IBM Technical Newsletter

File Number S360-29

Re: Form No. Y28-6800-3

This Newsletter No. Y33-6004

Date November 21, 1968

Previous Newsletter Nos. Y33-6002

IBM SYSTEM/360 OPERATING SYSTEM
PL/I (F) COMPILER
PROGRAM LOGIC MANUAL

This Technical Newsletter, a part of Release 17, of IBM System/360 Operating System, provides replacement pages for the PL/I (F) Compiler, Program Logic Manual, Form Y28-6800-3. These replacement pages remain in effect for subsequent releases unless specifically altered. Pages to be inserted and/or removed are listed below.

23,24
39,40
40.1(added)
61
127,128
343,344
405-408
413-416
421-428.1

A change to the text or a small change to an illustration is indicated by a vertical line to the left of the change; a changed or added illustration is denoted by the symbol • to the left of the caption.

Summary of Amendments

Additional material on BASED items has been added to Phase FX in Section 2; system generation material for the Model 91 has been incorporated in Appendix G; and the list of diagnostic messages in Appendix I has been updated.

Note: Please file this cover letter at the back of the manual to provide a record of changes.

*IBM United Kingdom Laboratories Ltd., Programming Publications, Hursley Park, Winchester, Hampshire, England.*

PRINTED IN U.S.A.

**Restricted Distribution**

The compiler completion codes are as follows:

| Code | Meaning |
|---|---|
| 0 | No diagnostic messages issued; compilation completed with no errors |
| 4 | Warning messages issued; program compiled |
| 8 | Error messages issued; program compiled but with errors; execution may fail |
| 12 | Severe error messages issued; compilation may be completed but with errors, successful execution improbable. If a severe error occurs during compile-time processing, a listing of the PL/I text on SYSUT3 will be printed if the SOURCE option is specified. The compilation will be terminated. |
| 16 | Terminal error messages issued; compilation terminated abnormally |

| Data Set | SYSIN | SYSLIB | SYSLIN | SYSPRINT | SYSPUNCH | SYSUT1 | SYSUT3 |
|---|---|---|---|---|---|---|---|
| Module | | | | | | | |
| AA[1] | | | WRITE | | | OPEN[3] | |
| AB | OPEN | | OPEN | OPEN/WRITE | OPEN | OPEN[3] | OPEN |
| AC[1] | | | | | | | WRITE/READ |
| AE[1] | | OPEN | | | | | |
| AG | | | | | | | CLOSE/OPEN |
| BW | | | | | | CLOSE | |
| BX | READ | | | | | | |
| CI | READ | | | WRITE | | READ/WRITE | WRITE/READ |
| AS[2] | READ | READ | | WRITE | | | WRITE |
| FY | | | | WRITE | | | |
| UA | | | | WRITE | | | |
| UD | | | | | WRITE | | |
| UF | | | | WRITE | | | |
| XB | | | | WRITE | | | |
| AE | CLOSE | | | | | | CLOSE |
| AK[4] | | | | | | CLOSE | |
| AK[5] | | CLOSE | CLOSE | CLOSE | CLOSE | CLOSE | |

[1]AA, AC, and AE are modules of the control phase, and contain actual I/O routines which interface with the O/S access methods (BSAM, QSAM). I/O activity shown for other modules indicates that these modules are utilizing the I/O routines.
[2]AS may read from included data sets in addition to those shown in the table.
[3]If the SIZE option results in 1K text and dictionary blocks, SYSUT1 is opened by Module AB. In the case of other SIZE options, SYSUT1 is opened by Module AA when the available main storage is full. The timing depends on the size of program to be compiled.
[4]AK closes only the spill file SYSUT1 when the batch option is used and a further source program is to be compiled.
[5]AK closes all other files upon termination of a single or batch compiler run.

● Figure 4. Input/Output Usage Table

## COMPILER CONTROL MODULES

In addition to modules AA and AB, further modules, AC, AD, AE, AF, AG, AH, AI, AK, AL, AM, AN, and JZ are used in compiler control. The functions of these modules are briefly described in the following paragraphs.

### Module AC

Module AC controls reading and writing operations on SYSUT3, the intermediate file. It is loaded only if the CHAR48 or MACRO option is specified, and is deleted at the end of the Read-In Phase.

ameter descriptions for entry points and defined items, are placed in the AUTOMATIC chain for the appropriate block.

7. The dictionary entry for any item described by a picture is expanded by the precision and scale or string length, extracted from the picture table entry. Identifiers of different modes sharing the same picture table are now placed in separate tables.

8. The 'dope vector required' bit (see Appendix C.5) is set on where necessary.

9. When a label array is found which has initial label statements for any of its elements, the chained statements are moved into the second file. The original statement is left in the text, to be removed by Phase FV.

10. Dictionary entries similar to label BCD entries are made for all TASK variables.

Phase FV

Phase FV scans the second file and reverses the pointers to the dictionary.

Dictionary entries for DEFINED data are completed (see Appendix C.4 and C.5). Overlay and correspondence defining are differentiated between, as are static and dynamic defining. A preliminary check of the validity of defining is also carried out.

When PROCEDURE and BEGIN statements are encountered, any second file statements associated with data in the AUTOMATIC chain for that block are inserted in the text following such statements.

When ALLOCATE statements are found, any second file statements associated with the item being allocated are inserted in the text following the statement.

When a reference to dynamically defined data is found, the base reference is inserted into the text following the defined reference.

When an initial label statement is encountered in the main text, it is not copied into the output string.

The dictionary reference of a POINTER in a PEXP (pointer expression) second file statement is inserted into the defined slot of the associated based variable. If the based variable is a structure this reference is propagated throughout the structure. The PEXP statement is then deleted.

A similar procedure is performed for BVEXP (based variable expression) second file statements whereby the dictionary reference of the AREA is inserted into the dictionary entry of the associated OFFSET variable.

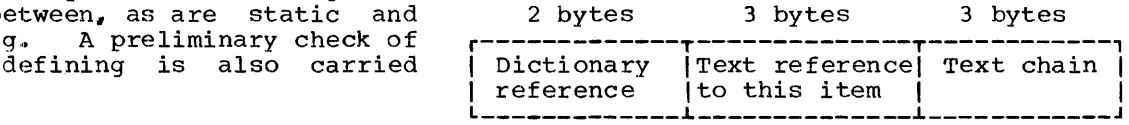
ADV second file statements referring to a BASED variable are checked for compliance with the (F) implementation rules. If the rules are obeyed, the dictionary entry of the 'bound' variable is inserted in the appropriate slot in the multiple table entry.

If an MTF statement refers to a based variable the appropriate bound slot is copied from one multiple table entry to the other.

Phase FX

Phase FX is an optional phase entered only if the XREF or ATR (cross reference lister and attribute lister respectively) options are specified. It scans the STATIC, AUTOMATIC, and CONTROLLED chains, and the formal parameter lists.

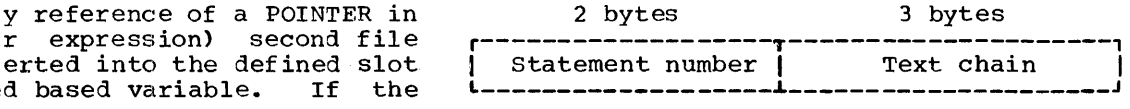
For each identifier it creates an entry in scratch text storage of the form:




This entry is inserted into a chain of similar entries in the alphabetical order of the BCD of the identifier.

If the XREF option is specified, the text is scanned for dictionary references. When the dictionary reference of an identifier is found in the text, an entry is created in a chain of entries from the dictionary entry of the identifier. If the identifier is that of a BASED item, an entry is also created in a chain of entries from the dictionary entry of the associated pointer.

Each chain member thus represents a text reference to an identifier and has the form:



Each reference chain for an identifier is in scratch text storage.

The sorted chain of identifiers is then scanned, and for each entry in the chain the following actions take place:

1. The statement number of the DECLARE statement, if any, in which the identifier was declared is printed

2. The BCD of the identifier is printed. For variables having constant dimensions and/or constant string lengths, these dimensions and lengths will be listed.

3. If the ATR option is specified, the dictionary entry of the identifier is analyzed and its attributes are printed

4. If the XREF option is specified, the reference chain for the identifier is scanned, and the statement number contained in each entry is printed

Finally, all scratch storage is released and control is passed to the Pretranslator Phase.

## THE PRETRANSLATOR LOGICAL PHASE

The purpose of the Pretranslator Phase is to expand those statements in the language that can be broken down into simpler statements, and to insert explicitly generated statements in place of implied ones.

Second level markers (see Appendix D.1) are removed from internal compiler codes, and some of the I/O statements are changed into a form more suitable for the pseudo-code phase.

Argument lists are examined and the matching of arguments with parameter descriptions takes place, with temporary variables being created where necessary, e.g., where data conversions are required.

If the compilation contains ON CHECK conditions the appropriate calls to the library routine are provided.

Any structure assignments containing the BY NAME option are processed.

If any structure assignment statements or structures in I/O lists are detected in the program, they are expanded into scalar assignments and DO groups.

If the program contains any array assignments, or array expressions in I/O lists, these are expanded into DO loops and scalar assignments or expressions.

If the program contains iSUB references, the subscripts are computed for the base array corresponding to the subscripts given for the defined array.

### Additions to the Text

In addition to changing the content of the text, the Pretranslator introduces some new symbols and grammatical forms into the source text. These are as follows:

The Umbrella Symbol: this is designated by the symbol code X'5E', which is used to introduce a literal as an operand. It is used only as a bound of a DO loop, or in a call of the dope vector pseudo-variable.

Statements within statements: a list of statements may be introduced within another statement. In this case the inserted list is enclosed in parentheses. Statements in the list are given no statement number field, but they have semi-colons at the end.

I/O statements: the form of I/O statements is changed considerably during the pretranslator phases, as explained in the description of Phase GB.

BUY and SELL statements: special statements are introduced for manipulating temporary storage at object time; they have a form similar to ALLOCATE and FREE statements.

Temporary Storage: Pretranslator phases create temporary variables for function and procedure calls where the arguments do not match the final parameters, where expressions appear as arguments, for control variables for DO loops in array and structure assignments, and for iSUB defined subscript lists. The Pretranslator has no mechanism for evaluating expressions. Therefore, temporaries which have no data type are created for expression arguments with no parameter description. The data type of these temporaries is completed by the Translator generic phase when the resultant data type of the expression has been determined.

When the Pretranslator creates a temporary from an argument which contains any array with adjustable bounds or adjustable string length, compiler functions (see Appendix D.8) are gener-

ated in-line, to set up the adjustable quantities at object time, to enable storage of the correct size to be acquired by means of the BUY statement.

Any initial value statements associated with the ALLOCATE statement are extracted and placed in-line. The initialization statements are then skipped, and the scan continues. The last two steps are also performed for LOCATE (based variable) and ALLOCATE (based variable) statements. Action for a BUY statement is similar to an ALLOCATE statement, with the following exceptions:

1. Bound and string length code is in-line, bracketed between BUYS and BUY statements - there is therefore no look ahead
2. There is no initial value code associated with temporaries
3. A slot in the DSA is updated with the pointer to the allocated storage for a temporary

The action on encountering a FREE statement is to generate code to load a parameter register with the pointer to the allocated storage for the FREE VDA Library call inserted by the pseudo-code.

Phase QU

Phase QU scans the pseudo-code text in search of instructions which have misaligned operands. (A misaligned operand has the UNALIGNED attribute and is not aligned on the boundary appropriate to its data type). When such an instruction is found, QU inserts a move character (MVC) instruction in the pseudo-code text to move the operand to or from an aligned workspace area, and substitutes the address of this workspace for the operand address in the original instruction. If the address of a misaligned operand is loaded into a register, a note is made of that register. QU thereafter treats the instructions which refer to it as if they referred to the operand itself, by inserting a move character instruction, and substituting the workspace address for the reference in the instruction.

Phase QU uses storage beginning at offset 32 from register 9 for its workspace.

Whenever a load address (LA) instruction is found which lies within the calling sequence of a library routine and which loads the address of a misaligned argument of that routine, an aligned workspace address is substituted in the instruction, and the requisite move character instruction is stacked. It is not inserted in the output text until the instruction is encountered that loads register 15 prior to the exit to the library routine, or in the case of EDIT-directed I/O routines, until the appropriate branch-and-link (BALR) instruction is encountered. The stacked move character instruction is inserted into the output before the exit to the routine if the argument in question is an input argument to the routine, and after the return from the routine if it is an output argument.

Phase QX

Phase QX is the 'AGGREGATE LENGTH TABLE' printing phase. It is entered only if the ATR (attribute list) or XREF (cross reference list) options are specified. It scans the STATIC, AUTOMATIC, CONTROLLED and COBOL chains, and, for each major structure or non-structured array that is found, an entry is printed in the AGGREGATE length table.

An AGGREGATE LENGTH TABLE entry consists of the source program DECLARE statement number, the identifier and the length (in bytes) of the aggregate. In the case of a CONTROLLED non-BASED aggregate no entry is printed for the DECLARE statement, but an entry is printed for each ALLOCATE for the aggregate, the source program ALLOCATE statement number being printed in the 'statement number' column.

Where the length of an aggregate is not known at compilation the word "ADJUSTABLE" is printed in the 'length in bytes' column of the entry for that aggregate. If an aggregate is dynamically defined, the word "DEFINED" appears in that column. Entries for COBOL mapped aggregates have the word "(COBOL)" appended.

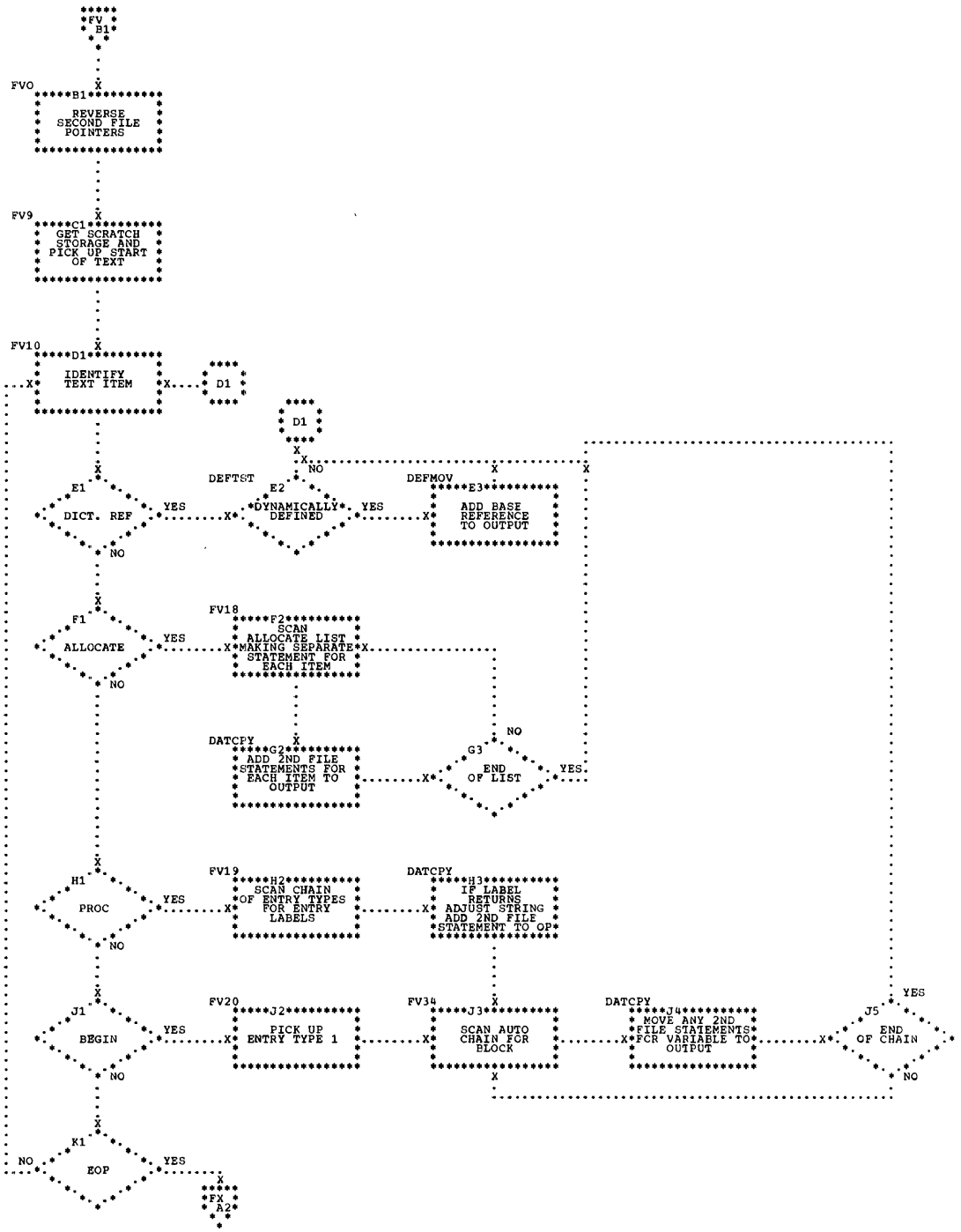
Before printing begins the aggregate length table entries are sorted so that the identifiers appear in collating sequence order.

## THE REGISTER ALLOCATION LOGICAL PHASE

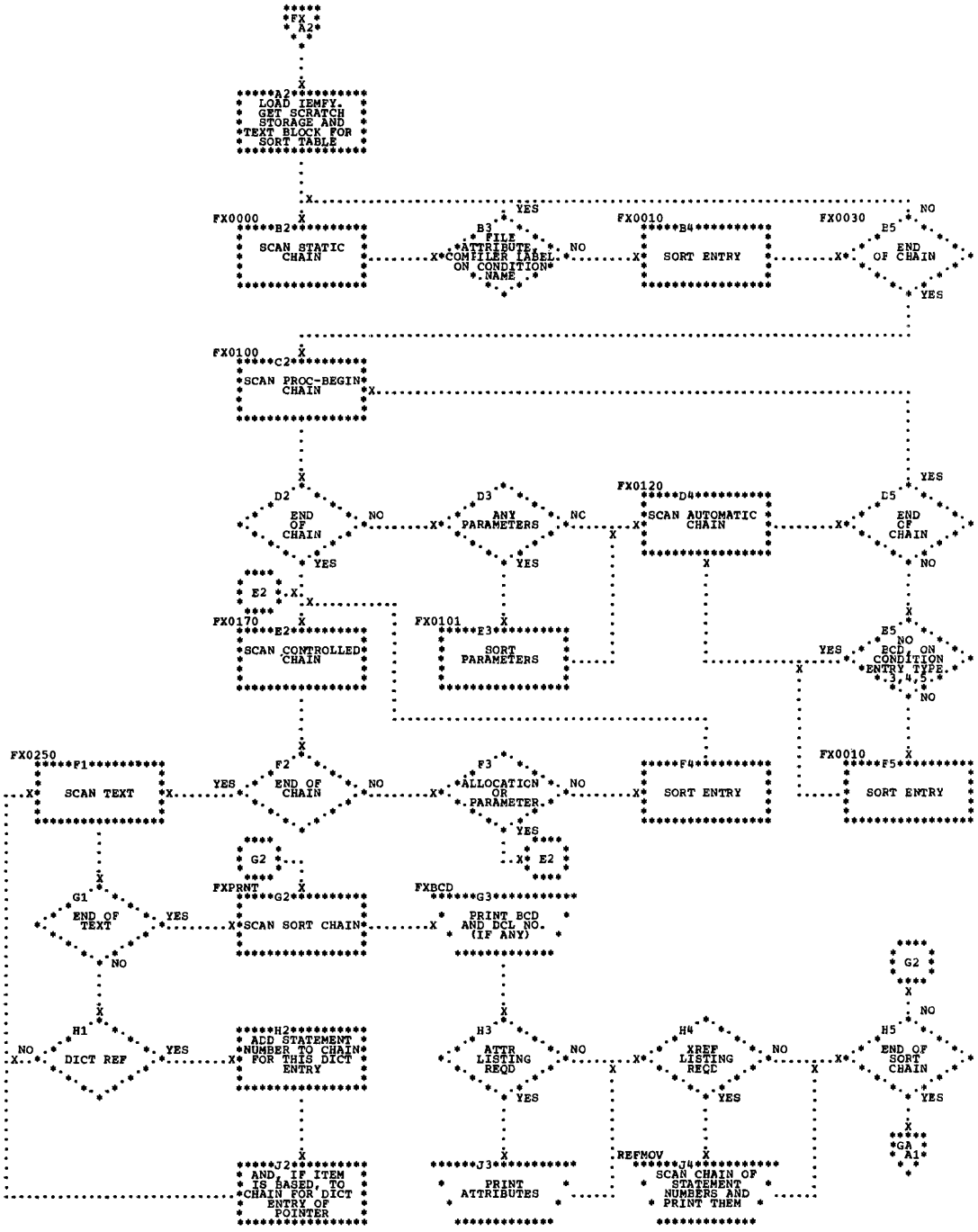
The purpose of the Register Allocation Phase is to insert into the text the appropriate addressing mechanisms for all types of storage, and to allocate physical general registers where symbolic registers are specified or required as base registers.

This phase comprises two physical phases, each with a specific function. The first, Phase RA, processes the addressing mechanisms, while the second phase, Phase RF, allocates the physical registers.

Chart FV. Phase FV Overall Logic Diagram



- Chart FX. Phase FX Overall Logic Diagram



## PHASE DIRECTORY

Because of the number of phases in the compiler, the phase directory is split into halves. The first half is constructed during the initialization of the compiler; also a list of names of the phases in the second half is kept in Phase AA. This list is used to pass status indications (i.e., whether phases are wanted or not wanted) from the first half to the second half. Phase JZ uses the list to construct a new directory for the second half.

The phase directory is constructed by use of the BLDL macro and a build list. The format of the build list is fully described in the publication IBM System/360 Operating System, Supervisor and Data Management Services, Form C28-6646.

Each entry in the build list is 30 bytes long. On returning from the BLDL macro, two bytes of the name field and ten other bytes of each satisfied entry in the build list are used to construct a 12-byte phase directory entry in the compiler control routines. The build list is destroyed after the initialization process is complete.

The format of a phase directory entry is as follows:

| Byte Number | Description |
|---|---|
| 1 - 2 | Phase name |
| 3 | Status byte |
| 4 - 5 | Concatenation number and Library identification |
| 6 - 8 | TTR of first text record; where TT is the relative track number, and R is the block number on that track |
| 9 - 10 | Total amount of storage required |
| 11 - 12 | Length of first text record |

## Control Code Word -- CCCODE

The format of the control code word (CCCODE), which is four bytes in length, is as follows:

| Byte | Bit | | |
|---|---|---|---|
| 0 | 0 | DUMP | 1 wanted<br>0 not wanted |
| | 1 | | 1 abort has occurred |
| | 2 | LIST | 1 not wanted<br>0 wanted |
| | 3 | LOAD | 1 not wanted<br>0 wanted |
| | 4 | DECK | 1 not wanted<br>0 wanted |
| | 5 | EXTREF | 1 not wanted<br>0 wanted |
| | 6 | XREF | 1 not wanted<br>0 wanted |
| | 7 | ATR | 1 not wanted<br>0 wanted |
| 1 | 0 | | 1 means U-format<br>0 means F-format records on input |
| | 1 | | 1 if track overflow is present |
| | 2 | | Severity code |
| | 3 | | Severity code |
| | 4 | | Severity code |
| | 5 | | Severity code<br>where 0000=FLAGW<br>0001=FLAGE<br>0010=FLAGS |
| | 6 | CHAR 48 | 1 not wanted<br>0 wanted |
| | 7 | MACRO | 1 not wanted<br>0 wanted |
| 2 | 0 | SOURCE | 1 not wanted<br>0 wanted |
| | 1 | CHK | 1 not wanted<br>0 wanted |
| | 2 | BCD | 1 BCD input<br>0 EBCDIC input |
| | 3 | SOURCE2 | 1 wanted<br>0 not wanted |
| | 4 | OPT | 1 wanted<br>0 not wanted |
| | 5 | | 1 AE required |
| | 6 | | 1 program check has occurred |
| | 7 | | 1 means first record has been read |
| 3 | 0 | STMT | 1 not wanted<br>0 wanted |

| | | |
|---|---|---|
| 1 | MACDCK | 1 not wanted<br>0 wanted |
| 2 | COMP | 1 not wanted<br>0 wanted |
| 3 | | 1 macro phase now running |
| 4 | | 1 batch record found<br>0 batch record not found |
| 5 | | 1 EOF record found<br>0 EOF record not found |
| 6 | | not used requirement |
| 7 | NEST | 1 wanted<br>0 not wanted |

The (F) Compiler requires main storage for the following purposes :

Compiler processing phases

Print buffers

Compiler control routines

Dictionary area

Text area

Input/Output buffers

Input/Output routines (BSAM)

The main storage required by each phase of the compiler need be contiguous only for each control section.

During the read-in phases a minimum of two dictionary blocks and two text blocks are available in storage simultaneously.

During the rest of the compilation four dictionary blocks and four text blocks are available in storage simultaneously.

The dictionary and text block size is chosen according to the amount of main storage available to the compiler. The SIZE option, interpreted at invocation time, provides the value used to determine the block size. The space needed for large I/O buffers is subtracted from SIZE and the space remaining is used when determining text and dictionary block size, as detailed in the publication IBM System/360 PL/I(F) Programmer's Guide. A table contained in Phase AB is searched, using the SIZE option as an argument. When the correct entry is found, the block size is extracted.

The first table shows the relationship between the compiler requirements and the text and dictionary block sizes. The second table details the storage allocation in each environment.

Compiler Requirements and Dictionary/Text Block Relationship

| Environment | Dictionary/Text Block Size | Compiler Requirements |
|---|---|---|
| A | 1K | 44K - 56K |
| B | 2K | 56K - 72K |
| C | 4K | 72K - 132K |
| D | 8K | 132K - 168K |
| E | 16K | 168K |

| Storage Allocation | DURING READ-IN PHASE | | | | | AFTER READ-IN PHASE | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | ENVIRONMENT | | | | | ENVIRONMENT | | | | |
| | A | B | C | D | E | A | B | C | D | E |
| OS Dynamic Storage | | | | | | | | | | |
| TIOT | 228 | 228 | 228 | 228 | 228 | 228 | 228 | 228 | 228 | 228 |
| SPIE | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 | 32 |
| LOAD | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 |
| OS Temporary Storage | | | | | | | | | | |
| End of Volume | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 | 800 |
| Data Management | 4894 | 4894 | 4894 | 4894 | 4894 | 4894 | 4894 | 4894 | 4894 | 4894 |
| Compiler Control | 12266 | 12266 | 12266 | 12266 | 12266 | 12266 | 12266 | 12266 | 12266 | 12266 |
| Phase Area | 16384 | 16384 | 16384 | 16384 | 16384 | 12288 | 12288 | 12288 | 12288 | 12288 |
| Text Area | 2048 | 8192 | 16384 | 32768 | 65536 | 4096 | 8192 | 16384 | 32768 | 65536 |
| Dictionary Area | 2048 | 8192 | 16384 | 32768 | 65536 | 4096 | 8192 | 16384 | 32768 | 65536 |
| Scratch Storage | 4096 | 4096 | 4096 | 4096 | 4096 | 4096 | 4096 | 4096 | 4096 | 4096 |
| I/O Buffers | 1538 | 1538 | 1538 | 1538 | 1538 | 1538 | 1538 | 1538 | 1538 | 1538 |
| TOTALS | 44374 | 56662 | 73038 | 105814 | 171340 | 44374 | 52566 | 68950 | 101718 | 167254 |

Initially, four text and four dictionary blocks are allocated to the compiler (two each are allocated when only 44K bytes of storage are available to the compiler. This is then expanded to four of each at the end of the read-in phase). If the text and/or dictionary expands to fill these blocks, more main storage is allocated as blocks. This process continues until the spill point is reached (i.e., until all the main storage available to the compiler has been used). If still more main storage is required, the spill file (SYSUT1) is opened, and blocks are written out.

The communications region is an area specified by the control routines, and used to communicate necessary information between the various phases of the compiler. The communications region is resident in the first dictionary block throughout the compilation.

Entry to the various compiler control routines is via a transfer vector. Details of the transfer vector and the organization of the communications region appear in this Appendix.

Note: The use of the communications region during compile-time processing is described in Appendix J.

## TRANSFER VECTORS

| Hex. Offset | Name | Description |
|---|---|---|
| 8 | ZUPL | Print a line |
| C | ZURD | Read a card |
| 10 | ZUGC | Get scratch storage |
| 14 | ZUTXTC | Get text block |
| 18 | ZURC | Release scratch storage |
| 1C | | |
| 20 | ZABORT | Dump and go to error message routines |
| 24 | ZLOADW | Load and return to caller |
| 28 | ZDICAB | Make dictionary entry. Absolute address returned |
| 2C | ZDICRF | Make dictionary entry. Dictionary reference returned |
| 30 | ZUERR | Make error message entry |
| 34 | ZDRFAB | Convert dictionary reference to absolute address |
| 38 | ZLOADX | Load with overlay and return to caller |
| 3C | | |
| 40 | REQEST | Give a list of phase names required or not wanted for this compilation |
| 44 | RELESE | Release all named phases |
| 48 | RLSCTL | Release all named phases and pass to next phase |
| 4C | ZDUMP | Dump specified core and continue |
| 50 | ZTXTRF | Convert absolute address to text reference |
| 54 | ZTXTAB | Convert text reference to absolute address |
| 58 | ZCHAIN | Find next block in chain |
| 5C | ZALTER | Change text block status |
| 60 | ZDABRF | Convert absolute address to dictionary reference |
| 64 | ZNALRF | Not aligned dictionary entry. Reference returned |
| 68 | ZNALDB | Not aligned dictionary entry. Absolute address returned |
| 6C | ZEND | Terminate job |
| 70 | ZULF | Write on load file |
| 74 | ZUSP | Write on punch |
| 78 | ZUBW | Write on backing store |
| 80 | RLSCTLX | Release all named phases and hand control to the next phase, after having loaded it with overlay |
| 84 | RECONS | Reconstitute instructions in IEMAL |
| 88 | DYNAMIC | Pass control to the dynamic dump routines, if required |
| 8C | IEMAL/ IEMAN | Address of second control phase |

## COMMUNICATIONS REGION

These tables give the following information for each location of the communications region: name of location; offset (i.e., relative address); use (i.e., stages of compilation during which the location is in use); and a description of the contents. Certain locations are used in one capacity during part of the compilation, and then re-used in a different capacity during another part of the compilation. In these cases, one location will have two table entries: details of alternative usage appear in the columns headed $Name_2$, $Use_2$, etc.

Table 3. Communications Region. Bit Usage in ZFLAGS

| BYTE NAME | OFFSET | BIT (HEX) | BIT NAME | DESCRIPTION Bits are set on, on encountering:- |
|---|---|---|---|---|
| ZFLAG1 | ZCOMM+16 | 80 | ZDEFFL | DEFINED attribute |
| | | 40 | ZAWAFL | ALLOCATE statement |
| | | 20 | ZSECFL | Second File statement |
| | | 10 | ZDIMFL | Dimension attribute |
| | | 08 | ZCHKFL | CHECK/NOCHECK prefix |
| | | 04 | ZONFL | ON, SIGNAL or REVERT statement |
| | | 02 | ZSTRFL | Structure |
| | | 01 | ZDECFL | DECLARE statement |
| ZFLAG2 | +17 | 80 | ZLIKFL | LIKE attribute |
| | | 40 | ZINTST | STATIC INITIAL |
| | | 20 | ZOPCFL | OPEN/CLOSE statement |
| | | 10 | ZGTPFL | GET/PUT statement |
| | | 08 | ZGOTFL | GO TO statement |
| | | 04 | ZTEPFL | TASK/EVENT/PRIORITY options, REPLY statement |
| | | 02 | ZPICFL | PICTURE attribute/format item |
| | | 01 | ZISBFL | iSUB defining |
| ZFLAG3 | +18 | 80 | ZCONTG | UNALIGNED(NONSTRING) attribute |
| | | 40 | ZSETFL | SETS attribute |
| | | 20 | ZOSSFL | DELAY, DISPLAY, WAIT statement |
| | | 10 | ZARGFL | Argument list |
| | | 08 | ZINLFL | INITIAL Label |
| | | 04 | ZDIOFL | DATA directed I/O |
| | | 02 | ZRECIO | RECORD I/O |
| | | 01 | ZINTAC | AUTO/CTL initialization |
| ZFLAG4 | +19 | 80 | ZFREE | FREE statement |
| | | 40 | STM256 | More than 256 statements |
| | | 20 | FILEFL | Files present |
| | | 10 | | SPARE |
| | | 08 | ZPUTFL | PUT DATA |
| | | 04 | ZGETFL | GET DATA |
| | | 02 | ZPTRFL | Pointer Qualifier |
| | | 01 | ZRODFL | STATIC DSA Entry |
| ZFLAG5 | +20 | 80 | ZFTASK | TASK/EVENT/PRIORITY option on a CALL statement |
| | | 40 | ZDENFL | Set by FT |
| | | 20 | ALCSLM | ALLOCATE, with second level marker |
| | | 10 to 01 | | Spare |

## APPENDIX G: SYSTEM GENERATION

For full details of the system generation process, see IBM System/360 Operating System: System Generation, Form C28-6554.

During the system generation process, a control section named IEMAF is assembled (see Figure 13) containing a table consisting of five fixed-point values aligned on full-word boundaries, immediately followed by a bit string field that is twelve bytes in length. The five fixed-point values are related to the compiler options LINECNT, SIZE, SORMGIN (start), SORMGIN (end), and CONTROL COLUMN (PAGECTL), respectively. Bits 0 to 38, and 42 to 45 in the string are used to specify the default status of the options. Bits 46 to 91 in the string are used to specify if an option keyword is to be deleted or not. A "1" in the bit string means "yes" and a "0" means "no". The remaining bits in the string are spare bits not currently in use. Figure 14 shows the bit identification table associated with the control section.

```
IEMAF    START
         DC F'60'
         DC F'999999'
         DC F'2'
         DC F'72'
         DC F'0'
         DC B'0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 '     DEFAULT
         DC B'0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 '     SWITCHES
         DC B'0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 '     DELETE
         DC B'0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 '     SWITCHES
         DC B'0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 '     SPARE
         DC B'0 0 0 0 0 0 0 0  0 0 0 0 0 0 0 0 '     SWITCHES
```

Figure 13. The IEMAF Control Section

| Bit | Parameter | Bit | Parameter | Bit | Parameter |
|---|---|---|---|---|---|
| 0 | ATR | 32 | NOOPLIST | 64 | DELETE=NOXREF |
| 1 | NOATR | 33 | STMT | 65 | DELETE=SOURCE |
| 2 | BCD | 34 | NOSTMT | 66 | DELETE=NOSOURCE |
| 3 | EBCDIC | 35 | MACRO | 67 | DELETE=SOURCE2 |
| 4 | CHAR60 | 36 | NOMACRO | 68 | DELETE=NOSOURCE2 |
| 5 | CHAR48 | 37 | NEST | 69 | DELETE=OPT |
| 6 | DECK | 38 | NONEST | 70 | DELETE=LINECNT |
| 7 | NODECK | 39 | Not used | 71 | DELETE=LINELNG |
| 8 | EXTREF | 40 | Not used | 72 | DELETE=SIZE |
| 9 | NOEXTREF | 41 | Not used | 73 | DELETE=SORMGIN |
| 10 | FLAGW | 42 | COMP | 74 | DELETE=DUMP |
| 11 | FLAGE | 43 | NOCOMP | 75 | DELETE=STMT |
| 12 | FLAGS | 44 | LIBRARY OPTION, REAL | 76 | DELETE=NOSTMT |
| 13 | LIST | 45 | LIBRARY OPTION, COMPLEX | 77 | DELETE=MACRO |
| 14 | NOLIST | 46 | DELETE=ATR | 78 | DELETE=NOMACRO |
| 15 | LOAD | 47 | DELETE=NOATR | 79 | DELETE=COMP |
| 16 | NOLOAD | 48 | DELETE=BCD | 80 | DELETE=NOCOMP |
| 17 | XREF | 49 | DELETE=EBCDIC | 81 | DELETE=M91 |
| 18 | NOXREF | 50 | DELETE=CHAR60 | 82 | DELETE=NOM91 |
| 19 | SOURCE | 51 | DELETE=CHAR48 | 83 | DELETE=PAGECTL |
| 20 | NOSOURCE | 52 | DELETE=DECK | 84 | DELETE=MACDCK |
| 21 | SOURCE2 | 53 | DELETE=NODECK | 85 | DELETE=NOMACDK |
| 22 | NOSOURCE2 | 54 | DELETE=EXTREF | 86 | DELETE=EXTDIC |
| 23 | OPT=0 | 55 | DELETE=NOEXTREF | 87 | DELETE=NOEXTDIC |
| 24 | OPT=1 | 56 | DELETE=FLAGW | 88 | DELETE=OPLIST |
| 25 | M91 | 57 | DELETE=FLAGE | 89 | DELETE=NOOPLIST |
| 26 | NOM91 | 58 | DELETE=FLAGS | 90 | DELETE=NEST |
| 27 | MACDCK | 59 | DELETE=LIST | 91 | DELETE=NONEST |
| 28 | NOMACDCK | 60 | DELETE=NOLIST | - | Bits 92-95 |
| 29 | EXTDIC | 61 | DELETE=LOAD | | not used |
| 30 | NOEXTDIC | 62 | DELETE=NOLOAD | | |
| 31 | OPLIST | 63 | DELETE=XREF | | |

●Figure 14. Bit Identification Table

## APPENDIX H: CODE PRODUCED FOR PROLOGUES AND EPILOGUES

The mechanism of dynamic storage management is described in the publication IBM System/360 Operating System PL/I Library Program Logic Manual, Form Z28-6591

Part of the code required to implement the storage management is generated as prologue and epilogue code by the compiler. This Appendix contains annotated examples of prologues and epilogues for PROCEDURE, BEGIN, and ON blocks.

### PROLOGUES AND EPILOGUES

Example in PL/I

```
A:I: PROCEDURE(X,Y);
     DECLARE Y CONTROLLED;
       .
       .
       .
     ON OVERFLOW C=0;
       .
       .
       .
B: BEGIN;
       .
       .
       .
   END;
       .
       .
       .
AB:IJK: ENTRY(Y,Z)
       .
       .
       .
     RETURN(EXPRESSION)
       .
       .
       .
   END;
```

```
A         BC     15,16,(0,15)          BRANCH ROUND FOLLOWING CONSTANTS
          DC     A11(1)                LENGTH OF BCD
          DC     C'A'                  BCD OF ENTRY POINT
SIZDSA    DC     F' SIZE OF DSA'
STATIC    DC     A(STATIC CONTROL      ADDRESS OF STATIC INTERNAL CONTROL SECTION
                 SECTION)              (ONLY COMPILED FOR EXTERNAL AND ON PROLOGUES)
          STM    14,11,12,(13)         SAVE STANDARD REGISTERS IN SAVE AREA OF
          *                            CALLER'S DSA
          LR     10,15                 SET UP FIRST PROLOGUE BASE
          BAL    8,GETDSA(0,10)        CALL ROUTINE TO GET DSA
          MVI    SWITCH(13),X'X1'      INSERT RETURN (EXPRESSION) SWITCH
*                                      (ONLY COMPILED IF THERE IS A RETURN (EXP)
*                                      AND THE ENTRY LABELS HAVE DIFFERENT DATA
*                                      ATTRIBUTES)
          BC     15,COPRAM1(0,10)      BRANCH TO COPY OVER PARAMETERS
```

```
         ST      4,84(13)
         ST      2,80(13)
         ST      2,8(13)
         MVI     76(13),X'00'
         ST      2,96(13)
         BR      14
         L       15,32(11)
         BR      15

*        END SUBROUTINE

*        EPILOGUE SUBROUTINE

         TM      1(13),X'80'
         BC      8,60(15)
         L       2,80(13)
         LTR     2,2
         BC      7,60(15)
         C       13,PR..IHEQSLA(12)
         BC      7,60(15)
         L       13,4(13)
         ST      13,PR..IHEQSLA(12)
         TM      0(13),X'80'
         BC      1,50(15)
         L       13,4(13)
         B       34(15)
         ST      2,8(13)
         LM      14,11,12(13)
         BR      14
         L       15,A..IHESAFA
         BR      15

*        END SUBROUTINE

*        STATIC PROLOGUE SUBROUTINE

         L       4,PR..IHEQINV(12)
         LTR     4,4
         BC      11,86(15)
         L       7,PR..IHEQLWO(12)
         MVC     80(4,3),80(7)
         LA      4,1(4)
         ST      4,PR..IHEQINV(12)
         ST      4,84(3)
         MVI     76(3),X'00'
         ST      3,8(13)
         LR      13,3
         L       3,PR..IHEQSLA(12)
         ST      3,4(13)
         ST      13,PR..IHEQSLA(12)
         SR      2,2
         ST      2,80(13)
         ST      2,8(13)
         ST      2,96(13)
         BR      14

*        END SUBROUTINE
```

## APPENDIX I: DIAGNOSTIC MESSAGES

The messages produced by the PL/I (F) Compiler are explained in the publication IBM System/360 Operating System, PL/I (F) Programmer's Guide, Form C28-6594. The following table associates a message number with the particular phase and module in which the corresponding message is generated.

| Message Number | Logical Phase | Module |
|---|---|---|
| IEM0001I | Read In | CA |
| IEM0002I | Read In | CA |
| IEM0003I | Read In | CA,CP |
| IEM0004I | Read In | CA |
| IEM0005I | Read In | CA,CL |
| IEM0006I | Read In | CA |
| IEM0007I | Read In | CA |
| IEM0008I | Read In | CA |
| IEM0009I | Read In | CA |
| IEM0010I | Read In | CA |
| IEM0011I | Read In | CA |
| IEM0012I | Read In | CA |
| IEM0013I | Read In | CA |
| IEM0014I | Read In | CA |
| IEM0015I | Read In | CA |
| IEM0016I | Read In | CA |
| IEM0017I | Read In | CA |
| IEM0018I | Read In | CA |
| IEM0019I | Read In | CA |
| IEM0020I | Read In | CA |
| IEM0021I | Read In | CA |
| IEM0022I | Read In | CA |
| IEM0023I | Read In | CA |
| IEM0024I | Read In | CA |
| IEM0025I | Read In | CA |
| IEM0026I | Read In | CA |
| IEM0027I | Read In | CA |
| IEM0028I | Read In | CG |
| IEM0029I | Read In | CA |
| IEM0031I | Read In | CA,CL,CT |
| IEM0032I | Read In | CC |
| IEM0033I | Read In | CC |
| IEM0035I | Read In | CC |
| IEM0037I | Read In | CC |
| IEM0038I | Read In | CC |
| IEM0039I | Read In | CC |
| IEM0040I | Read In | CC |
| IEM0043I | Read In | CC |
| IEM0044I | Read In | CC |
| IEM0045I | Read In | CC |
| IEM0046I | Read In | CC |
| IEM0048I | Read In | CG |
| IEM0050I | Read In | CL,CP |
| IEM0051I | Read In | CL,CP |
| IEM0052I | Read In | CO |
| IEM0053I | Read In | CO |
| IEM0054I | Read In | CO |
| IEM0055I | Read In | CP |
| IEM0057I | Read In | CC |
| IEM0058I | Read In | CC |
| IEM0059I | Read In | CP |
| IEM0060I | Read In | CP |
| IEM0061I | Read In | CP |
| IEM0063I | Read In | CO |
| IEM0064I | Read In | CC |
| IEM0066I | Read In | CG |
| IEM0067I | Read In | CL |
| IEM0069I | Read In | CG |
| IEM0070I | Read In | CG |
| IEM0071I | Read In | CG |
| IEM0072I | Read In | CG |
| IEM0074I | Read In | CG |
| IEM0075I | Read In | CG |
| IEM0076I | Read In | CG |
| IEM0077I | Read In | CG |
| IEM0078I | Read In | CG |
| IEM0080I | Read In | CG |
| IEM0081I | Read In | CG |
| IEM0082I | Read In | CG |
| IEM0083I | Read In | CG |
| IEM0084I | Read In | CG |
| IEM0085I | Read In | CI |
| IEM0090I | Read In | CI |
| IEM0094I | Read In | CI |
| IEM0095I | Read In | CI |
| IEM0096I | Read In | CG,CI |
| IEM0097I | Read In | CI |
| IEM0099I | Read In | CI |
| IEM0100I | Read In | CI |
| IEM0101I | Read In | CM |
| IEM0102I | Read In | CI |
| IEM0103I | Read In | CI |
| IEM0104I | Read In | CC |
| IEM0105I | Read In | CC,CG |
| IEM0106I | Read In | CI,CV |
| IEM0107I | Read In | CI |
| IEM0108I | Read In | CI |
| IEM0109I | Read In | CG,CI |
| IEM0110I | Read In | CI |
| IEM0111I | Read In | CI |
| IEM0112I | Read In | CI |
| IEM0113I | Read In | CG,CM |
| IEM0114I | Read In | CI |
| IEM0115I | Read In | CL |
| IEM0116I | Read In | CI |
| IEM0118I | Read In | CL |
| IEM0128I | Read In | CO |
| IEM0129I | Read In | CL |
| IEM0130I | Read In | CL |
| IEM0131I | Read In | CO |
| IEM0132I | Read In | CO |
| IEM0133I | Read In | CO |
| IEM0134I | Read In | CP |
| IEM0135I | Read In | CP |
| IEM0136I | Read In | CO |
| IEM0138I | Read In | CP |
| IEM0139I | Read In | CP |
| IEM0140I | Read In | CO |
| IEM0141I | Read In | CP |
| IEM0142I | Read In | CO |
| IEM0143I | Read In | CO |
| IEM0144I | Read In | CO |

| | | |
|---|---|---|
| IEM0145I | Read In | CO |
| IEM0146I | Read In | CO |
| IEM0147I | Read In | CO |
| IEM0149I | Read In | CL,CM |
| IEM0150I | Read In | CL |
| IEM0151I | Read In | CO |
| IEM0152I | Read In | CO |
| IEM0153I | Read In | CO |
| IEM0154I | Read In | CA |
| IEM0158I | Read In | CO |
| IEM0159I | Read In | CO |
| IEM0163I | Read In | CT |
| IEM0164I | Read In | CS,CT |
| IEM0166I | Read In | CL |
| IEM0172I | Read In | CL |
| IEM0180I | Read In | CT |
| IEM0181I | Read In | CL |
| IEM0182I | Read In | CL,CS, CT,CV |
| IEM0185I | Read In | CT |
| IEM0187I | Read In | CT |
| IEM0191I | Read In | CT |
| IEM0193I | Read In | CT |
| IEM0194I | Read In | CT |
| IEM0195I | Read In | CT |
| IEM0198I | Read In | CT |
| IEM0202I | Read In | CL |
| IEM0207I | Read In | CG |
| IEM0208I | Read In | CG |
| IEM0209I | Read In | CC |
| IEM0211I | Read In | CL |
| IEM0212I | Read In | CP |
| IEM0213I | Read In | CP |
| IEM0214I | Read In | CP |
| IEM0216I | Read In | CP |
| IEM0217I | Read In | CP |
| IEM0220I | Read In | CT |
| IEM0221I | Read In | CT |
| IEM0222I | Read In | CT |
| IEM0223I | Read In | CT |
| IEM0224I | Read In | CT |
| IEM0225I | Read In | CT |
| IEM0226I | Read In | CT |
| IEM0227I | Read In | CT |
| IEM0228I | Read In | CT |
| IEM0229I | Read In | CT |
| IEM0230I | Read In | CS,CT |
| IEM0231I | Read In | CT |
| IEM0232I | Read In | CT |
| IEM0233I | Read In | CV |
| IEM0235I | Read In | CS |
| IEM0236I | Read In | CS |
| IEM0237I | Read In | CS |
| IEM0238I | Read In | CV |
| IEM0239I | Read In | CS |
| IEM0240I | Read In | CV |
| IEM0241I | Read In | CV |
| IEM0242I | Read In | CV |
| IEM0243I | Read In | CV |
| IEM0244I | Read In | CV |
| IEM0245I | Read In | CV |
| IEM0247I | Read In | CW |
| IEM0254I | Read In | CC |
| IEM0255I | Read In | CG |
| IEM0510I | Dictionary | EH |
| IEM0511I | Dictionary | EH |
| IEM0512I | Dictionary | EH |
| IEM0513I | Dictionary | EG |
| IEM0514I | Dictionary | EG |
| IEM0515I | Dictionary | EG |
| IEM0516I | Dictionary | EG |
| IEM0517I | Dictionary | EG |
| IEM0518I | Dictionary | EG |
| IEM0519I | Dictionary | EG |
| IEM0520I | Dictionary | EG |
| IEM0521I | Dictionary | EG |
| IEM0522I | Dictionary | EG |
| IEM0523I | Dictionary | EG |
| IEM0524I | Dictionary | EH |
| IEM0525I | Dictionary | EI |
| IEM0527I | Dictionary | EJ |
| IEM0528I | Dictionary | EH,EI,EJ |
| IEM0529I | Dictionary | EI |
| IEM0530I | Dictionary | EI |
| IEM0531I | Dictionary | EI |
| IEM0532I | Dictionary | EI |
| IEM0533I | Dictionary | EI |
| IEM0534I | Dictionary | EI |
| IEM0535I | Dictionary | EI |
| IEM0536I | Dictionary | EI |
| IEM0537I | Dictionary | EI |
| IEM0538I | Dictionary | EJ |
| IEM0539I | Dictionary | EJ |
| IEM0540I | Dictionary | EJ |
| IEM0541I | Dictionary | EJ |
| IEM0542I | Dictionary | EJ |
| IEM0543I | Dictionary | EL,EK,EM |
| IEM0544I | Dictionary | EL,EK,EM |
| IEM0545I | Dictionary | EL,EK,EM |
| IEM0546I | Dictionary | EL,EK,EM |
| IEM0547I | Dictionary | EL,EK,EM |
| IEM0548I | Dictionary | EL,EK,EM |
| IEM0549I | Dictionary | EL,EK,EM |
| IEM0550I | Dictionary | EL,EK,EM |
| IEM0551I | Dictionary | EK,EL,EM |
| IEM0552I | Dictionary | EL,EK,EM |
| IEM0553I | Dictionary | EL,EK,EM |
| IEM0554I | Dictionary | EL,EK,EM |
| IEM0555I | Dictionary | EL,EK,EM |
| IEM0556I | Dictionary | EL,EK,EM |
| IEM0557I | Dictionary | EL,EK,EM |
| IEM0558I | Dictionary | EL,EK,EM |
| IEM0559I | Dictionary | EL,EK,EM |
| IEM0560I | Dictionary | EL,EK,EM |
| IEM0561I | Dictionary | EL,EK,EM |
| IEM0562I | Dictionary | EK,EL,EM |
| IEM0563I | Dictionary | EK,EL,EM |
| IEM0564I | Dictionary | EK,EL,EM |
| IEM0565I | Dictionary | EK,EL,EM |
| IEM0566I | Dictionary | EK,EL,EM |
| IEM0567I | Dictionary | EP |
| IEM0568I | Dictionary | EP |
| IEM0569I | Dictionary | EP |
| IEM0570I | Dictionary | EP |
| IEM0571I | Dictionary | EK |
| IEM0572I | Dictionary | EL |
| IEM0573I | Dictionary | EL |
| IEM0589I | Dictionary | EW |
| IEM0590I | Dictionary | EW |
| IEM0591I | Dictionary | EW |
| IEM0592I | Dictionary | EW |
| IEM0593I | Dictionary | EW |
| IEM0594I | Dictionary | EW |
| IEM0595I | Dictionary | EW |
| IEM0596I | Dictionary | EW |
| IEM0597I | Dictionary | EW |

| | | |
|---|---|---|
| IEM0598I | Dictionary | EW |
| IEM0599I | Dictionary | EW |
| IEM0602I | Dictionary | FV,FW |
| IEM0603I | Dictionary | FV,FW |
| IEM0604I | Dictionary | FV,FW |
| IEM06052 | Dictionary | FV,FW |
| IEM0606I | Dictionary | FV,FW |
| IEM0607I | Dictionary | FV,FW |
| IEM0608I | Dictionary | FV,FW |
| IEM0609I | Dictionary | FV,FW |
| IEM0610I | Dictionary | FV,FW |
| IEM0611I | Dictionary | FV,FW |
| IEM0612I | Dictionary | FV |
| IEM0623I | Dictionary | FV,FW |
| IEM0624I | Dictionary | FV,FW |
| IEM0625I | Dictionary | FV,FW |
| IEM0626I | Dictionary | FV,FW |
| IEM0627I | Dictionary | FV,FW |
| IEM0628I | Dictionary | FV,FW |
| IEM0629I | Dictionary | FV,FW |
| IEM0630I | Dictionary | FV,FW |
| IEM0631I | Dictionary | FV,FW |
| IEM0632I | Dictionary | FV,FW |
| IEM0633I | Dictionary | EY |
| IEM0634I | Dictionary | EY |
| IEM0636I | Dictionary | EY |
| IEM0637I | Dictionary | EY |
| IEM0638I | Dictionary | EY |
| IEM0640I | Dictionary | EY |
| IEM0641I | Dictionary | EY |
| IEM0642I | Dictionary | EY |
| IEM0643I | Dictionary | EY |
| IEM0644I | Dictionary | EY |
| IEM0645I | Dictionary | EY |
| IEM0646I | Dictionary | EY |
| IEM0647I | Dictionary | EY |
| IEM0652I | Dictionary | FE |
| IEM0653I | Dictionary | FE |
| IEM0654I | Dictionary | FE |
| IEM0655I | Dictionary | FE |
| IEM0656I | Dictionary | FE |
| IEM0657I | Dictionary | FE |
| IEM0658I | Dictionary | FE |
| IEM0673I | Dictionary | FE |
| IEM0674I | Dictionary | FF |
| IEM0675I | Dictionary | FF |
| IEM0676I | Dictionary | FF |
| IEM0677I | Dictionary | FE |
| IEM0682I | Dictionary | FI |
| IEM0683I | Dictionary | FI |
| IEM0684I | Dictionary | FI |
| IEM0685I | Dictionary | FI |
| IEM0686I | Dictionary | FI |
| IEM0687I | Dictionary | FI |
| IEM0688I | Dictionary | FI |
| IEM0689I | Dictionary | FI |
| IEM0690I | Dictionary | FI |
| IEM0691I | Dictionary | FI |
| IEM0692I | Dictionary | FI |
| IEM0693I | Dictionary | FI |
| IEM0694I | Dictionary | FI |
| IEM0695I | Dictionary | FI |
| IEM0696I | Dictionary | FI |
| IEM0697I | Dictionary | FI |
| IEM0698I | Dictionary | FI |
| IEM0699I | Dictionary | FI |
| IEM0700I | Dictionary | FI |
| IEM0701I | Dictionary | FI |
| IEM0702I | Dictionary | FI |
| IEM0703I | Dictionary | FI |
| IEM0704I | Dictionary | FI |
| IEM07051 | Dictionary | FI |
| IEM0706I | Dictionary | FI |
| UEM0707I | Dictionary | FI |
| IEM0708I | Dictionary | FK |
| IEM0709I | Dictionary | FK |
| IEM0710I | Dictionary | FK |
| IEM0711I | Dictionary | FK |
| IEM0712I | Dictionary | FK |
| IEM3713I | Dictionary | FK |
| IEM0715I | Dictionary | EJ |
| IEM0718I | Dictionary | FO |
| IEM0719I | Dictionary | FO |
| IEM0720I | Dictionary | FO |
| IFM0721I | Dictionary | FO |
| IEM0722I | Dictionary | FO |
| IEM0723I | Dictionary | FO |
| IEM0724I | Dictionary | FO |
| IEM0725I | Dictionary | FO |
| IEM0726I | Dictionary | FO |
| IEM0727I | Dictionary | FO |
| IEM0728I | Dictionary | FO |
| IEM0729I | Dictionary | FO |
| IEM0730I | Dictionary | FQ |
| IEM0731I | Dictionary | FQ |
| IEM0732I | Dictionary | FQ |
| IEM0733I | Dictionary | FQ |
| IEM0734I | Dictionary | FQ |
| IEM0735I | Dictionary | FQ |
| IEM0736I | Dictionary | FQ |
| IEM0737I | Dictionary | FQ |
| IEM0739I | Dictionary | FQ |
| IEM0740I | Dictionary | FQ |
| IEM0741I | Dictionary | FQ |
| IEM0742I | Dictionary | FQ |
| IEM0745I | Dictionary | FQ |
| IEM0746I | Dictionary | FQ |
| IEM0747I | Dictionary | FQ |
| IEM0748I | Dictionary | FQ |
| IEM0749I | Dictionary | FQ |
| IEM0750I | Dictionary | FQ |
| IEM0751I | Dictionary | FQ |
| IEM0752I | Dictionary | FQ |
| IEM0754I | Dictionary | FQ |
| IEM0755I | Dictionary | FQ |
| IEM0756I | Dictionary | FQ |
| IEM0758I | Dictionary | FQ |
| IEM0759I | Dictionary | FQ |
| IEM0760I | Dictionary | FQ |
| IEM0761I | Dictionary | FQ |
| IEM0762I | Dictionary | FQ |
| IEM0769I | Pretranslator | GB |
| IEM0770I | Pretranslator | GB |
| IEM0771I | Pretranslator | GB |
| IEM0778I | Pretranslator | GB |
| IEM0779I | Pretranslator | GB |
| IEM0780I | Pretranslator | GB |
| IEM0781I | Pretranslator | GB |
| IEM0782I | Pretranslator | GB |
| IEM0786I | Pretranslator | GK |
| IEM0787I | Pretranslator | GK |
| IEM0790I | Pretranslator | GK |
| IEM0791I | Pretranslator | GK |
| IEM0792I | Pretranslator | GP,GQ,GR |
| IEM0793I | Pretranslator | GP,GQ,GR |
| IEM0794I | Pretranslator | GP,GQ,GR |

| | | |
|---|---|---|
| IEM0795I | Pretranslator | GP,GQ,GR |
| IEM0796I | Pretranslator | GP,GQ,GR |
| IEM0797I | Pretranslator | GP,GQ,GR |
| IEM0798I | Pretranslator | GP,GQ,GR |
| IEM0799I | Pretranslator | GP,GQ,GR |
| IEM0800I | Pretranslator | GP,GQ,GR |
| IEM0801I | Pretranslator | GP,GQ,GR |
| IEM0802I | Pretranslator | GP,GQ,GR |
| IEM0803I | Pretranslator | GP,GQ,GR |
| IEM0804I | Pretranslator | GP,GQ,GR |
| IEM0805I | Pretranslator | GP,GQ,GR |
| IEM0806I | Pretranslator | GP,GQ,GR |
| IEM0807I | Pretranslator | GP,GQ,GR |
| IEM0816I | Pretranslator | GU,GV |
| IEM0817I | Pretranslator | GU,GV |
| IEM0818I | Pretranslator | GU,GV |
| IEM0819I | Pretranslator | GU,GV |
| IEM0820I | Pretranslator | GU,GV |
| IEM0821I | Pretranslator | GU,GV |
| IEM0823I | Pretranslator | GU,GV |
| IEM0824I | Pretranslator | GU |
| IEM0825I | Pretranslator | GU,GV |
| IEM0826I | Pretranslator | GU,GV |
| IEM0832I | Pretranslator | HF,HG |
| IEM0833I | Pretranslator | HF,HG |
| IEM0834I | Pretranslator | HF,HG |
| IEM0835I | Pretranslator | HF,HG |
| IEM0836I | Pretranslator | HF,HG |
| IEM0837I | Pretranslator | HF,HG |
| IEM0838I | Pretranslator | HF |
| IEM0848I | Pretranslator | HF,HG |
| IEM0849I | Pretranslator | HF,HG |
| IEM0850I | Pretranslator | HF,HG |
| IEM0851I | Pretranslator | HF,HG |
| IEM0852I | Pretranslator | HF,HG |
| IEM0853I | Pretranslator | HF,HG |
| IEM0864I | Pretranslator | HK,HL |
| IEM0865I | Pretranslator | HK,HL |
| IEM0866I | Pretranslator | HK,HL |
| IEM0867I | Pretranslator | HK,HL |
| IEM0868I | Pretranslator | HK,HL |
| IEM0869I | Pretranslator | HK,HL |
| IEM0870I | Pretranslator | HK,HL |
| IEM0871I | Pretranslator | HK,HL |
| IEM0872I | Pretranslator | HK,HL |
| IEM0873I | Pretranslator | HK,HL |
| IEM0874I | Pretranslator | HK,HL |
| IEM0875I | Pretranslator | HK,HL |
| IEM0876I | Pretranslator | HK,HL |
| IEM0877I | Pretranslator | HK,HL |
| IEM0878I | Pretranslator | HK,HL |
| IEM0879I | Pretranslator | HK,HL |
| IEM0880I | Pretranslator | HK,HL |
| IEM0881I | Pretranslator | HK,HL |
| IEM0882I | Pretranslator | HK |
| IEM0896I | Pretranslator | HP |
| IEM0897I | Pretranslator | HP |
| IEM0898I | Pretranslator | HP |
| IEM0899I | Pretranslator | HP |
| IEM0900I | Pretranslator | HP |
| IEM0901I | Pretranslator | HP |
| IEM0902I | Pretranslator | HP |
| IEM0903I | Pretranslator | HP |
| IEM0906I | Pretranslator | HP |
| IEM0907I | Pretranslator | HP |
| IEM1024I | Translator | IA |
| IEM1025I | Translator | IA |
| IEM1026I | Translator | IA |
| IEM1027I | Translator | IA |
| IEM1028I | Translator | IA |
| IEM1029I | Translator | IA |
| IEM1040I | Translator | IM |
| IEM1051I | Translator | IM |
| IEM1056I | Translator | IM |
| IEM1057I | Translator | IM |
| IEM1058I | Translator | IM |
| IEM1059I | Translator | IM |
| IEM1060I | Translator | IM |
| IEM1061I | Translator | IM |
| IEM1062I | Translator | IM |
| IEM1063I | Translator | IM |
| IEM1064I | Translator | IM |
| IEM1065I | Translator | IM |
| IEM1066I | Translator | IM |
| IEM1067I | Translator | IM |
| IEM1068I | Translator | IM |
| IEM1071I | Translator | IM |
| IEM1072I | Translator | IM |
| IEM1073I | Translator | IM |
| IEM1074I | Translator | IM |
| IEM1076I | Translator | JD |
| IEM1082I | Translator | IX |
| IEM1088I | Aggregates | JK |
| IEM1089I | Aggregates | JK |
| IEM1090I | Aggregates | JK |
| IEM1091I | Aggregate Preprocessor | JI |
| IEM1092I | Aggregates | JK |
| IEM1104I | Aggregates | JP |
| IEM1105I | Aggregates | JP |
| IEM1106I | Aggregates | JP |
| IEM1107I | Aggregates | JP |
| IEM1108I | Aggregates | JP |
| IEM1110I | Aggregates | JP |
| IEM1111I | Aggregates | JP |
| IEM1112I | Aggregates | JP |
| IEM1113I | Aggregates | JP |
| IEM1114I | Aggregates | JP |
| IEM1115I | Aggregates | JP |
| IEM1120I | Aggregates | JP |
| IEM1121I | Aggregates | JP |
| IEM1122I | Aggregates | JP |
| IEM1123I | Pseudo-code | LD |
| IEM1125I | Pseudo-code | LD |
| IEM1200I | Pseudo-code | LA |
| IEM1569I | Pseudo-code | LG-ON |
| IEM1570I | Pseudo-code | LG |
| IEM1571I | Pseudo-code | LG |
| IEM1572I | Pseudo-code | LG |
| IEM1574I | Pseudo-code | LG |
| IEM1575I | Pseudo-code | LG |
| IEM1588I | Pseudo-code | MD |
| IEM1600I | Pseudo-code | LS,LT,LU |
| IEM1601I | Pseudo-code | LS |
| IEM1602I | Pseudo-code | LS,LT,LU |
| IEM1603I | Pseudo-code | LS,LT,LU |
| IEM1604I | Pseudo-code | LS,LT,LU |
| IEM1605I | Pseudo-code | LS,LT,LU |
| IEM1606I | Pseudo-code | LS,LT,LU |
| IEM1607I | Pseudo-code | LS,LT,LU |
| IEM1608I | Pseudo-code | LS,LT,LU |
| IEM1609I | Pseudo-code | LS,LT,LU |
| IEM1610I | Pseudo-code | LW |
| IEM1611I | Pseudo-code | LW |
| IEM1612I | Pseudo-code | LW |
| IEM1613I | Pseudo-code | LS,LT,LU |
| IEM1614I | Pseudo-code | LW |

| | | |
|---|---|---|
| IEM1615I | Pseudo-code | ME |
| IEM1616I | Pseudo-code | ME |
| IEM1617I | Pseudo-code | MB |
| IEM1618I | Pseudo-code | MB |
| IEM1619I | Pseudo-code | MB |
| IEM1620I | Pseudo-code | MB |
| IEM1621I | Pseudo-code | MB |
| IEM1622I | Pseudo-code | MB,ME |
| IEM1623I | Pseudo-code | MB |
| IEM1624I | Pseudo-code | MB |
| IEM1625I | Pseudo-code | MB |
| IEM1626I | Pseudo-code | ME |
| IEM1627I | Pseudo-code | ME |
| IEM1628I | Pseudo-code | ME |
| IEM1629I | Pseudo-code | ME |
| IEM1630I | Pseudo-code | MG,MH |
| IEM1631I | Pseudo-code | MI,MJ |
| IEM1632I | Pseudo-code | MI,MJ |
| IEM1633I | Pseudo-code | ME |
| IEM1634I | Pseudo-code | ME |
| IEM1635I | Pseudo-code | ME |
| IEM1636I | Pseudo-code | ME |
| IEM1637I | Pseudo-code | ME |
| IEM1638I | Pseudo-code | ME |
| IEM1639I | Pseudo-code | ME |
| IEM1640I | Pseudo-code | MM,MN |
| IEM1641I | Pseudo-code | MM,MN |
| IEM1642I | Pseudo-code | MM,MN |
| IEM1643I | Pseudo-code | MM,MN |
| IEM1644I | Pseudo-code | MM,MN |
| IEM1645I | Pseudo-code | MM,MN |
| IEM1648I | Pseudo-code | MM,MN |
| IEM1649I | Pseudo-code | MM,MN |
| IEM1650I | Pseudo-code | MM,MN |
| IEM1651I | Pseudo-code | MM,MN |
| IEM1652I | Pseudo-code | MM,MN |
| IEM1653I | Pseudo-code | MM,MN |
| IEM1654I | Pseudo-code | MM,MN |
| IEM1655I | Pseudo-code | MN |
| IEM1656I | Pseudo-code | ME |
| IEM1657I | Pseudo-code | MM |
| IEM1670I | Pseudo-code | MP |
| IEM1671I | Pseudo-code | MP |
| IEM1680I | Pseudo-code | MS |
| IEM1687I | Pseudo-code | MS |
| IEM1688I | Pseudo-code | MS |
| IEM1689I | Pseudo-code | MS |
| IEM1691I | Pseudo-code | MS |
| IEM1692I | Pseudo-code | MS |
| IEM1693I | Pseudo-code | MS |
| IEM1750I | Pseudo-code | MS |
| IEM1751I | Pseudo-code | MS |
| IEM1752I | Pseudo-code | NA |
| IEM1753I | Pseudo-code | NA |
| IEM1754I | Pseudo-code | NA |
| IEM1790I | Pseudo-code | OG,OM |
| IEM1793I | Pseudo-code | OE |
| IEM1794I | Pseudo-code | OE |
| IEM1795I | Pseudo-code | OE |
| IEM1796I | Pseudo-code | OE |
| IEM1797I | Pseudo-code | OE |
| IEM1800I | Pseudo-code | OS |
| IEM1801I | Pseudo-code | OS |
| IEM1802I | Pseudo-code | OS |
| IEM1803I | Pseudo-code | OS |
| IEM1804I | Pseudo-code | OS |
| IEM1805I | Pseudo-code | OS |
| IEM1806I | Pseudo-code | OS |
| IEM1807I | Pseudo-code | OS |
| IEM1808I | Pseudo-code | OS |
| IEM1809I | Pseudo-code | OS |
| IEM1810I | Pseudo-code | OS |
| IEM1811I | Pseudo-code | OS |
| IEM1812I | Pseudo-code | OS |
| IEM1813I | Pseudo-code | OS |
| IEM1814I | Pseudo-code | OS |
| IEM1815I | Pseudo-code | OS |
| IEM1816I | Pseudo-code | NJ |
| IEM1817I | Pseudo-code | NJ |
| IEM1818I | Pseudo-code | NJ |
| IEM1819I | Pseudo-code | NJ |
| IEM1820I | Pseudo-code | NJ |
| IEM1821I | Pseudo-code | NJ |
| IEM1822I | Pseudo-code | NJ |
| IEM1823I | Pseudo-code | NJ |
| IEM1824I | Pseudo-code | NM |
| IEM1825I | Pseudo-code | NG |
| IEM1826I | Pseudo-code | NG |
| IEM1827I | Pseudo-code | NG |
| IEM1828I | Pseudo-code | NG |
| IEM1829I | Pseudo-code | NG |
| IEM1830I | Pseudo-code | NG |
| IEM1832I | Pseudo-code | NM |
| IEM1833I | Pseudo-code | NM |
| IEM1834I | Pseudo-code | NM |
| IEM1835I | Pseudo-code | NM |
| IEM1836I | Pseudo-code | NM |
| IEM1837I | Pseudo-code | NM |
| IEM1838I | Pseudo-code | NM |
| IEM1839I | Pseudo-code | NM |
| IEM1840I | Pseudo-code | NM |
| IEM1841I | Pseudo-code | NM |
| IEM1843I | Pseudo-code | NM |
| IEM1844I | Pseudo-code | NM |
| IEM1845I | Pseudo-code | NM |
| IEM1846I | Pseudo-code | NM |
| IEM1847I | Pseudo-code | NM |
| IEM1848I | Pseudo-code | NM |
| IEM1849I | Constant Conversions | OS |
| IEM1850I | Constant Conversions | OS |
| IEM1860I | Pseudo-code | NU |
| IEM1861I | Pseudo-code | NU |
| IEM1862I | Pseudo-code | NU |
| IEM1870I | Pseudo-code | NU |
| IEM1871I | Pseudo-code | NU |
| IEM1872I | Pseudo-code | NU |
| IEM1873I | Pseudo-code | NU |
| IEM1874I | Pseudo-code | NU |
| IEM1875I | Pseudo-code | NV |
| IEM2304I | Storage Allocation | PD |
| IEM2305I | Storage Allocation | PD |
| IEM2352I | Storage Allocation | PD |
| IEM2700I | Register Allocation | RF,RG,RH |
| IEM2701I | Register Allocation | RF,RG,RH |
| IEM2702I | Register Allocation | RF,RG,RH |
| IEM2703I | Register Allocation | RF,RG,RH |
| IEM2704I | Register Allocation | RF,RG,RH |
| IEM2705I | Register Allocation | RF,RG,RH |
| IEM2706I | Register Allocation | RF,RG,RH |
| IEM2707I | Register Allocation | RF,RG,RH |
| IEM2708I | Register Allocation | RF,RG,RH |
| IEM2709I | Register Allocation | RF,RG,RH |
| IEM2710I | Register Allocation | RF,RG,RH |
| IEM2711I | Register Allocation | RF,RG,RH |
| IEM2712I | Register Allocation | RF,RG,RH |
| IEM2817I | DCB Generation | GA |

| | | |
|---|---|---|
| IEM2818I | DCB Generation | GA |
| IEM2819I | DCB Generation | GA |
| IEM2820I | DCB Generation | GA |
| IEM2821I | DCB Generation | GA |
| IEM2822I | DCB Generation | GA |
| IEM2823I | DCB Generation | GA |
| IEM2824I | DCB Generation | GA |
| IEM2825I | DCB Generation | GA |
| IEM2826I | DCB Generation | GA |
| IEM2827I | DCB Generation | GA |
| IEM2828I | DCB Generation | GA |
| IEM2829I | DCB Generation | GA |
| IEM2833I | Final Assembly | TF |
| IEM2834I | Final Assembly | TF |
| IEM2835I | Final Assembly | TF |
| IEM2836I | Final Assembly | TF |
| IEM2837I | Final Assembly | TF |
| IEM2852I | Final Assembly | TJ |
| IEM2853I | Final Assembly | TJ |
| IEM2854I | Final Assembly | TJ |
| IEM2855I | Final Assembly | TJ |
| IEM2865I | Final Assembly | TO |
| IEM2866I | Final Assembly | TO |
| IEM2867I | Final Assembly | TO |
| IEM2868I | Final Assembly | TO |
| IEM2881I | Final Assembly | TT |
| IEM2882I | Final Assembly | TT |
| IEM2883I | Final Assembly | TT |
| IEM2884I | Final Assembly | TT |
| IEM2885I | Final Assembly | TT |
| IEM2886I | Final Assembly | TT |
| IEM2887I | Final Assembly | TT |
| IEM2888I | Final Assembly | TT |
| IEM2897I | Final Assembly | UA |
| IEM2898I | Final Assembly | UA |
| IEM2899I | Final Assembly | UC |
| IEM2900I | Final Assembly | UC |
| IEM2913I | Final Assembly | UF |
| IEM3088I | Dictionary, Declare Pass 2 | EL |
| IEM3136I-3149I | Dictionary, Declare Pass 2 | EL |
| IEM3151I | Dictionary, Declare Pass 2 | EL |
| IEM3153I | Dictionary, Declare Pass 2 | EL |
| IEM3154I | Dictionary, Declare Pass 2 | EL |
| IEM3156I | Dictionary, Declare Pass 2 | EL |
| IEM3162I | Dictionary, Declare Pass 2 | EL |
| IEM3167I-3173I | Dictionary, Declare Pass 2 | EL |
| IEM3176I-3190I | Dictionary, Declare Pass 2 | EL |
| IEM3199I-3213I | Dictionary, Declare Pass 2 | EL |
| IEM3584I | 48 Character Preprocessor | BX |
| IEM3840I | Compiler Control | AA |
| IEM3841I | Compiler Control | AA |
| IEM3842I | Compiler Control | AA |
| IEM3843I | Compiler Control | AA |
| IEM3844I | Compiler Control | AA |
| IEM3845I | Compiler Control | AA |
| IEM3846I | Compiler Control | AA |
| IEM3847I | Compiler Control | AA |
| IEM3848I | Compiler Control | AA |
| IEM3849I | Compiler Control | AA |
| IEM3850I | Compiler Control | AA |
| IEM3851I | Compiler Control | AA |
| IEM3852I | Compiler Control | AA |
| IEM3853I | Compiler Control | AA |
| IEM3855I | Compiler Control | AA |
| IEM3856I | Compiler Control | AA |
| IEM3857I | Compiler Control | AA |
| IEM3858I | Compiler Control | AA |
| IEM3859I | Compiler Control | AA |
| IEM3860I | Compiler Control | AA |
| IEM3861I | Compiler Control | AA |
| IEM3862I | Compiler Control | AA |
| IEM3863I | Compiler Control | AA |
| IEM3864I | Compiler Control | AA |
| IEM3865I | Compiler Control | AA |
| IEM3872I | Compiler Control | AA |
| IEM3873I | Compiler Control | AA |
| IEM3874I | Compiler Control | AA |
| IEM3875I | Compiler Control | AA |
| IEM3876I | Compiler Control | AA |
| IEM3877I | Compiler Control | AA |
| IEM3878I | Compiler Control | AA |
| IEM3880I | Compiler Control | AA |
| IEM3887I | Compiler Control | AA |
| IEM3888I | Compiler Control | AB |
| IEM3889I | Compiler Control | AB |
| IEM3890I | Compiler Control | AA |
| IEM3891I | Compiler Control | AA |
| IEM3892I | Compiler Control | AA |
| IEM3893I | Compiler Control | AA |
| IEM3894I | Compiler Control | AA |
| IEM3895I | Compiler Control | AA |
| IEM3896I | Compiler Control | AA |
| IEM3897I | Compiler Control | AA |
| IEM3898I | Compiler Control | AA |
| IEM3899I | Compiler Control | AL |
| IEM3900I | Compiler Control | AB |
| IEM3901I | Compiler Control | AB |
| IEM3902I | Compiler Control | AB |
| IEM3902I | Compiler Control | AB |
| IEM3903I | Compiler Control | AB |
| IEM3904I | Compiler Control | AA |
| IEM3905I | Compiler Control | AA |
| IEM3906I | Compiler Control | AA |
| IEM3907I | Compiler Control | AA |
| IEM3908I | Compiler Control | AA |
| IEM3909I | Compiler Control | AL |
| IEM3910I | Compiler Control | AB |
| IEM3911I | Compiler Control | AB |
| IEM3912I | Compiler Control | AB |
| IEM3913I | Compile-time Processor | AB |
| IEM3914I | Compile-time Processor | AB |
| IEM4106I | Compile-time Processor | AS |
| IEM4109I | Compile-time Processor | AS |
| IEM4112I | Compile-time Processor | AS |
| IEM4115I | Compile-time Processor | AS |
| IEM4118I | Compile-time Processor | AS |
| IEM4121I | Compile-time Processor | AS,BC,BG |
| IEM4124I | Compile-time Processor | BC,BG |
| IEM4130I | Compile-time Processor | BG |
| IEM4133I | Compile-time Processor | BC |
| IEM4134I | Compile-time Processor | BC |
| IEM4136I | Compile-time Processor | BC |
| IEM4139I | Compile-time Processor | BC |
| IEM4142I | Compile-time Processor | BC |
| IEM4143I | Compile-time Processor | BC |

IEM4148I Compile-time Processor BC
IEM4150I Compile-time Processor BC
IEM4151I Compile-time Processor BC
IEM4152I Compile-time Processor BC
IEM4153I Compile-time Processor BC
IEM4154I Compile-time Processor BC
IEM4157I Compile-time Processor BC
IEM4160I Compile-time Processor BC
IEM4163I Compile-time Processor BC
IEM4166I Compile-time Processor BC
IEM4169I Compile-time Processor BC
IEM4172I Compile-time Processor BC
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IEM4178I Compile-time Processor BC
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IEM4187I Compile-time Processor BC
IEM4188I Compile-time Processor BC
IEM4190I Compile-time Processor BC
IEM4193I Compile-time Processor BC
IEM4196I Compile-time Processor BC
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IEM4307I Compile-time Processor BC
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IEM43321 Compile-time Processor BC
IEM4334I Compile-time Processor BC
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IEM4343I Compile-time Processor BC
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IEM4352I Compile-time Processor BC
IEM4355I Compile-time Processor BC
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IEM4415I Compile-time Processor BC
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IEM4433I Compile-time Processor BG
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IEM4481I Compile-time Processor BG
IEM4484I Compile-time Processor BG
IEM4499I Compile-time Processor BG
IEM4502I Compile-time Processor BG
IEM4504I Compile-time Processor BG
IEM4505I Compile-time Processor BG
IEM4506I Compile-time Processor BG
IEM4508I Compile-time Processor BG
IEM4511I Compile-time Processor BC
IEM4514I Compile-time Processor BG
IEM4517I Compile-time Processor BG
IEM4520I Compile-time Processor BG
IEM4523I Compile-time Processor BG
IEM4526I Compile-time Processor AS
IEM4529I Compile-time Processor BC,BG
IEM4532I Compile-time Processor AS
IEM4535I Compile-time Processor AS
IEM4538I Compile-time Processor BC
IEM4547I Compile-time Processor AV
IEM4550I Compile-time Processor BG
IEM4553I Compile-time Processor BG
IEM4559I Compile-time Processor BG
IEM4562I Compile-time Processor BG

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IEM4570I   Compile-time Processor BG
IEM4572I   Compile-time Processor BG
IEM4574I   Compile-time Processor BG
IEM4576I   Compile-time Processor BG
IEM4578I   Compile-time Processor BG
IEM4580I   Compile-time Processor BG
```