

FLAM[®]-sub (MVS)

FRANKENSTEIN-LIMES-ACCESS-METHOD

USER MANUAL

— Edition July 2017 Version 4.7 —

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User Manual FLAM®-sub V4.7 (MVS)

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Preface

This manual describes how to handle the FLAM subsystem in the IBM z/OS (OS/390, MVS) operating system.

FLAM®-sub is an interface to FLAM® (MVS), the compression and encryption utility, and may only be used in conjunction with a license for FLAM®-utility.

FLAM® (MVS) is described in the manual FLAM® (MVS) V4.7, the encryption method is found in the manual FLAM® & AES.

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Summary of changes

Summary of changes 8 FLAM®-sub V4.7

This release is an adaption to the FLAM® (MVS) utility V4.7.

It includes the following new features

- **zEDC Support**

When the hardware compression accelerator card zEDC is found it will be used in MODE=ADC. This function is controlled via environment or system variables.

- **AES-encryption with MODE=CX8/VR8**

You can now use AES encrypted FLAMFILEs for direct record access as before without encryption in CX8/VR8 compression mode.

This function requires FLAM (MVS) V4.7 as minimum for decompression/decryption and is actually supported only on z/OS-systems.

- **LOGR Support**

FLAM-sub writes log data to a LOGR stream as the FLAM utility does if system variables are found.

Summary of changes 7 FLAM®-sub V4.5

This release is an adaption to the FLAM® (MVS) utility V4.5.

It includes the following new features

- **KME=FKMEFILE**

This key management extension routine reads a key from a sequential file to encrypt/decrypt the written/read data via the FLAM® subsystem.

The file may be of fixed or variable record length. Trailing blanks are ignored.

The syntax of the key is the same as of parameter CRYPTOKEY.

The file may be protected by RACF, so this is an easy way for encryption/decryption without any key-protocol.

- License check

The subsystem modules are now included in the FLAM® (MVS) LOAD library. There is an own license check implemented avoiding using the FLAM-subsystem without a special license.

Summary of changes 6 FLAM®-sub V4.4

The Key Management Interface of FLAM (MVS) (-> manual FLAM (MVS) V4.x, ch. 3.5.5) is implemented in this subsystem release:

A user written module is invoked when opening a data set to provide FLAM-sub with a key for encryption/decryption.

This method allows an automatic encryption/decryption of files without any manual user action. The key used is not shown in any protocol.

Summary of changes 5 FLAM®-sub V4.3

Introducing crypto hardware CPACF in newer hardware systems z9 and z10 allows FLAM®-sub V4.3 to use these new routines for AES encryption.

FLAM®-sub automatically checks the availability, so no parameter other than CRYPTOMODE=AES is needed.

Encryption by hardware increases performance and decreases cputime. Up to 30 % may be. It depends on the compression ratio, less compression increases time savings. Particularly using MODE=NDC, packing files without compression.

Summary of changes 4 FLAM®-sub V4.1

FLAM®-sub V4.1 benefits from the new and faster implementation of the AES algorithm in FLAM (MVS) V4.1.

Up to 50 % CPU time is saved using the new AES routines in the subsystem.

Summary of changes 3 FLAM®-sub V4.0

FLAM®-sub V4.0 incorporates the following changes as compared with Version 3:

Support of AES-encryption (Advanced Encryption Standard)

Using parameter CRYPTOMODE=AES all data will be encrypted in Advanced Encryption Standard mode, introduced in FLAM (MVS) V4. Additional information (hash-MACs) is stored in the FLAMFILE.

FLAMFILE split is supported

During output mode (writing records into an empty file) a FLAMFILE can be split serially or in parallel into several parts, subject to the settings of the parameters SPLITMODE, SPLITNUMBER, and SPLITSIZE.

MODE=NDC (No Data Compression) is supported

Data compression can be suppressed using MODE=NDC. Data are only formatted and, if requested, encrypted. This saves CPU time with data that do not compress efficiently (e.g. FLAMFILES or compressed image files). The same security features are available as for compressed data.

MODE=NDC is downwards compatible with FLAM V3.x.

Summary of changes 2 FLAM®-sub V3.0

FLAM®-sub V3.0 incorporates the following changes as compared with Version 2:

MODE=ADC (Advanced Data Compression) is supported

Using MODE=ADC all data are compressed by the new ADC-algorithm of FLAM V3.x, the highest efficient compression method for all data (even non-structured data).

Loading VSAM-KSDS with a Utility (i.e. IEBGENER, SORT)

Although utilities use a (sequential) DCB to open a subsystem data set, it is now possible to load a VSAM-KSDS file with FLAM®-sub.

Activate FLAM®-sub as a 'Started Task'

Start FLAM®-sub as a Started Task (S FLAM). So it is not longer necessary to wait for an IPL to test FLAM®-sub.

Summary of changes 1 FLAM®-sub V2.0

FLAM®-sub V2.0 incorporates the following changes as compared with Version 1:

VSAM accesses supported

The calling programs can be written either in Assembler or in COBOL.

All logical VSAM accesses are supported by FLAM®-sub V2.0, in both MOVE and LOCATE mode and for both synchronous and asynchronous calls.

In particular, VSAM-KSDS commands are also converted logically if an UPDATE is performed.

The index entries have been reduced to a minimum and compressed, so that less space is taken up in the memory and the overall performance is enhanced when VSAM files are accessed.

Physical accesses via memory addresses (RBA) are not supported.

Reading of uncompressed files supported

If the input is an uncompressed file, it can also optionally be read via the subsystem.

In this case, the keyword parameter IG10 must be entered for the subsystem:

```
//... DD ...,SUBSYS=(FLAM,IG10,'flam-parameter')
```

This parameter has no effect on compressed files.

TRACE function

A TRACE function can be activated for test purposes.

In this case, the keyword parameter TRACE must be entered for the subsystem:

```
//... DD ...,SUBSYS=(FLAM,TRACE,'flam-parameter')
```

All function calls to FLAM, as well as ACB and RPL of the calling program, are then traced in a file.

The trace file must be specified in the JCL. The FLAM parameter 'MSGDDN=ddname' indicates the DD name. If no name is specified the parameter for the DEFAULT specification is used (generally FLPRINT; cf. INST02 job of the FLAM utility).

The trace file can also be specified as a subsystem file:

```
//FLPRINT DD DSN=trace-file,SUBSYS=FLAM
```

New interface to FLAM utility

As of this version, all the required FLAM utility modules are loaded as resident programs, in other words the subsystem modules no longer need to be linked to the utility. Consequently, no 'relinks' are necessary if the license number for the utility changes.

On the other hand, the load module library of FLAM-utility now also needs APF authorization.

We recommend keeping the subsystem and utility load modules in one library.

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Chapter 1:

FLAM® as a subsystem

1. FLAM® as a subsystem

FLAM®-sub supports the subsystem interface of the command language (JCL) in z/OS. Files can thus be processed in compressed and encrypted form without having to modify the associated programs. The additional compression and decompression steps which were necessary in the past can now be dispensed with.

The calling program is not aware of any differences as compared with the conventional mode of file processing. It receives a record for a read call in the same way as before, while for a write call the data management system (DMS) receives the record as usual. The subsystem decompresses before reading and compresses before writing.

The compression results are similar to those of the FLAM utility (approx. 70-90%).

The FLAM subsystem even enables programs to be supported with file formats for which they were not originally written, in other words the program and the data formats can be separated from one another.

The FLAM subsystem is loaded almost entirely in the high address space (above 16 MB); only a small tuning module for 24-bit addressing works in the low address space. Since 24-bit addressing is used for the DMS accesses to PS files, a memory area corresponding to the length of one data record is created in the low address space. FLAM creates all work areas above the 16 MB limit, so that the usual memory area is still made available to the applications.

No changes are normally necessary in the calling programs.

The compressed files created by the subsystem (FLAMFILEs) can be decompressed by the FLAM utility at any time, and all FLAMFILEs created by the FLAM utility are accepted and processed logically by the FLAM subsystem. The same applies likewise to FLAMFILEs that are created/read via the record interface of FLAM (see also manual for FLAM V4.x).

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Chapter 2:

Subsystem call

2. Subsystem call

```
//ddname DD DSN=filename,
//          DISP=OLD,
//          SUBSYS=(FLAM,'flam-parameter')
```

This call designates the cataloged file filename for processing with the FLAM subsystem.

FLAM parameters can be specified in addition, in the same way as with the FLAM utility.

Invalid parameters are rejected by FLAM as JCL errors and the job they refer to is not even started. The DD command is still verified by JES.

The catalog entry for the file is not modified by FLAM. All entries such as the file name, the record and block lengths, the volume, etc. remain unchanged.

The files that must be processed with the FLAM subsystem are thus still verified by the check mechanisms, such as SMS and RACF.

There is no FLAM restriction on the number of files that can be processed "simultaneously" by the subsystem. The only restrictions are those imposed by the system itself, such as the maximum amount of available memory or the maximum possible number of DD statements.

If files for which the SUBSYS specification in the DD statement is not supported must be processed (for example, JES files), the problem can be overcome by specifying a FLAM parameter and a second DD statement:

```
//ddname DD SUBSYS=(FLAM,'FLAMDDN=ddname1'),
//          DCB=(LRECL=...,BLKSIZE=...)
//ddname1 DD SYSOUT=G,DEST=(.....),
//          DCB=(LRECL=80,.....)
```

Specifying a DD name ddname1 as a FLAM parameter causes the subsystem to process the file assigned by means of this name (in this case by writing in it). This file must be specified in the JCL. Similarly, ddname1 could be used as a decompression input. The calling program, on the other hand, uses the file assigned with ddname!

This method permits reading or writing in any file (JES, RJE, other subsystems, magnetic tapes, temporary files, etc.) which cannot otherwise be processed with the usual method (see examples).

If DCB attributes are specified for ddname, FLAM interprets them as values for the original (uncompressed) file. DCB specifications for ddname1 apply to the compressed file (the FLAMFILE).

Record and block formats which are completely different from one another can thus be set for the original and compressed files depending on the particular problem, in other words the subsystem allows an application to use files that have absolutely nothing in common with the entries in the program (see examples) and that without the subsystem might have to be converted.

If the FLAMFILE is accessed without a SUBSYS specification, it behaves like a "normal" file, in other words it can be read (copied, transferred) by means of utilities or file transfer programs without being decompressed!

Similarly, a FLAMFILE which is transferred by a file transfer program can be read and processed via the subsystem.

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Chapter 3:

Preconditions

3. Preconditions

FLAM must be installed on the computer (see installation instructions) both as a utility (V4.0 or higher) and as a subsystem.

Data records can be written, read, modified, inserted or deleted. The data set organization may be of PS or VSAM.

The accesses must be logical, in other words either in sequential order or according to a key. Accesses according to the RBA (relative byte address) of a data record or an alternate index are not possible!

A DCB for PS files or an ACB for VSAM files can be coded in the calling program. The programs (or more precisely the file control block DCB) must be stored in the low address space.

A FLAMFILE in KSDS format must have the same structure as in the FLAM utility (see manual for FLAM (MVS)), i.e.

Relative key position	0
Key length	one byte longer than the original
Record length	between 80 and 32760 bytes
Control interval size	any, depending on record length

Although FLAM supports a wide range of record length, please take care on performance views.

FLAM compresses a number of data records in a row (depending on MAXR and MAXB parameter). MAXB=64 means 64 KB of Data will be compressed. Assume a compression rate of 90 %, this will lead to a compression result of 6.4 KB compressed data. If you had defined the VSAM-KSDS-FLAMFILE like your original file (i.e. with record size of 400 byte) FLAM has to write 17 VSAM records for the compressed data, each with a new built key. So has FLAM to read 17 records to decompress one original record. So it is better to define a larger RECSIZE for the FLAMFILE, in this example you should use RECSIZE(7168 7168).

Note:

The runtime system of COBOL (PL/I, C) checks all assigned VSAM files.

The FLAMFILE must therefore be tuned to the VSAM file type if COBOL programs are used: for accesses to VSAM-ESDS it must also have been created as ESDS, while for accesses to VSAM-KSDS a KSDS-FLAMFILE must exist as well.

With Assembler programs, on the other hand, the FLAMFILE and the original file need not necessarily be of the same type (providing this is also meaningful).

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Chapter 4:

Principle of operation

4. Principle of operation

All the JCL specifications are checked before a batch job is started by JES. The parameters for the subsystem are transferred and verified by FLAM-sub. If an error is detected, the DD statement is rejected as a JCL error. In addition, a message is output in the JCL list (see messages in examples section). The job is thus only started if there are no errors; otherwise it is aborted in the usual way.

An OPEN command call in the program causes a connection to be set up to the FLAM subsystem. FLAM-sub decides at this stage whether the file must be compressed or decompressed. An open input means decompression (read only), while an open output means compression (write only). An open I/O allows full I/Os to the FLAMFILE via the key of the original records. At the same time, the record and block lengths are taken from the calling program (or from the DCB specifications in the JCL) and - in the case of an open output - transferred to the FLAM file header of the FLAMFILE (unless the HEADER=NO parameter has been specified).

The FLAM parameters specified in the JCL are also activated at the time of the open and the compression/decompression routines set accordingly.

All read and write accesses take place in accordance with the specifications in the program. Asynchronous VSAM calls are executed synchronously by the subsystem, while return codes are not returned (or the error routines activated) until the CHECK call.

It makes no difference whether the file is accessed by the program as BSAM, QSAM or VSAM. FLAM-sub maps all calls to the currently available FLAMFILE.

The record format can always be either variable or fixed.

If an error occurs, the error routine remains active in the calling program and is not overlaid by the subsystem. The error return codes that are returned by the subsystem correspond to those of the DMS (see also 'MVS/DFP Macro Instructions for VSAM Data Sets' for VSAM error codes), in other words the error routines need not be modified; the IEC ... messages of the DMS (MVS Message Library: System Messages) are still traced if necessary. Additional messages are output by FLAM-sub with WTO,Routcde=11 for FLAM errors and subsystem errors (see chapter 8, 'Subsystem messages'). They are documented both in the system log and in the JCL list.

No other messages are generated (the FLAM SHOW=ALL parameter of the utility has no effect).

A CLOSE for the file causes FLAM to close the FLAMFILE and free all the work areas again that were requested with the OPEN. New OPEN calls are now allowed.

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Chapter 5:

Restrictions

5. Restrictions

It is not normally necessary to modify the JCL as a result of using the FLAM subsystem.

If specifications such as the record and block lengths are omitted from the programs however (utilities such as IEBGENER and SORT function in this way), DCB specifications must be included in the DD statement!

The usual principle whereby the values are automatically taken from a catalog entry in such cases does not work if a subsystem is used. An OPEN routine only recognizes the actual presence of a subsystem file and no longer accesses a catalog entry (even if one exists).

5.1 In general

ADC

MODE=ADC is not allowed in update mode.

DGD

Data Generation Groups must be specified with the absolute name (FILE.G0004V00), not with the relative name (FILE(+1)).

DISP

The DISP parameter in the DD statement (e.g. DISP=NEW or DISP=(..., DELETE) cannot be interpreted and thus has no effect.

All files that are assigned directly via FLAM-sub (DSN=filename, SUBSYS=FLAM) must be cataloged.

If new files must be created, a second DD statement can be used:

```
//ddname DD SUBSYS=(FLAM, 'FLAMDDN=newfile')
//newfile DD DSN=...,
            DISP=(NEW,CATLG),
            UNIT=...,SPACE=...
```

Alternatively, the file must have been created in a previous STEP.

All types of access (GET, WRITE, PUT, POINT, ERASE, CHECK) with appropriate RPL modifications for VSAM are possible via the subsystem.

The following restrictions apply (see also manual 'DFSMS/MVS Macro Instructions for Data Sets, SC26-4913'):

5.2 DCB calls (PS files)

CLOSE	A temporary close call in conjunction with BSAM accesses (CLOSE ...,TYPE=T) is not passed on to the subsystem and has no effect.
LOCATE	All attempts to write in LOCATE mode are rejected.
POINT	A POINT in conjunction with BSAM accesses is rejected with the error message IEC141I 013-BC .. (it is not even passed on to the subsystem).
VBS	A file with RECFM=VS or VBS (spanned records) can be written in but not read (IEC141I 013-A8 ...).

5.3 ACB/RPL calls (VSAM files)

CHECK	Asynchronous calls are executed synchronously by FLAM-sub (though, as usual, no response to errors until CHECK).
CNVTAD	CNVTAD returns invalid specifications or zero.
ENDREQ	ENDREQ (terminate a request) has no effect (FLAM does not support locks and only holds the last key).
RPL	Accesses with more than one RPL (RPL list) are not supported (only the first RPL is interpreted).
SHOWCB	SHOWCB ACB=... The CINV, KEYLEN, LRECL and RKP fields contain the values for the original file, while all other specifications (such as ENDRBA, HALCRBA, etc.) refer to the FLAMFILE.
VERIFY	VERIFY (synchronize end of data) has no effect (VSAM control blocks are not updated).
VSAM-KSDS	If a VSAM-KSDS file must be loaded via FLAM-sub (OPEN OUTPUT in the program), the position and length of the key must be notified to the subsystem (important: the key position is 1 byte higher for FLAM than the RKP for IDCAMS!):

```
//... DD ...,
      SUBSYS=(FLAM,'OKEYP=value1,OKEYL=value2')
```

The reason for this is as follows:
These specifications are normally transferred by means of IDCAMS when the file is cataloged. With VSAM accesses these specifications are contained in the catalog entry and not in the ACB. The FLAMFILE has been cataloged there with completely different values however, so that the parameters of the original file are no longer available. This information is contained in the compressed file for all subsequent

accesses (INPUT or I/O) and does not need to be specified again.

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Chapter 6:

Parameters for FLAM®

6. Parameters for FLAM®

Parameters for FLAM are transferred in the DD statement of the SUBSYS specification:

```
SUBSYS=(FLAM,'parameter1=value1,parameter2=value2,...')
```

or

```
SUBSYS=(FLAM,'parameter1=value1';'parameter2=value2';...')
```

The parameters correspond to those of the FLAM utility (see also manual for FLAM V4.x).

Parentheses () can also be used instead of the equals sign '=', e.g. MO(ADC).

Any apostrophes contained within the parameter string literal must be duplicated (e.g. SUBSYS=(FLAM,'CRYPTOKEY=C"PASS WORD WITH BLANKS"').

CRYPTOKEY

Key to encrypt or decrypt a FLAMFILE

CRYPTOK

This parameter activates the cryptographic method, entered with parameter CRYPTOMODE.

Possible values:

1 - 64 characters starting with A'..' , C'..' , X'..' or a string

Using A'..' all characters are translated to ASCII with the internal translation table A/E.

Default: no key

Valid for: compression, decompression

Note:

Please take care of the different code tables or national character sets used on the different platforms.

E.g. using the key 'FLAM' both on Windows systems (ASCII) and on MVS (EBCDIC) leads to a cryptokey error. You have to pass X'464C414D20' (this is 'FLAM ' in ASCII) or A'FLAM' on MVS instead.

We recommend to use the hex input for a heterogeneous environment.

CRYPTOMODE	Choose the algorithm for encryption.				
CRYPTOM	<p>Possible values:</p> <table> <tr> <td>AES</td> <td>Advanced Encryption Standard</td> </tr> <tr> <td>FLAM</td> <td>the internal FLAM algorithm</td> </tr> </table> <p>Default: FLAM</p> <p>Valid for: Compression.</p> <p>Note: AES was introduced 2003 in FLAM V4.0 and is not compatible to older versions 3.x.</p> <p>The encryption will be activated by the parameter CRYPTOKEY. The encryption mode is stored in the FLAMFILE, only the key is necessary on decompression and decryption.</p> <p>Encryption implies MODE=ADC or NDC. Without entering a MODE-parameter ADC is used.</p>	AES	Advanced Encryption Standard	FLAM	the internal FLAM algorithm
AES	Advanced Encryption Standard				
FLAM	the internal FLAM algorithm				
FILEINFO	Transfer file name of original into file header.				
FI	<p>Possible values:</p> <table> <tr> <td>YES</td> <td>Transfer file name</td> </tr> <tr> <td>NO</td> <td>Do not transfer file name</td> </tr> </table> <p>Default: YES</p> <p>Valid for: Compression</p>	YES	Transfer file name	NO	Do not transfer file name
YES	Transfer file name				
NO	Do not transfer file name				
FLAMDDN	DD name of a FLAMFILE assigned by JCL.				
FLAMD	<p>Compresses to this file or decompresses from this file.</p> <p>Possible values:</p> <p>DD name with up to 8 characters</p> <p>Default: No name</p> <p>Valid for: Compression, decompression</p> <p>Note: The file name (DSN=name) with the SUBSYS-parameter is stored in the FLAMFILE, not the name of the file FLAMDD is pointing to.</p>				

HEADER	Creates a file header.
HE	<p>Possible values:</p> <p>YES Create file header</p> <p>NO Do not create file header</p> <p>Default: YES</p> <p>Valid for: Compression</p> <p>Note: Only for special usages, the header should always be created, so that the subsystem can access it in future in order to process the file.</p> <p>HEADER=YES is set using AES-encryption.</p>
KMEXIT	Use the key management exit module
KME	<p>Possible values:</p> <p>name name of the module (max. 8 characters)</p> <p>Default: none</p> <p>Valid for: en-/decryption</p> <p>The module is loaded dynamically.</p> <p>Note: This Parameter overrules CRYPTOKEY This module is required to benefit from a fully automatic encryption/decryption (-> manual FLAM (MVS) V4).</p> <p>Because of the specific conditions in a subsystem environment this module has to be written in Assembler! Using a high level language will lead to system errors.</p>
KMPARM	Parameter used for the KMEXIT.
KMP	<p>Possible values:</p> <p>Any input up to 256 characters in the form A'...', C'...', X'...', or as a string.</p> <p>Default: no parameter</p> <p>Valid for: encryption/decryption</p>

MAXBUFFER	Maximum size of the compressed-file matrix.								
MAXB	Possible values: <table> <tr> <td>0 - 7</td> <td>(Compatibility with FLAM V2.0)</td> </tr> <tr> <td>8 - 2047</td> <td>Size in kilobytes</td> </tr> <tr> <td>Default:</td> <td>64 Kbytes</td> </tr> <tr> <td>Valid for:</td> <td>Compression (CX8,VR8)</td> </tr> </table>	0 - 7	(Compatibility with FLAM V2.0)	8 - 2047	Size in kilobytes	Default:	64 Kbytes	Valid for:	Compression (CX8,VR8)
0 - 7	(Compatibility with FLAM V2.0)								
8 - 2047	Size in kilobytes								
Default:	64 Kbytes								
Valid for:	Compression (CX8,VR8)								
MAXRECORDS	Maximum number of records in a compressed-file matrix.								
MAXR	Possible values: <table> <tr> <td>1 - 255</td> <td>for MODE=CX7/CX8/VR8</td> </tr> <tr> <td>1 - 4095</td> <td>for MODE=ADC</td> </tr> <tr> <td>Default:</td> <td>255 or 4095 (depends on MODE-parameter)</td> </tr> <tr> <td>Valid for:</td> <td>Compression</td> </tr> </table> <p>Note for FLAMFILES in KSDS format: If accesses are normally direct, a lower value should be specified for MAXR (<= 64).</p>	1 - 255	for MODE=CX7/CX8/VR8	1 - 4095	for MODE=ADC	Default:	255 or 4095 (depends on MODE-parameter)	Valid for:	Compression
1 - 255	for MODE=CX7/CX8/VR8								
1 - 4095	for MODE=ADC								
Default:	255 or 4095 (depends on MODE-parameter)								
Valid for:	Compression								
MAXSIZE	Maximum record length of the compressed file.								
MAXS	Possible values: <table> <tr> <td>80 - 32760</td> <td></td> </tr> <tr> <td>Default:</td> <td>512 bytes</td> </tr> <tr> <td>Valid for:</td> <td>Compression</td> </tr> </table> <p>Note: The LRECL entry in the catalog takes priority for fixed files (RECFM=F,FB,FBS), while for variable files and VSAM, MAXS is valid as the maximum length, even if a higher value is specified in the catalog for LRECL or RECSIZE.</p>	80 - 32760		Default:	512 bytes	Valid for:	Compression		
80 - 32760									
Default:	512 bytes								
Valid for:	Compression								
MODE	Compression method								
MO	Possible values: <table> <tr> <td>ADC</td> <td>8-bit compressed file with highest compression (Advanced Data Compression)</td> </tr> <tr> <td>NDC</td> <td>no compression of data</td> </tr> </table>	ADC	8-bit compressed file with highest compression (Advanced Data Compression)	NDC	no compression of data				
ADC	8-bit compressed file with highest compression (Advanced Data Compression)								
NDC	no compression of data								

	CX7	Transformable, 7-bit compressed file
	CX8	8-bit compressed file (runtime-optimized)
	VR8	8-bit compressed file (memory-optimized)
	Default:	VR8
	Valid for:	Compression
	Note:	MODE=ADC is set using encryption when no MODE is set..
MSGDDN		DD name of a trace file assigned by JCL.
MSGD		Causes a TRACE to be written in this file (see TRACE parameter).
	Possible values:	
		DD name with up to 8 characters
	Default:	FLPRINT
	Valid for:	Compression, decompression
ODSORG		Specifies the original files data organization of the output.
ODSO		Possible values:
		PS, KSDS
	Default:	PS (output for a sequential data set)
	Valid for:	Compression
	Note:	Use this parameter to load a VSAM-KSDS file although a DCB for a PS file is used (i.e. by a utility).
OKEYLEN		Key length of the original file at the time of the output.
OKEYL		Possible values:
		0, 1 – 255
	Default:	8 if key sequenced data, 0 else
	Valid for:	Compression

OKEYPOS Key position of the original file at the time of the output.

OKEYP Possible values:
 0, 1 up to record length minus key length
 Default: 1 if key sequenced data
 Valid for: Compression

SECUREINFO Additional information stored in the FLAMFILE

SEC increasing the security of data. Changing the FLAMFILE (in any way) leads to an decompression error.

Possible values:

YES	create these information (default on encryption) on compression
NO	do not store any additional data
IGNORE	ignore any security violations on decompression
Default:	NO (without encryption) YES (with AES encryption)
Valid for:	compression, decompression

Note:
 Concatenation of "secure" FLAMFILES leads to security violations!

SECUREINFO=YES requires MODE=ADC or NDC and is set automatically using AES encryption.

SPLITMODE Mode to split a FLAMFILE

SPLITM Possible values:

NONE	no split
SERIAL	serial split
PARALLEL	parallel split
Default:	NONE
Valid for:	compression

Note:
 Split of FLAMFILES has been introduced in FLAM V4.0 and is not compatible to older versions.

The split information is stored in the FLAMFILE. So it is not necessary to use any parameter on decompression.

File- or DD-names must have numeric characters (ch. 3.1.5, or example in ch. 5.1.3 in manual FLAM (MVS) V4, or example 10.8 in this manual).

SPLITNUMBER

Number of fragments on parallel split

SPLITN

Possible values:

2 - 4 number of simultaneously written files

Default: 4

Valid for: compression

Note:

The information is stored in the FLAMFILE. So it is not necessary to use any parameter on decompression.

All fragments have to be catalogued and ready to read. It is not possible, to decompress one fragment alone.

Using this parameter requires SPLITMODE=PARALLEL.

SPLITSIZE

Amount in MB of a fragment on serial split

SPLITS

Possible values:

1 - 4095

Default: 100

Valid for: compression

Note:

The number of created files depends on the amount of compressed data. The information is stored in the FLAMFILE.

Using this parameter needs SPLITMODE=SERIAL.

TRANSLATE

Data conversion.

TRA

Possible values:

E/A Converts from EBCDIC to ASCII

A/E Converts from ASCII to EBCDIC

name Name (up to 8 characters) of a data module containing a 256 byte long translation table.

Default:	No conversion
Valid for:	Compression or decompression (but not simultaneously, i.e. I/O mode)

Environment Variable is stored in the file

//CEEOPTS DD ...

or set in a C-program.

It is used in the actual STEP only and must be repeated for every other STEP.

FL_ZEDC_SUPPORT

controls using of the ZEDC hardware-algorithm

possible values:

OFF switch to ,always NO ZEDC'.
ADC is still in effect on compression.
Decompression will be done in
software, if ZEDC compressed data
are found.

ON switch to ,always ZEDC'.
Instead of ADC, ZEDC is used.
Without hardware, software is used.

Default: without variable, ZEDC hardware is
used when found. Otherwise ADC is still
in effect.

Valid for: compression, decompression

System Variable

are stored in the system-parmlib

SYS1.PARMLIB(IEASYMxx)

When system- and environment variable are found, the
environment variable is used.

A system variable is used system wide in any STEP.

&FLZEDC

controls using of the ZEDC hardware-algorithm

possible values:

OFF	switch to ,always NO ZEDC'. ADC is still in effect on compression. Decompression will be done in software, if ZEDC compressed data are found.
ON	switch to ,always ZEDC'. Instead of ADC, ZEDC is used. Without hardware, software is used.
Default:	without variable, ZEDC hardware is used when found. Otherwise ADC is still in effect.
Valid for:	compression, decompression

&FLOGQL1 logstream

is the name of the first qualifier of the name (LOGR).

Without it no logging is done.

Possible values:

1-8 Character as in IXCMIAPU defined.

&FLOGQL2

is the name of the second qualifier of the log-stream name (LOGR).

Possible values:

1-8 Character as in IXCMIAPU defined.

&FLOGQL3

is the name of the third qualifier of the log-stream name (LOGR).

Possible values:

1-8 Character as in IXCMIAPU defined.

Valid for: compression, decompression

FLAM®-sub (MVS)

User Manual

Chapter 7:

**Parameters for
controlling the
subsystem**

7. Parameters for controlling the subsystem

These parameters are keyword parameters that must be specified separately from the FLAM parameters. They serve to control the subsystem and strictly speaking have nothing to do with FLAM.

```
...SUBSYS=(FLAM,parm, 'flam-parameter')
```

IG10

Causes return code 10 (not a FLAMFILE) to be ignored when opening for reading. The records are transferred to the calling program without being decompressed.

This parameter is meaningful in systems which can contain both compressed and uncompressed files (e.g. for tests).

TRACE

Activates the TRACE function.

All function calls to FLAM and the control blocks (ACB, RPL) of the calling program are traced.

The trace file must be specified in the JCL. The FLAM parameter 'MSGDDN=ddname' specifies the DD name (default: FLPRINT).

FLAM®-sub (MVS)

User Manual

Chapter 8:

Subsystem messages

8. Subsystem messages

FLAM-sub only outputs a message on the console in the event of an error (by means of WTO ,ROUTCDE=11). This message is also documented in the JCL log.

The letter after the message number specifies the time at which the error was detected:

I	When the subsystem was initialized
C	When the JCL was analyzed
A	When the file was allocated
O	When the file was opened
D	During the I/O operation
E	When the file was closed

Except when the subsystem is initialized during the IPL of the operating system, errors only affect the specified file for a particular job, in other words the subsystem remains active for the other files.

FLM0500I

INITIALIZATION OF SUBSYSTEM FLAM COMPLETED

The FLAM subsystem has been initialized correctly and is now available.

Response: None

FLM0501I

SUBSYSTEM FLAM NOT INSTALLED ON THIS SYSTEM

The subsystem cannot be initialized. It has not been installed on the computer.

Response: Insert the entry FLAM,FLSSIPL
in SYS1.PARMLIB(IEFSSN..).

FLM0502I

SUBSYSTEM FLAM ALREADY INITIALIZED

The program for initializing the subsystem was restarted after the IPL and then rejected. The subsystem that was already active is still active.

Response: FLAM-sub need not be restarted.

FLM0503I

NO MEMORY RECEIVED FOR INITIALIZATION

The operating system cannot make any memory available for initialization.
The subsystem is not active.

Response: An analysis is necessary (system
dump).

FLM0504I**SUBSYSTEM COULD NOT FREE SYSTEM MEMORY**

The memory made available by the operating system cannot be freed. The subsystem has nevertheless been initialized and is now available.

Response: An analysis is necessary (system dump).

FLM0505I**SUBSYSTEM FLAM FUNCTION MODULE NOT FOUND**

A FLAM-sub module required to initialize the subsystem is missing. The module was named by a previous operating system message. The subsystem has not been initialized.

Response: Store the subsystem modules in a library belonging to the LINKLIST concatenation.

FLM0506I**MODULE IEFJSVEC NOT FOUND**

The IEFJSVEC operating system module required to initialize the subsystem is missing. The subsystem has not been initialized.

Response: Set the missing module in a library that has been linked with the LINKLIB.

FLM0507I**IEFJSVEC: NO MEMORY FOR SSVT**

The subsystem initialization procedure was aborted by the IEFJSVEC operating system module because there is insufficient memory.

Response: An analysis is necessary (system dump).

FLM0508I**LOGIC ERROR IN IEFJSVEC**

The subsystem initialization procedure was aborted by the IEFJSVEC operating system module due to an internal error.

Response: An analysis is necessary (system dump).

FLM0510I**INTERNAL ERROR. RC = no**

An internal error has been detected.
The subsystem has not been initialized.

Response: Please inform your sales partner.

FLM0515I**INITIALIZATION OF SUBSYSTEM FLAM FAILED**

The subsystem cannot be initialized due to an error.
The error situation was documented in a previous message.

FLM0519I**FLAM SUBSYSTEM IS NOT LICENSED**

Your license does not allow using the subsystem.

**FLM0520C
FLM0502C****PARAMETER ERROR: ...
SYNTAX ERROR: ...**

An invalid parameter was entered in the DD statement
of the JCL for FLAM-sub.

Response: Correct the parameter (see
 'Parameters') and restart the job.

FLM0523C**NO MEMORY RECEIVED FOR JCL-CONVERTION**

A subsystem module was not allocated any memory by
the operating system.

Response: An analysis is necessary (system
 dump).

**FLM0530A
FLM0530A****PARAMETER ERROR: ...
SYNTAX ERROR: ...**

An invalid parameter was entered in the DD statement
of the JCL for FLAM-sub.
The invalid parameter is displayed.

Response: Correct the parameter (see
 'Parameters') and restart the job.

FLM0531A**NO MEMORY RECEIVED FOR ALLOCATION**

A subsystem module was not allocated any memory by
the operating system.

Response: An analysis is necessary (system
 dump).

FLM05400**OPEN ERROR. DDNAME=*ddname*. RC= *no*
(FLAM)/(VSAM)**

An error was detected at the time of the open for the file assigned in the JCL with *ddname*. FLAM return codes are specified in decimal format and VSAM errors in hexadecimal format (see also manual for FLAM (MVS) V4.x; and DFSMS Macro Instructions).

This message is followed by the IEC141I 013-xx message of the data management system, whereby the DD name used by the program is output. The message IEC161 may be output in connection with VSAM accesses.

The reported FLAM message numbers are equal to the numbers in FLAM utility (ch. 8 in the manual FLAM(MVS)).

Here some examples:

no:

-1	Not enough memory (license rights may have been violated)
10	The file is not a FLAMFILE (input or I/O)
11	FLAMFILE format error
12	Record length error
13	File length error
14	Checksum error
21	Illegal matrix buffer
22	Illegal compression method
23	Illegal CODE in FLAMFILE
24	Illegal BLOCKMODE
25	Illegal record length
31	File not assigned (DD statement missing)
33	Invalid file type
34	Invalid record format
35	Invalid record length
36	Invalid block length
40	Cannot load module or table (TRANS parameter)
60 - 78	FLAM syntax error
120	Name generation in error. Generating a new file name is impossible due to the lack of digit numbers in the name (i.e. only 1 digit number is in the name, cannot generate more than 9 file names).
121	One fragment of the splitted FLAMFILE is missing.
122	Sequence check error of a serially splitted FLAMFILE. The fragments are not in ascending order.
123	Fragments of the splitted FLAMFILE do not belong together.

124	The FLAMFILE was split in more fragments than the actual version can handle.
130	Security violation: FLAMFILE is not in original state during read (i.e concatenation of FLAMFILES, updates, inserts). Allowed to be ignored (SEC=IGNORE).
131	Missing records in a FLAMFILE. Allowed to be ignored.
132	A member was inserted into a group FLAMFILE. Allowed to be ignored.
133	Sequence error: FLAMFILE records are not in ascending order. Allowed to be ignored.
134	Security error: FLAMFILE starts without security information but then one were found. Cannot be ignored. Perhaps concatenation of FLAMFILES without and with security information.
531	Some fragments missing during decompression and parallel split.
Response:	If RC = -1 and correct license, specify a higher value for REGION in the EXEC statement; if RC = 11 - 14, the file is no longer available in its original state, the data contents have been modified (possibly by a file transfer program) or another type of error has occurred and must be rectified by following the instructions provided (see also manual for FLAM V4.x, Chapter 8). Some security violations are allowed to be ignored, but take care of the situation.

FLM05410**ALLOCATION FAILED FOR DSN *filename*
SVC99 ERROR CODE = *no1*. INFO CODE = *no2*.**

An error was detected when an attempt was made to allocate the file *filename* dynamically. The codes are specified in hexadecimal format.

Response: Analyse the error and info codes of the SVC99 as described in the manual ('MVS Authorized Assembler Services Guide, GC28-1763').

e.g. **error code = 1708**, info code = 2 or 5 means: **File is not cataloged** (remember: only cataloged files are allowed using FLAM-sub).

**FLM0543O TRANSLATE-PARAMETER INVALID WITH OPEN I/O -
IGNORED**

The TRANSLATE parameter is ignored in connection with an OPEN I/O.

Input and output records can only be translated according to the specified table with an OPEN INPUT or an OPEN OUTPUT.

Processing continues without translating the data.

**FLM0544O FORCED BY PARAMETER TO ACCESS AS UN-
COMPRESSED DATA**

No FLAMFILE was identified when a subsystem file was opened (message: FLM0440O with RC=10). The set subsystem parameter IG10 forces processing to continue on the basis of an uncompressed (original) file.

Important: If there is no original (uncompressed) file, unpredictable errors may occur.

**FLM0552D I/O ERROR. DDNAME = *ddname*. RC = *no* (FLAM)/(VSAM)
*file-name***

An error was detected by the FLAM subsystem while reading or writing in the specified file *file-name*. FLAM return codes are specified in decimal or hexadecimal format and VSAM errors in hexadecimal format.

This message may be followed by the IEC020I 001-.. message of the data management system.

You can find a list of VSAM return codes in the manual entitled 'DFSMS Macro Instructions'.

All FLAM return codes are listed in the FLAM-utility manual (ch. 8), but here some examples:

no:

- 11 FLAMFILE format error
- 12 Record length error
- 13 File length error
- 14 Checksum error

If one of the above codes is returned, the data in the FLAMFILE has been mutilated (e.g. as a result of a file transfer).

- 7 Password not declared
- 15 Record length greater than 32 KB
- 16 Record length greater than MAXB - 4
- 25 Illegal record length
- 29 Password in error

123-134 see FLM05400

Detecting a security violation the FLAM error code is reported as a hexadecimal value (nnmmmm). nn describes, where the error was detected:

01	Header
02	Segment
03	Membertrailer
04	Filetrailer

Mmmm is the error

0001	MAC1, the data MAC
0002	MAC2, the chaining MAC
0003	MAC3, the MAC over MACs
0010	data missing
0020	data inserted
0040	data updated
0080	record counter compressed data
0100	byte counter compressed data
0200	record counter original data
0400	byte counter original data
0800	chaining on FLAM encryption

The error codes are or'd, e.g. 030180 means: record and byte counter of the compressed data do not fit with the stored information, detected in the member trailer.

It is allowed to ignore these violations (SEC=IGNORE), but take care of the situation.

FLM0553D

NO MEMORY RECEIVED FOR I/O OPERATIONS

A subsystem module was not allocated any memory by the operating system. Consequently, no other information is available.

Response: Specify a higher value for REGION in the EXEC statement.

FLM0570E

CLOSE ERROR. DDNAME = *ddname*. RC = *no file-name*

An error was detected when an attempt was made to close the specified file.

Since compressed-file records may have to be written as well when a file is closed, see also FLM0552D message.

FLAM®-sub (MVS)

User Manual

Chapter 9:

Installing FLAM®-sub

9. Installing FLAM®-sub

The software may be downloaded from the FLAM homepage via internet.

README files are stored to guide the installation.

Manuals are provided as PDF-files to read the documents on an appropriate system (e.g. Unix, Windows).

It is allowed to copy and print the documents as often it is needed, but for internal use only.

9.1 LINKLST and authorization

The programs of the subsystem must be stored in an APF-authorized load library. This library must be linked to the system library SYS1.LINKLIB. The subsystem also reloads modules belonging to the FLAM utility at the time of the OPEN. The library of the FLAM utility must therefore be APF-authorized as well.

We recommend keeping all the load modules of FLAM-sub and FLAM-utility in a common library and using only this library.

The following entries are necessary in the SYS1.PARMLIB library for this purpose (see also z/OS Initialisation and Tuning Reference). xx is the serial number of your active system generation.

There is more than one method, to link a LOAD library to LINKLST.

a) To generate a link to the system library, insert the following line in the member LNKLSTxx:

```
SYS1.FLAMLIB,
```

Libraries which are concatenated in this way are normally APF-authorized as default. If not, they can be authorized by inserting the following line:

```
SYS1.FLAMLIB volume,
```

in the member IEAAPFxx,

where volume is the name of the disk on which the SYS1.FLAMLIB library is stored (if this entry is the last in the member, the comma must be omitted).

b) Insert some lines into the PROGxx member:

```
LINKLST      ADD
              NAME(LINKLSTxx)
              DSNAME(flamlib)
              VOLUME(volume)
And
APF          ADD
              DSNAME(flamlib)
              VOLUME(volume)
```

Many variants exist for this member, this is only one example.

9.2 Subsystem Start

There are two ways to start the subsystem. Defining a static subsystem that cannot be changed during the IPL session, and defining the more flexible dynamic subsystem via a started task.

a) The FLAM subsystem is initialized during a system IPL.

The following line must be inserted in the member IEFSSNxx of the SYS.PARMLIB library for this purpose:

```
FLAM,FLSSIPL
```

This entry must not precede the line containing 'JES'.

The order of the entries depends on how often the programs are called. The more frequently they are called, the higher up the entries should be inserted in the first third of the member.

The FLAM subsystem becomes available after the next system IPL, or you can use the console command:

```
SETSSI ADD,S=FLAM,I=FLSSIPL
```

to start FLAM subsystem manually without an IPL.

Note: you can't deactivate the subsystem and change any modules during the session.

b) A started task to activate FLAM subsystem is supplied.

The operator starts the subsystem entering

```
S FLAM
```

from the console.

If you insert the line

```
COM='S FLAM'
```

into the member COMMNDxx, the subsystem starts automatically without an operator interaction during the next IPL.

You can stop the subsystem with

```
P FLAM
```

And

```
F FLAM,VER
```

shows the version of all subsystem modules.

Stopping the subsystem, changing the FLAM-modules in the library (don't forget the LLA REFRESH!) and starting the subsystem again enables an easy way to update the subsystem.

FLAM®-sub (MVS)

User Manual

Chapter 10:

Examples

10. Examples

10.1 Input/output with cataloged files

The USER.EXAMPLE.INPUT file has been created as a compressed file (FLAMFILE), for example with the FLAM utility. It must now be read by another program. The USER.EXAMPLE.OUTPUT file was created by this program previously and must now likewise be compressed. Both files are cataloged.

Two different procedures are possible.

a) When the file was opened, the program specified the record and block lengths in the ACB or the DCB (or in the FD section if COBOL programs are used).

Solution: The SUBSYS specification in the DD statement is sufficient.

```
//stepname EXEC PGM=program
//INPUT DD DSN=USER.EXAMPLE.INPUT,
// DISP=SHR,
// SUBSYS=FLAM
//OUTPUT DD DSN=USER.EXAMPLE.OUTPUT,
// DISP=OLD,
// SUBSYS=FLAM
```

Since the "correct" values are specified in the calling program, the data records are transferred to or from the subsystem in accordance with them.

b) The calling program assumes that an "original" catalog entry exists, i.e. neither a record length nor a block length is specified in the program (IEBGENER, SORT and numerous utilities function in this way).

Solution: Specify additional DCB attributes in the DD statement.

```
//stepname EXEC PGM=program
//INPUT DD DSN=USER.EXAMPLE.INPUT,
// DISP=SHR,
// DCB=(RECFM=FB,LRECL=121,BLKSIZE=3025),
// SUBSYS=FLAM
//OUTPUT DD DSN=USER.EXAMPLE.OUTPUT,
// DISP=OLD,
// DCB=(RECFM=VB,LRECL=438,BLKSIZE=4096),
// SUBSYS=FLAM
```

The program is presented with the specified DCB attributes, irrespective of the actual catalog entry. The subsystem transfers records in accordance with these specifications. FLAM, on the other hand, reads or writes compressed-file records on the disk in cataloged format.

The subsystem activity is confirmed by the system messages in the JCL listing.

```
IEF237I FLAM ALLOCATED TO INPUT
IEF237I FLAM ALLOCATED TO OUTPUT
.
.
IEF285I USER.EXAMPLE.INPUT SUBSYSTEM
IEF285I USER.EXAMPLE.OUTPUT SUBSYSTEM
```

10.2 FLAM parameters and subsystem

Cf. example 1, except that a specific compression method (ADC) must be set for the output file.

Solution:

Enter the necessary parameters in the SUBSYS specification of the DD statement.

```
//stepname EXEC PGM=program
//INPUT DD DSN=USER.EXAMPLE.INPUT,
// DISP=SHR,
// SUBSYS=FLAM
//OUTPUT DD DSN=USER.EXAMPLE.OUTPUT,
// DISP=OLD,
// SUBSYS=(FLAM, 'MO=ADC')
```

The FLAM utility and the 'D,SHOW(ATT)' parameters or the I OPTION in the FLAM panels allow you to check whether or not the compression procedure is successful.

10.3 Creating a new file

A file called USER.EXAMPLE.NEWDAT must be created. It is not cataloged:

```
//OUTPUT DD DSN=USER.EXAMPLE.NEWDAT,
// DISP=(NEW,CATLG,),
// UNIT=SYSDA,SPACE=(CYL,(24,24)),
// DCB=(RECFM=FB,LRECL=121,BLKSIZE=3025)
```

Solution: Specify a second DD statement for FLAM-sub.

The original file description is given a new DD name, to which a FLAM parameter in the SUBSYS specification refers.

```
//OUTPUT DD SUBSYS=(FLAM, 'FLAMDD=NEWDAT'),
// DCB=(RECFM=FB,LRECL=121,BLKSIZE=3025)
//NEWDAT DD DSN=USER.EXAMPLE.NEWDAT,
// DISP=(NEW,CATLG,),
// UNIT=SYSDA,SPACE=(CYL,(6,6)),
// DCB=(RECFM=FB,LRECL=121,BLKSIZE=3025)
```

The compressed file USER.EXAMPLE.NEWDAT is thus created exactly the same as the original. The advantage of this method is that any subsequent copy or transfer programs which function without the SUBSYS specification will find the same catalog entry as for the original and therefore do not need to be specially tuned.

The new DD statement requires the DCB specification, since it was also mandatory in the original.

Otherwise, the compressed file can be set in any way, e.g.:

```
//OUTPUT DD SUBSYS=(FLAM, 'FLAMDD=NEWDAT'),
// DCB=(RECFM=FB,LRECL=121,BLKSIZE=3025)
//NEWDAT DD DSN=USER.EXAMPLE.NEWDAT,
// DISP=(NEW,CATLG),
// UNIT=SYSDA,SPACE=(CYL,(6,6)),
// DCB=(RECFM=FB,LRECL=1024,BLKSIZE=26624)
```

As far as the calling program (and the subsystem) is concerned, the original records are 121 bytes long.

The FLAMFILE, on the other hand, has longer records and blocks for performance reasons (this is the normal, recommended case).

The file descriptions can thus be separated from one another.

10.4 Temporary files

FLAM-sub cannot process any temporary files directly. A second DD statement is necessary for this purpose.

```
//DDNAME DD SUBSYS=(FLAM, 'FLAMDD=tempfile')
//tempfile DD DSN=##file,DISP=...
```

It is not necessary to specify a file name on account of the FLAMDD specification for DDNAME. A temporary file name is generated automatically by JES. FLAM-sub branches directly to the temporary file.

10.5 Other subsystems

Other subsystems, such as JES for SYSOUT/SYSIN, must be activated by means of a second DD statement.

```
//DDNAME DD SUBSYS=(FLAM, 'FLAMDD=subfile')
//subfile DD SYSOUT=A,DEST=(...),...
```

Depending on the program which is used, it may be necessary to specify DCB parameters in order to process the original file (DDNAME statement, cf. example 1).

10.6 Loading a VSAM-KSDS file

If a KSDS file is loaded, the file is opened for writing (OUTPUT). The keys must be transferred to VSAM in ascending order (this is also checked by FLAM-sub).

It is possible to load the file in I/O mode, in other words it must contain at least one record. At the same time, this leads to a deterioration in performance and an increase in the number of accesses.

The file itself is normally created using IDCAMS and is already cataloged when the job is executed.

The simplest method is to create a compressed KSDS file with the FLAM utility.

10.6.1 Load a real VSAM-KSDS file

A 'real VSAM-KSDS file' means, an ACB is provided to open the data set.

When the file is loaded via the subsystem, the key description of the original data must be specified in the form of parameters:

```
//OUTPUT DD DSN=USER.EXAMPLE.OUTPUT,
//          SUBSYS=(FLAM, 'OKEYPOS=21,OKEYLEN=64,MAXS=7168'),
//          DCB=(LRECL=512,BLKSIZE=20480)
```

The original records are up to 512 bytes long in this example, while the control interval takes up 20480 bytes and the key begins at position 21 and is 64 bytes long.

The subsystem should use the full record length of the VSAM file (7168 bytes).

Note: FLAM counts the key position starting at 1 (corresponds to RKP=0).

The VSAM file itself requires the entries (see also 'Preconditions') for the example:

```
KEYS(65 0)
RECSZ(7168 7168)
```

Important: Even if a higher value is specified for RECSZ, the FLAMFILE record length is restricted to 7168 bytes by the MAXS parameter.

Note:

A VSAM file must be empty when it is loaded, in other words either it must not contain any records or the REUSE parameter must have been specified for IDCAMS, to allow the file to be overwritten.

10.6.2 Load a VSAM-KSDS file via an utility

Most utilities (like IEBGENER or SORT) use a DCB to access a subsystem data set. FLAM subsystem then normally declares the data as physical sequential (PS) and has no knowledge about a key description.

Subsystem parameter overwrite this situation and force the subsystem to recognize the output data as key sequenced records:

```
//OUTPUT DD DSN=USER.EXAMPLE.OUTPUT,
// SUBSYS=(FLAM, 'ODSORG=KSDS,OKEYPOS=21,OKEYLEN=64,MAXS=7168'),
// DCB=(LRECL=512,BLKSIZE=20480)
```

The original records are up to 512 bytes long in this example, while the control interval takes up 20480 bytes and the key begins at position 21 and is 64 bytes long.

The subsystem shall use the full record length of the VSAM-KSDS file USER.EXAMPLE.OUTPUT (7168 bytes).

Note: FLAM counts the key position starting at 1 (corresponds to RKP=0).

The VSAM file USER.EXAMPLE.OUTPUT itself requires the entries (see also 'Preconditions') for the example:

```
KEYS(65 0)
RECSZ(7168 7168)
```

Important: Even if a higher value is specified for RECSZ, the FLAMFILE record length is restricted to 7168 bytes by the MAXS parameter.

Note:

FLAM subsystem checks the ascending order of the key sequence of the output records and returns the VSAM return code, if in error. The utility normally is unaware of this situation and returns a 'WRITE ERROR' without any further information.

10.7 TRACE function

A trace function is activated for both the input file and the output file for test purposes:

```
//INPUT      DD  DSN=filename1,SUBSYS=(FLAM,TRACE)
//OUTPUT     DD  DSN=filename2,
//           SUBSYS=(FLAM,TRACE,'MSGDDN=FLTRACE')
//*
//FLPRINT    DD  SYSOUT=*
//FLTRACE    DD  DSN=filename3,DISP=(NEW,CATLG),
                SPACE=(TRK,(12,12),RLSE),UNIT=SYSDA
```

Different files must be specified for the trace. FLTRACE is the assignment for the OUTPUT file trace. FLPRINT is taken as the default name, since no parameter has been specified in the DD statement.

The trace for INPUT is as follows (the records have been shortened here):

FLAM - TRACE FUNCTION - COPYRIGHT 2012 BY LIMES DATENTECHNIK GMBH

ACB DURING OPEN: 009E13A0

```
(A000004C 00000000 00000000 54000000 00000000 00000000 48900008 00000000
00000000 00000000 002C0041 009E12A8 03000000 0000521C 00000000 0C30005
00000000 00000000 00000000)
```

FLMOPN, ON ENTRY:

```
1:03700C04 (037008A0) 2:03700C08 (8349A192) 3:0349AA90 (00000001) 4:0349AA
```

FLMOPN, ON RETURN:

```
1:03700C04 (0372CD88) 2:03700C08 (00000000) 3:0349AA90 (00000001) 4:0349AA
```

FLMOPD, ON ENTRY:

```
1:03700C04 (0372CD88) 2:03700C08 (00000000) 3:0349AA90 (00000001) 4:03700C
5:03700CC4 ()
```

```
6:03700C20 (00000000) 7:03700C24 (00000009) 8:03700C28 (00000200) 9:03700C
```

```
10:03700C5C (00000000 00000000
```

```
00000001 00000008 00000000 00000000 00000000 00000000 00000000 00000000)
```

```

00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
11:03700C34(00001800) 12:03700C38(00000000) 13:03700C3C(00000000)
FLMOPD, ON RETURN:
1:03700C04(0372CD88) 2:03700C08(00000000) 3:0349AA90(00000001) 4:03700CC
5:03700CC4( )
6:03700C20(00000000) 7:03700C24(00000008) 8:03700C28(00000100) 9:03700CC
10:03700C5C(00000000 00000000)
00000000 00000000 00000001 00000000 00000000 00000000 00000000 00000000
00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
11:03700C34(00001800) 12:03700C38(00000000) 13:03700C3C(00000000)
FLMOPF, ON ENTRY:
1:03700C04(0372CD88) 2:03700C08(00000000) 3:03700C40(00000000) 4:03700C4
7:03700C50(00000001) 8:03700C54(000000FF) 9:03700C5C(00000000 00000000)
00000001 00000008 00000001 00000000 00000000 00000000 00000000 00000000
00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
10:03700C58(00000001) 11:03700CC4( ) 12:03700CC( )
FLMOPF, ON RETURN:
1:03700C04(0372CD88) 2:03700C08(00000000) 3:03700C40(000000C8) 4:03700C4
7:03700C50(00000001) 8:03700C54(000000FF) 9:03700C5C(00000000 00000000)
00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
10:03700C58(00000001) 11:03700CC4( ) 12:03700CC( )
FLMGHD, ON ENTRY:
1:03700C04(0372CD88) 2:03700C08(00000000) 3:03700E54(00000036)
4:03700E58(FLAM.DAT.CMP )
5:03700E4C(00000000) 6:03700E48(00000009) 7:03700E3C(00000050) 8:03700E0
9:03700C5C(00000000 00000000)
00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
10:03700E40(00000C30) 11:03700E38(00000000) 12:03700E28(01010000)
FLMGHD, ON RETURN:
1:03700C04(0372CD88) 2:03700C08(00000000) 3:03700E54(0000001C)
4:03700E58(FLAM.FLAMV27C.CLIST(ORGFLAM))
5:03700E4C(00000000) 6:03700E48(00000009) 7:03700E3C(00000050) 8:03700E0
9:03700C5C(00000000 00000000)
00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
10:03700E40(00000C30) 11:03700E38(00000000) 12:03700E28(01010000)
I/O-REQUEST: 00000000 GET
ACB: 000052F0
(A000004C 000147C0 8003E170 54000000 00000000 00000000 48900008 0000000
00000000 00000000 002C0041 009E12A8 12000000 0000521C 00000000 0C30005
00000000 00000000 00000000)
RPL: 00005390
(0000004C 00000000 00000000 00000000 00000000 00000000 000052F0 0000000
00045E5C 00000000 20000000 00000000 00000050 00000050 00000000 0000000
00000000 00000000 000053EC)
FLMGET, ON ENTRY:
1:03700C04(0372CD88) 2:03700C08(00000000) 3:000053C0(00000050)
4:00045E5C( )
5:000053C4(00000050)
FLMGET, ON RETURN:
1:03700C04(0372CD88) 2:03700C08(00000000) 3:000053C0(00000050)
4:00045E5C(PROC 0)
5:000053C4(00000050)
I/O-REQUEST: 00000000 GET
ACB: 000052F0

```

```

(A000004C 000147C0 8003E170 54000000 00000000 00000000 48900008 000000
00000000 00000000 002C0041 009E12A8 12000000 0000521C 00000000 0C3000
00000000 00000000 00000000)
RPL: 00005390
(0000004C 00000000 00000000 00000000 00000000 00000000 000052F0 000000
00045EAC 00000000 20000000 00000000 00000050 00000050 00000000 000000
00000000 00000000 000053EC)
FLMGET, ON ENTRY:
1:03700C04 (0372CD88) 2:03700C08 (00000000) 3:000053C0 (00000050)
4:00045EAC (
5:000053C4 (00000050)
FLMGET, ON RETURN:

1:03700C04 (0372CD88) 2:03700C08 (00000000) 3:000053C0 (00000050)
4:00045EAC (CONTROL NOLIST NOSYMLIST NOCONLIST NOFLUSH NOMSG NOCAPS
5:000053C4 (00000050)
.
.
FLMCLS, ON ENTRY:
1:03700C04 (0372CD88) 2:03700C08 (00000002)
FLMCLS, ON RETURN:
1:03700C04 (FFFFFFFF) 2:03700C08 (00000000)

```

The names of the FLAM functions (FLMOPN, FLMGET, etc.) and their parameters are equal to those listed in the manual for FLAM V4 (Chapter 3, Interfaces). The parameters are numbered in the same way as in the manual. The next specification is the parameter address. The parameter contents are enclosed in parentheses '()'.

The control blocks ACB and RPL are specified by the subsystem interface, even if a PS file is accessed.

Please refer to the IBM manuals for further details of these control blocks, e.g. 'Macro Instructions for VSAM Data Sets', 'Data Areas', or to the 'SYS1.AMODGEN(IFGACB)' and 'SYS1.AMODGEN(IFGRPL)' macros.

10.8 FLAMFILE split

10.8.1 Serial split

To split a file in several fragments, depending on the amount of data, the serial split is used.

```

//output DD DSN=FLAM.SUBDAT.A01.ADC,
//          SUBSYS=(FLAM, 'MO=ADC, SPLITM=SER, SPLITS=200')

```

The file FLAM.SUBDAT.A01.ADC is cataloged, the filename has two numeric characters (at least 1 numeric character is necessary). Compression method ADC is used for higher compression. One file must not exceed 200 MB data.

When more than 200 MB data are to be written, file FLAM.SUBDAT.A01.ADC is closed and file FLAM.SUBDAT.A02.ADC is searched and allocated, or if not found in the catalog, created. With two numeric characters it is possible to generate up to 99 files.

If your organisation requires special filenames or a higher flexibility for data set allocation is needed, assigning with DD-names is recommended. Only the first DD-name is passed to the subsystem.

```
//output DD SUBSYS=(FLAM, 'SPLITM=SER,SPLITS=200,FLAMDD=CMP01')
//*
//CMP01 DD DSN=filename1,DISP=OLD
//CMP02 DD DSN=filename2,DISP=OLD
//CMP03 DD DSN=filename3,DISP=(NEW,CATLG),
// UNIT=TAPE,...
```

All files must have the same record length, but the data set organization or format may differ.

When more than 200 MB are to be written, the file with DD-name CMP01 is closed and CMP02 is opened.

To read a splitted FLAMFILE it is not necessary to pass any parameter to the subsystem. The filename of the first fragment is named in the DD-statement:

```
//input DD DSN=FLAM.SUBDAT.A01.ADC,
// SUBSYS=FLAM
```

all following files will be allocated dynamically by the subsystem.

Assigning files via DD-statement is possible as well. The DD-name must have at least one numeric character, the first name is passed to the subsystem:

```
//input DD SUBSYS=(FLAM, 'FLAMDD=CMP01')
//*
//CMP01 DD DSN=filename1,DISP=SHR
//CMP02 DD DSN=filename2,DISP=SHR
//CMP03 DD DSN=filename3,DISP=SHR
```

Note:

The files must be assigned in the same order than they were written. The subsystem checks the sequence of the files. In case of errors, message FLM05400 and RC=122 is reported and the data management system detects an open error.

10.8.2 Parallel split

Parallel split means: up to 4 files are written or read "simultaneously".

All files must be cataloged and assigned within JCL! Therefore it is necessary to assign the subsystem files via the DD-statement. The DD-name must have at least one numeric character, the first name is passed to the subsystem.

```
//output DD DSN=any,
// SUBSYS=(FLAM, 'MO=ADC,SPLITM=PAR,SPLITN=3,FLAMDD=CMP01')
//*
//CMP01 DD DSN=filename1,DISP=OLD
//CMP02 DD DSN=filename2,DISP=OLD
//CMP03 DD DSN=filename3,DISP=OLD
```

All files must have the same record length, but the data set organization or format may differ.

JCL required for reading a split FLAMFILE in parallel:

```
//input DD DSN=any,
//      SUBSYS=(FLAM, 'FLAMDD=CMP01')
//*
//CMP01 DD DSN=filename1,DISP=SHR
//CMP02 DD DSN=filename2,DISP=SHR
//CMP03 DD DSN=filename3,DISP=SHR
```

The files may be in different order than they were written, the subsystem uses the original order automatically.

Note:

If one file is missing, message FLM05400 with RC=531 is reported by the subsystem and the data management system detects an OPEN-error.

Using DISP=NEW in the assigned DD-statements will lead to a system error 50D, so it is really necessary to catalog all files.

10.9 Encryption

10.9.1 Encryption via CRYPTOKEY parameter

To encrypt/decrypt the file a key is passed (CRYPTOKEY=...) to the subsystem. The cryptographic method is chosen by parameter CRYPTOMODE. Without this parameter, method FLAM is used (compatible to FLAM-sub V3)

```
//DDNAME DD DSN=filename,
//      SUBSYS=(FLAM, 'CRYPTOM=AES, CRYPTOK=OTTO')
```

Using parameter PASSWORD instead of CRYPTOKEY is allowed and compatible to FLAM-sub V3.

Please remember: any apostrophes contained within the parameter string literal must be duplicated:

```
//DDNAME DD DSN=filename,
//      SUBSYS=(FLAM, 'CRYPTOM=AES, CRYPTOK=X'AE01EA''')
```

10.9.2 Encryption via KME-module

A program *name* that supports the KME-interface (-> manual FLAM (MVS) V4.x, ch. 3.5.5), will be used as followed

```
//DDNAME DD DSN=filename,
//      SUBSYS=(FLAM, 'CRYPTOM=AES',
//      'KME=name,KMP=C''parameter for KME''')
```

This method benefits from a fully automatic encryption/decryption without any manual user action. The key used for encryption is never seen in any protocol.

10.9.3 Encryption using FKMEFILE

Program FKMEFILE is an example for using the KME interface. It reads a record containing a key from a sequential file and returns it to the subsystem. A parameter *ddname* is needed for the file to read.

The key must be the first record of the file. The syntax is as of parameter CRYPTOKEY: the key may be a string, a C'string with blanks', a A'key in ascii', or a X'hexvalue'. Trailing blanks are ignored.

```
//DDNAME DD DSN=filename,  
// SUBSYS=(FLAM,'CRYPTOM=AES',  
// 'KME=FKMEFILE,KMP=C' 'ddname1' '' )  
//* THIS is the key-file  
//ddname1 DD DSN=keyfilename,DISP=SHR
```

Just to test it on the fly

```
//ddname DD *  
C'this is my key'  
/*
```

10.10 Using zEDC

10.10.1 Automatically

With MODE=ADC the zEDC accelerator card zEDC will be used, when it is installed. Nothing else is to be done.

On decompression: if no card is found and the compression mode was zEDC a software routine decompresses the FLAMFILE.

```
//DDNAME DD DSN=filename,SUBSYS=(FLAM, 'MODE=ADC')
```

10.10.2 Never

Setting an environment variable for the actual job, the zEDC algorithm will not be used, although the card was found.

```
//DDNAME DD DSN=filename,SUBSYS=(FLAM, 'MODE=ADC')
//CEEOPPTS DD *
  ENVAR(' 'FL_ZEDC_SUPPORT=OFF' ')
/*
```

Same for all jobs when a system variable is defined in SYS1.PARMLIB(IEASYMxx):

```
SYMDEF (&FLZEDC=' OFF' )
```

10.10.3 Always zEDC

Setting an environment variable for the actual job, the zEDC algorithm will be used, although the card was not found.

```
//DDNAME DD DSN=filename,SUBSYS=(FLAM, 'MODE=ADC')
//CEEOPPTS DD *
  ENVAR(' 'FL_ZEDC_SUPPORT=ON' ')
/*
```

Same for all jobs when a system variable is defined in SYS1.PARMLIB(IEASYMxx):

```
SYMDEF (&FLZEDC=' ON' )
```