PROGRAMMING SPECIFICATIONS

CREF

INPUT FORMATS FOR CREF

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File: CREF.RNO
Edition: 3

1.0 INTRODUCTION

Two input formats are acceptable to CREF. The first is produced by early versions of MACRO (prior to version 30), the PALX assembler for the PDP-8, and early versions of F40 (prior to version 06). The second input format for CREF is produced by current versions of MACRO (version 30 and later), version 06 and later of F40, the Stanford FAIL assembler, version 6 and later of ALGOL, and version 4 and later of FORTRAN-10.

2.0 EARLY INPUT FORMAT

The codes listed below are produced by the early versions of MACRO and F40 as input to CREF. They are ignored by CREF if they contain control characters from current versions of MACRO and FORTRAN.

ASCII Code	Meaning
33	Indicates that the code type is an op code, a pseudo-op code, or an op code that the user has defined with OPDEF.
34	Indicates that the code type is a macro name.
35	Indicates the end of line.
36	Indicates a normal symbol; i.e., a symbol defined with an equal sign (=) or a colon (:).
37	Indicates a program break between F40 subroutines.

This input format to CREF should not be used when new programs are being developed.

3.0 CURRENT INPUT FORMAT

The control characters described below appear in the CREF input file produced by MACRO and FORTRAN.

On each line of the listing, CREF input data are enclosed by RUBOUT B and RUBOUT C. The symbols or instruction types, and the number of their component characters are defined by control characters. The set of control characters defining symbols and instructions is the same as the set defining the number of symbol or instruction characters. A control character's position determines its function. For example, in the input CREF data B^C^CENDC, the B indicates the beginning of the data, the first ^C defines the instruction END as a pseudo-op code, the second ^C defines the number of characters in the instruction END as 3, and the C terminates the CREF data. The control characters and their meanings are described below.

3.1 Beginning and Ending Control Characters

The control characters that begin and end the CREF input data are:

RUBOUT B (prints as B) which signals the beginning of the CREF data on each line,

RUBOUT C (prints as C) which terminates the CREF data on each line,

RUBOUT F which is identical to RUBOUT C, except that RUBOUT F does not increment or print line numbers.

RUBOUT A (prints as A) which terminates the CREF data on each line and adds a horizontal tab to the line of the listing, and

RUBOUT D which is identical to RUBOUT A, except that RUBOUT D does not increment or print line numbers.

RUBOUT E (prints as E) which marks a break between FORTRAN subroutines.

3.2 Symbol-Definition Control Characters

These control characters define symbols, instruction types, and macros:

Character	ASCII Code	Meaning
CONTROL-A (^A)	001	Precedes every occurrence of each symbol in the listing defined with an equals sign (=) or a colon (:).
CONTROL-B (^B)	002	Immediately follows a symbol in the listing defined with an equals sign or colon.

CONTROL-C (^C)	003	Precedes an op code (whether hardware- or OPDEF-defined) or a pseudo-op code.
CONTROL-D (^D)	004	Precedes an op code defined by OPDEF.
CONTROL-E (^E)	005	Precedes a macro call.
CONTROL-F (^F)	006	Precedes the definition of a macro.
CONTROL-G (^G)	007	Causes CREF to delete the last symbol that it read.
CONTROL-H (^H)	010	Combines two symbols that are defined at different block levels and are then discovered to be the same. For example, the combination occurs when FAIL exits the block--provided that the inner-block symbol has not been defined before exit.
CONTROL-I (^I)	011	Defines the symbol by giving it a name in place of the unique numeric.
CONTROL-J (^J)	012	Illegal in CREF.
CONTROL-K (^K)	013	Works exactly like 011 (^I), except that it operates on macros rather than on symbols.
CONTROL-L (^L)	014	Illegal in CREF.
CONTROL-M (^M)	015	Signals the beginning of a symbol block. The argument is the blockname.
CONTROL-N (^N)	016	Signals the end of a symbol block. The argument is the blockname.
CONTROL-O (^O)	017	Allows the compiler to input a line number not output by CREF. Thereafter, CREF assigns to this line number all information that it extracts from the source file.

Although CREF recognizes and accepts all of the above control characters, current versions of MACRO do not produce all of these characters. As shown in paragraph 3.0, CREF recognizes a symbol defined by OPDEF as an op code because ^D precedes its definition, and because ^C precedes its use.

MACRO treats symbols defined by OPDEF as macros, and precedes these symbols by ^F when they are defined and by ^E when they are used. Because MACRO has produced their control characters, CREF also treats these symbols as macros. But CREF's treatment of symbols defined by OPDEF as macros has no effect on cross-referencing, because OPDEF and macro symbols are grouped into the same table.

3.3 Character-Count-Definition Control Characters

The octal value of the control characters described below is used by CREF to determine the number of characters in a symbol or instruction. The same set of control characters defines the symbol as well as its number of characters. The control character's position determines its function. The character-count control character immediately precedes the symbol with no intervening spaces or characters (e.g., ^CEND). The control characters and their meanings are as follows:

Character	ASCII Code	Meaning
CONTROL-A (^A)	001	The symbol contains 1 character.
CONTROL-B (^B)	002	The symbol contains 2 characters.
CONTROL-C (^C)	003	The symbol contains 3 characters.
CONTROL-D (^D)	004	The symbol contains 4 characters.
CONTROL-E (^E)	005	The symbol contains 5 characters.
CONTROL-F (^F)	006	The symbol contains 6 characters.
.	.	.
.	.	.
.	.	.
	100(8)	The symbol contains 64 characters.

No symbol or instruction can contain more than sixty-four octal characters.

3.4 Example of the Current Input Format

The example below shows a small MACRO program and the listing produced by MACRO to be input to CREF.

```
        ;CREF SPECIAL CHARACTER DEMONSTRATION
.MAIN   MACRO 44.0 09:30 10-DEC-70 PAGE 1

        ;CREF SPECIAL CHARACTER DEMONSTRATION
        M=6                     ;1 CHAR SYMBOL DEFINITION
        MOVEI M                 ;5 CHARACTER OPCODE
                                ;1 CHAR SYMBOL USE
FOO:    SIXBIT/123/             ;3 CHAR SYMBOL DEFINITION
                                ;6 CHAR PSEUDO INSTRUCTION
        MOVEI 6+FOO             ;MORE OF THE ABOVE
OPDEF TTYCAL [51B11]            ;OPCODE DEFINITION
DEFINE TEST (X) <TLNE X>        ;MACRO DEFINTION
        TTYCAL                  ;OPCODE USE
        TEST M                  ;MACRO CALL & SYMBOL USE
        END                     ;PSEUDO INSTRUCTION OCCURRENCE

.MAIN   MACRO 44.0 09:30 10-DEC-70 PAGE 1
TEST  .MAC
BC                                      ;CREF SPECIAL CHARACTER DEMONSTRATION
B^A^AM^BC                       000006          M=6                     ;1 CHAR SYMBOL DEFINITION
B^C^EMOVEI^A^AMC        000000' 201000  000006          MOVEI M                 ;5 CHARACTER OPCODE
BC                                                              ;1 CHAR SYMBOL USE
B^A^CFOO^B^C^FSIXBITC   000001' 212223  000000  FOO:    SIXBIT /123/            ;3 CHAR SYMBOL DEFINITION
BC                                                              ;6 CHAR PSEUDO INSTRUCTION
B^C^EMOVEI^A^CFOOC      000002' 201000  000007'         MOVEI 6+FOO             ;MORE OF THE ABOVE
B^C^EOPDEF^F^FTTYCALC                           OPDEF TTYCAL [51B11]            ;OPCODE DEFINITION
B^C^FDEFINE^F^DTESTC                            DEFINE TEST (X) <TLNE X)        ;MACRO DEFINITION
B^E^FTTYCALC    000003' 005100  000000          TTYCAL                          ;OPCODE USE
B^E^STESTC                                      TEST M                          ;MACRO CALL & SYMBOL USE
B^C^DTLNE^A^AMC 000004' 603000  0000006 TLNE M
B^C^CENDC                                       END                             ;PSEUDO INSTRUCTION OCCURRENCE
NO ERRORS DETECTED
PROGRAM BREAK IS 000005
2K CORE USED
.MAIN   MACRO 44.0 09:30 10-DEC-70 PAGE 2
TEST  .MAC      SYMBOL TABLE
FOO             000001'
M               000006
TTYCAL  005100  000000
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