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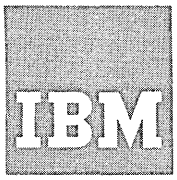

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IBM System/360 Operating System

TESTRAN

TESTRAN is a facility for testing programs written in the assembler language for execution under the System/360 Operating System. It is intended for use by the individual programmer in testing his own programs.

This publication explains how to use TESTRAN for typical testing purposes, how to write essential job control statements, and how to interpret printed test results. It formally describes TESTRAN statements, cataloged procedures supplied by IBM, and TESTRAN diagnostic messages.

The information in this publication applies to systems that include the primary control program (PCP) and to systems that provide multiprogramming with a fixed number of tasks (MFT or Option 2) or multiprogramming with a variable number of tasks (MVT or Option 4).

Second Edition (November 1968)

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This edition applies to Release 15/16 of IBM System/360 Operating System until otherwise indicated in new editions or Technical Newsletters. Changes are continually made to the specifications herein; before using this publication in connection with the operation of IBM systems, consult the latest IBM 360 SRL Newsletter, Form N20-0360, for the editions that are applicable and current.

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PREFACE

This publication describes the TESTRAN facility for testing programs written in the assembler language. It introduces this facility in Section 1, which shows by an example how TESTRAN helps in testing a program, and shows how the reader can use TESTRAN in testing his own programs.

Sections 2, 3, and 4 guide the reader in writing a source program, in writing job control statements, and in interpreting test results. The reader need not go beyond Section 2 before completing his source coding, and need not go beyond Section 3 before actually testing his program under the operating system. Also, he need not read any section in its entirety, because each treats a number of independent topics that can be referred to directly from the table of contents.

Several appendixes provide detailed descriptions of source statements, cataloged procedures, and diagnostic messages. Appendix A is of special interest, because it formally describes statements that are informally described in Section 2. The reader can use either Appendix A or Section 2 as the model for his own coding, depending on the style of presentation he prefers.

PREREQUISITE PUBLICATIONS

The following publications are prerequisites:

IBM System/360 Operating System:

Introduction, Form C28-6534

Concepts and Facilities, Form C28-6535

Assembler Language, Form C28-6514

Knowledge of the macro-language, as described in the Assembler Language publication, is not required. However, the reader should know the general functions of system-defined macro-instructions (SAVE, OPEN, GET, PUT, DCB) that are introduced in the Concepts and Facilities publication and are fully described in the publications:

IBM System/360 Operating System:

Supervisor and Data Management Services, Form C28-6646

Supervisor and Data Management Macro Instructions, C28-6647

PUBLICATIONS TO WHICH THE TEXT REFERS

The following publications are referred to in this publication, but are not necessarily prerequisites:

IBM System/360 Operating System:

Assembler (E) Programmer's Guide, Form C28-6595

Assembler (F) Programmer's Guide, Form C26-3756

Linkage Editor, Form C28-6538

Job Control Language, Form C28-6539

Utilities, Form C28-6586

Messages and Codes, Form C28-6631

Programmer's Guide to Debugging, Form C28-6670

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SECTION 1: INTRODUCTION

The testing of a major program can be as time-consuming as the design and coding of its routines. Although testing is always time well spent, the need to meet deadlines often leads to incomplete testing and subsequent failures. And a failure in a single control section can delay an entire project.

To help in testing programs, the IBM System/360 Operating System offers a facility known as the test translator, or TESTRAN. This facility helps to uncover faulty logic by providing printed information about the actual working of a program. At the programmer's direction, TESTRAN describes the changing contents of storage areas, registers, and control blocks, and also the way in which control flows from one group of instructions to another.

As an example, the test of a subroutine named PRIMER is shown in Figure 1. For any positive number X, PRIMER is designed to find the smallest number greater than X that is a prime number. The TESTRAN listing shows that PRIMER contains an error, because, as shown at (1) in the figure, it returns a result of 3 rather than 2 for X = 1.

From the TESTRAN listing, the programmer can reconstruct the flow of data and control that occurred during execution of PRIMER. As shown at (2), the value X = 1 was loaded into general register 10 before execution of the instruction assembled at 000064. Branches were made to ODD and GOT. The erroneous result +3 was stored from general register 11 before execution of the RETURN macro-instruction assembled at 0000C0.

Tracing the flow of control, it is easy to find the instructions that caused the error. Because X was an odd value, it was moved to register 11 and, at (3), increased by two. The result, being a prime number, was stored as the answer. The error is obviously based on the assumption that, if X is an odd number, the next larger prime number must also be an odd number. In the single case X = 1, the assumption is invalid.

The error in PRIMER is simple enough that it might easily be recognized even without the help of TESTRAN. From this example, however, it should be clear that TESTRAN could be most helpful in finding hidden and complicated errors. In addition, one should remember that even so trivial an error could be difficult to find if the subroutine were part of a large, complex program.

A TESTRAN listing, such as that shown in Figure 1, is printed after execution of the program being tested. During execution, TESTRAN can provide an additional service by checking for predefined error conditions and taking corrective actions when necessary. For example, the programmer might know that some value in his program should never exceed a certain maximum. The value might be a result computed by a subroutine, or it could be a counter used to control a processing loop. TESTRAN could be used to check the value and, if the maximum were exceeded, to substitute a lesser value or to pass control to some other part of the program. Of course, the final results of the program would probably be incorrect, but the continued processing would offer the chance of finding other errors not related to the faulty loop or subroutine.

TESTRAN LISTING

(1) For the value X = +1, the result returned by PRIMER is +3. It should be +2.

```
TESTING                    TESTRAN OUTPUT              DATE 66/084          TIME 00/00          PAGE    5

1) MACRO ID 003, DUMP CHANGES


 NONE


1) MACRO ID 002, TRACE FLOW  , TTPRIME , FROM (PRIMER  ) 000064 005784, CC=0
SVC 26             G'00' 0000003C G'01' 8000581C G'14' 4000582A G'15' 00005778

AT LOCATION (PRIMER  ) 000064 005784  ENTER  TTPRIME

1) MACRO ID 006, DUMP PANEL
G'10' +1
PSW  FF 0 5 0026 4 0 005786  CC=0  FIX POINT OVERFLOW OFF  DEC OVERFLOW OFF  EXP UNDERFLOW OFF  SIGNIFICANCE OFF

1) MACRO ID 002, TRACE FLOW  , TTPRIME , FROM (PRIMER  ) 000072 005792 TO ODD      (PRIMER  ) 000082 0057A2, CC=1
BC    70 F 02A          G'15' 00005778

1) MACRO ID 002, TRACE FLOW  , TTPRIME , FROM (PRIMER  ) 000094 0057B4 TO GOT      (PRIMER  ) 0000B8 0057D8, CC=2
BC    20 F 060          G'15' 00005778


1) MACRO ID 002, TRACE FLOW  , TTPRIME , FROM (PRIMER  ) 0000C0 0057E0, CC=2
SVC 26             G'00' 0000003C G'01' 8000581C G'14' 4000582A G'15' 00005778

AT LOCATION (PRIMER  ) 0000C0 0057EC  ENTER  TTPRIME

1) MACRO ID 009, TRACE STOP  TTPRIME  002

1) MACRO ID 010, DUMP PANEL
G'09' +3 G'10' +0 G'11' +3
PSW  FF 0 5 0026 6 0 0057E2  CC=2  FIX POINT OVERFLOW OFF  DEC OVERFLOW OFF  EXP UNDERFLOW OFF  SIGNIFICANCE OFF


AT LOCATION TTSVC2  (CALLTEST) 0000EA 00582A  ENTER  DATAGEN


1) MACRO ID 010, DUMP DATA   STARTING IN SECTION CALLTEST
   00F0          X          RESULT
   0C5830        +1         +3


AT LOCATION (PRIMER  ) 000058 005778  ENTER  TTPRIME
```

(2) The value X=+1 was loaded into general register 10 (G'10').

A branch was made to ODD from relative location 000072.

A branch was made to GOT from relative location 000094.

A result of +3 was stored from general register 11 (G'11').

```
   LOC   OBJECT CODE      ADDR1 ADDR2 STMT  SOURCE S
000058                              150 PRIMER   C
000058                              151          U
                                    152          S
00005C 58C1 0000                00000 155          L
000060 58AC 0000                00000 156          L
000064 12AA                         157          L
000066 47C0 F072                000CA 158          B
00006A 1BBB                         159          S
00006C 8CA0 0001                00001 160          S
000070 12BB                         161          L
000072 4770 F02A                00082 162          B
000076 8CA0 001F                001F 163          S
00007A 4AB0 F080                000D8 164          A
00007E 47EC F032                0008A 165          B
000082 8CA0 001F                001F 166 ODD       S
000086 4AB0 F082                000DA 167          A
00008A 4190 0003                00003 168 LOAD     L
00008E 1859                         169 AGAIN    L
000090 1C45                         170          M
000092 195B                         171          C
000094 4720 F060                00088 172          B
000098 4780 F058                000B0 173          B
00009C 1838                         174          L
00009E 1822                         175          S
0000A0 1D20                         176          D
0000A2 1222                         177          L
0000A4 4780 F058                000B0 178          B
0000A8 4A90 F082                000DA 179          A
0000AC 47F0 F036                0008E 180          B
0000B0 4ABC F082                000DA 181 INCR     A
0000B4 47F0 F032                0008A 182          B
0000B8 58C1 0004                00004 183 GOT      L
0000BC 50BC 0000                00000 184          S
(0000C0)                            185          R
                                    189 ERR      R
0000D8                              194          L
0000D8 0001                         195
0000DA 0002                         196
000058                              197          B
```

TESTRAN LISTING

```
RAN OUTPUT                DATE 66/084          TIME 00/00          PAGE    5

E , FROM (PRIMER   ) 000064 005784, CC=0
01' 8000581C G'14' 4000582A G'15' 00005778

 ENTER  TTPRIME

X POINT OVERFLOW OFF  DEC OVERFLOW OFF  EXP UNDERFLOW OFF  SIGNIFICANCE OFF

E , FROM (PRIMER   ) 000072 005792 TO ODD     (PRIMER   ) 000082 0057A2, CC=1

E , FROM (PRIMER   ) 000094 005784 TO GOT     (PRIMER   ) 0000B8 0057D8, CC=2

E , FROM (PRIMER   ) 0000C0 0057E0, CC=2
01' 8000581C G'14' 4000582A G'15' 00005778

 ENTER  TTPRIME

002

X POINT OVERFLOW OFF  DEC OVERFLOW OFF  EXP UNDERFLOW OFF  SIGNIFICANCE OFF

 00582A  ENTER  DATAGEN

 IN SECTION CALLTEST


 ENTER  TTPRIME
```

ASSEMBLY LISTING

```
                                                                    E 01FEB66 3/30/66
 LOC  OBJECT CODE     ADDR1 ADDR2 STMT  SOURCE STATEMENT
000058                            150 PRIMER  CSECT
000058                            151         USING *,15
                                  152         SAVE  (14,12)
00005C 58C1 0000           00000  155         L     12,0(1)     G'1' POINTS TO ADCON FOR X
000060 58AC 0000           00000  156         L     10,0(12)    PUT X IN G'10'
000064 12AA                       157         LTR   10,10
000066 47C0 F072           000CA  158         BC    12,ERR      IF X IS LE 0
00006A 1BBB                       159         SR    11,11       ZERO OUT G'11'
00006C 8CA0 0001           00001  160         SRDL  10,1        SHIFT LO-ORDER BIT INTO G'11'
000070 12BB                       161         LTR   11,11       Q)--WAS BIT A ZERO
000072 4770 F02A           00082  162         BNZ   ODD         NO
000076 8CA0 001F           0001F  163         SRDL  10,31       YES--X IS EVEN--MOVE INTO G'11'
00007A 4AB0 F080           00088  164         AH    11,=H'1'    MAKE X ODD
00007E 47FC F032           0003A  165         B     LOAD
000082 8CA0 001F           0001F  166 ODD      SRDL  10,31       MOVE X TO G'11'
000086 4AB0 F082           000DA  167         AH    11,=H'2'    INCREASE X TO NEXT ODD VALUE
00008A 4190 0003           00003  168 LOAD     LA    9,3         LOAD G'9' WITH Y
00008E 1859                       169 AGAIN    LR    5,9         MOVE Y TO G'5'
000090 1C45                       170         MR    4,5         SQUARE Y
000092 195B                       171         CR    5,11        Q)--IS Y**2 GT X
000094 4720 F060           00068  172         BH    GOT         YES--X IS PRIME
000098 4780 F058           000B0  173         BE    INCR        X = Y**2--X NOT PRIME
00009C 183B                       174         LR    3,11        PREPARE
00009E 1B22                       175         SR    2,2         TO DIVIDE
0000A0 1D29                       176         DR    2,9         X/Y
0000A2 1222                       177         LTR   2,2         Q)--REMAINDER
0000A4 4780 F058           00060  178         BZ    INCR        NO REMAINDER, X NOT PRIME
0000A8 4A90 F082           000DA  179         AH    9,=H'2'     REMAINDER--ADD 2 TO Y
0000AC 47F0 F036           0008E  180         B     AGAIN       TRY DIVISION BY NEW Y
0000B0 4ABC F082           000DA  181 INCR     AH    11,=H'2'    X WAS NOT PRIME--ADD 2 TO X
0000B4 47F0 F032           0006A  182         B     LOAD        GO SEE IF X+2 IS PRIME
0000B8 58C1 0004           00004  183 GOT      L     12,4(1)     G'1'+4 POINTS TO RESULT FIELD ADCON
0000BC 50BC 0000           00000  184         ST    11,0(12)    STORE RESULT FROM G'11'
(0000C0)                          185         RETURN (14,12),RC=4 NORMAL RETURN FROM PRIMER
                                  189 ERR     RETURN (14,12),RC=0 ERROR EXIT FROM PRIMER
0000D8                            194         LTORG
0000D8 0001                       195                 =H'1'
0000DA 0002                       196                 =H'2'
000058                            197         END
```

(2) The value X=+1 was loaded into general register 10 (G'10').

A branch was made to ODD from relative location 000072.

A branch was made to GOT from relative location 000094.

A result of +3 was stored from general register 11 (G'11').

(3) Because X was odd, X+2 was the first tentative result. The logic errs, because X+1 is the correct result when X=1.

Figure 1. Use of TESTRAN to Detect an Error in a Program

TESTING PROCEDURE

Requests for TESTRAN services are coded in a TESTRAN source module. This module is combined with the program to be tested (the problem program) either by the assembler or by the linkage editor, as shown in Figure 2. In the first case, the TESTRAN and problem program source modules are assembled together and result in a single object module. In the second case, the source modules are assembled separately, result in separate object modules, and are processed by the linkage editor to form a single load module.

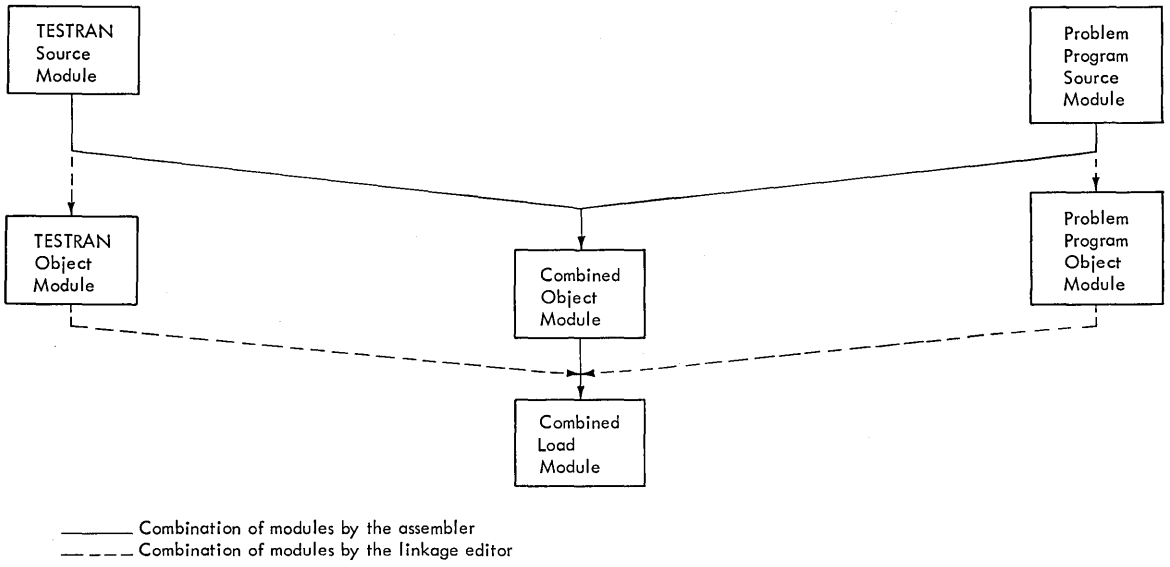

Figure 2. Combination of TESTRAN and Problem Program Source Modules

The single load module is loaded and executed as a problem program. Requests for test services are interpreted by the TESTRAN interpreter, a component of the control program that receives control during program interruptions. As shown in Figure 3, the TESTRAN interpreter places test information in a TESTRAN data set, along with control information which it copies from the unloaded form of the load module.

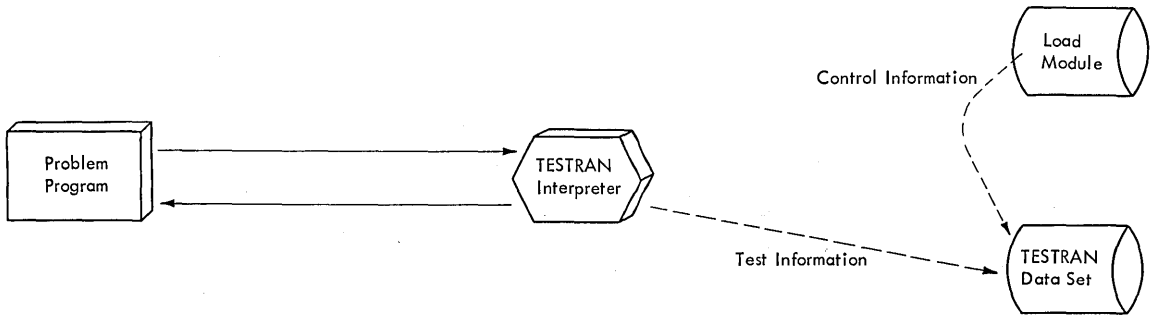

Figure 3. Execution Time Testing of the Problem Program

Test information, in the form of dumps and traces, is printed by the TESTRAN editor, as shown in Figure 4. A dump is a symbolic representation of data as it existed at a particular time during execution of the problem program. A trace is a record of control flow or references to data over a period of time.

Figure 4. Printing of Test Information

Like the assembler and the linkage editor, the TESTRAN editor is a processing program that is executed as a job step. It uses the control information copied from the load module to edit test information into a meaningful symbolic format. The control information includes symbol tables and a control dictionary for each object module that is included in the load module. The control dictionary is produced as a standard feature of assembly, while the symbol table is produced as an optional feature. Both are placed in the load module as an optional feature of linkage editing.

REQUESTING TESTRAN SERVICES

Requests for TESTRAN services are written as statements in the TESTRAN source module. Each statement is a coded TESTRAN macro-instruction, which the assembler automatically replaces with a series of constants. The constants, in effect, are a control statement that directs the TESTRAN interpreter to perform a specific operation.

When the interpreter performs a requested operation, the operation itself determines whether the next sequential macro-instruction is interpreted, or whether a logical branch is made to some other macro-instruction. The process of interpreting a TESTRAN macro-instruction thus resembles the execution of a machine instruction, and is more conveniently referred to hereafter as the execution of a TESTRAN statement.

STRUCTURE OF TESTRAN STATEMENTS

The structure of TESTRAN statements is similar to that of statements in the basic assembler language. Each statement includes an operation code and one or more operands. The operation code can be preceded by a symbolic name, and the operands can be followed by a comment.

The operation code and first operand together define the type of operation to be performed, and are used as generic names for statements. For example, a DUMP MAP statement dumps a map of control sections and allocated storage areas; the operand MAP distinguishes this statement from DUMP statements that request other types of dump operations.

FUNCTIONS OF TESTRAN STATEMENTS

The operations requested by TESTRAN statements provide the following general functions:

- Recording functions, which provide dumps and traces of the problem program.
- Linkage functions, which control linkage to the TESTRAN interpreter.

- Decision-making functions, which provide condition testing and conditional branching.

- Branching functions, which provide unconditional branching and subroutine capabilities.

- Assignment functions, which control values of variables in the problem program and of special variables used in decision making.

These functions are provided by statements that are formally described in Appendix A. Functional descriptions of the statements appear in the next section, which describes how to write statements for typical test applications.

SECTION 2: HOW TO WRITE TESTRAN STATEMENTS

This section shows how to write TESTRAN statements to perform typical testing functions. It gives examples of statements for performing each function, and the reader can adapt these examples to his own needs. If there is some question about adapting a specific example, refer to Appendix A for complete, formal descriptions of the statements involved.

Section 2 has three parts:

- Basic Recording Functions
- Testing of Complex Programs
- Logical Functions

The first part shows how to program various types of dumps and traces. The second part shows how to test programs that are not simply structured or not formed from single object modules. The third part shows how to perform various logical functions, such as the detection and correction of error conditions.

The first part of Section 2 should be of general interest, while the others should be read or ignored according to individual need. Each part discusses various topics, and these also should be studied in a selective fashion.

Note: TESTRAN statements can either follow or precede source statements of the problem program. If they follow, however, they must follow statements of a regular control section. They must not directly follow statements of a dummy or blank common control section.

BASIC RECORDING FUNCTIONS

This part of Section 2 describes various types of dumps and traces. Remember that a dump represents data as it exists at a particular time; a trace represents control flow or references to data over an extended period of time.

HOW TO DUMP A STORAGE AREA

Assume that the program containing the area is very simple and can be represented as follows:

```
ENTRY    SAVE  (14,12)
         .
         .
         .
PROCESS  MVC   MYDATA(20),0(6)
         .
         .
         .
MYDATA   DC    C'DATAAREA'
         DC    F'0,1,2'
         .
         .
         .
         END   ENTRY
```

The problem might then be to dump the 20-byte area beginning at MYDATA, just before the contents are changed by PROCESS. If so, the next listing shows a solution:

```
NEWENTRY TEST  OPEN,ENTRY
         TEST  AT,PROCESS
         DUMP  DATA,MYDATA,MYDATA+20
ENTRY    SAVE  (14,12)
           .
           .
           .
PROCESS  MVC   MYDATA(20),0(6)
           .
           .
           .
MYDATA   DC    C'DATAAREA'
         DC    F'0,1,2'
           .
           .
           .
         END   NEWENTRY
```

Execution begins at NEWENTRY, the beginning of a TESTRAN sequence that means "Enter the problem program at ENTRY; at PROCESS, dump the area from MYDATA to MYDATA+20." In this sequence, only the first statement is actually executed. This statement uses the information in another statement (TEST AT) to synchronize testing specified by a third statement (DUMP DATA) with execution of the problem program. It establishes a test point (a special link to the TESTRAN interpreter) at PROCESS, and passes control to ENTRY. When PROCESS is reached, the interpreter executes the DUMP DATA statement; it returns control to the problem program, where the MVC instruction is executed. The dump is printed as:

```
  0090    MYDATA
005F68    DATAAREA   +0    +1    +2
```

assuming that MYDATA was assembled at location 000090 and loaded at location 005F68.

To dump more than one area, the programmer simply writes additional DUMP DATA statements:

```
NEWENTRY TEST  OPEN,ENTRY
         TEST  AT,PROCESS
         DUMP  DATA,MYDATA,MYDATA+20
         DUMP  DATA,0(0,6),80(0,6)
           .
           .
           .
```

To dump these areas at more than one point in the program, he specifies additional instruction addresses in the TEST AT statement:

```
NEWENTRY TEST  OPEN,ENTRY
         TEST  AT,(PROCESS,INPUT,INPUT+18)
           .
           .
           .
```

To dump different areas at various test points, he uses additional TEST AT statements:

```
NEWENTRY TEST  OPEN,ENTRY
         TEST  AT,PROCESS
         DUMP  DATA,MYDATA,MYDATA+20
         TEST  AT,(INPUT,INPUT+18)
         DUMP  DATA,0(0,6),80(0,6)
         DUMP  DATA,TABLE(4),TABLE+8(4)
          .
          .
          .
```

A dumped area should lie entirely within a single control section or allocated storage area. If it does not, the area may be distorted by scatter loading of control sections or by variation in the relative locations of separately allocated areas. Also, if a dumped area begins in one control section and ends in another, only data from the first control section can be formatted properly.

In a system with storage protection, the TESTRAN interpreter limits dumps to contiguous storage blocks that have the same protection key as the job step task:

- In a system with MFT, a dump is truncated at the end of the job step partition.

- In a system with MVT, a dump is truncated at the end of the job step region, or at the beginning of a block within the region that has the supervisor protection key. (The supervisor protection key is assigned to re-enterable programs from the link and SVC libraries, to certain blocks used by the control program, and to blocks not assigned to any subpool.)

HOW TO DUMP CHANGES TO A STORAGE AREA

The method is the same as for dumping a storage area; the basic difference is that CHANGES replaces DATA in the DUMP statement:

```
NEWENTRY TEST  OPEN,ENTRY
         TEST  AT,PROCESS
         DUMP  CHANGES,MYDATA,MYDATA+20
ENTRY    SAVE  (14,12)
          .
          .
          .
PROCESS  MVC   MYDATA(20),0(6)
          .
          .
          .
MYDATA   DC    C'DATAAREA'
         DC    F'0,1,2'
          .
          .
          .
         END   NEWENTRY
```

Execution begins at NEWENTRY and continues at ENTRY. Before PROCESS is executed, the TESTRAN interpreter dumps the 20-byte area at MYDATA. If PROCESS is executed three times, the dumps may appear as:

```
  0090    MYDATA
005F68    DATAAREA    +0    +1    +2
--------------------------------
  0090    MYDATA
005F68    WORKAREA    +3
  00A0
005F78    -40
--------------------------------
  00A0
005F78    -41
```

The first dump shows the full contents of the four fields assembled at 000090 and loaded at 005F68. The second shows changes to the first, second, and fourth fields, and shows that the third field is unchanged. The third dump shows that only the fourth field has changed since the previous dump.

To show changes to an area, a DUMP CHANGES statement must be executed more than once. If PROCESS were executed only once, the example would have to be changed to specify additional test points:

```
NEWENTRY TEST  OPEN,ENTRY
         TEST  AT,(PROCESS,INPUT,INPUT+18)
         DUMP  CHANGES,MYDATA,MYDATA+20
          .
          .
          .
```

Change dumps would then occur at the test points PROCESS, INPUT, and INPUT+18. There might be other TESTRAN statements to be executed, however, and these statements might not be the same for each test point. In this case, it would be necessary to use branching statements:

```
NEWENTRY  TEST  OPEN,ENTRY
          TEST  AT,PROCESS
CONTINUE  DUMP  CHANGES,MYDATA,MYDATA+20
          TEST  AT,INPUT
          DUMP  DATA,0(0,6),80(0,6)
          GO    TO,CONTINUE
          TEST  AT,INPUT+18
          DUMP  DATA,TABLE(4),TABLE+8(4)
          GO    TO,CONTINUE
          .
          .
          .
```

The statement CONTINUE is the last executed at each test point. The GO TO statements in no way affect the logic of the program being tested; control is returned to each test point in the normal manner.

To dump changes to more than one area of storage, the programmer should specify each area in a separate statement:

```
NEWENTRY TEST  OPEN,ENTRY
         TEST  AT,PROCESS
         DUMP  CHANGES,MYDATA,MYDATA+20
         DUMP  CHANGES,TABLE(4),TABLE+8(4)
          .
          .
          .
```

Each statement produces a separate series of change dumps, even if two statements should specify the same storage area. Each dump shows changes to the area since the last dump by the same statement.

Changes in index values redefine areas that are specified by indexed addresses. For example, the statement

```
DUMP  CHANGES,ALPHA(4),ALPHA+60(4)
```

dumps a 60-byte area whose location depends on an index value in general register 4. On the first execution of the statement, the index value might be zero, causing a dump of the area from ALPHA to ALPHA+60. On the next execution, the index value might be 40, redefining the dumped area as that from ALPHA+40 to ALPHA+100. The second dump would show changed fields from ALPHA+40 to ALPHA+60 and all fields from ALPHA+60 to ALPHA+100.

HOW TO DUMP A DUMMY CONTROL SECTION

A dummy control section describes a storage area without actually reserving the area. The area may be allocated during execution, or may be reserved by a regular control section, as in the following example:

```
ENTRY    SAVE  (14,12)
           .
           .
           .
         LA    4,MYDATA
         USING DUMMY,4
PROCESS  MVC   DUMMY(20),0(6)
           .
           .
           .
MYDATA   DC    C'DATAAREA'
         DC    F'0,1,2'
           .
           .
           .
DUMMY    DSECT
COUNT    DS    XL4
NUMBERS  DS    4F
         END   ENTRY
```

This program defines a dummy control section named DUMMY, and assigns it the storage reserved for MYDATA. The example otherwise is the same as that used in "How to Dump a Storage Area." The instruction named PROCESS here refers to DUMMY rather than MYDATA, but its effect is the same as in the earlier example.

Assume that DUMMY is to be dumped after PROCESS has been executed, and that the 20-byte area at MYDATA is to be dumped as before. The program then becomes:

```
NEWENTRY TEST  OPEN,ENTRY
         TEST  AT,PROCESS
         DUMP  DATA,MYDATA,MYDATA+20
         TEST  AT,PROCESS+6
         USING DUMMY,4
         DUMP  DATA,COUNT,NUMBERS+16,DSECT=DUMMY
ENTRY    SAVE  (14,12)
           .
           .
           .
         LA    4,MYDATA
         USING DUMMY,4
PROCESS  MVC   DUMMY(20),0(6)
           .
           .
           .
MYDATA   DC    C'DATAAREA'
         DC    F'0,1,2'
           .
           .
           .
DUMMY    DSECT
COUNT    DS    XL4
NUMBERS  DS    4F
         END   NEWENTRY
```

As before, execution begins at NEWENTRY, control is passed to ENTRY, and the area of MYDATA is dumped at PROCESS. After PROCESS is executed, the new statements dump the 20 bytes from COUNT to NUMBERS+16. Thus, the two dumps of the same area might appear as follows:

```
  0090    MYDATA
005F68    DATAAREA    +0    +1    +2

  0000    COUNT       NUMBERS
005F68    00002A6     -647    +30   -1
```

The dumps show that MYDATA was assembled at 000090 and that COUNT was assembled at 000000; both had the same location (005F68) when dumped.

Note that a special operand (DSECT=DUMMY) points to a dummy control section, which is made addressable by a USING statement. A USING statement is not needed preceding the other TESTRAN statements, since their address operands are assembled as A-type address constants.

A dummy control section may describe more than one area of storage; for example, it may define each of several buffers in a buffer pool. If the areas are contiguous, they can be dumped by a single statement, as in the following example:

```
NEWENTRY TEST  OPEN,ENTRY
         TEST  AT, PROCESS+6
         USING DUMMY,4
         DUMP  DATA,COUNT,NUMBERS+16,DSECT=(DUMMY,3)
ENTRY    SAVE  (14,12)
         .
         .
         .
         LA    4,MYDATA
         USING DUMMY,4
PROCESS  MVC   DUMMY(60),0(6)
         .
         .
         .
MYDATA   DC    C'DATAAREA'
         DC    F'0,1,2'
         DS    XL40
         .
         .
         .
DUMMY    DSECT
COUNT    DS    XL4
NUMBERS  DS    4F
         END   NEWENTRY
```

PROCESS moves data into a 60-byte area beginning at DUMMY, i.e., at MYDATA. This area is dumped as three 20-byte areas ((NUMBERS+16)-COUNT=20), each area having the format defined in DUMMY:

```
  0000    COUNT       NUMBERS
005F68    000002A6    -647    +30   -1

  0000    COUNT       NUMBERS
005F7C    00000006    +4      +0    -2

  0000    COUNT       NUMBERS
005F90    000001CF    +278    -64   -89
```

Changes to a dummy control section can be dumped, just as changes to a regular control section. For this purpose, a DUMP CHANGES statement (with a DSECT operand) is used in place of a DUMP DATA statement. For examples of the use of DUMP CHANGES, refer to "How to Dump Changes to a Storage Area."

HOW TO DUMP STORAGE MAPS, REGISTERS, AND CONTROL BLOCKS

For simplicity, assume that a storage map, registers, and control blocks should all be dumped at X in the following program:

```
START    SAVE   (14,12)
         .
         .
         .
         OPEN   (MYDCB,(OUTPUT))
X        .
         .
         .
MYDCB    DCB    DSORG=PS,MACRF=(PM),DDNAME=MYDD
         END    START
```

The unshaded statements below perform these functions:

```
NEWSTART TEST   OPEN,START
         TEST   AT,X
         DUMP   MAP
         DUMP   PANEL
         DUMP   TABLE,TCB
         DUMP   TABLE,DCB,MYDCB
         DUMP   TABLE,DEB,MYDCB
START    SAVE   (14,12)
         .
         .
         .
         OPEN   (MYDCB,(OUTPUT))
X        .
         .
         .
MYDCB    DCB    DSORG=PS,MACRF=(PM),DDNAME=MYDD
         END    NEWSTART
```

Execution begins at NEWSTART, where X is established as a test point. Control passes to START, and the DUMP statements are executed at X. The dumps appear as follows:

Storage Map (recorded by DUMP MAP):

NAME	TYPE	CSECT NAME	ASSEMBLED AT	LOADED AT	LENGTH-DEC	HEX
GO	LOADED PROGRAM	NEWSTART	000000	009020	47	2F
	LOADED PROGRAM		000030	009050	172	AC
IEGTTRNK	LOADED PROGRAM			009120	1048	418
IEGTTROT	LOADED PROGRAM			07F3D0	1160	488
	OBTAINED STORAGE			07F858	96	60
	OBTAINED STORAGE			07F948	560	230
	OBTAINED STORAGE			07FBB0	360	168

Registers (recorded by DUMP PANEL):

```
G'00' 0007FD58 G'01' 0007FD58 G'02' 00000058 G'03' 50009050 G'04' 00006EE8 G'05' 0007FF5C G'06' 000054B0 G'07' 00000000
G'08' 0000003C G'09' 40011062 G'10' 0007FF1C G'11' 0007FF5C G'12' 00000180 G'13' 0007FE98 G'14' 50009088 G'15' 92007750
PSW  FF 1 5 0026 4 0 00908A  CC=0  FIX POINT OVERFLOW OFF  DEC OVERFLOW OFF  EXP UNDERFLOW OFF  SIGNIFICANCE OFF
  F'0' 00000000 00000000 F'2' 00000000 00000000 F'4' 00000000 00000000 F'6' 00000000 00000000
```

Task Control Block (recorded by DUMP TABLE,TCB):

```
SECTION    FIELD NAME   CONTENTS

           TCBFRS       00000000 00000000 00000000 82000170 00040000 0007DCB8 00000000 00000000
           TCBRBP       00009100
           TCBPIE       00000000
           TCBDEB       0007FCDC
           TCBTIO       0007FF5C
           TCBCMP       00000000
           TCBTRN       0007F948
           TCBMSS       00005670
           TCBPKF       10
           TCBFLGS      00000000 00000000 00000000 00000000 00000000
           TCBLMP       000
           TCBDSP       000
           TCBLLS       0007F3A8
           TCBJLB       00000000
           TCBJSE       00000000
           TCBGRS       000000C6 000054B0 800092F4 0007FB04 4007FF844 50004C1A 00000001 0007FAF0 0007FA90 0007FE58
                        0007FAF0 04000030 010000AC 40404040 40404040 40404040
           TCBIDF       01000000
           TCBFSA       404040
           TCBTCB       40404040
           TCBTME       40404040
```

Data Control Block (recorded by DUMP TABLE,DCB,MYDCB):

```
SECTION    FIELD NAME   CONTENTS

DEVICE DEPENDENT INTERFACES

           DCB          00000000 00000000 00000000 00000001 00810000

COMMON INTERFACE

           DCB          0207FC10 00004000 00000001

FOUNDATION BLOCK EXTENSION

           DCB          42000001 80000000

FOUNDATION BLOCK

           DCB          00400050 0007FCDC 92

ACCESS METHOD INTERFACES

           DCB          00775000 007B880C 00000100 09005028 28282840 07FBE000 07FCB800 07FCB800 00005000 00000100
                        00000000 00884848 70201EC9 C5C7E3E3 D9D5C600 4C0040F6 40404000 00000000 00000002 0026FE06
                        78000140 40404040 40404000 00000000 00000002 0027FE06 78000140 40404040 40404000 00000000
                        00000002 0028FE06 78000140 40404040 40404000 00000000 00000002 0029FE06 18000140 40404040
                        40404000 00000000 00000002 002AFE06 78000340 40404040 40404000 00000000 00000002 002DFE06
                        78000106
```

Data Extent Block (recorded by DUMP TABLE,DEB,MYDCB):

```
SECTION    FIELD NAME   CONTENTS

PREFIX SECTION

           DEBWKARA     00
           DEBDSCBA     00000000 000000
           DEBDCBMK     00000000 00000001 10011111 11100000
           DEBLNGTH     0C

NUCLEUS

           DEBNMSUB     003
           DEBTCBAD     000180
           DEBAMLNG     004
           DEBDEBAD     07F87C
           DEBOFLGS     11001000
           DEBIRBAD     000000
           DEBOPATB     00001111
           DEBSYSPG     000000
           DEBNMEXT     001
           DEBUSRPG     000000
           DEBPRIOR     000
           DEBECBAD     000000
           DEBPROTG     001
           DEBDEBID     015
           DEBDCBAD     00909C
           DEBEXSCL     002
           DEBAPPAD     07FCB8

EXTENT

           DEB          330020D0

ACCESS METHOD

           DEB          00010000

SUBROUTINE ID

           DEB          C1D9C1D2 1000
```

The format of each dump is explained in "Section 4: How to Interpret System Output." Note that:

- The storage map shows the length and location of each program that was loaded and each storage area that was obtained for the active task. The first program (GO) is the problem program; the others are components of the TESTRAN interpreter. GO includes two control sections: NEWSTART, which is defined by the TEST OPEN statement and contains all five TESTRAN statements, and an unnamed control section, which contains the problem program instructions.

- The dump of registers includes both the general and floating-point registers, assuming that the computing system includes the floating-point option. It also includes the program status word (PSW) that was stored when the problem program was interrupted at the current test point.

- The dumps of control blocks show the task control block (TCB) for the active task, the data control block (DCB) named MYDCB, and the data extent block (DEB) created during the opening of MYDCB.

In the second dump, the contents of all registers appear in hexadecimal format. The programmer can specify a different format (such as fixed-point or floating-point) in the DUMP PANEL statement (refer to "How to Control Output Format)." Since the specified format applies to all registers dumped by the statement, it is often desirable to use separate statements for dumping general and floating-point registers:

```
DUMP PANEL,G'0,15'
DUMP PANEL,F'0,6'
```

The first statement dumps the general registers 0 to 15; the second dumps the floating-point registers 0 to 6. The programmer can also select specific registers, as in the statement

```
DUMP  PANEL,(G'4',G'SUM',G'8,9',G'13,1')
```

which dumps only the following general registers:

- Register 4.
- The register whose number is the value of the symbol SUM.
- Registers 8 and 9.
- Registers 13, 14, 15, 0, and 1.

Of course, if the programmer wishes to dump specific general and floating-point registers, and to dump both in the same format, he can specify them in a single statement, such as:

```
DUMP  PANEL,(G'5',F'SUM',F'4,6',G'8,10')
```

HOW TO CONTROL OUTPUT FORMAT

The TESTRAN editor determines the format of the output from most TESTRAN statements. However, the statements

```
DUMP DATA
DUMP CHANGES
DUMP PANEL
TRACE REFER
```

produce output whose format may be determined in any of three ways:

1. By special operands.
2. By symbol tables.
3. By default.

By understanding each way of determining format, and the conditions under which it is used, the programmer can control the format of data recorded from registers and main storage.

SPECIAL OPERANDS: There are two operands by which the programmer can specify output format:

- The DATAM operand, which defines storage field or register format.
- The NAME operand, which defines a field name.

The DATAM operand can be used in any of the four statements; the NAME operand can be used in a DUMP DATA or DUMP CHANGES statement.

The DATAM Operand: The DATAM operand specifies the format of a field or register in terms of three attributes:

- Type
- Length
- Scale

The specification of attributes is similar to that in an assembler DC or DS statement and is illustrated by the following statements:

```
D1      DUMP  DATA,INPUT+6,DATAM=L74
D2      DUMP  CHANGES,0(0,13),72(0,13),DATAM=L4
D3      DUMP  PANEL,F'0,6',DATAM=D
T1      TRACE REFER,TABLE,TABLE+80,DATAM=FL4S-2
```

D1 dumps a single field that begins at INPUT+6. The length of the field is 74 bytes; because no type is specified, the contents of the field are printed as hexadecimal data.

D2 dumps a series of up to eighteen 4-byte fields, each containing changes to the contents of a 72-byte storage area.

D3 dumps the old program status word (OPSW) and the contents of the floating-point registers. The type of data in the registers is specified as D (long floating-point), which implies a length of 8 bytes for each.

T1 traces references to 4-byte fields within an 80-byte area. The trace shows the contents of a 4-byte fixed-point field beginning at each address to which a reference is made. The contents before and after the reference are shown multiplied by the scale factor (2^{-2}).

The NAME Operand: The NAME operand specifies a symbol that is printed as the name of a field dumped by a DUMP DATA or DUMP CHANGES statement. Its use is illustrated by the following statements:

```
D1      DUMP  DATA,TABLE(6),DATAM=CL8,NAME=FUNCTION
D2      DUMP  CHANGES,MATRIX,MATRIX+160,NAME=NEWMATRX
```

D1 dumps a single 8-byte field located at TABLE(6). FUNCTION is printed as the name of the field.

D2 dumps a 160-byte area, which may contain any number of fields. NEWMATRX is printed as the name of the first field that is dumped.

SYMBOL TABLES: Symbol tables are part of the control information that is passed to the TESTRAN editor by the TESTRAN interpreter. (See Figure 3.) Produced by the assembler, each symbol table describes fields defined in a named, unnamed, dummy, or blank common control section. The TESTRAN editor uses the symbol tables to:

- Determine field formats when the DATAM operand is omitted.
- Provide field names when both the DATAM and the NAME operands are omitted.

A blank common control section is common to two or more object modules, and is therefore represented by more than one symbol table. To print fields defined in a common control section, the TESTRAN editor identifies the object module in which the test point was located, and uses the symbol table for the control section as defined in that module.

Except in the case of a blank common control section, the symbol tables define only one format for a given area of storage. They do not define the format of fields that are overlapped by other fields, as in the following sequence:

```
LONGFLT  DS   D
SHORTFLT DS   E
         ORG  *-8
ADRLONG  DC   A(LONGFLT)
ADRSHORT DC   A(SHORTFLT)
```

This sequence defines fields that together occupy three full words. LONGFLT occupies the first two words, the second of which is overlapped by ADRLONG. SHORTFLT occupies the third word and is overlapped by ADRSHORT. If the three words were dumped, the first would be printed in default format, and the second and third would be printed as normal address constants.

DEFAULT: The fields described in the symbol tables are storage areas and constants defined by assembler DS and DC statements. Instructions are described only if named, and are therefore assumed to be the contents of any program area whose format is not defined in the tables. The area contents are analyzed for operation codes, which are used to determine the printing format for each instruction.

Unless treated as a dummy control section, an allocated area of main storage is not represented by a symbol table. By default, data from such an area is printed in 4-byte hexadecimal fields. Data from registers, including floating-point registers, is also printed in this format.

HOW TO TRACE CONTROL FLOW AND REFERENCES TO DATA

Suppose that the following sequence is the program to be traced:

```
BEGIN     SAVE   (14,12)
          .
          .
          .
REPEAT    ST     6,MYDATA
          .
          .
          .
DECIDE    BC     4,REPEAT
CONTINUE  CALL   ROUTINE1
          .
          .
          .
NEXTSTEP  SR     5,5
          .
          .
          .
MYDATA    DC     F'0'
          .
          .
          .
          END    BEGIN
```

The problem is to trace control flow from BEGIN to NEXTSTEP and to trace references to the area beginning at MYDATA. The traces are to be started at BEGIN and are to be stopped at NEXTSTEP.

The next sequence shows a solution:

```
NEWBEGIN  TEST   OPEN,BEGIN
          TEST   AT,BEGIN
          TRACE  FLOW,BEGIN,NEXTSTEP
          TRACE  CALL,CONTINUE,NEXTSTEP
          TRACE  REFER,MYDATA,MYDATA+72
          TEST   AT,NEXTSTEP
          TRACE  STOP
BEGIN     SAVE   (14,12)
          .
          .
          .
REPEAT    ST     6,MYDATA
          .
          .
          .
DECIDE    BC     4,REPEAT
CONTINUE  CALL   ROUTINE1
          .
          .
          .
NEXTSTEP  SR     5,5
          .
          .
          .
MYDATA    DC     F'0'
          .
          .
          .
          END    NEWBEGIN
```

Execution begins at NEWBEGIN, where a TEST OPEN statement establishes BEGIN and NEXTSTEP as test points. NEWBEGIN passes control to BEGIN, where three traces are started:

- The TRACE FLOW statement starts a trace of branches and supervisor calls to, from, or within the area from BEGIN to NEXTSTEP.
- The TRACE CALL statement starts a trace of subroutine calls by CALL macro-instructions located between CONTINUE and NEXTSTEP.
- The TRACE REFER statement traces references by instructions that could change data in the 72-byte area beginning at MYDATA.

To perform these traces, the TESTRAN interpreter retains control and executes the program interpretively, starting at BEGIN. At NEXTSTEP, the traces are stopped and execution continues normally.

The printed output of the three traces can be represented, in abbreviated fashion, as follows:

Output	Recorded During Execution of:
AT LOCATION BEGIN...	TESTRAN Statements
...TRACE FLOW... STARTED	
...TRACE CALL... STARTED	
...TRACE REFER... STARTED	
...TRACE REFER...TO MYDATA...FROM REPEAT... BEFORE +0 AFTER +16	Problem Program
...TRACE FLOW...FROM DECIDE...TO REPEAT...CC=1	
. . .	
...TRACE CALL...TO ROUTINE1...AT CONTINUE...	
. . .	
AT LOCATION NEXTSTEP...	TESTRAN Statements
...TRACE STOP,ALL	

The output shows that the traces were started at BEGIN and stopped at NEXTSTEP. It shows that the following events occurred during execution of the problem program:

- A reference was made to MYDATA by REPEAT, resulting in a new value of +16.
- A branch was made from DECIDE to REPEAT on condition code 1.
- A call was made to ROUTINE1 from CONTINUE.

Complete output, as actually printed by the TESTRAN editor, would also show the images of certain instructions, the values of symbolic addresses, and the contents of pertinent registers.

Suppose now that only the traces of control flow should be stopped at NEXTSTEP, and that the trace of references should be continued until the end of the program. The TESTRAN statements should then be written as follows:

```
NEWBEGIN TEST  OPEN,BEGIN
         TEST  AT,BEGIN
TRACE#1  TRACE FLOW,BEGIN,NEXTSTEP
TRACE#2  TRACE CALL,CONTINUE,NEXTSTEP
         TRACE REFER,MYDATA,MYDATA+72
         TEST  AT,NEXTSTEP
         TRACE STOP,(TRACE#1,TRACE#2)
```

The TRACE STOP statement here stops only the traces started by the statements TRACE#1 and TRACE#2. The TESTRAN interpreter continues its interpretive execution of the problem program, and records references to the area at MYDATA until termination of the task.

The TRACE STOP statement speeds up execution by reducing the number of traces. While any trace is in effect, the TESTRAN interpreter must examine each instruction before it is executed to determine whether it will cause some event, such as a branch, that must be recorded. This interpretive execution is necessarily slow, and the time it requires is reduced by stopping each trace when it is no longer needed.

Testing efficiency is also increased by limiting the size of storage areas specified in TRACE statements. For example, if there were three adjoining areas, all could be specified as a single area in a single statement; however, if only the first and third areas were of real interest, it would be better to eliminate output from the second area by using two TRACE statements to specify the first and third areas separately.

With respect to limiting traces, the following specific limits should be kept in mind:

- A trace area should lie entirely within a single control section or allocated storage area. If it does not, the area may be distorted by scatter loading of control sections or by variation in the relative locations of separately allocated areas. Also, if a trace area begins in one control section and ends in another, only data from the first control section can be formatted properly.

- No more than ten traces (corresponding to ten TRACE statements) can be performed simultaneously. If an eleventh trace is started, the tenth trace -- the one most recently started -- is stopped automatically.

A stopped trace can be restarted by executing again (at a later test point) the TRACE CALL, TRACE FLOW, or TRACE REFER statement that originally started the trace. In the same way, an active trace can be shifted to a new area if the area is specified by indexed addresses whose values have changed since the trace was started.

Traces of Asynchronous Exit Routines: Traces are stopped automatically when any of the following routines is entered:

- The end of task exit routine specified by the ETXR operand of an ATTACH macro-instruction.
- The timer completion exit routine specified by a STIMER macro-instruction.
- The error analysis exit routine specified by the SYNAD operand of a DCB macro-instruction.

To trace execution of one of these routines, it is necessary to start traces at a test point within the routine. When the routine returns control to the control program, these traces are automatically stopped and the traces stopped on entry to the routine are automatically restarted.

Traces are not stopped on entry to the program interruption exit routine specified by a SPIE macro-instruction.

Use of Dummy Control Sections: The programmer can trace references to fields of dummy control sections by using the general technique described in "How to Dump a Dummy Control Section." If he assigns varying locations to the dummy control section, he can shift the trace from one location to the next as in the following example:

```
NEWSTART TEST  OPEN,START
         TEST  AT,LOADBASE+2
         USING RECORD,6
         TRACE REFER,ID,DATE+5,DSECT=RECORD
         .
         .
         .
START    SAVE  (14,12)
         .
         .
         .
GETNEXT  GET   MYDCB
LOADBASE LR    6,1
         USING RECORD,6
         .
         .
         .
         PUTX  MYDCB
         B     GETNEXT
         .
         .
         .
MYDCB    DCB   DSORG=PS,MACRF=(GL,PL),DDNAME=MYDD
RECORD   DSECT
ID       DS    XL4
         .
         .
         .
DATE     DS    PL5
         END   NEWSTART
```

GETNEXT uses register 1 to point to a buffer that contains a record to be updated. The program assigns the buffer location to RECORD, a dummy control section that describes the record format. After processing the record, the program replaces it in the data set and executes the same set of instructions to update the next record. On each loop, the TRACE REFER statement is executed immediately after LOADBASE makes RECORD addressable. When first executed, it starts a trace of references to the buffer containing the first record; on each subsequent execution, it shifts the trace to the buffer containing the next record.

HOW TO COMMENT THE TESTRAN LISTING

A TESTRAN listing can become difficult to interpret when it contains many individual dumps and traces. To make the listing easier to interpret, the programmer can introduce comments that explain or call attention to particular items.

The programmer specifies a comment as an operand of a special DUMP statement (DUMP COMMENT) or in a special operand of a TRACE CALL, TRACE FLOW, or TRACE REFER statement. The following example illustrates both methods:

```
.
.
.
TEST  AT,PAYROLL
TRACE CALL,CALLFICA,NEXTSTEP,COMMENT='TRACE OF CALLS TO PAYROL-
      L SUBROUTINES'
TEST  AT,TESTCODE-4
DUMP  COMMENT,'G''15'' CONTAINS FICA RETURN CODE'
DUMP  PANEL,G'15'
.
.
.
```

The comment TRACE OF CALLS TO PAYROLL SUBROUTINES is printed with all output produced by the TRACE CALL statement. The comment G'15' CONTAINS FICA RETURN CODE is printed immediately before the dump of register 15.

(Note that the apostrophes in the second comment are each represented by a pair of apostrophes in the statement. This representation is necessary because apostrophes are used to delimit the comment; for other reasons, ampersands must be represented in the same way.)

HOW TO CLASSIFY TEST INFORMATION FOR SELECTIVE RETRIEVAL

To avoid printing large quantities of test output, the programmer can divide the output into several classes that can be retrieved selectively. By means of a job control statement, he can select one or more classes for printing immediately after execution of his program. From this information he can decide what other classes he needs for his evaluation of the program. He can then select these classes by submitting a new job that reprocesses the TESTRAN data set.

To classify output, the programmer writes a special operand (SELECT) in one of the following statements:

- TEST OPEN
- TEST AT
- Any DUMP or TRACE statement

Depending on where it appears, the SELECT operand classifies:

- Information recorded at the test points established by a TEST OPEN statement.
- Information recorded at the test point(s) specified in a TEST AT statement.
- Information recorded by an individual DUMP or TRACE statement.

The SELECT operand classifies information by means of a class identification number (an integer from 1 to 8), as in the following statement:

```
T1      TEST  OPEN,ENTRY,SELECT=8
```

All information recorded at the test points established by this statement belongs to class 8, except for information that is reclassified by a TEST AT, DUMP, or TRACE statement. Thus, if T1 is followed by

```
TEST  AT,PROCESS,SELECT=6
```

all information recorded at PROCESS belongs to class 6, except for information that is reclassified by a DUMP or TRACE statement, such as:

```
DUMP  DATA,MYDATA,SELECT=5
```

The dump of MYDATA belongs to class 5, and only to class 5. As a result of reclassification, it does not belong to either class 6 or class 8.

Use of the SELECT operand does not imply that all information must be classified. Unclassified as well as classified information can be selected for printing.

TESTING OF COMPLEX PROGRAMS

This part of Section 2 describes the testing of programs that are not simply structured or are not formed from single object modules.

HOW TO TEST A MODULE ALREADY IN A LIBRARY

As stated in Section 1, TESTRAN statements and the problem program can be assembled together or separately. Assembling the two together is usually the more convenient, but the sophisticated programmer may discover cases where separate assembly is more efficient. For example, the programmer may have assembled and tried to execute a program before deciding to use TESTRAN. If he has saved the program in a library, he may wish to assemble TESTRAN statements separately to avoid reassembling the program to be tested.

Separate assembly presents two major problems. First, there is no simple symbolic way that TESTRAN statements can refer to locations in the problem program. Second, assuming that the object or load module in the library contains no symbol tables, there is no simple way of obtaining TESTRAN output in the proper symbolic format.

References to the Problem Program: There are three ways that TESTRAN statements can refer to locations in the problem program. The first, which is the only way that can be used in TEST OPEN and TEST AT statements, is to write each address as an external reference plus or minus an appropriate displacement. The external reference is a symbol defined in the problem program and listed in the external symbol dictionary (the first part of the assembly listing). The displacement is the number of bytes from the location named by the symbol to the location of the operand; it can be calculated from the object code addresses contained in the assembly listing.

The second way of referring to the problem program is by explicit addresses. These can be written to use base registers loaded by the problem program. Displacements from base addresses can be calculated from the object code addresses in the assembly listing.

The third way of referring to the problem program is to use dummy control sections that describe the format of the problem program. The name of each must be declared as the address in a base register that is loaded by the problem program. Areas defined in the dummy control sections (which correspond to areas in the problem program) can then be referred to symbolically by DUMP DATA, DUMP CHANGES, and TRACE REFER statements that are written with DSECT operands. Remember that TESTRAN statements must not follow statements of a dummy control section.

Output Format: The output of DUMP DATA, DUMP CHANGES, and TRACE REFER statements is printed as four-byte hexadecimal fields unless each statement contains a DATAM or DSECT operand. The DATAM operand specifies a uniform field format for all data in the area specified by the statement. The DSECT operand specifies use of the symbol table for a dummy control section that is assembled with the TESTRAN statements.

Symbol tables are optional features of assembly and linkage editing, and are requested by means of job control statements. If the programmer anticipated the use of TESTRAN, he could have requested symbol tables when the problem program module was created. The tables for the problem program could then be used to determine the output format.

Linkage Editing and Execution: After being assembled, the TESTRAN module (TESTRAN statements and dummy control sections) is processed by the linkage editor. The programmer must provide linkage editor control statements to combine this module with the problem program module. For example, the statements:

```
INCLUDE MYLIB(MYPROG)
ENTRY   NEWSTART
NAME    MYPROG(R)
```

specify that the load module is to include the load module MYPROG from the library MYLIB; that the entry point is to be NEWSTART (assumed to be the name of a TEST OPEN statement); and that the new load module is to replace the original problem program module in the library.

The normal procedure is followed in executing the new load module and printing the TESTRAN output. If the output shows an error in a particular control section, the programmer can replace the control section with a new one through use of the linkage editor. Since a symbol table can be requested when assembling the new control section, the programmer may wish to eliminate DATAM or DSECT operands in TESTRAN statements that refer to the control section. If so, he assembles a complete new set of TESTRAN statements, which form an implicit control section named after the TEST OPEN statement. If each new control section is named after the control section it replaces, the replacement is automatic, and only two linkage editor control statements are needed:

```
INCLUDE MYLIB(MYPROG)
NAME    MYPROG(R)
```

When the new load module is tested, the TESTRAN output may show an error in one of the replacement control sections. If there is a symbol table for this control section, the control section should not be replaced with another of the same name. The linkage editor does not replace symbol tables when it replaces control sections; therefore, the table originally associated with each section name remains in effect.

Test Completion: When testing is completed, the programmer can direct the linkage editor to prepare the load module for productive use. For example, he might write the following control statements:

```
ENTRY   START
REPLACE NEWSTART
INCLUDE MYLIB(MYPROG)
NAME    MYPROG(R)
```

These statements restore the normal entry point (START) and delete the TESTRAN control section (NEWSTART). Symbol tables in the module are deleted as a result of omitting an option in a job control statement.

HOW TO ENLARGE ON A PARTIALLY TESTED PROGRAM

Suppose that the following program has been tested successfully:

```
TESTMOD1 TEST  OPEN,MOD1
         .
         .
         .
MOD1     CSECT
         .
         .
         .
         END   TESTMOD1
```

MOD1 is now to become a subroutine of another control section, MOD2, and the two control sections are to be tested together. The enlarged program is as follows:

```
TESTMOD2 TEST  OPEN,MOD2,OPTEST=TESTMOD1
         .
         .
         .
MOD2     CSECT
         .
         .
         .
CALLMOD1 CALL  MOD1
         .
         .
         .
TESTMOD1 TEST  OPEN,MOD1
         .
         .
         .
MOD1     CSECT
         .
         .
         .
         END   TESTMOD2
```

Execution begins at TESTMOD2, the first of a group of TESTRAN statements for testing MOD2. In effect, this statement executes the statement TESTMOD1; as a result, it establishes test points as specified by TEST AT statements following both TESTMOD1 and TESTMOD2. TESTMOD2 ignores the second operand (MOD1) of TESTMOD1 and passes control to the problem program at MOD2.

Because MOD1 has been tested previously, test information about MOD1 is simply insurance against unexpected errors. The programmer may therefore wish to defer printing this information until after he has examined the information about MOD2. If so, he can classify the information about MOD2 and select only this information for immediate printing. He can save the data set that contains the information and, if it proves necessary, select the information about MOD1 at a later date.

The programmer classifies information about MOD2 by means of a special operand (SELECT) described in "How to Classify Test Information for Selective Retrieval." There are several statements in which he can write this operand, but for the present purpose he can best write it in the TEST AT statements that follow TESTMOD2:

```
TESTMOD2 TEST  OPEN,MOD2,OPTEST=TESTMOD1
         TEST  AT,MOD2,SELECT=8
               .
               .
               .
         TEST  AT,CALLMOD1,SELECT=8
               .
               .
               .
```

The programmer can select information about MOD2 by specifying class 8 in a job control statement, as explained in Section 3. In a later job, he can repeat the editing of TESTRAN output and select unclassified output to print information about MOD1.

The SELECT operands in the TEST AT statements classify information recorded at test points in MOD2. A SELECT operand in the statement TESTMOD2 would provide the same function if that statement did not include the operand OPTEST=TESTMOD1. In a TEST OPEN statement, a SELECT operand classifies information recorded at all test points established by the statement, including those established as the result of an OPTEST operand. A SELECT operand in TESTMOD2 would therefore classify information recorded at test points in both MOD2 and MOD1. It would do so even if a different SELECT operand (e.g., SELECT=7) were written in TESTMOD1, because the operands of a TEST OPEN statement are ignored if the statement is not actually executed.

HOW TO TEST AN OVERLAY PROGRAM

An overlay program is a load module that is divided into several overlay segments. For testing purposes, each segment must be treated as a separate program. That is, it must contain its own TESTRAN statements, beginning with a TEST OPEN statement. During execution, only one TEST OPEN statement can receive control; it must be located in the root segment, and it must contain a special operand (OPTEST) that points to all other TEST OPEN statements, as in the following example:

```
                 TESTSEG1 TEST  OPEN,ENTRY,OPTEST=(TESTSEG2,TESTSEG3)
Segment 1                .
(Root Segment)           .
                         .
                 TESTSEG2 TEST  OPEN
                         .
Segment 2                .
                         .
                 TESTSEG3 TEST  OPEN
                         .
Segment 3                .
                         .
                         END   TESTSEG1
```

Except for references by the OPTEST operand, symbolic references between segments are not allowed in TESTRAN statements. External references must be declared in assembler EXTRN and ENTRY statements.

A TEST OPEN statement and the TESTRAN statements that follow it form an implicit TESTRAN control section that must be inserted in the proper overlay segment. Thus, for the example just given, the programmer might write the following linkage editor control statements:

```
        INSERT  TESTSEG1,...
        OVERLAY ROOTNODE
        INSERT  TESTSEG2,...
        OVERLAY ROOTNODE
        INSERT  TESTSEG3,...
```

When a segment is overlaid, traces started by TRACE statements in the segment are automatically stopped. They are not automatically restarted when the segment is reloaded, but are restarted when the TRACE statements are again executed at a test point in the segment. To ensure that traces are restarted, the programmer must therefore design his testing logic so that TRACE statements are executed each time a segment is entered after being overlaid and reloaded.

HOW TO TEST A DYNAMIC SERIAL PROGRAM

A dynamic serial program is a combination of two or more load modules that are loaded and executed as a single task. Each load module can contain TESTRAN statements; if it does, however, it is neither reenterable nor serially reusable.

A module that is not reusable is normally loaded each time it is entered by a supervisor assisted linkage. For this reason, a TEST OPEN statement must be executed to establish test points each time the module is entered by means of a LINK, XCTL, or ATTACH macro-instruction. Before control is passed or returned to another module, testing of the module should be stopped by a TEST CLOSE statement, as in the following example:

```
NEWENTRY TEST  OPEN,ENTRY
         .
         .
         .
         TEST  AT,FINISH
         TEST  CLOSE
ENTRY    SAVE  (14,12)
         .
         .
         .
FINISH   RETURN (14,15)
         END   NEWENTRY
```

At the test point FINISH, the TEST CLOSE statement nullifies the effect of the TEST OPEN statement and returns control to the test point. As a result, the TESTRAN interpreter releases storage areas acquired for internal functions. If not released, the areas would be duplicated the next time the module was loaded and tested. If the RETURN macro-instruction was replaced by an XCTL macro-instruction, the task would be abnormally terminated if TEST CLOSE were omitted.

If a nonreusable module is loaded by a LOAD macro-instruction, the loaded copy of the module may be entered more than once before it is deleted. When an entry point is identified by an IDENTIFY macro-instruction, a used copy is considered reenterable. In systems with the primary control program or MFT, a used copy is considered serially reusable whenever it is not currently in use. The programmer must ensure that LOAD and IDENTIFY macro-instructions do not cause improper use of a module that includes TESTRAN.

When a supervisor assisted linkage is made to another module, all traces are automatically stopped. They are not automatically restarted when control is returned, but can be restarted by appropriate TRACE statements. The TRACE statements should follow a TEST AT statement that specifies the return address as a test point.

HOW TO TEST A DYNAMIC PARALLEL PROGRAM

A dynamic parallel program is a combination of two or more load modules that are loaded and executed as more than a single task. A task may be the execution of a load module containing TESTRAN statements or the execution of several such modules as a dynamic serial program. Because TESTRAN modules are not reusable, the use of LOAD, ATTACH, and IDENTIFY macro-instructions should be restricted so that a single copy of a module is not executed under more than one task.

For each task there must be a separate TESTRAN data set. The TESTRAN interpreter defines and opens the necessary data control blocks, but the programmer must provide the corresponding DD control statements. The programmer must point to one of these statements by means of a special operand (DDN) in the first TEST OPEN statement executed under each task. For example, the statement

```
NEWENTRY TEST OPEN,ENTRY,DDN=TESTDD#1
```

points to a DD statement whose ddname is TESTDD#1. Of course, a given TEST OPEN statement must not be executed first under more than one task, since a unique DD statement is required for each data set. The processing of each data set by the TESTRAN editor must be performed as a separate job step.

When an ATTACH macro-instruction is executed, all traces are automatically stopped. These traces are not automatically restarted when control is returned to the next sequential instruction, but can be restarted by appropriate TRACE statements. The TRACE statements should follow a TEST AT statement that specifies a test point immediately following the ATTACH macro-instruction.

Traces are also stopped when a task is interrupted and another task is given control. When the interrupted task regains control, the stopped traces are restarted automatically.

LOGICAL FUNCTIONS

This part of Section 2 describes various logical functions: conditional testing, error recovery, and TESTRAN subroutines.

HOW TO TEST ON CONDITION

The programmer can write a sequence of TESTRAN statements so that it will not be executed every time a particular test point is reached, but only when certain conditions are met. The programmer can choose any conditions he wishes, formulating each as a matter of count, logic, or arithmetic value. Thus, he can make dumps and traces dependent on such conditions as:

- Reaching a particular test point more than a given number of times (a count condition).
- Failing to enter a particular problem program routine (a logical condition).
- Computing a value greater than some given value (an arithmetic condition).

Testing on Count Conditions: Consider the following simple sequence of TESTRAN statements:

```
         .
         .
         .
         TEST AT,XX
         DUMP PANEL
         .
         .
         .
```

These statements perform a series of dumps at a test point XX in a problem program. They do so unconditionally, because the DUMP statements are executed every time that control passes to XX.

Suppose now that XX is located in a subroutine that may be called many times. Since the test point may be reached repeatedly, unconditional testing could produce very large amounts of TESTRAN output. To limit the output to a meaningful sample, the testing can be made conditional, as in the following sequence, which arbitrarily limits dumps to the first 24 times that XX is reached.

```
         .
         .
         .
         TEST AT,XX
         TEST ON,,24,,SAMPLE
         GO BACK
SAMPLE   DUMP PANEL
         .
         .
         .
```

The TEST ON statement is the first statement executed at XX. Each time control passes to XX, the statement adds one to a counter, which initially has a value of zero. The statement then tests the counter for a value of 24 or less. If the counter has such a value, the statement branches to SAMPLE, and the DUMP statements are executed. If the counter has a greater value, the next sequential statement is executed; this statement, GO BACK, returns control to the problem program.

In this example, the TEST ON statement tests for a single condition: a counter value that is 24 or less. It can be written to test for further conditions, such as a counter value that is 5 or greater and is a multiple of 2:

```
TEST ON,5,24,2,SAMPLE
```

Each condition must be met, or no branch is made. Thus, no branch is made when the counter value is 5, because 5 is not a multiple of 2. The statement as written branches only on even values of the counter from 6 to 24.

When an operand is omitted, it has an assumed value that essentially negates testing for the condition it represents. For example, the second and fourth operands have assumed values of one; thus, the statement

```
TEST ON,,24,,SAMPLE
```

tests a counter for a value that is not less than 1, is not greater than 24, and is a multiple of 1. Since the counter value is 1 when the first test is made, the statement effectively tests only for a value not greater than 24. If the third operand were omitted, its assumed value would be $2^{31}-1$, which is the highest value that the counter can attain and the highest value that can be specified for any of the three operands.

At times, the programmer may want to test a counter against values that are generated during execution. In a TEST ON statement, he can refer to any full-word fixed-point value in a register or in main storage, as shown by the following statement:

```
TEST ON,G'6',MAXIMUM,G'REGX',CONTINUE
```

This statement branches to CONTINUE on each counter value that is not less than the value in general register 6 (G'6'), is not greater than the value at MAXIMUM, and is a multiple of the value in the general register whose number is the value of the symbol REGX. The contents of G'6', MAXIMUM, and G'REGX' are evaluated each time the statement is executed.

It is sometimes useful to be able to change the value of a counter and to use several TEST ON statements to test a single counter. In such instances, the counter must be given a name, as in the following example:

```
NEWENTRY TEST OPEN,ENTRY
         TEST DEFINE,COUNTER,#PARAMS
         TEST AT,A
         .
         .
         .
         TEST ON,1,G'3',G'3',FINISH,COUNTER=#PARAMS
         TEST AT,B
         TEST ON,1,G'3',G'3',FINISH,COUNTER=#PARAMS
         .
         .
         .
         GO BACK
FINISH   SET COUNTER,#PARAMS,=F'0'
         DUMP COMMENT,'LAST PARAMETER HAS BEEN PROCESSED.  NUMBER OF PA-
         RAMETERS IS IN G''3''.'
         DUMP PANEL,G'3'
         .
         .
         .
```

When executed, NEWENTRY establishes test points A and B, and creates a TESTRAN counter named #PARAMS. The counter is defined by the TEST DEFINE statement, which, like the TEST AT statements, is used as a source of information but is not executed. The TEST OPEN statement passes control to ENTRY, the entry point of the program being tested.

The statements in this example test a subroutine that is called to process a number of parameters. The number of parameters is provided in general register 3 (G'3'), and when each is processed, control passes to one of the two test points A and B. At either test point, a TEST ON statement increments the counter #PARAMS by one, so its current value is always the number of parameters that have been processed. When the value of the counter equals the value in G'3', one of the TEST ON statements resets the counter to its initial value of zero, and appropriate dumps are taken. The resetting of the counter prepares the TEST ON statements for use in testing the subroutine the next time it is called.

Testing on Logical Conditions: Suppose that there is a problem program that calls a certain subroutine only when certain conditions in the program are satisfied. If the subroutine is called, testing is to occur at a test point SS in the subroutine; if the subroutine is not called, testing is to occur later at a test point XX in the calling routine.

The following TESTRAN sequence makes testing at XX conditional on not testing at SS:

```
NEWENTRY TEST OPEN,ENTRY
         TEST DEFINE,FLAG,SSTEST
         TEST AT,SS
         SET FLAG,SSTEST,=1
         .
         .
         .
         TEST AT,XX
         TEST WHEN,SSTEST,RESET
         .
         .
         .
         GO BACK
RESET    SET FLAG,SSTEST,=0
```

When executed, NEWENTRY establishes test points at SS and XX, and creates a TESTRAN flag named SSTEST. The flag is defined by a TEST DEFINE statement, in the same way as a TESTRAN counter. The TEST OPEN statement passes control to ENTRY, the entry point of the program being tested.

The flag SSTEST is a single binary digit whose initial value is zero. If control passes to SS, the flag's value is changed to one by a SET FLAG statement. When control passes to XX, the flag is tested by a TEST WHEN statement; if its value is one, a branch is made to RESET, a statement that resets the flag to zero before control is returned to the problem program. If the value of the flag is zero, the testing statements following the TEST WHEN statement are executed.

Suppose now that there is a second subroutine, which may be called if the first subroutine is not called. If it is called, testing is to occur at a test point TT in the subroutine; if it is not called, testing is to occur at SS or XX as before. The following sequence makes testing at XX conditional on not testing at either SS or TT.

```
NEWENTRY TEST OPEN,ENTRY
         TEST DEFINE,FLAG,(SSTEST,TTTEST)
         TEST AT,SS
         SET FLAG,SSTEST,=1
         .
         .
         .
         TEST AT,TT
         SET FLAG,TTTEST,=1
         .
         .
         .
         TEST AT,XX
         TEST WHEN,SSTEST,AND,TTTEST,ERROR
         TEST WHEN,SSTEST,OR,TTTEST,RESET
         .
         .
         .
         GO BACK
ERROR    DUMP COMMENT,'SS AND TT WERE BOTH REACHED BEFORE XX'
RESET    SET FLAG,SSTEST,=0
         SET FLAG,TTTEST,SSTEST
```

In this example, NEWENTRY establishes three test points (SS, TT, and XX) and creates two TESTRAN flags (SSTEST and TTTEST). The flags are set to indicate testing at SS and TT; they are tested at XX by two TEST WHEN statements. The first TEST WHEN statement tests for an error condition: execution of both subroutines, indicated by both flags having values of one. If the error condition exists, the statement branches to ERROR, and an appropriate comment is inserted in the TESTRAN listing. If the error condition does not exist, the second TEST WHEN statement determines whether either of the subroutines has been executed. If either flag has a value of one, the statement branches to RESET, where two SET FLAG statements set SSTEST to zero and assign its new value (zero) to TTTEST.

Note that the operands AND and OR allow a single TEST WHEN statement to perform the function of a sequence of statements. The statements in this example are equivalent to the following sequences:

TEST WHEN,SSTEST,AND,TTTEST,ERROR:

```
         TEST WHEN,SSTEST,X
         GO TO,Y
X        TEST WHEN,TTTEST,ERROR
Y        .
         .
         .
```

TEST WHEN,SSTEST,OR,TTTEST,RESET:

```
         TEST WHEN,SSTEST,RESET
         TEST WHEN,TTTEST,RESET
```

Testing on Arithmetic Conditions: Suppose that there is a processing loop that performs fixed-point calculations involving general register 7 and a storage field named TEMP. According to the logic of the program, the value at TEMP should never exceed the value in register 7; if it does, an error has occurred, and dumps should be taken at LOOP+12. The following sequence shows a solution for this problem:

```
          .
          .
          .
          TEST AT,LOOP+12
          TEST WHEN,TEMP,GT,G'7',ERROR
          GO BACK
ERROR     DUMP COMMENT,'ERROR -- TEMP IS GREATER THAN G''7''.'
          DUMP DATA,TEMP
          DUMP PANEL,G'7',DATAM=F
          .
          .
          .
TEMP      DS   F
          .
          .
          .
```

The TEST WHEN statement is the first statement executed at LOOP+12. It means: "When the value at TEMP is greater than (GT) the value in general register 7 (G'7'), branch to ERROR." Appropriate dumps are taken if the branch is made; otherwise, control is returned to the program by the GO BACK statement.

A TEST WHEN statement can be used to test an arithmetic condition involving any of the following:

- Values in main storage
- Values in registers
- TESTRAN counters
- Literal constants

The condition must be expressed as a relationship between two values of the same data type and length, as, for example, two full-word fixed-point values. The relationship must be expressed by one of the following special operands:

GT - greater than
GE - greater than or equal to
EQ - equal to
NE - not equal to
LT - less than
LE - less than or equal to

The type and length of both values in a relationship is usually implied by the operand that represents the first value. Thus, in the relationship TEMP,GT,G'7', the operand TEMP implies fixed-point type and four-byte length, because TEMP is defined by a DS statement as a full-word fixed-point variable. If the relationship were expressed as G'7',LE,TEMP, four-byte length and hexadecimal type would be implied.

If the first value is represented by an external reference or by an address that includes no symbols, the type and length are implied by the operand that represents the second value in the relationship. For example, if COUNT in the relationship 4(0,3),EQ,COUNT is a TESTRAN counter, it implies fixed-point type and four-byte length for the value at 4(0,3).

Sometimes, it is necessary to specify type and length explicitly. For example, a reference to a value in a floating-point register implies a length of eight bytes. If the value is a short floating-point number, its true length can be specified as in the following statement:

```
          TEST WHEN,F'0',GE,F'4',CONTINUE,DATAM=E
```

The DATAM operand specifies the standard short floating-point type code E, which implies a length of four bytes, just as in a DS or DC statement. It might also be written as DATAM=DL4, thus specifying four-byte length for a long floating-point number.

HOW TO OFFSET PROGRAM ERRORS

Consider again the last example of the previous topic, "How to Test on Condition." In that example, a TEST WHEN statement was used to test a relationship between two values, and to branch to a sequence of DUMP statements if the relationship indicated an error condition. To offset the error condition, additional statements can be included in the sequence, as follows:

```
          .
          .
          .
          TEST AT,LOOP+12
          TEST WHEN,TEMP,GT,G'7',ERROR
          GO BACK
ERROR     DUMP COMMENT,'ERROR -- TEMP IS GREATER THAN G''7''.'
          DUMP DATA,TEMP
          DUMP PANEL,G'7',DATAM=F
          DUMP COMMENT,'SET TEMP EQUAL TO G''7''. GO BACK TO NEXTSTEP.'
          SET VARIABLE,TEMP,G'7'
          GO BACK,NEXTSTEP
```

The DUMP COMMENT statement describes how the error is offset. The SET VARIABLE statement sets TEMP equal to the value in general register 7, eliminating the error condition as defined in the TEST WHEN statement. The GO BACK statement returns control to NEXTSTEP in the problem program, forcing an exit from the processing loop that produced the error.

This example shows two ways of offsetting a program error:

- Using a SET VARIABLE statement to change problem program data.
- Using a GO BACK statement to change problem program control flow.

Neither way actually corrects the error; it simply provides an opportunity for additional testing by allowing execution to continue when it might otherwise be terminated.

If an error is successfully offset, execution may continue to normal completion, thus making it appear that there has not been an error. The DUMP COMMENT statement should therefore be used, as in the example, to call attention to any error that is detected, and to describe the offsetting action by TESTRAN statements.

Note that the SET VARIABLE statement in the example refers to two values, TEMP and G'7', and that these values have the same data type and length. Because the SET VARIABLE statement is equivalent to a move or load instruction, the length of the data to be moved or loaded is very important. It is determined in the same way that type and length are determined for values referred to by a TEST WHEN statement: it is either implied by one of the values, or is stated explicitly by a DATAM operand. Thus, to load a short floating-point number X into a floating-point register, the following statement might be written:

```
SET VARIABLE,F'0',X,DATAM=L4
```

The DATAM operand specifies a length of four bytes; if it were omitted, the operand F'0' would imply a length of eight bytes.

Consider the following sequence of TESTRAN statements:

```
        .
        .
        .
        TEST AT,(XX,YY,ZZ)
        DUMP CHANGES,MYDATA,MYDATA+100
        .
        .
        .
        GO BACK
```

In effect, this sequence is a closed subroutine that is called at the test points named in the TEST AT statement. When executed, it automatically returns control to the test point from which it was called.

Suppose now that this subroutine should be executed at an additional test point, WW. At WW, its execution is to be followed by the execution of additional TESTRAN statements rather than by immediate return of control to the problem program. This subroutine should then be called as in the following sequence:

```
                .
                .
                .
                TEST AT,WW
                GO IN,X
                .
                .
                .
                TEST AT,(XX,YY,ZZ)
X               DUMP CHANGES,MYDATA,MYDATA+100
                .
                .
                .
                GO OUT
```

The first statements in this sequence form a new subroutine that is called at the test point WW. The new subroutine calls the original subroutine by means of a GO IN statement, which specifies X as an entry point. In the original subroutine, GO BACK is replaced by GO OUT, which returns to the statement that follows GO IN. Like GO BACK, the GO OUT statement returns control to the problem program when the subroutine is called at XX, YY, or ZZ.

As shown in Figure 4A, GO IN and GO OUT statements can be used to create up to three levels of TESTRAN subroutines. That is, the first subroutine called by a GO IN statement can call a second subroutine, and the second can call a third. In each subroutine, a GO OUT statement can be used to return to the subroutine at the next higher level. The third (lowest) level subroutine can thus return to the second level subroutine, the second to the first, and the first to the subroutine that made the original call (the closed subroutine that was entered directly from a test point).

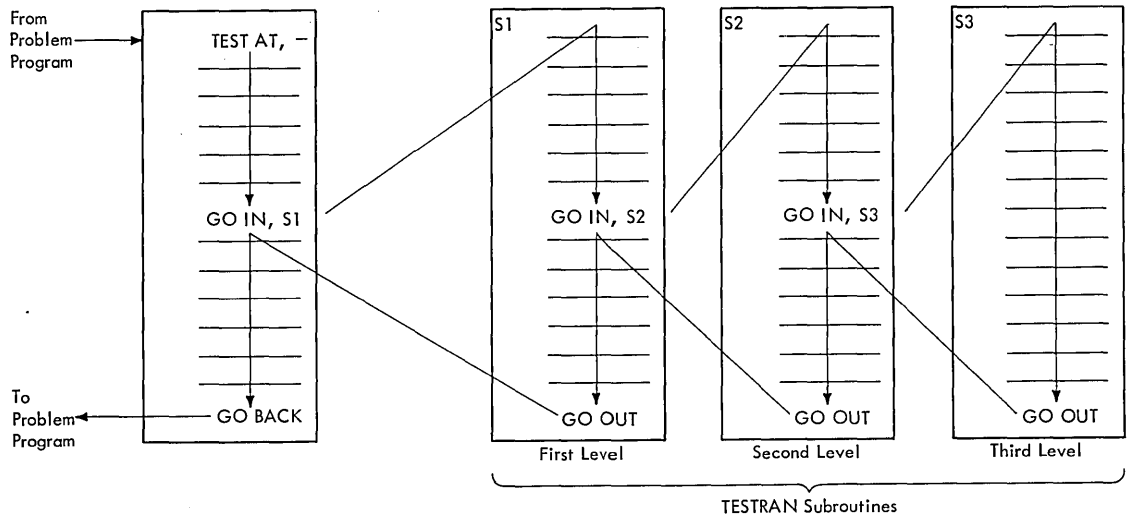

Figure 4A. Calling and Returning from Three Levels of TESTRAN Subroutines

If an attempt is made to create a fourth level subroutine, the ability to return from the first level subroutine is lost. In effect, the second level becomes the new first level, the third level becomes the new second level, and the newly created "fourth level" becomes the new third level. If a GO OUT statement is later executed at the old first level, control is returned to the problem program.

If a TESTRAN subroutine returns control to the problem program, existing subroutine levels cease to be recognized. At a later test point, new first, second, and third levels can be created, but old levels cannot be returned to. If an attempt is made to return to an old level by executing a GO OUT statement before executing a GO IN statement, control is returned to the problem program.

To use TESTRAN, the programmer must write job control statements to define the job to be performed by the operating system. A typical TESTRAN job consists of one or more job steps, each of which performs one of the following functions:

- Assembly of the problem program
- Linkage editing of the problem program
- Execution of the problem program
- Editing of test information

The job control statements used in defining jobs and job steps are described in the publication IBM System/360 Operating System: Job Control Language. Statements for performing specific TESTRAN-oriented jobs are listed below. The jobs defined by these model job definitions include the following job steps:

- Assembly
- Linkage Editing
- Execution
- TESTRAN Editing
- Assembly and Linkage Editing
- Assembly, Linkage Editing, and Execution
- Assembly, Linkage Editing, Execution, and TESTRAN Editing

Most of the model job definitions refer to IBM-supplied cataloged procedures, which are defined in Appendix B. Before attempting to use these procedures, the programmer should make certain that they have been included in the procedure library at his installation. If a procedure has been omitted, the programmer can copy the necessary statements from the appendix.

ASSEMBLY

Figure 5 defines a job that executes the E- or F-level assembler program. The statements in the figure are numbered, and are explained in the correspondingly numbered paragraphs below. The shaded statements are optional.

```
1. //jobname       JOB  job parameters
2. //              EXEC PROC=ASMxC,PARM=TEST
3. //ASM.SYSPUNCH DD   DSNAME=dsname,DISP=(NEW,KEEP),                  Continue
   //              UNIT=type,VOLUME=(PRIVATE,SER=ser#),SPACE=(80,200,50))
4. //ASM.SYSGO    DD   DSNAME=dsname,DISP=(NEW,KEEP),                  Continue
   //              UNIT=type,VOLUME=(PRIVATE,SER=ser#),SPACE=(80,(200,50))
5. //ASM.SYSIN    DD   data definition parameters
```

Figure 5. Job Control Statements for Assembly

1. This statement provides general job control information.

2. This statement refers to one of two cataloged procedures, each of which defines a single job step, ASM. The PROC parameter specifies the procedure ASMEC to select the E-level assembler program, or the procedure ASMFC to select the F-level assembler program. The PARM parameter specifies the option TEST, which causes symbol tables to

be included in the object module; it also implies the following options:

```
NOLOAD
DECK
LIST
XREF
LINECNT=standard line count
```

If desired, other options can be specified in place of the implied options. The TEST option, however, must be specified.

3. This statement is optional. If present, it saves the object module as a data set on a private magnetic tape or direct-access volume. The data set can subsequently be used as primary or additional input to the linkage editor. (If the data set is saved on a tape volume, the SPACE parameter can be omitted.)

   Statement 3 overrides the following statement in the procedure ASMEC:

   ```
   //SYSPUNCH DD UNIT=SYSCP
   ```

   or the following statement in the procedure ASMFC:

   ```
   //SYSPUNCH DD SYSOUT=B
   ```

   If the statement in the procedure is not overridden, it causes the object module to be produced as a deck of punched cards.

4. This statement is optional. If present, its function is the same as that of statement 3, and it should therefore be written only if statement 3 is omitted. This statement is valid only with the procedure ASMFC, and only when the LOAD option is specified in the PARM parameter.

5. This statement defines a data set that contains the source program to be assembled. This data set can appear in the input stream.

LINKAGE EDITING

Figure 6 defines a job that executes the largest linkage editor program available at the installation. The statements in the figure are numbered, and are explained in the correspondingly numbered paragraphs below. The shaded statements are optional.

```
1. //jobname       JOB  job parameters
2. //              EXEC PROC=LKED,PARM=TEST
3. //LKED.SYSLMOD DD   DSNAME=liBname(member),DISP=(MOD,KEEP),        Continue
   //              UNIT=type,VOLUME=(PRIVATE,SER=ser#)
4. //LKED.SYSIN   DD   data definition parameters
5. //LKED.ddname  DD   data definition parameters
```

Figure 6. Job Control Statements for Linkage Editing

1. This statement provides general job control information.

2. This statement refers to a cataloged procedure named LKED, which defines a single job step that is also named LKED.

Region Size: Region size is the amount of main storage available to a job step that is executed under a system with MVT. The procedure LKED defines region size as 96K, which is the minimum required for the 88K version of linkage editor F. (Region requirements for other versions are given below.) A larger or smaller region can be requested by writing:

```
REGION=nnnnnK
```

where nnnnn is a one- to five-digit decimal number specifying region size in units of K (1024) bytes.

Linkage Editor Options: The PARM parameter specifies the option TEST, which causes symbol tables and object module control dictionaries to be included in the load module. Additional options that can be specified are:

```
SCTR or OVLY
DC
OL
LIST
XREF or MAP
NCAL
LET or XCAL
SIZE=(value1,value2)
```

Of these, LIST and XREF (which includes MAP) are diagnostic options, and NCAL and LET (which includes XCAL) are special processing options that are useful in testing a program.

The SIZE option improves the performance of the F-level linkage editor by indicating the amount of available main storage ($value_1$), and the size of the text buffer ($value_2$). The possibility of one-pass processing is enhanced if the text buffer is at least as large as the load module to be created.

Minimum $value_2$ is 6K; maximum is 100K. Minimum $value_1$ depends on $value_2$ and on the size of the linkage editor; maximum $value_1$ is 9999K. The following table defines minimum $value_1$, together with the region size required in systems with MVT:

Size of the Linkage Editor	Minimum $value_1$	MVT Region Size
44K	$value_2$+38K	$value_1$+10K
88K	$value_2$+44K[1]	$value_1$+8K
128K	$value_2$+66K[2]	$value_1$+8K

[1]When $value_2$ is less than 44K, minimum $value_1$ is 88K.
[2]When $value_2$ is less than 66K, minimum $value_1$ is 128K.

If the SIZE option is omitted, default values are used. These values are established at system generation. In a system with MVT, care must be taken to specify the correct region size based on default $value_1$.

Because the TEST option must be specified, the NE, REUS, RENT, and REFR options cannot be specified. The load module is therefore editable but not reusable or refreshable.

3. This statement is optional. If present, it saves the load module as a member of a partitioned data set (library) on a private direct-access volume. The data set may be new or may already exist; if it exists, the load module replaces any other member of the data set that has the same member name. (If the data set already exists, the DISP parameter can be omitted because DISP=(MOD,PASS) is specified in the cataloged procedure.)

   The load module can be referred to by its member name for subsequent execution as a program or for reprocessing by the linkage editor. The saved load module should not be reprocessed, however, if the reprocessing involves replacing any non-TESTRAN control section with another control section of the same name. Such a control section would continue to be represented by the symbol tables and control dictionaries for the object module to which it originally belonged. Data recorded from this control section would therefore not be printed in the proper symbolic format.

   Statement 3 overrides the DSNAME, UNIT, and DISP parameters of the following statement in the procedure LKED:

```
//SYSLMOD  DD DSNAME=&GOSET(GO),SPACE=(1024,(50,20,1)),
//            UNIT=SYSDA,DISP=(MOD,PASS)
```

   If these parameters are not overridden, they cause the load module to be produced as a member of a temporary data set that is deleted at the end of the job.

4.) These statements define the input to the linkage editor. Statement
5.) 4 defines the primary input, which is a data set containing one or more object modules, or linkage editor control statements, or both.

   Statement 5 is optional. If present, it defines either an included data set or an automatic call library. It can be repeated as necessary to define any number of input data sets.

   Sequentially organized data sets can appear in the input stream. However, in a system with the primary control program, only one data set can appear in the input stream, and it must be defined by the last DD statement for the step LKED.

EXECUTION

Figure 7 defines a job that executes a program for testing by the TESTRAN interpreter. The statements in the figure are numbered, and are explained in the correspondingly numbered paragraphs below. The shaded statements are optional.

```
1. //jobname      JOB  job parameters
2. //JOBLIB       DD   DSNAME=libname,DISP=(OLD,PASS),                    Continue
   //              UNIT=type,VOLUME=(PRIVATE,SER=ser#)
3. //             EXEC PGM=member
4. //ddname       DD   DSNAME=dsname,DISP=(NEW,KEEP),                    Continue
   //              UNIT=type,VOLUME=(PRIVATE,SER=ser#),SPACE=(300,(200,50))
5. //SYSABEND     DD   SYSOUT=A
6. //ddname       DD   data definition parameters
```

Figure 7. Job Control Statements for Execution

1. This statement provides general job control information.

2. This statement is optional. If present, it points to a private load module library that is to be used as the job library. If this library has been cataloged, the UNIT and VOLUME parameters should be omitted.

3. This statement refers to a load module that is a member of either the system link library or the job library.

4. This statement saves the output of the TESTRAN interpreter as a data set on a private magnetic tape or direct-access volume. This data set can subsequently be referred to for processing by the TESTRAN editor. (If the data set is saved on a tape volume, the SPACE parameter can be omitted.)

   The data set contains test information resulting from the execution of a single task. In a system with a primary control program or MFT, there is only one task per job step; only one data set is required, and this statement need appear only once. In a system with MVT, there may be many tasks per job step; this statement must be repeated (with varying ddnames) as many times as necessary to define a separate data set for each task.

   The name of the DD statement for each data set is determined by the first TEST OPEN statement executed under the corresponding task. The TEST OPEN statement either implies the ddname SYSTEST, or specifies a ddname by means of a DDN operand.

5. This statement is optional. If present, it defines a data set to contain an abnormal termination dump. To limit this dump to problem program areas, the ddname SYSABEND can be changed to SYSUDUMP.

6. This statement is optional. If present, it defines a data set that is used by the problem program. It can be repeated as necessary to define any number of data sets.

   Sequentially organized input data sets can appear in the input stream. However, in a system with the primary control program, only one data set can appear in the input stream, and it must be defined by the last DD statement for the job step.

TESTRAN EDITING

Figure 8 defines a job that executes the TESTRAN editor. The statements in the figure are numbered, and are explained in the correspondingly numbered paragraphs below.

```
1. //jobname      JOB  job parameters
2. //             EXEC PROC=TTED
3. //EDIT.SYSTEST DD   DSNAME=dsname,DISP=OLD,                    Continue
   //             UNIT=(type,SEP=SYSUT1),VOLUME=(PRIVATE,SER=ser#)
```

Figure 8. Job Control Statements for TESTRAN Editing

1. This statement provides general job control information.

2. This statement refers to a cataloged procedure named TTED, which defines a single job step named EDIT.

   TESTRAN Editor Options: Three options can be specified by a PARM parameter written as:

   PARM=[*] [Ta] ... [Pb]

   *

   increases the speed of TESTRAN editing by a factor of four. At the same time, it increases main storage requirements from 18K bytes to 50K bytes. If present, it must occupy the first position in the parameter.

   In a system with MVT, the * option should always be specified. The procedure TTED provides a 50K byte region, which is wasted if the option is not specified.

   Ta

   identifies a class of test information that is to be edited. The value a is either an unsigned decimal integer from 1 to 8, a blank, or the letter A. If an integer, it is a class identification number specified by a SELECT keyword operand in one or more TEST OPEN, TEST AT, DUMP, or TRACE statements. If a blank, it indicates that all unclassified data is to be edited. If the letter A, it indicates that all data is to be edited, regardless of classification.

   The subfield Ta can be repeated as many times as necessary to select all desired information for processing during a single execution of the TESTRAN editor. Note that if a class of information is not selected, and has not previously been edited, the input TESTRAN data set should be saved to allow later editing of this information.

   If the subfield Ta is omitted, all information is printed as if TA were specified.

   Pb

   specifies the maximum number of pages to be printed. The value b is an unsigned decimal integer. It must not be greater than the maximum page count established at the installation during system generation.

   If the subfield Pb is omitted, the maximum count is as specified in the first TEST OPEN statement executed under the task that created the data set. If this TEST OPEN statement did not specify a maximum, the installation maximum is assumed.

3. This statement defines the input TESTRAN data set, which contains the test information to be edited.

   If all information is to be edited (rather than just selected classes), the disposition can be changed to DISP=(OLD,DELETE). It is safest, however, to keep the data set until printed output has actually been returned. The data set can then be deleted, if it is on a tape volume, by instructing the operations staff to scratch the tape; if it is on a direct-access volume, it can be deleted by use of the IEHPROGM utility program. For information on how to use IEHPROGM, refer to the publication IBM System/360 Operating System: Utilities.

ASSEMBLY AND LINKAGE EDITING

Figure 9 defines a job that executes the largest assembler and linkage editor available at the installation. The statements in the figure are numbered, and are explained in the correspondingly numbered paragraphs below. The shaded statements are optional.

```
 1. //jobname      JOB  job parameters
 2. //stepname     EXEC PROC=TASME
 3. //ASM.SYSPUNCH DD   DSNAME=dsname,DISP=(NEW,KEEP),                Continue
    //              UNIT=type,VOLUME=(PRIVATE,RETAIN,SER=ser#)
 4. //ASM.SYSGO    DD   SYSOUT=B
 5. //ASM.SYSIN    DD   data definition parameters
 6. //LKED.SYSLIN  DD   DSNAME=*.stepname.ASM.SYSPUNCH,DISP=OLD
 7. //LKED.SYSLMOD DD   DSNAME=libname(member),DISP=(MOD,KEEP),       Continue
    //              UNIT=type,VOLUME=(PRIVATE,SER=ser#)
 8. //LKED.SYSIN   DD   data definition parameters
 9. //LKED.ddname  DD   data definition parameters
```

Figure 9. Job Control Statements for Assembly and Linkage Editing

1. This statement provides general job control information.

2. This statement refers to a cataloged procedure named TASME, which defines two job steps: ASM and LKED.

   Region Size: Region size is the amount of main storage available to a job step that is executed under a system with MVT. The procedure TASME defines region size for the job steps ASM and LKED.

   For the step LKED, the procedure defines region size as 96K, which is the minimum required for the 88K version of linkage editor F. (For the region requirements of other versions, refer to "Linkage Editor Options.") A larger or smaller region can be requested by writing:

   ```
   REGION.LKED=nnnnnK
   ```

   where nnnnn is a one- to five-digit decimal number specifying region size in units of K (1024) bytes.

   Assembler Options: The following assembler options are specified or implied in the cataloged procedure:

   ```
   TEST
   NOLOAD
   DECK
   LIST
   XREF
   LINECNT=standard line count
   ```

   The TEST option is required to cause symbol tables to be included in the object module; the others are standard default options. NOLOAD and DECK indicate that the object module is to be stored on an external storage device. (Refer to paragraphs 3 and 4.) LIST and XREF are diagnostic options useful in program testing.

The default options can be overridden by writing:

```
PARM.ASM=(TEST,overriding options)
```

where the overriding options are any of the following:

```
LOAD
NODECK
NOLIST
NOXREF
LINECNT=nn
```

where nn is an unsigned decimal integer from 1 to 99. Any default option not overridden remains in effect. The TEST option, because it is not a default option, must be explicitly specified.

Linkage Editor Options: The following linkage editor options are specified in the cataloged procedure:

```
TEST
LIST
XREF
NCAL
LET
```

The TEST option is required to cause symbol tables and object module control dictionaries to be included in the load module. LIST and XREF are diagnostic options; NCAL and LET are special processing options that are useful in testing a program.

These options can be respecified by writing:

```
PARM.LKED=(TEST,respecified options)
```

where the respecified options are any of the following:

```
SCTR or OVLY
DC
OL
LIST
XREF or MAP
NCAL
LET or XCAL
SIZE=(value1,value2)
```

Each of the original options (TEST, LIST, XREF, NCAL, and LET) is overridden if it is not respecified. Because the TEST option must be respecified, the NE, REUS, RENT, and REFR options cannot be specified.

The SIZE option improves the performance of the F-level linkage editor by indicating the amount of available main storage ($value_1$), and the size of the text buffer ($value_2$). The possibility of one-pass processing is enhanced if the text buffer is at least as large as the load module to be created.

Minimum $value_2$ is 6K; maximum is 100K. Minimum $value_1$ depends on $value_2$ and on the size of the linkage editor; maximum $value_1$ is 9999K. The following table defines minimum $value_1$, together with the region size required in systems with MVT:

Size of the Linkage Editor	Minimum $value_1$	MVT Region Size
44K	$value_2$+38K	$value_1$+10K
88K	$value_2$+44K[1]	$value_1$+8K
128K	$value_2$+66K[2]	$value_1$+8K

[1]When $value_2$ is less than 44K, minimum $value_1$ is 88K.
[2]When $value_2$ is less than 66K, minimum $value_1$ is 128K.

If the SIZE option is omitted, default values are used. These values are established at system generation. In a system with MVT, care must be taken to specify the correct region size based on default $value_1$.

3. This statement is optional, but, if it is written, statement 6 must also be written. The two statements together save the object module produced by the assembler as a data set on a private magnetic tape or direct-access volume. This data set can later be used as primary or additional input to the linkage editor.

   Statements 3 and 6 override the DSNAME, UNIT, and DISP parameters of the following statements in the procedure TASME:

```
//SYSPUNCH  DD DSNAME=&LOADSET,UNIT=SYSDA,
//               SPACE=(80,(200,50)),DISP=(MOD,PASS)
//SYSLIN    DD DSNAME=&LOADSET,DISP=(OLD,DELETE)
```

   If these parameters are not overridden, they cause the object module to be produced as a temporary data set in direct-access storage. This data set is deleted at the end of the job.

   If statements 3 and 6 are present, statement 5 must appear between them in the sequence. If statement 4 is also present, it must appear between statements 3 and 5.

4. This statement is optional. If present, it produces a copy of the object module as a deck of punched cards. This statement is valid only for the F-level assembler, and is recognized only when LOAD is specified as an overriding option in statement 2.

5. This statement defines the data set that contains the source program to be assembled. This data set can appear in the input stream.

6. Refer to paragraph 3 above.

7. This statement is optional. If present, it saves the load module as a member of a partitioned data set (library) on a private direct-access volume. The data set may be new or may already exist; if it exists, the load module replaces any other member of the data set that has the same member name. (If the data set already exists, the DISP parameter can be omitted because DISP=(MOD,PASS) is specified in the cataloged procedure.)

   The load module can be referred to by its member name for later execution as a program or for reprocessing by the linkage editor. The saved load module should not be reprocessed, however, if the reprocessing involves replacing any non-TESTRAN control section with another control section of the same name. Such a control section

would continue to be represented by the symbol tables and control dictionaries for the object module to which it originally belonged. Data recorded from this control section would therefore not be printed in the proper symbolic format.

Statement 7 overrides the DSNAME, UNIT, and DISP parameters of the following statement in the procedure TASME:

```
//SYSLMOD  DD DSNAME=&GOSET(GO),SPACE=(1024,(50,20,1)),
//            UNIT=SYSDA,DISP=(MOD,PASS)
```

If these parameters are not overridden, they cause the load module to be produced as a member of a temporary data set that is deleted at the end of the job.

8.) These statements are optional. If present, they define input to
9.) the linkage editor.

Statement 8 defines a data set to be concatenated with the primary input to the linkage editor. (The primary input is the object module produced by the assembler; refer to paragraph 6 above.)

Statement 9 defines either an included data set or an automatic call library. It can be repeated as necessary to define any number of input data sets.

Sequentially organized data sets can appear in the input stream. However, in a system with the primary control program, only one data set can appear in the input stream, and it must be defined by the last DD statement for the step LKED.

ASSEMBLY, LINKAGE EDITING, AND EXECUTION

Figure 10 defines a job that executes the largest assembler and linkage editor available at the installation, and the load module produced by the linkage editor. The statements in the figure are numbered, and are explained in correspondingly numbered paragraphs below. The shaded statements are optional.

```
 1. //jobname       JOB  job parameters
 2. //JOBLIB        DD   DSNAME=libname,DISP=(OLD,PASS),                  Continue
    //               UNIT=type,VOLUME=(PRIVATE,SER=ser#)
 3. //stepname      EXEC PROC=TASMEG
 4. //ASM.SYSPUNCH DD   DSNAME=dsname,DISP=(NEW,KEEP),                   Continue
    //               UNIT=type,VOLUME=(PRIVATE,RETAIN,SER=ser#)
 5. //ASM.SYSGO     DD   SYSOUT=B
 6. //ASM.SYSIN     DD   data definition parameters
 7. //LKED.SYSLIN   DD   DSNAME=*.stepname.ASM.SYSPUNCH,DISP=OLD
 8. //LKED.SYSLMOD  DD   DSNAME=libname(member),DISP=(MOD,KEEP),          Continue
    //               UNIT=type,VOLUME=(PRIVATE,SER=ser#)
 9. //LKED.SYSIN    DD   data definition parameters
10. //LKED.ddname   DD   data definition parameters
11. //GO.ddname     DD   DSNAME=dsname,DISP=(NEW,KEEP),                   Continue
    //               UNIT=type,VOLUME=(PRIVATE,SER=ser#),SPACE=(300,(200,50))
12. //GO.SYSABEND   DD   SYSOUT=A
13. //GO.ddname     DD   data definition parameters
```

Figure 10. Job Control Statements for Assembly, Linkage Editing, and Execution

1. This statement provides general job control information.

2. This statement is optional. If present, it points to a private load module library that is to be used as the job library. If this library has been cataloged, the UNIT and VOLUME parameters should be omitted.

3. This statement refers to a cataloged procedure TASMEG that defines three job steps: ASM, LKED, and GO.

   Region Size: Region size is the amount of main storage available to a job step that is executed under a system with MVT. The procedure TASMEG defines the region size of each job step except the problem program job step, GO. For GO, the default region size is assumed.

   For the step LKED, the procedure defines region size as 96K, which is the minimum required for the 88K version of linkage editor F. (For the region requirements of other versions, refer to "Linkage Editor Options.") A larger or smaller region can be requested by writing:

   ```
   REGION.LKED=nnnnnK
   ```

   where nnnnn is a one- to five-digit decimal number specifying region size in units of K (1024) bytes.

   For the job step GO, a region larger than the default region size can be requested by writing:

   ```
   REGION.GO=nnnnnK
   ```

   Assembler Options: The following assembler options are specified or implied in the cataloged procedure:

   ```
   TEST
   NOLOAD
   DECK
   LIST
   XREF
   LINECNT=standard line count
   ```

   The TEST option is required to cause symbol tables to be included in the object module; the others are standard default options. NOLOAD and DECK indicate that the object module is to be stored on an external storage device. (Refer to paragraphs 4 and 5.) LIST and XREF are diagnostic options useful in program testing.

   The default options can be overridden by writing:

   ```
   PARM.ASM=(TEST,overriding options)
   ```

   where the overriding options are any of the following:

   ```
   LOAD
   NODECK
   NOLIST
   NOXREF
   LINECNT=nn
   ```

   where nn is an unsigned decimal integer from 1 to 99. Any default option not overridden remains in effect. The TEST option, because it is not a default option, must be explicitly specified.

Linkage Editor Options: The following linkage editor options are specified in the cataloged procedure:

```
TEST
LIST
XREF
NCAL
LET
```

The TEST option is required to cause symbol tables and object module control dictionaries to be included in the load module. LIST and XREF are diagnostic options; NCAL and LET are special processing options that are useful in testing a program.

These options can be respecified by writing:

```
PARM.LKED=(TEST,respecified options)
```

where the respecified options are any of the following:

```
SCTR or OVLY
DC
OL
LIST
XREF or MAP
NCAL
LET or XCAL
SIZE=(value1,value2)
```

Each of the original options (TEST, LIST, XREF, NCAL, and LET) is overridden if it is not respecified. Because the TEST option must be respecified, the NE, REUS, RENT, and REFR options cannot be specified.

The SIZE option improves the performance of the F-level linkage editor by indicating the amount of available main storage ($value_1$), and the size of the text buffer ($value_2$). The possibility of one-pass processing is enhanced if the text buffer is at least as large as the load module to be created.

Minimum $value_2$ is 6K; maximum is 100K. Minimum $value_1$ depends on $value_2$ and on the size of the linkage editor; maximum $value_1$ is 9999K. The following table defines minimum $value_1$, together with the region size required in systems with MVT:

Size of the Linkage Editor	Minimum $value_1$	MVT Region Size
44K	$value_2$+38K	$value_1$+10K
88K	$value_2$+44K[1]	$value_1$+8K
128K	$value_2$+66K[2]	$value_1$+8K

[1]When $value_2$ is less than 44K, minimum $value_1$ is 88K.
[2]When $value_2$ is less than 66K, minimum $value_1$ is 128K.

If the SIZE option is omitted, default values are used. These values are established at system generation. In a system with MVT, care must be taken to specify the correct region size based on default $value_1$.

Problem Program Information: Information can be passed to the problem program by writing:

```
PARM.GO=(xxx...)
```

where xxx... is the information.

4. This statement is optional, but, if it is written, statement 7 must also be written. The two statements together save the object module produced by the assembler as a data set on a private magnetic tape or direct-access volume. This data set can later be used as primary or additional input to the linkage editor.

   Statements 4 and 7 override the DSNAME, UNIT, and DISP parameters of the following statements in the procedure TASMEG:

```
//SYSPUNCH  DD DSNAME=&LOADSET,UNIT=SYSDA,
//             SPACE=(80,(200,50)),DISP=(MOD,PASS)
//SYSLIN    DD DSNAME=&LOADSET,DISP=(OLD,DELETE)
```

   If these parameters are not overridden, they cause the object module to be produced as a temporary data set in direct-access storage. This data set is deleted at the end of the job.

   If statements 4 and 7 are present, statement 6 must appear between them in the sequence. If statement 5 is also present, it must appear between statements 4 and 6.

5. This statement is optional. If present, it produces a copy of the object module as a deck of punched cards. This statement is valid only for the F-level assembler, and is recognized only when LOAD is specified as an overriding option in statement 3.

6. This statement defines a data set that contains the source program to be assembled. This data set can appear in the input stream.

7. Refer to paragraph 4 above.

8. This statement is optional. If present, it saves the load module as a member of a partitioned data set (library) on a private direct-access volume. The data set may be new or may already exist; if it exists, the load module replaces any other member of the data set that has the same member name. (If the data set already exists, the DISP parameter can be omitted because DISP=(MOD,PASS) is specified in the cataloged procedure.)

   The load module can be referred to by its member name for later execution as a program or for reprocessing by the linkage editor. The saved load module should not be reprocessed, however, if the reprocessing involves replacing any non-TESTRAN control section with another control section of the same name. Such a control section would continue to be represented by the symbol tables and control dictionaries for the object module to which it originally belonged. Data recorded from this control section would therefore not be printed in the proper symbolic format.

   Statement 8 overrides the DSNAME, UNIT, and DISP parameters of the following statement in the procedure TASMEG:

```
//SYSLMOD  DD DSNAME=&GOSET(GO),SPACE=(1024,(50,20,1)),
//            UNIT=SYSDA,DISP=(MOD,PASS)
```

If these parameters are not overridden, they cause the load module to be produced as a member of a temporary data set that is deleted at the end of the job.

9.) These statements are optional. If present, they define input to
10.) the linkage editor.

Statement 9 defines a data set to be concatenated with the primary input to the linkage editor. (The primary input is the object module produced by the assembler; refer to paragraph 7 above.)

Statement 10 defines either an included data set or an automatic call library. It can be repeated as necessary to define any number of input data sets.

Sequentially organized data sets can appear in the input stream. However, in a system with the primary control program, only one data set can appear in the input stream, and it must be defined by the last DD statement for the step LKED.

11. This statement saves the output of the TESTRAN interpreter as a data set on a private magnetic tape or direct-access volume. This data set can subsequently be referred to for processing by the TESTRAN editor. (If the data set is saved on a tape volume, the SPACE parameter can be omitted.)

The data set contains test information resulting from the execution of a single task. In a system with a primary control program or MFT, there is only one task per job step; only one data set is required, and this statement need appear only once. In a system with MVT, there may be many tasks per job step; this statement must be repeated (with varying ddnames) as many times as necessary to define a separate data set for each task.

The name of the DD statement for each data set is determined by the first TEST OPEN statement executed under the corresponding task. The TEST OPEN statement either implies the ddname SYSTEST, or specifies a ddname by means of a DDN operand.

12. This statement is optional. If present, it defines a data set to contain an abnormal termination dump. To limit this dump to problem program areas, the ddname SYSABEND can be changed to SYSUDUMP.

13. This statement is optional. If present, it defines a data set that is used by the problem program. It can be repeated as necessary to define any number of data sets.

Sequentially organized input data sets can appear in the input stream. However, in a system with the primary control program, only one data set can appear in the input stream, and it must be defined by the last DD statement for the step GO.

ASSEMBLY, LINKAGE EDITING, EXECUTION, AND TESTRAN EDITING

Figure 11 defines a job that executes the largest assembler and linkage editor available at the installation, the load module produced by the linkage editor, and the TESTRAN editor. The statements in the figure are numbered, and are explained in the correspondingly numbered paragraphs below. The shaded statements are optional.

```
 1. //jobname       JOB  job parameters
 2. //JOBLIB        DD   DSNAME=libname,DISP=(OLD,PASS),                Continue
    //               UNIT=type,VOLUME=(PRIVATE,SER=ser#)
 3. //stepname      EXEC PROC=TASMEGED,COND.EDIT=EVEN
 4. //ASM.SYSPUNCH DD   DSNAME=dsname,DISP=(NEW,KEEP),                 Continue
    //               UNIT=type,VOLUME=(PRIVATE,RETAIN,SER=ser#)
 5. //ASM.SYSGO     DD   SYSOUT=B
 6. //ASM.SYSIN     DD   data definition parameters
 7. //LKED.SYSLIN   DD   DSNAME=*.stepname.ASM.SYSPUNCH,DISP=OLD
 8. //LKED.SYSLMOD DD   DSNAME=libname(member),DISP=(MOD,KEEP),        Continue
    //               UNIT=type,VOLUME=(PRIVATE,SER=ser#)
 9. //LKED.SYSIN    DD   data definition parameters
10. //LKED.ddname   DD   data definition parameters
11. //GO.ddname     DD   DSNAME=dsname,DISP=(NEW,KEEP),UNIT=type,       Continue
    //               VOLUME=(PRIVATE,RETAIN,SER=ser#),SPACE=(300,(200,50))
12. //GO.SYSABEND   DD   SYSOUT=A
13. //GO.ddname     DD   data definition parameters
14. //EDIT.SYSTEST  DD   DSNAME=*.stepname.GO.ddname,DISP=OLD
15. //             EXEC PROC=TTED,COND=EVEN
16. //EDIT.SYSTEST DD   DSNAME=*.stepname.GO.ddname,DISP=OLD
```

GO

• Figure 11. Job Control Statements for Assembly, Linkage Editing, Execution, and TESTRAN Editing

1. This statement provides general job control information.

2. This statement is optional. If present, it points to a private load module library that is to be used as the job library. If this library has been cataloged, the UNIT and VOLUME parameters should be omitted.

3. This statement refers to a cataloged procedure TASMEGED that defines four job steps: ASM, LKED, GO, and EDIT. The COND parameter specifies that EDIT is to be executed even if a previous job step terminates abnormally. As a result, the output of the TESTRAN interpreter is always edited, even after abnormal termination of the job step that produces the output.

   Region Size: Region size is the amount of main storage available to a job step that is executed under a system with MVT. The procedure TASMEGED defines the region size of each job step except the problem program job step, GO. For GO, the default region size is assumed.

   For the step LKED, the procedure defines region size as 96K, which is the minimum required for the 88K version of linkage editor F. (For the region requirements of other versions, refer to "Linkage Editor Options.") A larger or smaller region can be requested by writing:

   ```
   REGION.LKED=nnnnnK
   ```

   where nnnnn is a one- to five-digit decimal number specifying region size in units of K (1024) bytes.

For the job step GO, a region larger than the default region size can be requested by writing:

```
REGION.GO=nnnnnK
```

Assembler Options: The following assembler options are specified or implied in the cataloged procedure:

```
TEST
NOLOAD
DECK
LIST
XREF
LINECNT=standard line count
```

The TEST option is required to cause symbol tables to be included in the object module; the others are standard default options. NOLOAD and DECK indicate that the object module is to be stored on an external storage device. (Refer to paragraphs 4 and 5.) LIST and XREF are diagnostic options useful in program testing.

The default options can be overridden by writing:

```
PARM.ASM=(TEST,overriding options)
```

where the overriding options are any of the following:

```
LOAD
NODECK
NOLIST
NOXREF
LINECNT=nn
```

where nn is an unsigned decimal integer from 1 to 99. Any default option not overridden remains in effect. The TEST option, because it is not a default option, must be explicitly specified.

Linkage Editor Options: The following linkage editor options are specified in the cataloged procedure:

```
TEST
LIST
XREF
NCAL
LET
```

The TEST option is required to cause symbol tables and object module control dictionaries to be included in the load module. LIST and XREF are diagnostic options; NCAL and LET are special processing options that are useful in testing a program.

These options can be respecified by writing:

PARM.LKED=(TEST,respecified options)

where the respecified options are any of the following:

SCTR or OVLY
DC
OL
LIST
XREF or MAP
NCAL
LET or XCAL
SIZE=($value_1$,$value_2$)

Each of the original options (TEST, LIST, XREF, NCAL, and LET) is overridden if it is not respecified. Because the TEST option must be respecified, the NE, REUS, RENT, and REFR options cannot be specified.

The SIZE option improves the performance of the F-level linkage editor by indicating the amount of available main storage ($value_1$), and the size of the text buffer ($value_2$). The possibility of one-pass processing is enhanced if the text buffer is at least as large as the load module to be created.

Minimum $value_2$ is 6K; maximum is 100K. Minimum $value_1$ depends on $value_2$ and on the size of the linkage editor; maximum $value_1$ is 9999K. The following table defines minimum $value_1$, together with the region size required in systems with MVT:

Size of the Linkage Editor	Minimum $value_1$	MVT Region Size
44K	$value_2$+38K	$value_1$+10K
88K	$value_2$+44K[1]	$value_1$+8K
128K	$value_2$+66K[2]	$value_1$+8K

[1]When $value_2$ is less than 44K, minimum $value_1$ is 88K.
[2]When $value_2$ is less than 66K, minimum $value_1$ is 128K.

If the SIZE option is omitted, default values are used. These values are established at system generation. In a system with MVT, care must be taken to specify the correct region size based on default $value_1$.

Problem Program Information: Information can be passed to the problem program by writing:

PARM.GO=(xxx...)

where xxx... is the information.

TESTRAN Editor Options: Two options can be specified by a PARM parameter written as:

PARM.EDIT=[*] [Ta] ... [Pb]

*
increases the speed of TESTRAN editing by a factor of four. At the same time, it increases main storage requirements from 18K bytes to 50K bytes. If present, it must occupy the first position in the parameter.

In a system with MVT, the * option should always be specified. The procedure TASMEGED provides a 50K byte region, which is wasted if the option is not specified.

Ta

identifies a class of test information that is to be edited. The value a is either an unsigned decimal integer from 1 to 8, a blank, or the letter A. If an integer, it is a class identification number specified by a SELECT keyword operand in one or more TEST OPEN, TEST AT, DUMP or TRACE statements. If a blank, it indicates that all unclassified data is to be edited. If the letter A, it indicates that all data is to be edited, regardless of classification.

The subfield Ta can be repeated as many times as necessary to select all desired information for processing during a single execution of the TESTRAN editor. Note that if a class of information is not selected, and has not previously been edited, the input TESTRAN data set should be saved to allow later editing of this information.

If the subfield Ta is omitted, all information is printed as if TA were specified.

Pb

specifies the maximum number of pages to be printed. The value b is an unsigned decimal integer. It must not be greater than the maximum page count established at the installation during system generation.

If the subfield Pb is omitted, the maximum count is as specified in the first TEST OPEN statement executed under the task that created the data set. If this TEST OPEN statement did not specify a maximum, the installation maximum is assumed.

4. This statement is optional, but, if it is written, statement 7 must also be written. The two statements together save the object module produced by the assembler as a data set on a private magnetic tape or direct-access volume. This data set can later be used as primary or additional input to the linkage editor.

   Statements 4 and 7 override the DSNAME, UNIT, and DISP parameters of the following statements in the procedure TASMEGED:

```
//SYSPUNCH  DD DSNAME=&LOADSET,UNIT=SYSDA,
//             SPACE=(80,(200,50)),DISP=(MOD,PASS)
//SYSLIN    DD DSNAME=&LOADSET,DISP=(OLD,DELETE)
```

   If these parameters are not overridden, they cause the object module to be produced as a temporary data set in direct-access storage. This data set is deleted at the end of the job.

   If statements 4 and 7 are present, statement 6 must appear between them in the sequence. If statement 5 is also present, it must appear between statements 4 and 6.

5. This statement is optional. If present, it produces a copy of the object module as a deck of punched cards. This statement is valid only for the F-level assembler, and is recognized only when LOAD is specified as an overriding option in statement 3.

6. This statement defines a data set that contains the source program to be assembled. This data set can appear in the input stream.

7. Refer to paragraph 4 above.

8. This statement is optional. If present, it saves the load module as a member of a partitioned data set (library) on a private direct-access volume. The data set may be new or may already exist; if it exists, the load module replaces any other member of the data set that has the same member name. (If the data set already exists, the DISP parameter can be omitted because DISP=(MOD,PASS) is specified in the cataloged procedure.)

   The load module can be referred to by its member name for later execution as a program or for reprocessing by the linkage editor. The saved load module should not be reprocessed, however, if the reprocessing involves replacing any non-TESTRAN control section with another control section of the same name. Such a control section would continue to be represented by the symbol tables and control dictionaries for the object module to which it originally belonged. Data recorded from this control section would therefore not be printed in the proper symbolic format.

   Statement 8 overrides the DSNAME, UNIT, and DISP parameters of the following statement in the procedure TASMEGED:

```
//SYSLMOD  DD DSNAME=&GOSET(GO),SPACE=(1024,(50,20,1)),
//            UNIT=SYSDA,DISP=(MOD,PASS)
```

   If these parameters are not overridden, they cause the load module to be produced as a member of a temporary data set that is deleted at the end of the job.

9.) These statements are optional. If present, they define input to
10.) the linkage editor.

   Statement 9 defines a data set to be concatenated with the primary input to the linkage editor. (The primary input is the object module produced by the assembler; refer to paragraph 7 above.)

   Statement 10 defines either an included data set or an automatic call library. It can be repeated as necessary to define any number of input data sets.

   Sequentially organized data sets can appear in the input stream. However, in a system with the primary control program, only one data set can appear in the input stream, and it must be defined by the last DD statement for the step LKED.

11. This statement saves the output of the TESTRAN interpreter as a data set on a private magnetic tape or direct-access volume. This data set can subsequently be referred to for processing by the TESTRAN editor. (If the data set is saved on a tape volume, the SPACE parameter can be omitted.)

   The data set contains test information resulting from the execution of a single task. In a system with a primary control program or MFT, there is only one task per job step; only one data set is required, and this statement need appear only once. In a system with MVT, there may be many tasks per job step; this statement must be repeated (with varying ddnames) as many times as necessary to define a separate data set for each task.

The name of the DD statement for each data set is determined by the first TEST OPEN statement executed under the corresponding task. The TEST OPEN statement either implies the ddname SYSTEST, or specifies a ddname by means of a DDN operand.

If SYSTEST is specified or implied as a ddname, the SYSTEST DD statement is optional. If present, this statement must precede all other DD statements for the job step GO, and should be written as:

```
//GO.SYSTEST   DD DSNAME=dsname,DISP=(NEW,KEEP),
//             UNIT=type,VOLUME=(PRIVATE,RETAIN,SER=ser#)
```

This statement overrides the DSNAME, UNIT, and DISP parameters of the following statement in the procedure TASMEGED:

```
//SYSTEST  DD DSNAME=&TESTSET,SPACE=(300,(200,50)),
//            UNIT=SYSSQ,DISP=(NEW,PASS)
```

If these parameters are not overridden, they define a temporary data set that is either on magnetic tape or in direct-access storage. This data set is deleted at the end of the job.

12. This statement is optional. If present, it defines a data set to contain an abnormal termination dump. To limit this dump to problem program areas, the ddname SYSABEND can be changed to SYSUDUMP.

13. This statement is optional. If present, it defines a data set that is used by the problem program. It can be repeated as necessary to define any number of data sets.

    Sequentially organized input data sets can appear in the input stream. However, in a system with the primary control program, only one data set can appear in the input stream, and it must be defined by the last DD statement for the step GO.

14. This statement points to a TESTRAN data set that contains TESTRAN interpreter output to be processed by the TESTRAN editor. It should be present if:

    - Statement 11 overrides the statement SYSTEST in the cataloged procedure, or
    - SYSTEST is not specified or implied as a ddname in a TEST OPEN statement.

    Otherwise, statement 14 should be omitted, because it overrides the DSNAME and DISP parameters of the following statement in the procedure TASMEGED:

```
//SYSTEST DD DSNAME=&TESTSET,UNIT=SYSSQ,SEP=SYSUT1,
//           DISP=(OLD,DELETE)
```

    If these parameters are not overridden, they refer to a temporary data set that is created by the TESTRAN interpreter, processed by the TESTRAN editor, and deleted at the end of the job.

Statement 14 can be written only once. Any data set that is defined by statement 11 but is not referred to by statement 14 cannot be edited under the procedure TASMEGED. Such a data set can be edited under another procedure, TTED, which is invoked by writing two optional statements, 15 and 16.

If all of the information in a data set is to be edited (rather than just selected classes), the disposition in statement 14 can be changed to DISP=(OLD,DELETE). It is safest, however, to keep the data set until printed output has actually been returned. The data set can then be deleted, if it is on a tape volume, by instructing the operations staff to scratch the tape; if it is on a direct-access volume, it can be deleted by use of the IEHPROGM utility program. For information on how to use IEHPROGM, refer to the publication IBM System/360 Operating System: Utilities.

15.) These statements are optional. If present, they define a job step
16.) that edits a TESTRAN data set defined by statement 11 but not referred to by statement 14. The two statements together can be repeated to define a number of job steps equal to the number of data sets that are to be edited.

Statement 15 refers to a cataloged procedure named TTED, which defines a job step named EDIT. The COND parameter specifies that this step is to be executed even if a previous step terminates abnormally. TESTRAN editor options can be specified as in statement 3.

Statement 16 points to the TESTRAN data set that is to be edited.

SECTION 4: HOW TO INTERPRET SYSTEM OUTPUT

Every TESTRAN job produces system output that includes listings of job control statements and of certain data sets. The control statements include both those in the input stream and those in cataloged procedures that are invoked in the input stream. The data sets are those to which the job control statements assign a SYSOUT disposition.

Typical system output data sets are abnormal termination dumps and the listings produced by the assembler, the linkage editor, and the TESTRAN editor. This section describes only the last listing; the others are described in the publications:

IBM System/360 Operating System: Programmer's Guide to Debugging

IBM System/360 Operating System: Assembler (E) Programmer's Guide

IBM System/360 Operating System: Assembler (F) Programmer's Guide

IBM System/360 Operating System: Linkage Editor

Interpreting a TESTRAN Listing: Test information is printed on the system output device in a column 120 characters wide. Each page includes a standard page heading and an average of 55 lines of information produced by one or more TESTRAN statements. The general format of a page is shown by the sample page in Figure 12.

The circled numbers in Figure 12 distinguish five basic formats for individual lines of print. These are as follows:

1. ...TESTRAN OUTPUT... heads each page.
2. AT LOCATION... indicates entry to the TESTRAN interpreter at a test point.
3. ...MACRO ID... indicates one of the following:
   - Execution of a DUMP, TRACE, TEST OPEN, or TEST CLOSE statement.
   - Output resulting from an executed TRACE statement.
   - Detection of an error following execution of a statement.
4. EXECUTED STATEMENTS,... traces execution of GO, SET, TEST ON, and TEST WHEN statements.
5. *** IEGE... indicates a diagnostic message from the TESTRAN editor.

Each of these formats is described in detail in the remainder of this section.

The printing formats for specific types of data are shown in Table 1. The letters used to represent printing formats in the table are used with the same meanings throughout the remainder of this section. In addition, the letter y is used to designate a printed character for which the data type is variable.

```
(1)  JOB1                          TESTRAN OUTPUT              DATE 10/164              TIME 10/04          PAGE    1

(3) 1) MACRO ID 000, TEST OPEN    , TESTRAN CONTROL SECTION = BEGIN    , IDENTIFICATION JOB1

(2) AT LOCATION          (SYMALTER) 0000EC 0100EC ENTER BEGIN

(4) EXECUTED STATEMENTS, BEGIN     003

(3) 2) MACRO ID 005, DUMP DATA    STARTING IN SECTION SYMALTER
      0154      INAREA
    010154      COMEBACK MVC    WRITAREA(88),ENTER       CLEAR BUFFER FOR NEXT CARD          0003

(3) 4) MACRO ID 006, DUMP PANEL
    G'04' 00010154 G'08' 000100FC
    PSW  00 0 1 0002 0 0 01008C  CC=0  FIX POINT OVERFLOW OFF  DEC OVERFLOW OFF  EXP UNDERFLOW OFF  SIGNIFICANCE OFF

(4) EXECUTED STATEMENTS, BEGIN     007, 008

(3) 1) MACRO ID 014, DUMP DATA    STARTING IN SECTION SYMALTER
      00F8      ERRFLAG     STARTIN     STARTO
    0100F8       *

(2) AT LOCATION RETURN1 (SYMALTER) 0000DA 0100DA ENTER BEGIN

(4) EXECUTED STATEMENTS, BEGIN     010

(3) 3) MACRO ID 012, DUMP DATA    STARTING IN SECTION SYMALTER
      00FC      OUTAREA
    0100FC      COMEBACK MVC    WRITAREA(88),ENTER       CLEAR BUFFER FOR NEXT CARD          0003

(4) EXECUTED STATEMENTS, BEGIN     013

(3) 1) MACRO ID 014, DUMP DATA    STARTING IN SECTION SYMALTER
      00F8      ERRFLAG     STARTIN     STARTO
    0100F8       *           1

(5) ***  IEGE07  END OF TESTRAN EDIT--0000005 STATEMENTS PROCESSE
```

Figure 12. TESTRAN Editor Listing: Sample Page

Table 1. Printing Formats for Data Types

Data Type	Assumed Length in Bytes (1)	Printing Format (2)
Character (3)	1	c
Hexadecimal	1	xx
Binary	1	bbbbbbbb
Fixed-point (half-word)	2	sddddd (4)
Fixed-point (full-word)	4	sddddddddd (4)
Short floating-point	4	s0.dddddddd Esdd
Long floating-point	8	s0.ddddddddddddddd Esdd
Packed decimal	1	sd
Zoned decimal	1	sd
Address (5)		
Instruction:		
RR format	2	cccc xx
RS, RX, and SI formats	4	cccc xx x xxx
SS format	6	cccc xx x xxx x xxx

Notes to Table 1

1. The lengths assumed in definitions of printing formats are the assembler implied lengths for the corresponding data types. (Refer to Appendix A, Table 5.)

2. The letters shown in definitions of printing formats have the following meanings:

   c is one EBCDIC character.
   x is one hexadecimal digit.
   b is one binary digit.
   s is an algebraic sign (+ or -).
   d is one decimal digit.
   0 is a high order zero.
   E means 'exponent'; the succeeding signed pair of digits is the exponent of the floating-point number.
   cccc is a machine mnemonic operation code.

3. Unprintable characters (other than blanks) are printed as two hexadecimal digits, the second of which appears on a separate line immediately below the first. For example, the hexadecimal data

   C1D3D7C8C103C4C1E3C1

   when edited into character format, is printed as

   ALPHA0DATA
        3

4. This format includes a decimal point that is positioned according to the scale factor associated with the data.

5. All addresses are printed in their source language formats.

PAGE HEADING (...TESTRAN OUTPUT...)

The following heading is printed at the top of each page:

```
cccccccc          TESTRAN OUTPUT          DATE dd/ddd          TIME dd/dd          PAGE dddd
```

cccccccc
is the output identification specified as the third positional operand of the first-executed TEST OPEN statement.

DATE dd/ddd
is the current date (year/day).

TIME dd/dd
is the time (hour/minute) at which editing was begun.

PAGE dddd
is the output page number.

TEST POINT IDENTIFICATION (AT LOCATION...)

The following line indicates entry to the TESTRAN interpreter at a test point:

```
AT LOCATION cccccccc(cccccccc) xxxxxx xxxxxx  ENTER  cccccccc
```

AT LOCATION cccccccc(cccccccc) xxxxxx xxxxxx
identifies the test point. The field cccccccc(cccccccc) identifies the test point by name (if any), and by name (if any) of the control section that contains the test point. The fields xxxxxx xxxxxx are the assembled and loaded addresses of the test point.

ENTER cccccccc
identifies the TESTRAN control section in which the test point was specified. (The control section is defined by an identically named TEST OPEN statement, as indicated in the assembly listing by message number IEGM04.)

Note: The SELECT operand does not affect printing of the AT LOCATION line. This line is omitted, however, if it is not followed by the output of a DUMP or TRACE statement, or by an error message.

STATEMENT OUTPUT (...MACRO ID...)

Statement output is all output that is identified by "MACRO ID". It includes TEST OPEN, TEST CLOSE, DUMP and TRACE statement output, and error messages issued by the TESTRAN interpreter. Specific types of statement output are described below.

DUMP CHANGES OUTPUT

DUMP CHANGES output is a change dump of main storage whose format is the same as that described below under "DUMP DATA Output."

DUMP COMMENT OUTPUT

The following lines are a dump of a programmer-written comment.

```
d) MACRO ID ddd, DUMP COMMENT
ccccc...
```

d)
is the class number assigned to the dump by a SELECT operand.

MACRO ID ddd, DUMP COMMENT
identifies the statement responsible for the dump. The identification number ddd is assigned by the assembler, and appears with the statement in the assembly listing (message number IEGM09).

ccccc...
is the dumped comment, which has a maximum length of 120 characters.

DUMP DATA OUTPUT

The following lines are a dump of main storage:

```
d) MACRO ID ddd, DUMP DATA    STARTING IN SECTION cccccccc
  xxxx     cccccccc          cccccccc          cccccccc
xxxxxx     yyyyyyyyyyyyy... yyyyyyyyyyyyy... yyyyyyyyyyyyy...
```

d)
is the class number assigned to the dump by a SELECT operand.

MACRO ID ddd, DUMP CHANGES
identifies the statement responsible for the dump. The identification number ddd is assigned by the assembler, and appears with the statement in the assembly listing (message number IEGM09).

STARTING IN SECTION cccccccc
identifies the control section that contains the dumped data.

xxxx
xxxxxx
are the assembled and loaded addresses of a dumped field. The field is the first field printed to the right of these addresses.

cccccccc
yyyyyyyyyyyyy...
are the symbolic name (if any) and contents of a dumped field. The name and format of the field are as defined in the problem program, or as specified by NAME and DATAM operands.

Note: The number of named fields per line varies from one to eleven due to differences in length; the starting positions are a minimum of nine printing positions apart. Fields too long for the current line are started on a new line.

In a dump of an instruction sequence, an instruction may be printed with the instruction SVC 26 immediately beneath it. If so, the instruction is located at a test point; the SVC instruction is the means by which the test point gives control to the TESTRAN interpreter. The SVC instruction replaced the original instruction when the test point was established; the original instruction was saved for execution on return of control to the test point.

DUMP MAP OUTPUT

The following lines are a map of control sections and allocated storage areas associated with a task that is active when a DUMP MAP statement is executed.

```
d) MACRO ID ddd, DUMP MAP

     NAME          TYPE              CSECT NAME   ASSEMBLED AT   LOADED AT   LENGTH-DEC   HEX

     cccccccc      LOADED PROGRAM    cccccccc     xxxxxx         xxxxxx      dddd         xxx
                   OBTAINED STORAGE                              xxxxxx      dddd         xxx
```

d)
is the class number assigned to the dump by a SELECT operand.

MACRO ID ddd, DUMP MAP
identifies the statement responsible for the dump. The identification number ddd is assigned by the assembler, and appears with the statement in the assembly listing (message number IEGM09).

NAME
is a column heading. The column identifies each program (load module) associated with the active task. Each program is represented by one line of print for each of its control sections. In a given line, the name cccccccc of a program is printed only if different from the name that applies to the previous line.

TYPE
is a column heading. The column indicates the type of storage area that is represented. LOADED PROGRAM indicates a control section for which storage was reserved during assembly. OBTAINED STORAGE indicates an allocated storage area.

CSECT NAME
is a column heading. The column identifies each control section of each program associated with the active task.

ASSEMBLED AT
is a column heading. The column contains the assembled address of each control section named in the dump.

LOADED AT
is a column heading. The column contains the loaded address of each control section named in the dump. It also contains the address of each allocated storage area.

LENGTH-DEC HEX
is a double column heading. The double column defines the decimal and hexadecimal length of each control section and allocated storage area.

Note: Some of the areas included in the dump will be areas allocated for use by the operating system.

DUMP PANEL OUTPUT

The following lines are a dump of registers and the program status word.

```
d) MACRO ID ddd, DUMP PANEL
G'dd' xxxxxxxx G'dd' xxxxxxxx G'dd' xxxxxxxx G'dd' xxxxxxxx G'dd' xxxxxxxx G'dd' xxxxxxxx G'dd' xxxxxxxx G'dd' xxxxxxxx
G'dd' xxxxxxxx G'dd' xxxxxxxx G'dd' xxxxxxxx G'dd' xxxxxxxx G'dd' xxxxxxxx G'dd' xxxxxxxx G'dd' xxxxxxxx G'dd' xxxxxxxx
PSW  xx x x xxxx x x xxxxxx  CC=d  FIX POINT OVERFLOW ccc  DEC OVERFLOW ccc  EXP UNDERFLOW ccc  SIGNIFICANCE ccc
  F'dd' xxxxxxxx xxxxxxxx F'dd' xxxxxxxx xxxxxxxx F'dd' xxxxxxxx xxxxxxxx F'dd' xxxxxxxx xxxxxxxx
```

d)
is the class number assigned to the dump by a SELECT operand.

MACRO ID ddd, DUMP PANEL
identifies the statement responsible for the dump. The identification number ddd is assigned by the assembler, and appears with the statement in the assembly listing (message number IEGM09).

G'dd' xxxxxxxx
is the number (dd) and contents (xxxxxxxx) of a dumped general register. The contents of the register are either in hexadecimal format as shown, or in some other format as specified by a DATAM operand.

PSW xx x xxxx x x xxxxxx
is the program status word (PSW) stored on interruption of the problem program at the current test point.

CC=d
specifies the value of the condition code (bits 34 and 35 of the program status word).

FIX POINT OVERFLOW ccc
specifies the status of the fixed-point overflow mask (bit 36 of the program status word). The status ccc is either ON or OFF.

DEC OVERFLOW ccc
specifies the status of the decimal overflow mask (bit 37 of the program status word). The status ccc is either ON or OFF.

EXP UNDERFLOW ccc
specifies the status of the exponent underflow mask (bit 38 of the program status word). The status ccc is either ON or OFF.

SIGNIFICANCE ccc
specifies the status of the significance mask (bit 39 of the program status word). The status ccc is either ON or OFF.

F'dd' xxxxxxxx xxxxxxxx
is the number (dd) and contents (xxxxxxxx xxxxxxxx) of a dumped floating-point register. The contents of the register are either in hexadecimal format as shown, or in some other format as specified by a DATAM operand.

DUMP TABLE OUTPUT

The following lines are a dump of a system table (control block).

```
d) MACRO ID ddd, DUMP TABLE  cccc cccccc BLOCK  LOADED AT cccccccc(cccccccc) xxxxxx xxxxxx
   SECTION    FIELD NAME   CONTENTS
   cccccccc
              cccccccc   yyyyy...
```

d)
is the class number assigned to the dump by a SELECT operand.

MACRO ID ddd, DUMP TABLE
identifies the statement responsible for the dump. The identification number ddd is assigned by the assembler, and appears with the statement in the assembly listing (message number IEGM09).

cccc ccccccc BLOCK
identifies the dumped table as a task control block, data control block, or data extent block.

LOADED AT cccccccc(cccccccc) xxxxxx xxxxxx
specifies the location of a task control block or data control block. The field cccccccc(cccccccc) specifies the name (if any) of a data control block and the name (if any) of the control section that contains the data control block. A single field xxxxxx specifies the address of a task control block; two fields xxxxxx xxxxxx specify both the assembled and loaded addresses of a data control block.

SECTION
is a column heading. The column identifies major sections of the table.

FIELD NAME
is a column heading. The column identifies fields within major sections of the table.

CONTENTS
is a column heading. The column defines the contents of each field.

ERROR MESSAGE

The following lines indicate detection of an error during execution of a TESTRAN statement.

```
d) MACRO ID ddd, ERROR
***  IEGIdd ccccc...
```

d)
is a class number assigned by a SELECT operand.

MACRO ID ddd, ERROR
identifies the statement that caused or detected the error. The identification number ddd is assigned by the assembler and appears with the statement in the assembly listing (message number IEGM09).

*** IEGIdd ccccc...
is an error message issued by the TESTRAN interpreter. The text of the message (ccccc...) is preceded by a standard system message code (IEGIdd). For an explanation of the message, refer to Appendix C, where all messages issued by the interpreter are listed in order by message code.

TEST CLOSE OUTPUT

The following lines indicate the execution of a TEST CLOSE statement.

```
d) MACRO ID ddd, TEST CLOSE
cccccccc(cccccccc) xxxxxx xxxxxx ...
```

d)
is the class number specified by the SELECT operand (if any) of a TEST OPEN statement.

MACRO ID ddd, TEST CLOSE
identifies the TEST CLOSE statement. The identification number ddd is assigned by the assembler and appears with the statement in the assembly listing (message number IEGM09).

cccccccc(cccccccc) xxxxxx xxxxxx
identifies a TESTRAN control section closed by the TEST CLOSE statement. The field cccccccc(cccccccc) contains a symbol generated during assembly and the name of the TESTRAN control section. The fields xxxxxx xxxxxx are the assembled and loaded addresses of the control section. (The control section is defined by an identically named TEST OPEN statement, as indicated in the assembly listing by message number IEGM04.)

Note: The SELECT operand does not affect the printing of these lines of information.

TEST OPEN OUTPUT

The following lines indicate the execution of a TEST OPEN statement.

```
d) MACRO ID ddd, TEST OPEN   , TESTRAN CONTROL SECTION = cccccccc, IDENTIFICATION cccccccc
 MAXIMUM NUMBER OF PAGES ddd, MAXIMUM NUMBER OF STATEMENTS ddd
```

d)
is the class number specified by the SELECT operand (if any) of the TEST OPEN statement.

MACRO ID ddd, TEST OPEN , TESTRAN CONTROL SECTION = cccccccc
identifies the TEST OPEN statement. The identification number ddd is assigned by the assembler and appears with the statement in the assembly listing (message number IEGM09). The name of the TESTRAN control section (cccccccc) is also the name of the TEST OPEN statement. (The control section is defined by the TEST OPEN statement, as indicated in the assembly listing by message number IEGM04.)

IDENTIFICATION cccccccc
specifies the output identification as provided by the third positional operand of the TEST OPEN statement.

MAXIMUM NUMBER OF PAGES ddd
specifies the maximum number of pages produced.

MAXIMUM NUMBER OF STATEMENTS ddd
specifies the maximum number of executed TESTRAN statements.

Note: The SELECT operand does not affect the printing of these lines of information.

TRACE CALL OUTPUT

The following groups of lines indicate the execution of a TRACE CALL statement and the later execution of a CALL macro-instruction.

```
d) MACRO ID ddd, TRACE CALL  , cccccccc, FROM cccccccc(cccccccc) xxxxxx xxxxxx TO cccccccc(cccccccc) xxxxxx xxxxxx
STARTED
ccccc...
```

```
d) MACRO ID ddd, TRACE CALL  , cccccccc, TO cccccccc(cccccccc) xxxxxx xxxxxx AT cccccccc(cccccccc) xxxxxx xxxxxx
G'dd' xxxxxxxx ...
G'dd' xxxxxxxx ...
ccccc...
```

d)
is the class number assigned to the trace by a SELECT operand.

MACRO ID ddd, TRACE CALL , cccccccc,
identifies the statement responsible for the trace. The identification number ddd is assigned by the assembler, and appears with the statement in the assembly listing (message number IEGM09). The field cccccccc is the name of the TESTRAN control section to which the statement belongs. (The control section is defined by an identically named TEST OPEN statement, as indicated in the assembly listing by message number IEGM04.)

FROM cccccccc(cccccccc) xxxxxx xxxxxx TO cccccccc(cccccccc) xxxxxx xxxxxx
defines the trace area. FROM cccccccc(cccccccc) specifies the name (if any) of the leftmost byte of the area and the name (if any) of the control section to which it belongs. TO cccccccc(cccccccc) gives the same information for the rightmost byte plus one. The fields xxxxxx xxxxxx are the corresponding assembled and loaded addresses.

TO cccccccc(cccccccc) xxxxxx xxxxxx AT cccccccc(cccccccc) xxxxxx xxxxxx
identifies a called subroutine and the calling macro-instruction. TO cccccccc(cccccccc) specifies the name (if any) of the subroutine entry point, and the name (if any) of the control section that contains the entry point. FROM cccccccc(cccccccc) specifies the name (if any) of the CALL macro-instruction and the name (if any) of the control section that contains the CALL macro-instruction. The fields xxxxxx xxxxxx are the corresponding assembled and loaded addresses.

G'dd' xxxxxxxx
gives the number (dd) and contents (xxxxxxxx) of a general register used by the CALL macro-instruction.

ccccc...
is a comment specified by a COMMENT operand (if any) in the TRACE CALL statement. The maximum length is 120 characters.

TRACE FLOW OUTPUT

The following groups of lines indicate the execution of a TRACE FLOW statement and the later execution of a branch or SVC instruction.

```
d) MACRO ID ddd, TRACE FLOW  , cccccccc, FROM cccccccc(cccccccc) xxxxxx xxxxxx TO cccccccc(cccccccc) xxxxxx xxxxxx
STARTED
ccccc...
```

```
d) MACRO ID ddd, TRACE FLOW  , cccccccc, FROM cccccccc(cccccccc) xxxxxx xxxxxx TO cccccccc(cccccccc) xxxxxx xxxxxx, CC=d
cccc xx x xxx        G'dd' xxxxxxxx ...
ccccc...
```

```
d) MACRO ID ddd, TRACE FLOW  , cccccccc, FROM cccccccc(cccccccc) xxxxxx xxxxxx TO cccccccc(cccccccc) xxxxxx xxxxxx, CC=d
cccc xx x xxx        EXECUTED AS cccc xx x xxx      BY EX   xx x xxx FROM LOCATION cccccccc(cccccccc) xxxxxx xxxxxx
G'dd' xxxxxxxx ...
ccccc...
```

d)
is the class number assigned to the trace by a SELECT operand.

MACRO ID ddd, TRACE FLOW , cccccccc,
identifies the statement responsible for the trace. The identification number ddd is assigned by the assembler and appears with the statement in the assembly listing (message number IEGM09). The field cccccccc is the name of the TESTRAN control section to which the statement belongs. (The control section is defined by an identically named TEST OPEN statement, as indicated in the assembly listing by message number IEGM04.)

FROM cccccccc(cccccccc) xxxxxx xxxxxx TO cccccccc(cccccccc) xxxxxx xxxxxx
either (1) defines the trace area, or (2) identifies an executed branch or SVC instruction and the branch destination:

1. FROM cccccccc(cccccccc) specifies the name (if any) of the leftmost byte of the trace area, and the name (if any) of the control section to which it belongs. TO cccccccc(cccccccc) gives the same information for the rightmost byte plus one. The fields xxxxxx xxxxxx are the corresponding assembled and loaded addresses.

2. FROM cccccccc(cccccccc) specifies the name (if any) of an executed branch or SVC instruction, and the name (if any) of the control section that contains the instruction. TO cccccccc(cccccccc) specifies the name (if any) of the branch destination, and the name (if any) of the control section that contains the destination. The fields xxxxxx xxxxxx are the corresponding assembled and loaded addresses.

CC=d
specifies the value of the condition code when the branch or SVC instruction is executed.

cccc xx x xxx
is the branch or SVC instruction. (If an RR-type instruction, it is printed as cccc xx.)

EXECUTED AS cccc xx x xxx BY EX xx x xxx
indicates execution of a branch or SVC instruction by an EX instruction (EX xx x xxx). The instruction as executed is cccc xx x xxx (or cccc xx if it is an RR-type instruction). The effective values of bits 8-15 are shown.

FROM LOCATION cccccccc(cccccccc) xxxxxx xxxxxx
specifies the location of the EX instruction. The field cccccccc(cccccccc) specifies the name (if any) of the EX instruction and the name (if any) of the control section that contains the instruction. The fields xxxxxx xxxxxx are the assembled and loaded addresses of the EX instruction.

G'dd' xxxxxxxx
gives the number (dd) and contents (xxxxxxxx) of a general register used by a branch or EX instruction.

ccccc...
is a comment specified by a COMMENT operand (if any) in the TRACE FLOW statement. The maximum length is 120 characters.

TRACE REFER OUTPUT

The following groups of lines indicate the execution of a TRACE REFER statement and the later execution of a reference to data.

```
d) MACRO ID ddd, TRACE REFER , cccccccc, FROM cccccccc(cccccccc) xxxxxx xxxxxx TO cccccccc(cccccccc) xxxxxx xxxxxx
STARTED
ccccc...
```

```
d) MACRO ID ddd, TRACE REFER , cccccccc, TO cccccccc(cccccccc) xxxxxx xxxxxx FROM cccccccc(cccccccc) xxxxxx xxxxxx
cccc xx x xxx x xxx  G'dd' xxxxxxxx ...
ccccc...
 BEFORE  yyyyy...                                    AFTER   yyyyy...
```

```
d) MACRO ID ddd, TRACE REFER , cccccccc, TO cccccccc(cccccccc) xxxxxx xxxxxx FROM cccccccc(cccccccc) xxxxxx xxxxxx
cccc xx x xxx x xxx EXECUTED AS cccc xx x xxx x xxx BY EX   xx x xxx FROM LOCATION cccccccc(cccccccc) xxxxxx xxxxxx
G'dd' xxxxxxxx ...
ccccc...
 BEFORE  yyyyy...                                    AFTER   yyyyy...
```

d)
is the class number assigned to the trace by a SELECT operand.

MACRO ID ddd, TRACE REFER , cccccccc,
identifies the statement responsible for the trace. The identification number ddd is assigned by the assembler and appears with the statement in the assembly listing (message number IEGM09). The field cccccccc is the name of the TESTRAN control section to which the statement belongs. (The control section is defined by an identically named TEST OPEN statement, as indicated in the assembly listing by message number IEGM04.)

FROM cccccccc(cccccccc) xxxxxx xxxxxx TO cccccccc(cccccccc) xxxxxx xxxxxx
defines the trace area. FROM cccccccc(cccccccc) specifies the name (if any) of the leftmost byte of the area and the name (if any) of the control section to which it belongs. TO cccccccc(cccccccc) gives the same information for the rightmost byte plus one. The fields xxxxxx xxxxxx are the corresponding assembled and loaded addresses.

TO cccccccc(cccccccc) xxxxxx xxxxxx FROM cccccccc(cccccccc) xxxxxx xxxxxx
identifies a field to which a reference is made and the instruction making the reference. TO cccccccc(cccccccc) specifies the name (if any) of the field and the name (if any) of the control section that contains the field. FROM cccccccc(cccccccc) specifies the name (if any) of the instruction making the reference and the name (if any) of the control section that contains the instruction. The fields xxxxxx xxxxxx are the corresponding assembled and loaded addresses.

cccc xx x xxx x xxx
is the instruction making the reference. (If an RS-, RX-, or SI-type instruction, it is printed as cccc xx x xxx.)

EXECUTED AS cccc xx x xxx x xxx BY EX xx x xxx
indicates that the instruction making the reference is executed by an EX instruction (EX xx x xxx). The instruction as executed is cccc xx x xxx x xxx (or cccc xx x xxx if it is an RS-, RX-, or SI-type instruction). The effective values of bits 8-15 are shown.

FROM LOCATION cccccccc(cccccccc) xxxxxx xxxxxx
specifies the location of the EX instruction. The field cccccccc(cccccccc) specifies the name (if any) of the control section that contains the instruction. The fields xxxxxx xxxxxx are the assembled and loaded addresses of the EX instruction.

G'dd' xxxxxxxx
gives the number (dd) and contents (xxxxxxxx) of a general register used by the instruction making the reference, or by an EX instruction.

ccccc...
is a comment specified by a COMMENT operand (if any) in the TRACE REFER statement. The maximum length is 120 characters.

BEFORE yyyyy...
specifies the contents of the field before the reference.

AFTER yyyyy...
specifies the contents of the field after the reference.

TRACE STOP OUTPUT

The following line indicates execution of a TRACE STOP statement.

```
d) MACRO ID ddd, TRACE STOP  cccccccc ddd, ddd, ..., cccccccc ddd, ddd, ...
```

d)
is the class number assigned by a SELECT operand.

MACRO ID ddd, TRACE STOP
identifies the TRACE STOP statement. The identification number ddd is assigned by the assembler and appears with the statement in the assembly listing (message number IEGM09).

cccccccc ddd, ddd,...
identifies TRACE statements referred to by the TRACE STOP statement. Each number ddd is the identification number of a TRACE statement in a TESTRAN control section cccccccc. Each identification number is assigned by the assembler and appears with a statement in the

assembly listing (message number IEGM09). Each TESTRAN control section is defined by an identically named TEST OPEN statement (message number IEGM04).

Note: If the TRACE STOP statement does not refer to other statements by name, the word ALL is printed to indicate that all traces are stopped.

TESTRAN STATEMENT TRACE (EXECUTED STATEMENTS...)

The following line traces execution of GO, SET, TEST ON, and TEST WHEN statements.

```
EXECUTED STATEMENTS, cccccccc ddd, ddd, ..., cccccccc ddd, ddd, ...
```

cccccccc ddd, ddd,...
identifies the executed statements. Each number ddd is the identification number of a statement in a TESTRAN control section named cccccccc. Each identification number is assigned by the assembler and appears with a statement in the assembly listing (message number IEGM09). Each TESTRAN control section is defined by an identically named TEST OPEN statement (message number IEGM04).

Note: This line is printed only if followed by the output of a DUMP or TRACE statement, or by an error message. The number of statements identified is limited to 28: the first 27 statements that are executed and the last statement that is executed before other output is generated.

TESTRAN EDITOR MESSAGE (*** IEGE...)

The following line is a diagnostic message issued by the TESTRAN editor.

```
*** IEGEdd ccccc...
```

IEGEdd
is a message code that identifies the message.

ccccc...
is the message text. For an explanation of the text, refer to Appendix C, which lists all messages in order by message code.

This appendix formally describes the function and format of TESTRAN statements.

CODING CONVENTIONS

TESTRAN statements are coded according to the coding conventions for assembler language macro-instructions. These conventions are described in the publication IBM System/360 Operating System: Assembler Language. They should be familiar to the reader who has experience in writing his own macro-instructions or in using those defined by the system for requesting supervisor and data management services.

The coding of macro-instructions differs in two ways from the coding of machine instructions:

1. There is no limit to the number of continuation lines that can be used.
2. There is a wider variety of operands.

For the reader who has no experience with macro-instructions, the following brief description of the operand field may be helpful.

The Operand Field: As in a machine instruction, the operand field consists of individual operands that are separated by commas. The meaning of each operand either is implied by its position in the field or is expressed by a keyword that is part of the operand itself. For example, the three statements

```
DUMP DATA,CHANGES,DATAM=L8,SELECT=1
DUMP DATA,CHANGES,SELECT=1,DATAM=L8
DUMP CHANGES,DATA,SELECT=1,DATAM=L8
```

each contain two positional operands followed by two keyword operands. Because the position of a keyword operand is unimportant, the first two statements are functionally equivalent; they are not equivalent to the third statement, which differs in its first and second (positional) operands.

Some operands are optional: they can be written or omitted as the programmer chooses. If a positional operand is omitted, it must be represented by a comma if it precedes a positional operand that is not omitted. In the statement

```
TEST ON,,,2,EVEN
```

the second and third operands are omitted and each is represented by a comma. An omitted positional operand is not represented by a comma if it is not followed by a positional operand that is actually written. An omitted keyword operand is never represented by a comma.

To allow the use of commas within an operand, a positional operand or the right-hand part of a keyword operand can sometimes be enclosed in parentheses. Within the parentheses, commas separate individual items of information, which together are called a sublist. In the statements

```
T1 TRACE STOP,(TRACE#1,TRACE#2,TRACE#3)
D1 DUMP DATA,INPUT,INPUT+80,DSECT=(INPUT,3)
```

the second (positional) operand of T1 is a sublist of three items, and the DSECT keyword operand in D1 contains a sublist of two items. The number of items in a sublist is variable; the programmer specifies one or more items as he chooses. If only one item is specified, no commas are needed to separate items and the enclosing parentheses can be omitted.

FUNCTIONS OF TESTRAN STATEMENTS

The following pages describe the functions of TESTRAN statements and their operands. For convenience, the statements are divided into four groups:

- DUMP and TRACE statements.
- TEST statements.
- GO statements.
- SET statements.

The description of each group has two parts:

- A list of the statements in the group and the general function of each statement.
- A list of the operands for the statements and the specific function of each operand.

To use this part of the appendix, turn to the last part, "Format of TESTRAN Statements," and fold out the last page to show Tables 2-5. Table 2 defines the format of TESTRAN statements using conventions that are standard in the Systems Reference Library. Tables 3-5 present supplementary

information about the format of certain operands.

To write a statement using this appendix, first select a statement from the list of statements for one of the groups. Refer to the tables on the foldout page to learn the format of the statement. Then refer to the list of operands for a description of each operand indicated in the tables.

DUMP AND TRACE STATEMENTS

The DUMP and TRACE statements record information about the problem program. Their basic functions are as follows:

DUMP DATA
dumps a storage area.

DUMP CHANGES
dumps changes to a storage area; dumped fields are printed only if (1) contained in the first dump taken by the statement, or (2) contained in a later dump and changed since the previous dump by the same statement.

DUMP COMMENT
dumps a programmer's comment contained in the statement.

DUMP MAP
dumps a map of control sections and allocated storage areas associated with the active task.

DUMP PANEL
dumps general and floating-point registers and the program status word stored at the most recent interruption of the problem program.

DUMP TABLE
dumps a specified system table (control block).

TRACE CALL
traces subroutine calls by CALL macroinstructions in a specified storage area.

TRACE FLOW
traces transfers (by branch and SVC instructions) to, from, or within a storage area.

TRACE REFER
traces references to a storage area by instructions that could change data within that area.

TRACE STOP
stops traces started by TRACE CALL, TRACE FLOW, and TRACE REFER statements.

Operands: The operands of the DUMP and TRACE statements are as follows:

address
- as the second operand, points to the leftmost byte of a storage area.
- as the third operand, points to the rightmost byte plus one of a storage area, with this exception: in a DUMP TABLE statement, the third operand points to the data control block (DCB) that is dumped or that is associated with the data extent block (DEB) that is dumped.

Note on Storage Areas: A storage area is defined by the effective values of the address operands at the time a DUMP or TRACE statement is executed. Indexing of addresses may cause an area to vary in size and location when a statement is executed several times (i.e., at several test points). A change dump of a variable area includes all additions to the previously dumped area, plus changed data that lies within both the present and previous areas. A trace is shifted from the previously defined area to a newly defined area on each execution of the statement that first started the trace.

If a statement does not point to both ends of a storage area, the length of the area is determined by the DATAM keyword operand. If this operand is omitted, the length is determined by the length attribute of the first symbol used in the address. If the address contains no symbols, or only an external symbol, the length is assumed to be one byte.

'text'
specifies a programmer's comment.

(registers[,registers]...)
- specifies the registers to be dumped.
- if absent, implies that all registers are to be dumped.

Note on Printing Format: Unless the DATAM keyword operand is written,

dumped registers (including floating-point registers) are printed in hexadecimal format.

TCB|DCB|DEB
specifies the system table to be dumped, as follows:

TCB - the task control block for the active task.
DCB - an open data control block whose address is the third operand of the statement.
DEB - the data extent block for an open data control block whose address is the third operand of the statement.

(symbol[,symbol]...)
- specifies the names of one or more TRACE statements that started traces which are to be stopped.
- if absent, implies that all current traces are to be stopped.

ds DSECT=(symbol{,1|,integer})
identifies a storage area as a dummy control section, or as part of a dummy control section.

symbol
1. is the name of the dummy control section.
2. specifies the assumed location of the dummy control section, which must be addressable by means of a base register previously defined and loaded by the problem program.

1|integer
1. specifies a number by which the length of the storage area is multiplied on execution of the statement.
2. specifies the maximum number of times the format of the dummy control section is to be repeated to define the format of printed information.

d DATAM=[type][L{length}][S{scale}]
- specifies type, length, and scale attributes.
- determines either the length of a storage area when the third positional operand is omitted, or the length of data (right justified) in a dumped register.
- determines either the printing format for each field of a storage area when the DSECT operand is omitted, or the printing format of data dumped from a register.

n NAME=symbol
- provides a symbol to be printed as the name of the first field of a dump.
- suppresses the printing of field names as they are defined in the source program.

c COMMENT='text'
annotates trace output with a programmer's comment.

s SELECT={1|2|3|4|5|6|7|8}
- classifies test information produced by the DUMP or TRACE statement; reclassifies this information if it has already been classified in a TEST OPEN or TEST AT statement.
- identifies the class by a number, which can be used (in a job control statement) to select the class for printing by the TESTRAN editor.

TEST STATEMENTS

TEST statements are of three types:

Linkage statements:	TEST OPEN TEST CLOSE
Specification statements:	TEST AT TEST DEFINE
Decision-making statements:	TEST ON TEST WHEN

Each type is described separately.

Linkage Statements

The TEST OPEN and TEST CLOSE statements control linkage between the problem program and the TESTRAN interpreter. Their basic functions are as follows:

TEST OPEN
- defines a TESTRAN control section having the same name as the statement itself.
- opens the TESTRAN control section; loads the standard entry point register (15), and passes control to the problem program entry point (second operand).
- specifies task options (third, fourth, MAXE, and MAXP operands).
- chains the opening of other TESTRAN control sections (OPTEST operand).
- classifies test information for selective retrieval (SELECT operand).

TEST CLOSE
- closes the TESTRAN control section in which it is located.
- closes any other TESTRAN control sections that were opened at the same time by chained opening.
- returns control to the problem program.

A TEST OPEN statement defines a control section that includes all TESTRAN statements that precede the next TEST OPEN statement, if any, in the source program. It must be the first TESTRAN statement in the source program.

When executed, the TEST OPEN statement "opens" the control section by reference to TEST specification statements. It establishes a link to the TESTRAN interpreter at each test point specified in a TEST AT statement, and it creates counters and flags as specified in TEST DEFINE statements.

A TEST CLOSE statement closes a TESTRAN control section by nullifying the linkages, counters, and flags established when the control section was opened. When closed, a control section cannot be entered by a branch from another TESTRAN control section, and its counters and flags cannot be used by statements in other control sections.

Operands: The operands of the TEST linkage statements are as follows:

address
- is placed in register 15.
- receives control after TEST OPEN.
- is required if TEST OPEN is executed.
- is ignored if TEST OPEN is not executed (i.e., if opening of the control section is chained by the execution of another TEST OPEN statement).

task options
- control testing under a task and editing of the resulting test output.
- can be specified only in the first TEST OPEN statement executed under a task; are ignored when specified in other TEST OPEN statements.
- are specified by five operands, one of which (the DDN operand) is sometimes required in systems with MVT.

symbol
1. appears in the heading of each page printed by the TESTRAN editor.
2. identifies test information produced under the task.

LINK|LOAD
1. specifies which system macro-instruction the TESTRAN interpreter should use to load its nonresident modules.
2. reduces (LINK) or increases (LOAD) both the storage requirements and the operating speed of the interpreter.

DDN=SYSTEST|DDN=symbol
1. points to the DD control statement for the TESTRAN data set.
2. is required (when testing a dynamic parallel program in a system with MVT) to define a separate TESTRAN data set for each task under which testing is performed.

MAXE=integer
1. specifies the maximum number of statements to be executed by the TESTRAN interpreter.[1]
2. causes abnormal termination if the maximum is exceeded.

MAXP=integer
1. specifies the maximum number of pages of test information to be produced.[1]
2. causes abnormal termination if the maximum is exceeded.

OPTEST=(symbol[,symbol],...)
- points to the TESTRAN control sections defined by other TEST OPEN statements.
- chains the opening of these control sections: causes all of them to be opened when the TEST OPEN statement is executed.
- is ignored if the TEST OPEN statement is not executed.

δ SELECT={1|2|3|4|5|6|7|8}
- classifies test information produced by control sections opened by the TEST OPEN statement.
- identifies the class by a number, which can be used (in a job control statement) to select the class for printing by the TESTRAN editor.
- is ignored if the TEST OPEN statement is not executed.

Specification Statements

The TEST AT and TEST DEFINE statements specify functions that are performed when the TESTRAN control section is opened:

TEST AT
- specifies one or more test points in the problem program (second operand).
- classifies test information for selective retrieval (SELECT operand).

TEST DEFINE
defines TESTRAN counters or flags.

---

[1]This maximum must not exceed the installation maximum established during system generation. If it does, or if the operand is omitted, the installation maximum is assumed.

A TEST AT statement must be placed so that the next sequential TESTRAN statement is the first that should be executed at each specified test point. A TEST DEFINE statement can be placed anywhere in a TESTRAN control section.

In an executed sequence of TESTRAN statements, a TEST AT statement returns control to the problem program. A TEST DEFINE statement performs no operation; the next sequential statement is executed.

Operands: The operands of the TEST specification statements are as follows:

({*|address}[,address]...)
- points to one or more test points in the problem program.
- refers, if * is written, to the value of the location counter for the current problem program control section.
- is subject to the following restrictions:
  1. Each specified address must be that of an instruction in the problem program.
  2. The instruction must not be a privileged or SVC instruction, or an EX instruction that executes a privileged or SVC instruction.
  3. The instruction must not be modified by any instruction or executed by an EX instruction.

δ SELECT={1|2|3|4|5|6|7|8}
- classifies test information recorded at test points specified in the statement; reclassifies this information if it has already been classified in a TEST OPEN statement.
- identifies the class by a number which can be used (in a job control statement) to select the class for printing by the TESTRAN editor.

COUNTER|FLAG
determines whether counters or flags are defined by the statement.

Note on Counters and Flags: A counter is a full-word, fixed-point value. A flag is a single binary digit. Both are set to zero when the control section is opened. Their values are lost when the control section is closed.

(symbol[,symbol]...)
specifies a name for each counter or flag (the number of names determines the number of counters or flags that are defined).

Decision-Making Statements

The TEST ON and TEST WHEN statements perform decision-making functions based on conditional branching to other TESTRAN statements. Their functions are as follows:

TEST ON
- increments a counter (COUNTER operand) by one.
- tests the counter against three values (second, third, and fourth operands).
- branches to a TESTRAN statement (fifth operand) if the value of the counter (1) is greater than or equal to the second operand, (2) is less than or equal to the third operand, and (3) is a multiple of the fourth operand.

TEST WHEN (first form)
- tests the value of a flag (second operand).
- branches to a TESTRAN statement (third operand) if the value of the flag is one.

TEST WHEN (second form)
- specifies a logical relationship between two flags (second, third and fourth operands).
- branches to a TESTRAN statement (fifth operand) if the relationship is correct.

TEST WHEN (third form)
- specifies an arithmetic relationship between counters and/or variables (second, third, and fourth operands).
- branches to a TESTRAN statement (fifth operand) if the relationship is correct.

Operands: The operands of the TEST ON and TEST WHEN statements are as follows:

ari address|register|integer
- specifies a fixed-point value from 1 to $2^{31}-1$.

address
1. points to a full-word, fixed-point value in main storage; this value need not be on a full-word boundary.
2. cannot be written as an integer.

register
points to a full-word, fixed-point value in a general register.

integer
is a decimal value that is assembled as a full-word, fixed-point value.

- if absent, implies the value 1 for the second or fourth operand, or the value $2^{31}-1$ for the third operand.

symbol
- as the second or fourth operand, points to a flag defined by a TEST DEFINE statement.
- as the third or fifth operand, points to a TESTRAN statement.

COUNTER=symbol
- points to a counter defined by a TEST DEFINE statement.
- if absent, implies that the statement increments and tests an unnamed counter that is automatically defined for exclusive use by the statement.

AND|OR
specifies a logical relationship between the flags specified by the second and fourth operands.

AND
specifies that the value of both flags is one.

OR
specifies that the value of one flag, or of both, is one.

arl address|register|literal
specifies an arithmetic value.

address
points to a value in the problem program or to a TESTRAN counter.

register
points to a value in a register.

literal
specifies a constant value that is assembled as part of the statement.

Note on Data Format: If the DATAM operand is omitted, the format (type and length) of both the second and fourth operands is implied as follows:

- If the second operand is an address, the format is determined by the attributes of the first symbol used in the address. If the address contains no symbols, or only an external symbol, the format is determined by the fourth operand in the same manner as by the second operand. However, if the fourth operand is also an address, and contains no symbol other than an external symbol, the format is assumed to be hexadecimal with a length of one byte.
- If the second operand is a reference to a general register, the format is hexadecimal with a length of four bytes. If it is a reference to a floating-point register, the format is floating-point with a length of eight bytes.
- If the second operand is a literal, the format is specified or implied by the literal notation.

GT|GE|EQ|NE|LT|LE
- specifies an arithmetic relationship between the values specified by the second and fourth operands.
- has the following meaning:

  GT - greater than
  GE - greater than or equal to
  EQ - equal to
  NE - not equal to
  LT - less than
  LE - less than or equal to

d DATAM=[type][L{length}][S{scale}]
- specifies type, length, and scale attributes.
- defines the type and length of values specified by the second and fourth operands.

GO STATEMENTS

The GO statements provide branching functions. Their basic functions are as follows:

GO TO
branches unconditionally to a TESTRAN statement.

GO IN
calls a TESTRAN subroutine.

GO OUT
returns from a TESTRAN subroutine.

GO BACK
returns control to the problem program, or passes control to a specified executable instruction.

Operands: The operands of the GO statements are as follows:

symbol
is the name of the TESTRAN statement that is branched to or that is the first statement of a TESTRAN subroutine.

Note on TESTRAN Subroutines: A maximum of three levels of TESTRAN subroutines can be maintained. The first level is lost if a fourth level is created.

address
- points to an executable instruction to which control is passed.
- if absent, causes execution of the problem program instruction at the current test point.

SET STATEMENTS

The SET statements assign values to counters, flags, and variables. Their functions are as follows:

SET COUNTER
assigns a value to a TESTRAN counter.

SET FLAG
assigns a value to a TESTRAN flag.

SET VARIABLE
assigns a value to a problem program variable (storage field or register).

Operands: The second operand of each SET statement points to a counter, flag, or variable; the third operand specifies the value that is assigned. The operands are as follows:

symbol
- in a SET COUNTER statement, points to a TESTRAN counter.
- in a SET FLAG statement, points to a TESTRAN flag.

arl address|register|literal
specifies the new value of a counter or variable.

address
points to a value in the problem program or to a TESTRAN counter.

register
points to a value in a register.

literal
specifies a constant value that is assembled as part of the statement.

=0|=1
specifies the new value (zero or one) of a TESTRAN flag.

address|register
points to a variable to which a value is assigned.

address
points to a value in the problem program.

register
points to a value in a register.

Note on Data Format: If the DATAM operand is omitted, the length of the values specified by the second and third operands is determined as follows:

- If the second operand is an address, the length is determined by the first symbol used in the address. If the address contains no symbols, or only an external symbol, the length is determined by the third operand in the same manner as by the second operand. However, if the third operand is also an address and contains no symbol other than an external symbol, the length is assumed to be one byte. If the third operand is a literal, the length is specified or implied by the literal notation.
- If the second operand is a reference to a general register, the implied length is four bytes. If it is a reference to a floating-point register, the implied length is eight bytes.

d DATAM=[type][L{length}][S{scale}]
- specifies type, length, and scale attributes.
- defines the length of values specified by the second and third operands of a SET VARIABLE statement.

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Table 2. Format of TESTRAN Statements

Name	Operation	Operand
[symbol]	DUMP	{DATA|CHANGES},address[,address][,*ds*][,*d*][,*n*][,*s*]
		COMMENT,'text'[,*s*]
		MAP[,*s*]
		PANEL[,(registers[,registers]...)][,*d*][,*s*]
		TABLE,{TCB|{{DCB|DEB},address}}[,*s*]
[symbol]	TRACE	CALL,address,address[,*c*][,*s*]
		FLOW,address[,address][,*c*][,*s*]
		REFER,address[,address][,*ds*][,*d*][,*c*][,*s*]
		STOP[,(symbol[,symbol]...)][,*s*]
symbol[1]	TEST	OPEN[,address[2],*task options*][,OPTEST=(symbol[,symbol]...)][,*s*]]
		CLOSE
		AT,({*|address[2]}[,address[2]]...)[,*s*]
		DEFINE,{COUNTER|FLAG},(symbol[,symbol]...)
		ON,[*ari*],[*ari*],[*ari*],symbol[,COUNTER=symbol]
		WHEN,symbol,symbol
		WHEN,symbol,{AND|OR},symbol,symbol
		WHEN,*arl*,{GT|GE|EQ|NE|LE|LT},*arl*,symbol[,*s*]
[symbol]	GO	{TO|IN},symbol
		OUT
		BACK[,address]
[symbol]	SET	COUNTER,symbol,*arl*
		FLAG,symbol,{symbol|=0|=1}
		VARIABLE,{address|register},*arl*[,*d*]

[1]A symbol is required in the name field of a TEST OPEN statement; it is optional in other TEST statements.
[2]This operand can be written only as a nonindexed implied address.

Table 3. Definitions of Abbreviations Used in Table 2

Abbreviation	Definition
ari	address|register|integer
arl	address|register|literal
c	COMMENT='text'
d	DATAM={type][L{length}][S{scale}]
ds	DSECT=(symbol{,1|,integer})
n	NAME=symbol
s	SELECT={1|2|3|4|5|6|7|8}
task options	[symbol]{,LINK|,LOAD}{,DDN=SYSTEST|,DDN=symbol}[,MAXE=integer][,MAXP=integer]

Table 4. Definitions of Variables Used in Tables 2 and 3

Variable	Definition
address	An indexed or nonindexed implied or explicit address[1]
integer	A decimal self-defining term
length	An unsigned decimal integer (see Table 5)
literal	A constant preceded by an equal sign (=)
register	A pointer to a general or floating-point register[2]
registers	A pointer to one or a series of general or floating-point registers[2]
scale	A signed or unsigned decimal integer (see Table 5)
symbol	A string of letters and digits that begins with a letter and is not longer than eight characters
text	A character constant[3]
type	A standard data type code (see Table 5)

[1]The format of an address is given by the fcllowing table:

	Indexed	Nonindexed
Implied address	s(x)	s
Explicit address	d(x,b)	d(0,b)

s is an absolute or relocatable expression; d, x, and b are absolute expressions. s is a numeric or symbolic storage address; x is an index register number; d is a displacement from a base address; b is a base address register number.

An implied address is assembled in base-displacement form only if a DSECT operand appears in the same statement. Normally, it is evaluated by an A-type address constant. If it is indexed, its effective value is that of the constant plus the contents of the index register at the time the statement is executed.

[2]The format of the pointer is given by the following table:

	Single Register	Series of Registers
General register	G'reg'	G'reg_1,reg_n'
Floating-point register	F'reg'	F'reg_1,reg_n'

reg, reg_1, and reg_n are each a symbol or decimal integer whose value is a valid register number. reg_1 and reg_n are the first and last registers of a series. reg_n can have either a higher or a lower value than reg_1.

[3]The format of the character constant is that of the constant subfield of a DC statement that defines a character constant. As shown in Tables 2 and 3, the constant is enclosed by apostrophes. The constant can include any valid EBCDIC character, but must include a pair of apostrophes or ampersands to represent a single apostrophe (') or ampersand (&). The maximum length is 120 characters, counting each pair of apostrophes or ampersands as a single character.

Table 5. Definition of Type, Length, and Scale

Type		Length in bytes[1]		Scale[2]
Code	Meaning	Specified	Implied	
C	character	1 to 256	1	(not applicable)
X	hexadecimal	1 to 256	1	(not applicable)
B	binary	1 to 256	1	(not applicable)
H	fixed-point	1 to 8	2	-187 to +346
F	fixed-point	1 to 8	4	-187 to +346
E	floating-point	1 to 8	4	(not applicable)
D	floating-point	1 to 8	8	(not applicable)
P	packed decimal	1 to 16	1	(not applicable)
Z	zoned decimal	1 to 16	1	(not applicable)
I	instruction	(not applicable)	(variable)	(not applicable)

[1]The implied length is used if the type, but not the length, is specified.
[2]The implied scale is zero if no scale is specified. If a positive scale is intended, the sign (+) can be omitted.

This appendix defines cataloged procedures that are supplied by IBM and are referred to in Section 3 of this publication.

PROCEDURE ASMEC

```
//ASM      EXEC  PGM=IETASM                                              00020000
//SYSLIB   DD  DSNAME=SYS1.MACLIB,DISP=OLD                              00040000
//SYSUT1   DD  UNIT=SYSSQ,SPACE=(400,(400,50))                          00060000
//SYSUT2   DD  UNIT=SYSSQ,SPACE=(400,(400,50))                          00080000
//SYSUT3   DD  UNIT=(SYSSQ,SEP=(SYSUT2,SYSUT1,SYSLIB)),                C00100000
//             SPACE=(400,(400,50))                                     00120000
//SYSPRINT DD  SYSOUT=A                                                 00140000
//SYSPUNCH DD  UNIT=SYSCP                                               00160000
```

PROCEDURE ASMFC

```
//ASM      EXEC  PGM=IEUASM,REGION=50K                                  00020000
//SYSLIB   DD  DSNAME=SYS1.MACLIB,DISP=SHR                              00040000
//SYSUT1   DD  UNIT=SYSSQ,SPACE=(1700,(400,50))                         00060000
//SYSUT2   DD  UNIT=SYSSQ,SPACE=(1700,(400,50))                         00080000
//SYSUT3   DD  UNIT=(SYSSQ,SEP=(SYSUT2,SYSUT1,SYSLIB)),                C00100000
//             SPACE=(1700,(400,50))                                    00120000
//SYSPRINT DD  SYSOUT=A                                                 00140000
//SYSPUNCH DD  SYSOUT=B                                                 00160000
```

PROCEDURE LKED

```
//LKED     EXEC  PGM=IEWL,PARM='XREF,LIST,LET,NCAL',REGION=96K          00020000
//SYSPRINT DD  SYSOUT=A                                                 00040000
//SYSLIN   DD  DDNAME=SYSIN                                             00060000
//SYSLMOD  DD  DSNAME=&GOSET(GO),SPACE=(1024,(50,20,1)),                C00080000
//             UNIT=SYSDA,DISP=(MOD,PASS)                               00100000
//SYSUT1   DD  UNIT=(SYSDA,SEP=(SYSLMOD,SYSLIN)),                       C00120000
//             SPACE=(1024,(200,20))                                    00140000
```

PROCEDURE TASME

```
//ASM      EXEC  PGM=ASMBLR,PARM=TEST,REGION=50K                              00020000
//SYSLIB   DD  DSNAME=SYS1.MACLIB,DISP=SHR                                    00040000
//SYSUT1   DD  UNIT=(SYSSQ,SEP=(SYSLIB)),SPACE=(1700,(400,50))               00060000
//SYSUT2   DD  UNIT=(SYSSQ,SEP=(SYSUT1)),SPACE=(1700,(400,50))               00080000
//SYSUT3   DD  UNIT=(SYSSQ,SEP=(SYSLIB,SYSUT2)),                            C00100000
//            SPACE=(1700,(400,50))                                          00120000
//SYSPRINT DD  SYSOUT=A                                                       00140000
//SYSPUNCH DD  DSNAME=&LOADSET,UNIT=SYSDA,                                   C00160000
//            SPACE=(80,(200,50)),DISP=(MOD,PASS)                            00180000
//LKED     EXEC  PGM=IEWL,PARM=(XREF,LIST,LET,NCAL,TEST),REGION=96K           00200000
//SYSPRINT DD  SYSOUT=A                                                       00220000
//SYSLIN   DD  DSNAME=&LOADSET,DISP=(OLD,DELETE)                              00240000
//            DD  DDNAME=SYSIN                                               00260000
//SYSLMOD  DD  DSNAME=&GOSET(GO),SPACE=(1024,(50,20,1)),                     C00280000
//            UNIT=SYSDA,DISP=(MOD,PASS)                                     00300000
//SYSUT1   DD  UNIT=(SYSDA,SEP=(SYSLMOD,SYSLIN)),                            C00320000
//            SPACE=(1024,(200,20))                                          00340000
```

PROCEDURE TASMEG

```
//ASM      EXEC  PGM=ASMBLR,PARM=TEST,REGION=50K                          00020000
//SYSLIB   DD  DSNAME=SYS1.MACLIB,DISP=SHR                               00040000
//SYSUT1   DD  UNIT=(SYSSQ,SEP=(SYSLIB)),SPACE=(1700,(400,50))           00060000
//SYSUT2   DD  UNIT=(SYSSQ,SEP=(SYSUT1)),SPACE=(1700,(400,50))           00080000
//SYSUT3   DD  UNIT=(SYSSQ,SEP=(SYSLIB,SYSUT2)),                        C00100000
//               SPACE=(1700,(400,50))                                   00120000
//SYSPRINT DD  SYSOUT=A                                                  00140000
//SYSPUNCH DD  DSNAME=&LOADSET,UNIT=SYSDA,                               C00160000
//               SPACE=(80,(200,50)),DISP=(MOD,PASS)                     00180000
//LKED     EXEC  PGM=IEWL,PARM=(XREF,LIST,LET,NCAL,TEST),REGION=96K      00200000
//SYSPRINT DD  SYSOUT=A                                                  00220000
//SYSLIN   DD  DSNAME=&LOADSET,DISP=(OLD,DELETE)                         00240000
//         DD  DDNAME=SYSIN                                              00260000
//SYSLMOD  DD  DSNAME=&GOSET(GO),SPACE=(1024,(50,20,1)),                 C00280000
//               UNIT=SYSDA,DISP=(MOD,PASS)                              00300000
//SYSUT1   DD  UNIT=(SYSDA,SEP=(SYSLMOD,SYSLIN)),                        C00320000
//               SPACE=(1024,(200,20))                                   00340000
//GO       EXEC  PGM=*.LKED.SYSLMOD                                      00360000
```

PROCEDURE TASMEGED

```
//ASM      EXEC  PGM=ASMBLR,PARM=TEST,REGION=50K                          00020000
//SYSLIB   DD  DSNAME=SYS1.MACLIB,DISP=SHR                               00040000
//SYSUT1   DD  UNIT=(SYSSQ,SEP=(SYSLIB)),SPACE=(1700,(400,50))           00060000
//SYSUT2   DD  UNIT=(SYSSQ,SEP=(SYSUT1)),SPACE=(1700,(400,50))           00080000
//SYSUT3   DD  UNIT=(SYSSQ,SEP=(SYSLIB,SYSUT2)),                        C00100000
//               SPACE=(1700,(400,50))                                   00120000
//SYSPRINT DD  SYSOUT=A                                                  00140000
//SYSPUNCH DD  DSNAME=&LOADSET,UNIT=SYSDA,                               C00160000
//               SPACE=(80,(200,50)),DISP=(MOD,PASS)                     00180000
//LKED     EXEC  PGM=IEWL,PARM=(XREF,LIST,LET,NCAL,TEST),REGION=96K      00200000
//SYSPRINT DD  SYSOUT=A                                                  00220000
//SYSLIN   DD  DSNAME=&LOADSET,DISP=(OLD,DELETE)                         00240000
//         DD  DDNAME=SYSIN                                              00260000
//SYSLMOD  DD  DSNAME=&GOSET(GO),SPACE=(1024,(50,20,1)),                 C00280000
//               UNIT=SYSDA,DISP=(MOD,PASS)                              00300000
//SYSUT1   DD  UNIT=(SYSDA,SEP=(SYSLMOD,SYSLIN)),                        C00320000
//               SPACE=(1024,(200,20))                                   00340000
//GO       EXEC  PGM=*.LKED.SYSLMOD                                      00360000
//SYSTEST  DD  DSNAME=&TESTSET,SPACE=(300,(200,50)),                     C00380000
//               UNIT=SYSSQ,DISP=(NEW,PASS)                              00400000
//EDIT     EXEC  PGM=IEGTTEDT,REGION=50K                                 00420000
//SYSUT1   DD  UNIT=SYSDA,SPACE=(500(300,100))                           00440000
//SYSTEST  DD  DSNAME=&TESTSET,UNIT=SYSSQ,SEP=SYSUT1,                    C00460000
//               DISP=(OLD,DELETE)                                       00480000
//SYSPRINT DD  SYSOUT=A                                                  00500000
```

Note: In the job step EDIT, the statement SYSUT1 defines a work data set for the TESTRAN editor. This data set must be on a direct-access device. Its primary space allocation must be at least two tracks.

PROCEDURE TTED

```
//EDIT     EXEC    PGM=IEGTTEDT,REGION=50K                               00020000
//SYSUT1   DD    UNIT=SYSDA,SPACE=(500,(300,100))                        00040000
//SYSPRINT DD    SYSOUT=A                                                00060000
```

Note: See note to the procedure TASMEGED.

This appendix reproduces the following sections from the publication IBM System/360 Operating System: Messages and Codes:

TESTRAN Editor Messages
TESTRAN Interpreter Messages
TESTRAN Macro-Expansion Messages

Table 6 describes the messages in these sections.

Table 6. TESTRAN Messages

MESSAGE	WHERE PRINTED	MESSAGE FORMAT	COMMENTS
TESTRAN Editor Messages	TESTRAN Listing (TESTRAN editor SYSPRINT data set)	*** IEGEnn text IEG = TESTRAN message code Enn = Message serial number indicating the TESTRAN editor text = Message text	Messages indicate errors found during the editing of test output.
TESTRAN Interpreter Messages	TESTRAN Listing (TESTRAN editor SYSPRINT data set)	*** IEGInn text IEG = TESTRAN message code Inn = Message serial number indicating the TESTRAN interpreter text = Message text	Messages indicate errors found by the TESTRAN interpreter during execution of the program being tested.
TESTRAN Macro-Expansion Messages	Assembly Listing (Assembler SYSPRINT data set)	ss,*** IEGMnn text ss = Severity code, which is one of the following: * Informational message; no effect on execution 4 Warning message; successful execution is probable 8 Error; execution may fail 12 Serious error; successful execution is improbable IEG = TESTRAN message code Mnn = Message serial number indicating macro-expansion text = Message text	Messages indicate errors in the position and syntax of TESTRAN statements. The assembler finds these errors when it expands TESTRAN statements (macro-instructions) into sequences of assembler language statements. If errors in a source statement cause errors in its expansion, the assembler may issue additional messages when it assembles the statements in the expansion. The additional messages do not have TESTRAN message codes and are not included in this appendix.

TESTRAN EDITOR MESSAGES

IEGE02 UNKNOWN MACRO

Explanation: During TESTRAN editing, an input record could not be related to a TESTRAN statement (macro-instruction) associated with the task that produced the data set.

System Action: The count of invalid records was incremented, and the record was ignored.

IEGE03 EXCESSIVE CHANGE DUMPS

Explanation: During TESTRAN editing, the output from an excessive number of DUMP CHANGES statements was selected for editing by the TESTRAN editor.

System Action: Only the output from the allowable number of DUMP CHANGES statements was edited.

User Response: To edit the output from subsequent DUMP CHANGES statements, repeat the job step without selecting the output from the DUMP CHANGES statements already edited.

IEGE04 INVALID RECORD--IGNORED

Explanation: During TESTRAN editing, an invalid or unreadable input record was encountered.

System Action: The count of invalid records was incremented, and the record was ignored.

IEGE05 EXCESSIVE INVALID RECORDS--EDIT DISCONTINUED

Explanation: During TESTRAN editing, the number of invalid or unreadable records in the data set exceeded the allowable limit.

System Action: The job step was terminated.

User Response: Determine whether the correct data set was used as input. If it was, recreate the data set by executing the problem program again.

IEGE06 EXCESSIVE OUTPUT

Explanation: During TESTRAN editing, the amount of edited output exceeded the limit specified in the PARM parameter of the EXEC statement for the job step being tested.

System Action: The job step was terminated.

User Response: Execute the job step again, specifying either a higher page limit or fewer output class identification numbers.

IEGE07 END OF TESTRAN EDIT--xxx STATEMENTS PROCESSED

Explanation: TESTRAN editing was completed.

In the message text, xxx is the number of TESTRAN statements executed by the TESTRAN interpreter.

IEGE08 INVALID OVERLAY RECORD

Explanation: During TESTRAN editing, an input record specified a change in an unknown overlay segment.

System Action: The record was ignored.

IEGE09 INVALID RELOCATION RECORD--EDIT DISCONTINUED

Explanation: During TESTRAN editing, an input record contained control section relocation information that did not correspond to the control section definitions of the program that was being tested.

System Action: The job step was terminated.

User Response: Determine whether the correct data set was used as input. If it was not, recreate the data set by executing the problem program again.

IEGE10 EXCESSIVE SECTION DEFINITIONS--ENTRY xxx

Explanation: During TESTRAN editing, the number of definitions of control, dummy, and blank common sections exceeded the limit allowed in the tested program.

In the message text, xxx is the entry name of the excess section.

System Action: Dumps and traces of the excess sections were printed in 4-byte hexadecimal format, except where this format was overridden by DATAM operands.

User Response: Reduce control sections, dummy sections, and blank common sections to the allowable number. Count each TESTRAN control section once for each time it is opened.

IEGE11 EXCESSIVE 'TEST AT'S

Explanation: During TESTRAN editing, the number of supervisor call (SVC) instructions inserted by TEST AT statements exceeded the limit.

System Action: Data resulting from the excess supervisor call instructions was ignored.

User Response: Reduce problem program addresses specified by TEST AT statements to the allowable number. Count each address once for each opening of the TESTRAN control section in which the address is specified.

IEGE12 EXCESSIVE 'TEST OPEN'S

Explanation: During TESTRAN editing, the opening of TESTRAN control sections by TEST OPEN statements exceeded the limit.

System Action: Data resulting from the excess control section openings was ignored.

User Response: Reduce TESTRAN control section openings to the allowable number.

IEGE13 UNABLE TO OPEN

Explanation: During TESTRAN editing, a required data set could not be opened because no DD statement was supplied for the data set.

System Action: The job step was terminated.

User Response: Supply the missing DD statement and execute the job step again.

IEGE14 IO ERROR

Explanation: During TESTRAN editing, an uncorrectable input/output error occurred.

System Action: The job step was terminated.

User Response: If the input/output error persists, have the computing system checked.

IEGE15 EXCESSIVE SEQUENCE BREAKS

Explanation: During TESTRAN editing, the assembler symbol tables proved unusable. There were too many breaks in the sequences of source statements defining named, unnamed, dummy, and blank common control sections.

System Action: The job step was terminated.

User Response: Restructure the source program to minimize the number of interruptions and continuations in the definition of each control section. Alternatively, assemble the program without symbol tables (i.e., without the TEST option), and use the DATAM operand to specify printing format.

TESTRAN INTERPRETER MESSAGES

IEGI00 INVALID ADDRESS--IGNORED

Explanation: During execution of the TESTRAN interpreter, a TESTRAN statement referred to an address higher than the highest address in main storage.

System Action: The statement was ignored.

User Response: If the job step is to be executed again, make sure that all address operands were specified correctly and were not modified. Also, check the contents of any registers referred to in the statement. Correct the error.

IEGI01 INVALID 'GO TO' AT xxx

Explanation: During execution of the TESTRAN interpreter, a GO TO or GO IN statement did not specify in its second operand the address of a TESTRAN statement in an open control section.

In the message text, xxx is the address in hexadecimal of the GO TO or GO IN statement.

System Action: The statement was ignored. The next sequential statement was executed.

User Response: If the job step is to be executed again, make sure that the second operand specified the address (symbolic name) of a TESTRAN statement and was not incorrectly modified. Also make sure that the control section containing the address will be open when the GO TO or GO IN statement is executed.

IEGI02 INACTIVE 'GO TO' AT xxx

Explanation: During execution of the TESTRAN interpreter, a GO TO or GO IN statement in an overlay program specified as its second operand the address of a TESTRAN statement. This statement was in a control section that was not currently in main storage.

In the message text, xxx is the address in hexadecimal of the GO TO or GO IN statement.

System Action: The GO TO or GO IN statement was ignored. The next sequential statement was executed.

User Response: If the job step is to be executed again, make sure that the control section containing the specified address will be in main storage when the GO TO or GO IN statement is executed.

IEGI03 INVALID 'GO OUT' AT xxx

Explanation: During execution of the TESTRAN interpreter, a GO OUT statement was to be executed, but the associated GO IN statement had not saved a return address.

In the message text, xxx is the address in hexadecimal of the GO OUT statement.

System Action: The GO OUT statement was treated as a GO BACK statement in which the second operand was omitted.

User Response: If the job step is to be executed again, determine why the return address was missing, making sure that no attempt was made to save more than three return addresses.

IEGI04 NULL 'TEST OPEN' ENTRY POINT--ABEND

Explanation: During execution of the TESTRAN interpreter, a TEST OPEN statement did not specify as its second operand an entry point address in the problem program to which control could be returned.

System Action: The task was terminated abnormally.

User Response: Specify the entry point address in the TEST OPEN statement, making sure that the statement was not incorrectly modified. Alternatively, avoid execution of this statement by listing it in the OPTEST operand of another TEST OPEN statement.

IEGI05 INVALID 'TEST AT'--IGNORED

Explanation: During execution of the TESTRAN interpreter, the second operand (address sublist) of a TEST AT statement specified an address that was outside the boundaries of the main storage assigned to the current task.

System Action: A supervisor call (SVC) instruction was not inserted at the erroneous address. Supervisor call instructions were inserted at valid addresses specified in the same sublist.

User Response: If the job step is to be executed again, make sure that the address was specified correctly and was not incorrectly modified. Correct the error.

IEGI06 EXCESSIVE OUTPUT REQUESTED

Explanation: During execution of the TESTRAN interpreter, the MAXP operand of a TEST OPEN statement specified a limit higher than the installation's limit on TESTRAN output.

System Action: The installation's limit was used instead of the limit specified by the statement.

User Response: If the job step is to be executed again, eliminate the MAXP operand, or specify a limit less than or equal to the installation's limit.

IEGI07 EXCESSIVE PROCESSING REQUESTED

Explanation: During execution of the TESTRAN interpreter, the MAXE operand of a TEST OPEN statement specified a limit higher than the installation's limit on processing by the TESTRAN interpreter.

System Action: The installation's limit was used instead of the limit specified by the statement.

User Response: If the job step is to be executed again, eliminate the MAXE operand, or specify a limit less than or equal to the installation's limit.

IEGI08 LIMIT OF ONE 'TEST OPEN' IN OVERLAY

Explanation: During execution of the TESTRAN interpreter, a second TEST OPEN statement was executed in an overlay program.

System Action: No control sections were opened on execution of the second TEST OPEN statement. Control was returned to the problem program at the address specified by the second operand.

User Response: If the job step is to be executed again, remove the second TEST OPEN statement from the overlay program. The one TEST OPEN statement allowed must be in the root segment. Its OPTEST operand should specify the names of other TEST OPEN statement 5 for which control sections are to be opened.

IEGI09 'AT' LOCATION CONTAINS INVALID TESTRAN SVC

Explanation: During execution of the TESTRAN interpreter, a supervisor call (SVC) instruction was not inserted in the program being tested when the TESTRAN control section was opened by a TEST OPEN statement. The address in the program at which the supervisor call instruction should have been inserted was specified in a TEST AT statement. The supervisor call instruction would have called the TESTRAN interpreter.

System Action: The address in the TEST AT statement was ignored and a supervisor call instruction was not inserted.

User Response: If the job step is to be executed again, make sure that the address specified in the TEST AT statement (1) was correct, (2) was not incorrectly modified, and (3) was the address of an executable problem program instruction.

IEGI10 DUMP TRUNCATED AT END OF STORAGE

Explanation: During execution of the TESTRAN interpreter, a DUMP DATA or DUMP CHANGES statement specified an ending address that was higher than the highest address in main storage.

System Action: Only the storage from the starting address to the end of storage was dumped.

User Response: If the job step is to be executed again, make sure that the third positional operand specifies an address within storage and that it was not incorrectly modified.

IEGI11 'TEST OPEN' LIMIT REACHED

Explanation: During execution of the TESTRAN interpreter, TESTRAN control sections had been opened 255 times and another request to open a TESTRAN control section was found in the same task. TESTRAN control sections can be opened only 255 times during execution of one task.

System Action: No additional control sections were opened. Control was returned to the problem program address specified by the TEST OPEN statement that was executed most recently.

User Response: If the job step is to be executed again, count the number of times TESTRAN control sections are opened. A control section is counted once for each time it should be opened according to the logic of the program. Change the program to reduce the total openings if they exceed 255. If the total openings are fewer than 256, check for an uncontrolled loop that might cause repeated opening and closing of one or more control sections.

IEGI12 DUMP TRUNCATED AT TASK BOUNDARY

Explanation: During execution of the TESTRAN interpreter, a DUMP DATA or DUMP CHANGES statement specified an ending address that was outside the boundaries of the main storage assigned to the task.

System Action: Only the storage from the starting address to the task boundary was dumped.

User Response: If the job step is to be executed again, make sure that the second and third positional operands of the statement were specified correctly and were

not incorrectly modified. If the program is scatter loaded, both operands should specify addresses in the same control section.

IEGI13 INVALID 'SET VARIABLE' 'TO' ADDRESS

Explanation: During execution of the TESTRAN interpreter, a SET VARIABLE statement specified a variable at an address that was outside the main storage assigned to the task.

System Action: The SET VARIABLE statement was ignored.

User Response: If the job step is to be executed again, make sure that the address of the variable was specified correctly and was not incorrectly modified. Also check the contents of any registers referred to in the statement.

IEGI15 UNDEFINED COUNTER

Explanation: During execution of the TESTRAN interpreter, a SET COUNTER or TEST ON statement referred to a TESTRAN counter that was not in an open TESTRAN control section.

System Action: The statement was ignored.

User Response: If the job step is to be executed again, define the counter with a TEST DEFINE statement in a control section that will be open when the counter is referred to.

IEGI16 TESTRAN CSECT ALTERED

Explanation: During execution of the TESTRAN interpreter, a control section containing TESTRAN statements was modified.

System Action: The task was terminated abnormally.

User Response: Find the error that caused the TESTRAN control section to be modified, correct it, and execute the job step again.

IEGI17 MAXIMUM PAGES EXCEEDED

Explanation: During execution of the TESTRAN interpreter, the limit on TESTRAN output was exceeded.

System Action: The task was terminated abnormally.

User Response: If excessive output was produced, check for errors in the statements that cause output and in the sequence in which they were executed. If the output was not excessive, specify a higher limit in the MAXP operand of the first TEST OPEN statement executed in the task. Then execute the job step again.

IEGI18 MAXIMUM STATEMENTS EXCEEDED

Explanation: During execution of the TESTRAN interpreter, the number of TESTRAN statements that can be processed during a single task exceeded the limit.

System Action: The task was terminated abnormally.

User Response: Check the test output for logical errors that would cause excessive processing. If no errors are found, specify a higher limit in the MAXE operand of the first TEST OPEN statement executed in the task. Then execute the job step again.

IEGI19 INVALID TESTRAN SVC--IGNORED

Explanation: Control was given to the TESTRAN interpreter by a supervisor call (SVC) instruction. The supervisor call instruction was not inserted by the TESTRAN interpreter in the current task.

System Action: No testing was performed. Control was returned to the location following the invalid supervisor call instruction.

User Response: If the job step is to be executed again, remove the invalid instruction or correct it.

IEGI20 INACTIVE TESTRAN SVC--IGNORED

Explanation: Control was given to the TESTRAN interpreter by a supervisor call (SVC) instruction that had been inserted during opening of a TESTRAN control section in another overlay segment. The segment containing the control section had been overlaid.

System Action: No testing was performed. The displaced problem program instruction was executed, and control was returned to the next sequential instruction.

User Response: If the job step is to be executed again, check all TEST AT statements to ensure that they specify problem program addresses in the same overlay segment. Correct any erroneous addresses.

IEGI21 INVALID 'TEST ON' BRANCH ADDRESS

Explanation: During execution of the TESTRAN interpreter, a TEST ON statement should have branched to another TESTRAN statement. The other statement was not in an open control section.

System Action: No branch occurred. The next sequential statement was executed.

User Response: If the job step is to be executed again, check the branch address which is specified by the fifth operand of the TEST ON statement. Ensure that the control section containing the address will be open when the TEST ON statement is executed.

IEGI22 INACTIVE 'TEST ON' BRANCH ADDRESS

Explanation: During execution of the TESTRAN interpreter, a TEST ON statement should have branched to another TESTRAN statement. The other statement was in an overlay segment not currently in main storage.

System Action: No branch occurred. The next sequential statement was executed.

User Response: If the job step is to be executed again, check the branch address, which is specified by the fifth operand of the TEST ON statement. Ensure that the control section containing the address will be in main storage when the TEST ON statement is executed.

IEGI23 'DUMP' TRUNCATED AT 65K BYTES

Explanation: During execution of the TESTRAN interpreter, a DUMP DATA or DUMP CHANGES statement specified dumping of a storage area containing more than 65,535 bytes.

System Action: Only the first 65,535 bytes of the specified area were dumped.

User Response: If the job step is to be executed again, check the starting and ending addresses for the dump; these are specified by the second and third positional operands. Ensure that the difference between the addresses will not exceed 65,535 bytes when the program is loaded. If the program is scatter loaded, both addresses must be in the same control section.

IEGI24 INACTIVE COUNTER

Explanation: During execution of the TESTRAN interpreter, a SET COUNTER or TEST ON statement referred to a TESTRAN counter in an overlay segment not currently in storage.

System Action: The statement was ignored.

User Response: If the job step is to be executed again, define the counter with a TEST DEFINE statement that will be in storage when the counter is referred to.

IEGI25 INVALID DATA LENGTH

Explanation: During execution of the TESTRAN interpreter, the second and fourth operands of a TEST WHEN statement specified the location of data in registers or main storage. Both the type and length attributes of this data were specified by a DATAM operand. The data length exceeded the limit for the data type.

System Action: The statement was ignored. The next sequential statement was executed.

User Response: If the job step is to be executed again, correct the DATAM operand by specifying a data length and type that are consistent.

IEGI26 INVALID 'DUMP' ADDRESS

Explanation: During execution of the TESTRAN interpreter, a DUMP DATA or DUMP CHANGES statement specified a starting or ending address that was higher than the highest address in main storage.

System Action: The statement was ignored.

User Response: If the job step is to be executed again, make sure that the second or third operand of the DUMP DATA or DUMP CHANGES statement was specified correctly and was not incorrectly modified. Also check the contents of any registers referred to in the operand.

IEGI27 INVALID 'WHEN' BRANCH ADDRESS

Explanation: During execution of the TESTRAN interpreter, a TEST WHEN statement should have branched to another TESTRAN statement. The other statement was not in an open control section.

System Action: No branch occurred. The next sequential statement was executed.

User Response: If the job step is to be executed again, check this branch address, which is specified by the last positional operand of the TEST WHEN statement. Ensure that the control section containing the address will be open when the TEST WHEN statement is executed.

IEGI28 INACTIVE 'WHEN' BRANCH ADDRESS

Explanation: During execution of the TESTRAN interpreter, a TEST WHEN statement should have branched to another TESTRAN statement. The other statement was in an overlay segment not currently in storage.

System Action: No branch occurred. The next sequential statement was executed.

User Response: If the job step is to be executed again, check the branch address, which is specified by the last positional operand of the TEST WHEN statement. Ensure that the control section containing the address will be in main storage when the TEST WHEN statement is executed.

IEGI29 INVALID SIGN ON DECIMAL FIELD

Explanation: During execution of the TESTRAN interpreter, the second or fourth positional operand of a TEST WHEN statement specified the address of a decimal value. The sign position of the decimal value contained an invalid bit configuration.

System Action: The TEST WHEN statement was ignored. The next sequential statement was executed.

User Response: If the job step is to be executed again, correct the sign in the rightmost byte of the decimal value.

IEGI30 ADDR1 GREATER THAN ADDR2

Explanation: During execution of the TESTRAN interpreter, a DUMP DATA, DUMP CHANGES, TRACE REFER, TRACE FLOW, or TRACE CALL statement specified a starting address that was higher than the ending address for the dump or trace.

System Action: The dump or trace was restricted to the single byte at the starting address.

User Response: If the job step is to be executed again, make sure that the second or third operand was specified correctly and was not incorrectly modified. Also check the contents of any registers referred to in the operand. If the program is scatter loaded, both operands should specify addresses in the same control section.

IEGI31 TRACE TABLE FULL AT xxx

Explanation: During execution of the TESTRAN interpreter, a TRACE CALL, TRACE FLOW, or TRACE REFER statement was executed when ten traces were already active.

In the message text, xxx is the address in hexadecimal of the statement.

System Action: A new trace was started, as specified by the statement. However, the tenth trace, the one that had been most recently started, was suspended.

User Response: If the job step is to be executed again, change the testing logic so that no more than ten traces are active at one time.

IEGI32 DEB UNAVAILABLE

Explanation: During execution of the TESTRAN interpreter, the second operand of a DUMP TABLE statement specified dumping of a data extent block (DEB). The associated data control block (DCB), specified by the third operand, was not currently open.

System Action: The DUMP TABLE statement was ignored.

User Response: If the job step is to be executed again, make sure that the data control block will be open when the DUMP TABLE statement is executed.

IEGI33 ILLEGAL 'TEST AT' DELETED FROM--xxx

Explanation: During execution of the TESTRAN interpreter, control was to be returned to the problem program at an address specified by a TEST AT statement. At the return address was a TESTRAN supervisor call (SVC) instruction that displaced either another supervisor call instruction or a privileged instruction. Before control was returned, the original instruction was replaced in the problem program.

In the message text, xxx is the return address in hexadecimal in the problem program.

System Action: If the original instruction was a privileged instruction, its execution caused abnormal termination of the task.

If it was a supervisor call instruction, it was executed normally and remained in the problem program until the TESTRAN interpreter received control from a supervisor call instruction inserted at some other address. Then, the original supervisor call instruction was again displaced by a TESTRAN supervisor call instruction.

User Response: If the original instruction was privileged, change the TEST AT statement so that it inserts the supervisor call instruction at another address. Then execute the job step again.

If the original instruction was a supervisor call instruction and if the job step is to be executed again, allow for the temporary displacement of the TESTRAN supervisor call instruction, or rewrite the TEST AT statement.

IEGI34 PROGRAM CHECK DURING 'GO BACK' -- INSTRUCTION AT xxx

Explanation: During execution of the TESTRAN interpreter, control was to be returned to the problem program after execution of an instruction that was displaced by insertion of a TESTRAN supervisor call (SVC) instruction. Execution of the displaced instruction caused a program interruption.

In the message text, xxx is the address in hexadecimal of the TESTRAN supervisor call instruction.

System Action: The standard system exit routine, or the routine specified by a SPIE macro-instruction, was given control.

User Response: Correct the instruction causing the program interruption and execute the job step again.

IEGI39 INACTIVE FLAG

Explanation: During execution of the TESTRAN interpreter, a SET FLAG or TEST WHEN statement referred to a TESTRAN flag contained in an overlay segment not currently in main storage.

System Action: The statement was ignored.

User Response: If the job step is to be executed again, define the flag with a TEST DEFINE statement that will be in storage when the flag is referred to.

IEGI41 UNDEFINED FLAG

Explanation: During execution of the TESTRAN interpreter, a SET FLAG or TEST WHEN statement referred to a TESTRAN flag not contained in an open TESTRAN control section.

System Action: The statement was ignored.

User Response: If the job step is to be executed again, define the flag with a TEST DEFINE statement in a control section that will be open when the flag is referred to.

IEGI42 INVALID 'TRACE STOP' ENTRY AT xxx

Explanation: During execution of the TESTRAN interpreter, the second operand of a TRACE STOP statement specified an address or sublist of addresses. One of these addresses was not the address of a TRACE statement and was, therefore, invalid.

In the message text, xxx is the invalid address in hexadecimal.

System Action: The invalid address was ignored. If the operand was a sublist, all traces corresponding to valid addresses were stopped.

User Response: If the job step is to be executed again, correct the invalid address.

IEGI43 'TRACE' STOPPED BY OVERLAY AT xxx

Explanation: During execution of the TESTRAN interpreter, the problem program loaded an overlay segment that overlaid all the TRACE statements for active traces.

In the message text, xxx is the address in hexadecimal of the instruction that caused the loading.

System Action: All traces were stopped. They were not automatically restarted when the segment containing the TRACE statements was reloaded.

User Response: If the job step is to be executed again, change the program so that the TRACE statements are not overlaid or be prepared to restart any traces that will be overlaid but will be required subsequently.

IEGI45 PROGRAM CHECK DURING 'TRACE' -- INSTRUCTION AT xxx

Explanation: During execution of the TESTRAN interpreter, a program interruption occurred during a trace of the problem program.

In the message text, xxx is the address in hexadecimal of the instruction that caused the interruption.

System Action: The standard system exit routine, or the routine specified by a SPIE macro-instruction, was given control. Active traces were not suspended.

User Response: If the job step is to be executed again, correct the instruction causing the program interruption.

IEGI47 'TRACE' STOPPED BY SVC AT xxx

Explanation: During execution of the TESTRAN interpreter, a LINK, XCTL, or RETURN macro-instruction was executed during a trace of the problem program.

In the message text, xxx is the address in hexadecimal of the supervisor call (SVC) instruction in the macro-expansion.

System Action: All traces were stopped. They were not automatically restarted when control was returned to the problem program.

User Response: If the job step is to be executed again, restart any traces that were stopped, but are required, upon return to the problem program.

IEGI48 FLOATING POINT REGISTER SELECTED
NO FLOATING POINT HARDWARE
JOB ABORTED

Explanation: During execution of the TESTRAN interpreter, a TESTRAN statement referred to a floating point register, but the computing system did not include the floating point option.

System Action: The task was terminated abnormally.

User Response: Either remove all references to floating point registers, and execute the job step again, or execute the job step on a computing system with the floating point option.

TESTRAN MACRO-EXPANSION MESSAGES

IEGM01 TEST HAS NOT BEEN OPENED

Explanation: A TESTRAN statement precedes the first valid TEST OPEN statement.

System Action: The statement was deleted. Severity code = 8.

User Response: Precede the statement with a valid TEST OPEN statement.

IEGM02 NAME NOT SPECIFIED

Explanation: A TEST OPEN statement does not contain a symbol in its name field.

System Action: The statement was deleted. Severity code = 12.

User Response: Provide the required symbolic name.

IEGM03 ENTRY POINT NOT SPECIFIED

Explanation: The second positional operand (problem program entry point) was omitted from a TEST OPEN statement.

System Action: The statement was processed normally. Severity code = *.

User Response: No response is required if the TEST OPEN statement never receives control directly, but instead is referred to by the OPTEST operand of another TEST OPEN statement. If the TEST OPEN statement does receive control directly, the omitted operand should be supplied.

IEGM04 THIS MACRO ESTABLISHES CSECT xxx

Explanation: A TEST OPEN statement, named xxx, initiates assembly of a control section with the same name. This control section will contain all subsequent TESTRAN statements until the next TEST OPEN macro-instruction initiates a new control section.

System Action: The statement was processed normally. Severity code = *.

IEGM05 xxx NOT A VALID OPERAND FOR yyy

Explanation: The first operand of a TESTRAN statement is xxx. This operand is not valid following the operation field yyy.

System Action: The statement was deleted. Severity code = 8.

User Response: Correct the first operand.

IEGM06 xxx yyy ADDRESS NOT SPECIFIED

Explanation: A required address operand was omitted from a TESTRAN statement whose operation field is xxx and whose first operand is yyy.

System Action: The statement was deleted. Severity code = 8.

User Response: Provide the required address operand.

IEGM07 THIS TEST DEFINE xxx HAS NO xxxS

Explanation: The third positional operand (flag or counter sublist) was omitted from a TEST DEFINE statement. The second positional operand, xxx, is either COUNTER or FLAG.

System Action: The statement was deleted. Severity code = 8.

User Response: Provide the required sublist of flag or counter names.

IEGM08 xxx NOT A VALID TEST DEFINE OPERAND

Explanation: The second positional operand of a TEST DEFINE statement is xxx. This operand is invalid.

System Action: The statement was deleted. Severity code = 8.

User Response: Correct the second operand. It must be either COUNTER or FLAG.

IEGM09 MACRO NUMBER xxx IN yyy

Explanation: An identification number, xxx, was assigned to a TESTRAN statement. This statement is in a control section named yyy, which is the name of the preceding TEST OPEN statement.

System Action: The statement was processed normally. Severity code = *.

User Response: Keep the assembler source and object program listing for comparison with the listing of TESTRAN edited output. The statement identification number, which appears in both listings, identifies all output produced by the statement.

IEGM10 SELECT CODE INVALID AND IGNORED

Explanation: The SELECT operand of a TESTRAN statement does not specify a valid TESTRAN output class.

System Action: The statement was processed, but the invalid operand was ignored. Severity code = 4.

User Response: Specify a valid output class number (an integer from 1 to 8), or compensate for the error by changing the PARM parameter of the EXEC statement for the TESTRAN editor.

IEGM12 xxx NOT A VALID OPERATOR

Explanation: The third positional operand of a TEST WHEN statement is xxx. This operand is not a valid logical or relational operator.

System Action: The statement was deleted. Severity code = 8.

User Response: Specify a valid logical operator (AND or OR) or relational operator (LT, LE, EQ, NE, GT, or GE).

IEGM13 INVALID LITERAL TYPE CODE

Explanation: An operand of a TESTRAN statement is a literal in which the type code is either absent or invalid.

System Action: The statement was deleted. Severity code = 8.

User Response: Correct the operand by specifying a valid type code following the equal sign (=) of the literal.

IEGM14 BOTH xxx AND yyy CANNOT BE LITERALS

Explanation: The second and fourth positional operands of a TEST WHEN statement are xxx and yyy, respectively. Both are literals. Because the arithmetic relationship between two literals is constant, a test of this relationship would be meaningless.

System Action: The statement was deleted. Severity code = 8.

User Response: Replace one literal with pointer to a main storage location, a register, or a TESTRAN counter.

IEGM17 DATAM IGNORED ON THIS FORM OF TEST WHEN

Explanation: A DATAM operand appears in a TEST WHEN statement that tests the condition of a TESTRAN flag, or a relationship between TESTRAN flags. The operand is invalid in this context.

System Action: The statement was processed, but the invalid operand was ignored. Severity code = 4.

User Response: Omit the DATAM operand, or rewrite the statement to test a relationship between arithmetic variables.

IEGM18 FORMAT UNKNOWN. 1 BYTE HEX ASSUMED

Explanation: In a SET VARIABLE or TEST WHEN statement, two operands specify the location of data, which is in registers or main storage. The attributes of this data are not defined in the symbol table nor are they specified by a DATAM operand. The data is, therefore, assumed to be hexadecimal with a length of one byte.

System Action: The statement was processed normally. Severity code = *.

User Response: If a 1-byte hexadecimal format is not intended, provide a DATAM operand that specifies the correct attributes.

IEGM19 TEST WHEN WRITTEN IMPROPERLY

Explanation: The format of a TEST WHEN statement is invalid.

System Action: The statement was deleted. Severity code = 8.

User Response: Correct the error in the format.

IEGM20 NO RIGHT PAREN IN OPERAND xxx

Explanation: A positional operand of a TESTRAN statement is an explicit or indexed implied address. In this operand, the right parenthesis was omitted. The position of the operand in the operand field is xxx.

System Action: The statement was processed; the right parenthesis was assumed to be present. Severity code = 4.

User Response: Check the source and object program listing to determine if assumption of the parenthesis resulted in correct processing of the statement. Rewrite the operand if the processing was not correct.

IEGM31 COMMENT IS INVALID

Explanation: In a DUMP COMMENT statement, the second positional operand (a programmer-written comment) either was omitted or is invalid. If invalid, the operand either is shorter than three characters (including delimiting apostrophes), or does not contain one or both of the required apostrophes.

System Action: The statement was deleted. Severity code = 8.

User Response: Specify or correct the comment operand.

IEGM32 xxx NOT A VALID TABLE TYPE

Explanation: The second positional operand of a DUMP TABLE statement is xxx. This operand is invalid.

System Action: The statement was deleted. Severity code = 8.

User Response: Correct the second operand. It must be DCB, DEB, or TCB.

IEGM33 INVALID REGISTER NOTATION

Explanation: The second positional operand (a register sublist) of a DUMP PANEL statement contains invalid register notation.

System Action: The statement was processed; the invalid operand was ignored and dumping of all registers was assumed. Severity code = 4.

User Response: No response is necessary.

IEGM34 INVALID TYPE CODE IN xxx

Explanation: The operand DATAM=xxx contains an invalid type code.

System Action: The statement was processed, but the invalid operand was ignored. Severity code = 4.

User Response: Correct the DATAM operand.

IEGM40 A REQUIRED ADDRESS NOT SPECIFIED

Explanation: This message occurred for either of two reasons:

- The second positional operand (the starting address for a trace) was omitted from a TRACE CALL, TRACE FLOW, or TRACE REFER statement.
- The third positional operand (the ending address for a trace) was omitted from a TRACE CALL statement.

System Action: The statement was deleted. Severity code = 8.

User Response: Provide the required address operand.

IEGM41 THIS TRACE STOP STOPS ALL TRACES

Explanation: The optional second positional operand (trace sublist) was omitted from a TRACE STOP statement. This statement will, therefore, stop all active traces.

System Action: The statement was processed normally. Severity code = *.

User Response: If all traces should not be stopped, provide the optional trace sublist operand to specify only those traces that are to be stopped.

IEGM42 COMMENT IS INVALID AND IGNORED

Explanation: The COMMENT operand of a TRACE statement is invalid. The operand either is shorter than three characters (including delimiting apostrophes), or does not contain one or both of the required apostrophes.

System Action: The statement was processed, but the invalid operand was ignored. Severity code = 4.

User Response: Correct the COMMENT operand.

IEGM50 2ND AND 3RD OPERANDS MUST BE PRESENT

Explanation: One or more required positional operands were omitted from a SET statement.

System Action: The statement was deleted. Severity code = 8.

User Response: Provide the required operand or operands.

IEGM51 SET FLAG CONDITION MUST BE =0 or =1

Explanation: The third positional operand (condition) of a SET FLAG statement is invalid.

System Action: The statement was deleted. Severity code = 8.

User Response: Write the third operand as =0 or =1, or as the symbolic name of a TESTRAN flag.

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Explanation:

p. 48.1, Fig 11: line 14 should be //GO.SYSTEST, not //EDIT.

p. 18, 2nd fig: need "DROP 4" before SAVE; otherwise "LA 4,MYDATA" may be wrong.

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