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MFTF TOTAL BENCHMARK

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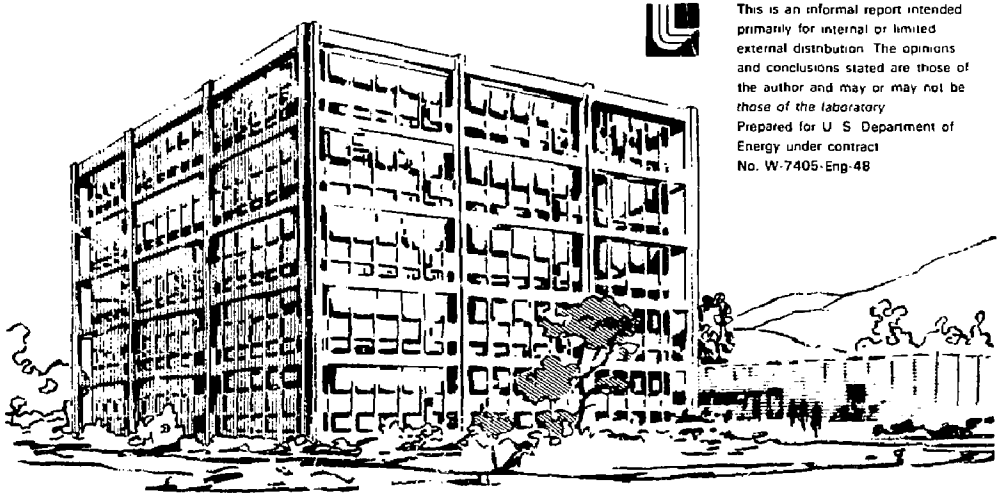

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MFTF TOTAL BENCHMARK

INTRODUCTION

A benchmark of the TOTAL* data base management system as applied to the Mirror Fusion Test Facility (MFTF) data base was implemented and run in February and March of 1979. The benchmark was run on an Interdata 8/32 and involved the following tasks:

- Data Base Design
- Data Base Generation
- Data Base Load
- Develop and Implement Programs to Simulate MFTF Usage of the Data Base

THE DATA BASE

The MFTF data base consists of control and diagnostic data. The control system regulates the various devices of the MFTF in order to prepare for and execute an experiment. Control data are typically scalar parameters which describe the status of the experimental devices and environment (e.g. on/off, temperature, open/close, pressure, and voltage). The diagnostic system collects and analyzes data as a result of the experiment (e.g. magnetic field, plasma fluctuation, and plasma density). Diagnostic data are voluminous, on the order of several megabytes, and predominately vector in nature.

SCOPE OF THE BENCHMARK

The benchmark was run on the MFTF Interdata 8/32 at Lawrence Livermore Laboratory in Livermore, California. The single most important requirement of the MFTF

*Reference to a company or product name does not imply approval or recommendation of the product by the University of California or the U. S. Department of Energy to the exclusion of others that may be suitable.

application is the speed of accessing and replacing data in the data base. Speed is needed in the control system to respond to events as they occur during the experiment.

Specifications for the project call for being able to fire the experiment once every five minutes. This means we need to write diagnostic data into the data base so that diagnostic programs can read and analyze the data and thus permit various experimental parameters to be adjusted prior to the next shot firing.

Multitask TOTAL was run in the foreground because several tasks would need to share the data base simultaneously. However, all benchmarks involved the running of only one task at a time.

DATA BASE FORMAT/BENCHMARKS

Control Data Base Format

There were six master data sets, a log data set and no variable entry data sets. The master data sets were loaded from 70 percent to 80 percent full. The first two master data sets were assigned I/O buffers so that all the logical records could be contained in memory. The remaining master data sets shared four copies of an I/O area.

Master Files	Total Logical Records	Logical Records Used	Logical Records Per Block	I/O Area
COM 1	82	60	82	MAS1
COM 2	91	70	91	MAS2
COM 3	99	80	9	MAS3
COM 4	72	50	8	MAS3
COM 5	126	100	9	MAS3
COM 6	100	75	10	MAS3

The output from the data base generation step for TOTAL is in Appendix A and describes in detail the format of the data base and its records.

Control Data Base Benchmarks

After the control data base was generated and loaded, several tests were run to determine the read and write speeds of TOTAL. The effect of logging upon the response time was also tested. The first six tests involved randomly selecting one of the six master files, randomly selecting a record and field within, and then operating upon the record. Each test performed the specified operation 10,000 times. Whenever a record was read and not to be rewritten the RLSE option was used to avoid the holding of records.

Test 1 - read records with no logging.

Test 2 - read records with logging.

Test 3 - write records with no logging.

Test 4 - write records with logging.

Test 5 - read or write records with no logging - 50% read, 50% write.

Test 6 - read or write records with logging - 50% read, 50% write.

The same tests were run on the first two master files alone because they had buffers allocated large enough to contain all of the logical records. These are tests 7 through 12 and correspond directly with 1 through 6.

In tests 1 through 6, the random selection of the master file was weighted. The percentage used for each master file and the actual number of operations performed on that file out of 10,000 follows:

Master File	Usage % Guide	Actual Usage
COM1	30	3041
COM2	35	3531

Master File	Usage % Guide	Actual Usage
COM3	10	1024
COM4	5	473
COM5	15	1521
COM6	5	410

In tests 7 through 12, the two master files were weighted equally. The actual usage was 5045 for COM1 and 4955 for COM2.

It should be noted that in tests 1 through 6, file placement affects the resulting times. All master files were kept on a user disk volume, different from the system volume which contained the description of the master files. The placement of the files on the user disk volume was beyond our control. All the tests were run on several different random placements of the files and the best set of times are reported. Other sets of times were up to 25 percent slower.

Diagnostic Data Base Format

There were four master data sets, each of which was linked to one or two variable entry data sets. The master data sets were loaded at 80 percent full while the variable entry data sets had their load-limit set to 99 percent since no new records would be added after the initial load.

The first master data set (DDP1) uses 30 of the 38 allocated records and is linked to two variable entry data sets (DDV1 and DDV2). The chains in DDV1 are from 23 to 30 records long of 1000 bytes each. The chains in DDV2 are three records long of 100 bytes each.

The second master data set (DDP2) uses 100 of the 125 allocated records and is linked to two variable entry data sets (DDV3 and DDV4). The chains in DDV3 are three or four records long of 50 bytes each. The chains in DDV4 are three of four records long of 25 bytes each.

The third master data set (DDP3) uses 1000 of the 1250 allocated records and is linked to one variable entry data set (DDV5). The chains in DDV5 are from eight to ten records long of 25 bytes each.

The fourth master data set (DDP4) uses 200 of the 250 allocated records and is linked to one variable entry data set (DDV6). The chains in DDV6 are from eight to ten records long of 100 bytes each.

The output from the data base generation step for TOTAL is in Appendix B and describes in detail the format and I/O buffer allocations of the data base and its records. The diagnostic data base comes to about 1.7 megabytes of user data.

Diagnostic Data Base Benchmark

Two tests were run on the diagnostic data. First, the data base was sequentially loaded, and secondly, the data base was sequentially read. Both tests operated on a master record and then on the associated variable records. The RLSE option was used for all reads to avoid the holding of records. No logging was used.

The placement of the master and variable entry files on disk appeared to have little affect on overall benchmark times. Again, the fastest set of times are reported only. The worst set of times was only about 3 percent slower. All master and variable entry files were kept on the user disk volume, different from the system volume.

BENCHMARK RESULTS

All times reported are time spent in TOTAL. Time is measured from after having called TOTAL to just before returning from TOTAL. The benchmarks were run on OS/32 system R03.2. The host language was Interdata's FORTRAN VI.

The system volume has an average apparent access time of 47.5 ms. and transfer rate of 321 KB/sec. The user volume has an average apparent access time of 38.3 ms. and transfer rate of 1200 KB/sec.

Control Data Base

TEST	TOTAL TIME (sec.)	FUNCTION	LOGGING	AVG. TIME/FUNCTION (ms)
1	159	READ	No	15.9
2	162	READ	Yes	16.2
3	370	WRITE	No	37.0
4	537	WRITE	Yes	53.7
5	277	RD/WR	No	27.7
6	390	RD/WR	Yes	39.0
7	113	READ	No	11.3
8	116	READ	Yes	11.6
9	267	WRITE	No	26.7
10	385	WRITE	Yes	38.5
11	198	RD/WR	No	19.8
12	253	RD/WR	Yes	25.3

Tests 7 through 12 use two master files which have buffers large enough to contain all the records in memory.

Diagnostic Data Base

1. To sequentially add records to the four sets of files.

MASTER FILE	TOTAL TIME (sec)
DDP1	54
DDP2	28
DDP3	331
DDP4	81
	493 seconds to add 1.7 megabytes of data

2. To sequentially read records from the four sets of files.

MASTER FILE	TOTAL TIME (sec)
DDP1	36
DDP2	37
DDP3	399
DDP4	80
	552 seconds to read 1.7 megabytes of data

APPENDIX A

OUTPUT FROM TOTAL FOP DATA BASE

GENERATION OF CONTROL DATA BASE

```
BEGIN-DATA-BASE-GENERATION
DATA-BASE-NAME=CONTRL
 *
OPTIONS=OUTPUT=Y
QUEUE=12
 *
SHARE-IO
IOAREA=MAS1=1
IOAREA=MAS2=1
IOAREA=MAS3=4
IOAREA=LOG1
END-IO
 *
```

```
BEGIN-MASTER-DATA-SET
DATA-SET-NAME=COM1
IOAREA=MAS1
 *
MASTER-DATA
COM1ROOT=0
COM1CTRL=2
COM1FLD0=1
COM1FLD1=1
COM1FLD2=2
COM1FLD3=1
COM1FLD4=2
COM1FLD5=2
COM1FLD6=4
COM1FLD7=1
COM1FLD8=2
END-DATA
 *
TOTAL-LOGICAL-RECORDS=02
LOGICAL-RECORD-LENGTH=28
LOGICAL-RECORDS-PER-BLOCK=02
DRIVE=10,9,V256
 *
END-MASTER-DATA-SET

    ALLOCATE V256:COM1.T00,C0,9

    UNUSED-CHARACTERS-PER-BLOCK     9          * CALCULATED *
    TOTAL-SECTORS=                  9          * CALCULATED *
 *
```

```
BEGIN-MASTER-DATA-SET
DATA-SET-NAME=COM2
IOAREA=MAS2
 *
MASTER-DATA
COM2RCNT=0
COM2CTRL=2
COM2FLD0=1
COM2FLD1=1
COM2FLD2=1
COM2FLD3=2
COM2FLD4=1
COM2FLD5=2
COM2FLD6=2
COM2FLD7=1
COM2FLD8=1
COM2FLD9=4
END-DATA
 *
TOTAL-LOGICAL-RECORDS=91
LOGICAL-RECORD-LENGTH=20
LOGICAL-RECORDS-PER-BLOCK=91
DRIVE=11,10,V256
 *
END-MASTER-DATA-SET

    ALLOCATE V256:COM2.T00,CO,10

    UNUSED-CHARACTERS-PER-BLOCK     12        * CALCULATED *
    TOTAL-SECTORS=                  10        * CALCULATED *
 *
```

```
BEGIN-MASTER-DATA-SET
DATA-SET-NAME=COM3
IOAREA=MAS3
*
MASTER-DATA
COM3ROOT=3
COM3CTRL=2
COM3FLD0=2
COM3FLD1=2
COM3FLD2=1
COM3FLD3=1
COM3FLD4=1
COM3FLD5=1
COM3FLD6=2
COM3FLD7=2
COM3FLD8=1
COM3FLD9=1
COM3FLDA=1
COM3FLDB=1
END-DATA
*
TOTAL-LOGICAL-RECORDS=99
LOGICAL-RECORD-LENGTH=28
LOGICAL-RECORDS-PER-BLOCK=9
DRIVE=12,11,V255
*
END-MASTER-DATA-SET

   ALLOCATE V255:COM3.T00,CO,11

   UNUSED-CHARACTERS-PER-BLOCK     4          * CALCULATED *
   TOTAL-SECTORS=                  11         * CALCULATED *
*
```

```
BEGIN-MASTER-DATA-SET
DATA-SET-NAME=COM4
IOAREA=MAS3
 *
MASTER-DATA
COM4ROOT=8
COM4CTRL=2
COM4FL00=1
COM4FLD1=1
COM4FLD2=4
COM4FLD3=2
COM4FLD4=2
COM4FLD5=1
COM4FLD6=4
COM4FLD7=1
COM4FLD8=1
COM4FLD9=2
COM4FLDA=2
END-DATA
 *
TOTAL-LOGICAL-RECORDS=72
LOGICAL-RECORD-LENGTH=32
LOGICAL-RECORDS-PER-BLOCK=8
DRIVE=13,9,V256
 *
END-MASTER-DATA-SET

   ALLOCATE V256:COM4.T00,CO,9

   TOTAL-SECTORS=                    9          * CALCULATED *
 *
```

```
BEGIN-MASTER-DATA-SET
DATA-SET-NAME=COM5
IOAREA=MAS3
 *
MASTER-DATA
COM5ROOT=8
COM5CTRL=2
COM5FLD0=2
COM5FLD1=2
COM5FLD2=1
COM5FLD3=1
COM5FLD4=1
COM5FLD5=4
COM5FLD6=1
COM5FLD7=1
COM5FLD8=2
COM5FLD9=2
END-DATA
 *
TOTAL-LOGICAL-RECORDS=126
LOGICAL-RECORD-LENGTH=20
LOGICAL-RECORDS-PER-BLOCK=3
DRIVE=14,14,V256
 *
END-MASTER-DATA-SET

    ALLOCATE V256:COM5,T00,CO,14

    UNUSED-CHARACTERS-PER-BLOCK     4          * CALCULATED *
    TOTAL-SECTORS=                  14         * CALCULATED *
 *
```

```
BEGIN-MASTER-DATA-SET
DATA-SET-NAME=COMG
IOAREA=MAS3
 *
MASTER-DATA
COMGROOT=0
COMGCTRL=2
COMGFLD0=1
COMGFLD1=1
COMGFLD2=2
COMGFLD3=1
COMGFLD4=2
COMGFLD5=2
COMGFLD6=1
COMGFLD7=1
COMGFLD8=1
COMGFLD9=2
END-DATA
 *
TOTAL-LOGICAL-RECORDS=100
LOGICAL-RECORD-LENGTH=24
LOGICAL-RECORDS-PER-BLOCK=10
DRIVE=8,10,V256
 *
END-MASTER-DATA-SET

    ALLOCATE V256:COMG.T00,CO,10

    UNUSED-CHARACTERS-PER-BLOCK     16        * CALCULATED *
    TOTAL-SECTORS=                  10        * CALCULATED *
 *
```

```
BEGIN-LOG-DATA-SET
DATA-SET-NAME=XLOG
IOAREA=LOG1
LOG-DATA
XLOGPREF=32
XLOGDATA=224
END-DATA
 *
DRIVE=9,11000,V256
END-LOG-DATA-SET

    ALLOCATE V256:XLOG.T00,CO,11000

    LOGICAL-RECORD-LENGTH=          256       * CALCULATED *
    LOGICAL-RECORDS-PER-BLOCK=      1         * CALCULATED *
    TOTAL-LOGICAL-RECORDS=          11000     * CALCULATED *
    TOTAL-SECTORS=                  11000     * CALCULATED *
 *
END-DATA-BASE-GENERATION
```

APPENDIX B

OUTPUT FROM TOTAL FOR DATA BASE

GENERATION OF DIAGNOSTIC DATA BASE

```
BEGIN-DATA-BASE-GENERATION
DATA-BASE-NAME=DIAGNS
 *
OPTIONS=OUTPUT=Y
QUEUE=22
 *
SHARE-IO
IOAREA=BUF1=2
IOAREA=BUF2=2
IOAREA=BUF3=2
IOAREA=BUF4=2
 *
IOAREA=VUF1=2
IOAREA=VUF2=2
IOAREA=VUF3=2
IOAREA=VUF4=2
IOAREA=VUF5=2
IOAREA=VUF6=2
 *
IOAREA=LOG1
END-IO
 *
```

```
BEGIN-MASTER-DATA-SET
DATA-SET-NAME=DDP1
IOAREA=BUF1
 *
MASTER-DATA
DDP1ROOT=0
DDP1CTRL=4
DDP1LEV1=0
DDP1LEV2=0
DDP1FLD1=3000
DDP1FLD2=2
DDP1FLD3=2
DDP1FLD4=4
DDP1FLD5=4
DDP1FLD6=2
DDP1FLD7=2
DDP1FLD8=4
DDP1FLD9=4
DDP1FLDA=4
END-DATA
 *
TOTAL-LOGICAL-RECORDS=30
LOGICAL-RECORD-LENGTH=3056
LOGICAL-RECORDS-PER-BLOCK=1
DRIVE=0,456,V256
END-MASTER-DATA-SET

    ALLOCATE V256:0DP1.T##,CO,456

    UNUSED-CHARACTERS-PER-BLOCK     16        * CALCULATED *
    TOTAL-SECTORS=                  456       * CALCULATED *
 *
```

```
BEGIN-VARIABLE-ENTRY-DATA-SET
DATA-SET-NAME=DDV1
IOAREA=VUF1
 *
BASE-DATA
DDV1FLD1=4
DDV1FLD2=1000
DDP1LRV1=8=DDV1FLD1
END-DATA
 *
TOTAL-LOGICAL-RECORDS=904
LOGICAL-RECORD-LENGTH=1012
LOGICAL-RECORDS-PER-BLOCK=4
DRIVE=7,3616,V256
LOAD-LIMIT=99
END-VARIABLE-ENTRY-DATA-SET

    ALLOCATE V256:DDV1.TXX,CO,3616

    UNUSED-CHARACTERS-PER-BLOCK      48        * CALCULATED *
    CONTROL-INTERVAL=                300       * CALCULATED *
    TOTAL-SECTORS=                   3616      * CALCULATED *
```

```
BEGIN-VARIABLE-ENTRY-DATA-SET
DATA-SET-NAME=DDV2
IOAREA=VUF2
 *
BASE-DATA
DDV2FLD1=4
DDV2FLD2=100
DDP1LKV2=3=DDV2FLD1
END-DATA
 *
TOTAL-LOGICAL-RECORDS=96
LOGICAL-RECORD-LENGTH=112
LOGICAL-RECORDS-PER-BLOCK=4
DRIVE=0,40,V256
LOAD-LIMIT=99
END-VARIABLE-ENTRY-DATA-SET

    ALLOCATE V256:DDV2.T00,CO,48

    UNUSED-CHARACTERS-PER-BLOCK      64        * CALCULATED *
    TOTAL-LOGICAL-RECORDS=           96        * CALCULATED *
    CONTROL-INTERVAL=                96        * CALCULATED *
    TOTAL-SECTORS=                   48        * CALCULATED *
 *
```

```
BEGIN-MASTER-DATA-SET
DATA-SET-NAME=DDP2
IOAREA=BUF2
*
MASTER-DATA
DDP2ROOT=0
DDP2CTRL=1
DDP2LKV1=0
DDP2LKV2=0
DDP2FLD1=100
DDP2FLD2=100
END-DATA
*
TOTAL-LOGICAL-RECORDS=125
LOGICAL-RECORD-LENGTH=226
LOGICAL-RECORDS-PER-BLOCK=10
DRIVE=9,117,V250
END-MASTER-DATA-SET

    ALLOCATE V250:DDP2.T00,CO,117

    UNUSED-CHARACTERS-PER-BLOCK     24      * CALCULATED *
    TOTAL-LOGICAL-RECORDS=          130     * CALCULATED *
    TOTAL-SECTORS=                  117     * CALCULATED *
*
```

```
BEGIN-VARIABLE-ENTRY-DATA-SET
DATA-SET-NAME=DDV3
IOAREA-VUF3
*
BASE-DATA
DDV3FLD1=4
DDV3FLD2=50
DDP2LEV1=0=DDV3FLD1
END-DATA
*
TOTAL-LOGICAL-RECORDS=400
LOGICAL-RECORD-LENGTH=64
LOGICAL-RECORDS-PER-BLOCK=8
DRIVE=13.102,V25G
LOAD-LIMIT=99
END-VARIABLE-ENTRY-DATA-SET

    ALLOCATE V25G:DDV3.TMP,CO,102

    CONTROL-INTERVAL=                3P4          CALCULATED *
    TOTAL-SECTORS=                   102        * CALCULATED *
*
```

```
BEGIN-VARIABLE-ENTRY-DATA-SET
DATA-SET-NAME=DDV4
IOAREA=VUF4
*
BASE-DATA
DDV4FLD1=A
DDV4FLD2=25
DDP2LKV2=8=DDV4FLD1
END-DATA
*
TOTAL-LOGICAL-RECORDS=
LOGICAL-RECORD-LENGTH=40
LOGICAL-RECORDS-PER-BLOCK=6
DRIVE=11.66,V256
LOAD-LIMIT=99
END-VARIABLE-ENTRY-DATA-SET

    ALLOCATE V256:DDV4.T00,C0,68

    UNUSED-CHARACTERS-PER-BLOCK     16        * CALCULATED *
    CONTROL-INTERVAL=               300       * CALCULATED *
    TOTAL-SECTORS=                  68        * CALCULATED *
*
```

```
BEGIN-MASTER-DATA-SET
DATA-SET-NAME=DDP3
IOAREA=BUF3
 *
MASTER-DATA
DDP3ROOT=0
DDP3CTRL=4
DDP3LKV1=8
DDP3FLD1=40
DDP3FLD2=150
DDP3FLD3=2
DDP3FLD4=2
DDP3FLD5=2
END-DATA
 *
TOTAL-LOGICAL-RECORDS=1250
LOGICAL-RECORD-LENGTH=216
LOGICAL-RECORDS-PER-BLOCK=7
DRIVE=12,1074,V256
END-MASTER-DATA-SET

    ALLOCATE V256:DDP3.T00,CO,1074

    UNUSED-CHARACTERS-PER-BLOCK      24        * CALCULATED *
    TOTAL-LOGICAL-RECORDS=           1253      * CALCULATED *
    TOTAL-SECTORS=                   1074      * CALCULATED *
 *
```

```
BEGIN-VARIABLE-ENTRY-DATA-SET
DATA-SET-NAME=DDV5
IOAREA=VUF5
 *
BASE-DATA
DDV5FLD1=4
DDV5FLD2=26
DDP3LKV1=0=DDV5FLD1
END-DATA
 *
TOTAL-LOGICAL-RECORDS=10000
LOGICAL-RECORD-LENGTH=40
LOGICAL-RECORDS-PER-BLOCK=57
DRIVE=13,1584,V256
LOAD-LIMIT=99
END-VARIABLE-ENTRY-DATA-SET

    ALLOCATE V256:DDV5.TEM.CO,1584

    UNUSED-CHARACTERS-PER-BLOCK      24       * CALCULATED *
    TOTAL-LOGICAL-RECORDS=           10032    * CALCULATED *
    CONTROL-INTERVAL=                342      * CALCULATED *
    TOTAL-SECTORS=                   1584     * CALCULATED *
 *
```

```
BEGIN-MASTER-DATA-SET
DATA-SET-NAME=DDP4
IOAREA=DUF4
 *
MASTER-DATA
DDP4ROOT=8
DDP4CTRL=4
DDP4LKV1=8
DDP4FLD1=4
DDP4FLD2=4
DDP4FLD3=4
END-DATA
 *
TOTAL-LOGICAL-RECORDS=256
LOGICAL-RECORD-LENGTH=32
LOGICAL-RECORDS-PER-BLOCK=8
DRIVE=14,32,V256
END-MASTER-DATA-SET

    ALLOCATE V256:DDP4.T00,C0,32

    TOTAL-LOGICAL-RECORDS=          256       * CALCULATED *
    TOTAL-SECTORS=                  32        * CALCULATED *
 *
```

```
BEGIN-VARIABLE-ENTRY-DATA-SET
DATA-SET-NAME=DDVG
IOAREA=VUFG
*
BASE-DATA
DDVGFLD1=4
DDVGFLD2=100
DDP4LKV1=C=DDVGFLD1
END-DATA
*
TOTAL-LOGICAL-RECORDS=2000
LOGICAL-RECORD-LENGTH=112
LOGICAL-RECORDS-PER-BLOCK=9
DRIVE=15,892,V25C
LOAD-LIMIT=99
END-VARIABLE-ENTRY-DATA-SET

    ALLOCATE V25C:DDVG.T00,CO,892

    UNUSED-CHARACTERS-PER-BLOCK     16        * CALCULATED *
    TOTAL-LOGICAL-RECORDS=          2007      * CALCULATED *
    CONTROL-INTERVAL=               306       * CALCULATED *
    TOTAL-SECTORS=                  892       * CALCULATED *
*
```

```
BEGIN-LOG-DATA-SET
DATA-SET-NAME=DLOG
IOAREA=LOG1
*
LOG-DATA
DLOGPREF=32
DLOGDATA=3296
END-DATA
*
DRIVE=5,10000,V256
END-LOG-DATA-SET

    ALLOCATE V256:DLOG.T00,CO,10000
    UNUSED-SECTORS=                 3          * CALCULATED *

    LOGICAL-RECORD-LENGTH=          3320       * CALCULATED *
    LOGICAL-RECORDS-PER-BLOCK=      1          * CALCULATED *
    TOTAL-LOGICAL-RECORDS=          769        * CALCULATED *
    TOTAL-SECTORS=                  9997       * CALCULATED *
*
END-DATA-BASE-GENERATION
```