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Natural for VSAM

Version 4.1.2

Natural for VSAM

This document applies to Natural for VSAM Version 4.1.2 and to all subsequent releases.

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# Table of Contents

<b>Natural for VSAM - Overview</b>	1
Natural for VSAM - Overview	1
<b>Natural for VSAM - General Information</b>	2
Natural for VSAM - General Information	2
Integration with Natural Security	3
Integration with Predict	3
Natural System Messages Related to VSAM	3
Components of Natural for VSAM	4
Structure of the Natural Interface to VSAM	5
<b>Natural for VSAM - Parameters</b>	6
Natural for VSAM - Parameters	6
Customizing NATPARM	6
VSIZE Parameter	6
NTDB Macro	7
Assembling the NVSPARM Parameter Module	8
NVMPARM Macro	9
NVMLSR Macro	17
NVMEXIT Macro	17
Natural I/O Modules for VSAM	18
NVSCICS Module	19
NVSMISC Module	20
<b>Installing Natural for VSAM</b>	23
Installing Natural for VSAM	23
General Information	23
Installation Jobs	23
Using System Maintenance Aid	23
Prerequisites	23
Installation Tape - OS/390 Systems	23
Copying the Tape Contents to Disk	24
Installation Tape - VSE/ESA Systems	25
Copying the Tape Contents to Disk	25
Installation Procedure - OS/390 and VSE/ESA	26
Step 1: Define CICS RDO Definitions - Job I005	26
Step 2: Prepare NVS Demo File - Job I008, Steps 1403 to 1407	26
Step 3: Create NVS Parameter Module - Job I055, Steps 1400 and 1401	26
Step 4: Create NVS I/O Module - Job I055, Steps 1410 and 1411, or Job I070, Step 1400	26
Step 5: Adapt all Natural Parameter Modules - Jobs I060, I080	26
Step 6: Relink all Natural Nuclei - Jobs I060, I080	27
Step 7: Load Examples - Job I061, Step 1400	28
Step 8: Customize your TP Monitor	28
Installation Verification - OS/390 and VSE/ESA	28
<b>Natural for VSAM - Operation</b>	29
Natural for VSAM - Operation	29
Invoking Natural for VSAM	29
OPEN/CLOSE Processing	29
OPRB Parameter for VSAM Databases	30
Natural File Access	33
Natural Data Definition Modules - DDMs	33
SYSDDM Main Menu	34
Catalog DDM	35
Edit DDM	40
Restrictions with DDM Generation as Compared to Adabas	46
Buffers for Memory Management	47

FCT - File Control Table . . . . .	47
FWA - File Work Area . . . . .	48
OPV - Open Table . . . . .	48
SFT - System File Table . . . . .	48
SWT - Switch Table . . . . .	49
TAF - Table of Accessed Files . . . . .	49
ROLL - Table of Session Status Information . . . . .	50
DFB - Table of Decoded Format Buffers . . . . .	50
TSA - Table of Sequential Access . . . . .	51
UPD - Table of Update Records . . . . .	51
VCA - Natural Control Area for VSAM . . . . .	51
User Exits . . . . .	52
User Exit USR0100N . . . . .	53
User Exit USR1047N . . . . .	54
User Exit USR2008N . . . . .	55
<b>Statement/Transaction Logic with VSAM - Overview . . . . .</b>	<b>56</b>
Statement/Transaction Logic with VSAM - Overview . . . . .	56
<b>Natural Statements with VSAM . . . . .</b>	<b>57</b>
Natural Statements with VSAM . . . . .	57
BACKOUT TRANSACTION . . . . .	58
DELETE . . . . .	58
END TRANSACTION . . . . .	58
FIND . . . . .	59
GET . . . . .	60
GET SAME . . . . .	60
GET TRANSACTION DATA . . . . .	60
HISTOGRAM . . . . .	60
READ . . . . .	61
STORE . . . . .	62
UPDATE . . . . .	62
<b>Natural Transaction Logic with VSAM . . . . .</b>	<b>63</b>
Natural Transaction Logic with VSAM . . . . .	63
With Native VSAM . . . . .	63
Under CICS . . . . .	63
NVSCICS Module . . . . .	63
Conversational Tasks . . . . .	64
Pseudo-Conversational Tasks . . . . .	64
<b>Using Natural with VSAM System Files . . . . .</b>	<b>65</b>
Using Natural with VSAM System Files . . . . .	65
Prerequisites . . . . .	65
Installing Natural on VSAM System Files - OS/390 . . . . .	65
Installation Tape . . . . .	65
Copying the Tape Contents to Disk . . . . .	66
Installation Procedure . . . . .	67
Installing Natural on VSAM System Files - VSE/ESA . . . . .	71
Installation Tape . . . . .	71
Installation Procedure . . . . .	73
Installation Verification with VSAM System Files . . . . .	77
Under OS/390 and VSE/ESA . . . . .	77
Restrictions . . . . .	78

# Natural for VSAM - Overview

This documentation describes the various aspects of Natural when used in a VSAM environment.

In the remainder of this documentation, Natural for VSAM is also referred to as NVS.

- **General Information** Information on supported environments, on the integration with Software AG's active dictionary Predict and on Natural system messages related to VSAM. In addition, an overview of the main components and the structure of the Natural interface to VSAM is provided.
- **Parameters** Description of the Natural for VSAM parameter and I/O modules.
- **Installation** Installation of Natural for VSAM in the supported operating system and TP-monitor environments.
- **Operation** Information on operational aspects like how to invoke Natural for VSAM, OPEN/CLOSE processing, Natural file access, buffers for memory management, and user exits.
- **Statement/Transaction Logic with VSAM** Special considerations on the use of Natural statements and system variables with VSAM. In addition, the Natural transaction logic with VSAM is discussed.
- **Using Natural with VSAM System Files** Usage and installation of Natural with VSAM system files.

For a list of the abend codes of Natural for VSAM, refer to Natural for VSAM Abend Codes (in the Natural Messages and Codes documentation).

# Natural for VSAM - General Information

With the Natural interface to VSAM, a Natural user is able to access data stored in VSAM files. The current version of Natural for Mainframes must be installed.

In general, there is no difference between using Natural with VSAM and using it with Adabas or any other supported database management system. The Natural interface to VSAM allows Natural programs to access VSAM data, using the same Natural DML statements that are available for Adabas. Therefore, programs written for VSAM can also be used to access, for example, Adabas databases.

All operations requiring interaction with VSAM are performed by the Natural interface to VSAM. Natural for VSAM is fully ESA- and Sysplex-eligible. It runs in batch mode and under the online environments CICS, Com-plete and TSO. Under CICS, it can be run in conversational or pseudo-conversational mode.

Natural for VSAM supports the following types of VSAM files:

- KSDS,
- ESDS,
- RRDS,
- VRDS.

The Natural system files FNAT, FUSER, FDIC, FSPOOL and FSEC can also be located on VSAM system files. For VSAM system files, Natural for VSAM uses the multi-fetch option to speed up the process of loading objects into the buffer pool.

For information on how to use and install Natural using VSAM files as system files, refer to the section Using Natural with VSAM System Files.

Natural for VSAM supports local shared resources (LSR) under TSO and in OS/390 and VSE/ESA batch modes. For CICS and Com-plete, the appropriate file definition tools must be used. The LSR option for VSAM files improves the performance of random access.

Natural for VSAM supports Create/Loading Mode for empty files under TSO as well as in batch mode.

Natural for VSAM supports the following types of Data Tables under CICS OS/390:

- User-Maintained Data Tables (UMT),
- CICS-Maintained Data Tables (CMT),
- Coupling Facility Data Tables (CFDT).

It also supports dataset name sharing (DSN) under TSO, and batch-mode processing in OS/390 and VSE/ESA, in particular to access datasets using a defined path.

Natural for VSAM supports extended-format datasets for all types of VSAM dataset organizations. There are, however, restrictions for ESDS, RRDS and VRDS which result from the use of the Natural system variable \*ISN and its internal size limit of 4 bytes.

This section covers the following topics:

- Integration with Natural Security
  - Integration with Predict
  - Natural System Messages Related to VSAM
  - Components of Natural for VSAM
  - Structure of the Natural Interface to VSAM
- 

## Integration with Natural Security

Since Natural Security supports the FSEC as VSAM system file, the following restrictions must be considered:

- Generation of ETIDs is disabled.
- Logging of maintenance actions is disabled.
- Password history is disabled.
- Definition of utility profiles is disabled.

## Integration with Predict

Since Predict supports VSAM, direct access to VSAM files is possible via Predict and information from VSAM can be transferred to the Predict dictionary to be integrated with data definitions for other environments.

VSAM physical and logical views can be incorporated and compared, new VSAM views can be generated, and Natural views can be generated and compared. All VSAM-specific data types and the referential integrity of VSAM are supported. See the Predict documentation for details.

## Natural System Messages Related to VSAM

The message number ranges of Natural system messages related to VSAM are 3500-3599.

## Components of Natural for VSAM

The Natural interface to VSAM consists of the following components:

- The NVSNUC module, which is mandatory, environment-independent, and delivered as a load module only.
- The NVSPARM module, which is mandatory, contains Natural parameters specific to VSAM, and is delivered in source form only.
- The I/O module, which is mandatory, differs depending on the actual environment, and is delivered in source form only.
- The modules necessary when running with VSAM system files; they are optional and delivered as load modules only.
- The user exits.
- Callable system services.

Natural for VSAM is fully (E)LPA or SVA-eligible for multiple environments (for example, CICS, Com-plete and batch). The NVSPARM module and the appropriate I/O module must be linked to the NATPARM parameter module. The NATPARM parameter module will be called front-end in this section.

## Structure of the Natural Interface to VSAM

Front End	(E)LPA or SVA
TP Driver (Batch/CICS/ Com-plete/TSO)	NATSTUB
	NATURAL
.	NATCONFIG
.	.
.	.
NATPARM	.
NVSPARM	NVSNUC
I/O Interface	NVSFNAT (1)
- NVSMISC	NVSFSP (2)
- NVSCICS	NVSFSEC (3)
IGWARLS (5)	NVSISPC (4)
User Exit defined with NVMEXIT	NVSISPV (4)

- (1) VSAM system file handling for FNAT, FUSER and FDIC.
- (2) VSAM system file handling for FSPOOL.
- (3) VSAM system file handling for FSEC.
- (4) VSAM system file handling for Natural ISPF.
- (5) IBM record level sharing query routine to support RLS=CHECK, OS/390 only (not CICS).

# Natural for VSAM - Parameters

The Natural parameters in a VSAM environment are defined in two locations: the Natural standard parameters, contained in the Natural parameter module NATPARM, and the Natural parameters specific to VSAM, contained in the source member NVSPARM. Both are provided as source members only and can be edited to conform to your site standards, and then assembled and linked using the appropriate jobs (see Installing Natural for VSAM).

In the remainder of this section Natural for VSAM is also referred to as NVS.

This section covers the following topics:

- Customizing NATPARM
- Assembling the NVSPARM Parameter Module
- Natural I/O Modules for VSAM

## Customizing NATPARM

To be able to run Natural in a VSAM environment, you must include the VSIZE parameter and the NTDB macro in your NATPARM parameter source (see the section Installation Procedure for OS/390 and VSE/ESA).

### For an Adabas system file:

```
VSIZE=72 ,
NTDB VSAM, vsam-dbid
```

### For a VSAM system file:

```
VSIZE=126 ,

FNAT=( vsam-dbid, fnr, dd-name ) ,
FUSER=( vsam-dbid, fnr, dd-name ) ,
FDIC=( vsam-dbid, fnr, dd-name ) ,
FSPOOL=( vsam-dbid, fnr, dd-name ) ,
FSEC=( vsam-dbid, fnr, dd-name )
```

```
NTDB VSAM, vsam-dbid
```

*dd-name* is the logical name (DD or DLBL) of the system file; see also Installing Natural on VSAM Files (OS/390), Step 9, and Installing Natural on VSAM Files (VSE/ESA), Step 9.

### Note:

If you use VSAM system files with Natural ISPF, see also the Natural ISPF documentation.

Below is information on:

- VSIZE Parameter
- NTDB Macro

## VSIZE Parameter

VSIZE is a Natural profile parameter which can also be specified dynamically. It is used to specify the size of the Natural buffer area for VSAM and defines the maximum memory usage for the internal tables of the Natural interface to VSAM; the actual sizes of these tables depend on the values set in NVSPARM (see Assembling the NVSPARM Parameter Module). Possible values are 0 - 512 KB.

If you use the default values specified in NVSPARM, the value of the VSIZE parameter must be at least 72 KB.

If VSIZE is set to 0, Natural for VSAM is not available and a corresponding error message is returned when trying to access VSAM files. Disabling Natural for VSAM leads to slight performance improvements because of skipping the initialization, relocation and roll efforts of the Natural interface to VSAM.

## **NTDB Macro**

The NTDB macro is used to specify the database numbers that relate to VSAM files, which means the logical assignments available for Natural.

The value range of NTDB parameters is described in Parameter Modules in the Natural Parameter Reference documentation.

**Note:**

Ensure that the DBIDs selected in the NTDB macro for VSAM do not conflict with DBIDs selected for other DBMSs.

## Assembling the NVSPARM Parameter Module

NVSPARM is delivered in source form only. If the default values supplied in the NVSPARM source do not meet your requirements, you can change the parameter values to suit your environment. The individual parameters contained in NVSPARM are described in the following section.

The NVSPARM module is created by assembling the macro:

- NVMPARM

and optionally one or more of the following macros:

- NVMLSR
- NVMEXIT

If more than one macro is specified, the NVMPARM macro must be specified first; further macros after the NVMPARM macro can be specified in any order.

The individual macros are:

- NVMPARM Macro
- NVMLSR Macro
- NVMEXIT Macro

## NVMPARM Macro

The NVMPARM macro contains the following parameters:

Parameter	Explanation
BTSUPP	Support of BACKOUT TRANSACTION statement.
CLSUPP	Support of CLOSE calls at session termination.
DDMCHECK	Support of DDM integrity.
DDSWITE	Maximum number of entries in DD/DLBL name switch buffer.
DFBE	Number of decoded format buffer entries.
DFBN	Number of fields in an entry of the decoded format buffer.
ENADIS	Enabling disabled files (CICS only).
ENAUNE	Enabling "unenabled" files (CICS only).
ETSUPP	Support of END TRANSACTION statement.
FORMAT	Support of record formatting for STORE and UPDATE statements.
KEYLGH	Length of VSAM keys used in I/O statements.
OPSUPP	Support of dynamic OPEN calls.
PATH	Support of path processing.
PSIGNF	Support of compiler option PSIGNF.
RETRY	Support of RETRY statement for ON ERROR clause.
TAFE	Maximum number of DDMs per Natural transaction.
RLS	Support of VSAM record level sharing.
ROLLSIZ	Size of area for session status information.
SFILE	Support of VSAM system files.
TAFN	Average number of DDM fields.
TSAE	Maximum number of nested READ and FIND statements.
TIMEOUT	Timeout in minutes for non-RLS processing in a Sysplex environment.
UPDL	Size of update table.

The individual parameters are described in the following section.

**BTSUPP - Support of BACKOUT TRANSACTION Statement**

This parameter determines whether BACKOUT TRANSACTION statements are executed or not. It is applicable only in TP environments where VSAM logging is supported.

Possible value	Default value	Explanation
ON	ON	Each BACKOUT TRANSACTION is executed and translated into an appropriate ROLLBACK command.
OFF		BACKOUT TRANSACTION statements are ignored.

**CLSUPP - Support of CLOSE Call at Session Termination**

This parameter determines whether or not a CLOSE call is executed at session termination. If a CLOSE is executed, Natural for VSAM forces an END TRANSACTION only in TP environments where VSAM logging is supported.

Possible value	Default value	Explanation
ON	ON	Each CLOSE call is executed and translated into an appropriate SYNCPOINT command.
OFF		Each CLOSE call is ignored.

**DDMCHECK - Support of DDM Integrity**

This parameter checks whether the file layout and, in consequence, the DDM has changed. The check is performed after each program termination at the NEXT level, through the Natural buffer pool. The DDMCHECK parameter is only relevant for development environments where DDMs are modified. In production environments, disable this feature to improve performance.

Possible value	Default value	Explanation
ON		DDM check enabled.
OFF	OFF	DDM check disabled.

**DDSWITE - Maximum Entries in DD/DLBL Name Switch Buffer**

This parameter specifies the maximum number of entries in the DD/DLBL name switch buffer. For details on switching DD names, see User Exit USR1047N.

Possible values	Default value
0 up to the value of the TAFE parameter	0

### DFBE - Number of Decoded Format Buffer Entries

This parameter specifies the initial number of entries in the table of decoded format buffers. For each active Natural I/O statement (FIND, READ, UPDATE, STORE) one entry is allocated in this table.

When increasing DFBE or DFBN, take into consideration that the allocated storage area size is obtained by multiplying these values and **not** by adding them.

Possible values	Default value
1 - 1000	10

### DFBN - Number of Fields in Entry of Decoded Format Buffer

This parameter specifies the average number of fields contained in an entry of the decoded format buffer table. One entry is built for each Natural I/O statement (FIND, READ, UPDATE, STORE).

When increasing DFBE or DFBN, take into consideration that the allocated storage area size is obtained by multiplying these values and **not** by adding them.

Possible values	Default value
1 - 1000	50

### ENADIS - Enabling Disabled Files

This parameter only applies to CICS environments and is only honored by the first file access performed in the current Natural session.

ENADIS is used to enable disabled files. If the parameter is set to OFF and the file has not been enabled, the NAT3516 error message must follow the first file access.

Possible value	Default value	Explanation
ON		For all disabled files accessed during the session, an EXEC CICS SET ENABLED command is executed.
OFF	OFF	All disabled files remain disabled.

### ENAUNE - Enabling Unenabled Files

This parameter only applies to CICS environments and is only honored by the first file access performed in the current Natural session.

ENAUNE is used to enable "unenabled" files. If the parameter is set to OFF and the file has not been enabled, the NAT3539 error message must follow the first file access.

Possible value	Default value	Explanation
ON		For all unenabled files accessed during the session, an EXEC CICS SET ENABLED command is executed.
OFF	OFF	All unenabled files remain unenabled.

### ETSUPP - Support of END TRANSACTION Statement

This parameter determines whether END TRANSACTION statements are executed or not. It is applicable only in TP environments where VSAM logging is supported.

Possible value	Default value	Explanation
ON	ON	Each END TRANSACTION is executed and translated into an appropriate SYNCPOINT command.
OFF		END TRANSACTION statements are ignored.

### FORMAT- Support of Record Formatting for STORE and UPDATE Statements

This parameter supports the formatting of VSAM records referenced in a STORE or UPDATE statement. Record fields that are not referenced and, therefore, contain binary zeros are converted into a format that corresponds to the field type and record length defined in the relevant DDM.

Possible value	Default value	Explanation
ON	ON	VSAM records are formatted in accordance with the corresponding DDM definitions.
OFF		VSAM records are not formatted and fields that are not referenced contain binary zeros.

NVS system file records are always formatted; this cannot be changed.

### KEYLGH - Length of VSAM Keys used in I/O Statements

This parameter specifies the length of VSAM keys used in Natural I/O statements. The maximum key length for a VSAM file is 255 bytes. The value of this parameter is used to calculate the size of the TSA table (Table of Sequential Access).

If you use VSAM system files, specify at least:

- 87 bytes for the FNAT, FUSER, FDIC and FSPOOL files,
- 126 bytes for the FSEC and Natural ISPF system files.

Possible values	Default value
1 - 255 (bytes)	32

### OPSUPP - Support of Dynamic OPEN Calls

This parameter is used to support multiple different OPEN calls within one session.

Possible value	Default value	Explanation
ON		Multiple different OPEN calls are supported by calling the user exit USR2008N; for further information, see User Exit USR2008N.
OFF	OFF	Multiple different OPEN calls are not supported within one session.

## PATH - Support of Path Processing

This parameter is used to handle a secondary key as a path or as a native AIX file.

Possible value	Default value	Explanation
ON		All secondary keys defined in a DDM are handled as paths for AIX files.
OFF		All secondary keys are handled as AIX files.
CHECK	CHECK	NVS checks whether the secondary keys are defined as paths or as AIXs in the VSAM catalog.

If you use the VSAM system files FSEC and/or FSPOOL, you must not specify ON: specify either OFF or CHECK.

### Note:

If PATH=CHECK is set under CICS and/or Com-plete in a VSE/ESA environment, the startup JCL job must contain the corresponding DLBL card(s).

## PSIGNF - Support of Compiler Option PSIGNF

This parameter is used to handle the internal representation of positive signs of packed numbers.

Possible value	Default value	Explanation
ON		NVS supports the compiler option PSIGN for a Natural object, the corresponding DDM description in the field ZONES is ignored.
OFF	OFF	NVS uses the DDM description in field ZONES.

## RETRY - Support of RETRY Statement for an ON ERROR Clause

This parameter is used to support the RETRY statement for the following NVS error messages:

NAT3541      File :1:, control interval/record held by another user.

NAT3520      Held VSAM record modified by another user.

The first value of the RETRY parameter applies to NAT3541, the second to NAT3520.

Possible values	Default value
(ON/OFF, ON/OFF)	(OFF, OFF)

### RLS - Support of Record Level Sharing

Applies to OS/390 only.

This parameter is used to support VSAM record level sharing under OS/390, DFSMS Version 1.5 or higher.

Possible value	Default value	Explanation
ON		All files are opened in RLS mode.
OFF	OFF	All files are opened in non-RLS mode (NSR, LSR).
CHECK		All files are checked whether they are defined as SMS-managed datasets with RLS options; if they are, the file is opened in RLS mode, if not in non-RLS mode.

### ROLLSIZ - Size of Area for Session Status Information

This parameter is applicable in a thread environment only (CICS, Com-plete, Natural as a Server).

It specifies the size of the area used by Natural to save internal session status information when a Natural transaction is terminated due to the end of a TP-monitor task.

Possible values	Default value
0 - 10000 (bytes)	550

### SFILE - Support of VSAM system files

This parameter is used to support VSAM system files.

Possible value	Default value	Explanation
ON		Supports NVS VSAM system files
OFF	OFF	No support of VSAM system files.
CHECK		Checks whether the Natural system files FNAT, FUSER and FDIC files are defined as NVS Version 4.1 VSAM system files with the required key length of 87.

**Note:**

If SFILE=CHECK is set under CICS and/or Com-plete in a VSE/ESA environment, the startup JCL job must contain the corresponding DLBL card(s).

### TAFE - Maximum Number of DDMs per Natural Session

This parameter specifies the maximum number of DDMs per Natural session.

Since it is possible to define several descriptors in one DDM, the TAFE parameter has impact on the sizes of the FCT, FWA, OPV and TAF buffers (see Buffers for Memory Management).

When increasing TAFE or TAFN, take into consideration that the allocated storage area size is obtained by multiplying these values and **not** by adding them.

Possible values	Default value
0 - 1000	10

### TAFN - Average Number of DDM Fields

This parameter specifies the average number of DDM fields contained in each entry in the table of accessed VSAM files.

When increasing TAFE or TAFN, take into consideration that the allocated storage area size is obtained by multiplying these values and **not** by adding them.

Possible values	Default value
0 - 1000	50

### TIMEOUT - Timeout in Seconds for an RLS Request

This parameter only applies to OS/390 CICS Version 5.3 or higher.

This parameter is used to support an RLS/non-RLS-file mixed environment under OS/390 CICS Version 5.3 or higher in a Natural for VSAM session.

Natural and Natural for VSAM Version 4.1 are plex-enabled, that is, after a terminal I/O the Natural session can be continued by the workload manager on a different OS/390 in a different CICS 5.3, provided the resources are plex-enabled. Since this is not the case with non-RLS files, the session must be run in conversational mode as soon as a VSAM file is opened in non-RLS mode.

With the TIMEOUT parameter, you can determine that non-RLS files are to be deleted from the NVS FCT queue. When there are no further non-RLS FCT entries for the particular Natural for VSAM session, Natural for VSAM switches to non-conversational mode, which means that Sysplex processing is possible again.

Possible values	Default value
0 - 10	0

**TSAE - Maximum Number of Nested READ and FIND Statements**

This parameter is used to set the maximum number of all nested READ and FIND statements.

Possible values	Default value
0 - 100	10

**UPDL - Size of Update Table**

This parameter indicates the size of the table used by the Natural interface to VSAM to save the fields of records read for subsequent updating. Because these records are not read with hold by Natural to avoid deadlock conditions, the content of the UPDL table is used to check if any changes have been made before the update request by another user.

Possible values	Default value
0 - 500000 (bytes)	8192 or 32768 if SFILE=ON is specified.

## NVMLSR Macro

The NVMLSR macro is only required if VSAM files are used as local shared resources. Its purpose is to substantially increase the performance of TSO and batch runs, and, at the same time, decrease the VSAM I/O rate.

The NVMLSR macro is specified as follows:

```
NVMLSR DDNAME=dd-name , SHRPOOL=nn
```

Parameter	Explanation
DDNAME	Logical file name that corresponds to the one in your JCL startup job.
SHRPOOL	Specifies a pool number (ID) between 0 and 15 for VSE/ESA or between 0 and 255 for OS/390; see also the relevant IBM VSAM documentation.

Up to 200 logical files are possible.

If ERROR=YES is specified in NVSMISC, all files defined with the NVMLSR macro must be defined via JCL at runtime; otherwise, an appropriate Natural initialization error message is returned.

If you have defined base clusters with NVMLSR which contain path entries, all paths must also be defined with NVMLSR.

For non-path environments the following applies:

If the upgrade option is active in the VSAM catalog and if a VSAM file is defined with NVMLSR and contains references to an alternate index (AIX), all AIX files must also be defined with NVMLSR.

Natural for VSAM automatically calculates the optimum pool size by using the corresponding VSAM catalog information on the files involved, and then creates separate subpools for data and index components.

In batch mode under OS/390, Natural for VSAM allocates the pools as ESO hiperspace if the following conditions are met:

- All sizes in the VSAM catalog are at least specified as 4 KB or a multiple of this value (this is valid for both data and index components).
- The library from which Natural for VSAM was loaded is an APF-authorized library.
- This condition is necessary to define the address space as "non-swapable", which is a prerequisite for ESO hiperspaces.

## NVMEXIT Macro

Natural for VSAM provides the facility to define one or more user exits. For each VSAM file to be accessed, one user exit can be defined. The definition of a user exit is done by using the NVMEXIT macro.

NVMEXIT is specified as follows:

```
NVMEXIT DDNAME=dd-name , PGM=exit-name , WORK=nnnn
```

Parameter	Explanation
DDNAME	DD/DLBL/FCT name of the VSAM file to be accessed.
PGM	Specifies the name of the user exit.
WORK	Specifies the size of the user exit work area (in bytes).  A minimum size of 72 bytes must be specified, which corresponds to the size of the IBM standard register saved area, that is 18 full words. The maximum size possible is 1024 bytes.  The work area is allocated inside the Natural save area for VSAM, which has been previously initialized to X'0' by Natural.

All user exits must be linked to the front-end.

### User Exit Linkage Conventions

When passing control to and from the user exit, standard IBM linkage conventions and standard linkage register notations are used.

Register	Usage
R1	Address pointer to the parameter address list.  The parameter address list provides you with the addresses of the record, of LRECL, of the current function and of the work area.
R3	Address pointer to the VSAM control area (VCA).
R12	Address pointer to the Natural basic control block (BB).
R13	Address of 18-word save area.
R14	Return address.
R15	Entry address/return code.  A return code of 0 indicates a normal return of control. In all other cases, a Natural error message is returned.

The current function (see Register 1 above) indicates the way control has been passed to the exit. Control can be passed either **before** or **after** a Natural call for VSAM (see also the DCRREQCD field in the NVMDCR macro delivered):

- With the STORE and UPDATE statements, control is passed before the call.
- With the FIND, GET, and READ statements, control is passed after the call.

### Sample User Exit

A sample user exit NVSEX01 is provided on the installation tape.

## Natural I/O Modules for VSAM

The Natural I/O module for VSAM depends on the actual environment in use.

All available I/O modules are delivered in source form so you can make site-specific modifications and use environment-specific macros and/or precompilers.

The I/O modules available are:

- NVSCICS Module - CICS only.
- NVSMISC Module - any other supported environment.

## NVSCICS Module

The NVSCICS module is required for CICS under OS/390 or VSE/ESA. The module contains the following parameter:

### **&FCTRELI - Indicator of Reliable Remote FCT Entries**

The &FCTRELI parameter indicates whether the key length and record size of a remote file are correctly defined in the FCT entry of the Application Owning Region (AOR).

Possible values	Default value
0 or 1	0

When this parameter is set to 1, NVSCICS assumes a correct FCT entry.

When this parameter is set to 0, NVSCICS issues dummy commands to force opening of the file in the File Owning Region (FOR) region and then repeats inquiring for the real values.

If the FCT entry does not contain a key length definition, NVSCICS uses the key length of the corresponding VSAM DDM.

## NVSMISC Module

The NVSMISC module is required in all environments except for CICS. The module mainly consists of the name of the relocatable module for VSE/ESA and the NVMMISC macro, which is used to generate the NVSMISC I/O interface according to your operating system and/or TP-monitor environment.

NVSMISC is specified as follows:

```

name NVMMISC
NONRLS=
TIMEOUT=
DSECTS=
DEFER=
COMMIT=
ERROR=
HFACTOR=
READINT=
SMARTS=
    
```

The *name* of the relocatable module must be 8 characters long; the default name is NVSMISCD (VSE/ESA only).

The individual parameters are described in the following section; specify these parameters according to your requirements.

### NONRLS - Switch from RLS to Non-RLS Mode

This parameter is ignored under VSE/ESA.

When Natural for VSAM issues an RLS-OPEN for an RLS file and this file has already been opened in non-RLS mode in this OS/390 session, this parameter specifies whether Natural for VSAM issues an open retry in a non-RLS mode, or whether an open error occurs.

Possible values	Default value
YES/NO	YES

### TIMEOUT - Timeout in Seconds for an RLS Request

This parameter is ignored under VSE/ESA.

This parameter specifies the time in seconds Natural for VSAM is waiting to obtain a lock on a Natural for VSAM record when a lock on the record is already held by another user. For further details refer to the IBM manual OS/390 DFSMS Version 1.5 or higher, Macro Instructions for Datasets.

Possible values	Default value
0 - 10	0

### DEFER - Defer Writes in LSR Pools

This parameter only applies in batch mode and under TSO.

This parameter specifies whether write operations to disk are to be deferred in the LSR pool. If so and if the LSR pool becomes full, Natural for VSAM writes to disk those 5% of the pool area which have not been used for the longest time.

Possible values	Default value
YES/NO	NO

#### DSECTS - List VSAM System DSECTS

The DSECTS parameter specifies whether the VSAM system DSECTS are to be listed or not.

Possible values	Default value
YES/NO	NO

#### COMMIT - Support of Buffer Flush for LSR Pools

This parameter only applies in batch mode and under TSO.

The COMMIT parameter specifies whether all non-committed updates in any LSR pool are to be written to disk with each END TRANSACTION statement of a user program.

Possible values	Default value
YES/NO	NO

#### Note:

The specification of COMMIT=YES increases the I/O rate considerably.

#### ERROR - Issue Initialization Error

This parameter issues a Natural initialization error if any DD or DLBL card is omitted in the runtime JCL (see also the macro NVMLSR).

Possible values	Default value
YES/NO	YES

If set to NO, processing is continued and Natural for VSAM will be initialized.

**HFACTOR - Factor for Hiperspace Buffers**

The HFACTOR parameter specifies a factor for the creation of ESO hiperspace buffers. When initializing such a hiperspace, the corresponding BLDVRP request may lead to a Natural error message, in which case the value of HFACTOR must be reduced.

Possible values	Default value
0 - a value where a corresponding Natural error message is returned	100

**READINT - Read Integrity for Upgrade Set**

The READINT parameter specifies whether read integrity for an upgrade set should be guaranteed or not.

Possible values	Default value
YES/NO	NO

**SMARTS - Support of SMARTS and Com-plete**

The SMARTS parameter is required if installing Natural for VSAM under SMARTS and/or in a Complete environment.

Possible values	Default value
YES/NO	NO

# Installing Natural for VSAM

This section describes how to install Natural for VSAM (also referred to as NVS) in the various environments supported. The installation procedure depends on the TP monitor being used.

- General Information
  - Prerequisites
  - Installation Tape - OS/390 Systems
  - Installation Tape - VSE/ESA Systems
  - Installation Procedure - OS/390 and VSE/ESA
  - Installation Verification - OS/390 and VSE/ESA
- 

## General Information

Below is information on:

- Installation Jobs
- Using System Maintenance Aid

## Installation Jobs

The installation of Software AG products is performed by installation jobs. These jobs are either created manually or generated by System Maintenance Aid (SMA).

For each step of the installation procedure under OS/390 and VSE/ESA, the job number of a job performing the respective task is indicated. This job number refers to an installation job generated by SMA. If you are not using SMA, an example installation job of the same number is provided in the job library on the NVS installation tape; you must adapt this example job to your requirements. Note that the job numbers on the tape are preceded by the product code (for example, NVSI070).

## Using System Maintenance Aid

For information on using Software AG's System Maintenance Aid (SMA) for the installation process, refer to the System Maintenance Aid documentation.

## Prerequisites

Products and versions are specified under Natural and Other Software AG Products and Operating/Teleprocessing Systems Required in the current Natural Release Notes for Mainframes.

## Installation Tape - OS/390 Systems

The installation tape contains the datasets listed in the table below. The sequence of the datasets is shown in the Report of Tape Creation which accompanies the installation tape.

Dataset Name	Contents
NVS $nnn$ .SRCE	NVS source modules.
NVS $nnn$ .LOAD	NVS load modules.
NVS $nnn$ .EXPL	NVS sample programs.
NVS $nnn$ .EMPL	VSAM EMPLOYEES demo file.
NVS $nnn$ .JOBS	NVS installation jobs.

The notation  $nnn$  in dataset names represents the version number of the product.

## Copying the Tape Contents to Disk

If you are using System Maintenance Aid (SMA), refer to the SMA documentation (included on the current edition of the Natural documentation CD).

If you are **not** using SMA, follow the instructions below.

This section explains how to:

- Copy data set COPY.JOB from tape to disk.
- Modify this data set to conform with your local naming conventions.

The JCL in this data set is then used to copy all data sets from tape to disk.

If the datasets for more than one product are delivered on the tape, the dataset COPY.JOB contains the JCL to unload the datasets for all delivered products from the tape to your disk.

After that, you will have to perform the individual install procedure for each component.

### Step 1 - Copy data set COPY.JOB from tape to disk

The data set COPY.JOB (label 2) contains the JCL to unload all other existing data sets from tape to disk. To unload COPY.JOB, use the following sample JCL:

```
//SAGTAPE JOB SAG,CLASS=1,MSGCLASS=X
//* -----
//COPY EXEC PGM=IEBGENER
//SYSUT1 DD DSN=COPY.JOB,
// DISP=(OLD,PASS),
// UNIT=(CASS,,DEFER),
// VOL=(,RETAIN,SER=<Tnnnnn>),
// LABEL=(2,SL)
//SYSUT2 DD DSN=<hi lev>.COPY.JOB,
// DISP=(NEW,CATLG,DELETE),
// UNIT=3390,VOL=SER=<vvvvvv>,
// SPACE=(TRK,(1,1),RLSE),
// DCB=*.SYSUT1
//SYSPRINT DD SYSOUT=*
//SYSIN DD DUMMY
//
```

Where:

<hilev> is a valid high level qualifier

<Tnnnnn> is the tape number

<vvvvvv> is the desired volser

## Step 2 - Modify COPYTAPE.JOB

Modify the COPYTAPE.JOB to conform with your local naming conventions and set the disk space parameters before submitting this job:

- Set HILEV to a valid high level qualifier.
- Set LOCATION to a storage location.
- Set EXPDT to a valid expiration date.

## Step 3 - Submit COPY.JOB

Submit COPY.JOB to unload all other data sets from the tape to your disk.

# Installation Tape - VSE/ESA Systems

The installation tape contains the datasets listed in the table below. The sequence of the datasets and the type and space they require on disk is shown in the Report of Tape Creation which accompanies the installation tape.

Dataset Name	Contents
NVS <i>nnn</i> .LIBR	NVS source modules, macros and relocatable modules.
NVS <i>nnn</i> .EXPL	NVS example programs.
NVS <i>nnn</i> .EMPL	VSAM EMPLOYEES demo file.

The notation *nnn* in dataset names represents the version number of the product.

## Copying the Tape Contents to Disk

Copy the sublibrary containing the sample installation jobs from tape using the following JCS:

```
* $$ JOB JNM=NATJOBS ,CLASS=0 ,DISP=D ,LDEST=* ,SYSID=1
* $$ LST CLASS=A,DISP=D
// JOB NATJOBS
// ASSGN SYS005,IGN
// ASSGN SYS006 ,cuu ,VOL=Tnnnnn
// MTC REW ,cuu
// MTC FSF,SYS006,nn
* Tape positioned at tape mark nn
* *** NOW PROCESSING NVSnnn.LIBR - SUBLIBRARY NVSnnnJ ***
// EXEC LIBR,PARM='MSHP'
RESTORE SUBLIB=SAGLIB.NVSnnnJ : SAGLIB.NVSnnnJ -
TAPE=SYS006 -
LIST=YES -
REPLACE=NO
/*
// MTC REW ,SYS006
/*
/&
* $$ EOJ
```

**Notation:**

<i>cuu</i>	represents the physical unit address of the tape drive.
<i>nn</i>	represents the file sequence number as shown in the Report of Tape Creation.
<i>nnn</i>	represents the version number of the product.

If you are not using System Maintenance Aid, adapt and run job NVSTAPE to copy the dataset from tape to disk. NVSTAPE is contained in sublibrary NVS*nnn*J on the Natural installation tape.

The dataset type and the space it requires on disk are shown in the Report of Tape Creation.

## Installation Procedure - OS/390 and VSE/ESA

To install NVS under the operating systems OS/390 and VSE/ESA, perform the following steps:

### Step 1: Define CICS RDO Definitions - Job I005

Define CICS RDO Definitions for sample VSAM files.

### Step 2: Prepare NVS Demo File - Job I008, Steps 1403 to 1407

Load the VSAM demo file EMPL (dataset NVS*nnn*.EMPL). Define the alternate index path EMPLX for the file EMPL.

### Step 3: Create NVS Parameter Module - Job I055, Steps 1400 and 1401

Edit, assemble, and link the NVS parameter module NVSPARM. See Assembling the NVSPARM Parameter Module in the section Parameters, for a description of the parameters which can be specified.

### Step 4: Create NVS I/O Module - Job I055, Steps 1410 and 1411, or Job I070, Step 1400

Assemble and link the NVS I/O module.

- If you install NVS under CICS, use the I/O module NVSCICS; for this module, use Job NVSI070 (Step 1400).
- If you install NVS under Com-plete, the I/O module NVSMISC must be assembled by using the parameter SMARTS=YES (Steps 1415 and 1416). See also SMARTS in the section Parameters.
- If you install NVS in any other environment, use NVSMISC. See the description of the parameters which can be specified in NVSMISC.

**Note:**

Under CICS versions below 5.3, the precompile step receives Condition Code 12, since new COMMAND level options are used depending on the CICS version applied. The corresponding assembly step must be finished with Return Code 0. This is normal and can be ignored.

### Step 5: Adapt all Natural Parameter Modules - Jobs I060, I080

Modify the appropriate I060 and I080 jobs according to the TP monitor or batch modules you are relinking; for example, NATI060 for batch, NCOI080 for Com-plete and NCII080 for CICS. This applies also to Relink all Natural Nuclei below.

Add the following parameter and macro call to your Natural parameter modules:

```
VSIZE=72
NTDB VSAM, vsam-dbid
```

The value for VSIZE depends on the values specified in NVSPARM (see also the SIZE Parameter in the section Parameters).

## Step 6: Relink all Natural Nuclei - Jobs I060, I080

For information on the components and structure of the Natural interface to VSAM, see also Components of Natural for VSAM and Structure of the Natural Interface to VSAM in the section General Information.

Add the following INCLUDE instruction in all links of the shared nucleus:

Platform	Instruction
OS/390	INCLUDE NVSLIB(NVSNUC)
VSE/ESA	INCLUDE NVSNUC

Add the following INCLUDE instruction in all links of the front-end:

Platform	Instruction
OS/390	INCLUDE SMALIB(NVSPARM)
VSE/ESA	INCLUDE NVSPARM

Add the following INCLUDE instruction in the link of the front-end in a CICS environment:

Platform	Instruction
OS/390	INCLUDE SMALIB(NVSCICS)
VSE/ESA	INCLUDE NVSCICS

Add the following INCLUDE instruction in the link of the front-end in any other supported environment (except CICS):

Platform	Instruction
OS/390	INCLUDE SMALIB(NVSMISC)
VSE/ESA	INCLUDE NVSMISCD

Add the following INCLUDE instruction in the link of the front-end under OS/390 in any other supported environment (except CICS) if RLS=CHECK is specified in NVSPARM:

Platform	Instruction
OS/390	INCLUDE CSSLIB (IGWARLS)

The routine IGWARLS is a callable service to support RLS processing. It resides in the system library SYS1.CSSLIB. Add the corresponding DD statement to the link step.

Platform	Instruction
OS/390	Add the corresponding DD statements to the link step for Natural and link-edit the executable module.
VSE/ESA	Add the corresponding sublibrary for NVS to the search chain for the linkage editor and link-edit the executable module.

## Step 7: Load Examples - Job I061, Step 1400

Use the system command INPL to load the NVS example programs (dataset NVS $nnn$ .EXPL) into the Natural system file.

## Step 8: Customize your TP Monitor

TP Monitor	Instruction
CICS	Add the entries for the NVS test files EMPLVS and EMPLVX to your RDO definition as described in Define CICS RDO Definitions above; you can find the CICS tables on the JOBS dataset as NVSI005.
Com-plete	Catalog all VSAM files to Com-plete using the CA function of the Com-plete utility UFILE.  If you have specified PATH=CHECK in NVSPARM:  <ol style="list-style-type: none"> <li>1. Catalog your front program to Com-plete using the CA function of the Com-plete utility ULIB with a region size of 40 KB if you have not changed the first default value of the WPSIZE parameter in the Natural parameter module. Under VSE/ESA, you must also catalog the front program as privileged.</li> <li>2. Load the IBM routine IGG0CLA0 either in the LPA or as resident program using the Com-plete utility UCTRL under OS/390.</li> </ol>
TSO	Add the following ALLOC statements to your Natural CLIST:  <pre>ALLOC F(EMPLVS) DA('SAGLIB.VSAM.EMPL') SHR ALLOC F(EMPLVX) DA('SAGLIB.VSAM.EMPLX.PATH') SHR</pre>

## Installation Verification - OS/390 and VSE/ESA

To verify whether the installation has been successfully performed, log on to the library SYSEXNVS and run the following programs:

- NVSINST1
- NVSINST2
- NVSINST3
- NVSINST4
- NVSINST5
- NVSINST6

If all these programs can be executed successfully, the installation of Natural for VSAM is completed and verified.

### Note for OS/390 batch mode:

For verification in batch mode under OS/390, you can run the job NVSI200 which executes the above programs.

# Natural for VSAM - Operation

This section provides information on various operational aspects of Natural for VSAM:

- Invoking Natural for VSAM
  - OPEN/CLOSE Processing
  - Natural File Access
  - Buffers for Memory Management
  - User Exits
- 

## Invoking Natural for VSAM

If the Natural interface to VSAM is available, it is initialized when you start a Natural session. It can be switched off by setting the VSIZE parameter to 0 (see also the relevant description in the section Parameters).

## OPEN/CLOSE Processing

In this section, VSAM files means both VSAM user files and VSAM Natural system files.

Database OPEN/CLOSE processing is controlled by the Natural parameter OPRB, which is described in Profile Parameters in the Natural Parameter Reference documentation.

Instead of using the OPRB parameter, you can also use the NTOPRB macro of the Natural parameter module, which is described in Parameter Modules in the Natural Parameter Reference documentation.

An OPEN/CLOSE error must be followed by the NAT3539 error message. In a TP environment, the NAT3516 error message can also occur during an active Natural session if the file is closed.

**Note:**

For dynamic OPEN handling within a session, you can use the user exit USR2008N.

The section below covers the following topic:

- OPRB Parameter for VSAM Databases

## OPRB Parameter for VSAM Databases

The OPRB parameter is not applicable under CICS or Com-plete, because in these environments, the TP monitor controls the OPEN/CLOSE processing of VSAM files.

By default, that is, without the OPRB parameter being specified, VSAM files are opened for input/output so that they can be read and/or updated.

If you want all used VSAM files to be opened for input only, you specify the OPRB parameter using the following syntax:

**OPRB = (.ALL)**

With this syntax, you specify an OPEN request for **all** VSAM files to be addressed. All files are opened for input only; individual files, however, are only opened when they are actually addressed by a given program.

**Note:**

If you want all VSAM system files to be opened for input, you have to set the Natural profile parameter ROSY=ON; see also the relevant section in the Natural Parameter Reference documentation.

If you want to open VSAM files for input (I) or output (O) per DBID, use the following syntax:

**OPRB = ( DBID = *nnn*, { MODE = { I } [ , *string*; ... ] } [ , ... ] )**  
*string*; ...

With MODE, you specify a global default handling for DBID *nnn*.

If you do not want to specify a default handling per DBID or if, for some VSAM files, you want an input/output handling other than the default one, you specify the *string* parameter in the appropriate way.

The DBID must be defined with the NTDB macro as a VSAM DBID, and *string* varies depending on the operating system (see below).

**Important:**

If several strings are to be defined, a semicolon (;) must be specified as delimiter character. If not, the semicolon must be omitted.

**Under OS/390**

Under OS/390, you specify the *string* as follows:

$$\left\{ \begin{array}{l} \text{FNR} = nnn \\ \text{DD} = dd\text{-name}, \text{TYP} = \end{array} \left\{ \begin{array}{l} \text{K} \\ \text{E} \\ \text{R} \\ \text{P} \end{array} \right\} \right\}, \left\{ \begin{array}{l} \text{O} \\ \text{I} \end{array} \right\}, \left\{ \begin{array}{l} \text{B} \\ \text{A} \end{array} \right\}$$

The specified VSAM files must be defined as DDMs. However, instead of specifying the file number of the Natural DDM that corresponds to the VSAM file to be addressed, the *dd-name* and type (**K**SDS, **E**SDS, **R**RDS, or **P**ATH) of this file can be specified directly, which saves you from having to look into the DDM first.

Individual files can be opened for output (option **O**), input (option **I**), opened **before** they are actually accessed (option **B**), or when they are accessed for the first time (option **A**).

For performance reasons, it is sometimes desirable to modify the VSAM STRNO (string number) parameter to provide more index and data buffers. By default, Natural uses string number 3 for input processing and string number 5 for output processing. Since STRNO is specified in the JCL, both values can be modified with the AMP parameter in the corresponding DD card.

**Under VSE/ESA**

Under VSE/ESA, no string number can be specified in the JCS. Therefore, the syntax has been enhanced to be able to specify a string number with the OPRB parameter, where *nm* can be in the range from 1 to 10. Thus, *string* represents:

$$\left\{ \begin{array}{l} \text{FNR} = nnn \\ \text{DD} = dd\text{-name}, \text{TYP} = \end{array} \left\{ \begin{array}{l} \text{K} \\ \text{E} \\ \text{R} \\ \text{P} \end{array} \right\} \right\}, \left\{ \begin{array}{l} \text{O} \\ \text{I} \end{array} \right\}, \left\{ \begin{array}{l} \text{B} \\ \text{A} \end{array} \right\}, [\text{STRNO} = nm]$$

### Sample OPRB Specification

The following OPRB example opens the specified files for input, while files not specified are opened for output by default:

```
OPRB=( DBID=254 ,MODE=I )
```

or

```
OPRB=( DBID=254 ,FNR=21 , I , A ; FNR=22 , I , A )
```

The VSAM DBID and FNR as specified in the DDM are required. Option **I** specifies the corresponding FNR to be opened for input; option **A** specifies the corresponding FNR to be opened only if the file is accessed by a Natural program.

The corresponding NTOPRB example would be:

```
NTOPRB 254 , 'MODE=I '
```

or

```
NTOPRB 254 , ' FNR=21 , I , A ' ; ' FNR=22 , I , A '
```

## Natural File Access

The Natural interface to VSAM supports VSAM entry-sequenced datasets (ESDS), key-sequenced datasets (KSDS), relative record datasets (RRDS), variable relative record datasets (VRDS), and paths for alternate indexes.

To enable Natural to access VSAM files, a Natural DDM is required for each VSAM file that is to be made accessible to Natural programs.

The section below covers the following topics:

- Natural Data Definition Modules - DDMs
- SYSDDM Main Menu
- Catalog DDM
- Edit DDM
- Restrictions with DDM Generation as Compared to Adabas

### Natural Data Definition Modules - DDMs

A DDM (data definition module) must be set up for each file. DDMs are created and maintained with Predict (see the Predict documentation for details) or with the Natural utility SYSDDM; they are stored in the Natural dictionary system file (FDIC).

With VSAM, in addition to logical Natural DDMs, also VSAM user DDMs can be created from one physical DDM.

If you do not have Predict installed, use the SYSDDM utility to generate DDMs from VSAM files. The SYSDDM utility is described in the Natural Utilities documentation; the parts of it relevant to VSAM are described in the following sections.

All DDMs used within a session are located in the Natural buffer pool. This increases performance and enables synchronization of DDM usage across multiple sessions.

## SYSDDM Main Menu

The following functions on the main menu of the SYSDDM utility are relevant to Natural for VSAM:

Function	Explanation
Catalog DDM	<p>The DDM currently in the work area is cataloged, making it available for use within Natural applications. The DDM must have previously been placed in the work area by a READ command, or have been entered by using the Edit DDM function described below.</p> <p>Below are further details about Catalog DDM.</p>
Edit DDM	<p>Reads a DDM from the system file FDIC and into the SYSDDM work area, where it can be edited.</p>
List services	<p>Lists a DDM. The DDM listed is not read into the work area as a result of this function. The display format and options are identical to those of the LIST DDM command.</p> <p>If no DDM name is entered, the List Services Menu is displayed; see the section SYSDDM Utility in the Natural Utilities documentation for further details.</p>
Copy DDM to other database/file	<p>One or all DDMs can be copied to a different Natural system file (FDIC) and/or to a different database. This is, for example, necessary during conversion of a Natural application from test to production status.</p> <p>In addition to the DDM name, DBID and FNR, with Natural for VSAM the file type <b>V</b> must be specified, as well as the DD/FCT name of the Natural system file FDIC, if the FDIC file is a VSAM file.</p> <p><b>Note:</b> The SYSDDM Copy function is supported for compatibility reasons only and will no longer be available in a future version. It is, therefore, recommended that you use the Copy function of the SYSMAIN utility, as described in the section SYSMAIN Utility in the Natural Utilities documentation.</p>
List DDMs with Additional Information	<p>Displays a list of the DDMs stored in the specified FDIC system file. From the list, you can select individual DDMs for further processing. This function differs from the List DDMs function in that it displays additional items of information on the individual DDMs.</p> <p>The information displayed includes file name, DBID, file number, DDM length, security type (with Natural Security only), file type (that is, LOG.DDM, PHY.FILE, LOG.FILE or USERDDM for VSAM DDMs) and remarks as, for example, the VSAM file organization (KSDS, VRDS, RRDS, ESDS); see the section SYSDDM Utility in the Natural Utilities documentation for details.</p>
Uncatalog DDM	<p>Deletes a previously cataloged DDM from the Natural system file FDIC. The DDM remains in the work area.</p> <p><b>Important:</b> If a DDM is uncataloged with SYSDDM, the corresponding Natural Security file profile is automatically deleted.</p>

The following parameters relevant to Natural for VSAM can be specified for the various functions:

Parameter	Explanation
DDM Name	The name of the DDM to be processed.
FNR	The file number of the DDM to be processed.
DBID	The database which contains the DDM to be processed.
Replace	If <b>Y</b> is entered, DDMs which are being copied or cataloged and which are already existent are replaced. If <b>N</b> is entered, such DDMs are not replaced.
System file type / Type of this DDM	The type of the system file / DDM. For VSAM, the type must be <b>V</b> .

## Catalog DDM

A DDM can be cataloged by either using Function Code **C** in the SYSDDM main menu or entering the CATALOG command in the command line of the DDM maintenance editor.

File name and file number are required for this function. With Natural for VSAM, a DBID assigned to VSAM must be specified. If no DBID is entered, it is assumed to be **0** and is generated dynamically at execution time based on the DBID of the Natural user system file (FUSER) in use (see also the description of the UDB parameter in the section Profile Parameters in the Natural Parameter Reference documentation).

If a DBID assigned to VSAM is specified (and **V** for VSAM in the field "Type of this DDM"), SYSDDM prompts you for additional information.

### Note:

The actual DBID assignments for VSAM is made with NTDB macros when assembling NATPARM; see Installation Procedure for OS/390 and VSE/ESA for details.

### Additional Options for VSAM Files

If the DDM is to access a VSAM file, an additional screen, requiring the entry of additional VSAM options, is displayed:

```

11:24:04          ***** NATURAL SYSDDM UTILITY *****                2001-01-29
                    - Catalog a VSAM file/DDM -
      DBID 254   FNR  12      DDM AUTOMOBILES-VS                      Def seq
-----
VSAM file information

VSAM file name ..... AUTO
VSAM View .....(Y/N) N
Logical related to FNR ....
User defined prefix .....

VSAM file organization

KSDS, ESDS, RRDS, VRDS (K,E,R,V) .. K

Compress file .....(Y/N) N
Zones X'0C' / X'0F' (C/F) F

```

The additional options for VSAM files consist of two parts: VSAM File Information and VSAM File Organization.

## VSAM File Information Options

Option	Explanation
VSAM File Name	<p>The DDNAME/FCT entry as defined to the TP monitor or when using batch mode, for example:</p> <pre data-bbox="437 510 651 533">//PERSON DD . . .</pre> <p>where PERSON would be entered under VSAM File Name.</p>
VSAM DDM	<p>Indicates whether this DDM represents a logical user DDM or a physical DDM.</p> <p><b>Y</b> Indicates that the DDM represents a logical DDM, which means that it does not necessarily correspond to the physical layout of the VSAM file. A logical DDM must use the same file number as the physical DDM from which it is derived, and the corresponding physical DDM must exist at the time the user DDM is invoked during execution. The short names of the logical DDM must be identical to those defined in the physical DDM. The sequence of fields within the DDM can be different from the physical sequence. The primary-key field must not be deleted from the DDM.</p> <p>Since the logical DDM is a subset of the physical DDM, the corresponding subsets of the underlying VSAM file appear to the user as independent files with different record layouts. When processing a logical DDM, the user obtains records only from the corresponding subset and not from any other subset contained in the same physical VSAM file.</p> <p><b>N</b> Indicates that the DDM represents a physical DDM. Only one DDM with a given file number can be used as the physical DDM for a VSAM file. This physical DDM is used internally by Natural to calculate field offsets.</p>

Logical DDMs are used to define different record types in a physical VSAM file. At DDM generation, these record types are identified by specifying a prefix for the primary key.

If a logical DDM is read, only records whose key begins with the specified prefix are returned from the VSAM file. Records beginning with any other prefix are ignored. If not specified otherwise, the prefix corresponds to the logical file number.

A different prefix must be assigned to each logical DDM. Natural automatically links the prefix with the logical key. The field layout in the logical DDM need not be the same as in the physical DDM.

The following two options are used only if the DDM represents a logical file which is to be derived from a physical VSAM file.

Option	Explanation
Logical Related to FNR	<p>This option is used to enter the file number of the physical DDM from which the logical file or DDM is derived.</p> <p>A logical DDM corresponds to a record type which is controlled by a prefix. Several logical record types can be contained in a physical VSAM file. The record types are distinguished by a prefix which determines which records are to be processed. See the example below.</p>
User-Defined Prefix	<p>The prefix value which is to be assigned for the logical file.</p> <p>The default prefix value is the logical file number (length 3).</p>

**Example of Logical Related to FNR**

```
Physical Dataset

Key

{ X1234X2345X3456 } DDM1 PREFIX = X FNR = 10
{ Z1234Z1209Z9000 } DDM2 PREFIX = Z FNR = 11

Read DDM1 with keyDisplay key

results in:

Key123423453456
```

**VSAM File Organization Options**

Option	Explanation
KSDS ESDS RRDS VRDS	<p>The type of VSAM file:</p> <p>K KSDS file (default)</p> <p>E ESDS file</p> <p>R RRDS file</p> <p>V VRDS file</p>
Compress File	<p>Specifies whether the file is to be compressed or not. The default is N.</p> <p>N Indicates that the file is not to be compressed. The file is written in the maximum length (that is, the length of all fields within this file) as defined in SYSDDM or Predict.</p> <p>Y Indicates that the file is to be written in variable record length. During compression, the record is scanned backwards for default values, which are blank for alphanumeric fields, low values for binary fields, low values with a zone for packed fields and X'F0' for numeric fields. Compression stops as soon as the first non-default value is detected or the first descriptor is found. The new computed length is used to write the record to the file; this applies to KSDS and ESDS files only.</p> <p>Compression of trailing null values in VSAM records minimizes the space required for VSAM records. The user exit USR0100N in the library SYSEXT is provided to be able to maintain the logical record length by a Natural program.</p>
ZONES X'0C' / X'0F'	<p>In Adabas all positive packed values have X'0F' as a zone. This value could be different in VSAM.</p> <p>F Indicates that all packed data are written to the VSAM file with the zone X'0F'. This is the default.</p> <p>C Indicates that all packed values are written to the VSAM file with the zone X'0C'.</p> <p>The Option can be nullified, if PSIGNF=ON in NVSPARM is specified. For more information, see the macro NTCMPO in the Natural Parameter Reference documentation.</p>

## Edit DDM

To edit the DDM currently loaded in the work area, you can use the DDM editor of the SYSDDM utility. If no DDM has been read into the work area, an empty screen is displayed, allowing the manual entry of a DDM definition.

Instead of entering a complete DDM manually, you can read an existing DDM definition into the work area, by entering "EDIT *DDMname*" in the DDM editor command line. This DDM can be modified and cataloged under a different name.

### Note:

When you modify a DDM, all objects which reference this DDM have to be cataloged again.

## DDM Editor

```

11:26:09                ***** EDIT DDM (VSAM) *****                2001-01-29
DDM Name EMPLOYEES-VS                Def.Seq.                DBID  254 FNR    1
Command
I T L DB Name                F Leng  S D Remark
----- top -----
  1 AA PERSONNEL-ID                A 8.0    P
*          C=NNNNNNNN
*          C=COUNTRY
G 1 AB FULL-NAME
  2 AC FIRST-NAME                A 20.0  N
  2 AD MIDDLE-NAME                A 20.0  N
  2 AE NAME                        A 20.0  A
  1 AF MAR-STAT                    A 1.0    F
*          M=MARRIED
*          S=SINGLE
*          D=DIVORCED
*          W=WIDOWED
  1 AG SEX                          A 1.0    F
  1 AH BIRTH                        N 6.0
G 1 A1 FULL-ADDRESS
M 2 AI ADDRESS-LINE                A 20.0  N
  2 AJ CITY                        A 20.0  N
    
```

If you enter the HELP command or a question mark in the command line, the editor help information is displayed.

The header information of the DDM editor is:

DDM	The name used to reference the DDM in a Natural program. The name must be unique within the specified Natural system file.
Def. Seq.	The default sequence by which the file is read when it is accessed with a READ LOGICAL statement in a Natural program.
DBID	<p>The database in which the file to be accessed with the DDM is contained.</p> <p>With Natural for VSAM, a DBID assigned to VSAM must be specified. If <b>0</b> is specified, the default DBID for the Natural user system file (FUSER) as defined in the Natural parameter module is used.</p> <p><b>Note:</b> The actual DBID assignments for VSAM are made with NTDB macros when assembling NATPARAM; see Installation Procedure for OS/390 and VSE/ESA in the section Installation for details.</p>
FNR	<p>The number of the file being referenced.</p> <p>The specified file number is used internally by Natural for VSAM.</p>

The DDM itself comprises the following field definition attributes which can be entered or modified:

Attribute	Explanation
I	Line indicator. This field is used by the DDM editor to mark lines.  E Lines containing an error detected during execution of the CHECK command.  S Lines containing a scanned value.  X/Y Lines selected for copy/move operation.
T	Field Type:  G Group header.  M Multiple-value field.  P Periodic group header.  * Comment line.  <i>blank</i> Elementary field.
L	Level number assigned to the field. Valid level numbers are 1 - 7. Level numbers have to be specified in consecutive ascending order.
DB	For VSAM files, the two-character code which is used in VSAM.
Name	A 3- to 32-character external field name. This is the field name used in Natural programs to reference the field.
F	Field format. For valid formats, refer to Definition of Format and Length in the section User-Defined Variables in the Natural Statements documentation.
Leng	Standard field length. This length can be overridden in a Natural program. For numeric fields (format N), the length is specified as <i>nn.m</i> , where <i>nn</i> represents the number of digits before the decimal point and <i>m</i> represents the number of digits after the decimal point.
S	This attribute is not applicable to Natural for VSAM.
D	Descriptor Option.  A Indicates that the field is an alternate index for a VSAM file.  P Indicates that the field is a primary key.  S Indicates that the field is a primary subdescriptor or superdescriptor; that is, a primary key for a VSAM file.  X Indicates that the field is an alternate subdescriptor or superdescriptor; that is, an alternate index for a VSAM file.
Remarks	A comment which applies to a field and/or the DDM.

Most of the editor and line commands available with the Natural program editor also apply to the Natural DDM editor. Special commands, such as PROFILE, RENUMBER, SET, SHIFT etc. and some line commands are not available. Refer to the section SYSDDM Utility of the Natural Utilities documentation and to the section Program Editor in the Natural Editors documentation for more details on editor commands.

### Extended Editing at Field Level

The DDM editor can also be used to enter or modify DDM definitions at field level.

Extended editing mode is used to specify field headers and edit masks to be applied when the field is used in a DISPLAY or INPUT statement, as well as further specifications for VSAM DDM definitions. All the other information specific to the field (field type, length, name, format, remarks) can also be modified at this point.

The extended editing mode is invoked by entering the line command **.E** in the first positions of the line containing the field.

A range of field definitions can be selected for editing by entering **.Ennn** where *nnn* is the number of fields to be selected.

The field level editing mode is terminated when you press ENTER with or without having made any modifications.

The Extended Field Editing screen displays special attributes of the field definition if the edited DDM is a VSAM DDM:

```

11:25:26          ***** EDIT DDM (VSAM) *****          2001-01-29
                    - Extended Field Editing -
DDM Name AUTOMOBILES-VS          Def.Seq.          DBID  254 FNR  12

I T L DB Name          F Leng  S D Remark
----- top -----
  1 GA OWNER-PERSONNEL-NUMBER          N 8.0    A SECONDARY KEY
-----

Field Header ..... OWNER/NUMBER_____
Field Edit Mask ..... _____

Alternate Index Name .. AUTOY___

Maximum Occurrence .... 1

Upgrade Flag ..... _ (X)
Unique Key Flag ..... _ (X)
Null Flag ..... _ (X)

Field GA redefines field ___ with offset 0
    
```

The following attributes can be specified:

Attribute	Explanation
Alternate Index Name	If the field references a VSAM alternate index or a path (denoted by an <b>A</b> in column <b>D</b> ), the index or path name must be entered here.
Maximum Occurrence	The number of occurrences for a multiple-value field or a periodic group (denoted by an <b>M</b> or <b>P</b> in column <b>T</b> ).
<b>The following flags only apply to alternate indexes and not to paths.</b>	
Upgrade Flag	<p>Since Natural does not use VSAM paths, upgrading can be performed either by Natural or by VSAM when using a KSDS or ESDS file with alternate indices defined.</p> <p>A blank value indicates that upgrading the alternate index is to be done by VSAM, which is the default. If VSAM is to perform the upgrading, define the VSAM file using IDCAMS with UPGRADE.</p> <p>If you enter an <b>X</b>, upgrading of the alternate index is performed by Natural. If so, the AIX must be defined with the NONUPGRADE option.</p> <p><b>Note:</b> For LSR handling, it is recommended that you specify this option. Under CICS, the FCT entry must also contain the VARIABLE option.</p>
Sort Flag	<p>If this option is marked with an <b>X</b>, the alternate index is to be read in ascending or descending value order.</p> <p>This option only takes effect if the Upgrade Flag option is specified, too.</p>
Unique Key Flag	<p>If this option is marked with an <b>X</b>, Natural ensures that the values of the alternate index field are unique. An attempt to update with a non-unique value results in an error message. The default value is a blank.</p> <p>This option only takes effect if the Upgrade Flag option is also specified.</p>
Null Flag	<p>A value of <b>S</b> indicates that null values for the alternate index field are suppressed. The default value is a blank.</p> <p>This option only takes effect if the Upgrade Flag option is also specified.</p>

**Note:**

For all DDMs cataloged with Natural which contain alternate indexes and any specifications for the above flags, all flags are nullified during runtime as soon as path processing is activated for these DDMs.

The last two fields on the screen are used to define sub-/superdescriptors for a VSAM file. For example, to define the field S1 as superdescriptor beginning in field BA and ending in field BB, the following would be entered:

**S1 redefines BA with offset 0**

The field S1 must have been defined to VSAM as a primary or secondary key.

VSAM superdescriptors can only be constructed from fields which are contiguous. To define the field S2 as a superdescriptor which begins in the 11th position of field BA and ends with the first two positions of field BB, the following would be entered:

**S2 redefines BA with offset 10**

In addition, the length of S2 would have to be set to 7. As mentioned above, S2 must have been defined as a primary or alternate index to VSAM.

## Restrictions with DDM Generation as Compared to Adabas

- No keys can be defined within periodic groups.
- Descriptors that contain multiple-value fields are not allowed with VSAM.
- Natural DDMs for VSAM cannot contain multiple-value fields or periodic groups **within** periodic groups.
- The same field cannot be defined more than once in the same DDM. A data definition as in the following example would lead to unpredictable results when used with VSAM:

**Example:**

```

...
G 01 AB FULL-NAME
      02 AC FIRST-NAMEA 20.0 N
      02 AD MIDDLE-I           A 1.0 N /* duplicate short name
      02 AE NAME               A 20.0
      01 AD MIDDLE-NAME        A 20.0 N /* duplicate short name
...

```

Natural would treat the field MIDDLE-I not as a redefinition of MIDDLE-NAME but as a separate field.

## Buffers for Memory Management

The VSIZE parameter is suballocated into ten different areas whose sizes are determined by the assembly of NVSPARM. The different VSAM areas are split into fixed and variable buffer types. If there is insufficient space in the VSIZE buffer for all NVSPARM areas, you receive error message NAT3592 during initialization. At runtime, error message NAT3513 can occur for fixed buffer types. In this case, you must adapt the corresponding NVSPARM value.

Variable buffers are increased during runtime, NAT3513 does not occur.

Some buffer sizes depend on the use of VSAM system files. The relevant buffers are FCT, FWA, TSA and UPD.

The VSIZE parameter is suballocated as follows:

- FCT - File Control Table
- FWA - File Work Area
- OPV - Open Table
- SFT - System File Table
- SWT - Switch Table
- TAF - Table of Accessed Files
- ROLL - Table of Session Status Information
- DFB - Table of Decoded Format Buffers
- TSA - Table of Sequential Access
- UPD - Table of Update Records
- VCA - Natural Control Area for VSAM

### FCT - File Control Table

FCT contains file-specific information and is a fixed buffer type.

FCT also contains the complete VSAM access control block (ACB), information on existing user exits, and information on the Natural CALLNAT interface USR0100N.

The size of the table is determined by using the following formula and then rounding up to a double-word boundary:

$$(72 + ACB-length) (TAFE * 2) + 80$$

Without VSAM system files, the default setting is:

$$(72 + 76) (10 * 2) + 80 = 3040$$

With VSAM system files, the default setting is:

$$(72 + 76) (26 * 2) + 80 = 7776$$

FCT and SWT (see below) share a common buffer area.

## FWA - File Work Area

FWA contains information on a VSAM request and is a fixed buffer type.

FWA also contains information on the VSAM request parameter list (RPL).

The size of the table is determined by using the following formula and then rounding up to a double-word boundary.

$$(40 + RPL\text{-}length) (TAFE * 2) + 80$$

Without VSAM system files the default setting is:

$$(40 + 76) (10 * 2) + 80 = 2400$$

With VSAM system files the default setting is:

$$(40 + (76*4)) (26 * 2) + 80 = 17968$$

FWA and OPV (see below) share a common buffer area.

## OPV - Open Table

OPV contains information on an OPRB string and is a fixed buffer type.

The size of the table is determined by using the following formula and then rounding up to a double-word boundary:

$$24 * (TAFE * 2) + 48$$

The default setting is :

$$24 * (10 * 2) + 48 = 528$$

OPV and FWA (see above) share a common buffer area.

## SFT - System File Table

This table is only active if VSAM system files are defined. The buffer type is fixed.

This area contains the description of the VSAM system files FNAT, FUSER, FDIC, FSEC and FSPOOL as well as the system file used by Natural ISPF, if available.

The size of the area is 8192 for SFILE=ON. The default setting is 0.

## SWT - Switch Table

SWT contains information necessary for the USR1047P user exit for dynamic DD/DLBL modification. SWT is allocated only if the value specified for the parameter DDSWITE in NVSPARM is greater than 0.

The SWT buffer type is fixed.

The size of the table is determined by using the following formula and then rounding up to a double-word boundary:

$$24 * DDSWITE + 48$$

The default setting is 0.

SWT and FCT (see above) share a common buffer area.

## TAF - Table of Accessed Files

This area describes the record layout for each file accessed by Natural; it is created by reading the physical or logical DDM for the file. Each TAF entry consists of a header entry and an entry for each field in the DDM. The header entry describes the type of file, file name, primary key, etc. The field entries describe the format, offset, and length of every field in the file. The layouts for the header and field entries are described in the macros NVMTAF and NVMFLD respectively.

The TAF buffer type is fixed.

The size of the table is determined by using the following formula and then rounding up to a double-word boundary:

$$(((32 * TAFN) + 112) * TAFE) + 80$$

The default setting is:

$$(((32 * 50) + 112) * 10) + 80 = 17200$$

## ROLL - Table of Session Status Information

This table is used to keep track of the position within a file for every active FIND or READ statement; it is identified by the CID. This allows Natural to release all VSAM resources during a ROLLOUT operation and then reposition itself correctly after a ROLLIN operation.

The ROLL buffer type is fixed.

The size of this area is determined by the parameter ROLLSIZ in the NVSPARM module, rounded up to a double-word boundary:

$$\text{TAXSIZE} + 80$$

The default setting is:

$$550 + 80 = 632$$

## DFB - Table of Decoded Format Buffers

The table is suballocated into two areas, one for global format IDs (GFIDs) and one for command IDs (CIDs).

For any given I/O request, this area describes which fields from the VSAM record area are returned to the Natural record buffer. Each DFB (decoded format buffer) entry consists of one header, identified by the CID or the GFID of the I/O request, plus an entry for each field to be returned to Natural. Each field entry in the DFB contains the format, offset, and length of the field as derived from the associated TAF entry for the file. The layouts of the header and field entries are described in the macros NVMDFB and NVMDFF respectively.

The DFB buffer type is fixed. If the no-space-condition occurs for GFID-oriented entries, the oldest entries are deleted.

The size of the TDFB area is determined by using the following formula and then rounding up to a double-word boundary:

$$(16 * \text{DFBN} * 2 + 36) * \text{DFBE} * 2 + 128$$

The default setting is:

$$(16 * 50 * 2 + 36) * 10 * 2 + 128 = 32848$$

## TSA - Table of Sequential Access

The TSA is used to keep important pointers and information on each READ/FIND statement. There is one TSA entry for each active READ and FIND statement, and each entry is identified by the CID. The layout of the TSA is described in the macro NVMTSA.

The TSA buffer type is variable.

The size of the area is determined by using the following formula and then rounding up to a double-word boundary:

$$(104 + \text{KEYLGH}) * \text{TSAE} + 80$$

The default setting is:

$$(104 + 32) * 10 + 80 = 1440$$

## UPD - Table of Update Records

This area contains an entry for every READ or FIND loop that contains an UPDATE or DELETE statement. These entries are released when an END TRANSACTION or BACKOUT TRANSACTION statement is executed. Each entry contains control information about the record and the values of all the fields that might be updated within the loop. The layout of each UPD entry is described in the macro NVMUPD.

The UPD buffer type is variable.

The size of the UPD area is determined by the parameter UPDL in the NVSPARM module, rounded up to a double-word boundary.

The default setting is 8272 without VSAM system files and 32848 with VSAM system files.

## VCA - Natural Control Area for VSAM

VCA is a fixed length area which contains pointers, addresses, flags, and work areas that are important to a Natural environment for VSAM. The layout for this area is described in the macro NVMCA. Within a Natural environment for VSAM, R3 always points to this area.

The size of this area is 6600 bytes.

## User Exits

Natural for VSAM provides the following user exits in the library SYSEXT:

User Exit	Function
USR0100N	Controls the VSAM variable record length (LRECL).
USR1047N	Supports dynamic switching of DD/DLBL names defined in a DDM.
USR2008N	Supports dynamic OPEN calls for VSAM datasets.

A short description of the user exits is provided in the following section; for more detailed information, log on to the library SYSEXT and display the desired exit(s).

Below is information on:

- User Exit USR0100N
- User Exit USR1047N
- User Exit USR2008N

## User Exit USR0100N

USR0100N controls the record length of variable VSAM files.

The user exit is invoked as follows (a sample program called USR0100P is provided in the library SYSEXT):

```
CALLLNAT 'USR0100N' parm1 parm2 parm3 parm4 parm5
```

The parameters are described in the following table:

Parameter	Format/Length	Explanation
<i>parm1</i>	A1	Specifies either of the following function codes:  G For retrieval statements; the current record length is determined for <i>parm5</i> .  P For update/store statements; the length specified in <i>parm5</i> becomes the current record length.
<i>parm2</i>	A8	Specifies the DD/DLBL name for the current file (optional); if specified, <i>parm5</i> is only valid for this file.
<i>parm3</i>	N5	Specifies the DBID taken from the DDM (optional); is used instead of the DD/DLBL name and only in conjunction with <i>parm4</i> .
<i>parm4</i>	N5	Specifies the FNR taken from the DDM (optional).
<i>parm5</i>	N5	Specifies or returns the record length depending on the setting of <i>parm1</i> .

**Note:**

If neither *parm2* nor *parm3* and *parm4* are specified, *parm5* is valid for all files.

## User Exit USR1047N

USR1047N enables dynamic modification of DD/DLBL names within a Natural program if the DDSWITE parameter is specified in NVSPARM. It can be used if data are spread over several VSAM files which have different DD/DLBL names, but the same record structure.

The user exit is invoked as follows (a sample program called USR1047P is provided in the library SYSEXT):

```
CALLNAT 'USR1047N' parm1 parm2 parm3 parm4
```

The various parameters are described in the following table:

Parameter	Format/Length	Explanation
<i>parm1</i>	A1	Specifies either of the following function codes:  S For switching of DD names with the next following database calls. R For resetting of DD names; the switch table entry of function S has been deleted (see SWT - Switch Table).
<i>parm2</i>	A8	Specifies the old DD name taken from the DDM.
<i>parm3</i>	A8	Specifies the new DD name for the next database calls.
<i>parm4</i>	P4	Return code of Natural for VSAM.

The parameter *parm4* can contain the following response codes:

Code	Explanation
0	Normal return.
4	The switch table (SWT) is too small; increase the DDSWITE parameter.
8	The switch table entry has not been found; program error.
12	Invalid function code.
16	The switch table is not allocated; that is, the DDSWITE parameter is set to 0.

## User Exit USR2008N

This user exit is not applicable under Complete and CICS.

USR2008N supports dynamic OPEN calls during a Natural session if OPSUPP=ON is specified in NVSPARM (see also OPSUPP in the section Parameters).

The user exit is invoked as follows (a sample program called USR2008P is provided in the library SYSEXT):

```
CALLNAT 'USR2008N' parm1 parm2 parm3 parm4 parm5 parm6
```

The parameters are described in the following table:

Parameter	Format/Length	Explanation
<i>parm1</i>	N5	Specifies the DBID taken from the NTDB macro definition; see NTDB Macro in the section Parameters.
<i>parm2</i>	A1	Specifies the global OPEN MODE; see OPEN/CLOSE Processing.
<i>parm3</i>	A4	Specifies the data management type, for example, VSAM.
<i>parm4</i>	A40/16	Specifies the valid OPRB syntax and/or DDM long name instead of the DD= or FNR= definitions.
<i>parm5</i>	P4	Returns the Natural for VSAM error number.
<i>parm6</i>	A50	Returns the Natural for VSAM error text.

# Statement/Transaction Logic with VSAM - Overview

This section describes special considerations on Natural statements and Natural transaction logic when used with VSAM.

The Natural statements used to access VSAM files are a subset of those provided with the Natural language. No new statements are needed to access a VSAM file, since each Natural statement performs the same function regardless of the database management system or access method used. Therefore, programs written for VSAM files can also be used to access Adabas databases.

The Natural interface to VSAM has no built-in transaction logic and uses the one of the environment it is running in. This leads to different results depending on the environment.

This section covers the following topics:

- Natural Statements with VSAM
- Natural Transaction Logic with VSAM

# Natural Statements with VSAM

This section mainly consists of information also contained in the Natural Statements documentation, where each Natural statement is described in detail, including notes on VSAM usage where applicable. Summarized below are the particular points a programmer has to bear in mind when using Natural statements with VSAM.

**Note:**

Since the Natural compiler does not check if a program adheres to the restrictions imposed by the Natural interface to VSAM, VSAM-specific programming errors concerning the use of Natural statements only occur when the program is executed.

Any Natural statement not mentioned in this section can be used with VSAM without restrictions.

Below is information on:

- BACKOUT TRANSACTION
  - DELETE
  - END TRANSACTION
  - FIND
  - GET
  - GET SAME
  - GET TRANSACTION DATA
  - HISTOGRAM
  - READ
  - STORE
  - UPDATE
-

## BACKOUT TRANSACTION

The BACKOUT TRANSACTION statement is used to back out all database updates performed during the current user logical transaction. This statement also releases all records held during the transaction.

If used with Natural for VSAM, the BACKOUT TRANSACTION statement releases records held in the UPD table. It does not back out transactions unless Natural is running under a TP monitor which supports dynamic transaction backout (for example, CICS). In this case, a ROLLBACK to the last SYNCPOINT is issued.

## DELETE

The DELETE statement is used to delete a record from a VSAM file.

The use of the DELETE statement places each record selected in the corresponding FIND or READ statement in hold status.

The DELETE statement is not valid for VSAM entry-sequenced data sets (ESDS).

## END TRANSACTION

The END TRANSACTION statement is used to indicate the end of a logical transaction. A logical transaction is the smallest logical unit of work (as defined by the user) which must be performed in its entirety to ensure that the information contained in the VSAM file is logically consistent.

The END TRANSACTION statement also releases all records placed in hold status during the transaction.

An END TRANSACTION only releases records held in the UPD table unless Natural is running under a TP monitor which supports dynamic transaction backout (for example, CICS). In this case, an END TRANSACTION statement causes a SYNCPOINT to be issued.

## FIND

The FIND statement is used to select a set of records from the VSAM file based on a search criterion consisting of fields defined as descriptors (keys).

The WITH clause is used to specify the search criterion consisting of key fields (descriptors) defined in the VSAM file.

Only VSAM key fields can be used.

The number of records to be selected as a result of a WITH clause can be limited by specifying the keyword LIMIT together with a limit value (*operand 1*) expressed as a numeric constant or a user-defined variable. The limit value is enclosed within parentheses. If the number of records selected exceeds the limit value, the program is terminated with an error message.

The descriptor must be defined in a VSAM file as a VSAM key field. In a DDM, it is marked with **P** for primary key, **S** for primary sub/superdescriptor, **X** for alternate sub/superdescriptor or **A** for alternate key (see Edit DDM in the section Operation, and the SYSDDM Utility as described in the Natural Utilities documentation).

The formats of the descriptor and the search value must be compatible.

The following Natural system variables are available with the FIND statement:

Variable	Content
*ISN	This variable contains the relative byte address of the record currently being processed (ESDS files only).  This variable is not available for the FIND NUMBER and FIND FIRST statements.
*NUMBER	This variable contains the number of records which satisfied the basic search criterion specified in the WITH clause, and before evaluation of any WHERE criterion.  *NUMBER only contains a meaningful value if the EQUAL TO operator is used in the search criterion. With any other operator, *NUMBER will be 0 if no records have been found; any other value indicates that records have been found, but the value will have no relation to the number of records actually found.  The same applies to *NUMBER with the FIND NUMBER statement.
*COUNTER	The number of times the processing loop has been entered.  This system variable is not available for the FIND FIRST statement.

The FIND statement is only valid for key-sequenced (KSDS) and entry-sequenced (ESDS) VSAM datasets. For ESDS, an alternate index or a path for an alternate index must be defined. Relative record datasets (RRDS) are not allowed, since they do not contain any key fields (descriptors).

## GET

The GET statement is used to read a record with a given VSAM record number. For an ESDS file, the record number (ISN) would be the relative byte address (RBA); for RRDS and VRDS files, it would be the relative record number (RRN). The GET statement does not initiate a processing loop. As a result, a subsequent UPDATE or DELETE statement will not be processed and Natural returns a corresponding error message.

For ESDS, the RBA must be contained in a user-defined variable (numeric format) or specified as an integer constant. The same rules apply for RRDS and VRDS with the exception that the RRN must be provided instead of the RBA.

## GET SAME

The GET SAME statement applies to VSAM ESDS, RRDS, and VRDS only (see also the GET statement above).

## GET TRANSACTION DATA

The GET TRANSACTION DATA statement is not applicable to the Natural interface to VSAM.

## HISTOGRAM

The HISTOGRAM statement is used to read the values of a field which is defined as a descriptor, subdescriptor, or superdescriptor.

The HISTOGRAM statement initiates a processing loop, but does not provide access to any fields other than the field specified in the statement.

Only VSAM key fields can be used as descriptors.

The following Natural system variable is available with the HISTOGRAM statement:

Variable	Content
*NUMBER	When used in conjunction with a KSDS primary key or a unique alternate index, *NUMBER is always 1.

**Note:**

The \*ISN system variable is not available for the Natural interface to VSAM.

When used with VSAM, the HISTOGRAM statement is only valid for KSDS and ESDS datasets. For ESDS, an alternate index or a path for an alternate index must be defined.

The values are read directly from the VSAM index and are returned in ascending or descending value sequence.

## READ

The READ statement is used to read records from a VSAM file. The records can be retrieved in the value sequence (ascending or descending) of a descriptor (key) field. The READ sequence initiates a processing loop.

IN LOGICAL SEQUENCE is used to read records in the order of the values of a descriptor (key). If LOGICAL is specified with a descriptor, the records are read in the value sequence of the descriptor. A descriptor can be used for sequence control. A descriptor within a periodic group cannot be used. If LOGICAL is specified without a descriptor, the records are read in the default descriptor sequence, as defined in the DDM.

WITH REPOSITION can be used for skip-sequential processing inside the active loop, the new position must be defined as the new start value for the loop and must reset the system variable \*COUNTER.

IN LOGICAL SEQUENCE is only valid for KSDS with primary and alternate keys defined and ESDS with alternate keys defined. A subdescriptor or superdescriptor can be used for sequence control, too.

The following Natural system variables are available with the READ statement:

Variable	Content
*ISN	This system variable contains either the RRN (for RRDS or VRDS) or the RBA (for ESDS) of the current record.
*COUNTER	This system variable contains the number of times the processing loop has been entered.

Records can also be retrieved IN PHYSICAL SEQUENCE, which is used to read records in the order in which they are physically stored in a database. It is only valid for VSAM ESDS, RRDS and VRDS. This is the default sequence.

STARTING WITH ISN can be used as start value for the loop in ascending or descending physical sequence.

BY ISN is used to read records in RBA and RRN order for ESDS, RRDS and VRDS files, respectively.

## STORE

The STORE statement is used to add a record to a database.

A unique value for the primary-key field or the alternate-index field must be provided if the dataset is defined with a primary key or a unique alternate index.

The USING/GIVING NUMBER clause is only valid for RRDS or VRDS, in which case the ISN corresponds to the relative record number.

USING/GIVING NUMBER is used to store a record with a user-supplied RRN. If a record with the specified RRN already exists, an error message is returned and the execution of the program is terminated, unless ON ERROR processing was specified.

The Natural system variable \*ISN contains the RRN assigned to the new record as a result of the STORE statement execution. A subsequent reference to \*ISN must include the statement number of the related STORE statement. \*ISN is available for RRDS or VRDS files only.

## UPDATE

The UPDATE statement is used to update one or more fields of a record in a database. The record to be updated must have been previously selected using a FIND or READ statement.

The primary key cannot be updated.

# Natural Transaction Logic with VSAM

Natural for VSAM uses the transaction logic of the environment it is running in. Thus, the results of the Natural END TRANSACTION and BACKOUT TRANSACTION statements (see also the relevant sections in Natural Statements with VSAM) differ depending on the actual environment:

- With Native VSAM
  - Under CICS
- 

## With Native VSAM

Since VSAM itself has no transaction logic, there is no transaction logic available if Natural is working in a native VSAM environment. This is the case under Complete, TSO, and in batch mode, which means when NVSMISC is the I/O module in use.

With NVSMISC, END TRANSACTION and BACKOUT TRANSACTION statements do not return any error messages, but are ignored by the Natural interface to VSAM.

## Under CICS

Under CICS, VSAM files can be defined as "recoverable resources" or for RLS as "recoverable sphere", all of which are synchronized by CICS using the concept of "logical units of work" (LUWs). An LUW ends if a SYNCPOINT command is issued or if the CICS task is terminated. Refer to the relevant CICS documentation for details.

Below is information on:

- NVSCICS Module
- Conversational Tasks
- Pseudo-Conversational Tasks

## NVSCICS Module

For CICS, the I/O module NVSCICS is a normal command-level application program. It transfers END TRANSACTION and BACKOUT TRANSACTION statements to the NATCICS driver which issues the EXEC CICS SYNCPOINT and EXEC CICS ROLLBACK commands. If an error occurs in a Natural session with uncommitted updates and no error transaction is supplied, Natural itself triggers the interface to VSAM to issue a ROLLBACK command.

If a SYNCPOINT or ROLLBACK command fails (for example, when CICS answers with a ROLLEDBACK condition to a SYNCPOINT request), error messages NAT3544 or NAT3545 are returned.

## Conversational Tasks

If the Natural session runs in CICS conversational mode, the LUW is not ended by a terminal I/O. Natural runs in conversational mode if either the Natural parameter PSEUDO=OFF has been specified or Natural itself has determined that pseudo-conversational processing is not possible.

Since terminal I/Os do not disturb the transaction logic of an application as long as Natural is running in conversational mode, a program like the following one would work without problems:

**Example:**

```
READ vsam-file
  UPDATE
  INPUT ...
END-READ
BACKOUT TRANSACTION
```

## Pseudo-Conversational Tasks

If the Natural session is running in pseudo-conversational mode, each terminal I/O terminates the CICS task, thus implicitly performing a SYNCPOINT. Therefore, the impact of a BACKOUT TRANSACTION statement, that is of an EXEC CICS SYNCPOINT ROLLBACK command, only goes back to the most recent terminal I/O. The example program above would, therefore, end with error message NAT3548, because it is not possible to roll back all the updates.

**Note:**

Keep in mind that all messages of the Natural interface to VSAM are issued at runtime only, since the Natural compiler is not able to detect this kind of logical error.

# Using Natural with VSAM System Files

The Natural system files FNAT, FUSER, FDIC, FSEC and FSPOOL can also be located on VSAM files.

This section covers the following topics:

- Prerequisites
  - Installing Natural on VSAM System Files - OS/390
  - Installing Natural on VSAM System Files - VSE/ESA
  - Installation Verification with VSAM System Files
  - Restrictions
- 

## Prerequisites

See the Prerequisites under Installing Natural for VSAM in the Installation section.

The layout of the VSAM system files FNAT, FUSER and FDIC has changed from Natural for VSAM Version 3.1. VSAM system files from Natural Version 3.1. and previous versions must be migrated with Natural for VSAM Version 3.1. For more details, see the release notes for Natural for VSAM Version 3.1 and the Natural for VSAM Version 3.1 documentation on Prerequisites in Using Natural with VSAM System Files.

For the installation of Natural ISPF on VSAM system files, refer to the Natural ISPF Installation and Administration documentation. Be sure that you use the relevant modules (NVSISPV and NVSISPC) provided on the NVS installation tape.

## Installing Natural on VSAM System Files - OS/390

This section describes step by step how to install Natural under the operating system OS/390 using VSAM system files. The information given is basically a combination of the installation descriptions for both base Natural and Natural for VSAM (NVS), plus some points specific to VSAM system files.

### Installation Tape

To install Natural with VSAM system files, you need the datasets for both base Natural and NVS. The required datasets are listed in the table below:

Dataset Name	Contents
NAT $nnn$ .ERRN	Natural error messages.
NAT $nnn$ .LOAD	Natural load modules.
NAT $nnn$ .SRCE	Natural source modules and macros.
NAT $nnn$ .JOBS	Example installation jobs.
NAT $nnn$ .INPL	Natural system programs.
NAT $nnn$ .EXPL	Natural example programs.
NVS $nnn$ .LOAD	NVS load modules.
NVS $nnn$ .SRCE	NVS source modules.
NVS $nnn$ .EMPL	NVS example file.
NVS $nnn$ .EXPL	NVS example programs.

The notation  $nnn$  in dataset names represents the version number of the product. The sequence of the datasets is shown in the Report of Tape Creation which accompanies the installation tape.

## Copying the Tape Contents to Disk

If you are using System Maintenance Aid (SMA), refer to the SMA documentation (included on the current edition of the Natural documentation CD).

If you are **not** using SMA, follow the instructions below.

This section explains how to:

- Copy data set COPY.JOB from tape to disk.
- Modify this data set to conform with your local naming conventions.

The JCL in this data set is then used to copy all data sets from tape to disk.

If the datasets for more than one product are delivered on the tape, the dataset COPY.JOB contains the JCL to unload the datasets for all delivered products from the tape to your disk.

After that, you will have to perform the individual install procedure for each component.

### Step 1 - Copy data set COPY.JOB from tape to disk

The data set COPY.JOB (label 2) contains the JCL to unload all other existing data sets from tape to disk. To unload COPY.JOB, use the following sample JCL:

```

//SAGTAPE JOB SAG,CLASS=1,MSGCLASS=X
//* -----
//COPY EXEC PGM=IEBGENER
//SYSUT1 DD DSN=COPY.JOB,
// DISP=(OLD,PASS),
// UNIT=(CASS,,DEFER),
// VOL=(,RETAIN,SER=<Tnnnnn>),
// LABEL=(2,SL)
//SYSUT2 DD DSN=<hilev>.COPY.JOB,
// DISP=(NEW,CATLG,DELETE),
// UNIT=3390,VOL=SER=<vvvvvv>,
// SPACE=(TRK,(1,1),RLSE),
// DCB=*.SYSUT1
//SYSPRINT DD SYSOUT=*
//SYSIN DD DUMMY
//

```

Where:

- <hilev> is a valid high level qualifier
- <Tnnnnn> is the tape number
- <vvvvvv> is the desired volser

## Step 2 - Modify COPYTAPE.JOB

Modify the COPYTAPE.JOB to conform with your local naming conventions and set the disk space parameters before submitting this job:

- Set HILEV to a valid high level qualifier.
- Set LOCATION to a storage location.
- Set EXPDT to a valid expiration date.

## Step 3 - Submit COPY.JOB

Submit COPY.JOB to unload all other data sets from the tape to your disk.

## Installation Procedure

Under OS/390, the installation procedure for Natural with VSAM system files consists of the following steps:

### Step 1: Prepare NVS Demo File - Job NVSI008, Steps 1403 to 1407

Load the VSAM demo file EMPL and define the alternate index path EMPLX for the file EMPL.

### Step 2: Prepare VSAM Clusters System Files - Job VSAMI008, Steps 1420 to 1446

Define three VSAM clusters to be used as system files for Natural (FNAT, FUSER and FDIC), an alternate index and a path for the alternate index for FDIC.

It is strongly recommended that you keep these three system files on separate VSAM clusters.

### Step 3: Prepare VSAM Cluster for the Spool File - Job VSAMI008, Steps 0300 to 0309

This step must only be performed if you have Natural Advanced Facilities installed and want your spool file to be a VSAM file, too.

Define an additional VSAM cluster to be used as spool file (FSPOOL) and five alternate indices.

**Note:**

Path processing is **not** supported for FSPOOL.

**Step 4: Prepare VSAM Cluster for the Security File - Job VSAMI008, Step 990 - 997**

This step must only be performed if you have Natural Security installed and want your security file to be a VSAM file, too.

Define an additional VSAM cluster to be used as security file (FSEC) and three alternate indices.

**Note:**

Path processing is **not** supported for FSEC.

**Step 5: Prepare VSAM Cluster for Scratch-Pad File - Job VSAMI008, Step 1450 - 1451**

This step must only be performed if you want to use a scratch-pad file; that is, if you want to use read-only system files (ROSY=ON); see also the parameter ROSY and the macro NTLFILE (described in the Natural Parameter Reference documentation).

Define an additional VSAM cluster to be used as scratch-pad file.

For the optional scratch-pad file inclusion, the following NATPARM parameters must be added or, if already present, updated with:

```
NTLFILE 212,dbid,nt-file-number,dd-name-scratch-pad-fileROSY=ON
```

If you want your system file(s) to be opened for input, adapt your Natural parameter module as follows:

```
FNAT=(dbid,fnr,filename,,RO),
FUSER=(dbid,fnr,filename,,RO),
FSEC=(dbid,fnr,filename,,RO),
```

**Step 6: Assemble Natural OS/390 Interface Module - Job NATI055, Steps 0100 and 0102**

Assemble and link the Natural OS/390 interface module NATOS contained in dataset NATnm.SRCE.

**Step 7: Create NVS Parameter Module - Job NVSI055, Steps 1400 and 1401**

Edit, assemble and link the NVS parameter module NVSPARM. For a description of the parameters which can be specified, see Assembling the NVSPARM Parameter Module in the section Parameters.

**Step 8: Create NVS I/O Module - Job NVSI055, Steps 1410 and 1411**

Assemble and link the NVS I/O module NVSMISC with the LSR options:

```
DEFER=YES
COMMIT=NO
READINT=NO
```

See a description of the parameters which can be specified in NVSMISC (see the section Parameters).

**Step 9: Create Natural Batch Parameter Module - Job VSAMI060, Steps 0010, 0015**

Create the Natural batch parameter module.

To install Natural with VSAM system files, in addition to the VSIZE and NTDB specification, you must modify the parameters FNAT, FUSER and FDIC as follows:

```
VSIZE=126 ,
FNAT=( vsam-dbid, fnr-fnat, dd-name-fnat) ,
FUSER=( vsam-dbid, fnr-fuser, dd-name-fuser) ,
FDIC=( vsam-dbid, fnr-fdic, dd-name-fdic) ,
NTDB VSAM, vsam-dbid
```

*vsam-dbid* must have the same value in all four entries.

It is recommended to use different files and different file numbers for FNAT and FUSER. The FDIC file **must** be a file different from FNAT and FUSER. Therefore, the FDIC parameter must not be omitted.

The DD names are the logical names of the system files; each DD name can be up to seven characters long. The DD name for the FDIC path is created by appending an **X** to the DD name of the FDIC file.

If you have Natural Advanced Facilities installed and want your spool file to be a VSAM file, modify the FSPPOOL parameter accordingly:

```
FSPPOOL=( vsam-dbid, fnr-fspool, dd-name-fspool)
```

If you have Natural Security installed and want your security file to be a VSAM file, modify the FSEC parameter accordingly:

```
FSEC=( vsam-dbid, fnr-fsec, dd-name-fsec)
```

The FSEC file must be a file different from FNAT.

## Step 10: Link Natural Batch Nucleus - Job VSAMI060, Step 0020

For information on the components and structure of the Natural interface to VSAM, see also Components of Natural for VSAM and Structure of the Natural Interface to VSAM in the section General Information.

With the INCLUDE instruction for the parameter module, specify the name of the Natural parameter module created in Step 8.

Add the following INCLUDE instructions to the link of the Natural batch nucleus:

```
INCLUDE NVSLIB(NVSNUC) INCLUDE NVSLIB(NVSNAT) INCLUDE NVSLIB(NVSPFO) INCLUDE NVSLIB(NVSPSEC) INCLUDE SMALIB(NVSPARM) INCLUDE SMALIB(NVSMISC)
```

The module NVSPFO is only required if you have Natural Advanced Facilities installed and want your spool file to be a VSAM file, too.

The module NVSPSEC is only required if you have Natural Security installed and want your security file to be a VSAM file, too.

If your front-end is **not** linked to your Natural nucleus, NVSPARM and NVSMISC must be linked to NATPARM instead.

Add the corresponding DD statements to the link step for Natural and link-edit the executable module.

Link the executable batch Natural nucleus.

## Step 11: Load System Programs - Job VSAMI061, Step 0100

Use the Natural system command INPL (see the Natural System Command Reference documentation) to load the Natural system programs (dataset NAT*nnn*.INPL) into the Natural system files.

Ensure that the DD names specified in NATPARM are specified in the INPL job, too. In addition, an alternate index DD name (*dd-name-fdicX*) must be specified for FDIC.

**Note:**

If you want to install any other Software AG products that require INPL steps, ensure that these INPL steps are adapted according to the VSAMI061 job.

### Step 12: Load Error Messages - Job VSAMI061, Steps 0102

Load the Natural error messages file (dataset NAT $nnn$ .ERRN) using the program ERRLODUS as described in the Natural SYSERR Utility documentation.

Ensure that the DD names specified in NATPARM are specified in the ERRLODUS job, too.

### Step 13: Load Examples - Job VSAMI061, Steps 0103 and 1400

Use the system command INPL to load the Natural example programs (dataset NAT $nnn$ .EXPL) and the NVS example programs (dataset NVS $nnn$ .EXPL) into the Natural system file.

Ensure that the DD names specified in NATPARM are specified in the INPL job, too. In addition, a path DD name (*dd-name-fdicX*) must be specified for FDIC.

### Step 14: Reorganize FNAT System File

Reorganize the FNAT system file using the VSAM facility AMS REPRO to unload and reload the file.

### Step 15: Create NVS I/O Module for CICS - Job NVSI070, Step 1400

This step must only be performed if you wish to install NVS under CICS.

If NVS is to be installed under CICS, assemble and link the module NVSCICS.

### Step 16: Install Online Natural

Proceed with the specific installation steps for Natural required under your TP monitor (see the relevant sections in the Natural Installation Guide for Mainframes), taking into account the following additions:

- Modify your Natural online parameter modules according to Step 8.
- Add the following INCLUDE instructions to all links of the online Natural nucleus:

```
INCLUDE NVSLIB(NVSNUC)
INCLUDE NVSLIB(NVSFNAT)
INCLUDE NVSLIB(NVSFSPO)
INCLUDE NVSLIB(NVSFSEC)
```

The module NVSFSP0 is only required if you have Natural Advanced Facilities installed and want your spool file to be a VSAM file, too. The online environment for Natural Advanced Facilities must be a CICS environment, and the VSAM spool files must be defined in the CICS FCT.

The module NVSFSEC is only required if you have Natural Security installed and want your security file to be a VSAM file, too.

The VSAM security files must be defined in the CICS FCT.

- Add the following INCLUDE instructions to the link of the front-end in a CICS environment:

```
INCLUDE SMALIB(NVSPARM)
INCLUDE SMALIB(NVSCICS)
```

- Add the following INCLUDE instructions to the link of the front-end in any other supported environment:

```
INCLUDE SMALIB(NVSPARM)
INCLUDE SMALIB(NVSMISC)
```

Before starting Natural, ensure that the DD and DSN names of the VSAM system files are known in your respective batch and online environments.

### Step 17: Customize your TP Monitor

TP Monitor	Instruction
Com-plete	<p>Catalog the VSAM system files FNAT, FUSER, FDIC and FDICX to Com-plete using the CA function of the Com-plete utility UFILE.</p> <p>If Natural Security is installed, catalog the VSAM security files FSEC, FSECA, FSECB and FSECC to Com-plete using the CA function of the Com-plete utility UFILE.</p> <p>If you have specified PATH=CHECK in NVSPARM, catalog your front program to Com-plete using the CA function of the Com-plete utility ULIB with a region size of 36 KB, if you have not changed the first default value for the WPSIZE parameter in the Natural parameter module.</p>
CICS	<p>Add the following entries to your FCT:</p> <ul style="list-style-type: none"> <li>● the NVS system files FNAT, FUSER, FDIC and FDICX;</li> <li>● the NVS test files EMPLVS and EMPLVX;</li> <li>● the Natural Security files FSEC, FSECA, FSECB and FSECC (if you have Natural Security installed).</li> </ul> <p>Refer to the job VSAMI005 for examples. You can add DD statements for these datasets to your CICS startup job, too.</p>
TSO	<p>Add the following statements to your Natural CLIST:</p> <pre> ALLOC F(FNAT) DA('SAGLIB.VSAM.FNAT') SHR ALLOC F(FUSER) DA('SAGLIB.VSAM.FUSER') SHR ALLOC F(FDIC) DA('SAGLIB.VSAM.FDIC') SHR ALLOC F(FDICX) DA('SAGLIB.VSAM.FDIC.PATH') SHR ALLOC F(FSEC) DA('SAGLIB.VSAM.FSEC') SHR ALLOC F(FSECA) DA('SAGLIB.VSAM.FSEC.AIXA') SHR ALLOC F(FSECB) DA('SAGLIB.VSAM.FSEC.AIXB') SHR ALLOC F(FSECC) DA('SAGLIB.VSAM.FSEC.AIXC') SHR ALLOC F(EMPLVS) DA('SAGLIB.VSAM.EMPLVS') SHR ALLOC F(EMPLVX) DA('SAGLIB.VSAM.EMPLVX.PATH') SHR </pre>

## Installing Natural on VSAM System Files - VSE/ESA

This section describes step by step how to install Natural under the operating system VSE/ESA using VSAM system files. The information given is basically a combination of the installation descriptions for both base Natural and Natural for VSAM (NVS), plus some points specific to VSAM system files.

### Installation Tape

To install Natural with VSAM system files, you need the datasets for both base Natural and NVS. The required datasets are listed in the table below:

Dataset Name	Contents
NAT $nnn$ .LIBR	Natural source modules, macros, relocatable modules and sample installation jobs.
NAT $nnn$ .INPL	Natural system programs.
NAT $nnn$ .EXPL	Natural example programs.
NAT $nnn$ .ERRN	Natural error messages.
NVS $nnn$ .LIBR	NVS source modules, macros and relocatable modules.
NVS $nnn$ .EMPL	NVS example file.
NVS $nnn$ .EXPL	NVS example programs.

The notation  $nnn$  in dataset names represents the version number of the product. The sequence of the datasets, their type and the space each dataset requires on disk are shown in the Report of Tape Creation which accompanies the installation tape.

### Copying the Tape Contents to Disk

The sample JCS supplied on tape for the installation of Natural assumes one library, which has installation sublibraries per Software AG product library. In addition to these sublibraries, you need a work sublibrary and a sublibrary for sample installation jobs for Natural. It is recommended that you create this library and the work sublibrary now.

Then copy the sublibrary containing the sample installation jobs from tape using the following JCS:

```
* $$ JOB JNM=NATJOBS,CLASS=0,DISP=D,LDEST=*,SYSID=1
* $$ LST CLASS=A,DISP=D
// JOB NATJOBS
// ASSGN SYS005,IGN
// ASSGN SYS006,cuu,VOL=NVS $nnn$ 
// MTC REW,SYS006
// MTC FSF,SYS006,nn
* Tape positioned at file ?, tape mark nn
* *** Now process NVS $nnn$ .LIBR - JOBS ***
// EXEC LIBR,PARM='MSHP'
RESTORE SUBLIB=SAGLIB.NVS $nnn$ J:SAGLIB.NVS $nnn$ J -
TAPE=SYS006 -
LIST=YES -
REPLACE=NO
/*
// MTC REW,SYS006
/*
/&
* $$ EOJ
```

The notation  $cuu$  represents the physical unit address of the tape drive.

The notation  $nn$  represents the file sequence number given by "(3 \* *file-no*) - 2", as shown on the Report of Tape Creation. Leave out the "// MTC FSF ..." instructions if your library is the first dataset on the tape.

The notation  $nnn$  represents the version number of the product.

Now use jobs NATTAPE and NVSTAPE from this job library to restore the Natural sublibrary from tape and make Natural known to MSHP.

All further datasets will be directly used from tape by the installation jobs.

## Installation Procedure

Under VSE/ESA, the installation procedure for Natural with VSAM system files consists of the following steps:

### Step 1: Prepare NVS Demo File - Job NVSI008, Steps 1403 to 1407

Load the VSAM demo file EMPL and define the alternate index path EMPLX for the file EMPL.

### Step 2: Prepare VSAM Clusters for System Files - Job VSAMI008, Steps 1420 to 1446

Define three VSAM clusters to be used as system files for Natural (FNAT, FUSER and FDIC) and a path for FDIC.

It is strongly recommended that you keep these three system files on separate VSAM clusters.

### Step 3: Prepare VSAM Cluster for Spool File - Job VSAMI008, Steps 0300 to 0309

This step must only be performed if you have Natural Advanced Facilities installed and want your spool file to be a VSAM file, too.

Define an additional VSAM cluster to be used as spool file (FSPOOL) and five alternate indices.

**Note:**

Path processing is **not** supported for FSPOOL.

### Step 4: Prepare VSAM Cluster for Security File - VSAMI008, Step 990 - 997

This step must only be performed if you have Natural Security installed and want your security file to be a VSAM file, too.

Define an additional VSAM cluster to be used as security file (FSEC) and three alternate indices.

**Note:**

Path processing is **not** supported for FSEC.

### Step 5: Prepare VSAM Cluster for Scratch-Pad File - Job VSAMI008, Step 1450 - 1451

This step must only be performed if you want to use a scratch-pad file; that is, if you want to use read-only system files (ROSY=ON); see also the parameter ROSY and the macro NTFILE in the section Profile Parameters in the Natural Parameters Reference documentation.

Define an additional VSAM cluster to be used as scratch-pad file.

For the optional scratch-pad file inclusion, the following NATPARM parameters must be added or, if already present, updated with:

```
NTFILE ID=212,DBID=dbid,FNR=nt-file-number,PASSWD=dd-name-scratch-pad-file
ROSY=ON
```

If you want your system file(s) to be opened for input, adapt your Natural parameter module as follows:

```
FNAT=(dbid,fnr,filename,,RO),
FUSER=(dbid,fnr,filename,,RO),
FSEC=(dbid,fnr,filename,,RO),
```

### Step 6: Assemble Natural VSE/ESA Interface Module - Job NATI055, Step 0100

Set the parameters in the source of the module NATVSE to suit your requirements. The NATVSE generation parameters are described in the section Running Natural in Batch under VSE/ESA (Natural in Batch Mode) in the Natural Operations for Mainframes documentation.

Assemble and link the Natural VSE/ESA interface module NATVSE contained in dataset NAT $nnn$ .LIBR.

### Step 7: Create NVS Parameter Module - Job NVSI055, Step 1400

Edit, assemble and link the NVS parameter module NVSPARM. For a description of the parameters which can be specified, see the section Assembling the NVSPARM Parameter Module.

For a quick installation, use the Natural for VSAM LSR feature and specify the following NVMLSR definitions in NVSPARM (see also NVMLSR Macro in the section Parameters):

```
NVMLSR DDNAME=fnat-dd-name, SHRPOOL=1
NVMLSR DDNAME=fuser-dd-name, SHRPOOL=2
NVMLSR DDNAME=fdic-dd-name, SHRPOOL=3
NVMLSR DDNAME=fdicx-dd-name, SHRPOOL=3
```

If you want to use FSEC system files:

```
NVMLSR DDNAME=fsec-dd-name, SHRPOOL=4
NVMLSR DDNAME=fseca-dd-name, SHRPOOL=4
NVMLSR DDNAME=fsecb-dd-name, SHRPOOL=4
NVMLSR DDNAME=fsecc-dd-name, SHRPOOL=4
```

### Step 8: Create NVS I/O Module - Job NVSI055, Step 1410

Assemble and link the NVS I/O module NVSMISC with the LSR options:

```
DEFER=YES
COMMIT=NO
READINT=NO
```

See the description of the parameters which can be specified in NVSMISC (see the section Parameters).

### Step 9: Create Natural Batch Parameter Module - Job VSAMI060, Steps 0010, 0015

Create the Natural batch parameter module.

To be able to install Natural with VSAM system files, in addition to the VSIZE and NTDB specification, modify the parameters FNAT, FUSER and FDIC as follows:

```
VSIZE=126,
FNAT=(vsam-dbid,fnr-fnat,dlbl-name-fnat),
FUSER=(vsam-dbid,fnr-fuser,dlbl-name-fuser),
FDIC=(vsam-dbid,fnr-fdic,dlbl-name-fdic),
NTDB VSAM,vsam-dbid
```

*vsam-dbid* must have the same value in all four entries.

It is recommended to use different files and different file numbers for FNAT and FUSER. The FDIC file **must** be a file different from FNAT and FUSER. Therefore, the FDIC parameter must not be omitted.

The DD names are the logical names of the system files; each DD name can be up to seven characters long. The DLBL name for FDIC is created by appending an **X** to the DLBL name for the FDIC file.

If you have Natural Advanced Facilities installed and want your spool file to be a VSAM file, modify the FSPPOOL parameter accordingly:

```
FSPPOOL=( vsam-dbid, fnr-fspool, dd-name-fspool)
```

Assemble and link the parameter module.

If you have Natural Security installed and want your security file to be a VSAM file, modify the FSEC parameter accordingly:

```
FSEC=( vsam-dbid, fnr-fsec, dd-name-fsec)
```

The FSEC file must be a file different from FNAT.

### Step 10: Link Natural Batch Nucleus - Job VSAMI060, Step 0020

For information on the components and structure of the Natural interface to VSAM, see also Components of Natural for VSAM and Structure of the Natural Interface to VSAM in the section General Information.

With the INCLUDE instruction for the parameter module, specify the name of the Natural parameter module created in Step 8.

Add the following INCLUDE instructions to the link of the Natural batch nucleus:

```
INCLUDE NVSNUCINCLUDE NVSFNATINCLUDE NVSFSPAINCLUDE NVSFSECINCLUDE NVSPARMINCLUDE NVSMISCD
```

The module NVSFSP is only required if you have Natural Advanced Facilities installed and want your spool file to be a VSAM file, too.

The module NVSFSEC is only required if you have Natural Security installed and want your security file to be a VSAM file, too.

If your front-end is **not** linked to your Natural nucleus, NVSPARM and NVSMISCD must be linked to NATPARM instead.

Add the corresponding sublibrary for NVS to the search chain for the linkage editor and link-edit the executable module.

Link the executable batch Natural nucleus.

### Step 11: Load System Programs - Job VSAMI061, Step 0100

Use the Natural system command INPL (see the Natural System Command Reference documentation) to load the Natural system programs (dataset NAT $nnn$ .INPL) into the Natural system files.

Ensure that the DLBL names specified in NATPARM (Step 8) are specified in the INPL job, too. In addition, a path DLBL name (*dlbl-name-fdicX*) must be specified for FDIC.

**Note:**

If you want to install any other Software AG products that require INPL steps, ensure that these INPL steps are adapted according to the VSAMI061 job.

### Step 12: Load Error Messages - Job VSAMI061, Steps 0102

Load the Natural error messages file (dataset NAT $nnn$ .ERRN) using the ERRLODUS utility (which is described in the Natural SYSERR Utility documentation).

Ensure that the DLBL names specified in NATPARM (Step 8) are specified in the ERRLODUS job, too.

### Step 13: Load Examples - Job VSAMI061, Step 0103

Use the system command INPL to load the Natural example programs (dataset NAT $nnn$ .EXPL) and the NVS example programs (dataset NVS $nnn$ .EXPL) into the Natural system file.

Ensure that the DLBL names specified in NATPARM (Step 8) are specified in the INPL job, too. In addition, a path DLBL name (*dlbl-name-fdicX*) must be specified for FDIC.

### Step 14: Reorganize the FNAT System File

Reorganize the FNAT system file using the VSAM facility AMS REPRO to unload and reload the file.

### Step 15: Create NVS I/O Module for CICS - Job NVSI070, Step 1400

This step must only be performed if you wish to install NVS under CICS.

If NVS is to be installed under CICS, assemble and link the module NVSCICS.

### Step 16: Install Online Natural

Proceed with the specific installation steps for Natural required under your TP monitor (see the relevant sections in the Natural Installation Guide for Mainframes), taking into account the following additions:

- Modify your Natural online parameter modules according to Step 8.
- Add the following INCLUDE instructions to all links of the online Natural nucleus:

```
INCLUDE NVSNUC
INCLUDE NVSFNAT
INCLUDE NVSFSP0
INCLUDE NVSFSEC
```

The module NVSFSP0 is only required if you have Natural Advanced Facilities installed and want your spool file to be a VSAM file, too. The online environment for Natural Advanced Facilities must be a CICS environment, and the VSAM spool files must be defined in the CICS FCT.

The module NVSFSEC is only required if you have Natural Security installed and want your security file to be a VSAM file, too.

The VSAM security files must be defined in the CICS FCT.

- Add the following INCLUDE instructions to the link of the front-end in a CICS environment:
- ```
INCLUDE NVSPARM
INCLUDE NVSCICS
```
- Add the following INCLUDE instructions to the link of the front-end in a Com-plete environment:

```
INCLUDE NVSPARM
INCLUDE NVSMISCD
```

- Add the corresponding sublibrary for NVS to the search chain for the linkage editor and link-edit the executable module.

**Note:**

Before starting Natural, ensure that the DLBL names of the VSAM system files are known in your batch and online environments.

**Step 17: Customize your TP Monitor**

| TP Monitor | Instruction                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Com-plete  | <p>Add the following DLBL statements to your Com-plete startup job:</p> <pre>// DLBL FNAT, 'DSN=SAGLIB.VSAM.FNAT', ,VSAM,CAT=xxxx // DLBL FUSER, 'DSN=SAGLIB.VSAM.FUSER', ,VSAM,CAT=xxxx // DLBL FDIC, 'DSN=SAGLIB.VSAM.FDIC', ,VSAM,CAT=xxxx // DLBL FDICX, 'DSN=SAGLIB.VSAM.FDIC.PATH', ,VSAM,CAT=xxxx // DLBL EMPLVS, 'DSN=SAGLIB.VSAM.EMPLVS', ,VSAM,CAT=xxxx // DLBL EMPLVX, 'DSN=SAGLIB.VSAM.EMPLVX.PATH', ,VSAM,CAT=xxxx</pre> <p>If Natural Security is installed, add the following DLBL statements to your Com-plete startup job:</p> <pre>// DLBL FSEC, 'DSN=SAGLIB.VSAM.FSEC', ,VSAM,CAT=xxxx // DLBL FSECA, 'DSN=SAGLIB.VSAM.FSEC.AIXA', ,VSAM,CAT=xxxx // DLBL FSECB, 'DSN=SAGLIB.VSAM.FSEC.AIXB', ,VSAM,CAT=xxxx // DLBL FSECC, 'DSN=SAGLIB.VSAM.FSEC.AIXC', ,VSAM,CAT=xxxx</pre> <p>If you have specified PATH=CHECK in NVSPARM, catalog your front program to Com-plete using the CA function of the Com-plete utility ULIB with a region size of 36 KB, if you have not changed the first default value for the WPSIZE parameter in the Natural parameter module.</p> |
| CICS       | <p>Add the following entries to your FCT:</p> <ul style="list-style-type: none"> <li>● the NVS system files FNAT, FUSER, FDIC and FDICX;</li> <li>● the NVS test files EMPLVS and EMPLVX;</li> <li>● the Natural Security files FSEC, FSECA, FSECB and FSECC (if you have Natural Security installed).</li> </ul> <p>Refer to the job VSAMI005 for examples. You can add DLBL statements for these datasets to your CICS startup job, too.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

**Installation Verification with VSAM System Files****Under OS/390 and VSE/ESA**

To verify whether the installation has been successfully performed, log on to the library SYSEXNVS and run the following programs:

- NVSINST1
- NVSINST2
- NVSINST3
- NVSINST4
- NVSINST5
- NVSINST6

If all these programs can be executed successfully, the installation of Natural on VSAM system files is completed and verified.

**Note for OS/390 batch mode:**

For verification in batch mode under OS/390, you can run the job VSAMI200 which executes the above programs.

## Restrictions

The Natural VSAM system files FSEC and FSPOOL cannot be used for record-level sharing (RLS), as the related AIX files cannot be accessed using a path definition. The reason is that null values are not suppressed during VSAM upgrade handling for AIX keys. The record length of AIX files related to FSEC and FSPOOL would be exceeded for AIX keys filled with blanks or binary zeros. This would cause problems under CICS, as the record length supported is limited to 32 K only. Natural for VSAM supports null-value suppression for AIX keys and the upgrade handling for AIX files.