure that no users are signed on and no jobs are active.

__ **Step 3** Type the following on a command line and press the Enter key:

```
PWRDWNSYS OPTION(*IMMED) RESTART(*YES)
```

__ **Step 4** When the IPL is complete, sign on the system.

__ **Step 5** Start any other subsystems that need to be started, such as QTCP or QSNADS.

```
STRSBS SBSD(subsystem-name)
```

Chapter 9. Selecting the Right Recovery Strategy

If you are faced with recovering all or part of your system, you may feel stress or even panic. Your goal is to get your system back to normal as quickly as possible. You want constructive action immediately.

Use this chapter to determine the correct procedure for recovering your system. Do the following:

- Find the appropriate checklist.
- Make a copy of it.
- Check off each step as you complete it.
- Make notes about what you did and what happened.
- Keep the checklist for future reference.

But before beginning your recovery, you must do the following:

- Make sure you understand what has caused the problem. Understanding the cause helps you choose the correct recovery steps.
- Plan your recovery. Use the charts in this chapter to find the correct recovery steps for your situation.
- Keep a record of what you have already done and what you do for the rest of your recovery. This record is important if you need help later.
- If your problem requires hardware or software service, make sure you understand what the service representative did. Do not be afraid to ask questions, such as:
  - Was a disk unit replaced? If yes, which one?
  - Was the Licensed Internal Code restored? If yes, what option from the Install Licensed Internal Code (LIC) menu was used?
  - Did the disk configuration need to be recovered? Was it successful?
  - Could the failed disk unit be pumped? How successfully?

Some Common Recovery Terminology

You may need to understand these terms when discussing your situation with your service representative or software support:

abnormal end (abend)
A system failure or operator action that causes the system to end without being able to end all jobs and close all files. Your system may end abnormally because of a power failure or a problem with certain hardware or software components.

auxiliary storage pool
A group of units defined from all the disk units that make up auxiliary storage. Auxiliary storage pools (ASPs) allow you to isolate objects on one or more specific disk units. This may reduce the loss of data due to a disk media failure. In most cases, only data stored on disk units in the affected ASP is lost.

dedicated service tools (DST)
A set of tools to work with the system when the operating system is not available or not working.

disk configuration
An internal system table that tells how the physical disk units are arranged on your system. The disk configuration is used to assign units to an auxiliary storage pool. The disk configuration is stored on the load source unit.

disk pump
A commonly used term for the procedure used by a service representative to attempt to copy data from a disk unit that has failed.

library user ASP
A user ASP that contains libraries and folders and all the objects associated with them

Licensed Internal Code
The layer of AS/400 architecture just above the hardware. You must have the Licensed Internal Code on your machine before you can restore the operating system.

load source unit
The first unit (unit 1) in the system ASP. It contains the Licensed Internal Code and the disk configuration for your system.

nonlibrary user ASP
A user ASP that may contain journals, journal receivers, and save files. The libraries associated with these objects are in the system ASP. A nonlibrary user ASP is sometimes called an **old-style ASP**, because it was the only type of user ASP available before Version 1 Release 3 of the OS/400 licensed program.

system ASP
An auxiliary storage pool that is created by the system and always configured. The system ASP (ASP 1) contains the Licensed Internal Code, licensed programs, and system libraries. The system ASP may also contain user libraries, folders, and directories. The system ASP contains all configured disk units that are not assigned to a user ASP.

system service tools (SST)
A subset of the DST tools. The tools available through SST, such as displaying the disk configuration, can be used while the operating system is running and other users are on the system.

user ASP
An auxiliary storage pool created by grouping together a physical set of disk units and assigning them a

number 2 through 16. ASP 1 is always reserved as the system ASP.

Recovery Procedure for a Power Failure

If your system stops because power is lost, you need to follow special procedures when you start the system again. Chapter 12, "Starting the System after It Ends Abnormally" describes this procedure.

If you experience frequent power outages, consider an uninterruptible power supply for your system. The part of the *Backup and Recovery – Advanced* book called "Uninterruptible Power Supply" describes setting up and using an uninterruptible power supply for the AS/400 system.

If power loss to workstations causes your system to perform constant error recovery, you should modify your applications to handle losing communications to workstations. The chapter in the *Backup and Recovery – Advanced* book called "Techniques and Programming Examples for Backup and Recovery" describes how to do this.

Recovery Procedure for a System Failure

A system failure is a problem either with hardware (other than direct access storage devices (DASD)) or with operating system software that causes your system to end abnormally. After your service representative has corrected the problem, follow the procedure to start your system after an abnormal end. Chapter 12, "Starting the System after It Ends Abnormally" describes the procedure.

If the service representative replaced a disk unit, use the information in "Choosing the Recovery Procedure for a Disk Failure or Disk Errors" to determine the correct recovery procedure.

Recovery Procedure for a Program Failure or Human Error

You may need to recover objects because a program updated them incorrectly or because a user deleted them. Review the information in Chapter 15, "How to Restore Specific Types of Information" for the kind of objects you are restoring. Some objects have special considerations or need to be restored in a particular sequence.

If you are restoring an object that does not exist on the system, private authorities for the object are not restored with it. You can do one of the following:

- Reconstruct the private authorities manually, using the Edit Object Authority display.
- Restore private authorities by using this procedure:

  __ **Step 1.** Restore all user profiles from your most recent SAVSYS or SAVSECDTA tape. Type: `RSTUSRPRF`. Restoring user profiles requires a restricted state.

  __ **Step 2.** Restore the objects you need to recover.

  __ **Step 3.** Restore authorities. Type: `RSTAUT`. Restoring authority requires a restricted state.

Choosing the Recovery Procedure for a Disk Failure or Disk Errors

Warning: When a system reference code (SRC) appears on your system unit, use the *AS/400 Licensed Internal Code Diagnostic Aids – Volume 1* to determine what the code means. If you receive an SRC code that indicates a DASD problem, do not perform an IPL before your service representative arrives. If you perform an IPL, your service representative may not be able to recover data from the damaged disk unit.

This topic describes the actions that you take if you are recovering because a disk unit failed or was damaged. The steps you follow to recover from a disk failure depend on:

- What unit failed.
- Whether disk protection, such as device parity protection or mirrored protection is active.
- Whether you have user ASPs configured.
- Whether some or all of the sectors on the disk are damaged. If a disk unit must be replaced, a service representative normally tries to copy the information from the disk unit when it is replaced. This procedure is sometimes referred to as a disk pump.

Use Table 9-1 on page 9-3 to determine what recovery procedure you should follow, based on the failure that has occurred on your system. To find your situation on the chart, ask your service representative whether data was copied successfully (the results of the disk pump):

Service Representative Terminology	Terminology in Recovery Charts
Full pump	None of the data is lost
Partial pump	Some of the data is lost
Could not pump	All of the data is lost

Recovery for Disk Errors That Do Not Require Disk Replacement: Some types of disk units automatically recover from errors without needing to be replaced. In some cases, however, sectors are damaged before the disk unit reassigns them and some object damage occurs. If you receive a message indicating that object damage has occurred and disk sectors have been reassigned, consider this to be the value `Some` for the column *Data Loss on the Failed Unit* in Table 9-1 on page 9-3.

If you are recovering from disk errors but you did not need a service representative to replace the disk unit, you may need to perform tasks that are normally performed by a service

representative. Make a copy of the appropriate checklist and mark it as follows:

1. Begin at the task immediately following "Attach the new disk unit."
2. If the checklist has a task "Restore the disk unit data," skip that task.

Table 9-1. Choosing the Correct Recovery Procedure for Disk Media Failure

Type of Unit That Failed	Data Loss on Failed Unit	Availability Protection on Failed Unit	User ASPs Configured?	Procedure to Follow
Load source unit	None	None	N/A [1]	Checklist 1 on page 9-4
Load source unit	Some[2]	None	N/A [1]	Checklist 2 on page 9-5
Load source unit	All	None	No	Checklist 3 on page 9-7
Load source unit. No user ASPs in overflowed status[3]	All	None	Yes	Checklist 4 on page 9-8
Load source unit. One or more user ASPs in overflowed status[3].	All	None	Yes	Checklist 5 on page 9-10
Non-load source unit in system ASP[4]	None	None	N/A [1]	Checklist 6 on page 9-12
Non-load source unit in system ASP[4]	Some[2]	None	N/A [1]	Checklist 7 on page 9-13
Non-load source unit in system ASP[4]	All	None	No	Checklist 8 on page 9-15
Non-load source unit in system ASP[4]. No user ASPs in overflowed status[3].	All	None	Yes	Checklist 9 on page 9-16
Non-load source unit in system ASP[4]. One or more user ASPs in overflowed status[3].	All	None	Yes	Checklist 10 on page 9-18
Disk unit in user ASP	None	None	Yes	Checklist 6 on page 9-12
Disk unit in user ASP	Some[2]	None	Yes	Checklist 11 on page 9-20
Disk unit in user ASP. Failed unit not in overflowed status[3].	All	None	Yes	Checklist 12 on page 9-21
Disk unit in user ASP. Failed unit in overflowed status[3].	All	None	Yes	Checklist 13 on page 9-23
Any	N/A	Mirrored protection	N/A [1]	Checklist 14 on page 9-25
Any	N/A	Device parity protection	N/A [1]	Checklist 15 on page 9-26

1 The recovery procedure is the same whether or not user ASPs are configured.

2 If the service representative was partially successful in saving data from a failed disk unit, you should consider treating the situation as a complete data loss on the failed unit.

3 If a unit in your system ASP fails and a replacement is not immediately available, you can use the procedure in Checklist 16 on page 9-27. This procedure allows you to return your system to operation. You will have less disk storage and you will need to recover all the data in the system ASP.

4 Step 4 on page 13-11 describes how to determine whether a user ASP is in overflowed status.

Actions for Disk Failure–Checklist 1

This checklist should be used for the following problem situation:

Failed Unit: Load source unit

Data Loss: None

User ASP Configured: N/A

Before you begin your recovery, make a copy of this checklist. Fill in the appropriate areas as you and the service representative perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you to diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-2. Recovery Checklist for Disk Failure–Checklist 1

Task	Start Time	End Time	What To Do	Where To Read More About It
Actions to Be Performed by the Service Representative				
___ **Task 1**			Save the disk unit data.	
___ **Task 2**			Attach the new disk unit.	
___ **Task 3**			Install the Licensed Internal Code using option **4** (Install Licensed Internal Code and Restore Disk Unit Data)[1].	"Preparation for Loading the Licensed Internal Code" on page 10-2 and "Loading the Licensed Internal Code" on page 10-5.
___ **Task 4**			Restore the disk unit data.	
Actions to Be Performed by the User				
___ **Task 5**			Perform an IPL. Follow the procedure for starting the system after it ends abnormally.	Chapter 12, "Starting the System after It Ends Abnormally," task 1 through task 4.

1 If you have a 2440 Tape Unit with the high-speed feature enabled, you must disable it before restoring the Licensed Internal Code. See "Disabling and Enabling the High-Speed Feature on the 2440 Tape Unit" on page 10-11 for instructions. You may enable the feature again after you complete all the steps in Task 3.

Actions for Disk Failure–Checklist 2

This checklist should be used for the following problem situation:

Failed Unit: Load source unit

Data Loss: Some

User ASP Configured: N/A

Before you begin your recovery, make a copy of this checklist. Fill in the appropriate areas as you and the service representative perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you to diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-3 (Page 1 of 2). Recovery Checklist for Disk Failure–Checklist 2

Task	Start Time	End Time	What To Do	Where To Read More About It
Actions to Be Performed by the Service Representative				
___ **Task 1**			Save the disk unit data.	
___ **Task 2**			Attach the new disk unit.	
___ **Task 3**			Install the Licensed Internal Code using option **4** (Install Licensed Internal Code and Restore Disk Unit Data)[1].	"Preparation for Loading the Licensed Internal Code" on page 10-2 and "Loading the Licensed Internal Code" on page 10-5.
___ **Task 4**			Restore the disk unit data.	
Actions to Be Performed by the User				
___ **Task 5**			Perform an IPL. Follow the procedure for starting the system after it ends abnormally.	Chapter 12, "Starting the System after It Ends Abnormally," task 1 through task 4.
___ **Task 6**			Restore the operating system. You are performing an **abbreviated install** operation.	Chapter 11, "Restoring the Operating System," task 1 through task 6.
___ **Task 7**			If you restored the operating system using distribution tapes, some system information, such as access path recovery times and the system reply list, may have been reset to default values. Verify these values and correct them if necessary.	"How to Recover System Information" on page 15-1.
___ **Task 8**			Reclaim storage.	"Reclaiming Storage" on page 8-5.
___ **Task 9**			Evaluate the extent of the damage. Determine whether you will attempt to recover damaged objects or restore the entire system. **Do not skip this step.**	"Task 4–Recovering from Damaged Objects and Unreadable Sectors" on page 12-8.
___ **Task 10**			If you have decided to do a complete restore operation, use Table 9-19 on page 9-30 to determine the correct procedure for restoring user information.	

Table 9-3 (Page 2 of 2). Recovery Checklist for Disk Failure–Checklist 2

Task	Start Time	End Time	What To Do	Where To Read More About It
___ **Task 11**			If you have decided to attempt to recover damaged objects, perform the tasks described in "Task 4–Recovering from Damaged Objects and Unreadable Sectors" on page 12-8.	

1 If you have a 2440 Tape Unit with the high-speed feature enabled, you must disable it before restoring the Licensed Internal Code. See "Disabling and Enabling the High-Speed Feature on the 2440 Tape Unit" on page 10-11 for instructions. You may enable the feature again after you complete all the steps in Task 3.

Actions for Disk Failure–Checklist 3

This checklist should be used for the following problem situation:

Failed Unit: Load source unit

Data Loss: All

User ASP Configured: No

Before you begin your recovery, make a copy of this checklist. Fill in the appropriate areas as you and the service representative perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you to diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-4. Recovery Checklist for Disk Failure–Checklist 3

Task	Start Time	End Time	What To Do	Where To Read More About It
Actions to Be Performed by the Service Representative				
___ **Task 1**			Attach the new disk unit.	
___ **Task 2**			Prepare to load the Licensed Internal Code[1].	"Preparation for Loading the Licensed Internal Code" on page 10-2.
___ **Task 3**			Install the Licensed Internal Code using option **3** (Install Licensed Internal Code and Recover Configuration)[1].	"Loading the Licensed Internal Code" on page 10-5.
___ **Task 4**			Recover the disk configuration (assignment of disks to ASPs and protection).	"Recovering Your Disk Configuration" on page 10-9
Actions to Be Performed by the User				
___ **Task 5**			Restore the operating system, beginning with "Task 1–Starting to Restore the Operating System" on page 11-3. You are performing a **complete restore** operation.	Chapter 11, "Restoring the Operating System," task 1 through task 6.
___ **Task 6**			If you restored the operating system using distribution media, some system information, such as access path recovery times and the system reply list, was returned to default values. Set these values correctly.	"How to Recover System Information" on page 15-1.
___ **Task 7**			Use Table 9-19 on page 9-30 to determine the correct procedure for recovering user information. You will need to recover all user data.	

1 If you have a 2440 Tape Unit with the high-speed feature enabled, you must disable it before restoring the Licensed Internal Code. See "Disabling and Enabling the High-Speed Feature on the 2440 Tape Unit" on page 10-11 for instructions. You may enable the feature again after you complete all the steps in Task 3.

Actions for Disk Failure–Checklist 4

This checklist should be used for the following problem situation:

Failed Unit: Load source unit

Data Loss: All

User ASP Configured: Yes

User ASP Overflowed: No

Before you begin your recovery, make a copy of this checklist. Fill in the appropriate areas as you and the service representative perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you to diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-5 (Page 1 of 2). Recovery Checklist for Disk Failure–Checklist 4

Task	Start Time	End Time	What To Do	Where To Read More About It
Actions to Be Performed by the Service Representative				
___ **Task 1**			Attach the new disk unit.	
___ **Task 2**			Prepare to load the Licensed Internal Code[1].	"Preparation for Loading the Licensed Internal Code" on page 10-2.
___ **Task 3**			Install the Licensed Internal Code using option **3** (Install Licensed Internal Code and Recover Configuration)[1].	"Loading the Licensed Internal Code" on page 10-5.
___ **Task 4**			Recover the disk configuration (assignment of disks to ASPs and protection).	"Recovering Your Disk Configuration" on page 10-9
Actions to Be Performed by the User				
___ **Task 5**			Restore the operating system, beginning with "Task 1–Starting to Restore the Operating System" on page 11-3. You are performing a **complete restore** operation.	Chapter 11, "Restoring the Operating System," task 1 through task 6.
___ **Task 6**			If you restored the operating system using distribution media, some system information, such as access path recovery times and the system reply list, was returned to default values. Set these values correctly.	"How to Recover System Information" on page 15-1.
___ **Task 7**			If necessary, change the QALWOBJRST system value. Write the old value here: _____	"Setting the QALWOBJRST System Value to Allow Complete Recovery" on page 8-7.
___ **Task 8**			Change the system value that controls whether the job log wraps when it is full. Use the Work with System Values command: WRKSYSVAL QJOBMSGQFL. Write down the current value here: _____. Then change the value to *PRTWRAP.	*Work Management* book.

Table 9-5 (Page 2 of 2). Recovery Checklist for Disk Failure–Checklist 4

Task	Start Time	End Time	What To Do	Where To Read More About It
___ **Task 9**			Describe or diagram, as much as possible, the contents of your user ASPs before the failure.	"Describing the Contents of Your User Auxiliary Storage Pools" on page 13-1.
___ **Task 10**			Recover user profiles, configuration, libraries in the system ASP, and the contents of your user ASPs. If you are restoring the QGPL library or the QUSRSYS library, you must restore them before restoring any other user libraries.	"Recovering a User ASP After Recovering the System ASP" on page 13-2, task 1 through task 10.
___ **Task 11**			Restore document library objects.	"How to Restore Documents and Folders" on page 15-20.
___ **Task 12**			Restore your last complete save of directories.	"How to Restore Objects in Directories" on page 15-24.
___ **Task 13**			Restore changed objects and apply journaled changes.	Chapter 16, "Restoring Changed Objects and Applying Journaled Changes," task 1 through task 7.
___ **Task 14**			Restore authority. Type: `RSTAUT`	"How to Restore Object Authorities" on page 15-4.
___ **Task 15**			If necessary, change the QALWOBJRST system value.	"Setting the QALWOBJRST System Value to Restrict Restore Operations" on page 8-7.
___ **Task 16**			If necessary, change the QJOBMSGQFL system value back to its original value by using the WRKSYSVAL command.	*Work Management* book.
___ **Task 17**			Perform a normal IPL.	"Performing a Normal IPL" on page 8-10.

1 If you have a 2440 Tape Unit with the high-speed feature enabled, you must disable it before restoring the Licensed Internal Code. See "Disabling and Enabling the High-Speed Feature on the 2440 Tape Unit" on page 10-11 for instructions. You may enable the feature again after you complete all the steps in Task 3.

Actions for Disk Failure–Checklist 5

This checklist should be used for the following problem situation:

Failed Unit: Load source unit

Data Loss: All

User ASP Configured: Yes

User ASP Overflowed: Yes

Before you begin your recovery, make a copy of this checklist. Fill in the appropriate areas as you and the service representative perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you to diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-6 (Page 1 of 2). Recovery Checklist for Disk Failure–Checklist 5

Task	Start Time	End Time	What To Do	Where To Read More About It
Actions to Be Performed by the Service Representative				
___ **Task 1**			Attach the new disk unit.	
___ **Task 2**			Prepare to load the Licensed Internal Code[1].	"Preparation for Loading the Licensed Internal Code" on page 10-2.
___ **Task 3**			Install the Licensed Internal Code using option **3** (Install Licensed Internal Code and Recover Configuration)[1].	"Loading the Licensed Internal Code" on page 10-5.
___ **Task 4**			Recover the disk configuration (assignment of disks to ASPs and protection).	"Recovering Your Disk Configuration" on page 10-9
Actions to Be Performed by the User				
___ **Task 5**			Restore the operating system, beginning with "Task 1–Starting to Restore the Operating System" on page 11-3. You are performing a **complete restore** operation.	Chapter 11, "Restoring the Operating System," task 1 through task 6.
___ **Task 6**			If you restored the operating system using distribution media, some system information, such as access path recovery times and the system reply list, may have been reset to default values. Verify these values and correct them if necessary.	"How to Recover System Information" on page 15-1.
___ **Task 7**			If necessary, change the QALWOBJRST system value. Write the old value here: _____	"Setting the QALWOBJRST System Value to Allow Complete Recovery" on page 8-7.
___ **Task 8**			Change the system value that controls whether the job log wraps when it is full. Use the Work with System Values command: WRKSYSVAL QJOBMSGQFL. Write down the current value here: _____. Then change the value to *PRTWRAP.	*Work Management* book.

Table 9-6 (Page 2 of 2). Recovery Checklist for Disk Failure–Checklist 5

Task	Start Time	End Time	What To Do	Where To Read More About It
___ **Task 9**			Describe or diagram, as much as possible, the contents of your user ASPs before the failure.	"Describing the Contents of Your User Auxiliary Storage Pools" on page 13-1.
___ **Task 10**			Recover user profiles, configuration, libraries in the system ASP, and the contents of the user ASPs that were not in overflowed status. If you are restoring the QGPL library or the QUSRSYS library, you must restore them before restoring any other user libraries.	"Recovering a User ASP After Recovering the System ASP" on page 13-2, task 1 through task 10.
___ **Task 11**			Recover the objects in the user ASPs that were overflowed.	"Recovering a Damaged User Auxiliary Storage Pool" on page 13-14, task 1 through task 8.
___ **Task 12**			Restore document library objects to the system ASP and to any overflowed user ASPs that had DLOs.	"How to Restore Documents and Folders" on page 15-20.
___ **Task 13**			Restore your last complete save of directories.	"How to Restore Objects in Directories" on page 15-24.
___ **Task 14**			Restore changed objects and apply journaled changes.	Chapter 16, "Restoring Changed Objects and Applying Journaled Changes" on page 16-1.
___ **Task 15**			Restore authority. Type: `RSTAUT`	"How to Restore Object Authorities" on page 15-4.
___ **Task 16**			If necessary, change the QALWOBJRST system value.	"Setting the QALWOBJRST System Value to Restrict Restore Operations" on page 8-7.
___ **Task 17**			If necessary, change the QJOBMSGQFL system value back to its original value by using the WRKSYSVAL command.	*Work Management* book.
___ **Task 18**			Perform a normal IPL.	"Performing a Normal IPL" on page 8-10.

1 If you have a 2440 Tape Unit with the high-speed feature enabled, you must disable it before restoring the Licensed Internal Code. See "Disabling and Enabling the High-Speed Feature on the 2440 Tape Unit" on page 10-11 for instructions. You may enable the feature again after you complete all the steps in Task 3.

Actions for Disk Failure–Checklist 6

This checklist should be used for the following problem situation:

Failed Unit: Non-load source unit in system ASP or
Disk unit in user ASP

Data Loss: None

User ASP Configured: N/A

Before you begin your recovery, make a copy of this checklist. Fill in the appropriate areas as you and the service representative perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you to diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-7. Recovery Checklist for Disk Failure–Checklist 6

Task	Start Time	End Time	What To Do	Where To Read More About It
Actions to Be Performed by the Service Representative				
___ **Task 1**			Save the disk unit data.	
___ **Task 2**			Attach a new disk unit.	
___ **Task 3**			Restore data to the new disk unit.	
Actions to Be Performed by the User				
___ **Task 4**			Perform an IPL. Follow the procedure for starting the system after it ends abnormally.	Chapter 12, "Starting the System after It Ends Abnormally," task 1 through task 4.

Actions for Disk Failure–Checklist 7

This checklist should be used for the following problem situation:

Failed Unit: Non-load source unit in system ASP

Data Loss: Some

User ASP Configured: N/A

Before you begin your recovery, make a copy of this checklist. Fill in the appropriate areas as you and the service representative perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you to diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-8 (Page 1 of 2). Recovery Checklist for Disk Failure–Checklist 7

Task	Start Time	End Time	What To Do	Where To Read More About It
Actions to Be Performed by the Service Representative				
___ **Task 1**			Save the disk unit data.	
___ **Task 2**			Attach the new disk unit.	
___ **Task 3**			Restore the disk unit data.	
Actions to Be Performed by the User				
___ **Task 4**			Restore the operating system, beginning with "Task 1–Starting to Restore the Operating System" on page 11-3. You are performing an **abbreviated install** operation.	Chapter 11, "Restoring the Operating System," task 1 through task 6.
___ **Task 5**			If you restored the operating system using distribution media, some system information, such as access path recovery times and the system reply list, may have been reset to default values. Verify these values and correct them if necessary.	"How to Recover System Information" on page 15-1.
___ **Task 6**			Reclaim storage.	"Reclaiming Storage" on page 8-5.
___ **Task 7**			Evaluate the extent of the damage. Determine whether you will attempt to recover damaged objects or restore the entire system. **Do not skip this step**.	"Task 4–Recovering from Damaged Objects and Unreadable Sectors" on page 12-8.
___ **Task 8**			If you have decided to do a complete restore operation, use Table 9-19 on page 9-30 to determine the correct procedure for recovering user information.	
___ **Task 9**			If you have decided to attempt to recover damaged objects, perform the tasks in "Task 4–Recovering from Damaged Objects and Unreadable Sectors" on page 12-8.	

Table 9-8 (Page 2 of 2). Recovery Checklist for Disk Failure–Checklist 7

Task	Start Time	End Time	What To Do	Where To Read More About It
1			If you have a 2440 Tape Unit with the high-speed feature enabled, you must disable it before restoring the Licensed Internal Code. See "Disabling and Enabling the High-Speed Feature on the 2440 Tape Unit" on page 10-11 for instructions.	

Actions for Disk Failure–Checklist 8

This checklist should be used for the following problem situation:

Failed Unit: Non-load source unit in system ASP

Data Loss: All

User ASP Configured: No

Before you begin your recovery, make a copy of this checklist. Fill in the appropriate areas as you and the service representative perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you to diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-9. Recovery Checklist for Disk Failure–Checklist 8

Task	Start Time	End Time	What To Do	Where To Read More About It
Actions to Be Performed by the Service Representative				
___ **Task 1**			Attach the new disk unit.	
___ **Task 2**			Delete the ASP data.	
___ **Task 3**			Restore the Licensed Internal Code using option **1** (Restore Licensed Internal Code)[1]. If user ASPs are configured, they remain intact.	"Preparation for Loading the Licensed Internal Code" on page 10-2 and "Loading the Licensed Internal Code" on page 10-5.
Actions to Be Performed by the User				
___ **Task 4**			Restore the operating system, beginning with "Task 1–Starting to Restore the Operating System" on page 11-3. You are performing an **abbreviated install** operation.	Chapter 11, "Restoring the Operating System," task 1 through task 6.
___ **Task 5**			If you restored the operating system using distribution media, some system information, such as access path recovery times and the system reply list, may have been reset to default values. Verify these values and correct them if necessary.	"How to Recover System Information" on page 15-1.
___ **Task 6**			Reclaim storage.	"Reclaiming Storage" on page 8-5.
___ **Task 7**			Use Table 9-19 on page 9-30 to determine the correct procedure for recovering user information.	

1 If you have a 2440 Tape Unit with the high-speed feature enabled, you must disable it before restoring the Licensed Internal Code. See "Disabling and Enabling the High-Speed Feature on the 2440 Tape Unit" on page 10-11 for instructions. You may enable the feature again after you complete all the steps in Task 3.

Actions for Disk Failure–Checklist 9

This checklist should be used for the following problem situation:

Failed Unit: Non-load source unit in system ASP

Data Loss: All

User ASP Configured: Yes

User ASP Overflowed: No

Before you begin your recovery, make a copy of this checklist. Fill in the appropriate areas as you and the service representative perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you to diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-10 (Page 1 of 2). Recovery Checklist for Disk Failure–Checklist 9

Task	Start Time	End Time	What To Do	Where To Read More About It
Actions to Be Performed by the Service Representative				
___ **Task 1**			Delete the data in the ASP that contains the failed unit.	
___ **Task 2**			Replace the failed disk unit.	
___ **Task 3**			Configure the replacement disk unit by adding it to the correct ASP.	
___ **Task 4**			Restore the Licensed Internal Code using option **1** (Restore Licensed Internal Code)[1]. If user ASPs are configured, they remain intact.	"Preparation for Loading the Licensed Internal Code" on page 10-2 and "Loading the Licensed Internal Code" on page 10-5.
Actions to Be Performed by the User				
___ **Task 5**			Restore the operating system, beginning with "Task 1–Starting to Restore the Operating System" on page 11-3. You are performing an **abbreviated install** operation.	Chapter 11, "Restoring the Operating System," task 1 through task 6.
___ **Task 6**			If you restored the operating system using distribution media, some system information, such as access path recovery times and the system reply list, may have been reset to default values. Verify these values and correct them if necessary.	"How to Recover System Information" on page 15-1.
___ **Task 7**			If necessary, change the QALWOBJRST system value. Write the old value here: _____	"Setting the QALWOBJRST System Value to Allow Complete Recovery" on page 8-7.
___ **Task 8**			Change the system value that controls whether the job log wraps when it is full. Use the Work with System Values command: WRKSYSVAL QJOBMSGQFL. Write down the current value here: _____. Then change the value to *PRTWRAP.	*Work Management* book.

Table 9-10 (Page 2 of 2). Recovery Checklist for Disk Failure–Checklist 9

Task	Start Time	End Time	What To Do	Where To Read More About It
___ **Task 9**			Describe or diagram, as much as possible, the contents of your user ASPs before the failure.	"Describing the Contents of Your User Auxiliary Storage Pools" on page 13-1.
___ **Task 10**			Recover user profiles, configuration, libraries in the system ASP, and the contents of your user ASPs. If you are restoring the QGPL library or the QUSRSYS library, you must restore them before restoring any other user libraries.	"Recovering a User ASP After Recovering the System ASP" on page 13-2, task 1 through task 10.
___ **Task 11**			Restore document library objects to the system ASP.	"How to Restore Documents and Folders" on page 15-20.
___ **Task 12**			Restore your last complete save of directories.	"How to Restore Objects in Directories" on page 15-24.
___ **Task 13**			Restore changed objects and apply journaled changes.	Chapter 16, "Restoring Changed Objects and Applying Journaled Changes," task 1 through task 7.
___ **Task 14**			Restore authority. Type: `RSTAUT`	"How to Restore Object Authorities" on page 15-4.
___ **Task 15**			If necessary, change the QALWOBJRST system value.	"Setting the QALWOBJRST System Value to Restrict Restore Operations" on page 8-7.
___ **Task 16**			If necessary, change the QJOBMSGQFL system value back to its original value by using the WRKSYSVAL command.	*Work Management* book.
___ **Task 17**			Perform a normal IPL.	"Performing a Normal IPL" on page 8-10.

1 If you have a 2440 Tape Unit with the high-speed feature enabled, you must disable it before restoring the Licensed Internal Code. See "Disabling and Enabling the High-Speed Feature on the 2440 Tape Unit" on page 10-11 for instructions. You may enable the feature again after you complete all the steps in Task 4.

Actions for Disk Failure–Checklist 10

This checklist should be used for the following problem situation:

Failed Unit: Non-load source unit in system ASP

Data Loss: All

User ASP Configured: Yes

User ASP Overflowed: Yes

Before you begin your recovery, make a copy of this checklist. Fill in the appropriate areas as you and the service representative perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you to diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-11 (Page 1 of 2). Recovery Checklist for Disk Failure–Checklist 10

Task	Start Time	End Time	What To Do	Where To Read More About It
Actions to Be Performed by the Service Representative				
___ **Task 1**			Delete the data in the ASP that contains the failed unit. When you delete the data in the system ASP, the system also deletes data in any user ASPs that have a status of overflowed.	
___ **Task 2**			Replace the failed disk unit.	
___ **Task 3**			Configure the replacement disk unit by adding it to the correct ASP.	
___ **Task 4**			Restore the Licensed Internal Code using option **1** (Restore Licensed Internal Code)[1]. If user ASPs are configured and are not overflowed, they remain intact.	"Preparation for Loading the Licensed Internal Code" on page 10-2 and "Loading the Licensed Internal Code" on page 10-5.
Actions to Be Performed by the User				
___ **Task 5**			Restore the operating system, beginning with "Task 1–Starting to Restore the Operating System" on page 11-3. You are performing an **abbreviated install** operation.	Chapter 11, "Restoring the Operating System," task 1 through task 6.
___ **Task 6**			If you restored the operating system using distribution media, some system information, such as access path recovery times and the system reply list, was returned to default values. Set these values correctly.	"How to Recover System Information" on page 15-1.
___ **Task 7**			If necessary, change the QALWOBJRST system value. Write the old value here: _____	"Setting the QALWOBJRST System Value to Allow Complete Recovery" on page 8-7.

Table 9-11 (Page 2 of 2). Recovery Checklist for Disk Failure–Checklist 10

Task	Start Time	End Time	What To Do	Where To Read More About It
___ **Task 8**			Change the system value that controls whether the job log wraps when it is full. Use the Work with System Values command: WRKSYSVAL QJOBMSGQFL. Write down the current value here: _____. Then change the value to *PRTWRAP.	*Work Management* book.
___ **Task 9**			Describe or diagram, as much as possible, the contents of your user ASPs before the failure.	"Describing the Contents of Your User Auxiliary Storage Pools" on page 13-1.
___ **Task 10**			Recover user profiles, configuration, libraries in the system ASP, and the contents of any user ASPs that were not in overflowed status. If you are restoring the QGPL library or the QUSRSYS library, you must restore them before restoring any other user libraries.	"Recovering a User ASP After Recovering the System ASP" on page 13-2, task 1 through task 10.
___ **Task 11**			Recover the objects in the user ASPs that were overflowed.	"Recovering a Damaged User Auxiliary Storage Pool" on page 13-14, task 1 through task 8.
___ **Task 12**			Restore document library objects to the system ASP and to any overflowed user ASPs that had DLOs.	"How to Restore Documents and Folders" on page 15-20.
___ **Task 13**			Restore your last complete save of directories.	"How to Restore Objects in Directories" on page 15-24.
___ **Task 14**			Restore changed objects and apply journaled changes.	Chapter 16, "Restoring Changed Objects and Applying Journaled Changes," task 1 through task 7.
___ **Task 15**			Restore authority. Type: RSTAUT	"How to Restore Object Authorities" on page 15-4.
___ **Task 16**			If necessary, change the QALWOBJRST system value.	"Setting the QALWOBJRST System Value to Restrict Restore Operations" on page 8-7.
___ **Task 17**			If necessary, change the QJOBMSGQFL system value back to its original value by using the WRKSYSVAL command.	*Work Management* book.
___ **Task 18**			Perform a normal IPL.	"Performing a Normal IPL" on page 8-10.

1 If you have a 2440 Tape Unit with the high-speed feature enabled, you must disable it before restoring the Licensed Internal Code. See "Disabling and Enabling the High-Speed Feature on the 2440 Tape Unit" on page 10-11 for instructions. You may enable the feature again after you complete all the steps in Task 4.

Actions for Disk Failure–Checklist 11

This checklist should be used for the following problem situation:

Failed Unit: User ASP

Data Loss: Some

Before you begin your recovery, make a copy of this checklist. Fill in the appropriate areas as you and the service representative perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you to diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-12. Recovery Checklist for Disk Failure–Checklist 11

Task	Start Time	End Time	What To Do	Where To Read More About It
Actions to Be Performed by the Service Representative				
___ **Task 1**			Save the disk unit	
___ **Task 2**			Attach the new disk unit.	
___ **Task 3**			Restore the disk unit data.	
Actions to Be Performed by the User				
___ **Task 4**			Perform an IPL. Follow the procedure for starting the system after it ends abnormally.	Chapter 12, "Starting the System after It Ends Abnormally," task 1 through task 4.
___ **Task 5**			Reclaim storage.	"Reclaiming Storage" on page 8-5.
___ **Task 6**			Evaluate the extent of the damage. Determine whether you will attempt to recover damaged objects or restore the entire system. **Do not skip this step**.	"Task 4–Recovering from Damaged Objects and Unreadable Sectors" on page 12-8.
___ **Task 7**			If you have decided to do a complete restore operation, use Table 9-19 on page 9-30 to determine the correct procedure for recovering user information.	
___ **Task 8**			If you have decided to attempt to recover damaged objects, perform the tasks in "Task 4–Recovering from Damaged Objects and Unreadable Sectors" on page 12-8.	

Actions for Disk Failure–Checklist 12

This checklist should be used for the following problem situation:

Failed Unit: User ASP
Not in overflow status

Data Loss: All

Before you begin your recovery, make a copy of this checklist. Fill in the appropriate areas as you and the service representative perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you to diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-13 (Page 1 of 2). Recovery Checklist for Disk Failure–Checklist 12

Task	Start Time	End Time	What To Do	Where To Read More About It
Actions to Be Performed by the Service Representative				
___ **Task 1**			Delete the data in the ASP that contains the failed unit.	
___ **Task 2**			Replace the failed disk unit.	
___ **Task 3**			Configure the replacement disk unit by adding it to the correct ASP.	
Actions to Be Performed by the User				
___ **Task 4**			Perform the IPL. Follow the procedure for starting the system after it ends abnormally.	Chapter 12, "Starting the System after It Ends Abnormally," task 1 through task 4.
___ **Task 5**			Restore user profiles: `RSTUSRPRF USRPRF(*ALL) DEV(TAP01)`	"How to Restore User Profiles" on page 15-1.
___ **Task 6**			If necessary, change the QALWOBJRST system value. Write the old value here: _____	"Setting the QALWOBJRST System Value to Allow Complete Recovery" on page 8-7.
___ **Task 7**			Change the system value that controls whether the job log wraps when it is full. Use the Work with System Values command: WRKSYSVAL QJOBMSGQFL. Write down the current value here: _____. Then change the value to *PRTWRAP.	*Work Management* book.
___ **Task 8**			Recover the objects in the user ASP.	"Recovering a Damaged User Auxiliary Storage Pool" on page 13-14, task 1 through task 8.
___ **Task 9**			Restore changed objects to the user ASP. Apply journaled changes to files in the user ASP.	Chapter 16, "Restoring Changed Objects and Applying Journaled Changes," task 1 through task 7.
___ **Task 10**			Restore authority. Type: `RSTAUT`	"How to Restore Object Authorities" on page 15-4.
___ **Task 11**			If necessary, change the QALWOBJRST system value.	"Setting the QALWOBJRST System Value to Restrict Restore Operations" on page 8-7.

Table 9-13 (Page 2 of 2). Recovery Checklist for Disk Failure–Checklist 12

Task	Start Time	End Time	What To Do	Where To Read More About It
___ **Task 12**			If necessary, change the QJOBMSGQFL system value back to its original value by using the WRKSYSVAL command.	*Work Management* book.
___ **Task 13**			Perform a normal IPL.	"Performing a Normal IPL" on page 8-10.

Actions for Disk Failure–Checklist 13

This checklist should be used for the following problem situation:

Failed Unit: User ASP
In overflow status

Data Loss: All

Before you begin your recovery, make a copy of this checklist. Fill in the appropriate areas as you and the service representative perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you to diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-14 (Page 1 of 2). Recovery Checklist for Disk Failure–Checklist 13

Task	Start Time	End Time	What To Do	Where To Read More About It
Actions to Be Performed by the Service Representative				
___ **Task 1**			Delete the data in the ASP that contains the failed unit.	
___ **Task 2**			Replace the failed disk unit.	
___ **Task 3**			Configure the replacement disk unit by adding it to the correct ASP.	
Actions to Be Performed by the User				
___ **Task 4**			Perform an IPL. Follow the procedure for starting the system after it ends abnormally.	Chapter 12, "Starting the System after It Ends Abnormally" on page 12-1.
___ **Task 5**			Reclaim storage.	"Reclaiming Storage" on page 8-5.
___ **Task 6**			Delete the overflowed objects.	"Deleting Overflowed Objects during Recovery" on page 13-14.
___ **Task 7**			If necessary, change the QALWOBJRST system value. Write the old value here: _____	"Setting the QALWOBJRST System Value to Allow Complete Recovery" on page 8-7.
___ **Task 8**			Change the system value that controls whether the job log wraps when it is full. Use the Work with System Values command: WRKSYSVAL QJOBMSGQFL. Write down the current value here: _____. Then change the value to *PRTWRAP.	*Work Management* book.
___ **Task 9**			Recover the objects in the user ASP.	"Recovering a Damaged User Auxiliary Storage Pool" on page 13-14, task 1 through task 8.
___ **Task 10**			Restore changed objects to the user ASP. Apply journaled changes to files in the user ASP.	Chapter 16, "Restoring Changed Objects and Applying Journaled Changes," task 1 through task 7.
___ **Task 11**			Restore authority. Type: `RSTAUT`	"How to Restore Object Authorities" on page 15-4.

Table 9-14 (Page 2 of 2). Recovery Checklist for Disk Failure–Checklist 13

Task	Start Time	End Time	What To Do	Where To Read More About It
___ **Task 12**			If necessary, change the QALWOBJRST system value.	"Setting the QALWOBJRST System Value to Restrict Restore Operations" on page 8-7.
___ **Task 13**			If necessary, change the QJOBMSGQFL system value back to its original value by using the WRKSYSVAL command.	*Work Management* book.
___ **Task 14**			Perform a normal IPL.	"Performing a Normal IPL" on page 8-10.

Actions for Disk Failure–Checklist 14

This checklist should be used for the following problem situation:

Failed Unit: Any

Mirrored Protection: Yes

Before you begin your recovery, make a copy of this checklist. Fill in the appropriate areas as you and the service representative perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you to diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Note: For many failures, the system does not have to stopped and started again. The service representative can repair the failed component while the system continues to run. See the chapter of the *Backup and Recovery – Advanced* book called "Mirrored Protection–Recovery Actions."

Table 9-15. Recovery Checklist for Disk Failure–Checklist 14

Task	Start Time	End Time	What To Do	Where To Read More About It
Actions to Be Performed by the Service Representative				
___ **Task 1**			Replace the failed disk unit.	
___ **Task 2**			Resume mirrored protection.	
___ **Task 3**			Perform an IPL.	
Actions to Be Performed by the User				
___ **Task 4**			Ensure that disk configuration is correct.	The chapter in the *Backup and Recovery – Advanced* book called "Working with Mirrored Protection."

Actions for Disk Failure–Checklist 15

This checklist should be used for the following problem situation:

Failed Unit: Any

Device Parity Protection: Yes

Before you begin your recovery, make a copy of this checklist. Fill in the appropriate areas as you and the service representative perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you to diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Note: For many failures, the system does not have to stopped and started again. The service representative can repair the failed component while the system continues to run. See the chapter of the *Backup and Recovery – Advanced* book called "Working with Device Parity Protection."

Table 9-16. Recovery Checklist for Disk Failure–Checklist 15

Task	Start Time	End Time	What To Do	Where To Read More About It
Actions to Be Performed by the Service Representative				
___ **Task 1**			Attach the new disk unit.	
___ **Task 2**			Restart device parity protection.	
___ **Task 3**			Perform an IPL.	
Actions to Be Performed by the User				
___ **Task 4**			Ensure that disk configuration is correct.	The chapter in the *Backup and Recovery – Advanced* book called "Working with Device Parity Protection."

Actions for Disk Failure–Checklist 16

This checklist should be used for the following problem situation:

Failed Unit: Non-Load source unit in system ASP

Data Loss: N/A

Disk unit cannot be replaced immediately

Before you begin your recovery, make a copy of this checklist. Fill in the appropriate areas as you and the service representative perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you to diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-17. Recovery Checklist for Disk Failure–Checklist 16

Task	Start Time	End Time	What To Do	Where To Read More About It
Actions to Be Performed by the User				
___ **Task 1**			Remove the failed disk unit from the configuration.	"Removing a Failed Disk Unit from the System ASP" on page 13-19.
___ **Task 2**			Restore the Licensed Internal Code using option **1** (Restore Licensed Internal Code)[1].	"Preparation for Loading the Licensed Internal Code" on page 10-2 and "Loading the Licensed Internal Code" on page 10-5.
___ **Task 3**			Restore the operating system, beginning with "Task 1–Starting to Restore the Operating System" on page 11-3. You are performing a **complete restore** operation.	Chapter 11, "Restoring the Operating System," task 1 through task 6.
___ **Task 4**			If you restored the operating system using distribution media, some system information, such as access path recovery times and the system reply list, may have been reset to default values. Verify these values and correct them if necessary.	"How to Recover System Information" on page 15-1.
___ **Task 5**			Use Table 9-19 on page 9-30 to determine the correct procedure for recovering user information.	

1 If you have a 2440 Tape Unit with the high-speed feature enabled, you must disable it before restoring the Licensed Internal Code. See "Disabling and Enabling the High-Speed Feature on the 2440 Tape Unit" on page 10-11 for instructions. You may enable the feature again after you complete all the steps in Task 2.

Recovering after a Complete System Loss–Checklist 17

This checklist should be used if you need to restore your entire system to a different system that is running the same version of the OS/400 licensed program. Do not use this checklist to restore information from an IMPI AS/400 system to a RISC-based AS/400 system. Consult the *AS/400 Road Map for Changing to PowerPC Technology* for instructions for moving information to a RISC-based AS/400 system.

Before you begin your recovery, make a copy of this checklist. Fill in the appropriate areas as you and the service representative perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you to diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-18 (Page 1 of 2). Recovery Checklist for Complete System Loss–Checklist 17

Task	Start Time	End Time	What To Do	Where To Read More About It
Actions to Be Performed by the User				
___ **Task 1**			Prepare to load the Licensed Internal Code[1].	"Preparation for Loading the Licensed Internal Code" on page 10-2.
___ **Task 2**			Install the Licensed Internal Code using option **2** (Install Licensed Internal Code and Initialize system)[1].	"Preparation for Loading the Licensed Internal Code" on page 10-2 and "Loading the Licensed Internal Code" on page 10-5.
___ **Task 3**			Configure the disk units (assign to ASP and set up disk protection).	*Backup and Recovery – Advanced.*
___ **Task 4**			Restore the operating system, beginning with "Task 1–Starting to Restore the Operating System" on page 11-3. You are performing a **complete restore** operation.	Chapter 11, "Restoring the Operating System," task 1 through task 6.
___ **Task 5**			If you restored the operating system using distribution media, some system information, such as access path recovery times and the system reply list, may have been reset to default values. Verify these values and correct them if necessary.	"How to Recover System Information" on page 15-1.
___ **Task 6**			Recover user information from your save tapes. Restore changed objects and apply journal entries. **If you are restoring to a different system, you must specify** `ALWOBJDIF(*ALL)` **on the RSTxxx commands.**	"Choosing the Procedure to Recover User Information" on page 9-30.
___ **Task 7**			If you do not know what the password is for the QSECOFR profile, change it before signing off: `CHGUSRPRF USRPRF(QSECOFR) PASSWORD(`*`new-password`*`)`	"What Happens When You Restore User Profiles" on page 15-2.
___ **Task 8**			If you restored from distribution media, restore your system information to the correct settings.	"How to Recover System Information" on page 15-1.

Table 9-18 (Page 2 of 2). Recovery Checklist for Complete System Loss–Checklist 17

Task	Start Time	End Time	What To Do	Where To Read More About It
___ **Task 9**			If you restored to a different system and your security level is 30 or greater, *ALLOBJ special authority has been removed from all user profiles except certain IBM-supplied profiles. Use the CHGUSRPRF command to give *ALLOBJ special authority to users who need it.	"What Happens When You Restore User Profiles" on page 15-2.

___ **Task 10**			Perform either a:
			`SIGNOFF *LIST`
			or a
			`DSPJOBLOG * *PRINT`
			Check the job log to ensure all objects were restored. The job log contains information about the restore operation. To verify that all objects were restored, spool the job log for printing along with the job's remaining spooled output, if any.
			Message CPC3703 is sent to the job log for each library that was successfully restored. Message CPF3773 is sent to tell you how many objects were restored. Objects are not restored for various reasons. Check for any error messages, correct the errors, and then restore those objects from the media.	

___ **Task 11**			Perform a normal IPL.	"Performing a Normal IPL" on page 8-10.

1 If you have a 2440 Tape Unit with the high-speed feature enabled, you must disable it before restoring the Licensed Internal Code. See "Disabling and Enabling the High-Speed Feature on the 2440 Tape Unit" on page 10-11 for instructions. You may enable the feature again after you complete all the steps in Task 2.

Choosing the Procedure to Recover User Information

Your first step in a recovery is to return your system to a normal operating condition. This may require:

- Replacing hardware
- Restoring or installing the Licensed Internal Code
- Performing an IPL after the system ends abnormally

When your system is running normally, you are ready to recover user information. Use Table 9-19 to determine the procedure you should follow. In the table, N/A in a column means that the recovery procedure is the same, whether you respond yes or no.

Table 9-19. Choosing the Correct Recovery Procedure for User Information

Are You Recovering All ASPs?	Save Procedure Used	Do You Use SAVCHGOBJ or Journaling?	Do You Want to Use Menu Options to Recover?	Recovery Procedure to Follow
Yes	Commands	N/A	See note 1.	"Recovering User Information Using Commands–Checklist 18" on page 9-31
Yes	Save menu option 21	No	Yes	"Using Option 21 from the Restore Menu–Checklist 19" on page 9-34
Yes	Save menu option 21	Yes	N/A	"Recovering User Information Using Commands–Checklist 18" on page 9-31
Yes	Save menu option 21	No	No	"Recovering User Information Using Commands–Checklist 18" on page 9-31
Yes	Save menu option 22 Save menu option 23	No	Yes	"Using Options 22 and 23 from the Restore Menu–Checklist 20" on page 9-35
Yes	Save menu option 22 Save menu option 23	Yes	N/A	"Recovering User Information Using Commands–Checklist 18" on page 9-31
Yes	Save menu option 22 Save menu option 23	No	No	"Recovering User Information Using Commands–Checklist 18" on page 9-31
Yes	Save menu option 21 Save menu option 23	No	Yes	"Using Options 22 and 23 from the Restore Menu–Checklist 20" on page 9-35
Yes	Save menu option 21 Save menu option 23	Yes	N/A	"Recovering User Information Using Commands–Checklist 18" on page 9-31
Yes	Save menu option 21 Save menu option 23	No	No	"Recovering User Information Using Commands–Checklist 18" on page 9-31
Yes	Operational Assistant Backup[2]	N/A	N/A	"Recovering User Information Using Tapes from Operational Assistant Backup–Checklist 21" on page 9-37
No	Any	N/A	N/A	"Recovering User Information Using Commands–Checklist 18" on page 9-31

1 If you save using commands rather than menu options, you should recover using commands.

2 You have saved using either the RUNBCKUP command or the Run Backup menu.

Recovering User Information Using Commands–Checklist 18

This checklist shows the sequence of steps you should use to recover user information using commands. You may need to perform some tasks more than once. The correct steps for your situation depend on:

- How you saved your information.
- Whether you use journaling or whether applications you have purchased use journaling.
- Whether you have document library objects.
- Whether you have objects in directories.
- Whether you save changed objects.

Before you begin recovering user information, make a copy of this checklist. Fill in the appropriate areas as you perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Restoring to a Different System?

- You must specify `ALWOBJDIF(*ALL)` on the RSTxxx commands.
- You must specify `SRM(*NONE)` on the RSTCFG command.
- If your system was at security level 30 or higher when you saved, *ALLOBJ special authority is removed from all user profiles except QSECOFR when you restore.
- Network attributes are reset to the IBM-supplied defaults.

Table 9-20 (Page 1 of 3). Checklist for Recovering User Information Using Commands

Task	Start Time	End Time	What To Do	Where To Read More About It
___ **Task 1**			If your system is not already in a restricted state, ensure that all users are off the system and that all jobs are ended. Then type `ENDSBS SBS(*ALL) OPTION(*CNTRLD) DELAY(600)`[1,2].	"Putting Your System in a Restricted State" on page 8-4.
___ **Task 2**			If necessary, change the QALWOBJRST system value. Write the old value here: _____	"Setting the QALWOBJRST System Value to Allow Complete Recovery" on page 8-7.
___ **Task 3**			Change the system value that controls whether the job log wraps when it is full. Use the Work with System Values command: WRKSYSVAL QJOBMSGQFL. Write down the current value here: _____. Then change the value to *PRTWRAP.	*Work Management* book.
___ **Task 4**			Prevent messages that are not related to the recovery from interrupting by typing: `CHGMSGQ MSGQ(QSYSOPR) DLVRY(*NOTIFY) SEV(99)`	
What ENDOPT?			When you are restoring from tape, you tell the system whether or not to rewind the tape. If you are using tape in the tasks that follow, specify `ENDOPT(*LEAVE)` when you have additional steps. Specify `ENDOPT(*REWIND)` for your last step.	
___ **Task 5**			Restore user profiles: `RSTUSRPRF DEV(TAP01) USRPRF(*ALL)`	"How to Restore User Profiles" on page 15-1.

Table 9-20 (Page 2 of 3). Checklist for Recovering User Information Using Commands

Task	Start Time	End Time	What To Do	Where To Read More About It
___ **Task 6**			Restore device configuration: `RSTCFG OBJ(*ALL) OBJTYPE(*ALL) DEV(TAP01)`	"How to Restore Configuration Objects" on page 15-5.
___ **Task 7**			Restore the user libraries to each user ASP that you are recovering. If you are restoring the QGPL library and the QUSRSYS library and doing partial recovery, restore these libraries before any other libraries. When recovering the entire system, there is no need to restore QGPL and QUSRSYS libraries first.	"How to Restore Libraries" on page 15-8.
___ **Task 8**			Restore the ownership for DLOs in the user ASPs you are not restoring.	"Task 7–Reclaiming Document Library Objects" on page 13-7.
___ **Task 9**			Restore your last complete save of document library objects to each user ASP you are recovering.	"How to Restore Documents and Folders" on page 15-20.
___ **Task 10**			Restore your last complete save of directories.	"How to Restore Objects in Directories" on page 15-24.
___ **Task 11**			Restore changed objects and apply journaled changes.	Chapter 16, "Restoring Changed Objects and Applying Journaled Changes," task 1 through task 7.
___ **Task 12**			Restore authority. Type: `RSTAUT`	"How to Restore Object Authorities" on page 15-4.
___ **Task 13**			Reapply any PTFs that were applied since your last SAVSYS operation.	"Restoring Program Temporary Fixes" on page 15-28.
___ **Task 14**			If necessary, change the QALWOBJRST system value.	"Setting the QALWOBJRST System Value to Restrict Restore Operations" on page 8-7.
___ **Task 15**			If necessary, change the QJOBMSGQFL system value back to its original value by using the WRKSYSVAL command.	*Work Management* book.
___ **Task 16**			If you are recovering from a complete system loss, return to "Recovering after a Complete System Loss–Checklist 17" on page 9-28. Continue with task 7 on that checklist.	

Table 9-20 (Page 3 of 3). Checklist for Recovering User Information Using Commands

Task	Start Time	End Time	What To Do	Where To Read More About It

___ **Task 17**			Perform either a:
			`SIGNOFF *LIST`
			or a
			`DSPJOBLOG * *PRINT`
			Check the job log to ensure all objects were restored. The job log contains information about the restore operation. To verify that all objects were restored, spool the job log for printing along with the job's remaining spooled output, if any.
			Message CPC3703 is sent to the job log for each library that was successfully restored. Message CPF3773 is sent to tell you how many objects were restored. Objects are not restored for various reasons. Check for any error messages, correct the errors, and then restore those objects from the media.	

___ **Task 18**			Perform a normal IPL.	"Performing a Normal IPL" on page 8-10.
___ **Task 19**			Review job logs or output from your restore operations to ensure that all objects were restored successfully.	"How to Verify That Objects Are Restored Successfully" on page 8-8.

1 Your system must be in a restricted state to restore user profiles. Other steps in the recovery may not require a restricted state. However, to ensure the success of your recovery and better performance when you are restoring information, a restricted state is recommended.

2 For the delay parameter, specify a number of seconds that allows your system time to bring most jobs to a normal end. On a large, busy system, you may need a longer delay.

Using Option 21 from the Restore Menu–Checklist 19

This checklist shows the sequence of steps you should use to recover user information using option 21 from the Restore menu. Option 21 restores your system to your last complete save.

Before you begin recovering user information, make a copy of this checklist. Fill in the appropriate areas as you perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-21. Checklist for Recovering User Information Using Option 21

Task	Start Time	End Time	What To Do	Where To Read More About It
___ **Task 1**			If necessary, change the QALWOBJRST system value. Write the old value here: _____	"Setting the QALWOBJRST System Value to Allow Complete Recovery" on page 8-7.
___ **Task 2**			Change the system value that controls whether the job log wraps when it is full. Use the Work with System Values command: WRKSYSVAL QJOBMSGQFL. Write down the current value here: _____. Then change the value to *PRTWRAP.	*Work Management* book.
___ **Task 3**			Perform option 21 from the Restore menu. Use your most recent tapes from performing option 21 on the Save menu. **If you are recovering using "Recovering after a Complete System Loss–Checklist 17" on page 9-28 and restoring to a different system, you must prompt on the menu options and you must specify ALBOBJDIF(*ALL) on the RSTxxx commands and SRM(*NONE) on the RSTCFG command.**	"Using Restore Menu Options 21, 22, and 23" on page 14-1.
___ **Task 4**			Reapply any PTFs that were applied since your last SAVSYS operation.	"Restoring Program Temporary Fixes" on page 15-28.
___ **Task 5**			If necessary, change the QALWOBJRST system value.	"Setting the QALWOBJRST System Value to Restrict Restore Operations" on page 8-7.
___ **Task 6**			If necessary, change the QJOBMSGQFL system value back to its original value by using the WRKSYSVAL command.	*Work Management* book.
___ **Task 7**			Perform a normal IPL.	"Performing a Normal IPL" on page 8-10.
___ **Task 8**			Review job logs or output from your restore operations to ensure that all objects were restored successfully.	"How to Verify That Objects Are Restored Successfully" on page 8-8.

Using Options 22 and 23 from the Restore Menu–Checklist 20

This checklist shows the sequence of steps you should use to recover user information using option 22 and 23 from the restore menu. Option 22 restores your IBM-supplied libraries to your last save. Option 23 restores your user libraries to your last save.

Before you begin recovering user information, make a copy of this checklist. Fill in the appropriate areas as you perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-22 (Page 1 of 2). Checklist for Recovering User Information Using Options 22 and 23

Task	Start Time	End Time	What To Do	Where To Read More About It
___ **Task 1**			If necessary, change the QALWOBJRST system value. Write the old value here: _____	"Setting the QALWOBJRST System Value to Allow Complete Recovery" on page 8-7.
___ **Task 2**			Change the system value that controls whether the job log wraps when it is full. Use the Work with System Values command: WRKSYSVAL QJOBMSGQFL. Write down the current value here: _____. Then change the value to *PRTWRAP.	*Work Management* book.
___ **Task 3**			Perform option 22 from the Restore menu to restore IBM-supplied libraries. Use your most recent tapes from performing either option 21 or option 22 on the Save menu. **If you are recovering using "Recovering after a Complete System Loss–Checklist 17" on page 9-28 and restoring to a different system, you must prompt on the menu options and you must specify ALBOBJDIF(*ALL) on the RSTxxx commands and SRM(*NONE) on the RSTCFG command.**	"Using Restore Menu Options 21, 22, and 23" on page 14-1.
___ **Task 4**			Perform option 23 from the Restore menu to restore user libraries. Use your most recent tapes from performing either option 21 or option 23 on the Save menu. **If you are recovering using "Recovering after a Complete System Loss–Checklist 17" on page 9-28 and restoring to a different system, you must prompt on the menu options and you must specify ALBOBJDIF(*ALL) on the RSTxxx commands and SRM(*NONE) on the RSTCFG command.**	"Using Restore Menu Options 21, 22, and 23" on page 14-1.
___ **Task 5**			Reapply any PTFs that were applied since your last SAVSYS operation.	"Restoring Program Temporary Fixes" on page 15-28.

Table 9-22 (Page 2 of 2). Checklist for Recovering User Information Using Options 22 and 23

Task	Start Time	End Time	What To Do	Where To Read More About It
___ **Task 6**			If necessary, change the QALWOBJRST system value.	"Setting the QALWOBJRST System Value to Restrict Restore Operations" on page 8-7.
___ **Task 7**			If necessary, change the QJOBMSGQFL system value back to its original value by using the WRKSYSVAL command.	*Work Management* book.
___ **Task 8**			Perform a normal IPL.	"Performing a Normal IPL" on page 8-10.
___ **Task 9**			Review job logs or output from your restore operations to ensure that all objects were restored successfully.	"How to Verify That Objects Are Restored Successfully" on page 8-8.

Recovering User Information Using Tapes from Operational Assistant Backup–Checklist 21

This checklist shows the sequence of steps you should use to recover user information when you have saved using Operational Assistant backup. These procedures assume that all of your backup is done using Operational Assistant. You have not mixed Operational Assistant backup with other save methods, with the exception of using the SAV command to save objects in directories.

Before you begin recovering user information, make a copy of this checklist. Fill in the appropriate areas as you perform the recovery steps. This checklist provides an important record of your recovery actions. It may help you diagnose any problems that occur after the recovery. It may also be useful in evaluating your backup strategy.

Most steps in the checklist include references to other topics in this book. Refer to these topics if you need more information about how to perform a particular step. You may not need to perform some steps, such as restoring objects in directories, if they do not apply in your situation.

Table 9-23 (Page 1 of 2). Checklist for Recovering User Information Using Operational Assistant Backup Tapes

Task	Start Time	End Time	What To Do	Where To Read More About it
___ **Task 1**			If your system is operational and the QUSRSYS library is on the system, print the Backup Status and the Backup History by typing: `DSPBCKSTS OUTPUT(*PRINT)`.	
___ **Task 2**			If your system is operational and the QUSRSYS library is on the system, print the Backup List by typing: `DSPBCKUPL OUTPUT(*PRINT)`.	
___ **Task 3**			If your system is not already in a restricted state, ensure all users are off the system. Then type `ENDSBS SBS(*ALL) OPTION(*CNTRLD) DELAY(600)`[1,2].	"Putting Your System in a Restricted State" on page 8-4.
___ **Task 4**			If necessary, change the QALWOBJRST system value. Write the old value here: _____	"Setting the QALWOBJRST System Value to Allow Complete Recovery" on page 8-7.
___ **Task 5**			Change the system value that controls whether the job log wraps when it is full. Use the Work with System Values command: WRKSYSVAL QJOBMSGQFL. Write down the current value here: _____. Then change the value to *PRTWRAP.	*Work Management* book.
___ **Task 6**			Prevent messages that are not related to the recovery from interrupting by typing: `CHGMSGQ MSGQ(QSYSOPR) DLVRY(*NOTIFY) SEV(99)`	
___ **Task 7**			Restore user profiles: `RSTUSRPRF DEV(TAP01) USRPRF(*ALL)`.	"How to Restore User Profiles" on page 15-1.
___ **Task 8**			Restore device configuration: `RSTCFG OBJ(*ALL) OBJTYPE(*ALL) DEV(TAP01)`	"How to Restore Configuration Objects" on page 15-5.

Table 9-23 (Page 2 of 2). Checklist for Recovering User Information Using Operational Assistant Backup Tapes

Task	Start Time	End Time	What To Do	Where To Read More About It
___ **Task 9**			Restore the user libraries to each user ASP that you are recovering. If you are restoring the QGPL library and the QUSRSYS library and doing partial recovery, restore these libraries before any other libraries. When recovering the entire system, there is no need to restore QGPL and QUSRSYS libraries first.	"How to Restore Your Libraries" on page 17-2
___ **Task 10**			Restore the ownership for DLOs in the user ASPs that you are not restoring.	"Task 7–Reclaiming Document Library Objects" on page 13-7.
___ **Task 11**			Restore your last complete save of document library objects to each user ASP that you are recovering.	"How to Restore Documents and Folders" on page 15-20.
___ **Task 12**			Restore your last complete save of directories.	"How to Restore Objects in Directories" on page 15-24.
___ **Task 13**			Restore incremental backups of libraries.	"How to Restore Libraries That You Saved by Using a Backup List" on page 17-3.
___ **Task 14**			Restore changed objects.	"How to Restore Changed Objects That You Saved by Using a Operational Assistant" on page 17-3.
___ **Task 15**			Restore authority. Type: `RSTAUT`	"How to Restore Object Authorities" on page 15-4.
___ **Task 16**			If necessary, change the QALWOBJRST system value.	"Setting the QALWOBJRST System Value to Restrict Restore Operations" on page 8-7.
___ **Task 17**			If necessary, change the QJOBMSGQFL system value back to its original value by using the WRKSYSVAL command.	*Work Management* book.
___ **Task 18**			Perform a normal IPL.	"Performing a Normal IPL" on page 8-10.
___ **Task 19**			Review job logs or output from your restore operations to ensure that all objects were restored successfully.	"How to Verify That Objects Are Restored Successfully" on page 8-8.

1 Your system must be in a restricted state to restore user profiles. Other steps in the recovery may not require a restricted state. However, to ensure the success of your recovery and better performance when you are restoring information, a restricted state is recommended.

2 For the delay parameter, specify a number of seconds that allows your system time to bring most jobs to a normal end. On a large, busy system, you may need a longer delay.

Chapter 10. Recovering the Licensed Internal Code

Licensed Internal Code is the layer of AS/400 architecture just above the hardware. You must have the Licensed Internal Code on your machine before you can restore the operating system. You must use the control panel on your system unit to start the recovery of the Licensed Internal Code.

The Install Licensed Internal Code (LIC) menu provides several methods for loading the Licensed Internal Code to your system. Table 10-1 describes the options and how they are used:

Table 10-1. Options from the Install the Licensed Internal Code (LIC) Menu

Option Number	Description	Purpose
1	Restore Licensed Internal Code	Restores the Licensed Internal Code without removing other information that is on the system. Option 1 is similar to Function Code 23 on earlier versions of the AS/400 system. Option 1 is normally used in the following situations: • You are encountering problems with the operating system, such as damaged objects. You sometimes need to restore the Licensed Internal Code before restoring the operating system. • The software support center recommends it. • You have replaced a failed disk unit other than unit 1 in the system ASP. • You are updating your system to a new release. See the *Software Installation* book for the procedures to install a new release of the AS/400 system.
2	Install the Licensed Internal Code and Initialize system	Installs the Licensed Internal Code and removes all data from all disk units. Option 2 is similar to Function Code 24 on earlier versions of the AS/400 system. Option 2 is normally used in the following situations: • You are doing a restore operation using the SAVSTG tapes. • You are restoring to another system to recover from a complete system loss.
3	Install Licensed Internal Code and Recover Configuration	Installs the Licensed Internal Code and prompts you to begin the procedure to recover information about how the disks were configured on your system (including ASP assignments and protection). Option 3 is similar to Function Code 24 on earlier version of the AS/400 system. Option 3 is normally used in the following situations: • You have replaced the load source unit. • The software support center recommends it.
4	Install Licensed Internal Code and Restore Disk Unit Data	Installs the Licensed Internal Code and restores data to a replacement disk unit. This option is used only by a service representative after data was successfully saved (pumped) from a failed disk unit.
5	Install Licensed Internal Code and Upgrade Load Source	This option is used in certain cases when you are changing to a RISC-based system. See the *AS/400 Road Map for Changing to PowerPC Technology* for more information.

Use the charts in Chapter 9 to determine which procedures in this chapter are required for your situation.

Attention!

Make sure you use the correct procedure for your situation. Some of the procedures in this chapter will remove all data from your system.

Preparation for Loading the Licensed Internal Code

The tasks for starting to load the Licensed Internal Code include the following:

- Finding the right media and documentation.
- Stopping your system, if it is running.
- Performing an IPL from an alternate device, either tape or optical media.

Check off each step in these tasks as you complete it.

Task 1–Getting Ready to Load the Licensed Internal Code

Find These Things Before You Begin:

__ Your most recent SAVSYS tapes. A SAVSYS tape is created by one of the following:

Running the Save System (SAVSYS) command.
Using option 21 from the Save menu.
Using option 22 from the Save menu.
Using option 11 from the Run Backup menu.

__ If you do not have current SAVSYS tapes or they are damaged, you need the following:

__ The distribution media (optical media or tape) supplied by IBM.

__ All the optical media for program temporary fixes you have applied. Use the distribution media only if you do not have SAVSYS tapes. If you use the distribution media to restore the Licensed Internal Code, you will lose some of your system information, such as the program temporary fixes you have applied.

__ The list of all the program temporary fixes (PTFs) applied to your system at the time you saved the entire system. This list should be attached to your backup log or found with your SAVSYS tapes.

__ The key or keystick for the system if it is not already inserted in the control panel.

__ The manual for the tape or optical device that is your alternate IPL device. It describes other SRC codes you might see.

Do These Things Before You Begin:

__ Clean the read and write heads of the tape unit.

__ If your system is operational, print a list of all the program temporary fixes (PTFs) currently on the system. Type the following and press the Enter key:

```
DSPPTF LICPGM(*ALL) OUTPUT(*PRINT)
```

Task 2–Powering Down the System

Using a 2440 Tape Unit?

Be sure to disable the high-speed feature before restoring the Licensed Internal Code. See "Disabling and Enabling the High-Speed Feature on the 2440 Tape Unit" on page 10-11 for instructions.

If your system is already powered off or if you are recovering to a system at an IBM Business Recovery Services Center, skip this task and begin with "Task 3–Preparing the System

to Perform an IPL from an Alternate Device" on page 10-3 It is not necessary to power down a system that has no activity on the system.

__ **Step 1** Sign on the system as QSECOFR.

__ **Step 2** Change the QSYSOPR message queue:

```
CHGMSGQ MSGQ(QSYSOPR) DLVRY(*BREAK) SEV(60)
```

__ **Step 3** Bring your system to a restricted state:

```
ENDSBS SBS(*ALL) OPTION(*CNTRLD) DELAY(600)
```

Note: Specify a number of seconds for the delay parameter that is long enough for your system to bring most jobs to a normal end. On a large, busy system, you may need more time.

The system displays a message that subsystem ending is in progress. The system displays another message when all subsystems have ended and the system is in a restricted state. After the subsystems have ended, continue with the next step.

__ **Step 4** Change the QSYSOPR message queue:

```
CHGMSGQ MSGQ(QSYSOPR) DLVRY(*BREAK) SEV(99)
```

Note: Communications messages with a severity of 99 that require a reply can interrupt your restore operation. You can either identify these messages and add them to the system reply list, or you can change the delivery of the QSYSOPR message queue to *NOTIFY. This prevents the communications messages from interrupting the interactive restore operation.

__ **Step 5** Power down the system:

```
PWRDWNSYS OPTION(*IMMED)
```

Note: When the Power On light goes off on all racks of the 9406 or the control panel of the 9402 or 9404, continue with the next task.

Task 3–Preparing the System to Perform an IPL from an Alternate Device

To perform an initial program load (IPL) from tape or CD-ROM, you must use the control panel on the system unit. Do the following (the steps vary slightly based on the type of system unit that you have. Consult the *System Startup and Problem Handling* book if you are unsure of the procedures for your system).

__ **Step 1** If your system unit has a lock on the control panel, use the key or keystick to unlock the control panel.

__ **Step 2** Place the system in Manual mode.

__ **Step 3** Press the Function Select switch (or buttons) to display `02` (IPL) in the Function display.

__ **Step 4** Press the Enter button on the control panel.

__ **Step 5** Press the Function Select switch (or buttons) to display `D` (IPL from tape or CD-ROM) in the Data display.

__ **Step 6** Press the Enter button on the control panel.

__ **Step 7** Ensure that any switches for the alternate IPL device and for all disk units are in the On position.

Task 4–Loading the Licensed Internal Code from Media

Step 1 Find the Licensed Internal Code tape or optical media. It is the first volume of the most current set of SAVSYS tapes or the first volume of the distribution optical media.

> **Attention!**
>
> Use the distribution media only if no SAVSYS tape exists. If you use the distribution media some system information will be lost. This includes, but is not limited to, PTFs and PTF packages. If you use the distribution media all cumulative PTF packages and individual PTFs applied after the initial installation of your system must be installed again.

Step 2 Place the tape in the tape unit used for the IPL, or place the optical media in the optical disk unit. When you start the IPL, the system searches the alternate IPL devices for the correct media. For more information on loading the tape or optical media, see the setup manual for the device.

Note: If your alternate IPL device cannot be loaded when the power is off, continue with the next step. You will be prompted later by an SRC code for the tape or optical device.

Step 3 Turn on the power to the system.

Step 4 If you could not load your tape in step 2, load the first tape volume into the tape unit used for the IPL. Make the device ready and then continue with the next step.

Note: If your system was not powered down after ending the subsystems, do the following:

a. Press the Function Select switch (or buttons) to display `03` (continue the IPL) in the Function display on the control panel.

b. Press the Enter button on the control panel.

Step 5 Ensure that the tape device or optical device is online or ready. No action is required for devices that perform this step automatically (such as the tape cartridge unit).

Step 6 Ensure that the console display is turned on. After a delay, you should see the Install Licensed Internal Code menu. The length of the delay varies, depending on your system configuration and the speed of your alternate IPL device. The delay is usually between 5 minutes and 30 minutes. When you see this menu, continue with step 7 on page 10-5.

If the system attention light appears and one of the SRC codes shown in Table 10-2 is displayed in the Data display, complete the instructions for that SRC code.

Table 10-2 (Page 1 of 2). SRC Codes When Loading the Licensed Internal Code

SRC Code	Why It Appears	What You Do
A1xx 1933 A12x 1933 ('x' is any character)	The tape unit for the alternate IPL is not ready.	Make sure the correct tape is loaded. Make the tape unit ready. Wait for the System Attention light to go off. Then continue with the next step. If the System Attention light stays on for more than 5 minutes, check to see if you have the correct tape loaded in the tape unit for the alternate IPL and make the tape unit ready. Then continue with the next step.

Table 10-2 (Page 2 of 2). SRC Codes When Loading the Licensed Internal Code

SRC Code	Why It Appears	What You Do
B1xx 1803 **B1xx 1806** **B1xx 1938**	The tape unit for the alternate IPL was not found or was not ready.	Make sure the tape unit is powered on, the correct tape is loaded, and ready. Then continue with the next step.
B1xx 1934	The wrong tape is loaded. Or the high-speed feature is enabled on the 2440 Tape Unit.	Load the correct tape and make the tape unit ready. Then continue with the next step or disable the high-speed feature on the 2440 Tape Unit.
2507 0001 **2642 0001** **2643 0001**	A tape is not loaded in the tape unit for the alternate IPL.	Make sure the correct tape is loaded in the correct unit. Then continue with the next step.
2644 3136	The tape unit is assigned to another system.	Go to the other system and vary off the tape unit. Make sure the correct tape is loaded. Then continue with the next step.
Any other SRC	The system has encountered a problem loading the Licensed Internal Code.	

If the System Attention light is lit and no SRC code appears on the control panel, do the following:

Step a. Press the Function Select switch (or buttons) to display `03` (continue the IPL) in the Function display on the control panel.

Step b. Press the Enter button on the control panel.

Then continue with the next step.

Step 7 The Install Licensed Internal Code display is shown on your console:

```
                    Install Licensed Internal Code

Select one of the following:

     1. Install Licensed Internal Code
     2. Work with Dedicated Service Tools (DST)
```

Type a `1` and press the Enter key.

Step 8 The Install Licensed Internal Code (LIC) display is shown on your console.

Stop!

You are now ready to recover your Licensed Internal Code. Consult your recovery checklist before continuing. The checklist tells you the correct option to select from the Install Licensed Internal Code (LIC) display.

Loading the Licensed Internal Code

To complete the procedure for loading the Licensed Internal Code to your system during a recovery, do the following:

__ **Step 1** You should see the Install Licensed Internal Code (LIC) display:

```
                    Install Licensed Internal Code (LIC)

Disk selected to write the Licensed Internal Code to:
    Serial Number     Type     Model     I/O Bus      Controller     Device
     xx-xxxxxxx       xxxx      xxx          x             x            x

Select one of the following:

     1. Restore Licensed Internal Code
     2. Install Licensed Internal Code and Initialize system
     3. Install Licensed Internal Code and Recover Configuration
     4. Install Licensed Internal Code and Restore Disk Unit Data
     5. Install Licensed Internal Code and Upgrade Load Source
```

Select the correct option and press the Enter key.

Attention!

Be sure you consult the correct recovery checklist before selecting an option from the Install Licensed Internal Code (LIC) display. Some options remove all data from your system.

__ **Step 2** One of the following Install LIC and Initialize System–Confirmation screens is shown if you chose option 2, 3, 4, or 5 from the LIC installation display. You must press F10 to continue the installation; pressing the enter key just re-displays the confirmation screen.

```
                Install LIC and Initialize System - Confirmation

Warning:
    All data on this system will be destroyed and the Licensed
    Internal Code will be written to the selected disk if you
    choose to continue the initialize and install.

    Return to the install selection screen and choose one of the
    other options if you want to perform some type of recovery
    after the install of the Licensed Internal Code is complete.



    Press F10 to continue the install.
    Press F12 (Cancel) to return to the previous screen.
    Press F3 (Exit) to return to the install selection screen.
```

```
              Install LIC and Recover Configuration - Confirmation

Warning:
    All data on the selected disk will be destroyed and the Licensed
    Internal Code will be written to this disk if you choose to
    continue the install.  When the install is complete, an IPL
    will be done and you will be prompted to continue the recovery
    of the DASD configuration.



    Press F10 to continue the install.
    Press F12 (Cancel) to return to the previous screen.
    Press F3 (Exit) to return to the install selection screen.
```

```
          Install LIC and Restore Disk Unit Data - Confirmation

Warning:
    All data on the selected disk will be destroyed and the Licensed
    Internal Code will be written to this disk if you choose to
    continue the install.  When the install is complete, an IPL
    will be done and you will be prompted to restore the disk unit
    data that you previously saved.




    Press F10 to continue the install.
    Press F12 (Cancel) to return to the previous screen.
    Press F3 (Exit) to return to the install selection screen.
```

```
          Install LIC and Upgrade Load Source - Confirmation

Warning:
    All data on the selected disk will be destroyed and the Licensed
    Internal Code will be written to this disk if you choose to
    continue the install.  When the install is complete, an IPL
    will be done and you will be prompted to complete the upgrade.




    Press F10 to continue the install.
    Press F12 (Cancel) to return to the previous screen.
    Press F3 (Exit) to return to the install selection screen.
```

See Appendix A, "Licensed Internal Code Installation Error Screens" on page A-1 for information on the possible error screens that can be displayed during LIC installation.

The Initialize the Disk–Status screen is shown if you chose option 2, 3, 4, or 5 on the install selection menu, and then pressed F10 on the confirmation screen. The actual time to initialize the disk can be considerably less than the estimated time, depending on the current state of the disk.

```
              Initialize the Disk - Status

The load source disk is being initialized.


Estimated time to initialize in minutes :   ___

Elapsed time in minutes . . . . . :   ___._
```

__ **Step 3** The Install Licensed Internal Code–Status display is shown on your console. You do not need to respond to this display. This display is shown for approximately 30 minutes.

```
                    Install Licensed Internal Code - Status

Install of the Licensed Internal Code in progress.

Percent complete . . . . . :     x

Elapsed time in minutes  . . . . . :     x.x









Please wait.

Wait for next display or press F16 for DST main menu
```

__ **Step 4** If an error occurs, you may see a display that requires a response.

```
                    Disk Configuration Warning Report

Type option, press Enter
    5=Display Detailed Report

Press F10 to accept all warnings and continue the IPL.
The system will attempt to correct the warnings.

OPT    Warning
___    New disk configuration
```

Perform the action necessary as prompted by the display. Otherwise, press F10 to continue.

Stop!

You have finished loading your Licensed Internal Code. From this checklist you must decide to either select F3=Exit to Dedicated Service Tools (DST) to work with the disk units or F10=Accept warnings and continue the IPL.

Starting Your System After Restoring Licensed Internal Code

Perform this procedure if you do not need to restore the operating system. After you complete loading the Licensed Internal Code, you should see the IPL or Install the System display:

```
                          IPL or Install the System

Select one of the following:

          1. Perform an IPL
          2. Install the operating system
          3. Use Dedicated Service Tools (DST)
          4. Perform automatic installation of the operating system
          5. Save Licensed Internal Code
```

Do the following:

__ Step 1. Select option 1 (Perform an IPL) on the IPL or Install the System menu. When the IPL completes, the Sign On display is shown.

__ Step 2. If your operator panel has a keylock switch, turn the key in the keylock switch to the normal position.

__ Step 3. Sign on the system as QSECOFR.

__ Step 4. If the Select Product to Work with PTFs display appears, press F3 (Exit) to continue the IPL.

__ Step 5. Press the Enter key in response to any messages that are displayed.

__ Step 6. When you are shown the IPL options display, type your choices and press the Enter key.

```
                                IPL Options

Type choices, press Enter.

  System date  . . . . . . . . . . . . . .   07 / 26 / 88
  System time  . . . . . . . . . . . . . .   12 : 00 : 00
  Clear job queues . . . . . . . . . . . .   N
  Clear output queues  . . . . . . . . . .   N
  Clear incomplete job logs  . . . . . . .   N
  Start print writers  . . . . . . . . . .   Y
  Start this device only . . . . . . . . .   N


  Set major system options . . . . . . . .   Y
  Define or change system at IPL . . . . .   N
```

Stop!

You have now completed starting your system after recovering the Licensed Internal Code. Consult your recovery checklist to determine the next step in your recovery process.

Recovering Your Disk Configuration

When you install the Licensed Internal Code using option 2 or option 3 from the Install Licensed Internal Code (LIC) menu, the system does the following:

- Clears disk unit 1. Disk unit 1 contains information about how all the other disk units on your system are configured.
- Assigns all disk units to the system ASP.
- Prepares to delete all data in the system ASP. The system ASP is not actually cleared until you perform the IPL after installing the Licensed Internal Code.

Every disk unit on your system contains information about how it is configured. Dedicated services tools (DST) provides an option to recover the disk configuration on your system by using this information. The system reads every disk, assigns it to the correct auxiliary storage pool (ASP), and rebuilds the disk configuration information on unit 1.

In many cases, you can recover your disk configuration and avoid having to reload all your user ASPs. To recover your disk configuration, do the following:

__ **Step 1** When you complete installing the Licensed Internal Code, you are shown the Disk Configuration Error Report display on the A or B mode IPL:

```
                    Disk Configuration Error Report

Type option, press Enter
    5=Display Detailed Report

OPT    Error
__     Missing disk configuration
__     ____________________________________________________
__     ____________________________________________________
```

__ **Step 2** If you type a 5 in the option column (OPT), you are shown Missing Disk Configuration display:

```
                    Missing Disk Configuration

The system disk configuration has been lost.  The IPL
cannot be continued.

The following are the recommended recovery procedures:
 o  If the original system has more than one disk unit
    configured and you want to keep the configuration
    currently on the system, use Recover configuration
    under Work with Disk Units.
      -  Press F3 to use Dedicated Service Tools (DST).
      -  Select option 4, Work with disk units.
      -  Select option 2, Work with disk unit recovery.
      -  Select option 5, Recover configuration.

 o  If the original system had only one disk unit configured
    or you do not want to save the data currently on the
    system, re-install the Licensed Internal Code, then
    re-create the configuration, restore your data.

F3=Exit to use Dedicated Service Tools (DST)   F12=Cancel
```

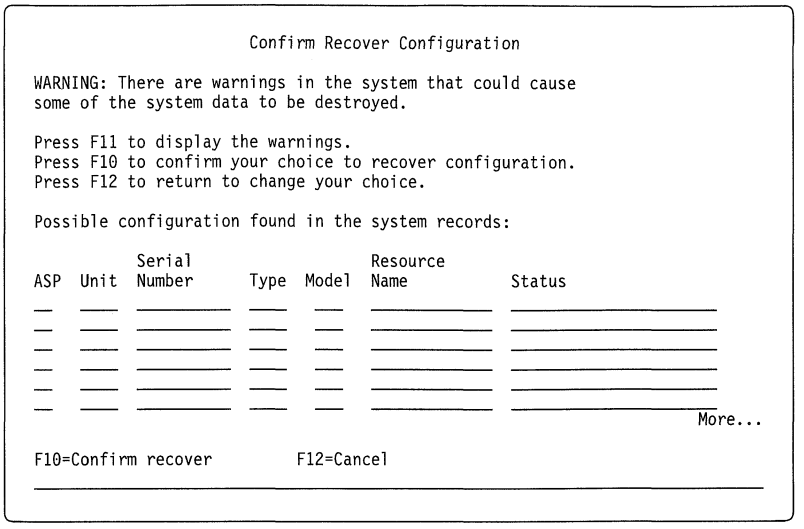
From either display, press F3 (Exit to Use Dedicated Service Tools (DST)). You are shown the Use Dedicated Service Tools (DST) menu.

__ **Step 3** From the Use Dedicated Service Tools (DST) menu, select option 4 (Work with Disk Units).

__ **Step 4** From the Work with Disk Units menu, select option 2 (Work with Disk Unit Recovery).

__ **Step 5** From the Work with Disk Unit Recovery menu, select option 5 (Recover Disk Configuration). You are shown one of the following displays. The display you are shown depends on the recovery steps that you have already performed.

```
                    Confirm Recover Configuration

Confirming the configuration will automatically IPL the system.
You will return to the DST main menu following IPL.

Press Enter to confirm that the following configuration is correct.
Press F12 to return to change your choice.

Possible configuration found in the system records:

                Serial                          Resource
ASP  Unit       Number        Type  Model       Name          Status
__   ____  ____________  ____  ____  ____________  ____________________
__   ____  ____________  ____  ____  ____________  ____________________
__   ____  ____________  ____  ____  ____________  ____________________
__   ____  ____________  ____  ____  ____________  ____________________
__   ____  ____________  ____  ____  ____________  ____________________
__   ____  ____________  ____  ____  ____________  ____________________
__   ____  ____________  ____  ____  ____________  ____________________
__   ____  ____________  ____  ____  ____________  ____________________
                                                                  More...

F12=Cancel
```



__ **Step 6** Check the configuration of disk units on the display. The display shows the disk units that are assigned to each user ASP and to the system ASP (ASP 1). The warning on the display means that the system will clear all data on disk units in the system ASP.

If this configuration is *not* correct, contact a service representative or software support for assistance. Do not proceed further without getting help.

If the configuration that is shown *is* correct, press F10 to confirm the configuration. The system builds the configuration information and returns to the DST menu.

__ **Step 7** Press F12 to cancel the DST menu. You are shown the IPL or Install the System menu.

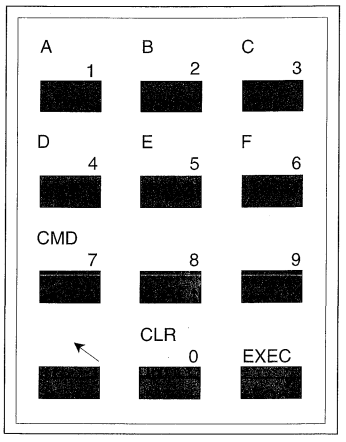
Stop!

You have now completed installing your Licensed Internal Code. Continue with the next step on your recovery checklist, which is restoring the operating system.

Disabling and Enabling the High-Speed Feature on the 2440 Tape Unit

If you have a 2440 Tape Unit with the high-speed feature enabled, it must be disabled before you can install or restore the Licensed Internal Code. After the restore operation, you can enable the high speed again. The high-speed feature is disabled or enabled from the control panel on the 2440 Tape Unit.

To find the control panel, open the front door of the 2440 Tape Unit. The control panel is located in the upper right-hand corner. The following figure illustrates the control panel.



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Disabling the High-Speed Feature: To disable the high-speed feature before the restore operation, do the following from the control panel:

1. Press the arrow key and then the CMD 7 key.
2. Press the 9 key and then the 2 key.
3. Press the EXEC key.
4. Press the arrow key and then the CMD 7 key.
5. Press the 9 key and then the 3 key.
6. Press the EXEC key.
7. Press the arrow key and then the CMD 7 key.
8. Press the 6 key twice.
9. Press the EXEC key.
10. Press the 1 key.
11. Press the EXEC key.

Enabling the High-Speed Feature: To enable the high-speed feature after the restore operation, do the following from the control panel:

1. Press the arrow key and then the CMD 7 key.
2. Press the 9 key and then the 2 key.
3. Press the EXEC key.
4. Press the arrow key and then the CMD 7 key.
5. Press the 9 key and then the 3 key.
6. Press the EXEC key.
7. Press the arrow key and then the CMD 7 key.
8. Press the 6 key twice.
9. Press the EXEC key.
10. Press the CLR 0 key.
11. Press the EXEC key.

Chapter 11. Restoring the Operating System

This chapter describes the procedures for recovering the operating system. The procedure described here assumes that the Licensed Internal Code is already installed on your system. Normally, the Licensed Internal Code is installed. However, if the Licensed Internal Code is not on your system or is damaged, use the charts in Chapter 9 to determine the correct recovery procedure for your situation.

Why You Restore the Operating System: You might need to restore the operating system for several reasons, such as:

- You are encountering problems with the operating system, such as damaged objects.
- The software support center recommends it.
- You have replaced a disk unit in the system ASP.
- You are updating your system to a new release. See the *Software Installation* book or the *AS/400 Road Map for Changing to PowerPC Technology* book for the procedures to install a new release of the AS/400 system.

Find These Things Before You Begin:

___ Your most recent SAVSYS tapes. A SAVSYS tape is created by one of the following:

Running the Save System (SAVSYS) command
Using option 21 from the Save menu.
Using option 22 from the Save menu.
Using option 11 from the Run Backup menu.

___ If you do not have current SAVSYS tapes or they are damaged, you need the following:

- The distribution media supplied by IBM
- All the media for program temporary fixes (PTFs) that you have applied.

Attention!

Use the distribution media only if you do not have SAVSYS tapes. If you use the distribution media to restore the operating system, the version you restore will not have any of the PTFs that you have applied. In addition, the following are set to the default values that ship with the OS/400 licensed program:

- System information
- Network attributes
- Configuration lists
- Edit descriptions
- Reply list entries
- IBM-supplied subsystem descriptions
- Passwords for IBM-supplied profiles

___ The list of all the PTFs applied to your system at the time you saved the entire system. This list should be attached to your backup log or found with your SAVSYS tapes.

___ The key or keystick for the system.

___ The DST password, if you have set up your system with the installation of the operating system secured.

___ The QSECOFR password that is associated with the SAVSYS tapes that you are using.

Do These Things Before You Begin:

__ Clean the read and write heads of the tape unit.

__ If your system is operational, print a list of all the PTFs currently on the system, unless you printed the list before restoring the Licensed Internal Code. Type the following and press the Enter key:

```
DSPPTF LICPGM(*ALL) OUTPUT(*PRINT)
```

Choosing the Right Procedure for Restoring the Operating System

You can restore the operating system in several different ways. At several points during the restore process, you need to make decisions based on which of these operations you are using:

Complete Restore Use a complete restore operation if the operating system is not on your system or if it has damaged objects. This restores all the IBM-supplied objects in the QSYS library and the language libraries from media.

Abbreviated Install Use an abbreviated install operation to replace parts of the operating system or system information, such as system values or the system reply list.

Use the recovery checklist that you selected in Chapter 9 to determine the correct procedure for your situation. You also need to know whether you are restoring from SAVSYS tapes or the IBM-supplied distribution media. Use the distribution media only if you do not have usable SAVSYS tapes.

How to Begin Restoring the Operating System: The steps you have already performed determine where you start:

- If you have just restored or installed the Licensed Internal Code, you are doing a complete restore operation of the OS/400 program. You should see the IPL or Install the System display. Start with the steps described in "Steps for Restoring the OS/400 Licensed Program" on page 11-3.
- If restoring the operating system is the first step or only step in your recovery process, start by performing a manual IPL. This is described in "Loading the Operating System Using a Manual IPL."

Loading the Operating System Using a Manual IPL

Follow these steps to begin loading the operating system. Use these steps only if you have not just restored the Licensed Internal Code, as described in Chapter 10.

To perform a manual IPL, do the following:

__ **Step 1** Ensure the tape unit or the CD-ROM unit is ready. For more information on loading the tape or the CD-ROM, see the setup manual for the device.

__ **Step 2** Load the first tape from your most recent SAVSYS tapes in the tape unit. If you do not have SAVSYS tapes or they are unusable, load the first CD-ROM from the distribution media. Use the distribution media only if no SAVSYS tape exists.

__ **Step 3** Ensure the key or keystick is in the system unit.

__ **Step 4** Place the system in manual mode.

__ **Step 5** Ensure that all jobs are ended and all users are signed off.

__ **Step 6** Power down the system:

```
PWRDWNSYS OPTION(*IMMED) RESTART(*YES) IPLSRC(B)
```

__ **Step 7** Continue with "Steps for Restoring the OS/400 Licensed Program" on page 11-3.

Steps for Restoring the OS/400 Licensed Program

You are ready to begin these steps when you have completed an IPL. Either you have just restored the Licensed Internal Code or you have just performed a manual IPL from your alternate IPL device. You should see the IPL or Install the System display:

```
                        IPL or Install the System

Select one of the following:

          1. Perform an IPL
          2. Install the operating system
          3. Use Dedicated Service Tools (DST)
          4. Perform automatic installation of the operating system
          5. Save Licensed Internal Code
```

Task 1–Starting to Restore the Operating System

__ **Step 1** Ensure that the first tape from your most recent SAVSYS tapes is loaded in the tape unit. If you do not have SAVSYS tapes, load the first operating system CD-ROM.

__ **Step 2** From the IPL or Install the System display, select option 2 (Install the operating system).

Note: Do not use option 4 (Perform automatic installation of the operating system) to restore the operating system.

__ **Step 3** Press the Enter key.

The Confirm Install of the Operating System display is shown.

```
                    Confirm Install of Operating System

Press Enter to confirm your choice to install the operating system.
Press F12 to return and cancel your choice to install the
  operating system.
```

__ **Step 4** Press the Enter key. If you see the Dedicated Service Tools (DST) Sign On display, continue with step 5. If you see the Select a Language Group display, skip to step 6.

__ **Step 5** If your system is set up to prevent unauthorized installation of the operating system, you are shown the following display:

```
                    Dedicated Service Tools (DST) Sign On

Type choice, press Enter.

  DST user . . . . . .  _____
  DST password . . . . .  _____
```

Type the DST user and the DST password and press the Enter key. You see the Select a Language Group display.

Notes:

a. The DST user is the same as the shipped value for the password for the DST level. The DST user for security level DST is QSECOFR.

b. If your current DST password does not work, the password may have been reset to the shipped value. Try QSECOFR as the DST password.

c. For more information about preventing unauthorized installation of the operating system, see the *Security – Reference* book.

__ **Step 6** You are shown the Select a Language Group display:

```
                          Select a Language Group

Note:  The language feature shown is the language feature
installed on the system.

Type choice, press Enter.

  Language feature . . . . . . . . . . . . . . .  2924
```

This display shows the primary language currently on the save media that you are restoring.

This value should match the value that is already on your system. If it does not, check to ensure that you have the correct save media. If you change the value on the display, you will be prompted to insert different media to load a different language feature.

If you are restoring a primary language other than English, the language-sensitive system values are set to their default values. You need to reset them to the correct values for your installation by doing the following:

- At step 4 on page 11-10, specify `Y` for the *Define or change system at IPL* prompt.
- At step 4a on page 11-12, set the system values.

Press the Enter key. You are shown the Confirm Language Feature Selection display.

```
                      Confirm Language Feature Selection

Language feature  . . . . . . . . . . . . . . . . . . :   2924

Press Enter to confirm your choice for language feature.
  Installing the system will continue.
Press F12 to return to change your choice for
  language feature.
```

__ **Step 7** Press the Enter key to confirm the information.

Note: If you have to change your system's primary language, see the *Software Installation* book for more information.

If you see the Add All Disk Units to the System display, continue with step 8. If you see an IPL status message display, skip to step 9 on page 11-5.

__ **Step 8** This display is shown only if disk units are in nonconfigured status:

```
                      Add All Disk Units to the System

Select one of the following:

   1. Keep the current disk configuration
   2. Perform disk configuration using DST
   3. Add all disk units to the system auxiliary storage pool
```

Disk units may be in nonconfigured status for these reasons:

- The Licensed Internal Code was installed using option 2 or option 3. The recover disk configuration procedure was not run. All disk units except unit 1 appear in nonconfigured status.
- You have new or spare disk units that have not yet been configured on your system.

Use the information in Table 11-1 to determine how to respond to this display:

Table 11-1. Configuring Disk While Installing the Operating System

Your Recovery Situation	How To Respond to the Display
Restoring your entire system to a different system or to an upgraded system.	• If you plan to have user ASPs or mirrored protection you can select option 2 to configure your disks now. Or, you can select option 1 now and configure the disks after you have restored the operating system. Use the instructions in the *Backup and Recovery – Advanced* book if you plan to configure disk protection or user ASPs. • If you want all disks in the system ASP and do not plan to have mirrored protection, select option 3.
The Licensed Internal Code was installed on your own system using option 2 or option 3 during a recovery.	• If you want all disks in the system ASP and do not plan to have mirrored protection, select option 3. • If you had user ASPs or mirrored protection on your system before the failure, you can select option 2 to reconfigure your disks. This removes any data from disks that show as not configured. • You can select option 1 and configure your disks later. However, the system will not be able to recover the data on the disks that are not configured.

After selecting option 3, you receive a Warning Report display. Take the directed action for more detailed information, if necessary. Otherwise, press F10 to accept the warnings and continue.

If you installed the Licensed Internal Code using option 2, you receive a Warning report display. Take the directed action for more detailed information, if necessary. Otherwise, press F10 to accept the warnings and continue.

__ **Step 9** Following is an example of a status display. You may see several similar displays before the Install the Operating System display is shown. These status displays do not require any action by the user.

```
                          IPL Step in Progress

IPL step . . . . : Storage Management Recovery
```

The following list shows some of the IPL steps that are shown on the IPL Step in Progress display:

Authority Recovery
Journal Recovery
Database Recovery
Journal Synchronization
Start the Operating System

Some of the IPL steps could take a long time.

While the system is performing the IPL, system reference codes (SRCs) are displayed on the control panel of the system unit to indicate what step is in

progress. The *AS/400 Service Functions* book describes these SRCs. If the same SRC is displayed for a long time in solid (not flickering) lights, your system may have a problem completing the IPL. Look up the SRC in the *AS/400 Licensed Internal Code Diagnostic Aids – Volume 1* book or contact software support.

You may be prompted for additional volumes of your SAVSYS tapes or the distribution media. Follow the instructions on the display.

After the IPL steps complete, the Install the Operating System menu appears:

```
                        Install the Operating System

Type options, press Enter.

     Install
       option . . . .  __             1=Take defaults (No other
                                        options are displayed)
                                      2=Change install options

     Date:
       Year . . . . .  __             00-99
       Month  . . . .  __             01-12
       Day  . . . . .  __             01-31

     Time:
       Hour . . . . .  __             00-23
       Minute . . . .  __             00-59
       Second . . . .  __             00-59
```

__ **Step 10** Continue with Task 2.

Task 2–Selecting the Installation Options

__ **Step 1** Type your choice for the *Install option* prompt based on the following:

- If you are doing a *complete restore* operation, select option 1 (Take defaults). This restores the entire operating system. Use this option if any of the following is true:
  - You are recovering from a failure of the load source unit.
  - You are restoring your entire system.
  - You are upgrading to a new system.
  - You are recovering damaged objects in your operating system.
- If you are doing an *abbreviated install* operation, select option 2 (Change install options). This allows you to specify which parts of the operating system you want to restore. Use this option if you are recovering damaged system information, such as system values.

__ **Step 2** If the date and time are not correct, type new values.

__ **Step 3** Press the Enter key.

If you selected install option 1 (Take defaults), skip to step 11 on page 11-9.

If you selected install option 2 (Change install options), you are shown the Specify Install Options display:

```
                          Specify Install Options

Type choices, press Enter.

     Restore option . . . . __          1=Restore programs and language
                                          objects from current media set
                                        2=Do not restore programs or
                                          language objects
                                        3=Restore only language objects
                                          from current media set
                                        4=Restore only language objects
                                          from a different media set

     Job and output
       queues option . . . . _           1=Clear,  2=Keep
```

Continue with step 4.

__ **Step 4** Type your choice for the *Restore option* prompt based on the following:

1 = Restore programs and language objects

This option restores system objects from the media that you are using. Use this option if damage to a system user profile is found. If you select the option, you will be prompted to specify whether to restore system information, edit descriptions, or the system reply list.

Note: If your system had access path recovery times for user ASPs and the user ASPs have not yet been reconfigured, the system cannot restore access path recovery times for the ASPs. Use the Edit Recovery Times for Access Paths (EDTRCYAP) command to set the times after you have reconfigured your ASP configuration.

2 = Do not restore programs or language objects

This option leaves the current programs and language objects on the system. Select this option to do an abbreviated install of the operating system.

When you select this option, the system does the following:

- Nothing is restored from media. Any damaged objects that the system deletes and creates again are empty.
- All libraries on the system are checked for damage. Damaged libraries are deleted and then created again.
- All system libraries (including QSYS) are created if they do not exist.
- Information associated with the user profiles is created if it does not exist or is damaged.
- The system entry-point table is created again.

3 = Restore only language objects from current media

This option loads only those objects that make up the national language. The search for the language files begins on the current media. Select this option only if you need to change your primary language because you are recovering using the distribution media.

4 = Restore only language objects from a different media

This option loads only those objects that make up the national language. The system prompts you to insert the language media. Select this option only if you need to change your primary language because you are recovering using the distribution media.

Note: Consult the *Software Installation* book if you want to change the primary language. You should avoid changing the primary language during a recovery.

__ **Step 5** Type your choice for the *Clear Job and Output Queues* prompt based on the following:

1 = Clear
If you do not want to keep any spooled files or entries on job queues after the installation or if you know they are damaged, select this option. The system removes all jobs on job queues and spooled files. It re-creates any internal objects associated with them. You should select this option if you are performing an abbreviated installation of the operating system. This option also resets the counter for assigning unique job numbers.

2 = Keep
Any entries on job queues and output queues remain after the installation. This is the normal option for this prompt.

__ **Step 6** Type your choices on the display and press the Enter key.

If you did not specify 1 for the *Restore option* prompt, skip to step 11 on page 11-9.

If you specified 1 for the *Restore option* prompt, you are shown the Specify Restore Options display:

```
                        Specify Restore Options

Type choices, press Enter.

     Restore from media set:

        System information. . . _       1=Restore,  2=Do not restore
        Edit descriptions . . . _       1=Restore,  2=Do not restore
        Message reply list. . . _       1=Restore,  2=Do not restore
```

Continue with step 7.

__ **Step 7** Type your choice for the *System information* prompt based on the following:

1 = Restore
The system restores the system values and system management objects, such as access path recovery times, from media. Select this option if any of the following is true:

- You received a message during a previous IPL stating that the system value object was created again.
- You want to restore them to their values from your last save operation.
- You restored the operating system using option 2 or option 3 from the Install Licensed Internal Code (LIC) display.

If you have changed your primary language since your last save operation, the system may change some language-dependent system values during the restore operation.

2 = Do not restore
The system values and system management objects that are currently on the system are not changed.

A system value object must always be present on an operational system. If the system value object does not exist, the system restores it, even if you select option 2.

Note: For more information about system values, see the *Work Management* book. For more information about access path recovery times, see the chapter of the *Backup and Recovery – Advanced* book

called "Protecting Access Paths Using System-Managed Access-Path Protection."

__ **Step 8** Type your choice for the *Edit descriptions* prompt based on the following:

1 = Restore
The system restores the edit descriptions from media. Select this option if:

- The edit descriptions are damaged.
- You want to restore them to their values from your last save operation.
- You installed the Licensed Internal Code by using option 2 or option 3 from the Install Licensed Internal Code (LIC) display.

2 = Do not restore
The edit descriptions currently on the system are not changed.

Note:

For more information about edit descriptions, see the *Programming Reference Summary*.

__ **Step 9** Type your choice for the *Message Reply List* prompt based on the following:

1 = Restore
The system restores the reply list from media. Select this option if:

- The message reply list is damaged.
- You want to restore it to its values from your last save operation.
- You installed the Licensed Internal Code by using option 2 or option 3 from the Install Licensed Internal Code (LIC) display.

2=Do not restore
The message reply list currently on the system is not changed.

Note: For more information about message reply lists, see the *Programming Reference Summary*.

The default for these options is 2 if the operating system is loaded on the system. The default is 1 if the operating system is not already loaded.

__ **Step 10** Type your choices on the display and press the Enter key.

__ **Step 11** Messages are shown to indicate how many program or language objects are restored. They are for your information only and require no response.

__ **Step 12** Continue loading media in sequence when messages are shown that ask you to load additional media. The system searches through the media and loads the necessary programs and language information. After processing all the system save tapes or distribution media, the following message may be displayed at the bottom of a blank display:

```
Operating system has been installed.  IPL in progress.
```

When the IPL is complete, the IPL Sign On display is shown and the system in ready to complete the IPL. Continue with the next task.

Task 3–Selecting IPL Options

__ **Step 1** Sign on as QSECOFR. The password for QSECOFR depends on the recovery steps you have performed:

- If you restored the operating system without first restoring the Licensed Internal Code, the QSECOFR password was not changed during the restore process.

- If you used option 1 to restore the Licensed Internal Code before you restored the operating system, the QSECOFR password is the password associated with the SAVSYS tapes you used.
- If you used option 2 or option 3 to install the Licensed Internal Code before restoring the operating system, no password is required at this time. The system security level is restored after the operating system is installed and the IPL completes. When the IPL completes, the QSECOFR password is the password associated with the SAVSYS tapes you used.

Note: If you do not know the QSECOFR password, you can use DST to reset the password to its shipped value of QSECOFR. See the *Security – Basic* book for instructions.

__ **Step 2** Press the Enter key. Informational messages are displayed.

__ **Step 3** If the Select Product to Work with PTFs display appears, press F3 (Exit) to continue.

```
                Select Product to Work with PTFs

Position to . . . . . .___________ Product


Type options, press Enter.  Press F21 to select all.
   1=Select

             Product
Opt  Product  Option  Release
 _   5763999  *BASE   V3R1M0
 _   5763SS1  *BASE   V3R1M0
```

__ **Step 4** You are shown the IPL Options display:

```
                                IPL Options

Type choices, press Enter.

  System date  . . . . . . . . . . . . . .   07 / 26 / 88
  System time  . . . . . . . . . . . . . .   12 : 00 : 00
  Clear job queues . . . . . . . . . . . .   N
  Clear output queues  . . . . . . . . . .   N
  Clear incomplete job logs  . . . . . . .   N
  Start print writers  . . . . . . . . . .   Y
  Start this device only . . . . . . . . .   N


  Set major system options . . . . . . . .   Y
  Define or change system at IPL . . . . .   N
```

The values that appear as defaults depend on the recovery steps you have performed.

__ **Step 5** If the system date and system time are not correct, type the correct values. If you installed the Licensed Internal Code using option 2 or option 3, the date and time may be blank. The system date must have a year value in the range of 87 to 99, or 00 to 22.

__ **Step 6** Type your choice for the *Start print writers* prompt based on the following:

N = No Select this value if you are going to restore user profiles, device configuration objects, user libraries, and authorities.

Y = Yes Select this value if you have completed your recovery.

__ **Step 7** Type your choice for the *Start this device only* prompt based on the following:

Y = Yes Select this value if you are going to restore user profiles, device configuration objects, user libraries, and authorities. Only the console is started (varied on).

N = No Select this value if you have completed your recovery. All devices are started.

__ **Step 8** Type `Y` (Yes) for the *Set major system options* prompt.

__ **Step 9** Type your choice for the *Define or change system at IPL* prompt based on the following:

Y = Yes Select this option if:

- You are restoring to a different system because of a complete system loss or a system upgrade.
- The System/36 environment is your main operating environment. You need to change the QIPLTYPE system value.
- You are recovering only part of your system. You need to ensure that all the libraries in the library list (QSYSLIBL and QUSRLIBL system values) are restored or remove the libraries not being restored from the library list.
- The primary language on your system is not English.

N = No You want to bypass defining or changing the system during IPL.

__ **Step 10** Type your choices on the display and press the Enter key. Continue with the next task.

Task 4–Setting Major System Options

__ **Step 1** You are shown the Set Major System Options display:

```
                        Set Major System Options

Type choices, press Enter.

  Enable automatic configuration . . . . . Y           Y=Yes, N=No
  Device configuration naming  . . . . . . *NORMAL     *NORMAL, *S36,
                                                       *DEVADR
  Default special environment. . . . . . . *NONE       *NONE, *S36
```

__ **Step 2**

Enable automatic configuration?

If you choose to enable automatic configuration, the system will create a device description for every device that is attached to your system. The device description will be named according to the value that you specify for *Device configuration naming*. You may need to change the names and descriptions of these device descriptions later.

If you choose not to enable automatic configuration, you will need to configure at least one tape device later in your recovery. You must configure the tape device after you have finished restoring the operating system and before you begin restoring any other information. You may also need to correct the device configuration for the system console and respond to SRC A900 2000. (step 10 on page 11-15). The instructions to recover from SRC A900 2000 are provided.

__ **Step 3** Type your choices and press the Enter key.

__ **Step 4** If you specified Y for the *Define or change system at IPL* prompt in step 4 on page 11-10, continue with "Task 5–Defining or Changing the System at IPL" on page 11-12. If you specified N for the the *Define or change system at IPL* prompt in step 4 on page 11-10, skip to "Task 6–Completing the IPL" on page 11-14.

Task 5–Defining or Changing the System at IPL

__ **Step 1** If you specified Y for *Enable automatic configuration* on the Set Major System Options display, skip to step 3. If you specified N, continue with step 2.

__ **Step 2** If you have chosen not to enable automatic configuration, you must change the QIPLTYPE system value. Do the following:

__ **Step a.** From the Define or Change the System at IPL menu, select option 3 (System value commands). Press the Enter key.

__ **Step b.** Select option 3 (Work with system values) and press the Enter key.

__ **Step c.** Type a 2 in the *Option* column next to the system value QIPLTYPE and press the Enter key.

__ **Step d.** Change the value to 2 and press the Enter key.

__ **Step e.** Press F12 until you return to the Define or Change the System at IPL menu.

__ **Step 3** If you are restoring from the distribution media, continue with step 4.

If the primary language on your system is not English, continue with step 4.

If you are restoring to a different system or to an upgraded system from your SAVSYS tapes, skip to step 5 on page 11-13.

If you are restoring to the same system from your SAVSYS tapes, skip to step 6 on page 11-13.

__ **Step 4** When you restore the system from the distribution media or when you restore to a different system from SAVSYS tapes, the system resets some system information, such as system values and network attributes, to the IBM-supplied defaults.

Use whatever documentation you have to set the system values to the correct settings for your installation:

__ **Step a.** From the Define or Change the System at IPL menu, select option 3 (System value commands) and press the Enter key.

__ **Step b.** Select option 3 (Work with system values) and press the Enter key.

__ **Step c.** Type a 2 in the *Option* column next to the system values that you want to change and press the Enter key. If the primary language on your system is not English, you may need to reset these language-sensitive system values:

QCCSID	Default system code character set
QCHRID	Default system code page
QCNTRYID	Country identifier
QCURSYM	Currency symbol
QDATFMT	Date editing format
QDATSEP	Date separator
QDECFMT	Decimal data editing format
QKBDTYPE	Default workstation keyboard type
QIGCCDEFNT	Double-byte coded font name
QLANGID	Language identifier

QLEAPADJ	Leap year adjustment
QTIMESEP	Time separator
QUTCOFFSET	Coorinated universal time offset

__ **Step** **d.** Change the values to the correct values and press the Enter key.

__ **Step** **e.** Press F12 to return to the Define or Change the System

Note: Some system values cannot be changed at this time. You will need to change these values later in the recovery process.

__ **Step** **5** If you are restoring to a different system with a different serial number, the following network attributes are reset to the shipped values:

- System name
- Local network ID
- Local control point name
- Default local location name
- Default node
- Default type
- Maximum number of intermediate sessions
- Route addition resistance
- Network node servers
- Alter primary focal point
- Alert default focal point

If you are restoring from distribution media and have previously changed the network attributes from the IBM-supplied defaults, you need to reset them. Do the following:

__ **Step** **a.** From the Define or Change the System at IPL menu, select option 4 (Network attributes commands) and press the Enter key.

__ **Step** **b.** Select option 2 (Change network attributes). Press the Enter key to display a list of network attributes.

__ **Step** **c.** Change the values to the correct network attributes and press the Enter key.

__ **Step** **d.** Press F12 (Cancel) to return to the Define or Change the System at IPL menu.

__ **Step** **6** If you are partially restoring (only some libraries), continue with step 7. Otherwise, skip to step 8.

__ **Step** **7** If you are partially restoring, you need to make sure that all libraries specified in the QSYSLIBL and QUSRLIBL system values are on the system. Do the following:

__ **Step** **a.** From the Define or Change the System at IPL menu, select option 3 (System value commands). Press the Enter key.

__ **Step** **b.** Select option 3 (Work with system values) and press the Enter key.

__ **Step** **c.** Type a 2 in the *Option* column next to the system values you want to change and press the Enter key.

__ **Step** **d.** Change the values to the correct values and press the Enter key.

__ **Step** **e.** Press F12 to return to the Define or Change the System at IPL menu.

__ **Step** **8** Continue with "Task 6–Completing the IPL" on page 11-14.

Task 6–Completing the IPL

__ **Step 1** Press F3 to continue the IPL.

__ **Step 2** The following display is shown during the IPL process (attended mode) when system access paths are marked for rebuild:

```
                    Edit Rebuild of Access Paths                RCHAS331
                                                          05/12/90  13:49:34

IPL threshold . . . . . . . . . . . . . 50   0-99

Type sequence, press Enter.
Sequence:  1-99, *OPN, *HLD

                    ------------Access Paths----------  Unique  Rebuild
Seq   Status        File        Library     Member       Keyed   Time
25__  IPL           QAPZSYM2    QSYS        QAPZSYM2     NO      00:00:01
```

"Task 2–Using the Edit Rebuild of Access Paths Display" on page 12-5 describes how to interpret and update this display.

A status message is sent to notify the user that the system is performing access path recovery.

__ **Step 3** Make any changes and press the Enter key. If you have made changes, the Edit Rebuild of Access Paths display is shown again confirming your changes or showing error messages. Repeat this step until the Display Access Path Status display is shown or the IPL continues.

__ **Step 4** The Display Access Path Status display is updated every 5 seconds while the system is rebuilding access paths:

```
                      Display Access Path Status

IPL Threshold . . . . . . : 50

          ----------Access Paths----------   Rebuild     Current
Status    File        Library    Member      Build Time  Run Time
RUN       QAPZSYM2    QSYS       QAPZSYM2    00:00:01    00:00:01
JRN       QAPZREQ2    QSYS       QAPZREQ2    00:00:01
SYS       QASULE03    QSYS       QASULE03    00:00:01
IPL       QASULE01    QSYS       QASULE01    00:00:01
```

If you want to make changes, press F12 (Cancel) to return to the Edit Rebuild of Access Paths display. If all access paths are rebuilt or you no longer want to see the display, press F3 (Exit and continue IPL).

__ **Step 5** The following display is shown if referential constraints need to be verified:

```
                      Edit Check Pending Constraints              RCHASLJF
                                                          03/30/94  10:09:27
Type sequence, press Enter.
Sequence:  1-99, *HLD

                      ----------Constraints-----------  Verify    Elapsed
Seq   Status          Cst       File        Library     Time      Time

75__  AFTIPL       CSTF1       FILE567890  LIB4567890  00:00:56  00:00:00
```

"Task 3–Using the Edit Check Pending Constraints Display" on page 12-6 describes how to interpret and update this display.

__ **Step 6** Make any changes and press the Enter key. If you have made changes, the Edit Check Pending Constraints display is shown again confirming your changes or showing error messages. Repeat this step until the Display Constraint Status display is shown or the IPL continues.

__ **Step 7** The Display Constraint Status display is updated every 5 seconds while the system is verifying constraints:

```
                    Display Constraint Status

IPL Threshold . . . . . . . : 50

          ----------Constraints----------   Verify      Elapsed
Status    Constraint  File       Library     Time        Time
RUN       CUST1       CUSTMAST   CUSTLIB     00:00:04    00:00:01
RUN       CUST2       CUSTMAST   CUSTLIB     00:00:05    00:00:01
IPL       ORDHST1     ORDHIST    ORDLIB      00:00:23    00:00:00
```

If you want to make changes, press F12 (Cancel) to return to the Edit Check Pending Constraints display. If all constraints are verified or you no longer want to see the display, press F3 (Exit and continue IPL).

__ **Step 8** If QSYSOPR messages are displayed, press the Enter key.

__ **Step 9** Press the Enter key to continue. If you restore the operating system from distribution media, you may have a problem with sending messages or creating documents if you have OfficeVision for OS/400. To prevent errors, enter the following command:

```
MRGMSGF QOFC/QZOFCMSG QSYS/QOFCMSG
```

__ **Step 10** You may receive A900 2000 on the control panel or message CPF0975, `Console did not vary on`, on the console display. This occurs if your system configuration was lost and you have disabled automatic configuration. The system has created device description QCONSOLE to allow you to continue the restore operation. You may also receive SRC A900 2000 if you perform an IPL when the QIPLTYPE system value is set to `2`. Do not create a user-defined device description for the console display. This can cause unpredictable results.

If you receive this message, perform the steps described in "Recovering from SRC A900 2000" before continuing.

__ **Step 11** If you restored from the distribution media using a 1/4-inch cartridge tape drive, the light on the tape drive may still be on. After the system has finished restoring the operating system, you may remove the tape while the light is on.

Stop!

When the Sign On display appears, you have completed restoring the operating system. Consult your recovery checklist for the next step in your recovery process.

Recovering from SRC A900 2000

When you restore the operating system, you may see SRC A900 2000. This happens when you use option 2 or option 3 to install the Licensed Internal Code and automatic configuration is not active while you are restoring the operating system. Before you can continue your recovery operations, you must create a tape description and possibly a controller description to finish the restore operation. Do not create a user-defined device description for the console display. Your device configuration is no longer on the system. Before you can restore your configuration, you must configure the tape device for the restore operation.

Note: The system may display SRC A900 2000 on the control panel. This means that the system console is not configured. The system creates a temporary configuration for the system console. Your configuration for the console will be restored later. SRC A900 2000 will continue to be displayed until you perform an IPL.

Do the following:

If your tape unit is a 3422, 3430, 3480, or a 3490, do the following:

__ **Step 1** Use the Work with Hardware Resource (WRKHDWRSC) command to determine the location of the tape controller.

```
WRKHDWRSC TYPE(*STG)
```

__ **Step 2** Locate the resource name for the tape controller on the Work with Storage Resources display. The values 2604, 2622, or 2644 are displayed in the *Type* column.

__ **Step 3** Type a 9 (Work with) in the *OPT* column next to name and press the Enter key. The Work with Storage Controller Resources display is shown.

__ **Step 4** Locate the resource for the tape controller (for example, TAPCTL01).

__ **Step 5** Type a 7 (Create description) in the *Opt* column next to the name and press the Enter key. The Create Controller Description display is shown.

__ **Step 6** Enter a tape controller name (such as TAPCTL01) in the *New device description* prompt and press the Enter key.

__ **Step 7** On the Create CTL Desc (Tape) (CRTCTLTAP) display, enter a controller description name and controller type and model.

__ **Step 8** Use the Create Device Description command to create a device description for each tape unit attached to the controller. For example:

```
CRTDEVTAP DEVD(TAPxx) TYPE(34xx) MODEL(model-number)
     CTLD(tape-controller-description) TEXT('text description')
```

where DEVD is the name of the description, TYPE is tape unit type, MODEL is the model (or *ANY), and CTLD is the name of the controller description created above.

__ **Step 9** Use the Work with Configuration Status command to vary on the controller and tape unit.

```
WRKCFGSTS *CTL *TAP
```

__ **Step 10** Find the controller description and type a 1 in the *Opt* column next to the name. Press the Enter key. This varies on the controller and any tape units attached to the controller.

If you are not using a 34xx tape unit, do the following:

__ **Step 1** Use the Work with Hardware Resource (WRKHDWRSC) command to determine tape controller name.

```
WRKHDWRSC TYPE(*STG)
```

__ **Step 2** Locate the tape controller on the Work with Hardware Resources display.

__ **Step 3** Type a 9 (Work with) next to tape controller name and press the Enter key.

__ **Step 4** Locate the resource name for the tape unit (for example, TAP01).

__ **Step 5** Enter a 5 (Work with Configuration) in the *Opt* column next to the tape resource name and press the Enter key.

You are shown the Work with Configuration Descriptions display.

__ **Step 6** Type a 1 (Create) in the *Option* field and a tape device description name (for example, TAP01) in the *New device description* field. Press the Enter key. You are shown the Create Device Description (Tape) display.

__ **Step 7** Change any values that you wish to change, then press the Enter key to create the device description. You are shown the Work with Configuration Descriptions display again. The device that you created should appear on the display.

__ **Step 8** Type an 8 (Work with configuration status) in front of the new device description. You are shown the Work with Configuration Status display.

__ **Step 9** Type a 1 (Vary on) in front of the new device. If the status does not change to Varied On, wait a few minutes. Then press F5 (Refresh). If the status still does not change to Varied On, follow normal problem determination procedures for the device.

__ **Step 10** Press F3 until you return to the main menu.

SRC A900 2000 remains displayed on the control panel throughout the remaining restore operations. When the final IPL of the system is complete, SRC A900 2000 disappears. The user-defined device description for the console display will be restored when the Restore Configuration (RSTCFG) command is run later in the recovery.

Stop!

When the Sign On display appears, you have completed restoring the operating system. Consult your recovery checklist for the next step in your recovery process.

Chapter 12. Starting the System after It Ends Abnormally

When your system stops normally, it does the following:

- Writes changed pages of information from memory to auxiliary storage.
- Closes access paths and files.
- Ends programs and jobs at natural stopping points.

If your system stops without having time to do these things, it is called an **abnormal end**. Your system might end abnormally for the following reasons:

- A power failure.
- A disk failure, if you do not have mirrored protection or device parity protection.
- A failure in the processor.
- Failure of a critical operating system program.
- Operator action (forced power down).

What Happens When Your System Stops

The following list describes circumstances that cause your system to stop unexpectedly and what happens:

Power failure with uninterruptible power supply
When the system loses normal power, the uninterruptible power supply system takes over and keeps the system running. The system detects this change and sends a message to your power-monitoring program. Your program can decide whether to keep the system running until power returns or to begin an orderly shutdown. The chapter of the *Backup and Recovery – Advanced* book called "Description of Power Loss Recovery" describes this process.

Power failure with continuously powered main store
If your system has this feature, a battery provides sufficient power to shut down the system and maintain the contents of memory for up to 2 days after a power loss. In many cases, this can significantly reduce the amount of time the system requires to perform an initial program load (IPL) after a power loss. The continuously powered main store feature can also take control if the uninterruptible power supply system can no longer maintain power.

When power is restored, the system automatically restarts. You may see the DASD Checker display. See "Using the DASD Checker Display" on page 12-2 for more information about this display.

Power failure with no protection
If your system does not have an uninterruptible power supply or the continuously powered main store feature and the power fails, your system stops immediately. The contents of main memory are lost. The system must reconstruct information when power returns. This can be very time-consuming. Whether the system starts automatically depends on how you have set the QPWRRSTIPL system value.

Disk failure with device parity protection or mirrored protection
In many cases, the system can continue running without full disk protection until the failed unit is replaced. The *Backup and Recovery – Advanced* has more information about disk protection.

Disk failure without disk protection
This is like a power failure without protection. The system stops immediately. After the disk is repaired or replaced, the system must reconstruct information about jobs that were running and files that were open.

Failure of a critical operating system program
The system stops immediately, just as it does with an unprotected power failure or disk failure. The system attempts to copy the contents of main memory so that the

problem can be analyzed. This is called a **main storage dump**. If your system has more than 96MB of main storage, you will see the Work with Current Main Storage Dump display when the system stops. See "Using the Work with Current Main Storage Dump Display" on page 12-2 for more information about this display.

Using the DASD Checker Display

When your system starts, it checks to ensure that it can access all of the disk units that are configured. If it cannot access one or more disk units, you are shown the DASD Checker display:

Following a temporary power outage, you may see this display because power has been restored to the processor but not to the peripheral devices. Wait to respond to the display until power is restored to all the disk units. The system's ability to access all the disk units when the system is starting, particularly if you have the continuously powered main store feature, is important for a successful recovery. If disk units are not available, the system may not be able to recover changed pages of memory. This can lengthen the time it takes to perform the IPL.

This screen may also be presented:

- After abnormal termination if the system is unable to activate all of the DASD on the re-IPL.
- During any system IPL that has a similar problem, even if normal system shutdown had taken the system down last.

Using the Work with Current Main Storage Dump Display

If your system encounters a serious software problem, you are shown the Main Storage Dump Manager display:

```
                        Main Storage Dump Manager

The system has failed and Licensed Internal Code (LIC) is
attempting to recover from the failure.

                     Word 11 . . . :   B6000302
                     Word 12 . . . :
                     Word 13 . . . :
                     Word 14 . . . :
                     Word 15 . . . :
                     Word 16 . . . :
                     Word 17 . . . :
                     Word 18 . . . :
                     Word 19 . . . :

Warning: The Main Storage Dump (MSD) must be copied for service.
         Failure to copy the Main Storage Dump will limit
         the ability to diagnose the failure.

Press Enter to copy the MSD for service or view the MSD.


F3=Exit     F12=Cancel
```

Follow the instructions of your service provider in responding to this display. In most cases, you should make a copy of main storage, either to tape or to auxiliary storage (disk), to assist with diagnosing the problem.

The *AS/400 Service Functions* book has more information about the Main Storage Dump Manager function.

Restarting Your System

When you have solved whatever problem caused your system to stop, you must start it again. In some cases, you start the initial program load (IPL) yourself. In other cases, such as a power loss, the system starts automatically. When you start your system again after it ends abnormally, the system tries to put things back in order. It closes files that were in use, rebuilds access paths that were open, and verifies file constraints. This process can take a long time.

If you want the system to determine when to rebuild and verify, perform a normal (automatic) IPL to restart your system. If you want to view and change the schedules for rebuilding access paths and verifying referential constraints, follow the steps in this chapter:

Task 1–Performing an Attended IPL

Perform an attended IPL so that you have the opportunity to change rebuild options.

Note: Your service representative may have started the IPL already. If so, skip to the step in this task for the display that is currently shown on your system.

To perform an attended initial program load (IPL), you must use the control panel on the system unit. Do the following (the steps vary slightly based on the type of system unit that you have. Consult the *System Startup and Problem Handling* book if you are unsure of the procedures for your system).

__ **Step 1** If your system unit has a lock on the control panel, use the key or keystick to unlock the control panel.

__ **Step 2** Place the system in Manual mode.

__ **Step 3** Ensure that any switches for all disk units are in the On position.

__ **Step 4** If your system is currently running, ensure that all users are signed off and all jobs are ended. Then type:

```
PWRDWNSYS OPTION(*CTLD) DELAY(600)
  RESTART(*YES)
```

Note: For the delay parameter, specify a number of seconds that allows your system time to bring most jobs to a normal end. On a large, busy system, you may need a longer delay.

__ **Step 5** If your system is not running, power on your system.

__ **Step 6** When you see the IPL or Install the System display, select option 1 (Perform an IPL). Following is an example of a status display. These status displays do not require any action by the user.

```
                        IPL Step in Progress

IPL step . . . . : Storage Management Recovery
```

The following list shows some of the IPL steps that are shown on the IPL Step in Progress display:

- Authority Recovery
- Journal Recovery
- Database Recovery
- Journal Synchronization
- Start the Operating System

Some of the IPL steps could take a long time.

While the system is performing the IPL, system reference codes (SRCs) are displayed on the control panel of the system unit to indicate what step is in

progress. The *AS/400 Service Functions* book describes these SRCs. If the same SRC is displayed for a long time in solid (not flickering) lights, your system may have a problem completing the IPL. Look up the SRC in the *AS/400 Licensed Internal Code Diagnostic Aids – Volume 1* book or contact software support.

__ **Step 7** Press the Enter key. Informational messages are displayed.

__ **Step 8** If the Select Product to Work with PTFs display appears, press F3 (Exit) to continue.

```
                Select Product to Work with PTFs

Position to . . . . . .___________ Product


Type options, press Enter.  Press F21 to select all.
   1=Select

              Product
Opt  Product  Option  Release
 _   5763999  *BASE   V3R1M0
 _   5763SS1  *BASE   V3R1M0
```

__ **Step 9** You are shown the IPL Options display:

```
                                IPL Options

Type choices, press Enter.

  System date  . . . . . . . . . . . . . .   07 / 26 / 88
  System time  . . . . . . . . . . . . . .   12 : 00 : 00
  Clear job queues . . . . . . . . . . . .   N
  Clear output queues  . . . . . . . . . .   N
  Clear incomplete job logs  . . . . . . .   N
  Start print writers  . . . . . . . . . .   Y
  Start this device only . . . . . . . . .   N


  Set major system options . . . . . . . .   Y
  Define or change system at IPL . . . . .   N
```

The values that appear as defaults depend on the recovery steps you have performed.

__ **Step 10** If the system date and system time are not correct, type the correct values. If you installed the Licensed Internal Code using option 2 or option 3, the date and time may be blank. The system date must have a year value in the range of 87 to 99, or 00 to 22.

__ **Step 11** Specify these responses for the prompts on the display:

Clear job queues	N
Clear output queues	N
Clear incomplete job logs	N
Start print writers	Y
Start this device only	Y
Set major system options	N
Define or change system at IPL	N

__ **Step 12** Enter your choices and press the Enter key.

Task 2–Using the Edit Rebuild of Access Paths Display

If access paths are marked for rebuilding, you are shown the following display:

```
                  Edit Rebuild of Access Paths                RCHAS331
                                                    05/12/90  13:49:34

IPL threshold . . . . . . . . . . . . . 50   0-99

Type sequence, press Enter.
Sequence:  1-99, *OPN, *HLD

                  ------------Access Paths----------  Unique  Rebuild
Seq   Status      File        Library     Member      Keyed   Time
25__  IPL         QAPZSYM2    QSYS        QAPZSYM2    NO      00:00:01
25__  IPL         QAPZREQ2    QSYS        QAPZREQ2    NO      00:00:01
25__  IPL         QAPZPTF3    QSYS        QAPZPTF3    NO      00:00:01
25__  IPL         QAPZPTF2    QSYS        QAPZPTF2    NO      00:00:01
25__  IPL         QAPZOBJ2    QSYS        QAPZOBJ2    NO      00:00:01
*OPN  OPEN        QTWALL      QSYS        QTWALL      NO      00:00:06
*OPN  OPEN        QASULTEL    QSYS        QASULTEL    NO      00:00:01
*OPN  OPEN        QASULE05    QSYS        QASULE05    NO      00:00:01
*OPN  OPEN        QASULE03    QSYS        QASULE03    NO      00:00:01
*OPN  OPEN        QASULE01    QSYS        QASULE01    NO      00:00:01
                                                          More...
F5=Refresh   F11=Display member text   F13=Change multiple  F15=Sort by
F16=Repeat position to   F17=Position to
```

Note: No access paths are listed if all access paths marked for rebuild have a status of SYS, JRN, or SMAPP.

While you are working with this display, the system is rebuilding access paths. You can use this display to:

- Change the sequence in which access paths are rebuilt.
- Delay rebuilding some access paths until after the IPL.

__ **Step 1** If you do not want to make changes to this display, press the Enter key. Skip to step 5 on page 12-6. If you want to make changes, continue with step 2.

__ **Step 2** You may change the value of the IPL threshold. All access paths with a sequence (SEQ) less than or equal to the threshold are rebuilt during the IPL. Access paths with a greater sequence number are rebuilt after the IPL completes. The default threshold is 50.

__ **Step 3** You may change the *sequence (SEQ)* column on the display for specific access paths. Initially, the sequence numbers are set this way:

25 Files with MAINT(*IMMED) and RECOV(*IPL)
75 Files with MAINT(*IMMED) and RECOV(*AFTIPL)
***OPN** Files with MAINT(*DLY)

Within a group (same sequence numbers), the system rebuilds access paths according to rebuild time, starting with the longest rebuild time.

Rebuild time is an estimate, based on the file size and key length. For journaled access paths (status JRN) and access paths protected by system-managed access-path protection (status SMAPP), the rebuild time shows as 0. The system uses the journal entries to recover these access paths rather than rebuilding them. The time required is minimal.

The estimate for rebuild time assumes that the rebuild job is not contending for resources. If an access path is rebuilt after the IPL, the rebuild will probably take longer.

__ **Step 4** Type your changes and press the Enter key. You are shown the Edit Rebuild of Access Paths display again. You see error messages if the system could not make some of the changes you requested. For example,

you may have tried to change the sequence number for an access path that the system rebuilt while you were using the display.

If you have errors, return to step 2 on page 12-5.

__ **Step 5** When you have finished the display, press the Enter key without making changes. You are shown the Display Access Path Status display:

```
                    Display Access Path Status

IPL Threshold . . . . . : 50

          ----------Access Paths----------   Rebuild     Current
Status    File       Library    Member      Build Time  Run Time
RUN       QAPZSYM2   QSYS       QAPZSYM2    00:00:01    00:00:01
JRN       QAPZREQ2   QSYS       QAPZREQ2    00:00:01
SYS       QASULE03   QSYS       QASULE03    00:00:01
IPL       QASULE01   QSYS       QASULE01    00:00:01
```

This display is updated every 5 seconds while the system is rebuilding access paths.

__ **Step 6** If you want to make changes to the IPL threshold or the sequence for rebuilding access paths, press F12 (Cancel) to return to the Edit Rebuild of Access Paths display. Repeat steps 2 through 5.

If you do not want to make changes, you can allow the Display Access Path Status display to continue updating or you can press F3 (Exit and continue IPL). In either case, the system completes rebuilding access paths before continuing to the next step of the IPL.

Task 3–Using the Edit Check Pending Constraints Display

You can define required attributes for physical files on the system. These are referred to as **referential constraints** or simply **constraints**. When you perform an IPL after the system ends abnormally or when you restore database files, the system checks the validity of file constraints. See the *DB2 for OS/400 Database Programming* book for more information about using referential constraints.

If database constraints are marked for verification, you are shown the following display:

```
                      Edit Check Pending Constraints              RCHASLJF
                                                          03/30/94  10:09:27
IPL threshold . . . . . . . . . . . . . 50_  0-99

Type sequence, press Enter.
Sequence:  1-99, *HLD

                      ----------Constraints----------  Verify    Elapsed
Seq   Status          Cst       File        Library     Time      Time

75__  AFTIPL       CSTF1       FILE567890  LIB4567890  00:00:56  00:00:00
75__  AFTIPL       CSTF2       FILE567890  LIB4567890  00:00:56  00:00:00
*HLD  INVAP        CSTF5       FILE567890  LIB4567890  10:30:06  00:00:00
*HLD  CHKPND       CSTF6       FILE567890  LIB4567890  09:30:06  00:00:00
*HLD  HELD         CSTF7       FILE567890  LIB4567890  08:30:06  00:00:00
                                                          More...
```

You can use this display to do the following:

- Change the sequence in which constraints are verified.
- Have the system verify some constraints before the IPL completes.
- Delay verification for some constraints until you specifically request it.

__ **Step 1** If you do not want to make changes to this display, press the Enter key and skip to step 5 on page 12-7. If you want to make changes, continue with step 2 on page 12-7.

__ **Step 2** You may change the value of the IPL threshold. All constraints with a sequence (SEQ) less than or equal to the threshold are verified during the IPL. Constraints with a greater sequence number are verified after the IPL completes. The default threshold is 50.

__ **Step 3** You may change the *sequence* (SEQ) column on the display for specific constraints. Initially, the sequence for all constraints is set to 75.

Within a group (same sequence numbers), the system verifies constraints according to verify time, starting with the longest estimated time.

Verify time is an estimate. The estimate assumes that the verify job is not contending for resources. If a constraint is verified after the IPL, the verify may take longer.

If you want to delay the verification of a constraint indefinitely, specify *HLD for the sequence. You can use the Edit Check Pending Constraint (EDTCPCST) command later to set a sequence and have the system verify the constraint.

__ **Step 4** Type your changes and press the Enter key. You are shown the Edit Check Pending Constraint display again. You see error messages if the system could not make some of the changes you requested. For example, you may have tried to change the sequence number for a constraint that the system verified while you were using the display.

If you have errors, return to step 2.

__ **Step 5** When you have finished the display, press the Enter key without making changes. You are shown the Display Constraint Status display:

```
                    Display Constraint Status

IPL Threshold . . . . . : 50

          ----------Constraints-----------   Verify      Elapsed
Status    Constraint  File       Library     Time        Time
RUN       CUST1       CUSTMAST   CUSTLIB     00:00:04    00:00:01
RUN       CUST2       CUSTMAST   CUSTLIB     00:00:05    00:00:01
IPL       ORDHST1     ORDHIST    ORDLIB      00:00:23    00:00:00



F3=Exit and continue IPL   F12=Cancel
```

This display is updated every 5 seconds while the system is verifying constraints.

__ **Step 6** If you want to make changes to the IPL threshold or the sequence for verifying constraints, press F12 (Cancel) to return to the Edit Check Pending Constraints display. Repeat steps 2 through 5.

If you do not want to make changes, you can allow the Display Constraint Status display to continue updating or you can press F3 (Exit and continue IPL). In either case, the system completes verifying constraints before continuing to the next step of the IPL.

__ **Step 7** When the IPL completes, continue with "Task 4–Recovering from Damaged Objects and Unreadable Sectors" on page 12-8.

Task 4–Recovering from Damaged Objects and Unreadable Sectors

If your system stops without warning or disk errors occur, some object description information may not be updated correctly. If this happens, the object is considered damaged. When you perform an IPL, the system attempts to locate damaged objects and write them to the object recovery list. It writes a message (CPI18xx) to the history (QHST) log for each damaged object that it finds. If any damaged objects are added to the object recovery list during the IPL, message CPI8197 is sent to the QSYSOPR message queue.

Note: Some damage, such as damage to the contents of a database file, may not be detected until the object is used. If you suspect a large number of objects on your system have been damaged, contact your service representative for advice on how to recover.

Do the following to check and recover damaged objects:

__ **Step 1** Display the QHST (history) log by typing `DSPLOG` and pressing F4 (Prompt).

__ **Step 2** On the prompt display, fill in a starting date and time to limit the number of entries you see.

__ **Step 3** On the display, fill in *PRINT for the *Output* prompt and press the Enter key.

__ **Step 4** Type: `WRKSPLF`. You are shown a list of spooled files for your job.

__ **Step 5** Locate the spooled file for the DSPLOG command. Use option 3 to hold the spooled file.

__ **Step 6** Use option 5 to display the spooled file.

__ **Step 7** Look for entries for damaged objects and files that are not synchronized. You can use the Find function to search for lines that have these character strings: `damage` and `sync`. Following are some examples of messages you might see:

CPF3113	Member damaged
CPF3175	File not synchronized
CPF3176	Data space partially damaged
CPF3171	Journal damaged
CPF3172	Objects not synchronized with the journal
CPF3173	Journal receiver damaged
CPF3174	Journal receiver partially damaged
CPF81xx	General messages about object damage

__ **Step 8** Write down the names and types of the objects you find. Consult Table 12-1 for the correct recovery procedure, based on the type of object that is damaged:

Table 12-1 (Page 1 of 2). Recovery for Damaged Objects by Object Type

Type of Object	Recovery Procedure
Operating system object in QSYS library	Contact software support for assistance. You may need to install the operating system again.
IBM-supplied user profile	Perform an abbreviated installation of the operating system.
Job description that is specified on the workstation entry for the console in the controlling subsystem	If no other workstation entries exist for the controlling subsystem, the system is not usable. Contact software support for assistance.
Job queue	Perform an IPL. Restore or re-create the damaged job queue. All entries are lost.

Table 12-1 (Page 2 of 2). Recovery for Damaged Objects by Object Type

Type of Object	Recovery Procedure
Output queue	Perform an IPL. If the output queue is the default output queue for a printer, it is re-created and its entries are rebuilt. Other output queues must be restored or re-created. Their entries are not recovered.
Damaged file whose name starts with QAOSS	Delete the file. Restore it from a backup copy. Run the RCLDLO DLO(*ALL) command.
Database file	See "Recovering Damaged Database Files" on page 12-9
Journal	See "Recovering a Damaged Journal" on page 12-11.
Journal receiver	See "Recovering a Damaged Journal Receiver" on page 12-12.
Journaled file	See "Recovering a Journaled File That Is Damaged or Not Synchronized" on page 12-12.
All others	See "Recovering Other Types of Damaged Objects" on page 12-12.

__ **Step 9** Watch for additional indications that objects have been damaged. Some indications are:

- You cannot start the system because auxiliary storage is full.
- The system has ended abnormally several times since the last time you ran the Reclaim Storage (RCLSTG) procedure.
- You see objects on the Work with Objects by Owner display that have no library associated with them.
- The system status display shows an unexpectedly high percentage of auxiliary storage used.
- You cannot access the data in a database file because a member is damaged. This is indicated by message CPF8113.
- You cannot access objects because they are secured by a damaged authorization list or authority holder.

If you see these indications on your system, run the RCLSTG procedure. Running the procedure is described in "Reclaiming Storage" on page 8-5.

If you see these indications after a disk unit was replaced and the data was restored from a partial pump, you should recover the entire ASP that contained the failed disk unit. See the appropriate checklist.

Recovering Damaged Database Files

Some types of object-level damage to database files can be recovered by performing a special IPL during which the system analyzes every disk segment for parts of database objects. Following are examples of object-level damage:

- Lost pointers between the index (access path) and the data.
- Unidentified objects on the object recovery list.

If you are experiencing problems with database files, you can display the Licensed Internal Code log to determine whether a special IPL may resolve the problems.

Note: You must have *SERVICE special authority to perform the tasks that are described in this topic.

Do the following:

__ **Step 1** Type STRSST and press the Enter key. You are shown the System Service Tools (SST) menu.

__ **Step 2** Select option 1 (Start a service tool). You are shown the Start a Service Tool display.

__ **Step 3** Select option 5 (Licensed Internal Code log). You are shown the Licensed Internal Code Log display.

__ **Step 4** Select option 1 (Select entries from the Licensed Internal Code log). You are shown the Specify Licensed Internal Code Log Selection Values display.

```
                    Specify Licensed Internal Code Log Selection Value

Type choices, press Enter

  Note ID:
    Starting  . . . . . . . . . . .   FFFFFFFF 00000000-FFFFFFFF

  Entry type:
    Major code  . . . . . . . . . .   0600     0000-FFFF
    Minor code  . . . . . . . . . .   145F     0000-FFFF

  Starting:
    Date. . . . . . . . . . . . . .   00/00/00 MM/DD/YY
    Time. . . . . . . . . . . . . .   00:00:00 HH:MM:SS
  Ending:
    Date. . . . . . . . . . . . . .   00/00/00 MM/DD/YY
    Time. . . . . . . . . . . . . .   00:00:00 HH:MM:SS


F3=Exit  F12=Cancel
```

__ **Step 5** Type `0600` for the *Major code* prompt.

__ **Step 6** Type `145F` for the *Minor code* prompt.

__ **Step 7** For the starting date and time, enter values that approximate when you first started to have problems.

__ **Step 8** For the ending date and time, enter the current date and time.

__ **Step 9** Press the Enter key. If any errors have been recorded that may be resolved by a special IPL, you are shown a list of the entries. Otherwise, you receive a message that no log entries matched your criteria.

If you have log entries that suggest a special IPL, you need to schedule a time for this IPL. It may take many hours for the system to analyze all the disk segments. As a rough estimate, the analysis phase of the IPL will take approximately 1 second for each object on your system.

When you are ready to perform the IPL, do the following:

__ **Step 1** Place your system in a restricted state. See "Putting Your System in a Restricted State" on page 8-4.

__ **Step 2** Type `STRSST` and press the Enter key. You are shown the System Service Tools (SST) menu.

__ **Step 3** Select option 1 (Start a service tool). You are shown the Start a Service Tool display.

__ **Step 4** Select option 4 (Display/Alter/Dump). You are shown the Display/Alter/Dump Output Device display.

__ **Step 5** Select option 1 (Display/Alter storage). You are shown the Select Data display.

__ **Step 6** Select option 5 (Starting address). You are shown the Specify Starting Address display:

```
                          Specify Starting Address

Output device  . . . . . :   Display/Alter storage

Type choice, press Enter.

  Address  . . . . . .  .   000000000E 000000
```

__ **Step 7** Type `000000000E 000000` for the address and press the Enter key. You are shown the Display Storage display:

```
                            Display Storage

Control . . . . . .                nnnnn, Pnnnnn, Lcccccc, .cccccc, >
Address . . . . . .  00000E0000 000000

0000      83800040 00000000 00000000 0E000000      * ... ..............  *
0010      00010000 00000000 00000000 00000000      * ................    *
0020      80000000 00000000 00000000 00000000      * ................    *
```

__ **Step 8** On the third data line (offset 0020), type 8 in the first character. Press F11 (Alter storage) to make the change take affect.

__ **Step 9** Press F3 until you return to the Exit System Service Tools display.

__ **Step 10** Press the Enter key (continue ending SST).

__ **Step 11** On the command line, type

`PWRDWNSYS OPTION(*IMMED) RESTART(*YES)`

This causes the system to begin the special IPL.

Recovering a Damaged Journal

Do the following:

__ **Step 1.** Type `WRKJRN`.

__ **Step 2.** On the prompt display, type the name of the journal. You are shown the Work with Journals display:

```
                            Work with Journals

Type options, press Enter.
  2=Forward recovery       3=Backout recovery   5=Display journal status
  6=Recover damaged journal   7=Recover damaged journal receivers
  9=Associate receivers with journal

Opt  Journal     Library     Text
     JRNACC      DSTA1       JOURNAL FOR ACCOUNTS
```

__ **Step 3.** Select option 6 (Recover damaged journal).

__ **Step 4.** Type `WRKJRNA JRN(`*library-name/journal-name*`) OUTPUT(*PRINT)`. You receive a listing showing all the physical files and access paths that are currently being journaled.

__ **Step 5.** Start journaling for any physical files that should be journaled but are not on the list by using the STRJRNPF command.

__ **Step 6.** Start journaling for any access paths that should be journaled but are not on the list by using the STRJRNAP command.

__ **Step 7.** Save each physical file and access path. You should always save files after you start journaling them.

Recovering a Damaged Journal Receiver

Do the following:

__ **Step 1.** Type WRKJRN.

__ **Step 2.** On the prompt display, type the name of the journal associated with the damaged journal receiver. You are shown the Work with Journals display:

```
                              Work with Journals

Type options, press Enter.
  2=Forward recovery       3=Backout recovery   5=Display journal status
  6=Recover damaged journal   7=Recover damaged journal receivers
  9=Associate receivers with journal

Opt  Journal     Library     Text
     JRNACC      DSTA1       JOURNAL FOR ACCOUNTS
```

__ **Step 3.** Select option 7 (Recover damaged journal receivers).

Recovering a Journaled File That Is Damaged or Not Synchronized

For a journaled file that is damaged, do the following:

__ **Step 1.** Find your most recent saved copy of the file.

__ **Step 2.** Delete the file.

__ **Step 3.** Load the tape and restore the file. Type:

```
RSTOBJ OBJ(object-name) OBJTYPE(*FILE)
  SAVLIB(library-name) DEV(tape-device)
```

__ **Step 4.** Restore any journal receivers needed to recover the file, if they are not already on the system.

__ **Step 5.** Use the APYJRNCHG command to apply journaled changes. The chapter of the *Backup and Recovery – Advanced* book called "Working with Journals, Journal Receivers, and Journal Entries" provides more information about applying journaled changes.

For a journaled file that could not be synchronized, do the following:

__ **Step 1.** Restore the file from your most recent saved copy.

__ **Step 2.** Apply journaled changes to bring the file up to date.

Note: If other files are related to the file that is not synchronized, you may need to perform this procedure for all the files. Otherwise, the files may not be synchronized with each other.

Recovering Other Types of Damaged Objects

Use the following procedure to recover most damaged objects on the system. Table 12-1 on page 12-8 shows which types of objects require special procedures.

__ **Step 1.** Find your most recent saved copy of the damaged object.

Note: If the damaged object is in the QSYS library, you may need to restore the operating system. Contact software support for assistance.

__ **Step 2.** Delete the object.

__ **Step 3.** Load the tape and restore the object. Type

```
RSTOBJ OBJ(object-name) OBJTYPE(object-type)
  SAVLIB(library-name) DEV(tape-device)
```

Chapter 13. Recovering Information in a User Auxiliary Storage Pool

When you have user ASPs on your system, you assign specific libraries or objects to certain physical disk devices. One reason for having user ASPs is to limit the amount of information you need to recover if a DASD device must be replaced.

The basic process for recovering a user ASP is:

1. Understand what was in the user ASP.
2. Choose the correct recovery procedure.
3. Plan your recovery.
4. Perform the recovery steps.

Describing the Contents of Your User Auxiliary Storage Pools

To choose the correct procedure for recovering the information on your user ASPs, you must understand what they looked like before the failure. Figure 13-1 shows an example of a user ASP configuration. This example is used throughout the explanations that follow. You may want to begin by drawing a similar picture of your configuration.

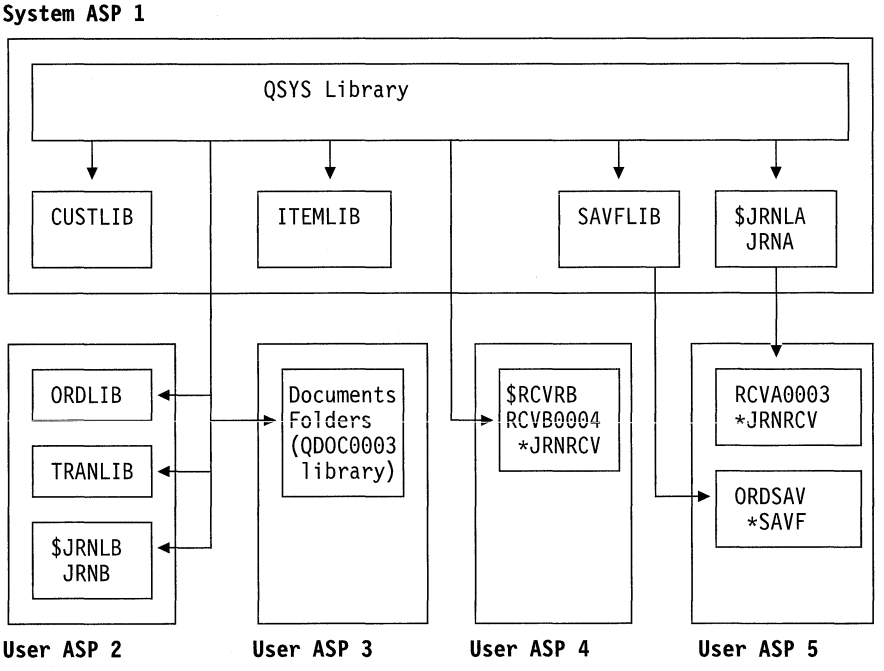


Figure 13-1. User ASP Configuration Before Failure

In the example:

- ASP 2 is a library user ASP. It contains these libraries: ORDLIB, TRANLIB, and $JRNLB.
- Files in the ORDLIB library and TRANLIB library are journaled to the JRNB journal in the $JRNLB library.
- The journal receivers for the JRNB journal are in the $RCVRB library in ASP 4.
- ASP 3 is a library user ASP containing documents and folders.
- ASP 4 is a library user ASP. It contains the $RCVRB library.
- ASP 5 is a nonlibrary user ASP. It contains the ORDSAV save file. ORDSAV is in the SAVFLIB library, which is in the system ASP. It also contains the RCVA0003 journal receiver, which is in the $JRNLA library.

Before the failure, the receiver directory for the JRNA journal looks like this:

```
                        Work with Receiver Directory

Journal . . . . . :   JRNA            Library . . . . . :   $JRNLA

Total size of receivers . . . . . . . . . . . . . . . . . :   155648

Type options, press Enter.
  4=Delete   8=Display attributes

                                          Attach                        Save
Opt  Receiver    Library     Number       Date      Status              Date
 _   RCVA0001    $JRNLA      00001        06/08/9x  SAVED               06/08/9x
 _   RCVA0002    $JRNLA      00002        06/09/9x  SAVED               06/09/9x
 _   RCVA0003    $JRNLA      00003        06/09/9x  ATTACHED            00/00/00
```

Choosing the Procedure to Recover User ASPs

These basic situations may require you to recover information in a user ASP:

- You have replaced a disk unit in the system ASP. Although the data is still in your user ASPs, you must recover the system's ability to locate that data (addressability). This process is described in "Recovering a User ASP After Recovering the System ASP."
- You have replaced a disk unit in a user ASP. All the information that was in the user ASP must be recovered. If this is your situation, follow the procedure described in "Recovering a Damaged User Auxiliary Storage Pool" on page 13-14.
- You have replaced a disk unit in the system ASP. One of your user ASPs was in overflowed status. You must recover the addressability to information in the user ASPs that were not overflowed by using the procedure described in "Recovering a User ASP After Recovering the System ASP." You must also recover the information in the user ASP that was overflowed by using the procedure described in "Recovering a Damaged User Auxiliary Storage Pool" on page 13-14.

Recovering a User ASP After Recovering the System ASP

Perform this procedure after restoring your Licensed Internal Code and the operating system.

When you replace a unit in your system ASP, the system loses addressability to the objects in your user ASPs. The system in the example would look like this after the operating system has been restored:

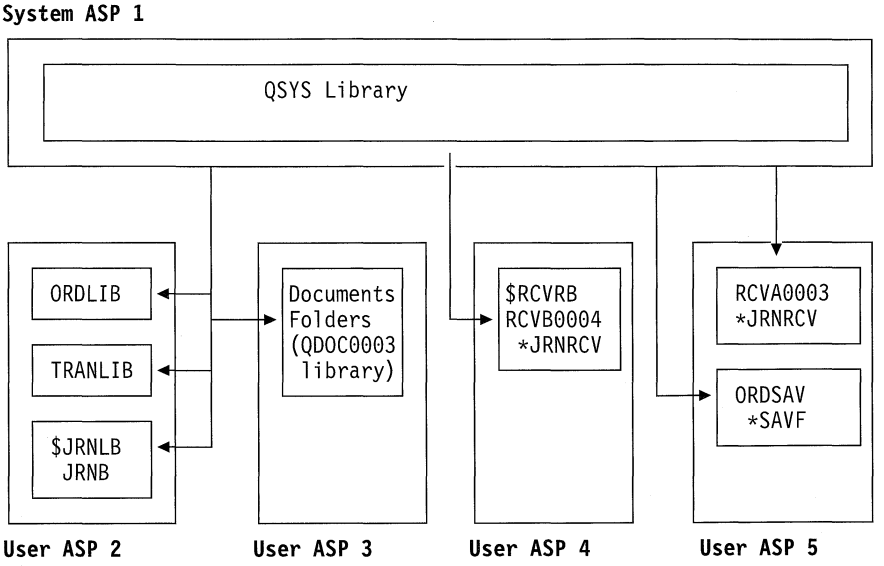


Figure 13-2. User ASP Configuration After Restoring Operating System

The libraries and objects in the user ASPs are not known to the system.

You can use the procedures described in this topic to recover the objects in your user ASPs. However, the system cannot recover ownership to the objects other than document library objects (DLO) in the user ASPs because the addresses for all user profiles are changed when you restore them. All object types except DLOs use the address of the user profile to identify the owner.

Recovering object ownership for objects other than DLOs requires manually assigning ownership for every object in every user ASP.

Decision

You have these choices:

- Use the procedures in this topic. Manually recover ownership for all objects in the user ASP except DLOs. If you have a small number of non-DLO objects in the user ASPs, this is a reasonable alternative.
- Treat the situation as a total recovery and restore all your information from your save tapes. If you have a large number of objects in your user ASPs and good backup, this is probably the best alternative. If you choose to do this, perform the steps described in "Recovering User Information Using Commands–Checklist 18" on page 9-31 to recover all the user information on your system.
- Restore everything on your system except DLOs. Follow the steps described in "Recovering User Information Using Commands–Checklist 18" on page 9-31. Be sure to run the RCLDLO command at step 10. At step 11, be sure to restore DLOs only to the ASPs that you are recovering.

Task 1–Reclaiming Storage

__ **Step 1** Sign on the system with a user profile that is authorized to the RCLSTG command. Either sign on at the console or use the Transfer Job (TFRJOB) command to transfer your job to the controlling subsystem.

__ **Step 2** Type `DSPSYSVAL QALWUSRDMN`. If the current value does not include the QRCL (Reclaim Storage) library or does not specify *ALL, use the CHGSYSVAL command to add QRCL to the list of libraries for this system value.

__ **Step 3** Ensure your system is in a restricted state. If it is not, follow the procedure in "Putting Your System in a Restricted State" on page 8-4.

__ **Step 4** Start the reclaim storage process by typing:

```
RCLSTG
```

After the reclaim storage procedure, the example system looks like this:

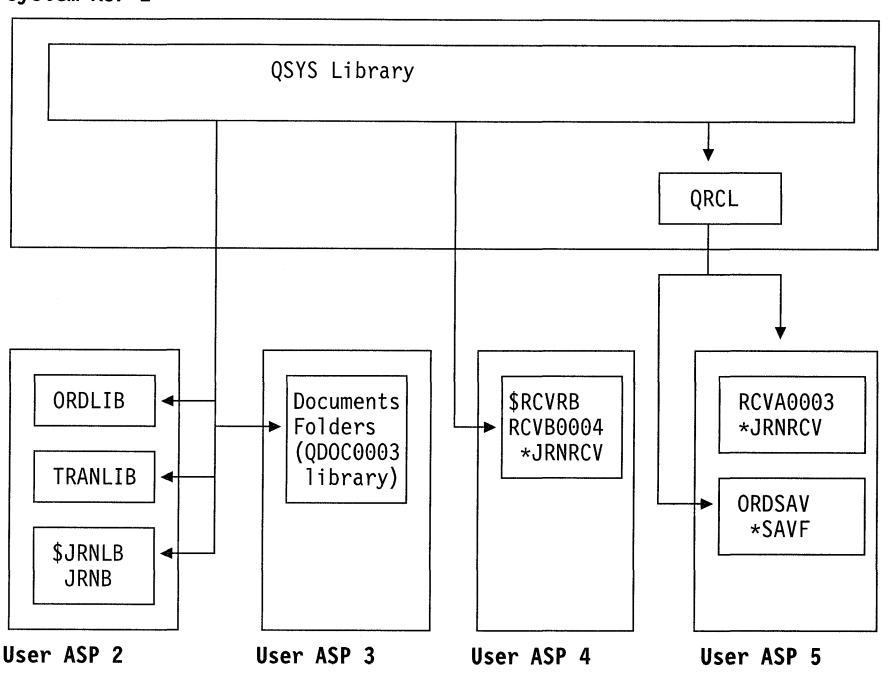


Figure 13-3. User ASP Configuration After Reclaiming Storage

The system recovers addressability to the objects in ASP 5, but it cannot recover their original library assignments. They are placed in the QRCL (Recovery) library. The objects in all user ASPs are owned by the QDFTOWN (Default Owner) user profile.

"Reclaiming Storage" on page 8-5 provides more information about the RCLSTG procedure.

Task 2–Restoring User Profiles

__ **Step 1** Sign on as QSECOFR.

__ **Step 2** Ensure the system is in a restricted state. See "Putting Your System in a Restricted State" on page 8-4.

__ **Step 3** Find the most recent tape that has your user profiles. It may be a SAVSYS tape or a SAVSECDTA tape. The file on the tape is called QFILEUPR.

__ **Step 4** If you are using a SAVSYS tape, type:

```
RSTUSRPRF DEV(TAP01) USRPRF(*ALL)
   ENDOPT(*LEAVE)
```

If you are using a SAVSECDTA tape, type:

```
RSTUSRPRF DEV(TAP01) USRPRF(*ALL)
   ENDOPT(*UNLOAD)
```

The time that this takes can vary significantly. "What Happens When You Restore User Profiles" on page 15-2 describes what the system does when you restore user profiles.

Task 3–Restoring the Configuration

__ **Step 1** Find the most recent tape that has your configuration. It may be a SAVSYS tape or a SAVCFG tape. The file on the tape is called QFILEIOC.

__ **Step 2** If you are using a SAVSYS tape, type:

```
RSTCFG OBJ(*ALL) DEV(TAP01) OBJTYPE(*ALL)
   ENDOPT(*LEAVE)
```

If you are using a SAVCFG tape, type:

```
RSTCFG OBJ(*ALL) DEV(TAP01) OBJTYPE(*ALL)
   ENDOPT(*UNLOAD)
```

Task 4–Recovering Journals and Journal Receivers in the QRCL Library

__ **Step 1** Determine if any objects are in the QRCL library. Type: `DSPLIB QRCL`. You see the Display Library display.

__ **Step 2** If no objects are listed on the display, skip to "Task 5–Restoring Libraries to the System Auxiliary Storage Pool" on page 13-6.

__ **Step 3** If the QRCL library contains objects, save them before proceeding with your recovery. Load a scratch tape. Type the following:

```
SAVLIB LIB(QRCL) DEV(TAP01) ENDOPT(*UNLOAD)
```

__ **Step 4** If the QRCL library does not contain journals or journal receivers, skip to "Task 5–Restoring Libraries to the System Auxiliary Storage Pool" on page 13-6.

__ **Step 5** Create one or more libraries in the system ASP for the journals and journal receivers from the QRCL library. The libraries you create must have the same names as the original libraries that contained the journals and journal receivers.

In the example shown in Figure 13-3 on page 13-4, the QRCL library contains the ORDSAV save file and the RCVA0003 journal receiver. At this point you need to create the $JRNLA library. You would type: `CRTLIB LIB($JRNLA)`.

__ **Step 6** Move the journals and journal receivers to the newly created libraries. This is the only circumstance in which you can move journals and journal receivers between libraries. You must use the MOVOBJ command. You cannot use save and restore commands. The MOVOBJ command leaves the journal or journal receiver in the user ASP but establishes its association with the correct library.

For the example shown in Figure 13-3 on page 13-4, you would type:

```
MOVOBJ OBJ(QRCL/RCVA0003) OBJTYPE(*JRNRCV) TOLIB($JRNLA)
```

__ **Step 7** Delete the QRCL library by typing `DLTLIB QRCL`.

Note: If the QRCL library contains save files, you will recover them in"Task 8–Recovering Save Files from the QRCL Library" on page 13-7. When you recover them, you will use the tape that you created in step 3.

At this point, the system in the example would look like this:

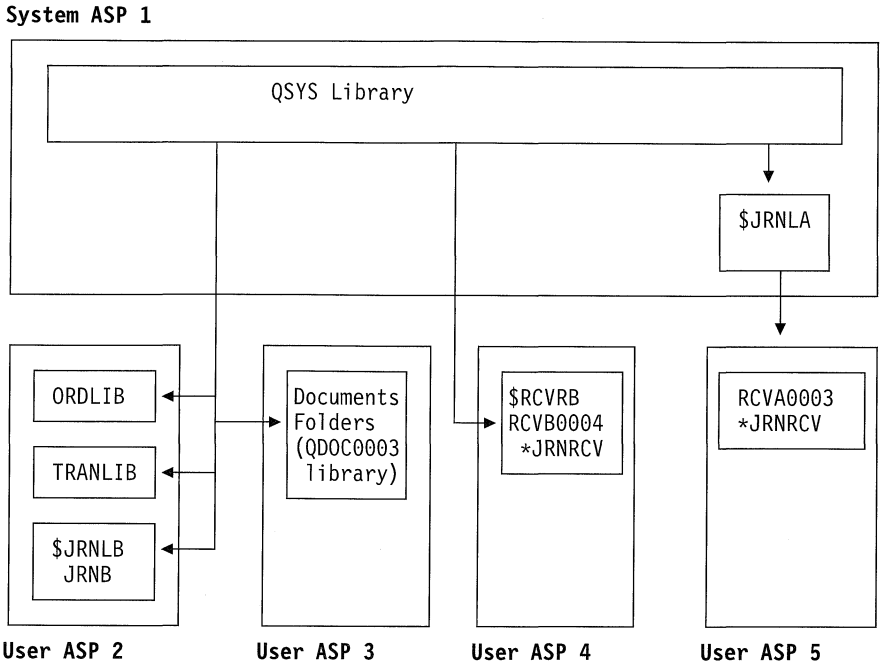


Figure 13-4. User ASP Configuration After Recovering Isolated Journal Receiver

Task 5–Restoring Libraries to the System Auxiliary Storage Pool

__ **Step 1** Decide which libraries to restore. You should restore only the libraries in your system ASP. Do not restore the libraries that are already on your system in user ASPs.

If you are not sure which libraries are currently on your system, type `DSPOBJD OBJ(*ALL) OBJTYPE(*LIB)`.

Note: When you install the operating system, the system creates the QGPL library and the QUSRSYS library. You should still restore these libraries to restore the data from your saved copy.

__ **Step 2** Plan your restore sequence. If you restore in the wrong sequence, your journaling environment may not be started again or some objects may not restore successfully.

For example, journals must be restored before the journaled files. If journals and files are in the same library, the system restores them in the correct order. If they are in different libraries, you must restore them in the correct order. Similarly, physical files must be restored before their associated logical files. Read "Sequence for Restoring Related Objects" on page 8-4 for more information.

__ **Step 3** Choose the commands or menu options you will use. You can restore libraries by name or in a group, such as *NONSYS. See "The Relationship Between Save and Restore Commands" on page 8-3 for more information.

If you restore libraries in a group, **omit the libraries in your user ASPs**.

__ **Step 4** Type the restore commands or menu options that you have chosen. In the example shown in Figure 13-1 on page 13-1, libraries were saved using SAVLIB(*ALLUSR). One way to restore them would be to type:

```
RSTLIB SAVLIB(*ALLUSR) DEV(TAP01)
       OMITLIB(ORDLIB TRANLIB $JRNLB $RCVRB)
```

If a media error occurs...

if you have an unrecoverable media error when you are restoring multiple libraries, see "Recovering from an Error While Restoring Libraries" on page 8-9.

Task 6–Restoring Document Library Objects to the System Auxiliary Storage Pool

__ **Step 1** Find your most recent tape that was used to save all documents in the system ASP. You may have specified `ASP(1)` or `ASP(*ANY)` for the save operation. The tape should have the library QDOC on it.

__ **Step 2** Use the following command to restore the DLOs:

```
RSTDLO DLO(*ALL) FLR(*ANY) ASP(1)
```

If a media error occurs...

If you have an unrecoverable media error when you are restoring DLOs, see "Recovering from an Error While Restoring DLOs" on page 8-10.

Task 7–Reclaiming Document Library Objects

__ **Step 1** If you do not have DLOs in any user ASPs, skip to "Task 8–Recovering Save Files from the QRCL Library."

__ **Step 2** Type:

```
RCLDLO DLO(*ALL) ASP(*ANY)
```

This procedure rebuilds the association between the DLOs in the user ASP and the search index records. It also attempts to assign the DLOs to the correct owner.

Task 8–Recovering Save Files from the QRCL Library

If you did not have any save files in the QRCL library, skip to "Task 9–Associating Journal Receivers with Journals."

Note: You displayed the QRCL library in "Task 4–Recovering Journals and Journal Receivers in the QRCL Library" on page 13-5.

__ **Step 1** Load the scratch tape you created in "Task 4–Recovering Journals and Journal Receivers in the QRCL Library" on page 13-5.

__ **Step 2** Ensure that the original libraries for the save files were restored in "Task 5–Restoring Libraries to the System Auxiliary Storage Pool" on page 13-6. You can check by typing `DSPOBJD OBJ(`*`library-name`*`) OBJTYPE(*LIB)`.

__ **Step 3** Restore each save file from the scratch tape to the correct library and user ASP. In the example shown in Figure 13-1 on page 13-1, you would type:

```
RSTOBJ OBJ(ORDSAV) SAVLIB(QRCL) RSTLIB(SAVFLIB)
       OBJTYPE(*SAVF) RSTASP(5)
```

Task 9–Associating Journal Receivers with Journals

If you do not have any journals or journal receivers involved in the recovery, skip to "Task 10–Restoring Object Ownership" on page 13-9.

Whenever you do a recovery involving journals and journal receivers, you should ensure that your journal receivers are associated with the journal. This topic provides basic information about how to associate your journals and journal receivers. If you have problems, consult the *Backup and Recovery – Advanced* book for more complete information.

Based on the steps performed so far, the receiver directory for journal JRNA in the example would look like this:

```
                        Work with Receiver Directory

Journal . . . . . :   JRNA           Library . . . . . :   $JRNLA

Total size of receivers . . . . . :   155648

Type options, press Enter.
  4=Delete   8=Display attributes

                                      Attach                      Save
Opt  Receiver    Library     Number   Date      Status            Date
 _   RCVA0003    $JRNLA      00001    06/08/9x  ONLINE            00/00/00
 _   RCVA1002    $JRNLA      01001    06/09/9x  ATTACHED          00/00/00
```

Notice that when JRNA was restored, the system created a new journal receiver called RCVA1002 and attached it. The receiver name is based on the name of the journal receiver that was attached when the journal was saved.

Do the following to associate journals and journal receivers:

__ **Step 1.** Type WRKJRN on a command line and press the Enter key.

__ **Step 2.** On the prompt display, type the name of the journal and the library name.

__ **Step 3.** On the Work with Journals display, type a 9 (Associate receivers with journal) in the *Opt* column next to the journal that you want to work with.

__ **Step 4.** Press the Enter key.

The receivers are reassociated with the journal.

If any of the journal receivers in the user ASP were created before V3R1, using option 9 from the Work with Journals display might not associate them in the correct sequence. If you have journal receivers from a prior release or if any of the journal receivers you need are not online, do this:

__ **Step 1.** Save the journal receivers that are on the system to a scratch tape:

```
SAVOBJ OBJ(*ALL) LIB(library-name) DEV(TAP01)
   OBJTYPE(*JRNRCV) VOL(*MOUNTED) ENDOPT(*UNLOAD)
```

__ **Step 2.** After you ensure that the receivers were saved successfully, delete the journal receivers from the library:

- __ **Step a.** Type WRKLIB *library-name* and press the Enter key. You are shown the work with library display.
- __ **Step b.** Type a 12 (Work with Objects) in the *Opt* column.
- __ **Step c.** Type a 4 (Delete) in the *Opt* for each journal receiver you want to delete.
- __ **Step d.** Press the Enter key.

__ **Step 3.** Restore the journal receivers you need from the scratch tape and from your save tapes. Restore them from newest to oldest by typing the following command for each journal receiver:

```
RSTOBJ OBJ(receiver-name) LIB(library-name) DEV(TAP01)
   OBJTYPE(*JRNRCV) VOL(*MOUNTED) ENDOPT(*UNLOAD)
```

The receivers are reassociated with the journal.

At this point the receiver directory for JRNA looks like this:

```
                        Work with Receiver Directory

Journal . . . . . :   JRNA            Library . . . . . :   $JRNLA

Total size of receivers . . . . . :   155648

Type options, press Enter.
  4=Delete   8=Display attributes

                                        Attach                          Save
Opt  Receiver    Library     Number     Date       Status               Date
 _   RCVA0001    $JRNLA      00001      06/08/9x   SAVED                06/08/9x
 _   RCVA0002    $JRNLA      00002      06/09/9x   SAVED                06/09/9x
 _   RCVA0003    $JRNLA      00003      06/08/9x   ONLINE               00/00/00
 _   RCVA1002    $JRNLA      01002      06/09/9x   ATTACHED             00/00/00
```

Task 10–Restoring Object Ownership

The RCLSTG procedure assigned ownership of all the objects in your user ASPs to the QDFTOWN user profile. In "Task 7–Reclaiming Document Library Objects" on page 13-7, you transferred ownership of DLOs to the correct user profiles. To transfer ownership of the other objects to the correct user profiles, do the following:

__ **Step 1** Type `WRKOBJOWN USRPRF(QDFTOWN)` and press the Enter key.

The Work with Objects by Owner display is shown:

```
                          Work with Objects by Owner

User profile . . . . . :   QDFTOWN

Type options, press Enter.
  2=Edit authority        4=Delete   5=Display author
  8=Display description   9=Change owner

Opt  Object       Library      Type      Attribute
 9   ORDRCV001    JRNLIB       *JRNRCV
 9   ORDHDR       ORDLIB       *FILE
 9   ORDDTL       ORDLIB       *FILE
 9   ORDHST       ORDLIB       *FILE
 9   ORDSAV       SAVFLIB      *SAVF
 9   TRAN01       TRANLIB      *FILE

  :
Parameters or command
===> NEWOWN(OWNORD)
F3=Exit   F4=Prompt   F5=Refresh   F9=Retrieve
F18=Bottom
```

Note: If you see document library objects on this list (type *DOC or *FLR), one of the following has occurred:

- You forgot to run RCLDLO. See "Task 7–Reclaiming Document Library Objects" on page 13-7.
- The user profile that owns the DLO has not been restored. Restore the user profile. Then run the RCLDLO command.
- The DLO was owned by the QDFTOWN profile when it was saved. Determine the correct owner for the DLO and transfer ownership.

__ **Step 2** To transfer ownership of objects individually:

__ **Step a.** Type a 9 in the *Opt* column for the object and press the Enter key. The Change Object Owner display is shown.

__ **Step b.** Type the name of the correct owner in the *New owner* prompt and press the Enter key.

__ **Step c.** Repeat steps 2a and 2b for each object on the display.

__ **Step 3** To transfer ownership of multiple objects that should have the same owner, use the technique shown in the display:

__ **Step** **a.** Type 9 in the *Opt* column.

__ **Step** **b.** Type NEWOWN(*owner-name*) on the parameter line at the bottom of the display.

__ **Step** **c.** Press the Enter key. The system transfers ownership of each object you specified to the new owner.

Stop!

You have completed the recovery of information in your user auxiliary storage pools. Consult your recovery checklist for the next step in your recovery process.

Recovering An Overflowed User Auxiliary Storage Pool

The topics in this section provide basic information about working with user ASPs in recovery situations. The chapter in the *Backup and Recovery – Advanced* called "Working with Auxiliary Storage Pools" provides more information about setting up and managing user ASPs.

When the disk units allocated to a user ASP become full, the user ASP is in **overflowed status**. The system sends message CPI0953 to the QSYSOPR message queue warning you that an ASP is approaching its storage threshold. The system sends message CPI0954 when the storage threshold has been exceeded and the ASP is in overflowed status.

You should reset a user ASP in overflowed status as soon as possible. An overflowed ASP affects system performance. It also makes recovery more difficult and may increase the amount of data lost if a failure occurs. Follow the procedure in "Resetting An Overflowed User Auxiliary Storage Pool without an IPL."

Resetting An Overflowed User Auxiliary Storage Pool without an IPL

Do the following to reset a user ASP in overflowed status:

__ **Step** **1** Determine which objects in the ASP have overflowed. Use one of these methods:

- Use the DSPOBJD command to create an output file. Then run a query against that output file:

  __ **Step** **a.** For the first library in the user ASP, type:

  ```
  DSPOBJD OBJ(library-name/*ALL) OBJTYPE(*ALL)
    DETAIL(*FULL) OUTPUT(*OUTFILE)
    OUTFILE(library-name/file-name)
  ```

  __ **Step** **b.** For each additional library in the user ASP, type:

  ```
  DSPOBJD OBJ(library-name/*ALL) OBJTYPE(*ALL)
    DETAIL(*FULL) OUTPUT(*OUTFILE)
    OUTFILE(library-name/file-name)
    OUTMBR(*FIRST *ADD)
  ```

  __ **Step** **c.** Create a query against the output file. Look for objects that have a 1 (Yes) in the ODOASP (overflowed ASP) field.

- For a user ASP that contains only DLOs, use the QRYDOCLIB command. It has a parameter to display overflowed DLOs.

__ **Step** **2** Save each overflowed object to a scratch tape.

__ **Step** **3** Delete each overflowed object.

Some objects, such as journals and physical files, require that you take certain actions before deleting them. Table 13-1 on page 13-11 shows what to do before deleting these objects.

Table 13-1. Object Types That Require Special Procedures for Deleting

Object Type	Do This Before Deleting
Journal	"Steps before Deleting a Journal" on page 15-17
Journal receiver	"Steps before Deleting a Journal Receiver" on page 15-19
Physical file	"Steps before Deleting a Physical File" on page 15-17

__ **Step 4** Ensure that the ASP is no longer in overflowed status. You should have received a message in the QSYSOPR message queue that the overflow condition has been recovered. You can also use System Service Tools (SST) to check:

__ **Step a.** Type STRSST. You are shown the System Service Tools (SST) menu.

__ **Step b.** Select the option to work with disk units.

__ **Step c.** Select the option to display disk configuration.

__ **Step d.** Select the option to display disk configuration capacity. You are shown the Display Disk Configuration Capacity display:

```
                    Display Disk Configuration Capacity

                                                    --Protected--  --Unprotected--
ASP  Unit  Type  Model  Threshold  Overflow   Size  %Used    Size  %Used
 1                          90%    No            0  0.00%   1400   8.22%
       1  9332   400                            0  0.00%    200  17.97%
       2  9332   400                            0  0.00%    200   6.60%
   :
 2                                 Yes           0  0.00%    200  99.99%
       8  9332   200       90%                  0  0.00%    200  99.99%
```

This display shows whether any ASPs are in overflowed status.

If the user ASP is still overflowed, follow the procedure described in "Resetting An Overflowed User Auxiliary Storage Pool during an IPL."

__ **Step 5** Before you can restore the overflowed objects from tape, you must make additional space available in the user ASP. Do one or more of the following:

- Delete objects from the ASP if you no longer need them.
- Move one or more libraries to a different ASP.

  Note: You cannot use the MOVOBJ command to do this. You must save the library, delete it, and restore it to a different ASP.
- Move one or more folders to a different ASP by saving the folder, deleting it, and restoring it to a different ASP.
- Assign additional disk units to the ASP.

__ **Step 6** After you have made additional space available in the ASP, restore the objects you saved in step 2 on page 13-10.

__ **Step 7** Check to make sure the user ASP has sufficient space and is not overflowed. Repeat the procedure described in step 4.

Resetting An Overflowed User Auxiliary Storage Pool during an IPL

Sometimes you are not able to find all the overflowed objects in a user ASP. If you have taken the steps described in "Resetting An Overflowed User Auxiliary Storage Pool without an IPL" on page 13-10 and the user ASP is still overflowed, you can perform a manual IPL to reset the user ASP. Do the following:

__ **Step 1** Ensure that you have enough space to reset the overflowed user ASP. Do the following:

__ **Step a.** Type STRSST. You are shown the System Service Tools (SST) menu.

__ **Step b.** Select the option to work with disk units.

__ **Step c.** Select the option to display disk configuration.

__ **Step d.** Select the option to display disk configuration capacity. You are shown the Display Disk Configuration Capacity display:

```
                    Display Disk Configuration Capacity

                                                    --Protected--  --Unprotected--
ASP  Unit  Type  Model  Threshold  Overflow  Size  %Used    Size  %Used
 1                          90%    No          0   0.00%   1400   8.22%
       1   9332   400                         0   0.00%    200  17.97%
       2   9332   400                         0   0.00%    200   6.60%
   :
 2                                 Yes         0   0.00%    200  99.99%
       8   9332   200       90%               0   0.00%    200  99.99%
```

This display shows whether any ASPs are in overflowed status.

__ **Step e.** Calculate the amount of space you have available in the overflowed ASP:

__ **Step 1)** Multiply the size of the ASP by the percent used.

__ **Step 2)** Subtract the result of step 1e1 from 100.

__ **Step f.** Press F9 (Display ASP Overflow information) to display the overflow amount and the amount of storage needed to recover the overflowed objects.

```
                    Display ASP Overflow Information

                          Overflow      ----Amount Needed to Recover----
ASP  Threshold             Amount        To Capacity     To Threshold
 2      90%                   14                0               0
 3      90%                   25               25              45
```

__ **Step g.** The result from step 1e2 should be greater than the amount needed to recover the overflowed ASP.

__ **Step h.** If you do not have enough space, repeat the instructions in step 5 on page 13-11 to free more space.

__ **Step 2** Do the following to put your system in a restricted state:

__ **Step a** Before putting your system in a restricted state, ensure that all users are signed off and all jobs are ended.

__ **Step b** To receive notification that the subsystems have ended, type the following and press the Enter key:

```
CHGMSGQ MSGQ(QSYSOPR) DLVRY(*BREAK)
   SEV(60)
```

__ **Step c** To end all subsystems, type the following:

```
ENDSBS SBS(*ALL) OPTION(*CNTRLD) DELAY(600)
```

Note: For the delay parameter, specify a number of seconds that allows your system time to bring most jobs to a normal end. On a large, busy system, you may need a longer delay.

A message is sent that indicates that the procedure for ending subsystems is in progress. A final message is sent when the system is in a restricted state.

__ **Step 3** Perform a manual IPL and access DST:

__ **Step a.** Ensure the key or keystick is in the system unit.

__ **Step b.** Place the system in manual mode.

__ **Step c.** Power down the system:

```
PWRDWNSYS OPTION(*IMMED) RESTART(*YES) IPLSRC(B)
```

__ **Step d.** When the IPL completes, the IPL or Install the System menu appears.

```
                        IPL or Install the System

Select one of the following:

          1. Perform an IPL
          2. Install the operating system
          3. Use Dedicated Service Tools (DST)
          4. Perform automatic installation of the operating system
          5. Save Licensed Internal Code
```

__ **Step e.** Select option 3 (Use Dedicated Service Tools (DST)) and press the Enter key. The Dedicated Service Tools (DST) Sign On display is shown.

```
                     Dedicated Service Tools (DST) Sign On

Type choice, press Enter.

  DST user . . . . . .  _____
  DST password . . . . .  _____
```

__ **Step f.** Sign on DST with the DST security-level or full-level password. The *Security – Reference* book has more information about DST passwords.

The Use Dedicated Service Tools (DST) menu is shown.

```
                     Use Dedicated Service Tools (DST)

Select one of the following:

          1. Perform an IPL
          2. Install the operating system
          3. Work with licensed internal code
          4. Work with disk units
          5. Work with DST environment
          6. Select DST console mode
          7. Start a service tool
          8. Perform automatic installation of the operating system
          9. Work with save storage and restore storage
         10. Work with remote DST support
```

__ **Step 4** Select option 1 (Perform an IPL). You are shown the Reset Overflowed User ASP display:

```
                          Reset Overflowed User ASP

The following user ASPs are overflowed.


ASP
 2
 3
```

__ **Step 5** Press the Enter key to request recovery of the overflowed user ASPs. The recovery takes place during the storage management recovery phase of the IPL. The operation takes from several minutes to a few hours, depending

on the number of objects on the system and the amount of data to be recovered.

__ **Step 6** When the IPL of the system is complete, the Sign On display is shown.

__ **Step 7** Sign on and verify the results by checking the messages in the QSYSOPR message queue.

Deleting Overflowed Objects during Recovery

Use this procedure if you are recovering a user ASP that was in overflowed status.

__ **Step 1** After running the RCLSTG procedure, display the contents of the QRCL library by typing: `DSPLIB QRCL`

__ **Step 2** Write down the names of the objects in the library. These objects were overflowed into the system ASP at the time of the failure.

Although the initial disk extents for these objects may have been allocated in the system ASP, portions of the objects may still have been lost. The integrity of these objects cannot be predicted. They should be deleted and recovered.

__ **Step 3** Delete the overflowed objects. You must take special action before deleting certain types of objects. See Table 13-1 on page 13-11 for more information.

__ **Step 4** When you run the RCLSTG command, any documents from the lost user ASP that were in overflowed status are placed in the user ASP again. (The system creates a new QDOCnnnn library, where *nnnn* is the number of the lost ASP, and places the overflowed DLOs in it.)

Assuming you have not yet restored DLOs to the user ASP, type this to delete the overflowed DLOs:

```
DLTDLO DLO(*ALL) FLR(*ANY) ASP(n)
```

n is the number of the ASP whose data was lost.

Recovering a Damaged User Auxiliary Storage Pool

Perform this procedure if one of the following is true:

- The service representative has replaced a failed disk unit in a user ASP. When you lose a disk unit in an ASP, you must recover all of the information in that ASP. The information in other ASPs on your system is not affected.
- The system has reassigned sectors on a disk unit, but object damage has occurred.
- You have replaced a disk unit in the system ASP and one or more user ASPs was overflowed.

Task 1–Restoring User Profiles

Even though user profiles are not lost when you replace a unit in a user ASP, they must be restored to prepare for restoring authority to objects in the user ASP. Do the following:

__ **Step 1** Sign on with the QSECOFR user profile.

__ **Step 2** Load your most recent SAVSYS or SAVSECDTA tape.

__ **Step 3** Restore all user profiles. Type:

```
RSTUSRPRF DEV(TAP01) USRPRF(*ALL) ENDOPT(*UNLOAD)
```

__ **Step 4** If you know what libraries or objects were in the user ASP that was lost, skip to "Task 3–Determining Tasks to Restore Objects" on page 13-16.

If you do not know what was in the user ASP, continue with "Task 2–Determining the Contents of the Lost Auxiliary Storage Pool" on page 13-15.

Task 2–Determining the Contents of the Lost Auxiliary Storage Pool

If your system has a small number of libraries and is well-documented, like the one in Figure 13-1 on page 13-1, your task is relatively simple. In the example, if a disk unit in ASP 2 is replaced, the user must recover the ORDLIB, TRANLIB, and $JRNLB libraries. If a disk unit in ASP 5 is replaced, the user must recover all the journal receivers in the $JRNLA library and the ORDSAV save file in the SAVFLIB library.

If you are not sure what was on the user ASP, do this:

__ **Step 1** Sign on with a user profile that has *ALLOBJ special authority so that your listings show all libraries.

__ **Step 2** Print a list of the libraries that are on the lost user ASP by doing the following:

__ **Step a.** Create a list of all the libraries in an output file:

```
DSPOBJD OBJ(QSYS/*ALL) OBJTYPE(*LIB) OUTPUT(*PRINT)
        DETAIL(*FULL) OUTPUT(*OUTFILE)
        OUTFILE(library-name/file-name)
```

__ **Step b.** Use a program or a query tool to display or print the output file. Select all entries that have an ASP field that matches the ASP that is lost.

Notes:

1) When you lose a user ASP, you lose the contents of any libraries in the ASP, not the libraries themselves. The library objects are in the QSYS library, which is in the system ASP.

2) If you had documents in the user ASP, you should have a library on your listing for the ASP. The library name is QDOCnnnn, where *nnnn* is the number of the ASP.

__ **Step 3** If you have determined what must be recovered, continue with "Task 3–Determining Tasks to Restore Objects" on page 13-16. If you have not found any libraries to recover, continue with step 4.

__ **Step 4** If you did not find any libraries to recover in step 2, the ASP was probably a nonlibrary user ASP. A nonlibrary user ASP can contain only save files, journals, and journal receivers.

Determining the objects that were in a nonlibrary user ASP can be very time consuming. The following steps are one method. This method works only if you have not yet run RCLSTG after losing the user ASP.

__ **Step a.** Type: `DSPOBJD OBJ(*ALL/*ALL) OBJTYPE(*LIB *FILE *JRN *JRNRCV) OUTPUT(*OUTFILE) OUTFILE(library-name/file-name)`.

__ **Step b.** Use a program or query tool to list all the objects in the output file that are in the ASP that is damaged.

__ **Step 5** When you have determined the objects that need to be recovered, continue with "Task 3–Determining Tasks to Restore Objects" on page 13-16.

Task 3–Determining Tasks to Restore Objects

__ **Step 1** Use Table 13-2 to determine how to recover the objects in your user ASP. It shows the recovery tasks you must perform, based on the contents of the user ASP you are recovering.

__ **Step 2** If you have different types of objects to recover, such as libraries and documents, perform the tasks in the order shown in the table.

Table 13-2. Tasks for Restoring User ASP Objects

Type of ASP	Contents	Recovery Tasks
Library User ASP	Libraries	"Task 4–Restoring Libraries to the User Auxiliary Storage Pool"
Library User ASP	Documents	"Task 5–Restoring Documents to the User Auxiliary Storage Pool"
Nonlibrary User ASP	Journals	"Task 6–Restoring Journals to the User Auxiliary Storage Pool" on page 13-17
Nonlibrary User ASP	Journal receivers	"Task 7–Restoring Journal Receivers to the User Auxiliary Storage Pool" on page 13-18
Nonlibrary User ASP	Save files	"Task 8–Restore Save Files to the User Auxiliary Storage Pool" on page 13-18

Task 4–Restoring Libraries to the User Auxiliary Storage Pool

__ **Step 1** Sign on with a user profile that has *SAVSYS and *JOBCTL special authority.

__ **Step 2** For each library you need to recover, load the correct volume from your latest save tapes.

__ **Step 3** Type:

```
RSTLIB SAVLIB(library-name) DEV(TAP01)
   ENDOPT(*LEAVE)
```

Note: You should restore changed objects and apply journaled changes for all the ASPs included in your recovery at the same time. These steps appear on the recovery checklist at the appropriate point.

__ **Step 4** Continue with the next task shown in Table 13-2. If you have completed all the appropriate tasks in the table, continue with the next task in the recovery checklist from Chapter 9.

Task 5–Restoring Documents to the User Auxiliary Storage Pool

__ **Step 1** Sign on with a user profile that has *SAVSYS and *JOBCTL special authority.

__ **Step 2** Load the tape with your last complete save of documents in the user ASP.

__ **Step 3** Restore the documents to the user ASP by typing:

```
RSTDLO DLO(*ALL) SAVASP(ASP-number)
   RSTASP(ASP-number)
```

This restores the documents and makes any changes necessary to the search index database files.

__ **Step 4** Use the Query Document Library (QRYDOCLIB) to locate any documents that were created on the user ASP since the last save operation. Query by ASP number and creation date. Inform your users that these documents were lost and develop a plan to re-create them.

__ **Step 5** Continue with the next task in the recovery checklist from Chapter 9.

Task 6–Restoring Journals to the User Auxiliary Storage Pool

__ **Step 1** Sign on with a user profile that has *SAVSYS and *JOBCTL special authority.

__ **Step 2** For each journal you need to recover, load the correct save tape and type:

```
RSTOBJ OBJ(journal-name) SAVLIB(library-name)
       DEV(TAP01) OBJTYPE(*JRN)
```

When you restore the journal, the system automatically creates and attaches a new journal receiver. The chapter of the *Backup and Recovery – Advanced* book called "Planning and Setting Up Journaling" describes how the system names the journal receiver that is created when you restore a journal.

__ **Step 3** Establish your journaling environment again. Do this:

__ **Step a.** For each physical file that was journaled to the restored journal, type:

```
STRJRNPF FILE(library-name/file-name)
   JRN(library-name/journal-name)
```

Note: The default is to journal after-images only. If you are not sure whether you journaled after-images or both before- and after-images, you can use the Display File Description (DSPFD) command for the file to find out.

__ **Step b.** For each access path that was journaled to the restored journal, type:

```
STRJRNAP FILE(library-name/file-name)
   JRN(library-name/journal-name)
```

__ **Step c.** Save each physical file that you started journaling.

__ **Step 4** If you need to restore journal receivers for the journals, skip to "Task 7–Restoring Journal Receivers to the User Auxiliary Storage Pool" on page 13-18.

__ **Step 5** Associate journal receivers with the journals you restored. Do the following:

__ **Step a.** Type WRKJRN on a command line and press the Enter key.

__ **Step b.** On the prompt display, type the name of the journal and the library name.

__ **Step c.** On the Work with Journals display, type a 9 (Associate receivers with journal) in the *Opt* column next to the journal that you want to work with.

__ **Step d.** Press the Enter key.

The receivers are reassociated with the journal.

If any of the journal receivers in the user ASP were created before V3R1, using option 9 from the Work with Journals display might not associate them in the correct sequence. If you have journal receivers from a prior release or if any of the journal receivers you need are not online, do this:

__ **Step a.** Save the journal receivers that are on the system to a scratch tape:

```
SAVOBJ OBJ(*ALL) LIB(library-name) DEV(TAP01)
   OBJTYPE(*JRNRCV) VOL(*MOUNTED) ENDOPT(*UNLOAD)
```

__ **Step b.** After you ensure that the receivers were saved successfully, delete the journal receivers from the library:

__ **Step 1)** Type WRKLIB *library-name* and press the Enter key. You are shown the work with library display.

__ **Step 2)** Type a 12 (Work with Objects) in the *Opt* column.

__ **Step 3)** Type a 4 (Delete) in the *Opt* for each journal receiver you want to delete.

__ **Step 4)** Press the Enter key.

__ **Step c.** Restore the journal receivers you need from the scratch tape and from your save tapes. Restore them from newest to oldest by typing the following command for each journal receiver:

```
RSTOBJ OBJ(receiver-name) LIB(library-name) DEV(TAP01)
   OBJTYPE(*JRNRCV) VOL(*MOUNTED) ENDOPT(*UNLOAD)
```

The receivers are reassociated with the journal.

__ **Step 6** Continue with the next task shown in Table 13-2 on page 13-16. If you have completed all the appropriate tasks in the table, continue with the next task in the recovery checklist from Chapter 9.

Task 7–Restoring Journal Receivers to the User Auxiliary Storage Pool

__ **Step 1** Sign on with a user profile that has *SAVSYS and *JOBCTL special authority.

__ **Step 2** For each journal receiver you need to recover, load the correct save tape and type:

```
RSTOBJ OBJ(receiver-name) SAVLIB(library-name)
       DEV(TAP01) OBJTYPE(*JRNRCV)
```

Note: For journal receivers created before V3R1, restore the journal receivers from newest to oldest to ensure that they are associated with the journal in the correct sequence. If all the journal receivers were created on V3R1 or later, you can restore them in any sequence.

__ **Step 3** Continue with the next task shown in Table 13-2 on page 13-16. If you have completed all the appropriate tasks in the table, continue with the next task in the recovery checklist from Chapter 9.

Task 8–Restore Save Files to the User Auxiliary Storage Pool

__ **Step 1** Sign on with a user profile that has *SAVSYS and *JOBCTL special authority.

__ **Step 2** For each save file you need to recover, load the correct save tape and type:

```
RSTOBJ OBJ(save-file-name) SAVLIB(library-name)
       DEV(TAP01) OBJTYPE(*SAVF)
```

Note: This command restores the description of the save file and its contents, if you specified SAVFDTA(*YES) when you saved the save file. If you specified SAVFDTA(*NO) when you saved the save file, this command restores only the save file description.

__ **Step 3** Continue with the next task in the recovery checklist from Chapter 9.

Removing a Failed Disk Unit from the System ASP

Use this procedure to remove a disk unit from your configuration if the unit has failed. This procedure allows you to return your system to operation if a replacement disk unit is not immediately available. However, this procedure removes all data from your system and requires a complete restore operation.

After performing this procedure, your system will have less disk capacity. You may not be able to restore all user information until you have installed and configured a replacement disk unit.

Before you perform this procedure, ensure that the remaining 2800-001 storage units in your system ASP are large enough for a main storage dump. Consult software support or see the chapter in the *Backup and Recovery – Advanced* book called "Overview of Auxiliary Storage Pools."

Task 1. Access Dedicated Service Tools

__ **Step 1** Turn off the power to the system.

__ **Step 2** Select manual mode on the control panel.

If your system is a 9402, 9404, 9404 Server Series, or a 9406, do the following:

__ **Step a** Ensure the key is in the keylock switch on the control panel.

__ **Step b** Turn the key in the keylock switch until it points to the Manual position.

__ **Step c** Press the Function Select switch (or buttons) to display `02` in the Function display and press the Enter button on the control panel.

__ **Step d** Select IPL type A by pressing the Function Select switch (or buttons) on the control panel until `A` is shown on the Data display.

__ **Step e** Press the Enter button on the control panel.

__ **Step f** Ensure that any switches for the tape unit used for the IPL and all disk units are in the On position.

If your system is a 9402/9404 Model 2xx, do this:

__ **Step a** Unlock and open the control panel cover by using the control panel cover key.

__ **Step b** Press the Function Select buttons to display `02` in the Function display and press the Enter button on the control panel.

__ **Step c** Press the Function Select buttons to display `A M` in the Function display and press the Enter button on the control panel.

__ **Step d** Ensure that any switches for the tape unit used for the IPL and all disk units are in the On position.

If your system is a 9404/9406 Model 3xx, do this:

__ **Step a** Insert the keystick.

__ **Step b** Press the Mode button on the control panel and select Manual mode.

__ **Step** **c** Press the Function Select buttons to display 02 in the Function display and press the Enter button on the control panel.

__ **Step** **d** Select IPL type A by pressing the Function Select buttons on the control panel until A is shown on the Data display. Press the Enter button on the control panel.

__ **Step** **e** Ensure that any switches for the tape unit used for the IPL and all disk units are in the On position.

__ **Step** **3** Power on the system.

__ **Step** **4** When the IPL completes, the IPL or Install the System menu appears.

```
                        IPL or Install the System

Select one of the following:

          1. Perform an IPL
          2. Install the operating system
          3. Use Dedicated Service Tools (DST)
          4. Perform automatic installation of the operating system
          5. Save Licensed Internal Code
```

__ **Step** **5** Select option 3 (Use Dedicated Service Tools (DST)) and press the Enter key. The Dedicated Service Tools (DST) Sign On display is shown.

```
                    Dedicated Service Tools (DST) Sign On

Type choice, press Enter.

  DST user . . . . . .  _____
  DST password . . . . .  _____
```

__ **Step** **6** Sign on DST with the DST security-level or full-level password. The *Security – Reference* book has more information about DST passwords.

The Use Dedicated Service Tools (DST) menu is shown.

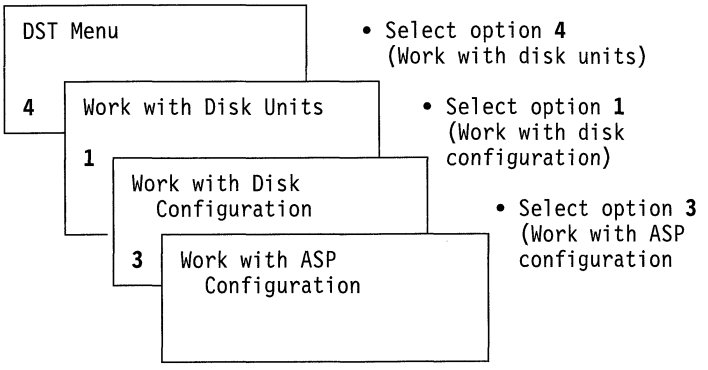
```
                      Use Dedicated Service Tools (DST)

Select one of the following:

          1. Perform an IPL
          2. Install the operating system
          3. Work with licensed internal code
          4. Work with disk units
          5. Work with DST environment
          6. Select DST console mode
          7. Start a service tool
          8. Perform automatic installation of the operating system
          9. Work with save storage and restore storage
         10. Work with remote DST support
```

Task 2. Delete the Auxiliary Storage Pool Data

__ **Step** **1** From the Use Dedicated Service Tools (DST), do the following:



__ **Step 2** Select option 5 (Delete ASP data) on the Work with ASP Configuration display.

Note: Selecting this option deletes all data in the system ASP. Do not use this procedure unless you have a failed disk unit and there is no immediate replacement for the disk unit.

```
                    Select ASP to Delete Data From

Type options, press Enter
  4=Delete ASP data

Option  ASP  Threshold  Overflow    --Protected--  --Unprotected
                                      Size  %Used     Size  %Used
          1       90%       No        0.00  0.00%    1200  74.84%
          2       90%      Yes        0.00  0.00%     200  99.99%
          3       90%      Yes        0.00  0.00%     200  99.99%
```

__ **Step 3** Type a 4 in the *Option* column to select the ASP that you want to delete the data from and press the Enter key. The following display is shown.

```
                          Confirm Delete ASP Data

Warning:  All data will be deleted from the selected ASPs.  You
have selected to delete data from ASP 1.  This will prevent you
from changing the disk configuration in some ways until the system
is IPLed again to DST.

Press F10 to confirm your choice for 4=Delete ASP data.
Press F12=Cancel to return to change your choice.

                                      --Protected--  --Unprotected--
Option  ASP  Threshold  Overflow     Size  %Used     Size  %Used
  4       1      90%       No          0   0.00     1200    *
```

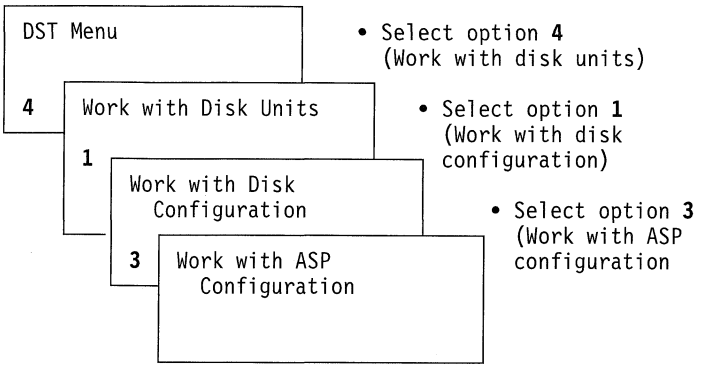
__ **Step 4** Press F10 (Confirm) to confirm your choice to delete the ASP data.

__ **Step 5** When the delete of the ASP data is complete, you return to the Use Dedicated Service Tools (DST) menu.

Task 3. Remove the Disk Unit from the Auxiliary Storage Pool Configuration

To remove the disk unit from the ASP, do the following:

__ **Step 1** From the Use Dedicated Service Tools (DST), do the following:



__ **Step 2** Select option 8 (Remove units from configuration) on the Work with ASP Configuration display.

```
                        Remove Units from Configuration

Type options, press Enter.
  4=Remove unit from configuration


                  Serial
OPT  Unit  ASP    Number      Type   Model   Address        Status
       2    1   10-00A7529  9332     400   0010-0001FFFF  Configured
       3    1   10-00A4936  9332     400   0010-0100FFFF  Configured
       4    1   10-00A4936  9332     400   0010-0101FFFF  Configured
 4     5    1   10-00A7498  9332     400   0010-0300FFFF  Configured
 4     6    1   10-00A7498  9332     400   0010-0301FFFF  Configured
       7    1   10-00A7530  9332     400   0010-0400FFFF  Configured
       8    1   10-00A7530  9332     400   0010-0401FFFF  Configured
```

__ **Step 3** Type a 4 (Remove unit from configuration) in the *OPT* column for each unit that you want to remove and press the Enter key.

__ **Step 4** The Confirm Remove of Units display is shown.

```
                            Confirm Remove of Units

Removing disk units will take several minutes.

Press Enter to confirm remove of disk units.
Press F9=Capacity information to display the capacity information.
Press F12=Cancel to return to change your choice.


                  Serial
OPT  Unit  ASP    Number      Type   Model   Address        Status
 4     5    1   10-00A7498  9332     400   0010-0300FFFF  Configured
 4     6    1   10-00A7498  9332     400   0010-0301FFFF  Configured
```

__ **Step 5** Press F9 (Capacity information) to display the resulting capacity.

```
                              Resulting Capacity

The configuration change that you requested would result in the
following ASP capacities.

Press Enter to continue.

                ----------Current----------  ----------Modified----------
                --Protected--  -Unprotected-  --Protected--  -Unprotected-
ASP   Threshold   Size  %Used   Size  %Used   Size   %Used    Size   %Used
 1        90%         0  0.00%   1600 52.70%     0    0.00%   1200   70.26%
```

__ **Step 6** Press the Enter key to return to the Confirm Remove of Units display.

__ **Step 7** Press the Enter key on the Confirm Remove of Units display to remove the selected units. The system moves the data off the units selected to be removed to the remaining units in the source ASP. The remove operation can take several minutes during which the system appears inactive.

__ **Step 8** When the remove operation is complete, you return to the Work with ASP Configuration display.

__ **Step 9** Press F3 until you return to the Use Dedicated Service Tools (DST) display.

Chapter 14. The Restore Menu

The Restore menu provides many options for recovering information. Figure 14-1 shows the menu. Options marked with a plus sign (+) require the system to be in a restricted state. When your system is in a restricted state, that does not prevent client workstations from attempting to access information. If you have directories managed by the LAN Server for OS/400 program, you should vary off the network server descriptions.

```
RESTORE                              Restore

Select one of the following:

  Restore Data
     1. Files
     2. Libraries
     3. Documents and folders
     4. Programs
     5. Other objects
     6. Licensed programs
     7. Configuration
  +  8. User profiles
     9. Objects in directories
```

Figure 14-1. Restore Menu–First Display

You can page down on the Restore menu to see additional options:

Restore System and User Data

+	21	System and user data
+	22	System data only
+	23	All user data

Restore Office Data

	30	All documents, folders, and mail
	31	Documents and folders
	32	Mail only
	33	Calendars

Restore Libraries

+	40	All libraries other than system library
	41	All IBM libraries other than system library
	42	All user libraries

Restore from Different Systems

	50	Restore from System/36 format

What the Restore Menu Options Do

Following are the commands the system runs for the menu options that restore multiple libraries, documents, or directories. In parentheses () following the description of the menu option is the name of the CL program the system runs, if the menu option has a program. You can change this CL program if you need different values than the system-supplied defaults.

Option Number — **Description and Commands**

21 System and user data (QMNRSTE):

```
ENDSBS SBS(*ALL) OPTION(*IMMED)
RSTUSRPRF USRPRF(*ALL)
RSTCFG OBJ(*ALL)
RSTLIB SAVLIB(*NONSYS)
RSTDLO DLO(*ALL) SAVFLR(*ANY)
RST DEV(/QSYS.LIB/TAPxx.DEVD))
    OBJ(('/*') ('/QSYS.LIB' *OMIT)
    ('/QDLS' *OMIT)
RSTAUT
STRSBS SBSD(controlling subsystem)
```

22 System data only (QSRRSTI):

```
ENDSBS SBS(*ALL) OPTION(*IMMED)
RSTUSRPRF USRPRF(*ALL)
RSTCFG OBJ(*ALL)
RSTLIB SAVLIB(*IBM)
STRSBS SBSD(controlling subsystem)
```

23 All user data (QSRRSTU):

```
ENDSBS SBS(*ALL) OPTION(*IMMED)
RSTUSRPRF USRPRF(*ALL)
RSTCFG OBJ(*ALL)
RSTLIB SAVLIB(*ALLUSR)
RSTDLO DLO(*ALL) SAVFLR(*ANY)
RST DEV(/QSYS.LIB/TAPxx.DEVD))
    OBJ(('/*') ('/QSYS.LIB' *OMIT)
    ('/QDLS' *OMIT)
RSTAUT
STRSBS SBSD(controlling subsystem)
```

Using Restore Menu Options 21, 22, and 23

This topic describes the procedure for restoring information using option 21, 22, or 23 from the Restore menu. The basic steps are the same for each menu option. Which option or options you use depends on which save menu option was used and what other procedures, if any, you use to save information. This is discussed in "Choosing the Procedure to Recover User Information" on page 9-30.

Before You Begin

__ Clean the read and write heads of the tape unit.

__ **Step 1** Sign on the system with sufficient authority to do the operation:

Procedure You Are Running	How To Sign On
Restore menu, option 21, 22, or 23, after restoring Licensed Internal Code using function code 24.	QSECOFR profile with QSECOFR password
Restore menu, option 21, 22, or 23, after restoring Licensed Internal Code using function code 23.	QSECOFR profile with your assigned password for that profile

__ **Step 2** Ensure that the correct volume of your last set of save tapes is loaded and make the tape device ready. The tape should contain the file labeled QFILEUPR. Run the DSPTAP command and specify DATA(*LABELS) to find the file labeled QFILEUPR.

__ **Step 3** Ensure that any device configuration objects not used in the restore operation are varied off. You can use the Work with Configuration Status (WRKCFGSTS) command to display the status of devices.

__ **Step 4** Ensure that the devices you are using for the restore operation (workstations, tape devices, and tape controllers) are varied on. These configuration objects are excluded from the restore operation (message CPF379C in the job log).

__ **Step 5** Display the Restore menu: `GO RESTORE`.

__ **Step 6** If you want to do an *attended restore*, skip to step 7. In most cases, you should do an attended restore operation to monitor for messages and correct any problems that occur. This helps your system return to operation as quickly as possible. If you want to do an *unattended restore*, do the following steps. This prevents your restore operation from stopping because of unanswered messages:

__ **Step a.** Display the reply list sequence numbers to find what numbers are available for use:

```
WRKRPYLE
```

__ **Step b.** If MSGID(CPA3709) is not already in your reply list, add it. For *xxxx*, substitute an unused sequence number from 1 through 9999:

```
ADDRPYLE SEQNBR(xxxx) MSGID(CPA3709) RPY('G')
```

__ **Step c.** Change your job to use the reply list:

```
CHGJOB INQMSGRPY(*SYSRPYL)
```

__ **Step 7** Select the option (21, 22, or 23) from the Restore menu and press the Enter key. You are shown the Specify Command Defaults display:

```
                          Specify Command Defaults

Type choices, press Enter.

  Tape devices . . . . . .   TAP01       Names
                             _____
                             _____
                             _____

  Prompt for commands  . . . . .   N          Y=Yes, N=No

  Message queue delivery . . . .   *BREAK     *BREAK, *NOTIFY
```

__ **Step 8** Type your choices for the *Tape device* prompt. You can specify up to four tape device names. If you specify more than one device, the system automatically switches to the next tape device after the current tape is read.

__ **Step 9** Type your choice for the *Prompt for commands* prompt. Specify `N` (No) if you want to run an unattended restore. Specify `Y` (Yes) if you want to change the defaults on the RSTxxx commands.

__ **Step 10** Type your choice for the *Message queue delivery* prompt. Specify *NOTIFY if you want to do an unattended restore. This prevents communications messages from stopping the restore procedure. If you specify *NOTIFY, severity 99 messages that are not associated with the restore operation do not interrupt the restore process. For example, messages that request a new volume to be loaded interrupt the restore operation because they are associated with the job. You cannot continue until you reply to these messages.

Specify *BREAK, if you want to be interrupted for severity 99 messages that require a reply.

__ **Step 11** After you type your choices, press the Enter key.

__ **Step 12** If you responded `Y` to the *Prompt for commands* prompt, you are shown the End Subsystem display. Type any changes and press the Enter key. While the system is ending subsystems, you see and respond to these messages:

__ **Step a.** `CPF0994 ENDSBS(*ALL) command being processed.` Press the Enter key.

__ **Step b.** `CPF0968 System ended to restricted condition.` Press the Enter key.

If you responded `N` to the *Prompt for commands* prompt, skip to step 15 on page 14-4.

__ **Step 13** When the system is ready to perform each major step in the restore process, you are shown the prompt display for that step. The time between displays may be quite long.

For option 21, you are shown these displays:

- `ENDSBS SBS(*ALL) OPTION(*IMMED)`
- `RSTUSRPRF USRPRF(*ALL)`
- `RSTCFG OBJ(*ALL)`
- `RSTLIB SAVLIB(*NONSYS)`
- `RSTDLO DLO(*ALL) SAVFLR(*ANY)`
- `RST DEV('/QSYS.LIB/TAP`*xx*`DEVD') OBJ(('/*') ('/QSYS.LIB' *OMIT) ('/QDLS' *OMIT))`
- `STRSBS SBSD(`*controlling subsystem*`)`

__ **Step 14**

For option 22 (System data only) you are shown these displays:

- `ENDSBS SBS(*ALL) OPTION(*IMMED)`
- `RSTUSRPRF USRPRF(*ALL)`
- `RSTCFG`
- `RSTLIB SAVLIB(*IBM)`
- `STRSBS SBSD(controlling-subsystem)`

For option 23 (All user data) you are shown these displays:

- `ENDSBS SBS(*ALL) OPTION(*IMMED)`
- `RSTUSRPRF USRPRF(*ALL)`
- `RSTCFG`
- `RSTLIB SAVLIB(*ALLUSR)`
- `RSTDLO DLO(*ALL) SAVFLR(*ANY)`

- `RST DEV('/QSYS.LIB/TAPxxDEVD') OBJ(('/*') ('/QSYS.LIB' *OMIT) ('/QDLS' *OMIT))`
- `STRSBS SBSD(controlling-subsystem)`

Type your changes, if any, when the display is shown and press the Enter key.

Note: The RSTAUT command will run immediately after these commands when you use option 21 or option 23. **If you use option 22 only, you must run the RSTAUT command.** You are not shown the display for the RSTAUT command because it has no parameters. You cannot prevent it from running when your restore using the menu options. If you have additional restore operations to run, you may need to restore security data and restore authority again after those restore operations.

__ **Step 15** When the system sends a message asking you to load the next volume, load the next tape and respond to the message.

If a media error occurs...

If an error occurs during the restore operation, see "Recovery from an Unsuccessful Restore Operation" on page 8-9.

If an unrecoverable error occurs when running the RSTDLO DLO(*ALL) SAVFLR(*ANY) command, see "Recovering from an Error While Restoring DLOs" on page 8-10.

__ **Step 16** If you used the distribution tapes to restore the operating system, some information was not restored. If you are restoring to a different system, the network attributes are reset to the IBM-supplied defaults. You must create or change this information again. You should have lists of this information that were created at the time you performed your save operation.

The following may need to be created or changed:

- Configuration lists
- Network attributes
- Edit descriptions
- Reply list entries
- IBM-supplied subsystem descriptions

a. For the configuration lists, do the following:

   Use the Work With Configuration Lists (WRKCFGL CFGL(*ALL)) command to create the configuration lists to match the information in your list.

b. For network attributes, do the following:

   Use the Change Network Attributes (CHGNETA) command to change the network attributes to match the information in your list.

c. For edit descriptions, do the following:

   Use the Work with Edit Descriptions (WRKEDTD EDTD(*ALL)) command to create edit descriptions to match the information in your list.

d. For reply list entries, do the following:

   Use the Add Reply List Entry (ADDRPYLE) command to add reply list entries to match the information in your list.

e. For IBM-supplied subsystem descriptions, do the following:

   Use the Work with Subsystem Descriptions (WRKSBSD SBSD(*ALL)) command to change the IBM-supplied subsystem descriptions to match the information in your list.

__ **Step 17** This completes the restore operation.

__ **Step 18** If you are unsure what the QSECOFR password is, change it now. To see if the password has expired, type the following:

```
DSPUSRPRF QSECOFR
```

The passwords from tape are now the current passwords. If the password expiration is active for the QSECOFR user profile, you will see the expiration date on the Date password expired field. If the date is the current system date or prior, change the password for the QSECOFR user profile.

__ **Step 19** Check the job log to ensure all objects were restored.

The job log contains information about the restore operation. To verify that all objects were restored, you should spool the job log for printing, along with the job's remaining spooled output, if any.

```
DSPJOBLOG * *PRINT
```

Or

```
SIGNOFF *LIST
```

Message CPC3703 is sent to the job log for each library that was successfully restored. Message CPF3773 is sent to tell you how many objects were restored. It also tells you how many objects were not restored. Objects are not restored for various reasons. Check for any error messages, correct the errors, and then restore those objects from the media.

Chapter 15. How to Restore Specific Types of Information

This chapter describes procedures for restoring particular types of information on the system. It also describes considerations when you restore particular types of information, whether you restore the information using menu options or commands.

How to Recover System Information

You can customize some system information, such as edit descriptions and network attributes. This system information is saved when you run the SAVSYS command. It cannot be saved separately.

If you have SAVSYS tapes and need to restore system information, follow the procedure described in Chapter 11, "Restoring the Operating System." Do an **abbreviated** installation of the operating system.

If you have restored your operating system from distribution tapes, you need to reconstruct system information. "Task 1–Printing System Documentation and Preparing to Save" on page 4-2 describes how to print the system information. Find the most recent listings you have. Table 15-1 shows the commands for changing the system information to the correct values:

Table 15-1. Commands for Changing System Information

Information Type	Command
Access path recovery times[1]	EDTRCYAP
Configuration lists	WRKCFGL
Edit descriptions	WRKEDTD
IBM-supplied subsystem descriptions	WRKSBSD
Network attributes	CHGNETA
Reply list entries	ADDRPYLE
Service attributes	CHGSRVA
System values	WRKSYSVAL

1 When you reset your access path recovery times, ensure that the ASP configuration matches the configuration at the time that you printed the recovery times. If it does not, make a note to reset your access path recovery times after recovering your ASP configuration.

Sequence for Restoring Security Information

Security information on your system consists of:

- User profiles and group profiles
- Authorization lists
- Authority holders
- Authority information stored with objects:
  - Owner
  - Owner authority
  - Primary group
  - Primary group authority
  - Public authority
- Private authorities

It is essential that you restore security information in the correct sequence. Otherwise, object ownership and authority information is not restored correctly and your applications may not run correctly. The recovery checklists include the correct sequence of steps for restoring security information. If you are developing your own restore procedure, restore security information in the following sequence:

1. Restore user profiles. The user profile that owns an object must exist before the object can be restored.

   If you restore all user profiles (RSTUSRPRF USRPRF(*ALL)), you also restore authorization lists and authority holders. Authorization lists and authority holders must also be on the system before you restore objects.
2. Restore objects. This restores ownership and the authority information stored with the object.
3. Restore authority. This restores users' private authorities to objects.

Note: If you have the LAN Server for OS/400 program, see the *LAN Server for OS/400 Administration* book for special procedures to restore security information.

How to Restore User Profiles

You can restore a single user profile, a list of user profiles, or all user profiles. You restore a user profile to move a user from one AS/400 system to another AS/400 system and to recover a damaged user profile.

Note: You cannot delete an IBM-supplied user profile if it is damaged. You must restore the operating system again to recover a damaged IBM-supplied user profile.

Table 15-2. How User Profiles Are Restored

Method	Restricted State?
RSTUSRPRF command [1]	Yes
Restore menu option 8 [1]	Yes
Restore menu option 21 [1,2]	Yes
Restore menu option 22 [1,2]	Yes
Restore menu option 23 [1,2]	Yes

1 You must have *SAVSYS special authority. You must have *ALLOBJ special authority to specify ALWOBJDIF(*ALL).

2 These menu options restore all user profiles.

Do This to Restore All User Profiles

__ **Step 1** Sign on as QSECOFR.

__ **Step 2** Ensure the system is in a restricted state. See "Putting Your System in a Restricted State" on page 8-4.

__ **Step 3** Find the most recent tape that has your user profiles. It may be a SAVSYS tape or a SAVSECDTA tape. The file on the tape is called QFILEUPR.

__ **Step 4** If you are using a SAVSYS tape, type:

```
RSTUSRPRF DEV(TAP01) USRPRF(*ALL)
   ENDOPT(*LEAVE)
```

If you are using a SAVSECDTA tape, type:

```
RSTUSRPRF DEV(TAP01) USRPRF(*ALL)
   ENDOPT(*UNLOAD)
```

What Happens When You Restore User Profiles

When you restore a user profile, you restore all the attributes of the profile that you see on the Display User Profile display. The system builds a working table that holds that user's private authorities to objects. You must use the Restore Authority (RSTAUT) command to restore the user's private authorities. (See "How to Restore Object Authorities" on page 15-4.)

Some values in a user profile may be changed when it is restored. Table 15-3 shows the actions the system takes when you restore user profiles:

Table 15-3. Results of Restoring User Profiles

	Restore Procedure Used		
User Profile Attributes	**Restore *ALL User Profiles**	**Restore Individual User Profile That Already Exists on System**	**Restore Individual User Profile That Does Not Exist on System**
Group profile (GRPPRF)	Value is restored from media	Value on system is not changed	Value is set to *NONE
Owner (OWNER) of new objects	Value is restored from media	Value on system is not changed	Value is set to *USRPRF
Group authority (GRPAUT) to new objects	Value is restored from media	Value on system is not changed	Value is set to *NONE
Password	Value is restored from media	Value on system is not changed	Value is set to *NONE
Document Password	Value is restored from media	Value on system is not changed	Value is set to *NONE
Date password was last changed	Value is restored from media	Value on system is not changed	The current date is used.
Owner of user profile	See "How the System Establishes Ownership for Restored Objects" on page 15-3.	Value on system is not changed	Value is restored from the media. If the owning profile does not exist, ownership is assigned to the QDFTOWN user profile.
Primary group of user profile	See "How the System Establishes the Primary Group for Restored Objects" on page 15-4	Value on system is not changed.	Value is restored from the media. If the primary group does not exist, the value in the user profile is set to *NONE.
*ALLOBJ special authority	See "Restoring *ALLOBJ Special Authority" on page 15-3.	See "Restoring *ALLOBJ Special Authority" on page 15-3.	See "Restoring *ALLOBJ Special Authority" on page 15-3.
User identification number (*uid*)	Value on system is not changed.	Value on system is not changed.	Value is restored from the media unless it is a duplicate of a *uid* on the system. In that case, a new *uid* is generated.
Group identification number (*gid*)	Value on system is not changed.	Value on system is not changed.	Value is restored from the media unless it is a duplicate of a *gid* on the system. In that case, a new *gid* is generated.

Note. This situation does not apply when migrating from a System/38. See the *System/38 Migration Planning* book for more information.

What You Should Know About Restoring User Profiles

Keep these things in mind when you restore user profiles:

Restoring All Profiles: When you restore all profiles, the system does not first delete all profiles, authorization lists, and authority holders on the system. Therefore, the result is both of the following:

- All the profiles, authorization lists, and authority holders on the media.
- Any profiles, authorization lists, and authority holders on the system that were not on the save media.

Restoring all profiles is the only way to restore authorization lists and authority holders. However, if an authorization list secures an object in library QSYS, the association between the authorization list and the object is not restored automatically. This is because the objects in QSYS library are restored before the authorization lists. *An Implementation Guide for AS/400 Security and Auditing* contains sample programs (ALLAUTL and FIXAUTL) that can be used to attach authorization lists to the objects in library QSYS when the authorization lists are restored.

Security Note

If the IBM-supplied user profiles have the default passwords on your save media, they will again have default passwords after you restore. This is a security exposure. After a restore operation, verify that the IBM-supplied user profiles do not have the default passwords.

Restoring *ALLOBJ Special Authority: *ALLOBJ special authority is removed from user profiles being restored to a system at security level 30 or higher in either of these situations:

- The profile was saved from a different system.
- The profile was saved from the same system at security level 10 or 20.

*ALLOBJ special authority is not removed from these IBM-supplied profiles:

QSYS
QSECOFR
QLPAUTO
QLPINSTALL

Moving Users to Another System: To transfer user profiles and their authorities to another system, do the following:

1. Save the user profiles and authorities using the SAVSECDTA command.
2. Save the owned objects.
3. Restore the user profiles using RSTUSRPRF USRPRF(*ALL) ALWOBJDIF(*ALL).
4. Restore the needed objects using the RSTLIB, RSTOBJ, RST, or RSTDLO commands specifying ALWOBJDIF(*ALL).
5. Restore the private authorities of the user profiles using the RSTAUT command.

Saving Objects for a Previous Release: When you save an object from V3R1 and specify a target release that is an earlier release, the system removes some security information. The following security features are new for V3R1 and are removed:

- The primary group for an object.
- *OBJALTER, *OBJREF, and *EXECUTE authority.
- Data authorities for logical files.

The chapter of the *Backup and Recovery – Advanced* book called "Release-to-Release Support" provides more information about moving objects between systems running different releases of the operating system. The *Security – Reference* book provides more information about these security features.

How the System Establishes Ownership for Restored Objects

Most objects on the system have an owner. The exception to this is objects in the QLANSrv file system because most PC applications do not have a concept of object ownership.

When you restore an object, the system determines what profile owns the restored object by using the following rules:

- If the profile that owns the object is on the system, ownership is restored to that profile.
- If the owner profile does not exist on the system, ownership of the object is given to the QDFTOWN (default owner) user profile.
- If the object exists on the system and the owner on the system is different from the owner on the save media, the object is not restored unless ALWOBJDIF(*ALL) is specified. In that case, the object is restored and the owner on the system is used.
- See "How the System Restores Programs" on page 15-19 for additional considerations when restoring programs.

How the System Establishes the Authorization List for a Restored Object

Table 15-4 shows what happens when you restore an object that already exists if the object is linked to an authorization list. These rules do not apply when you are restoring a document or a folder.

Table 15-4. Restoring an Object Linked to an Authorization List

Authorization List on System and Media	Value of ALWOBJDIF Parameter	Result
Same	Any	Data restored; link to authorization list not changed.
Different	*NONE	Object is not restored
Different	*ALL	Data restored; linked to authorization list associated with existing object.

How the System Establishes the Primary Group for Restored Objects

Many objects on the system have a primary group. When you restore an object, the system determines the primary group for the object using the following rules:

- If the profile that is the primary group for the object is on the system, that profile is the primary group for the object.
- If the profile that is the primary group for the object is not on the system, the primary group is set to *NONE. Message CPI380E is sent to the job log.
- If the object exists on the system and the primary group on the system is different from the primary group on the save media, the primary group on the system is used. Message CPI3811 is sent to the job log.

How to Restore Object Authorities

Restoring a user's private authorities to objects is a separate task from restoring user profiles. When you restore user profiles, the system builds an authority reference table for each user profile that you restore. The authority reference table temporarily holds the user's private authorities to objects.

Possible Method	Restricted State?
RSTAUT command [1]	Yes
Restore menu option 21 [1]	Yes
Restore menu option 22 [1]	Yes
Restore menu option 23 [1]	Yes

[1] You must have *SAVSYS special authority.

When you run the Restore Authority (RSTAUT) command, the system restores authority for each user you specify. If you restore authority for all users, the system restores authority using every authority reference table it finds on the system.

Because the RSTAUT function uses and then deletes the authorization table built by the RSTUSRPRF command, you can restore authority only once for each restored user profile.

Note: Authorities are saved and restored differently for objects in the QLANSrv file system. All authorities, including private authorities, are saved and restored with the object. "How to Restore LAN Server for OS/400 Information" on page 15-25 provides more information.

Do This to Restore Authorities: Restoring authorities should be the last thing you do, before performing an IPL, in a recovery. To restore all private authorities, type: RSTAUT.

You can also restore authority for a specific profile or a list of profiles. For example, if you have restored a single user profile to the system because it was damaged, you can also use the RSTAUT command and specify that profile name.

What the System Does When You Restore Authority

When you run the RSTAUT command, the system grants all the private authorities it finds in each authority reference table. The user's private authorities after the command are both of the following:

- The authorities from the temporary authority reference table.
- Any authorities granted to the user since the save operation.

How the System Restores Authority–Example 1: Assume the authority to PRICES looks like this at the time of the save operation:

```
                          Display Object Authority
Object . . . . . :   PRICES          Owner . . . . .
  Library  . . . . :     CONTRACTS     Primary group  .
Object type  . . . :   *FILE
Object secured by authorization list  . . . . . .
                          Object
User        Group       Authority
OWNCP                   *ALL
DPTSM                   *CHANGE
DPTMG                   *CHANGE
WILSONJ                 *USE
*PUBLIC                 *EXCLUDE
```

Note: Your display looks different when your user profile has a user option setting of *EXPERT.

After you save security information, you grant and revoke several authorities to the PRICES file. Just before the restore operation, the authority looks like this:

```
                          Display Object Authority
Object . . . . . :   PRICES          Owner . . . . .
  Library  . . . . :     CONTRACTS     Primary group  .
Object type  . . . :   *FILE
Object secured by authorization list  . . . . . .
                          Object
User        Group       Authority
OWNCP                   *ALL
DPTSM                   *USE
DPTMG                   *CHANGE
WILSONJ                 *EXCLUDE
ANDERSP                 *USE
*PUBLIC                 *EXCLUDE
```

If authority is restored for all users, the authority to the PRICES file looks like this:

```
                          Display Object Authority
Object . . . . . :   PRICES          Owner . . . . .
  Library  . . . . :     CONTRACTS     Primary group  .
Object type  . . . :   *FILE
Object secured by authorization list  . . . . . .
                          Object
User        Group       Authority
OWNCP                   *ALL
DPTSM                   *CHANGE
DPTMG                   *CHANGE
WILSONJ                 *USE
ANDERSP                 *USE
*PUBLIC                 *EXCLUDE
```

Authorities for DPTSM and WILSONJ are restored to the values they have on the save media. The authority for ANDERSP remains, even though it did not exist on the save media.

How the System Restores Authority–Example 2: Assume the authority for the PRICES file looks like this just before the restore operation:

```
                          Display Object Authority
Object . . . . . :   PRICES          Owner . . . . .
  Library  . . . . :   CONTRACTS     Primary group  .
Object type  . . . :   *FILE
Object secured by authorization list  . . . . . .
                          Object
User        Group       Authority
OWNCP                   *ALL
DPTMG                   *CHANGE
WILSONJ                 *CHANGE
*PUBLIC                 *USE
```

If authority is restored for all users, the authority to the PRICES file looks like this:

```
                          Display Object Authority
Object . . . . . :   PRICES          Owner . . . . .
  Library  . . . . :   CONTRACTS     Primary group  .
Object type  . . . :   *FILE
Object secured by authorization list  . . . . . .
                          Object
User        Group       Authority
OWNCP                   *ALL
DPTSM                   *CHANGE
DPTMG                   *CHANGE
WILSONJ                 *CHANGE
*PUBLIC                 *USE
```

Notice that WILSONJ still has *CHANGE authority. The authority from the save media (*USE) is granted to WILSONJ, but the authority WILSONJ already has is not revoked. *USE authority is added to *CHANGE authority, so WILSONJ has *CHANGE authority.

Notice also that *PUBLIC authority is not affected by this process. Public authority is stored with the object and is handled when the object is restored. If public authority on the system is different from public authority on the save media, the public authority on the system is used.

Authority is restored to the object with the same name in the same library. In some cases, this could result in restoring authority to a different object.

Assume that you delete program PGMA in library CUSTLIB. You create a new program with the same name but different function. If you restore authority, users who were authorized to the original PGMA are now authorized to the new PGMA. See "How the System Restores Programs" on page 15-19 for more information.

How to Restore Configuration Objects

You can restore:

- All configuration objects
- A group of configuration objects by generic name
- Only specific types of configuration objects, such as line descriptions or connection lists.
- System resource management information

A configuration object must be varied off before you can restore it.

Table 15-5. How Configuration Objects Are Restored

Possible Method	Restricted State?
RSTCFG command [1]	No
Restore menu option 7	No
Restore menu option 21	Yes
Restore menu option 22	Yes
Restore menu option 23	Yes

[1] You must have *ALLOBJ special authority to specify ALWOBJDIF(*ALL)

Do This to Restore All Configuration Objects

__ **Step 1** Find the most recent tape that has your configuration. It may be a SAVSYS tape or a SAVCFG tape. The file on the tape is called QFILEIOC.

__ **Step 2** If you are using a SAVSYS tape, type:

```
RSTCFG OBJ(*ALL) DEV(TAP01) OBJTYPE(*ALL)
   ENDOPT(*LEAVE)
```

If you are using a SAVCFG tape, type:

```
RSTCFG OBJ(*ALL) DEV(TAP01) OBJTYPE(*ALL)
   ENDOPT(*UNLOAD)
```

Restoring to a Different System?

You must specify ALWOBJDIF(*ALL) when you restore the configuration to a different system.

The restoring of configuration objects to a different system whose configuration objects exist overlays the existing configuration. In some cases, the configuration description may not match the hardware on the system.

Do not restore system resource management objects to another system. This causes problems that can be fixed only by a service representative. When you use the RSTCFG command to another system, specify SRM(*NONE).

Correcting Problems with the System Resource Management Information

The system resource management (SRM) information provides a link between the hardware on your system and the software descriptions of that hardware (the configuration). When you restore your configuration to a different system, you should not restore the SRM information because it will not match the hardware on the target system. Sometimes during a system upgrade, you are instructed to restore the SRM information to your system even though some of your hardware has changed.

If you have restored the SRM information and the hardware configuration does not match, use the following procedure to correct the SRM information:

__ **Step 1** Type `WRKHDWRSC TYPE(*CMN)` and press the Enter key. You are shown the Work with Communications Resources display.

__ **Step 2** Press F11 (Display resource addresses/statuses).

__ **Step 3** For any resource that has a status of *Not detected*, type a 4 (Remove) in the Option column. Do this only if the hardware is not physically on the system. You may need to check with your hardware service representative to determine this.

__ **Step 4** Repeat steps 1 through 3 for resource type *LWS. You will see the Work with Local Work Station Resources display.

__ **Step 5** Type `WRKHDWRSC TYPE(*STG)` and press the Enter key. You are shown the Work with Storage Resources display.

__ **Step 6** For any resource that has a status of *Not detected*, type a 4 (Remove) in the Option column. Do this only if the hardware is not physically on the system. You may need to check with your hardware service representative to determine this.

__ **Step 7** Repeat steps 5 and 6 for resource type *CSA and for resource type *PRC. You will see the displays for those resource types. If you do not have a particular resource type defined on your system, you receive a message on the display.

Note: For resource type *PRC, do not delete the resource CEC01, even if its status is *Not detected*.

Recovering Devices That Will Not Vary On

If you have a problem with your devices, such as not being able to vary on a device, it may be because the system resource management (SRM) database that was restored does not match the device descriptions on the system.

To correct the problem for a tape unit or a tape controller, do the following:

__ **Step 1** Type `WRKHDWRSC TYPE(*STG)`. You are shown the Work with Storage Resources display.

__ **Step 2** Type a 9 (Work with resource) in the *Opt* column next to the resource name that would not vary on. The Work with Storage Controller Resources display is shown.

__ **Step 3** Write down the valid resource name for the device type and model that you tried to vary on.

__ **Step 4** Press F12 (Cancel) until you return to a display with a command line.

__ **Step 5** If the problem is with a tape unit, other than a 3422, 3430, 3480, or 3490, skip to step 8.

__ **Step 6** Type `WRKCTLD CTLD(`*`controller-name`*`)`. You are shown the Work with Controller Descriptions display.

__ **Step 7** Type 2 (Change) in the *Opt* column next to the controller that would not vary on and press the Enter key. The Change Controller Description display is shown. Skip to step 10.

__ **Step 8** Type `WRKDEVD DEVD(`*`device-name`*`)`. The Work with Device Descriptions display is shown.

__ **Step 9** Type 2 (Change) in the *Opt* column next to the device description that you want to change and press the Enter key. The Change Device Description display is shown.

__ **Step 10** Change the name in the *Resource name* prompt to the correct name for the resource and press the Enter key. You return to the Work with Device Descriptions display or the Work with Controller Descriptions display.

__ **Step 11** Type 8 (Work with status) in the *Opt* column next to the device or controller that you changed and press the Enter key. The Work with Configuration Status display is shown.

__ **Step 12** Type 1 (Vary on) in the *Opt* column next to the device description name or the controller

description name. Press the Enter key to vary it on.

Local Workstation Controller: To correct the problem for a workstation, do the following:

__ **Step 1** Type the following and press the Enter key to display the Work with Local Workstation Resources display.

```
WRKHDWRSC TYPE(*LWS)
```

__ **Step 2** Find the correct controller description for the device that would not vary on.

__ **Step 3** Type a 5 (Work with configuration description) in the *Opt* column next to the controller description name and press the Enter key. The Work with Configuration Description display is shown.

__ **Step 4** Type a 5 (Display) in the *Opt* column to display the valid resource name for the workstation controller.

__ **Step 5** Press F12 (Cancel) until you return to a display with a command line.

__ **Step 6** Type the following and press the Enter key to display the device description for the device that would not vary on.

```
WRKCTLD CTLD(controller-name)
```

The Work with Controller Descriptions display is shown.

__ **Step 7** Type a 2 (Change) in the *Opt* column next to the controller description that you want to change and press the Enter key. The Change Controller Description display is shown.

__ **Step 8** Change the name in the *Resource name* prompt to the correct name for the resource and press the Enter key. You will return to the Work with Controller Descriptions display.

__ **Step 9** Type an 8 (Work with status) in the *Opt* column next to the controller description that you changed and press the Enter key. The Work with Configuration Status display is shown.

__ **Step 10** Type a 1 (Vary on) in the *Opt* column next to the controller description name and press the Enter key to vary on the device.

Note: It is possible that another device description is varied on for this resource. Vary off the device first and then vary on the changed device description. This situation can happen to the console device.

Recovering When You Change the Console Type

When you restore your information to a different system or an upgraded system, you may have a different console type on the target system. After you have restored user information, you need to create a new controller and device description. Do the following:

__ **Step 1** Type `WRKHDWRSC *LWS` and press the Enter key. You are shown the Work with Local Work Station Resources display.

__ **Step 2** Type a 5 (Work with controller descriptions) in the *Opt* column next to the name of the first workstation controller. Press the Enter key. You are shown the Work with Controller Descriptions display.

Note: The first workstation controller may not be CTL01.

__ **Step 3** Type a 1 in the *Opt* column and press the Enter key. You are shown the Create Controller Description display.

__ **Step 4** For the *New controller description* prompt, type the name that you want for the console. Press the Enter key.

Note: If you want to use the name that you had on your old system, you must first delete the device configuration name and then re-create it.

__ **Step 5** Use the CRTDEVDSP command to create a device description for the console.

Recovering the System/36 Environment Configuration

If you are experiencing a problem with the System/36 environment after restoring the system, it may be caused by the locking rules used during the installation process. The QS36ENV configuration object in library #LIBRARY may have been locked by the System/36 environment.

This object contains the System/36 environment names for the workstation, printer, tape and diskette units on the system, and default System/36 environment values used for all users. This object may have been modified by the Change S/36 Environment Configuration (CHGS36) command to customize the System/36 environment.

When the first subsystem is started on the system after the installation process is complete, a new #LIBRARY and a new QS36ENV object in #LIBRARY are created with the AS/400 system defaults. In addition to creating the new objects, each subsystem holds a lock on the QS36ENV configuration object to ensure that it is not deleted. This lock will not allow the saved QS36ENV configuration object to be restored.

If the QS36ENV configuration object did not restore, start with step 1 on page 15-8. If the configuration object did restore but you are experiencing problems with the System/36 environment configuration, go to step 5 on page 15-8.

__ **Step 1** Rename the newly created #LIBRARY to something else (for example, #LIBNEW).

The locks held on the QS36ENV object remain with the renamed library. This allows the saved System/36 environment configuration object to be restored.

__ **Step 2** Restore the saved copy of library #LIBRARY: `RSTLIB SAVLIB(#LIBRARY)`

__ **Step 3** Perform an IPL of the system.

The QS36ENV object in the restored copy of #LIBRARY is the System/36 environment configuration again.

__ **Step 4** Delete the earlier renamed version of #LIBRARY (for example, #LIBNEW).

__ **Step 5** Use the Change S/36 Environment Configuration (CHGS36) command to refresh the configuration object.

a. Select each of the device types that you want to change.
   - Workstation devices
   - Printer devices
   - Tape devices
   - Diskette devices

b. For each device type that you want to change:
   1) Press the F5 key to ensure the configuration object matches the device descriptions on the system.
   2) If any System/36 names are not specified, do one of the following:
      - Press the F10 key to use the AS/400 defaults for the System/36 names for those devices.
      - Update the System/36 names manually.

c. Save the changes to the configuration object.

See the topic on configuring the System/36 environment in the *Concepts and Programmer's Guide for the System/36 Environment* for more information about configuring the System/36 environment.

How to Restore Libraries

Restoring entire libraries is a common way to recover user information. You can use the Restore Library (RSTLIB) command to restore a single saved library or a group of libraries. You cannot restore a QDOCnnnn (Document) library using the RSTLIB command. Use the Restore Document Library Object (RSTDLO) command to restore documents. You cannot restore the QSYS (System) library using the RSTLIB command. Use the procedure for restoring the operating system.

You can use the RSTLIB command to restore libraries in these groups:

***NONSYS** All libraries that were saved with SAVLIB LIB(*NONSYS) command, including the IBM-supplied libraries QGPL, QUSRSYS, and licensed program libraries.

***ALLUSR** All user libraries that were saved with SAVLIB LIB(*ALLUSR) or SAVLIB LIB(*NONSYS).

***IBM** All IBM-supplied libraries that were saved with SAVLIB LIB(*IBM) or SAVLIB(*NONSYS). Only IBM-supplied libraries that contain IBM objects are restored.

Figure 8-1 on page 8-2 shows which libraries are saved and restored in these groups. If you are restoring the QGPL library or the QUSRSYS library, you must restore them before restoring any other user libraries. If you use the special values (*ALLUSR or *NONSYS), the system restores these libraries in the correct sequence.

When you restore a group of libraries (*ALLUSR, *NONSYS, or *IBM), you can omit up to 300 libraries using the OMITLIB parameter. The libraries you omit are not restored from the save tapes or diskettes.

Attention!

If you have related objects, such as physical and logical files or journals and journaled files, in different libraries, you must ensure that you restore them in the correct sequence. Read "Sequence for Restoring Related Objects" on page 8-4.

If you are restoring to a different system, specify ALWOBJDIF(*ALL) when you are restoring libraries.

The RSTLIB command restores the entire library, including the library description, object descriptions (only descriptions are restored for logical files, job queues, message queues, output queues, user queues, and data queues), and the contents of other objects. This command also restores status information for programming temporary fixes (PTFs) that were in the library at the time the library was saved.

When you are restoring a library that was saved on a system at an earlier release, you can use the *Force object conversion* (FRCOBJCVN) parameter to specify whether programs

| are translated when they are restored. This can significantly
| impact the time it takes to restore the library. See "Restoring
| Programs to a Different Release" on page 15-20 for more
| information.

When you use the RSTLIB command, you can use the OPTION parameter to specify which objects in a library are restored:

Possible Values for the OPTION Parameter of the RSTLIB Command:

***ALL**	Old objects are replaced and new objects are added to a library. *ALL is the default.
***OLD**	Only old objects that already exist on the system are replaced in a library.
***NEW**	Only objects not found on the system are added to a library. The old objects are not replaced.
***FREE**	Only those objects that have their storage freed on the system are restored.

Do This to Restore All Libraries from a Single Save Operation: Following is the procedure for restoring all libraries that were saved with a single command or menu option.

__ **Step 1** Sign on with a user profile that has *SAVSYS special authority. Using *SAVSYS special authority ensures you will not have authority problems during the restore procedure and improves restore performance.

__ **Step 2** Ensure the system is in a restricted state. For more information, see "Putting Your System in a Restricted State" on page 8-4.

__ **Step 3** Find your most recent save tapes.

__ **Step 4** Use Table 15-6 to determine which special value to use for the RSTLIB command. Type your choice and press F4 (prompt).

Table 15-6. Methods for Restoring All Libraries–Single Save Operation

How Your Libraries Were Saved	Type This to Restore Them
Save Menu option 21	`RSTLIB SAVLIB(*NONSYS)`
SAVLIB LIB(*NONSYS)	`RSTLIB SAVLIB(*NONSYS)`

__ **Step 5** Fill in your choices for other parameters, such as tape device and whether to rewind the tape. Press the Enter key.

__ **Step 6** If you receive messages to load tapes, load the correct tapes and respond to the messages.

__ **Step 7** When the restore operation completes, check your job log to see which libraries were restored and whether any objects were not restored.

Do This to Restore All Libraries from Multiple Save Operations: Following is the procedure for restoring all libraries if they were saved with multiple menu options or commands. Adapt the examples to fit your own save procedures and recovery situation. Before restoring multiple libraries, make sure you read about "Sequence for Restoring Related Objects" on page 8-4.

__ **Step 1** Sign on with a user profile that has *SAVSYS special authority.

__ **Step 2** Ensure the system is in a restricted state.

__ **Step 3** Find your most recent save tapes.

__ **Step 4** Use Table 15-7 to determine which special value to use for the RSTLIB command. If the table shows more than one command, repeat this step and step 5 for each command. Type your choice and press F4 (prompt).

Table 15-7. Methods for Restoring All Libraries–Multiple Save Operations

How Your Libraries Were Saved	Type This to Restore Them
Save Menu options 22 and 23	`RSTLIB SAVLIB(*IBM)` `RSTLIB SAVLIB(*ALLUSR)`
Save Menu options 21 and 23	`RSTLIB SAVLIB(*IBM)` `RSTLIB SAVLIB(*ALLUSR)`

`SAVLIB *NONSYS` followed by `SAVLIB LIB(LIBA LIBB LIBC)`	`RSTLIB SAVLIB(*NONSYS)`
	`  OMITLIB(LIBA LIBB LIBC)`
	`RSTLIB LIB(LIBA)`
	`RSTLIB LIB(LIBB)`
	`RSTLIB LIB(LIBC)`

__ **Step 5** Fill in your choices for other parameters, such as tape device and whether to rewind the tape. Press the Enter key.

__ **Step 6** If you receive messages to load tapes, load the correct tapes and respond to the messages.

__ **Step 7** When the restore operation completes, check your job log to see which libraries were restored and whether any objects were not restored.

How to Restore Objects

You can use the Restore Object (RSTOBJ) command to restore individual objects or an entire library. When you restore a library using the RSTOBJ command, the library description is not restored. Objects can be restored to only one library with the RSTOBJ command.

Attention!

Do not use RSTOBJ to restore licensed programs to library QSYS. Unpredictable results can occur.

How to Restore Database Files

You can restore one or more database files or one or more members of database files by using the RSTOBJ command. Figure 15-1 shows, conceptually, how a database file with two members looks to the system. It has multiple parts:

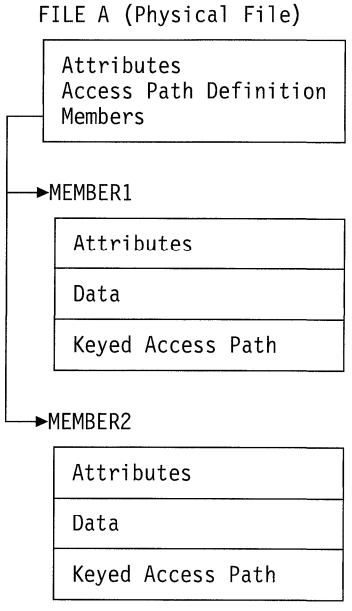


Figure 15-1. Example of a Database File with Two Members

If FILEA exists on the system and you restore it, the system restores the data and access paths for FILEA's two members. The attributes for the file and its members are not changed on the system.

If you want to restore the file attributes as they existed at the time of the save operation, delete the file, then restore it. If you want to restore the member attributes, remove the member (RMVM) and then restore it, specifying MBROPT(*NEW).

When you restore a database file, the system uses information stored with the file and the parameters you specify to make decisions. The topics that follow describe special considerations when restoring database files and members.

Unique File Identification: You can restore a file only to itself. A saved version and a copied version of the same file are not the same and cannot be used interchangeably in a restore operation. Figure 15-2 illustrates this:

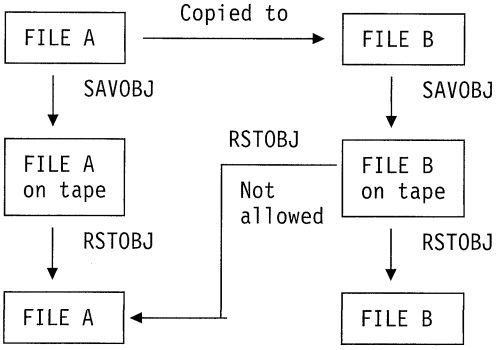


Figure 15-2. Restoring a Copy of a File

File Locking during Restore Operation: When you restore a file, no member of the file can be used during the restore operation, even through logical files. The file is exclusively locked during the restore operation.

Comparing File Attributes during a Restore Operation

When you restore a database file or member that exists on the system, the system expects the creation dates for the system copy and the media copy to be the same. If they are not the same, the system cannot ensure that the contents of the saved copy match the format of the copy on the system.

If you specify ALWOBJDIF(*NONE) on the restore command, the system does not restore the file or member if the creation dates do not match. A message is sent to the user to indicate the file or member could not be restored from the media. ALWOBJDIF(*NONE) is the default.

The creation dates on the system and media might be different because:

- A file or member was deleted and created again after the save operation.
- The file or member on the media was created on another system, but it has the same name as an existing file or member.

If you really want to restore a file or member whose creation date differs from the system version, you have two choices:

- Delete the file or member from the system. Then restore.
- Specify ALWOBJDIF(*ALL) on the restore command. However, this can cause problems. You should be aware of what the system does when you specify ALWOBJDIF(*ALL).

How the System Restores Database Files with ALWOBJDIF(*ALL): Figure 15-3 on page 15-11 shows what the system does when creation dates for a database file are different on the system and media copies:

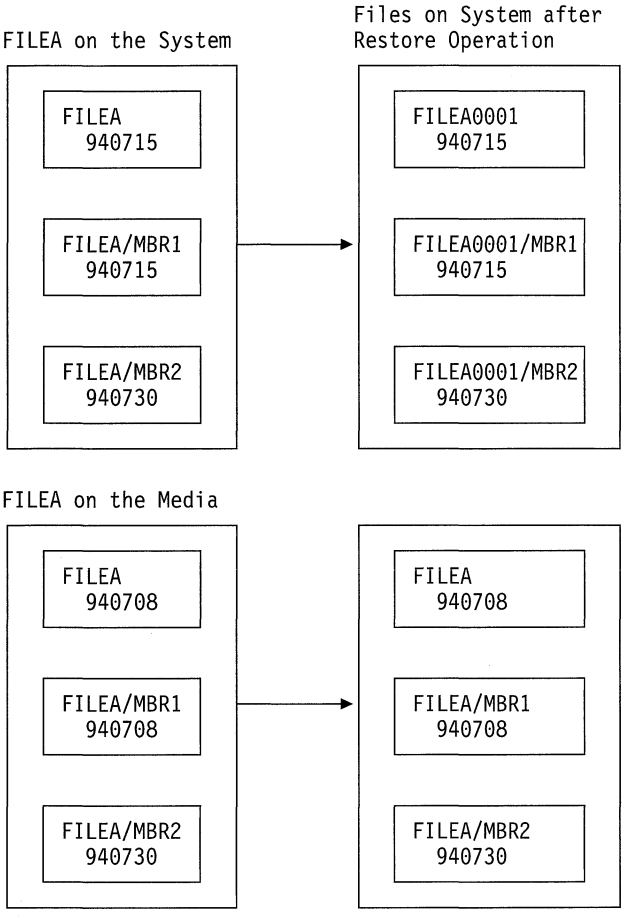


Figure 15-3. Restoring Database Files with Different Creation Dates

The file on the system is renamed. The media version is restored. A message is sent to the user.

Figure 15-4 shows what the system does when the creation date for one of the members in the file is different:

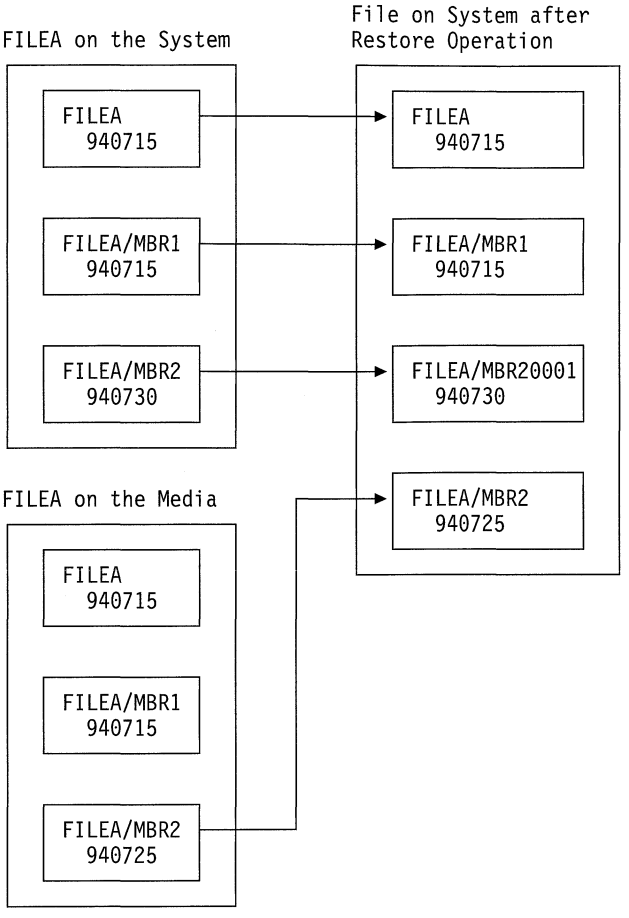


Figure 15-4. Restoring Database Files with Different Creation Dates

The member on the system is renamed. All members from the media are restored. A message is sent to the user.

When you specify ALWOBJDIF(*ALL) and additional members are created during a restore operation, the system ignores the MAXMBRS (maximum members) parameter for the file. After the restore operation, you may have more than the allowed members in the file.

If a logical file is associated with a file or member that is renamed, the logical file is still associated with the renamed file or member, not the restored member.

In both examples, specifying ALWOBJDIF(*ALL) can result in duplicate information, additional files, and additional members. Your system becomes cluttered and your applications may produce unexpected results. If you specify ALWOBJDIF(*ALL), carefully check the messages you receive and analyze your files and members after the restore operation.

Notes:

1. The ALWOBJDIF parameter also affects object ownership. This is described in "How the System Establishes Ownership for Restored Objects" on page 15-3.
2. When you specify MBROPT(*MATCH) on a restore command, you cannot specify ALWOBJDIF(*ALL). See "How the System Matches File Members during a Restore Operation" on page 15-12.

How the System Matches File Members during a Restore Operation

When you are restoring to an existing database file, you use the member option (MBROPT) parameter on either the RSTOBJ command or the RSTLIB command to tell the system what to do if the members do not match. The choices are:

***MATCH** If the set of members on the save media and on the database are not identical, the restore operation fails. *MATCH is the default.

***ALL** All members on the save media are restored, whether or not they exist on the system copy.

***NEW** Only those members on the save media that do not exist in the database file are restored.

***OLD** Only those members on the save media that already exist in the database file are restored.

Note: The ALWOBJDIF parameter determines what the system does if creation dates on the members do not match. See "Comparing File Attributes during a Restore Operation" on page 15-10.

How to Restore Members to a File

You can restore a list of members for a database file using the FILEMBR parameter of the RSTOBJ command. This list may consist of specifically named members, generically named members, or a combination of both specifically and generically named members.

The FILEMBR parameter is used to specify:

- A list of file members (specific or generic) for a specific database file
- The same group of members from more than one file

The default value *ALL causes all file members of files specified with the OBJ parameter to be restored.

Restrictions on the File Member Parameter: The following restrictions apply to the FILEMBR parameter:

- Each database file specified in the FILEMBR parameter must also be specified in the OBJ parameter by its complete name, a generic name, or *ALL.
- Generic names are not valid for the database file name.
- Generic names are valid for the member name.

  If a generic file member name is used, and the file does not have members that fit the generic name, the file is not restored. If all files specified by the FILEMBR parameter are not restored, a diagnostic message is sent and the restore operation ends with an escape message giving the number of files not restored.

  If a name that is not generic is used, the specific members must exist in the file for any part of the file to be restored.
- The OBJTYPE must be *ALL or include *FILE.
- The MBROPT parameter must not have the *MATCH value.

How to Restore Logical Files

When you restore a logical file, the system uses the description for the logical file to establish its relationship with the based-on physical files and logical files. All based-on files must exist before you can restore the logical file.

You can restore a logical file to a library different than the library for the associated physical file. However, the associated physical file must remain in or be restored to its original library location.

If you try to restore a logical file to a library in which it does not exist, the restore operation fails if any of the associated physical files have had their storage freed.

When a logical file is restored, it must be dependent on the same physical files as it was when it was saved.

- The logical file is created over the physical files in the library where they are being restored if any of the following occur:
  - The logical file and the associated physical files existed in the same library at the time of the save operation.
  - The logical file and the associated physical files are present in the library where the files are being restored.
  - The logical file and the associated physical files are being restored to the same library.
- If the files are not present in the restore library, then the logical files are created over the physical files in the original saved library.
- If the correct physical files are not found in either library, then the restore operation of the logical file fails. To correct the problem, run the RSTOBJ command again and specify OBJ(*NEW). If the restore operation is successful, an informational message (CPF3291) is sent to indicate which library was used for associated physical files.

The creation dates of the physical files must not have changed since the logical file was saved. If the date has changed, an informational message (CPF3293) is sent indi-

cating that the physical file has been changed since the save operation, but the restore operation continues.

Restore physical or logical files with dependent logical files before the dependent logical files, unless the physical and logical files already exist on the system. The following considerations apply to restoring logical files:

- If the dependent physical or logical files are in the same library, the system provides the proper sequencing.
- If the files are in different libraries, you must restore the libraries in order, so that the physical or logical files that have logical files built on them are restored first.
- If the depended-on physical or logical files are not restored before you attempt to restore the logical files, restoring the logical files fails.
- This sequencing also applies to other requirements between files, such as shared formats. You can restore those logical files that failed by using the RSTOBJ command.

How the System Restores Access Paths

The description for a database file contains a description of its access path, if it has one. When you save a database file, you may save the access path with the file. This depends on the type of file, the type of access path, and how you performed the save operation. See "How to Save Access Paths" on page 5-5.

When you restore a file, the system either restores the access path with the file or rebuilds the access path based on the information in the file description. The process of rebuilding the access path for a large database file can take a long time. This topic describes when the system restores access paths and when it cannot. If possible, you should plan your save operations to avoid having to rebuild access paths during a restore operation.

The system always restores the access path for a keyed physical file of type *DATA unless the access path was not saved. The access path for a keyed physical file is always saved, unless the access path is not valid at the time of the save.

Normally, source physical files are not keyed. The default for the CRTSRCPF is to create a non-keyed file. When you restore a keyed source physical file, the access path is rebuilt after the restore operation.

Access paths owned by logical files are restored if **all** of the following conditions are true:

- The access path was saved. Although this seems obvious, access paths are saved only if certain conditions are met. See "How to Save Access Paths" on page 5-5.
- All based-on physical files are in the same library and are being restored at the same time on the same restore command.
- If the logical file exists on the system, it does not specify MAINT(*REBLD).
- The logical file owned the access path at the time it was saved.
- If the logical file is created again by the restore operation and it shares an access path that already exists, the key length for the access path must be equal to the maximum key length of the logical file or you receive an error.

If you meet these conditions, you minimize the rebuilding of access paths. However, during the restore operation, the system checks the integrity of each access path. If it detects any discrepancy, the access path is rebuilt.

In a few cases, the system may decide to rebuild access paths even though they were saved. For example, you may have defined a new logical file that specified the same key as the physical file but also specified UNIQUE. The based-on physical file was in use at the time that the logical file was created. Therefore, the system had to create a new access path for the logical file. Assume you save these two files with a single command. If you restore them with a single command, the system will determine that they can share a single access path. Instead of restoring the two access paths, it builds a new, shared access path for the two files.

Restoring a File Network–Examples: Figure 15-5 shows a physical file and two logical files:

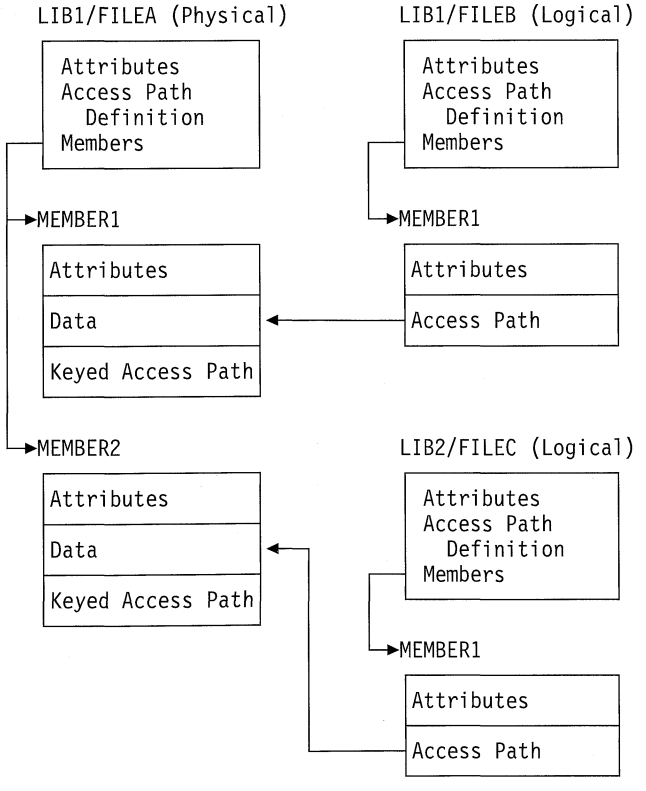


Figure 15-5. Restoring Access Paths

Assume these files were saved with this command:

```
SAVLIB LIB(LIB1 LIB2) ACCPTH(*YES)
```

The save tape contains all three files (FILEA, FILEB, and FILEC) and three access paths, each owned by a different file. Table 15-8 shows what the system does when you restore these libraries using different methods. These examples assume that none of the files are on the system when they are restored:

Table 15-8. Restoring a File Network

Sequence of Restore Commands	What the System Does
Example 1: 1. RSTLIB SAVLIB(LIB1) 2. RSTLIB SAVLIB(LIB2)	Results of Example 1: 1. FILEA and FILEB are restored. The access paths owned by FILEA and FILEB are restored. 2. FILEC is restored. The access path owned by FILEC is rebuilt.
Example 2: 1. RSTLIB SAVLIB(LIB2) 2. RSTLIB SAVLIB(LIB1)	Results of Example 2. 1. FILEC is not restored because FILEA is not on the system. 2. FILEA and FILEB are restored. The access paths owned by FILEA and FILEB are restored.

These examples highlight the problems that can occur when logical files and based-on physical files are in different libraries. Access paths are restored when physical files are restored because they are built over data contained in the physical file. In the first example, FILEC owned the access path but FILEC was not on the system when the physical file was restored. Therefore, the access path was not restored. In the second example, FILEC could not be restored because its based-on physical file (FILEA) was not on the system.

How to Prevent the System from Rebuilding a Large Access Path: If the situation shown in Table 15-8 occurs on your system and you want to prevent the system from rebuilding a large access path, do the following:

__ **Step 1** Restore the physical file or the library containing the physical file first. In the case of example 2, restore FILEA or LIB1.

__ **Step 2** Restore the logical file (FILEC) using the RSTOBJ command.

__ **Step 3** Immediately after restoring the logical file, type EDTRBDAP. You are shown the Edit Rebuild of Access Paths display.

__ **Step 4** Change the value in the *Seq* column for the logical file to *HLD.

__ **Step 5** Restore the physical file (FILEA) again using the RSTOBJ command. Because the logical file (FILEC) is now on the system, the system will restore the access path owned by FILEC.

__ **Step 6** Type EDTRBDAP. You are shown the Edit Rebuild of Access Paths display.

__ **Step 7** Change the sequence number for FILEC to a value from 1 through 99 to remove the access path from the display.

How the System Restores Files with Shared Formats

When a database file is restored and that file, before it was saved, had shared the record format of another file, an attempt is made to find the file whose format was shared, and reestablish the original format sharing.

The search for restoring the shared format starts in the library to which the restored file is directed and continues in the library from which the restored file was saved. Following are the results of the search:

- If the sharing file is found and has not been changed (level check) since the save, then no new format is created for the restored file.
- If the sharing file is not found, or it is found but fails the level check, then a new format for the restored file is created with the same definition as the one it initially shared.
- If a format sharing file has been renamed, deleted, or moved to a library other than the save or restore library, a new format is created for the dependent file when the dependent file is restored.

How the System Restores Files with Referential Constraints

Information about DB2/400* database files is kept in system cross-reference files. This includes information about constraints that are defined. When you define a referential constraint, you specify that a record with a certain primary key must exist in the parent file before a record with the same values in a foreign key can exist in the dependent file. For example, you cannot add an order to the order file (dependent file) unless a record exists for the customer in the customer file (parent file).

A referential constraint is defined, stored, and saved with the dependent file. Each referential constraint has a name, which must be unique for the library that contains the dependent file. When you restore a file that has a referential constraint name that already exists in the library, the system generates a new name for the referential constraint that is being restored.

When you restore a database file that already exists on the system, the referential constraints defined for the system copy of the file are used. If the saved version of the file has additional referential constraints that are not on the system copy, these additional constraints are not restored.

When you restore a database file that does not exist, you should ensure that any referential constraints that were not on the saved copy are reestablished. Otherwise, you lose the data integrity checking that was on your system before a failure occurred.

Files that are related by referential constraints form a database network similar to the network formed by logical files and the based-on physical files. You should try to save an entire referential constraint network in one operation. If this is not possible, you should at least save the files with consecutive operations where no activity occurs in between. This ensures that the files are synchronized.

If you journal database files, you should journal all physical files that are part of a referential constraint network. This ensures that your referential constraints remain valid after you have applied journaled changes. The chapter of the *Backup and Recovery – Advanced* book called "Planning and Setting Up Journaling" provides more information about journaling and referential constraints.

Referential Constraint Network–Example:

Figure 15-6 shows an example of a referential constraint network.

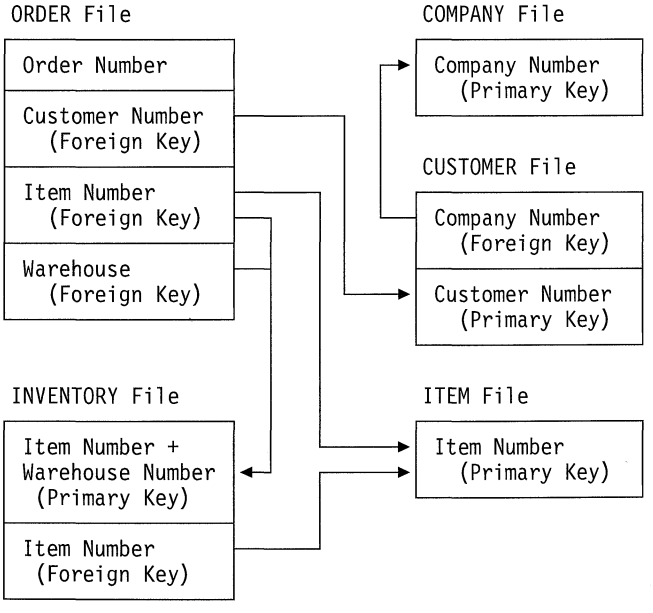


Figure 15-6. Restoring a Referential Constraint Network

You can restore the files in this network in any sequence. When you restore the files, the system reestablishes the relationships and attempts to determine whether the constraints are still valid.

For example, if you restore both the ITEM file and the INVENTORY file, the system checks the internal information stored with the files to determine whether the indexes for the two files are synchronized.

If the internal information does not match, the system validates the constraint for the INVENTORY file. It does this by reading every record in the INVENTORY file and ensuring that a record with that item number exists in the ITEM file. If this process is successful, the constraint is valid. If this process is not successful, the status of the constraint is set to **Check pending**. When the status of a constraint is check pending, you must take action to correct the situation, either by restoring one of the files or using a program to update the files.

If you restore one of the files, the system again attempts to validate the constraint. If you use a program to update the information, you must use the Edit Check Pending (EDTCPCST) command to force the system to revalidate the constraint. The topic "Task 3–Using the Edit Check Pending Constraints Display" on page 12-6 describes how to determine the status of files that have referential constraints.

The *DB2 for OS/400 Database Programming* book has more information about using referential constraints.

How the System Restores Files with Triggers

You can define one or more trigger programs for a file. When a certain event occurs in the file, the system calls the trigger program. When you save a file that has trigger programs, you are saving only the definitions of the trigger programs, not the programs themselves. You must ensure that the programs are also saved, perhaps by placing them in the library with the file.

When you restore a database file that already exists, the system does not restore any trigger program definitions from the save media. When you restore a database file that does not exist, you should ensure that any definitions for trigger programs that were not on the saved copy are reestablished. Otherwise, you lose the data integrity checking that was on your system before a failure occurred.

The system does not stop restoring a database file if its trigger programs cannot be found. Therefore, you must ensure that files and trigger programs are saved and restored correctly. Otherwise, the system may not perform some of the actions that your applications expect.

Table 15-9 on page 15-16 shows examples of actions the system takes when you restore the physical file FILEA and the trigger program PGMA:

Table 15-9. Restoring Files That Have Trigger Programs

Save Procedure That Is Used	Restore Procedure That Is Used	How the Trigger Program Is Defined after the Restore Operation
FILEA is saved from LIBX. PGMA is saved from LIBX. The trigger is defined as LIBX/PGMA.	PGMA is restored to LIBY. FILEA is restored to LIBX.	The trigger is defined as LIBX/PGMA. When an event occurs that causes this trigger, the program will not be found.
FILEA is saved from LIBX. PGMA is saved from LIBX. The trigger is defined as LIBX/PGMA.	PGMA is restored to LIBY. FILEA is restored to LIBY.	The trigger is defined as LIBY/PGMA.
FILEA is saved from LIBX. PGMA is saved from LIBY. The trigger is defined as LIBY/PGMA.	PGMA is restored to LIBZ. FILEA is restored to LIBZ.	The trigger is defined as LIBX/PGMA. When an event occurs that causes this trigger, the program will not be found.

The *DB2 for OS/400 Database Programming* book provides more information about using trigger programs. The chapter of the *Backup and Recovery – Advanced* book called "Planning and Setting Up Journaling" describes special considerations when you journal database files that have triggers defined. You must make special provisions to ensure the integrity of your data because trigger programs are not called when you apply journaled changes.

How to Restore Files That Are Journaled

If the journal exists on the system before the files are restored, all files that were saved while being journaled (or saved while having their access paths journaled) are journaled again provided one of the following is true:

- The files are not on the system at restore time.
- The files are on the system and journaling was not ended for the files.

When you restore a file that was being journaled at the time of the save operation, an entry is written to the journal to indicate that it was restored.

When you restore access paths that were being journaled at the time of the save operation, no journal entry is written to the journal to indicate that it was restored.

If the journal is not on the system at the time a journaled file is being restored, the restore operation for the file causes a warning message to be sent and journaling is not resumed. This warning message causes a diagnostic message to be sent at the end of the restore operation. (See the topic "How to Verify That Objects Are Restored Successfully" on page 8-8.)

What Happens When You Restore Journaled Files to a Different Library: The system assigns a unique internal journal identifier (JID) to every object that is journaled. If you restore a journaled file to a library other than the original library, and the file still exists on the system and continues to be journaled to the same journal, the JID of the restored file is changed. No message is sent telling the user that the JID of the restored file is changed.

All the journal entries associated with the media copy of the file have the original JID. You cannot apply these journal entries to the file that was restored to a different library because it has a different JID. For this reason, you should avoid restoring a journaled file to a different library.

For example, in Figure 15-7, the original file FILEA in LIBX library has an internal journal identifier of Z that is recorded with every journal entry associated with FILEA in LIBX. When FILEA is restored from the media to LIBC library, it is assigned the journal identifier of Y because FILEA still exists in LIBX and continues to be journaled.

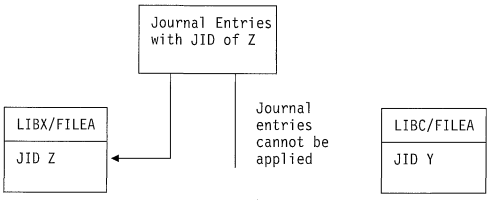


Figure 15-7. Restoring a Journaled File to a Different Library

Any journal operation that references a file by name and involves using journal entries requires that the journal identifier of the file and the journal identifier recorded in the journal entries be the same. Because FILEA in LIBC has journal identifier Y, journal entries with journal identifier Z are not associated with the restored FILEA in LIBC. As a result, journal changes recorded for FILEA in LIBX cannot be applied to FILEA in LIBC. For the same reason, referencing FILEA in LIBC on the Display Journal (DSPJRN), Receive Journal Entry (RCVJRNE), or Retrieve Journal Entry (RTVJRNE) commands does not return entries for FILEA in LIBX.

To display or retrieve the journal entries of the original file:

1. Save and then delete the existing file on the system.
2. Restore the original file to the system.
3. Display or retrieve the journal entries.
4. Delete the original file.
5. Restore the existing file back to the system.

Steps before Deleting a Physical File

In some situations, you must delete a physical file as part of your recovery. For example, the physical file may be damaged. Or a physical file in a user ASP may have overflowed into the system ASP. You cannot delete a physical file if other files are dependent on it, such as logical files or files that share the record format.

Before deleting a physical file, do the following:

__ **Step 1** Use the Display Database Relationships (DSPDBR) command to list all the files that are dependent on the physical file.

__ **Step 2** Save and delete each file that is dependent on the physical file.

After you have recovered the physical file, restore all the dependent files.

How to Restore Journals and Journal Receivers

You can restore journals or journal receivers only to the same library from which they were saved. Use the RSTOBJ and RSTLIB commands to restore journals and journal receivers. When you are restoring multiple objects with one of these commands, journals and journaled files are restored before the journal receivers.

When you use several commands to restore several objects, restore the objects in this order:

1. Journals
2. Based-on physical files associated with those journals
3. Dependent logical files
4. Journal receivers

If you have journal receivers that were created before V3R1, you must restore them in the order of newest to the oldest to establish the receiver chain correctly.

How to Restore Journals

When you restore a journal, the system creates a new journal receiver and attaches it. The characteristics of the new journal receiver are based on the journal receiver that was attached when the journal was saved:

- The system creates a name that is not likely to conflict with other journal receivers that may be on the system. The topic "Naming Journal Receivers" in the *Backup and Recovery – Advanced* book describes how the system generates a name.
- The system attempts to assign the same owner and to create the journal receiver in the same library. If the owner of the receiver is not found, the receiver is assigned to the default owner (QDFTOWN) user profile.
- The system starts a new receiver chain. The chapter of the *Backup and Recovery – Advanced* book called "Working with Journals, Journal Receivers, and Journal Entries" discusses receiver chains.
- If dual receivers were being used when the journal was saved, dual receivers are created and attached to the journal.

You cannot restore a journal to a library containing a journal with the same name because you would overlay the existing journal with old information. If a journal must be restored (because of damage) to a library, the existing journal must be deleted first.

Steps before Deleting a Journal

In some situations, you must delete a journal as part of your recovery. For example, the journal may be damaged. Or a journal in a user ASP may have overflowed into the system ASP. You cannot delete a journal while files are being journaled to it.

You use the Delete Journal (DLTJRN) command to delete a journal. Before deleting a journal, try to do the following steps. You may not be able to perform these steps successfully if the journal is damaged.

__ **Step 1.** Type

```
WRKJRNA JRN(library-name/journal-name)
OUTPUT(*PRINT)
```

and press the Enter key. You receive a listing showing all the physical files and access paths that are currently being journaled.

__ **Step 2.** End journaling for all the access paths assigned to the journal by typing:

```
ENDJRNAP FILE(*ALL)
JRN(library-name/journal-name)
```

__ **Step 3.** End journaling for all the physical files assigned to the journal by typing:

```
ENDJRNPF FILE(*ALL)
JRN(library-name/journal-name)
```

| When you try to delete the journal, you may receive
| message CPF7021 indicating the journal is being used for
| commitment control. If this occurs, end the jobs that are
| using commitment control and then try to delete the journal
| again. You can use the End Job (ENDJOB) command or
| you can use the *End* option from the Work with Active Jobs
| (WRKACTJOB) display.

After you restore the journal or create it again, you must start journaling again for each file and access path. You should save the files after you start journaling, in case the system assigned a new journal identifier (JID) to a file.

How to Restore Journal Receivers

If you have journal receivers that were created before V3R1, restore them from newest to oldest to establish the receiver chain correctly. If the journal receivers were created on V3R1 or later, you can restore them in any sequence. If you restore journal receivers in a single command, the system restores them in the correct sequence.

The system will not restore a journal receiver over the journal receiver that is currently attached. The system will not restore a journal receiver over an existing journal receiver that contains more entries. If you use the SAVCHGOBJ command to save journal receivers, this is likely to occur. The journal receiver that is attached at the time of the save operation is a changed object and is saved by the command. When you restore, you receive message CPF3706 and the system continues with the next journal receiver.

If you use a save procedure that saves the currently attached journal receiver, you may encounter the situation of attempting to restore a journal receiver with fewer entries than the journal receiver on the system. For example, assume you save your journal receivers when receiver RCVR0006 is attached. RCVR0006 has 1500 entries. Later, you use the CHGJRN command to create and attach a new receiver. Now receiver RCVR0007 is attached. Receiver RCVR0006 is still on the system and has 4300 entries. If you attempt to restore receiver RCVR0006 from your save tape, the operation fails because the saved copy has only 1500 entries.

If the library you specify on the restore command for a journal receiver does not exist, the system restores the journal receiver to the library that contains the journal. If you specify RSTASP(*SAVASP) and the ASP does not exist, the system usually restores the journal receiver to the same ASP as the library that contains the journal.

Placing Journal Receivers in the Correct Auxiliary Storage Pool: If the attached journal receivers are not in the desired ASP after the restore operation, do the following:

__ **Step 1.** Create a journal receiver in the desired ASP. Follow your existing naming convention and use the same journal receiver attributes.

__ **Step 2.** Use the CHGJRN command to attach the new journal receiver to the journal.

Resolving Name Conflicts When Restoring Journal Receivers: When you restore a journal, the system creates and attaches a new journal receiver. The system attempts to name this journal receiver so that a name conflict does not occur. However, in rare cases, this new journal receiver may have a name that matches the name of a journal receiver that you need to restore. If this occurs, do the following:

__ **Step 1.** Create a new journal receiver with a name separate from your normal naming convention. For example, type: `CRTJRNRCV JRNRCV(`*`library-name`*`/TMP0001)`.

__ **Step 2.** Use the CHGJRN command to attach the temporary journal receiver: `CHGJRN JRN(`*`library-name/journal-name`*`) JRNRCV(library-name/TMP0001)`.

__ **Step 3.** Delete the journal receiver that has the name conflict. This journal receiver should not have any entries you need for your recovery because it was created when the journal was restored.

__ **Step 4.** Restore the journal receivers.

__ **Step 5.** Create a journal receiver that continues your naming convention and has the same journal receiver attributes.

__ **Step 6.** Use the CHGJRN command again to attach the journal receiver that you created in step 5.

Correcting the Journal Receiver Directory: Every journal has a directory of journal receivers. The sequence of journal receivers is called the **receiver chain**. Before you begin a recovery using journal receivers, you should ensure that this receiver directory is current and correct.

Do the following:

__ **Step 1.** Type `WRKJRNA JRN(`*`library-name/journal-name`*`)` and press the Enter key.

__ **Step 2.** From the Work with Journal Attributes display, press F15 (Work with receiver directory). You are shown the Work with Receiver Directory display.

__ **Step 3.** If the receiver directory is not correct, do the following:

- __ **Step a.** Type `WRKJRN` and press the Enter key.
- __ **Step b.** On the prompt display, enter the name of the journal.
- __ **Step c.** On the Work with Journals display, type a `9` (Associate receivers with journal) in the option column in front of the journal. The system establishes the receiver chain for the journal.

Note: If some of the journal receivers were created prior to Version 3 Release 1 Modification 0, you may need to restore all the journal receivers, from newest to oldest, to establish the receiver chain correctly.

Steps before Deleting a Journal Receiver

In some situations, you must delete a journal receiver as part of your recovery. For example, the journal receiver may be damaged. Or a journal receiver in a user ASP may have overflowed into the system ASP.

You cannot delete a journal receiver that is currently attached. You also cannot delete a journal receiver if later journal receivers in the receiver chain are still on the system, unless the receiver to be deleted is damaged.

If you need the journal receiver for recovery, you should not delete it without first saving it. If you do, the system warns you but does not prevent you from deleting the journal receiver.

Before deleting a journal receiver, do the following:

__ **Step 1.** If the journal receiver is attached, detach it by typing:

```
CHGJRN JRN(library-name/journal-name)
   JRNRCV(*GEN)
```

Notes:

a. If you are using dual receivers, specify `JRNRCV(*GEN *GEN)`.

b. If the current journal receiver is damaged, you cannot specify `JRNRCV(*GEN)`. Use the Create Journal Receiver (CRTJRNRCV) command to create a new journal receiver that follows your naming convention and has the same attributes. Specify that receiver name on the CHGJRN command.

__ **Step 2.** If earlier journal receivers are on the system, save them and delete them. You can print the receiver chain by typing `WRKJRNA JRN(library-name/journal-name) OUTPUT(*PRINT)`.

How the System Restores Programs

Restoring programs to your system represents a security exposure. A restored program may have been altered to perform functions that you do not intend, or the program may adopt the authority of a powerful user profile.

When the QSECURITY (security level) system value on your system is 40 or higher, the system checks for restricted instructions in all programs that are restored. You can also use the QALWOBJRST system value to prevent certain types of objects from being restored to your system. See "Controlling Restoration of Security-Sensitive Objects" on page 8-7.

The system stores a validation value for all programs created on V1R3 of the operating system or later versions. When a program is restored, the system calculates the validation value and compares it to the value on the media. If they are different, the system creates the program again from the program object. The system cannot re-create a program if the program's observability has been removed.

Table 15-10 shows what the system does when restoring programs. The *Security – Reference* book has more information about protecting your system from programs that might circumvent security.

Table 15-10. System Actions When Restoring Programs

Situation Description	Audit Journal Entry	Message	Owner	Version of Program Restored	Private and Public Authorities
Program created before V1R3; security level less than 40	None	None	Unchanged	Original	Unchanged
Program created before V1R3; security level 40 or higher; ALWOBJDIF(*ALL)	None	None	Unchanged	Original	Unchanged
Program created before V1R3; security level 40 or higher; ALWOBJDIF(*NONE); retranslation successful	None	None	Unchanged	Re-created	Unchanged
Program created before V1R3; security level 40 or higher; ALWOBJDIF(*NONE); retranslation not successful	Yes	CPF375B	QDFTOWN	Original	Revoked
Program created on V1R3 or later; validation value is valid	None	None	Unchanged	Original	Unchanged
Program created on V1R3 or later; validation value is not valid, retranslation successful	Yes	CPF375C	Unchanged	Re-created	Unchanged
Program created on V1R3 or later; validation value is not valid; retranslation is not successful; security level less than 40	Yes	CPF375A	Unchanged	Original	Unchanged
Program created on V1R3 or later; validation value is not valid; retranslation is not successful; security level 40 or greater; ALWOBJDIF(*ALL)	Yes	CPF375D	Unchanged	Original	Unchanged
Program created on V1R3 or later; validation value is not valid; retranslation is not successful; security level 40 or greater; ALWOBJDIF(*NONE)	Yes	CPF375B	QDFTOWN	Original	Revoked

Restoring Programs to a Different Release

AS/400 processors that run Version 3 Release 1 Modification 0 or earlier of the OS/400 licensed programs are IMPI (internal microprogramming interface) processors. IMPI refers to the low-level instruction set and the Licensed Internal Code. AS/400 processors that run Version 3 Release 6 or higher of the OS/400 licensed programs are PowerPC AS processors. When you move a program object (*MODULE, *PGM, *SRVPGM, *SQLPKG) between a system with an IMPI processor and a system with a PowerPC AS processor, the system must create the program object again from the observable information that is stored with the program.

Object conversion occurs at one of the following times:

- When the object is used for the first time. This is the default.
- When you use the Start Object Conversion (STROBJCVN) command to convert objects. This is normally done for an entire library.
- When you restore the object. The Force Object Conversion On Restore (QFRCCVNRST) system value and the Force Object Conversion (FRCOBJCVN) parameter on the restore command determine whether an object is converted when it is restored.

Following are the possible values for the QFRCCVNRST system value. The default value is 0.

Possible Values for the QFRCCVNRST System Value:	
0	Objects are not converted when they are restored. This is the recommended value when restoring all your user libraries.
1	A restored object is converted if the object is not already in the format required by the target system. If a program does not have observability, it is restored but not converted. A message is sent.

Following are the possible values for the FRCOBJCVN parameter on the RSTLIB command, the RSTOBJ command, and the RST command. The default value is *SYSVAL. If you specify *YES, you must specify a second part of the parameter.

Possible Values for the FRCOBJCVN Parameter:	
***SYSVAL**	The value specified for the QFRCCVNRST system value is used.
***NO**	Objects are not converted when they are restored.
***YES *RQD**	A restored object is converted if the object is not already in the format required by the target system. If a program does not have observability, it is restored but not converted. A message is sent.
***YES *ALL**	A restored object is converted even if it is already in the format required by the target system. If a program does not have observability, it is not restored. You might choose this option after your new system is operational if you have high security requirements.

The *AS/400 Road Map for Changing to PowerPC Technology* has more information about moving from an IMPI system to a RISC-based system.

How to Restore Save File Data

If the data in a save file is saved to tape or diskette using the SAVSAVFDTA command, it appears as though the data originally came from tape or diskette when it is restored. You can use the RSTOBJ, RSTLIB, RST, RSTDLO, RSTCFG or RSTUSRPRF commands to restore the data.

If the save file data is saved to tape or diskette using the SAVLIB, SAVOBJ,or SAVCHGOBJ command and SAVFDTA(*YES) was specified on the save command, the save file must be restored before the objects contained in the save file can be restored.

How to Restore Spooled Output Files

You cannot directly save and restore spooled files on an output queue. If you use the technique described in "How to Save Spooled Files" on page 5-8, you can restore the spooled files by first restoring the database files with a restore command, such as Restore Object (RSTOBJ) or Restore Library (RSTLIB), and then copy the database file members to the spooled output files by using the Copy File (CPYF) command and specifying TOFILE(QSYSPRT).

How to Restore Licensed Programs

Use the RSTLICPGM command to add or replace licensed programs on the system. Refer to the *Software Installation* book for more information about installing licensed programs.

How to Restore Documents and Folders

Use the Restore Document Library Object (RSTDLO) command to restore documents, folders, and mail. To use this command most efficiently, you should know how documents were saved. To determine this, use the output that was printed for the SAVDLO procedures or use the DSPTAP command. RSTDLO performance is also better if you have *SAVSYS special authority.

The RSTDLO command provides many options. You can restore:

- By user-specified document name or system object name.
- All the documents and folders you saved by typing: `RSTDLO DLO(*ALL) SAVFLR(*ANY)`. If you saved DLOs from more than one ASP, you must specify `SAVASP(*ANY)`. You must also specify the sequence numbers (SEQNBR parameter) for the files on the tape.

  Note: When you use RSTDLO DLO(*ALL), this includes the folders used by IBM-supplied programs, such as Client Access for OS/400. Ensure that these folders were saved from the current release, or you may need to install the licensed programs again.
- 1 to 300 documents from the same media file by specifying the names of the documents or the system object names.
- 1 to 300 folders from the same media file.
- All filed documents that are not in any folder on the save media.
- A folder by specify `DLO(*ALL) SAVFLR(`*`folder-name`*`)`. See "How to Restore Folders" for more information.

When you restore documents, you can rename them, restore them to a different folder, or have the system assign new system object names. The folder for a document determines its ASP location. You can move a document to a different ASP by doing the following:

1. Save the document.
2. Delete it with the DLTDLO command.
3. Restore it into a folder in a different ASP.

When you restore documents or folders from a list and specify SEQNBR(*SEARCH), the system restores from the first tape file that contains any of the documents or folders that you specified. If the tape file does not contain all the documents and folders in your list, the system does not search other tape files for the additional documents and folders. You can specify `SEQNBR(`*`starting-sequence ending-sequence`*`)` to search more than one tape file.

When you restore DLOs, the system updates the search index database information for the DLOs. If you receive error messages during the restore procedure because the information in the database does not match the DLOs, run the Reclaim Document Library Object (RCLDLO) command. Then try the restore procedure again.

Note: The message tells you if the RCLDLO procedure is necessary. Use RCLDLO only if you are instructed by a message or by the recovery checklist you are using.

Authority Required to Restore DLOs: If you are restoring DLOs into a folder, you must have authority to the folder. If you are restoring existing DLOs, you must have authority to those DLOs. Certain combinations of the RSTDLO command require additional authority. The *Security – Reference* book provides information about the specific authorities required for the RSTDLO command.

How the System Restores New DLOs: When you restore new DLOs, the system files them. The DLO is treated as new to the system if any of the following is true:

- It has been previously deleted.
- It is being restored to a different system.
- It is being restored with the NEWOBJ(*NEW) parameter.

How the System Restores Existing DLOs: When you are restoring an existing DLO, the system skips the DLO and continues with the next one if either of the following is true:

- The DLO is in use.
- You do not have the necessary authority.

If the existing document is damaged, some of the security information may be lost. The restore operation continues and a message is sent informing you that the document is damaged and some of the security information is lost.

Restrictions for Running Multiple DLO Commands: No two of the following commands may be run on one system at the same time:

```
SAVDLO
RSTDLO
RCLDLO DLO(*ALL)
RCLDLO DLO(*INT)
DLTDLO DLO(*ALL)
RNMDIRE
```

An attempt to run these commands at the same time results in the message CPF8A47: `Internal system objects are in use.` The second SAVDLO, RSTDLO, or RCLDLO operation ends with no objects saved, restored, or reclaimed.

Size Limitations When Restoring Document Library Objects: On V2R3 or later, you cannot restore more than 349 000 objects to a single library. Before V2R3, the limit is 250 000 objects from a single library. Because DLOs are nominally stored in libraries, this limit applies to the QDOC library in the system ASP and to the QDOCnnnn libraries in user ASPs.

How to Restore Folders

To restore a folder object, the entire folder (the folder object plus all document and folder objects within it) must also be restored. However, if the specific folder being restored was stored in other folders at the time it was saved, those higher level folders do not have to be restored to restore the specific folder.

When you restore a folder, the fully qualified folder path name you are restoring must exist unless you are restoring a first-level folder. For example, if you save folder A and then delete it, you can enter RSTDLO DLO(*ALL) SAVFLR(A) and restore folder A in addition to all the documents and folders in it. However, if you want to restore folder A/B/C/D, you must create folder A, then folder B in folder A, then folder C in folder A/B, before you can restore folder D in folder C.

You only have to create the folders that comprise the A/B/C path, and you do not have to create folder D in folder A/B/C before you can restore it.

If you try to restore a folder that is in use, the system bypasses restoring the folder and all the DLOs in it.

If you try to restore into an existing folder but the folder is damaged and cannot be reclaimed, you receive a message informing you that the folder is damaged and not restored. The folder and all documents and folders in it are not restored.

How to Rename Documents When Restoring

You can use the RENAME parameter to give documents a different name when they are restored. You can also place them in a different folder using the RSTFLR parameter.

If renaming a document when it is restored would result in a duplicate name in a folder, the system does the following:

- If ALWOBJDIF(*NONE) is specified, the document is not restored.
- If ALWOBJDIF(*ALL) is specified, the document is restored and replaces the existing document in the folder.

You can specify more than one value for the RENAME parameter. The system matches the RENAME values with the DLO values until it runs out of values for one or the other. Assume you specify:

```
RSTDLO DLO(A B C D) SAVFLR(X) RENAME(J K L) RSTFLR(Y)
```

After the restore operation, you would have these documents:

Document J in folder Y
Document K in folder Y
Document L in folder Y
Document D in folder Y

How to Restore Mail and Distribution Objects

You can restore mail by specifying `RSTDLO DLO(*MAIL)`. If you specified `SAVDLO DLO(*MAIL)` when you saved, you can specify `RSTDLO DLO(*ALL) SAVFLR(*ANY)` to restore mail.

Specifying RSTDLO DLO(*MAIL) restores only those filed documents that have a mail log reference at the time they are saved, plus all the distribution objects and distribution documents from the save media or online save file. Specifying RSTDLO DLO(*ALL) SAVFLR(*ANY) restores all distribution objects, all documents, and all folders from the save media or online save file.

Distribution documents and objects cannot be restored individually. If you specify any other form of the RSTDLO command, such as RSTDLO DLO(*ALL) SAVFLR(A) and RSTDLO DLO(X) SAVFLR(A/B), then no distribution documents and objects are restored. If the filed documents that are restored using these other forms of the RSTDLO command contain mail log references, then the mail log references are restored if the distribution objects exist on the system.

Mail log references are updated for all existing local recipients of a restored document. Mail log references on remote systems for remote recipients are not restored. If a document being restored still exists in a mail log at the time it is restored, then the contents of the document are restored and the status of the document in the mail log is not changed. If the document being restored has been deleted from a mail log, then the status of the restored document is either *filed* for a filed document or *opened* for a distribution document.

Mail log references are restored for a local sender of a document if there was an entry in the sender's mail log at the time the distributions were saved. Entries in the mail logs of remote senders are not saved or restored.

How the System Restores Descriptive Information for DLOs

The creation date, file date, and revision date for restored documents and folders are set as follows:

- The creation date of the document or folder on the save media is restored with the document or folder.
- When the RSTDLO command replaces a document or folder, the file date of the document or folder being replaced on the system is used.
- The object revision date is set to the current date when the document or folder is restored.
- The content revision date of the document on the save media is restored with the document.
- The content revision date is set to the current date when replacing a folder.
- The content revision date of the folder on the save media is restored with the folder if the folder is new.

How the System Restores Authority and Ownership for DLOs

"How the System Establishes Ownership for Restored Objects" on page 15-3 and "How to Restore Object Authorities" on page 15-4 describe how the system handles ownership and authority when restoring objects. These same rules apply when restoring DLOs, with these additions:

- If the user profile that owns a DLO is not in the system distribution directory, ownership is assigned to the QDFTOWN user profile.
- When you restore a DLO that does not exist on the system, any access codes and explicit users are removed. If you have restored user profiles and you later run the RSTAUT command, the private authorities

to the DLO are restored. The access codes are not restored.

When to Run the Rename Directory (RNMDIRE) Command

When you need to run the Rename Directory Entry (RNMDIRE) command for a local user, schedule it just before you perform the following operations:

- Saving mail
- Saving the system distribution directory

If the rename operation is performed just before saving the mail and the directory, the changed information is saved and the information will be the same as what is on the system. If the information on the media does not match the information on the system, the mail will not be restored during the restore operation.

When to Run the Document Library Object (RNMDLO) Command

When you need to run the Rename Document Library Object (RNMDLO) command, schedule it just before you back up document library objects. If the rename operation is performed just before saving the document library object, the changed name is saved and the information on the media will be the same as what is on the system.

If you rename a document library object after a save operation, the document library object name on the system is different than the name on the media. However, the system object names remain the same. The restore operation fails because the system thinks the document library object already exists. Message CPF90A3 or CPF909C is sent indicating that the document or folder already exists.

Do one of the following:

- To create a new document or folder, specify NEWOBJ(*NEW).
- To replace an existing document, specify RENAME(*document-name*), where *document-name* is the name given to the document by the RNMDLO command.
- To replace an existing folder, specify RSTFLR(*folder-name*), where *folder-name* is the name given to the folder by the RNMDLO command.

Output from the RSTDLO Command: You can use the OUTPUT parameter on the RSTDLO command to show information about the restored documents, folders, and mail. You can either print the output (OUTPUT(*PRINT)) or save it to a database file (OUTPUT(*OUTFILE)).

If you print the output, you should be aware of device dependencies:

- The heading information in the output is device-dependent. All information does not appear for all devices.
- The print file for the RSTDLO command uses a character identifier (CHRID) of 697500. If the printer you are using does not support this character identifier, you will receive message CPA3388. To print the RSTDLO output and not receive message CPA3388, specify the following before specifying *PRINT on the RSTDLO command:

  ```
  CHGPRTF FILE(QSYSOPR/QPRSTDLO) CHRID(*DEV)
  ```

  For more information about character identifiers (CHRID), see the *Printer Device Programming* book.

If you use an output file, the system uses the file format QSYS/QAOJRSTO.OJRDLO. The file layout is described in the *Office Services Concepts and Programmer's Guide* book.

Recovery of Text Index Files for Text Search Services

The text index database files are a part of the Text Search Services. The text index recovery process must ensure a consistent, usable set of index files. The text search index contents must be consistent with the document library contents. The last version indexed date for all documents is recorded in both the text index and the individual documents. The dates are used in the recovery process to ensure that the text index and the document library content match.

The text index database files are saved when library QUSRSYS is saved. A list of the files that are saved when library QUSRSYS is saved is shown in a table in the *Office Services Concepts and Programmer's Guide* book.

If you are restoring the text index files, then all of the files must be restored together from the same backup media. If they are not restored from the same media, their association to each other is lost. The loss of the association to each other can cause unpredictable results. If you do not have saved copies of the files, you must delete the files and then restore them from your distribution tapes.

The text index details are kept in the administration table file. Pointers to the current index are stored in the table. The administration table file must be restored with the other files. If you have changed the defaults for the text index details, then before restoring the files, write down the current text index details (if available). To display the text index details, type `WRKTXTIDX` on a command line and press the Enter key. Then select option 5 (Display details) on the Work with Text Index display. You can enter the values again after the table is restored.

If the scheduling queue (file QABBIQTB) is damaged and there are documents on the system, you can restore the scheduling queue and can get back some of the requests that were lost if the saved scheduling queue is a very recent

copy. Retaining the requests on the restored scheduling queue may not be a benefit if it is not a recent copy.

If you are recovering all text index search files and documents from the same set of save tapes, you should not have problems. If you are recovering your system in pieces, consult Appendix D, "Procedures for Recovering the Text Index" for possible problems and their solutions.

For more information about Text Search Services, see the *Office Services Concepts and Programmer's Guide*.

How to Restore Objects in Directories

Use the RST (Restore) command to restore objects that you have saved with the SAV command. These commands are most commonly used to save and restore objects in the QLANSrv file system, the QOpenSys file system, and the *Root* file system.

You can use the RST command to restore:

- A specific object
- A directory or subdirectory
- An entire file system
- Objects that meet search criteria
- A list of object path names

You can rename an object or restore it to a different directory by using the new-name element of the object (OBJ) parameter.

The OBJ parameter on the RST command supports the use of wildcard characters and the directory hierarchy. On-line information and the *Integrated File System Introduction* book provide more information about how to specify object names when you use integrated file system commands.

Some file systems allow the same physical object to be named different ways, using aliases and links. The topic "How to Save Objects That Have More Than One Name" on page 5-12 shows examples of objects with links and how those objects are saved.

In Figure 15-8, FILEA in the JCHDIR directory and FILEA in the DRHDIR directory are both hard links to the same file. They point to the same object. They can have the same name or different names for the objects.

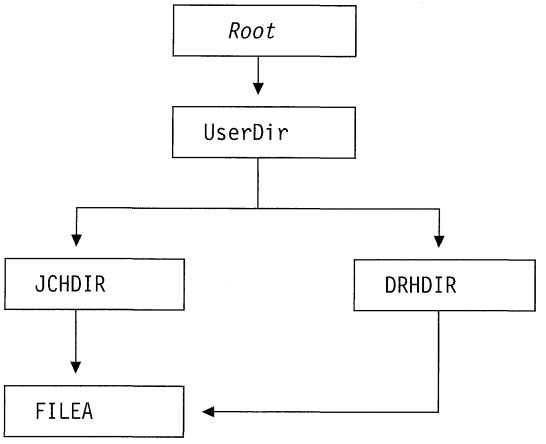


Figure 15-8. An Object with Hard Links–Example

Table 15-11 shows several examples of how these objects are restored. These examples assume that you use this SAV command: `SAV OBJ('/UserDir/*')`. The tape contains FILEA and both hard links pointing to the file.

Table 15-11. Restoring Objects That Have Hard Links

Restore Command Used	Objects That Are on the System before the RST Command	Objects after the RST Command
`RST OBJ('/UserDir/*')`	JCHDIR/FILEA	The saved data is restored. The object DRHDIR/FILEA is created on the system. It points to the same object as JCHDIR/FILEA.
`RST OBJ('/UserDir/DRHDIR/*')`	JCHDIR/FILEA	A new object, DRHDIR/FILEA, is created. The JCHDIR/FILEA that exists on the system is not affected by the restore operation.
`RST OBJ('/UserDir/*')`, or `RST OBJ('/UserDir/JCHDIR/*')`, or `RST OBJ('/UserDir/DRHDIR/*')`	JCHDIR/FILEA, DRHDIR/FILEA	Data from the media copy of FILEA is restored over the system copy because the same name is specified as a name that already exists on the system.

Figure 15-9 on page 15-25 shows the symbolic link called `customer` pointing to the CUSTMAS file in the CUSTLIB library.

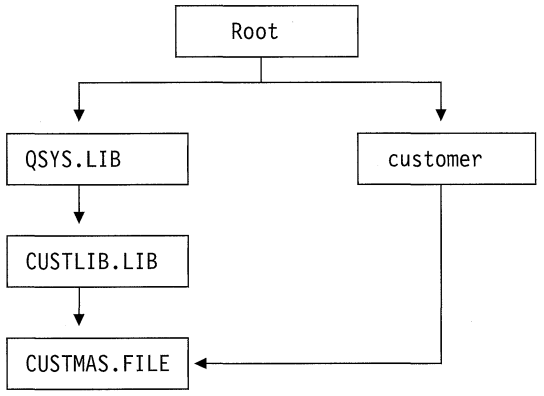


Figure 15-9. An Object with a Symbolic–Example

If you restore the customer object (`RST OBJ('/customer')`), you are restoring only the fact that it points to the CUSTMAS file, not the file itself. If the CUSTMAS file does not exist, the restore operation succeeds. However, if you try to use the customer object, you receive an error message. If you restore the CUSTMAS file or create it again, the symbolic link between customer and the CUSTMAS file is re-established.

How to Restore LAN Server for OS/400 Information

"How LAN Server for OS/400 Information Is Stored and Saved" on page 5-13 describes the directories used for the LAN Server for OS/400 licensed program and the procedures for saving information from those directories. How you restore LAN Server for OS/400 information depends on how you saved it.

In a complete recovery, you must restore the following:

- The domain controller database if one of the network servers on your system is the domain controller.
- All the directories.
- Authority information.

The *LAN Server for OS/400 Administration* book describes the recovery steps.

How to Restore System Object Model Objects

Protected SOM objects are stored in directories in the *Root* file system. Methods are modules in service programs that are stored in libraries in the QSYS.LIB file system. When you restore an object-oriented application that uses SOM objects, you must ensure that you keep the application objects synchronized. For example, you may have recently changed the definition of state data for an class to include a new instance variable (field) and methods that use the instance variable. You also added modules in the service program that contain the methods. If you restore an old version of the service program that does not have the modules defined, your application will not work correctly.

Every SOM object has a name and an SOM object ID. You use the SOM object ID (SOMOBJID) parameter on the Restore (RST) command to determine what the system does when you restore a SOM object. Following are the values for the SOMOBJID parameter:

***SAVED** The restored object will have the SOM object ID of the saved version.

***SYS** The restored object may have a new SOM object ID that is generated by the system. If a new SOM object is being restored, the system will assign a new SOM object ID. If the SOM object exists on the system, the SOM object idea of the system copy is used.

Normally, you would specify *SAVED to restore the SOM object ID that was saved. However, you might want to generate new SOM object IDs is you are creating a second copy of an application, such as a test version.

Table 15-12 shows what happens when you restore a SOM object:

Table 15-12 (Page 1 of 2). Results of Restoring a SOM Object

Name Exists	Object ID Exists	Same Name and ID on Media and System	Value of SOMOBJID Parameter	Result	Example	
					What You Do	What the System Does
Y	Y	Y	Any	The object is overlaid	Create NAMEA.idx Save NAMEA.idx Restore NAMEA.idx	NAMEA.idx on media overlays NAMEA.idx on system

Table 15-12 (Page 2 of 2). Results of Restoring a SOM Object

Name Exists	Object ID Exists	Same Name and ID on Media and System	Value of SOMOBJID Parameter	Result	Example	
					What You Do	What the System Does
Y	Y	N	*SAVED	Object is not restored	Create NAMEA.idx Save NAMEA.idx Rename NAMEA.idx to NAMEB.idx Create NAMEA.idy Restore NAMEA.idx	NAMEA.idx is not restored; message is sent
Y	Y	N	*SYS	Contents of the saved object are restored, but the SOM object ID of the system version of the object is used.	Create NAMEA.idx Save NAMEA.idx Rename NAMEA.idx to NAMEB.idx Create NAMEA.idy Restore NAMEA.idx	NAMEA.idy is overlaid with NAMEA.idx from media Object remains NAMEA.idy NAMEB.idx is unchanged
Y	N		*SAVED	Object is not restored	Create NAMEA.idx Save NAMEA.idx Delete NAMEA.idx Create NAMEA.idy Restore NAMEA.idx	Object is not restored; Message is sent
Y	N		*SYS	Contents of the saved object are restored, but the SOM object ID of the system version of the object is used.	Create NAMEA.idx Save NAMEA.idx Delete NAMEA.idx Create NAMEA.idy Restore NAMEA.idx	NAMEA.idy is overlaid with NAMEA.idx from media object remains NAMEA.idy.
N	Y	-	*SAVED	Contents of saved object are restored to system version of object. System name is used. Link is created from media name to system name.	Create NAMEA.idx Save NAMEA.idx Rename NAMEA.idx to NAMEB.idx Restore NAMEA.idx	Contents of NAMEA.idx are restored to NAMEB.idx Link is creasted from A to NAMEB.idx Message is sent
N	Y	-	*SYS	New object is created with saved name an a new (generated) SOM object ID	Create NAMEA.idx Save NAMEA.idx Rename NAMEA.idx to NAMEB.idx Restore NAMEA.idx	NAMEA.idy is created on system Contents of NAMEA.idx are restored from media to NAMEA.idy NAMEB.idx is unchanged
N	N	-	*SAVED	New object is created with name and SOM object ID from media	Create NAMEA.idx Save NAMEA.idx Delete NAMEA.idx Restore NAMEA.idx	Create NAMEA.idx on system
N	N	-	*SYS	New object is created with name from media and new (generated) SOM object ID	Create NAMEA.idx Save NAMEA.idx Delete NAMEA.idx Restore NAMEA.idx	Create NAMEA.idy on system

Note:

NAMEA and NAMEB are object names
idx and idy are SOM object IDs

| You can use the Display SOM Object (DSPSOMOBJ) command to see the object ID associated with a SOM object. You can use a DSPxxx command to see the object ID for a SOM object that has been saved to media.

| When you restore SOM objects, you must also ensure that the versions of the SOM objects in the directories match any associated programs in libraries. The simplest way is to make sure that you save SOM objects and their associated programs at the same time.

| The *SOMobjects (SOM/DSOM 2.1) User Guide* has more information about using SOM objects.

Restrictions When Using the Restore Command

The RST command can be used to restore objects to any file system. The topics that follow describe restrictions that apply when using the RST command.

Restrictions When Restoring Objects to Multiple File Systems: When you use the RST command to restore objects to more than one file system at the same time and the file systems include the QSYS.LIB file system or the QDLS file system, the following restrictions apply:

- Different file systems support different types of objects and different methods of naming objects. Therefore, when you restore objects from more than one file system with the same command, you cannot specify object names or object types. You can restore all objects from all file systems, or you can omit some file systems. These combinations are valid:
  - Restoring all objects on the system: `OBJ('/*')`

    Note: Using this command is not the same as using option 21 from the Restore menu. Following are the differences between SAV OBJ('/*') and option 21:
    - RST OBJ('/*') does not put the system in a restricted state.
    - RST OBJ('/*') does not start the controlling subsystem when it finishes.
    - RST OBJ('/*') does not provide prompting to change default options.
  - Restoring all objects in all file systems except the QSYS.LIB file system and the QDLS file system: `OBJ(('/*') ('/QSYS.LIB' *OMIT) ('/QDLS' *OMIT))`
  - Saving all objects in all files systems except the QSYS.LIB file system, the QDLS file system, and one or more other file systems: `OBJ(('/*') ('/QSYS.LIB' *OMIT) ('/QDLS' *OMIT) ('/other values' *OMIT))`
- Values for other parameters of the RST command are supported only for some file systems. You must choose values that are supported by all file systems. Specify the following parameters and values:

OPTION	*ALL
ALWOBJDIF	*NONE or *ALL
LABEL	*SEARCH
OUTPUT	*NONE
SUBTREE	*ALL
SYSTEM	*LCL
DEV	(Must be a tape device)
VOL	*MOUNTED

- When you specify RST OBJ('/*'), the following applies:
  - The system restores only objects saved by SAV OBJ('/*').
  - The system must be in a restricted state.
  - You must have *SAVSYS or *ALLOBJ special authority.
  - | You cannot specify diskette, save file, or optical media for the DEV parameter.
  - | You must specify `SEQNBR(*SEARCH)`.

  Note: RST OBJ('/*') is not the recommended method for restoring the entire system. Chapter 9, "Selecting the Right Recovery Strategy" describes how to determine the recovery procedure for your situation.

Restrictions When Restoring Objects to the QSYS.LIB File System: When you use the RST command to restore objects to the QSYS.LIB (library) file system, the following restrictions apply:

- The OBJ parameter must have only one name.
- You specify objects in the same way that you specify them on the RSTOBJ command and the RSTLIB command. Table 15-13 shows the valid options for the Object (OBJ) parameter when restoring objects to the QSYS.LIB file system and the equivalent RSTOBJ or RSTLIB command:

Table 15-13 (Page 1 of 2). Using the RST Command for QSYS.LIB Objects

Object Parameter on RST Command	Equivalent RSTxxx Command
`OBJ('/QSYS.LIB/`*library-name*`.LIB')`	`RSTLIB SAVLIB(`*library-name*`)`
`OBJ('/QSYS.LIB /`*library-name*`.LIB/*')`	`RSTOBJ SAVLIB(`*library-name*`) OBJ(*ALL) OBJTYPE(*ALL)`
`OBJ('/QSYS.LIB/`*library-name*`.LIB /*.`*object-type*`')`	`RSTOBJ SAVLIB(`*library-name*`) OBJ(*ALL) OBJTYPE(`*object-type*`)`
`OBJ('/QSYS.LIB/`*library-name*`.LIB /`*object-name*`.`*object-type*`')`	`RSTOBJ SAVLIB(`*library-name*`) OBJ(`*object-name*`) OBJTYPE(`*object-type*`)`
`OBJ('/QSYS.LIB/`*library-name*`.LIB /`*file-name*`.FILE/*')`	`RSTOBJ SAVLIB(`*library-name*`) OBJ(`*file-name*`) OBJTYPE(*FILE)`
`OBJ('/QSYS.LIB/`*library-name*`.LIB /`*file-name*`.FILE/*.MBR')`	`RSTOBJ SAVLIB(`*library-name*`) OBJ(`*file-name*`) OBJTYPE(*FILE)`

Table 15-13 (Page 2 of 2). Using the RST Command for QSYS.LIB Objects

Object Parameter on RST Command	Equivalent RSTxxx Command
OBJ('/QSYS.LIB/*library-name*.LIB /*file-name*.FILE /*member-name*.MBR')	RSTOBJ SAVLIB(*library-name*) OBJ(*file-name*) OBJTYPE(*FILE) FILEMBR((*ALL) (*member-name*))

- You can specify only object types that are allowed on the RSTOBJ command. For example, you cannot use the RST command to restore user profiles because OBJTYPE(*USRPRF) is not allowed on the RSTOBJ command.
- Some libraries in the QSYS.LIB file system cannot be restored with the RSTLIB command because of the type of information they contain. Following are examples:
  - The QDOC library, because it contains documents.
  - The QSYS library, because it contains system objects.

  You cannot use the RST command to restore these entire libraries:

QDOC	QSRV
QDOCnnnn	QSPL
QRECOVERY	QSYS
QRPLOBJ	QTEMP

- You can use the new-name element of the object parameter to rename an object in a directory, restore an object to a different directory, or restore an object to a different library. Table 15-14 shows some examples:

*Table 15-14. *INCLUDE Options on the RST Command–Examples*

Restore Command	Results
RST OBJ(('/DBSDIR/FILEB' *INCLUDE '/DBSDIR/FILEX'))	FILEX is created in the DBSDIR directory. The data that was saved with FILEB is restored to FILEX. If FILEB still exists on the system, it is not changed.
RST OBJ(('/DBSDIR/FILE*' *INCLUDE LMSDIR))	Restores all objects from the DBSDIR whose names begin with FILE to the LMSDIR directory.
RST OBJ(('/QSYS.LIB/LIB1.LIB' *INCLUDE '/QSYS.LIB/LIB2.LIB'))	RSTLIB SAVLIB(LIB1) RSTLIB(LIB2)
RST OBJ(('/QSYS.LIB/LIB1.LIB/* *INCLUDE '/QSYS.LIB/LIB2.LIB'))	RSTOBJ OBJ(*ALL) SAVLIB(LIB1) RSTLIB(LIB2)
RST OBJ(('/QSYS.LIB/LIB1.LIB/*.type' *INCLUDE '/QSYS.LIB/LIB2.LIB'))	RSTOBJ OBJ(*ALL) OBJTYPE(*type) SAVLIB(LIB1) RSTLIB(LIB2)

- For database file members, OPTION(*NEW) restores members for new files only.
- Other parameters must have these values:

  SUBTREE *ALL
  SYSTEM *LCL
  OUTPUT *NONE
  ALWOBJDIF *ALL or *NONE

- You can only rename the library, you cannot rename the object. The new name must be *SAME or

  /QSYS.LIB/libname.LIB

  where the library specified by *libname* must exist.

Restrictions When Restoring Objects to the QDLS File System: When you use the RST command to restore objects to the QDLS (document library services) file system, the following restrictions apply:

- The OBJ parameter must have only one name.
- The OBJ and SUBTREE parameters must be one of the following:
  - OBJ('/QDLS/*path/folder-name*') SUBTREE(*ALL)
  - OBJ('/QDLS/*path/document-name*') SUBTREE(*OBJ)
- Other parameters must have these values:

  SYSTEM *LCL
  OUTPUT *NONE
  ALWOBJDIF *ALL or *NONE
  OPTION *ALL

Restoring Program Temporary Fixes

If you have restored the Licensed Internal Code or the operating system, you need to ensure that the PTFs on your system are current. Do the following:

__ **Step 1** Print a list of all the program temporary fixes (PTFs) currently on the system. Type the following and press the Enter key:

```
DSPPTF LICPGM(*ALL) OUTPUT(*PRINT)
```

__ **Step 2** Compare this list of PTFs with the list you printed when you saved the system. If the lists are the same, return to your recovery checklist. If PTFs are missing from the list you printed in step 1, you must apply them. Continue with the next step.

__ **Step 3** Find the most recent cumulative program temporary fix tape. This package could be on a distribution tape or on a stand-alone tape.

Note: If you do not have the PTFs you need, order them and apply them later. Continue with your recovery checklist.

__ **Step 4** You can use option 8 (Install program temporary fix package) on the Program Temporary Fix menu. All of the PTFs in the cumulative PTF package will be installed for

the licensed programs you have installed on your system. Refer to the *AS/400 System PTF Shipping Information Letter* for special instructions that are required.

If you want to restore individual PTFs, see the *System Operation* book for more information about applying individual PTFs.

Chapter 16. Restoring Changed Objects and Applying Journaled Changes

Figure 16-1 shows a typical time line for recovering your system.

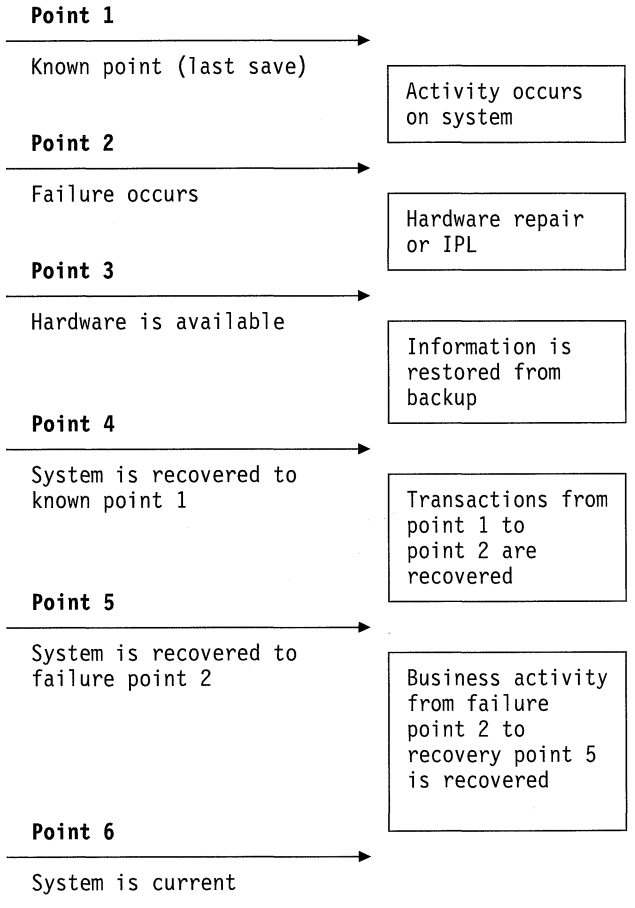


Figure 16-1. Sample Recovery Time Line

Chapter 10 through Chapter 15 describe what is required to reach point 4 in the time line. This returns your system to the point of the last complete save operation.

This chapter describes two procedures that are available to reach point 5 in the time line:

- Restoring changed objects
- Applying journal changes

These procedures are designed to recover activity that has occurred since the last complete save operation.

Task 1–Restoring Changed Objects

"How to Save Only Changed Objects" on page 5-3 describes two methods of saving changed objects. Table 16-1 shows the two methods and the correct restore procedures for each:

Table 16-1. Restore Procedures for Changed Objects

Save Method	Description	Restore Procedure
Cumulative	You save all changes since the last complete save operation.	"Restoring Changed Objects by Library" on page 16-2
Not cumulative	You save changes since the last SAVCHGOBJ operation.	"Restoring Changed Objects Individually" on page 16-2

If you save journal receivers using the SAVCHGOBJ command, read "How to Restore Journal Receivers" on page 15-18 for special considerations that may apply when restoring them.

Restoring Changed Objects by Library

Do the following to restore changed objects by library:

__ **Step 1** Load the SAVCHGOBJ tape.

__ **Step 2** Type `DSPTAP DEV(TAP01) OUTPUT(*PRINT)` and press the Enter key.

__ **Step 3** For each library on the list, type:

```
RSTOBJ OBJ(*ALL) DEV(TAP01) SAVLIB(library-name)
   OBJTYPE(*ALL) ENDOPT(*LEAVE) MBROPT(*ALL)
```

Repeat this step for each library on the tape.

__ **Step 4** If you have journaled changes to apply, continue with "Task 3–Determining What Journal Receivers to Use" on page 16-3. If you do not need to apply journaled changes, skip to "Task 6–Restoring Changed Documents and Folders" on page 16-7. If you are not sure whether you need to apply journaled changes, continue with "Task 2–Determining Whether You Need to Apply Journaled Changes."

Restoring Changed Objects Individually

If your method for saving changed objects is not cumulative, you may have the same object on more than one set of SAVCHGOBJ tapes. You may choose to restore each set of SAVCHGOBJ tapes completely, starting from the oldest tape. This is the simplest method. However, it may be time-consuming if you have the same large objects on more than one SAVCHGOBJ tape.

If you want to restore each set of SAVCHGOBJ tapes completely, follow the procedure described in "Restoring Changed Objects by Library" for each set of tapes. If you want to restore each object only once, follow this procedure:

__ **Step 1** Load each SAVCHGOBJ tape.

__ **Step 2** Type `DSPTAP DEV(TAP01) OUTPUT(*PRINT)` and press the Enter key.

__ **Step 3** Compare the listings and find the most recent saved copy of each object.

__ **Step 4** For each object, load the correct tape and tape:

```
RSTOBJ OBJ(object-name)
   DEV(TAP01) SAVLIB(library-name)
   OBJTYPE(*ALL) ENDOPT(*LEAVE) MBROPT(*ALL)
```

Repeat this step for each object you need to restore.

__ **Step 5** If you have journaled changes to apply, continue with "Task 3–Determining What Journal Receivers to Use" on page 16-3. If you do not need to apply journaled changes, skip to "Task 6–Restoring Changed Documents and Folders" on page 16-7. If you are not sure whether you need to apply journaled changes, continue with "Task 2–Determining Whether You Need to Apply Journaled Changes."

Task 2–Determining Whether You Need to Apply Journaled Changes

You may have set up journaling yourself, or you may be using applications that use journaling. For example, the OfficeVision for OS/400 program and the Client Access for OS/400 program use the QUSRSYS/QAOSDIAJRN journal. Some applications provided by software vendors also use journaling.

If you know you have journaled changes to apply, continue with "Task 3–Determining What Journal Receivers to Use" on page 16-3. If you are not sure, do the following:

__ **Step 1** Type `DSPOBJD OBJ(*ALL/*ALL) OBJTYPE(*JRN) OUTPUT(*PRINT)` and press the Enter key. This command prints a list of all the journals on your system.

__ **Step 2** For each journal on the list, do the following:

- __ **Step a.** Type: `WRKJRNA JRN(`*library-name/journal-name*`)`. You are shown the Work with Journal Attributes display.
- __ **Step b.** Press F13 to display the physical files being journaled.
- __ **Step c.** Press F12 to return to the Work with Journal Attributes display.
- __ **Step d.** Press F15 to display the receiver directory.
- __ **Step e.** Press F12 to return to the Work with Journal Attributes display.
- __ **Step f.** From the information you have seen, you should be able to determine whether any physical files are being journaled and whether any journal entries exist that are more recent than your most recent saved copies of the files. You can also determine which receivers are on the system for the journal. Repeat these steps for each additional journal.

__ **Step 3** If you need to apply journaled changes, continue with "Task 3–Determining What Journal Receivers to Use." If you do not need to apply journaled changes, skip to "Task 6–Restoring Changed Documents and Folders" on page 16-7.

Task 3–Determining What Journal Receivers to Use

The next several topics describe the general procedure for applying journaled changes. The *Backup and Recovery – Advanced* book provides more information about journaling and applying journaled changes.

Follow this procedure:

__ **Step 1** Ensure that all the journal receivers required for the apply journaled changes operation are available on the system. In general, you will need all journal receivers that were attached to the journal for the length of time for which journaled changes are now to be applied to the restored files.

__ **Step 2** Restore all necessary journal receivers that are not already on the system. Use the Display Journal Receiver Attributes (DSPJRNRCVA) command to determine when a journal receiver was attached to and detached from a journal.

__ **Step 3** Determine the name of the last journal receiver (the last receiver restored) and whether there are chain breaks by printing the receiver chain:

- __ **Step a.** Type `WRKJRNA JRN(`*library-name/journal-name*`) OUTPUT(*PRINT)` and press the Enter key. You receive a listing that shows the receiver directory, all the files being journaled, and all the access paths being journaled.
- __ **Step b.** Look at the receiver directory part of the listing. If you saved the currently attached journal receiver, your journal receiver directory should look similar to Figure 16-2 on page 16-4. The journal receiver that was attached during the save procedure shows a status of `Partial`. The following example shows the displayed version of the receiver directory:

```
                        Work with Receiver Directory

Journal  . . . . . :   JRNA            Library  . . . . . :   $JRNLA

Total size of receivers . . . . . :   155648

Type options, press Enter.
  4=Delete   8=Display attributes

                                      Attach                      Save
Opt  Receiver    Library     Number   Date      Status            Date
 _   RCVA0001    DSTJRN      00001    06/08/9x  SAVED             06/08/9x
 _   RCVA0002    DSTJRN      00002    06/09/9x  SAVED             06/09/9x
 _   RCVA0003    DSTJRN      00003    06/09/9x  PARTIAL           06/09/9x
 _   RCVA1003    DSTJRN      01001    06/10/9x  ATTACHED          00/00/00
```

Figure 16-2. Receiver Directory–Saving Attached Receivers

If you save only detached journal receivers, your receiver directory should look similar to Figure 16-3:

```
                        Work with Receiver Directory

Journal  . . . . . :   JRNA            Library  . . . . . :   $JRNLA

Total size of receivers . . . . . :   155648

Type options, press Enter.
  4=Delete   8=Display attributes

                                      Attach                      Save
Opt  Receiver    Library     Number   Date      Status            Date
 _   RCVA0001    DSTJRN      00001    06/08/9x  SAVED             06/08/9x
 _   RCVA0002    DSTJRN      00002    06/09/9x  SAVED             06/09/9x
 _   RCVA0003    DSTJRN      00003    06/09/9x  SAVED             06/09/9x
 _   RCVA1003    DSTJRN      01001    06/10/9x  ATTACHED          00/00/00
```

Figure 16-3. Receiver Directory–Saving Detached Receivers

__ **Step 4** On the listing, mark the name of the last receiver with a status of `SAVED` or `PARTIAL`.

__ **Step 5** Determine the chain of receivers to be used in the APYJRNCHG command from the Work with Receiver Directory listing. Mark the first and last receiver that you need, based on the date that you saved the files being recovered. Notice that the first and last receiver are the same if only one journal receiver was restored.

Note: While looking at the receiver directory, you should also look for any receiver chain breaks. You can determine a chain break by looking at the first two digits in the *Number* column on the Work with Receiver Directory display. You cannot apply journaled changes across receiver chain breaks. Therefore, you must write down the beginning and ending receiver names for each receiver chain. Then you need to run a series of apply journaled changes operations, one for each chain using these receivers. A chain break may mean that you are missing all or part of a journal receiver. (It was on the system and was not saved before the failure occurred.) You should evaluate how applying journaled changes across a change break may affect the integrity of your data. The *Backup and Recovery – Advanced* book has more information about receiver chain breaks.

__ **Step 6** If the ending receiver has a status of PARTIAL (saved-while-attached), determine the last entry to be applied for the last receiver:

__ **Step a** Type 8 (Display attributes) in the *Opt* field next to the receiver name.

__ **Step b** Write down the value for the *Last Sequence Number* field.

__ **Step 7** Look at the part of the listing that shows what files and access paths are currently being journaled. (You printed the listing in step 3a on page 16-3.) Compare it to your records of what files and access paths should be journaled. If you follow the procedures in "Task 1–Printing System Documentation and Preparing to Save" on page 4-2 before you save your system, you print the list in step 22 on page 4-5.

__ **Step 8** For each physical file that should be journaled and does not appear on the current listing, type:

```
STRJRNPF FILE(library-name/file-name)
   JRN(library-name/journal-name)
```

__ **Step 9** For each access path that should be journaled and does not appear on the current listing, type:

```
STRJRNAP FILE(library-name/file-name)
   JRN(library-name/journal-name)
```

__ **Step 10** The journal receiver that is currently attached may not match your naming conventions. Usually this is because the journal receiver was created when you restored the journal. If this is the case, create a new receiver that follows the same naming convention and receiver attributes as the last receiver but assign it a number of one greater. In the example shown on the Work with Receiver Directory display, you would type:

```
CRTJRNRCV JRNRCV(DSTJRN/RCVA0004)
```

__ **Step 11** Use the CHGJRN command to detach the current receiver and attach the journal receiver you just created. In the example, you would type:

```
CHGJRN JRN($JRNLA/JRNA)
       JRNRCV(DSTJRN/RCVA0004)
```

Task 4–Applying Journaled Changes for User Journals

Do the following steps if you need to apply journaled changes to user journals. If you do not need to apply journaled changes, skip to "Task 5–Applying Journaled Changes for the QAOSDIAJRN Journal" on page 16-6.

__ **Step 1** If you have a single receiver chain for the journal entries that you need to apply and the status of the last receiver you are using is SAVED, type the following:

```
APYJRNCHG JRN(library-name/journal-name)
          FILE((library-name/*ALL))
          RCVRNG(lib-name/first-receiver lib-name/last-receiver)
          FROMENT(*LASTSAVE) TOENT(*LASTRST)
```

If you have a single receiver chain for the journal entries that you need to apply and the status of the last receiver you are using is PARTIAL, type the following:

```
APYJRNCHG JRN(library-name/journal-name)
          FILE((library-name/*ALL))
          RCVRNG(lib-name/first-receiver lib-name/last-receiver)
          FROMENT(*LASTSAVE) TOENT(last-sequence-number)
```

where the *last-sequence-number* is the number you wrote down in step 6 of "Task 3–Determining What Journal Receivers to Use" on page 16-3.

__ **Step 2** If you have determined that this journal had receiver chain breaks, you must decide whether you are actually missing journal receivers and necessary journal entries or whether the chain breaks were caused by something else. You should evaluate how applying journaled changes across a chain break may affect the integrity of your data. The chapter of the *Backup and Recovery – Advanced* book called "Working with Journals, Journal Receivers, and Journal Entries" provides more information about receiver chain breaks.

If you decide to apply journal entries across chain breaks, you must use a APYJRNCHG command for each chain. Type the APYJRNCHG command and use these values in place of the values shown in step 1 on page 16-5.

For the first (earliest) receiver chain:

RCVRNG First and last receivers in this chain
FROMENT *LASTSAVE
TOENT *LAST

For each middle receiver chain:

RCVRNG First and last receivers in this chain
FROMENT *FIRST
TOENT *LAST

For the last receiver chain:

RCVRNG First and last receivers in this chain
FROMENT *FIRST
TOENT *last-sequence-number*

where the *last-sequence-number* is the number you wrote down in step 6 on page 16-5.

Task 5–Applying Journaled Changes for the QAOSDIAJRN Journal

If you have document library objects, you may need to apply journaled changes from the receivers associated with the QAOSDIAJRN journal. If you are not sure, determine when you last saved the QUSRSYS library. Then perform the steps through step 1e to determine whether you have any journal entries for the QAOSDIAJRN journal that are more recent than your save tapes for the QUSRSYS library.

You cannot apply all journaled changes in the QAOSDIAJRN journal in library QUSRSYS. You must specify individual files on the FILE parameter instead of *ALL. Do not apply journal changes to the document and folder search index database files (QAOSSS10 through QAOSSS15, QAOSSS17, and QAOSSS18) for journal QAOSDIAJRN in library QUSRSYS.

__ **Step 1** Display the receiver chain for the QAOSDIAJRN journal by doing the following:

__ **Step a.** Type: `WRKJRNA JRN(QUSRSYS/QAOSDIAJRN)` and press the Enter key.

__ **Step b.** From the Work with Journal Attributes display, press F15 (Work with receiver directory). Examine the receiver directory to determine whether any chain breaks exist. (See the note on page 16-4.)

__ **Step c.** Type 8 (Display attributes) in the *Opt* field next to the receiver name of the last receiver that is not attached.

__ **Step d.** On the Display Journal Receiver Attributes display, write down the value for the *Last Sequence Number* field.

__ **Step e.** Press F12 three times to return to a command line.

__ **Step 2** If no chain breaks exist, type the following to apply journaled changes for the QAOSDIAJRN journal to individual files:

```
APYJRNCHG JRN(QUSRSYS/QAOSDIAJRN)
     FILE((QUSRSYS/QAOKPLCA) (QUSRSYS/QAOSAY05)
          (QUSRSYS/QAOKPX4A) (QUSRSYS/QAOSAY07)
          (QUSRSYS/QAOKP01A) (QUSRSYS/QAOKP02A)
          (QUSRSYS/QAOKP03A) (QUSRSYS/QAOKP04A)
          (QUSRSYS/QAOKP05A) (QUSRSYS/QAOKP06A)
          (QUSRSYS/QAOKP08A) (QUSRSYS/QAOKP09A))
      RCVRNG(lib-name/first-receiver lib-name/last-receiver)
      FROMENT(*LASTSAVE) TOENT(last-sequence-number)
```

where *last-sequence-entry* is the number you wrote down in step 1d on page 16-6.

__ **Step 3** If chain breaks exist, you must determine whether any journal receivers are missing and how that may affect the integrity of your recovery. If you decide to apply journaled changes, use the command shown in step 2 of this topic. Repeat the command for each receiver chain, substituting the correct receiver range, from-entry, and to-entry parameters. Step 2 in the topic "Task 4–Applying Journaled Changes for User Journals" on page 16-5 describes how to use these parameters.

Task 6–Restoring Changed Documents and Folders

Perform this task if you save changed documents and folders. If you do not need to do this task, skip to "Task 7–Restoring Changed Objects in Directories."

Do the following:

__ **Step 1** If your procedure for saving changed DLOs is cumulative, load the last daily SAVDLO tape. If your procedure is not cumulative, start with your earliest daily save tape and repeat these steps for each set of SAVDLO tapes.

__ **Step 2** If you have documents in user ASPs, display the tapes to find the sequence numbers for each ASP. Type `DSPTAP DEV(TAP01) OUTPUT(*PRINT)`. Mark the names and sequence numbers of the files on the listing. They will be named QDOC for the system ASP and QDOCnnnn for each user ASP that contains DLOs, where *nnnn* is the number of the ASP.

__ **Step 3** To restore the DLOs to a single ASP, type:

```
RSTDLO DLO(*ALL) DEV(TAP01) SAVFLR(*ANY)
   SAVASP(ASP-number) RSTASP(*SAVASP)
```

__ **Step 4** To restore the DLOs to all ASPs, type:

```
RSTDLO DLO(*ALL) DEV(TAP01) SAVFLR(*ANY)
   SAVASP(*ANY) RSTASP(*SAVASP)
   SEQNBR(beginning-sequence ending-sequence)
```

__ **Step 5** If an unrecoverable error occurs when running the RSTDLO DLO(*ALL) SAVFLR(*ANY) command, see "Recovering from an Error While Restoring DLOs" on page 8-10.

Task 7–Restoring Changed Objects in Directories

Perform this task if you saved changed objects in directories. If you do not need to do this task, continue with the next step in your recovery checklist.

If you use a cumulative method when you saved changed objects from directories (your save tapes contain all objects that have changes since the last complete save operation), do the following:

__ **Step 1** Mount your most recent tape from saving changed objects in directories.

__ **Step 2** Type:

```
RST DEV('/QSYS.LIB/TAP01.DEVD')
    OBJ(('/*') ('/QSYS.LIB' *OMIT) ('/QDLS' *OMIT))
```

If your tapes from saving changed objects in directories are not cumulative, repeat the following steps for each set of tapes since your last complete save operation. Start with the oldest tapes and end with the most recent tapes.

__ **Step 1** Mount the tape.

__ **Step 2** Type:

```
RST DEV('/QSYS.LIB/TAP01.DEVD')
    OBJ(('/*') ('/QSYS.LIB' *OMIT) ('/QDLS' *OMIT))
```

Chapter 17. How to Restore Your System Using Operational Assistant Tapes

The topic "Recovering User Information Using Tapes from Operational Assistant Backup–Checklist 21" on page 9-37 provides a list of the steps necessary to recover user information on your system. This chapter describes specific tasks associated with restoring information from Operational Assistant backup tapes. The descriptions assume that you are recovering all the data on your system. If you are recovering a single library or a single ASP, adapt the procedures to your situation.

Figure 17-1 shows the parts of your system and how they are saved with Operational Assistant. Refer to it in the topics that follow.

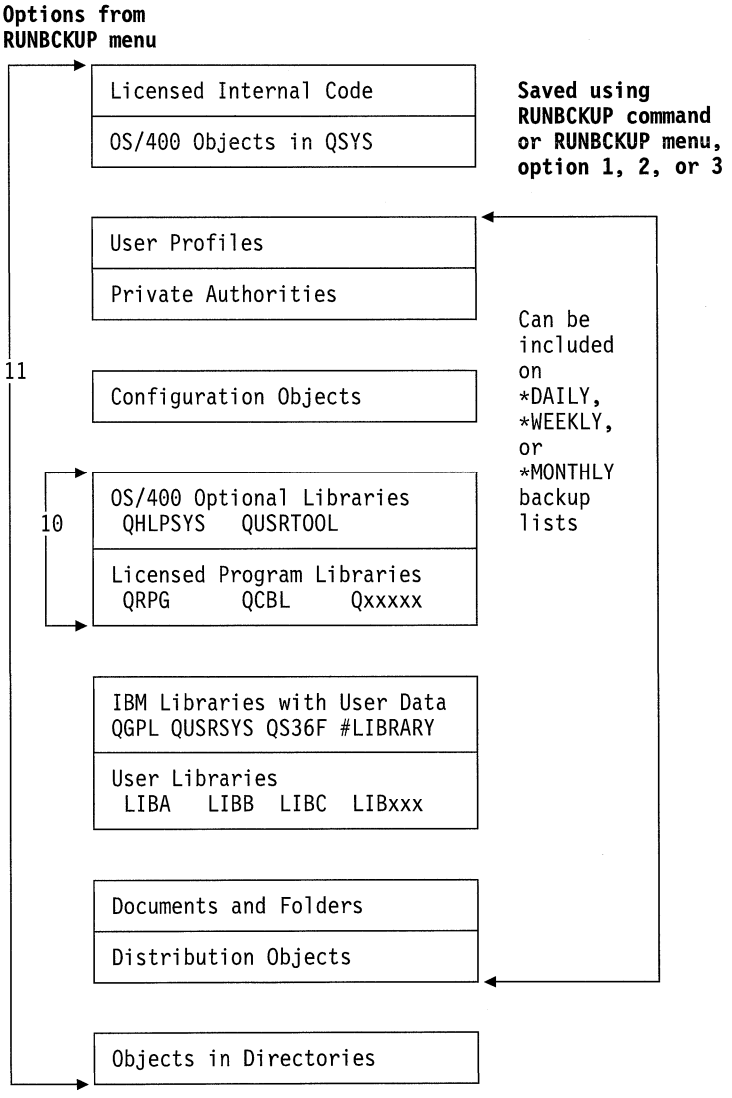


Figure 17-1. How the System Is Saved with Operational Assistant Backup

How to Restore Your Libraries

To recover your entire system, you must restore IBM-supplied libraries and user libraries. To restore IBM-supplied libraries, do the following:

__ **Step 1** Find the tapes that you used most recently to save IBM-supplied libraries. You saved them by using one of these methods:

- Option 10 from the Run Backup menu.
- Option 11 from the Run Backup menu.
- The `SAVLIB LIB(*IBM)` command.
- The `SAVLIB LIB(*NONSYS)` command.
- Option 21 from the Save menu.
- Option 22 from the Save menu.
- Option 41 from the Save menu.

__ **Step 2** Mount the first tape and type: `RSTLIB SAVLIB(*IBM) DEV(TAP01)`. Press the Enter key.

To restore user libraries, do the following:

__ **Step 1** Find the tapes that you used most recently to save all user libraries. You saved them by using one of these methods:

- Option 1, 2, or 3 from the Run Backup menu and specifying `2` (All) for the *User libraries* option.
- Option 11 from the Run Backup menu.
- The `SAVLIB LIB(*ALLUSR)` command.
- The `SAVLIB LIB(*NONSYS)` command.
- Option 21 from the Save menu.
- Option 23 from the Save menu.
- Option 40 from the Save menu.
- Option 42 from the Save menu.

If you are not sure which tapes have your user libraries on them, do the following for each possible tape:

__ **Step a.** Mount the tape.

__ **Step b.** Type `DSPTAP DEV(TAP01)`

__ **Step c.** Page through the displays, looking for the file called QFILE.

__ **Step d.** When you find the tape with the QFILE file on it, write down the sequence number for that file on the tape.

__ **Step e.** Leave the tape in the tape unit and type: `DSPTAP DEV(TAP01) LABEL(QFILE) SEQNBR(`*`sequence-number`*`) DATA(*SAVRST) OUTPUT(*PRINT)`.

__ **Step f.** If the listing contains user libraries, it was created by either the SAVLIB(*NONSYS) command or the SAVLIB(*ALLUSR) command. The libraries from the tape can be restored using the RSTLIB SAVLIB(*ALLUSR) command.

__ **Step 2** Mount the first tape that has user libraries and type: `RSTLIB SAVLIB(*ALLUSR) DEV(TAP01)`. Press the Enter key.

You have now restored all the libraries on your system to the point where they were all saved completely. Return to "Recovering User Information Using Tapes from Operational Assistant Backup–Checklist 21" on page 9-37.

How to Restore Libraries That You Saved by Using a Backup List

This topic describes how to restore libraries that you saved using a backup list, either for daily or weekly backup. It assumes that you save all libraries for your monthly backup. This topic describes how to restore libraries, not changed objects. Use this procedure if all of the following are true:

- You have an Operational Assistant backup that is more recent than the last time you saved the entire system or all libraries.
- You specified `1` (Selected from list) for the *User libraries* option for your Operational Assistant backup.
- You specified `N` (No) for the *Save changed objects only* option for your Operational Assistant backup.

If you have both a weekly and a daily backup that meet these conditions, do the following:

- If your daily backup and weekly backup both save exactly the same libraries from the backup list, perform steps 2 through 4 once, using your most recent set of tapes (daily or weekly).
- If your daily backup saves fewer libraries than your weekly backup, do the following:
  - If your most recent backup is a weekly backup, perform steps 2 through 4 once, using your most recent set of weekly tapes.
  - If your most recent backup is a daily backup, perform steps 2 through 4 once, using your most recent set of weekly tapes. Repeat step 2 through 4, using your most recent set of daily tapes.

__ **Step 1** Mount the first tape.

__ **Step 2** Find the printed copy of the backup list associated with the save tapes. If you have the list, skip to step 4

__ **Step 3** If you do not have the list, display the contents of the save tapes by typing: `DSPTAP DEV(TAP01) OUTPUT(*PRINT) DATA(*SAVRST)`.

__ **Step 4** Use the listing from step 2 or step 3. For each library that was saved, do the following:

__ **Step a.** Type: `RSTLIB SAVLIB(`*`library-name`*`) DEV(TAP01)`.

__ **Step b.** Check off the library name on the list.

Note: Restore the user libraries to each user ASP that you are recovering. If you are restoring the QGPL library and the QUSRSYS library and doing partial recovery, restore these libraries before any other libraries. When recovering the entire system, there is no need to restore QGPL and QUSRSYS libraries first.

How to Restore Changed Objects That You Saved by Using a Operational Assistant

If you save only changed objects for either your weekly or daily backup, use this procedure. If you save changed objects both weekly and daily, use your most recent set of tapes. If you save complete libraries on your weekly backup and changes on your daily backup, perform this procedure only if your daily backup is more recent than your weekly backup.

Do the following:

__ **Step 1** Mount the first tape from your most recent backup of changed objects.

__ **Step 2** Determine if any objects are on the tape for libraries that do not exist on the system:

__ **Step a.** Print a list of libraries on the system by typing: `DSPBCKUPL OUTPUT(*PRINT)`.

__ **Step** **b.** Print the contents of the tape by typing: `DSPTAP DEV(TAP01) OUTPUT(*PRINT) DATA(*SAVRST)`.

__ **Step** **c.** Compare the two lists. Mark any libraries on the DSPTAP listing (from step 2b) that do not appear on the DSPBCKUPL listing (from step 2a on page 17-3).

__ **Step** **d.** For any libraries you marked in step 2c, type the following: `CRTLIB LIB(`*`library-name`*`)`.

__ **Step** **3** Restore the changed objects from the tapes. For each library that appears on the DSPTAP listing (from step 2b), type:

```
RSTOBJ OBJ(*ALL) SAVLIB(library-name)
       OBJTYPE(*ALL) DEV(TAP01)
```

Chapter 18. Restoring the System from the Save Storage Media

When you recover your system from the Save Storage (SAVSTG) media, you reset your system to the point when the SAVSTG procedure was run. Your system will not be available for use until the restore process completes successfully.

If your system has mirrored protection now, when the restore storage procedure runs, your system will not have mirrored protection on any Auxiliary Storage Pool (ASP).

Find These Things Before You Begin

__ The list of all the Licensed Internal Code fixes applied to your system at the time you saved storage. This list should be attached to your backup log or found with the SAVSTG tapes.

__ If you applied any PTFs since the last save storage operation, you will need your most recent cumulative PTF tape.

__ If any hardware on your system has been moved or has been changed since you did the Save Storage (SAVSTG), you will need a recent SAVSYS or SAVCFG tape. The SAVSYS or SAVCFG tape contains configuration information that will have to be restored after the restore storage is completed.

Do These Things Before You Begin:

__ Clean the read and write head of the tape unit.

__ Print a list of all the Licensed Internal Code fixes currently on the system. Type the following and press the Enter key:

```
DSPPTF LICPGM(*ALL) OUTPUT(*PRINT)
```

Task 1–Powering Down the System and Loading the Licensed Internal Code

__ **Step 1** Ensure that all users are off the system.

__ **Step 2** Type the following to power down the system:

```
PWRDWNSYS OPTION(*IMMED)
```

__ **Step 3** Load the first SAVSTG tape in the tape unit that is your alternative IPL device.

__ **Step 4** Install the Licensed Internal Code using the procedure described in "Task 4–Loading the Licensed Internal Code from Media" on page 10-4 and "Loading the Licensed Internal Code" on page 10-5. Select option **2** (Install Licensed Internal Code and Initialize System) from the Install Licensed Internal Code (LIC) display. When the procedure asks for SAVSYS tapes, use your SAVSTG tapes instead.

Task 2–Restoring the Save Storage Tapes

__ **Step 1** When the IPL completes, the IPL or Install the System menu appears.

```
                          IPL or Install the System

Select one of the following:

          1. Perform an IPL
          2. Install the operating system
          3. Use Dedicated Service Tools (DST)
          4. Perform automatic installation of the operating system
          5. Save Licensed Internal Code
```

__ **Step 2** Select option 3 (Use Dedicated Service Tools (DST)) and press the Enter key. The Dedicated Service Tools (DST) Sign On display is shown.

```
                    Dedicated Service Tools (DST) Sign On

Type choice, press Enter.

  DST user . . . . . .  _____
  DST password . . . . .  _____
```

__ **Step 3** Sign on DST with the DST security-level or full-level password. The *Security – Reference* book has more information about DST passwords.

The Use Dedicated Service Tools (DST) menu is shown.

```
                        Use Dedicated Service Tools (DST)

Select one of the following:

          1. Perform an IPL
          2. Install the operating system
          3. Work with licensed internal code
          4. Work with disk units
          5. Work with DST environment
          6. Select DST console mode
          7. Start a service tool
          8. Perform automatic installation of the operating system
          9. Work with save storage and restore storage
         10. Work with remote DST support
```

__ **Step 4** Select option 9 (Work with save storage and restore storage) and press the Enter key.

__ **Step 5** Select option 1 (Restore storage) and press the Enter key. The Specify Volume Identifier display is shown:

```
                          Specify Volume Identifier

Type choice, press Enter.

 Volume identifier . . . . . .  _____
```

__ **Step 6** Type the volume name in the *Volume Identifier* prompt. The volume name is SAVEDS. This is the volume currently loaded. You are shown one of the following displays. Continue with the step indicated:

Display Name	Continue with This Step
Select Tape Unit	Step 7
Device Intervention Required	Step 8 on page 18-3
Confirm Restore Storage	Step 11 on page 18-3

__ **Step 7** If the Select Tape Unit display appears, select the proper unit and press the Enter key.

```
                          Select Tape Unit

Type option, press Enter.
  1=Select

                                          Serial
Option      Type      Model               Number          Resource Name
  _          ___       ___                ________        ____________
  _          ___       ___                ________        ____________
  :
```

Continue with step 11 on page 18-3.

__ **Step 8** If the wrong volume is loaded, the following display appears:

```
                        Device Intervention Required

Device type. . . . . . . . . . . . . . . . . . . . :      ____
Device model . . . . . . . . . . . . . . . . . . . :      ____
   :
If the wrong volume was loaded, type change, press Enter.

Type choice, press enter
  New volume or file  . . . . . . . . . . . . . .      ________________
   :

Wrong volume loaded
```

__ **Step 9** Type the name of the correct volume or file, and press the Enter key. The following display is shown:

```
                        Device Intervention Required

Device type. . . . . . . . . . . . . . . . . . . . :      ____
Device model . . . . . . . . . . . . . . . . . . . :      ____
   :
Type choice, press enter
  Action  . . . . . . . . . . . . . . . . . . . . . 1=Cancel
                                                    ________________
                                                    3=Retry
                                                    ________________
```

__ **Step 10** Select option 3 (Retry), and press the Enter key.

__ **Step 11** There is a delay while the tape is read to determine what has been saved on the tape. The Confirm Restore Storage display is shown.

```
                        Confirm Restore Storage

 Warning: A restore of storage will destroy the current data
 on the system.  The restore will take several minutes for eacj
 unit saved.  An automatic IPL is part of the restore.

 Press F10 to confirm your choice to restore all storage.
 Press F12 to return to change your choice.

            ------ Restore To ------------------      ------ Saved From ---------
                                Serial       Resource       Serial       Resource
 Unit  ASP  Type  Model         Number       Name           Number       Address
    1    1  6602   030          00-0261624   DD003          00-0261624   DD003
    3    5  6602   030          00-0211957   DD002          00-0211957   DD002
   :
```

__ **Step 12** Press F10 (Confirm restore) to confirm. The restore status display on the console continually displays the progress of the restore operation.

```
                            Function Status

You selected to restore storage.



                        51% Complete
                12 pages not readable
```

The display indicates what percent of the total system sectors have been restored. However, this is an estimate and cannot be used to predict how long the entire restore procedure will take.

__ **Step 13** If no errors occur, the system performs a programmed IPL when the restore storage process completes, go to "Task 4–Completing the Restore Storage Operation" on page 18-4 otherwise, continue to "Task 3–Responding to Messages" on page 18-4.

Task 3–Responding to Messages

While you are performing the restore storage operation, you may see the Device Intervention Required display or the Handle Tape Intervention display.

When one of these displays appears, look for messages at the bottom of the display or for an I/O manager code on the display. Respond to the display using the information in Table 18-1:

Table 18-1. Handling Messages When Restoring Storage

Message or Code	Your Action
End of tape encountered. Load next volume.	Load the next tape volume. Select option 3 (Continue), and press the Enter key.
Tape unit not ready	Make the tape unit ready, select option 3 (Continue), and press the Enter key.
Wrong volume loaded	Remove the tape. Load the correct tape. Selection option 3 (Retry) and press the Enter key.

If the tape could not be read because of a media error, the following display is shown:

```
                          Restore Storage

Status of restore . . . . . . . . . . . . . . . :       Ended

A media error was found on tape.

If this is the first time the restore storage has ended because
a media error occurred on this tape, do the following:
 1.  Remove the tape from the tape device.
 2.  Clean the tape path using the cleaning procedure
     described in the tape device operator's guide.
 3.  Press Enter, F3, or F12 to continue.  The system will
     perform an IPL, an then display either the IPL or Install
     the System menu or the Missing Disk Units display.
 4.  Select the option to use Dedicated Service Tools (DST)
 5.  Select the option to Work with Save Storage and Restore
     Storage.
 6.  Select the option Resume restore storage.
 7.  Insert the tape which had the media error into the tape
     device.
 8.  Make the tape device ready, if necessary.
```

Media Error While Restoring?

For information on how to recover, see "Resuming the Restore Storage Operation" on page 18-7.

Task 4–Completing the Restore Storage Operation

__ **Step 1** When the IPL completes after the restore storage operation, the IPL or Install the System menu appears.

```
                          IPL or Install the System

Select one of the following:

          1. Perform an IPL
          2. Install the operating system
          3. Use Dedicated Service Tools (DST)
          4. Perform automatic installation of the operating system
          5. Save Licensed Internal Code
```

__ **Step 2** Perform an attended IPL by selecting the Perform an IPL option.

__ **Step 3** If the following display is shown, disk units have been attached to the system and are in nonconfigured status.

```
                    Add All Disk Units to the System

Select one of the following:

   1. Keep the current disk configuration
   2. Perform disk configuration using DST
   3. Add all disk units to the system auxiliary storage pool
```

Select option 3 (Add all disk units to the system auxiliary storage pool) and press the Enter key.

As the disk units are configured, the following display is shown:

```
  :

          Formatting additional disk units in progress.
                 Seconds running . . . . :  ____

  :
```

Adding disk units takes several minutes. The time it takes depends on the size of each unit and the number of units to be added.

__ **Step 4** The Sign On display appears. Sign on as QSECOFR.

Note: It is important that the following steps are performed so that the device resource names are updated correctly.

__ **Step 5** At the IPL Options display:

a. Set the Start this device only option to Y (yes).
b. Set the Define or change system at IPL option to Y (yes).
c. Select the System value commands option.
d. Select the Change system values option.
e. Ensure that the system value QAUTOCFG is '0' (zero).
f. Ensure that the system value QIPLTYPE is '2'.
g. Press F3 twice to continue the IPL.

Note: As the IPL continues, SRC A900-2000 may appear. See "Recovering from SRC A900 2000" on page 11-15.

__ **Step 6** When the IPL is complete, ensure that the system is in a restricted state. See "Putting Your System in a Restricted State" on page 8-4.

__ **Step 7** You have to restore the configuration of your system. Use the most recent tape that has your saved configuration. If you performed the Restore Storage on the same system that you did the Save Storage (SAVSTG) on, you were instructed to create a SAVCFG tape before the SAVSTG ran. If your system configuration has changed since the Save Storage was performed, use the most recent SAVCFG or SAVSYS tape. If you performed the Restore Storage on a system different than the system the Save Storage (SAVSTG) ran on, use the most recent SAVCFG or SAVSYS tape from the system you restored to. The file on the tape is called QFILETOC.

If you are using a SAVSYS tape, type:

```
RSTCFG OBJ(*ALL) DEV(TAP01) OBJTAPE(*ALL) ENDOPT(*LEAVE)
```

If you are using a SAVCFG tape, type:

```
RSTCFG OBJ(*ALL) DEV(TAP01) OBJTAPE(*ALL) ENDOPT(*UNLOAD)
```

__ **Step 8** Change the system value for QIPLTYPE to the original value. Type:

```
CHGSYSVAL QIPLTYPE '0'
```

__ **Step 9** Change the system value for QAUTOCFG to the original value. Type:

```
CHGSYSVAL QAUTOCFG '1'
```

__ **Step 10** When the Restore Configuration (RSTCFG) command is complete, do a PWRDWNSYS *IMMED RESTART(*YES).

If you have a problem with your devices, such as not being able to vary on a device, see "Recovering Devices That Will Not Vary On" on page 15-6.

When you restore your information to a different system or an upgraded system, you may have a different console type on the target system. See "Recovering When You Change the Console Type" on page 15-7.

__ **Step 11** While the system is IPLing, you may see an error message about the System/36 environment, such as CPF3761. Refer to "Recovering the System/36 Environment Configuration" on page 15-7 for the procedure to follow after you have completed restoring storage.

__ **Step 12** When the IPL completes, the restore history information for data area QSAVSTG in library QSYS is updated to show the date and time of the last restore storage operation. Use the Display Object Description (DSPOBJD) to display the last date and time of the restore storage operation.

__ **Step 13** Use the Display Log (DSPLOG) command to display the QHST log or use the Display Messages (DSPMSG) command to display the QSYSOPR messages. Look at the restore storage message CPC3735 to determine if:

- The system found any sectors that had data that could not be restored. The data may have been unreadable during the Save Storage operation.
- The restore storage process is complete.

__ **Step 14** If you have additional information to restore, such as SAVCHGOBJ tapes or journaled changes to apply, continue with "Task 5–Restoring Additional Information." Otherwise, skip to "Task 6–Restoring Program Temporary Fixes (PTFs)" on page 18-7 .

Task 5–Restoring Additional Information

If you are restoring changed objects, changed DLOs, or changed objects in directories, you must first restore user profiles. This builds the authority information for any new objects that you restore. If you are applying only journaled changes, start with step 4.

__ **Step 1** Sign on as QSECOFR.

__ **Step 2** Put your system in a restricted state. See "Putting Your System in a Restricted State" on page 8-4.

__ **Step 3** Restore user profiles. See "How to Restore User Profiles" on page 15-1.

__ **Step 4** Restore changed objects and apply journaled changes. Follow the instructions in Chapter 16, "Restoring Changed Objects and Applying Journaled Changes" on page 16-1.

__ **Step 5** Restore authority by typing: `RSTAUT`.

Task 6–Restoring Program Temporary Fixes (PTFs)

If you have applied PTFs since your SAVSTG procedure, follow the instructions in "Restoring Program Temporary Fixes" on page 15-28.

Stop!

You have now completed restoring your system from SAVSTG media.

Resuming the Restore Storage Operation

You can use this procedure to resume the restore storage operation that ended before the entire restore operation of the disk unit data was complete.

To start the restore storage operation again, do the following:

__ **Step 1** From the Dedicated Service Tools (DST) menu, select option 9 (Work with save storage and restore storage) and press the Enter key.

__ **Step 2** Select option 2 (Resume restore storage) and press the Enter key.

__ **Step 3** If the following display is shown, load the tape that is indicated and press the Enter key.

```
                          Resume Restore Storage

Do the following:

 1.  Locate the tape to resume the restore on.  The tape
     that was being read when the restore storage was
     interrupted has the following identification:
         Volume identifier  . . . . . :  _______
         Sequence number  . . . . . . :  ___
 2.  Insert the tape in the tape device.
 3.  Make the tape device ready, if necessary.

Note:
  If the restore storage was interrupted because of a media
  error on a tape, you may want to resume the restore
  storage on the tape following the failing tape.  If you
  resume the restore storage on that tape, the system will
  have damaged objects, and the system might not be able to
  perform and IPL to OS/400 when the restore storage is complete.

Press Enter to continue.
```

__ **Step 4** If the wrong volume is loaded, you are shown the Device Intervention Required display with a message at the bottom. Type the name of the correct volume or file, and press the Enter key.

__ **Step 5** The restore storage operation starts again.

If the restore storage operation continues to fail on the same tape with a tape media failure, you have three options:

- Use a previous copy of your save storage tapes to completely restore storage.
- Resume the restore storage operation using the tape following the tape with the media error. If the tape that has the media error is the last tape to restore in the set, option 3 (Force end of an interrupted restore storage) on the Restore Storage menu should be selected.

  Attention! Some disk unit data is not restored. There may also be many objects damaged on the system when the restore operation completes. An initial program load of the operating system may not be successful. You should restore the operating system again.
- Initialize your system and then begin a restore of your system from tapes created using SAVSYS and SAVLIB commands or options from the Save menu.

- Use a previous copy of your save storage tapes to completely restore storage.

Supplemental Information

Appendix A. Licensed Internal Code Installation Error Screens

One of the following three screens may be displayed if you chose option 1 (restore) on the install selection menu and the selected disk is not currently a load source disk. In this case, the restore cannot be done. If the selected disk is the correct one to install to, return to the selection menu and choose the correct install option 2, 3, 4, or 5 to initialize the disk and perform an installation. If the selected disk is not the correct one, or if an existing load source disk should have been found, follow the appropriate procedures to determine why the correct disk did not report in, or was not recognized.

If there is information about a missing disk(s) (second or third of the following three screens), it indicates what the last load source disk was on this system. If that disk should still exist (it has not been removed or replaced), determine why it was not found. If that disk has been removed or replaced, then this is just informational and may not indicate an error.

```
                Restore Licensed Internal Code

Disk selected to write the Licensed Internal Code to:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       _____

The disk selected has not previously been a load source.  The
restore of the Licensed Internal Code cannot be done.


Press Enter to return to the Install Licensed Internal Code
screen.
```

```
                Restore Licensed Internal Code

Disk selected to write the Licensed Internal Code to:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       _____

   The load source disk could not be found (see disk information
   below).


Missing load source disk:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       _____

The disk selected has not previously been a load source.  The
restore of the Licensed Internal Code cannot be done.


Press Enter to return to the Install Licensed Internal Code
screen.
```

```
                Restore Licensed Internal Code

Disk selected to write the Licensed Internal Code to:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       _____

   The load source disk and its mirrored pair could not be found
   (see disk information below).


Missing load source disk:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       _____
  _____________   ____   ____    _____     _____       _____

The disk selected has not previously been a load source.  The
restore of the Licensed Internal Code cannot be done.


Press Enter to return to the Install Licensed Internal Code
screen.
```

The following screen can be displayed if you chose option 1 (restore) on the install selection menu, but the release level of the Licensed Internal Code on the install media cannot be restored over the current release level on disk. Verify that you have the correct install media (version/release/modification level). If the level is correct, then you must do an initialize and install to get the new LIC installed over the existing LIC on the disk.

```
                Restore Licensed Internal Code

Disk selected to write the Licensed Internal Code to:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       _____

The release level of the Licensed Internal Code on the distribution
media cannot be restored over the existing release level on the
selected disk.


Press Enter to return to the Install Licensed Internal Code
screen.
```

The following screen can be displayed if you chose option 1 (restore) on the install selection menu and the selected disk is currently a load source disk, but the pertinent data on the disk cannot be read and, therefore, a restore cannot be done. You must do an initialize and installation to install the new LIC on this disk.

```
                Restore Licensed Internal Code

Disk selected to write the Licensed Internal Code to:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       _____

The selected disk cannot be read.  The restore of the Licensed
Internal Code cannot be done.


Press Enter to return to the Install Licensed Internal Code
screen.
```

The following screen can be displayed if two load source disks are detected on your system. The *best* disk was selected for the restore or installation. The data about the other disk is informational so you can verify that the correct disk was selected. If the correct disk was not selected, follow the appropriate procedures to disable or remove the selected disk, so that the other disk is selected when you rerun the task.

```
                Install Licensed Internal Code - Warning

Disk selected to write the Licensed Internal Code to:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       ____

Warning:
    Another load source disk has also been found on this system.
    If you continue the restore or install, the disk listed
    above will be used.


Additional load source disk:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       ____

Press Enter to continue the restore or install on the selected
disk.
```

The following screen is displayed if mirroring is active but one disk of the load source mirrored pair cannot be found. The restore or installation can still continue on the selected disk, but will not be mirrored until the missing disk becomes again active. You may want to follow the appropriate procedures to determine why one of the disks were not found.

```
                Install Licensed Internal Code - Warning

Disk selected to write the Licensed Internal Code to:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       ____

Warning:
    The mirrored unit for this load source was not found (see
    disk information below).  The restore or install can continue
    on the selected load source.  The missing mirrored unit will
    be suspended when the restore or install is complete.


Missing load source disk:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       ____

Press Enter to continue the restore or install on the selected
disk.
```

The following two screens are displayed if the disk selected for the install to is not the same disk that was previously the load source on this system. If the missing disk should still exist (it has not been removed or replaced), determine why it was not found. If the disk was removed or replaced, this data is just informational and may not indicate an error.

```
                Install Licensed Internal Code - Warning

Disk selected to write the Licensed Internal Code to:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       ____

Warning:
    The load source disk could not be found (see disk information
    below).


Missing load source disk:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       ____

Press Enter to continue the initialize and install on the
selected disk.
```

```
                Install Licensed Internal Code - Warning

Disk selected to write the Licensed Internal Code to:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       ____

Warning:
    The load source disk and its mirrored pair could not be found
    (see disk information below).


Missing load source disk:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       ____
  _____________   ____   ____    _____     _____       ____

Press Enter to continue the initialize and install on the
selected disk.
```

The following screen is displayed if mirroring is active and the active load source disk can not be found. One unit of the load source mirrored pair was found but is not currently active. You can install to it, but you will not be allowed to IPL past DST with it. You may want to follow the appropriate procedures to determine why the active load source disk can not be found.

```
                Install Licensed Internal Code - Warning

Disk selected to write the Licensed Internal Code to:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       ____

Warning:
    A load source disk could not be found (see disk information
    below).
    The disk selected to be the load source (see above) is
    suspended.  You may install to it and perform an IPL from it to
    get to DST and perform DASD diagnostics.  However, you will not
    be able to perform an IPL past DST with it.


Missing load source disk:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       ____

Press Enter to continue the restore or install on the selected
disk.
```

One of the following three screens is displayed if no disk can be found. That is, no disk reported in, or was recognized by the system.

If information is supplied about a missing disk(s) (second and third of the three screens), it indicates what was the last load source disk on this system. If that disk should still exist (it has not been removed or replaced), then determine why it was not found. If that disk has been removed or replaced, then this data is just informational and may not be the reason for the error.

```
                    Install Licensed Internal Code - Error

Error:
    A disk could not be selected to be the load source.
    You can return to the Dedicated Service Tools display and
    run diagnostics to determine why a disk could not be
    selected.

    Correct the problem and install the Licensed Internal Code
    again.


Press Enter to return to the Dedicated Service Tools display.
```

```
                    Install Licensed Internal Code - Error

Error:
    The load source disk could not be found (see disk information
    below).

Missing load source disk:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       _____

    A disk could not be selected to be the load source.
    You can return to the Dedicated Service Tools display and
    run diagnostics to determine why a disk could not be
    selected.

    Correct the problem and install the Licensed Internal Code
    again.


Press Enter to return to the Dedicated Service Tools display.
```

```
                    Install Licensed Internal Code - Error

Error:
    The load source disk and its mirrored pair could not be found
    (see disk information below).

Missing load source disk:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       _____
  _____________   ____   ____    _____     _____       _____

    A disk could not be selected to be the load source.
    You can return to the Dedicated Service Tools display and
    run diagnostics to determine why a disk could not be
    selected.

    Correct the problem and install the Licensed Internal Code
    again.

Press Enter to return to the Dedicated Service Tools display.
```

One of the following two screens is displayed if a disk is found, but it is not at a valid address to be the load source.

If there is information about a missing disk(s) (the second screen), it indicates what the last load source disk was on this system. If that disk should still exist (it has not been removed or replaced), determine why it was not found. If it has been removed or replaced, this is just informational and may not be the reason for the error.

```
                    Install Licensed Internal Code - Error

Error:
    A disk was found, but it is not at a valid address to be the
    load source device.

Selected disk:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       _____


The install cannot be done.  Press Enter to return to the Dedicated
Service Tools display.
```

```
                    Install Licensed Internal Code - Error

Error:
    A disk was found, but it is not at a valid address to be the
    load source device.

Selected disk:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       _____

The following disk was a load source previously, but could not be
found.

Missing load source disk:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       _____


The install cannot be done.  Press Enter to return to the Dedicated
Service Tools display.
```

The following screen is displayed if an existing load source disk is found, but is not at a valid address to be the load source. If it was intentionally moved, determine why no other disk could be found to which to install. If this is the correct disk, determine why it is not at a valid address.

```
                    Install Licensed Internal Code - Error

Error:
    The following disk was a load source previously, but it is not
    currently at a valid address to be the load source device.

Selected disk:
  Serial Number   Type   Model   I/O Bus   Controller  Device
  _____________   ____   ____    _____     _____       _____


The install cannot be done.  Press Enter to return to the Dedicated
Service Tools display.
```

The following screen is displayed if an existing load source disk was found and:

- Is not at a valid address to be the load source.
- Is one unit of a mirrored pair.
- Is currently not the active load source.

Information about the previously active load source is also listed. If this load source should still be available to install to, use the appropriate procedures to determine why it could not be found.

```
                    Install Licensed Internal Code - Error

Error:
    The following disk was a load source, but it is not currently
    active, and it is not at a valid address to be the load source
    device.

Selected disk:
  Serial Number   Type   Model   I/O Bus   Controller  Device
    _________      ____    ___    ____       ____        ____

The following disk was the previously active load source, but it
could not be found.

Missing load source disk:
  Serial Number   Type   Model   I/O Bus   Controller  Device
    _________      ____    ___    ____       ____        ____

The install cannot be done.  Press Enter to return to the Dedicated
Service Tools display.
```

Appendix B. Example Disaster Recovery Plan

The objective of a disaster recovery plan is to ensure that you can respond to a disaster or other emergency that affects information systems and minimize the effect on the operation of the business. This topic provides you with guidelines for the kind of information and procedures that you need to recover from a disaster. When you have prepared the information described in this topic, store your document in a safe, accessible location off site.

Section 1. Major Goals of a Disaster Recovery Plan–Example

The major goals of this plan are the following:

- To minimize interruptions to the normal operations.
- To limit the extent of disruption and damage.
- To minimize the economic impact of the interruption.
- To establish alternative means of operation in advance.
- To train personnel with emergency procedures.
- To provide for smooth and rapid restoration of service.

Section 2. Personnel–Example

Data Processing Personnel			
Name	**Position**	**Address**	**Telephone**

User Personnel			
Name	**Position**	**Address**	**Telephone**

Other Important Telephone Numbers			
Name	**Position**	**Address**	**Telephone**

Organization Chart

Include a copy of the organization chart with your plan.

Section 3. Application Profile–Example

Use the Display Software Resources (DSPSFWRSC) command to complete this table.

Application Profile				
Application Name	**Critical Yes / No**	**Fixed Asset Yes / No**	**Manufacturer**	**Comments**

Comment Legend:

1. Runs daily.
2. Runs weekly on _____.
3. Runs monthly on _____.

Section 4. Inventory Profile–Example

Use the Work with Hardware Products (WRKHDWPRD) command to complete this table:

Inventory Profile					
Manufacturer	**Description**	**Model**	**Serial Number**	**Own or Leased**	**Cost**

Notes:

1. This list should be audited every _____ months.

2. This list should include:

Processing units	System printer
Disk units	Tape and diskette units
Models	Controllers
Workstation controllers	I/O processors
Personal computers	General data communication
Spare workstations	Spare displays
Telephones	Racks
Air conditioner or heater	Humidifier or dehumidifier

Miscellaneous Inventory		
Description	**Quantity**	**Comments**

Note:

This list should include:

Tapes	Diskettes
PC software (such as DOS)	Emulation packages
File cabinet contents or documentation	Language software (such as COBOL for OS/400 and RPG for OS/400)
Tape vault contents	Printer supplies (such as paper and forms)

Section 5. Information Services Backup Procedures

- AS/400 System
  - Daily, journals receivers are changed at _____ and at _____ .
  - Daily, a save of changes objects in the following libraries is done at _____ :
    - _____
    - _____
    - _____
    - _____
    - _____
    - _____
    - _____
    - _____

    This procedure also saves the journals and journal receivers.
  - On _____ at _____ a complete save of the system is done.
  - All save media is stored off-site in a vault at _____ location.
- Personal Computer
  - It is recommended that all personal computers be backed up. Copies of the personal computer files should be uploaded to the AS/400 on _____ (date) at _____ (time), just before a complete save of the system is done. It is then saved with the normal system save procedure. This provides for a more secure backup of personal computer-related systems where a local area disaster could wipe out important personal computer systems.

Section 6. Disaster Recovery Procedures

For any disaster recovery plan, the following three elements should be addressed.

Emergency Response Procedures

To document the appropriate emergency response to a fire, natural disaster, or any other activity in order to protect lives and limit damage.

Backup Operations Procedures

To ensure that essential data processing operational tasks can be conducted after the disruption.

Recovery Actions Procedures

To facilitate the rapid restoration of a data processing system following a disaster.

Disaster Action Checklist

1. Plan Initiation
   a. Notify senior management
   b. Contact and set up disaster recovery team
   c. Determine degree of disaster
   d. Implement proper application recovery plan dependent on extent of disaster (see "Section 7. Recovery Plan–Mobile Site")
   e. Monitor progress
   f. Contact backup site and establish schedules
   g. Contact all other necessary personnel—both user and data processing
   h. Contact vendors—both hardware and software
   i. Notify users of the disruption of service
2. Follow-Up Checklist
   a. List teams and tasks of each
   b. Obtain emergency cash and set up transportation to and from backup site, if necessary
   c. Set up living quarters, if necessary
   d. Set up eating establishments, as required
   e. List all personnel and their telephone numbers
   f. Establish user participation plan
   g. Set up the delivery and the receipt of mail
   h. Establish emergency office supplies
   i. Rent or purchase equipment, as needed
   j. Determine applications to be run and in what sequence
   k. Identify number of workstations needed
   l. Check out any off-line equipment needs for each application
   m. Check on forms needed for each application
   n. Check all data being taken to backup site before leaving and leave inventory profile at home location
   o. Set up primary vendors for assistance with problems incurred during emergency
   p. Plan for transportation of any additional items needed at backup site
   q. Take directions (map) to backup site
   r. Check for additional magnetic tapes, if required
   s. Take copies of system and operational documentation and procedural manuals.
   t. Ensure that all personnel involved know their tasks
   u. Notify insurance companies

Recovery Start-Up Procedures for Use after Actual Disaster

1. Notify _____ Disaster Recovery Services of the need to utilize service and of recovery plan selection.

   Note: Guaranteed delivery time countdown begins at the time _____ is notified of recovery plan selection.

   a. Disaster notification numbers

      _____ or _____

      These telephone numbers are in service from _____ am until _____ pm Monday through Friday.

   b. Disaster notification number

      _____

This telephone number is in service for disaster notification after business hours, on weekends, and during holidays. Please use this number only for the notification of the actual disaster.

2. Provide _____ with an equipment delivery site address (when applicable), a contact, and an alternate contact for coordinating service and telephone numbers at which contacts can be reached 24 hours a day.
3. Contact power and telephone service suppliers and schedule any necessary service connections.
4. Notify _____ immediately if any related plans should change.

Section 7. Recovery Plan–Mobile Site

1. Notify _____ of the nature of the disaster and the need to select the mobile site plan.
2. Confirm in writing the substance of the telephone notification to _____ within 48 hours of the telephone notification.
3. Confirm all needed backup media are available to load the backup machine.
4. Prepare a purchase order to cover the use of backup equipment.
5. Notify _____ of plans for a trailer and its placement (on _____ side of _____). (See "Mobile Site Setup Plan" on page B-6.)
6. Depending on communication needs, notify telephone company (_____) of possible emergency line changes.
7. Begin setting up power and communications at _____.
   a. Power and communications are prearranged to hook into when trailer arrives.
   b. At the point where telephone lines come into the building (_____), break the current linkage to the administration controllers (_____). These lines are rerouted to lines going to the mobile site. They are linked to modems at the mobile site.

      The lines currently going from _____ to _____ would then be linked to the mobile unit via modems.
   c. This could conceivably require _____ to redirect lines at _____ complex to a more secure area in case of disaster.
8. When the trailer arrives, plug into power and do necessary checks.
9. Plug into the communications lines and do necessary checks.
10. Begin loading system from backups (see "Section 9. Restoring the Entire System" on page B-7).
11. Begin normal operations as soon as possible:
    a. Daily jobs
    b. Daily saves
    c. Weekly saves
12. Plan a schedule to back up the system in order to restore on a home-base computer when a site is available. (Use regular system backup procedures).
13. Secure mobile site and distribute keys as required.
14. Keep a maintenance log on mobile equipment.

Mobile Site Setup Plan

Attach the mobile site setup plan here.

Communication Disaster Plan

Attach the communication disaster plan, including the wiring diagrams.

Electrical Service

Attach the electrical service diagram here.

Section 8. Recovery Plan–Hot Site

The disaster recovery service provides an alternate hot site. The site has a backup system for temporary use while the home site is being reestablished.

1. Notify _____ of the nature of the disaster and of its desire for a hot site.
2. Request air shipment of modems to _____ for communications. (See _____ for communications for the hot site.)
3. Confirm in writing the telephone notification to _____ within 48 hours of the telephone notification.
4. Begin making necessary travel arrangements to the site for the operations team.
5. Confirm that all needed tapes are available and packed for shipment to restore on the backup system.
6. Prepare a purchase order to cover the use of the backup system.
7. Review the checklist for all necessary materials before departing to the hot site.
8. Make sure that the disaster recovery team at the disaster site has the necessary information to begin restoring the site. (See "Section 12. Disaster Site Rebuilding" on page B-9).
9. Provide for travel expenses (cash advance).
10. After arriving at the hot site, contact home base to establish communications procedures.
11. Review materials brought to the hot site for completeness.
12. Begin loading the system from the save tapes.
13. Begin normal operations as soon as possible:
    a. Daily jobs
    b. Daily saves
    c. Weekly saves
14. Plan the schedule to back up the hot-site system in order to restore on the home-base computer.

Hot-Site System Configuration

Attach the hot-site system configuration here.

Section 9. Restoring the Entire System

To get your system back to the way it was before the disaster, use the procedures in "Recovering after a Complete System Loss–Checklist 17" on page 9-28.

Before You Begin: Find the following tapes, equipment, and information from the on-site tape vault or the off-site storage location:

___ The model-unique Licensed Internal Code tape or the feature-unique Licensed Internal Code tape, if you are restoring to the same system

___ All tapes from the most recent complete save operation

___ The most recent tapes from saving security data (SAVSECDTA or SAVSYS)

___ The most recent tapes from saving your configuration, if necessary

___ All tapes containing journals and journal receivers saved since the most recent daily save operation

___ All tapes from the most recent daily save operation

___ PTF list (stored with the most recent complete save tapes, weekly save tapes, or both)

___ Tape list from most recent complete save operation

___ Tape list from most recent weekly save operation

___ Tape list from daily saves

___ History log from the most recent complete save operation

___ History log from the most recent weekly save operation

___ History log from the daily save operations

___ The *Software Installation* book

___ The *System Startup and Problem Handling* book

___ The *Backup and Recovery – Basic* book

___ Telephone directory

___ Modem manual

___ Tool kit

Section 10. Rebuilding Process

The management team must assess the damage and begin the reconstruction of a new data center.

If the original site must be restored or replaced, the following are some of the factors to consider:

- What is the projected availability of all needed computer equipment?
- Will it be more effective and efficient to upgrade the computer systems with newer equipment?
- What is the estimated time needed for repairs or construction of the data site?
- Is there an alternative site that more readily could be upgraded for computer purposes?

Once the decision to rebuild the data center has been made, go to "Section 12. Disaster Site Rebuilding" on page B-9.

Section 11. Testing the Disaster Recovery Plan

In successful contingency planning, it is important to test and evaluate the plan regularly. Data processing operations are volatile in nature, resulting in frequent changes to equipment, programs, and documentation. These actions make it critical to consider the plan as a changing document.

Table B-1 should be helpful for conducting a recovery test.

Table B-1 (Page 1 of 2). Checklist for Testing the Disaster Recovery Plan

Item	Yes	No	Appli-cable	Not Appli-cable	Com-ments
Conducting a Recovery Test					
1. Select the purpose of the test. What aspects of the plan are being evaluated?					
2. Describe the objectives of the test. How will you measure successful achievement of the objectives?					
3. Meet with management and explain the test and objectives. Gain their agreement and support.					
4. Have management announce the test and the expected completion time.					
5. Collect test results at the end of the test period.					
6. Evaluate results. Was recovery successful? Why or why not?					
7. Determine the implications of the test results. Does successful recovery in a simple case imply successful recovery for all critical jobs in the tolerable outage period?					
8. Make recommendations for changes. Call for responses by a given date.					
9. Notify other areas of results. Include users and auditors.					
10. Change the disaster recovery plan manual as necessary.					
Areas to be Tested					
1. Recovery of individual application systems by using files and documentation stored off-site.					
2. Ability to process on a different computer.					
3. Reloading of system tapes and performing an IPL by using files and documentation stored off-site.					
4. Ability of management to determine priority of systems with limited processing.					
5. Ability to recover and process successfully without key people.					
6. Ability of the plan to clarify areas of responsibility and the chain of command.					
7. Effectiveness of security measures and security bypass procedures during the recovery period.					
8. Ability to accomplish emergency evacuation and basic first-aid responses.					
9. Ability of users of real-time systems to cope with a temporary loss of on-line information.					
10. Ability of users to continue day-to-day operations without applications or jobs that are considered noncritical.					
11. Ability to contact the key people or their designated alternates quickly.					
12. Ability of data entry personnel to provide the input to critical systems by using alternate sites and different input media.					
13. Availability of peripheral equipment and processing, such as printers and scanners.					

Table B-1 (Page 2 of 2). Checklist for Testing the Disaster Recovery Plan

Item	Yes	No	Appli-cable	Not Appli-cable	Com-ments
14. Availability of support equipment, such as air conditioners and dehumidifiers. 15. Availability of support: supplies, transportation, communication. 16. Distribution of output produced at the recovery site. 17. Availability of important forms and paper stock. 18. Ability to adapt plan to lesser disasters.					

Section 12. Disaster Site Rebuilding

- Floor plan of data center.
- Determine current hardware needs and possible alternatives. (See "Section 4. Inventory Profile–Example" on page B-2.)
- Data center square footage, power requirements and security requirements.
  - Square footage _____
  - Power requirements _____
  - Security requirements: locked area, preferably with combination lock on one door.
  - Floor-to-ceiling studding
  - Detectors for high temperature, water, smoke, fire and motion
  - Raised floor

Vendors

-
-
-
-
-

Floor Plan

Include a copy of the proposed floor plan here.

Section 12. Record of Plan Changes

Keep your plan current. Keep records of changes to your configuration, your applications, and your backup schedules and procedures. For example, you can get print a list of your current local hardware, by typing:

```
DSPLCLHDW OUTPUT(*PRINT)
```

Appendix C. How to Save Object Types–Summary

Table C-1 summarizes how objects of each type can be saved. It includes the variable specified on the object type (OBJTYPE) parameter and shows which commands can be used to save each object type. An X appears in the column for the SAV command if an object of that type can be saved individually by using the SAV command. When you specify SAV OBJ(/*), all objects of all types are saved.

Table C-1 (Page 1 of 3). Objects Saved by Commands According to Object Type

		SAVxxx Command:						
Object Type	**System Object Type**	**OBJ**	**LIB**	**SEC DTA**	**SYS**	**CFG**	**DLO**	**SAV**
Alert table	*ALRTBL	X	X					X
Authority holder	*AUTHLR			X[6]	X[6]			
Authorization list	*AUTL			X[6]	X[6]			
Bind directory	*BNDDIR	X	X					X
C locale description	*CLD	X	X		X[1]			X
Chart format	*CHTFMT	X	X		X[1]			X
Change request descriptor	*CRQD	X	X					X
Class	*CLS	X	X		X[1]			X
Class-of-service description	*COSD				X[3]	X		
Command definition	*CMD	X	X		X[1]			X
Communications side information	*CSI	X	X		X[1]			X
Configuration list[3,4]	*CFGL				X	X		
Connection list[3]	*CNNL				X[3]	X		
Controller description	*CTLD				X[3]	X		
Cross-system product map	*CSPMAP	X	X		X[1]			X
Cross-system product table	*CSPTBL	X	X		X[1]			X
Data area	*DTAARA	X	X		X[1]			X
Data queue[2]	*DTAQ	X	X		X[1]			X
Data dictionary	*DTADCT		X					X
Device description	*DEVD				X[3]	X		
Directory	*DIR							X
Distributed directory	*DDIR							X
Distributed stream file	*DSTMF							X
Distributions	*MAIL[8]						X	
Document	*DOC						X	X
Double-byte character set dictionary	*IGCDCT	X	X		X[1]			X
Double-byte character set sort table	*IGCSRT	X	X		X[1]			X
Double-byte character set font table	*IGCTBL	X	X		X[1]			X
Edit description[4]	*EDTD	X	X		X			X
Exit registration	*EXITRG	X	X		X			X
File[2,5]	*FILE	X	X		X[1,7]			X
Filter	*FTR	X	X		X[1,7]			X
Folder	*FLR						X	X
Font resource	*FNTRSC	X	X		X[1]			X
Forms control table	*FCT	X	X		X[1]			X
Forms definition	*FORMDF	X	X		X[1]			X

Table C-1 (Page 2 of 3). Objects Saved by Commands According to Object Type

Object Type	System Object Type	SAVxxx Command: OBJ	LIB	SEC DTA	SYS	CFG	DLO	SAV
Graphics symbol set	*GSS	X	X		X[1]			X
Internet packet exchange description	*IPXD				X	X[3]		
Job description	*JOBD	X	X		X[1]			X
Job queue[2]	*JOBQ	X	X		X[1]			X
Job scheduler	*JOBSCD	X	X		X[1]			X
Journal[2]	*JRN	X	X		X[1]			X
Journal receiver	*JRNRCV	X	X		X[1]			X
Library [9]	*LIB		X[7]					X
Line description	*LIND				X[3]	X		
Locale	*LOCALE	X	X		X[1]			X
Menu	*MENU	X	X		X[1]			X
Message file	*MSGF	X	X		X[1]			X
Message queue[2]	*MSGQ	X	X		X[1]			X
Mode description	*MODD				X[3]	X		
Module	*MODULE	X	X					X
AS/400 Advanced 36 machine	*M36	X	X		X[1]			X
AS/400 Advanced 36 machine configuration	*M36CFG	X	X		X[1]			X
NetBIOS description	*NTBD				X[3]	X		
Network interface description	*NWID				X[3]	X		
Network server description	*NWSD				X[3]	X		
Node list	*NODL	X	X					X
Object reference table	*ORTABLE	X	X		X[1]			X
Output queue[2]	*OUTQ	X	X					X
Overlay	*OVL	X	X		X[1]			X
Page definition	*PAGDFN	X	X		X[1]			X
Page segment	*PAGSEG	X	X		X[1]			X
Panel group	*PNLGRP	X	X		X[1]			X
Printer description group	*PDG	X	X		X[1]			X
Product availability	*PRDAVL	X	X		X[1]			X
Program	*PGM	X	X		X[1]			X
PSF configuration object	*PSFCFG	X	X		X[1]			X
Query definition	*QRYDFN	X	X		X[1]			X
Query form	*QMFORM	X	X		X[1]			X
Query manager query	*QMQRY	X	X		X[1]			X
Reference code translation table	*RCT	X	X		X[1]			X
System/36 machine description	*S36	X	X		X[1]			X
Search index	*SCHIDX	X	X		X[1]			X
Server storage	*SVRSTG	X	X					X
Service program	*SRVPGM	X	X					X
Session description	*SSND	X	X		X[1]			X
Socket	*SOCKET	X	X		X			X
Spelling help dictionary	*SPADCT	X	X		X[1]			X
SQL package	*SQLPKG	X	X		X			X
Stream file	*STMF							X

Table C-1 (Page 3 of 3). Objects Saved by Commands According to Object Type

Object Type	System Object Type	SAVxxx Command: OBJ	LIB	SEC DTA	SYS	CFG	DLO	SAV
Subsystem description	*SBSD	X	X		X[1]			X
Symbolic link	*SYMLINK							X
System object model object	*SOMOBJ							X
System resource management data	*SRMDATA[8]				X[1]	X		
Table	*TBL	X	X		X[1]			X
User index	*USRIDX	X	X		X[1]			X
User profile	*USRPRF			X[6]	X[6]			
User queue	*USRQ	X	X		X[1]			X
User space	*USRSPC	X	X		X[1]			X
Workstation customization	*WSCST	X	X					X

Notes:

1 If the object is in library QSYS.

2 For save files, only descriptions are saved when SAVFDTA(*NO) is specified on the save command. For other objects that have only their descriptions saved, see Table 5-2 on page 5-3.

3 These are restored using the RSTCFG command.

4 Edit descriptions and configuration lists reside only in library QSYS.

5 The SAVSAVFDTA command saves only the contents of save files.

6 User profiles are restored using the RSTUSRPRF command. Authorities are restored using the RSTAUT command after needed objects are restored. Authorization lists and authority holders are restored when RSTUSRPRF USRPRF(*ALL) is specified.

7 If there are save files in the library, the save file data is saved by default.

8 Mail and SRM data consists of internal object types.

9 Table 5-1 on page 5-1 shows which IBM-supplied libraries cannot be saved with the SAVLIB command.

Appendix D. Procedures for Recovering the Text Index

Table D-1 shows problems that can occur with the text-index database files and associated libraries. The table also provides solutions and procedures to correct the problems.

Table D-1 (Page 1 of 2). Recovery for Search Index Services Files

Problem and Cause	Solution	Procedure
Problem: All text index files are gone. Cause: Library QUSRSYS was cleared or deleted[1].	Restore all files from save media. After the restore operation is complete, run the reclaim operation[2,3]. After the reclaim operation is complete, start updating index requests.	1. RSTLIB SAVLIB(QUSRSYS) 2. RCLDLO DLO(*ALL) 3. STRUPDIDX
Problem: The scheduling queue file is not usable. Cause: Scheduling queue was damaged or deleted.	Restore the scheduling queue file and optionally clear the scheduling queue.	1. RSTOBJ OBJ(QABBIQTB) SAVLIB(QUSRSYS) 2. WRKTXTIDX 3. Select option 2 (Change details) on the index that has the scheduling queue to be cleared. 4. Under the clear parameter, select a *Y* to clear the scheduling queue.
Problem: The text index files are usable. Their content is not usable. Cause: Text index files that were not all saved at the same time were restored.	Delete all the text index files from QUSRSYS and then restore all the files from save media[4]. After the restore operation is complete, run the reclaim operation[2,3]. After the reclaim operation is complete, start updating index requests.	1. DLTF OBJ(QABB*) LIB(QUSRSYS) 2. RSTOBJ OBJ(QABB*) SAVLIB(QUSRSYS) 3. RCLDLO DLO(*ALL) 4. STRUPDIDX
Problem: The document library and text index files are lost. Cause: A disk unit failure occurred that resulted in data loss on the system ASP, or function code 24 was selected to install the Licensed Internal Code.	Restore text index files and then the document library[5]. See cases 1 through 4 in Table D-2 on page D-3 about the types of index request created when using the RSTDLO command.	See Table 9-1 on page 9-3 for the procedure to restore the system ASP. The procedure restores QUSRSYS (text index files) and documents.
Problem: The document library is lost. The text index files are not lost. Cause: Library QDOC or library QDOCnnnn was cleared or deleted.	Clear the scheduling queue[6], restore the document library and start updating index requests. After the update operation has completed[7], you may optionally want to run the reclaim operation, and then start updating index requests again[2]. See Table D-2 on page D-3 for rules about the types of index request created when using the RSTDLO command.	1. WRKTXTIDX 2. Select option 2 (Change details) on the index that has the scheduling queue to be cleared. 3. Under the clear parameter, select a *Y* to clear the scheduling queue. 4. RSTDLO DLO(*ALL) SAVFLR(*ANY) 5. STRUPDIDX 6. RCLDLO DLO(*ALL) 7. STRUPDIDX
Problem: One or more documents are lost. Cause: One or more documents were damaged or deleted.	Start updating index requests[6]. After the update operation has completed[8], restore the lost documents. Start updating index requests again. See cases 1 through 4 in Table D-2 on page D-3 about the types of index requests created when using the RSTDLO command.	1. STRUPDIDX 2. RSTDLO DLO(document-name SAVFLR(folder-name) 3. STRUPDIDX

Table D-1 (Page 2 of 2). Recovery for Search Index Services Files

Problem and Cause	Solution	Procedure
Problem: One or more text index files are lost. Cause: One or more QABB* files (except (QABBIQTB)) were damaged or deleted. Library QDOC is not lost.	Create a save file for the undamaged scheduling queue. Save the scheduling queue to the save file. Delete all the text index files from QUSRSYS. Restore all the files from save media[5]. Delete the restored scheduling queue and then restore it from the save file[5]. After the restore operation is complete, run the reclaim operation[2,3]. When the reclaim operation is complete, start updating text index requests. When the update index requests are complete, delete the save file.	1. CRTSAVF FILE(QUSRSYS/SAVTXTQ) TEXT('Save of Text Search Scheduling Queue') 2. SAVOBJ OBJ(QABBIQTB) LIB(QUSRSYS) DEV(*SAVF) SAVF(QUSRSYS/SAVTXTQ) ACCPTH(*YES) 3. DLTF FILE(QUSRSYS/QABB*) 4. RSTOBJ OBJ(QABB*) SAVLIB(QUSRSYS) 5. DLTF FILE(QUSRSYS/QABBIQTB) 6. RSTOBJ OBJ(QABBIQTB) SAVLIB(QUSRSYS) DEV(*SAVF) SAVF(QUSRSYS/SAVTXTQ) 7. RCLDLO DLO(*ALL) 8. STRUPDIDX 9. DLTF FILE(QUSRSYS/SAVTXTQ)
Problem: The last-version index dates for documents do not match, or documents you expected to find in a search are not found. Cause: STRUPDIDX command was interrupted, encountered errors, or was not started.	Start updating index requests[6]. After the update operation has completed[7], run the reclaim operation[2,3].	1. STRUPDIDX 2. RCLDLO DLO(*ALL) 3. STRUPDIDX

Notes:

1 Only library QUSRSYS is lost. The recovery for this problem is not used if you are recovering the system using function code 24 to install the Licensed Internal Code.

2 The RCLDLO command deletes from the index all document content that does not have a corresponding document on the system. Documents that are stored in the index but not on the system take up space in the index, although they are never found in the search.

3 The RCLDLO command looks at each index entry to see if the index date for both the entry and the corresponding document match. If the document date does not match, the date is stored in the index. If the document has a last-version index date with no corresponding entry in the index, the RCLDLO command creates an add request for the document to bring the index up to date.

4 If the damaged files only are deleted and then restored without all other index files, the following occurs:

- The restore operation clears the text index
- The reclaim operation (RCLDLO command) creates an add index request for every document on the system that is marked as being indexed before.
- The documents should correctly indicate whether they are or are not in the index.

5 If the scheduling queue contains requests, these requests will be processed the next time the STRUPDIDX command is run.

6 Pending requests on the scheduling queue could cause unpredictable results if the queue is not processed or cleared prior to performing the rest of the recovery operation.

7 While the update operation is in progress, the *Update Started* status on the Work with Text Index display is set to *Yes*. When the update operation has completed, this status is set to *No*. A job completion message is also sent to the user who ran the STRUPDIDX command.

Table D-2. Type of Index Request Created when Using the Restore Document Library Object (RSTDLO) Command

NEWOBJ(*NEW) Is Specified	Document Was Indexed when Saved	Index Entry Exists for Document in QABB* Files	Type of Index Request Created
(1) No	No	No	None
(2) No	No	Yes	Remove
(3) No	Yes	No	Add
(4) No	Yes	Yes	Create an add request if version indexed dates are different. None if version indexed dates are equal.
(5) Yes	No	N/A	None
(6) Yes	Yes	N/A	Add

Bibliography

This topic lists publications that provide additional information about topics described or referred to in this book.

- *ADSTAR Distributed Storage Manager General Information*, GH35-0114.

  This book provides information about how to set up and manage the ADSTAR Distributed Storage Manager/400 licensed program.

- *ADTS/400: Application Development Manager/400 User's Guide*, SC09-2133,

  This book provides information about how to set up and use ADTS/400.

- *AnyMail/400 Mail Server Framework Support*, SC41-3411.

  This book contains information on supporting the mail server framework MSF, including MSF errors and MSF function. It describes how to use the MSF commands, the MSF exit points and exit programs, and the QZMF journal support.

- *Are You Saving the Right Stuff?*, G325-6153.

  This poster is a visual reminder of the methods available for saving and restoring information on your system. It also highlights the software, hardware, people, and service offerings that are available to help you with backup, recovery, and availability.

- *APPN Support*, SC41-3407.

  This book provides information about the concepts of AS/400 Advanced Peer-to-Peer Networking (APPN) and about planning APPN networks.

- *APPC Programming*, SC41-3443.

  This book describes the advanced program-to-program communications (APPC) support for AS/400 and provides the information necessary for developing communications application programs.

- *AS/400 System Availability and Recovery*, GG24-3912.

  This Redbook gives examples for using the save-while-active function, auxiliary storage pools, and disk protection tools (device parity protection, mirrored protection, and checksum protection).

- *Automated Tape Library Planning and Management*, SC41-3309.

  This book provides information about tasks that can be performed with an automated tape library (ATL). It describes recommended methods for designing and using ATLs. It compares ATL devices that are currently available.

- *Backup and Recovery – Advanced*, SC41-4305.

  This book provides information about setting up and managing the following:

  - Journaling, access path protection, and commitment control
  - User auxiliary storage pools (ASPs)
  - Disk protection (device parity protection and mirrored protection)

  It provides performance information about backup media and save/restore operations. It also includes advanced backup and recovery topics, such as using save-while-active support, saving and restoring to a different release, and programming tips and techniques.

- *Backup Recovery and Media Services for OS/400*, SC41-4345.

  This book provides information about developing and implementing a backup and recovery strategy using the Backup Recovery and Media Services/400 licensed program. It describes how to create and maintain the policies that govern your backup strategy.

- *Central Site Distribution*, SC41-4308.

  This book provides information about how to distribute licensed programs, program temporary fixes (PTFs), and application programs to other systems under IBM licensing agreements. It includes planning information and instructions on how to create and distribute tapes to other systems.

- *CL Programming*, SC41-4721.

  This book provides the application programmer or programmer with a wide range discussion of the AS/400 programming topics.

- *CL Reference*, SC41-4722.

  This book provides the application programmer with a description of the AS/400 control language (CL) and its commands. Each command includes a syntax diagram, parameters, default values, keywords, and an example.

- *Communications Configuration*, SC41-3401.

  This book contains general configuration information, including detailed descriptions of network interfaces, network servers, line, controller, device, mode, NetBIOS, and class-of-service descriptions, configuration lists, and connection lists.

- *DB2 for OS/400 Database Programming*, SC41-4701.

  This book provides a detailed discussion of the AS/400 database organization, including information on how to create, describe, and update database files on the system. This book also describes how to define files to the system using OS/400 data description specifications (DDS) keywords.

- *AS/400 Licensed Internal Code Diagnostic Aids – Volume 1*, LY44-4900, and *AS/400 Licensed Internal Code Diagnostic Aids – Volume 2*, LY44-4901.

These books provide information about error logs, dumps, traces, and other service tools to be used to determine, isolate, and solve programming problems occurring with the OS/400 and vertical Licensed Internal Code (VLIC), and other hardware and software failures. They contain trace points and VLIC log (VLOG) information for the AS/400 VLIC code and are to be used to help solve and diagnose problems and submit authorized program analysis reports (APARs) or Licensed Internal Code trouble reports (LICTRs).

- *An Implementation Guide to AS/400 Security and Auditing*, GG24-4200.

  This Redbook describes how to implement security on the AS/400 system. It includes discussions of security as it relates to C2, cryptography, communications, and PC connectivity.

- *InfoSeeker – Getting Started*, SC41-4001.

  This book provides information about getting started with InfoSeeker–the OS/400 implementation of the IBM BookManager READ product family. It shows how information can be read or searched for using a powerful search function. It also introduces online books and bookshelves.

- *Integrated File System Introduction*, SC41-4711.

  This book provides an overview of the integrated file system, which includes:

  - What it is
  - Why you might want to use it
  - The interfaces you can use to interact with it
  - The APIs and techniques you can use in programs that interact with it
  - Characteristics of individual file systems

- *LAN Server for OS/400 Administration*, SC41-3423.

  This book provides information about using the LAN Server for OS/400 licensed program, including information about the File Server I/O Processor (File Server IOP). Discussion includes installing, configuring, and using the LAN Server for OS/400 and the File Server IOP.

- *Local Device Configuration*, SC41-4121.

  This book provides the system operator or system administrator with information on how to do an initial configuration and how to change the configuration. This book also contains conceptual information about device configuration.

- *Office Services Concepts and Programmer's Guide*, SH21-0703.

  This book provides information about writing applications that use OfficeVision for OS/400 functions. This book also includes an overview of directory services, document distribution services, document library services, document and folder save and restore and storage management, security services, word processing services, and information on finding new ways to integrate your applications with OfficeVision for OS/400.

- *OptiConnect/400 Guide*, SC24-5715

  This book provides information on OptiConnect/400 and how to use this support, including installation and problem analysis information.

- *Optical Support*, SC41-4310.

  This book provides information on how to attach optical devices to your system. It describes the commands that can be used to work with optical devices.

- *Physical Planning Reference*, SA41-4109.

  This book provides the data processing manager, system administrator, and installation planning representative with information for planning to set up the AS/400 system. This guide also includes information on cable considerations, physical specifications, electronic customer support (ECS), and unpacking considerations.

- *Printer Device Programming*, SC41-3713.

  This book provides information to help you understand and control printing. It provides specific information on printing elements and concepts of the AS/400 system, printer file and print spooling support for printing operations, and printer connectivity.

  It includes considerations for using personal computers, other printing functions such as AS/400 Business Graphics Utility (BGU), advanced function printing* (AFP*), and examples of working with the AS/400 system printing elements such as how to move spooled output files from one output queue to a different output queue. It also includes an appendix of control language (CL) commands used to manage printing workload.

- *Programming Reference Summary*, SX41-4720.

  This book provides quick and easy access to summary information about many of the languages and utilities available on the AS/400 system. It contains summaries of:

  - AS/400 CL commands (in OS/400 licensed program and in all other licensed programs), in various forms.
  - Information related to CL commands, such as the IBM-supplied files that are used by many commands.
  - IBM-supplied objects, including libraries.
  - IBM-supplied system values.
  - DDS keywords for physical, logical, display, printer, and ICF files.
  - UIM tag language and dialog commands.
  - REXX instructions and built-in functions.
  - Other languages (like RPG) and utilities (like SDA).

- *AS/400 Road Map for Changing to PowerPC Technology*,SA41-4150.

  This book describes how to move from an AS/400 system that is running Version 3 Release 1 Modification 0 or an earlier version of the OS/400 licensed program

to a RISC-based AS/400 system. It includes planning information and step-by-step instructions.

- *Security – Basic*, SC41-3301.

  This book explains why security is necessary, defines major concepts, and provides information on planning, implementing, and monitoring basic security on the AS/400 system.

- *Security – Reference*, SC41-4302.

  This book provides the programmer (or someone who is assigned the responsibilities of a security officer) with information about system security concepts, planning for security, and setting up security on the system. This guide does not describe security for specific licensed programs, languages, and utilities.

- *Simple Network Management Protocol (SNMP) Support*, SC41-4412.

  This book provides the system operator, programmer, or system administrator with information for configuring the AS/400 system to use the simple network management protocol (SNMP) support.

- *Software Installation*, SC41-4120.

  This book provides the system operator or system administrator with step-by-step procedures for initially installing, installing licensed programs, program temporary fixes (PTFs), and secondary languages from IBM.

  This guide is also for users who already have an AS/400 system with an installed release and want to upgrade to a new release.

- *SOMobjects (SOM/DSOM 2.1) Reference*, SC41-4632.

  This book describes how to use the AS/400 support for System Object Model (SOM) objects.

- *System API Reference*, SC41-4801.

  This book provides information for the experienced programmer on how to use the application programming interfaces (APIs) to such OS/400 functions as:

  - Dynamic Screen Manager
  - Files (database, spooled, hierarchical)
  - Message handling
  - National language support
  - Network management
  - Objects
  - Problem management
  - Registration facility
  - Security
  - Software products
  - Source debug
  - UNIX-type
  - User-defined communications
  - User interface
  - Work management

  Includes original program model (OPM), Integrated Language Environment (ILE), and UNIX-type APIs.

- *System Operation*, SC41-4203.

  This book provides information about handling messages, working with jobs and printer output, devices communications, working with support functions, cleaning up your system, and so on.

- *System Operation for New Users*, SC41-3200.

  This book provides display station operators with information about how to sign on and off; send and receive messages, respond to keyboard error messages, use function keys; and use display, command, and help information to control and manage their own jobs.

- *System Operation Quick Reference*, SX41-4201.

  This book provides the system operator with quick reference information when working with the AS/400 system. This guide contains summaries of information such as system values and OS/400 DDS keywords.

- *System Startup and Problem Handling*, SC41-4206.

  This book provides information about the system unit control panel, starting and stopping the system, using tapes and diskettes, working with program temporary fixes, and handling problems.

- *System/36 to AS/400 Migration Aid User's Guide and Reference*, SC09-1166.

  This book provides the system operator, applications programmer, systems programmer and data processing manager with information about using the S/36* to AS/400* migration aid to move S/36 items to the AS/400 System using menus and displays or commands.

- *System/38 Migration Planning*, SC41-4153.

  This book provides information to help migrate products and applications using the AS/400 System/38 Migration Aid. It includes information for planning the details of migration and an overview of the functions on the System/38 to AS/400 Migration Aid.

- *System/38 to AS/400 Migration Aid User's Guide and Reference*, SC09-1165.

  This book provides the system operator, application programmer, programmer, or data processing manager with information about using the System/38 to AS/400 Migration Aid to move System/38 objects to the AS/400 system using menus and displays, or commands.

- *TCP/IP Configuration and Reference*, SC41-3420

  This book provides information for configuring TCP/IP support and applications. The applications included are TELNET, File Transfer Protocol (FTP), Simple Mail Transfer Protocol (SMTP), line printer requester (LPR), and line printer daemon (LPD).

- *Work Management*, SC41-4306.

  This book provides the programmer with information about how to create a work management environment and how to change it.

- *9406 Models Bxx-Fxx Installation and Upgrade*, SY44-3930.

This book provides the service representative with information about upgrading equipment on the 9406 System Unit. It provides information on an entire range of upgrades such as simple memory card additions, device and rack additions, and model upgrades. It is used with the instruction packets that are shipped with the upgrade equipment.

Index

Special Characters

Numerics

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